Boeing Plant 2
Seattle/Tukwila, Washington

Interim Measure Work Plan for the North and South Sheetpiles in the 2-10 Building Area (AOC 2-10.3A and AOC 2-10.4A)

Phase 2: IM Design and Implementation

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List of Abbreviations and Acronyms

Acronym/Abbreviation	Definition
%R	Percent Recovery
ACGIH	American Conference of Governmental Industrial Hygienists
AMSL	Above Mean Sea Level
AOC	Area of Concern
APHA	American Public Health Association
APR	Air Purifying Respirator
ARI	Analytical Resources, Incorporated
ASTM	American Society for Testing and Materials
Boeing	The Boeing Company
Bgs	Below Ground Surface
BTEX	Benzene, toluene, ethylbenzene, xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CGI	Combustible Gas Indicator
cis-1,2-DCE	cis-1,2-dichloroethene
CLP	Contract Laboratory Program
CMS	Corrective Measures Study
COC	Contaminant of Concern
CSM	Conceptual Site Model
CVOC	Chlorinated volatile organic compound
DCE	Dichloroethene
DHE	*Dehalococcoides spp.*
DNAPL	Dense Non-aqueous Phase Liquid
DO	Dissolved Oxygen
DOT	Department of Transportation
DQO	Data Quality Objective
Ecology	Washington Department of Ecology
EPA	Environmental Protection Agency
EQL	Estimated Quantization Limit
ERD	Enhanced Reductive Dechlorination
ETS	Environmental Technology Solutions
FES	Field Engineer/Scientist
FID	Organic Vapor Analyzer
FS	Field Supervisor
FT	Field Technician
ft	Feet
GAC	Granular Activated Carbon
HASP	Health and Safety Plan

Acronym/Abbreviation	Definition
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDLH	Immediately Dangerous to Life and Health
IDW	Investigation Derived Waste
IM	Interim Measure
LDW	Lower Duwamish Waterway
LEL	Lower Explosive Limit
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSDS	Material Safety Data Sheet
MUL	Maximum Use Level
NOC	Notice of Construction
N/S	north and south
NAPL	Non-aqueous Phase Liquids
NGVD29	National Geodetic Vertical Datum 1929
NIOSH	National Institute for Occupational Safety and Health
O&M	Operation and Maintenance
ORP	Oxidation-Reduction Potential
OSHA	Occupational Safety and Health Administration
PDB	Passive Diffusion Bags
PEL	Permissible Exposure Limit
PID	Photo Ionization Detector
ppb	Parts per Billion
PPE	Personal Protective Equipment
ppm	Parts per Million
PSCAA	Puget Sound Clean Air Agency
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RL	Reporting Limit
RPD	Relative Percent Difference
RTECS	Registry of Toxic Effects of Chemical Substances
SAP	Sampling and Analysis Plan
SEPA	State Environmental Policy Act
SOP	Standard Operating Procedure
SVE	Soil Vapor Extraction
TCA	1,1,2 Trichloroethane
TCE	Trichloroethene

Acronym/Abbreviation	Definition
TCLP	Toxic Characteristic Leaching Procedure
TLV	Threshold Limit Value
TMCL	Target Media Cleanup Level
TOC	Total Organic Carbon
trans-1,2-DCE	trans-1,2-dichloroethene
ug/L	Micrograms per Liter
UIC	Underground Injection Control
USCS	Unified Soil Classification System
VC	Vinyl Chloride
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
WISHA	Washington Industrial Safety and Health Act
WP	Work Plan

1.0 Introduction

This Interim Measure (IM) Work Plan for the north and south (N/S) sheetpile areas in the Building 2-10 Area (Area of Concern [AOC] 2-10.3A and AOC 2-10.4A) has been prepared on behalf of The Boeing Company (Boeing) to further remedial activities at Boeing Plant 2 in Seattle/Tukwila, Washington. This IM Work Plan has been prepared and the IM will be implemented under the Resource Conservation and Recovery Act (RCRA) Administrative Order on Consent, dated January 18, 1994, between Boeing and the U.S. Environmental Protection Agency (USEPA) Region 10 ([RCRA Docket No. 1092-01-22-3008[(h]).

Boeing plans to implement IMs for areas associated with the N/S sheetpile areas in the 2-10 Building. A significant amount of characterization data has been collected in the areas in and around the 2-10 N/S sheetpile areas; however, much of the groundwater data were more than 7 years old and not sufficiently current for the IM design. Phase 1 of this IM (Data Collection) was implemented in accordance with the approved Work Plan (Floyd|Snider and CALIBRE 2009a) including soil, groundwater and soil vapor sampling. This second Work Plan (Phase 2: IM Design and Implementation) has been prepared to summarize the data collected (from Phase 1), propose IMs to address contamination present at each sheetpile area, and present design details sufficient to start the IMs.

1.1 FACILITY LOCATION AND BACKGROUND

Plant 2 is located on approximately 107 acres between the Duwamish Waterway and East Marginal Way South, in Seattle/Tukwila, Washington. The general location of Plant 2 is shown on Figure 1.1. Plant 2 began operating in 1936 and contains numerous manufacturing and process buildings related to aircraft fabrication. Plant 2 continues to support aerospace manufacturing. Figure 1.2 presents the location of the 2-10 Area, the N/S sheetpile areas, and other features in the 2-10 Area.

The Plant 2 area lies within the Duwamish Valley. The hydrogeologic setting is an alluvial basin between bounding uplands to the east and west. In the local area, the aquifer within the alluvial valley flows in a westerly direction towards, and discharges to, the Duwamish Waterway. A general description of the site hydrogeology and summary of previous investigations is presented in the *RCRA Facility Investigation Groundwater Investigation Interim Report*, dated January 1996 (Weston 1996).

The 2-10 Building, one of the larger buildings at Plant 2, is located adjacent to the shoreline north of the 16th Avenue Bridge. Boeing's present use of the 2-10 Building is storage with some parts machining and handling in support of aircraft design and testing including offices for staff.

The initial 1992 investigations identified a solvent release to soil and groundwater at two degreaser areas in the 2-10 Building. Boeing elected to implement interim corrective measures at these two areas in 1993 (Weston 1993a and 1993b). A containment technology using a hanging sheetpile wall was constructed around each area using interlocking sheetpiles with sealed joints (a sealable sheetpile manufactured under license by Waterloo Groundwater Control Technologies). The work was initiated in late 1993 and completed in April 1994 (Weston 1994). Performance monitoring following completion of sheetpile installation included new

groundwater monitoring wells and sampling for 12 monthly events (October 1994 to September 1995). An effectiveness evaluation of the two sheetpile structures was performed in 2001 (Weston 2001). This evaluation included installing new wells and sampling groundwater from existing wells.

Expanding active uses in the building will impose access constraints for the required site investigation work and any future corrective actions required. Accordingly, work to select, design, and implement any necessary remedial actions associated with the N/S sheetpile areas is being expedited through the preparation and submittal of this Work Plan and approach. The manner in which Boeing intends to coordinate this work with other actions planned for the 2-10 Building and the surrounding 2-10 Area is addressed below.

1.2 OBJECTIVE AND COORDINATION OF PLANNED INTERIM MEASURES

1.2.1 Objective of the Interim Measures

The objective of the IMs is to remove (or destroy through degradation) the mass of solvent contamination within the vadose zone enclosed by the sheetpiles and in groundwater within and down gradient of the N/S sheetpile areas of the 2-10 Building. The goals of the IMs are to:

- Destroy or remove contaminant mass in order to decrease the residual contamination in the source area, and
- Gather performance data from the mass removal IMs that will be useful in evaluating technologies and post-IM conditions for the CMS.

Final cleanup levels have not been established for Plant 2 at this time. As an IM, this work is not intended to be a final remedy; therefore, the IM can proceed even though cleanup levels have not been finalized as has been the case for IMs at other locations at Plant 2. The Corrective Measures Study (CMS) for the 2-10 Area will evaluate whether additional work needs to be performed after the IM in order to complete corrective action for all media.

1.2.2 Objective of the Phase 1 Data Collection

Before the IMs can be designed or implemented, additional data was needed to define current conditions. Specifically, the goals of the Phase 1 Data Collection were defined as follows:

- Collect soil and groundwater data to define the current nature and extent of solvent contamination in the source area, including any non-aqueous phase liquids that may be present.
- Collect soil gas data to use in combination with indoor air data being collected under the Vapor Intrusion Sampling Work Plan to assess the current potential for vapor intrusion into the 2-10 Building (refer to Section 1.2.3).

This report summarizes the recently collected data and describes the planned IM remedial actions. This report also presents the results of other recent sampling in the immediate area that are relevant to the planned IMs. The other sampling includes the ongoing Shoreline Monitoring Program (several wells immediately down gradient of the north and south sheetpile

areas) and the 2-10 Area Data Gap Investigation sampling (several probe samples and additional monitoring well samples in the immediate area of the N/S sheetpiles).

1.2.3 Planned Interim Measure Remedial Actions for Phase 2

Two remedial technologies were previously identified as the likely candidate remedies that may be implemented for one or both 2-10 Building sheetpile IMs: soil vapor extraction (SVE) for extracting volatile organic compounds (VOCs) in vadose zone soils, and enhanced reductive dechlorination (ERD) for degrading VOCs in groundwater and saturated soils. These technologies have been implemented successfully at other areas of Plant 2 with similar contamination and conditions. EPA has designated SVE as a presumptive remedy for VOCs in soil and the site conditions (VOCs in vadose zone soils) are well suited to this technology (USEPA 1996). In addition, enhanced reductive dechlorination is being proposed as a candidate technology to address VOCs in groundwater for both of the 2-10 Building sheetpile IMs.

The data collected in the Phase 1 sampling (reported in this Work Plan) are generally consistent with the historical data/conditions and the Conceptual Site Model (CSM). A general summary of the recent data related to the selection of the IM remedial actions includes the following:

1. VOCs are present in soil and soil vapor samples and the sandy/silty sand soil type appears conducive to SVE.

2. Groundwater chemistry is generally reducing with VOCs present as PCE/TCE and dechlorination daughter products of DCE, vinyl chloride and ethene, see Figure 1.3 for a dechlorination process flow diagram. These data indicate that ERD as a biostimulation approach should be effective.

Based on the CSM and the recent characterization data, these two remedial technologies are proposed for VOCs present near the 2-10 N/S sheetpile areas (SVE for VOCs in vadose zone soils, and ERD for VOCs in groundwater and saturated soils). This Phase 2 Work Plan (IM Design and Implementation) summarizes the recent data, develops general design criteria for the proposed IMs and provides design details.

1.2.4 Coordination with Indoor Air Sampling

Site conditions and chemicals detected indicate the potential for vapor intrusion in the 2-10 Building. Boeing and EPA determined that indoor air sampling was warranted given the changing use of the building. The indoor air data sampling was completed and data were submitted separately as part of the *Work Plan for Vapor Intrusion Sampling, Building 2-10* (Golder 2008). The field work for indoor air sampling was completed at a similar time frame (within 60 days) as the soil gas sampling in the Phase 1 investigation in this study. The indoor air sampling (completed in December 2009) identified TCE levels in the range of 0.2 to 1.9 ug/m^3 compared to the MTCA Method C standard of 1.0 ug/m^3.

The standard MTCA C formula for indoor air is based on continuous exposure for 30 years at a 10^{-5} risk (24 hours/day, 365 days/year for 30 years in an industrial setting). An alternate exposure frequency (using the MTCA C formula) is presented in the Indoor Air Sampling report as an exposure frequency of 0.4 and a 20-year exposure period (Golder 2010). An exposure frequency of 0.4 is still conservative and corresponds with a 70-hour work week, for 50 weeks

each year. All of the measured values are lower than this revised Method C standard. All of the measured values are lower than the occupational standards set by the Washington Industrial Safety and Health Act (WISHA). Low levels of several other VOCs were also detected in selected air samples (carbon tetrachloride, tetrachloroethene, and vinyl chloride). All of these other compounds were detected at levels less than 1 ug/m^3 (typically in a range of 0.1 to 0.5 ug/m^3 or below detection limits), and all detected values (for carbon tetrachloride, tetrachloroethene, and vinyl chloride) were less than their respective MTCA Method C standards and occupational standards.

The TCE concentrations measured in the December 2009 indoor air sampling are presented below, along with relevant comparison criteria.

Sample ID (all locations within 2-10s Building)	TCE ug/m^3
A	1.4
B	0.87
C / (and duplicate)	1.9/ 1.8
D	0.97
E	0.2
F	1.7
G	1.4
H	1.3
I	1.4
J	1.4
K	0.32
L	1.1
M	1.4
N	1.4
O	1.5
P	1.4

Note: MTCA C standard 0.98 ug/m^3 based on 10^{-5} risk, exposure 24 hrs/day, 7 days/wk, 52 wks/yr, 30 years. Unofficial action level 3.7 ug/m^3 based on 10^{-5} risk, 0.4 exposure frequency (70 hrs/wk, 50 wks/yr), 20 years.

1.3 WORK PLAN ORGANIZATION

This Work Plan is organized as follows:

- Section 1: Introduction
- Section 2: Summary of Phase 1 Sampling
- Section 3: Interim Measures Design
- Section 4: Performance Monitoring
- Section 5: Recommendations
- Section 6: References

- Appendix A: Probe Boring Logs
- Appendix B: Field Sample Data Forms
- Appendix C: Laboratory Data Sheets (this appendix is provided solely in the attached CD, no paper copy is included)
- Appendix D: Field Logbook Sheets
- Appendix E: Design Calculations
- Appendix F: Standard Operating Procedures
- Appendix G: Prior Phase 1 Work Plan (including Conceptual Site Model, SAP, QAPP; this appendix is provided solely in the attached CD, no paper copy is included)

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2.0 Summary of Phase 1 Sampling

CALIBRE personnel met with the onsite Boeing facility supervisors prior to starting the field investigations in order to schedule all sampling activities in a manner that would minimize impacts to ongoing production. Manufacturing in the 2-10 Building supports the launch of Boeing 787 aircraft and all field investigation work was scheduled to provide a minimum potential interference with the facility operations/production requirements. After this meeting, the week between December 25th and January 1st was determined to pose the least impact on production. The probe work was scheduled for this period and all other preparatory work before the sampling was planned around this schedule. The work was also coordinated with the 2-10 Building indoor air sampling (conducted by Golder Associates) so that the 2-10 Building IM Phase 1 sampling would not adversely affect the indoor air sampling (all coring was implemented after the indoor air sampling and well development/purging was completed at least 3 days prior to the indoor air sampling).

Prior to groundwater sampling at the 2-10 sheetpile areas the monitoring wells were re-developed to ensure they would produce water in sufficient quantities and that they would accurately represent current conditions in the aquifer. All of the groundwater wells to be sampled had been previously installed and were redeveloped. Well development consisted of a minimum of three surge and pump cycles. Each surge period consisted of a minimum of ten surges over the well screen length and each pump cycle was completed until the extracted water was clear without visible silt or particulates. If after three cycles the water had not cleared, additional surge and pump cycles were repeated until the water cleared within a nominal time at the start of purging. Well development was completed from 11-16 December 2009. The location of monitoring wells that were redeveloped (all wells near the N/S sheetpile areas, except PL2-212B as described below) are shown in Figure 1.2 (and also in Figures 2.2 and 2.3 for the N/S sheetpiles, respectively).

The planned locations for the probes were cleared by a utility clearance contractor on 14 December 2009 and the concrete was cored 21 December 2009 (this was scheduled to start after completion of the indoor air sampling to eliminate the chance of impact on that work). The soil sampling locations are shown in Figure 2.3. Probe samples for soil and two groundwater locations were completed 28 & 29 December 2009. All soil samples were collected using a core barrel sampler with a 1 5/8 -inch diameter and four foot length. The boring logs of observed soil types are provided in Appendix A. A total of seven locations were sampled for VOCs in soil at discrete intervals and two locations for VOCs in groundwater. Soil samples were analyzed for VOCs by method 8260C and grain size analysis (at three locations) by method ASTM D422.

Four of the probe locations, PL2-SSL1, PL2-SSL4, PL2-SSL5, and PL2-SSL7 (shown in Figure 2.3), were constructed as soil vapor sampling points after completion of soil sampling. The vapor monitoring points were subsequently sampled at a later date. Two groundwater samples were collected at probe locations PL2-GP1 and PL2-GP2, both samples were collected using a peristaltic pump and analyzed for VOCs by method 8260C.

During the well development, well PL2-212B could not be located. After referring to several maps and consulting with Boeing personnel it was determined the well was located under heavy equipment tool storage containers that could not be moved without impeding current production.

An alternate to use of this well was proposed to and accepted by EPA by using two other probe samples in the immediate area (completed as part of the 2-10 Area Data Gap Investigation). The groundwater sampling was initiated after receipt of EPA approval to this work plan modification (i.e., dropping well PL2-212B and replacing it with 2 probe samples). The groundwater monitoring wells were sampled from 8-10 February 2010. Groundwater samples were obtained using low-flow purging techniques while monitoring field water quality parameters. Two exceptions to the low-flow purging were wells PL2-218A and PL2-218B, which used passive diffusion bags (PDBs) for the VOC samples (in accordance with the work plan). Both wells have long screened intervals and PDBs were placed at the top and bottom of the screen interval for each well. The PDBs were placed in the wells on 12 January 2010 and removed on 9 February 2010.

Soil vapor samples were collected on 11 and 12 February 2010 from the four installed vapor points. The soil vapor samples were collected using 6-L SUMMA canisters and analyzed for VOCs by method TO-15. Prior to collection of the vapor sample from each well, a series of leak tests were implemented to verify the integrity of the well seal and test the sample collection train for leaks. All leak tests were performed following established protocols. The SUMMA canisters were filled over approximately 20 minutes and sealed with approximately 4 inches Hg vacuum to ensure leakage would not occur in transport. The VOC data from the vapor points sampled are presented in Tables 2.1, 2.4, 2.5, and 2.7.

2.1 DATA SUMMARY OF PHASE 1 SAMPLING

For most of the wells, three cycles of surging and pumping provided sufficient well development (i.e., the well yielded clear water without noticeable fines/particulates). A few wells (PL2-254A, PL2-255A, PL2-252A, PL2-257A, PL2-209A, and PL2-212A) required additional development cycles. Details of the well development for each well are presented in Appendix D (Field Log Book Sheets).

Soil samples collected from the seven probe locations showed detections of TCE (or related daughter products) in all samples from all depths with the exception of location PL2-SSL4. The highest TCE concentration detected, 47,000 ug/kg, was at location PL2-SSL2 from a depth of 5 feet bgs (in the north sheetpile area). This is consistent with expected results as this probe was located immediately down gradient from the former TCE degreaser pit. In the south sheetpile area the highest TCE detection was at location PL2-SSL7 (120 ug/kg). Summaries of VOC detections in soil by location and depth are provided in Tables 2.1 thru 2.7.

Vapor sampling was completed following the work plan and no vapor samples were collected at the time of soil sampling. Four of the seven soil-probe locations were completed as soil-vapor sampling points. The rationale for four vapor-sampling locations was based on the Conceptual Site Model (i.e., previously identified releases from degreasers, high TCE levels in soil/water, sheetpile enclosures installed, and the expectation that vapor levels would likely be present in most areas within the sheetpile areas). The vapor sampling points were installed as wells (vapor points) that can be sampled again for performance monitoring as part of the planned soil vapor extraction operation. The results of the vapor sampling are provided in Tables 2.1, 2.4, 2.5 and 2.7. The vapor sampling results identified TCE, cis 1,2-DCE, and trans 1,2-DCE in each of the samples with the highest TCE levels detected near the degreaser area within the north sheetpile.

Groundwater sampling completed in support of this Phase 1 IM was done in four events; initial probe sampling (2 locations sampled on 28-29 December 2009), groundwater well sampling (20 groundwater wells sampled on 8-10 February 2010), groundwater well sampling done as a part of the Shoreline Monitoring Program (6 wells sampled on 10 February 2010), and groundwater probe sampling completed as part of the 2-10 Area Data Gaps Investigation. Two deep groundwater samples were taken during the probe investigation, PL2-GP1 and PL2-GP2. PL2-GP1 was a deep water sample (50 ft bgs) taken immediately down gradient of a former TCE degreaser located between the two sheetpile areas near well PL2-210A. This sample was analyzed for VOCs and indicated non-detect levels (< 0.2 ug/L) for all COCs. Probe PL2-GP2 was used to collect a water sample at 85 feet bgs near well PL2-218B. Results indicate a detection of 0.7 ug/L cis 1,2-DCE but no other COCs. Results for both probe groundwater samples are presented in Table 2.8.

After the IM Phase 1 sampling data were received it was determined that some data were inconsistent with historical trends and an internal review of the sampling procedures/sequence was conducted. Section 12.0 of the QAPP for the 2-10 Interim Measure Work Plan for the North and South Sheetpiles (Section 12 Corrective Actions), states “corrective actions are to be initiated when the following situations arise”:

- Specific requirements of the analysis method or sampling/analysis procedure are not met.
- DQOs for precision, accuracy, and completeness are not achieved.
- Laboratory or field data review indicates that data are incomplete or that improper calculation, methodology, or technique was employed, or that an instrument malfunction has occurred.

During the data/sampling process review it was determined two sampling protocols were inadvertently missed in the 2-10s IM Phase 1 sampling. First, the sampling sequence was not completed in a manner of sampling from wells expected to be clean towards the higher concentrations progression thereby reducing the chance of cross contamination of the subsequent samples. Second, collection of an equipment rinsate blank when using non-dedicated sampling equipment was not completed and in fact should have been based on the use of the submersible pump (non-dedicated equipment). At a later date (on 13 and 14 May 2010) the suspect equipment was tested with deionized water (a belated equipment rinsate blank). The results of this rinsate blank confirmed the suspicion of equipment cross contamination. The short term contact with pump and +24 hour contact showed total CVOCs of 13.7 ug/L and 195 ug/L respectively. The results from the +24 hour contact rinsate blank are within the same range of detections as the compromised samples. The sampling pump was decontaminated between sampling locations but the data demonstrate that the decontamination procedures were not sufficient.

Based on the rinsate blank results, all VOC data from 2-10s IM Phase 1 sampling were rejected except the 4 PDB samples taken from PL2-218A and PL2-218B which had no sampling train contact (and results are consistent with historical trends and Data Gaps sampling). The 2-10 Area Data Gaps Investigation sampling covered all of the wells with compromised data collected as part of the 2-10 Building IM sampling, and a recommendation was made to and approved by EPA to use the 2-10 Area Data Gap Investigation results in place of the Phase 1 sampling results.

The groundwater sampling results are presented in Tables 2.9 thru 2.13. The results indicate continuing reduction in the concentrations of COCs in groundwater at both the north and south sheetpile areas. The current and historical CVOC data from wells in and around the north sheetpile area are presented in Table 2.14. The current groundwater data (Feb.-Mar. 2010) for CVOCs near the north sheetpile area are presented in Figure 2.1. Significant levels of CVOCs are found in the A zone wells and lower detections in the B zone wells. Up gradient of the north sheetpile, well PL2-259B (45 ft bgs) indicates non-detect for CVOCs PCE through DCE and a low-level detection of vinyl chloride at 0.3 ug/L. To the east of the north sheetpile well PL2-271A (25 ft bgs) indicates non-detect for all CVOCs. These wells provide reasonable bounds that the VOC plume has not migrated to these areas. Similarly well PL2-258C, down gradient of the north sheetpile area, indicates no detections of chlorinated volatile organic compounds (CVOCs) and provides a reasonable bound that the VOC plume has not migrated to that depth (97 ft bgs). Results at well PL2-212A (9.5 ft bgs), up gradient shallow zone inside the north sheetpile area, indicates high concentrations of TCE, DCE, and vinyl chloride: at 62,000 ug/L, 22,000 ug/L, and 7,700 ug/L respectively. The shallow zone probe results (10 ft bgs) for DP-038, which is down gradient of PL2-212A and used in place of well PL2-212B, show similarly high levels for TCE, DCE, and vinyl chloride: at 3,900 ug/L, 150,000 ug/L, and 28,000 ug/L respectively. The deeper zone results for this probe (41 ft bgs) differ significantly with the highest detection at 4.4 ug/L of DCE, which indicates the plume is present primarily in the A zone and has not moved deeper in this area. Down gradient wells PL2-218A/B, inside the north sheetpile, show non detect for TCE and reduced concentrations of daughter products, indicating degradation is taking place. Well PL2-258A, shallow zone down gradient of the north sheetpile, shows elevated levels of DCE and VC relative to historical concentrations, VC in particular at 300 ug/L in February 2010 increased to 1,500 ug/L in March 2010.

Chlorinated volatile organic compound detections within the south sheetpile area indicate lower concentrations of CVOCs throughout the shallow A zone. The current and historical CVOC data from wells in and around the south sheetpile area are presented in Table 2.13. The current groundwater data (Feb.-Mar. 2010) for CVOCs near the south sheetpile area are presented in Figure 2.2. Well PL2-253A shows non-detect for parent CVOCs and the highest detection in the area of 91 ug/L for vinyl chloride. Well PL2-209B, 47.5 ft bgs, shows non-detect (< 0.2 ug/L) for the target CVOCs. Wells down gradient of the south sheetpile, PL2-252A, PL2-254A, and PL2-266A show low-level detections for the target CVOCs ranging from non-detect to 0.5 ug/L. Shoreline Monitoring Wells PL2-214A, PL2-214B, and PL2-214C indicate non detect levels for the target CVOCs as well. Well PL2-262B (45 ft bgs) and surrounding A and B zone probes (10 and 41 ft bgs), up gradient of the south sheetpile, indicate low-level detections of target CVOCs.

Soil vapor samples were collected from the four vapor monitoring points installed during probe sampling (PL2-SSL1 and PL2-SSL4 in the north sheetpile area, and PL2-SSL5 and PL2-SSL7 in the south sheetpile area). The analytical results for CVOCs detected in the soil vapor samples collected in Feb. 2010 are presented in Figure 2.3. All four samples indentified CVOCs within soil vapor; the highest concentrations were detected near the former degreaser sumps with the north sheetpile area having much higher vapor concentrations. Tables 2.1, 2.4, 2.5, and 2.7 present the compounds detected and corresponding concentrations for the soil vapor samples.

2.2 QUALITY ASSURANCE REVIEW

Fourteen (14) sample packages were received for the sampling related to the north and south Interim Measures; QD12 (soil completed on 12/29/09), QJ21 (groundwater sampling completed on 2/9/10), QJ86 (soil vapor sampling completed on 2/12/10), CENSUS-021HB_14903160 (groundwater bacteria census completed on 2/9/10), 1002322_d (soil vapor sampling conducted on 2/12/10), QM60 (groundwater sampling completed on 3/4/10), QM82 (groundwater sampling completed on 3/5/10), QM94 (groundwater sampling completed on 3/8/10), QN02 (groundwater sampling completed on 3/9/10), QN20 (groundwater sampling completed on 3/10/10), QN47 (groundwater sampling completed on 3/11/10), QN81 (groundwater sampling completed on 3/12/10), QO65 (groundwater sampling completed on 3/17/10), and QO99 (groundwater sampling completed on 3/18/10). These data packages are included as Appendix C.

Samples were collected following the sampling procedures and quality assurance guidelines in the project work plan and Quality Assurance Project Plan (QAPP) including the following:

- Sampling Standard Operating Procedures (SOPs) from the QAPP were followed
- Field sample forms were filled out to record sampling data
- Samples were preserved as appropriate
- Samples were placed in a cooler with ice as appropriate, and maintained under chain-of-custody for each delivery
- Duplicate samples were taken at a rate of 1 duplicate per 10 samples
- Matrix Spike and Matrix Spike Duplicate Samples were taken at a rate of 1 MS/MSD per 20 samples

Sample collection, recording, preservation, and analysis met the requirements in the work plan and QAPP (Floyd|Snider and CALIBRE 2009b). All chain-of-custody forms were completed with minor edits discussed by both project and laboratory personnel. Sample package QD12 was above the recommended temperature range (2 - 6°C) at the time of delivery to the laboratory, delivered at a temperature of 8.9°C. The samples were collected a short time earlier in the same day, placed in a cooler with ice but had not yet cooled to the target temperature range. All other sample packages were delivered to the laboratory within the recommended temperature range. All samples were analyzed within required holding times. Analyses for all samples were completed using approved analytical methods identified in the work plan/QAPP. The laboratories performed method-specific standard calibrations and checks to ensure equipment was operating in specified parameters as part of the sample analysis. A more detailed summary of the data validation/review has been prepared by Golder Associates (Golder 2010).

Field duplicates (blind samples to the laboratories) taken during groundwater sampling all met the project QAPP goals for precision, a relative percent difference (RPD) less than 50%. Soil vapor and one of two soil sample duplicates were also within the goals of the project QAPP. The field duplicate soil sample from location PL2-SSL2 had RPD values which exceed the QAPP goal for two of the constituents, trichloroethene and acetone, all other constituents were within the desired goal. The difference in concentrations for the two constituents appears to be

an example of soil heterogeneity and the data is still considered to be useable for the purposes of the project.

Select groundwater samples collected by EPI in March 2010 (sample packages: QM60, QM82, QM94, QN02, QN20, QN47, QN81, QO65, and QO99) have been used in place of the 2-10 IM Phase 1 samples as a result of compromised data. A complete data validation report will be completed through EPI, however included in this report is Quality Assurance review for the selected well groundwater results used in place of the 2-10 IM Phase 1 samples collected in February 2010. All sample packages were delivered to the lab in good condition with multiple coolers, some of which were delivered outside of the recommended temperature range (2 – 6°C). A cooler from QM60 was delivered with a temperature of 1.3°C; two coolers from QM82 were delivered with temperatures of 7.7°C and 9.6°C; two coolers from QM94 were delivered with temperatures of 0.8°C and 1.3°C; a cooler from QN02 was delivered with a temperature of 1.9°C; two coolers from QN20 were delivered with a temperature of 1.3°C and 1.7°C; a cooler from QN47 was delivered with a temperature of 6.7°C; a cooler from QO65 was delivered with a temperature of 7.3°C; a cooler from QO99 was delivered with a temperature of 0.7°C. All samples were analyzed for VOCs by EPA Method 8260C within method required holding times with the exception of one sample. Sample 2-10-PL2-214C-W-0 had a pH of 7 and was analyzed outside of the method recommended holding time due to preservation. Data for this sample was reported as is. All other samples had a pH less than 2 except sample 2-10-PL2-209B-W-0 which had a pH of 3. The laboratories performed method-specific standard calibrations and checks to ensure equipment was operating in specified parameters as part of the sample analysis.

All data obtained from sampling are considered suitable for the intended use based on the project QAPP and the documentation/SOPs/data review noted above.

2.3 SUMMARY OF PHASE 1 DATA AND EVALUATION

The CSM from the Phase 1 Work Plan is included in Appendix G. The CSM has been developed to reflect the best interpretation of all relevant site data presently available. As new data are collected, they have been tested (and will continue to be tested) for consistency with the CSM, and the CSM will be modified as appropriate. The CSM is intended to evolve with the understanding of the site conditions and ultimately transition into a Performance Model to which post-remediation monitoring data would be compared to determine if the IM is performing as expected.

Given the CSM, two primary objectives for data collection/evaluation effort were identified:

1. Establish current site conditions to evaluate the two primary pathways of concern (discharge to the adjacent waterway and potential exposure via indoor air).
2. Evaluate the feasibility of candidate technologies for implementing IMs to address VOCs in soil and groundwater. Two technologies have been identified as the most likely candidates for the next phase of IMs: SVE to remove any vadose zone contamination (and if necessary, manage any vapor intrusion risk), and ERD, to accelerate mass removal (through biodegradation) from the saturated zone.

Several decisions were identified in the Phase 1 Work Plan with respect to these two objectives; they are summarized below along with the interpretations/conclusions from the recent sampling.

	Key project decisions related to exposure, nature, and extent	***Evaluation based on recent data***
1a.	Does vapor intrusion to indoor air pose an unacceptable risk?	*Measurable VOC levels detected, TCE values in the range of 0.2 to 1.9 ug/m^3 compared to the MTCA Method C standard of 1 ug/m^3. All detected values are less than an unofficial action level of 3.7 ug/m^3. (Golder 2010).*
1b.	Do current VOCs in soil/soil vapor presently contribute to water quality contamination (within the contained sheetpiles)?	*Yes*
1c.	Have current conditions changed from historical conditions relative to the identified contamination from the degreaser operations (i.e., how much have concentrations changed [increase or decrease] relative to historical data and do those changes impact the IM design)?	*Generally, VOC levels near sources are reduced but do not change the IM design. In some more distant plume areas concentrations have changed, some increasing (PL2-218B increased from 1,500 ug/L to 9,800 ug/L cis1,2DCE), some decreasing (PL2-245A decreased for all CVOCs; TCE from 11 to 0.9 ug/L, cis 1,2 DCE from 220 to 15 ug/L, and vinyl chloride from 120 to 3.8 ug/L).*
1d.	Do the existing data adequately define the plume boundaries for IM design?	*Yes, within and down gradient of the N/S sheetpile areas.*
1e.	Are VOC concentrations decreasing within the sheetpile areas?	*Yes, near the source areas (indicating dechlorination is occurring), but not as much away from the sources.*
1f.	Are VOC concentrations decreasing outside the sheetpile areas?	*Yes, wells outside of the N/S sheetpiles generally show a decrease in CVOC concentrations. Most groundwater concentrations within the sheetpiles demonstrated dechlorination occurring i.e. daughter products increased. VOC concentrations outside of the sheetpiles demonstrate this trend as well.*

	Key project decisions related selection of IM technology	***Evaluation based on recent data***
2a.	If a vapor intrusion pathway exists (i.e., measured as a complete pathway), will SVE control it adequately?	*Pathway exists at levels slightly above risk levels for industrial settings (standard MTCA Method C value for TCE); SVE is expected to further reduce exposure potential.*
2b.	If VOCs are present in soil vapor at elevated levels, is SVE an appropriate means of controlling or eliminating the contaminant mass and what rate of VOC loading to activated carbon or other treatment technology should be expected from the SVE operation?	*Yes SVE is appropriate and Phase 1 characterization data provide suitable design criteria for activated carbon off-gas treatment technology.*
2c.	If historical conditions have changed, will they change the identity or design of the IMs?	*No change for selection/identity of IMs, minor changes in IM design/layout based on current nature and extent data.*
2d.	How will ERD affect current degradation rates outside the sheetpile enclosure?	*Phase 1 characterization data indicate dechlorination is occurring (low redox levels, Dehalococcoides spp. are present, ethene is present). Biostimulation through ERD is expected to accelerate degradation rates.*
2e.	How will ERD affect current degradation rates inside the sheetpile enclosure?	*Conditions look favorable and biostimulation through ERD is expected to accelerate degradation rates.*

3.0 Interim Measures Design

The following sections describe the general design for the IMs; SVE for VOCs present in soil and soil vapor, and ERD for VOCs present in groundwater. The general details include the basis for the design, design criteria, general plan-view layout of the treatment areas (both vadose zone soils and groundwater), typical process flow diagrams for the treatment processes, permitting requirements and plans for performance monitoring. This section describes the design details and expected permitting requirements. The performance monitoring plan is described in Section 4.

3.1 SOIL VAPOR EXTRACTION

The current (and historical) data indicate solvent contamination in soil and soil vapor (TCE and related degradation daughter products) near the degreasers at the N/S sheetpile areas. These data regarding soil and soil-vapor samples indicate that IMs are warranted at both the north and south sheetpile areas.

3.1.1 Basis for SVE Design

The site data near the north sheetpile area indicate TCE is present in soil in the areas around the soil vapor probe locations PL2-SSL1 and PL2-SSL4. Vapor concentrations indicate high concentrations of TCE and the daughter product DCE. Soil samples taken from locations PL2-SSL1, PL2-SSL2, and PL2-SSL3 indicate elevated concentrations of TCE and DCE from a 5 foot depth to the water table (approximately 10-13 ft bgs, varies by tide).

At the south sheetpile area, vapor samples taken from PL2-SSL5 and PL2-SSL7 had detections of TCE at both vapor sampling points. Soil samples taken from location PL2-SSL5, PL2-SSL6, and PL2-SSL7 indicate TCE concentrations from depths of 5 feet to the water table. No daughter products were detected in the soil samples.

The recent data (soil and soil-vapor samples) identified VOCs at levels warranting IMs at both the north and south sheetpile areas. Soil grain size analyses completed with the Phase 1 sampling indicate soils with a high sand content and an estimated conductivity of 2×10^{-3} cm/s, (a rough estimate based on the grain size distribution, see Table 3.1 for details). This estimated conductivity is sufficiently high to indicate that SVE should be effective (i.e., the vent well yield is high enough to make SVE effective).

3.1.2 SVE Design Criteria

Based on the conductivity estimate (2×10^{-3} cm/s), a SVE yield calculation was completed as part of the SVE design. Assuming the extraction wells are 4-inch diameter and the system will be operated at 60 inches water of vacuum (4.4 inches mercury), a vent well extraction yield of 1.6 cubic feet per minute per foot of well screen should be feasible. General design criteria indicate that multiple pore volume flushes will be required for effective SVE treatment of these areas (USEPA 1991, USACE 2002). For areas within the north sheetpile, the higher initial CVOC concentrations will require a larger number of pore volume flushes which may be achieved by either a longer operating period and/or an increased extraction rate.

A series of standard SVE design calculations were completed in order to estimate the number of SVE vent wells necessary to remediate the two sheetpile areas within a targeted six-month time period (the target of a six-month operating period is intended as a general design criteria; actual conditions may be longer or shorter). The summary of the SVE design calculations are presented in Table 3.2; additional details are presented in Appendix E. Within the north sheetpile area, the area around well PL2-212A (north east area) has much higher concentrations than elsewhere in the sheetpile areas. Based on this, it was assumed that this area will require twice as many pore volume flushes during the treatment period of six months. An estimated 400 flushes will be necessary in the north east area whereas only an estimated 200 will be necessary in the north west area. Based on the estimated number of pore volume flushes and SVE yield calculations a total of five vapor extraction wells are included in the design, three in the north east half and two in the north west.

The southern sheetpile area has TCE concentrations in soil that are much lower than the east portion of the northern sheetpile area and therefore it is expected that fewer pore volume flushes will be required. As such, 200 flushes were used as a design basis to remediate soil in the southern sheetpile area over a six-month period. Based on these requirements, the conceptual SVE design includes two SVE vent wells in the southern sheetpile area. These two vent wells will be constructed in the same manner as those in the northern sheetpile area

3.1.3 SVE Layout and Typical Process Flow Diagram

Figure 3.1 presents the plan view layout of SVE vent wells and SVE equipment package locations. The SVE design has been developed to treat the entire area within each sheetpile. The locations have been chosen to cover the required area and minimize access restrictions. However, the actual well layout may change based on physical access within the work areas of the 2-10 Building and the presence of underground utilities/obstructions. If feasible and deemed necessary, slant drilling may be considered for SVE wells.

Figure 3.2 provides a process flow diagram for a typical SVE system. The typical details presented in Figure 3.2 may change slightly based on pre-existing SVE equipment packages that are available. The vent wells are to be constructed of 4-inch PVC to a depth of ten feet below ground surface. The typical well construction details are presented in Figure 3.2. The two SVE vent wells near monitoring well PL2-212A (the well with the highest TCE concentration) will be constructed out of stainless steel casing to provide more chemical resistance (compared to PVC wells).

3.2 ENHANCED REDUCTIVE DECHLORINATION

The current (and historical) data indicate solvent contamination in groundwater (TCE and related degradation daughter products) near the degreasers at the N/S sheetpile areas. These data indicate that IMs are warranted at both the north and south sheetpile areas. After starting the SVE system for a soil remedy, and performance monitoring indicates reduced vapor concentrations, a groundwater remedy is recommended to reduce COC concentrations in areas within and near the sheetpile areas. The proposed groundwater remedy is enhanced reductive dechlorination (ERD), which has been successfully implemented in nearby solvent plumes.

3.2.1 Basis for ERD Design

The current groundwater conditions indicate reductive dechlorination is already occurring. The recent sampling data indicates that the dechlorination daughter products of TCE (cis1,2-DCE, trans 1,2-DCE, vinyl chloride, and ethene) are present indicating that dechlorination is occurring and that the proper bacteria (*Dehalococcoides spp.,* required for full dechlorination), appear to be present. These findings are consistent with groundwater quality conditions observed at the site. The oxidation-reduction potential (ORP) is in the strongly reducing range for all but two wells sampled.

The addition of appropriate substrates has been shown to accelerate the dechlorination process. The substrate is fermented to produce dissolved hydrogen (an electron donor), which is utilized by the dechlorinating bacteria to metabolize the chlorinated compounds. For the two sheetpile areas the proposed substrate will consist of food quality waste sucrose solution obtained from a local distribution company or a local recycling facility. The substrate injection will also include a buffer addition (sodium bicarbonate, baking soda) to limit some acidification (lowering of pH) due to substrate fermentation and the dechlorination processes.

3.2.2 ERD Design Criteria

ERD has been successfully implemented at similar sites using a substrate solution injected to reach an in-situ substrate concentration of 500 to 1,000 mg/L (substrate as TOC after in-situ mixing). Based on this, the number of substrate injection wells necessary to supply sufficient nutrients to the groundwater can be calculated using the treatment area and saturated depth.

Groundwater monitoring data within the two sheetpile areas indicates that the VOC plume is present at varying depths within the northern and southern sheetpile areas.

In the east portion of the northern sheetpile (near PL2 212A) the VOC plume extends to a depth approximately 40 ft bgs, near the western half of the northern sheetpile the VOC plume extends to a depth greater than 58 ft bgs and trace levels (0.7 ug/L cis 1,2 DCE) were detected at 85 ft bgs. The layout of the ERD design has been developed to treat the VOC plume from about 40+ ft bgs in east, progressing to a depth of 60+ ft bgs in the westerly flow path.

The south sheetpile appears to have VOC concentrations to a depth of approximately 25 feet below ground surface for a saturated plume thickness of 15 feet. Within the given saturated thicknesses and the footprint of the sheetpile areas, the estimated mass of substrate per injection is 11,240 pounds for the northern sheetpile area and 2,020 pounds for the southern sheetpile area, see Table 3.2 for details. The general ERD design calculations (areas, depths, volumes, and substrate mass to reach target TOC levels) are presented in Appendix E.

Typically substrate is injected at a concentration of 6-12%; for this design, substrate is assumed to be a 10% solution. At this concentration and an average injection volume of 1,200 gallons per well, 11 injection wells will be required for the north sheetpile area. The south sheetpile area will have an average injection of 500 gallons per well (the thinner saturated zone where the VOC plume is present requires shorter screen intervals) with a total of 5 injection wells. All injections will be completed according to established standard operating procedures (SOPs) provided in Appendix F.

3.3.3 ERD Layout and Typical Process Flow Diagram

Figure 3.3 presents planned locations of ERD injection wells for the IM. The actual well layout may change based on physical access within the work areas of the 2-10 Building and the presence of underground utilities/obstructions. Figure 3.4 provides a process flow diagram of a typical substrate injection.

Each ERD injection well is to be constructed of 4-inch PVC to varying depths below ground surface (targeted to reach the base of the CVOC plume in each area). The typical well construction details are presented in Figure 3.5. Shallow ERD injection wells (25 ft bgs or less) will be constructed with a single screen interval. Deeper ERD injections wells will include multiple screen intervals (separate segments) so that substrate can be injected over different intervals. This construction detail is included so that the operational ERD substrate injection can be adjusted to include segmented injection over differing intervals.

3.3 PERMITTING REQUIREMENTS

The permitting requirements include an air-discharge permit (for the SVE systems operation) from the Puget Sound Clean Air Agency (PSCAA) and Underground Injection Control (UIC) registration. The design details included in this Work Plan will be adapted and submitted for these two permit requirements.

The PSCAA Notice of Construction (NOC) permit for air discharges from soil and groundwater remediation systems (PSCAA form SGR) will be completed and submitted to PSCAA along with the State Environmental Policy Act (SEPA) checklist.

The UIC Registration (for Class V UIC wells that automatically meet the non-endangerment standard) will be registered on-line with the Department of Ecology Water Quality Program.

4.0 Performance Monitoring

The proposed IMs for each sheetpile area will require performance monitoring. The objectives and details for the performance monitoring are described in this section. The prior Phase 1 Work Plan presented a Sampling and Analysis Plan (Floyd|Snider and CALIBRE 2009a) and Quality Assurance Project Plan (Floyd|Snider and CALIBRE 2009b). The procedures, analytical methods, documentation, and reporting defined in the approved SAP and QAPP will be followed for the performance monitoring. The Phase 1 Work Plan documents (included the SAP and QAPP) are included in the attached CD for simple reference. This addition to the SAP requirements focuses on additional sampling planned for performance monitoring of the IMs.

Key decisions related to the IM performance are expected to include:

1. Are the IMs effectively removing (or destroying) mass of the targeted CVOCs?
2. Are there optimization measures that can improve the IM performance (i.e., faster or more efficient mass removal, achieving lower CVOC levels in targeted media)?
3. Are the IM equipment/treatment systems being operated in a manner which meet the required permit conditions (such as a PSCAA air discharge permit)?
4. Has this IM effectively met the performance criteria in the unsaturated zone for both the north and south sheetpile areas?

Other key decisions related to the IM performance may be identified which require other and/or different monitoring and data evaluation.

4.1 SVE SYSTEM PERFORMANCE MONITORING

Performance monitoring data for the SVE operation is expected to include vapor concentrations in the extracted vapors and at the discharge point (after treatment). Operational optimization measures may include different flushing patterns within the enclosed sheetpile areas and pulsing of the SVE operation after extracted vapor concentrations decline significantly.

The SVE monitoring will initially focus primarily on field measurements of vapor concentrations using a photo-ionization detector (PID); the vapor concentrations are high enough that the PID measurements will meet the data requirements for performance monitoring/optimization. After vapor concentrations decline significantly (due to the SVE mass removal) additional soil vapor sampling using TO-15 analysis will be conducted to verify the field sampling results. The points to be monitored with a PID will include each vapor extraction well, the total combined vapor for each area at the influent to the treatment system (north and south sheetpiles are expected to be operated separately) and the discharge concentrations after vapor phase treatment with activated carbon.

The initial frequency of field monitoring (for SVE operation) will start out as twice a week for two weeks, weekly for another two weeks and monthly thereafter. The time series of SVE performance monitoring data will be evaluated as they are collected and used for system optimization (i.e., to modify system operation to efficiently extract the largest mass of the targeted CVOCs). Recommendations for changes in the frequency of monitoring will be made after the performance monitoring data are evaluated. The data evaluation will be presented in a Technical Memorandum no later than 4 months after SVE system startup (the recommendations

may be prepared earlier if the conditions change very rapidly, i.e., if the monitoring data indicate a rapid decline in VOCs in soil vapor).

The SVE monitoring locations to be sampled include the following (locations are shown in Figures 2.3 and 3.1):

Field PID Measurements (total VOCs as calibrated to isobutylene; at frequency of twice a week for two weeks, weekly for weeks three and four, and monthly thereafter).

North sheetpile locations	South sheetpile locations
SVE-N-1	SVE-S-6
SVE-N-2	SVE-S-7
SVE-N-3	Combined Inlet to SVE system
SVE-N-4	Discharge after treatment with carbon
SVE-N-5	
Combined Inlet to SVE system	
Discharge after treatment with carbon	

TO-15 Analysis (GC/MS analysis for CVOCs; frequency to be determined after the PID measurements indicate a significant decline in vapor concentrations, such as a 95 % decline in PID levels).

North sheetpile locations	South sheetpile locations
SVE-N-1	SVE-S-6
SVE-N-2	SSL7
SSL1	SSL5
SSL4	
SVE-N-5	

The performance monitoring defined above will be modified if the PSCAA discharge permit conditions require additional or changed monitoring (to be determined after the permit is issued).

Confirmational sampling will be completed following SVE operation to provide another line of evidence to confirm that appropriate performance criteria have been met. This confirmational soil sampling (post operation) will be completed near three prior sampling locations in the north sheetpile area (SSL-1, SSL-2 and SSL-4) and near one prior sampling location in the south sheetpile area (SSL-7).

4.2 ERD PROCESS PERFORMANCE MONITORING

Performance monitoring data for the ERD operation will include CVOC concentrations in groundwater along with several other remedial optimization parameters (redox, dissolved oxygen, pH, TOC, dissolved gasses, and bacterial census counts).

The ERD monitoring will focus primarily on VOCs in groundwater samples (using method 8260C), dissolved gasses (method RSK-175) and total organic carbon (TOC) using method 415.1. The initial frequency of monitoring will start out as once a month for 3 months and then quarterly thereafter. The wells to be sampled for selected analytes are listed below (the layout of wells is shown in Figure 3.3):

8260C (VOCs), RSK-175 (dissolved gasses) and
415.1 (TOC) Analysis for ERD Performance Monitoring

North sheetpile locations	South sheetpile locations
PL2-212A	PL2-257A
PL2-218 A/B	PL2-256A
PL2-258 A/B	PL2-209 A/B
ERDIW-N-1	ERDIW-S-12
ERDIW-N-5	ERDIW-S-13
ERDIW-N-6	
ERDIW-N-4	

Dechlorinating Bacteria Census Count (*Dehalococcoides spp*).
for ERD Performance Monitoring

North sheetpile locations	South sheetpile locations
PL2-212A	PL2-209 A
PL2-218 A/B	ERDIW-S-12
ERDIW-N-4	

In addition, well PL2 -258C will be sampled for VOCs using method 8260C after six months of operation to confirm that no changes to groundwater quality have occurred at that depth. The results of that testing (sampling for VOCs from PL2-258C), will be evaluated to determine if further sampling of PL2-258C is necessary as part of this IM.

The performance monitoring for dechlorinating bacteria census count will be completed one time after substrate injection; the timing will depend on changes in VOCs, redox and other parameters. The initial estimate is that this sampling will be completed three months after the initial substrate injection.

The time series of performance monitoring data related to ERD will be evaluated as they are collected and used for system optimization (i.e., to add substrate and/or buffer as required to efficiently degrade the largest mass of the targeted CVOCs). Recommendations for changes in the frequency of monitoring will be made after the performance monitoring data are evaluated. The data evaluation will be presented in a Technical Memorandum no later than eight months after ERD system startup (the recommendations may be prepared earlier if the conditions change very rapidly).

Relevant field parameters (related to ERD optimization/performance) will also be monitored with each sampling event (pH, redox and dissolved oxygen).

5.0 Recommendations and Schedule

This second Work Plan (Phase 2: IM Design and Implementation) has been prepared to propose IMs to remediate contamination present at the two sheetpile areas in the 2-10s Building. A short summary of the general design details and proposed schedule are summarized below.

Two remedial technologies are recommended for each of the 2-10 Building sheetpile IMs: soil vapor extraction (SVE) for treating VOCs in vadose zone soils and enhanced reductive dechlorination (ERD) for treating VOCs in groundwater and saturated soils. The recently collected 2-10 IM Phase 1 sampling data along with the results of other recent sampling in the immediate area provide justification for the proposed remedial technologies in specific areas of the sheetpile areas. In the north sheetpile, based on the estimated number of pore volume flushes and SVE yield calculations a total of five (5) extraction wells will be necessary, three (3) in the north east half and two (2) in the north west. The southern sheetpile area has concentrations of TCE in soil that are much lower than the portions of the northern sheetpile area and will therefore require fewer pore volume flushes. Based on these characteristics, the SVE design includes two (2) SVE vent wells in the southern sheetpile area. The general design details for the SVE systems are shown in Figures 3.1 through 3.2.

After the SVE system is operational and performance monitoring indicates reduced vapor concentrations, the ERD groundwater remedy should be initiated to reduce COC concentrations in areas within the N/S sheetpiles and also including an area immediately up gradient of the south sheetpile and an area down gradient of the north sheetpile. The recommended groundwater remedy is enhanced reductive dechlorination (ERD) which has been successfully implemented in nearby solvent plumes. Based on the overall areas of treatment and depths of detected COCs, eleven (11) ERD injection wells are planned for the north sheetpile area and five (5) ERD injection wells in the south sheetpile area. The general design details for the ERD treatment areas are shown in Figures 3.3 through 3.5.

The proposed IM implementation plan and milestone schedule is as follows:

Task	Start Date (1)	Task Duration (days)	Notes / description
Phase 2 Work Plan Submittal	28-Jul-10	1	
Phase 2 Work Plan Submittal: Rev 1	14-Oct-10	1	Revised work plan prepared to address comments dated 15- Sept-2010
EPA Approval of Phase 2 Work Plan	28-Nov-10	45	Estimated
Start IM construction	1-Dec-10	3	Application for permits started
SVE Drilling, Piping, Equipment Installation	31-Dec-10	30	A total of 7 SVE wells installed, 5 in the north sheetpile and 2 in the south sheetpile. After well drilling, piping and equipment packages to be installed.
ERD Drilling	14-Jan-11	14	A total of 16 wells will be installed, 11 in the north sheetpile and 5 in the south sheetpile. Drilling is assumed to commence after the SVE wells have been installed (only one drill crew mobilization).
PSCAA NOC permit & UIC Registration	22-Jan-11	8	SVE system discharge permit from PSCAA (estimated receipt date). Injection well registration with UIC program.
SVE System Startup	30-Jan-11	5	SVE system will be started after the Performance Monitoring Plan has been approved and the system is installed and PSCAA discharge permit issued.
ERD Initial Substrate Injection	15-Apr-11	2	ERD substrate injections will commence after operation of the SVE system has shown a decrease in vapor phase concentrations.
IM Construction Report Submittal	30-May-11	1	Documentation of IM Systems installation.

(1) Note: Dates listed above are estimates and may change based on review/approval cycles and access for intrusive work within the production area.

6.0 References

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Tables

Table 2.1 Sampling Summary for Location PL2-SSL1

Location: PL2-SSL1 - Soil

Sample Date	Sample Location	Sample Depth (ft)	Method	Parameter	Units	Result	Flags	Reporting Limit
29-Dec-09	PL2-SSL1	5	SW8260C	Tetrachloroethene	µg/kg	<1.1	U	1.1
29-Dec-09	PL2-SSL1	5	SW8260C	Trichloroethene	µg/kg	16,000		130
29-Dec-09	PL2-SSL1	5	SW8260C	cis-1,2-Dichloroethene	µg/kg	110		1.1
29-Dec-09	PL2-SSL1	5	SW8260C	trans-1,2-Dichloroethene	µg/kg	4.3		1.1
29-Dec-09	PL2-SSL1	5	SW8260C	Vinyl Chloride	µg/kg	<1.1	U	1.1
29-Dec-09	PL2-SSL1	5	SW8260C	Acetone	µg/kg	31		5.4
29-Dec-09	PL2-SSL1	5	SW8260C	Chloroform	µg/kg	3	M	1.1
29-Dec-09	PL2-SSL1	5	SW8260C	1,1,2- Trichloroethane	µg/kg	2.6		1.1
29-Dec-09	PL2-SSL1	10	SW8260C	Tetrachloroethene	µg/kg	<1.1	U	1.1
29-Dec-09	PL2-SSL1	10	SW8260C	Trichloroethene	µg/kg	7,200		160
29-Dec-09	PL2-SSL1	10	SW8260C	cis-1,2-Dichloroethene	µg/kg	220		1.1
29-Dec-09	PL2-SSL1	10	SW8260C	trans-1,2-Dichloroethene	µg/kg	7.5		1.1
29-Dec-09	PL2-SSL1	10	SW8260C	Vinyl Chloride	µg/kg	<1.1	U	1.1
29-Dec-09	PL2-SSL1	10	SW8260C	Acetone	µg/kg	59		5.7
29-Dec-09	PL2-SSL1	10	SW8260C	Chloroform	µg/kg	6.7		1.1
29-Dec-09	PL2-SSL1	10	SW8260C	1,1,2- Trichloroethane	µg/kg	4.6		1.1
29-Dec-09	PL2-SSL1	10	SW8260C	Tetrachloroethene	µg/kg	<1.3	U	1.3
29-Dec-09	PL2-SSL1	10	SW8260C	Trichloroethene	µg/kg	9,100		120
29-Dec-09	PL2-SSL1	10	SW8260C	cis-1,2-Dichloroethene	µg/kg	150		1.3
29-Dec-09	PL2-SSL1	10	SW8260C	trans-1,2-Dichloroethene	µg/kg	5.4		1.3
29-Dec-09	PL2-SSL1	10	SW8260C	Vinyl Chloride	µg/kg	<1.3	U	1.3
29-Dec-09	PL2-SSL1	10	SW8260C	Acetone	µg/kg	46		6.3
29-Dec-09	PL2-SSL1	10	SW8260C	Chloroform	µg/kg	4.3	M	1.3
29-Dec-09	PL2-SSL1	10	SW8260C	1,1,2- Trichloroethane	µg/kg	3.4		1.3

Location: PL2-SSL1 - Soil Vapor

Sample Date	Sample Location	Sample Depth (ft)	Method	Parameter	Units	Result	Flags	Reporting Limit
12-Feb-10	PL2-SSL1	8	TO-15	Tetrachloroethene	ppbv	<760	U	760
12-Feb-10	PL2-SSL1	8	TO-15	Trichloroethene	ppbv	240,000		760
12-Feb-10	PL2-SSL1	8	TO-15	cis-1,2-Dichloroethene	ppbv	14,000		760
12-Feb-10	PL2-SSL1	8	TO-15	trans-1,2-Dichloroethene	ppbv	970		760
12-Feb-10	PL2-SSL1	8	TO-15	Vinyl Chloride	ppbv	<760		760
12-Feb-10	PL2-SSL1	8	TO-15	Tetrachloroethene	ppbv	<760	U	760
12-Feb-10	PL2-SSL1	8	TO-15	Trichloroethene	ppbv	260,000		760
12-Feb-10	PL2-SSL1	8	TO-15	cis-1,2-Dichloroethene	ppbv	14,000		760
12-Feb-10	PL2-SSL1	8	TO-15	trans-1,2-Dichloroethene	ppbv	1,000		760
12-Feb-10	PL2-SSL1	8	TO-15	Vinyl Chloride	ppbv	<760		760

Table 2.1 Sampling Summary for Location PL2-SSL1

Location: PL2-SSL1 - Tedlar Bag

Sample Date	Sample Location	Sample Depth (ft)	Method	Parameter	Units	Result	Flags	Reporting Limit
12-Feb-10	PL2-SSL1	8	TO-15 Mod	Tetrachloroethene	ppbv	<120	U	120
12-Feb-10	PL2-SSL1	8	TO-15 Mod	Trichloroethene	ppbv	350,000		150
12-Feb-10	PL2-SSL1	8	TO-15 Mod	cis-1,2-Dichloroethene	ppbv	34,000		200
12-Feb-10	PL2-SSL1	8	TO-15 Mod	trans-1,2-Dichloroethene	ppbv	2,100		200
12-Feb-10	PL2-SSL1	8	TO-15 Mod	Vinyl Chloride	ppbv	<310	U	310

Note: The Tedlar bag sample was analyzed for target CVOCs only. Sample was performed to determine laboratory effectiveness for use in performance monitoring.

Note: Soil vapor sampling results present the compounds detected and resulting concentrations, not the full analyte list. Samples were analyzed by method TO-15 and included the associated full list of compounds.

Abbreviations:

- ft feet
- µg/kg micrograms/kilogram
- ppbv parts per billion by volume

Qualifier:

- U Non-detect
- J Estimated
- E Estimated concentration exceeded calibration range
- M Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters.
- B Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's Reporting Limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.

Table 2.2 Sampling Summary for Location PL2-SSL2

Location: PL2-SSL2 - Soil

Sample Date	Sample Location	Sample Depth (ft)	Method	Parameter	Units	Result	Flags	Reporting Limit
29-Dec-09	PL2-SSL2	5	SW8260C	Tetrachloroethene	µg/kg	<1.2	U	1.2
29-Dec-09	PL2-SSL2	5	SW8260C	Trichloroethene	µg/kg	47,000		240
29-Dec-09	PL2-SSL2	5	SW8260C	cis-1,2-Dichloroethene	µg/kg	2,300		240
29-Dec-09	PL2-SSL2	5	SW8260C	trans-1,2-Dichloroethene	µg/kg	49		1.2
29-Dec-09	PL2-SSL2	5	SW8260C	Vinyl Chloride	µg/kg	<1.2	U	1.2
29-Dec-09	PL2-SSL2	5	SW8260C	Acetone	µg/kg	37		6.0
29-Dec-09	PL2-SSL2	5	SW8260C	Carbon Disulfide	µg/kg	3.4		1.2
29-Dec-09	PL2-SSL2	5	SW8260C	1,1,1- Trichloroethane	µg/kg	1.2		1.2
29-Dec-09	PL2-SSL2	10	SW8260C	Tetrachloroethene	µg/kg	<1.3	U	1.3
29-Dec-09	PL2-SSL2	10	SW8260C	Trichloroethene	µg/kg	870		74
29-Dec-09	PL2-SSL2	10	SW8260C	cis-1,2-Dichloroethene	µg/kg	120		1.3
29-Dec-09	PL2-SSL2	10	SW8260C	trans-1,2-Dichloroethene	µg/kg	6		1.3
29-Dec-09	PL2-SSL2	10	SW8260C	Vinyl Chloride	µg/kg	<1.3	U	1.3
29-Dec-09	PL2-SSL2	10	SW8260C	Acetone	µg/kg	66		6.5
29-Dec-09	PL2-SSL2	10	SW8260C	Chloroform	µg/kg	2.8		1.3
29-Dec-09	PL2-SSL2	10	SW8260C	Tetrachloroethene	µg/kg	<1.3	U	1.3
29-Dec-09	PL2-SSL2	10	SW8260C	Trichloroethene	µg/kg	240		1.3
29-Dec-09	PL2-SSL2	10	SW8260C	cis-1,2-Dichloroethene	µg/kg	75		1.3
29-Dec-09	PL2-SSL2	10	SW8260C	trans-1,2-Dichloroethene	µg/kg	4.2		1.3
29-Dec-09	PL2-SSL2	10	SW8260C	Vinyl Chloride	µg/kg	<1.3	U	1.3
29-Dec-09	PL2-SSL2	10	SW8260C	Acetone	µg/kg	39		6.3
29-Dec-09	PL2-SSL2	10	SW8260C	Chloroform	µg/kg	1.8	M	1.3

Abbreviations:

ft feet

µg/kg micrograms/kilogram

Qualifier:

U Non-detect

J Estimated

E Estimated concentration exceeded calibration range

M Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters.

B Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's Reporting Limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.

Table 2.3 Sampling Summary for Location PL2-SSL3

Location: PL2-SSL3 - Soil

Sample Date	Sample Location	Sample Depth (ft)	Method	Parameter	Units	Result	Flags	Reporting Limit
29-Dec-09	PL2-SSL3	10	SW8260C	Tetrachloroethene	µg/kg	<1.4	U	1.4
29-Dec-09	PL2-SSL3	10	SW8260C	Trichloroethene	µg/kg	37		1.4
29-Dec-09	PL2-SSL3	10	SW8260C	cis-1,2-Dichloroethene	µg/kg	15		1.4
29-Dec-09	PL2-SSL3	10	SW8260C	trans-1,2-Dichloroethene	µg/kg	1.4		1.4
29-Dec-09	PL2-SSL3	10	SW8260C	Vinyl Chloride	µg/kg	<1.4	U	1.4
29-Dec-09	PL2-SSL3	10	SW8260C	Acetone	µg/kg	14		6.7

Abbreviations:

ft feet

µg/kg micrograms/kilogram

ppbv parts per billion by volume

Qualifier:

U Non-detect

J Estimated

E Estimated concentration exceeded calibration range

M Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters.

B Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's Reporting Limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.

Table 2.4 Sampling Summary for Location PL2-SSL4

Location: PL2-SSL4 - Soil

Sample Date	Sample Location	Sample Depth (ft)	Method	Parameter	Units	Result	Flags	Reporting Limit
28-Dec-09	PL2-SSL4	10	SW8260C	Tetrachloroethene	µg/kg	<1.3	U	1.3
28-Dec-09	PL2-SSL4	10	SW8260C	Trichloroethene	µg/kg	<1.3	U	1.3
28-Dec-09	PL2-SSL4	10	SW8260C	cis-1,2-Dichloroethene	µg/kg	<1.3	U	1.3
28-Dec-09	PL2-SSL4	10	SW8260C	trans-1,2-Dichloroethene	µg/kg	<1.3	U	1.3
28-Dec-09	PL2-SSL4	10	SW8260C	Vinyl Chloride	µg/kg	<1.3	U	1.3
28-Dec-09	PL2-SSL4	10	SW8260C	Acetone	µg/kg	13		6.3
28-Dec-09	PL2-SSL4	14	SW8260C	Tetrachloroethene	µg/kg	<1.6	U	1.6
28-Dec-09	PL2-SSL4	14	SW8260C	Trichloroethene	µg/kg	<1.6	U	1.6
28-Dec-09	PL2-SSL4	14	SW8260C	cis-1,2-Dichloroethene	µg/kg	<1.6	U	1.6
28-Dec-09	PL2-SSL4	14	SW8260C	trans-1,2-Dichloroethene	µg/kg	<1.6	U	1.6
28-Dec-09	PL2-SSL4	14	SW8260C	Vinyl Chloride	µg/kg	<1.6	U	1.6
28-Dec-09	PL2-SSL4	14	SW8260C	Acetone	µg/kg	41		8.0
28-Dec-09	PL2-SSL4	14	SW8260C	Carbon Disulfide	µg/kg	1.8		1.6

Location: PL2-SSL4 - Soil Vapor

Sample Date	Sample Location	Sample Depth (ft)	Method	Parameter	Units	Result	Flags	Reporting Limit
11-Feb-10	PL2-SSL4	8	TO-15	Tetrachloroethene	ppbv	<19	U	19
11-Feb-10	PL2-SSL4	8	TO-15	Trichloroethene	ppbv	7,700		19
11-Feb-10	PL2-SSL4	8	TO-15	cis-1,2-Dichloroethene	ppbv	280		19
11-Feb-10	PL2-SSL4	8	TO-15	trans-1,2-Dichloroethene	ppbv	<19	U	19
11-Feb-10	PL2-SSL4	8	TO-15	Vinyl Chloride	ppbv	<19	U	19
11-Feb-10	PL2-SSL4	8	TO-15	Chloroform	ppbv	27		19

Note: Soil vapor sampling results present the compounds detected and resulting concentrations, not the full analyte list. Samples were analyzed by method TO-15 and included the associated full list of compounds.

Abbreviations:

ft feet

µg/kg micrograms/kilogram

ppbv parts per billion by volume

Qualifier:

U Non-detect

J Estimated

E Estimated concentration exceeded calibration range

M Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters.

B Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's Reporting Limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.

Table 2.5 Sampling Summary for Location PL2-SSL5

Location: PL2-SSL5 - Soil

Sample Date	Sample Location	Sample Depth (ft)	Method	Parameter	Units	Result	Flags	Reporting Limit
28-Dec-09	PL2-SSL5	5	SW8260C	Tetrachloroethene	µg/kg	<1.2	U	1.2
28-Dec-09	PL2-SSL5	5	SW8260C	Trichloroethene	µg/kg	39		1.2
28-Dec-09	PL2-SSL5	5	SW8260C	cis-1,2-Dichloroethene	µg/kg	<1.2	U	1.2
28-Dec-09	PL2-SSL5	5	SW8260C	trans-1,2-Dichloroethene	µg/kg	<1.2	U	1.2
28-Dec-09	PL2-SSL5	5	SW8260C	Vinyl Chloride	µg/kg	<1.2	U	1.2
28-Dec-09	PL2-SSL5	5	SW8260C	Acetone	µg/kg	15	B	6.0
28-Dec-09	PL2-SSL5	10	SW8260C	Tetrachloroethene	µg/kg	<1.2	U	1.2
28-Dec-09	PL2-SSL5	10	SW8260C	Trichloroethene	µg/kg	25		1.2
28-Dec-09	PL2-SSL5	10	SW8260C	cis-1,2-Dichloroethene	µg/kg	<1.2	U	1.2
28-Dec-09	PL2-SSL5	10	SW8260C	trans-1,2-Dichloroethene	µg/kg	<1.2	U	1.2
28-Dec-09	PL2-SSL5	10	SW8260C	Vinyl Chloride	µg/kg	<1.2	U	1.2
28-Dec-09	PL2-SSL5	10	SW8260C	Acetone	µg/kg	60	B	6.0

Location: PL2-SSL5 - Soil Vapor

Sample Date	Sample Location	Sample Depth (ft)	Method	Parameter	Units	Result	Flags	Reporting Limit
12-Feb-10	PL2-SSL5	8	TO-15	Tetrachloroethene	ppbv	<1.9	U	1.9
12-Feb-10	PL2-SSL5	8	TO-15	Trichloroethene	ppbv	360		1.9
12-Feb-10	PL2-SSL5	8	TO-15	cis-1,2-Dichloroethene	ppbv	13		1.9
12-Feb-10	PL2-SSL5	8	TO-15	trans-1,2-Dichloroethene	ppbv	<1.9	U	1.9
12-Feb-10	PL2-SSL5	8	TO-15	Vinyl Chloride	ppbv	<1.9	U	1.9
12-Feb-10	PL2-SSL5	8	TO-15	Ethanol	ppbv	34		7.8
12-Feb-10	PL2-SSL5	8	TO-15	Acetone	ppbv	16		7.8
12-Feb-10	PL2-SSL5	8	TO-15	2-Propanol	ppbv	18		7.8
12-Feb-10	PL2-SSL5	8	TO-15	Hexane	ppbv	2.7		1.9
12-Feb-10	PL2-SSL5	8	TO-15	2-Butanone	ppbv	12		1.9
12-Feb-10	PL2-SSL5	8	TO-15	Cyclohexane	ppbv	16		1.9
12-Feb-10	PL2-SSL5	8	TO-15	Heptane	ppbv	160		1.9
12-Feb-10	PL2-SSL5	8	TO-15	Toluene	ppbv	130		1.9
12-Feb-10	PL2-SSL5	8	TO-15	m,p- Xylene	ppbv	3.4		1.9

Note: Soil vapor sampling results present the compounds detected and resulting concentrations, not the full analyte list. Samples were analyzed by method TO-15 and included the associated full list of compounds.

Abbreviations:

ft feet

µg/kg micrograms/kilogram

ppbv parts per billion by volume

Qualifier:

U Non-detect

J Estimated

E Estimated concentration exceeded calibration range

M Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters.

B Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's Reporting Limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.

Table 2.6 Sampling Summary for Location PL2-SSL6

Location: PL2-SSL6 - Soil

Sample Date	Sample Location	Sample Depth (ft)	Method	Parameter	Units	Result	Flags	Reporting Limit
28-Dec-09	PL2-SSL6	5	SW8260C	Tetrachloroethene	µg/kg	<1.1	U	1.1
28-Dec-09	PL2-SSL6	5	SW8260C	Trichloroethene	µg/kg	73		1.1
28-Dec-09	PL2-SSL6	5	SW8260C	cis-1,2-Dichloroethene	µg/kg	<1.1	U	1.1
28-Dec-09	PL2-SSL6	5	SW8260C	trans-1,2-Dichloroethene	µg/kg	<1.1	U	1.1
28-Dec-09	PL2-SSL6	5	SW8260C	Vinyl Chloride	µg/kg	<1.1	U	1.1
28-Dec-09	PL2-SSL6	5	SW8260C	Acetone	µg/kg	37	B	5.6
28-Dec-09	PL2-SSL6	10	SW8260C	Tetrachloroethene	µg/kg	<1.6	U	1.6
28-Dec-09	PL2-SSL6	10	SW8260C	Trichloroethene	µg/kg	64		1.6
28-Dec-09	PL2-SSL6	10	SW8260C	cis-1,2-Dichloroethene	µg/kg	<1.6	U	1.6
28-Dec-09	PL2-SSL6	10	SW8260C	trans-1,2-Dichloroethene	µg/kg	<1.6	U	1.6
28-Dec-09	PL2-SSL6	10	SW8260C	Vinyl Chloride	µg/kg	<1.6	U	1.6
28-Dec-09	PL2-SSL6	10	SW8260C	Acetone	µg/kg	45	B	8.0

Abbreviations:

ft feet

µg/kg micrograms/kilogram

ppbv parts per billion by volume

Qualifier:

U Non-detect

J Estimated

E Estimated concentration exceeded calibration range

M Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters.

B Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's Reporting Limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.

Table 2.7 Sampling Summary for Location PL2-SSL7

Location: PL2-SSL7 - Soil

Sample Date	Sample Location	Sample Depth (ft)	Method	Parameter	Units	Result	Flags	Reporting Limit
28-Dec-09	PL2-SSL7	5	SW8260C	Tetrachloroethene	µg/kg	<1.3	U	1.3
28-Dec-09	PL2-SSL7	5	SW8260C	Trichloroethene	µg/kg	120		1.3
28-Dec-09	PL2-SSL7	5	SW8260C	cis-1,2-Dichloroethene	µg/kg	<1.3	U	1.3
28-Dec-09	PL2-SSL7	5	SW8260C	trans-1,2-Dichloroethene	µg/kg	<1.3	U	1.3
28-Dec-09	PL2-SSL7	5	SW8260C	Vinyl Chloride	µg/kg	<1.3	U	1.3
28-Dec-09	PL2-SSL7	5	SW8260C	Acetone	µg/kg	16	B	6.3
28-Dec-09	PL2-SSL7	10	SW8260C	Tetrachloroethene	µg/kg	<1.5	U	1.5
28-Dec-09	PL2-SSL7	10	SW8260C	Trichloroethene	µg/kg	75		1.5
28-Dec-09	PL2-SSL7	10	SW8260C	cis-1,2-Dichloroethene	µg/kg	<1.5	U	1.5
28-Dec-09	PL2-SSL7	10	SW8260C	trans-1,2-Dichloroethene	µg/kg	<1.5	U	1.5
28-Dec-09	PL2-SSL7	10	SW8260C	Vinyl Chloride	µg/kg	<1.5	U	1.5
28-Dec-09	PL2-SSL7	10	SW8260C	Acetone	µg/kg	33	B	7.5

Location: PL2-SSL7 - Soil Vapor

Sample Date	Sample Location	Sample Depth (ft)	Method	Parameter	Units	Result	Flags	Reporting Limit
11-Feb-10	PL2-SSL7	8	TO-15	Tetrachloroethene	ppbv	<49	U	49
11-Feb-10	PL2-SSL7	8	TO-15	Trichloroethene	ppbv	17,000		49
11-Feb-10	PL2-SSL7	8	TO-15	cis-1,2-Dichloroethene	ppbv	<49	U	49
11-Feb-10	PL2-SSL7	8	TO-15	trans-1,2-Dichloroethene	ppbv	<49	U	49
11-Feb-10	PL2-SSL7	8	TO-15	Vinyl Chloride	ppbv	<49	U	49
11-Feb-10	PL2-SSL7	8	TO-15	Chloroform	ppbv	27		49
11-Feb-10	PL2-SSL7	8	TO-15	Heptane	ppbv	59		49

Note: Soil vapor sampling results present the compounds detected and resulting concentrations, not the full analyte list. Samples were analyzed by method TO-15 and included the associated full list of compounds.

Abbreviations:

ft feet

µg/kg micrograms/kilogram

ppbv parts per billion by volume

Qualifier:

U Non-detect

J Estimated

E Estimated concentration exceeded calibration range

M Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters.

B Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's Reporting Limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.

Table 2.8 Summary of 2-10s Interim Measure Groundwater Probe Samples

Location: PL2-GP1 - Groundwater

Sample Date	Sample Location	Sample Depth (ft)	Method	Parameter	Units	Result	Flags	Reporting Limit
28-Dec-09	PL2-GP1	50	SW8260C	Tetrachloroethene	µg/L	<0.2	U	0.2
28-Dec-09	PL2-GP1	50	SW8260C	Trichloroethene	µg/L	<0.2	U	0.2
28-Dec-09	PL2-GP1	50	SW8260C	cis-1,2-Dichloroethene	µg/L	<0.2	U	0.2
28-Dec-09	PL2-GP1	50	SW8260C	trans-1,2-Dichloroethene	µg/L	<0.2	U	0.2
28-Dec-09	PL2-GP1	50	SW8260C	Vinyl Chloride	µg/L	<0.2	U	0.2
28-Dec-09	PL2-GP1	50	SW8260C	Carbon Disulfide	µg/L	0.4		0.2

Location: PL2-GP2 - Groundwater

Sample Date	Sample Location	Sample Depth (ft)	Method	Parameter	Units	Result	Flags	Reporting Limit
28-Dec-09	PL2-GP2	85	SW8260C	Tetrachloroethene	µg/L	<0.2	U	0.2
29-Dec-09	PL2-GP2	85	SW8260C	Trichloroethene	µg/L	<0.2	U	0.2
29-Dec-09	PL2-GP2	85	SW8260C	cis-1,2-Dichloroethene	µg/L	0.7		0.2
29-Dec-09	PL2-GP2	85	SW8260C	trans-1,2-Dichloroethene	µg/L	<0.2	U	0.2
29-Dec-09	PL2-GP2	85	SW8260C	Vinyl Chloride	µg/L	<0.2	U	0.2
29-Dec-09	PL2-GP2	85	SW8260C	Acetone	µg/L	5.1	Q	5.0
28-Dec-09	PL2-GP2	85	SW8260C	Tetrachloroethene	µg/L	<0.2	U	0.2
29-Dec-09	PL2-GP2	85	SW8260C	Trichloroethene	µg/L	<0.2	U	0.2
29-Dec-09	PL2-GP2	85	SW8260C	cis-1,2-Dichloroethene	µg/L	0.7		0.2
29-Dec-09	PL2-GP2	85	SW8260C	trans-1,2-Dichloroethene	µg/L	<0.2	U	0.2
29-Dec-09	PL2-GP2	85	SW8260C	Vinyl Chloride	µg/L	<0.2	U	0.2
29-Dec-09	PL2-GP2	85	SW8260C	Acetone	µg/L	6.3	Q	5.0

Abbreviations:

ft feet
µg/L micrograms/Liter

Qualifier:

U Non-detect
J Estimated
E Estimated concentration exceeded calibration range
Y The analyte is not detected at or above the reported concentration.
Q Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20%Drift or minimum RRF).
D The spiked compound was not detected due to sample extract dilution

Table 2.9 Summary of Volatile Organic Compounds in Groundwater, North Sheetpile

		Well Depth	Sample Depth	Tetrachloroethene		Trichloroethene		cis-1,2-Dichloroethene		trans-1,2-Dichloroethene		Vinyl Chloride		Toluene		1,1-Dichlorethene		Acetone		
Sample Date	**Location**	**ft**	**ft**	**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**Notes**
3/11/2010	PL2-259B	50	45	<0.2	U	<0.2	U	<0.2	U	<0.2	U	0.3		<0.2	U	<0.2	U	<5.0	U	
3/12/2010	PL2-249A	20	17.5	<0.2	U	<0.2	U	0.3		<0.2	U	0.3		<0.2	U	<0.2	U	<5.0	U	
3/17/2010	PL2-212A	15	9.5	<20	U	62,000		22,000		610		7,700		<20	U	32		<500	U	
2/11/2010	DP-037		10	<0.2	U	28		48		0.4		3.9		<0.2	U	<0.2	U	<5.0	U	
2/11/2010	DP-037		41	<0.2	U	<0.2	U	<0.2	U	<0.2	U	0.6		<0.2	U	<0.2	U	<5.0	U	
2/13/2010	DP-038-DL		10	<20	U	3,900		150,000		4,800		28,000		<20	U	270		<200	U	Reanalysis
2/13/2010	DP-038		41	<0.2	U	0.7		4.4		0.4		1.2		3		<0.2	U	<5.0	U	
2/15/2010	DP-039		10	<0.2	U	0.5		<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	
2/15/2010	DP-039		41	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	
2/17/2010	DP-040		10	<0.2	U	<0.2	U	<0.2	U	<0.2	U	0.3		<0.2	U	<0.2	U	<5.0	U	
2/17/2010	DP-040		41	<0.2	U	<0.2	U	<0.2	U	0.5		0.4		<0.2	U	<0.2	U	<5.0	U	
3/18/2010	PL2-247A	20	17.5	<0.2	U	<0.2	U	0.2		<0.2	U	0.5		<0.2	U	<0.2	U	<5.0	U	
3/18/2010	PL2-247A	20	17.5	<0.2	U	<0.2	U	0.2		<0.2	U	0.5		<0.2	U	<0.2	U	<5.0	U	Duplicate
2/9/2010	PL2-218A	30	15	<0.2	U	18		2,200		310		1,100		<0.2	U	3.7		6.7		
2/9/2010	PL2-218A	30	28	<0.2	U	<10	U	1,000		120		480	Q	<0.2	U	1.6		6.8		
2/9/2010	PL2-218B	60	45	<0.2	U	<1.0	U	91		1.5		1		<0.2	U	<0.2	U	6.7		
2/9/2010	PL2-218B	60	58	<0.2	U	<1.0	U	200		0.5		1.3		0.9		<0.2	U	6.6		
3/18/2010	PL2-245A	20	17.5	<0.2	U	0.9		15		1.6		3.8		<0.2	U	<0.2	U	<5.0	U	
3/18/2010	PL2-245A	20	17.5	<0.2	U	0.9		15		1.5		3.7		<0.2	U	<0.2	U	<5.0	U	Duplicate
3/11/2010	PL2-244A	20	17.5	<0.2	U	<0.2	U	0.4		<0.2	U	21		<0.2	U	<0.2	U	<5.0	U	
3/10/2010	PL2-268AR	35	32.5	<0.2	U	<0.2	U	<0.2	U	<0.2	U	1		<0.2	U	<0.2	U	<5.0	U	
3/10/2010	PL2-268AR	35	32.5	<0.2	U	<0.2	U	<0.2	U	<0.2	U	1		<0.2	U	<0.2	U	<5.0	U	Duplicate
3/11/2010	PL2-269A	36	33	<0.2	U	<0.2	U	<0.2	U	<0.2	U	0.6		<0.2	U	<0.2	U	<5.0	U	
3/4/2010	PL2-271A	30	25	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	
3/10/2010	PL2-258A	23	15.5	<0.2	U	<0.2	U	28		20		1,500		<0.2	U	<0.2	U	<5.0	U	Reanalysis
3/10/2010	PL2-258B	49	45	<0.2	U	0.5		42		0.5		0.7		<0.2	U	<0.2	U	<5.0	U	
3/10/2010	PL2-258C	102	97	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	
12/28/2009	PL2-GP1		50	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	
12/29/2009	PL2-GP2		85	<0.2	U	<0.2	U	0.7		<0.2	U	<0.2	U	<0.2	U	<0.2	U	5.1	Q	
12/29/2009	PL2-GP2		85	<0.2	U	<0.2	U	0.7		<0.2	U	<0.2	U	<0.2	U	<0.2	U	6.3	Q	
2/23/2010	DP-044-DL		10	<0.2	U	<0.2	U	0.4		<0.2	U	180		0.5		<0.2	U	<5.0	U	Reanalysis
2/13/2010	DP-045		10	<0.2	U	<0.2	U	0.2		<0.2	U	0.3		2.2		<0.2	U	<5.0	U	
2/13/2010	DP-045		41	<0.2	U	<0.2	U	0.9		<0.2	U	<0.2	U	1.5		<0.2	U	<5.0	U	

Abbreviations:

ft feet
µg/L micrograms/Liter

Qualifier:

U Non-detect
J Estimated
E Estimated concentration exceeded calibration range
Y The analyte is not detected at or above the reported concentration.
Q Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20%Drift or minimum RRF).
D The spiked compound was not detected due to sample extract dilution

Table 2.10 Summary of Volatile Organic Compounds in Groundwater, South Sheetpile

		Well Depth	Sample Depth	Tetrachloroethene		Trichloroethene		cis-1,2-Dichloroethene		trans-1,2-Dichloroethene		Vinyl Chloride		Toluene		1,1-Dichlorethene		Acetone		
Sample Date	**Location**	**ft**	**ft**	**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**Notes**
1/21/2010	DP-090		10	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	0.3		<0.2	U	<5.0	U	
1/21/2010	DP-090		41	<0.2	U	8.9		<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	
3/9/2010	PL2-262B	50	45	<0.2	U	0.8		0.7		<0.2	U	<0.2	U	<0.2	UJ	<0.2	U	<5.0	UJ	
1/20/2010	DP-091		10	<0.2	U	9		0.4		<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	
1/20/2010	DP-091		41	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	
2/17/2010	DP-092		10	<0.2	U	1		0.6		<0.2	U	1.1		1.2		<0.2	U	<5.0	U	
2/17/2010	DP-092		41	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	2.1		<0.2	U	<5.0	U	
3/9/2010	PL2-257A	18	15.5	<0.2	U	20		52		1		3.9		<0.2	U	0.3		<5.0	U	
3/12/2010	PL2-256A	18	15.5	<0.2	U	<0.2	U	0.3		<0.2	U	0.7		<0.2	U	<0.2	U	<5.0	U	
3/17/2010	PL2-209A	18	13	<0.2	U	1.1		42		0.2		26		<0.2	U	<0.2	U	<5.0	U	
3/17/2010	PL2-209B	55	47.5	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	
3/12/2010	PL2-255A	17.5	15	<0.2	U	3.4		2.3		<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	
3/12/2010	PL2-255A	17.5	15	<0.2	U	3.2		2.4		<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	Duplicate
3/12/2010	PL2-253A	17	14.5	<0.2	U	<0.2	U	15		0.8		91		<0.2	U	<0.2	U	<5.0	U	Reanalysis
3/12/2010	PL2-253A	17	14.5	<0.2	U	<0.2	U	15		0.7		91		<0.2	U	<0.2	U	<5.0	U	Duplicate, Reanalysis
3/8/2010	PL2-254A	17	15	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	
3/8/2010	PL2-252A	18	16	<0.2	U	0.3		0.4		<0.2	U	0.3		<0.2	U	<0.2	U	<5.0	U	
3/8/2010	PL2-266A	30	28	<0.2	U	0.2		<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	
3/8/2010	PL2-266A	30	28	<0.2	U	0.5		<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	Duplicate
3/5/2010	PL2-214A	30	22.5	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	
3/5/2010	PL2-214B	60	52.5	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	
3/5/2010	PL2-214B	60	52.5	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<5.0	U	Duplicate
3/5/2010	PL2-214C	80	78	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	UR	<0.2	U	<5.0	UR	
2/22/2010	DP-101		10	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	0.4		<0.2	U	<5.0	U	
2/22/2010	DP-101		41	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	0.6		<0.2	U	<5.0	U	
2/18/2010	DP-102		10	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	2		<0.2	U	<5.0	U	
2/18/2010	DP-102		41	<0.2	U	<0.2	U	<0.2	U	<0.2	U	<0.2	U	1.8		<0.2	U	<5.0	U	

Abbreviations:

ft feet
µg/L micrograms/Liter

Qualifier:

U Non-detect
J Estimated
E Estimated concentration exceeded calibration range
Y The analyte is not detected at or above the reported concentration.
Q Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20%Drift or minimum RRF).
D The spiked compound was not detected due to sample extract dilution

Table 2.11 Summary of Other Parameters in Groundwater, North Sheetpile

Dissolved Gases		**Methane**		**Ethane**		**Ethene**		**TOC**		**Chloride**		**Sulfate**		
Sample Date	**Location**	**µg/L**		**µg/L**		**µg/L**		**mg/L**		**mg/L**		**mg/L**		**Notes**
2/9/2010	PL2-212A	3,120		546		720		43.6		144		21.6		
2/9/2010	PL2-218A	3,170		14.6		2.7		26.2		12.7		1.6		
2/9/2010	PL2-218B	117		<1.2	U	<1.1	U	17.4						
2/10/2010	PL2-244A							27.1						

Metals		**Calcium**		**Magnesium**		**Potassium**		**Sodium**		**Arsenic**		**Manganese**		
Sample Date	**Location**	**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**Notes**
2/9/2010	PL2-212A	15,000		8,010		13,600		257,000		8		243		
2/9/2010	PL2-218A	23,200		17,700		10,300		48,800		16		450		
2/9/2010	PL2-218B									6		3,870		
2/10/2010	PL2-244A									12.5		601		
2/10/2010	PL2-258B	357,000		593,000						<1	U	6,330		Total
2/10/2010	PL2-258B	352,000		571,000						<1	U	6,080		Dissolved

Abbreviations:

- TOC Total Organic Carbon
- ft feet
- µg/L micrograms/Liter
- mg/L milligrams/Liter

Qualifier:

- U Non-detect
- J Estimated
- E Estimated concentration exceeded calibration range
- Y The analyte is not detected at or above the reported concentration.
- Q Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20%Drift or minimum RRF).
- D The spiked compound was not detected due to sample extract dilution

Table 2.12 Summary of Other Parameters in Groundwater, South Sheetpile

Dissolved Gases		Methane		Ethane		Ethene		TOC		Alkalinity		Carbonate		Bicarbonate		Hydroxide		Chloride		Sulfate	
Sample Date	**Location**	**µg/L**		**µg/L**		**µg/L**		**mg/L**		**mg/L**		**mg/L $CaCO_3$**		**mg/L $CaCO_3$**		**mg/L $CaCO_3$**		**mg/L**		**mg/L**	
2/9/2010	PL2-209A	774		4.0		<1.1	U	20.0		178		<1.0	U	178		<1.0	U	10.5		9.6	
2/9/2010	PL2-209B							31.2													
2/10/2010	PL2-253A	2,340		20.9		2.3		11.0		263		<1.0	U	263		<1.0	U	24.1		16.4	
2/10/2010	PL2-252A							14.6													

Metals		Calcium		Magnesium		Potassium		Sodium		Arsenic		Manganese		
Date	**Location**	**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**Notes**
2/9/2010	PL2-209A	8,560		9,880		3,150		70,300		13		737		
2/9/2010	PL2-209B									<5	U	1,910		
2/10/2010	PL2-253A	10,500		15,200		8,150		107,000		1.5		321		
2/10/2010	PL2-252A									0.8		350		
2/10/2010	PL2-214A	10,900		11,400						7.5		381		Total
2/10/2010	PL2-214A	15,900		27,300						0.7		367		Dissolved
2/10/2010	PL2-214B	294,000		633,000						<1	U	2,450		Total
2/10/2010	PL2-214B	299,000		631,000						1		2,410		Dissolved

Abbreviations:

- TOC Total Organic Carbon
- ft feet
- µg/L micrograms/Liter
- mg/L milligrams/Liter
- mg/L $CaCO_3$ milligrams/Liter Calcium Carbonate

Qualifier:

- U Non-detect
- J Estimated
- E Estimated concentration exceeded calibration range
- Y The analyte is not detected at or above the reported concentration.
- Q Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20%Drift or minimum RRF).
- D The spiked compound was not detected due to sample extract dilution

Table 2.13 Summary of DHE Samples in Groundwater

		DHE	
Sample Date	**Location**	**cells/ml**	
2/9/2010	PL2-209A	72.2	
2/9/2010	PL2-212A	1,580.0	
2/9/2010	PL2-218A	86.7	
2/9/2010	PL2-218B	73.8	

Abbreviations:

DHE Dehalococcoides
cells/ml cells/milliliter

Qualifier:

U Non-detect
J Estimated
E Estimated concentration exceeded calibration range
Y or above the reported concentration.
D not detected due to sample extract dilution

Table 2.14 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, North Sheetpile

Location	Sample Date	Well Depth feet	Sample Depth feet	Tetrachloroethene µg/L		Trichloroethene µg/L		cis-1,2-Dichloroethene µg/L		trans-1,2-Dichloroethene µg/L		Vinyl Chloride µg/L		Notes
North Sheetpile Outside Piling														
PL2-259B	3/29/1995	50	-	1	U	1	U	1	U	1	U	0.11		
PL2-259B	3/29/1995	50	-			1	U	1	U	1	U	0.02	U	
PL2-259B	8/19/2002	50	-	1	U	1	U	1	U	1	U	1	U	
PL2-259B	2/10/2010	50	48	2.8	**R**	75	**R**	16	**R**	0.7	**R**	1.7	**R**	
PL2-259B	3/11/2010	50	45	0.2	U	0.2	U	0.2	U	0.2	U	0.3		
PL2-268A	4/26/2001	35	-	1	U	1	U	1	U	1	U	4.4		
PL2-268A	8/1/2001	35	-	1	U	1	U	1	U	1	U	1	U	
PL2-268AR	10/30/2001	35	-	1	U	1	U	1	U	1	U	1	U	
PL2-268AR	1/30/2002	35	-	1	U	1	U	1	U	1	U	1.1		
PL2-268AR	2/10/2010	35	33	5.0	**R**	140	**R**	38	**R**	1.6	**R**	4.7	**R**	
PL2-268AR	3/10/2010	35	32.5	0.2	U	0.2	U	0.2	U	0.2	U	1		
PL2-268AR	3/10/2010	35	32.5	0.2	U	0.2	U	0.2	U	0.2	U	1		DUP
PL2-244A	10/7/1994	20	-	10	U	120		950		32		530		
PL2-244A	10/7/1994	20	-	20	U	110		920		32		480		
PL2-244A	10/7/1994	20	-	20	U	120		950		32		530		
PL2-244A	11/11/1994	20	-	5	U	76		460		14		160		
PL2-244A	12/9/1994	20	-	1	U	62		710	D	27		360	D	
PL2-244A	12/9/1994	20	-	1	U	57		670	D	32		460	D	
PL2-244A	1/21/1995	20	-	1	U	66	J	800	D	58	J	270	D	
PL2-244A	2/17/1995	20	-	1	U	57		840	D	44		560	D	
PL2-244A	3/17/1995	20	-	1	U	32		940	D	72		950	D	
PL2-244A	4/21/1995	20	-	1	U	34		1,600	D	88		700	D	
PL2-244A	5/24/1995	20	-	1	U	42		1,700	D	88		780	D	
PL2-244A	6/15/1995	20	-	1	U	22		1,000	D	76		530	D	
PL2-244A	7/19/1995	20	-	1	U	46		750	D	62		430	D	
PL2-244A	8/17/1995	20	-	1	U	20		690	D	53		350	D	
PL2-244A	9/22/1995	20	-	1	U	37		830	D	62		260	D	
PL2-244A	4/16/2001	20	-	1	U	2		50		6.5		180		
PL2-244A	7/30/2001	20	-	1	U	1	U	12		2.5		61		
PL2-244A	10/29/2001	20	-	1	U	1	U	3.4		1.1		16		
PL2-244A	1/31/2002	20	-	1	U	1	U	12		3.6		150		
PL2-244A	2/10/2010	20	18	2.9	**R**	140	**R**	33	**R**	1.5	**R**	5.6	**R**	
PL2-244A	3/11/2010	20	17.5	0.2	U	0.2	U	0.4		0.2	U	21		
PL2-269A	4/26/2001	36	-	1	U	1	U	1	U	1	U	1	U	
PL2-269A	7/30/2001	36	-	1	U	1	U	1	U	1	U	1	U	
PL2-269A	10/30/2001	36	-	1	U	1	U	1	U	1	U	1	U	
PL2-269A	1/30/2002	36	-	1	U	1	U	1	U	1	U	1	U	
PL2-269A	2/10/2010	36	34	3.7	**R**	150	**R**	43	**R**	1.7	**R**	4.1	**R**	
PL2-269A	3/11/2010	36	33	0.2	U	0.2	U	0.2	U	0.2	U	0.6		

Table 2.14 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, North Sheetpile

		Well Depth	Sample Depth	Tetrachloroethene		Trichloroethene		cis-1,2-Dichloroethene		trans-1,2-Dichloroethene		Vinyl Chloride		
Location	**Sample Date**	**feet**	**feet**	**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**Notes**
PL2-258A	3/28/1995	23	-	100	U	100	U	4,700		340		1,500		
PL2-258A	8/11/1995	23	-	1	U	3.5		6,000	D	310	D	1,500	D	
PL2-258A	11/15/1995	23	-	1	U	3.3		4,900	JDH	220	JDH	890	JDH	
PL2-258A	2/28/1996	23	-	1	U	7.3		6,900	D	440	D	1,800	D	
PL2-258A	5/20/1996	23	-	1	U	240	D	4,200	D	260	D	1,200	D	
PL2-258A	8/20/1996	23	-	50	U	50	U	6,400		320		1,800		
PL2-258A	11/18/1996	23	-	1	U	4		3,800	D	230	D	2,400	D	
PL2-258A	4/24/2001	23	-	10	UJ	10	UJ	1,600		300		1,000		
PL2-258A	7/26/2001	23	-	1	U	1	U	620	D	110		340	D	
PL2-258A	7/26/2001	23	-	1	U	1	U	660	D	120		340	D	
PL2-258A	10/23/2001	23	-	1	U	1	U	78		35		190		
PL2-258A	1/24/2002	23	-	1	U	1	U	1,900	D	380	D	1,600	D	
PL2-258A	6/19/2003	23	-	1	U	1	U	520		130		390		
PL2-258A	9/3/2003	23	-	5	U	5	U	47		26		260		
PL2-258A	12/10/2003	23	-	20	U	20	U	95		47		1,400		
PL2-258A	2/4/2004	23	-	10	U	10	U	1,000		230		1,600		
PL2-258A	2/4/2004	23	-	10	U	10	U	1,100		240		1,600		
PL2-258A	5/11/2004	23	-	15	U	15	U	1,400		290		1,300	JL	
PL2-258A	8/4/2004	23	-	1	U	1	U	9.1		16		72		
PL2-258A	11/2/2004	23	-	10	U	10	U	5.4		22		180		
PL2-258A	11/2/2004	23	-	1	U	1	U	10	U	15		110		
PL2-258A	1/31/2005	23	-	1	UJ	1	UJ	2.7	J	8.4	J	84	J	
PL2-258A	5/4/2005	23	-	1	U	1	U	68		44		560	E	
PL2-258A	5/4/2005	23	-	5	U	5	U	57		38		380		
PL2-258A	8/4/2005	23	-	1	U	1	U	2.7		8.5		55		
PL2-258A	11/1/2005	23	-	1	U	1	U	1.2		3		40		
PL2-258A	2/8/2006	23	-	1	U	1	U	120		57		5,000	E	
PL2-258A	2/8/2006	23	-	100	U	100	U	110		100	U	1,100		
PL2-258A	5/3/2006	23	-	1	U	1	U	420	E	130		490	E	
PL2-258A	5/3/2006	23	-	5	U	5	U	330		100		440		
PL2-258A	5/3/2006	23	-	10	U	10	U	320		99		350		
PL2-258A	8/2/2006	23	-	1.5	U	1.5	U	8.7		22		99		
PL2-258A	11/8/2006	23	-	0.6	U	0.6	U	0.6	U	1.2		17		
PL2-258A	2/5/2007	23	-	10	U	10	U	420		120		920		
PL2-258A	5/3/2007	23	-	30	U	30	U	490		140		1,200		
PL2-258A	8/7/2007	23	-	1	U	1	U	2.5		12		81		
PL2-258A	11/15/2007	23	-	1	U	1	U	1	U	3.2		130		
PL2-258A	2/1/2008	23	-	1	U	1	U	1.3		9.5		370	E	
PL2-258A	2/1/2008	23	-	5	U	5	U	5	U	8.6		320		
PL2-258A	8/1/2008	23	-	1	U	1	U	1	U	1	U	16		
PL2-258A	2/5/2009	23	-	1	U	1	U	1	U	1.1		270	E	
PL2-258A	2/5/2009	23	-	4	U	4	U	4	U	4	U	320		
PL2-258A	2/5/2009	23	-	1	U	1	U	1	U	1.4		280	E	
PL2-258A	2/5/2009	23	-	4	U	4	U	4	U	4	U	260		
PL2-258A	8/12/2009	23	-	1	U	1	U	1	U	1	U	54		
PL2-258A	2/10/2010	23	-	1	U	1	U	1	U	2.3		300		
PL2-258A	3/10/2010	23	15.5	0.2	U	0.2	U	28		20		1,500		

Table 2.14 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, North Sheetpile

		Well Depth	Sample Depth	Tetrachloroethene		Trichloroethene		cis-1,2-Dichloroethene		trans-1,2-Dichloroethene		Vinyl Chloride		
Location	**Sample Date**	**feet**	**feet**	**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**Notes**
PL2-258B	3/28/1995	50	-	1	U	8		5,900	D	11		2.2		
PL2-258B	8/15/1995	50	-	1	U	6.8		5,000	D	23		43		
PL2-258B	11/15/1995	50	-	1	U	2.4		680	D	4.6		7.6		
PL2-258B	2/28/1996	50	-	1	U	6		3,600	D	4.8		2	U	
PL2-258B	5/20/1996	50	-	1	U	4.4		3,900	D	4.4		2	U	
PL2-258B	8/20/1996	50	-	1	U	5.4		4,800	D	5.2		5.5		
PL2-258B	11/18/1996	50	-	1	U	3.4		1,200	D	2.6		4.5		
PL2-258B	4/25/2001	50	-	1	U	1.8		490	D	1.8		4.3	J	
PL2-258B	7/26/2001	50	-	10	U	10	U	1,200		10	U	10	U	
PL2-258B	10/23/2001	50	-	15	U	15	U	1,400		15	U	15	U	
PL2-258B	1/24/2002	50	-	1	U	1.5		760	D	2.6		3.4		
PL2-258B	6/19/2003	50	-	1	U	1.7		1,600		9.1		3.4		
PL2-258B	9/3/2003	50	-	10	U	10	U	2,800		10	U	10	U	
PL2-258B	12/10/2003	50	-	30	U	30	U	4,600		30	U	30	U	
PL2-258B	2/4/2004	50	-	50	U	50	U	3,000		50	U	50	U	
PL2-258B	5/11/2004	50	-	1	U	1.6		2,100		4.3		4.1	JL	
PL2-258B	8/4/2004	50	-	20	U	20	U	2,200		20	U	20	U	
PL2-258B	11/2/2004	50	-	25	U	25	U	2,700		25	U	25	U	
PL2-258B	1/31/2005	50	-	30	UJ	30	UJ	1,600	J	30	UJ	30	UJ	
PL2-258B	5/4/2005	50	-	1	U	1	U	120		1	U	1	U	
PL2-258B	8/4/2005	50	-	10	U	10	U	1,600		10	U	10	U	
PL2-258B	11/1/2005	50	-	1	U	1.2		1,200	E	3		3.3		
PL2-258B	11/1/2005	50	-	20	U	20	U	1,200		20	U	20	U	
PL2-258B	2/8/2006	50	-	10	U	10	U	960		10	U	10	U	
PL2-258B	5/3/2006	50	-	10	U	10	U	940		10	U	10	U	
PL2-258B	8/2/2006	50	-	10	U	10	U	1,800		10	U	10	U	
PL2-258B	11/8/2006	50	-	10	U	10	U	950		10	U	10	U	
PL2-258B	11/8/2006	50	-	1	U	1	U	63		1	U	1	U	
PL2-258B	2/5/2007	50	-	10	U	10	U	820		10	U	10	U	
PL2-258B	5/3/2007	50	-	30	U	30	U	930		30	U	30	U	
PL2-258B	8/7/2007	50	-	1	U	1.1		1,100	E	2		3.7		
PL2-258B	8/7/2007	50	-	10	U	10	U	1,100		10	U	10	U	
PL2-258B	11/15/2007	50	-	5	U	5	U	460		5	U	5	U	
PL2-258B	2/1/2008	50	-	5	U	5	U	410		5	U	5	U	
PL2-258B	8/1/2008	50	-	5	U	5	U	390		5	U	5	U	
PL2-258B	2/5/2009	50	-	1	U	1	U	150		1	U	2.1		
PL2-258B	8/12/2009	50	-	1	U	1	U	160		1	U	1	U	
PL2-258B	2/10/2010	50	-	1	U	1	U	50		1	U	1	U	
PL2-258B	3/10/2010	50	45	0.2	U	0.5		42		0.5		0.7		

Table 2.14 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, North Sheetpile

		Well Depth	Sample Depth	Tetrachloroethene		Trichloroethene		cis-1,2-Dichloroethene		trans-1,2-Dichloroethene		Vinyl Chloride		
Location	**Sample Date**	**feet**	**feet**	**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**Notes**
PL2-258C	3/29/1995	102	-	1	U	1	U	2.2		1	U	0.024		
PL2-258C	11/15/1995	102	-	1	U	1	U	1	U	1	U	0.024		
PL2-258C	2/29/1996	102	-	1	U	1	U	1	U	1	U	2	U	
PL2-258C	5/21/1996	102	-	1	U	1	U	1	U	1	U	2	U	
PL2-258C	8/20/1996	102	-	1	U	1	U	1	U	1	U	2	U	
PL2-258C	11/18/1996	102	-	1	U	1	U	1	U	1	U	2	U	
PL2-258C	4/25/2001	102	-	1	U	1	U	1	U	1	U	1	UJ	
PL2-258C	7/26/2001	102	-	1	U	1	U	1	U	1	U	1	U	
PL2-258C	10/23/2001	102	-	1	U	1	U	1	U	1	U	1	U	
PL2-258C	1/24/2002	102	-	1	U	1	U	1	U	1	U	1	U	
PL2-258C	6/19/2003	102	-	1	U	1	U	1	U	1	U	1	U	
PL2-258C	12/10/2003	102	-	1	U	1	U	1	U	1	U	1	U	
PL2-258C	5/11/2004	102	-	1	U	1	U	1	U	1	U	1	UJL	
PL2-258C	11/2/2004	102	-	1	U	1	U	1	U	1	U	1	U	
PL2-258C	5/4/2005	102	-	1	U	1	U	1	U	1	U	1	U	
PL2-258C	11/1/2005	102	-	1	U	1	U	1	U	1	U	1	U	
PL2-258C	5/3/2006	102	-	1	U	1	U	1	U	1	U	1	U	
PL2-258C	11/8/2006	102	-	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	
PL2-258C	5/3/2007	102	-	1	U	1	U	1	U	1	U	1	U	
PL2-258C	11/15/2007	102	-	1	U	1	U	1	U	1	U	1	U	
PL2-258C	2/1/2008	102	-	1	U	1	U	1	U	1	U	1	U	
PL2-258C	8/1/2008	102	-	1	U	1	U	1	U	1	U	1	U	
PL2-258C	2/5/2009	102	-	1	U	1	U	1	U	1	U	1	U	
PL2-258C	8/12/2009	102	-	1	U	1	U	1	U	1	U	1	U	
PL2-258C	2/10/2010	102	-	1	U	1	U	1	U	1	U	1	U	
PL2-258C	3/10/2010	102	97	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	

Table 2.14 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, North Sheetpile

		Well Depth	Sample Depth	Tetrachloroethene		Trichloroethene		cis-1,2-Dichloroethene		trans-1,2-Dichloroethene		Vinyl Chloride		
Location	**Sample Date**	**feet**	**feet**	**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**Notes**
PL2-271A	4/25/2001	30	-	1	U	1	U	1	U	1	U	1	J	
PL2-271A	7/26/2001	30	-	1	U	1	U	1	U	1	U	1		
PL2-271A	11/5/2001	30	-	1	U	1	U	1	U	1	U	1.3	J	
PL2-271A	1/23/2002	30	-	1	U	1	U	1	U	1	U	1.1		
PL2-271A	6/19/2003	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-271A	12/10/2003	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-271A	5/11/2004	30	-	1	U	1	U	1	U	1	U	1	UJL	
PL2-271A	11/2/2004	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-271A	5/4/2005	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-271A	8/4/2005	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-271A	11/1/2005	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-271A	5/3/2006	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-271A	11/8/2006	30	-	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	
PL2-271A	5/3/2007	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-271A	11/14/2007	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-271A	2/1/2008	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-271A	8/1/2008	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-271A	2/5/2009	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-271A	8/12/2009	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-271A	2/10/2010	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-271A	3/4/2010	30	25	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	

North Sheetpile Inside Piling

PL2-249A	10/7/1994	20	-	1	U	50		11		1	U	2.2		
PL2-249A	10/7/1994	20	-	1	U	110		20		1.6		2.4		
PL2-249A	10/7/1994	20	-	1	U	41		7.9		1	U	2.4		
PL2-249A	10/7/1994	20	-	1	U	1	U	1	U	1	U	2	U	
PL2-249A	11/11/1994	20	-	1	U	140		24		2		1.2		
PL2-249A	12/9/1994	20	-	1	U	190		33		2.8		2	U	
PL2-249A	12/9/1994	20	-	1	U	24		5.1		1	U	3.1		
PL2-249A	1/19/1995	20	-	1	UJ	5.4	J	1.2	J	1	UJ	2	UJ	
PL2-249A	2/17/1995	20	-	1	U	14		1.4		1	U	2.6		
PL2-249A	3/17/1995	20	-	1	U	1	U	1	U	1	U	2.3		
PL2-249A	4/21/1995	20	-	1	U	5.1		1.7		1	U	2	U	
PL2-249A	5/24/1995	20	-	1	U	16		3.5		1	U	2	U	
PL2-249A	6/15/1995	20	-	1	U	14		2.6		1	U	2.1		
PL2-249A	7/19/1995	20	-	1	U	36		5.1		1	U	2.8		

Table 2.14 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, North Sheetpile

Location	Sample Date	Well Depth feet	Sample Depth feet	Tetrachloroethene µg/L		Trichloroethene µg/L		cis-1,2-Dichloroethene µg/L		trans-1,2-Dichloroethene µg/L		Vinyl Chloride µg/L		Notes
PL2-249A	8/17/1995	20	-	1	U	5.9		1.4		1	U	2	U	
PL2-249A	9/22/1995	20	-	1	U	7.8		1.5		1	U	2	U	
PL2-249A	4/18/2001	20	-	1	U	3.4		1	U	1	U	1	U	
PL2-249A	8/7/2001	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-249A	10/30/2001	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-249A	1/30/2002	20	-	1	U	1	U	1	U	1	U	1.1		
PL2-249A	2/10/2010	20	18	3.2	**R**	190	**R**	57	**R**	2.5	**R**	7.4	**R**	
PL2-249A	3/12/2010	20	17.5	0.2	U	0.2	U	0.3		0.2	U	0.3		
PL2-212A	3/5/1992	15	-	300	U	420,000		86,000		2,500		25,000		
PL2-212A	8/20/1992	15	-	25,000	U	380,000		53,000		25,000	U	50,000	U	
PL2-212A	4/18/2001	15	-	500	U	78,000		35,000		1,300		9,800		
PL2-212A	2/9/2010	15	13	500	**UR**	53,000	**UR**	24,000	**UR**	780	**UR**	9,400	**UR**	
PL2-212A	2/9/2010	15	13	500	**UR**	55,000	**UR**	24,000	**UR**	780	**UR**	9,100	**UR**	DUP
PL2-212A	3/17/2010	15	9.5	20	U	62,000		22,000		640		7,700		
PL2-247A	10/7/1994	20	-	10	U	17		700		67		850		
PL2-247A	10/7/1994	20	-	50	U	50	U	710		59		910		
PL2-247A	11/11/1994	20	-	1	U	15		500	D	42		430		
PL2-247A	12/9/1994	20	-	1	U	3.9		280	D	26		250	D	
PL2-247A	12/9/1994	20	-	1	U	4		380	D	50		460	D	
PL2-247A	1/21/1995	20	-	1	U	1.8		170		29		220	D	
PL2-247A	2/17/1995	20	-	1	U	2.6		90		20		190		
PL2-247A	3/17/1995	20	-	1	U	1	U	53		13		160		
PL2-247A	4/21/1995	20	-			1	U	46		12		120		
PL2-247A	5/24/1995	20	-	1	U	1	U	26		6.9		77		
PL2-247A	6/15/1995	20	-	1	U	1	U	34		10		140		

Table 2.14 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, North Sheetpile

Location	Sample Date	Well Depth feet	Sample Depth feet	Tetrachloroethene µg/L		Trichloroethene µg/L		cis-1,2-Dichloroethene µg/L		trans-1,2-Dichloroethene µg/L		Vinyl Chloride µg/L		Notes
PL2-247A	7/19/1995	20	-	1	U	1	U	34		9.8		160		
PL2-247A	8/17/1995	20	-	1	U	1	U	27		8.3		110		
PL2-247A	9/22/1995	20	-	1	U	1	U	20		7		79		
PL2-247A	4/16/2001	20	-	15	UJ	15	UJ	15	UJ	15	UJ	15	UJ	
PL2-247A	8/1/2001	20	-	1	U	1	U	1	U	1	U	19		
PL2-247A	10/25/2001	20	-	1	U	1	U	19		1	U	270	D	
PL2-247A	1/29/2002	20	-	1	U	1	U	1	U	1	U	1.1		
PL2-247A	2/10/2010	20	18	4.7	**R**	230	**R**	69	**R**	2.9	**R**	7.5	**R**	
PL2-247A	2/10/2010	20	18	4.8	**R**	240	**R**	72	**R**	2.8	**R**	7.9	**R**	DUP
PL2-247A	3/18/2010	20	17.5	0.2	U	0.2	U	0.2		0.2	U	0.5		
PL2-247A	3/18/2010	20	17.5	0.2	U	0.2	U	0.2		0.2	U	0.5		DUP
PL2-218A	8/14/1992	30	-	10	U	790		2,000		110		810		
PL2-218A	4/16/2001	30	-	1	U	1,300	D	1,100	D	100		190		
PL2-218A	2/9/2010	30	15	0.2	U	18		2,200		310		1,100		15 ft bgs
PL2-218A	2/9/2010	30	28	0.2	U	10	U	1,000		120		480	Q	28 ft bgs
PL2-218A	3/18/2010	30	22.5	0.2	U	1.6		930		110		460		
PL2-218A	3/18/2010	30	22.5	0.2	U	1.8		780		92		400		DUP
PL2-218B	8/18/1992	60	-	10	U	68		2,500		10	U	20	U	
PL2-218B	4/16/2001	60	-	20	UJ	20	UJ	2,400		20	UJ	20	UJ	
PL2-218B	7/30/2001	60	-	1	U	1.7		460	D	2.2		12		
PL2-218B	10/29/2001	60	-	5	U	5	U	380		5	U	7.6		
PL2-218B	1/31/2002	60	-	5	U	5	U	1,500	D	5.6		5	U	
PL2-218B	2/9/2010	60	45	0.2	U	1	U	91		1.5		1		45 ft bgs
PL2-218B	2/9/2010	60	58	0.2	U	1	U	200		0.5		1.3		58 ft bgs
PL2-218B	3/18/2010	60	52.5	0.2	U	1.2		9,800		15		3.5		

Table 2.14 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, North Sheetpile

		Well Depth	Sample Depth	Tetrachloroethene		Trichloroethene		cis-1,2-Dichloroethene		trans-1,2-Dichloroethene		Vinyl Chloride		
Location	**Sample Date**	**feet**	**feet**	**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**Notes**
PL2-245A	10/7/1994	20	-	10	U	400		1,300		110		690		
PL2-245A	10/7/1994	20	-	20	U	500		1,500		130		840		
PL2-245A	11/11/1994	20	-	10	U	200		680		48		220		
PL2-245A	12/9/1994	20	-	1	U	230	D	980	D	76		520	D	
PL2-245A	12/9/1994	20	-	1	U	240	D	1,100	D	80		540	D	
PL2-245A	1/21/1995	20	-	1	U	58	D	950	D	87		350	D	
PL2-245A	2/17/1995	20	-	1	U	120		900	D	68		800	D	
PL2-245A	3/17/1995	20	-	1	U	170		780	D	91		580	D	
PL2-245A	4/21/1995	20	-	1	U	150		1,300	D	100		970	D	
PL2-245A	5/24/1995	20	-	1	U	200		2,300	D	150		1,200	D	
PL2-245A	6/15/1995	20	-	1	U	150		2,500	D	150		1,600	D	
PL2-245A	7/19/1995	20	-	1	U	120		960	D	100		440	D	
PL2-245A	8/17/1995	20	-	1	U	110		870	D	81		240	D	
PL2-245A	9/22/1995	20	-	1	U	94		680	D	65		210	D	
PL2-245A	4/16/2001	20	-	15	UJ	28		220		16		170	H	
PL2-245A	7/30/2001	20	-	1	U	18		190		14		70		
PL2-245A	10/29/2001	20	-	1	U	16		300	D	15		76		
PL2-245A	1/31/2002	20	-	1	U	11		220	D	19		120		
PL2-245A	2/10/2010	20	18	3.1	**R**	150	**R**	61	**R**	3.5	**R**	10	**R**	
PL2-245A	3/18/2010	20	17.5	0.2	U	0.9		15		1.6		3.8		
PL2-245A	3/18/2010	20	17.5	0.2	U	0.9		15		1.5		3.7		DUP

Abbreviations:

µg/L micrograms/Liter

- Sample taken within screen interval

Qualifier:

U Non-detect

J Estimated

E Estimated concentration exceeded calibration range

Y The analyte is not detected at or above the reported concentration.

Q Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20%Drift or minimum RRF).

D The spiked compound was not detected due to sample extract dilution

H The natural concentration of the spiked element is so much greater than the concentration spiked that an accurate determination of spike recovery is not possible,

L Analyte concentration is ≤5 times the Reporting Limit and the replicate control limit defaults to ±1 RL insteadof the normal 20% RPD

R Rejected data

Table 2.15 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, South Sheetpile

Location	Sample Date	Well Depth feet	Sample Depth feet	Tetrachloroethene µg/L		Trichloroethene µg/L		cis-1,2-Dichloroethene µg/L		trans-1,2-Dichloroethene µg/L		Vinyl Chloride µg/L		Notes
South Sheetpile Outside Piling														
PL2-262B	3/30/1995	50	-	1	U	1	U	1	U	1	U	0.54		
PL2-262B	8/7/2002	50	-	1	U	1	U	1	U	1	U	1	U	
PL2-262B	2/9/2010	50	48	4.8	**R**	400	**R**	110	**R**	4.9	**R**	13	**R**	
PL2-262B	3/9/2010	50	45	0.2	U	0.8		0.7		0.2	U	0.2	U	
PL2-257A	10/4/1994	18	-	1	U	860	D	85		2.9		86		
PL2-257A	10/4/1994	18	-	1	U	1,100	D	92		3.4		82		
PL2-257A	10/7/1994	18	-	1.9		1,100	D	92		1	U	82		
PL2-257A	11/8/1994	18	-	2	U	320		51		2	U	39		
PL2-257A	12/9/1994	18	-	1	U	480	D	71		1.3		67		
PL2-257A	12/9/1994	18	-	1	U	450	D	82		1.5		83		
PL2-257A	1/18/1995	18	-	1	U	410	D	97		1.4		100		
PL2-257A	2/17/1995	18	-	1	U	820	D	130		3.1		110		
PL2-257A	3/16/1995	18	-	1	U	450	D	150		1.4		38		
PL2-257A	4/20/1995	18	-	1	U	650	D	220	D	1.9		32		
PL2-257A	5/23/1995	18	-	1	U	610	D	300	D	3		60		
PL2-257A	6/14/1995	18	-	1	U	190		300	D	1.5		39		
PL2-257A	7/18/1995	18	-	1	U	370	D	480	D	2.4		70		
PL2-257A	8/18/1995	18	-	1	U	200		350	D	2		67		
PL2-257A	9/22/1995	18	-	10	U	940		320		10	U	26		
PL2-257A	4/30/2001	18	-	1	U	22		220	D	2.6		63		
PL2-257A	8/6/2001	18	-	5	U	12		190		5	U	42		
PL2-257A	11/1/2001	18	-	1	U	1	U	1	U	1	U	1	U	
PL2-257A	2/4/2002	18	-	1	U	2.8		190		2.7		66		
PL2-257A	2/8/2010	18	16	4.0	**R**	23	**R**	59	**R**	1.3	**R**	5.0	**R**	
PL2-257A	3/9/2010	18	15.5	0.2	U	20		52		1		3.9		
PL2-252A	10/4/1994	18	-	1	U	20		720	D	2.4		100		
PL2-252A	10/4/1994	18	-	1	U	47		760	D	2		34		
PL2-252A	10/7/1994	18	-	1	U	47		760	D	2		34		
PL2-252A	11/10/1994	18	-	1	U	19		720	D	1.4		32		
PL2-252A	12/7/1994	18	-	1	U	25		700	D	1.1		11		
PL2-252A	12/8/1994	18	-	1	U	21		750	D	1.3		25		
PL2-252A	1/18/1995	18	-	1	U	24		450	D	1.1		22		
PL2-252A	2/17/1995	18	-	1	U	20		410	D	1.1		26		
PL2-252A	3/16/1995	18	-	1	U	19		290	D	1	U	15		

Table 2.15 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, South Sheetpile

Location	Sample Date	Well Depth	Sample Depth	Tetrachloroethene		Trichloroethene		cis-1,2-Dichloroethene		trans-1,2-Dichloroethene		Vinyl Chloride		Notes
		feet	feet	µg/L		µg/L		µg/L		µg/L		µg/L		
PL2-252A	4/20/1995	18	-	1	U	6.6		350	D	1	U	34		
PL2-252A	5/23/1995	18	-	1	U	8		320	D	1	U	16		
PL2-252A	6/14/1995	18	-	1	U	7.3		320	D	1	U	12		
PL2-252A	7/18/1995	18	-	1	U	3.8		320	D	1	U	30		
PL2-252A	8/17/1995	18	-	1	U	1.8		260	D	1.4		30		
PL2-252A	9/22/1995	18	-	1	U	2.2		260	D	1.3		15		
PL2-252A	4/25/2001	18	-	1	U	1	U	1	U	1	U	2.6		
PL2-252A	8/2/2001	18	-	1	U	1	U	3.6		1	U	1	U	
PL2-252A	10/30/2001	18	-	1	U	1	U	1.4		1	U	1	U	
PL2-252A	1/29/2002	18	-	1	U	1	U	1	U	1	U	1	U	
PL2-252A	2/10/2010	18	16.5	3.8	**R**	140	**R**	32	**R**	1.5	**R**	6.6	**R**	
PL2-252A	3/8/2010	18	16	0.2	U	0.3		0.4		0.2	U	0.3		
PL2-266A	4/25/2001	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-266A	8/6/2001	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-266A	11/1/2001	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-266A	1/31/2002	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-266A	2/10/2010	30	28	4.7	**R**	100	**R**	24	**R**	1.0	**R**	3.3	**R**	
PL2-266A	3/8/2010	30	28	0.2	U	0.2		0.2	U	0.2	U	0.2	U	
PL2-266A	3/8/2010	30	28	0.2	U	0.5		0.2	U	0.2	U	0.2	U	DUP
PL2-254A	10/4/1994	17	-	1	U	1	U	1	U	1	U	0.23		
PL2-254A	10/4/1994	17	-	1	U	1	U	1	U	1	U	0.076		
PL2-254A	10/7/1994	17	-	1	U	1	U	1	U	1	U	0.076		
PL2-254A	11/10/1994	17	-	1	U	1	U	1	U	1	U	0.46		
PL2-254A	12/7/1994	17	-	1	U	1	U	1	U	1	U	2	U	
PL2-254A	12/8/1994	17	-	1	U	1	U	1	U	1	U	2	U	
PL2-254A	1/19/1995	17	-	1	U	1	U	1	U	1	U	2	U	
PL2-254A	2/17/1995	17	-	1	U	1	U	1	U	1	U	2	U	
PL2-254A	3/16/1995	17	-	1	U	1	U	1	U	1	U	2	U	
PL2-254A	4/20/1995	17	-	1	U	1	U	1	U	1	U	2	U	
PL2-254A	5/24/1995	17	-	1	U	1	U	1	U	1	U	2	U	
PL2-254A	6/15/1995	17	-	1	U	1	U	1	U	1	U	2	U	
PL2-254A	7/18/1995	17	-	1	U	1	U	1	U	1	U	2	U	
PL2-254A	8/17/1995	17	-	1	U	1	U	1	U	1	U	2	U	
PL2-254A	9/22/1995	17	-	1	U	1	U	1	U	1	U	2	U	
PL2-254A	4/25/2001	17	-	1	U	1	U	1	U	1	U	1	U	
PL2-254A	8/3/2001	17	-	1	UJ	1	UJ	1	UJ	1	UJ	1	UJ	
PL2-254A	11/1/2001	17	-	1	U	1	U	1	U	1	U	1	U	
PL2-254A	1/31/2002	17	-	1	U	1	U	1	U	1	U	1	U	
PL2-254A	2/8/2010	17	15	6.0	**R**	27	**R**	16	**R**	0.7	**R**	0.3	**R**	
PL2-254A	3/8/2010	17	15	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	

Table 2.15 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, South Sheetpile

		Well Depth	Sample Depth	Tetrachloroethene		Trichloroethene		cis-1,2-Dichloroethene		trans-1,2-Dichloroethene		Vinyl Chloride		
Location	**Sample Date**	**feet**	**feet**	**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**Notes**
PL2-214A	8/18/1992	30	-	1	U	4.2		31		1	U	10		
PL2-214A	3/13/1995	30	-	1	U	1	U	1	U	1	U	18		
PL2-214A	8/7/1995	30	-	1	U	1	U	1	U	1	U	10		
PL2-214A	11/16/1995	30	-	1	U	1	U	1	U	1	U	2.4		
PL2-214A	2/27/1996	30	-	1	U	1	U	1.9		1	U	47		
PL2-214A	5/21/1996	30	-	1	U	1	U	1	U	1	U	2.9		
PL2-214A	8/21/1996	30	-	1	U	1	U	1	U	1	U	10		
PL2-214A	11/18/1996	30	-	1	U	6.1		120		1	U	74		
PL2-214A	4/25/2001	30	-	1	U	1	U	1	U	1	U	1	UJ	
PL2-214A	4/25/2001	30	-	1	U	1	U	1	U	1	U	1	UJ	
PL2-214A	7/25/2001	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	11/5/2001	30	-	1	U	1	U	1	U	1	U	1	UJ	
PL2-214A	1/23/2002	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	6/19/2003	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	6/19/2003	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	9/3/2003	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	12/10/2003	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	2/3/2004	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	5/11/2004	30	-	1	U	1	U	1	U	1	U	1	UJL	
PL2-214A	8/4/2004	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	8/4/2004	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	11/2/2004	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	11/2/2004	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	1/31/2005	30	-	1	UJ	1	UJ	1	UJ	1	UJ	1	UJ	
PL2-214A	5/4/2005	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	8/4/2005	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	11/1/2005	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	2/8/2006	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	5/3/2006	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	8/3/2006	30	-	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	
PL2-214A	11/8/2006	30	-	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	
PL2-214A	2/5/2007	30	-	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	
PL2-214A	5/8/2007	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	8/7/2007	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	8/7/2007	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	11/15/2007	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	2/7/2008	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	8/3/2008	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	2/5/2009	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	8/12/2009	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	8/12/2009	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	2/10/2010	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-214A	3/5/2010	30	22.5	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	

Table 2.15 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, South Sheetpile

		Well Depth	Sample Depth	Tetrachloroethene		Trichloroethene		cis-1,2-Dichloroethene		trans-1,2-Dichloroethene		Vinyl Chloride		
Location	**Sample Date**	**feet**	**feet**	**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**Notes**
PL2-214B	8/18/1992	60	-	1	U	1	U	1	U	1	U	2	U	
PL2-214B	3/15/1995	60	-	1	U	1	U	1	U	1	U	0.024		
PL2-214B	8/16/1995	60	-	1	U	1	U	1	U	1	U	0.037	J	
PL2-214B	11/16/1995	60	-	1	U	1	U	1	U	1	U	0.015		
PL2-214B	2/27/1996	60	-	1	U	1	U	1	U	1	U	2	U	
PL2-214B	5/22/1996	60	-	1	U	1	U	1	U	1	U	2	U	
PL2-214B	8/21/1996	60	-	1	U	1	U	1	U	1	U	2	U	
PL2-214B	11/19/1996	60	-	1	U	39		4.7		1	U	2	U	
PL2-214B	4/25/2001	60	-	1	U	1	U	1	U	1	U	1	UJ	
PL2-214B	7/25/2001	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	11/5/2001	60	-	1	U	1	U	1	U	1	U	1	UJ	
PL2-214B	1/23/2002	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	6/19/2003	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	9/3/2003	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	12/10/2003	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	2/3/2004	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	5/11/2004	60	-	1	U	1	U	1	U	1	U	1	UJL	
PL2-214B	8/4/2004	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	11/2/2004	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	1/31/2005	60	-	1	UJ	1	UJ	1	UJ	1	UJ	1	UJ	
PL2-214B	5/4/2005	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	8/4/2005	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	11/1/2005	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	2/8/2006	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	5/3/2006	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	8/3/2006	60	-	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	
PL2-214B	11/8/2006	60	-	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	
PL2-214B	2/5/2007	60	-	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	
PL2-214B	5/8/2007	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	8/7/2007	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	11/15/2007	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	11/15/2007	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	2/7/2008	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	8/3/2008	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	2/5/2009	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	8/12/2009	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	2/10/2010	60	-	1	U	1	U	1	U	1	U	1	U	
PL2-214B	3/5/2010	60	52.5	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	
PL2-214B	3/5/2010	60	52.5	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	DUP

Table 2.15 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, South Sheetpile

Location	Sample Date	Well Depth feet	Sample Depth feet	Tetrachloroethene µg/L		Trichloroethene µg/L		cis-1,2-Dichloroethene µg/L		trans-1,2-Dichloroethene µg/L		Vinyl Chloride µg/L		Notes
PL2-214C	4/25/2001	80	-	1	U	1	U	1	U	1	U	1	UJ	
PL2-214C	7/25/2001	80	-	1	U	1	U	1	U	1	U	1	U	
PL2-214C	11/5/2001	80	-	1	U	1	U	1	U	1	U	1	UJ	
PL2-214C	1/23/2002	80	-	1	U	1	U	1	U	1	U	1	U	
PL2-214C	6/19/2003	80	-	1	U	1	U	1	U	1	U	1	U	
PL2-214C	12/10/2003	80	-	1	U	1	U	1	U	1	U	1	U	
PL2-214C	5/11/2004	80	-	1	U	1	U	1	U	1	U	1	UJL	
PL2-214C	5/11/2004	80	-	1	U	1	U	1	U	1	U	1	UJL	
PL2-214C	11/2/2004	80	-	1	U	1	U	1	U	1	U	1	U	
PL2-214C	5/4/2005	80	-	1	U	1	U	1	U	1	U	1	U	
PL2-214C	11/1/2005	80	-	1	U	1	U	1	U	1	U	1	U	
PL2-214C	5/3/2006	80	-	1	U	1	U	1	U	1	U	1	U	
PL2-214C	11/8/2006	80	-	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	
PL2-214C	5/8/2007	80	-	1	U	1	U	1	U	1	U	1	U	
PL2-214C	11/15/2007	80	-	1	U	1	U	1	U	1	U	1	U	
PL2-214C	2/7/2008	80	-	1	U	1	U	1	U	1	U	1	U	
PL2-214C	8/3/2008	80	-	1	U	1	U	1	U	1	U	1	U	
PL2-214C	2/5/2009	80	-	1	U	1	U	1	U	1	U	1	U	
PL2-214C	8/12/2009	80	-	1	U	1	U	1	U	1	U	1	U	
PL2-214C	2/10/2010	80	-	1	U	1	U	1	U	1	U	1	U	
PL2-214C	3/5/2010	80	78	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	
PL2-213A	3/8/2010	30	22.5	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	
PL2-213A	3/8/2010	30	22.5	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	DUP
PL2-213B	8/19/1992	30	-	1	U	1	U	1	U	1	U	2	U	
PL2-213B	5/1/2001	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-213B	8/3/2001	30	-	1	UJ	1	UJ	1	UJ	1	UJ	1	UJ	
PL2-213B	11/1/2001	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-213B	1/31/2002	30	-	1	U	1	U	1	U	1	U	1	U	
PL2-213B	3/8/2010	30	28	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	
PL2-216A	8/19/1992	30	-	1	U	1	U	1	U	1	U	2	U	
PL2-216A	3/5/2010	30	17.5	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	

Table 2.15 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, South Sheetpile

		Well Depth	Sample Depth	Tetrachloroethene		Trichloroethene		cis-1,2-Dichloroethene		trans-1,2-Dichloroethene		Vinyl Chloride		
Location	**Sample Date**	**feet**	**feet**	**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**Notes**
PL2-232A	12/20/1993	20	-	1	U	1	U	1	U	1	U	3		
PL2-232A	8/15/1995	20	-	1	U	1	U	1	U	1	U	3.4		
PL2-232A	11/17/1995	20	-	1	U	1	U	1	U	1	U	2.3		
PL2-232A	2/28/1996	20	-	1	U	1	U	1	U	1	U	3.5		
PL2-232A	5/22/1996	20	-	1	U	1	U	1	U	1	U	2.3		
PL2-232A	8/22/1996	20	-	1	U	1	U	1	U	1	U	4.7		
PL2-232A	11/19/1996	20	-	1	U	1	U	1	U	1	U	2.4		
PL2-232A	5/17/2001	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	7/24/2001	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	11/5/2001	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	1/23/2002	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	6/18/2003	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	12/10/2003	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	12/10/2003	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	5/11/2004	20	-	1	U	1	U	1	U	1	U	1	UJL	
PL2-232A	11/2/2004	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	5/4/2005	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	8/3/2005	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	11/1/2005	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	5/3/2006	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	11/8/2006	20	-	0.2	U	0.2	U	0.2	U	0.2	U	0.4		
PL2-232A	5/8/2007	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	11/14/2007	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	2/7/2008	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	8/3/2008	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	2/5/2009	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	8/11/2009	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	2/10/2010	20	-	1	U	1	U	1	U	1	U	1	U	
PL2-232A	3/9/2010	20	12.5	0.2	U	0.2	U	0.2	U	0.2	U	0.2		

Table 2.15 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, South Sheetpile

Location	Sample Date	Well Depth feet	Sample Depth feet	Tetrachloroethene µg/L		Trichloroethene µg/L		cis-1,2-Dichloroethene µg/L		trans-1,2-Dichloroethene µg/L		Vinyl Chloride µg/L		Notes
South Sheetpile Inside Piling														
PL2-256A	10/4/1994	18	-	1	U	220	D	18		1	U	2.2		
PL2-256A	10/4/1994	18	-	1	U	420	D	36		1	U	4.6		
PL2-256A	11/8/1994	18	-	1	U	30		19		1	U	1.7	J	
PL2-256A	11/9/1994	18	-	1	U	30		15		1	U	2		
PL2-256A	11/10/1994	18	-	1	U	56		19		1	U	2.6		
PL2-256A	11/11/1994	18	-	1	U	180	D	22		1	U	4.5		
PL2-256A	12/9/1994	18	-	1	U	190	J	26		1	U	4.1		
PL2-256A	12/9/1994	18	-	1	U	200		28		1	U	4.1		
PL2-256A	12/9/1994	18	-	1	U	110	J	28		1	U	5.4		
PL2-256A	1/18/1995	18	-	1	U	58		24		1	U	3.4		
PL2-256A	2/17/1995	18	-	1	U	99		81		1	U	7		
PL2-256A	3/16/1995	18	-	1	U	130		20		1	U	2.7		
PL2-256A	4/20/1995	18	-	1	U	78		64		1	U	8.3		
PL2-256A	5/23/1995	18	-	1	U	68		200		1	U	22		
PL2-256A	6/14/1995	18	-	1	U	46		18		1	U	5.9		
PL2-256A	7/18/1995	18	-	1	U	50		130		1	U	66		
PL2-256A	8/17/1995	18	-	1	U	23		37		1	U	88		
PL2-256A	9/22/1995	18	-	1	U	58		130		1	U	57		
PL2-256A	4/30/2001	18	-	1	U	8.1		6		1	U	10	J	
PL2-256A	8/6/2001	18	-	1	U	1.7		1.8		1	U	1.8		
PL2-256A	11/1/2001	18	-	1	U	3		200	J	2.4		72		
PL2-256A	2/4/2002	18	-	1	U	1	U	4.4		1	U	11		
PL2-256A	2/8/2010	18	16	6.4	**R**	20	**R**	8.9	**R**	0.4	**R**	0.4	**R**	
PL2-256A	3/12/2010	18	15.5	0.2	U	0.2	U	0.3		0.2	U	0.7		
PL2-209A	2/28/1992	18	-	1	U	32,000	B	840		37		160		
PL2-209A	8/20/1992	18	-	500	U	9,300		1,100		500	U	1,000	U	
PL2-209A	4/19/2001	18	-	10	UJ	10	UJ	930		10	UJ	100		
PL2-209A	2/9/2010	18	16	3.4	**R**	13	**R**	28	**R**	0.4	**R**	17	**R**	
PL2-209A	2/9/2010	18	16	3.4	**R**	14	**R**	30	**R**	0.4	**R**	20	**R**	DUP
PL2-209A	3/17/2010	18	13	0.2	U	1.1		42		0.2		26		

Table 2.15 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, South Sheetpile

Location	Sample Date	Well Depth feet	Sample Depth feet	Tetrachloroethene µg/L		Trichloroethene µg/L		cis-1,2-Dichloroethene µg/L		trans-1,2-Dichloroethene µg/L		Vinyl Chloride µg/L		Notes
PL2-209B	8/19/1992	55	-	1	U	1	U	1	U	1	U	2	U	
PL2-209B	8/11/1995	55	-	1	U	1	U	1	U	1	U	0.034		
PL2-209B	11/16/1995	55	-	1	U	1	U	1	U	1	U	0.026		
PL2-209B	2/27/1996	55	-	1	U	1	U	1	U	1	U	2	U	
PL2-209B	5/24/1996	55	-	1	U	1	U	1	U	1	U	2	U	
PL2-209B	8/21/1996	55	-	1	U	4.8		1	U	1	U	2	U	
PL2-209B	11/19/1996	55	-	1	U	1	U	1	U	1	U	2	U	
PL2-209B	4/19/2001	55	-	1	U	1	U	1	U	1	U	1	U	
PL2-209B	8/2/2001	55	-	1	U	1	U	1	U	1	U	1	U	
PL2-209B	10/31/2001	55	-	1	U	1	U	1	U	1	U	1	U	
PL2-209B	1/30/2002	55	-	1	U	1	U	1	U	1	U	1	U	
PL2-209B	2/9/2010	55	53	2.4	**R**	12	**R**	4.6	**R**	0.2	**R**	0.2	U**R**	
PL2-209B	3/17/2010	55	47.5	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	
PL2-255A	10/4/1994	17.5	-	1	U	2.4		1	U	1	U	0.42		
PL2-255A	10/4/1994	17.5	-	1	U	11		1	U	1	U	0.08		
PL2-255A	11/10/1994	17.5	-	1	U	3.3		1	U	1	U	0.81		
PL2-255A	12/7/1994	17.5	-	1	U	2.8		1	U	1	U	2	U	
PL2-255A	12/8/1994	17.5	-	1	U	4.1		1	U	1	U	2	U	
PL2-255A	1/19/1995	17.5	-	1	U	2.6		1	U	1	U	2	U	
PL2-255A	2/17/1995	17.5	-	1	U	3.4		1.2		1	U	2	U	
PL2-255A	3/16/1995	17.5	-	1	U	2.4		1	U	1	U	2	U	
PL2-255A	4/20/1995	17.5	-	1	U	4.5		1	U	1	U	2	U	
PL2-255A	5/24/1995	17.5	-	1	U	9.5		1	U	1	U	2	U	
PL2-255A	6/15/1995	17.5	-	1	U	4.9		1	U	1	U	2	U	
PL2-255A	7/18/1995	17.5	-	1	U	12		1	U	1	U	2	U	
PL2-255A	8/17/1995	17.5	-	1	U	5.1		1	U	1	U	2	U	
PL2-255A	9/22/1995	17.5	-	1	U	12		1	U	1	U	2	U	
PL2-255A	4/25/2001	17.5	-	1	U	17		1	U	1	U	1	U	
PL2-255A	8/3/2001	17.5	-	1	UJ	1	UJ	1.2	J	1	UJ	1	UJ	
PL2-255A	11/6/2001	17.5	-	1	U	1	U	1	U	1	U	1	UJ	
PL2-255A	1/31/2002	17.5	-	1	U	1	U	4.1		1	U	1.2		
PL2-255A	2/8/2010	17.5	15.5	0.2	U**R**	19	**R**	10	**R**	0.4	**R**	0.3	**R**	
PL2-255A	3/12/2010	17.5	15	0.2	U	3.4		2.3		0.2	U	0.2	U	
PL2-255A	3/12/2010	17.5	15	0.2	U	3.2		2.4		0.2	U	0.2	U	DUP

Table 2.15 Summary of Historical Volatile Organic Compounds Concentrations in Groundwater, South Sheetpile

Location	Sample Date	Well Depth feet	Sample Depth feet	Tetrachloroethene µg/L		Trichloroethene µg/L		cis-1,2-Dichloroethene µg/L		trans-1,2-Dichloroethene µg/L		Vinyl Chloride µg/L		Notes
PL2-253A	10/4/1994	17	-	1	U	650	D	1,200	D	3.4		74		
PL2-253A	10/4/1994	17	-	1	U	920	D	960	D	1.6		12		
PL2-253A	11/8/1994	17	-	1	U	650	D	1,900	D	3		160		
PL2-253A	11/9/1994	17	-	1	U	380	D	1,400	D	4.1		180	D	
PL2-253A	11/10/1994	17	-	1	U	640	D	1,500	D	2		86		
PL2-253A	11/11/1994	17	-	1	U	570	D	1,500	D	1.8		51		
PL2-253A	12/7/1994	17	-	1	U	460	D	1,800	D	2.6		93		
PL2-253A	12/8/1994	17	-	1	U	560	D	1,600	D	2.5		71		
PL2-253A	1/18/1995	17	-	1	U	270	D	1,100	D	2		84		
PL2-253A	2/17/1995	17	-	1	U	290	D	1,200	D	1.6		44		
PL2-253A	3/16/1995	17	-	1	U	170	D	1,200	D	2.8		89		
PL2-253A	4/20/1995	17	-	1	U	150		1,600	D	2.3		120		
PL2-253A	5/23/1995	17	-	1	U	140		1,300	D	2.5		77		
PL2-253A	6/14/1995	17	-	1	U	100		1,400	D	4.2		160		
PL2-253A	7/18/1995	17	-	1	U	130		1,600	D	2		76		
PL2-253A	8/17/1995	17	-	1	U	89		1,400	D	6.2		100		
PL2-253A	9/22/1995	17	-	1	U	180		1,200	D	3.4		17		
PL2-253A	4/25/2001	17	-	1	U	1	U	320	D	3.1		160		
PL2-253A	8/2/2001	17	-	1	U	3.8		390	D	2.2		97		
PL2-253A	10/30/2001	17	-	5	U	5	U	380		5	U	130		
PL2-253A	1/29/2002	17	-	5	U	5	U	420		5	U	140		
PL2-253A	2/10/2010	17	15	2.8	**R**	150	**R**	49	**R**	2.0	**R**	110	**R**	
PL2-253A	3/12/2010	17	14.5	0.2	U	0.2	U	14		0.8		91		
PL2-253A	3/12/2010	17	14.5	0.2	U	0.2	U	15		0.7		91		DUP

Abbreviations:

µg/L micrograms/Liter

\- Sample taken within screen interval

Qualifier:

U Non-detect

J Estimated

E Estimated concentration exceeded calibration range

Y The analyte is not detected at or above the reported concentration.

Q Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20%Drift or minimum RRF).

D The spiked compound was not detected due to sample extract dilution

H The natural concentration of the spiked element is so much greater than the concentration spiked that an accurate determination of spike recovery is not possible,

R Rejected data

Table 3.1 Estimated Soil Permeability Based on Grainsize

Sample Number	USCS Soil Class	D_{10} mm	D_{30} mm	D_{60} mm	Coefficient of curvature C_c	Coefficient of uniformity C_u	Estimated K based on D_{10} and Hazen formula (C=1.0)
PL2-SSL1	SM	0.011	0.10	0.13	9.09	11.82	1.2E-04
PL2-SSL2	SM	0.010	0.11	0.22	11.00	22.00	1.0E-04
PL2-SSL5	SM	0.081	0.18	0.35	2.22	4.32	6.6E-03
					median (cm/sec)		1.2E-04
					average		2.3E-03
					geometric mean		4.3E-04

USCS = Unified Soil Classification System

Coefficient of curvature $C_c = (D_{30})^2/(D_{10} \times D_{30})$

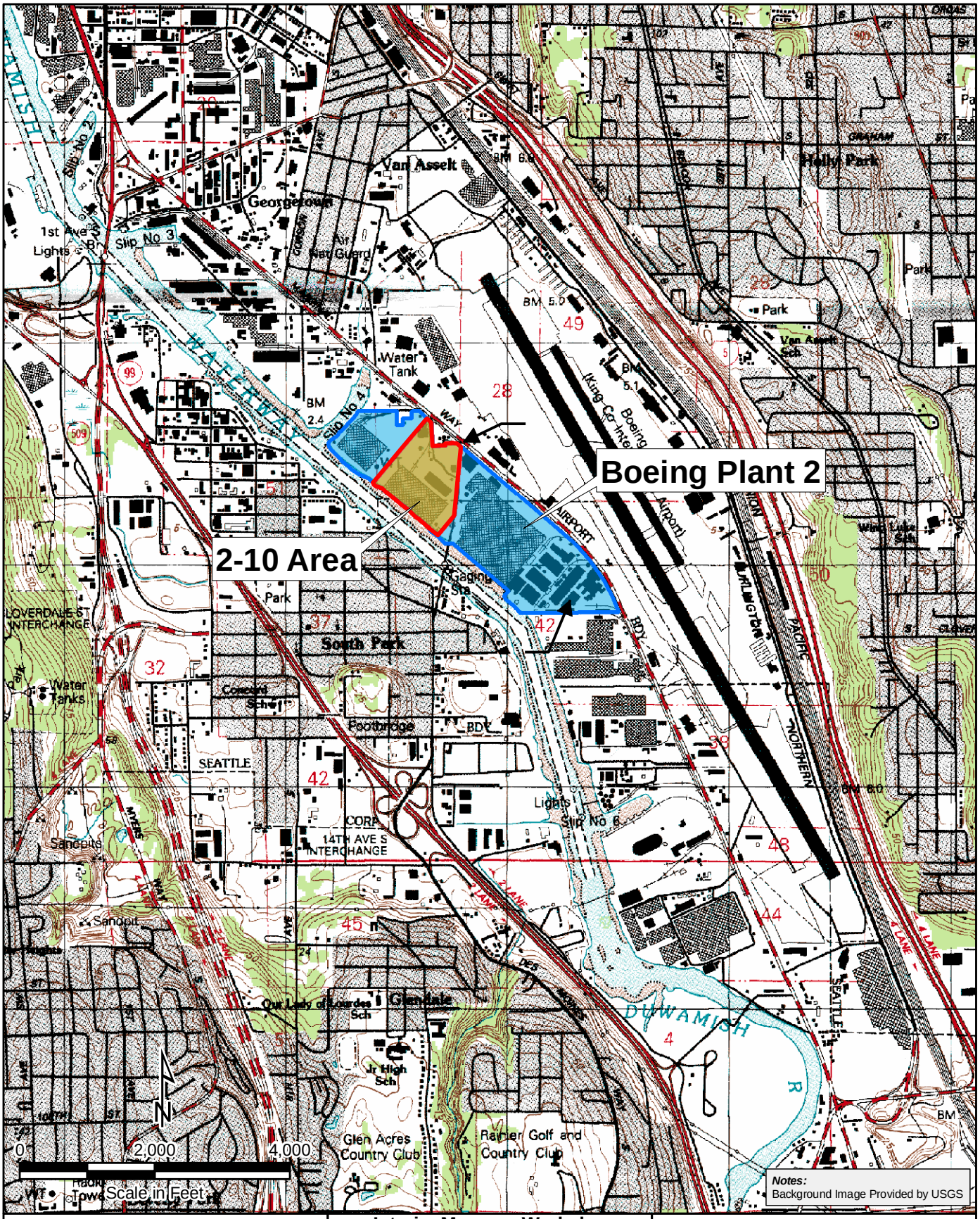
Coefficient of uniformity $C_u = D_{60} / D_{10}$

K(cm/s) = C $(D_{10})^2$ (with D_{10} in mm, and C ~ 1.0)

Table 3.2 Summary of Design Calculations Building 2-10 Interim Measures

	North Sheetpile	Northern Area Outside Sheetpile	South Sheetpile
Required SVE Flow Rate Cubic Feet Per Minute	77	--	33
Number of Soil Vapor Extraction Points	5	--	2
Injected Substrate Concentration, mg/L	500	1,000	500
Substrate Mass Per Injection, pounds	8,883	2,359	2,016
Number of Groundwater Injection Wells	9	2	5

Figures



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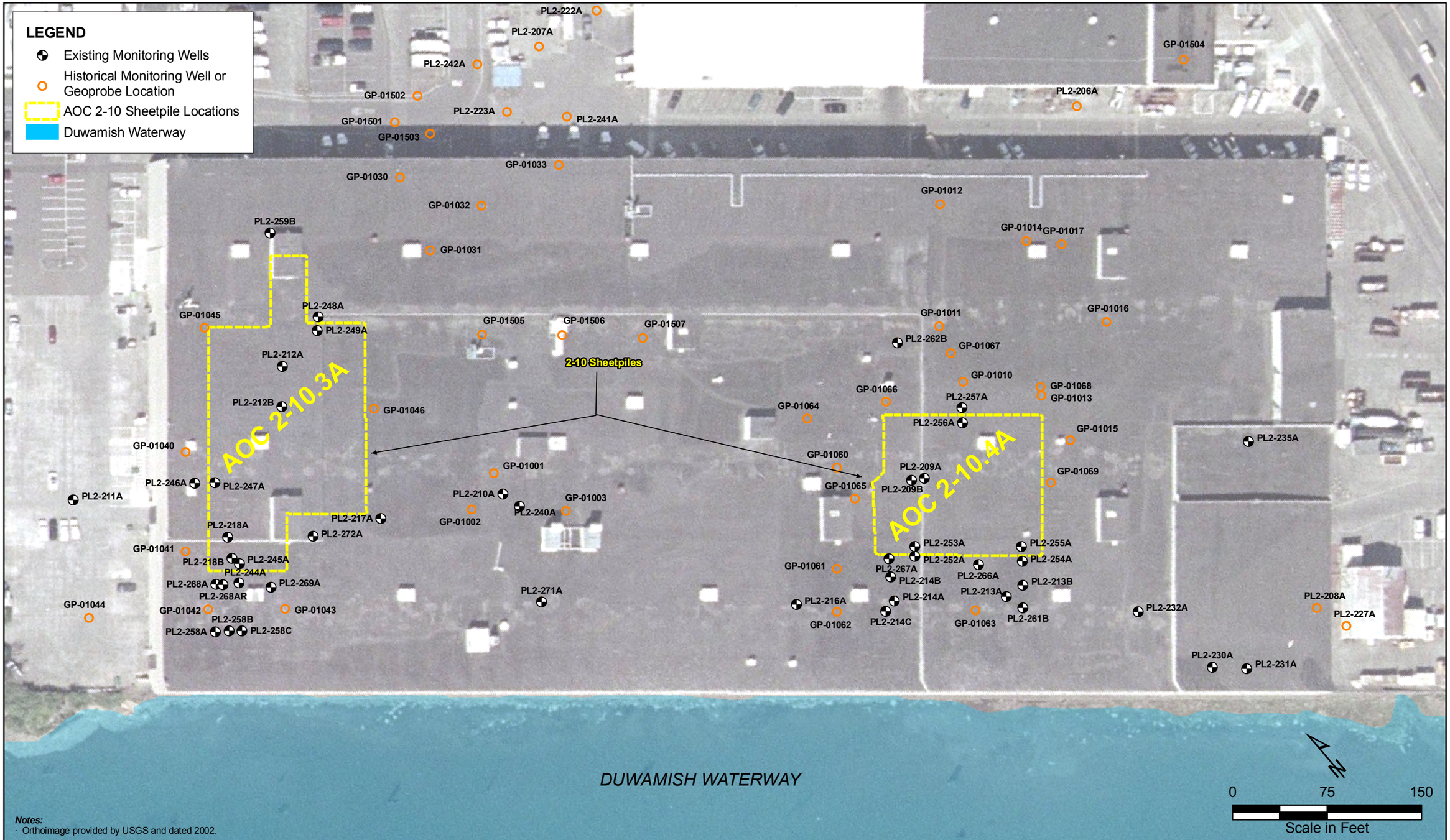
Interim Measure Workplan
North and South Sheetpiles
in the 2-10 Building
Boeing Plant 2
Seattle / Tukwila, Washington

Figure 1.1
Vicinity Map

File: F:\projects\Boeing - Plant 2\GIS\2-10 Area\Figure 1.1 (Vicinity Map).mxd
Date: 11/12/2008



Notes:
· Orthoimage provided by USGS and dated 2002.

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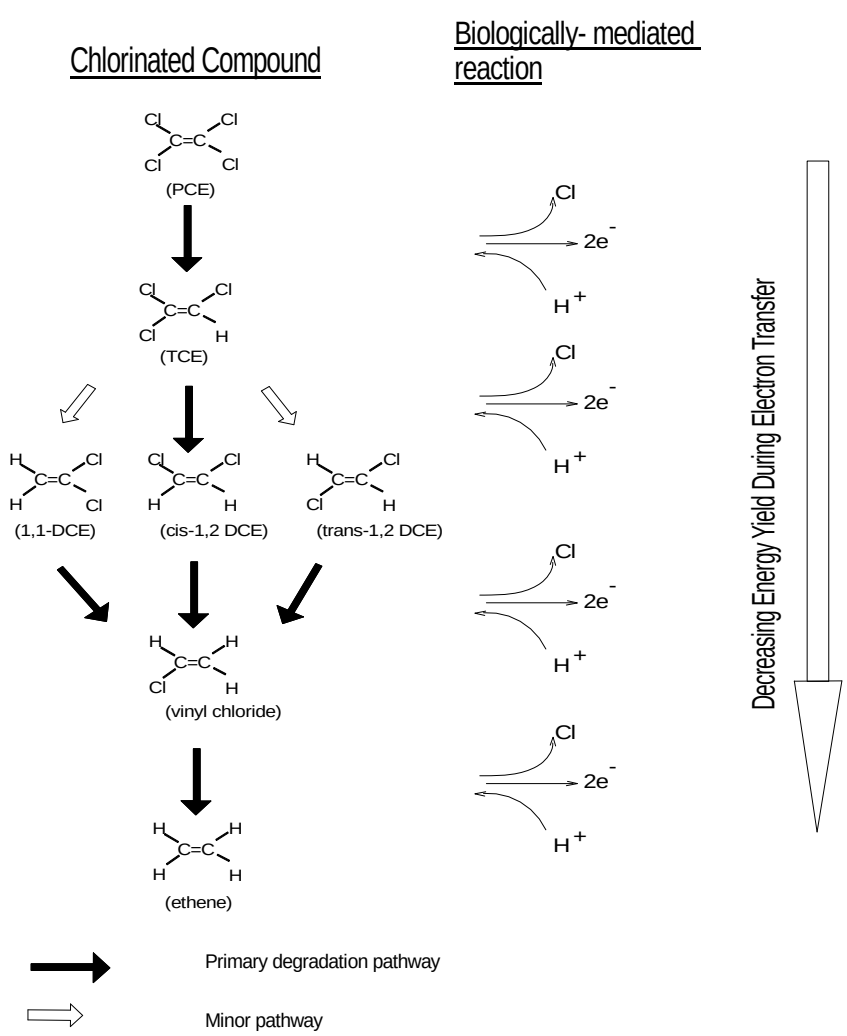
Interim Measure Work Plan
North and South Sheetpiles in the 2-10 Building
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 1.2
North and South Sheetpile Locations
and Building 2-10 Features

File: F:\projects\Boeing - Plant 2\GIS\2-10 Area\Figure 1.2 (Sheetpile Locations and Building 2-10 Features).mxd
Date: 7/13/2010



Enabling Aquifer Condition	Typical Redox Energy Level for Optimum Degradation (see note below)
Anaerobic Denitrification	Redox measures +250 to +100 mV
Anaerobic Iron (III) reduction	Redox measures +100 to 0 mV
Anaerobic Sulfate reduction	Redox measures 0 to -200 mV
Methane fermentation Methanogenesis	Redox measures -200 mV and lower

Note: a wide range of ORP values have been cited in prior studies; values presented here are general ranges from prior work (example reference sources include: Faris and Vlassopoulos [2003] and Wiedemeier et al. [1998]

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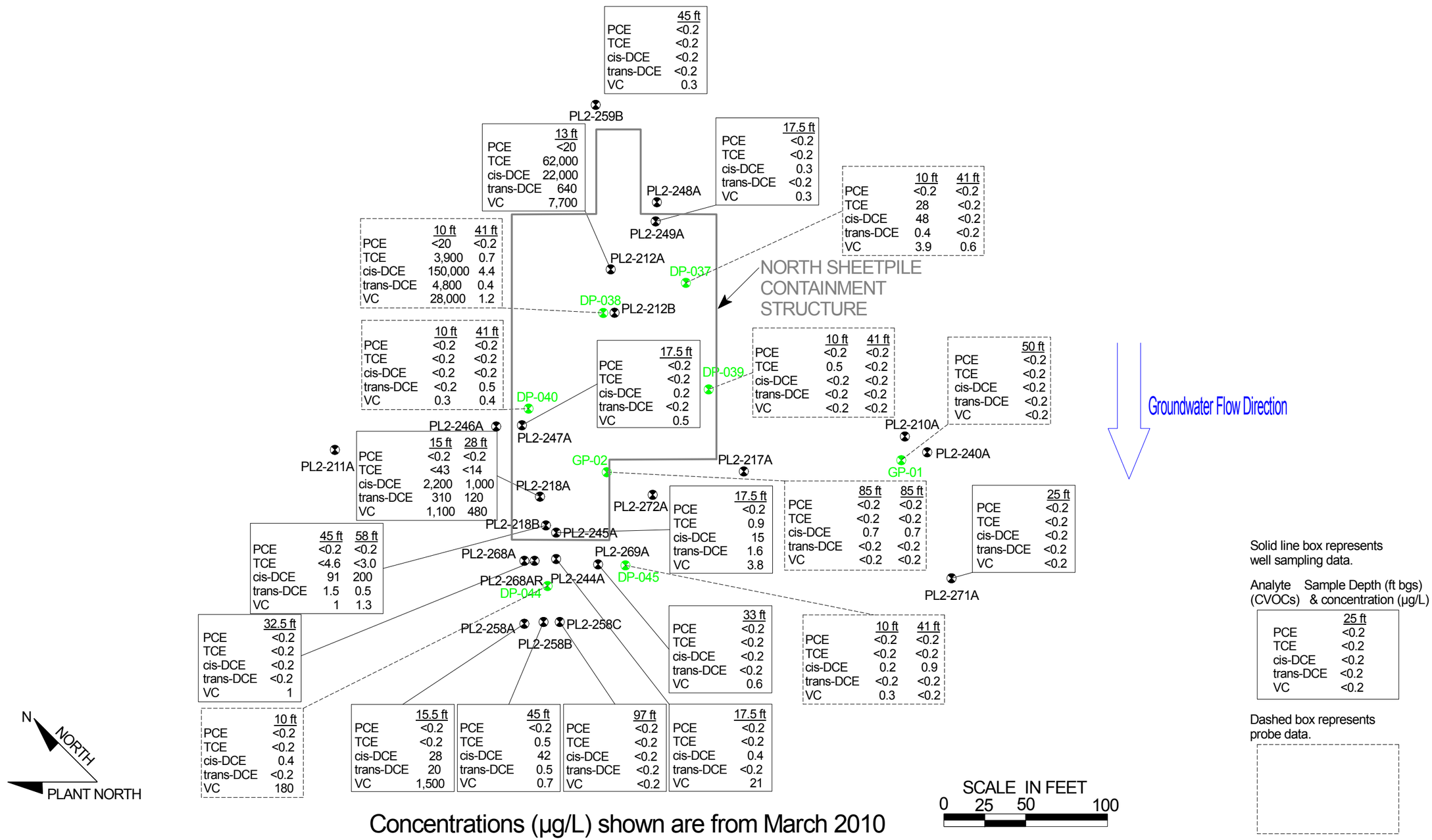
Interim Measure Work Plan for the North and South Sheetpiles in the 2-10 Building Area
Boeing Plant 2
Seattle, Washington

Figure 1.3
Primary Degradation Pathways of Chlorinated Ethenes by Reductive Dechlorination



Concentrations (µg/L) shown are from March 2010

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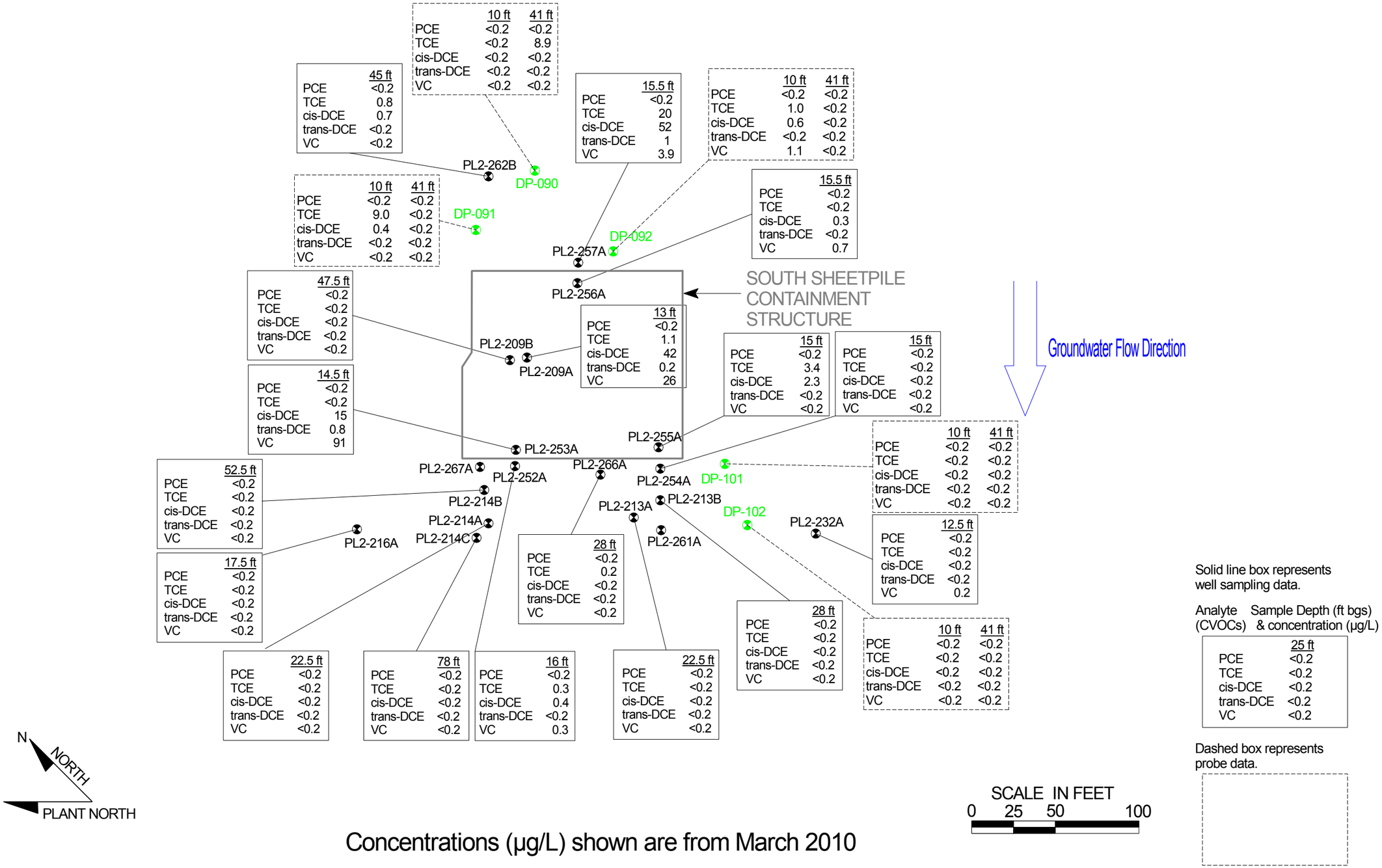
Interim Measure Work Plan
North and South Sheetpiles in the 2-10 Bldg
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 2.1
Chlorinated Volatile Organic Concentrations in Groundwater, North Sheetpile Area
Building 2-10



Concentrations (µg/L) shown are from March 2010

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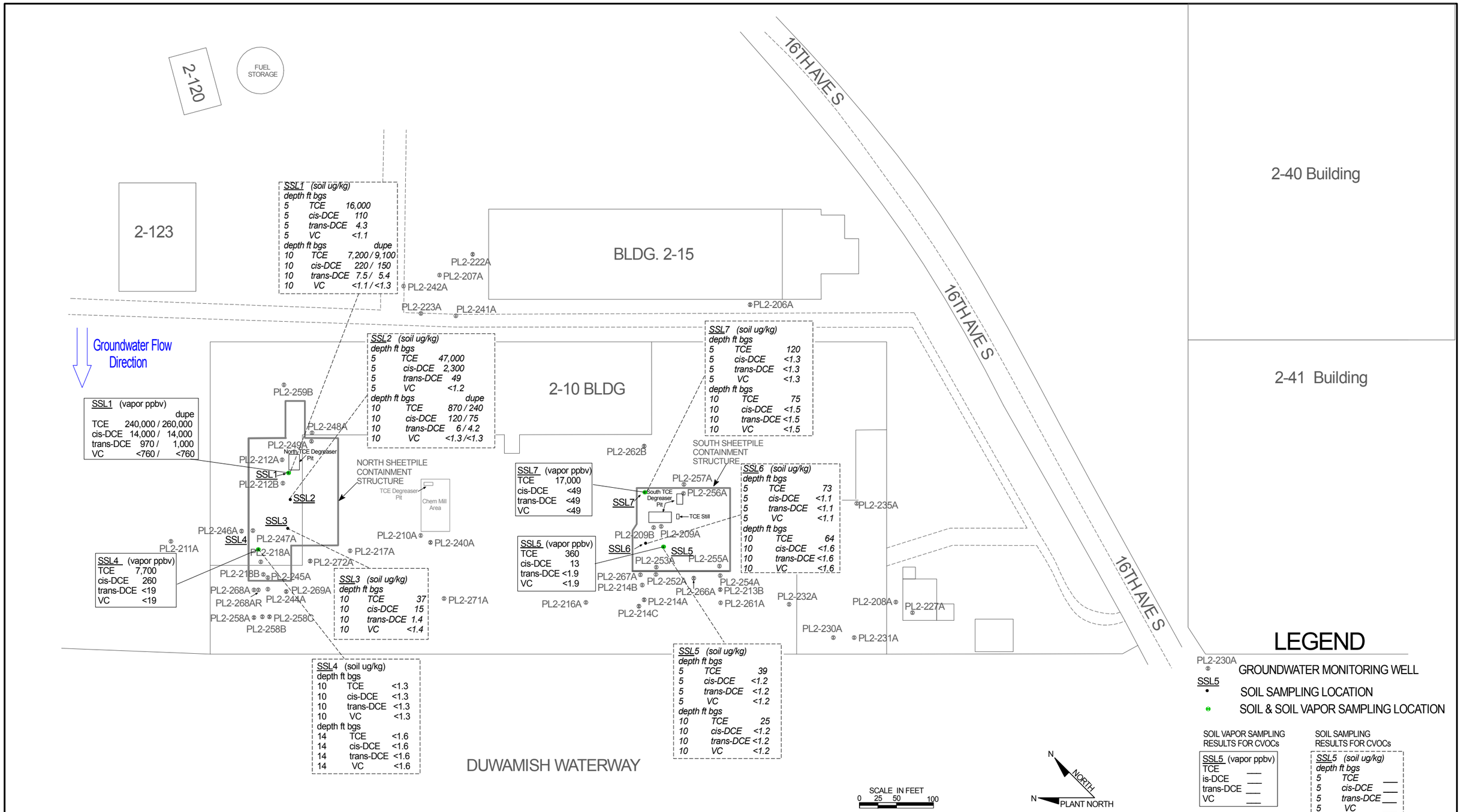
Interim Measure Work Plan
North and South Sheetpiles in the 2-10 Bldg
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 2.2
Chlorinated Volatile Organic Concentrations in Groundwater, South Sheetpile Area
Building 2-10



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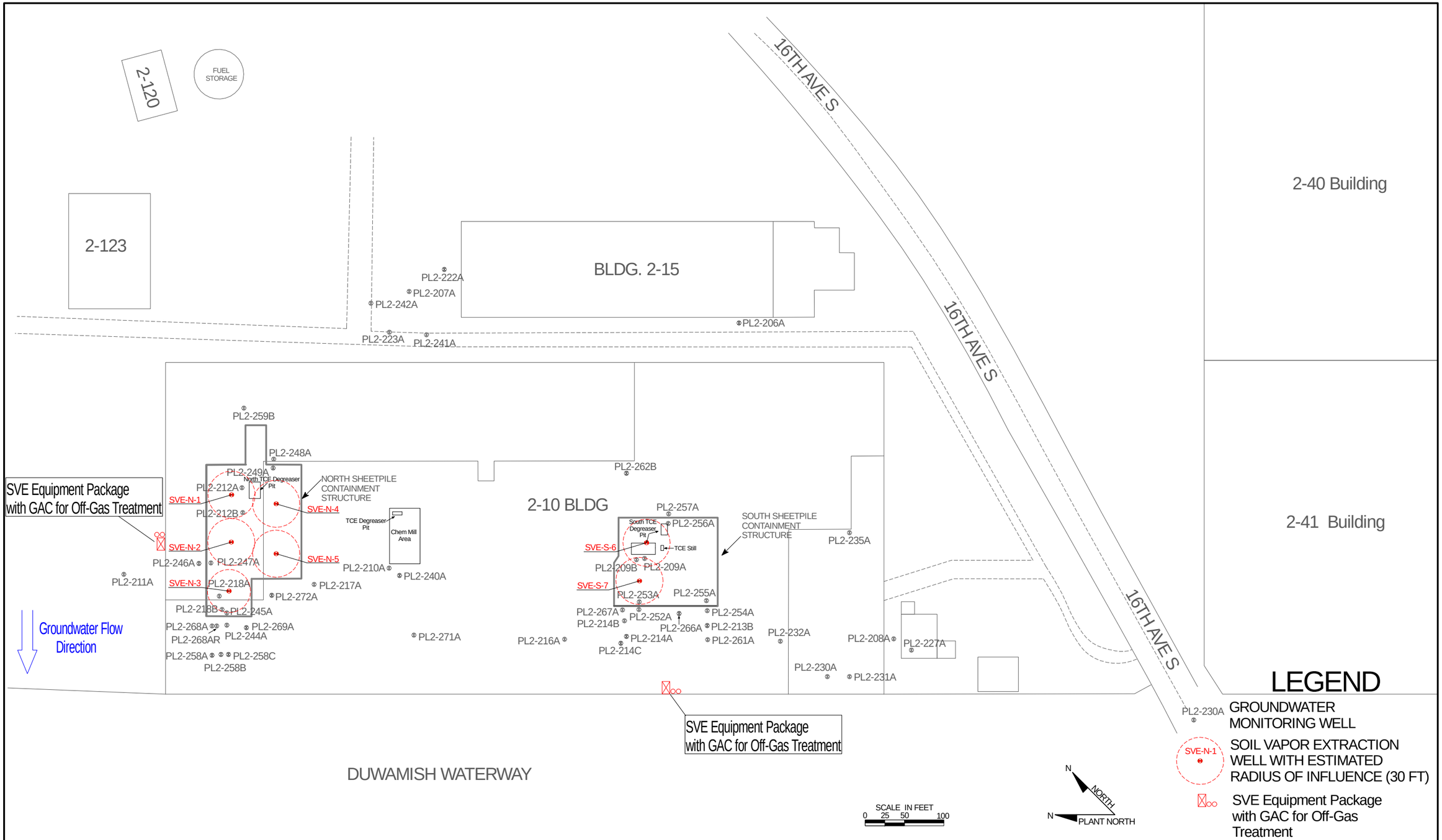
Interim Measure Work Plan
North and South Sheetpiles in the 2-10 Building
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 2.3
Soil and Soil Vapor Sampling Data
Interim Measure
North and South Sheetpiles
2-10 Building



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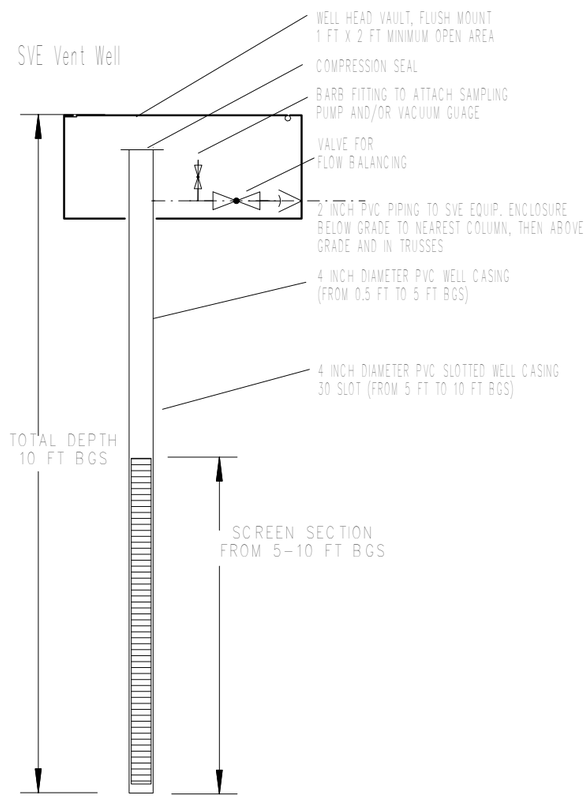
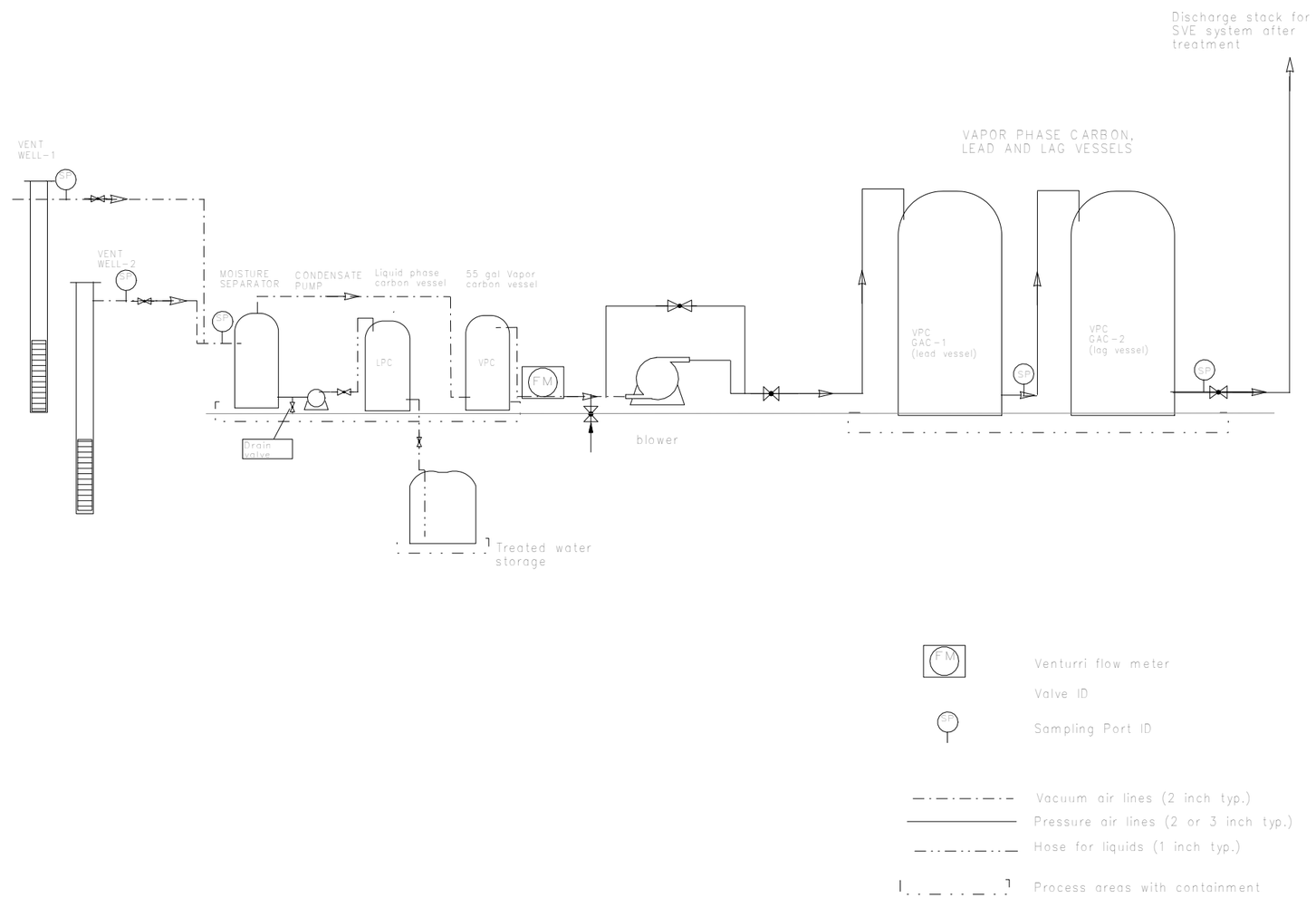
Interim Measure Work Plan
North and South Sheetpiles in the 2-10 Building
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 3.1
Conceptual Design Soil Vapor Extraction Wells
North and South Sheetpiles IMs
Building 2-10

SVE Vent Well Construction (typical)



SVE Equipment System Layout (typical)



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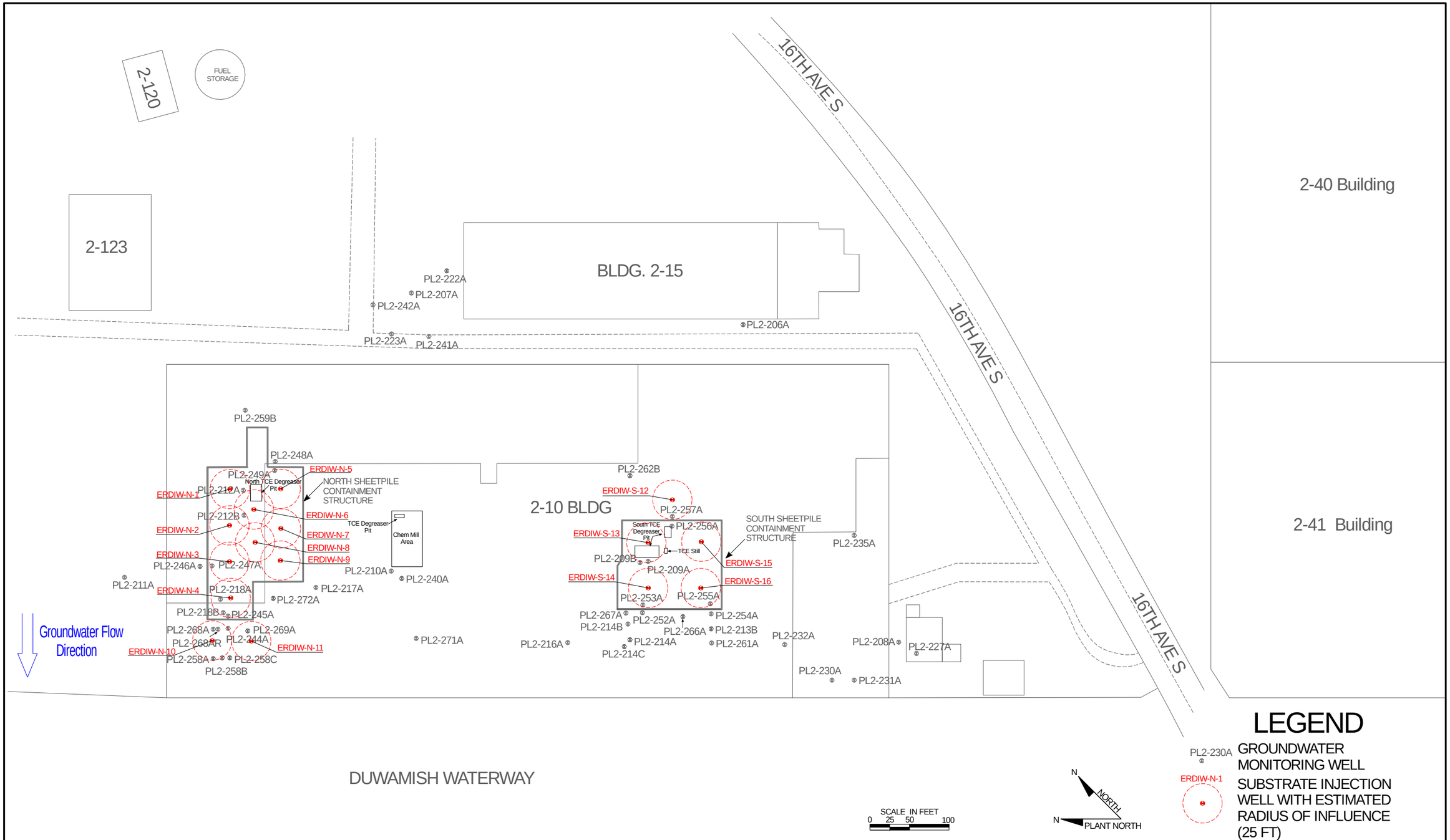
Interim Measure Work Plan
North and South Sheetpiles in the 2-10 Bldg
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 3.2
SVE System Diagram
Interim Measures
Building 2-10



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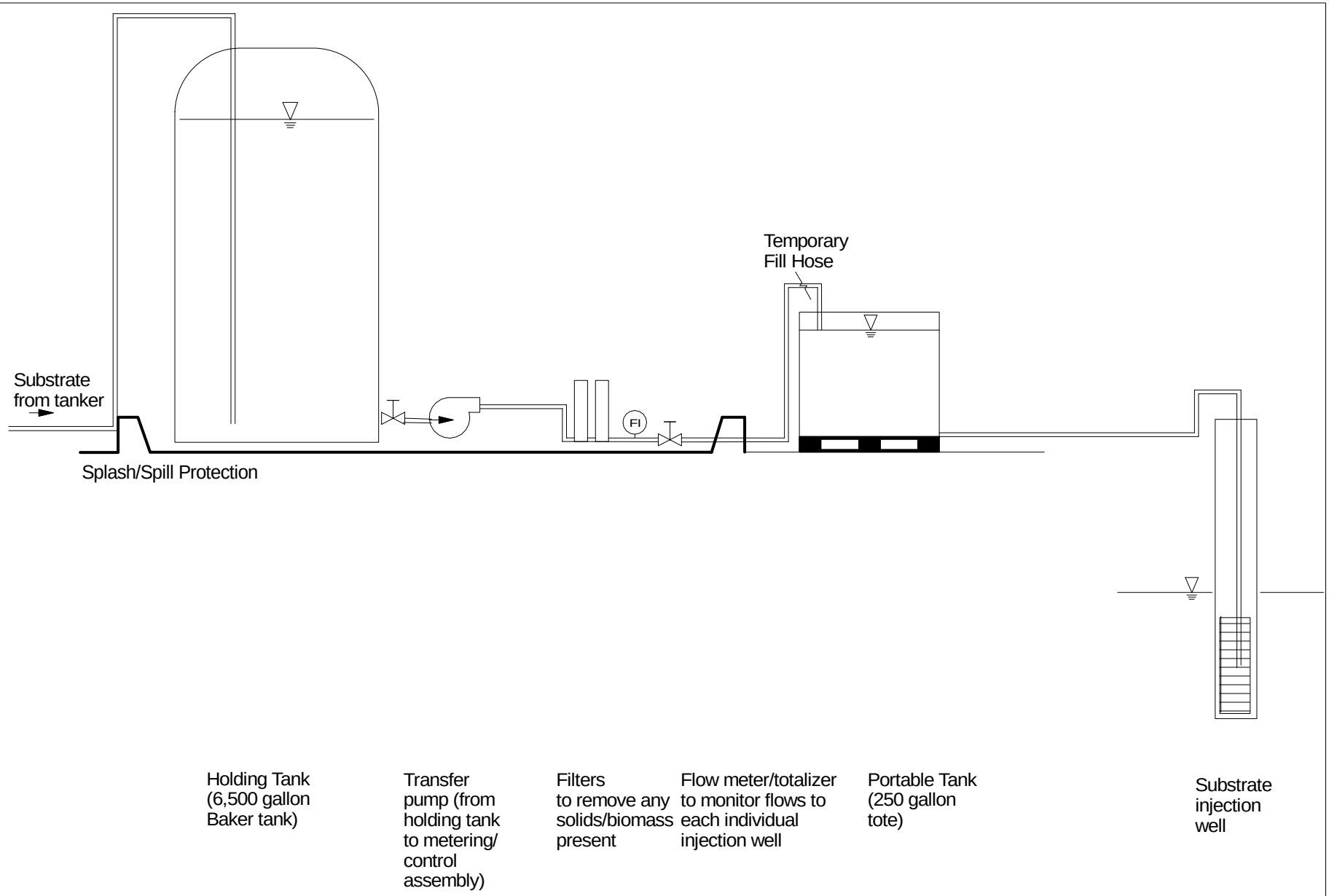
Interim Measure Work Plan
North and South Sheetpiles in the 2-10 Building
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 3.3
Conceptual Design Substrate Injection Wells
North and South Sheetpiles IMs
Building 2-10



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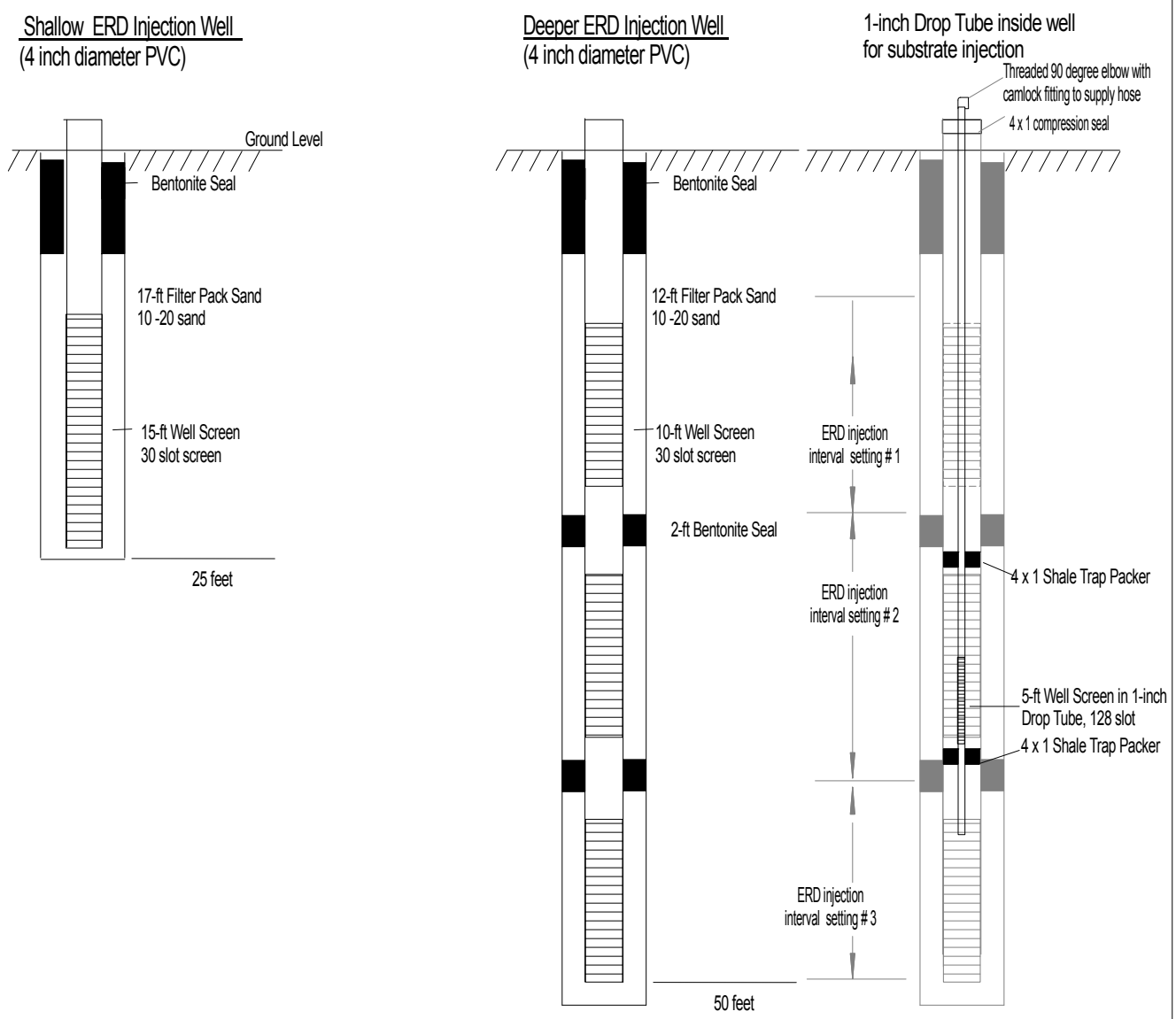
Interim Measure Work Plan
North and South Sheetpiles in the 2-10 Bldg
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 3.4
Generalized ERD Process Flow Diagram
Interim Measures
Building 2-10

ERD Injection Layout.SKF

6/10/2010



The ERD Injection well design is adjustable so that different intervals may be injected combined, separately, or sequentially into one or more specific target intervals. The drop tube (right hand side figure) may be raised or lowered and the packer interval may be adjusted to one or more screen sections of the ERD injection well for varying permeability. As depicted above, ERD drop tube is configured for delivery over interval setting # 2 (~ 25 to 35 ft bgs).

Details are conceptual design, actual details will vary and be adjusted based on lithology and target screen depth

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Interim Measure Work Plan
North and South Sheetpiles in the 2-10 Bldg
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 3.5
ERD Injection Well Design
Interim Measures
Building 2-10

Appendix A Probe Boring Logs

GEOLOGIC BORING LOG

PROJECT: 2-10 IM	JOB NO.: K0275001-001	SHEET 1 Of 1	BORING NO.: PL2-SSL1
PROJECT LOCATION: Boeing Plant 2, 2-10 Bldg	BORING LOCATION: PL2-SSL1		TOTAL DEPTH: 12ft
		BEGUN: 1135	
DRILL CONTRACTOR: Cascade	GEOLOGIST: GWD	FINISHED: 1220	
DRILL RIG: Geoprobe	DRILLER: Lynn Goble	GROUND ELEV.:	
HOLE SIZE: 2”	WEATHER: Inside	GROUND WATER (DEPTH/ELEV.): Approx. 10 ft bgs	
DRILLING METHOD: Direct Push	DRILLING FLUID/SOURCE: N/A	TOP OF ROCK (DEPTH/ELEV.):	
SAMPLER TYPE: Core Barrel		HAMMER WEIGHT:	
SAMPLER LENGTH AND DIAM.: 4ft long 1-5/8” inches wide		HAMMER FALL:	

DEPTH, FT	SAMPLE TYPE//DEPTH/ NUMBER	BLOW COUNT PER 6 IN.	PERCENT RECOVERY	NOTES: (PRODUCT, ODOR, OVA READING, ETC.)	USCS LOG	STRATIGRAPHIC DESCRIPTION
					SP	Coarse sand with brown fleck
5 -	S-091229-PL2-SSL1-05-0		90%			
				6’ – PID 5.26 ppm	SM	Silty-sand mixture
				8’ – PID 31.1 ppm	GP	Rock layer at 7.5’ ~5” thick (3/4” gravel)
					SP	Black coarse sand beginning at 8 ft bgs
10 -	S-091229-PL2-SSL1-10-0		100%	10’ – PID 22.2 ppm		
	S-091229-PL2-SSL1-10-1					
15 -						

SAMPLE TYPES
SS=SPLIT SPOON, ST=SHELBY TUBE
R= ROCK CORE, O=OTHER

GEOLOGIC BORING LOG

PROJECT: 2-10 IM	JOB NO.: K0275001-001	SHEET 1 Of 1	BORING NO.: PL2-SSL2
PROJECT LOCATION: Boeing Plant 2, 2-10 Bldg	BORING LOCATION: PL2-SSL2		TOTAL DEPTH: 12ft
		BEGUN: 0805	
DRILL CONTRACTOR: Cascade	GEOLOGIST: GWD	FINISHED: 0830	
DRILL RIG: Geporobe	DRILLER: Lynn Goble	GROUND ELEV.:	
HOLE SIZE: 2”	WEATHER: Inside	GROUND WATER (DEPTH/ELEV.): Approx. 10 ft bgs	
DRILLING METHOD: Direct Push	DRILLING FLUID/SOURCE: N/A	TOP OF ROCK (DEPTH/ELEV.):	
SAMPLER TYPE: Core Barrel		HAMMER WEIGHT:	
SAMPLER LENGTH AND DIAM.: 4ft long 1-5/8” inches wide		HAMMER FALL:	

DEPTH, FT	SAMPLE TYPE//DEPTH/ NUMBER	BLOW COUNT PER 6 IN.	PERCENT RECOVERY	NOTES: (PRODUCT, ODOR, OVA READING, ETC.)	USCS LOG	STRATIGRAPHIC DESCRIPTION
					SP	Coarse sand with brown fleck
5 -	S-091229-PL2-SSL2-05-0		100%	6’ – PID 3.50 ppm	OL	@ 5ft Black tight organic layer, appears to be a natural ash layer, no large charcoal pieces
					SP	
					OL	@ 6ft – 4 inch thick organic layer
				8’ – PID 0.775 ppm	SP	Dark brown sand with gray/light colored flecks
10 -	S-091229-PL2-SSL2-10-0		100%	10’ – PID 0.047 ppm		
	S-091229-PL2-SSL2-10-1					
15 -						

SAMPLE TYPES
SS=SPLIT SPOON, ST=SHELBY TUBE
R= ROCK CORE, O=OTHER

GEOLOGIC BORING LOG

PROJECT: 2-10 IM	JOB NO.: K0275001-001	SHEET 1 Of 1	BORING NO.: PL2-SSL3
PROJECT LOCATION: Boeing Plant 2, 2-10 Bldg	BORING LOCATION: PL2-SSL3		TOTAL DEPTH: 12ft
		BEGUN: 0840	
DRILL CONTRACTOR: Cascade	GEOLOGIST: GWD	FINISHED: 0855	
DRILL RIG:	DRILLER: Lynn Goble	GROUND ELEV.:	
HOLE SIZE: 2”	WEATHER: Inside	GROUND WATER (DEPTH/ELEV.): Approx. 10 ft bgs	
DRILLING METHOD: Direct Push	DRILLING FLUID/SOURCE: N/A	TOP OF ROCK (DEPTH/ELEV.):	
SAMPLER TYPE: Core Barrel		HAMMER WEIGHT:	
SAMPLER LENGTH AND DIAM.: 4ft long 1-5/8” inches wide		HAMMER FALL:	

DEPTH, FT	SAMPLE TYPE//DEPTH/ NUMBER	BLOW COUNT PER 6 IN.	PERCENT RECOVERY	NOTES: (PRODUCT, ODOR, OVA READING, ETC.)	USCS LOG	STRATIGRAPHIC DESCRIPTION
5 -						
				Very slight burnt wood smell @ 3 inches		3 inch thick – dark black ash/sand layer @ 8 ft.
	S-091229-PL2-SSL3-10-0				SP	
10 -			100%	10’ – PID 0 ppm		Loose sand
15 -						

SAMPLE TYPES
SS=SPLIT SPOON, ST=SHELBY TUBE
R= ROCK CORE, O=OTHER

GEOLOGIC BORING LOG

PROJECT: 2-10 IM	JOB NO.: K0275001-001	SHEET 1 Of 1	BORING NO.: PL2-SSL4
PROJECT LOCATION: Boeing Plant 2, 2-10 Bldg	BORING LOCATION: PL2-SSL4		TOTAL DEPTH: 16ft
		BEGUN: 1515	
DRILL CONTRACTOR: Cascade	GEOLOGIST: GWD	FINISHED: 1615	
DRILL RIG: Geoprobe	DRILLER: Lynn Goble	GROUND ELEV.:	
HOLE SIZE: 2”	WEATHER: Inside	GROUND WATER (DEPTH/ELEV.): Approx. 10 ft bgs	
DRILLING METHOD: Direct Push	DRILLING FLUID/SOURCE: N/A	TOP OF ROCK (DEPTH/ELEV.):	
SAMPLER TYPE: Core Barrel		HAMMER WEIGHT:	
SAMPLER LENGTH AND DIAM.: 4ft long 1-5/8” inches wide		HAMMER FALL:	

DEPTH, FT	SAMPLE TYPE//DEPTH/ NUMBER	BLOW COUNT PER 6 IN.	PERCENT RECOVERY	NOTES: (PRODUCT, ODOR, OVA READING, ETC.)	USCS LOG	STRATIGRAPHIC DESCRIPTION
5 -						
				8’ – PID 0 ppm	SP	8 ft – Light brown sand w/gray flecks
10 -	S-091228-PL2-SSL4-10-0		100%			
					SM	11 ft – silty sand
	S-091228-PL2-SSL4-14-0		100%	12’ – PID 0 ppm	SP	14 ft
15 -						

SAMPLE TYPES
SS=SPLIT SPOON, ST=SHELBY TUBE
R= ROCK CORE, O=OTHER

GEOLOGIC BORING LOG

PROJECT: 2-10 IM	JOB NO.: K0275001-001	SHEET 1 Of 1	BORING NO.: PL2-SSL5
PROJECT LOCATION: Boeing Plant 2, 2-10 Bldg	BORING LOCATION: PL2-SSL5		TOTAL DEPTH: 12ft
		BEGUN: 0840	
DRILL CONTRACTOR: Cascade	GEOLOGIST: GWD	FINISHED: 0945	
DRILL RIG: Geoprobe	DRILLER: Lynn Goble	GROUND ELEV.:	
HOLE SIZE: 2”	WEATHER: Inside	GROUND WATER (DEPTH/ELEV.): Approx. 10 ft bgs	
DRILLING METHOD: Direct Push	DRILLING FLUID/SOURCE: N/A	TOP OF ROCK (DEPTH/ELEV.):	
SAMPLER TYPE: Core Barrel		HAMMER WEIGHT:	
SAMPLER LENGTH AND DIAM.: 4ft long 1-5/8” inches wide		HAMMER FALL:	

DEPTH, FT	SAMPLE TYPE//DEPTH/ NUMBER	BLOW COUNT PER 6 IN.	PERCENT RECOVERY	NOTES: (PRODUCT, ODOR, OVA READING, ETC.)	USCS LOG	STRATIGRAPHIC DESCRIPTION
5-	S-091228-PL2-SSL5-05-0		90%	5’ – PID 0 ppm	SP	Coarse sand to 6 ft bgs Fine sand w/silt from 6-7 ft bgs
10--	S-091228-PL2-SSL5-10-0		90%	10’ – PID 0 ppm	SM SP	8 ft – higher silt content, dense Coarse Sand
15 -						

SAMPLE TYPES
SS=SPLIT SPOON, ST=SHELBY TUBE
R= ROCK CORE, O=OTHER

GEOLOGIC BORING LOG

PROJECT: 2-10 IM	JOB NO.: K0275001-001	SHEET 1 Of 1	BORING NO.: PL2-SSL6
PROJECT LOCATION: Boeing Plant 2, 2-10 Bldg	BORING LOCATION: PL2-SSL6		TOTAL DEPTH: 12ft
		BEGUN: 1020	
DRILL CONTRACTOR: Cascade	GEOLOGIST: GWD	FINISHED: 1040	
DRILL RIG: Geoprobe	DRILLER: Lynn Goble	GROUND ELEV.:	
HOLE SIZE: 2”	WEATHER: Inside	GROUND WATER (DEPTH/ELEV.): Approx. 10 ft bgs	
DRILLING METHOD: Direct Push	DRILLING FLUID/SOURCE: N/A	TOP OF ROCK (DEPTH/ELEV.):	
SAMPLER TYPE: Core Barrel		HAMMER WEIGHT:	
SAMPLER LENGTH AND DIAM.: 4ft long 1-5/8” inches wide		HAMMER FALL:	

DEPTH, FT	SAMPLE TYPE//DEPTH/ NUMBER	BLOW COUNT PER 6 IN.	PERCENT RECOVERY	NOTES: (PRODUCT, ODOR, OVA READING, ETC.)	USCS LOG	STRATIGRAPHIC DESCRIPTION
5 -	S-091228-PL2-SSL6-05-0		100%	5’ – PID 0 ppm	SP	Coarse sand with gray fleck
10 -	S-091228-PL2-SSL6-10-0		100%	10’ – PID 0 ppm	ML SP	Silty sand – light brown colored Coarse Sand
15 -						

SAMPLE TYPES
SS=SPLIT SPOON, ST=SHELBY TUBE
R= ROCK CORE, O=OTHER

GEOLOGIC BORING LOG

PROJECT: 2-10 IM	JOB NO.: K0275001-001	SHEET 1 Of 1	BORING NO.: PL2-SSL7
PROJECT LOCATION: Boeing Plant 2, 2-10 Bldg	BORING LOCATION: PL2-SSL7		TOTAL DEPTH: 12ft
		BEGUN: 1310	
DRILL CONTRACTOR: Cascade	GEOLOGIST: GWD	FINISHED: 1340	
DRILL RIG: Geoprobe	DRILLER: Lynn Goble	GROUND ELEV.:	
HOLE SIZE: 2”	WEATHER: Inside	GROUND WATER (DEPTH/ELEV.): Approx. 10 ft bgs	
DRILLING METHOD: Direct Push	DRILLING FLUID/SOURCE: N/A	TOP OF ROCK (DEPTH/ELEV.):	
SAMPLER TYPE: Core Barrel		HAMMER WEIGHT:	
SAMPLER LENGTH AND DIAM.:4ft long 1-5/8” inches wide		HAMMER FALL:	

DEPTH, FT	SAMPLE TYPE//DEPTH/ NUMBER	BLOW COUNT PER 6 IN.	PERCENT RECOVERY	NOTES: (PRODUCT, ODOR, OVA READING, ETC.)	USCS LOG	STRATIGRAPHIC DESCRIPTION
					SM	4 ft - Light brown SM
5 -	S-091228-PL2-SSL7-05-0		100%	5’ – PID 0 ppm	SP	Gray coarse sand
10 -	S-091228-PL2-SSL7-10-0		100%	10’ – PID 0 ppm	SM	9 ft - Light brown silty layer
15 -						

SAMPLE TYPES
SS=SPLIT SPOON, ST=SHELBY TUBE
R= ROCK CORE, O=OTHER

Appendix B Field Sample Data Forms

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: Standard
ARI Client Company: Boeing	Phone:
Client Contact: Will Ernst	
Client Project Name: 2-10 Sheet Pile	
Client Project #: K0275001	Samplers: G Dawson J Neste

Page: 1	of 2
Date: 2/8/10 - 2/9/10	Ice Present? yes
No. of Coolers: 1	Cooler Temps: 5.4

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

Sample ID	Date	Time	Matrix	No. Containers	VOC 8260C	TOC 415.1	Dissolved Metals 200.8/6010B	MEE RSK-175	Total Metals (Cations)	Anions 300.0	Alkalinity 310.1		Notes/Comments
GW-100208-PL2-254A-0	2/8/10	1126	GW	3 voa	X								
GW-100208-PL2-255A-0	2/8/10	1243	GW	3 voa	X								
GW-100208-PL2-256A-0	2/8/10	1327	GW	3 voa	X								
GW-100208-PL2-257A-0	2/8/10	1432	GW	3 voa	X								
GW-100209-PL2-209B-0	2/9/10	0937	GW	5	X	X	X						
GW-100209-PL2-209A-0	2/9/10	1004	GW	11	X	X	X	X	X	X	X		
GW-100209-PL2-209A-1	2/9/10	1004	GW	3	X								
GW-100209-PL2-212A-0	2/9/10	1126	GW	10	X	X	X	X	X	X			
GW-100209-PL2-212A-1	2/9/10	1130	GW	3	X								
GW-100209-PL2-218A-15-0	2/9/10	1325	GW	3	X								

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
cc Tom McKeon Diss metals: Arsenic + manganese Cations: calcium, magnesium, potassium + sodium anions: chloride, sulfate Alkalinity: bicarbonate, carbonate, hydroxide-ion	(Signature) [signature]	(Signature) [signature]	(Signature)	(Signature)
	Printed Name: Justin Neste	Printed Name: J Peterson	Printed Name:	Printed Name:
	Company: CALIBRE	Company: ARI	Company:	Company:
	Date & Time: 2/9/10 1856	Date & Time: 2/9/10 1856	Date & Time:	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: 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.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: Standard	Page: 2	of 2
ARI Client Company: Boeing	Phone:	Date: 2/9/10	Ice Present? Y/N
Client Contact: Will Ernst		No. of Coolers: 1	Cooler Temps: 5.4
Client Project Name: 2-10 Sheet pile			
Client Project #: K0275001	Samplers: G Dawson J Neste		

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

Sample ID	Date	Time	Matrix	No. Containers	VOC 8260C	TOC 415.1	Dissolved Metals 200.8/6010B	MEE RSK-175	Total Metals (Cations)	Anions 300.0			Notes/Comments
GW-100209-PLZ-2184-28-0	2/9/10	1330	GW	3	X								
GW-100209-PLZ-2184-0	2/9/10	1357	GW	7		X	X	X	X	X			
GW-100209-PLZ-2188-45-0	2/9/10	1438	GW	3	X								
GW-100209-PLZ-2188-58-0	2/9/10	1443	GW	3	X								
GW-100209-PLZ-2188-0	2/9/10	1505	GW	5		X	X	X					
GW-100209-PLZ-2678-0	2/9/10	1604	GW	3	X								

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
A Tom McKeon Dissolved Arsenic no signature Examine Chain of Custody for Pressure + Seal Anions, Metals, + Sulfide All in cooler	(Signature) Justin Neste	(Signature) Peterson	(Signature)	(Signature)
	Printed Name: Justin Neste	Printed Name: Peterson	Printed Name:	Printed Name:
	Company: CALIBRE	Company: ARI	Company:	Company:
	Date & Time: 2/9/10 1656	Date & Time: 2/9/10 1656	Date & Time:	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: 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.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: Standard
ARI Client Company: Boeing	Phone:
Client Contact: Will Blair	
Client Project Name: 10 Street Site	
Client Project #: KD275001	Samplers: G Dawson J Neste

Page: 1	of 2
Date: 2/10/10	Ice Present? Y
No. of Coolers: 1	Cooler Temps: 2.3

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

Sample ID	Date	Time	Matrix	No. Containers	VOC 8260C	TOC	Dissolved metals	Dissolved Cations	Total metals	Anions	Alkalinity		Notes/Comments
GW-100210-PL2-249A-0	2/10/10	0925	GW	3	X								
GW-100210-PL2-247A-0	2/10/10	1012	GW	3	X								
GW-100210-PL2-247A-1	2/10/10	~~1011~~ 1016	GW	3	X								
GW-100210-PL2-268AR-0	2/10/10	1049	GW	3	X								
GW-100210-PL2-269A-0	2/10/10	1210	GW	3	X								
GW-100210-PL2-245A-0	2/10/10	1246	GW	3	X								
GW-100210-PL2-244A-0	2/10/10	1317	GW	5	X	X	X						
GW-100210-PL2-253A-0	2/10/10	1404	GW	11	X	X	X	X	X	X	X		
GW-100210-PL2-252A-0	2/10/10	1434	GW	5	X	X	X						
GW-100210-PL2-266A-0	2/10/10	1508	GW	3	X								

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
cc Tom Mckenna	(Signature) [signature]	(Signature) [signature]	(Signature)	(Signature)
	Printed Name: Justin Neste	Printed Name: A. Volgardson	Printed Name:	Printed Name:
	Company: CALIBRE	Company: ARI	Company:	Company:
	Date & Time: 2/10/10 1654	Date & Time: 2/10/10 1654	Date & Time:	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.*

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Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: Standard	Page: 2	of 2
ARI Client Company: Burns	Phone:	Date: 2/10/10	Ice Present? Y
Client Contact: Will Ernst		No. of Coolers: 1	Cooler Temps: 2.3
Client Project Name: 2-10 Sheetpile			
Client Project #: K0275001	Samplers: G Dawson J Nesie		

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

Sample ID	Date	Time	Matrix	No. Containers	VOC								Notes/Comments
GW-100210-PL2-766A-4	2/10/10	1508	GW	3	X								MS/MSD
GW-100210-PL2-759B-0	2/10/10	1556	GW	3	X								

Comments/Special Instructions	Relinquished by: (Signature)	Received by: (Signature)	Relinquished by: (Signature)	Received by: (Signature)
cc Tom Mickson	Printed Name: Justin Nesie	Printed Name: A. Valgardson	Printed Name:	Printed Name:
	Company: CALIBRE	Company: ARI	Company:	Company:
	Date & Time: 2/10/10 1654	Date & Time: 2/10/10 1654	Date & Time:	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: 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.

REPORT TO:

Reports will be provided to the contact(s) listed below. Parties other than the contact(s) listed below will require prior approval.

Name:
Company:
Address:

email:
Phone: ( )
Fax: ( )

Project Manager:
Project Name:
Project No.:

INVOICE TO:

For Invoices paid by a third party it is imperative that contact information & corresponding reference No. be provided.

Name:
Company:
Address:

email:
Phone: ( )
Fax: ( )

Purchase Order No.
Subcontract No.

microbialinsights

2340 Stock Creek Blvd.
Rockford, TN 37853-3044
phone (865) 573-8188
fax: (865) 573-8133
email: info@microbe.com
www.microbe.com

Please Check One:

☐ More samples to follow
☐ No Additional Samples

Saturday Delivery

Please see sampling protocol for instructions

Report Type: ☐ Standard (default) ☐ Comprehensive (15% surcharge) ☐ Historical (30% surcharge)

Please contact us prior to submitting samples regarding questions about the analyses you are requesting at (865) 573-8188 (8:00 am to 4:00 pm M-F). After these hours please call (865) 300-8053.

Sample Information											CENSUS: Please select the target organism/gene																										
MI ID (Laboratory Use Only)	Sample Name	Date Sampled	Time Sampled	Matrix	PLFA	VFA	M/E/E	DGGE+3ID	DGGE+5ID		qDHC (Dehalococcoides)	DHC Functional genes	qDHB (Dehalobacter)	qDSM (Desulfuromonas)	qDSB (Desulfitobacterium)	qEBAC (Total)	qDSR (SRBs only)	qSRB/IRB	qMGN (methanogens)	qMOB (methanotrophs)	qDNF (Dentrifying)	qAOB (ammonia oxidizing)	qPM1 (MTBE aerobic)	qTOD (Intial PAHs aerobic)	qCAT (Intermediate PAHs aerobic)	qBSS (Toluen/Xylene Anaerobic)	qNAH (Napthalene aerobic)	add. qPCR:	add. qPCR:	add. qPCR:	RNA (Expression Option)*	Other:	Other:	Other:	Other:

Relinquished by: Date: Received by: Date

In order for analysis to be completed correctly, it is vital that chain of custody is filled out correctly & that all relative information is provided. Failure to provide sufficient and/or correct information regarding reporting, invoicing & analyses requested information may result in delays for which MI will not be liable. *** additional cost and sample preservation are associated with RNA samples.**

Well Sampling Data Sheet

Date	2/8/10	Site Location	2-10 Sheetpile South
Samplers	GD JN	Well ID	PL2-262B
Casing Material	PVC	Constructed Depth	50'
Casing Diameter	2"	Condition of Well	

Field Measurements: 2/8/10

Time	1451	Depth Measured From:	
Depth to Water	10.34		Top of access port
	2/9/10	x	Mark on PVC casing
	1533		Mark of protective casing
	10.41		Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	1457	Purge End Time	1607			
Approximate Gallons Purged	2.0					

Water Monitoring Conditions: 2/8 2/9 1548 2/9 2/9

Time	1458	~~1502~~	1552	1556	1600		
pH	6.65	6.97	6.63	6.65	6.65		
Conductivity	96	0.25	0.38	0.39	0.39		
Turbidity	990	990	990	990	990		
D.O.	9.6	9.7	4.9	3.3	2.4		
Temperature	18.1	16.0	16.7	17.0	17.3		
orp	-97	-123	-149	-160	-165		
Gallons Purged							

Sampling Data:

Time	1604	Sample ID	~~CTW-GW-100205-PL2-262B-E~~
pH	6.65	Duplicates	CTW-100209-PL2-262B-O
Conductivity	0.38	QA/QC Volumes	
Turbidity	990		
D.O.	2.1		
Temperature	17.4		
orp	-167		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	X	Ions, NO3, NH4, K	
Total Metals		Other	
Dissolved Metals			

2/8 **Sampling Notes:**

1553 After first reading, battery went dead, charged it. Nothing happened so took my car battery out to use & nothing happened. Middle pump is working but base pump is not. Will come back to finish tomorrow.

2/9 No swell, clear water in samplers. Purge back it water is brownish & cloudy.

Well Sampling Data Sheet

Date	2/8/10	Site Location	2-10 Sheetpile
Samplers	GD JN	Well ID	PL2-257A
Casing Material	metal	Constructed Depth	17.5
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	1410	Depth Measured From:	
Depth to Water	10.15		Top of access port
		X	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	1416	Purge End Time	1436			
Approximate Gallons Purged	2.0					

Water Monitoring Conditions:

Time	1416	1420	1424	1428			
pH	5.57	5.94	6.07	6.10			
Conductivity	98	97	94	96			
Turbidity	990	990	990	990			
D.O.	9.0	6.5	4.3	3.6			
Temperature	18.7	18.9	19.5	19.4			
orp	133	116	105	100			
Gallons Purged							

Sampling Data:

Time	1432	Sample ID	GW-100208-PL2-257A-0
pH	6.15	Duplicates	
Conductivity	99	QA/QC Volumes	
Turbidity	990		
D.O.	2.7		
Temperature	19.4		
orp	94		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	X	Ions, NO3, NH4, K	
Total Metals		Other	
Dissolved Metals			

Sampling Notes:

clear water w/ small amount of black particulate at bottom of purge water bucket. Sandy ~~at~~ looking)

Well Sampling Data Sheet

Date	2/8/10	Site Location	2-10 SHEEPPIN
Samplers	GD JN	Well ID	PL2-256A
Casing Material	metal	Constructed Depth	17.5
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	1306	Depth Measured From:	
Depth to Water	9.85		Top of access port
		x	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	1310	Purge End Time	1353			
Approximate Gallons Purged		2.0				

Water Monitoring Conditions:

Time	1311	1315	1319	1323			
pH	6.38	5.98	5.91	5.99			
Conductivity	28	27	27	27			
Turbidity	990	990	990	990			
D.O.	9.4	5.0	3.6	2.8			
Temperature	18.4	18.9	19.0	19.3			
orp	-68	-65	-65	-65			
Gallons Purged							

Sampling Data:

Time	1327	Sample ID	GW-100205-PL2-256A-D
pH	6.00	Duplicates	
Conductivity	27	QA/QC Volumes	
Turbidity	990		
D.O.	2.4		
Temperature	19.5		
orp	-70		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	X	Ions, NO3, NH4, K	
Total Metals		Other	
Dissolved Metals			

Sampling Notes:

Black sediment at bottom of purge bucket (small amount). No smell.
Started on notebook screen - low battery indicator, so we went to fax and to extra QL battery

Well Sampling Data Sheet

Date	2/9/10	Site Location	2-10 Sheet Pile South
Samplers	GD JN	Well ID	PL2-255A
Casing Material	metal	Constructed Depth	17.5
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	1223	Depth Measured From:	
Depth to Water	9.86		Top of access port
		x	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	1227	Purge End Time	1245			
Approximate Gallons Purged		3.5				

Water Monitoring Conditions:

Time	1227	1231	1235	1239			
pH	6.56	6.13	6.16	6.05			
Conductivity	35	38	37	37			
Turbidity	990	990	990	990			
D.O.	8.8	5.0	3.7	2.9			
Temperature	19.3	19.4	19.6	19.9			
orp	99	100	98	98			
Gallons Purged							

Sampling Data:

Time	1243	Sample ID	GW 100208-PL2-255A-0
pH	6.10	Duplicates	
Conductivity	36	QA/QC Volumes	
Turbidity	990		
D.O.	2.5		
Temperature	20.3		
orp	95		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	X	Ions, NO3, NH4, K	
Total Metals		Other	
Dissolved Metals			

Sampling Notes:

clear liquid, no smell

Well Sampling Data Sheet

Date	2/8/10	Site Location	Boeing 2-10 South SP
Samplers	GD JN	Well ID	PL2-254A
Casing Material	Metal	Constructed Depth	17.5'
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	1048	Depth Measured From:	
Depth to Water	7.79		Top of access port
		X	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	1101	Purge End Time	1129			
Approximate Gallons Purged	2.0					

Water Monitoring Conditions:

Time	1101	1105	1109	1113	1115	1122	
pH	4.89	5.34	5.48	5.59	5.66	5.69	
Conductivity	40	38	37	37	37	36	
Turbidity	990	990	990	990	990	990	
D.O.	8.2	5.1	3.2	2.2	1.7	1.6	
Temperature	18.0	18.4	18.6	19.1	19.7	20.0	
orp	186	40	-6	-29	-43	-50	
Gallons Purged							

Sampling Data:

Time	1128	Sample ID	~~PL2-254A-020810~~ GW-100208-PL2-254A-D
pH	5.73	Duplicates	
Conductivity	36	QA/QC Volumes	
Turbidity	990		
D.O.	1.5		
Temperature	20.2		
orp	-56		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	X	Ions, NO3, NH4, K	
Total Metals		Other	
Dissolved Metals			

Sampling Notes:

Screen 12.5-17.5 Water, clear liquid.

Well Sampling Data Sheet

Date	2/9/10	Site Location	2-10 Sheetpile
Samplers	GD JN	Well ID	PL2-209B
Casing Material	PVC	Constructed Depth	55'
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	0910	Depth Measured From:	
Depth to Water	10.56		Top of access port
		X	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	0918	Purge End Time	0940			
Approximate Gallons Purged	3.0					

Water Monitoring Conditions:

Time	0920	0925	0929	0933			
pH	6.50	6.95	6.98	7.00			
Conductivity	1.8	1.8	1.8	1.8			
Turbidity	990	990	990	990			
D.O.	7.4	3.0	2.5	2.1			
Temperature	16.5	17.0	17.1	17.1			
orp	-139	-188	-191	-194			
Gallons Purged							

Sampling Data:

Time	0937	Sample ID	GW-100209-PL2-209B-0
pH	7.02	Duplicates	
Conductivity	1.8	QA/QC Volumes	-
Turbidity	990		
D.O.	1.7		
Temperature	17.2		
orp	-195		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	X	Ions, NO3, NH4, K	
Total Metals		Other TOC, ~~Dissolved Gases~~,	X
Dissolved Metals	X		

Sampling Notes:

Installed new base whale pump before sampling today.
when calibrating horiba - error 5 mg (Turbidity probe malfunction)
No small, clear liquid

Well Sampling Data Sheet

Date	2/9/10	Site Location	2-10 Shell Pipe - S
Samplers	GD JM	Well ID	PL2-209A
Casing Material	PVC	Constructed Depth	18'
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	0945	Depth Measured From:	
Depth to Water	10.58		Top of access port
		X	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	0945	Purge End Time	1045			
Approximate Gallons Purged		4.5				

Water Monitoring Conditions:

Time	0948	0952	0956	1000			
pH	7.93	6.44	6.29	6.23			
Conductivity	0.09	56	55	53			
Turbidity	990	990	990	990			
D.O.	1.8	1.6	1.3	1.1			
Temperature	18.1	18.2	18.4	18.8			
orp	-131	-155	-149	-148			
Gallons Purged							

Sampling Data:

Time	1004	Sample ID	GW-100220-PL2-209A-0
pH	[illegible]	Duplicates	GW-100220-PL2-209A-1
Conductivity	[illegible]	QA/QC Volumes	–
Turbidity	990		
D.O.	1.0		
Temperature	19.3		
orp	-147		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	X	Ions, NO3, NH4, K	X
Total Metals	X	Other TOC	X
Dissolved Metals	X	Dissolved Gases, Anions, Cations, Alkalinity, DHE	

Sampling Notes:

No color or smell. Deep taken. 750 mL taken through 1 (0.45) DHE filter

Well Sampling Data Sheet

Date	2/9/10	Site Location	2-10 N sheetpile
Samplers	GD JN	Well ID	PL2-212A
Casing Material	PVC	Constructed Depth	16'
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	1059	Depth Measured From:	
Depth to Water	10.52		Top of access port
		x	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	1109	Purge End Time	1130			
Approximate Gallons Purged	3.0					

Water Monitoring Conditions:

Time	1109	1113	1118	1122			
pH	6.64	6.41	6.40	6.40			
Conductivity	0.13	0.13	0.13	0.13			
Turbidity	990	990	990	990			
D.O.	8.1	5.0	3.0	2.3			
Temperature	19.5	19.7	20.4	20.8			
orp	-48	-77	-91	-95			
Gallons Purged							

Sampling Data:

Time	1126	Sample ID	GW-100209-PL2-212A-0 - 1126
pH	6.38	Duplicates	GW-100209-PL2-212A-1 - 1130
Conductivity	0.13	QA/QC Volumes	
Turbidity	990	~~MS/MSD~~	~~GW-100209-PL2-212A-4~~
D.O.	1.6		
Temperature	21.3		
orp	-97		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	x	Ions, NO3, NH4, K	x
Total Metals	x	Other	x
Dissolved Metals	x		

TOC, DHE
Dissolved Gases.

Sampling Notes:

Dup + ~~MS/MSD~~ 1 Slightly dirty water brown/black particulate in water. 500 mL taken through 2 DHE filters (250 mL each)

Well Sampling Data Sheet

Date	2/9/10	Site Location	2-10 Sheetpile N
Samplers	GO JN	Well ID	PL2-218A
Casing Material	PVC	Constructed Depth	30'
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	1333	Depth Measured From:	
Depth to Water	9.82		Top of access port
		X	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	1337	Purge End Time	1415			
Approximate Gallons Purged	3.0					

Water Monitoring Conditions:

Time	1340	1345	1349	1353			
pH	7.27	6.18	6.18	6.21			
Conductivity	67	66	66	65			
Turbidity	990	990	990	990			
D.O.	9.4	4.9	3.5	2.6			
Temperature	17.7	18.6	18.7	19.0			
orp	-87	-120	-126	-130			
Gallons Purged							

Sampling Data:

Time	1357	Sample ID	GW-100209-PL2-218A-0
pH	6.21	Duplicates	
Conductivity	65	QA/QC Volumes	
Turbidity	990		
D.O.	2.3		
Temperature	19.2		
orp	-131		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics *	X	Ions, NO3, NH4, K	X
Total Metals	X	Other	X
Dissolved Metals	X		

TOC, Dissolved gases
DHE

Sampling Notes:

PDB { GW-100209-PL2-218A-15-0 - 1325
GW-100209-PL2-218A-25-0 1330
* VOCs by PDB

No smell, cloudy brown liquid

Well Sampling Data Sheet

Date	2/9/10	Site Location	2-10 Sheetpile
Samplers	GD JN	Well ID	PL2-218B
Casing Material	PVC	Constructed Depth	60'
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	1432	Depth Measured From:	
Depth to Water	10.05		Top of access port
		x	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	1446	Purge End Time	1520			
Approximate Gallons Purged		3.0				

Water Monitoring Conditions:

Time	1448	1452	1457	1501			
pH	6.47	6.69	6.73	6.73			
Conductivity	1.4	1.9	2.1	2.2			
Turbidity	990	990	990	990			
D.O.	9.2	5.0	3.0	2.4			
Temperature	15.9	16.4	16.9	17.1			
orp	-91	-173	-183	-191			
Gallons Purged							

Sampling Data:

Time	1505	Sample ID	GW-100209-PL2-218B-0
pH	6.74	Duplicates	
Conductivity	2.2	QA/QC Volumes	
Turbidity	990		
D.O.	2.1		
Temperature	17.2		
orp	-193		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics *	x	Ions, NO3, NH4, K	
Total Metals	~~x~~	Other	x
Dissolved Metals	x		

TOC, DHE
Dissolved gases.

Sampling Notes:

PDB
GW-100209-PL2-218B-45-0 - 1438
GW-100209-PL2-218B-58-0 - 1443
* uses by PDB

No smell, color is brownish w/ fine particulate in purge bucket. looks clear in sampling jars.

Well Sampling Data Sheet

Date	2/10/10	Site Location	2-10 Sherpike
Samplers	CTD JN	Well ID	PLL-259B
Casing Material	PVC	Constructed Depth	50'
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	1536	Depth Measured From:	
Depth to Water	10.21		Top of access port
		X	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	1540	Purge End Time	1559			
Approximate Gallons Purged		2.0				

Water Monitoring Conditions:

Time	1540	1544	1548	1552			
pH	6.37	6.18	6.31	6.34			
Conductivity	.77	.93	0.10	0.11			
Turbidity	990	990	990	990			
D.O.	7.1	5.0	2.8	2.6			
Temperature	17.2	16.6	16.3	16.3			
orp	-27	-61	-104	-117			
Gallons Purged							

Sampling Data:

Time	1556	Sample ID	CTD-100210-PLL-259B-0
pH	6.37	Duplicates	
Conductivity	0.11	QA/QC Volumes	–
Turbidity	990		
D.O.	1.5		
Temperature	16.3		
orp	-124		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	X	Ions, NO3, NH4, K	
Total Metals		Other	
Dissolved Metals			

Sampling Notes:

No odor, small in purge water.

Well Sampling Data Sheet

Date	2/10/10	Site Location	2-10 Sheet Pile S
Samplers	GD TN	Well ID	PL2 266H
Casing Material	PVC	Constructed Depth	30'
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	1445	Depth Measured From:	
Depth to Water	9.50		Top of access port
		X	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	1451	Purge End Time	1514			
Approximate Gallons Purged	2.0					

Water Monitoring Conditions:

Time	1451	1455	1500	1504			
pH	6.50	6.11	6.13	6.15			
Conductivity	33	37	38	37			
Turbidity	990	990	990	990			
D.O.	6.1	3.7	2.2	1.6			
Temperature	18.1	18.7	19.1	19.3			
orp	-51	-66	-95	-106			
Gallons Purged							

Sampling Data:

Time	1508	Sample ID	GW-100210-PL2-266H-0
pH	6.20	Duplicates	GW-100210-PL2-266H-4
Conductivity	37	QA/QC Volumes	
Turbidity	990		
D.O.	1.3		
Temperature	19.5		
orp	-114		

Note on COC its MS/MSD

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	X	Ions, NO3, NH4, K	
Total Metals		Other	
Dissolved Metals			

Sampling Notes:

No smell ; clear groundwater.

Well Sampling Data Sheet

Date	2/10/10	Site Location	270 Sheepmix S
Samplers	[illegible] JN	Well ID	[illegible]-252A
Casing Material	Metal	Constructed Depth	17.57
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	1410	Depth Measured From:	
Depth to Water	10.53		Top of access port
		X	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	1415	Purge End Time	1438			
Approximate Gallons Purged	2.0					

Water Monitoring Conditions:

Time	1418	1422	1426	1430			
pH	6.48	6.27	6.27	6.26			
Conductivity	88	88	88	87			
Turbidity	990	990	990	990			
D.O.	4.8	3.2	2.0	1.4			
Temperature	18.6	19.0	19.4	19.9			
orp	-79	-92	-99	-104			
Gallons Purged							

Sampling Data:

Time	1434	Sample ID	GW-100210-PL2-2524-0
pH	6.27	Duplicates	
Conductivity	88	QA/QC Volumes	
Turbidity	990		
D.O.	1.2		
Temperature	20.1		
orp	-106		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	X	Ions, NO3, NH4, K	
Total Metals		Other TOC	X
Dissolved Metals	X		

Sampling Notes:

No color; No smell

Well Sampling Data Sheet

Date	2/10/10	Site Location	12-10 Sheet pile S
Samplers	GD JN	Well ID	PLL 15 SA
Casing Material	metal	Constructed Depth	17.5'
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	1345	Depth Measured From:	
Depth to Water	10.67		Top of access port
		x	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	1348	Purge End Time	1412			
Approximate Gallons Purged		3.0				

Water Monitoring Conditions:

Time	1348	1352	1356	1400			
pH	7.23	6.31	6.32	6.31			
Conductivity	66	68	68	65			
Turbidity	990	990	990	990			
D.O.	6.7	3.6	2.5	2.1			
Temperature	18.6	19.4	19.7	19.9			
orp	-68	-50	-88	-98			
Gallons Purged							

Sampling Data:

Time	1404	Sample ID	GW-100210-PLL2-15SA C
pH	6.34	Duplicates	
Conductivity	68	QA/QC Volumes	–
Turbidity	990		
D.O.	1.6		
Temperature	20.1		
orp	-106		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	x	Ions, NO3, NH4, K	x
Total Metals	x	Other	x
Dissolved Metals	x		

TOC, Dissolved Gases
Alkalinity.

Sampling Notes:

No odor, No sheen

Well Sampling Data Sheet

Date	2/10/10	Site Location	2-10 Sheetpile N
Samplers	JN. GD	Well ID	PL2-244A
Casing Material	Metal	Constructed Depth	
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	1255	Depth Measured From:	
Depth to Water	9.66		Top of access port
		X	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	1300	Purge End Time	1323			
Approximate Gallons Purged	2.5					

Water Monitoring Conditions:

Time	1310	1304	1309	1313			
pH	7.04	6.30	6.32	6.36			
Conductivity	77	79	78	78			
Turbidity	990	990	990	990			
D.O.	6.0	3.7	2.2	1.8			
Temperature	18.6	19.0	20.4	19.9			
orp	-75	-119	-134	-142			
Gallons Purged							

Sampling Data:

Time	1317	Sample ID	GW-100210-PL2-244A-0
pH	6.38	Duplicates	
Conductivity	79	QA/QC Volumes	
Turbidity	990		
D.O.	1.4		
Temperature	20.0		
orp	-151		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	X	Ions, NO3, NH4, K	
Total Metals		Other TOC	X
Dissolved Metals	X		

Sampling Notes:

No color or small in purge water.

Well Sampling Data Sheet

Date	2/10/11	Site Location	210 Sweetpine N
Samplers	GD JN	Well ID	PL2-245A
Casing Material	metal	Constructed Depth	26'
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	1221	Depth Measured From:	
Depth to Water	9.98		Top of access port
		X	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	1230	Purge End Time	1241			
Approximate Gallons Purged		2.6 gal				

Water Monitoring Conditions:

Time	1230	1234	1238	1242			
pH	6.55	6.26	6.25	6.27			
Conductivity	64	62	60	59			
Turbidity	990	990	990	990			
D.O.	6.2	4.1	2.4	1.8			
Temperature	19.1	19.5	20.0	20.3			
orp	-54	-96	-113	-122			
Gallons Purged							

Sampling Data:

Time	1246	Sample ID	GW-100210-PL2-245A-0
pH	6.23	Duplicates	
Conductivity	59	QA/QC Volumes	–
Turbidity	990		
D.O.	1.4		
Temperature	20.4		
orp	-129		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	X	Ions, NO3, NH4, K	
Total Metals		Other	
Dissolved Metals			

Sampling Notes:

No color or smell.

Well Sampling Data Sheet

Date	2/10/10	Site Location	2-10 Sharpie N
Samplers	GD JN	Well ID	PL2-269A
Casing Material	PVC	Constructed Depth	36'
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	1151	Depth Measured From:	
Depth to Water	16.13		Top of access port
		X	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	1154	Purge End Time	1214			
Approximate Gallons Purged	3.0					

Water Monitoring Conditions:

Time	1154	1158	1202	1206			
pH	6.91	6.15	6.15	6.16			
Conductivity	86	91	90	89			
Turbidity	990	990	990	990			
D.O.	1.6	4.9	3.4	2.6			
Temperature	17.1	17.6	18.1	18.5			
orp	-1	-69	-89	-106			
Gallons Purged							

Sampling Data:

Time	1210	Sample ID	GW-100210-PL2-269A-0
pH	6.17	Duplicates	
Conductivity	89	QA/QC Volumes	–
Turbidity	990		
D.O.	2.0		
Temperature	18.9		
orp	-105		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	X	Ions, NO3, NH4, K	
Total Metals		Other	
Dissolved Metals			

Sampling Notes:

No color or smell from purge water.

Well Sampling Data Sheet

Date	2/10/10	Site Location	2-10 Sheet pile N
Samplers	GD JN	Well ID	PL2-26SAR
Casing Material	PVC	Constructed Depth	34.5'
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	1028	Depth Measured From:	
Depth to Water	10.44		Top of access port
		x	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	1033	Purge End Time	1054			
Approximate Gallons Purged		2.5				

Water Monitoring Conditions:

Time	1033	1037	1041	1045			
pH	6.16	6.17	6.17	6.18			
Conductivity	89	94	92	92			
Turbidity	990	990	990	990			
D.O.	4.9	3.4	2.1	1.5			
Temperature	17.5	17.5	17.9	18.3			
orp	-52	-86	-99	-105			
Gallons Purged							

Sampling Data:

Time	1049	Sample ID	GW-100210 PL2-26SAR-C
pH	6.18	Duplicates	
Conductivity	92	QA/QC Volumes	–
Turbidity	990		
D.O.	1.3		
Temperature	18.4		
orp	-111		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	x	Ions, NO3, NH4, K	
Total Metals		Other	
Dissolved Metals			

Sampling Notes:

No smell or color

Well Sampling Data Sheet

Date	2/10/10	Site Location	2-10 Superfund
Samplers	GD JN	Well ID	PLL-247A
Casing Material	~~2"~~ metal	Constructed Depth	20'
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	0953	Depth Measured From:	
Depth to Water	10.59		Top of access port
		X	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	0956	Purge End Time	1019			
Approximate Gallons Purged		2.0				

Water Monitoring Conditions:

Time	0956	1000	1004	1008			
pH	6.50	6.14	6.24	6.27			
Conductivity	67	67	66	66			
Turbidity	990	990	990	990			
D.O.	7.0	4.8	2.4	2.3			
Temperature	18.9	19.2	19.7	20.0			
orp	-24	-93	-122	-136			
Gallons Purged							

Sampling Data:

Time	1012	Sample ID	GW-100210-PLL-247A-0	- 1012
pH	6.29	Duplicates	GW-100210-PLL-247A-1	- 1016
Conductivity	66	QA/QC Volumes	-	
Turbidity	990			
D.O.	1.8			
Temperature	20.2			
orp	-136			

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	X	Ions, NO3, NH4, K	
Total Metals		Other	
Dissolved Metals			

Sampling Notes:

No color, black Bailey [illegible] at bottom of bucket

Well Sampling Data Sheet

Date	2/10/10	Site Location	2-10 Smart Pile N
Samplers	JN GD	Well ID	PL2-249A
Casing Material		Constructed Depth	20'
Casing Diameter	2"	Condition of Well	

Field Measurements:

Time	0859	Depth Measured From:	
Depth to Water	10.44		Top of access port
		X	Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time	0905	Purge End Time	0925			
Approximate Gallons Purged		2.5				

Water Monitoring Conditions:

Time	0905	0909	0913	0917	0921		
pH	5.11	5.59	5.50	5.41	6.00		
Conductivity	42	42	42	42	42		
Turbidity	990	990	990	990	990		
D.O.	1.2	1.3	2.4	2.3	1.8		
Temperature	18.2	18.6	18.8	18.9	19.0		
orp	147	-49	-43	-116	-123		
Gallons Purged							

Sampling Data:

Time	0925	Sample ID	GW-100210-PL2-249A-0
pH	6.05	Duplicates	
Conductivity	42	QA/QC Volumes	–
Turbidity	990		
D.O.	1.6		
Temperature	19.6		
orp	-123		

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	
					Other		

Analyses to be Performed:

Volatile Organics	X	Ions, NO3, NH4, K	
Total Metals		Other ~~TOC~~	~~X~~
Dissolved Metals	~~X~~		

only VOC's sampled

Sampling Notes:

The small cuttings in purge bucket was slightly brown dirty color. Samples in jars looked clear. ~~[illegible]~~

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: STD	Page: 1	of 1
ARI Client Company: Boeing	Phone:	Date: 2/12/10	Ice Present?
Client Contact: Will Ernst		No. of Coolers:	Cooler Temps:
Client Project Name: 2-10 sheet pile			
Client Project #: F0275001-001	Samplers: GLD JN		

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

Sample ID	Date	Time	Matrix	No. Containers	TO-15								Notes/Comments
SV-100212-PC2-SSL1-8-TD	2/12/10	1052	A.C	1	X								

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
cc Tom Mckean	(Signature)	(Signature)	(Signature)	(Signature)
	Printed Name: Grant Dawson	Printed Name: Nikka Mulumba	Printed Name:	Printed Name:
	Company: Calibre	Company: ARI	Company:	Company:
	Date & Time: 2/12/10 1330	Date & Time: 2/12/10 1330	Date & Time:	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: 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.

Table 3.3
Soil Vapor Sampling Locations

Soil Vapor Sampling Location	Planned Sampling Depth (feet bgs)	Analytes VOCs[1]	Description of Location (Relative to Prior Soil Sampling)
North Sheetpile			
SSL1, Dup	8	X	near PL2-212A
SSL4	8	X	near PL2-218A
South Sheetpile			
SSL5	8	X	near PL2-209A
SSL7	8	X	near E18

Notes:

X Indicates planned sample/analysis.
1 VOCs by TO-15.

Abbreviations:

bgs Below ground surface
VOC Volatile organic compound

canister # 5593 start end time
SV-100211-PL2-SSL1-8-0 0922

Vapor Monitoring Data Sheet

Date	2/12/16	Site Location	2-10 Sheetpile
Samplers	CWD JN	Well ID	SSL-4
		Constructed Depth	10'

Sample Train Leak Test:

Zero Time Vacuum	-60 kPa
5-min Vacuum	-52 kPa
10-min Vacuum	-40 kPa

Shroud Test:

Gas Used:	Helium
Elapsed Time:	16 min
Helium Detected:	yes (100ppm high)

Purge Volume:

Sample Train Length (ft)	3	10
Tube Dia. (in)	3/8	1
Volume (L)	0.07	3.08

3.15L

Volume Reference Table:

Hose Dia. (in)	Volume (L/ft)	
0.125 (1/8)	0.0024	
0.25 (1/4)	0.0096	
0.375 (3/8)	0.0217	x3 = 0.07L
0.5 (1/2)	0.0386	
1 (1)	0.1543	x10 = 1.54 x2 = 3.08L

Vapor Sample Purging Data:

Time	1114	1118	1121	1125	1128		
Flow Rate (mL/min)	200 mL/min	200 mL/min	200 mL/min	200 mL/min	200 mL/min		
PID (note ppb or ppm)	203 ppb	0 ppb	0 ppb	0 ppb	0 ppb		
Oxygen	20.6	20.7	20.8	20.9	20.8		
Carbon Dioxide	–	–	–	–			
Trace Gas	100 ppm	0 ppm	0 ppm	70 ppm	25 ppm		

Sampling Data:

Time	1128	
Sample ID	SV-100212-PL2-	SSL4 -8-0
Duplicates	–	
PID Reading	~~25 ppb~~ 0 ppb	

Analyses to be Performed:

Volatile Organics (TO-15)	X

Sampling Device:

SUMMA	X	Tedlar Bag	
SUMMA Flow Rate	167 mL/min		
SUMMA Start Vacuum	-29" Hg		
SUMMA Final Vacuum	-4" Hg		

Sampling Notes:

can # 13663

Vapor Monitoring Data Sheet

Date	2/11/10	Site Location	2-10 Sheet Pile
Samplers	GD JN	Well ID	SSL-5
		Constructed Depth	10 ft

Sample Train Leak Test:

Zero Time Vacuum	-70 kPa	
5-min Vacuum	-60 kPa	ok
10-min Vacuum	-50 kPa	ok

Shroud Test:

Gas Used:	Helium
Elapsed Time:	16 min
Helium Detected:	yes (high at 550 ppm)

Purge Volume:

Sample Train Length (ft)	3	10
Tube Dia. (in)	3/8	1
Volume (L)	3.1 L	

Volume Reference Table:

Hose Dia. (in)	Volume (L/ft)	
0.125 (1/8)	0.0024	
0.25 (1/4)	0.0096	
0.375 (3/8)	0.0217	x 3 = 0.07 L
0.5 (1/2)	0.0386	
1 (1)	0.1543	x 10 = 1.5 x 2 = 3.0 L

Vapor Sample Purging Data:

		restart					
Time	1537	1543	1547	1554	1600		
Flow Rate (mL/min)	200 mL/min	200 mL/min	200 mL/min	200 mL/min	200 mL/min		
PID (note ppb or ppm)	445 ppb	166 ppb	255 ppb	109 ppb	39 ppb		
Oxygen	20.9	20.9	21.0	21.0	21.0		
Carbon Dioxide	—	—	—	—	—		
Trace Gas	1350 ppm	0 ppm	425 ppm	550 ppm	500 ppm		

Sampling Data:

Time	1600
Sample ID	SI-100211-PL2-SSL5-S-0
Duplicates	-
PID Reading	39 ppb

Analyses to be Performed:

Volatile Organics (TO-15)	X

Sampling Device:

SUMMA	X	Tedlar Bag	
SUMMA Flow Rate	167 mL/min		
SUMMA Start Vacuum	-28" Hg		
SUMMA Final Vacuum	-4" Hg		

Sampling Notes:

3.1 L / 200 mL/min = 15.5 min, re taped and sealed after helium detection, tightened well barb and valve.

Can # - 96101 Sample depth - 8'

Vapor Monitoring Data Sheet

Date	2/11/16	Site Location	2-10 Sheetpile
Samplers	CUD JN	Well ID	SSL-7
		Constructed Depth	10 ft

Sample Train Leak Test:

Zero Time Vacuum	-70 kPa	
5-min Vacuum	-60 kPa	OK
10-min Vacuum	-50 kPa	OK

Shroud Test:

Gas Used:	Helium
Elapsed Time:	24 min
Helium Detected:	0 ppm

Purge Volume:

Sample Train Length (ft)	3	10
Tube Dia. (in)	3/8	1
Volume (L)	3.1 L	

Volume Reference Table:

Hose Dia. (in)	Volume (L/ft)	
0.125 (1/8)	0.0024	
0.25 (1/4)	0.0096	
0.375 (3/8)	0.0217	x3 = 0.07L
0.5 (1/2)	0.0386	
1 (1)	0.1543	x10 = 1.5 x2 = 3.0 L

Vapor Sample Purging Data:

Time	1420	1425	1430	1435	1440		
Flow Rate (mL/min)	~200	~200	~200	~200	~200		
PID (note ppb or ppm)	0 ppb	0 ppb	0 ppb	215 ppb	514 ppb		
Oxygen	20.9	20.9	20.9	20.9	20.9		
Carbon Dioxide	—	—	—	—	—		
Trace Gas	0 ppm	0 ppm	0 ppm	0 ppm	0 ppm		

Sampling Data:

Time	1440	
Sample ID	SV-100211-PL2	-SSL7-
Duplicates	—	~~15~~ -0 8
PID Reading	814 ppb	

Analyses to be Performed:

Volatile Organics (TO-15)	X

Sampling Device:

SUMMA	X	Tedlar Bag	
SUMMA Flow Rate	167 mL/min		
SUMMA Start Vacuum	30" Hg		
SUMMA Final Vacuum	4" Hg		

Sampling Notes:

3.1L / 200 mL/min = 15.5 min

Can # - 13857 Sample depth of 8 ft

Vapor Monitoring Data Sheet

Date	4/12/10	Site Location	2-10 Sheetpile
Samplers	GDJN	Well ID	SSL1
		Constructed Depth	10ft

Sample Train Leak Test:

Zero Time Vacuum	-60 kPa	
5-min Vacuum	-50 kPa	ok
10-min Vacuum	-38 kPa	ok

Shroud Test:

Gas Used:	Helium
Elapsed Time:	17 min
Helium Detected:	yes, 104 ppm

Purge Volume:

Sample Train Length (ft)	3	10
Tube Dia. (in)	3/8	1
Volume (L)	3.1L	

Volume Reference Table:

Hose Dia. (in)	Volume (L/ft)	
0.125 (1/8)	0.0024	
0.25 (1/4)	0.0096	
0.375 (3/8)	0.0217	x 3 = 0.07 L
0.5 (1/2)	0.0386	
1 (1)	0.1543	x 10 = 1.5 x 2 = 3.0 L

Vapor Sample Purging Data:

Time	0905	0910	0915	0918	0922		
Flow Rate (mL/min)	200 mL/min	200 mL/min	200 mL/min	200 mL/min	200 mL/min		
PID (note ppb or ppm)	116 ppm	143 ppm	117 ppm	107 ppm	200 ppm		
Oxygen	20.1	19.2	20.0	20.1	20.2		
Carbon Dioxide	-	-	-	-			
Trace Gas	0 ppm	0 ppm	0 ppm	7.5 ppm	104 ppm		

Sampling Data:

Time	0922	
Sample ID	SV-100212-PL2-SSL1-8-0	
Duplicates	SV-100212-PL2-SSL1-8-1	
PID Reading	200 ppm	@ 1003

Analyses to be Performed:

Volatile Organics (TO-15)	X

Sampling Device:

SUMMA	X	Tedlar Bag	X
SUMMA Flow Rate	167 mL/min	Dup	
SUMMA Start Vacuum	-29" Hg	-30" Hg	
SUMMA Final Vacuum	~~-30~~ -4" Hg	-4" Hg	

Sampling Notes:

3.1L / 200 mL/min = 15.5 min purge. Taking duplicate sample along with a Tedlar bag sample. Dup: SV-100212-PL2-SSL1-8-1. Tedlar bag - SV-100212-PL2-SSL1-8-TB Can #: 5593, Dup = 4120B There was a strong spray paint smell in the air around this well, PID & oxygen meters blinking while taking readings from purge air.

Dup initial vacuum = -30" Hg

Tedlar bag @ 1052

Appendix C Lab Data Packages (included in attached CD)

Appendix C

The Lab data package pages for VOCs in groundwater for the following wells were removed from Appendix C, as the data were rejected and therefore not presented in the 2-10 IM Phase 2 Work Plan.

North Sheetpile Area Febr. 9-10, 2010
PL2-259B
PL2-249A
PL2-247A
PL2-247A
PL2-245A
PL2-245A
PL2-244A
PL2-268AR
PL2-268AR
PL2-269A

South Sheetpile Area Febr. 9-10,2010
PL2-262B
PL2-257A
PL2-256A
PL2-209A
PL2-209B
PL2-255A
PL2-255A
PL2-253A
PL2-253A
PL2-254A
PL2-252A
PL2-266A
PL2-266A

The data were rejected due to cross-contamination of a sampling pump. All data presented in this appendix are from the Shoreline sampling program and the 2-10s Data Gap sampling.

2340 Stock Creek Blvd.
Rockford TN 37853-3044
Phone: (865) 573-8188
Fax: (865) 573-8133
Email: info@microbe.com

Client: Tom McKeon
CALIBRE Systems
16935 SE 39th St
Bellevue, WA 98008

Phone: 425.643.4634

Fax:

Identifier: 021HB **Date Rec:** 02/10/2010 **Report Date:** 02/11/2010

Client Project #: K0275001 **Client Project Name:** 2-10 Sheetpile

Purchase Order #: K0275001-001

Analysis Requested: CENSUS

Reviewed By:

Anita Biernacki

NOTICE: This report is intended only for the addressee shown above and may contain confidential or privileged information. If the recipient of this material is not the intended recipient or if you have received this in error, please notify Microbial Insights, Inc. immediately. The data and other information in this report represent only the sample(s) analyzed and are rendered upon condition that it is not to be reproduced without approval from Microbial Insights, Inc. Thank you for your cooperation.

MICROBIAL INSIGHTS, INC.

2340 Stock Creek Blvd. Rockford, TN 37853-3044
Tel. (865) 573-8188 Fax. (865) 573-8133

CENSUS

Client: **CALIBRE Systems**
Project: 2-10 Sheetpile

MI Project Number: **021HB**
Date Received: 02/10/2010

Sample Information

Client Sample ID:		**GW-100209-PL2-209A-0**	**GW-100209-PL2-212A-0**	**GW-100209-PL2-218A-0**	**GW-100209-PL2-218B-0**
Sample Date:		02/09/2010	02/09/2010	02/09/2010	02/09/2010
Units:		cells/mL	cells/mL	cells/mL	cells/mL
Analyst:		CT	CT	CT	CT
Dechlorinating Bacteria					
Dehalococcoides spp.	DHC	**7.22E+01**	**1.58E+03**	**8.67E+01**	**7.38E+01**

Legend:
NA = Not Analyzed NS = Not Sampled J = Estimated gene copies below PQL but above LQL I = Inhibited
< = Result not detected

2340 Stock Creek Blvd.
Rockford TN 37853-3044
Phone: (865) 573-8188
Fax: (865) 573-8133
Email: info@microbe.com

Identifier: 021HB **Date Rec:** 02/10/2010 **Report Date:** 02/11/2010

Client Project #: K0275001 **Client Project Name:** 2-10 Sheetpile

Purchase Order #: K0275001-001

Comments:

Analytical Resources, Incorporated
Analytical Chemists and Consultants

January 13, 2010

Kent Angelos
Golder Associates Inc.
18300 NE Union Hill Road, Suite 200
Redmond, WA 98052-3333

Client Project Name: Plant 2 2-10 Sheetpiles
Client Project Number: PL210SP
ARI ID: QD12

Dear Mr. Angelos:

Please find enclosed the original Chain of Custody records, sample receipt documentation, and the final results for the project referenced above.

Sample receipt and analytical details are addressed in the enclosed Case Narrative.

A copy of this report and all associated ARI raw data will be kept on file with ARI. Should you have any questions or problems, please feel free to call me at any time.

Respectfully,
ANALYTICAL RESOURCES, INC.

Kelly Bottem
Client Services Manager
(206) 695-6211
kellyb@arilabs.com
www.arilabs.com

cc: William Ernst, The Boeing Company, PO Box 3707, MS 1W-12, Seattle, WA 98124
Tom Mckeon, Calibre

4611 South 134th Place, Suite 100 • Tukwila WA 98168 • **206-695-6200** • **206-695-6201** fax

Chain of Custody
Documentation

prepared
for

The Boeing Company

Project: Bldg 2-10 Sheetpiles

ARI JOB NO: QD12

prepared
by

Analytical Resources, Inc.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: QD12	Turn-around Requested: STD
ARI Client Company: Boeing / Calibre	Phone: (425) 891-7724
Client Contact: Will Ernst / Tom McKeon	
Client Project Name: Bldg 2-10 Sheetpiles	
Client Project #: ~~PL2109P~~	Samplers: Grant Dawson

Page: 1	of 2
Date: 12/29/09	Ice Present? Yes
No. of Coolers: 1	Cooler Temps: 8.9

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

Sample ID	Date	Time	Matrix	No. Containers	Grain Size Analysis	VOCs 5035	VOCs 8260						Notes/Comments
S-091228-PL2-SSL5-05-0	12/28/09	850	Soil	4		X							
S-091228-PL2-SSL5-10-0	12/28/09	905	Soil	5	X								
S-091228-PL2-SSL6-05-0	12/28/09	1025	Soil	4		X							
S-091228-PL2-SSL6-10-0	12/28/09	1030	Soil	4		X							
S-091228-PL2-SSL7-05-0	12/28/09	1320	Soil	4		X							
S-091228-PL2-SSL7-10-0	12/28/09	1325	Soil	4		X							
GW-091228-PL2-GP1-50-0	12/28/09	1435	Water	3			X						
S-091228-PL2-SSL4-10-0	12/28/09	1545	Soil	4		X							
S-091228-PL2-SSL4-14-0	12/28/09	1550	Soil	4		X							
S-091229-PL2-SSL2-5-0	12/29/09	815	Soil	4		X							

Comments/Special Instructions

Relinquished by:	Received by:	Relinquished by:	Received by:
(Signature) [signature]	(Signature) [signature]	(Signature)	(Signature)
Printed Name: Grant Dawson	Printed Name: Jonathon Walter	Printed Name:	Printed Name:
Company: Calibre	Company: ARI	Company:	Company:
Date & Time: 12/29/09 1420	Date & Time: 12/29/09 1420	Date & Time:	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: 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.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: STD
ARI Client Company: Boeing/Calibre	Phone: (425) 891-7724
Client Contact: Will Ernst / Tom Mckeon	
Client Project Name: Bldg 2-10 sheetpiles	
Client Project #: P1210SP	Samplers: Grant Dawson

Page: 2 of 2	
Date: 12/29/09	Ice Present? Yes
No. of Coolers: 1	Cooler Temps: 8.9

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

Sample ID	Date	Time	Matrix	No. Containers	Grain Size Analysis	VOCs 5035	VOCs 8260						Notes/Comments
S-091229-PL2-SSL2-10-0	12/29/09	825	Soil	5	X	X							
S-091229-PL2-SSL2-10-1	12/29/09	835	Soil	4		X							
S-091229-PL2-SSL3-10-0	12/29/09	850	Soil	4		X							
GW-091229-PL2-GP2-85-0	12/29/09	1010	Water	3			X						
GW-091229-PL2-GP2-85-1	12/29/09	1015	Water	3			X						
S-091229-PL2-SSL1-05-0	12/29/09	1150	Soil	4		X							
S-091229-PL2-SSL1-10-1	12/29/09	1155	Soil	4		X							
S-091229-PL2-SSL1-10-0	12/29/09	1200	Soil	5	X								

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
	(Signature) [signature]	(Signature) [signature]	(Signature)	(Signature)
	Printed Name: Grant Dawson	Printed Name: Jonathon Walter	Printed Name:	Printed Name:
	Company: Calibre	Company: ARI	Company:	Company:
	Date & Time: 12/29/09 1420	Date & Time: 12/29/09 1420	Date & Time:	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: 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.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Cooler Receipt Form

ARI Client: Boeing

COC No(s): _____ (NA)

Assigned ARI Job No: QD12

Project Name: Bldg 2-10 Sheet piles

Delivered by: Fed-Ex UPS Courier Hand Delivered Other: _____

Tracking No: _____ (NA)

Preliminary Examination Phase:

Were intact, properly signed and dated custody seals attached to the outside of to cooler?	YES	(NO)
Were custody papers included with the cooler?	(YES)	NO
Were custody papers properly filled out (ink, signed, etc.)	(YES)	NO
Temperature of Cooler(s) (°C) (recommended 2.0-6.0 °C for chemistry)	8.9	

If cooler temperature is out of compliance fill out form 00070F

Temp Gun ID#: 90941619

Cooler Accepted by: JW Date: 12/29/09 Time: 1420

Complete custody forms and attach all shipping documents

Log-In Phase:

Was a temperature blank included in the cooler?		YES	(NO)
What kind of packing material was used? ... Bubble Wrap (Wet Ice) Gel Packs Baggies (Foam Block) Paper Other: _____			
Was sufficient ice used (if appropriate)?	NA	YES	(NO)
Were all bottles sealed in individual plastic bags?		YES	(NO)
Did all bottles arrive in good condition (unbroken)?		(YES)	NO
Were all bottle labels complete and legible?		(YES)	NO
Did the number of containers listed on COC match with the number of containers received?		(YES) AV	(NO)
Did all bottle labels and tags agree with custody papers?		(YES)	NO
Were all bottles used correct for the requested analyses?		(YES)	NO
Do any of the analyses (bottles) require preservation? (attach preservation sheet, excluding VOCs)...	(NA)	YES	NO
Were all VOC vials free of air bubbles?	NA	YES	(NO)
Was sufficient amount of sample sent in each bottle?		(YES)	NO
Date VOC Trip Blank was made at ARI	NA	12/18/09	

Samples Logged by: AV Date: 12/29/09 Time: 1531

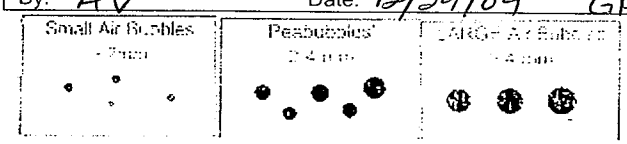
***** Notify Project Manager of discrepancies or concerns *****

Sample ID on Bottle	Sample ID on COC	Sample ID on Bottle	Sample ID on COC

Additional Notes, Discrepancies, & Resolutions:

a grainsize container has the ID-SSL5-05-0, which is not marked on c.o.c, and no grainsize container arrived for SSL5-10-0, and 5035 VOAs did arrive for this sample. GP2-85-0 = many small(3) HS(2)
GP2-85-1 = HS(2) and many Sm(3)

By: AV Date: 12/29/09



Small → "sm"
Peabubbles → "pb"
Large → "lg"
Headspace → "hs"

Trip blanks = 2pb
SSL1-10-0, does not have VOC marked on c.o.c, it has 3 vials and 1 TS jar.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Cooler Temperature Compliance Form

Cooler#: 1 Temperature(°C): 8.9

Sample ID	Bottle Count	Bottle Type
SSL5-05-0	5	3 40ml voa, 1 16oz jar, 1 1½ Septa
SSL5-10-0	4	3 40ml voa, 1 1½oz Septa
SSL6-05-0	4	" "
SSL6-10-0	4	" "
SSL7-05-0	4	" "
SSL7-10-0	4	" "
GP1-50-0	3	3 40ml voa
SSL4-10-0	4	3 40ml voa, 1 1½ septa

Cooler#: 1 cont. Temperature(°C):

Sample ID	Bottle Count	Bottle Type
SSL4-14-0	4	3 40ml voa, 1 1½ septa
SSL2-5-0	4	" "
SSL2-10-0	5	1 16oz Jar, 3 40ml voa, 1 1½oz Septa
SSL2-10-1	4	3 40ml voa, 1 1½oz Septa
SSL3-10-0	4	" "
GP2-85-0	3	3 40ml voa
GP2-85-1	3	"
SSL-05-0	4	3 40ml voa, 1 1½oz Septa

Cooler#: 1 cont. Temperature(°C):

Sample ID	Bottle Count	Bottle Type
SSL1-10-1	4	3 40ml voa, 1 1½oz Septa
SSL1-10-0	5	1 16oz Jar, 3 40ml voa, 1 1½oz Septa
Trip Blanks	2	2 40ml voa

Cooler#: Temperature(°C):

Sample ID	Bottle Count	Bottle Type

Completed by: AV Date: 12/29/09 Time: 1537

Case Narrative

prepared
for

The Boeing Company

Project: Bldg 2-10 Sheetpiles

ARI JOB NO: QD12

prepared
by

Analytical Resources, Inc.

Sample Receipt:

Analytical Resources, Inc. accepted fifteen soil samples and three water samples and one trip blank in good condition on December 29, 2010. The samples were received at a cooler temperature of 8.9°C. For further details regarding sample receipt please refer to the enclosed Cooler Receipt Form.

Select samples were analyzed for Volatile Organics and Grain Size, as requested on the Chain of Custody.

Volatile Organics by EPA Method 8260C:

The samples were analyzed between 12/29/09 and 1/7/10 - within the method recommended holding time. The water samples had a pH of <2.0 with the exception of samples OD12 Q and R had a pH of 5 but were analyzed within method recommended holding times.

Initial calibration(s): All analytes of interest were within method acceptance criteria.

Continuing calibration(s): The 12/29/09 CCAL is out of control high for Vinyl Chloride and Trichlorofluoromethane. All associated samples that contain analyte have been flagged with a "Q" qualifier.

The 12/30/09 CCAL is out of control high for Vinyl Chloride. All associated samples that contain analyte have been flagged with a "Q" qualifier.

The 12/31/09 CCAL is out of control low for Bromomethane, Acetone and 2-Butanone. All associated samples that contain analyte have been flagged with a "Q" qualifier.

The 1/7/10 CCAL is out of control high for Carbon Disulfide. All associated samples that contain analyte have been flagged with a "Q" qualifier.

Internal Standards: The internal standards were in control.

Surrogates: All surrogate recoveries were within control limits.

Method Blank(s): The 12/29/09 method blank contained acetone. All associated samples that contain analyte have been flagged with a "B" qualifier.

Samples: There were no anomalies associated with these samples.

LCS/LCSD(s): The 12/30/09 LCS is out of control high for Bromoform and the LCSD is out of control high for Acetone, 2-Hexanone and Bromoform. No further corrective action was taken.

The 12/31/09 LCS is out of control low for Acetone. The LCSD is in control and no further corrective action was taken.

MS/MSD(s): The MS and MSD were in control.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Client: The Boeing Company	**ARI Job No.:** QD12
Client Project: Bldg 2-10 Sheetpiles	

Case Narrative

1. Three samples were received on December 29, 2009, and were in good condition.
2. The samples were submitted for grain size distribution according to ASTM D422. The samples were prepared according to ASTM D421.
3. An assumed specific gravity of 2.65 was used in the hydrometer calculations.
4. A standard milkshake mixer type device was used to disperse the fine fraction sample.
5. The data is provided in summary tables and plots.
6. There were no further anomalies in the samples or test method.

Approved by: Gretchen Scott
Geotechnical Laboratory Manager

Date: 1/11/10

4611 South 134th Place, Suite 100 • Tukwila WA 98168 • **206-695-6200** • **206-695-6201** fax

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Data Reporting Qualifiers

Effective 7/10/2009

Inorganic Data

U Indicates that the target analyte was not detected at the reported concentration

* Duplicate RPD is not within established control limits

B Reported value is less than the CRDL but ≥ the Reporting Limit

N Matrix Spike recovery not within established control limits

NA Not Applicable, analyte not spiked

H The natural concentration of the spiked element is so much greater than the concentration spiked that an accurate determination of spike recovery is not possible

L Analyte concentration is ≤5 times the Reporting Limit and the replicate control limit defaults to ±1 RL instead of the normal 20% RPD

Organic Data

U Indicates that the target analyte was not detected at the reported concentration

* Flagged value is not within established control limits

B Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's Reporting Limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.

J Estimated concentration when the value is less than ARI's established reporting limits

D The spiked compound was not detected due to sample extract dilution

E Estimated concentration calculated for an analyte response above the valid instrument calibration range. A dilution is required to obtain an accurate quantification of the analyte.

Q Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20%Drift or minimum RRF).

S Indicates an analyte response that has saturated the detector. The calculated concentration is not valid; a dilution is required to obtain valid quantification of the analyte

Data Reporting Qualifiers

Effective 7/10/2009

NA The flagged analyte was not analyzed for

NR Spiked compound recovery is not reported due to chromatographic interference

NS The flagged analyte was not spiked into the sample

M Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters. This flag is used only for GC-MS analyses

M2 The sample contains PCB congeners that do not match any standard Aroclor pattern. The PCBs are identified and quantified as the Aroclor whose pattern most closely matches that of the sample. The reported value is an estimate.

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification"

Y The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.

C The analyte was positively identified on only one of two chromatographic columns. Chromatographic interference prevented a positive identification on the second column

P The analyte was detected on both chromatographic columns but the quantified values differ by ≥40% RPD with no obvious chromatographic interference

Geotechnical Data

A The total of all fines fractions. This flag is used to report total fines when only sieve analysis is requested and balances total grain size with sample weight.

F Samples were frozen prior to particle size determination

SM Sample matrix was not appropriate for the requested analysis. This normally refers to samples contaminated with an organic product that interferes with the sieving process and/or moisture content, porosity and saturation calculations

SS Sample did not contain the proportion of "fines" required to perform the pipette portion of the grain size analysis

W Weight of sample in some pipette aliquots was below the level required for accurate weighting

Data Summary Package

prepared
for

The Boeing Company

Project: Bldg 2-10 Sheetpiles

ARI JOB NO: QD12

prepared
by

Analytical Resources, Inc.

VOLATILE ANALYSIS

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: S-091228-PL2-SSL5-05-0
SAMPLE

Lab Sample ID: QD12A
LIMS ID: 09-31875
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/28/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 12/29/09 17:34

Sample Amount: 4.17 g-dry-wt
Purge Volume: 5.0 mL
Moisture: 5.8%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.2	< 1.2	U
74-83-9	Bromomethane	1.2	< 1.2	U
75-01-4	Vinyl Chloride	1.2	< 1.2	U
75-00-3	Chloroethane	1.2	< 1.2	U
75-09-2	Methylene Chloride	2.4	< 2.4	U
67-64-1	**Acetone**	**6.0**	**15**	**B**
75-15-0	Carbon Disulfide	1.2	< 1.2	U
75-35-4	1,1-Dichloroethene	1.2	< 1.2	U
75-34-3	1,1-Dichloroethane	1.2	< 1.2	U
156-60-5	trans-1,2-Dichloroethene	1.2	< 1.2	U
156-59-2	cis-1,2-Dichloroethene	1.2	< 1.2	U
67-66-3	Chloroform	1.2	< 1.2	U
107-06-2	1,2-Dichloroethane	1.2	< 1.2	U
78-93-3	2-Butanone	6.0	< 6.0	U
71-55-6	1,1,1-Trichloroethane	1.2	< 1.2	U
56-23-5	Carbon Tetrachloride	1.2	< 1.2	U
108-05-4	Vinyl Acetate	6.0	< 6.0	U
75-27-4	Bromodichloromethane	1.2	< 1.2	U
78-87-5	1,2-Dichloropropane	1.2	< 1.2	U
10061-01-5	cis-1,3-Dichloropropene	1.2	< 1.2	U
79-01-6	**Trichloroethene**	**1.2**	**39**	
124-48-1	Dibromochloromethane	1.2	< 1.2	U
79-00-5	1,1,2-Trichloroethane	1.2	< 1.2	U
71-43-2	Benzene	1.2	< 1.2	U
10061-02-6	trans-1,3-Dichloropropene	1.2	< 1.2	U
110-75-8	2-Chloroethylvinylether	6.0	< 6.0	U
75-25-2	Bromoform	1.2	< 1.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	6.0	< 6.0	U
591-78-6	2-Hexanone	6.0	< 6.0	U
127-18-4	Tetrachloroethene	1.2	< 1.2	U
79-34-5	1,1,2,2-Tetrachloroethane	1.2	< 1.2	U
108-88-3	Toluene	1.2	< 1.2	U
108-90-7	Chlorobenzene	1.2	< 1.2	U
100-41-4	Ethylbenzene	1.2	< 1.2	U
100-42-5	Styrene	1.2	< 1.2	U
75-69-4	Trichlorofluoromethane	1.2	< 1.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.4	< 2.4	U
179601-23-1	m,p-Xylene	1.2	< 1.2	U
95-47-6	o-Xylene	1.2	< 1.2	U

Reported in μg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	140%
d8-Toluene	109%
Bromofluorobenzene	107%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: S-091228-PL2-SSL5-10-0
SAMPLE

Lab Sample ID: QD12B
LIMS ID: 09-31876
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/28/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 12/29/09 18:00

Sample Amount: 4.28 g-dry-wt
Purge Volume: 5.0 mL
Moisture: 10.6%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.2	< 1.2	U
74-83-9	Bromomethane	1.2	< 1.2	U
75-01-4	Vinyl Chloride	1.2	< 1.2	U
75-00-3	Chloroethane	1.2	< 1.2	U
75-09-2	Methylene Chloride	2.3	< 2.3	U
67-64-1	**Acetone**	**5.8**	**60**	**B**
75-15-0	Carbon Disulfide	1.2	< 1.2	U
75-35-4	1,1-Dichloroethene	1.2	< 1.2	U
75-34-3	1,1-Dichloroethane	1.2	< 1.2	U
156-60-5	trans-1,2-Dichloroethene	1.2	< 1.2	U
156-59-2	cis-1,2-Dichloroethene	1.2	< 1.2	U
67-66-3	Chloroform	1.2	< 1.2	U
107-06-2	1,2-Dichloroethane	1.2	< 1.2	U
78-93-3	2-Butanone	5.8	< 5.8	U
71-55-6	1,1,1-Trichloroethane	1.2	< 1.2	U
56-23-5	Carbon Tetrachloride	1.2	< 1.2	U
108-05-4	Vinyl Acetate	5.8	< 5.8	U
75-27-4	Bromodichloromethane	1.2	< 1.2	U
78-87-5	1,2-Dichloropropane	1.2	< 1.2	U
10061-01-5	cis-1,3-Dichloropropene	1.2	< 1.2	U
79-01-6	**Trichloroethene**	**1.2**	**25**	
124-48-1	Dibromochloromethane	1.2	< 1.2	U
79-00-5	1,1,2-Trichloroethane	1.2	< 1.2	U
71-43-2	Benzene	1.2	< 1.2	U
10061-02-6	trans-1,3-Dichloropropene	1.2	< 1.2	U
110-75-8	2-Chloroethylvinylether	5.8	< 5.8	U
75-25-2	Bromoform	1.2	< 1.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.8	< 5.8	U
591-78-6	2-Hexanone	5.8	< 5.8	U
127-18-4	Tetrachloroethene	1.2	< 1.2	U
79-34-5	1,1,2,2-Tetrachloroethane	1.2	< 1.2	U
108-88-3	Toluene	1.2	< 1.2	U
108-90-7	Chlorobenzene	1.2	< 1.2	U
100-41-4	Ethylbenzene	1.2	< 1.2	U
100-42-5	Styrene	1.2	< 1.2	U
75-69-4	Trichlorofluoromethane	1.2	< 1.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.3	< 2.3	U
179601-23-1	m,p-Xylene	1.2	< 1.2	U
95-47-6	o-Xylene	1.2	< 1.2	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	139%
d8-Toluene	110%
Bromofluorobenzene	109%

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: S-091228-PL2-SSL6-05-0
SAMPLE

Lab Sample ID: QD12C
LIMS ID: 09-31877
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/28/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 12/29/09 18:27

Sample Amount: 4.50 g-dry-wt
Purge Volume: 5.0 mL
Moisture: 6.0%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.1	< 1.1	U
74-83-9	Bromomethane	1.1	< 1.1	U
75-01-4	Vinyl Chloride	1.1	< 1.1	U
75-00-3	Chloroethane	1.1	< 1.1	U
75-09-2	Methylene Chloride	2.2	< 2.2	U
67-64-1	**Acetone**	**5.6**	**37**	**B**
75-15-0	Carbon Disulfide	1.1	< 1.1	U
75-35-4	1,1-Dichloroethene	1.1	< 1.1	U
75-34-3	1,1-Dichloroethane	1.1	< 1.1	U
156-60-5	trans-1,2-Dichloroethene	1.1	< 1.1	U
156-59-2	cis-1,2-Dichloroethene	1.1	< 1.1	U
67-66-3	Chloroform	1.1	< 1.1	U
107-06-2	1,2-Dichloroethane	1.1	< 1.1	U
78-93-3	2-Butanone	5.6	< 5.6	U
71-55-6	1,1,1-Trichloroethane	1.1	< 1.1	U
56-23-5	Carbon Tetrachloride	1.1	< 1.1	U
108-05-4	Vinyl Acetate	5.6	< 5.6	U
75-27-4	Bromodichloromethane	1.1	< 1.1	U
78-87-5	1,2-Dichloropropane	1.1	< 1.1	U
10061-01-5	cis-1,3-Dichloropropene	1.1	< 1.1	U
79-01-6	**Trichloroethene**	**1.1**	**73**	
124-48-1	Dibromochloromethane	1.1	< 1.1	U
79-00-5	1,1,2-Trichloroethane	1.1	< 1.1	U
71-43-2	Benzene	1.1	< 1.1	U
10061-02-6	trans-1,3-Dichloropropene	1.1	< 1.1	U
110-75-8	2-Chloroethylvinylether	5.6	< 5.6	U
75-25-2	Bromoform	1.1	< 1.1	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.6	< 5.6	U
591-78-6	2-Hexanone	5.6	< 5.6	U
127-18-4	Tetrachloroethene	1.1	< 1.1	U
79-34-5	1,1,2,2-Tetrachloroethane	1.1	< 1.1	U
108-88-3	Toluene	1.1	< 1.1	U
108-90-7	Chlorobenzene	1.1	< 1.1	U
100-41-4	Ethylbenzene	1.1	< 1.1	U
100-42-5	Styrene	1.1	< 1.1	U
75-69-4	Trichlorofluoromethane	1.1	< 1.1	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.2	< 2.2	U
179601-23-1	m,p-Xylene	1.1	< 1.1	U
95-47-6	o-Xylene	1.1	< 1.1	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	143%
d8-Toluene	108%
Bromofluorobenzene	108%

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: S-091228-PL2-SSL6-10-0
SAMPLE

Lab Sample ID: QD12D
LIMS ID: 09-31878
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/28/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 12/29/09 18:54

Sample Amount: 3.13 g-dry-wt
Purge Volume: 5.0 mL
Moisture: 31.0%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.6	< 1.6	U
74-83-9	Bromomethane	1.6	< 1.6	U
75-01-4	Vinyl Chloride	1.6	< 1.6	U
75-00-3	Chloroethane	1.6	< 1.6	U
75-09-2	Methylene Chloride	3.2	< 3.2	U
67-64-1	**Acetone**	**8.0**	**45**	**B**
75-15-0	Carbon Disulfide	1.6	< 1.6	U
75-35-4	1,1-Dichloroethene	1.6	< 1.6	U
75-34-3	1,1-Dichloroethane	1.6	< 1.6	U
156-60-5	trans-1,2-Dichloroethene	1.6	< 1.6	U
156-59-2	cis-1,2-Dichloroethene	1.6	< 1.6	U
67-66-3	Chloroform	1.6	< 1.6	U
107-06-2	1,2-Dichloroethane	1.6	< 1.6	U
78-93-3	2-Butanone	8.0	< 8.0	U
71-55-6	1,1,1-Trichloroethane	1.6	< 1.6	U
56-23-5	Carbon Tetrachloride	1.6	< 1.6	U
108-05-4	Vinyl Acetate	8.0	< 8.0	U
75-27-4	Bromodichloromethane	1.6	< 1.6	U
78-87-5	1,2-Dichloropropane	1.6	< 1.6	U
10061-01-5	cis-1,3-Dichloropropene	1.6	< 1.6	U
79-01-6	**Trichloroethene**	**1.6**	**64**	
124-48-1	Dibromochloromethane	1.6	< 1.6	U
79-00-5	1,1,2-Trichloroethane	1.6	< 1.6	U
71-43-2	Benzene	1.6	< 1.6	U
10061-02-6	trans-1,3-Dichloropropene	1.6	< 1.6	U
110-75-8	2-Chloroethylvinylether	8.0	< 8.0	U
75-25-2	Bromoform	1.6	< 1.6	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	8.0	< 8.0	U
591-78-6	2-Hexanone	8.0	< 8.0	U
127-18-4	Tetrachloroethene	1.6	< 1.6	U
79-34-5	1,1,2,2-Tetrachloroethane	1.6	< 1.6	U
108-88-3	Toluene	1.6	< 1.6	U
108-90-7	Chlorobenzene	1.6	< 1.6	U
100-41-4	Ethylbenzene	1.6	< 1.6	U
100-42-5	Styrene	1.6	< 1.6	U
75-69-4	Trichlorofluoromethane	1.6	< 1.6	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	3.2	< 3.2	U
179601-23-1	m,p-Xylene	1.6	< 1.6	U
95-47-6	o-Xylene	1.6	< 1.6	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	142%
d8-Toluene	108%
Bromofluorobenzene	108%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: S-091228-PL2-SSL7-05-0
SAMPLE

Lab Sample ID: QD12E
LIMS ID: 09-31879
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/28/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 12/29/09 19:21

Sample Amount: 3.95 g-dry-wt
Purge Volume: 5.0 mL
Moisture: 10.0%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.3	< 1.3	U
74-83-9	Bromomethane	1.3	< 1.3	U
75-01-4	Vinyl Chloride	1.3	< 1.3	U
75-00-3	Chloroethane	1.3	< 1.3	U
75-09-2	Methylene Chloride	2.5	< 2.5	U
67-64-1	**Acetone**	**6.3**	**16**	**B**
75-15-0	Carbon Disulfide	1.3	< 1.3	U
75-35-4	1,1-Dichloroethene	1.3	< 1.3	U
75-34-3	1,1-Dichloroethane	1.3	< 1.3	U
156-60-5	trans-1,2-Dichloroethene	1.3	< 1.3	U
156-59-2	cis-1,2-Dichloroethene	1.3	< 1.3	U
67-66-3	Chloroform	1.3	< 1.3	U
107-06-2	1,2-Dichloroethane	1.3	< 1.3	U
78-93-3	2-Butanone	6.3	< 6.3	U
71-55-6	1,1,1-Trichloroethane	1.3	< 1.3	U
56-23-5	Carbon Tetrachloride	1.3	< 1.3	U
108-05-4	Vinyl Acetate	6.3	< 6.3	U
75-27-4	Bromodichloromethane	1.3	< 1.3	U
78-87-5	1,2-Dichloropropane	1.3	< 1.3	U
10061-01-5	cis-1,3-Dichloropropene	1.3	< 1.3	U
79-01-6	**Trichloroethene**	**1.3**	**120**	
124-48-1	Dibromochloromethane	1.3	< 1.3	U
79-00-5	1,1,2-Trichloroethane	1.3	< 1.3	U
71-43-2	Benzene	1.3	< 1.3	U
10061-02-6	trans-1,3-Dichloropropene	1.3	< 1.3	U
110-75-8	2-Chloroethylvinylether	6.3	< 6.3	U
75-25-2	Bromoform	1.3	< 1.3	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	6.3	< 6.3	U
591-78-6	2-Hexanone	6.3	< 6.3	U
127-18-4	Tetrachloroethene	1.3	< 1.3	U
79-34-5	1,1,2,2-Tetrachloroethane	1.3	< 1.3	U
108-88-3	Toluene	1.3	< 1.3	U
108-90-7	Chlorobenzene	1.3	< 1.3	U
100-41-4	Ethylbenzene	1.3	< 1.3	U
100-42-5	Styrene	1.3	< 1.3	U
75-69-4	Trichlorofluoromethane	1.3	< 1.3	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.5	< 2.5	U
179601-23-1	m,p-Xylene	1.3	< 1.3	U
95-47-6	o-Xylene	1.3	< 1.3	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	144%
d8-Toluene	111%
Bromofluorobenzene	108%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: S-091228-PL2-SSL7-10-0**
 SAMPLE

Lab Sample ID: QD12F
LIMS ID: 09-31880
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/28/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 12/29/09 19:48

Sample Amount: 3.35 g-dry-wt
Purge Volume: 5.0 mL
Moisture: 17.7%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.5	< 1.5	U
74-83-9	Bromomethane	1.5	< 1.5	U
75-01-4	Vinyl Chloride	1.5	< 1.5	U
75-00-3	Chloroethane	1.5	< 1.5	U
75-09-2	Methylene Chloride	3.0	< 3.0	U
67-64-1	**Acetone**	**7.5**	**33**	**B**
75-15-0	Carbon Disulfide	1.5	< 1.5	U
75-35-4	1,1-Dichloroethene	1.5	< 1.5	U
75-34-3	1,1-Dichloroethane	1.5	< 1.5	U
156-60-5	trans-1,2-Dichloroethene	1.5	< 1.5	U
156-59-2	cis-1,2-Dichloroethene	1.5	< 1.5	U
67-66-3	Chloroform	1.5	< 1.5	U
107-06-2	1,2-Dichloroethane	1.5	< 1.5	U
78-93-3	2-Butanone	7.5	< 7.5	U
71-55-6	1,1,1-Trichloroethane	1.5	< 1.5	U
56-23-5	Carbon Tetrachloride	1.5	< 1.5	U
108-05-4	Vinyl Acetate	7.5	< 7.5	U
75-27-4	Bromodichloromethane	1.5	< 1.5	U
78-87-5	1,2-Dichloropropane	1.5	< 1.5	U
10061-01-5	cis-1,3-Dichloropropene	1.5	< 1.5	U
79-01-6	**Trichloroethene**	**1.5**	**75**	
124-48-1	Dibromochloromethane	1.5	< 1.5	U
79-00-5	1,1,2-Trichloroethane	1.5	< 1.5	U
71-43-2	Benzene	1.5	< 1.5	U
10061-02-6	trans-1,3-Dichloropropene	1.5	< 1.5	U
110-75-8	2-Chloroethylvinylether	7.5	< 7.5	U
75-25-2	Bromoform	1.5	< 1.5	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	7.5	< 7.5	U
591-78-6	2-Hexanone	7.5	< 7.5	U
127-18-4	Tetrachloroethene	1.5	< 1.5	U
79-34-5	1,1,2,2-Tetrachloroethane	1.5	< 1.5	U
108-88-3	Toluene	1.5	< 1.5	U
108-90-7	Chlorobenzene	1.5	< 1.5	U
100-41-4	Ethylbenzene	1.5	< 1.5	U
100-42-5	Styrene	1.5	< 1.5	U
75-69-4	Trichlorofluoromethane	1.5	< 1.5	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	3.0	< 3.0	U
179601-23-1	m,p-Xylene	1.5	< 1.5	U
95-47-6	o-Xylene	1.5	< 1.5	U

Reported in μg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	145%
d8-Toluene	108%
Bromofluorobenzene	108%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: S-091228-PL2-SSL4-10-0
SAMPLE

Lab Sample ID: QD12G
LIMS ID: 09-31881
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/28/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 12/30/09 16:24

Sample Amount: 3.96 g-dry-wt
Purge Volume: 5.0 mL
Moisture: 3.6%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.3	< 1.3	U
74-83-9	Bromomethane	1.3	< 1.3	U
75-01-4	Vinyl Chloride	1.3	< 1.3	U
75-00-3	Chloroethane	1.3	< 1.3	U
75-09-2	Methylene Chloride	2.5	< 2.5	U
67-64-1	**Acetone**	**6.3**	**13**	
75-15-0	Carbon Disulfide	1.3	< 1.3	U
75-35-4	1,1-Dichloroethene	1.3	< 1.3	U
75-34-3	1,1-Dichloroethane	1.3	< 1.3	U
156-60-5	trans-1,2-Dichloroethene	1.3	< 1.3	U
156-59-2	cis-1,2-Dichloroethene	1.3	< 1.3	U
67-66-3	Chloroform	1.3	< 1.3	U
107-06-2	1,2-Dichloroethane	1.3	< 1.3	U
78-93-3	2-Butanone	6.3	< 6.3	U
71-55-6	1,1,1-Trichloroethane	1.3	< 1.3	U
56-23-5	Carbon Tetrachloride	1.3	< 1.3	U
108-05-4	Vinyl Acetate	6.3	< 6.3	U
75-27-4	Bromodichloromethane	1.3	< 1.3	U
78-87-5	1,2-Dichloropropane	1.3	< 1.3	U
10061-01-5	cis-1,3-Dichloropropene	1.3	< 1.3	U
79-01-6	Trichloroethene	1.3	< 1.3	U
124-48-1	Dibromochloromethane	1.3	< 1.3	U
79-00-5	1,1,2-Trichloroethane	1.3	< 1.3	U
71-43-2	Benzene	1.3	< 1.3	U
10061-02-6	trans-1,3-Dichloropropene	1.3	< 1.3	U
110-75-8	2-Chloroethylvinylether	6.3	< 6.3	U
75-25-2	Bromoform	1.3	< 1.3	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	6.3	< 6.3	U
591-78-6	2-Hexanone	6.3	< 6.3	U
127-18-4	Tetrachloroethene	1.3	< 1.3	U
79-34-5	1,1,2,2-Tetrachloroethane	1.3	< 1.3	U
108-88-3	Toluene	1.3	< 1.3	U
108-90-7	Chlorobenzene	1.3	< 1.3	U
100-41-4	Ethylbenzene	1.3	< 1.3	U
100-42-5	Styrene	1.3	< 1.3	U
75-69-4	Trichlorofluoromethane	1.3	< 1.3	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.5	< 2.5	U
179601-23-1	m,p-Xylene	1.3	< 1.3	U
95-47-6	o-Xylene	1.3	< 1.3	U

Reported in μg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	148%
d8-Toluene	111%
Bromofluorobenzene	109%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: S-091228-PL2-SSL4-14-0
SAMPLE

Lab Sample ID: QD12H
LIMS ID: 09-31882
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/28/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 12/30/09 16:51

Sample Amount: 3.13 g-dry-wt
Purge Volume: 5.0 mL
Moisture: 22.2%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.6	< 1.6	U
74-83-9	Bromomethane	1.6	< 1.6	U
75-01-4	Vinyl Chloride	1.6	< 1.6	U
75-00-3	Chloroethane	1.6	< 1.6	U
75-09-2	Methylene Chloride	3.2	< 3.2	U
67-64-1	**Acetone**	**8.0**	**41**	
75-15-0	**Carbon Disulfide**	**1.6**	**1.8**	
75-35-4	1,1-Dichloroethene	1.6	< 1.6	U
75-34-3	1,1-Dichloroethane	1.6	< 1.6	U
156-60-5	trans-1,2-Dichloroethene	1.6	< 1.6	U
156-59-2	cis-1,2-Dichloroethene	1.6	< 1.6	U
67-66-3	Chloroform	1.6	< 1.6	U
107-06-2	1,2-Dichloroethane	1.6	< 1.6	U
78-93-3	2-Butanone	8.0	< 8.0	U
71-55-6	1,1,1-Trichloroethane	1.6	< 1.6	U
56-23-5	Carbon Tetrachloride	1.6	< 1.6	U
108-05-4	Vinyl Acetate	8.0	< 8.0	U
75-27-4	Bromodichloromethane	1.6	< 1.6	U
78-87-5	1,2-Dichloropropane	1.6	< 1.6	U
10061-01-5	cis-1,3-Dichloropropene	1.6	< 1.6	U
79-01-6	Trichloroethene	1.6	< 1.6	U
124-48-1	Dibromochloromethane	1.6	< 1.6	U
79-00-5	1,1,2-Trichloroethane	1.6	< 1.6	U
71-43-2	Benzene	1.6	< 1.6	U
10061-02-6	trans-1,3-Dichloropropene	1.6	< 1.6	U
110-75-8	2-Chloroethylvinylether	8.0	< 8.0	U
75-25-2	Bromoform	1.6	< 1.6	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	8.0	< 8.0	U
591-78-6	2-Hexanone	8.0	< 8.0	U
127-18-4	Tetrachloroethene	1.6	< 1.6	U
79-34-5	1,1,2,2-Tetrachloroethane	1.6	< 1.6	U
108-88-3	Toluene	1.6	< 1.6	U
108-90-7	Chlorobenzene	1.6	< 1.6	U
100-41-4	Ethylbenzene	1.6	< 1.6	U
100-42-5	Styrene	1.6	< 1.6	U
75-69-4	Trichlorofluoromethane	1.6	< 1.6	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	3.2	< 3.2	U
179601-23-1	m,p-Xylene	1.6	< 1.6	U
95-47-6	o-Xylene	1.6	< 1.6	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	150%
d8-Toluene	107%
Bromofluorobenzene	108%

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: S-091229-PL2-SSL2-5-0
SAMPLE

Lab Sample ID: QD12I
LIMS ID: 09-31883
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 12/30/09 17:17

Sample Amount: 4.16 g-dry-wt
Purge Volume: 5.0 mL
Moisture: 16.2%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.2	< 1.2	U
74-83-9	Bromomethane	1.2	< 1.2	U
75-01-4	Vinyl Chloride	1.2	< 1.2	U
75-00-3	Chloroethane	1.2	< 1.2	U
75-09-2	Methylene Chloride	2.4	< 2.4	U
67-64-1	**Acetone**	**6.0**	**37**	
75-15-0	**Carbon Disulfide**	**1.2**	**3.4**	
75-35-4	1,1-Dichloroethene	1.2	< 1.2	U
75-34-3	1,1-Dichloroethane	1.2	< 1.2	U
156-60-5	**trans-1,2-Dichloroethene**	**1.2**	**49**	
156-59-2	**cis-1,2-Dichloroethene**	**1.2**	**390**	**ES**
67-66-3	Chloroform	1.2	< 1.2	U
107-06-2	1,2-Dichloroethane	1.2	< 1.2	U
78-93-3	2-Butanone	6.0	< 6.0	U
71-55-6	1,1,1-Trichloroethane	1.2	< 1.2	U
56-23-5	Carbon Tetrachloride	1.2	< 1.2	U
108-05-4	Vinyl Acetate	6.0	< 6.0	U
75-27-4	Bromodichloromethane	1.2	< 1.2	U
78-87-5	1,2-Dichloropropane	1.2	< 1.2	U
10061-01-5	cis-1,3-Dichloropropene	1.2	< 1.2	U
79-01-6	**Trichloroethene**	**1.2**	**1,000**	**ES**
124-48-1	Dibromochloromethane	1.2	< 1.2	U
79-00-5	**1,1,2-Trichloroethane**	**1.2**	**1.2**	
71-43-2	Benzene	1.2	< 1.2	U
10061-02-6	trans-1,3-Dichloropropene	1.2	< 1.2	U
110-75-8	2-Chloroethylvinylether	6.0	< 6.0	U
75-25-2	Bromoform	1.2	< 1.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	6.0	< 6.0	U
591-78-6	2-Hexanone	6.0	< 6.0	U
127-18-4	Tetrachloroethene	1.2	< 1.2	U
79-34-5	1,1,2,2-Tetrachloroethane	1.2	< 1.2	U
108-88-3	Toluene	1.2	< 1.2	U
108-90-7	Chlorobenzene	1.2	< 1.2	U
100-41-4	Ethylbenzene	1.2	< 1.2	U
100-42-5	Styrene	1.2	< 1.2	U
75-69-4	Trichlorofluoromethane	1.2	< 1.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.4	< 2.4	U
179601-23-1	m,p-Xylene	1.2	< 1.2	U
95-47-6	o-Xylene	1.2	< 1.2	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	132%
d8-Toluene	118%
Bromofluorobenzene	106%

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: S-091229-PL2-SSL2-5-0
REANALYSIS

Lab Sample ID: QD12I
LIMS ID: 09-31883
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 01/07/10 13:24

Sample Amount: 20.9 mg-dry-wt
Purge Volume: 5.0 mL
Moisture: 16.2%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	240	< 240	U
74-83-9	Bromomethane	240	< 240	U
75-01-4	Vinyl Chloride	240	< 240	U
75-00-3	Chloroethane	240	< 240	U
75-09-2	Methylene Chloride	480	< 480	U
67-64-1	Acetone	1,200	< 1,200	U
75-15-0	**Carbon Disulfide**	**240**	**310**	**Q**
75-35-4	1,1-Dichloroethene	240	< 240	U
75-34-3	1,1-Dichloroethane	240	< 240	U
156-60-5	**trans-1,2-Dichloroethene**	**240**	**300**	
156-59-2	**cis-1,2-Dichloroethene**	**240**	**2,300**	
67-66-3	Chloroform	240	< 240	U
107-06-2	1,2-Dichloroethane	240	< 240	U
78-93-3	2-Butanone	1,200	< 1,200	U
71-55-6	1,1,1-Trichloroethane	240	< 240	U
56-23-5	Carbon Tetrachloride	240	< 240	U
108-05-4	Vinyl Acetate	1,200	< 1,200	U
75-27-4	Bromodichloromethane	240	< 240	U
78-87-5	1,2-Dichloropropane	240	< 240	U
10061-01-5	cis-1,3-Dichloropropene	240	< 240	U
79-01-6	**Trichloroethene**	**240**	**47,000**	
124-48-1	Dibromochloromethane	240	< 240	U
79-00-5	1,1,2-Trichloroethane	240	< 240	U
71-43-2	Benzene	240	< 240	U
10061-02-6	trans-1,3-Dichloropropene	240	< 240	U
110-75-8	2-Chloroethylvinylether	1,200	< 1,200	U
75-25-2	Bromoform	240	< 240	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	1,200	< 1,200	U
591-78-6	2-Hexanone	1,200	< 1,200	U
127-18-4	Tetrachloroethene	240	< 240	U
79-34-5	1,1,2,2-Tetrachloroethane	240	< 240	U
108-88-3	Toluene	240	< 240	U
108-90-7	Chlorobenzene	240	< 240	U
100-41-4	Ethylbenzene	240	< 240	U
100-42-5	Styrene	240	< 240	U
75-69-4	Trichlorofluoromethane	240	< 240	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	480	< 480	U
179601-23-1	m,p-Xylene	240	< 240	U
95-47-6	o-Xylene	240	< 240	U

Reported in μg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	102%
d8-Toluene	101%
Bromofluorobenzene	98.5%

Results corrected for soil moisture content per Section 11.10.5 of EPA Method 8000C.

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: S-091229-PL2-SSL2-10-0**
 SAMPLE

Lab Sample ID: QD12J
LIMS ID: 09-31884
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 01/07/10 12:53

Sample Amount: 3.86 g-dry-wt
Purge Volume: 5.0 mL
Moisture: 13.1%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.3	< 1.3	U
74-83-9	Bromomethane	1.3	< 1.3	U
75-01-4	Vinyl Chloride	1.3	< 1.3	U
75-00-3	Chloroethane	1.3	< 1.3	U
75-09-2	Methylene Chloride	2.6	< 2.6	U
67-64-1	**Acetone**	**6.5**	**66**	
75-15-0	Carbon Disulfide	1.3	< 1.3	U
75-35-4	1,1-Dichloroethene	1.3	< 1.3	U
75-34-3	1,1-Dichloroethane	1.3	< 1.3	U
156-60-5	**trans-1,2-Dichloroethene**	**1.3**	**6.0**	
156-59-2	**cis-1,2-Dichloroethene**	**1.3**	**120**	
67-66-3	**Chloroform**	**1.3**	**2.8**	
107-06-2	1,2-Dichloroethane	1.3	< 1.3	U
78-93-3	2-Butanone	6.5	< 6.5	U
71-55-6	1,1,1-Trichloroethane	1.3	< 1.3	U
56-23-5	Carbon Tetrachloride	1.3	< 1.3	U
108-05-4	Vinyl Acetate	6.5	< 6.5	U
75-27-4	Bromodichloromethane	1.3	< 1.3	U
78-87-5	1,2-Dichloropropane	1.3	< 1.3	U
10061-01-5	cis-1,3-Dichloropropene	1.3	< 1.3	U
79-01-6	**Trichloroethene**	**1.3**	**360**	**E**
124-48-1	Dibromochloromethane	1.3	< 1.3	U
79-00-5	1,1,2-Trichloroethane	1.3	< 1.3	U
71-43-2	Benzene	1.3	< 1.3	U
10061-02-6	trans-1,3-Dichloropropene	1.3	< 1.3	U
110-75-8	2-Chloroethylvinylether	6.5	< 6.5	U
75-25-2	Bromoform	1.3	< 1.3	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	6.5	< 6.5	U
591-78-6	2-Hexanone	6.5	< 6.5	U
127-18-4	Tetrachloroethene	1.3	< 1.3	U
79-34-5	1,1,2,2-Tetrachloroethane	1.3	< 1.3	U
108-88-3	Toluene	1.3	< 1.3	U
108-90-7	Chlorobenzene	1.3	< 1.3	U
100-41-4	Ethylbenzene	1.3	< 1.3	U
100-42-5	Styrene	1.3	< 1.3	U
75-69-4	Trichlorofluoromethane	1.3	< 1.3	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.6	< 2.6	U
179601-23-1	m,p-Xylene	1.3	< 1.3	U
95-47-6	o-Xylene	1.3	< 1.3	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	110%
d8-Toluene	102%
Bromofluorobenzene	99.8%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: S-091229-PL2-SSL2-10-0
REANALYSIS

Lab Sample ID: QD12J
LIMS ID: 09-31884
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 01/07/10 18:46

Sample Amount: 67.1 mg-dry-wt
Purge Volume: 5.0 mL
Moisture: 13.1%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	74	< 74	U
74-83-9	Bromomethane	74	< 74	U
75-01-4	Vinyl Chloride	74	< 74	U
75-00-3	Chloroethane	74	< 74	U
75-09-2	Methylene Chloride	150	< 150	U
67-64-1	Acetone	370	< 370	U
75-15-0	Carbon Disulfide	74	< 74	U
75-35-4	1,1-Dichloroethene	74	< 74	U
75-34-3	1,1-Dichloroethane	74	< 74	U
156-60-5	trans-1,2-Dichloroethene	74	< 74	U
156-59-2	**cis-1,2-Dichloroethene**	**74**	**190**	
67-66-3	Chloroform	74	< 74	U
107-06-2	1,2-Dichloroethane	74	< 74	U
78-93-3	2-Butanone	370	< 370	U
71-55-6	1,1,1-Trichloroethane	74	< 74	U
56-23-5	Carbon Tetrachloride	74	< 74	U
108-05-4	Vinyl Acetate	370	< 370	U
75-27-4	Bromodichloromethane	74	< 74	U
78-87-5	1,2-Dichloropropane	74	< 74	U
10061-01-5	cis-1,3-Dichloropropene	74	< 74	U
79-01-6	**Trichloroethene**	**74**	**870**	
124-48-1	Dibromochloromethane	74	< 74	U
79-00-5	1,1,2-Trichloroethane	74	< 74	U
71-43-2	Benzene	74	< 74	U
10061-02-6	trans-1,3-Dichloropropene	74	< 74	U
110-75-8	2-Chloroethylvinylether	370	< 370	U
75-25-2	Bromoform	74	< 74	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	370	< 370	U
591-78-6	2-Hexanone	370	< 370	U
127-18-4	Tetrachloroethene	74	< 74	U
79-34-5	1,1,2,2-Tetrachloroethane	74	< 74	U
108-88-3	Toluene	74	< 74	U
108-90-7	Chlorobenzene	74	< 74	U
100-41-4	Ethylbenzene	74	< 74	U
100-42-5	Styrene	74	< 74	U
75-69-4	Trichlorofluoromethane	74	< 74	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	150	< 150	U
179601-23-1	m,p-Xylene	74	< 74	U
95-47-6	o-Xylene	74	< 74	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	106%
d8-Toluene	100%
Bromofluorobenzene	97.3%

Results corrected for soil moisture content per Section 11.10.5 of EPA Method 8000C.

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: S-091229-PL2-SSL2-10-1**
 SAMPLE

Lab Sample ID: QD12K
LIMS ID: 09-31885
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 12/30/09 18:11

Sample Amount: 3.96 g-dry-wt
Purge Volume: 5.0 mL
Moisture: 5.5%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.3	< 1.3	U
74-83-9	Bromomethane	1.3	< 1.3	U
75-01-4	Vinyl Chloride	1.3	< 1.3	U
75-00-3	Chloroethane	1.3	< 1.3	U
75-09-2	Methylene Chloride	2.5	< 2.5	U
67-64-1	**Acetone**	**6.3**	**39**	
75-15-0	Carbon Disulfide	1.3	< 1.3	U
75-35-4	1,1-Dichloroethene	1.3	< 1.3	U
75-34-3	1,1-Dichloroethane	1.3	< 1.3	U
156-60-5	**trans-1,2-Dichloroethene**	**1.3**	**4.2**	
156-59-2	**cis-1,2-Dichloroethene**	**1.3**	**75**	
67-66-3	**Chloroform**	**1.3**	**1.8**	**M**
107-06-2	1,2-Dichloroethane	1.3	< 1.3	U
78-93-3	2-Butanone	6.3	< 6.3	U
71-55-6	1,1,1-Trichloroethane	1.3	< 1.3	U
56-23-5	Carbon Tetrachloride	1.3	< 1.3	U
108-05-4	Vinyl Acetate	6.3	< 6.3	U
75-27-4	Bromodichloromethane	1.3	< 1.3	U
78-87-5	1,2-Dichloropropane	1.3	< 1.3	U
10061-01-5	cis-1,3-Dichloropropene	1.3	< 1.3	U
79-01-6	**Trichloroethene**	**1.3**	**240**	
124-48-1	Dibromochloromethane	1.3	< 1.3	U
79-00-5	1,1,2-Trichloroethane	1.3	< 1.3	U
71-43-2	Benzene	1.3	< 1.3	U
10061-02-6	trans-1,3-Dichloropropene	1.3	< 1.3	U
110-75-8	2-Chloroethylvinylether	6.3	< 6.3	U
75-25-2	Bromoform	1.3	< 1.3	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	6.3	< 6.3	U
591-78-6	2-Hexanone	6.3	< 6.3	U
127-18-4	Tetrachloroethene	1.3	< 1.3	U
79-34-5	1,1,2,2-Tetrachloroethane	1.3	< 1.3	U
108-88-3	Toluene	1.3	< 1.3	U
108-90-7	Chlorobenzene	1.3	< 1.3	U
100-41-4	Ethylbenzene	1.3	< 1.3	U
100-42-5	Styrene	1.3	< 1.3	U
75-69-4	Trichlorofluoromethane	1.3	< 1.3	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.5	< 2.5	U
179601-23-1	m,p-Xylene	1.3	< 1.3	U
95-47-6	o-Xylene	1.3	< 1.3	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	139%
d8-Toluene	110%
Bromofluorobenzene	106%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: S-091229-PL2-SSL3-10-0**
 SAMPLE

Lab Sample ID: QD12L
LIMS ID: 09-31886
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 12/30/09 18:38

Sample Amount: 3.71 g-dry-wt
Purge Volume: 5.0 mL
Moisture: 11.0%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.4	< 1.4	U
74-83-9	Bromomethane	1.4	< 1.4	U
75-01-4	Vinyl Chloride	1.4	< 1.4	U
75-00-3	Chloroethane	1.4	< 1.4	U
75-09-2	Methylene Chloride	2.7	< 2.7	U
67-64-1	**Acetone**	**6.7**	**14**	
75-15-0	Carbon Disulfide	1.4	< 1.4	U
75-35-4	1,1-Dichloroethene	1.4	< 1.4	U
75-34-3	1,1-Dichloroethane	1.4	< 1.4	U
156-60-5	**trans-1,2-Dichloroethene**	**1.4**	**1.4**	
156-59-2	**cis-1,2-Dichloroethene**	**1.4**	**15**	
67-66-3	Chloroform	1.4	< 1.4	U
107-06-2	1,2-Dichloroethane	1.4	< 1.4	U
78-93-3	2-Butanone	6.7	< 6.7	U
71-55-6	1,1,1-Trichloroethane	1.4	< 1.4	U
56-23-5	Carbon Tetrachloride	1.4	< 1.4	U
108-05-4	Vinyl Acetate	6.7	< 6.7	U
75-27-4	Bromodichloromethane	1.4	< 1.4	U
78-87-5	1,2-Dichloropropane	1.4	< 1.4	U
10061-01-5	cis-1,3-Dichloropropene	1.4	< 1.4	U
79-01-6	**Trichloroethene**	**1.4**	**37**	
124-48-1	Dibromochloromethane	1.4	< 1.4	U
79-00-5	1,1,2-Trichloroethane	1.4	< 1.4	U
71-43-2	Benzene	1.4	< 1.4	U
10061-02-6	trans-1,3-Dichloropropene	1.4	< 1.4	U
110-75-8	2-Chloroethylvinylether	6.7	< 6.7	U
75-25-2	Bromoform	1.4	< 1.4	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	6.7	< 6.7	U
591-78-6	2-Hexanone	6.7	< 6.7	U
127-18-4	Tetrachloroethene	1.4	< 1.4	U
79-34-5	1,1,2,2-Tetrachloroethane	1.4	< 1.4	U
108-88-3	Toluene	1.4	< 1.4	U
108-90-7	Chlorobenzene	1.4	< 1.4	U
100-41-4	Ethylbenzene	1.4	< 1.4	U
100-42-5	Styrene	1.4	< 1.4	U
75-69-4	Trichlorofluoromethane	1.4	< 1.4	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.7	< 2.7	U
179601-23-1	m,p-Xylene	1.4	< 1.4	U
95-47-6	o-Xylene	1.4	< 1.4	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	143%
d8-Toluene	109%
Bromofluorobenzene	107%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: S-091229-PL2-SSL1-05-0
SAMPLE

Lab Sample ID: QD12M
LIMS ID: 09-31887
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 12/30/09 19:05

Sample Amount: 4.66 g-dry-wt
Purge Volume: 5.0 mL
Moisture: 11.2%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.1	< 1.1	U
74-83-9	Bromomethane	1.1	< 1.1	U
75-01-4	Vinyl Chloride	1.1	< 1.1	U
75-00-3	Chloroethane	1.1	< 1.1	U
75-09-2	Methylene Chloride	2.1	< 2.1	U
67-64-1	**Acetone**	**5.4**	**31**	
75-15-0	Carbon Disulfide	1.1	< 1.1	U
75-35-4	1,1-Dichloroethene	1.1	< 1.1	U
75-34-3	1,1-Dichloroethane	1.1	< 1.1	U
156-60-5	**trans-1,2-Dichloroethene**	**1.1**	**4.3**	
156-59-2	**cis-1,2-Dichloroethene**	**1.1**	**110**	
67-66-3	**Chloroform**	**1.1**	**3.0**	**M**
107-06-2	1,2-Dichloroethane	1.1	< 1.1	U
78-93-3	2-Butanone	5.4	< 5.4	U
71-55-6	1,1,1-Trichloroethane	1.1	< 1.1	U
56-23-5	Carbon Tetrachloride	1.1	< 1.1	U
108-05-4	Vinyl Acetate	5.4	< 5.4	U
75-27-4	Bromodichloromethane	1.1	< 1.1	U
78-87-5	1,2-Dichloropropane	1.1	< 1.1	U
10061-01-5	cis-1,3-Dichloropropene	1.1	< 1.1	U
79-01-6	**Trichloroethene**	**1.1**	**800**	**ES**
124-48-1	Dibromochloromethane	1.1	< 1.1	U
79-00-5	**1,1,2-Trichloroethane**	**1.1**	**2.6**	
71-43-2	Benzene	1.1	< 1.1	U
10061-02-6	trans-1,3-Dichloropropene	1.1	< 1.1	U
110-75-8	2-Chloroethylvinylether	5.4	< 5.4	U
75-25-2	Bromoform	1.1	< 1.1	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.4	< 5.4	U
591-78-6	2-Hexanone	5.4	< 5.4	U
127-18-4	Tetrachloroethene	1.1	< 1.1	U
79-34-5	1,1,2,2-Tetrachloroethane	1.1	< 1.1	U
108-88-3	Toluene	1.1	< 1.1	U
108-90-7	Chlorobenzene	1.1	< 1.1	U
100-41-4	Ethylbenzene	1.1	< 1.1	U
100-42-5	Styrene	1.1	< 1.1	U
75-69-4	Trichlorofluoromethane	1.1	< 1.1	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.1	< 2.1	U
179601-23-1	m,p-Xylene	1.1	< 1.1	U
95-47-6	o-Xylene	1.1	< 1.1	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	147%
d8-Toluene	116%
Bromofluorobenzene	105%

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: S-091229-PL2-SSL1-05-0**
 REANALYSIS

Lab Sample ID: QD12M
LIMS ID: 09-31887
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 01/07/10 13:51

Sample Amount: 38.1 mg-dry-wt
Purge Volume: 5.0 mL
Moisture: 11.2%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	130	< 130	U
74-83-9	Bromomethane	130	< 130	U
75-01-4	Vinyl Chloride	130	< 130	U
75-00-3	Chloroethane	130	< 130	U
75-09-2	Methylene Chloride	260	< 260	U
67-64-1	Acetone	660	< 660	U
75-15-0	Carbon Disulfide	130	< 130	U
75-35-4	1,1-Dichloroethene	130	< 130	U
75-34-3	1,1-Dichloroethane	130	< 130	U
156-60-5	trans-1,2-Dichloroethene	130	< 130	U
156-59-2	**cis-1,2-Dichloroethene**	**130**	**460**	
67-66-3	Chloroform	130	< 130	U
107-06-2	1,2-Dichloroethane	130	< 130	U
78-93-3	2-Butanone	660	< 660	U
71-55-6	1,1,1-Trichloroethane	130	< 130	U
56-23-5	Carbon Tetrachloride	130	< 130	U
108-05-4	Vinyl Acetate	660	< 660	U
75-27-4	Bromodichloromethane	130	< 130	U
78-87-5	1,2-Dichloropropane	130	< 130	U
10061-01-5	cis-1,3-Dichloropropene	130	< 130	U
79-01-6	**Trichloroethene**	**130**	**16,000**	
124-48-1	Dibromochloromethane	130	< 130	U
79-00-5	1,1,2-Trichloroethane	130	< 130	U
71-43-2	Benzene	130	< 130	U
10061-02-6	trans-1,3-Dichloropropene	130	< 130	U
110-75-8	2-Chloroethylvinylether	660	< 660	U
75-25-2	Bromoform	130	< 130	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	660	< 660	U
591-78-6	2-Hexanone	660	< 660	U
127-18-4	Tetrachloroethene	130	< 130	U
79-34-5	1,1,2,2-Tetrachloroethane	130	< 130	U
108-88-3	Toluene	130	< 130	U
108-90-7	Chlorobenzene	130	< 130	U
100-41-4	Ethylbenzene	130	< 130	U
100-42-5	Styrene	130	< 130	U
75-69-4	Trichlorofluoromethane	130	< 130	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	260	< 260	U
179601-23-1	m,p-Xylene	130	< 130	U
95-47-6	o-Xylene	130	< 130	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	99.7%
d8-Toluene	101%
Bromofluorobenzene	97.9%

Results corrected for soil moisture content per Section 11.10.5 of EPA Method 8000C.

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: S-091229-PL2-SSL1-10-1**
 SAMPLE

Lab Sample ID: QD12N
LIMS ID: 09-31888
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 12/30/09 19:32

Sample Amount: 3.98 g-dry-wt
Purge Volume: 5.0 mL
Moisture: 8.8%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.3	< 1.3	U
74-83-9	Bromomethane	1.3	< 1.3	U
75-01-4	Vinyl Chloride	1.3	< 1.3	U
75-00-3	Chloroethane	1.3	< 1.3	U
75-09-2	Methylene Chloride	2.5	< 2.5	U
67-64-1	**Acetone**	**6.3**	**46**	
75-15-0	Carbon Disulfide	1.3	< 1.3	U
75-35-4	1,1-Dichloroethene	1.3	< 1.3	U
75-34-3	1,1-Dichloroethane	1.3	< 1.3	U
156-60-5	**trans-1,2-Dichloroethene**	**1.3**	**5.4**	
156-59-2	**cis-1,2-Dichloroethene**	**1.3**	**150**	
67-66-3	**Chloroform**	**1.3**	**4.3**	**M**
107-06-2	1,2-Dichloroethane	1.3	< 1.3	U
78-93-3	2-Butanone	6.3	< 6.3	U
71-55-6	1,1,1-Trichloroethane	1.3	< 1.3	U
56-23-5	Carbon Tetrachloride	1.3	< 1.3	U
108-05-4	Vinyl Acetate	6.3	< 6.3	U
75-27-4	Bromodichloromethane	1.3	< 1.3	U
78-87-5	1,2-Dichloropropane	1.3	< 1.3	U
10061-01-5	cis-1,3-Dichloropropene	1.3	< 1.3	U
79-01-6	**Trichloroethene**	**1.3**	**1,100**	**ES**
124-48-1	Dibromochloromethane	1.3	< 1.3	U
79-00-5	**1,1,2-Trichloroethane**	**1.3**	**3.4**	
71-43-2	Benzene	1.3	< 1.3	U
10061-02-6	trans-1,3-Dichloropropene	1.3	< 1.3	U
110-75-8	2-Chloroethylvinylether	6.3	< 6.3	U
75-25-2	Bromoform	1.3	< 1.3	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	6.3	< 6.3	U
591-78-6	2-Hexanone	6.3	< 6.3	U
127-18-4	Tetrachloroethene	1.3	< 1.3	U
79-34-5	1,1,2,2-Tetrachloroethane	1.3	< 1.3	U
108-88-3	Toluene	1.3	< 1.3	U
108-90-7	Chlorobenzene	1.3	< 1.3	U
100-41-4	Ethylbenzene	1.3	< 1.3	U
100-42-5	Styrene	1.3	< 1.3	U
75-69-4	Trichlorofluoromethane	1.3	< 1.3	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.5	< 2.5	U
179601-23-1	m,p-Xylene	1.3	< 1.3	U
95-47-6	o-Xylene	1.3	< 1.3	U

Reported in μg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	146%
d8-Toluene	119%
Bromofluorobenzene	104%

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: S-091229-PL2-SSL1-10-1**
 REANALYSIS

Lab Sample ID: QD12N
LIMS ID: 09-31888
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 01/07/10 14:20

Sample Amount: 40.7 mg-dry-wt
Purge Volume: 5.0 mL
Moisture: 8.8%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	120	< 120	U
74-83-9	Bromomethane	120	< 120	U
75-01-4	Vinyl Chloride	120	< 120	U
75-00-3	Chloroethane	120	< 120	U
75-09-2	Methylene Chloride	250	< 250	U
67-64-1	Acetone	610	< 610	U
75-15-0	Carbon Disulfide	120	< 120	U
75-35-4	1,1-Dichloroethene	120	< 120	U
75-34-3	1,1-Dichloroethane	120	< 120	U
156-60-5	trans-1,2-Dichloroethene	120	< 120	U
156-59-2	**cis-1,2-Dichloroethene**	**120**	**400**	
67-66-3	Chloroform	120	< 120	U
107-06-2	1,2-Dichloroethane	120	< 120	U
78-93-3	2-Butanone	610	< 610	U
71-55-6	1,1,1-Trichloroethane	120	< 120	U
56-23-5	Carbon Tetrachloride	120	< 120	U
108-05-4	Vinyl Acetate	610	< 610	U
75-27-4	Bromodichloromethane	120	< 120	U
78-87-5	1,2-Dichloropropane	120	< 120	U
10061-01-5	cis-1,3-Dichloropropene	120	< 120	U
79-01-6	**Trichloroethene**	**120**	**9,100**	
124-48-1	Dibromochloromethane	120	< 120	U
79-00-5	1,1,2-Trichloroethane	120	< 120	U
71-43-2	Benzene	120	< 120	U
10061-02-6	trans-1,3-Dichloropropene	120	< 120	U
110-75-8	2-Chloroethylvinylether	610	< 610	U
75-25-2	Bromoform	120	< 120	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	610	< 610	U
591-78-6	2-Hexanone	610	< 610	U
127-18-4	Tetrachloroethene	120	< 120	U
79-34-5	1,1,2,2-Tetrachloroethane	120	< 120	U
108-88-3	Toluene	120	< 120	U
108-90-7	Chlorobenzene	120	< 120	U
100-41-4	Ethylbenzene	120	< 120	U
100-42-5	Styrene	120	< 120	U
75-69-4	Trichlorofluoromethane	120	< 120	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	250	< 250	U
179601-23-1	m,p-Xylene	120	< 120	U
95-47-6	o-Xylene	120	< 120	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	102%
d8-Toluene	103%
Bromofluorobenzene	97.1%

Results corrected for soil moisture content per Section 11.10.5 of EPA Method 8000C.

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: S-091229-PL2-SSL1-10-0**
 SAMPLE

Lab Sample ID: QD120
LIMS ID: 09-31889
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 12/30/09 19:58

Sample Amount: 4.42 g-dry-wt
Purge Volume: 5.0 mL
Moisture: 7.2%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.1	< 1.1	U
74-83-9	Bromomethane	1.1	< 1.1	U
75-01-4	Vinyl Chloride	1.1	< 1.1	U
75-00-3	Chloroethane	1.1	< 1.1	U
75-09-2	Methylene Chloride	2.3	< 2.3	U
67-64-1	**Acetone**	**5.7**	**59**	
75-15-0	Carbon Disulfide	1.1	< 1.1	U
75-35-4	1,1-Dichloroethene	1.1	< 1.1	U
75-34-3	1,1-Dichloroethane	1.1	< 1.1	U
156-60-5	**trans-1,2-Dichloroethene**	**1.1**	**7.5**	
156-59-2	**cis-1,2-Dichloroethene**	**1.1**	**220**	
67-66-3	**Chloroform**	**1.1**	**6.7**	
107-06-2	1,2-Dichloroethane	1.1	< 1.1	U
78-93-3	2-Butanone	5.7	< 5.7	U
71-55-6	1,1,1-Trichloroethane	1.1	< 1.1	U
56-23-5	Carbon Tetrachloride	1.1	< 1.1	U
108-05-4	Vinyl Acetate	5.7	< 5.7	U
75-27-4	Bromodichloromethane	1.1	< 1.1	U
78-87-5	1,2-Dichloropropane	1.1	< 1.1	U
10061-01-5	cis-1,3-Dichloropropene	1.1	< 1.1	U
79-01-6	**Trichloroethene**	**1.1**	**1,100**	**ES**
124-48-1	Dibromochloromethane	1.1	< 1.1	U
79-00-5	**1,1,2-Trichloroethane**	**1.1**	**4.6**	
71-43-2	Benzene	1.1	< 1.1	U
10061-02-6	trans-1,3-Dichloropropene	1.1	< 1.1	U
110-75-8	2-Chloroethylvinylether	5.7	< 5.7	U
75-25-2	Bromoform	1.1	< 1.1	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.7	< 5.7	U
591-78-6	2-Hexanone	5.7	< 5.7	U
127-18-4	Tetrachloroethene	1.1	< 1.1	U
79-34-5	1,1,2,2-Tetrachloroethane	1.1	< 1.1	U
108-88-3	Toluene	1.1	< 1.1	U
108-90-7	Chlorobenzene	1.1	< 1.1	U
100-41-4	Ethylbenzene	1.1	< 1.1	U
100-42-5	Styrene	1.1	< 1.1	U
75-69-4	Trichlorofluoromethane	1.1	< 1.1	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.3	< 2.3	U
179601-23-1	m,p-Xylene	1.1	< 1.1	U
95-47-6	o-Xylene	1.1	< 1.1	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	140%
d8-Toluene	119%
Bromofluorobenzene	106%

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: S-091229-PL2-SSL1-10-0**
 REANALYSIS

Lab Sample ID: QD120
LIMS ID: 09-31889
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 01/07/10 14:45

Sample Amount: 30.2 mg-dry-wt
Purge Volume: 5.0 mL
Moisture: 7.2%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	160	< 160	U
74-83-9	Bromomethane	160	< 160	U
75-01-4	Vinyl Chloride	160	< 160	U
75-00-3	Chloroethane	160	< 160	U
75-09-2	Methylene Chloride	330	< 330	U
67-64-1	Acetone	830	< 830	U
75-15-0	Carbon Disulfide	160	< 160	U
75-35-4	1,1-Dichloroethene	160	< 160	U
75-34-3	1,1-Dichloroethane	160	< 160	U
156-60-5	trans-1,2-Dichloroethene	160	< 160	U
156-59-2	**cis-1,2-Dichloroethene**	**160**	**360**	
67-66-3	Chloroform	160	< 160	U
107-06-2	1,2-Dichloroethane	160	< 160	U
78-93-3	2-Butanone	830	< 830	U
71-55-6	1,1,1-Trichloroethane	160	< 160	U
56-23-5	Carbon Tetrachloride	160	< 160	U
108-05-4	Vinyl Acetate	830	< 830	U
75-27-4	Bromodichloromethane	160	< 160	U
78-87-5	1,2-Dichloropropane	160	< 160	U
10061-01-5	cis-1,3-Dichloropropene	160	< 160	U
79-01-6	**Trichloroethene**	**160**	**7,200**	
124-48-1	Dibromochloromethane	160	< 160	U
79-00-5	1,1,2-Trichloroethane	160	< 160	U
71-43-2	Benzene	160	< 160	U
10061-02-6	trans-1,3-Dichloropropene	160	< 160	U
110-75-8	2-Chloroethylvinylether	830	< 830	U
75-25-2	Bromoform	160	< 160	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	830	< 830	U
591-78-6	2-Hexanone	830	< 830	U
127-18-4	Tetrachloroethene	160	< 160	U
79-34-5	1,1,2,2-Tetrachloroethane	160	< 160	U
108-88-3	Toluene	160	< 160	U
108-90-7	Chlorobenzene	160	< 160	U
100-41-4	Ethylbenzene	160	< 160	U
100-42-5	Styrene	160	< 160	U
75-69-4	Trichlorofluoromethane	160	< 160	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	330	< 330	U
179601-23-1	m,p-Xylene	160	< 160	U
95-47-6	o-Xylene	160	< 160	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	103%
d8-Toluene	103%
Bromofluorobenzene	99.6%

Results corrected for soil moisture content per Section 11.10.5 of EPA Method 8000C.

FORM I

ANALYTICAL RESOURCES INCORPORATED

VOA SURROGATE RECOVERY SUMMARY

Matrix: Soil

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

ARI ID	Client ID	Level	DCE	TOL	BFB	DCB	TOT OUT
MB-122909	Method Blank	Low	118%	106%	102%	NA	0
LCS-122909	Lab Control	Low	108%	108%	103%	NA	0
LCSD-122909	Lab Control Dup	Low	109%	106%	105%	NA	0
QD12A	S-091228-PL2-SSL5-05-0	Low	140%	109%	107%	NA	0
QD12B	S-091228-PL2-SSL5-10-0	Low	139%	110%	109%	NA	0
QD12C	S-091228-PL2-SSL6-05-0	Low	143%	108%	108%	NA	0
QD12D	S-091228-PL2-SSL6-10-0	Low	142%	108%	108%	NA	0
QD12E	S-091228-PL2-SSL7-05-0	Low	144%	111%	108%	NA	0
QD12F	S-091228-PL2-SSL7-10-0	Low	145%	108%	108%	NA	0
MB-123009	Method Blank	Low	121%	106%	102%	NA	0
LCS-123009	Lab Control	Low	108%	105%	105%	NA	0
LCSD-123009	Lab Control Dup	Low	115%	107%	105%	NA	0
QD12G	S-091228-PL2-SSL4-10-0	Low	148%	111%	109%	NA	0
QD12H	S-091228-PL2-SSL4-14-0	Low	150%	107%	108%	NA	0
MB-010710	Method Blank	Med	102%	103%	97.3%	NA	0
LCS-010710	Lab Control	Med	92.8%	99.7%	99.8%	NA	0
LCSD-010710	Lab Control Dup	Med	94.8%	99.8%	100%	NA	0
QD12I	S-091229-PL2-SSL2-5-0	Low	132%	118%*	106%	NA	1
QD12IRE	S-091229-PL2-SSL2-5-0	Med	102%	101%	98.5%	NA	0
MB-010710	Method Blank	Low	102%	103%	97.3%	NA	0
LCS-010710	Lab Control	Low	92.8%	99.7%	99.8%	NA	0
LCSD-010710	Lab Control Dup	Low	94.8%	99.8%	100%	NA	0
QD12J	S-091229-PL2-SSL2-10-0	Low	110%	102%	99.8%	NA	0
QD12JRE	S-091229-PL2-SSL2-10-0	Med	106%	100%	97.3%	NA	0
QD12JMS	S-091229-PL2-SSL2-10-0	Med	97.6%	101%	100%	NA	0
QD12JMSD	S-091229-PL2-SSL2-10-0	Med	97.8%	101%	100%	NA	0
QD12K	S-091229-PL2-SSL2-10-1	Low	139%	110%	106%	NA	0
QD12L	S-091229-PL2-SSL3-10-0	Low	143%	109%	107%	NA	0
QD12M	S-091229-PL2-SSL1-05-0	Low	147%	116%*	105%	NA	1
QD12MRE	S-091229-PL2-SSL1-05-0	Med	99.7%	101%	97.9%	NA	0
QD12N	S-091229-PL2-SSL1-10-1	Low	146%	119%*	104%	NA	1
QD12NRE	S-091229-PL2-SSL1-10-1	Med	102%	103%	97.1%	NA	0
QD12O	S-091229-PL2-SSL1-10-0	Low	140%	119%*	106%	NA	1
QD12ORE	S-091229-PL2-SSL1-10-0	Med	103%	103%	99.6%	NA	0

	LCS/MB LIMITS		QC LIMITS	
SW8260C	Low	Med	Low	Med
(DCE) = d4-1,2-Dichloroethane	79-121	76-120	75-152	69-120
(TOL) = d8-Toluene	80-120	80-120	82-115	80-120
(BFB) = Bromofluorobenzene	80-120	80-120	64-120	76-128
(DCB) = d4-1,2-Dichlorobenzene	80-120	80-120	80-120	80-120

Log Number Range: 09-31875 to 09-31889

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: S-091229-PL2-SSL2-10-0**

MATRIX SPIKE

Lab Sample ID: QD12J
LIMS ID: 09-31884
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst MS: FINN5/PAB
MSD: FINN5/PAB
Date Analyzed MS: 01/07/10 20:33
MSD: 01/07/10 21:00

Sample Amount MS: 67.1 mg-dry-wt
MSD: 67.1 mg-dry-wt
Purge Volume MS: 5.0 mL
MSD: 5.0 mL
Moisture: 13.1%

Analyte	Sample	MS	Spike Added-MS	MS Recovery	MSD	Spike Added-MSD	MSD Recovery	RPD
Chloromethane	< 74.5 U	3360	3730	90.1%	3590	3730	96.2%	6.6%
Bromomethane	< 74.5 U	2980	3730	79.9%	3320	3730	89.0%	10.8%
Vinyl Chloride	< 74.5 U	3620	3730	97.1%	3640	3730	97.6%	0.6%
Chloroethane	< 74.5 U	4260	3730	114%	4240	3730	114%	0.5%
Methylene Chloride	< 149 U	3770	3730	101%	3870	3730	104%	2.6%
Acetone	< 372 U	16700	18600	89.8%	16800	18600	90.3%	0.6%
Carbon Disulfide	< 74.5 U	3770 Q	3730	101%	3840 Q	3730	103%	1.8%
1,1-Dichloroethene	< 74.5 U	3490	3730	93.6%	3580	3730	96.0%	2.5%
1,1-Dichloroethane	< 74.5 U	3580	3730	96.0%	3710	3730	99.5%	3.6%
trans-1,2-Dichloroethene	< 74.5 U	3510	3730	94.1%	3570	3730	95.7%	1.7%
cis-1,2-Dichloroethene	191	3790	3730	96.5%	3860	3730	98.4%	1.8%
Chloroform	< 74.5 U	3620	3730	97.1%	3720	3730	99.7%	2.7%
1,2-Dichloroethane	< 74.5 U	3660	3730	98.1%	3770	3730	101%	3.0%
2-Butanone	< 372 U	17800	18600	95.7%	17800	18600	95.7%	0.0%
1,1,1-Trichloroethane	< 74.5 U	3470	3730	93.0%	3570	3730	95.7%	2.8%
Carbon Tetrachloride	< 74.5 U	3450	3730	92.5%	3480	3730	93.3%	0.9%
Vinyl Acetate	< 372 U	3620	3730	97.1%	3700	3730	99.2%	2.2%
Bromodichloromethane	< 74.5 U	3460	3730	92.8%	3480	3730	93.3%	0.6%
1,2-Dichloropropane	< 74.5 U	3510	3730	94.1%	3530	3730	94.6%	0.6%
cis-1,3-Dichloropropene	< 74.5 U	3570	3730	95.7%	3620	3730	97.1%	1.4%
Trichloroethene	874	4320	3730	92.4%	4300	3730	91.8%	0.5%
Dibromochloromethane	< 74.5 U	3520	3730	94.4%	3590	3730	96.2%	2.0%
1,1,2-Trichloroethane	< 74.5 U	3740	3730	100%	3750	3730	101%	0.3%
Benzene	< 74.5 U	3730	3730	100%	3750	3730	101%	0.5%
trans-1,3-Dichloropropene	< 74.5 U	3630	3730	97.3%	3680	3730	98.7%	1.4%
2-Chloroethylvinylether	< 372 U	3720	3730	99.7%	3840	3730	103%	3.2%
Bromoform	< 74.5 U	3240	3730	86.9%	3310	3730	88.7%	2.1%
4-Methyl-2-Pentanone (MIBK)	< 372 U	17900	18600	96.2%	18000	18600	96.8%	0.6%
2-Hexanone	< 372 U	18100	18600	97.3%	18900	18600	102%	4.3%
Tetrachloroethene	< 74.5 U	3440	3730	92.2%	3540	3730	94.9%	2.9%
1,1,2,2-Tetrachloroethane	< 74.5 U	3670	3730	98.4%	3680	3730	98.7%	0.3%
Toluene	< 74.5 U	3660	3730	98.1%	3600	3730	96.5%	1.7%
Chlorobenzene	< 74.5 U	3620	3730	97.1%	3630	3730	97.3%	0.3%
Ethylbenzene	< 74.5 U	3850	3730	103%	3890	3730	104%	1.0%
Styrene	< 74.5 U	3730	3730	100%	3790	3730	102%	1.6%
Trichlorofluoromethane	< 74.5 U	3180	3730	85.3%	3130	3730	83.9%	1.6%
1,1,2-Trichloro-1,2,2-trifl	< 149 U	3700	3730	99.2%	3750	3730	101%	1.3%
m,p-Xylene	< 74.5 U	7300	7450	98.0%	7430	7450	99.7%	1.8%
o-Xylene	< 74.5 U	3590	3730	96.2%	3650	3730	97.9%	1.7%

Reported in µg/kg (ppb)

RPD calculated using sample concentrations per SW846.

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: S-091229-PL2-SSL2-10-0
MATRIX SPIKE

Lab Sample ID: QD12J
LIMS ID: 09-31884
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 01/07/10 20:33

Sample Amount: 67.1 mg-dry-wt
Purge Volume: 5.0 mL
Moisture: 13.1%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	74	---	
74-83-9	Bromomethane	74	---	
75-01-4	Vinyl Chloride	74	---	
75-00-3	Chloroethane	74	---	
75-09-2	Methylene Chloride	150	---	
67-64-1	Acetone	370	---	
75-15-0	Carbon Disulfide	74	---	
75-35-4	1,1-Dichloroethene	74	---	
75-34-3	1,1-Dichloroethane	74	---	
156-60-5	trans-1,2-Dichloroethene	74	---	
156-59-2	cis-1,2-Dichloroethene	74	---	
67-66-3	Chloroform	74	---	
107-06-2	1,2-Dichloroethane	74	---	
78-93-3	2-Butanone	370	---	
71-55-6	1,1,1-Trichloroethane	74	---	
56-23-5	Carbon Tetrachloride	74	---	
108-05-4	Vinyl Acetate	370	---	
75-27-4	Bromodichloromethane	74	---	
78-87-5	1,2-Dichloropropane	74	---	
10061-01-5	cis-1,3-Dichloropropene	74	---	
79-01-6	Trichloroethene	74	---	
124-48-1	Dibromochloromethane	74	---	
79-00-5	1,1,2-Trichloroethane	74	---	
71-43-2	Benzene	74	---	
10061-02-6	trans-1,3-Dichloropropene	74	---	
110-75-8	2-Chloroethylvinylether	370	---	
75-25-2	Bromoform	74	---	
108-10-1	4-Methyl-2-Pentanone (MIBK)	370	---	
591-78-6	2-Hexanone	370	---	
127-18-4	Tetrachloroethene	74	---	
79-34-5	1,1,2,2-Tetrachloroethane	74	---	
108-88-3	Toluene	74	---	
108-90-7	Chlorobenzene	74	---	
100-41-4	Ethylbenzene	74	---	
100-42-5	Styrene	74	---	
75-69-4	Trichlorofluoromethane	74	---	
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	150	---	
179601-23-1	m,p-Xylene	74	---	
95-47-6	o-Xylene	74	---	

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	97.6%
d8-Toluene	101%
Bromofluorobenzene	100%

Results corrected for soil moisture content per Section 11.10.5 of EPA Method 8000C.

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: S-091229-PL2-SSL2-10-0
MATRIX SPIKE DUP

Lab Sample ID: QD12J
LIMS ID: 09-31884
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst: FINN5/PAB
Date Analyzed: 01/07/10 21:00

Sample Amount: 67.1 mg-dry-wt
Purge Volume: 5.0 mL
Moisture: 13.1%

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	74	---	
74-83-9	Bromomethane	74	---	
75-01-4	Vinyl Chloride	74	---	
75-00-3	Chloroethane	74	---	
75-09-2	Methylene Chloride	150	---	
67-64-1	Acetone	370	---	
75-15-0	Carbon Disulfide	74	---	
75-35-4	1,1-Dichloroethene	74	---	
75-34-3	1,1-Dichloroethane	74	---	
156-60-5	trans-1,2-Dichloroethene	74	---	
156-59-2	cis-1,2-Dichloroethene	74	---	
67-66-3	Chloroform	74	---	
107-06-2	1,2-Dichloroethane	74	---	
78-93-3	2-Butanone	370	---	
71-55-6	1,1,1-Trichloroethane	74	---	
56-23-5	Carbon Tetrachloride	74	---	
108-05-4	Vinyl Acetate	370	---	
75-27-4	Bromodichloromethane	74	---	
78-87-5	1,2-Dichloropropane	74	---	
10061-01-5	cis-1,3-Dichloropropene	74	---	
79-01-6	Trichloroethene	74	---	
124-48-1	Dibromochloromethane	74	---	
79-00-5	1,1,2-Trichloroethane	74	---	
71-43-2	Benzene	74	---	
10061-02-6	trans-1,3-Dichloropropene	74	---	
110-75-8	2-Chloroethylvinylether	370	---	
75-25-2	Bromoform	74	---	
108-10-1	4-Methyl-2-Pentanone (MIBK)	370	---	
591-78-6	2-Hexanone	370	---	
127-18-4	Tetrachloroethene	74	---	
79-34-5	1,1,2,2-Tetrachloroethane	74	---	
108-88-3	Toluene	74	---	
108-90-7	Chlorobenzene	74	---	
100-41-4	Ethylbenzene	74	---	
100-42-5	Styrene	74	---	
75-69-4	Trichlorofluoromethane	74	---	
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	150	---	
179601-23-1	m,p-Xylene	74	---	
95-47-6	o-Xylene	74	---	

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	97.8%
d8-Toluene	101%
Bromofluorobenzene	100%

Results corrected for soil moisture content per Section 11.10.5 of EPA Method 8000C.

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-122909**

LAB CONTROL SAMPLE

Lab Sample ID: LCS-122909
LIMS ID: 09-31875
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: NA
Date Received: NA

Instrument/Analyst LCS: FINN5/PAB
LCSD: FINN5/PAB
Date Analyzed LCS: 12/29/09 09:26
LCSD: 12/29/09 10:00

Sample Amount LCS: 5.00 g-dry-wt
LCSD: 5.00 g-dry-wt
Purge Volume LCS: 5.0 mL
LCSD: 5.0 mL
Moisture: NA

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
Chloromethane	46.2	50.0	92.4%	50.3	50.0	101%	8.5%
Bromomethane	44.1	50.0	88.2%	47.2	50.0	94.4%	6.8%
Vinyl Chloride	54.8 Q	50.0	110%	59.4 Q	50.0	119%	8.1%
Chloroethane	50.1	50.0	100%	55.0	50.0	110%	9.3%
Methylene Chloride	43.9	50.0	87.8%	46.8	50.0	93.6%	6.4%
Acetone	256	250	102%	262	250	105%	2.3%
Carbon Disulfide	48.9	50.0	97.8%	51.1	50.0	102%	4.4%
1,1-Dichloroethene	44.0	50.0	88.0%	48.5	50.0	97.0%	9.7%
1,1-Dichloroethane	46.1	50.0	92.2%	50.3	50.0	101%	8.7%
trans-1,2-Dichloroethene	45.3	50.0	90.6%	48.7	50.0	97.4%	7.2%
cis-1,2-Dichloroethene	43.9	50.0	87.8%	48.9	50.0	97.8%	10.8%
Chloroform	46.0	50.0	92.0%	49.8	50.0	99.6%	7.9%
1,2-Dichloroethane	48.0	50.0	96.0%	50.3	50.0	101%	4.7%
2-Butanone	236	250	94.4%	245	250	98.0%	3.7%
1,1,1-Trichloroethane	47.1	50.0	94.2%	51.9	50.0	104%	9.7%
Carbon Tetrachloride	49.1	50.0	98.2%	53.5	50.0	107%	8.6%
Vinyl Acetate	49.4	50.0	98.8%	51.9	50.0	104%	4.9%
Bromodichloromethane	49.1	50.0	98.2%	51.8	50.0	104%	5.4%
1,2-Dichloropropane	45.0	50.0	90.0%	48.0	50.0	96.0%	6.5%
cis-1,3-Dichloropropene	48.4	50.0	96.8%	52.3	50.0	105%	7.7%
Trichloroethene	45.8	50.0	91.6%	50.3	50.0	101%	9.4%
Dibromochloromethane	48.8	50.0	97.6%	51.5	50.0	103%	5.4%
1,1,2-Trichloroethane	46.4	50.0	92.8%	49.2	50.0	98.4%	5.9%
Benzene	44.9	50.0	89.8%	48.4	50.0	96.8%	7.5%
trans-1,3-Dichloropropene	49.6	50.0	99.2%	53.7	50.0	107%	7.9%
2-Chloroethylvinylether	55.0	50.0	110%	54.6	50.0	109%	0.7%
Bromoform	54.9	50.0	110%	55.7	50.0	111%	1.4%
4-Methyl-2-Pentanone (MIBK)	248	250	99.2%	257	250	103%	3.6%
2-Hexanone	270	250	108%	281	250	112%	4.0%
Tetrachloroethene	46.1	50.0	92.2%	49.2	50.0	98.4%	6.5%
1,1,2,2-Tetrachloroethane	46.8	50.0	93.6%	47.5	50.0	95.0%	1.5%
Toluene	45.5	50.0	91.0%	49.5	50.0	99.0%	8.4%
Chlorobenzene	45.8	50.0	91.6%	48.2	50.0	96.4%	5.1%
Ethylbenzene	48.2	50.0	96.4%	51.8	50.0	104%	7.2%
Styrene	47.9	50.0	95.8%	50.8	50.0	102%	5.9%
Trichlorofluoromethane	53.6 Q	50.0	107%	58.5 Q	50.0	117%	8.7%
1,1,2-Trichloro-1,2,2-trifluoroetha	45.8	50.0	91.6%	49.8	50.0	99.6%	8.4%
m,p-Xylene	95.0	100	95.0%	101	100	101%	6.1%
o-Xylene	45.8	50.0	91.6%	48.7	50.0	97.4%	6.1%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-122909**

LAB CONTROL SAMPLE

Lab Sample ID: LCS-122909
LIMS ID: 09-31875
Matrix: Soil

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD

Reported in µg/kg (ppb)

RPD calculated using sample concentrations per SW846.

Volatile Surrogate Recovery

	LCS	LCSD
d4-1,2-Dichloroethane	108%	109%
d8-Toluene	108%	106%
Bromofluorobenzene	103%	105%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-123009**

LAB CONTROL SAMPLE

Lab Sample ID: LCS-123009
LIMS ID: 09-31881
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: NA
Date Received: NA

Instrument/Analyst LCS: FINN5/PAB
LCSD: FINN5/PAB
Date Analyzed LCS: 12/30/09 10:57
LCSD: 12/30/09 11:41

Sample Amount LCS: 5.00 g-dry-wt
LCSD: 5.00 g-dry-wt
Purge Volume LCS: 5.0 mL
LCSD: 5.0 mL
Moisture: NA

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
Chloromethane	49.5	50.0	99.0%	54.1	50.0	108%	8.9%
Bromomethane	48.7	50.0	97.4%	51.2	50.0	102%	5.0%
Vinyl Chloride	58.3 Q	50.0	117%	62.1 Q	50.0	124%	6.3%
Chloroethane	53.7	50.0	107%	57.5	50.0	115%	6.8%
Methylene Chloride	45.9	50.0	91.8%	48.0	50.0	96.0%	4.5%
Acetone	321	250	128%	345	250	138%	7.2%
Carbon Disulfide	52.1	50.0	104%	47.0	50.0	94.0%	10.3%
1,1-Dichloroethene	46.3	50.0	92.6%	50.9	50.0	102%	9.5%
1,1-Dichloroethane	49.5	50.0	99.0%	53.1	50.0	106%	7.0%
trans-1,2-Dichloroethene	48.1	50.0	96.2%	51.4	50.0	103%	6.6%
cis-1,2-Dichloroethene	47.7	50.0	95.4%	48.7	50.0	97.4%	2.1%
Chloroform	49.3	50.0	98.6%	51.9	50.0	104%	5.1%
1,2-Dichloroethane	51.7	50.0	103%	53.7	50.0	107%	3.8%
2-Butanone	289	250	116%	300	250	120%	3.7%
1,1,1-Trichloroethane	51.2	50.0	102%	55.1	50.0	110%	7.3%
Carbon Tetrachloride	53.4	50.0	107%	55.5	50.0	111%	3.9%
Vinyl Acetate	55.5	50.0	111%	57.2	50.0	114%	3.0%
Bromodichloromethane	53.6	50.0	107%	54.6	50.0	109%	1.8%
1,2-Dichloropropane	48.0	50.0	96.0%	49.2	50.0	98.4%	2.5%
cis-1,3-Dichloropropene	54.1	50.0	108%	54.8	50.0	110%	1.3%
Trichloroethene	49.2	50.0	98.4%	51.7	50.0	103%	5.0%
Dibromochloromethane	54.5	50.0	109%	55.1	50.0	110%	1.1%
1,1,2-Trichloroethane	51.4	50.0	103%	52.2	50.0	104%	1.5%
Benzene	47.9	50.0	95.8%	49.8	50.0	99.6%	3.9%
trans-1,3-Dichloropropene	55.2	50.0	110%	56.0	50.0	112%	1.4%
2-Chloroethylvinylether	65.3	50.0	131%	59.8	50.0	120%	8.8%
Bromoform	62.4	50.0	125%	60.8	50.0	122%	2.6%
4-Methyl-2-Pentanone (MIBK)	289	250	116%	293	250	117%	1.4%
2-Hexanone	323	250	129%	328	250	131%	1.5%
Tetrachloroethene	48.7	50.0	97.4%	49.7	50.0	99.4%	2.0%
1,1,2,2-Tetrachloroethane	54.7	50.0	109%	53.5	50.0	107%	2.2%
Toluene	48.8	50.0	97.6%	49.7	50.0	99.4%	1.8%
Chlorobenzene	49.5	50.0	99.0%	49.9	50.0	99.8%	0.8%
Ethylbenzene	52.6	50.0	105%	52.9	50.0	106%	0.6%
Styrene	52.0	50.0	104%	52.0	50.0	104%	0.0%
Trichlorofluoromethane	56.8	50.0	114%	62.0	50.0	124%	8.8%
1,1,2-Trichloro-1,2,2-trifluoroetha	47.9	50.0	95.8%	52.0	50.0	104%	8.2%
m,p-Xylene	103	100	103%	104	100	104%	1.0%
o-Xylene	49.6	50.0	99.2%	50.5	50.0	101%	1.8%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: LCS-123009
LAB CONTROL SAMPLE

Lab Sample ID: LCS-123009
LIMS ID: 09-31881
Matrix: Soil

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD

Reported in µg/kg (ppb)

RPD calculated using sample concentrations per SW846.

Volatile Surrogate Recovery

	LCS	LCSD
d4-1,2-Dichloroethane	108%	115%
d8-Toluene	105%	107%
Bromofluorobenzene	105%	105%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-010710**

LAB CONTROL SAMPLE

Lab Sample ID: LCS-010710
LIMS ID: 09-31884
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: NA
Date Received: NA

Instrument/Analyst LCS: FINN5/PAB
LCSD: FINN5/PAB
Date Analyzed LCS: 01/07/10 11:07
LCSD: 01/07/10 11:42

Sample Amount LCS: 5.00 g-dry-wt
LCSD: 5.00 g-dry-wt
Purge Volume LCS: 5.0 mL
LCSD: 5.0 mL
Moisture: NA

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
Chloromethane	45.0	50.0	90.0%	43.8	50.0	87.6%	2.7%
Bromomethane	47.5	50.0	95.0%	44.9	50.0	89.8%	5.6%
Vinyl Chloride	57.4	50.0	115%	56.0	50.0	112%	2.5%
Chloroethane	62.2	50.0	124%	55.4	50.0	111%	11.6%
Methylene Chloride	51.7	50.0	103%	50.9	50.0	102%	1.6%
Acetone	230	250	92.0%	235	250	94.0%	2.2%
Carbon Disulfide	54.3 Q	50.0	109%	51.7 Q	50.0	103%	4.9%
1,1-Dichloroethene	48.6	50.0	97.2%	48.6	50.0	97.2%	0.0%
1,1-Dichloroethane	49.4	50.0	98.8%	49.4	50.0	98.8%	0.0%
trans-1,2-Dichloroethene	49.6	50.0	99.2%	48.7	50.0	97.4%	1.8%
cis-1,2-Dichloroethene	47.8	50.0	95.6%	48.8	50.0	97.6%	2.1%
Chloroform	48.4	50.0	96.8%	48.2	50.0	96.4%	0.4%
1,2-Dichloroethane	46.0	50.0	92.0%	46.6	50.0	93.2%	1.3%
2-Butanone	231	250	92.4%	235	250	94.0%	1.7%
1,1,1-Trichloroethane	48.7	50.0	97.4%	48.0	50.0	96.0%	1.4%
Carbon Tetrachloride	48.6	50.0	97.2%	48.0	50.0	96.0%	1.2%
Vinyl Acetate	48.3	50.0	96.6%	50.0	50.0	100%	3.5%
Bromodichloromethane	47.1	50.0	94.2%	47.1	50.0	94.2%	0.0%
1,2-Dichloropropane	47.0	50.0	94.0%	48.0	50.0	96.0%	2.1%
cis-1,3-Dichloropropene	49.1	50.0	98.2%	49.6	50.0	99.2%	1.0%
Trichloroethene	49.0	50.0	98.0%	48.4	50.0	96.8%	1.2%
Dibromochloromethane	50.7	50.0	101%	50.1	50.0	100%	1.2%
1,1,2-Trichloroethane	46.9	50.0	93.8%	47.7	50.0	95.4%	1.7%
Benzene	50.1	50.0	100%	50.1	50.0	100%	0.0%
trans-1,3-Dichloropropene	48.6	50.0	97.2%	50.3	50.0	101%	3.4%
2-Chloroethylvinylether	48.6	50.0	97.2%	48.2	50.0	96.4%	0.8%
Bromoform	46.7	50.0	93.4%	47.1	50.0	94.2%	0.9%
4-Methyl-2-Pentanone (MIBK)	223	250	89.2%	236	250	94.4%	5.7%
2-Hexanone	239	250	95.6%	246	250	98.4%	2.9%
Tetrachloroethene	51.5	50.0	103%	48.4	50.0	96.8%	6.2%
1,1,2,2-Tetrachloroethane	46.8	50.0	93.6%	47.6	50.0	95.2%	1.7%
Toluene	48.4	50.0	96.8%	48.9	50.0	97.8%	1.0%
Chlorobenzene	49.5	50.0	99.0%	49.2	50.0	98.4%	0.6%
Ethylbenzene	53.5	50.0	107%	52.5	50.0	105%	1.9%
Styrene	52.2	50.0	104%	51.6	50.0	103%	1.2%
Trichlorofluoromethane	51.5	50.0	103%	51.0	50.0	102%	1.0%
1,1,2-Trichloro-1,2,2-trifluoroetha	50.4	50.0	101%	49.5	50.0	99.0%	1.8%
m,p-Xylene	106	100	106%	104	100	104%	1.9%
o-Xylene	50.1	50.0	100%	49.5	50.0	99.0%	1.2%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-010710**

LAB CONTROL SAMPLE

Lab Sample ID: LCS-010710
LIMS ID: 09-31884
Matrix: Soil

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD

Reported in µg/kg (ppb)

RPD calculated using sample concentrations per SW846.

Volatile Surrogate Recovery

	LCS	LCSD
d4-1,2-Dichloroethane	92.8%	94.8%
d8-Toluene	99.7%	99.8%
Bromofluorobenzene	99.8%	100%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-010710**

LAB CONTROL SAMPLE

Lab Sample ID: LCS-010710
LIMS ID: 09-31883
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: NA
Date Received: NA

Instrument/Analyst LCS: FINN5/PAB
LCSD: FINN5/PAB
Date Analyzed LCS: 01/07/10 11:07
LCSD: 01/07/10 11:42

Sample Amount LCS: 100 mg-dry-wt
LCSD: 100 mg-dry-wt
Purge Volume LCS: 5.0 mL
LCSD: 5.0 mL
Moisture: NA

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
Chloromethane	2250	2500	90.0%	2190	2500	87.6%	2.7%
Bromomethane	2380	2500	95.2%	2240	2500	89.6%	6.1%
Vinyl Chloride	2870	2500	115%	2800	2500	112%	2.5%
Chloroethane	3110	2500	124%	2770	2500	111%	11.6%
Methylene Chloride	2590	2500	104%	2540	2500	102%	1.9%
Acetone	11500	12500	92.0%	11800	12500	94.4%	2.6%
Carbon Disulfide	2710 Q	2500	108%	2590 Q	2500	104%	4.5%
1,1-Dichloroethene	2430	2500	97.2%	2430	2500	97.2%	0.0%
1,1-Dichloroethane	2470	2500	98.8%	2470	2500	98.8%	0.0%
trans-1,2-Dichloroethene	2480	2500	99.2%	2440	2500	97.6%	1.6%
cis-1,2-Dichloroethene	2390	2500	95.6%	2440	2500	97.6%	2.1%
Chloroform	2420	2500	96.8%	2410	2500	96.4%	0.4%
1,2-Dichloroethane	2300	2500	92.0%	2330	2500	93.2%	1.3%
2-Butanone	11600	12500	92.8%	11800	12500	94.4%	1.7%
1,1,1-Trichloroethane	2430	2500	97.2%	2400	2500	96.0%	1.2%
Carbon Tetrachloride	2430	2500	97.2%	2400	2500	96.0%	1.2%
Vinyl Acetate	2420	2500	96.8%	2500	2500	100%	3.3%
Bromodichloromethane	2350	2500	94.0%	2350	2500	94.0%	0.0%
1,2-Dichloropropane	2350	2500	94.0%	2400	2500	96.0%	2.1%
cis-1,3-Dichloropropene	2460	2500	98.4%	2480	2500	99.2%	0.8%
Trichloroethene	2450	2500	98.0%	2420	2500	96.8%	1.2%
Dibromochloromethane	2530	2500	101%	2510	2500	100%	0.8%
1,1,2-Trichloroethane	2350	2500	94.0%	2380	2500	95.2%	1.3%
Benzene	2510	2500	100%	2500	2500	100%	0.4%
trans-1,3-Dichloropropene	2430	2500	97.2%	2520	2500	101%	3.6%
2-Chloroethylvinylether	2430	2500	97.2%	2410	2500	96.4%	0.8%
Bromoform	2330	2500	93.2%	2350	2500	94.0%	0.9%
4-Methyl-2-Pentanone (MIBK)	11200	12500	89.6%	11800	12500	94.4%	5.2%
2-Hexanone	11900	12500	95.2%	12300	12500	98.4%	3.3%
Tetrachloroethene	2580	2500	103%	2420	2500	96.8%	6.4%
1,1,2,2-Tetrachloroethane	2340	2500	93.6%	2380	2500	95.2%	1.7%
Toluene	2420	2500	96.8%	2450	2500	98.0%	1.2%
Chlorobenzene	2480	2500	99.2%	2460	2500	98.4%	0.8%
Ethylbenzene	2680	2500	107%	2630	2500	105%	1.9%
Styrene	2610	2500	104%	2580	2500	103%	1.2%
Trichlorofluoromethane	2570	2500	103%	2550	2500	102%	0.8%
1,1,2-Trichloro-1,2,2-trifluoroetha	2520	2500	101%	2470	2500	98.8%	2.0%
m,p-Xylene	5320	5000	106%	5190	5000	104%	2.5%
o-Xylene	2510	2500	100%	2470	2500	98.8%	1.6%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-010710**
 LAB CONTROL SAMPLE

Lab Sample ID: LCS-010710 QC Report No: QD12-The Boeing Company
LIMS ID: 09-31883 Project: Bldg 2-10 Sheetpiles
Matrix: Soil

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD

Reported in µg/kg (ppb)

RPD calculated using sample concentrations per SW846.

Volatile Surrogate Recovery

	LCS	LCSD
d4-1,2-Dichloroethane	92.8%	94.8%
d8-Toluene	99.7%	99.8%
Bromofluorobenzene	99.8%	100%

4A
VOLATILE METHOD BLANK SUMMARY

Method Blank ID.

MB1229

Lab Name: ANALYTICAL RESOURCES, INC

Client: BOEING

ARI Job No: QD12

Project: 2-10 SHEETPILE

Lab File ID: MB1229

Lab Sample ID: MB1229

Date Analyzed: 12/29/09

Time Analyzed: 1027

Instrument ID: FINN5

Heated Purge: (Y/N) Y

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	LCS1229	LCS1229	LCS1229	0926
02	LCS1229	LCS1229	LCS1229A	1000
03	S-091228-PL2	QD12A	QD12A	1734
04	S-091228-PL2	QD12B	QD12B	1800
05	S-091228-PL2	QD12C	QD12C	1827
06	S-091228-PL2	QD12D	QD12D	1854
07	S-091228-PL2	QD12E	QD12E	1921
08	S-091228-PL2	QD12F	QD12F	1948
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COMMENTS:

FORM IV VOA

OLM3.2M

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: MB-122909**

METHOD BLANK

Lab Sample ID: MB-122909
LIMS ID: 09-31875
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: NA
Date Received: NA

Instrument/Analyst: FINN5/PAB
Date Analyzed: 12/29/09 10:27

Sample Amount: 5.00 g-dry-wt
Purge Volume: 5.0 mL
Moisture: NA

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.0	< 1.0	U
74-83-9	Bromomethane	1.0	< 1.0	U
75-01-4	Vinyl Chloride	1.0	< 1.0	U
75-00-3	Chloroethane	1.0	< 1.0	U
75-09-2	Methylene Chloride	2.0	< 2.0	U
67-64-1	**Acetone**	**5.0**	**7.8**	
75-15-0	Carbon Disulfide	1.0	< 1.0	U
75-35-4	1,1-Dichloroethene	1.0	< 1.0	U
75-34-3	1,1-Dichloroethane	1.0	< 1.0	U
156-60-5	trans-1,2-Dichloroethene	1.0	< 1.0	U
156-59-2	cis-1,2-Dichloroethene	1.0	< 1.0	U
67-66-3	Chloroform	1.0	< 1.0	U
107-06-2	1,2-Dichloroethane	1.0	< 1.0	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	1.0	< 1.0	U
56-23-5	Carbon Tetrachloride	1.0	< 1.0	U
108-05-4	Vinyl Acetate	5.0	< 5.0	U
75-27-4	Bromodichloromethane	1.0	< 1.0	U
78-87-5	1,2-Dichloropropane	1.0	< 1.0	U
10061-01-5	cis-1,3-Dichloropropene	1.0	< 1.0	U
79-01-6	Trichloroethene	1.0	< 1.0	U
124-48-1	Dibromochloromethane	1.0	< 1.0	U
79-00-5	1,1,2-Trichloroethane	1.0	< 1.0	U
71-43-2	Benzene	1.0	< 1.0	U
10061-02-6	trans-1,3-Dichloropropene	1.0	< 1.0	U
110-75-8	2-Chloroethylvinylether	5.0	< 5.0	U
75-25-2	Bromoform	1.0	< 1.0	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	1.0	< 1.0	U
79-34-5	1,1,2,2-Tetrachloroethane	1.0	< 1.0	U
108-88-3	Toluene	1.0	< 1.0	U
108-90-7	Chlorobenzene	1.0	< 1.0	U
100-41-4	Ethylbenzene	1.0	< 1.0	U
100-42-5	Styrene	1.0	< 1.0	U
75-69-4	Trichlorofluoromethane	1.0	< 1.0	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.0	< 2.0	U
179601-23-1	m,p-Xylene	1.0	< 1.0	U
95-47-6	o-Xylene	1.0	< 1.0	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	118%
d8-Toluene	106%
Bromofluorobenzene	102%

4A
VOLATILE METHOD BLANK SUMMARY

Method Blank ID.

MB1230

Lab Name: ANALYTICAL RESOURCES, INC

Client: BOEING

ARI Job No: QD12

Project: 2-10 SHEETPILE

Lab File ID: MB1230A

Lab Sample ID: MB1230

Date Analyzed: 12/30/09

Time Analyzed: 1256

Instrument ID: FINN5

Heated Purge: (Y/N) Y

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	LCS1230	LCS1230	LCS1230	1057
02	LCS1230	LCS1230	LCS1230A	1141
03	S-091228-PL2	QD12G	QD12G	1624
04	S-091228-PL2	QD12H	QD12H	1651
05	S-091229-PL2	QD12I	QD12I	1717
06	S-091229-PL2	QD12K	QD12K	1811
07	S-091229-PL2	QD12L	QD12L	1838
08	S-091229-PL2	QD12M	QD12M	1905
09	S-091229-PL2	QD12N	QD12N	1932
10	S-091229-PL2	QD12O	QD12O	1958
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COMMENTS:

FORM IV VOA

OLM3.2M

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: MB-123009**

METHOD BLANK

Lab Sample ID: MB-123009
LIMS ID: 09-31881
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: NA
Date Received: NA

Instrument/Analyst: FINN5/PAB
Date Analyzed: 12/30/09 12:56

Sample Amount: 5.00 g-dry-wt
Purge Volume: 5.0 mL
Moisture: NA

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.0	< 1.0	U
74-83-9	Bromomethane	1.0	< 1.0	U
75-01-4	Vinyl Chloride	1.0	< 1.0	U
75-00-3	Chloroethane	1.0	< 1.0	U
75-09-2	Methylene Chloride	2.0	< 2.0	U
67-64-1	Acetone	5.0	< 5.0	U
75-15-0	Carbon Disulfide	1.0	< 1.0	U
75-35-4	1,1-Dichloroethene	1.0	< 1.0	U
75-34-3	1,1-Dichloroethane	1.0	< 1.0	U
156-60-5	trans-1,2-Dichloroethene	1.0	< 1.0	U
156-59-2	cis-1,2-Dichloroethene	1.0	< 1.0	U
67-66-3	Chloroform	1.0	< 1.0	U
107-06-2	1,2-Dichloroethane	1.0	< 1.0	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	1.0	< 1.0	U
56-23-5	Carbon Tetrachloride	1.0	< 1.0	U
108-05-4	Vinyl Acetate	5.0	< 5.0	U
75-27-4	Bromodichloromethane	1.0	< 1.0	U
78-87-5	1,2-Dichloropropane	1.0	< 1.0	U
10061-01-5	cis-1,3-Dichloropropene	1.0	< 1.0	U
79-01-6	Trichloroethene	1.0	< 1.0	U
124-48-1	Dibromochloromethane	1.0	< 1.0	U
79-00-5	1,1,2-Trichloroethane	1.0	< 1.0	U
71-43-2	Benzene	1.0	< 1.0	U
10061-02-6	trans-1,3-Dichloropropene	1.0	< 1.0	U
110-75-8	2-Chloroethylvinylether	5.0	< 5.0	U
75-25-2	Bromoform	1.0	< 1.0	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	1.0	< 1.0	U
79-34-5	1,1,2,2-Tetrachloroethane	1.0	< 1.0	U
108-88-3	Toluene	1.0	< 1.0	U
108-90-7	Chlorobenzene	1.0	< 1.0	U
100-41-4	Ethylbenzene	1.0	< 1.0	U
100-42-5	Styrene	1.0	< 1.0	U
75-69-4	Trichlorofluoromethane	1.0	< 1.0	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.0	< 2.0	U
179601-23-1	m,p-Xylene	1.0	< 1.0	U
95-47-6	o-Xylene	1.0	< 1.0	U

Reported in µg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	121%
d8-Toluene	106%
Bromofluorobenzene	102%

FORM I

4A
VOLATILE METHOD BLANK SUMMARY

Method Blank ID.

MB0107

Lab Name: ANALYTICAL RESOURCES, INC

Client: BOEING

ARI Job No: QD12

Project: 2-10 SHEETPILE

Lab File ID: MB0107

Lab Sample ID: MB0107

Date Analyzed: 01/07/10

Time Analyzed: 1209

Instrument ID: FINN5

Heated Purge: (Y/N) Y

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	LCS0107	LCS0107	LCS0107	1107
02	LCS0107	LCS0107	LCS0107A	1142
03	S-091229-PL2	QD12J	QD12J2	1253
04	S-091229-PL2	QD12I	QD12I2	1324
05	S-091229-PL2	QD12M	QD12M2	1351
06	S-091229-PL2	QD12N	QD12N2	1420
07	S-091229-PL2	QD12O	QD12O2	1445
08	S-091229-PL2	QD12J	QD12J3	1846
09	S-091229-PL2	QD12JMS	QD12JMS	2033
10	S-091229-PL2	QD12JMSD	QD12JMSD	2100
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COMMENTS:

FORM IV VOA

OLM3.2M

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: MB-010710**

METHOD BLANK

Lab Sample ID: MB-010710
LIMS ID: 09-31884
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: NA
Date Received: NA

Instrument/Analyst: FINN5/PAB
Date Analyzed: 01/07/10 12:09

Sample Amount: 5.00 g-dry-wt
Purge Volume: 5.0 mL
Moisture: NA

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.0	< 1.0	U
74-83-9	Bromomethane	1.0	< 1.0	U
75-01-4	Vinyl Chloride	1.0	< 1.0	U
75-00-3	Chloroethane	1.0	< 1.0	U
75-09-2	Methylene Chloride	2.0	< 2.0	U
67-64-1	Acetone	5.0	< 5.0	U
75-15-0	Carbon Disulfide	1.0	< 1.0	U
75-35-4	1,1-Dichloroethene	1.0	< 1.0	U
75-34-3	1,1-Dichloroethane	1.0	< 1.0	U
156-60-5	trans-1,2-Dichloroethene	1.0	< 1.0	U
156-59-2	cis-1,2-Dichloroethene	1.0	< 1.0	U
67-66-3	Chloroform	1.0	< 1.0	U
107-06-2	1,2-Dichloroethane	1.0	< 1.0	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	1.0	< 1.0	U
56-23-5	Carbon Tetrachloride	1.0	< 1.0	U
108-05-4	Vinyl Acetate	5.0	< 5.0	U
75-27-4	Bromodichloromethane	1.0	< 1.0	U
78-87-5	1,2-Dichloropropane	1.0	< 1.0	U
10061-01-5	cis-1,3-Dichloropropene	1.0	< 1.0	U
79-01-6	Trichloroethene	1.0	< 1.0	U
124-48-1	Dibromochloromethane	1.0	< 1.0	U
79-00-5	1,1,2-Trichloroethane	1.0	< 1.0	U
71-43-2	Benzene	1.0	< 1.0	U
10061-02-6	trans-1,3-Dichloropropene	1.0	< 1.0	U
110-75-8	2-Chloroethylvinylether	5.0	< 5.0	U
75-25-2	Bromoform	1.0	< 1.0	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	1.0	< 1.0	U
79-34-5	1,1,2,2-Tetrachloroethane	1.0	< 1.0	U
108-88-3	Toluene	1.0	< 1.0	U
108-90-7	Chlorobenzene	1.0	< 1.0	U
100-41-4	Ethylbenzene	1.0	< 1.0	U
100-42-5	Styrene	1.0	< 1.0	U
75-69-4	Trichlorofluoromethane	1.0	< 1.0	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.0	< 2.0	U
179601-23-1	m,p-Xylene	1.0	< 1.0	U
95-47-6	o-Xylene	1.0	< 1.0	U

Reported in μg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	102%
d8-Toluene	103%
Bromofluorobenzene	97.3%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: MB-010710**

METHOD BLANK

Lab Sample ID: MB-010710
LIMS ID: 09-31883
Matrix: Soil
Data Release Authorized:
Reported: 01/08/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: NA
Date Received: NA

Instrument/Analyst: FINN5/PAB
Date Analyzed: 01/07/10 12:09

Sample Amount: 100 mg-dry-wt
Purge Volume: 5.0 mL
Moisture: NA

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	50	< 50	U
74-83-9	Bromomethane	50	< 50	U
75-01-4	Vinyl Chloride	50	< 50	U
75-00-3	Chloroethane	50	< 50	U
75-09-2	Methylene Chloride	100	< 100	U
67-64-1	Acetone	250	< 250	U
75-15-0	Carbon Disulfide	50	< 50	U
75-35-4	1,1-Dichloroethene	50	< 50	U
75-34-3	1,1-Dichloroethane	50	< 50	U
156-60-5	trans-1,2-Dichloroethene	50	< 50	U
156-59-2	cis-1,2-Dichloroethene	50	< 50	U
67-66-3	Chloroform	50	< 50	U
107-06-2	1,2-Dichloroethane	50	< 50	U
78-93-3	2-Butanone	250	< 250	U
71-55-6	1,1,1-Trichloroethane	50	< 50	U
56-23-5	Carbon Tetrachloride	50	< 50	U
108-05-4	Vinyl Acetate	250	< 250	U
75-27-4	Bromodichloromethane	50	< 50	U
78-87-5	1,2-Dichloropropane	50	< 50	U
10061-01-5	cis-1,3-Dichloropropene	50	< 50	U
79-01-6	Trichloroethene	50	< 50	U
124-48-1	Dibromochloromethane	50	< 50	U
79-00-5	1,1,2-Trichloroethane	50	< 50	U
71-43-2	Benzene	50	< 50	U
10061-02-6	trans-1,3-Dichloropropene	50	< 50	U
110-75-8	2-Chloroethylvinylether	250	< 250	U
75-25-2	Bromoform	50	< 50	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	250	< 250	U
591-78-6	2-Hexanone	250	< 250	U
127-18-4	Tetrachloroethene	50	< 50	U
79-34-5	1,1,2,2-Tetrachloroethane	50	< 50	U
108-88-3	Toluene	50	< 50	U
108-90-7	Chlorobenzene	50	< 50	U
100-41-4	Ethylbenzene	50	< 50	U
100-42-5	Styrene	50	< 50	U
75-69-4	Trichlorofluoromethane	50	< 50	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	100	< 100	U
179601-23-1	m,p-Xylene	50	< 50	U
95-47-6	o-Xylene	50	< 50	U

Reported in μg/kg (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	102%
d8-Toluene	103%
Bromofluorobenzene	97.3%

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: GW-091228-PL2-GP1-50-0
SAMPLE

Lab Sample ID: QD12P
LIMS ID: 09-31890
Matrix: Water
Data Release Authorized:
Reported: 01/06/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/28/09
Date Received: 12/29/09

Instrument/Analyst: NT5/PKC
Date Analyzed: 12/31/09 13:58

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	< 0.5	U
74-83-9	Bromomethane	0.5	< 0.5	U
75-01-4	Vinyl Chloride	0.2	< 0.2	U
75-00-3	Chloroethane	0.2	< 0.2	U
75-09-2	Methylene Chloride	0.5	< 0.5	U
67-64-1	Acetone	5.0	< 5.0	U
75-15-0	**Carbon Disulfide**	**0.2**	**0.4**	
75-35-4	1,1-Dichloroethene	0.2	< 0.2	U
75-34-3	1,1-Dichloroethane	0.2	< 0.2	U
156-60-5	trans-1,2-Dichloroethene	0.2	< 0.2	U
156-59-2	cis-1,2-Dichloroethene	0.2	< 0.2	U
67-66-3	Chloroform	0.2	< 0.2	U
107-06-2	1,2-Dichloroethane	0.2	< 0.2	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.2	< 0.2	U
56-23-5	Carbon Tetrachloride	0.2	< 0.2	U
108-05-4	Vinyl Acetate	1.0	< 1.0	U
75-27-4	Bromodichloromethane	0.2	< 0.2	U
78-87-5	1,2-Dichloropropane	0.2	< 0.2	U
10061-01-5	cis-1,3-Dichloropropene	0.2	< 0.2	U
79-01-6	Trichloroethene	0.2	< 0.2	U
124-48-1	Dibromochloromethane	0.2	< 0.2	U
79-00-5	1,1,2-Trichloroethane	0.2	< 0.2	U
71-43-2	Benzene	0.2	< 0.2	U
10061-02-6	trans-1,3-Dichloropropene	0.2	< 0.2	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.2	< 0.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.2	< 0.2	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	< 0.2	U
108-88-3	Toluene	0.2	< 0.2	U
108-90-7	Chlorobenzene	0.2	< 0.2	U
100-41-4	Ethylbenzene	0.2	< 0.2	U
100-42-5	Styrene	0.2	< 0.2	U
75-69-4	Trichlorofluoromethane	0.2	< 0.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	< 0.2	U
179601-23-1	m,p-Xylene	0.4	< 0.4	U
95-47-6	o-Xylene	0.2	< 0.2	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	94.3%
d8-Toluene	99.8%
Bromofluorobenzene	96.8%

2-Chloroethylvinylether is an acid labile compound and may not be recovered from an acid preserved sample.

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: GW-091229-PL2-GP2-85-0
SAMPLE

Lab Sample ID: QD12Q
LIMS ID: 09-31891
Matrix: Water
Data Release Authorized:
Reported: 01/06/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst: NT5/PKC
Date Analyzed: 12/31/09 14:23

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	< 0.5	U
74-83-9	Bromomethane	0.5	< 0.5	U
75-01-4	Vinyl Chloride	0.2	< 0.2	U
75-00-3	Chloroethane	0.2	< 0.2	U
75-09-2	Methylene Chloride	0.5	< 0.5	U
67-64-1	**Acetone**	**5.0**	**5.1**	**Q**
75-15-0	Carbon Disulfide	0.2	< 0.2	U
75-35-4	1,1-Dichloroethene	0.2	< 0.2	U
75-34-3	1,1-Dichloroethane	0.2	< 0.2	U
156-60-5	trans-1,2-Dichloroethene	0.2	< 0.2	U
156-59-2	**cis-1,2-Dichloroethene**	**0.2**	**0.7**	
67-66-3	Chloroform	0.2	< 0.2	U
107-06-2	1,2-Dichloroethane	0.2	< 0.2	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.2	< 0.2	U
56-23-5	Carbon Tetrachloride	0.2	< 0.2	U
108-05-4	Vinyl Acetate	1.0	< 1.0	U
75-27-4	Bromodichloromethane	0.2	< 0.2	U
78-87-5	1,2-Dichloropropane	0.2	< 0.2	U
10061-01-5	cis-1,3-Dichloropropene	0.2	< 0.2	U
79-01-6	Trichloroethene	0.2	< 0.2	U
124-48-1	Dibromochloromethane	0.2	< 0.2	U
79-00-5	1,1,2-Trichloroethane	0.2	< 0.2	U
71-43-2	Benzene	0.2	< 0.2	U
10061-02-6	trans-1,3-Dichloropropene	0.2	< 0.2	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.2	< 0.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.2	< 0.2	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	< 0.2	U
108-88-3	Toluene	0.2	< 0.2	U
108-90-7	Chlorobenzene	0.2	< 0.2	U
100-41-4	Ethylbenzene	0.2	< 0.2	U
100-42-5	Styrene	0.2	< 0.2	U
75-69-4	Trichlorofluoromethane	0.2	< 0.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	< 0.2	U
179601-23-1	m,p-Xylene	0.4	< 0.4	U
95-47-6	o-Xylene	0.2	< 0.2	U

Reported in μg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	96.2%
d8-Toluene	100%
Bromofluorobenzene	96.4%

2-Chloroethylvinylether is an acid labile compound and may not be recovered from an acid preserved sample.

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: GW-091229-PL2-GP2-85-1
SAMPLE

Lab Sample ID: QD12R
LIMS ID: 09-31892
Matrix: Water
Data Release Authorized:
Reported: 01/06/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/29/09
Date Received: 12/29/09

Instrument/Analyst: NT5/PKC
Date Analyzed: 12/31/09 14:49

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	< 0.5	U
74-83-9	Bromomethane	0.5	< 0.5	U
75-01-4	Vinyl Chloride	0.2	< 0.2	U
75-00-3	Chloroethane	0.2	< 0.2	U
75-09-2	Methylene Chloride	0.5	< 0.5	U
67-64-1	**Acetone**	**5.0**	**6.3**	**Q**
75-15-0	Carbon Disulfide	0.2	< 0.2	U
75-35-4	1,1-Dichloroethene	0.2	< 0.2	U
75-34-3	1,1-Dichloroethane	0.2	< 0.2	U
156-60-5	trans-1,2-Dichloroethene	0.2	< 0.2	U
156-59-2	**cis-1,2-Dichloroethene**	**0.2**	**0.7**	
67-66-3	Chloroform	0.2	< 0.2	U
107-06-2	1,2-Dichloroethane	0.2	< 0.2	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.2	< 0.2	U
56-23-5	Carbon Tetrachloride	0.2	< 0.2	U
108-05-4	Vinyl Acetate	1.0	< 1.0	U
75-27-4	Bromodichloromethane	0.2	< 0.2	U
78-87-5	1,2-Dichloropropane	0.2	< 0.2	U
10061-01-5	cis-1,3-Dichloropropene	0.2	< 0.2	U
79-01-6	Trichloroethene	0.2	< 0.2	U
124-48-1	Dibromochloromethane	0.2	< 0.2	U
79-00-5	1,1,2-Trichloroethane	0.2	< 0.2	U
71-43-2	Benzene	0.2	< 0.2	U
10061-02-6	trans-1,3-Dichloropropene	0.2	< 0.2	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.2	< 0.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.2	< 0.2	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	< 0.2	U
108-88-3	Toluene	0.2	< 0.2	U
108-90-7	Chlorobenzene	0.2	< 0.2	U
100-41-4	Ethylbenzene	0.2	< 0.2	U
100-42-5	Styrene	0.2	< 0.2	U
75-69-4	Trichlorofluoromethane	0.2	< 0.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	< 0.2	U
179601-23-1	m,p-Xylene	0.4	< 0.4	U
95-47-6	o-Xylene	0.2	< 0.2	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	99.4%
d8-Toluene	101%
Bromofluorobenzene	95.7%

2-Chloroethylvinylether is an acid labile compound and may not be recovered from an acid preserved sample.

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: Trip Blanks**
 SAMPLE

Lab Sample ID: QD12S
LIMS ID: 09-31895
Matrix: Water
Data Release Authorized:
Reported: 01/06/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: 12/28/09
Date Received: 12/29/09

Instrument/Analyst: NT5/PKC
Date Analyzed: 12/31/09 12:15

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	< 0.5	U
74-83-9	Bromomethane	0.5	< 0.5	U
75-01-4	Vinyl Chloride	0.2	< 0.2	U
75-00-3	Chloroethane	0.2	< 0.2	U
75-09-2	Methylene Chloride	0.5	< 0.5	U
67-64-1	Acetone	5.0	< 5.0	U
75-15-0	Carbon Disulfide	0.2	< 0.2	U
75-35-4	1,1-Dichloroethene	0.2	< 0.2	U
75-34-3	1,1-Dichloroethane	0.2	< 0.2	U
156-60-5	trans-1,2-Dichloroethene	0.2	< 0.2	U
156-59-2	cis-1,2-Dichloroethene	0.2	< 0.2	U
67-66-3	Chloroform	0.2	< 0.2	U
107-06-2	1,2-Dichloroethane	0.2	< 0.2	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.2	< 0.2	U
56-23-5	Carbon Tetrachloride	0.2	< 0.2	U
108-05-4	Vinyl Acetate	1.0	< 1.0	U
75-27-4	Bromodichloromethane	0.2	< 0.2	U
78-87-5	1,2-Dichloropropane	0.2	< 0.2	U
10061-01-5	cis-1,3-Dichloropropene	0.2	< 0.2	U
79-01-6	Trichloroethene	0.2	< 0.2	U
124-48-1	Dibromochloromethane	0.2	< 0.2	U
79-00-5	1,1,2-Trichloroethane	0.2	< 0.2	U
71-43-2	Benzene	0.2	< 0.2	U
10061-02-6	trans-1,3-Dichloropropene	0.2	< 0.2	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.2	< 0.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.2	< 0.2	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	< 0.2	U
108-88-3	Toluene	0.2	< 0.2	U
108-90-7	Chlorobenzene	0.2	< 0.2	U
100-41-4	Ethylbenzene	0.2	< 0.2	U
100-42-5	Styrene	0.2	< 0.2	U
75-69-4	Trichlorofluoromethane	0.2	< 0.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	< 0.2	U
179601-23-1	m,p-Xylene	0.4	< 0.4	U
95-47-6	o-Xylene	0.2	< 0.2	U

Reported in μg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	92.6%
d8-Toluene	99.1%
Bromofluorobenzene	94.5%

2-Chloroethylvinylether is an acid labile compound and may not be recovered from an acid preserved sample.

FORM I

ANALYTICAL RESOURCES INCORPORATED

VOA SURROGATE RECOVERY SUMMARY

Matrix: Water

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

ARI ID	Client ID	PV	DCE	TOL	BFB	DCB	TOT OUT
MB-123109	Method Blank	10	91.3%	101%	96.8%	NA	0
LCS-123109	Lab Control	10	92.3%	99.6%	98.3%	NA	0
LCSD-123109	Lab Control Dup	10	92.8%	101%	97.8%	NA	0
QD12P	GW-091228-PL2-GP1-50-0	10	94.3%	99.8%	96.8%	NA	0
QD12Q	GW-091229-PL2-GP2-85-0	10	96.2%	100%	96.4%	NA	0
QD12R	GW-091229-PL2-GP2-85-1	10	99.4%	101%	95.7%	NA	0
QD12S	Trip Blanks	10	92.6%	99.1%	94.5%	NA	0

SW8260C	LCS/MB LIMITS	QC LIMITS
(DCE) = d4-1,2-Dichloroethane	70-132	80-143
(TOL) = d8-Toluene	80-120	80-120
(BFB) = Bromofluorobenzene	80-120	80-120
(DCB) = d4-1,2-Dichlorobenzene	80-120	80-120

Prep Method: SW5030B
Log Number Range: 09-31890 to 09-31895

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-123109**

LAB CONTROL SAMPLE

Lab Sample ID: LCS-123109
LIMS ID: 09-31890
Matrix: Water
Data Release Authorized:
Reported: 01/06/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: NA
Date Received: NA

Instrument/Analyst LCS: NT5/PKC
LCSD: NT5/PKC
Date Analyzed LCS: 12/31/09 10:50
LCSD: 12/31/09 11:15

Sample Amount LCS: 10.0 mL
LCSD: 10.0 mL
Purge Volume LCS: 10.0 mL
LCSD: 10.0 mL

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
Chloromethane	10.6	10.0	106%	10.7	10.0	107%	0.9%
Bromomethane	7.9 Q	10.0	79.0%	8.2 Q	10.0	82.0%	3.7%
Vinyl Chloride	9.8	10.0	98.0%	10.2	10.0	102%	4.0%
Chloroethane	9.8	10.0	98.0%	10.2	10.0	102%	4.0%
Methylene Chloride	9.5	10.0	95.0%	9.7	10.0	97.0%	2.1%
Acetone	34.2 Q	50.0	68.4%	35.4 Q	50.0	70.8%	3.4%
Carbon Disulfide	10.4	10.0	104%	10.0	10.0	100%	3.9%
1,1-Dichloroethene	10.0	10.0	100%	10.4	10.0	104%	3.9%
1,1-Dichloroethane	10.0	10.0	100%	10.3	10.0	103%	3.0%
trans-1,2-Dichloroethene	9.7	10.0	97.0%	9.9	10.0	99.0%	2.0%
cis-1,2-Dichloroethene	10.1	10.0	101%	10.2	10.0	102%	1.0%
Chloroform	9.9	10.0	99.0%	10.2	10.0	102%	3.0%
1,2-Dichloroethane	8.4	10.0	84.0%	9.0	10.0	90.0%	6.9%
2-Butanone	39.6 Q	50.0	79.2%	40.8 Q	50.0	81.6%	3.0%
1,1,1-Trichloroethane	9.7	10.0	97.0%	10.1	10.0	101%	4.0%
Carbon Tetrachloride	9.9	10.0	99.0%	10.4	10.0	104%	4.9%
Vinyl Acetate	8.1	10.0	81.0%	8.3	10.0	83.0%	2.4%
Bromodichloromethane	9.6	10.0	96.0%	10.2	10.0	102%	6.1%
1,2-Dichloropropane	9.6	10.0	96.0%	10.0	10.0	100%	4.1%
cis-1,3-Dichloropropene	9.3	10.0	93.0%	9.9	10.0	99.0%	6.2%
Trichloroethene	9.8	10.0	98.0%	10.6	10.0	106%	7.8%
Dibromochloromethane	9.5	10.0	95.0%	9.8	10.0	98.0%	3.1%
1,1,2-Trichloroethane	8.8	10.0	88.0%	9.5	10.0	95.0%	7.7%
Benzene	9.9	10.0	99.0%	10.5	10.0	105%	5.9%
trans-1,3-Dichloropropene	8.8	10.0	88.0%	9.4	10.0	94.0%	6.6%
2-Chloroethylvinylether	8.5	10.0	85.0%	9.1	10.0	91.0%	6.8%
Bromoform	9.0	10.0	90.0%	9.3	10.0	93.0%	3.3%
4-Methyl-2-Pentanone (MIBK)	41.8	50.0	83.6%	44.6	50.0	89.2%	6.5%
2-Hexanone	39.7	50.0	79.4%	42.5	50.0	85.0%	6.8%
Tetrachloroethene	9.6	10.0	96.0%	10.0	10.0	100%	4.1%
1,1,2,2-Tetrachloroethane	9.1	10.0	91.0%	9.6	10.0	96.0%	5.3%
Toluene	10.0	10.0	100%	10.4	10.0	104%	3.9%
Chlorobenzene	9.8	10.0	98.0%	10.1	10.0	101%	3.0%
Ethylbenzene	10.4	10.0	104%	10.7	10.0	107%	2.8%
Styrene	10.1	10.0	101%	10.5	10.0	105%	3.9%
Trichlorofluoromethane	9.1	10.0	91.0%	9.6	10.0	96.0%	5.3%
1,1,2-Trichloro-1,2,2-trifluoroetha	10.0	10.0	100%	10.2	10.0	102%	2.0%
m,p-Xylene	20.4	20.0	102%	20.9	20.0	104%	2.4%
o-Xylene	10.1	10.0	101%	10.3	10.0	103%	2.0%

Reported in µg/L (ppb)

RPD calculated using sample concentrations per SW846.

Volatile Surrogate Recovery

	LCS	LCSD

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-123109**
 LAB CONTROL SAMPLE

Lab Sample ID: LCS-123109 QC Report No: QD12-The Boeing Company
LIMS ID: 09-31890 Project: Bldg 2-10 Sheetpiles
Matrix: Water

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
d4-1,2-Dichloroethane		92.3%	92.8%				
d8-Toluene		99.6%	101%				
Bromofluorobenzene		98.3%	97.8%				

4A
VOLATILE METHOD BLANK SUMMARY

Method Blank ID.

MB1231

Lab Name: ANALYTICAL RESOURCES, INC

Client: THE BOEING COMANY

ARI Job No: QD12

Project: BLDG 2-10 SHEETPILES

Lab File ID: 12310905

Lab Sample ID: MB1231

Date Analyzed: 12/31/09

Time Analyzed: 1141

Instrument ID: NT5

Heated Purge: (Y/N) N

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	LCS1231	LCS1231	12310903	1050
02	LCSD1231	LCSD1231	12310904	1115
03	TRIP BLANKS	QD12S	12310906	1215
04	GW-091228-PL	QD12P	12310910	1358
05	GW-091229-PL	QD12Q	12310911	1423
06	GW-091229-PL	QD12R	12310912	1449
07				
08				
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COMMENTS:

FORM IV VOA

OLM3.2M

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: MB-123109**
 METHOD BLANK

Lab Sample ID: MB-123109
LIMS ID: 09-31890
Matrix: Water
Data Release Authorized:
Reported: 01/06/10

QC Report No: QD12-The Boeing Company
Project: Bldg 2-10 Sheetpiles

Date Sampled: NA
Date Received: NA

Instrument/Analyst: NT5/PKC
Date Analyzed: 12/31/09 11:41

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	< 0.5	U
74-83-9	Bromomethane	0.5	< 0.5	U
75-01-4	Vinyl Chloride	0.2	< 0.2	U
75-00-3	Chloroethane	0.2	< 0.2	U
75-09-2	Methylene Chloride	0.5	< 0.5	U
67-64-1	Acetone	5.0	< 5.0	U
75-15-0	Carbon Disulfide	0.2	< 0.2	U
75-35-4	1,1-Dichloroethene	0.2	< 0.2	U
75-34-3	1,1-Dichloroethane	0.2	< 0.2	U
156-60-5	trans-1,2-Dichloroethene	0.2	< 0.2	U
156-59-2	cis-1,2-Dichloroethene	0.2	< 0.2	U
67-66-3	Chloroform	0.2	< 0.2	U
107-06-2	1,2-Dichloroethane	0.2	< 0.2	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.2	< 0.2	U
56-23-5	Carbon Tetrachloride	0.2	< 0.2	U
108-05-4	Vinyl Acetate	1.0	< 1.0	U
75-27-4	Bromodichloromethane	0.2	< 0.2	U
78-87-5	1,2-Dichloropropane	0.2	< 0.2	U
10061-01-5	cis-1,3-Dichloropropene	0.2	< 0.2	U
79-01-6	Trichloroethene	0.2	< 0.2	U
124-48-1	Dibromochloromethane	0.2	< 0.2	U
79-00-5	1,1,2-Trichloroethane	0.2	< 0.2	U
71-43-2	Benzene	0.2	< 0.2	U
10061-02-6	trans-1,3-Dichloropropene	0.2	< 0.2	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.2	< 0.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.2	< 0.2	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	< 0.2	U
108-88-3	Toluene	0.2	< 0.2	U
108-90-7	Chlorobenzene	0.2	< 0.2	U
100-41-4	Ethylbenzene	0.2	< 0.2	U
100-42-5	Styrene	0.2	< 0.2	U
75-69-4	Trichlorofluoromethane	0.2	< 0.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	< 0.2	U
179601-23-1	m,p-Xylene	0.4	< 0.4	U
95-47-6	o-Xylene	0.2	< 0.2	U

Reported in μg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	91.3%
d8-Toluene	101%
Bromofluorobenzene	96.8%

GEOTECHNICAL ANALYSIS

The Boeing Company
Bldg 2-10 Sheetpiles

Percent Finer (Passing) Than the Indicated Size

Sieve Size (microns)	3"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	#4 (4750)	#10 (2000)	#20 (850)	#40 (425)	#60 (250)	#100 (150)	#200 (75)	32	22	13	9	7	3.2	1.3
S-091228-PL2-SSL5-05-0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.1	94.4	86.0	65.3	39.3	23.5	8.5	7.4	4.9	4.5	4.1	4.1	3.3	2.9
S-091229-PL2-SSL2-10-0	100.0	100.0	100.0	100.0	97.3	96.4	95.7	94.5	92.2	88.9	77.8	60.2	36.1	18.8	15.8	12.1	10.5	9.3	8.1	6.5	4.9
S-091229-PL2-SSL1-10-0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.6	99.2	97.4	91.8	82.2	57.2	16.4	12.2	12.2	10.5	7.9	5.2	4.4	3.1

Testing performed according to ASTM D421/D422

QD12

The Boeing Company
Bldg 2-10 Sheetpiles

Percent Retained in Each Size Fraction

Description	%Coarse Gravel				% Gravel			% Coarse Sand	% Medium Sand		% Fine Sand			% Very Coarse Silt	% Coarse Silt	% Medium Silt	% Fine Silt	% Fine Silt	% Very Fine Silt	% Clay
Particle Size (microns)	3-2"	2-1 1/2"	1 1/2"-1"	1-3/4"	3/4-1/2"	1/2-3/8"	3/8"-4750	4750-2000	2000-850	850-425	425-250	250-150	150-75	75-32	32-22	22-13	13-9	9-7	7-3.2	<3.2
S-091228-PL2-SSL5-05-0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	3.8	8.4	20.7	26.0	15.8	15.0	1.1	2.5	0.4	0.4	0.0	0.8	3.3
S-091229-PL2-SSL2-10-0	0.0	0.0	0.0	2.7	0.9	0.7	1.2	2.2	3.3	11.2	17.6	24.1	17.2	3.0	3.6	1.6	1.2	1.2	1.6	6.5
S-091229-PL2-SSL1-10-0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	1.9	5.5	9.6	25.0	40.8	4.2	0.0	1.7	2.6	2.6	0.9	4.4

QD12

Sample Number:	S-091228-PL2-SSL5-05-0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	98.14	94.36	86.01	65.29	39.31	23.55	8.52	7.40	4.94	4.53	4.11	4.11	3.29	2.88
		125000	75000	50000	37500	25000	19000	12500	9500	4750	2000	850	425	250	150	75	36.6	23.5	13.6	9.7	6.8	3.4	1.41
Test Temperature	18.5	5"	3"	2"	1.5"	1"	3/4"	1/2"	3/8"	4	10	20	40	60	100	200							
Specific Gravity	2.65																						

Wet Wt & Tare	33.91
Dry Wt & Tare	33.8
Wt Moisture	0.11
Wt Tare	1.52
Dry Soil	32.28
Moisture Content	0.003407683
Air Dry Total Sample	232.12
Oven Dry Total Samp	231.3759802
Air Dry Hydro Sample	115.24
Oven Dry Wt Hydro	114.8486323
Amount Plus #10	13.04
W (14.2) =	121.7079056

Sieve Analysis Portion

Sieve Size	Weight of Soil + Tare	Total Weight of Soil		Percent Retained	Percent Passing
5"	10.22	0.00		0.00	100.00
3"	10.22	0.00		0.00	100.00
2"	10.22	0.00		0.00	100.00
1.5"	10.22	0.00		0.00	100.00
1	10.22	0.00		0.00	100.00
3/4	10.22	0.00		0.00	100.00
1/2	10.22	0.00		0.00	100.00
3/8	10.22	0.00		0.00	100.00
4	14.53	4.31		1.86	98.14
10	23.26	13.04		5.64	94.36
20	33.43	10.17	8.36	13.99	86.01
40	58.65	35.39	29.08	34.71	65.29
60	90.26	67.00	55.05	60.69	39.31
100	109.45	86.19	70.82	76.45	23.55
200	127.74	104.48	85.84	91.48	8.52

Hydrometer Analysis Portion

Time	Hydro Reading	Comp Correct	Percent Finer	"L"	D	K	a
1	15	6.0	7.40	13.8	51.73467	0.013907	1.001385
2	15	6.0	7.40	13.8	36.58194	0.013907	1.001385
5	12	6.0	4.94	14.3	23.54387	0.013907	1.001385
15	11.5	6.0	4.53	14.4	13.63187	0.013907	1.001385
30	11	6.0	4.11	14.5	9.66655	0.013907	1.001385
60	11	6.0	4.11	14.5	6.835283	0.013907	1.001385
250	9.5	5.5	3.29	14.7	3.376869	0.013907	1.001385
1440	9.5	6.0	2.88	14.7	1.407029	0.013907	1.001385

Sample Number:	S-091229-PL2-SSL2-10-0	100.00	100.00	100.00	100.00	100.00	97.32	96.38	95.70	94.46	92.25	88.92	77.75	60.16	36.08	18.84	15.79	12.15	10.53	9.31	8.10	6.48	4.86
		125000	75000	50000	37500	25000	19000	12500	9500	4750	2000	850	425	250	150	75	34.2	22.3	13.0	9.3	6.6	3.3	1.39
Test Temperature	18.5	5"	3"	2"	1.5"	1"	3/4"	1/2"	3/8"	4	10	20	40	60	100	200							
Specific Gravity	2.65																						

Wet Wt & Tare	38.42
Dry Wt & Tare	38.08
Wt Moisture	0.34
Wt Tare	1.52
Dry Soil	36.56
Moisture Content	0.009299781
Air Dry Total Sample	449.15
Oven Dry Total Samp	445.329561
Air Dry Hydro Sample	115.11
Oven Dry Wt Hydro	114.0493659
Amount Plus #10	34.52
W (14.2) =	123.6328432

Sieve Analysis Portion

Sieve Size	Weight of Soil + Tare	Total Weight of Soil		Percent Retained	Percent Passing
5"	10.15	0.00		0.00	100.00
3"	10.15	0.00		0.00	100.00
2"	10.15	0.00		0.00	100.00
1.5"	10.15	0.00		0.00	100.00
1	10.15	0.00		0.00	100.00
3/4	22.07	11.92		2.68	97.32
1/2	26.26	16.11		3.62	96.38
3/8	29.29	19.14		4.30	95.70
4	34.83	24.68		5.54	94.46
10	44.67	34.52		7.75	92.25
20	48.79	4.12	3.33	11.08	88.92
40	62.59	17.92	14.49	22.25	77.75
60	84.34	39.67	32.09	39.84	60.16
100	114.11	69.44	56.17	63.92	36.08
200	135.43	90.76	73.41	81.16	18.84

Time	Hydro Reading	Comp Correct	Percent Finer	"L"	D	K	a
1	28	6	17.82	11.7	47.58584	0.013907	1.001385
2	25.5	6	15.79	12.1	34.23197	0.013907	1.001385
5	21	6	12.15	12.9	22.29929	0.013907	1.001385
15	19	6	10.53	13.2	13.03761	0.013907	1.001385
30	17.5	6	9.31	13.4	9.304539	0.013907	1.001385
60	16	6	8.10	13.7	6.639251	0.013907	1.001385
250	13.5	5.5	6.48	14.1	3.300922	0.013907	1.001385
1440	12	6	4.86	14.3	1.387336	0.013907	1.001385

Sample Number:	S-091229-PL2-SSL1-10-0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.65	99.23	97.37	91.84	82.24	57.21	16.38	12.21	12.21	10.47	7.85	5.23	4.36	3.05
		125000	75000	50000	37500	25000	19000	12500	9500	4750	2000	850	425	250	150	75	35.2	22.3	13.0	9.4	6.7	3.3	1.40
Test Temperature	19	5"	3"	2"	1.5"	1"	3/4"	1/2"	3/8"	4	10	20	40	60	100	200							
Specific Gravity	2.65																						

Wet Wt & Tare	37.97
Dry Wt & Tare	37.48
Wt Moisture	0.49
Wt Tare	1.49
Dry Soil	35.99
Moisture Content	0.013614893
Air Dry Total Sample	367.4
Oven Dry Total Samp	362.5025521
Air Dry Hydro Sample	115.47
Oven Dry Wt Hydro	113.9190049
Amount Plus #10	2.79
W (14.2) =	114.8025827

Sieve Analysis Portion

Sieve Size	Weight of Soil + Tare	Total Weight of Soil		Percent Retained	Percent Passing
5"	10	0.00		0.00	100.00
3"	10	0.00		0.00	100.00
2"	10	0.00		0.00	100.00
1 1/2"	10	0.00		0.00	100.00
1	10	0.00		0.00	100.00
3/4	10	0.00		0.00	100.00
1/2	10	0.00		0.00	100.00
3/8	10	0.00		0.00	100.00
4	11.27	1.27		0.35	99.65
10	12.79	2.79		0.77	99.23
20	14.93	2.14	1.86	2.63	97.37
40	21.27	8.48	7.39	8.16	91.84
60	32.3	19.51	16.99	17.76	82.24
100	61.03	48.24	42.02	42.79	57.21
200	107.9	95.11	82.85	83.62	16.38

Hydrometer Analysis Portion

Time	Hydro Reading	Comp Correct	Percent Finer	"L"	D	K	a
1	21.5	6	13.52	12.8	49.35551	0.013809	1.001385
2	20	6	12.21	13.0	35.23386	0.013809	1.001385
5	20	6	12.21	13.0	22.28385	0.013809	1.001385
15	18	6	10.47	13.3	13.02653	0.013809	1.001385
30	15	6	7.85	13.8	9.379275	0.013809	1.001385
60	12	6	5.23	14.3	6.748936	0.013809	1.001385
250	10.5	5.5	4.36	14.6	3.334529	0.013809	1.001385
1440	9.5	6	3.05	14.7	1.397176	0.013809	1.001385

TOTAL SOLIDS

Volatiles Total Solids-voats
Data By: Pat Basilio
Created: 1/ 8/10

Worklist: 7956
Analyst: PAB
Comments:

ARI ID	Tare Wt (g)	Wet Wt (g)	Dry Wt (g)	% Solids
1. QD12A 09-31875	1.47	10.47	9.95	94.22
2. QD12B 09-31876	1.50	9.26	8.44	89.43
3. QD12C 09-31877	1.49	9.15	8.69	93.99
4. QD12D 09-31878	1.50	10.36	7.61	68.96
5. QD12E 09-31879	1.48	10.12	9.26	90.05
6. QD12F 09-31880	1.47	9.70	8.24	82.26
7. QD12G 09-31881	1.48	10.29	9.97	96.37
8. QD12H 09-31882	1.50	11.42	9.22	77.82
9. QD12I 09-31883	1.48	8.62	7.46	83.75
10. QD12J 09-31884	1.47	9.09	8.09	86.88
11. QD12K 09-31885	1.47	12.00	11.42	94.49
12. QD12L 09-31886	1.17	9.81	8.86	89.00
13. QD12M 09-31887	1.15	9.47	8.54	88.82
14. QD12N 09-31888	1.15	10.95	10.09	91.22
15. QD12O 09-31889	1.15	11.50	10.76	92.85

* - VOA TS Copied From BETX TS
% - VOA TS Copied From Metals TS
$ - VOA TS Copied From Extraction TS

Chain of Custody
Documentation

prepared
for

The Boeing Company

Project: 2-10 Sheetpile, K0275001

ARI JOB NO: QJ21, QJ43

prepared
by

Analytical Resources, Inc.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: QJ21	Turn-around Requested: Standard
ARI Client Company: Boeing	Phone:
Client Contact: Will Ernst	
Client Project Name: 2-10 Sheet pile	
Client Project #: K0275001	Samplers: G Dawson J Neste

Page: 1 of 2	
Date: 2/8/10 - 2/9/10	Ice Present? yes
No. of Coolers: 1	Cooler Temps: 5.4

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

Sample ID	Date	Time	Matrix	No. Containers	VOC 8260C	TOC 415.1	Dissolved metals 200.8/6010B	MEE RSK-175	Total metals (cations)	Anions 300.0	Alkalinity 300.1		Notes/Comments
GW-100208-PL2-254A-0	2/8/10	1126	GW	3 voa	X								
GW-100208-PL2-255A-0	2/8/10	1243	GW	3 voa	X								
GW-100208-PL2-256A-0	2/8/10	1327	GW	3 voa	X								
GW-100208-PL2-257A-0	2/8/10	1432	GW	3 voa	X								
GW-100209-PL2-209B-0	2/9/10	0937	GW	5	X	X	X						
GW-100209-PL2-209A-0	2/9/10	1004	GW	11	X	X	X	X	X	X	X		
GW-100209-PL2-209A-1	2/9/10	1004	GW	3	X								
GW-100209-PL2-212A-0	2/9/10	1126	GW	10	X	X	X	X	X	X			
GW-100209-PL2-212A-1	2/9/10	1130	GW	3	X								
GW-100209-PL2-218A-15-0	2/9/10	1325	GW	3	X								

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
cc Tom McKeon. Diss metals: Arsenic + manganese. Cations: calcium, magnesium potassium & sodium. anions: chloride, sulfate. Alkalinity: bicarbonate, carbonate, hydroxide-ion.	(Signature) [signature]	(Signature) Peterson	(Signature)	(Signature)
	Printed Name: Justin Neste	Printed Name: J Peterson	Printed Name:	Printed Name:
	Company: CALIBRE	Company: ARI	Company:	Company:
	Date & Time: 2/9/10 1656	Date & Time: 2/9/10 1650	Date & Time:	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: 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.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: QJ21	Turn-around Requested: Standard
ARI Client Company: Boeing	Phone:
Client Contact: Will Ernst	
Client Project Name: 2-10 Sheet pile	
Client Project #: K0275001	Samplers: G Dawson J Neste

Page: 2	of 2
Date: 2/9/10	Ice Present? yes
No. of Coolers: 1	Cooler Temps: 5.4

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

Sample ID	Date	Time	Matrix	No. Containers	VOC 8260C	TOC 415.1	Dissolved metals 200.8/6010B	MEE RSK-175	Total metals (cations)	Anions 300.0			Notes/Comments
GW-100209-PL2-218A-28-0	2/9/10	1330	GW	3	X								
GW-100209-PL2-218A-0	2/9/10	1357	GW	7		X	X	X	X	X			
GW-100209-PL2-218B-45-0	2/9/10	1438	GW	3	X								
GW-100209-PL2-218B-58-0	2/9/10	1443	GW	3	X								
GW-100209-PL2-218B-0	2/9/10	1505	GW	5		X	X	X					
GW-100209-PL2-262B-0	2/9/10	1604	GW	3	X								

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
cc Tom McKeon Diss metals: Arsenic & manganese cations: calcium, magnesium potassium & Sodium Anions: chloride, sulfate Alkalinity: bicarbonate, carbonate, hydroxide-ion.	(Signature): Justin Neste	(Signature): J Peterson	(Signature):	(Signature):
	Printed Name: Justin Neste	Printed Name: J Peterson	Printed Name:	Printed Name:
	Company: CALIBRE	Company: ARI	Company:	Company:
	Date & Time: 2/9/10 1656	Date & Time: 2/9/10 1656	Date & Time:	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: 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.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Cooler Receipt Form

ARI Client: Boeing
COC No(s): _____ (NA)
Assigned ARI Job No: QJ21

Project Name: 2-10 Sheetpile
Delivered by: Fed-Ex UPS Courier Hand Delivered Other: _____
Tracking No: _____ (NA)

Preliminary Examination Phase:

Were intact, properly signed and dated custody seals attached to the outside of to cooler?	YES	(NO)
Were custody papers included with the cooler?	(YES)	NO
Were custody papers properly filled out (ink, signed, etc.)	(YES)	NO
Temperature of Cooler(s) (°C) (recommended 2.0-6.0 °C for chemistry)	5.4	

If cooler temperature is out of compliance fill out form 00070F — Temp Gun ID#: 91087952

Cooler Accepted by: JP Date: 2/9/10 Time: 1655

Complete custody forms and attach all shipping documents

Log-In Phase:

Was a temperature blank included in the cooler?		YES	(NO)
What kind of packing material was used?	Bubble Wrap (Wet Ice) Gel Packs (Baggies) (Foam Block) Paper Other:		
Was sufficient ice used (if appropriate)?	NA	(YES)	NO
Were all bottles sealed in individual plastic bags?		YES	(NO)
Did all bottles arrive in good condition (unbroken)?		(YES)	NO
Were all bottle labels complete and legible?		(YES)	NO
Did the number of containers listed on COC match with the number of containers received?		(YES)	NO
Did all bottle labels and tags agree with custody papers?		(YES)	NO
Were all bottles used correct for the requested analyses?		(YES)	NO
Do any of the analyses (bottles) require preservation? (attach preservation sheet, excluding VOCs)	NA	(YES)	NO
Were all VOC vials free of air bubbles?	NA	YES	(NO)
Was sufficient amount of sample sent in each bottle?		(YES)	NO
Date VOC Trip Blank was made at ARI	NA	2/2/10	

Samples Logged by: JP Date: 2/9/10 Time: 1740

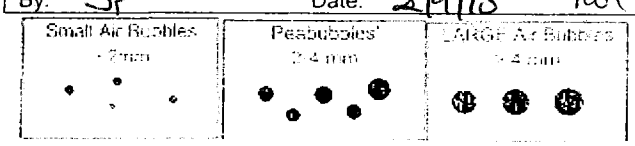
***** Notify Project Manager of discrepancies or concerns *****

Sample ID on Bottle	Sample ID on COC	Sample ID on Bottle	Sample ID on COC

Additional Notes, Discrepancies, & Resolutions:

3 of 4 Trip Blanks have "Pb's and "Pb's in 2 of 3 voa vials – ID = GW-100209-PL2-209B-0. Trip Blank analysis not on the Chain of Custody.

By: JP Date: 2/9/10



Small → "sm"
Peabubbles → "pb"
Large → "lg"
Headspace → "hs"

PRESERVATION VERIFICATION 02/09/10

ANALYTICAL RESOURCES INCORPORATED

ARI Job No: **QJ21**

PC: Kelly
VTSR: 02/09/10

Inquiry Number: P2DG
Analysis Requested: 02/09/10
Contact: Ernst, Will
Client: The Boeing Company
Logged by: JP
Sample Set Used: Yes-320
Validatable Package: Yes
Deliverables:

Project #: K0275001
Project: 2-10 Sheetpile
Sample Site:
SDG No:
Analytical Protocol: In-house

LOGNUM ARI ID	CLIENT ID	CN >12	WAD >12	NH3 <2	COD <2	FOG <2	MET <2	PHEN <2	PHOS <2	TKN <2	NO23 <2	TOC <2	S2 >9	AK102 <2	Fe2+ <2	DMET FLT	DOC FLT	PARAMETER	ADJUSTED TO	LOT NUMBER	AMOUNT ADDED	DATE/BY
10-3590 **QJ21E**	GW-100209-PL2-209B-0						DIS FAIL					PASS				Y						
10-3591 **QJ21F**	GW-100209-PL2-209A-0						DIS PASS					PASS				Y						
10-3593 **QJ21H**	GW-100209-PL2-212A-0						DIS					PASS				Y						
10-3597 **QJ21L**	GW-100209-PL2-218A-0						DIS					PASS				Y						
10-3600 **QJ21O**	GW-100209-PL2-218B-0						DIS					PASS				Y						
10-3603 **QJ21R**	GW-100209-PL2-209A-0						TOT															
10-3604 **QJ21S**	GW-100209-PL2-212A-0						TOT															
10-3605 **QJ21T**	GW-100209-PL2-218A-0						TOT PASS															

Checked By JP Date 2/9/10

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: QJ43	Turn-around Requested: Standard
ARI Client Company: Boeing	Phone:
Client Contact: Will ernst	
Client Project Name: 2-10 Sheet pile	
Client Project #: K0275001	Samplers: G Dawson J Neste

Page: 1	of 2
Date: 2/10/10	Ice Present? Y
No. of Coolers: 1	Cooler Temps: 2.3

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

Sample ID	Date	Time	Matrix	No. Containers	VOC 8260.C	TOC	Dissolved metals.	Dissolved Gases	Total metals (cations)	Anions	Alkalinity		Notes/Comments
GW-100210-PL2-249A-0	2/10/10	0925	GW	3	X								
GW-100210-PL2-247A-0	2/10/10	1012	GW	3	X								
GW-100210-PL2-247A-1	2/10/10	~~1016~~ 1016	GW	3	X								
GW-100210-PL2-268AR-0	2/10/10	1049	GW	3	X								
GW-100210-PL2-269A-0	2/10/10	1210	GW	3	X								
GW-100210-PL2-245A-0	2/10/10	1246	GW	3	X								
GW-100210-PL2-244A-0	2/10/10	1317	GW	5	X	X	X						
GW-100210-PL2-253A-0	2/10/10	1404	GW	11	X	X	X	X	X	X	X		
GW-100210-PL2-252A-0	2/10/10	1434	GW	5	X	X	X						
GW-100210-PL2-266A-0	2/10/10	1508	GW	3	X								

Comments/Special Instructions
cc Tom Mckeon

Relinquished by:	Received by:	Relinquished by:	Received by:
(Signature) [signature]	(Signature) [signature]	(Signature)	(Signature)
Printed Name: Justin Neste	Printed Name: A. Volgardsen	Printed Name:	Printed Name:
Company: CALIBRE	Company: ARI	Company:	Company:
Date & Time: 2/10/10 1654	Date & Time: 2/10/10 1654	Date & Time:	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: 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.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: QJ543	Turn-around Requested: Standard
ARI Client Company: Boeing	Phone:
Client Contact: Will Ernst	
Client Project Name: 2-10 Sheetpile	
Client Project #: K0275001	Samplers: G Dawson J Neste

Page: 2 of 2	
Date: 2/10/10	Ice Present? Y
No. of Coolers: 1	Cooler Temps: 2.3

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

Sample ID	Date	Time	Matrix	No. Containers	VOC								Notes/Comments
GW-100210-PL2-266A-4	2/10/10	1508	GW	3	X								MS/MSD
GW-100210-PL2-259B-0	2/10/10	1556	GW	3	X								

Analysis Requested

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
cc Tom Mckeon	(Signature) [signature]	(Signature) [signature]	(Signature)	(Signature)
	Printed Name: Justin Neste	Printed Name: A. Volgardsen	Printed Name:	Printed Name:
	Company: CALIBRE	Company: ARI	Company:	Company:
	Date & Time: 2/10/10 1654	Date & Time: 2/10/10 1654	Date & Time:	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: 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.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Cooler Receipt Form

ARI Client: Boeing
COC No(s): _____ (NA)
Assigned ARI Job No: QJ43

Project Name: 2-10 Sheetpile
Delivered by: Fed-Ex UPS Courier (Hand Delivered) Other: _____
Tracking No: _____ (NA)

Preliminary Examination Phase:

Were intact, properly signed and dated custody seals attached to the outside of to cooler?	YES	(NO)
Were custody papers included with the cooler?	(YES)	NO
Were custody papers properly filled out (ink, signed, etc.)	(YES)	NO

Temperature of Cooler(s) (°C) (recommended 2.0-6.0 °C for chemistry)..... 0.3

If cooler temperature is out of compliance fill out form 00070F — Temp Gun ID#: 90944619

Cooler Accepted by: AV Date: 2/10/10 Time: 1655

Complete custody forms and attach all shipping documents

Log-In Phase:

Was a temperature blank included in the cooler?		YES	(NO)
What kind of packing material was used? ... (Bubble Wrap) (Wet Ice) Gel Packs Baggies (Foam Block) Paper Other:			
Was sufficient ice used (if appropriate)?	NA	(YES)	NO
Were all bottles sealed in individual plastic bags?		YES	(NO)
Did all bottles arrive in good condition (unbroken)?		(YES)	NO
Were all bottle labels complete and legible?		(YES)	NO
Did the number of containers listed on COC match with the number of containers received?		(YES)	NO
Did all bottle labels and tags agree with custody papers?		(YES)	NO
Were all bottles used correct for the requested analyses?		(YES)	NO
Do any of the analyses (bottles) require preservation? (attach preservation sheet, excluding VOCs)...	NA	(YES)	NO
Were all VOC vials free of air bubbles?	NA	YES	(NO)
Was sufficient amount of sample sent in each bottle?		(YES)	NO
Date VOC Trip Blank was made at ARI	NA	2/2/10	

Samples Logged by: JP Date: 2/10/10 Time: 1725

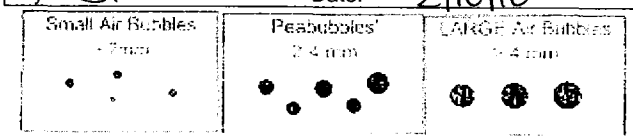
***** Notify Project Manager of discrepancies or concerns *****

Sample ID on Bottle	Sample ID on COC	Sample ID on Bottle	Sample ID on COC

Additional Notes, Discrepancies, & Resolutions:

"Pb" in 2 of 6 Trip Blanks, Trip Blank analysis not included on the Chain of Custody. Sample GW-100210-PL2-2464-4 has 6 containers, not 3.

By: JP Date: 2/10/10



Small → "sm"
Peabubbles → "pb"
Large → "lg"
Headspace → "hs"

PRESERVATION VERIFICATION 02/10/10

ANALYTICAL RESOURCES INCORPORATED

ARI Job No: **QJ43**

PC: Kelly
VTSR: 02/10/10

Inquiry Number: NONE
Analysis Requested: 02/10/10
Contact: Ernst, Will
Client: The Boeing Company
Logged by: JP
Sample Set Used: Yes-482
Validatable Package: No
Deliverables:

Project #: K0275001
Project: 2-10 Sheetpile
Sample Site:
SDG No:
Analytical Protocol: In-house

LOGNUM ARI ID	CLIENT ID	CN >12	WAD >12	NH3 <2	COD <2	FOG <2	MET <2	PHEN <2	PHOS <2	TKN <2	NO23 <2	TOC <2	S2 >9	AK102 <2	Fe2+ <2	DMET FLT	DOC FLT	PARAMETER	ADJUSTED TO	LOT NUMBER	AMOUNT ADDED	DATE/BY
10-3733 **QJ43G**	GW-100210-PL2-244A-0						DIS PASS					PASS				Y						
10-3734 **QJ43H**	GW-100210-PL2-253A-0						DIS									Y						
10-3735 **QJ43I**	GW-100210-PL2-252A-0						DIS					PASS				Y						
10-3740 **QJ43N**	GW-100210-PL2-253A-0						TOT PASS															

Checked By JP Date 2/10/10

Case Narrative

prepared
for

The Boeing Company

Project: 2-10 Sheetpile, K0275001

ARI JOB NO: QJ21, QJ43

prepared
by

Analytical Resources, Inc.

Data Reporting Qualifiers

Effective 7/10/2009

Inorganic Data

U Indicates that the target analyte was not detected at the reported concentration

* Duplicate RPD is not within established control limits

B Reported value is less than the CRDL but ≥ the Reporting Limit

N Matrix Spike recovery not within established control limits

NA Not Applicable, analyte not spiked

H The natural concentration of the spiked element is so much greater than the concentration spiked that an accurate determination of spike recovery is not possible

L Analyte concentration is ≤5 times the Reporting Limit and the replicate control limit defaults to ±1 RL instead of the normal 20% RPD

Organic Data

U Indicates that the target analyte was not detected at the reported concentration

* Flagged value is not within established control limits

B Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's Reporting Limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.

J Estimated concentration when the value is less than ARI's established reporting limits

D The spiked compound was not detected due to sample extract dilution

E Estimated concentration calculated for an analyte response above the valid instrument calibration range. A dilution is required to obtain an accurate quantification of the analyte.

Q Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20%Drift or minimum RRF).

S Indicates an analyte response that has saturated the detector. The calculated concentration is not valid; a dilution is required to obtain valid quantification of the analyte

NA The flagged analyte was not analyzed for

NR Spiked compound recovery is not reported due to chromatographic interference

NS The flagged analyte was not spiked into the sample

M Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters. This flag is used only for GC-MS analyses

M2 The sample contains PCB congeners that do not match any standard Aroclor pattern. The PCBs are identified and quantified as the Aroclor whose pattern most closely matches that of the sample. The reported value is an estimate.

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification"

Y The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.

C The analyte was positively identified on only one of two chromatographic columns. Chromatographic interference prevented a positive identification on the second column

P The analyte was detected on both chromatographic columns but the quantified values differ by ≥40% RPD with no obvious chromatographic interference

Geotechnical Data

A The total of all fines fractions. This flag is used to report total fines when only sieve analysis is requested and balances total grain size with sample weight.

F Samples were frozen prior to particle size determination

SM Sample matrix was not appropriate for the requested analysis. This normally refers to samples contaminated with an organic product that interferes with the sieving process and/or moisture content, porosity and saturation calculations

SS Sample did not contain the proportion of "fines" required to perform the pipette portion of the grain size analysis

W Weight of sample in some pipette aliquots was below the level required for accurate weighting

Analytical Resources,Incorporated
Analytical Chemists and Consultants

Spike Recovery Control Limits for Analysis of Aqueous Samples Volatile Organic Compounds (VOA) EPA SW-846 Methods 8260C 5 mL Purge Volume [9]

Effective: 5/1/09

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use. http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Extraction Method:	ARI[1] Control Limits	ARI[1,2] ME Limits	DoD[6] Control Limits	DoD[2,6] ME Limits
LCS Spike Recovery [8]				-
Dichlorodifluoromethane	48 - 147	32 - 164	30 - 155	10 - 175
Chloromethane	66 - 130	55 - 141	40 - 125	25 - 140
Vinyl Chloride	73 - 130	64 - 140	50 - 145	35 - 165
Bromomethane	60 - 138	47 - 151	30 - 145	10 - 165
Chloroethane	52 - 151	36 - 168	60 - 135	50 - 145
Trichlorofluoromethane	36 - 175	13 - 198	60 - 145	45 - 160
Acrolein	34 - 164	12 - 186	(4)	(4)
1,1,2-Trichloro-1,2,2-trifluoroethane	69 - 132	59 - 143	(4)	(4)
Acetone	60 - 144	46 - 158	40 - 140	20 - 160
1,1-Dichloroethene	73 - 124	65 - 133	70 - 130	55 - 140
Bromoethane	70 - 133	60 - 144	(4)	(4)
Methyl Iodide	57 - 149	42 - 164	(4)	(4)
Methylene Chloride	74 - 121	66 - 129	55 - 140	40 - 155
Acrylonitrile	75 - 141	64 - 152	(4)	(4)
Methyl tert-Butyl Ether	79 - 127	71 - 135	65 - 125	55 - 135
Carbon Disulfide	67 - 133	56 - 144	35 - 160	15 - 185
trans-1,2-Dichloroethene	80 - **120**	74 - 126	60 - 140	45 - 150
Vinyl Acetate	61 - 145	47 - 159	(4)	(4)
1,1-Dichloroethane	80 - 123	73 - 130	70 - 135	60 - 145
2-Butanone	64 - 149	50 - 163	30 - 150	10 - 170
2,2-Dichloropropane	72 - 136	61 - 147	70 - 135	60 - 150
cis-1,2-Dichloroethene	**80 - 120**	78 - 125	70 - 125	60 - 135
Chloroform	80 - 121	73 - 128	65 - 135	50 - 150
Bromodichloromethane	80 - 122	73 - 129	75 - 120	70 - 130
1,1,1-Trichloroethane	80 - 124	73 - 131	65 - 130	55 - 145
1,1-Dichloropropene	**80** - 123	76 - 130	75 - 130	65 - 140
Carbon Tetrachloride	77 - 123	69 - 131	65 - 140	55 - 150
1,2-Dichloroethane	78 - 121	71 - 128	70 - 130	60 - 140
Benzene	**80 - 120**	80 - 124	80 - 120	75 - 130
Trichloroethene	**80 - 120**	76 - 124	70 - 125	60 - 135
1,2-Dichloropropane	**80** - 120	76 - 126	75 - 125	65 - 135
Bromochloromethane	**80** - 120	77 - 126	65 - 130	55 - 140
Dibromomethane	**80 - 120**	76 - 122	75 - 125	65 - 135
2-Chloroethylvinylether	59 - 136	46 - 149	(4)	(4)
4-Methyl-2-Pentanone	68 - 138	56 - 150	60 - 135	45 - 145
cis-1,3-Dichloropropene	74 - 127	65 - 136	70 - 130	60 - 140

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Spike Recovery Control Limits for Analysis of Aqueous Samples Volatile Organic Compounds (VOA) EPA SW-846 Methods 8260C 5 mL Purge Volume [9]

Effective: 5/1/09

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use. http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Extraction Method:	ARI[1] Control Limits	ARI[1,2] ME Limits	DoD[6] Control Limits	DoD[2,6] ME Limits
Toluene	**80 - 120**	78 - 122	75 - 120	70 - 130
trans-1,3-Dichloropropene	68 - 131	58 - 142	55 - 140	40 - 155
2-Hexanone	70 - 136	59 - 147	55 - 130	45 - 140
1,1,2-Trichloroethane	**80 - 120**	79 - 120	75 - 125	65 - 135
1,3-Dichloropropane	**80** - 120	76 - 126	75 - 125	65 - 135
Tetrachloroethene	79 - **120**	73 - 125	45 - 150	25 - 165
Dibromochloromethane	77 - 123	69 - 131	60 - 135	45 - 145
Ethylene Dibromide	**80** - 121	76 - 128	(4)	(4)
Chlorobenzene	**80 - 120**	77 - 121	80 - 120	75 - 130
Ethylbenzene	83 - 122	77 - 129	75 - 125	65 - 135
1,1,2,2-Tetrachloroethane	**80** - 121	74 - 128	65 - 130	55 - 140
m,p-Xylene	**80** - 123	79 - 129	75 - 130	65 - 135
o-Xylene	**80** - 125	75 - 132	80 - 120	75 - 130
Styrene	72 - 130	62 - 140	65 - 135	55 - 145
Isopropylbenzene	**80** - 129	78 - 136	75 - 125	65 - 135
Bromoform	71 - **120**	63 - 126	70 - 130	60 - 140
1,1,1,2-Tetrachloroethane	77 - 122	70 - 130	80 - 130	75 - 135
1,2,3-Trichloropropane	**80** - 120	76 - 126	75 - 125	65 - 130
trans-1,4-Dichloro-2-butene	62 - 146	48 - 160	(4)	(4)
n-Propylbenzene	**80** - 128	78 - 135	70 - 130	65 - 140
Bromobenzene	**80 - 120**	78 - 122	75 - 125	70 - 130
1,3,5-Trimethylbenzene	**80** - 129	77 - 137	75 - 130	65 - 140
2-Chlorotoluene	**80** - 124	75 - 131	75 - 125	65 - 135
4-Chlorotoluene	**80** - 124	75 - 131	75 - 130	65 - 135
tert-Butylbenzene	**80** - 128	76 - 136	70 - 130	60 - 140
1,2,4-Trimethylbenzene	**80** - 130	75 - 138	75 - 130	65 - 140
sec-Butylbenzene	**80** - 129	78 - 136	70 - 125	65 - 135
4-Isopropyltoluene	**80** - 133	75 - 141	75 - 130	65 - 140
1,3-Dichlorobenzene	**80 - 120**	76 - 124	75 - 125	65 - 130
1,4-Dichlorobenzene	**80 - 120**	75 - 122	75 - 125	65 - 130
n-Butylbenzene	78 - 140	68 - 150	70 - 135	55 - 150
1,2-Dichlorobenzene	**80 - 120**	77 - 121	70 - 120	60 - 130
1,2-Dibromo-3-chloropropane	72 - 131	62 - 141	50 - 130	35 - 145
1,2,4-Trichlorobenzene	75 - 130	66 - 139	65 - 135	55 - 145
Hexachloro-1,3-butadiene	73 - 129	64 - 138	50 - 140	35 - 160
Naphthalene	66 - 140	54 - 152	55 - 140	40 - 150
1,2,3-Trichlorobenzene	74 - 130	65 - 139	55 - 140	45 - 155

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Analytical Chemists and Consultants

Spike Recovery Control Limits for Analysis of Aqueous Samples Volatile Organic Compounds (VOA) EPA SW-846 Methods 8260C 5 mL Purge Volume [9]

Effective: 5/1/09

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use. http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Extraction Method:	ARI[1] Control Limits	ARI[1,2] ME Limits	DoD[6] Control Limits	DoD[2,6] ME Limits
MB/LCS Surrogate Recovery				
Dibromofluoromethane	**80 - 120**	(3)	85 - 115	(3)
d4-1,2-Dichloroethane	83 - 122	(3)	70 - 120	(3)
d8-Toluene	**80 - 120**	(3)	85 - 120	(3)
4-Bromofluorobenzene	**80 - 120**	(3)	75 - 120	(3)
d4-1,2-Dichlorobenzene	**80 - 120**	(3)	(4)	(3)(4)
Sample Surrogate Recovery				
Dibromofluoromethane	30 - 160 [7]	(3)	85 - 115	(3)
d4-1,2-Dichloroethane	**80** - 125	(3)	70 - 120	(3)
d8-Toluene	**80 - 120**	(3)	85 - 120	(3)
4-Bromofluorobenzene	**80 - 120**	(3)	75 - 120	(3)
D4-1,2-Dichlorobenzene	**80 - 120**	(3)	(4)	(3)(4)

(1) Control Limits calculated using all data generated 1/1/08 through 12/31/08.
(2) **ME** = A **marginal exceedance** defined in the NELAC Standard[5] as beyond the LCS-CL but still within the ME limits. ME limits are between 3 and 4 standard deviations around the mean. A maximum of four marginal exceedances are acceptable. Five or more marginal exceedances require corrective action.
(3) Marginal Exceedances not allowed for surrogate standards.
(4) The DoD-QSM [6] does not list recovery limits for these compounds.
(5) **2003 NELAC Standard (EPA/600/R-04/003), July 2003**, Chapter 5, pages 251-252.
(6) Page 182 of: **Department of Defense Quality Systems Manual for Environmental Laboratories, Version 3 Final, March 2005** Prepared By Environmental Data Quality Workgroup, Department of Navy, Lead Service (Based On National Environmental Laboratory Accreditation Conference (NELAC) Chapter 5 (Quality Systems) NELAC Voted Version – 5 June 2003
(7) 30 – 160 are default, advisory control limits used when there is insufficient data to calculate historic control limits. **DO NOT** use these limits as the sole reason to reject the data from a batch of analyses
(8) Laboratory Control Sample (LCS) spike recovery control limits also used as advisory control limits for sample matrix spike (MS) analyzes. MS recovery values are advisory and not used to assess the acceptability of an analytical batch.
(9) Highlighted control limits (**bold font**) are adjusted from the calculated values as follows:

a) ARI does not use control limits < 10 for the lower limit or < 100 for the upper limit.
b) Control limits for analyzes with no separate preparation procedure are adjusted to reflect the minimum uncertainty in the calibration of the instrument allowed by the referenced analytical method.

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Spike Recovery Control Limits for Natural Attenuation Parameters (Methane, Ethane, Ethene) EPA Method RSK-175 [1,2]

Effective 5/1/09

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use.
http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Sample Matrix:	Water
LCS Spike Recovery [3]	
Methane	**80 - 120**
Ethane	**80 - 120**
Ethene	**80 - 120**
Acetylene	73 - 123
Method Blank/LCS Surrogate Recovery	
Propane	79 - 132
Sample Surrogate Recovery	
Propane	72 - 122

(1) ARI's Control limits calculated using all available spike recovery data from 1/1/08 to 3/31/09

(2) Highlighted control limits (bold font) are adjusted from the calculated values as follows:

a) Highlighted control limits (**bold font**) adjusted to demonstrate that ARI does not use control limits < 10 for the lower limit or < 100 for the upper limit.

b) Control limits for analyzes with no separate preparation procedure are adjusted to reflect the minimum uncertainty in the calibration of the instrument allowed by the referenced analytical method.

(3) Laboratory Control Sample (LCS) spike recovery control limits also used as advisory control limits for sample matrix spike (MS) analyzes. MS recovery values are advisory and not used to assess the acceptability of an analytical batch.

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Summary of Laboratory Control Limits Metals Analyses (All Methods & Sample Matrices)

Effective 5/1/09

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use. http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Element	Matrix Spike Recovery	LCS Recovery	Replicate RPD
Aluminum	75 - 125	80 - 120	≤ 20%
Antimony	75 - 125	80 - 120	≤ 20%
Arsenic	75 - 125	80 - 120	≤ 20%
Barium	75 - 125	80 - 120	≤ 20%
Beryllium	75 - 125	80 - 120	≤ 20%
Boron	75 - 125	80 - 120	≤ 20%
Cadmium	75 - 125	80 - 120	≤ 20%
Calcium	75 - 125	80 - 120	≤ 20%
Chromium	75 - 125	80 - 120	≤ 20%
Cobalt	75 - 125	80 - 120	≤ 20%
Copper	75 - 125	80 - 120	≤ 20%
Iron	75 - 125	80 - 120	≤ 20%
Lead	75 - 125	80 - 120	≤ 20%
Magnesium	75 - 125	80 - 120	≤ 20%
Manganese	75 - 125	80 - 120	≤ 20%
Mercury	75 - 125	80 - 120	≤ 20%
Nickel	75 - 125	80 - 120	≤ 20%
Potassium	75 - 125	80 - 120	≤ 20%
Selenium	75 - 125	80 - 120	≤ 20%
Silica	75 - 125	80 - 120	≤ 20%
Silver	75 - 125	80 - 120	≤ 20%
Sodium	75 - 125	80 - 120	≤ 20%
Strontium	75 - 125	80 - 120	≤ 20%
Thallium	75 - 125	80 - 120	≤ 20%
Vanadium	75 - 125	80 - 120	≤ 20%
Zinc	75 - 125	80 - 120	≤ 20%

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Spike Recovery Control Limits for Conventional Wet Chemistry

Effective 5/1/09

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use. http://www.arilabs.com/portal/downloads/ARI-CLs.zip

	ARI's Control Limits	
Sample Matrix:	Water	Soil / Sediment
Matrix Spike Recoveries	% Recovery	% Recovery
Ammonia	75 - 125	75 - 125
Bromide	75 125	75 - 125
Chloride	75 125	75 - 125
Cyanide	75 - 125	75 - 125
Ferrous Iron	75 - 125	75 - 125
Fluoride	75 - 125	75 - 125
Formaldehyde	75 - 125	75 - 125
Hexane Extractable Material	-- - --	78 - 114
Hexavalent Chromium	75 - 125	75 - 125
Nitrate/Nitrite	75 - 125	75 - 125
Oil and Grease	75 - 125	75 - 125
Phenol	75 - 125	75 - 125
Phosphorous	75 - 125	75 - 125
Sulfate	75 - 125	75 - 125
Sulfide	75 - 125	75 - 125
Total Kjeldahl Nitrogen	75 - 125	75 - 125
Total Organic Carbon	75 - 125	75 - 125
Duplicate RPDs		
Acidity	±20%	±20%
Alkalinity	±20%	±20%
BOD	±20%	±20%
Cation Exchange	±20%	±20%
COD	±20%	±20%
Conductivity	±20%	±20%
Salinity	±20%	±20%
Solids	±20%	±20%
Turbidity	±20%	±20%

Data Summary Package

prepared
for

The Boeing Company

Project: 2-10 Sheetpile, K0275001

ARI JOB NO: QJ21, QJ43

prepared
by

Analytical Resources, Inc.

VOLATILE ANALYSIS

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: GW-100209-PL2-212A-0
SAMPLE

Lab Sample ID: QJ21H
LIMS ID: 10-3593
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Instrument/Analyst: NT5/PKC
Date Analyzed: 02/22/10 14:16

Sample Amount: 0.0040 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1,200	< 1,200	U
74-83-9	Bromomethane	1,200	< 1,200	U
75-01-4	**Vinyl Chloride**	**500**	**9,400**	
75-00-3	Chloroethane	500	< 500	U
75-09-2	Methylene Chloride	1,200	< 1,200	U
67-64-1	Acetone	12,000	< 12,000	U
75-15-0	Carbon Disulfide	500	< 500	U
75-35-4	1,1-Dichloroethene	500	< 500	U
75-34-3	1,1-Dichloroethane	500	< 500	U
156-60-5	**trans-1,2-Dichloroethene**	**500**	**780**	
156-59-2	**cis-1,2-Dichloroethene**	**500**	**24,000**	
67-66-3	Chloroform	500	< 500	U
107-06-2	1,2-Dichloroethane	500	< 500	U
78-93-3	2-Butanone	12,000	< 12,000	U
71-55-6	1,1,1-Trichloroethane	500	< 500	U
56-23-5	Carbon Tetrachloride	500	< 500	U
108-05-4	Vinyl Acetate	2,500	< 2,500	U
75-27-4	Bromodichloromethane	500	< 500	U
78-87-5	1,2-Dichloropropane	500	< 500	U
10061-01-5	cis-1,3-Dichloropropene	500	< 500	U
79-01-6	**Trichloroethene**	**500**	**53,000**	
124-48-1	Dibromochloromethane	500	< 500	U
79-00-5	1,1,2-Trichloroethane	500	< 500	U
71-43-2	Benzene	500	< 500	U
10061-02-6	trans-1,3-Dichloropropene	500	< 500	U
110-75-8	2-Chloroethylvinylether	2,500	< 2,500	U
75-25-2	Bromoform	500	< 500	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	12,000	< 12,000	U
591-78-6	2-Hexanone	12,000	< 12,000	U
127-18-4	Tetrachloroethene	500	< 500	U
79-34-5	1,1,2,2-Tetrachloroethane	500	< 500	U
108-88-3	Toluene	500	< 500	U
108-90-7	Chlorobenzene	500	< 500	U
100-41-4	Ethylbenzene	500	< 500	U
100-42-5	Styrene	500	< 500	U
75-69-4	Trichlorofluoromethane	500	< 500	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	500	< 500	U
179601-23-1	m,p-Xylene	1,000	< 1,000	U
95-47-6	o-Xylene	500	< 500	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	111%
d8-Toluene	95.4%
Bromofluorobenzene	92.3%

2-Chloroethylvinylether is an acid labile compound and may not be recovered from an acid preserved sample.

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: GW-100209-PL2-212A-1**
 SAMPLE

Lab Sample ID: QJ21I
LIMS ID: 10-3594
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Instrument/Analyst: NT5/PKC
Date Analyzed: 02/22/10 14:41

Sample Amount: 0.0040 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1,200	< 1,200	U
74-83-9	Bromomethane	1,200	< 1,200	U
75-01-4	**Vinyl Chloride**	**500**	**9,100**	
75-00-3	Chloroethane	500	< 500	U
75-09-2	Methylene Chloride	1,200	< 1,200	U
67-64-1	Acetone	12,000	< 12,000	U
75-15-0	Carbon Disulfide	500	< 500	U
75-35-4	1,1-Dichloroethene	500	< 500	U
75-34-3	1,1-Dichloroethane	500	< 500	U
156-60-5	**trans-1,2-Dichloroethene**	**500**	**780**	
156-59-2	**cis-1,2-Dichloroethene**	**500**	**24,000**	
67-66-3	Chloroform	500	< 500	U
107-06-2	1,2-Dichloroethane	500	< 500	U
78-93-3	2-Butanone	12,000	< 12,000	U
71-55-6	1,1,1-Trichloroethane	500	< 500	U
56-23-5	Carbon Tetrachloride	500	< 500	U
108-05-4	Vinyl Acetate	2,500	< 2,500	U
75-27-4	Bromodichloromethane	500	< 500	U
78-87-5	1,2-Dichloropropane	500	< 500	U
10061-01-5	cis-1,3-Dichloropropene	500	< 500	U
79-01-6	**Trichloroethene**	**500**	**55,000**	
124-48-1	Dibromochloromethane	500	< 500	U
79-00-5	1,1,2-Trichloroethane	500	< 500	U
71-43-2	Benzene	500	< 500	U
10061-02-6	trans-1,3-Dichloropropene	500	< 500	U
110-75-8	2-Chloroethylvinylether	2,500	< 2,500	U
75-25-2	Bromoform	500	< 500	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	12,000	< 12,000	U
591-78-6	2-Hexanone	12,000	< 12,000	U
127-18-4	Tetrachloroethene	500	< 500	U
79-34-5	1,1,2,2-Tetrachloroethane	500	< 500	U
108-88-3	Toluene	500	< 500	U
108-90-7	Chlorobenzene	500	< 500	U
100-41-4	Ethylbenzene	500	< 500	U
100-42-5	Styrene	500	< 500	U
75-69-4	Trichlorofluoromethane	500	< 500	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	500	< 500	U
179601-23-1	m,p-Xylene	1,000	< 1,000	U
95-47-6	o-Xylene	500	< 500	U

Reported in μg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	109%
d8-Toluene	94.5%
Bromofluorobenzene	91.9%

2-Chloroethylvinylether is an acid labile compound and may not be recovered from an acid preserved sample.

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: GW-100209-PL2-218A-15-0**
 SAMPLE

Lab Sample ID: QJ21J
LIMS ID: 10-3595
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Instrument/Analyst: NT5/PKC
Date Analyzed: 02/19/10 19:16

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	< 0.5	U
74-83-9	Bromomethane	0.5	< 0.5	U
75-01-4	**Vinyl Chloride**	**0.2**	**650**	**ES**
75-00-3	Chloroethane	0.2	< 0.2	U
75-09-2	Methylene Chloride	0.5	< 0.5	U
67-64-1	**Acetone**	**5.0**	**6.7**	
75-15-0	Carbon Disulfide	0.2	< 0.2	U
75-35-4	**1,1-Dichloroethene**	**0.2**	**3.7**	
75-34-3	1,1-Dichloroethane	0.2	< 0.2	U
156-60-5	**trans-1,2-Dichloroethene**	**0.2**	**240**	**E**
156-59-2	**cis-1,2-Dichloroethene**	**0.2**	**960**	**ES**
67-66-3	Chloroform	0.2	< 0.2	U
107-06-2	1,2-Dichloroethane	0.2	< 0.2	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.2	< 0.2	U
56-23-5	Carbon Tetrachloride	0.2	< 0.2	U
108-05-4	Vinyl Acetate	1.0	< 1.0	U
75-27-4	Bromodichloromethane	0.2	< 0.2	U
78-87-5	1,2-Dichloropropane	0.2	< 0.2	U
10061-01-5	cis-1,3-Dichloropropene	0.2	< 0.2	U
79-01-6	Trichloroethene	43	< 43	Y
124-48-1	Dibromochloromethane	0.2	< 0.2	U
79-00-5	1,1,2-Trichloroethane	0.2	< 0.2	U
71-43-2	Benzene	0.2	< 0.2	U
10061-02-6	trans-1,3-Dichloropropene	0.2	< 0.2	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.2	< 0.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.2	< 0.2	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	< 0.2	U
108-88-3	Toluene	0.2	< 0.2	U
108-90-7	Chlorobenzene	0.2	< 0.2	U
100-41-4	Ethylbenzene	0.2	< 0.2	U
100-42-5	Styrene	0.2	< 0.2	U
75-69-4	Trichlorofluoromethane	0.2	< 0.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	< 0.2	U
179601-23-1	m,p-Xylene	0.4	< 0.4	U
95-47-6	o-Xylene	0.2	< 0.2	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	105%
d8-Toluene	93.0%
Bromofluorobenzene	92.7%

2-Chloroethylvinylether is an acid labile compound and may not be recovered from an acid preserved sample.

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: GW-100209-PL2-218A-15-0
REANALYSIS

Lab Sample ID: QJ21J
LIMS ID: 10-3595
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Instrument/Analyst: NT9/AAR
Date Analyzed: 02/20/10 15:40

Sample Amount: 0.500 mL
Purge Volume: 5.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	10	< 10	U
74-83-9	Bromomethane	10	< 10	U
75-01-4	**Vinyl Chloride**	**10**	**1,100**	**Q**
75-00-3	Chloroethane	10	< 10	U
75-09-2	Methylene Chloride	20	< 20	U
67-64-1	Acetone	100	< 100	U
75-15-0	Carbon Disulfide	10	< 10	U
75-35-4	1,1-Dichloroethene	10	< 10	U
75-34-3	1,1-Dichloroethane	10	< 10	U
156-60-5	**trans-1,2-Dichloroethene**	**10**	**310**	
156-59-2	**cis-1,2-Dichloroethene**	**10**	**2,200**	**E**
67-66-3	Chloroform	10	< 10	U
107-06-2	1,2-Dichloroethane	10	< 10	U
78-93-3	2-Butanone	50	< 50	U
71-55-6	1,1,1-Trichloroethane	10	< 10	U
56-23-5	Carbon Tetrachloride	10	< 10	U
108-05-4	Vinyl Acetate	50	< 50	U
75-27-4	Bromodichloromethane	10	< 10	U
78-87-5	1,2-Dichloropropane	10	< 10	U
10061-01-5	cis-1,3-Dichloropropene	10	< 10	U
79-01-6	**Trichloroethene**	**10**	**18**	
124-48-1	Dibromochloromethane	10	< 10	U
79-00-5	1,1,2-Trichloroethane	10	< 10	U
71-43-2	Benzene	10	< 10	U
10061-02-6	trans-1,3-Dichloropropene	10	< 10	U
110-75-8	2-Chloroethylvinylether	50	< 50	U
75-25-2	Bromoform	10	< 10	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	50	< 50	U
591-78-6	2-Hexanone	50	< 50	U
127-18-4	Tetrachloroethene	10	< 10	U
79-34-5	1,1,2,2-Tetrachloroethane	10	< 10	U
108-88-3	Toluene	10	< 10	U
108-90-7	Chlorobenzene	10	< 10	U
100-41-4	Ethylbenzene	10	< 10	U
100-42-5	Styrene	10	< 10	U
75-69-4	Trichlorofluoromethane	10	< 10	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	20	< 20	U
179601-23-1	m,p-Xylene	20	< 20	U
95-47-6	o-Xylene	10	< 10	U

Reported in μg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	89.7%
d8-Toluene	100%
Bromofluorobenzene	102%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: GW-100209-PL2-218A-15-0**
 DILUTION

Lab Sample ID: QJ21J
LIMS ID: 10-3595
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Instrument/Analyst: NT5/PKC
Date Analyzed: 02/22/10 15:07

Sample Amount: 0.100 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	50	< 50	U
74-83-9	Bromomethane	50	< 50	U
75-01-4	**Vinyl Chloride**	**20**	**1,100**	
75-00-3	Chloroethane	20	< 20	U
75-09-2	Methylene Chloride	50	< 50	U
67-64-1	Acetone	500	< 500	U
75-15-0	Carbon Disulfide	20	< 20	U
75-35-4	1,1-Dichloroethene	20	< 20	U
75-34-3	1,1-Dichloroethane	20	< 20	U
156-60-5	**trans-1,2-Dichloroethene**	**20**	**300**	
156-59-2	**cis-1,2-Dichloroethene**	**20**	**2,200**	
67-66-3	Chloroform	20	< 20	U
107-06-2	1,2-Dichloroethane	20	< 20	U
78-93-3	2-Butanone	500	< 500	U
71-55-6	1,1,1-Trichloroethane	20	< 20	U
56-23-5	Carbon Tetrachloride	20	< 20	U
108-05-4	Vinyl Acetate	100	< 100	U
75-27-4	Bromodichloromethane	20	< 20	U
78-87-5	1,2-Dichloropropane	20	< 20	U
10061-01-5	cis-1,3-Dichloropropene	20	< 20	U
79-01-6	**Trichloroethene**	**20**	**27**	
124-48-1	Dibromochloromethane	20	< 20	U
79-00-5	1,1,2-Trichloroethane	20	< 20	U
71-43-2	Benzene	20	< 20	U
10061-02-6	trans-1,3-Dichloropropene	20	< 20	U
110-75-8	2-Chloroethylvinylether	100	< 100	U
75-25-2	Bromoform	20	< 20	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	500	< 500	U
591-78-6	2-Hexanone	500	< 500	U
127-18-4	Tetrachloroethene	20	< 20	U
79-34-5	1,1,2,2-Tetrachloroethane	20	< 20	U
108-88-3	Toluene	20	< 20	U
108-90-7	Chlorobenzene	20	< 20	U
100-41-4	Ethylbenzene	20	< 20	U
100-42-5	Styrene	20	< 20	U
75-69-4	Trichlorofluoromethane	20	< 20	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	20	< 20	U
179601-23-1	m,p-Xylene	40	< 40	U
95-47-6	o-Xylene	20	< 20	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	108%
d8-Toluene	98.6%
Bromofluorobenzene	90.3%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: GW-100209-PL2-218A-28-0**
 SAMPLE

Lab Sample ID: QJ21K
LIMS ID: 10-3596
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Instrument/Analyst: NT5/PKC
Date Analyzed: 02/19/10 19:42

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	< 0.5	U
74-83-9	Bromomethane	0.5	< 0.5	U
75-01-4	**Vinyl Chloride**	**0.2**	**370**	**ES**
75-00-3	Chloroethane	0.2	< 0.2	U
75-09-2	Methylene Chloride	0.5	< 0.5	U
67-64-1	**Acetone**	**5.0**	**6.8**	
75-15-0	Carbon Disulfide	0.2	< 0.2	U
75-35-4	**1,1-Dichloroethene**	**0.2**	**1.6**	
75-34-3	1,1-Dichloroethane	0.2	< 0.2	U
156-60-5	**trans-1,2-Dichloroethene**	**0.2**	**100**	**E**
156-59-2	**cis-1,2-Dichloroethene**	**0.2**	**660**	**ES**
67-66-3	Chloroform	0.2	< 0.2	U
107-06-2	1,2-Dichloroethane	0.2	< 0.2	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.2	< 0.2	U
56-23-5	Carbon Tetrachloride	0.2	< 0.2	U
108-05-4	Vinyl Acetate	1.0	< 1.0	U
75-27-4	Bromodichloromethane	0.2	< 0.2	U
78-87-5	1,2-Dichloropropane	0.2	< 0.2	U
10061-01-5	cis-1,3-Dichloropropene	0.2	< 0.2	U
79-01-6	Trichloroethene	14	< 14	Y
124-48-1	Dibromochloromethane	0.2	< 0.2	U
79-00-5	1,1,2-Trichloroethane	0.2	< 0.2	U
71-43-2	Benzene	0.2	< 0.2	U
10061-02-6	trans-1,3-Dichloropropene	0.2	< 0.2	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.2	< 0.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.2	< 0.2	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	< 0.2	U
108-88-3	Toluene	0.2	< 0.2	U
108-90-7	Chlorobenzene	0.2	< 0.2	U
100-41-4	Ethylbenzene	0.2	< 0.2	U
100-42-5	Styrene	0.2	< 0.2	U
75-69-4	Trichlorofluoromethane	0.2	< 0.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	< 0.2	U
179601-23-1	m,p-Xylene	0.4	< 0.4	U
95-47-6	o-Xylene	0.2	< 0.2	U

Reported in μg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	105%
d8-Toluene	94.6%
Bromofluorobenzene	88.6%

2-Chloroethylvinylether is an acid labile compound and may not be recovered from an acid preserved sample.

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: GW-100209-PL2-218A-28-0**
 REANALYSIS

Lab Sample ID: QJ21K
LIMS ID: 10-3596
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Instrument/Analyst: NT9/AAR
Date Analyzed: 02/20/10 16:08

Sample Amount: 0.500 mL
Purge Volume: 5.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	10	< 10	U
74-83-9	Bromomethane	10	< 10	U
75-01-4	**Vinyl Chloride**	**10**	**480**	**Q**
75-00-3	Chloroethane	10	< 10	U
75-09-2	Methylene Chloride	20	< 20	U
67-64-1	Acetone	100	< 100	U
75-15-0	Carbon Disulfide	10	< 10	U
75-35-4	1,1-Dichloroethene	10	< 10	U
75-34-3	1,1-Dichloroethane	10	< 10	U
156-60-5	**trans-1,2-Dichloroethene**	**10**	**120**	
156-59-2	**cis-1,2-Dichloroethene**	**10**	**1,000**	
67-66-3	Chloroform	10	< 10	U
107-06-2	1,2-Dichloroethane	10	< 10	U
78-93-3	2-Butanone	50	< 50	U
71-55-6	1,1,1-Trichloroethane	10	< 10	U
56-23-5	Carbon Tetrachloride	10	< 10	U
108-05-4	Vinyl Acetate	50	< 50	U
75-27-4	Bromodichloromethane	10	< 10	U
78-87-5	1,2-Dichloropropane	10	< 10	U
10061-01-5	cis-1,3-Dichloropropene	10	< 10	U
79-01-6	Trichloroethene	10	< 10	U
124-48-1	Dibromochloromethane	10	< 10	U
79-00-5	1,1,2-Trichloroethane	10	< 10	U
71-43-2	Benzene	10	< 10	U
10061-02-6	trans-1,3-Dichloropropene	10	< 10	U
110-75-8	2-Chloroethylvinylether	50	< 50	U
75-25-2	Bromoform	10	< 10	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	50	< 50	U
591-78-6	2-Hexanone	50	< 50	U
127-18-4	Tetrachloroethene	10	< 10	U
79-34-5	1,1,2,2-Tetrachloroethane	10	< 10	U
108-88-3	Toluene	10	< 10	U
108-90-7	Chlorobenzene	10	< 10	U
100-41-4	Ethylbenzene	10	< 10	U
100-42-5	Styrene	10	< 10	U
75-69-4	Trichlorofluoromethane	10	< 10	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	20	< 20	U
179601-23-1	m,p-Xylene	20	< 20	U
95-47-6	o-Xylene	10	< 10	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	89.2%
d8-Toluene	98.8%
Bromofluorobenzene	101%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: GW-100209-PL2-218B-45-0**
 SAMPLE

Lab Sample ID: QJ21M
LIMS ID: 10-3598
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Instrument/Analyst: NT5/PKC
Date Analyzed: 02/19/10 20:07

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	< 0.5	U
74-83-9	Bromomethane	0.5	< 0.5	U
75-01-4	**Vinyl Chloride**	**0.2**	**1.0**	
75-00-3	Chloroethane	0.2	< 0.2	U
75-09-2	Methylene Chloride	0.5	< 0.5	U
67-64-1	**Acetone**	**5.0**	**6.7**	
75-15-0	Carbon Disulfide	0.2	< 0.2	U
75-35-4	1,1-Dichloroethene	0.2	< 0.2	U
75-34-3	1,1-Dichloroethane	0.2	< 0.2	U
156-60-5	**trans-1,2-Dichloroethene**	**0.2**	**1.5**	
156-59-2	**cis-1,2-Dichloroethene**	**0.2**	**83**	**E**
67-66-3	Chloroform	0.2	< 0.2	U
107-06-2	1,2-Dichloroethane	0.2	< 0.2	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.2	< 0.2	U
56-23-5	Carbon Tetrachloride	0.2	< 0.2	U
108-05-4	Vinyl Acetate	1.0	< 1.0	U
75-27-4	Bromodichloromethane	0.2	< 0.2	U
78-87-5	1,2-Dichloropropane	0.2	< 0.2	U
10061-01-5	cis-1,3-Dichloropropene	0.2	< 0.2	U
79-01-6	Trichloroethene	4.6	< 4.6	Y
124-48-1	Dibromochloromethane	0.2	< 0.2	U
79-00-5	1,1,2-Trichloroethane	0.2	< 0.2	U
71-43-2	Benzene	0.2	< 0.2	U
10061-02-6	trans-1,3-Dichloropropene	0.2	< 0.2	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.2	< 0.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.2	< 0.2	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	< 0.2	U
108-88-3	Toluene	0.2	< 0.2	U
108-90-7	Chlorobenzene	0.2	< 0.2	U
100-41-4	Ethylbenzene	0.2	< 0.2	U
100-42-5	Styrene	0.2	< 0.2	U
75-69-4	Trichlorofluoromethane	0.2	< 0.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	< 0.2	U
179601-23-1	m,p-Xylene	0.4	< 0.4	U
95-47-6	o-Xylene	0.2	< 0.2	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	103%
d8-Toluene	97.7%
Bromofluorobenzene	91.9%

2-Chloroethylvinylether is an acid labile compound and may not be recovered from an acid preserved sample.

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: GW-100209-PL2-218B-45-0
REANALYSIS

Lab Sample ID: QJ21M
LIMS ID: 10-3598
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Instrument/Analyst: NT9/AAR
Date Analyzed: 02/20/10 14:44

Sample Amount: 5.00 mL
Purge Volume: 5.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.0	< 1.0	U
74-83-9	Bromomethane	1.0	< 1.0	U
75-01-4	Vinyl Chloride	1.0	< 1.0	U
75-00-3	Chloroethane	1.0	< 1.0	U
75-09-2	Methylene Chloride	2.0	< 2.0	U
67-64-1	Acetone	10	< 10	U
75-15-0	Carbon Disulfide	1.0	< 1.0	U
75-35-4	1,1-Dichloroethene	1.0	< 1.0	U
75-34-3	1,1-Dichloroethane	1.0	< 1.0	U
156-60-5	**trans-1,2-Dichloroethene**	**1.0**	**1.5**	
156-59-2	**cis-1,2-Dichloroethene**	**1.0**	**91**	
67-66-3	Chloroform	1.0	< 1.0	U
107-06-2	1,2-Dichloroethane	1.0	< 1.0	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	1.0	< 1.0	U
56-23-5	Carbon Tetrachloride	1.0	< 1.0	U
108-05-4	Vinyl Acetate	5.0	< 5.0	U
75-27-4	Bromodichloromethane	1.0	< 1.0	U
78-87-5	1,2-Dichloropropane	1.0	< 1.0	U
10061-01-5	cis-1,3-Dichloropropene	1.0	< 1.0	U
79-01-6	Trichloroethene	1.0	< 1.0	U
124-48-1	Dibromochloromethane	1.0	< 1.0	U
79-00-5	1,1,2-Trichloroethane	1.0	< 1.0	U
71-43-2	Benzene	1.0	< 1.0	U
10061-02-6	trans-1,3-Dichloropropene	1.0	< 1.0	U
110-75-8	2-Chloroethylvinylether	5.0	< 5.0	U
75-25-2	Bromoform	1.0	< 1.0	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	1.0	< 1.0	U
79-34-5	1,1,2,2-Tetrachloroethane	1.0	< 1.0	U
108-88-3	Toluene	1.0	< 1.0	U
108-90-7	Chlorobenzene	1.0	< 1.0	U
100-41-4	Ethylbenzene	1.0	< 1.0	U
100-42-5	Styrene	1.0	< 1.0	U
75-69-4	Trichlorofluoromethane	1.0	< 1.0	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.0	< 2.0	U
179601-23-1	m,p-Xylene	2.0	< 2.0	U
95-47-6	o-Xylene	1.0	< 1.0	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	92.1%
d8-Toluene	99.2%
Bromofluorobenzene	104%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: GW-100209-PL2-218B-58-0**
 SAMPLE

Lab Sample ID: QJ21N
LIMS ID: 10-3599
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Instrument/Analyst: NT5/PKC
Date Analyzed: 02/19/10 20:33

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	< 0.5	U
74-83-9	Bromomethane	0.5	< 0.5	U
75-01-4	**Vinyl Chloride**	**0.2**	**1.3**	
75-00-3	Chloroethane	0.2	< 0.2	U
75-09-2	Methylene Chloride	0.5	< 0.5	U
67-64-1	**Acetone**	**5.0**	**6.6**	
75-15-0	Carbon Disulfide	0.2	< 0.2	U
75-35-4	1,1-Dichloroethene	0.2	< 0.2	U
75-34-3	1,1-Dichloroethane	0.2	< 0.2	U
156-60-5	**trans-1,2-Dichloroethene**	**0.2**	**0.5**	
156-59-2	**cis-1,2-Dichloroethene**	**0.2**	**180**	**E**
67-66-3	Chloroform	0.2	< 0.2	U
107-06-2	1,2-Dichloroethane	0.2	< 0.2	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.2	< 0.2	U
56-23-5	Carbon Tetrachloride	0.2	< 0.2	U
108-05-4	Vinyl Acetate	1.0	< 1.0	U
75-27-4	Bromodichloromethane	0.2	< 0.2	U
78-87-5	1,2-Dichloropropane	0.2	< 0.2	U
10061-01-5	cis-1,3-Dichloropropene	0.2	< 0.2	U
79-01-6	Trichloroethene	3.0	< 3.0	Y
124-48-1	Dibromochloromethane	0.2	< 0.2	U
79-00-5	1,1,2-Trichloroethane	0.2	< 0.2	U
71-43-2	Benzene	0.2	< 0.2	U
10061-02-6	trans-1,3-Dichloropropene	0.2	< 0.2	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.2	< 0.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.2	< 0.2	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	< 0.2	U
108-88-3	**Toluene**	**0.2**	**0.9**	
108-90-7	Chlorobenzene	0.2	< 0.2	U
100-41-4	Ethylbenzene	0.2	< 0.2	U
100-42-5	Styrene	0.2	< 0.2	U
75-69-4	Trichlorofluoromethane	0.2	< 0.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	< 0.2	U
179601-23-1	m,p-Xylene	0.4	< 0.4	U
95-47-6	o-Xylene	0.2	< 0.2	U

Reported in μg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	104%
d8-Toluene	97.2%
Bromofluorobenzene	92.8%

2-Chloroethylvinylether is an acid labile compound and may not be recovered from an acid preserved sample.

FORM I

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: GW-100209-PL2-218B-58-0
REANALYSIS

Lab Sample ID: QJ21N
LIMS ID: 10-3599
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Instrument/Analyst: NT9/AAR
Date Analyzed: 02/20/10 15:12

Sample Amount: 5.00 mL
Purge Volume: 5.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.0	< 1.0	U
74-83-9	Bromomethane	1.0	< 1.0	U
75-01-4	**Vinyl Chloride**	**1.0**	**1.3**	**Q**
75-00-3	Chloroethane	1.0	< 1.0	U
75-09-2	**Methylene Chloride**	**2.0**	**3.0**	
67-64-1	Acetone	10	< 10	U
75-15-0	Carbon Disulfide	1.0	< 1.0	U
75-35-4	1,1-Dichloroethene	1.0	< 1.0	U
75-34-3	1,1-Dichloroethane	1.0	< 1.0	U
156-60-5	trans-1,2-Dichloroethene	1.0	< 1.0	U
156-59-2	**cis-1,2-Dichloroethene**	**1.0**	**200**	
67-66-3	Chloroform	1.0	< 1.0	U
107-06-2	1,2-Dichloroethane	1.0	< 1.0	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	1.0	< 1.0	U
56-23-5	Carbon Tetrachloride	1.0	< 1.0	U
108-05-4	Vinyl Acetate	5.0	< 5.0	U
75-27-4	Bromodichloromethane	1.0	< 1.0	U
78-87-5	1,2-Dichloropropane	1.0	< 1.0	U
10061-01-5	cis-1,3-Dichloropropene	1.0	< 1.0	U
79-01-6	Trichloroethene	1.0	< 1.0	U
124-48-1	Dibromochloromethane	1.0	< 1.0	U
79-00-5	1,1,2-Trichloroethane	1.0	< 1.0	U
71-43-2	Benzene	1.0	< 1.0	U
10061-02-6	trans-1,3-Dichloropropene	1.0	< 1.0	U
110-75-8	2-Chloroethylvinylether	5.0	< 5.0	U
75-25-2	Bromoform	1.0	< 1.0	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	1.0	< 1.0	U
79-34-5	1,1,2,2-Tetrachloroethane	1.0	< 1.0	U
108-88-3	**Toluene**	**1.0**	**1.4**	
108-90-7	Chlorobenzene	1.0	< 1.0	U
100-41-4	Ethylbenzene	1.0	< 1.0	U
100-42-5	Styrene	1.0	< 1.0	U
75-69-4	Trichlorofluoromethane	1.0	< 1.0	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.0	< 2.0	U
179601-23-1	m,p-Xylene	2.0	< 2.0	U
95-47-6	o-Xylene	1.0	< 1.0	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	91.0%
d8-Toluene	98.9%
Bromofluorobenzene	104%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: Trip Blank SAMPLE**

Lab Sample ID: QJ21Q
LIMS ID: 10-3602
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Instrument/Analyst: NT10/AAR
Date Analyzed: 02/12/10 16:08

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	< 0.5	U
74-83-9	Bromomethane	0.5	< 0.5	U
75-01-4	Vinyl Chloride	0.2	< 0.2	U
75-00-3	Chloroethane	0.2	< 0.2	U
75-09-2	Methylene Chloride	0.5	< 0.5	U
67-64-1	Acetone	5.0	< 5.0	U
75-15-0	Carbon Disulfide	0.2	< 0.2	U
75-35-4	1,1-Dichloroethene	0.2	< 0.2	U
75-34-3	1,1-Dichloroethane	0.2	< 0.2	U
156-60-5	trans-1,2-Dichloroethene	0.2	< 0.2	U
156-59-2	cis-1,2-Dichloroethene	0.2	< 0.2	U
67-66-3	Chloroform	0.2	< 0.2	U
107-06-2	1,2-Dichloroethane	0.2	< 0.2	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.2	< 0.2	U
56-23-5	Carbon Tetrachloride	0.2	< 0.2	U
108-05-4	Vinyl Acetate	1.0	< 1.0	U
75-27-4	Bromodichloromethane	0.2	< 0.2	U
78-87-5	1,2-Dichloropropane	0.2	< 0.2	U
10061-01-5	cis-1,3-Dichloropropene	0.2	< 0.2	U
79-01-6	Trichloroethene	0.2	< 0.2	U
124-48-1	Dibromochloromethane	0.2	< 0.2	U
79-00-5	1,1,2-Trichloroethane	0.2	< 0.2	U
71-43-2	Benzene	0.2	< 0.2	U
10061-02-6	trans-1,3-Dichloropropene	0.2	< 0.2	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.2	< 0.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.2	< 0.2	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	< 0.2	U
108-88-3	Toluene	0.2	< 0.2	U
108-90-7	Chlorobenzene	0.2	< 0.2	U
100-41-4	Ethylbenzene	0.2	< 0.2	U
100-42-5	Styrene	0.2	< 0.2	U
75-69-4	Trichlorofluoromethane	0.2	< 0.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	< 0.2	U
179601-23-1	m,p-Xylene	0.4	< 0.4	U
95-47-6	o-Xylene	0.2	< 0.2	U

Reported in μg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	102%
d8-Toluene	101%
Bromofluorobenzene	94.8%

2-Chloroethylvinylether is an acid labile compound and may not be recovered from an acid preserved sample.

FORM I

ANALYTICAL RESOURCES INCORPORATED

VOA SURROGATE RECOVERY SUMMARY

Matrix: Groundwater

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001

ARI ID	Client ID	PV	DCE	TOL	BFB	DCB	TOT OUT
MB-021210	Method Blank	10	101%	99.4%	91.8%	NA	0
LCS-021210	Lab Control	10	101%	100%	104%	NA	0
LCSD-021210	Lab Control Dup	10	103%	100%	99.7%	NA	0
QJ21A	GW-100208-PL2-254A-0	10	104%	96.2%	100%	NA	0
QJ21B	GW-100208-PL2-255A-0	10	102%	95.8%	91.8%	NA	0
QJ21C	GW-100208-PL2-256A-0	10	103%	96.4%	98.5%	NA	0
QJ21D	GW-100208-PL2-257A-0	10	101%	96.0%	92.0%	NA	0
QJ21E	GW-100209-PL2-209B-0	10	105%	97.9%	96.7%	NA	0
QJ21F	GW-100209-PL2-209A-0	10	102%	96.5%	92.3%	NA	0
QJ21G	GW-100209-PL2-209A-1	10	101%	97.0%	95.2%	NA	0
MB-022210	Method Blank	10	108%	99.6%	89.0%	NA	0
LCS-022210	Lab Control	10	105%	97.3%	94.9%	NA	0
LCSD-022210	Lab Control Dup	10	108%	99.1%	95.4%	NA	0
QJ21H	GW-100209-PL2-212A-0	10	111%	95.4%	92.3%	NA	0
QJ21I	GW-100209-PL2-212A-1	10	109%	94.5%	91.9%	NA	0
QJ21J	GW-100209-PL2-218A-15-0	10	105%	93.0%	92.7%	NA	0
QJ21JDL	GW-100209-PL2-218A-15-0	10	108%	98.6%	90.3%	NA	0
MB-021910	Method Blank	10	110%	100%	92.2%	NA	0
LCS-021910	Lab Control	10	108%	101%	93.1%	NA	0
LCSD-021910	Lab Control Dup	10	106%	99.5%	95.2%	NA	0
QJ21K	GW-100209-PL2-218A-28-0	10	105%	94.6%	88.6%	NA	0
QJ21M	GW-100209-PL2-218B-45-0	10	103%	97.7%	91.9%	NA	0
QJ21N	GW-100209-PL2-218B-58-0	10	104%	97.2%	92.8%	NA	0
QJ21P	GW-100209-PL2-262B-0	10	109%	94.4%	91.6%	NA	0
QJ21PDL	GW-100209-PL2-262B-0	10	110%	94.4%	90.5%	NA	0
QJ21Q	Trip Blank	10	102%	101%	94.8%	NA	0

SW8260C	LCS/MB LIMITS	QC LIMITS
(DCE) = d4-1,2-Dichloroethane	70-132	80-143
(TOL) = d8-Toluene	80-120	80-120
(BFB) = Bromofluorobenzene	80-120	80-120
(DCB) = d4-1,2-Dichlorobenzene	80-120	80-120

Prep Method: SW5030B
Log Number Range: 10-3586 to 10-3602

ANALYTICAL RESOURCES INCORPORATED

VOA SURROGATE RECOVERY SUMMARY

Matrix: Groundwater

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001

ARI ID	Client ID	PV	DCE	TOL	BFB	DCB	TOT OUT
MB-022010	Method Blank	5	92.6%	98.4%	101%	NA	0
LCS-022010	Lab Control	5	89.2%	98.0%	102%	NA	0
LCSD-022010	Lab Control Dup	5	89.6%	98.9%	103%	NA	0
QJ21JDL	GW-100209-PL2-218A-15-0	5	89.7%	100%	102%	NA	0
QJ21KDL	GW-100209-PL2-218A-28-0	5	89.2%	98.8%	101%	NA	0
QJ21MRE	GW-100209-PL2-218B-45-0	5	92.1%	99.2%	104%	NA	0
QJ21NRE	GW-100209-PL2-218B-58-0	5	91.0%	98.9%	104%	NA	0

SW8260C	LCS/MB LIMITS	QC LIMITS
(DCE) = d4-1,2-Dichloroethane	83-122	80-125
(TOL) = d8-Toluene	80-120	80-120
(BFB) = Bromofluorobenzene	80-120	80-120
(DCB) = d4-1,2-Dichlorobenzene	80-120	80-120

Prep Method: SW5030B
Log Number Range: 10-3586 to 10-3602

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-021210**
 LAB CONTROL SAMPLE

Lab Sample ID: LCS-021210
LIMS ID: 10-3586
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: NA
Date Received: NA

Instrument/Analyst LCS: NT10/AAR
LCSD: NT10/AAR
Date Analyzed LCS: 02/12/10 11:50
LCSD: 02/12/10 12:20

Sample Amount LCS: 10.0 mL
LCSD: 10.0 mL
Purge Volume LCS: 10.0 mL
LCSD: 10.0 mL

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
Chloromethane	7.4	10.0	74.0%	7.8	10.0	78.0%	5.3%
Bromomethane	8.2	10.0	82.0%	7.1	10.0	71.0%	14.4%
Vinyl Chloride	9.7	10.0	97.0%	8.7	10.0	87.0%	10.9%
Chloroethane	10.3	10.0	103%	8.8	10.0	88.0%	15.7%
Methylene Chloride	10.0	10.0	100%	8.8	10.0	88.0%	12.8%
Acetone	46.9	50.0	93.8%	42.7	50.0	85.4%	9.4%
Carbon Disulfide	10.9	10.0	109%	9.6	10.0	96.0%	12.7%
1,1-Dichloroethene	11.1	10.0	111%	9.2	10.0	92.0%	18.7%
1,1-Dichloroethane	10.6	10.0	106%	9.9	10.0	99.0%	6.8%
trans-1,2-Dichloroethene	10.8	10.0	108%	9.9	10.0	99.0%	8.7%
cis-1,2-Dichloroethene	10.4	10.0	104%	10.3	10.0	103%	1.0%
Chloroform	10.0	10.0	100%	9.9	10.0	99.0%	1.0%
1,2-Dichloroethane	9.7	10.0	97.0%	9.4	10.0	94.0%	3.1%
2-Butanone	50.5	50.0	101%	49.5	50.0	99.0%	2.0%
1,1,1-Trichloroethane	10.6	10.0	106%	9.7	10.0	97.0%	8.9%
Carbon Tetrachloride	10.4	10.0	104%	9.6	10.0	96.0%	8.0%
Vinyl Acetate	9.9	10.0	99.0%	10.1	10.0	101%	2.0%
Bromodichloromethane	9.9	10.0	99.0%	9.9	10.0	99.0%	0.0%
1,2-Dichloropropane	9.9	10.0	99.0%	9.8	10.0	98.0%	1.0%
cis-1,3-Dichloropropene	10.2	10.0	102%	10.3	10.0	103%	1.0%
Trichloroethene	10.5	10.0	105%	10.3	10.0	103%	1.9%
Dibromochloromethane	9.7	10.0	97.0%	9.8	10.0	98.0%	1.0%
1,1,2-Trichloroethane	10.2	10.0	102%	10.0	10.0	100%	2.0%
Benzene	10.3	10.0	103%	10.0	10.0	100%	3.0%
trans-1,3-Dichloropropene	10.4	10.0	104%	10.2	10.0	102%	1.9%
2-Chloroethylvinylether	8.9	10.0	89.0%	9.0	10.0	90.0%	1.1%
Bromoform	8.6	10.0	86.0%	9.4	10.0	94.0%	8.9%
4-Methyl-2-Pentanone (MIBK)	51.1	50.0	102%	48.4	50.0	96.8%	5.4%
2-Hexanone	50.8	50.0	102%	48.9	50.0	97.8%	3.8%
Tetrachloroethene	9.8	10.0	98.0%	9.6	10.0	96.0%	2.1%
1,1,2,2-Tetrachloroethane	9.2	10.0	92.0%	9.2	10.0	92.0%	0.0%
Toluene	10.3	10.0	103%	10.0	10.0	100%	3.0%
Chlorobenzene	10.2	10.0	102%	10.0	10.0	100%	2.0%
Ethylbenzene	10.2	10.0	102%	10.3	10.0	103%	1.0%
Styrene	11.0	10.0	110%	10.9	10.0	109%	0.9%
Trichlorofluoromethane	10.8	10.0	108%	9.5	10.0	95.0%	12.8%
1,1,2-Trichloro-1,2,2-trifluoroetha	10.5	10.0	105%	9.2	10.0	92.0%	13.2%
m,p-Xylene	21.4	20.0	107%	20.7	20.0	104%	3.3%
o-Xylene	10.6	10.0	106%	10.2	10.0	102%	3.8%

Reported in µg/L (ppb)

RPD calculated using sample concentrations per SW846.

Volatile Surrogate Recovery

	LCS	LCSD

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-021210**
 LAB CONTROL SAMPLE

Lab Sample ID: LCS-021210
LIMS ID: 10-3586
Matrix: Groundwater

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
d4-1,2-Dichloroethane		101%	103%				
d8-Toluene		100%	100%				
Bromofluorobenzene		104%	99.7%				

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-021910**
 LAB CONTROL SAMPLE

Lab Sample ID: LCS-021910
LIMS ID: 10-3596
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: NA
Date Received: NA

Instrument/Analyst LCS: NT5/PKC
LCSD: NT5/PKC
Date Analyzed LCS: 02/19/10 09:46
LCSD: 02/19/10 10:11

Sample Amount LCS: 10.0 mL
LCSD: 10.0 mL
Purge Volume LCS: 10.0 mL
LCSD: 10.0 mL

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
Chloromethane	10.1	10.0	101%	10.4	10.0	104%	2.9%
Bromomethane	9.2	10.0	92.0%	9.1	10.0	91.0%	1.1%
Vinyl Chloride	10.0	10.0	100%	10.0	10.0	100%	0.0%
Chloroethane	10.1	10.0	101%	10.0	10.0	100%	1.0%
Methylene Chloride	10.0	10.0	100%	10.0	10.0	100%	0.0%
Acetone	52.6	50.0	105%	53.8	50.0	108%	2.3%
Carbon Disulfide	10.4	10.0	104%	10.4	10.0	104%	0.0%
1,1-Dichloroethene	9.6	10.0	96.0%	9.8	10.0	98.0%	2.1%
1,1-Dichloroethane	10.3	10.0	103%	10.5	10.0	105%	1.9%
trans-1,2-Dichloroethene	9.5	10.0	95.0%	9.8	10.0	98.0%	3.1%
cis-1,2-Dichloroethene	9.6	10.0	96.0%	10.0	10.0	100%	4.1%
Chloroform	9.7	10.0	97.0%	9.8	10.0	98.0%	1.0%
1,2-Dichloroethane	9.4	10.0	94.0%	10.1	10.0	101%	7.2%
2-Butanone	50.8	50.0	102%	54.8	50.0	110%	7.6%
1,1,1-Trichloroethane	9.8	10.0	98.0%	10.1	10.0	101%	3.0%
Carbon Tetrachloride	10.1	10.0	101%	10.5	10.0	105%	3.9%
Vinyl Acetate	9.8	10.0	98.0%	10.1	10.0	101%	3.0%
Bromodichloromethane	9.4	10.0	94.0%	9.6	10.0	96.0%	2.1%
1,2-Dichloropropane	10.0	10.0	100%	10.3	10.0	103%	3.0%
cis-1,3-Dichloropropene	9.7	10.0	97.0%	10.0	10.0	100%	3.0%
Trichloroethene	9.5	10.0	95.0%	9.8	10.0	98.0%	3.1%
Dibromochloromethane	9.0	10.0	90.0%	9.4	10.0	94.0%	4.3%
1,1,2-Trichloroethane	10.0	10.0	100%	10.0	10.0	100%	0.0%
Benzene	9.9	10.0	99.0%	10.1	10.0	101%	2.0%
trans-1,3-Dichloropropene	9.4	10.0	94.0%	9.6	10.0	96.0%	2.1%
2-Chloroethylvinylether	8.1 Q	10.0	81.0%	8.3 Q	10.0	83.0%	2.4%
Bromoform	9.2	10.0	92.0%	9.4	10.0	94.0%	2.2%
4-Methyl-2-Pentanone (MIBK)	52.3	50.0	105%	53.9	50.0	108%	3.0%
2-Hexanone	51.1	50.0	102%	54.2	50.0	108%	5.9%
Tetrachloroethene	9.1	10.0	91.0%	9.7	10.0	97.0%	6.4%
1,1,2,2-Tetrachloroethane	8.9	10.0	89.0%	9.5	10.0	95.0%	6.5%
Toluene	9.6	10.0	96.0%	9.9	10.0	99.0%	3.1%
Chlorobenzene	9.4	10.0	94.0%	10.0	10.0	100%	6.2%
Ethylbenzene	9.6	10.0	96.0%	10.2	10.0	102%	6.1%
Styrene	9.3	10.0	93.0%	9.9	10.0	99.0%	6.2%
Trichlorofluoromethane	9.7	10.0	97.0%	9.8	10.0	98.0%	1.0%
1,1,2-Trichloro-1,2,2-trifluoroetha	10.0	10.0	100%	10.4	10.0	104%	3.9%
m,p-Xylene	18.6	20.0	93.0%	20.1	20.0	100%	7.8%
o-Xylene	9.4	10.0	94.0%	9.8	10.0	98.0%	4.2%

Reported in µg/L (ppb)

RPD calculated using sample concentrations per SW846.

Volatile Surrogate Recovery

	LCS	LCSD

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-021910**
 LAB CONTROL SAMPLE

Lab Sample ID: LCS-021910
LIMS ID: 10-3596
Matrix: Groundwater

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
d4-1,2-Dichloroethane		108%	106%				
d8-Toluene		101%	99.5%				
Bromofluorobenzene		93.1%	95.2%				

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-022010**
 LAB CONTROL SAMPLE

Lab Sample ID: LCS-022010
LIMS ID: 10-3595
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: NA
Date Received: NA

Instrument/Analyst LCS: NT9/AAR
LCSD: NT9/AAR
Date Analyzed LCS: 02/20/10 12:22
LCSD: 02/20/10 12:51

Sample Amount LCS: 5.00 mL
LCSD: 5.00 mL
Purge Volume LCS: 5.0 mL
LCSD: 5.0 mL

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
Chloromethane	63.6 Q	50.0	127%	62.8 Q	50.0	126%	1.3%
Bromomethane	49.6	50.0	99.2%	49.9	50.0	99.8%	0.6%
Vinyl Chloride	62.8 Q	50.0	126%	62.9 Q	50.0	126%	0.2%
Chloroethane	44.7	50.0	89.4%	44.7	50.0	89.4%	0.0%
Methylene Chloride	46.8	50.0	93.6%	45.9	50.0	91.8%	1.9%
Acetone	224	250	89.6%	215	250	86.0%	4.1%
Carbon Disulfide	58.2	50.0	116%	58.5	50.0	117%	0.5%
1,1-Dichloroethene	57.2	50.0	114%	57.3	50.0	115%	0.2%
1,1-Dichloroethane	56.7	50.0	113%	56.4	50.0	113%	0.5%
trans-1,2-Dichloroethene	54.9	50.0	110%	56.2	50.0	112%	2.3%
cis-1,2-Dichloroethene	54.5	50.0	109%	53.8	50.0	108%	1.3%
Chloroform	52.4	50.0	105%	52.3	50.0	105%	0.2%
1,2-Dichloroethane	50.3	50.0	101%	49.1	50.0	98.2%	2.4%
2-Butanone	252	250	101%	244	250	97.6%	3.2%
1,1,1-Trichloroethane	53.2	50.0	106%	53.5	50.0	107%	0.6%
Carbon Tetrachloride	54.0	50.0	108%	55.4	50.0	111%	2.6%
Vinyl Acetate	57.7	50.0	115%	55.5	50.0	111%	3.9%
Bromodichloromethane	51.8	50.0	104%	50.9	50.0	102%	1.8%
1,2-Dichloropropane	56.1	50.0	112%	55.8	50.0	112%	0.5%
cis-1,3-Dichloropropene	53.2	50.0	106%	52.7	50.0	105%	0.9%
Trichloroethene	53.7	50.0	107%	54.3	50.0	109%	1.1%
Dibromochloromethane	56.5	50.0	113%	54.8	50.0	110%	3.1%
1,1,2-Trichloroethane	51.3	50.0	103%	49.3	50.0	98.6%	4.0%
Benzene	53.9	50.0	108%	54.0	50.0	108%	0.2%
trans-1,3-Dichloropropene	50.8	50.0	102%	49.8	50.0	99.6%	2.0%
2-Chloroethylvinylether	206 Q	50.0	412%	202 Q	50.0	404%	2.0%
Bromoform	51.0	50.0	102%	48.6	50.0	97.2%	4.8%
4-Methyl-2-Pentanone (MIBK)	275	250	110%	262	250	105%	4.8%
2-Hexanone	296	250	118%	281	250	112%	5.2%
Tetrachloroethene	58.9	50.0	118%	58.8	50.0	118%	0.2%
1,1,2,2-Tetrachloroethane	53.2	50.0	106%	50.4	50.0	101%	5.4%
Toluene	52.7	50.0	105%	53.2	50.0	106%	0.9%
Chlorobenzene	54.6	50.0	109%	54.5	50.0	109%	0.2%
Ethylbenzene	56.2	50.0	112%	56.9	50.0	114%	1.2%
Styrene	56.1	50.0	112%	56.0	50.0	112%	0.2%
Trichlorofluoromethane	34.8 Q	50.0	69.6%	35.1 Q	50.0	70.2%	0.9%
1,1,2-Trichloro-1,2,2-trifluoroetha	56.7	50.0	113%	58.8	50.0	118%	3.6%
m,p-Xylene	115	100	115%	116	100	116%	0.9%
o-Xylene	56.5	50.0	113%	56.9	50.0	114%	0.7%

Reported in µg/L (ppb)

RPD calculated using sample concentrations per SW846.

Volatile Surrogate Recovery

	LCS	LCSD

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: LCS-022010
LAB CONTROL SAMPLE

Lab Sample ID: LCS-022010
LIMS ID: 10-3595
Matrix: Groundwater

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
d4-1,2-Dichloroethane		89.2%	89.6%				
d8-Toluene		98.0%	98.9%				
Bromofluorobenzene		102%	103%				

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-022210**
 LAB CONTROL SAMPLE

Lab Sample ID: LCS-022210
LIMS ID: 10-3593
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: NA
Date Received: NA

Instrument/Analyst LCS: NT5/PKC
LCSD: NT5/PKC
Date Analyzed LCS: 02/22/10 10:42
LCSD: 02/22/10 11:07

Sample Amount LCS: 10.0 mL
LCSD: 10.0 mL
Purge Volume LCS: 10.0 mL
LCSD: 10.0 mL

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
Chloromethane	10.0	10.0	100%	9.6	10.0	96.0%	4.1%
Bromomethane	8.8	10.0	88.0%	8.9	10.0	89.0%	1.1%
Vinyl Chloride	9.6	10.0	96.0%	9.2	10.0	92.0%	4.3%
Chloroethane	9.4	10.0	94.0%	9.2	10.0	92.0%	2.2%
Methylene Chloride	9.8	10.0	98.0%	9.2	10.0	92.0%	6.3%
Acetone	50.0	50.0	100%	50.2	50.0	100%	0.4%
Carbon Disulfide	10.2	10.0	102%	9.9	10.0	99.0%	3.0%
1,1-Dichloroethene	9.3	10.0	93.0%	9.3	10.0	93.0%	0.0%
1,1-Dichloroethane	10.0	10.0	100%	9.8	10.0	98.0%	2.0%
trans-1,2-Dichloroethene	9.4	10.0	94.0%	9.1	10.0	91.0%	3.2%
cis-1,2-Dichloroethene	9.4	10.0	94.0%	9.3	10.0	93.0%	1.1%
Chloroform	9.6	10.0	96.0%	9.4	10.0	94.0%	2.1%
1,2-Dichloroethane	9.2	10.0	92.0%	9.3	10.0	93.0%	1.1%
2-Butanone	51.6	50.0	103%	49.8	50.0	99.6%	3.6%
1,1,1-Trichloroethane	9.6	10.0	96.0%	9.6	10.0	96.0%	0.0%
Carbon Tetrachloride	9.8	10.0	98.0%	9.6	10.0	96.0%	2.1%
Vinyl Acetate	9.6	10.0	96.0%	9.6	10.0	96.0%	0.0%
Bromodichloromethane	9.2	10.0	92.0%	9.2	10.0	92.0%	0.0%
1,2-Dichloropropane	9.6	10.0	96.0%	9.7	10.0	97.0%	1.0%
cis-1,3-Dichloropropene	9.4	10.0	94.0%	9.4	10.0	94.0%	0.0%
Trichloroethene	9.2	10.0	92.0%	9.1	10.0	91.0%	1.1%
Dibromochloromethane	8.8	10.0	88.0%	8.6	10.0	86.0%	2.3%
1,1,2-Trichloroethane	9.6	10.0	96.0%	9.6	10.0	96.0%	0.0%
Benzene	9.6	10.0	96.0%	9.5	10.0	95.0%	1.0%
trans-1,3-Dichloropropene	9.0	10.0	90.0%	8.8	10.0	88.0%	2.2%
2-Chloroethylvinylether	7.6 Q	10.0	76.0%	7.8 Q	10.0	78.0%	2.6%
Bromoform	9.1	10.0	91.0%	9.1	10.0	91.0%	0.0%
4-Methyl-2-Pentanone (MIBK)	49.8	50.0	99.6%	51.8	50.0	104%	3.9%
2-Hexanone	49.7	50.0	99.4%	50.3	50.0	101%	1.2%
Tetrachloroethene	9.2	10.0	92.0%	9.0	10.0	90.0%	2.2%
1,1,2,2-Tetrachloroethane	8.9	10.0	89.0%	8.7	10.0	87.0%	2.3%
Toluene	9.3	10.0	93.0%	9.3	10.0	93.0%	0.0%
Chlorobenzene	9.5	10.0	95.0%	9.4	10.0	94.0%	1.1%
Ethylbenzene	9.8	10.0	98.0%	9.4	10.0	94.0%	4.2%
Styrene	9.4	10.0	94.0%	9.1	10.0	91.0%	3.2%
Trichlorofluoromethane	9.4	10.0	94.0%	9.3	10.0	93.0%	1.1%
1,1,2-Trichloro-1,2,2-trifluoroetha	10.1	10.0	101%	9.5	10.0	95.0%	6.1%
m,p-Xylene	19.0	20.0	95.0%	18.5	20.0	92.5%	2.7%
o-Xylene	9.2	10.0	92.0%	9.2	10.0	92.0%	0.0%

Reported in μg/L (ppb)

RPD calculated using sample concentrations per SW846.

Volatile Surrogate Recovery

	LCS	LCSD

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-022210**
 LAB CONTROL SAMPLE

Lab Sample ID: LCS-022210
LIMS ID: 10-3593
Matrix: Groundwater

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
d4-1,2-Dichloroethane		105%	108%				
d8-Toluene		97.3%	99.1%				
Bromofluorobenzene		94.9%	95.4%				

4A
VOLATILE METHOD BLANK SUMMARY

Method Blank ID.

MB0219

Lab Name: ANALYTICAL RESOURCES, INC

Client: THE BOEING COMPANY

ARI Job No: QJ21

Project: 2-10 SHEETPILE

Lab File ID: 02191005

Lab Sample ID: MB0219

Date Analyzed: 02/19/10

Time Analyzed: 1037

Instrument ID: NT5

Heated Purge: (Y/N) N

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	LCS0219	LCS0219	02191003	0946
02	LCSD0219	LCSD0219	02191004	1011
03	GW-100209-PL	QJ21P	02191007	1136
04	GW-100209-PL	QJ21J	02191025	1916
05	GW-100209-PL	QJ21K	02191026	1942
06	GW-100209-PL	QJ21M	02191027	2007
07	GW-100209-PL	QJ21N	02191028	2033
08				
09				
10				
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COMMENTS:

FORM IV VOA

OLM3.2M

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: MB-021910
METHOD BLANK

Lab Sample ID: MB-021910
LIMS ID: 10-3596
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: NA
Date Received: NA

Instrument/Analyst: NT5/PKC
Date Analyzed: 02/19/10 10:37

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	< 0.5	U
74-83-9	Bromomethane	0.5	< 0.5	U
75-01-4	Vinyl Chloride	0.2	< 0.2	U
75-00-3	Chloroethane	0.2	< 0.2	U
75-09-2	Methylene Chloride	0.5	< 0.5	U
67-64-1	Acetone	5.0	< 5.0	U
75-15-0	Carbon Disulfide	0.2	< 0.2	U
75-35-4	1,1-Dichloroethene	0.2	< 0.2	U
75-34-3	1,1-Dichloroethane	0.2	< 0.2	U
156-60-5	trans-1,2-Dichloroethene	0.2	< 0.2	U
156-59-2	cis-1,2-Dichloroethene	0.2	< 0.2	U
67-66-3	Chloroform	0.2	< 0.2	U
107-06-2	1,2-Dichloroethane	0.2	< 0.2	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.2	< 0.2	U
56-23-5	Carbon Tetrachloride	0.2	< 0.2	U
108-05-4	Vinyl Acetate	1.0	< 1.0	U
75-27-4	Bromodichloromethane	0.2	< 0.2	U
78-87-5	1,2-Dichloropropane	0.2	< 0.2	U
10061-01-5	cis-1,3-Dichloropropene	0.2	< 0.2	U
79-01-6	Trichloroethene	0.2	< 0.2	U
124-48-1	Dibromochloromethane	0.2	< 0.2	U
79-00-5	1,1,2-Trichloroethane	0.2	< 0.2	U
71-43-2	Benzene	0.2	< 0.2	U
10061-02-6	trans-1,3-Dichloropropene	0.2	< 0.2	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.2	< 0.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.2	< 0.2	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	< 0.2	U
108-88-3	Toluene	0.2	< 0.2	U
108-90-7	Chlorobenzene	0.2	< 0.2	U
100-41-4	Ethylbenzene	0.2	< 0.2	U
100-42-5	Styrene	0.2	< 0.2	U
75-69-4	Trichlorofluoromethane	0.2	< 0.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	< 0.2	U
179601-23-1	m,p-Xylene	0.4	< 0.4	U
95-47-6	o-Xylene	0.2	< 0.2	U

Reported in μg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	110%
d8-Toluene	100%
Bromofluorobenzene	92.2%

4A
VOLATILE METHOD BLANK SUMMARY

Method Blank ID.

MB0222A

Lab Name: ANALYTICAL RESOURCES, INC

Client: THE BOEING COMPANY

ARI Job No: QJ21

Project: 2-10 SHEETPILE

Lab File ID: 02221007

Lab Sample ID: MB0222A

Date Analyzed: 02/22/10

Time Analyzed: 1208

Instrument ID: NT5

Heated Purge: (Y/N) N

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	LCS0222	LCS0222	02221004	1042
02	LCSD0222	LCSD0222	02221005	1107
03	GW-100209-PL	QJ21H	02221012	1416
04	GW-100209-PL	QJ21I	02221013	1441
05	GW-100209-PL	QJ21J	02221014	1507
06	GW-100209-PL	QJ21P	02221015	1532
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COMMENTS:

FORM IV VOA

OLM3.2M

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: MB-022210
METHOD BLANK

Lab Sample ID: MB-022210
LIMS ID: 10-3593
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: NA
Date Received: NA

Instrument/Analyst: NT5/PKC
Date Analyzed: 02/22/10 12:08

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	< 0.5	U
74-83-9	Bromomethane	0.5	< 0.5	U
75-01-4	Vinyl Chloride	0.2	< 0.2	U
75-00-3	Chloroethane	0.2	< 0.2	U
75-09-2	Methylene Chloride	0.5	< 0.5	U
67-64-1	Acetone	5.0	< 5.0	U
75-15-0	Carbon Disulfide	0.2	< 0.2	U
75-35-4	1,1-Dichloroethene	0.2	< 0.2	U
75-34-3	1,1-Dichloroethane	0.2	< 0.2	U
156-60-5	trans-1,2-Dichloroethene	0.2	< 0.2	U
156-59-2	cis-1,2-Dichloroethene	0.2	< 0.2	U
67-66-3	Chloroform	0.2	< 0.2	U
107-06-2	1,2-Dichloroethane	0.2	< 0.2	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.2	< 0.2	U
56-23-5	Carbon Tetrachloride	0.2	< 0.2	U
108-05-4	Vinyl Acetate	1.0	< 1.0	U
75-27-4	Bromodichloromethane	0.2	< 0.2	U
78-87-5	1,2-Dichloropropane	0.2	< 0.2	U
10061-01-5	cis-1,3-Dichloropropene	0.2	< 0.2	U
79-01-6	Trichloroethene	0.2	< 0.2	U
124-48-1	Dibromochloromethane	0.2	< 0.2	U
79-00-5	1,1,2-Trichloroethane	0.2	< 0.2	U
71-43-2	Benzene	0.2	< 0.2	U
10061-02-6	trans-1,3-Dichloropropene	0.2	< 0.2	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.2	< 0.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.2	< 0.2	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	< 0.2	U
108-88-3	Toluene	0.2	< 0.2	U
108-90-7	Chlorobenzene	0.2	< 0.2	U
100-41-4	Ethylbenzene	0.2	< 0.2	U
100-42-5	Styrene	0.2	< 0.2	U
75-69-4	Trichlorofluoromethane	0.2	< 0.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	< 0.2	U
179601-23-1	m,p-Xylene	0.4	< 0.4	U
95-47-6	o-Xylene	0.2	< 0.2	U

Reported in μg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	108%
d8-Toluene	99.6%
Bromofluorobenzene	89.0%

4A
VOLATILE METHOD BLANK SUMMARY

Method Blank ID.

MB0220

Lab Name: ANALYTICAL RESOURCES, INC

Client: THE BOEING COMPANY

ARI Job No: QJ21

Project: 2-10 SHEETPILE

Lab File ID: MB0220

Lab Sample ID: MB0220

Date Analyzed: 02/20/10

Time Analyzed: 1319

Instrument ID: NT9

Heated Purge: (Y/N) Y

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	LCS0220	LCS0220	LCS0220C	1222
02	LCS0220	LCS0220	LCS0220D	1251
03	GW-100209-PL	QJ21M	QJ21M2	1444
04	GW-100209-PL	QJ21N	QJ21N2	1512
05	GW-100209-PL	QJ21J	QJ21J2	1540
06	GW-100209-PL	QJ21K	QJ21K2	1608
07	2-10-DP-038-	QK01D	QK01D2	1858
08				
09				
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COMMENTS:

FORM IV VOA

OLM3.2M

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: MB-022010**
METHOD BLANK

Lab Sample ID: MB-022010
LIMS ID: 10-3595
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: NA
Date Received: NA

Instrument/Analyst: NT9/AAR
Date Analyzed: 02/20/10 13:19

Sample Amount: 5.00 mL
Purge Volume: 5.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	1.0	< 1.0	U
74-83-9	Bromomethane	1.0	< 1.0	U
75-01-4	Vinyl Chloride	1.0	< 1.0	U
75-00-3	Chloroethane	1.0	< 1.0	U
75-09-2	Methylene Chloride	2.0	< 2.0	U
67-64-1	Acetone	10	< 10	U
75-15-0	Carbon Disulfide	1.0	< 1.0	U
75-35-4	1,1-Dichloroethene	1.0	< 1.0	U
75-34-3	1,1-Dichloroethane	1.0	< 1.0	U
156-60-5	trans-1,2-Dichloroethene	1.0	< 1.0	U
156-59-2	cis-1,2-Dichloroethene	1.0	< 1.0	U
67-66-3	Chloroform	1.0	< 1.0	U
107-06-2	1,2-Dichloroethane	1.0	< 1.0	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	1.0	< 1.0	U
56-23-5	Carbon Tetrachloride	1.0	< 1.0	U
108-05-4	Vinyl Acetate	5.0	< 5.0	U
75-27-4	Bromodichloromethane	1.0	< 1.0	U
78-87-5	1,2-Dichloropropane	1.0	< 1.0	U
10061-01-5	cis-1,3-Dichloropropene	1.0	< 1.0	U
79-01-6	Trichloroethene	1.0	< 1.0	U
124-48-1	Dibromochloromethane	1.0	< 1.0	U
79-00-5	1,1,2-Trichloroethane	1.0	< 1.0	U
71-43-2	Benzene	1.0	< 1.0	U
10061-02-6	trans-1,3-Dichloropropene	1.0	< 1.0	U
110-75-8	2-Chloroethylvinylether	5.0	< 5.0	U
75-25-2	Bromoform	1.0	< 1.0	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	1.0	< 1.0	U
79-34-5	1,1,2,2-Tetrachloroethane	1.0	< 1.0	U
108-88-3	Toluene	1.0	< 1.0	U
108-90-7	Chlorobenzene	1.0	< 1.0	U
100-41-4	Ethylbenzene	1.0	< 1.0	U
100-42-5	Styrene	1.0	< 1.0	U
75-69-4	Trichlorofluoromethane	1.0	< 1.0	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	2.0	< 2.0	U
179601-23-1	m,p-Xylene	2.0	< 2.0	U
95-47-6	o-Xylene	1.0	< 1.0	U

Reported in μg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	92.6%
d8-Toluene	98.4%
Bromofluorobenzene	101%

4A
VOLATILE METHOD BLANK SUMMARY

Method Blank ID.

MB0212

Lab Name: ANALYTICAL RESOURCES, INC

Client: THE BOEING COMPANY

ARI Job No: QJ21

Project: 2-10 SHEETPILE

Lab File ID: MB0212

Lab Sample ID: MB0212

Date Analyzed: 02/12/10

Time Analyzed: 1251

Instrument ID: NT10

Heated Purge: (Y/N) N

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	LCS0212	LCS0212	LCS0212	1150
02	LCS0212	LCS0212	LCS0212A	1220
03	TRIP BLANK	QJ21Q	QJ21Q	1608
04	GW-100208-PL	QJ21A	QJ21A	1740
05	GW-100208-PL	QJ21B	QJ21B	1809
06	GW-100208-PL	QJ21C	QJ21C	1939
07	GW-100208-PL	QJ21D	QJ21D	2009
08	GW-100209-PL	QJ21E	QJ21E	2039
09	GW-100209-PL	QJ21F	QJ21F	2109
10	GW-100209-PL	QJ21G	QJ21G	2138
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COMMENTS:

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: MB-021210**
 METHOD BLANK

Lab Sample ID: MB-021210
LIMS ID: 10-3586
Matrix: Groundwater
Data Release Authorized:
Reported: 02/24/10

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: NA
Date Received: NA

Instrument/Analyst: NT10/AAR
Date Analyzed: 02/12/10 12:51

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	< 0.5	U
74-83-9	Bromomethane	0.5	< 0.5	U
75-01-4	Vinyl Chloride	0.2	< 0.2	U
75-00-3	Chloroethane	0.2	< 0.2	U
75-09-2	Methylene Chloride	0.5	< 0.5	U
67-64-1	Acetone	5.0	< 5.0	U
75-15-0	Carbon Disulfide	0.2	< 0.2	U
75-35-4	1,1-Dichloroethene	0.2	< 0.2	U
75-34-3	1,1-Dichloroethane	0.2	< 0.2	U
156-60-5	trans-1,2-Dichloroethene	0.2	< 0.2	U
156-59-2	cis-1,2-Dichloroethene	0.2	< 0.2	U
67-66-3	Chloroform	0.2	< 0.2	U
107-06-2	1,2-Dichloroethane	0.2	< 0.2	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.2	< 0.2	U
56-23-5	Carbon Tetrachloride	0.2	< 0.2	U
108-05-4	Vinyl Acetate	1.0	< 1.0	U
75-27-4	Bromodichloromethane	0.2	< 0.2	U
78-87-5	1,2-Dichloropropane	0.2	< 0.2	U
10061-01-5	cis-1,3-Dichloropropene	0.2	< 0.2	U
79-01-6	Trichloroethene	0.2	< 0.2	U
124-48-1	Dibromochloromethane	0.2	< 0.2	U
79-00-5	1,1,2-Trichloroethane	0.2	< 0.2	U
71-43-2	Benzene	0.2	< 0.2	U
10061-02-6	trans-1,3-Dichloropropene	0.2	< 0.2	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.2	< 0.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.2	< 0.2	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	< 0.2	U
108-88-3	Toluene	0.2	< 0.2	U
108-90-7	Chlorobenzene	0.2	< 0.2	U
100-41-4	Ethylbenzene	0.2	< 0.2	U
100-42-5	Styrene	0.2	< 0.2	U
75-69-4	Trichlorofluoromethane	0.2	< 0.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	< 0.2	U
179601-23-1	m,p-Xylene	0.4	< 0.4	U
95-47-6	o-Xylene	0.2	< 0.2	U

Reported in μg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	101%
d8-Toluene	99.4%
Bromofluorobenzene	91.8%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: Trip Blank
SAMPLE

Lab Sample ID: QJ43M
LIMS ID: 10-3739
Matrix: Groundwater
Data Release Authorized:
Reported: 02/23/10

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/10/10
Date Received: 02/10/10

Instrument/Analyst: NT5/PKC
Date Analyzed: 02/18/10 11:33

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	< 0.5	U
74-83-9	Bromomethane	0.5	< 0.5	U
75-01-4	Vinyl Chloride	0.2	< 0.2	U
75-00-3	Chloroethane	0.2	< 0.2	U
75-09-2	Methylene Chloride	0.5	< 0.5	U
67-64-1	Acetone	5.0	< 5.0	U
75-15-0	Carbon Disulfide	0.2	< 0.2	U
75-35-4	1,1-Dichloroethene	0.2	< 0.2	U
75-34-3	1,1-Dichloroethane	0.2	< 0.2	U
156-60-5	trans-1,2-Dichloroethene	0.2	< 0.2	U
156-59-2	cis-1,2-Dichloroethene	0.2	< 0.2	U
67-66-3	Chloroform	0.2	< 0.2	U
107-06-2	1,2-Dichloroethane	0.2	< 0.2	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.2	< 0.2	U
56-23-5	Carbon Tetrachloride	0.2	< 0.2	U
108-05-4	Vinyl Acetate	1.0	< 1.0	U
75-27-4	Bromodichloromethane	0.2	< 0.2	U
78-87-5	1,2-Dichloropropane	0.2	< 0.2	U
10061-01-5	cis-1,3-Dichloropropene	0.2	< 0.2	U
79-01-6	Trichloroethene	0.2	< 0.2	U
124-48-1	Dibromochloromethane	0.2	< 0.2	U
79-00-5	1,1,2-Trichloroethane	0.2	< 0.2	U
71-43-2	Benzene	0.2	< 0.2	U
10061-02-6	trans-1,3-Dichloropropene	0.2	< 0.2	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.2	< 0.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.2	< 0.2	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	< 0.2	U
108-88-3	Toluene	0.2	< 0.2	U
108-90-7	Chlorobenzene	0.2	< 0.2	U
100-41-4	Ethylbenzene	0.2	< 0.2	U
100-42-5	Styrene	0.2	< 0.2	U
75-69-4	Trichlorofluoromethane	0.2	< 0.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	< 0.2	U
179601-23-1	m,p-Xylene	0.4	< 0.4	U
95-47-6	o-Xylene	0.2	< 0.2	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	109%
d8-Toluene	98.8%
Bromofluorobenzene	90.1%

2-Chloroethylvinylether is an acid labile compound and may not be recovered from an acid preserved sample.

FORM I

ANALYTICAL RESOURCES INCORPORATED

VOA SURROGATE RECOVERY SUMMARY

Matrix: Groundwater

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001

ARI ID	Client ID	PV	DCE	TOL	BFB	DCB	TOT OUT
MB-021810	Method Blank	10	111%	101%	93.9%	NA	0
LCS-021810	Lab Control	10	106%	103%	97.3%	NA	0
LCSD-021810	Lab Control Dup	10	107%	102%	97.8%	NA	0
QJ43A	GW-100210-PL2-249A-0	10	109%	94.4%	94.0%	NA	0
QJ43ADL	GW-100210-PL2-249A-0	10	110%	94.9%	89.8%	NA	0
MB-021910	Method Blank	10	110%	100%	92.2%	NA	0
LCS-021910	Lab Control	10	108%	101%	93.1%	NA	0
LCSD-021910	Lab Control Dup	10	106%	99.5%	95.2%	NA	0
QJ43B	GW-100210-PL2-247A-0	10	109%	93.6%	91.9%	NA	0
QJ43BDL	GW-100210-PL2-247A-0	10	112%	94.4%	89.7%	NA	0
QJ43C	GW-100210-PL2-247A-1	10	107%	94.8%	92.0%	NA	0
QJ43CDL	GW-100210-PL2-247A-1	10	108%	92.7%	94.4%	NA	0
QJ43D	GW-100210-PL2-268AR-0	10	111%	93.8%	92.3%	NA	0
QJ43DDL	GW-100210-PL2-268AR-0	10	108%	95.7%	90.5%	NA	0
QJ43E	GW-100210-PL2-269A-0	10	110%	94.3%	91.6%	NA	0
QJ43EDL	GW-100210-PL2-269A-0	10	109%	94.4%	93.8%	NA	0
QJ43F	GW-100210-PL2-245A-0	10	110%	93.6%	92.7%	NA	0
QJ43FDL	GW-100210-PL2-245A-0	10	110%	94.7%	92.3%	NA	0
QJ43G	GW-100210-PL2-244A-0	10	110%	94.1%	90.6%	NA	0
QJ43GDL	GW-100210-PL2-244A-0	10	108%	94.4%	88.8%	NA	0
QJ43H	GW-100210-PL2-253A-0	10	110%	95.5%	89.4%	NA	0
QJ43HDL	GW-100210-PL2-253A-0	10	107%	94.4%	91.6%	NA	0
QJ43I	GW-100210-PL2-252A-0	10	110%	92.8%	90.1%	NA	0
QJ43IDL	GW-100210-PL2-252A-0	10	110%	96.1%	92.0%	NA	0
QJ43J	GW-100210-PL2-266A-0	10	107%	92.4%	92.3%	NA	0
QJ43JDL	GW-100210-PL2-266A-0	10	109%	95.4%	87.6%	NA	0
QJ43K	GW-100210-PL2-266A-4	10	108%	93.3%	93.4%	NA	0
QJ43KDL	GW-100210-PL2-266A-4	10	109%	96.7%	89.4%	NA	0
QJ43KMS	GW-100210-PL2-266A-4	10	105%	94.8%	95.1%	NA	0
QJ43KMSD	GW-100210-PL2-266A-4	10	108%	96.8%	96.4%	NA	0
QJ43L	GW-100210-PL2-259B-0	10	108%	94.6%	90.8%	NA	0
QJ43LDL	GW-100210-PL2-259B-0	10	110%	95.9%	92.7%	NA	0
QJ43M	Trip Blank	10	109%	98.8%	90.1%	NA	0

	LCS/MB LIMITS	QC LIMITS
SW8260C		
(DCE) = d4-1,2-Dichloroethane	70-132	80-143
(TOL) = d8-Toluene	80-120	80-120
(BFB) = Bromofluorobenzene	80-120	80-120
(DCB) = d4-1,2-Dichlorobenzene	80-120	80-120

Prep Method: SW5030B
Log Number Range: 10-3727 to 10-3739

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: GW-100210-PL2-266A-4**
Page 1 of 1 **MATRIX SPIKE**

Lab Sample ID: QJ43K
LIMS ID: 10-3737
Matrix: Groundwater
Data Release Authorized:
Reported: 02/23/10

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/10/10
Date Received: 02/10/10

Instrument/Analyst MS: NT5/PKC
MSD: NT5/PKC
Date Analyzed MS: 02/18/10 20:06
MSD: 02/18/10 20:32

Sample Amount MS: 10.0 mL
MSD: 10.0 mL
Purge Volume MS: 10.0 mL
MSD: 10.0 mL

Analyte	Sample	MS	Spike Added-MS	MS Recovery	MSD	Spike Added-MSD	MSD Recovery	RPD
Chloromethane	< 0.5 U	10.7	10.0	107%	10.6	10.0	106%	0.9%
Bromomethane	< 0.5 U	8.5	10.0	85.0%	8.9	10.0	89.0%	4.6%
Vinyl Chloride	4.6	14.1	10.0	95.0%	14.7	10.0	101%	4.2%
Chloroethane	< 0.2 U	10.7	10.0	107%	10.0	10.0	100%	6.8%
Methylene Chloride	< 0.5 U	10.2	10.0	102%	10.0	10.0	100%	2.0%
Acetone	< 5.0 U	54.8	50.0	110%	58.0	50.0	116%	5.7%
Carbon Disulfide	< 0.2 U	10.0	10.0	100%	10.1	10.0	101%	1.0%
1,1-Dichloroethene	< 0.2 U	9.8	10.0	98.0%	9.6	10.0	96.0%	2.1%
1,1-Dichloroethane	< 0.2 U	10.6	10.0	106%	10.5	10.0	105%	0.9%
trans-1,2-Dichloroethene	1.3	11.0	10.0	97.0%	11.3	10.0	100%	2.7%
cis-1,2-Dichloroethene	34.5	40.8	10.0	63.0%	44.4	10.0	99.0%	8.5%
Chloroform	< 0.2 U	10.1	10.0	101%	10.1	10.0	101%	0.0%
1,2-Dichloroethane	< 0.2 U	9.4	10.0	94.0%	9.6	10.0	96.0%	2.1%
2-Butanone	< 5.0 U	51.5	50.0	103%	53.2	50.0	106%	3.2%
1,1,1-Trichloroethane	< 0.2 U	10.3	10.0	103%	10.1	10.0	101%	2.0%
Carbon Tetrachloride	< 0.2 U	10.0	10.0	100%	10.2	10.0	102%	2.0%
Vinyl Acetate	< 1.0 U	8.8	10.0	88.0%	8.8	10.0	88.0%	0.0%
Bromodichloromethane	< 0.2 U	9.2	10.0	92.0%	9.4	10.0	94.0%	2.2%
1,2-Dichloropropane	< 0.2 U	9.9	10.0	99.0%	10.0	10.0	100%	1.0%
cis-1,3-Dichloropropene	< 0.2 U	9.1	10.0	91.0%	9.5	10.0	95.0%	4.3%
Trichloroethene	130 E	129	10.0	NA	140	10.0	100%	NA
Dibromochloromethane	< 0.2 U	8.2	10.0	82.0%	8.6	10.0	86.0%	4.8%
1,1,2-Trichloroethane	< 0.2 U	10.1	10.0	101%	10.0	10.0	100%	1.0%
Benzene	< 0.2 U	9.9	10.0	99.0%	10.0	10.0	100%	1.0%
trans-1,3-Dichloropropene	< 0.2 U	8.8	10.0	88.0%	9.1	10.0	91.0%	3.4%
2-Chloroethylvinylether	< 1.0 U	< 1.0 U	10.0	NA	< 1.0 U	10.0	NA	NA
Bromoform	< 0.2 U	8.1	10.0	81.0%	8.7	10.0	87.0%	7.1%
4-Methyl-2-Pentanone (MIBK)	< 5.0 U	52.6	50.0	105%	53.4	50.0	107%	1.5%
2-Hexanone	< 5.0 U	52.1	50.0	104%	51.9	50.0	104%	0.4%
Tetrachloroethene	4.1	13.4	10.0	93.0%	13.4	10.0	93.0%	0.0%
1,1,2,2-Tetrachloroethane	< 0.2 U	8.8	10.0	88.0%	9.3	10.0	93.0%	5.5%
Toluene	0.2	9.7	10.0	95.0%	9.9	10.0	97.0%	2.0%
Chlorobenzene	< 0.2 U	9.7	10.0	97.0%	9.9	10.0	99.0%	2.0%
Ethylbenzene	< 0.2 U	10.2	10.0	102%	9.8	10.0	98.0%	4.0%
Styrene	< 0.2 U	7.2	10.0	72.0%	6.8	10.0	68.0%	5.7%
Trichlorofluoromethane	< 0.2 U	10.1	10.0	101%	9.8	10.0	98.0%	3.0%
1,1,2-Trichloro-1,2,2-trifl	< 0.2 U	10.1	10.0	101%	10.3	10.0	103%	2.0%
m,p-Xylene	< 0.4 U	18.6	20.0	93.0%	18.3	20.0	91.5%	1.6%
o-Xylene	< 0.2 U	9.3	10.0	93.0%	9.1	10.0	91.0%	2.2%

Reported in μg/L (ppb)

NA-No recovery due to high concentration of analyte in original sample, calculated negative recovery, or undetected spike.
RPD calculated using sample concentrations per SW846.

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: GW-100210-PL2-266A-4
MATRIX SPIKE

Lab Sample ID: QJ43K
LIMS ID: 10-3737
Matrix: Groundwater
Data Release Authorized:
Reported: 02/23/10

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/10/10
Date Received: 02/10/10

Instrument/Analyst: NT5/PKC
Date Analyzed: 02/18/10 20:06

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	---	
74-83-9	Bromomethane	0.5	---	
75-01-4	Vinyl Chloride	0.2	---	
75-00-3	Chloroethane	0.2	---	
75-09-2	Methylene Chloride	0.5	---	
67-64-1	Acetone	5.0	---	
75-15-0	Carbon Disulfide	0.2	---	
75-35-4	1,1-Dichloroethene	0.2	---	
75-34-3	1,1-Dichloroethane	0.2	---	
156-60-5	trans-1,2-Dichloroethene	0.2	---	
156-59-2	cis-1,2-Dichloroethene	0.2	---	
67-66-3	Chloroform	0.2	---	
107-06-2	1,2-Dichloroethane	0.2	---	
78-93-3	2-Butanone	5.0	---	
71-55-6	1,1,1-Trichloroethane	0.2	---	
56-23-5	Carbon Tetrachloride	0.2	---	
108-05-4	Vinyl Acetate	1.0	---	
75-27-4	Bromodichloromethane	0.2	---	
78-87-5	1,2-Dichloropropane	0.2	---	
10061-01-5	cis-1,3-Dichloropropene	0.2	---	
79-01-6	Trichloroethene	0.2	---	
124-48-1	Dibromochloromethane	0.2	---	
79-00-5	1,1,2-Trichloroethane	0.2	---	
71-43-2	Benzene	0.2	---	
10061-02-6	trans-1,3-Dichloropropene	0.2	---	
110-75-8	2-Chloroethylvinylether	1.0	---	
75-25-2	Bromoform	0.2	---	
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	---	
591-78-6	2-Hexanone	5.0	---	
127-18-4	Tetrachloroethene	0.2	---	
79-34-5	1,1,2,2-Tetrachloroethane	0.2	---	
108-88-3	Toluene	0.2	---	
108-90-7	Chlorobenzene	0.2	---	
100-41-4	Ethylbenzene	0.2	---	
100-42-5	Styrene	0.2	---	
75-69-4	Trichlorofluoromethane	0.2	---	
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	---	
179601-23-1	m,p-Xylene	0.4	---	
95-47-6	o-Xylene	0.2	---	

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	105%
d8-Toluene	94.8%
Bromofluorobenzene	95.1%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: GW-100210-PL2-266A-4
MATRIX SPIKE DUP

Lab Sample ID: QJ43K
LIMS ID: 10-3737
Matrix: Groundwater
Data Release Authorized:
Reported: 02/23/10

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/10/10
Date Received: 02/10/10

Instrument/Analyst: NT5/PKC
Date Analyzed: 02/18/10 20:32

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	---	
74-83-9	Bromomethane	0.5	---	
75-01-4	Vinyl Chloride	0.2	---	
75-00-3	Chloroethane	0.2	---	
75-09-2	Methylene Chloride	0.5	---	
67-64-1	Acetone	5.0	---	
75-15-0	Carbon Disulfide	0.2	---	
75-35-4	1,1-Dichloroethene	0.2	---	
75-34-3	1,1-Dichloroethane	0.2	---	
156-60-5	trans-1,2-Dichloroethene	0.2	---	
156-59-2	cis-1,2-Dichloroethene	0.2	---	
67-66-3	Chloroform	0.2	---	
107-06-2	1,2-Dichloroethane	0.2	---	
78-93-3	2-Butanone	5.0	---	
71-55-6	1,1,1-Trichloroethane	0.2	---	
56-23-5	Carbon Tetrachloride	0.2	---	
108-05-4	Vinyl Acetate	1.0	---	
75-27-4	Bromodichloromethane	0.2	---	
78-87-5	1,2-Dichloropropane	0.2	---	
10061-01-5	cis-1,3-Dichloropropene	0.2	---	
79-01-6	Trichloroethene	0.2	---	
124-48-1	Dibromochloromethane	0.2	---	
79-00-5	1,1,2-Trichloroethane	0.2	---	
71-43-2	Benzene	0.2	---	
10061-02-6	trans-1,3-Dichloropropene	0.2	---	
110-75-8	2-Chloroethylvinylether	1.0	---	
75-25-2	Bromoform	0.2	---	
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	---	
591-78-6	2-Hexanone	5.0	---	
127-18-4	Tetrachloroethene	0.2	---	
79-34-5	1,1,2,2-Tetrachloroethane	0.2	---	
108-88-3	Toluene	0.2	---	
108-90-7	Chlorobenzene	0.2	---	
100-41-4	Ethylbenzene	0.2	---	
100-42-5	Styrene	0.2	---	
75-69-4	Trichlorofluoromethane	0.2	---	
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	---	
179601-23-1	m,p-Xylene	0.4	---	
95-47-6	o-Xylene	0.2	---	

Reported in μg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	108%
d8-Toluene	96.8%
Bromofluorobenzene	96.4%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-021810**
 LAB CONTROL SAMPLE

Lab Sample ID: LCS-021810
LIMS ID: 10-3727
Matrix: Groundwater
Data Release Authorized:
Reported: 02/23/10

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: NA
Date Received: NA

Instrument/Analyst LCS: NT5/PKC
LCSD: NT5/PKC
Date Analyzed LCS: 02/18/10 10:09
LCSD: 02/18/10 10:35

Sample Amount LCS: 10.0 mL
LCSD: 10.0 mL
Purge Volume LCS: 10.0 mL
LCSD: 10.0 mL

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
Chloromethane	10.2	10.0	102%	11.0	10.0	110%	7.5%
Bromomethane	8.8	10.0	88.0%	9.0	10.0	90.0%	2.2%
Vinyl Chloride	9.9	10.0	99.0%	10.5	10.0	105%	5.9%
Chloroethane	9.8	10.0	98.0%	10.3	10.0	103%	5.0%
Methylene Chloride	9.8	10.0	98.0%	10.1	10.0	101%	3.0%
Acetone	54.0	50.0	108%	55.8	50.0	112%	3.3%
Carbon Disulfide	10.3	10.0	103%	10.8	10.0	108%	4.7%
1,1-Dichloroethene	9.5	10.0	95.0%	9.7	10.0	97.0%	2.1%
1,1-Dichloroethane	10.1	10.0	101%	10.4	10.0	104%	2.9%
trans-1,2-Dichloroethene	9.8	10.0	98.0%	9.8	10.0	98.0%	0.0%
cis-1,2-Dichloroethene	9.7	10.0	97.0%	9.6	10.0	96.0%	1.0%
Chloroform	9.7	10.0	97.0%	9.8	10.0	98.0%	1.0%
1,2-Dichloroethane	9.7	10.0	97.0%	9.8	10.0	98.0%	1.0%
2-Butanone	51.4	50.0	103%	52.2	50.0	104%	1.5%
1,1,1-Trichloroethane	9.8	10.0	98.0%	9.8	10.0	98.0%	0.0%
Carbon Tetrachloride	10.4	10.0	104%	10.1	10.0	101%	2.9%
Vinyl Acetate	10.0	10.0	100%	9.9	10.0	99.0%	1.0%
Bromodichloromethane	9.8	10.0	98.0%	9.4	10.0	94.0%	4.2%
1,2-Dichloropropane	10.3	10.0	103%	10.0	10.0	100%	3.0%
cis-1,3-Dichloropropene	10.1	10.0	101%	9.8	10.0	98.0%	3.0%
Trichloroethene	9.8	10.0	98.0%	9.4	10.0	94.0%	4.2%
Dibromochloromethane	9.1	10.0	91.0%	9.0	10.0	90.0%	1.1%
1,1,2-Trichloroethane	10.4	10.0	104%	10.1	10.0	101%	2.9%
Benzene	10.2	10.0	102%	9.9	10.0	99.0%	3.0%
trans-1,3-Dichloropropene	9.6	10.0	96.0%	9.4	10.0	94.0%	2.1%
2-Chloroethylvinylether	8.1 Q	10.0	81.0%	7.9 Q	10.0	79.0%	2.5%
Bromoform	9.7	10.0	97.0%	9.1	10.0	91.0%	6.4%
4-Methyl-2-Pentanone (MIBK)	53.9	50.0	108%	53.2	50.0	106%	1.3%
2-Hexanone	52.4	50.0	105%	52.0	50.0	104%	0.8%
Tetrachloroethene	9.4	10.0	94.0%	9.3	10.0	93.0%	1.1%
1,1,2,2-Tetrachloroethane	9.1	10.0	91.0%	9.1	10.0	91.0%	0.0%
Toluene	10.0	10.0	100%	9.7	10.0	97.0%	3.0%
Chlorobenzene	9.7	10.0	97.0%	9.5	10.0	95.0%	2.1%
Ethylbenzene	10.0	10.0	100%	9.8	10.0	98.0%	2.0%
Styrene	9.7	10.0	97.0%	9.6	10.0	96.0%	1.0%
Trichlorofluoromethane	9.6	10.0	96.0%	10.2	10.0	102%	6.1%
1,1,2-Trichloro-1,2,2-trifluoroetha	10.1	10.0	101%	10.4	10.0	104%	2.9%
m,p-Xylene	19.6	20.0	98.0%	19.4	20.0	97.0%	1.0%
o-Xylene	9.6	10.0	96.0%	9.4	10.0	94.0%	2.1%

Reported in μg/L (ppb)

RPD calculated using sample concentrations per SW846.

Volatile Surrogate Recovery

	LCS	LCSD

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: LCS-021810**
 LAB CONTROL SAMPLE

Lab Sample ID: LCS-021810
LIMS ID: 10-3727
Matrix: Groundwater

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
d4-1,2-Dichloroethane		106%	107%				
d8-Toluene		103%	102%				
Bromofluorobenzene		97.3%	97.8%				

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: LCS-021910
LAB CONTROL SAMPLE

Lab Sample ID: LCS-021910
LIMS ID: 10-3728
Matrix: Groundwater
Data Release Authorized:
Reported: 02/23/10

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: NA
Date Received: NA

Instrument/Analyst LCS: NT5/PKC
LCSD: NT5/PKC
Date Analyzed LCS: 02/19/10 09:46
LCSD: 02/19/10 10:11

Sample Amount LCS: 10.0 mL
LCSD: 10.0 mL
Purge Volume LCS: 10.0 mL
LCSD: 10.0 mL

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
Chloromethane	10.1	10.0	101%	10.4	10.0	104%	2.9%
Bromomethane	9.2	10.0	92.0%	9.1	10.0	91.0%	1.1%
Vinyl Chloride	10.0	10.0	100%	10.0	10.0	100%	0.0%
Chloroethane	10.1	10.0	101%	10.0	10.0	100%	1.0%
Methylene Chloride	10.0	10.0	100%	10.0	10.0	100%	0.0%
Acetone	52.6	50.0	105%	53.8	50.0	108%	2.3%
Carbon Disulfide	10.4	10.0	104%	10.4	10.0	104%	0.0%
1,1-Dichloroethene	9.6	10.0	96.0%	9.8	10.0	98.0%	2.1%
1,1-Dichloroethane	10.3	10.0	103%	10.5	10.0	105%	1.9%
trans-1,2-Dichloroethene	9.5	10.0	95.0%	9.8	10.0	98.0%	3.1%
cis-1,2-Dichloroethene	9.6	10.0	96.0%	10.0	10.0	100%	4.1%
Chloroform	9.7	10.0	97.0%	9.8	10.0	98.0%	1.0%
1,2-Dichloroethane	9.4	10.0	94.0%	10.1	10.0	101%	7.2%
2-Butanone	50.8	50.0	102%	54.8	50.0	110%	7.6%
1,1,1-Trichloroethane	9.8	10.0	98.0%	10.1	10.0	101%	3.0%
Carbon Tetrachloride	10.1	10.0	101%	10.5	10.0	105%	3.9%
Vinyl Acetate	9.8	10.0	98.0%	10.1	10.0	101%	3.0%
Bromodichloromethane	9.4	10.0	94.0%	9.6	10.0	96.0%	2.1%
1,2-Dichloropropane	10.0	10.0	100%	10.3	10.0	103%	3.0%
cis-1,3-Dichloropropene	9.7	10.0	97.0%	10.0	10.0	100%	3.0%
Trichloroethene	9.5	10.0	95.0%	9.8	10.0	98.0%	3.1%
Dibromochloromethane	9.0	10.0	90.0%	9.4	10.0	94.0%	4.3%
1,1,2-Trichloroethane	10.0	10.0	100%	10.0	10.0	100%	0.0%
Benzene	9.9	10.0	99.0%	10.1	10.0	101%	2.0%
trans-1,3-Dichloropropene	9.4	10.0	94.0%	9.6	10.0	96.0%	2.1%
2-Chloroethylvinylether	8.1 Q	10.0	81.0%	8.3 Q	10.0	83.0%	2.4%
Bromoform	9.2	10.0	92.0%	9.4	10.0	94.0%	2.2%
4-Methyl-2-Pentanone (MIBK)	52.3	50.0	105%	53.9	50.0	108%	3.0%
2-Hexanone	51.1	50.0	102%	54.2	50.0	108%	5.9%
Tetrachloroethene	9.1	10.0	91.0%	9.7	10.0	97.0%	6.4%
1,1,2,2-Tetrachloroethane	8.9	10.0	89.0%	9.5	10.0	95.0%	6.5%
Toluene	9.6	10.0	96.0%	9.9	10.0	99.0%	3.1%
Chlorobenzene	9.4	10.0	94.0%	10.0	10.0	100%	6.2%
Ethylbenzene	9.6	10.0	96.0%	10.2	10.0	102%	6.1%
Styrene	9.3	10.0	93.0%	9.9	10.0	99.0%	6.2%
Trichlorofluoromethane	9.7	10.0	97.0%	9.8	10.0	98.0%	1.0%
1,1,2-Trichloro-1,2,2-trifluoroetha	10.0	10.0	100%	10.4	10.0	104%	3.9%
m,p-Xylene	18.6	20.0	93.0%	20.1	20.0	100%	7.8%
o-Xylene	9.4	10.0	94.0%	9.8	10.0	98.0%	4.2%

Reported in µg/L (ppb)

RPD calculated using sample concentrations per SW846.

Volatile Surrogate Recovery

	LCS	LCSD

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: LCS-021910
LAB CONTROL SAMPLE

Lab Sample ID: LCS-021910
LIMS ID: 10-3728
Matrix: Groundwater

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
d4-1,2-Dichloroethane		108%	106%				
d8-Toluene		101%	99.5%				
Bromofluorobenzene		93.1%	95.2%				

4A
VOLATILE METHOD BLANK SUMMARY

Method Blank ID.

MB0218

Lab Name: ANALYTICAL RESOURCES, INC

Client: THE BOEING COMPANY

ARI Job No: QJ43

Project: 2-10 SHEETPILE

Lab File ID: 02181005

Lab Sample ID: MB0218

Date Analyzed: 02/18/10

Time Analyzed: 1101

Instrument ID: NT5

Heated Purge: (Y/N) N

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	LCS0218	LCS0218	02181003	1009
02	LCSD0218	LCSD0218	02181004	1035
03	TRIP BLANK	QJ43M	02181006	1133
04	GW-100210-PL	QJ43A	02181010	1316
05	GW-100210-PL	QJ43B	02181011	1341
06	GW-100210-PL	QJ43C	02181012	1407
07	GW-100210-PL	QJ43D	02181013	1433
08	GW-100210-PL	QJ43E	02181014	1458
09	GW-100210-PL	QJ43F	02181015	1524
10	GW-100210-PL	QJ43G	02181016	1550
11	GW-100210-PL	QJ43H	02181017	1615
12	GW-100210-PL	QJ43I	02181018	1641
13	GW-100210-PL	QJ43J	02181019	1707
14	GW-100210-PL	QJ43K	02181020	1732
15	GW-100210-PL	QJ43L	02181021	1758
16				
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30				

COMMENTS:

FORM IV VOA

OLM3.2M

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: MB-021810**
 METHOD BLANK

Lab Sample ID: MB-021810
LIMS ID: 10-3727
Matrix: Groundwater
Data Release Authorized:
Reported: 02/23/10

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: NA
Date Received: NA

Instrument/Analyst: NT5/PKC
Date Analyzed: 02/18/10 11:01

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	< 0.5	U
74-83-9	Bromomethane	0.5	< 0.5	U
75-01-4	Vinyl Chloride	0.2	< 0.2	U
75-00-3	Chloroethane	0.2	< 0.2	U
75-09-2	Methylene Chloride	0.5	< 0.5	U
67-64-1	Acetone	5.0	< 5.0	U
75-15-0	Carbon Disulfide	0.2	< 0.2	U
75-35-4	1,1-Dichloroethene	0.2	< 0.2	U
75-34-3	1,1-Dichloroethane	0.2	< 0.2	U
156-60-5	trans-1,2-Dichloroethene	0.2	< 0.2	U
156-59-2	cis-1,2-Dichloroethene	0.2	< 0.2	U
67-66-3	Chloroform	0.2	< 0.2	U
107-06-2	1,2-Dichloroethane	0.2	< 0.2	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.2	< 0.2	U
56-23-5	Carbon Tetrachloride	0.2	< 0.2	U
108-05-4	Vinyl Acetate	1.0	< 1.0	U
75-27-4	Bromodichloromethane	0.2	< 0.2	U
78-87-5	1,2-Dichloropropane	0.2	< 0.2	U
10061-01-5	cis-1,3-Dichloropropene	0.2	< 0.2	U
79-01-6	Trichloroethene	0.2	< 0.2	U
124-48-1	Dibromochloromethane	0.2	< 0.2	U
79-00-5	1,1,2-Trichloroethane	0.2	< 0.2	U
71-43-2	Benzene	0.2	< 0.2	U
10061-02-6	trans-1,3-Dichloropropene	0.2	< 0.2	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.2	< 0.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.2	< 0.2	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	< 0.2	U
108-88-3	Toluene	0.2	< 0.2	U
108-90-7	Chlorobenzene	0.2	< 0.2	U
100-41-4	Ethylbenzene	0.2	< 0.2	U
100-42-5	Styrene	0.2	< 0.2	U
75-69-4	Trichlorofluoromethane	0.2	< 0.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	< 0.2	U
179601-23-1	m,p-Xylene	0.4	< 0.4	U
95-47-6	o-Xylene	0.2	< 0.2	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	111%
d8-Toluene	101%
Bromofluorobenzene	93.9%

4A
VOLATILE METHOD BLANK SUMMARY

Method Blank ID.

MB0219

Lab Name: ANALYTICAL RESOURCES, INC

Client: THE BOEING COMPANY

ARI Job No: QJ43

Project: 2-10 SHEETPILE

Lab File ID: 02191005

Lab Sample ID: MB0219

Date Analyzed: 02/19/10

Time Analyzed: 1037

Instrument ID: NT5

Heated Purge: (Y/N) N

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	LCS0219	LCS0219	02191003	0946
02	LCSD0219	LCSD0219	02191004	1011
03	GW-100210-PL	QJ43A	02191009	1227
04	GW-100210-PL	QJ43B	02191010	1253
05	GW-100210-PL	QJ43C	02191011	1319
06	GW-100210-PL	QJ43D	02191012	1344
07	GW-100210-PL	QJ43E	02191013	1410
08	GW-100210-PL	QJ43F	02191014	1435
09	GW-100210-PL	QJ43G	02191015	1501
10	GW-100210-PL	QJ43H	02191016	1527
11	GW-100210-PL	QJ43I	02191017	1552
12	GW-100210-PL	QJ43J	02191020	1708
13	GW-100210-PL	QJ43K	02191021	1734
14	GW-100210-PL	QJ43L	02191022	1759
15				
16				
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30				

COMMENTS:

FORM IV VOA

OLM3.2M

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Volatiles by Purge & Trap GC/MS-Method SW8260C **Sample ID: MB-021910**

METHOD BLANK

Lab Sample ID: MB-021910
LIMS ID: 10-3728
Matrix: Groundwater
Data Release Authorized:
Reported: 02/23/10

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: NA
Date Received: NA

Instrument/Analyst: NT5/PKC
Date Analyzed: 02/19/10 10:37

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
74-87-3	Chloromethane	0.5	< 0.5	U
74-83-9	Bromomethane	0.5	< 0.5	U
75-01-4	Vinyl Chloride	0.2	< 0.2	U
75-00-3	Chloroethane	0.2	< 0.2	U
75-09-2	Methylene Chloride	0.5	< 0.5	U
67-64-1	Acetone	5.0	< 5.0	U
75-15-0	Carbon Disulfide	0.2	< 0.2	U
75-35-4	1,1-Dichloroethene	0.2	< 0.2	U
75-34-3	1,1-Dichloroethane	0.2	< 0.2	U
156-60-5	trans-1,2-Dichloroethene	0.2	< 0.2	U
156-59-2	cis-1,2-Dichloroethene	0.2	< 0.2	U
67-66-3	Chloroform	0.2	< 0.2	U
107-06-2	1,2-Dichloroethane	0.2	< 0.2	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.2	< 0.2	U
56-23-5	Carbon Tetrachloride	0.2	< 0.2	U
108-05-4	Vinyl Acetate	1.0	< 1.0	U
75-27-4	Bromodichloromethane	0.2	< 0.2	U
78-87-5	1,2-Dichloropropane	0.2	< 0.2	U
10061-01-5	cis-1,3-Dichloropropene	0.2	< 0.2	U
79-01-6	Trichloroethene	0.2	< 0.2	U
124-48-1	Dibromochloromethane	0.2	< 0.2	U
79-00-5	1,1,2-Trichloroethane	0.2	< 0.2	U
71-43-2	Benzene	0.2	< 0.2	U
10061-02-6	trans-1,3-Dichloropropene	0.2	< 0.2	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.2	< 0.2	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.2	< 0.2	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	< 0.2	U
108-88-3	Toluene	0.2	< 0.2	U
108-90-7	Chlorobenzene	0.2	< 0.2	U
100-41-4	Ethylbenzene	0.2	< 0.2	U
100-42-5	Styrene	0.2	< 0.2	U
75-69-4	Trichlorofluoromethane	0.2	< 0.2	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroe	0.2	< 0.2	U
179601-23-1	m,p-Xylene	0.4	< 0.4	U
95-47-6	o-Xylene	0.2	< 0.2	U

Reported in μg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	110%
d8-Toluene	100%
Bromofluorobenzene	92.2%

DISSOLVED GASSES (MEE) ANALYSIS

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
METHANE ETHANE ETHENE
Modified RSK 175

Matrix: Groundwater

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Received: 02/09/10

Data Release Authorized:
Reported: 02/24/10

ARI ID	Sample ID	Analysis Date	DL	Analyte	RL	Result
QJ21F	GW-100209-PL2-209A-0	02/17/10	1.0	**Methane**	**0.7**	**774**
10-3591				**Ethane**	**1.2**	**4.0**
				Ethene	1.1	< 1.1 U
QJ21H	GW-100209-PL2-212A-0	02/17/10	1.0	**Methane**	**0.7**	**3,120**
10-3593				**Ethane**	**1.2**	**546**
				Ethene	**1.1**	**720**
QJ21L	GW-100209-PL2-218A-0	02/17/10	1.0	**Methane**	**0.7**	**3,170**
10-3597				**Ethane**	**1.2**	**14.6**
				Ethene	**1.1**	**2.7**
QJ21O	GW-100209-PL2-218B-0	02/17/10	1.0	**Methane**	**0.7**	**117**
10-3600				Ethane	1.2	< 1.2 U
				Ethene	1.1	< 1.1 U
021710MB	Method Blank	02/17/10	1.0	Methane	0.7	< 0.7 U
021710MB	Method Blank	02/17/10	1.0	Ethane	1.2	< 1.2 U
021710MB	Method Blank	02/17/10	1.0	Ethene	1.1	< 1.1 U

Reported in ug/L (ppb)

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
METHANE ETHANE ETHENE
Modified RSK 175

Matrix: Groundwater

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Received: 02/10/10

Data Release Authorized:
Reported: 02/24/10

ARI ID	Sample ID	Analysis Date	DL	Analyte	RL	Result
QJ43H	GW-100210-PL2-253A-0	02/17/10	1.0	**Methane**	**0.7**	**2,340**
10-3734				**Ethane**	**1.2**	**20.9**
				Ethene	**1.1**	**2.3**
021710MB	Method Blank	02/17/10	1.0	Methane	0.7	< 0.7 U
021710MB	Method Blank	02/17/10	1.0	Ethane	1.2	< 1.2 U
021710MB	Method Blank	02/17/10	1.0	Ethene	1.1	< 1.1 U

Reported in ug/L (ppb)

ANALYTICAL RESOURCES INCORPORATED

RSK 175 WATER SURROGATE RECOVERY SUMMARY

Matrix: Groundwater

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001

ARI ID	Client ID	PRP	TOT OUT
QJ21F	GW-100209-PL2-209A-0	88.7%	0
QJ21H	GW-100209-PL2-212A-0	92.5%	0
QJ21L	GW-100209-PL2-218A-0	91.0%	0
QJ21O	GW-100209-PL2-218B-0	86.6%	0
MB-021710	Method Blank	90.0%	0
LCS-021710	Lab Control	90.8%	0
LCSD-021710	Lab Control Dup	86.5%	0

	LCS/MB LIMITS	QC LIMITS
(PRP) = Propane	(79-132)	(72-122)

Log Number Range: 10-3591 to 10-3600

FORM-II RSK 175

ANALYTICAL RESOURCES INCORPORATED

RSK 175 WATER SURROGATE RECOVERY SUMMARY

Matrix: Groundwater

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001

ARI ID	Client ID	PRP	TOT OUT
QJ43H	GW-100210-PL2-253A-0	119%	0
MB-021710	Method Blank	90.0%	0
LCS-021710	Lab Control	90.8%	0
LCSD-021710	Lab Control Dup	86.5%	0

	LCS/MB LIMITS	QC LIMITS
(PRP) = Propane	(79-132)	(72-122)

Log Number Range: 10-3734 to 10-3734

FORM-II RSK 175

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
METHANE ETHANE ETHENE
Modified RSK 175
Page 1 of 1
Matrix: Groundwater

QC Report No: QJ21-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Received: 02/09/10

Data Release Authorized:
Reported: 02/24/10

ARI ID	Analysis Date	Analyte	Spike	Result	Recovery	RPD
021710LCS	02/17/10	Methane	654	562	85.9%	6.2%
021710LCSD				528	80.7%	
021710LCS	02/17/10	Ethane	1,230	1,190	97.0%	1.7%
021710LCSD				1,170	95.4%	
021710LCS	02/17/10	Ethene	1,150	1,120	97.8%	1.8%
021710LCSD				1,100	96.1%	

Reported in ug/L (ppb)

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
METHANE ETHANE ETHENE
Modified RSK 175

Matrix: Groundwater

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Received: 02/10/10

Data Release Authorized:
Reported: 02/24/10

ARI ID	Analysis Date	Analyte	Spike	Result	Recovery	RPD
021710LCS	02/17/10	Methane	654	562	85.9%	6.2%
021710LCSD				528	80.7%	
021710LCS	02/17/10	Ethane	1,230	1,190	97.0%	1.7%
021710LCSD				1,170	95.4%	
021710LCS	02/17/10	Ethene	1,150	1,120	97.8%	1.8%
021710LCSD				1,100	96.1%	

Reported in ug/L (ppb)

GENERAL CHEMISTRY ANALYSIS

SAMPLE RESULTS-CONVENTIONALS
QJ21-The Boeing Company

ANALYTICAL RESOURCES INCORPORATED

Matrix: Groundwater
Data Release Authorized:
Reported: 02/12/10

Project: 2-10 Sheetpile
Event: K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Client ID: GW-100209-PL2-209B-0
ARI ID: 10-3590 QJ21E

Analyte	Date Batch	Method	Units	RL	Sample
Total Organic Carbon	02/10/10 021010#1	EPA 415.1	mg/L	3.00	31.2

RL Analytical reporting limit
U Undetected at reported detection limit

SAMPLE RESULTS-CONVENTIONALS
QJ21-The Boeing Company

ANALYTICAL RESOURCES INCORPORATED

Matrix: Groundwater
Data Release Authorized:
Reported: 02/12/10

Project: 2-10 Sheetpile
Event: K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Client ID: GW-100209-PL2-209A-0
ARI ID: 10-3591 QJ21F

Analyte	Date Batch	Method	Units	RL	Sample
Alkalinity	02/11/10 021110#1	SM 2320	mg/L CaCO3	1.0	178
Carbonate	02/11/10	SM 2320	mg/L CaCO3	1.0	< 1.0 U
Bicarbonate	02/11/10	SM 2320	mg/L CaCO3	1.0	178
Hydroxide	02/11/10	SM 2320	mg/L CaCO3	1.0	< 1.0 U
Chloride	02/10/10 021010#1	EPA 300.0	mg/L	2.0	10.5
Sulfate	02/10/10 021010#1	EPA 300.0	mg/L	2.0	9.6
Total Organic Carbon	02/10/10 021010#1	EPA 415.1	mg/L	1.50	20.0

RL Analytical reporting limit
U Undetected at reported detection limit

SAMPLE RESULTS-CONVENTIONALS
QJ21-The Boeing Company

ANALYTICAL RESOURCES INCORPORATED

Matrix: Groundwater
Data Release Authorized:
Reported: 02/12/10

Project: 2-10 Sheetpile
Event: K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Client ID: GW-100209-PL2-212A-0
ARI ID: 10-3593 QJ21H

Analyte	Date Batch	Method	Units	RL	Sample
Chloride	02/11/10 021110#1	EPA 300.0	mg/L	5.0	144
Sulfate	02/10/10 021010#1	EPA 300.0	mg/L	2.0	21.6
Total Organic Carbon	02/10/10 021010#1	EPA 415.1	mg/L	3.00	43.6

RL Analytical reporting limit
U Undetected at reported detection limit

SAMPLE RESULTS-CONVENTIONALS
QJ21-The Boeing Company

ANALYTICAL RESOURCES INCORPORATED

Matrix: Groundwater
Data Release Authorized:
Reported: 02/12/10

Project: 2-10 Sheetpile
Event: K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Client ID: GW-100209-PL2-218A-0
ARI ID: 10-3597 QJ21L

Analyte	Date Batch	Method	Units	RL	Sample
Chloride	02/10/10 021010#1	EPA 300.0	mg/L	2.0	12.7
Sulfate	02/11/10 021110#1	EPA 300.0	mg/L	0.1	1.6
Total Organic Carbon	02/10/10 021010#1	EPA 415.1	mg/L	1.50	26.2

RL Analytical reporting limit
U Undetected at reported detection limit

SAMPLE RESULTS-CONVENTIONALS
QJ21-The Boeing Company

ANALYTICAL RESOURCES INCORPORATED

Matrix: Groundwater
Data Release Authorized:
Reported: 02/12/10

Project: 2-10 Sheetpile
Event: K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Client ID: GW-100209-PL2-218B-0
ARI ID: 10-3600 QJ21O

Analyte	Date Batch	Method	Units	RL	Sample
Total Organic Carbon	02/10/10 021010#1	EPA 415.1	mg/L	3.00	17.4

RL Analytical reporting limit
U Undetected at reported detection limit

MS/MSD RESULTS-CONVENTIONALS
QJ21-The Boeing Company

ANALYTICAL RESOURCES INCORPORATED

Matrix: Groundwater
Data Release Authorized:
Reported: 02/12/10

Project: 2-10 Sheetpile
Event: K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Analyte	Method	Date	Units	Sample	Spike	Spike Added	Recovery
ARI ID: QJ21E Client ID: GW-100209-PL2-209B-0							
Total Organic Carbon	EPA 415.1	02/10/10	mg/L	31.2	63.2	40.0	80.0%
ARI ID: QJ21F Client ID: GW-100209-PL2-209A-0							
Chloride	EPA 300.0	02/10/10	mg/L	10.5	48.9	40.0	96.0%
Sulfate	EPA 300.0	02/10/10	mg/L	9.6	46.5	40.0	92.2%

REPLICATE RESULTS-CONVENTIONALS
QJ21-The Boeing Company

ANALYTICAL RESOURCES INCORPORATED

Matrix: Groundwater
Data Release Authorized:
Reported: 02/12/10

Project: 2-10 Sheetpile
Event: K0275001
Date Sampled: 02/09/10
Date Received: 02/09/10

Analyte	Method	Date	Units	Sample	Replicate(s)	RPD/RSD
ARI ID: QJ21E Client ID: GW-100209-PL2-209B-0						
Total Organic Carbon	EPA 415.1	02/10/10	mg/L	31.2	34.2	9.2%
ARI ID: QJ21F Client ID: GW-100209-PL2-209A-0						
Alkalinity	SM 2320	02/11/10	mg/L CaCO3	178	177	0.6%
Carbonate	SM 2320	02/11/10	mg/L CaCO3	< 1.0	< 1.0	NA
Bicarbonate	SM 2320	02/11/10	mg/L CaCO3	178	177	0.6%
Hydroxide	SM 2320	02/11/10	mg/L CaCO3	< 1.0	< 1.0	NA
Chloride	EPA 300.0	02/10/10	mg/L	10.5	10.2	2.9%
Sulfate	EPA 300.0	02/10/10	mg/L	9.6	9.4	2.1%

METHOD BLANK RESULTS-CONVENTIONALS
QJ21-The Boeing Company

ANALYTICAL RESOURCES INCORPORATED

Matrix: Groundwater
Data Release Authorized:
Reported: 02/12/10

Project: 2-10 Sheetpile
Event: K0275001
Date Sampled: NA
Date Received: NA

Analyte	Method	Date	Units	Blank	ID
Chloride	EPA 300.0	02/10/10	mg/L	< 0.1 U	
		02/11/10		< 0.1 U	
Sulfate	EPA 300.0	02/10/10	mg/L	< 0.1 U	
		02/11/10		< 0.1 U	
Total Organic Carbon	EPA 415.1	02/10/10	mg/L	< 1.50 U	

STANDARD REFERENCE RESULTS-CONVENTIONALS
QJ21-The Boeing Company

ANALYTICAL RESOURCES INCORPORATED

Matrix: Groundwater
Data Release Authorized
Reported: 02/12/10

Project: 2-10 Sheetpile
Event: K0275001
Date Sampled: NA
Date Received: NA

Analyte/SRM ID	Method	Date	Units	SRM	True Value	Recovery
Alkalinity ERA #P114506	SM 2320	02/11/10	mg/L CaCO3	73.2	73.6	99.5%
Chloride ERA #230109	EPA 300.0	02/10/10 02/11/10	mg/L	3.0 3.0	3.0 3.0	100.0% 100.0%
Sulfate ERA #220109	EPA 300.0	02/10/10 02/11/10	mg/L	3.0 3.0	3.0 3.0	100.0% 100.0%
Total Organic Carbon ERA 0506-09-01	EPA 415.1	02/10/10	mg/L	19.4	20.0	97.0%

SAMPLE RESULTS-CONVENTIONALS
QJ43-The Boeing Company

ANALYTICAL RESOURCES INCORPORATED

Matrix: Groundwater
Data Release Authorized:
Reported: 02/16/10

Project: 2-10 Sheetpile
Event: K0275001
Date Sampled: 02/10/10
Date Received: 02/10/10

Client ID: GW-100210-PL2-244A-0
ARI ID: 10-3733 QJ43G

Analyte	Date Batch	Method	Units	RL	Sample
Total Organic Carbon	02/10/10 021010#1	EPA 415.1	mg/L	1.50	27.1

RL Analytical reporting limit
U Undetected at reported detection limit

SAMPLE RESULTS-CONVENTIONALS
QJ43-The Boeing Company

ANALYTICAL RESOURCES INCORPORATED

Matrix: Groundwater
Data Release Authorized
Reported: 02/16/10

Project: 2-10 Sheetpile
Event: K0275001
Date Sampled: 02/10/10
Date Received: 02/10/10

Client ID: GW-100210-PL2-253A-0
ARI ID: 10-3734 QJ43H

Analyte	Date Batch	Method	Units	RL	Sample
Alkalinity	02/11/10 021110#1	SM 2320	mg/L CaCO3	1.0	263
Carbonate	02/11/10	SM 2320	mg/L CaCO3	1.0	< 1.0 U
Bicarbonate	02/11/10	SM 2320	mg/L CaCO3	1.0	263
Hydroxide	02/11/10	SM 2320	mg/L CaCO3	1.0	< 1.0 U
Chloride	02/11/10 021110#1	EPA 300.0	mg/L	1.0	24.1
Sulfate	02/11/10 021110#1	EPA 300.0	mg/L	1.0	16.4
Total Organic Carbon	02/11/10 021110#1	EPA 415.1	mg/L	1.50	11.0

RL Analytical reporting limit
U Undetected at reported detection limit

SAMPLE RESULTS-CONVENTIONALS
QJ43-The Boeing Company

ANALYTICAL RESOURCES INCORPORATED

Matrix: Groundwater
Data Release Authorized:
Reported: 02/16/10

Project: 2-10 Sheetpile
Event: K0275001
Date Sampled: 02/10/10
Date Received: 02/10/10

Client ID: GW-100210-PL2-252A-0
ARI ID: 10-3735 QJ43I

Analyte	Date Batch	Method	Units	RL	Sample
Total Organic Carbon	02/10/10 021010#1	EPA 415.1	mg/L	1.50	14.6

RL Analytical reporting limit
U Undetected at reported detection limit

MS/MSD RESULTS-CONVENTIONALS
QJ43-The Boeing Company

ANALYTICAL RESOURCES INCORPORATED

Matrix: Groundwater
Data Release Authorized:
Reported: 02/16/10

Project: 2-10 Sheetpile
Event: K0275001
Date Sampled: 02/10/10
Date Received: 02/10/10

Analyte	Method	Date	Units	Sample	Spike	Spike Added	Recovery
ARI ID: QJ43H Client ID: GW-100210-PL2-253A-0							
Chloride	EPA 300.0	02/11/10	mg/L	24.1	43.6	20.0	97.5%
Sulfate	EPA 300.0	02/11/10	mg/L	16.4	36.0	20.0	98.0%
Total Organic Carbon	EPA 415.1	02/11/10	mg/L	11.0	30.8	20.0	99.0%

REPLICATE RESULTS-CONVENTIONALS
QJ43-The Boeing Company

ANALYTICAL RESOURCES INCORPORATED

Matrix: Groundwater
Data Release Authorized:
Reported: 02/16/10

Project: 2-10 Sheetpile
Event: K0275001
Date Sampled: 02/10/10
Date Received: 02/10/10

Analyte	Method	Date	Units	Sample	Replicate(s)	RPD/RSD
ARI ID: QJ43H Client ID: GW-100210-PL2-253A-0						
Alkalinity	SM 2320	02/11/10	mg/L CaCO3	263	262	0.4%
Carbonate	SM 2320	02/11/10	mg/L CaCO3	< 1.0	< 1.0	NA
Bicarbonate	SM 2320	02/11/10	mg/L CaCO3	263	262	0.4%
Hydroxide	SM 2320	02/11/10	mg/L CaCO3	< 1.0	< 1.0	NA
Chloride	EPA 300.0	02/11/10	mg/L	24.1	24.0	0.4%
Sulfate	EPA 300.0	02/11/10	mg/L	16.4	16.1	1.8%
Total Organic Carbon	EPA 415.1	02/11/10	mg/L	11.0	11.0	0.0%

METHOD BLANK RESULTS-CONVENTIONALS
QJ43-The Boeing Company

ANALYTICAL RESOURCES INCORPORATED

Matrix: Groundwater
Data Release Authorized:
Reported: 02/16/10

Project: 2-10 Sheetpile
Event: K0275001
Date Sampled: NA
Date Received: NA

Analyte	Method	Date	Units	Blank	ID
Chloride	EPA 300.0	02/11/10	mg/L	< 0.1 U	
Sulfate	EPA 300.0	02/11/10	mg/L	< 0.1 U	
Total Organic Carbon	EPA 415.1	02/10/10	mg/L	< 1.50 U	
		02/11/10		< 1.50 U	

STANDARD REFERENCE RESULTS-CONVENTIONALS
QJ43-The Boeing Company

ANALYTICAL RESOURCES INCORPORATED

Matrix: Groundwater
Data Release Authorized:
Reported: 02/16/10

Project: 2-10 Sheetpile
Event: K0275001
Date Sampled: NA
Date Received: NA

Analyte/SRM ID	Method	Date	Units	SRM	True Value	Recovery
Alkalinity ERA #P114506	SM 2320	02/11/10	mg/L CaCO3	73.2	73.6	99.5%
Chloride ERA #230109	EPA 300.0	02/11/10	mg/L	3.0	3.0	100.0%
Sulfate ERA #220109	EPA 300.0	02/11/10	mg/L	3.0	3.0	100.0%
Total Organic Carbon ERA 0506-09-01	EPA 415.1	02/10/10 02/11/10	mg/L	19.4 19.0	20.0 20.0	97.0% 95.0%

Cover Page

INORGANIC ANALYSIS DATA PACKAGE

ANALYTICAL RESOURCES INCORPORATED

CLIENT: The Boeing Company

PROJECT: 2-10 Sheetpile

SDG: QJ43

CLIENT ID	ARI ID	ARI LIMS ID	REPREP
GW-100210-PL2-244A	QJ43G	10-3733	
PBW	QJ43MB1	10-3733	
LCSW	QJ43MB1SPK	10-3733	
GW-100210-PL2-253A	QJ43H	10-3734	
GW-100210-PL2-252A	QJ43I	10-3735	
PBW	QJ43MB2	10-3740	
LCSW	QJ43MB2SPK	10-3740	
GW-100210-PL2-253A	QJ43N	10-3740	

Were ICP interelement corrections applied ?	Yes/No	YES
Were ICP background corrections applied ?	Yes/No	YES
If yes - were raw data generated before application of background corrections ?	Yes/No	NO

Comments: _____

THIS DATA PACKAGE HAS BEEN REVIEWED AND AUTHORIZED FOR RELEASE BY:

Signature: _____ Name: Jay Kuhn

Date: 3/15/10 Title: Inorganics Director

ANALYTICAL RESOURCES INCORPORATED

INORGANICS ANALYSIS DATA SHEET
DISSOLVED METALS

Sample ID: GW-100210-PL2-244A-0
SAMPLE

Lab Sample ID: QJ43G
LIMS ID: 10-3733
Matrix: Groundwater
Data Release Authorized:
Reported: 03/15/10

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/10/10
Date Received: 02/10/10

Prep Meth	Prep Date	Analysis Method	Analysis Date	CAS Number	Analyte	RL	µg/L	Q
200.8	02/12/10	200.8	02/15/10	**7440-38-2**	**Arsenic**	0.2	**12.5**	
6010B	02/11/10	6010B	03/11/10	**7439-96-5**	**Manganese**	1	**601**	

U-Analyte undetected at given RL
RL-Reporting Limit

ANALYTICAL RESOURCES INCORPORATED

INORGANICS ANALYSIS DATA SHEET
DISSOLVED METALS

Sample ID: GW-100210-PL2-253A-0
SAMPLE

Lab Sample ID: QJ43H
LIMS ID: 10-3734
Matrix: Groundwater
Data Release Authorized:
Reported: 03/15/10

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/10/10
Date Received: 02/10/10

Prep Meth	Prep Date	Analysis Method	Analysis Date	CAS Number	Analyte	RL	µg/L	Q
200.8	02/12/10	200.8	02/15/10	**7440-38-2**	**Arsenic**	0.2	**1.5**	
6010B	02/11/10	6010B	03/11/10	**7439-96-5**	**Manganese**	1	**321**	

U-Analyte undetected at given RL
RL-Reporting Limit

ANALYTICAL RESOURCES INCORPORATED

INORGANICS ANALYSIS DATA SHEET
DISSOLVED METALS

Sample ID: GW-100210-PL2-252A-0
SAMPLE

Lab Sample ID: QJ43I
LIMS ID: 10-3735
Matrix: Groundwater
Data Release Authorized:
Reported: 03/15/10

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/10/10
Date Received: 02/10/10

Prep Meth	Prep Date	Analysis Method	Analysis Date	CAS Number	Analyte	RL	µg/L	Q
200.8	02/12/10	200.8	02/15/10	**7440-38-2**	**Arsenic**	0.2	**0.8**	
6010B	02/11/10	6010B	03/11/10	**7439-96-5**	**Manganese**	1	**350**	

U-Analyte undetected at given RL
RL-Reporting Limit

ANALYTICAL RESOURCES INCORPORATED

INORGANICS ANALYSIS DATA SHEET
DISSOLVED METALS

Sample ID: METHOD BLANK

Lab Sample ID: QJ43MB
LIMS ID: 10-3733
Matrix: Groundwater
Data Release Authorized:
Reported: 03/15/10

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: NA
Date Received: NA

Prep Meth	Prep Date	Analysis Method	Analysis Date	CAS Number	Analyte	RL	µg/L	Q
200.8	02/12/10	200.8	02/15/10	7440-38-2	Arsenic	0.2	0.2	U
6010B	02/11/10	6010B	03/11/10	7439-96-5	Manganese	1	1	U

U-Analyte undetected at given RL
RL-Reporting Limit

ANALYTICAL RESOURCES INCORPORATED

INORGANICS ANALYSIS DATA SHEET
DISSOLVED METALS

Sample ID: LAB CONTROL

Lab Sample ID: QJ43LCS
LIMS ID: 10-3733
Matrix: Groundwater
Data Release Authorized:
Reported: 03/15/10

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: NA
Date Received: NA

BLANK SPIKE QUALITY CONTROL REPORT

Analyte	Analysis Method	Spike Found	Spike Added	% Recovery	Q
Arsenic	200.8	27.1	25.0	108%	
Manganese	6010B	483	500	96.6%	

Reported in µg/L

N-Control limit not met
Control Limits: 80-120%

ANALYTICAL RESOURCES INCORPORATED

INORGANICS ANALYSIS DATA SHEET
TOTAL METALS

Sample ID: GW-100210-PL2-253A-0
SAMPLE

Lab Sample ID: QJ43N
LIMS ID: 10-3740
Matrix: Groundwater
Data Release Authorized:
Reported: 03/15/10

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: 02/10/10
Date Received: 02/10/10

Prep Meth	Prep Date	Analysis Method	Analysis Date	CAS Number	Analyte	RL	µg/L	Q
3010A	02/11/10	6010B	03/11/10	**7440-70-2**	**Calcium**	50	**10,500**	
3010A	02/11/10	6010B	03/11/10	**7439-95-4**	**Magnesium**	50	**15,200**	
3010A	02/11/10	6010B	03/11/10	**7440-09-7**	**Potassium**	500	**8,150**	
3010A	02/11/10	6010B	03/11/10	**7440-23-5**	**Sodium**	500	**107,000**	

Calculated Hardness (mg-CaCO3/L): 89

U-Analyte undetected at given RL
RL-Reporting Limit

ANALYTICAL RESOURCES INCORPORATED

INORGANICS ANALYSIS DATA SHEET
TOTAL METALS

Sample ID: METHOD BLANK

Lab Sample ID: QJ43MB
LIMS ID: 10-3740
Matrix: Groundwater
Data Release Authorized:
Reported: 03/15/10

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: NA
Date Received: NA

Prep Meth	Prep Date	Analysis Method	Analysis Date	CAS Number	Analyte	RL	µg/L	Q
3010A	02/11/10	6010B	03/11/10	7440-70-2	Calcium	50	50	U
3010A	02/11/10	6010B	03/11/10	7439-95-4	Magnesium	50	50	U
3010A	02/11/10	6010B	03/11/10	7440-09-7	Potassium	500	500	U
3010A	02/11/10	6010B	03/11/10	7440-23-5	Sodium	500	500	U

U-Analyte undetected at given RL
RL-Reporting Limit

ANALYTICAL RESOURCES INCORPORATED

INORGANICS ANALYSIS DATA SHEET
TOTAL METALS

Sample ID: LAB CONTROL

Lab Sample ID: QJ43LCS
LIMS ID: 10-3740
Matrix: Groundwater
Data Release Authorized:
Reported: 03/15/10

QC Report No: QJ43-The Boeing Company
Project: 2-10 Sheetpile
K0275001
Date Sampled: NA
Date Received: NA

BLANK SPIKE QUALITY CONTROL REPORT

Analyte	Analysis Method	Spike Found	Spike Added	% Recovery	Q
Calcium	6010B	10300	10000	103%	
Magnesium	6010B	10500	10000	105%	
Potassium	6010B	9910	10000	99.1%	
Sodium	6010B	10800	10000	108%	

Reported in µg/L

N-Control limit not met
Control Limits: 80-120%

Analytical Resources, Incorporated
Analytical Chemists and Consultants

February 22, 2010

Kent Angelos
Golder Associates Inc.
18300 NE Union Hill Road, Suite 200
Redmond, WA 98052-3333

Client Project Name: Plant 2 2-10 Sheetpiles
Client Project Number: PL210SP
ARI ID: QJ86

Dear Mr. Angelos:

Please find enclosed the original Chain of Custody record, sample receipt documentation, and the final results for the project referenced above. The air sample was analyzed for VOCs, as requested on the COC. The samples were received at cooler temperatures of AMB°C.

The sample required a dilution analysis. The client should consider the initial "E" flag analysis the more accurate analysis of the sample.

A copy of this report and all associated ARI raw data will be kept on file with ARI. Should you have any questions or problems, please feel free to call me at any time.

Respectfully,

ANALYTICAL RESOURCES, INC.

Kelly Bottem
Client Services Manager
(206) 695-6211
kellyb@arilabs.com
www.arilabs.com

cc: William Ernst, The Boeing Company, PO Box 3707, MS 1W-12, Seattle, WA 98124
Tom Mckeon, Calibre

4611 South 134th Place, Suite 100 • Tukwila WA 98168 • **206-695-6200** • **206-695-6201** fax

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: Q286	Turn-around Requested: STD
ARI Client Company: Boeing	Phone:
Client Contact: Will Ernst	
Client Project Name: 2-10 Sheetpile	
Client Project #: K0275001-001	Samplers: GWD JN

Page: 1	of 1
Date: 2/12/10	Ice Present?
No. of Coolers:	Cooler Temps:

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

Sample ID	Date	Time	Matrix	No. Containers	TO-15								Notes/Comments
SV-100212-PL2-SSL1-8-TD	2/12/10	1052	Air	1	X								

Analysis Requested

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
cc Tom McKean	(Signature) [signature]	(Signature) [signature]	(Signature)	(Signature)
	Printed Name: Grant Dawson	Printed Name: Mikka Mulumba	Printed Name:	Printed Name:
	Company: Calibre	Company: ARI	Company:	Company:
	Date & Time: 2/12/10 1330	Date & Time: 2/12/10 1330	Date & Time:	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: 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.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Cooler Receipt Form

ARI Client: Boeing

COC No(s): _____ (NA)

Assigned ARI Job No: QJ86

Project Name: 2-10 Sheetpile

Delivered by: Fed-Ex UPS Courier Hand Delivered Other: _____

Tracking No: _____ (NA)

Preliminary Examination Phase:

Were intact, properly signed and dated custody seals attached to the outside of to cooler?	YES	(NO)
Were custody papers included with the cooler?	(YES)	NO
Were custody papers properly filled out (ink, signed, etc.)	(YES)	NO
Temperature of Cooler(s) (°C) (recommended 2.0-6.0 °C for chemistry) AMB		

If cooler temperature is out of compliance fill out form 00070F

Temp Gun ID#: ——

Cooler Accepted by: MM Date: 2-12-10 Time: 1330

Complete custody forms and attach all shipping documents

Log-In Phase:

Was a temperature blank included in the cooler?		YES	(NO)
What kind of packing material was used? ... Bubble Wrap Wet Ice Gel Packs Baggies Foam Block Paper Other: —			
Was sufficient ice used (if appropriate)?	(NA)	YES	NO
Were all bottles sealed in individual plastic bags?		YES	(NO)
Did all bottles arrive in good condition (unbroken)?		(YES)	NO
Were all bottle labels complete and legible?		(YES)	NO
Did the number of containers listed on COC match with the number of containers received?		(YES)	NO
Did all bottle labels and tags agree with custody papers?		(YES)	NO
Were all bottles used correct for the requested analyses?		(YES)	NO
Do any of the analyses (bottles) require preservation? (attach preservation sheet, excluding VOCs)...	(NA)	YES	NO
Were all VOC vials free of air bubbles?	(NA)	YES	NO
Was sufficient amount of sample sent in each bottle?		(YES)	NO
Date VOC Trip Blank was made at ARI	(NA)	_____	

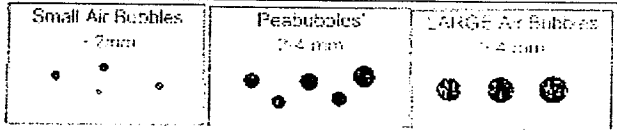
Samples Logged by: AV Date: 2/12/10 Time: 1340

***** Notify Project Manager of discrepancies or concerns *****

Sample ID on Bottle	Sample ID on COC	Sample ID on Bottle	Sample ID on COC

Additional Notes, Discrepancies, & Resolutions:

By: Date:



Small → "sm"
Peabubbles → "pb"
Large → "lg"
Headspace → "hs"

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Modified TO-14/TO-15

Sample ID: SV-100212-PL2-SSL1-8-TD
SAMPLE

Lab Sample ID: QJ86A
LIMS ID: 10-3957
Matrix: Air
Data Release Authorized:
Reported: 02/19/10

QC Report No: QJ86-The Boeing Company
Project: 2-10 Sheetpile
K0275001-001
Date Sampled: 02/12/10
Date Received: 02/12/10

Instrument/Analyst: NT10/AAR
Date Analyzed: 02/12/10 18:40

Sample Amount: 2.50 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result
75-01-4	Vinyl Chloride	310	< 310 U
75-35-4	1,1-Dichloroethene	200	< 200 U
156-60-5	**trans-1,2-Dichloroethene**	**200**	**2,100**
156-59-2	**cis-1,2-Dichloroethene**	**200**	**34,000**
79-01-6	**Trichloroethene**	**150**	**350,000 E**
127-18-4	Tetrachloroethene	120	< 120 U

Reported in ppbV

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	105%
d8-Toluene	94.1%
Bromofluorobenzene	101%
d4-1,2-Dichlorobenzene	100%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Modified TO-14/TO-15

Sample ID: SV-100212-PL2-SSL1-8-TD
DILUTION

Lab Sample ID: QJ86A
LIMS ID: 10-3957
Matrix: Air
Data Release Authorized:
Reported: 02/19/10

QC Report No: QJ86-The Boeing Company
Project: 2-10 Sheetpile
K0275001-001
Date Sampled: 02/12/10
Date Received: 02/12/10

Instrument/Analyst: NT10/AAR
Date Analyzed: 02/12/10 17:10

Sample Amount: 0.20 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result
75-01-4	Vinyl Chloride	3,900	< 3,900 U
75-35-4	1,1-Dichloroethene	2,500	< 2,500 U
156-60-5	trans-1,2-Dichloroethene	2,500	< 2,500 U
156-59-2	**cis-1,2-Dichloroethene**	**2,500**	**3,200**
79-01-6	**Trichloroethene**	**1,900**	**21,000**
127-18-4	Tetrachloroethene	1,500	< 1,500 U

Reported in ppbV

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	103%
d8-Toluene	101%
Bromofluorobenzene	95.6%
d4-1,2-Dichlorobenzene	109%

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Modified TO-14/TO-15

Sample ID: MB-021210
METHOD BLANK

Lab Sample ID: MB-021210
LIMS ID: 10-3957
Matrix: Air
Data Release Authorized:
Reported: 02/19/10

QC Report No: QJ86-The Boeing Company
Project: 2-10 Sheetpile
K0275001-001
Date Sampled: NA
Date Received: NA

Instrument/Analyst: NT10/PKC
Date Analyzed: 02/12/10 12:51

Sample Amount: 10.0 mL
Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result
75-01-4	Vinyl Chloride	78	< 78 U
75-35-4	1,1-Dichloroethene	50	< 50 U
156-60-5	trans-1,2-Dichloroethene	50	< 50 U
156-59-2	cis-1,2-Dichloroethene	50	< 50 U
79-01-6	Trichloroethene	37	< 37 U
127-18-4	Tetrachloroethene	30	< 30 U

Reported in ppbV

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	101%
d8-Toluene	99.4%
Bromofluorobenzene	91.8%
d4-1,2-Dichlorobenzene	104%

ANALYTICAL RESOURCES INCORPORATED

VOA SURROGATE RECOVERY SUMMARY

Matrix: Air

QC Report No: QJ86-The Boeing Company
Project: 2-10 Sheetpile
K0275001-001

ARI ID	Client ID	PV	DCE	TOL	BFB	DCB	TOT OUT
MB-021210	Method Blank	10	101%	99.4%	91.8%	104%	0
LCS-021210	Lab Control	10	101%	100%	104%	97.5%	0
LCSD-021210	Lab Control Dup	10	103%	100%	99.7%	94.6%	0
QJ86A	SV-100212-PL2-SSL1-8-TD	10	105%	94.1%	101%	100%	0
QJ86ADL	SV-100212-PL2-SSL1-8-TD	10	103%	101%	95.6%	109%	0

Modified TO-14/TO-15	LCS/MB LIMITS	QC LIMITS
(DCE) = d4-1,2-Dichloroethane	30-160	30-160
(TOL) = d8-Toluene	30-160	30-160
(BFB) = Bromofluorobenzene	30-160	30-160
(DCB) = d4-1,2-Dichlorobenzene	30-160	30-160

Log Number Range: 10-3957 to 10-3957

ANALYTICAL RESOURCES INCORPORATED

ORGANICS ANALYSIS DATA SHEET
Modified TO-14/TO-15

Sample ID: LCS-021210
LCS/LCSD

Lab Sample ID: LCS-021210
LIMS ID: 10-3957
Matrix: Air
Data Release Authorized:
Reported: 02/19/10

QC Report No: QJ86-The Boeing Company
Project: 2-10 Sheetpile
K0275001-001
Date Sampled: NA
Date Received: NA

Instrument/Analyst LCS: NT10/PKC
LCSD: NT10/PKC
Date Analyzed LCS: 02/12/10 11:50
LCSD: 02/12/10 12:20

Sample Amount LCS: 10.0 mL
LCSD: 10.0 mL
Purge Volume LCS: 10.0 mL
LCSD: 10.0 mL

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
Vinyl Chloride	3,810	3,910	97.4%	3,400	3,910	87.0%	11.4%
1,1-Dichloroethene	2,800	2,520	111%	2,320	2,520	92.1%	18.8%
trans-1,2-Dichloroethene	2,730	2,520	108%	2,500	2,520	99.2%	8.8%
cis-1,2-Dichloroethene	2,610	2,520	104%	2,600	2,520	103%	0.4%
Trichloroethene	1,960	1,860	105%	1,920	1,860	103%	2.1%
Tetrachloroethene	1,450	1,470	98.6%	1,410	1,470	95.9%	2.8%

Reported in ppbV
RPD calculated using sample concentrations per SW846.

Volatile Surrogate Recovery

	LCS	LCSD
d4-1,2-Dichloroethane	101%	103%
d8-Toluene	100%	100%
Bromofluorobenzene	104%	99.7%
d4-1,2-Dichlorobenzene	97.5%	94.6%

Air Toxics LTD.
Laboratory Services Since 1989

3/1/2010
Mr. Grant Dawson
Calibre
17811 Wayne Ave N

Shoreline WA 98133

Project Name: Boeing 2-10 Sheetpile
Project #: K0275001-001
Workorder #: 1002322

Dear Mr. Grant Dawson

The following report includes the data for the above referenced project for sample(s) received on 2/16/2010 at Air Toxics Ltd.

The data and associated QC analyzed by Modified TO-15 are compliant with the project requirements or laboratory criteria with the exception of the deviations noted in the attached case narrative.

Thank you for choosing Air Toxics Ltd. for your air analysis needs. Air Toxics Ltd. is committed to providing accurate data of the highest quality. Please feel free to contact the Project Manager: Kelly Buettner at 916-985-1000 if you have any questions regarding the data in this report.

Regards,

Kelly Buettner

Project Manager

Air Toxics LTD.
Laboratory Services Since 1989

WORK ORDER #: 1002322

Work Order Summary

CLIENT:	Mr. Grant Dawson Calibre 17811 Wayne Ave N Shoreline, WA 98133	**BILL TO:**	Mr. Will Ernst Boeing PO Box 3707 MC 6Y-94 Seattle, WA 98124-2207
PHONE:	509-430-6752	**P.O. #**	K0275001-001
FAX:		**PROJECT #**	K0275001-001 Boeing 2-10 Sheetpile
DATE RECEIVED:	02/16/2010	**CONTACT:**	Kelly Buettner
DATE COMPLETED:	03/01/2010		

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.	FINAL PRESSURE
01A	SV-100211-PL2-SSL7-8-0	Modified TO-15	4.5 "Hg	5 psi
02A	SV-100211-PL2-SSL4-8-0	Modified TO-15	4.0 "Hg	5 psi
03A	SV-100212-PL2-SSL1-8-0	Modified TO-15	3.5 "Hg	5 psi
04A	SV-100212-PL2-SSL1-8-1	Modified TO-15	3.5 "Hg	5 psi
04AA	SV-100212-PL2-SSL1-8-1 Lab Duplicate	Modified TO-15	3.5 "Hg	5 psi
05A	SV-100212-PL2-SSL5-8-0	Modified TO-15	4.0 "Hg	5 psi
06A	Lab Blank	Modified TO-15	NA	NA
06B	Lab Blank	Modified TO-15	NA	NA
07A	CCV	Modified TO-15	NA	NA
07B	CCV	Modified TO-15	NA	NA
08A	LCS	Modified TO-15	NA	NA
08B	LCS	Modified TO-15	NA	NA

CERTIFIED BY: Linda L. Freeman DATE: 03/01/10

Laboratory Director

Certfication numbers: CA NELAP - 02110CA, LA NELAP/LELAP- AI 30763,
NY NELAP - 11291, UT NELAP - 9166389892, AZ Licensure AZ0719
Name of Accrediting Agency: NELAP/Florida Department of Health, Scope of Application: Clean Air Act,
Accreditation number: E87680, Effective date: 07/01/09, Expiration date: 06/30/10
Air Toxics Ltd. certifies that the test results contained in this report meet all requirements of the NELAC standards

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LABORATORY NARRATIVE
Modified TO-15 Std & Soil Gas
Calibre
Workorder# 1002322

The laboratory performed analysis via modified EPA Method TO-15 using GC/MS in the Full Scan mode. The method involves concentrating up to 1.0 liter of air. The concentrated aliquot is then flash vaporized and swept through a water management system to remove water vapor. Following dehumidification, the sample passes directly into the GC/MS for analysis.

This workorder was independently validated prior to submittal using 'USEPA National Functional Guidelines' as generally applied to the analysis of volatile organic compounds in air. A rules-based, logic driven, independent validation engine was employed to assess completeness, evaluate pass/fail of relevant project quality control requirements and verification of all quantified amounts.

Method modifications taken to run these samples are summarized in the table below. Specific project requirements may over-ride the ATL modifications.

Requirement	***TO-15***	***ATL Modifications***
Daily CCV	+- 30% Difference	</= 30% Difference with two allowed out up to </=40%.; flag and narrate outliers
Sample collection media	Summa canister	ATL recommends use of summa canisters to insure data defensibility, but will report results from Tedlar bags at client request
Method Detection Limit	Follow 40CFR Pt.136 App. B	The MDL met all relevant requirements in Method TO-15 (statistical MDL less than the LOQ). The concentration of the spiked replicate may have exceeded 10X the calculated MDL in some cases

Receiving Notes

The Chain of Custody (COC) information for samples SV-100212-PL2-SSL1-8-1 and SV-100212-PL2-SSL5-8-0 did not match the entries on the sample tags with regard to sample identification. Therefore the information that was provided by the client was used to process and report the samples.

Analytical Notes

All Quality Control Limit exceedences and affected sample results are noted by flags. Each flag is defined at the bottom of this Case Narrative and on each Sample Result Summary page. Target compound non-detects in the samples that are associated with high bias in QC analyses have not been flagged.

Definition of Data Qualifying Flags

Eight qualifiers may have been used on the data analysis sheets and indicates as follows:

B - Compound present in laboratory blank greater than reporting limit (background subtraction not performed).

J - Estimated value.

E - Exceeds instrument calibration range.
S - Saturated peak.
Q - Exceeds quality control limits.
U - Compound analyzed for but not detected above the reporting limit.
UJ- Non-detected compound associated with low bias in the CCV
N - The identification is based on presumptive evidence.

File extensions may have been used on the data analysis sheets and indicates as follows:
a-File was requantified
b-File was quantified by a second column and detector
r1-File was requantified for the purpose of reissue

Summary of Detected Compounds
MODIFIED EPA METHOD TO-15 GC/MS

Client Sample ID: SV-100211-PL2-SSL7-8-0

Lab ID#: 1002322-01A

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Chloroform	49	58	240	280
Heptane	49	59	200	240
Trichloroethene	49	17000	260	93000

Client Sample ID: SV-100211-PL2-SSL4-8-0

Lab ID#: 1002322-02A

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
cis-1,2-Dichloroethene	19	280	77	1100
Chloroform	19	27	95	130
Trichloroethene	19	7700	100	41000

Client Sample ID: SV-100212-PL2-SSL1-8-0

Lab ID#: 1002322-03A

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
trans-1,2-Dichloroethene	760	970	3000	3800
cis-1,2-Dichloroethene	760	14000	3000	54000
Trichloroethene	760	240000	4100	1300000

Client Sample ID: SV-100212-PL2-SSL1-8-1

Lab ID#: 1002322-04A

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
trans-1,2-Dichloroethene	760	1000	3000	4200
cis-1,2-Dichloroethene	760	14000	3000	55000
Trichloroethene	760	260000	4100	1400000

Client Sample ID: SV-100212-PL2-SSL1-8-1 Lab Duplicate

Lab ID#: 1002322-04AA

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
trans-1,2-Dichloroethene	760	1100	3000	4200
cis-1,2-Dichloroethene	760	15000	3000	59000

Summary of Detected Compounds
MODIFIED EPA METHOD TO-15 GC/MS

Client Sample ID: SV-100212-PL2-SSL1-8-1 Lab Duplicate

Lab ID#: 1002322-04AA

Trichloroethene	760	270000	4100	1400000

Client Sample ID: SV-100212-PL2-SSL5-8-0

Lab ID#: 1002322-05A

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Ethanol	7.8	34	15	64
Acetone	7.8	16	18	39
2-Propanol	7.8	18	19	45
Hexane	1.9	2.7	6.8	9.5
2-Butanone (Methyl Ethyl Ketone)	1.9	12	5.7	37
cis-1,2-Dichloroethene	1.9	13	7.7	51
Cyclohexane	1.9	16	6.7	55
Heptane	1.9	160	8.0	640
Trichloroethene	1.9	360	10	1900
Toluene	1.9	130	7.3	500
m,p-Xylene	1.9	3.4	8.4	14

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: SV-100211-PL2-SSL7-8-0

Lab ID#: 1002322-01A

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**w022219**	**Date of Collection:**	**2/11/10 2:40:00 PM**
Dil. Factor:	**9.88**	**Date of Analysis:**	**2/22/10 09:30 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Freon 12	49	Not Detected	240	Not Detected
Freon 114	49	Not Detected	340	Not Detected
Chloromethane	200	Not Detected	410	Not Detected
Vinyl Chloride	49	Not Detected	130	Not Detected
1,3-Butadiene	49	Not Detected	110	Not Detected
Bromomethane	49	Not Detected	190	Not Detected
Chloroethane	49	Not Detected	130	Not Detected
Freon 11	49	Not Detected	280	Not Detected
Ethanol	200	Not Detected	370	Not Detected
Freon 113	49	Not Detected	380	Not Detected
1,1-Dichloroethene	49	Not Detected	200	Not Detected
Acetone	200	Not Detected	470	Not Detected
2-Propanol	200	Not Detected	480	Not Detected
Carbon Disulfide	49	Not Detected	150	Not Detected
3-Chloropropene	200	Not Detected	620	Not Detected
Methylene Chloride	49	Not Detected	170	Not Detected
Methyl tert-butyl ether	49	Not Detected	180	Not Detected
trans-1,2-Dichloroethene	49	Not Detected	200	Not Detected
Hexane	49	Not Detected	170	Not Detected
1,1-Dichloroethane	49	Not Detected	200	Not Detected
2-Butanone (Methyl Ethyl Ketone)	49	Not Detected	140	Not Detected
cis-1,2-Dichloroethene	49	Not Detected	200	Not Detected
Tetrahydrofuran	49	Not Detected	140	Not Detected
Chloroform	49	58	240	280
1,1,1-Trichloroethane	49	Not Detected	270	Not Detected
Cyclohexane	49	Not Detected	170	Not Detected
Carbon Tetrachloride	49	Not Detected	310	Not Detected
2,2,4-Trimethylpentane	49	Not Detected	230	Not Detected
Benzene	49	Not Detected	160	Not Detected
1,2-Dichloroethane	49	Not Detected	200	Not Detected
Heptane	49	59	200	240
Trichloroethene	49	17000	260	93000
1,2-Dichloropropane	49	Not Detected	230	Not Detected
1,4-Dioxane	200	Not Detected	710	Not Detected
Bromodichloromethane	49	Not Detected	330	Not Detected
cis-1,3-Dichloropropene	49	Not Detected	220	Not Detected
4-Methyl-2-pentanone	49	Not Detected	200	Not Detected
Toluene	49	Not Detected	190	Not Detected
trans-1,3-Dichloropropene	49	Not Detected	220	Not Detected

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: SV-100211-PL2-SSL7-8-0

Lab ID#: 1002322-01A

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**w022219**	**Date of Collection:**	**2/11/10 2:40:00 PM**
Dil. Factor:	**9.88**	**Date of Analysis:**	**2/22/10 09:30 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1,2-Trichloroethane	49	Not Detected	270	Not Detected
Tetrachloroethene	49	Not Detected	340	Not Detected
2-Hexanone	200	Not Detected	810	Not Detected
Dibromochloromethane	49	Not Detected	420	Not Detected
1,2-Dibromoethane (EDB)	49	Not Detected	380	Not Detected
Chlorobenzene	49	Not Detected	230	Not Detected
Ethyl Benzene	49	Not Detected	210	Not Detected
m,p-Xylene	49	Not Detected	210	Not Detected
o-Xylene	49	Not Detected	210	Not Detected
Styrene	49	Not Detected	210	Not Detected
Bromoform	49	Not Detected	510	Not Detected
Cumene	49	Not Detected	240	Not Detected
1,1,2,2-Tetrachloroethane	49	Not Detected	340	Not Detected
Propylbenzene	49	Not Detected	240	Not Detected
4-Ethyltoluene	49	Not Detected	240	Not Detected
1,3,5-Trimethylbenzene	49	Not Detected	240	Not Detected
1,2,4-Trimethylbenzene	49	Not Detected	240	Not Detected
1,3-Dichlorobenzene	49	Not Detected	300	Not Detected
1,4-Dichlorobenzene	49	Not Detected	300	Not Detected
alpha-Chlorotoluene	49	Not Detected	260	Not Detected
1,2-Dichlorobenzene	49	Not Detected	300	Not Detected
1,2,4-Trichlorobenzene	200	Not Detected	1500	Not Detected
Hexachlorobutadiene	200	Not Detected	2100	Not Detected

Container Type: 6 Liter Summa Canister

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	99	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	124	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: SV-100211-PL2-SSL4-8-0

Lab ID#: 1002322-02A

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**w022220**	**Date of Collection:**	**2/11/10 4:00:00 PM**
Dil. Factor:	**3.88**	**Date of Analysis:**	**2/22/10 09:53 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Freon 12	19	Not Detected	96	Not Detected
Freon 114	19	Not Detected	140	Not Detected
Chloromethane	78	Not Detected	160	Not Detected
Vinyl Chloride	19	Not Detected	50	Not Detected
1,3-Butadiene	19	Not Detected	43	Not Detected
Bromomethane	19	Not Detected	75	Not Detected
Chloroethane	19	Not Detected	51	Not Detected
Freon 11	19	Not Detected	110	Not Detected
Ethanol	78	Not Detected	150	Not Detected
Freon 113	19	Not Detected	150	Not Detected
1,1-Dichloroethene	19	Not Detected	77	Not Detected
Acetone	78	Not Detected	180	Not Detected
2-Propanol	78	Not Detected	190	Not Detected
Carbon Disulfide	19	Not Detected	60	Not Detected
3-Chloropropene	78	Not Detected	240	Not Detected
Methylene Chloride	19	Not Detected	67	Not Detected
Methyl tert-butyl ether	19	Not Detected	70	Not Detected
trans-1,2-Dichloroethene	19	Not Detected	77	Not Detected
Hexane	19	Not Detected	68	Not Detected
1,1-Dichloroethane	19	Not Detected	78	Not Detected
2-Butanone (Methyl Ethyl Ketone)	19	Not Detected	57	Not Detected
cis-1,2-Dichloroethene	19	280	77	1100
Tetrahydrofuran	19	Not Detected	57	Not Detected
Chloroform	19	27	95	130
1,1,1-Trichloroethane	19	Not Detected	100	Not Detected
Cyclohexane	19	Not Detected	67	Not Detected
Carbon Tetrachloride	19	Not Detected	120	Not Detected
2,2,4-Trimethylpentane	19	Not Detected	91	Not Detected
Benzene	19	Not Detected	62	Not Detected
1,2-Dichloroethane	19	Not Detected	78	Not Detected
Heptane	19	Not Detected	80	Not Detected
Trichloroethene	19	7700	100	41000
1,2-Dichloropropane	19	Not Detected	90	Not Detected
1,4-Dioxane	78	Not Detected	280	Not Detected
Bromodichloromethane	19	Not Detected	130	Not Detected
cis-1,3-Dichloropropene	19	Not Detected	88	Not Detected
4-Methyl-2-pentanone	19	Not Detected	79	Not Detected
Toluene	19	Not Detected	73	Not Detected
trans-1,3-Dichloropropene	19	Not Detected	88	Not Detected

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: SV-100211-PL2-SSL4-8-0

Lab ID#: 1002322-02A

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**w022220**	**Date of Collection:**	**2/11/10 4:00:00 PM**
Dil. Factor:	**3.88**	**Date of Analysis:**	**2/22/10 09:53 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1,2-Trichloroethane	19	Not Detected	100	Not Detected
Tetrachloroethene	19	Not Detected	130	Not Detected
2-Hexanone	78	Not Detected	320	Not Detected
Dibromochloromethane	19	Not Detected	160	Not Detected
1,2-Dibromoethane (EDB)	19	Not Detected	150	Not Detected
Chlorobenzene	19	Not Detected	89	Not Detected
Ethyl Benzene	19	Not Detected	84	Not Detected
m,p-Xylene	19	Not Detected	84	Not Detected
o-Xylene	19	Not Detected	84	Not Detected
Styrene	19	Not Detected	83	Not Detected
Bromoform	19	Not Detected	200	Not Detected
Cumene	19	Not Detected	95	Not Detected
1,1,2,2-Tetrachloroethane	19	Not Detected	130	Not Detected
Propylbenzene	19	Not Detected	95	Not Detected
4-Ethyltoluene	19	Not Detected	95	Not Detected
1,3,5-Trimethylbenzene	19	Not Detected	95	Not Detected
1,2,4-Trimethylbenzene	19	Not Detected	95	Not Detected
1,3-Dichlorobenzene	19	Not Detected	120	Not Detected
1,4-Dichlorobenzene	19	Not Detected	120	Not Detected
alpha-Chlorotoluene	19	Not Detected	100	Not Detected
1,2-Dichlorobenzene	19	Not Detected	120	Not Detected
1,2,4-Trichlorobenzene	78	Not Detected	580	Not Detected
Hexachlorobutadiene	78	Not Detected	830	Not Detected

Container Type: 6 Liter Summa Canister

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	100	70-130
Toluene-d8	103	70-130
4-Bromofluorobenzene	123	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: SV-100212-PL2-SSL1-8-0

Lab ID#: 1002322-03A

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**w022221**	**Date of Collection:**	**2/12/10 9:22:00 AM**
Dil. Factor:	**152**	**Date of Analysis:**	**2/22/10 10:17 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Freon 12	760	Not Detected	3800	Not Detected
Freon 114	760	Not Detected	5300	Not Detected
Chloromethane	3000	Not Detected	6300	Not Detected
Vinyl Chloride	760	Not Detected	1900	Not Detected
1,3-Butadiene	760	Not Detected	1700	Not Detected
Bromomethane	760	Not Detected	3000	Not Detected
Chloroethane	760	Not Detected	2000	Not Detected
Freon 11	760	Not Detected	4300	Not Detected
Ethanol	3000	Not Detected	5700	Not Detected
Freon 113	760	Not Detected	5800	Not Detected
1,1-Dichloroethene	760	Not Detected	3000	Not Detected
Acetone	3000	Not Detected	7200	Not Detected
2-Propanol	3000	Not Detected	7500	Not Detected
Carbon Disulfide	760	Not Detected	2400	Not Detected
3-Chloropropene	3000	Not Detected	9500	Not Detected
Methylene Chloride	760	Not Detected	2600	Not Detected
Methyl tert-butyl ether	760	Not Detected	2700	Not Detected
trans-1,2-Dichloroethene	760	970	3000	3800
Hexane	760	Not Detected	2700	Not Detected
1,1-Dichloroethane	760	Not Detected	3100	Not Detected
2-Butanone (Methyl Ethyl Ketone)	760	Not Detected	2200	Not Detected
cis-1,2-Dichloroethene	760	14000	3000	54000
Tetrahydrofuran	760	Not Detected	2200	Not Detected
Chloroform	760	Not Detected	3700	Not Detected
1,1,1-Trichloroethane	760	Not Detected	4100	Not Detected
Cyclohexane	760	Not Detected	2600	Not Detected
Carbon Tetrachloride	760	Not Detected	4800	Not Detected
2,2,4-Trimethylpentane	760	Not Detected	3600	Not Detected
Benzene	760	Not Detected	2400	Not Detected
1,2-Dichloroethane	760	Not Detected	3100	Not Detected
Heptane	760	Not Detected	3100	Not Detected
Trichloroethene	760	240000	4100	1300000
1,2-Dichloropropane	760	Not Detected	3500	Not Detected
1,4-Dioxane	3000	Not Detected	11000	Not Detected
Bromodichloromethane	760	Not Detected	5100	Not Detected
cis-1,3-Dichloropropene	760	Not Detected	3400	Not Detected
4-Methyl-2-pentanone	760	Not Detected	3100	Not Detected
Toluene	760	Not Detected	2900	Not Detected
trans-1,3-Dichloropropene	760	Not Detected	3400	Not Detected

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: SV-100212-PL2-SSL1-8-0

Lab ID#: 1002322-03A

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**w022221**	**Date of Collection:**	**2/12/10 9:22:00 AM**
Dil. Factor:	**152**	**Date of Analysis:**	**2/22/10 10:17 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1,2-Trichloroethane	760	Not Detected	4100	Not Detected
Tetrachloroethene	760	Not Detected	5200	Not Detected
2-Hexanone	3000	Not Detected	12000	Not Detected
Dibromochloromethane	760	Not Detected	6500	Not Detected
1,2-Dibromoethane (EDB)	760	Not Detected	5800	Not Detected
Chlorobenzene	760	Not Detected	3500	Not Detected
Ethyl Benzene	760	Not Detected	3300	Not Detected
m,p-Xylene	760	Not Detected	3300	Not Detected
o-Xylene	760	Not Detected	3300	Not Detected
Styrene	760	Not Detected	3200	Not Detected
Bromoform	760	Not Detected	7800	Not Detected
Cumene	760	Not Detected	3700	Not Detected
1,1,2,2-Tetrachloroethane	760	Not Detected	5200	Not Detected
Propylbenzene	760	Not Detected	3700	Not Detected
4-Ethyltoluene	760	Not Detected	3700	Not Detected
1,3,5-Trimethylbenzene	760	Not Detected	3700	Not Detected
1,2,4-Trimethylbenzene	760	Not Detected	3700	Not Detected
1,3-Dichlorobenzene	760	Not Detected	4600	Not Detected
1,4-Dichlorobenzene	760	Not Detected	4600	Not Detected
alpha-Chlorotoluene	760	Not Detected	3900	Not Detected
1,2-Dichlorobenzene	760	Not Detected	4600	Not Detected
1,2,4-Trichlorobenzene	3000	Not Detected	22000	Not Detected
Hexachlorobutadiene	3000	Not Detected	32000	Not Detected

Container Type: 6 Liter Summa Canister

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	97	70-130
Toluene-d8	103	70-130
4-Bromofluorobenzene	111	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: SV-100212-PL2-SSL1-8-1

Lab ID#: 1002322-04A

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**w022222**	**Date of Collection:**	**2/12/10 10:03:00 AM**
Dil. Factor:	**152**	**Date of Analysis:**	**2/22/10 10:50 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Freon 12	760	Not Detected	3800	Not Detected
Freon 114	760	Not Detected	5300	Not Detected
Chloromethane	3000	Not Detected	6300	Not Detected
Vinyl Chloride	760	Not Detected	1900	Not Detected
1,3-Butadiene	760	Not Detected	1700	Not Detected
Bromomethane	760	Not Detected	3000	Not Detected
Chloroethane	760	Not Detected	2000	Not Detected
Freon 11	760	Not Detected	4300	Not Detected
Ethanol	3000	Not Detected	5700	Not Detected
Freon 113	760	Not Detected	5800	Not Detected
1,1-Dichloroethene	760	Not Detected	3000	Not Detected
Acetone	3000	Not Detected	7200	Not Detected
2-Propanol	3000	Not Detected	7500	Not Detected
Carbon Disulfide	760	Not Detected	2400	Not Detected
3-Chloropropene	3000	Not Detected	9500	Not Detected
Methylene Chloride	760	Not Detected	2600	Not Detected
Methyl tert-butyl ether	760	Not Detected	2700	Not Detected
trans-1,2-Dichloroethene	760	1000	3000	4200
Hexane	760	Not Detected	2700	Not Detected
1,1-Dichloroethane	760	Not Detected	3100	Not Detected
2-Butanone (Methyl Ethyl Ketone)	760	Not Detected	2200	Not Detected
cis-1,2-Dichloroethene	760	14000	3000	55000
Tetrahydrofuran	760	Not Detected	2200	Not Detected
Chloroform	760	Not Detected	3700	Not Detected
1,1,1-Trichloroethane	760	Not Detected	4100	Not Detected
Cyclohexane	760	Not Detected	2600	Not Detected
Carbon Tetrachloride	760	Not Detected	4800	Not Detected
2,2,4-Trimethylpentane	760	Not Detected	3600	Not Detected
Benzene	760	Not Detected	2400	Not Detected
1,2-Dichloroethane	760	Not Detected	3100	Not Detected
Heptane	760	Not Detected	3100	Not Detected
Trichloroethene	760	260000	4100	1400000
1,2-Dichloropropane	760	Not Detected	3500	Not Detected
1,4-Dioxane	3000	Not Detected	11000	Not Detected
Bromodichloromethane	760	Not Detected	5100	Not Detected
cis-1,3-Dichloropropene	760	Not Detected	3400	Not Detected
4-Methyl-2-pentanone	760	Not Detected	3100	Not Detected
Toluene	760	Not Detected	2900	Not Detected
trans-1,3-Dichloropropene	760	Not Detected	3400	Not Detected

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: SV-100212-PL2-SSL1-8-1

Lab ID#: 1002322-04A

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**w022222**	**Date of Collection:**	**2/12/10 10:03:00 AM**
Dil. Factor:	**152**	**Date of Analysis:**	**2/22/10 10:50 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1,2-Trichloroethane	760	Not Detected	4100	Not Detected
Tetrachloroethene	760	Not Detected	5200	Not Detected
2-Hexanone	3000	Not Detected	12000	Not Detected
Dibromochloromethane	760	Not Detected	6500	Not Detected
1,2-Dibromoethane (EDB)	760	Not Detected	5800	Not Detected
Chlorobenzene	760	Not Detected	3500	Not Detected
Ethyl Benzene	760	Not Detected	3300	Not Detected
m,p-Xylene	760	Not Detected	3300	Not Detected
o-Xylene	760	Not Detected	3300	Not Detected
Styrene	760	Not Detected	3200	Not Detected
Bromoform	760	Not Detected	7800	Not Detected
Cumene	760	Not Detected	3700	Not Detected
1,1,2,2-Tetrachloroethane	760	Not Detected	5200	Not Detected
Propylbenzene	760	Not Detected	3700	Not Detected
4-Ethyltoluene	760	Not Detected	3700	Not Detected
1,3,5-Trimethylbenzene	760	Not Detected	3700	Not Detected
1,2,4-Trimethylbenzene	760	Not Detected	3700	Not Detected
1,3-Dichlorobenzene	760	Not Detected	4600	Not Detected
1,4-Dichlorobenzene	760	Not Detected	4600	Not Detected
alpha-Chlorotoluene	760	Not Detected	3900	Not Detected
1,2-Dichlorobenzene	760	Not Detected	4600	Not Detected
1,2,4-Trichlorobenzene	3000	Not Detected	22000	Not Detected
Hexachlorobutadiene	3000	Not Detected	32000	Not Detected

Container Type: 6 Liter Summa Canister

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	98	70-130
Toluene-d8	102	70-130
4-Bromofluorobenzene	110	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: SV-100212-PL2-SSL1-8-1 Lab Duplicate

Lab ID#: 1002322-04AA

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**w022223**	**Date of Collection:**	**2/12/10 10:03:00 AM**
Dil. Factor:	**152**	**Date of Analysis:**	**2/22/10 11:15 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Freon 12	760	Not Detected	3800	Not Detected
Freon 114	760	Not Detected	5300	Not Detected
Chloromethane	3000	Not Detected	6300	Not Detected
Vinyl Chloride	760	Not Detected	1900	Not Detected
1,3-Butadiene	760	Not Detected	1700	Not Detected
Bromomethane	760	Not Detected	3000	Not Detected
Chloroethane	760	Not Detected	2000	Not Detected
Freon 11	760	Not Detected	4300	Not Detected
Ethanol	3000	Not Detected	5700	Not Detected
Freon 113	760	Not Detected	5800	Not Detected
1,1-Dichloroethene	760	Not Detected	3000	Not Detected
Acetone	3000	Not Detected	7200	Not Detected
2-Propanol	3000	Not Detected	7500	Not Detected
Carbon Disulfide	760	Not Detected	2400	Not Detected
3-Chloropropene	3000	Not Detected	9500	Not Detected
Methylene Chloride	760	Not Detected	2600	Not Detected
Methyl tert-butyl ether	760	Not Detected	2700	Not Detected
trans-1,2-Dichloroethene	760	1100	3000	4200
Hexane	760	Not Detected	2700	Not Detected
1,1-Dichloroethane	760	Not Detected	3100	Not Detected
2-Butanone (Methyl Ethyl Ketone)	760	Not Detected	2200	Not Detected
cis-1,2-Dichloroethene	760	15000	3000	59000
Tetrahydrofuran	760	Not Detected	2200	Not Detected
Chloroform	760	Not Detected	3700	Not Detected
1,1,1-Trichloroethane	760	Not Detected	4100	Not Detected
Cyclohexane	760	Not Detected	2600	Not Detected
Carbon Tetrachloride	760	Not Detected	4800	Not Detected
2,2,4-Trimethylpentane	760	Not Detected	3600	Not Detected
Benzene	760	Not Detected	2400	Not Detected
1,2-Dichloroethane	760	Not Detected	3100	Not Detected
Heptane	760	Not Detected	3100	Not Detected
Trichloroethene	760	270000	4100	1400000
1,2-Dichloropropane	760	Not Detected	3500	Not Detected
1,4-Dioxane	3000	Not Detected	11000	Not Detected
Bromodichloromethane	760	Not Detected	5100	Not Detected
cis-1,3-Dichloropropene	760	Not Detected	3400	Not Detected
4-Methyl-2-pentanone	760	Not Detected	3100	Not Detected
Toluene	760	Not Detected	2900	Not Detected
trans-1,3-Dichloropropene	760	Not Detected	3400	Not Detected

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: SV-100212-PL2-SSL1-8-1 Lab Duplicate

Lab ID#: 1002322-04AA

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**w022223**	**Date of Collection:**	**2/12/10 10:03:00 AM**
Dil. Factor:	**152**	**Date of Analysis:**	**2/22/10 11:15 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1,2-Trichloroethane	760	Not Detected	4100	Not Detected
Tetrachloroethene	760	Not Detected	5200	Not Detected
2-Hexanone	3000	Not Detected	12000	Not Detected
Dibromochloromethane	760	Not Detected	6500	Not Detected
1,2-Dibromoethane (EDB)	760	Not Detected	5800	Not Detected
Chlorobenzene	760	Not Detected	3500	Not Detected
Ethyl Benzene	760	Not Detected	3300	Not Detected
m,p-Xylene	760	Not Detected	3300	Not Detected
o-Xylene	760	Not Detected	3300	Not Detected
Styrene	760	Not Detected	3200	Not Detected
Bromoform	760	Not Detected	7800	Not Detected
Cumene	760	Not Detected	3700	Not Detected
1,1,2,2-Tetrachloroethane	760	Not Detected	5200	Not Detected
Propylbenzene	760	Not Detected	3700	Not Detected
4-Ethyltoluene	760	Not Detected	3700	Not Detected
1,3,5-Trimethylbenzene	760	Not Detected	3700	Not Detected
1,2,4-Trimethylbenzene	760	Not Detected	3700	Not Detected
1,3-Dichlorobenzene	760	Not Detected	4600	Not Detected
1,4-Dichlorobenzene	760	Not Detected	4600	Not Detected
alpha-Chlorotoluene	760	Not Detected	3900	Not Detected
1,2-Dichlorobenzene	760	Not Detected	4600	Not Detected
1,2,4-Trichlorobenzene	3000	Not Detected	22000	Not Detected
Hexachlorobutadiene	3000	Not Detected	32000	Not Detected

Container Type: 6 Liter Summa Canister

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	100	70-130
Toluene-d8	102	70-130
4-Bromofluorobenzene	108	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: SV-100212-PL2-SSL5-8-0

Lab ID#: 1002322-05A

MODIFIED EPA METHOD TO-15 GC/MS FULL SCAN

File Name:	**d022220**	**Date of Collection:**	**2/12/10 11:28:00 AM**
Dil. Factor:	**3.88**	**Date of Analysis:**	**2/22/10 03:54 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Freon 12	1.9	Not Detected	9.6	Not Detected
Freon 114	1.9	Not Detected	14	Not Detected
Chloromethane	7.8	Not Detected	16	Not Detected
Vinyl Chloride	1.9	Not Detected	5.0	Not Detected
1,3-Butadiene	1.9	Not Detected	4.3	Not Detected
Bromomethane	1.9	Not Detected	7.5	Not Detected
Chloroethane	1.9	Not Detected	5.1	Not Detected
Freon 11	1.9	Not Detected	11	Not Detected
Ethanol	7.8	34	15	64
Freon 113	1.9	Not Detected	15	Not Detected
1,1-Dichloroethene	1.9	Not Detected	7.7	Not Detected
Acetone	7.8	16	18	39
2-Propanol	7.8	18	19	45
Carbon Disulfide	1.9	Not Detected	6.0	Not Detected
3-Chloropropene	7.8	Not Detected	24	Not Detected
Methylene Chloride	1.9	Not Detected	6.7	Not Detected
Methyl tert-butyl ether	1.9	Not Detected	7.0	Not Detected
trans-1,2-Dichloroethene	1.9	Not Detected	7.7	Not Detected
Hexane	1.9	2.7	6.8	9.5
1,1-Dichloroethane	1.9	Not Detected	7.8	Not Detected
2-Butanone (Methyl Ethyl Ketone)	1.9	12	5.7	37
cis-1,2-Dichloroethene	1.9	13	7.7	51
Tetrahydrofuran	1.9	Not Detected	5.7	Not Detected
Chloroform	1.9	Not Detected	9.5	Not Detected
1,1,1-Trichloroethane	1.9	Not Detected	10	Not Detected
Cyclohexane	1.9	16	6.7	55
Carbon Tetrachloride	1.9	Not Detected	12	Not Detected
2,2,4-Trimethylpentane	1.9	Not Detected	9.1	Not Detected
Benzene	1.9	Not Detected	6.2	Not Detected
1,2-Dichloroethane	1.9	Not Detected	7.8	Not Detected
Heptane	1.9	160	8.0	640
Trichloroethene	1.9	360	10	1900
1,2-Dichloropropane	1.9	Not Detected	9.0	Not Detected
1,4-Dioxane	7.8	Not Detected	28	Not Detected
Bromodichloromethane	1.9	Not Detected	13	Not Detected
cis-1,3-Dichloropropene	1.9	Not Detected	8.8	Not Detected
4-Methyl-2-pentanone	1.9	Not Detected	7.9	Not Detected
Toluene	1.9	130	7.3	500
trans-1,3-Dichloropropene	1.9	Not Detected	8.8	Not Detected

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: SV-100212-PL2-SSL5-8-0

Lab ID#: 1002322-05A

MODIFIED EPA METHOD TO-15 GC/MS FULL SCAN

File Name:	**d022220**	**Date of Collection:**	**2/12/10 11:28:00 AM**
Dil. Factor:	**3.88**	**Date of Analysis:**	**2/22/10 03:54 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1,2-Trichloroethane	1.9	Not Detected	10	Not Detected
Tetrachloroethene	1.9	Not Detected	13	Not Detected
2-Hexanone	7.8	Not Detected	32	Not Detected
Dibromochloromethane	1.9	Not Detected	16	Not Detected
1,2-Dibromoethane (EDB)	1.9	Not Detected	15	Not Detected
Chlorobenzene	1.9	Not Detected	8.9	Not Detected
Ethyl Benzene	1.9	Not Detected	8.4	Not Detected
m,p-Xylene	1.9	3.4	8.4	14
o-Xylene	1.9	Not Detected	8.4	Not Detected
Styrene	1.9	Not Detected	8.3	Not Detected
Bromoform	1.9	Not Detected	20	Not Detected
Cumene	1.9	Not Detected	9.5	Not Detected
1,1,2,2-Tetrachloroethane	1.9	Not Detected	13	Not Detected
Propylbenzene	1.9	Not Detected	9.5	Not Detected
4-Ethyltoluene	1.9	Not Detected	9.5	Not Detected
1,3,5-Trimethylbenzene	1.9	Not Detected	9.5	Not Detected
1,2,4-Trimethylbenzene	1.9	Not Detected	9.5	Not Detected
1,3-Dichlorobenzene	1.9	Not Detected	12	Not Detected
1,4-Dichlorobenzene	1.9	Not Detected	12	Not Detected
alpha-Chlorotoluene	1.9	Not Detected	10	Not Detected
1,2-Dichlorobenzene	1.9	Not Detected	12	Not Detected
1,2,4-Trichlorobenzene	7.8	Not Detected	58	Not Detected
Hexachlorobutadiene	7.8	Not Detected	83	Not Detected

Container Type: 6 Liter Summa Canister

Surrogates	%Recovery	Method Limits
Toluene-d8	96	70-130
1,2-Dichloroethane-d4	106	70-130
4-Bromofluorobenzene	103	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: Lab Blank

Lab ID#: 1002322-06A

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**w022205**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 2/22/10 09:17 AM**	

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Freon 12	5.0	Not Detected	25	Not Detected
Freon 114	5.0	Not Detected	35	Not Detected
Chloromethane	20	Not Detected	41	Not Detected
Vinyl Chloride	5.0	Not Detected	13	Not Detected
1,3-Butadiene	5.0	Not Detected	11	Not Detected
Bromomethane	5.0	Not Detected	19	Not Detected
Chloroethane	5.0	Not Detected	13	Not Detected
Freon 11	5.0	Not Detected	28	Not Detected
Ethanol	20	Not Detected	38	Not Detected
Freon 113	5.0	Not Detected	38	Not Detected
1,1-Dichloroethene	5.0	Not Detected	20	Not Detected
Acetone	20	Not Detected	48	Not Detected
2-Propanol	20	Not Detected	49	Not Detected
Carbon Disulfide	5.0	Not Detected	16	Not Detected
3-Chloropropene	20	Not Detected	63	Not Detected
Methylene Chloride	5.0	Not Detected	17	Not Detected
Methyl tert-butyl ether	5.0	Not Detected	18	Not Detected
trans-1,2-Dichloroethene	5.0	Not Detected	20	Not Detected
Hexane	5.0	Not Detected	18	Not Detected
1,1-Dichloroethane	5.0	Not Detected	20	Not Detected
2-Butanone (Methyl Ethyl Ketone)	5.0	Not Detected	15	Not Detected
cis-1,2-Dichloroethene	5.0	Not Detected	20	Not Detected
Tetrahydrofuran	5.0	Not Detected	15	Not Detected
Chloroform	5.0	Not Detected	24	Not Detected
1,1,1-Trichloroethane	5.0	Not Detected	27	Not Detected
Cyclohexane	5.0	Not Detected	17	Not Detected
Carbon Tetrachloride	5.0	Not Detected	31	Not Detected
2,2,4-Trimethylpentane	5.0	Not Detected	23	Not Detected
Benzene	5.0	Not Detected	16	Not Detected
1,2-Dichloroethane	5.0	Not Detected	20	Not Detected
Heptane	5.0	Not Detected	20	Not Detected
Trichloroethene	5.0	Not Detected	27	Not Detected
1,2-Dichloropropane	5.0	Not Detected	23	Not Detected
1,4-Dioxane	20	Not Detected	72	Not Detected
Bromodichloromethane	5.0	Not Detected	34	Not Detected
cis-1,3-Dichloropropene	5.0	Not Detected	23	Not Detected
4-Methyl-2-pentanone	5.0	Not Detected	20	Not Detected
Toluene	5.0	Not Detected	19	Not Detected
trans-1,3-Dichloropropene	5.0	Not Detected	23	Not Detected

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: Lab Blank

Lab ID#: 1002322-06A

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**w022205**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 2/22/10 09:17 AM**	

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1,2-Trichloroethane	5.0	Not Detected	27	Not Detected
Tetrachloroethene	5.0	Not Detected	34	Not Detected
2-Hexanone	20	Not Detected	82	Not Detected
Dibromochloromethane	5.0	Not Detected	42	Not Detected
1,2-Dibromoethane (EDB)	5.0	Not Detected	38	Not Detected
Chlorobenzene	5.0	Not Detected	23	Not Detected
Ethyl Benzene	5.0	Not Detected	22	Not Detected
m,p-Xylene	5.0	Not Detected	22	Not Detected
o-Xylene	5.0	Not Detected	22	Not Detected
Styrene	5.0	Not Detected	21	Not Detected
Bromoform	5.0	Not Detected	52	Not Detected
Cumene	5.0	Not Detected	24	Not Detected
1,1,2,2-Tetrachloroethane	5.0	Not Detected	34	Not Detected
Propylbenzene	5.0	Not Detected	24	Not Detected
4-Ethyltoluene	5.0	Not Detected	24	Not Detected
1,3,5-Trimethylbenzene	5.0	Not Detected	24	Not Detected
1,2,4-Trimethylbenzene	5.0	Not Detected	24	Not Detected
1,3-Dichlorobenzene	5.0	Not Detected	30	Not Detected
1,4-Dichlorobenzene	5.0	Not Detected	30	Not Detected
alpha-Chlorotoluene	5.0	Not Detected	26	Not Detected
1,2-Dichlorobenzene	5.0	Not Detected	30	Not Detected
1,2,4-Trichlorobenzene	20	Not Detected	150	Not Detected
Hexachlorobutadiene	20	Not Detected	210	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	99	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	111	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: Lab Blank

Lab ID#: 1002322-06B

MODIFIED EPA METHOD TO-15 GC/MS FULL SCAN

File Name:	**d022211**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 2/22/10 12:09 PM**	

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Freon 12	0.50	Not Detected	2.5	Not Detected
Freon 114	0.50	Not Detected	3.5	Not Detected
Chloromethane	2.0	Not Detected	4.1	Not Detected
Vinyl Chloride	0.50	Not Detected	1.3	Not Detected
1,3-Butadiene	0.50	Not Detected	1.1	Not Detected
Bromomethane	0.50	Not Detected	1.9	Not Detected
Chloroethane	0.50	Not Detected	1.3	Not Detected
Freon 11	0.50	Not Detected	2.8	Not Detected
Ethanol	2.0	Not Detected	3.8	Not Detected
Freon 113	0.50	Not Detected	3.8	Not Detected
1,1-Dichloroethene	0.50	Not Detected	2.0	Not Detected
Acetone	2.0	Not Detected	4.8	Not Detected
2-Propanol	2.0	Not Detected	4.9	Not Detected
Carbon Disulfide	0.50	Not Detected	1.6	Not Detected
3-Chloropropene	2.0	Not Detected	6.3	Not Detected
Methylene Chloride	0.50	Not Detected	1.7	Not Detected
Methyl tert-butyl ether	0.50	Not Detected	1.8	Not Detected
trans-1,2-Dichloroethene	0.50	Not Detected	2.0	Not Detected
Hexane	0.50	Not Detected	1.8	Not Detected
1,1-Dichloroethane	0.50	Not Detected	2.0	Not Detected
2-Butanone (Methyl Ethyl Ketone)	0.50	Not Detected	1.5	Not Detected
cis-1,2-Dichloroethene	0.50	Not Detected	2.0	Not Detected
Tetrahydrofuran	0.50	Not Detected	1.5	Not Detected
Chloroform	0.50	Not Detected	2.4	Not Detected
1,1,1-Trichloroethane	0.50	Not Detected	2.7	Not Detected
Cyclohexane	0.50	Not Detected	1.7	Not Detected
Carbon Tetrachloride	0.50	Not Detected	3.1	Not Detected
2,2,4-Trimethylpentane	0.50	Not Detected	2.3	Not Detected
Benzene	0.50	Not Detected	1.6	Not Detected
1,2-Dichloroethane	0.50	Not Detected	2.0	Not Detected
Heptane	0.50	Not Detected	2.0	Not Detected
Trichloroethene	0.50	Not Detected	2.7	Not Detected
1,2-Dichloropropane	0.50	Not Detected	2.3	Not Detected
1,4-Dioxane	2.0	Not Detected	7.2	Not Detected
Bromodichloromethane	0.50	Not Detected	3.4	Not Detected
cis-1,3-Dichloropropene	0.50	Not Detected	2.3	Not Detected
4-Methyl-2-pentanone	0.50	Not Detected	2.0	Not Detected
Toluene	0.50	Not Detected	1.9	Not Detected
trans-1,3-Dichloropropene	0.50	Not Detected	2.3	Not Detected

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: Lab Blank

Lab ID#: 1002322-06B

MODIFIED EPA METHOD TO-15 GC/MS FULL SCAN

File Name:	**d022211**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 2/22/10 12:09 PM**	

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1,2-Trichloroethane	0.50	Not Detected	2.7	Not Detected
Tetrachloroethene	0.50	Not Detected	3.4	Not Detected
2-Hexanone	2.0	Not Detected	8.2	Not Detected
Dibromochloromethane	0.50	Not Detected	4.2	Not Detected
1,2-Dibromoethane (EDB)	0.50	Not Detected	3.8	Not Detected
Chlorobenzene	0.50	Not Detected	2.3	Not Detected
Ethyl Benzene	0.50	Not Detected	2.2	Not Detected
m,p-Xylene	0.50	Not Detected	2.2	Not Detected
o-Xylene	0.50	Not Detected	2.2	Not Detected
Styrene	0.50	Not Detected	2.1	Not Detected
Bromoform	0.50	Not Detected	5.2	Not Detected
Cumene	0.50	Not Detected	2.4	Not Detected
1,1,2,2-Tetrachloroethane	0.50	Not Detected	3.4	Not Detected
Propylbenzene	0.50	Not Detected	2.4	Not Detected
4-Ethyltoluene	0.50	Not Detected	2.4	Not Detected
1,3,5-Trimethylbenzene	0.50	Not Detected	2.4	Not Detected
1,2,4-Trimethylbenzene	0.50	Not Detected	2.4	Not Detected
1,3-Dichlorobenzene	0.50	Not Detected	3.0	Not Detected
1,4-Dichlorobenzene	0.50	Not Detected	3.0	Not Detected
alpha-Chlorotoluene	0.50	Not Detected	2.6	Not Detected
1,2-Dichlorobenzene	0.50	Not Detected	3.0	Not Detected
1,2,4-Trichlorobenzene	2.0	Not Detected	15	Not Detected
Hexachlorobutadiene	2.0	Not Detected	21	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
Toluene-d8	100	70-130
1,2-Dichloroethane-d4	100	70-130
4-Bromofluorobenzene	105	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: CCV

Lab ID#: 1002322-07A

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**w022202**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 2/22/10 07:39 AM**	

Compound	%Recovery
Freon 12	96
Freon 114	94
Chloromethane	79
Vinyl Chloride	92
1,3-Butadiene	93
Bromomethane	97
Chloroethane	96
Freon 11	96
Ethanol	86
Freon 113	101
1,1-Dichloroethene	92
Acetone	98
2-Propanol	78
Carbon Disulfide	100
3-Chloropropene	89
Methylene Chloride	89
Methyl tert-butyl ether	104
trans-1,2-Dichloroethene	100
Hexane	94
1,1-Dichloroethane	94
2-Butanone (Methyl Ethyl Ketone)	97
cis-1,2-Dichloroethene	89
Tetrahydrofuran	86
Chloroform	95
1,1,1-Trichloroethane	91
Cyclohexane	94
Carbon Tetrachloride	96
2,2,4-Trimethylpentane	92
Benzene	97
1,2-Dichloroethane	95
Heptane	100
Trichloroethene	94
1,2-Dichloropropane	93
1,4-Dioxane	94
Bromodichloromethane	94
cis-1,3-Dichloropropene	89
4-Methyl-2-pentanone	95
Toluene	96
trans-1,3-Dichloropropene	90

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: CCV

Lab ID#: 1002322-07A

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**w022202**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 2/22/10 07:39 AM**	

Compound	**%Recovery**
1,1,2-Trichloroethane	95
Tetrachloroethene	102
2-Hexanone	87
Dibromochloromethane	97
1,2-Dibromoethane (EDB)	92
Chlorobenzene	96
Ethyl Benzene	92
m,p-Xylene	95
o-Xylene	94
Styrene	87
Bromoform	110
Cumene	99
1,1,2,2-Tetrachloroethane	97
Propylbenzene	101
4-Ethyltoluene	102
1,3,5-Trimethylbenzene	90
1,2,4-Trimethylbenzene	100
1,3-Dichlorobenzene	96
1,4-Dichlorobenzene	101
alpha-Chlorotoluene	101
1,2-Dichlorobenzene	98
1,2,4-Trichlorobenzene	110
Hexachlorobutadiene	137 Q

Q = Exceeds Quality Control limits.

Container Type: NA - Not Applicable

Surrogates	**%Recovery**	**Method Limits**
1,2-Dichloroethane-d4	100	70-130
Toluene-d8	104	70-130
4-Bromofluorobenzene	120	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: CCV

Lab ID#: 1002322-07B

MODIFIED EPA METHOD TO-15 GC/MS FULL SCAN

File Name:	**d022204**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 2/22/10 08:40 AM**

Compound	%Recovery
Freon 12	100
Freon 114	100
Chloromethane	87
Vinyl Chloride	104
1,3-Butadiene	90
Bromomethane	97
Chloroethane	86
Freon 11	98
Ethanol	74
Freon 113	101
1,1-Dichloroethene	96
Acetone	81
2-Propanol	72
Carbon Disulfide	88
3-Chloropropene	92
Methylene Chloride	72
Methyl tert-butyl ether	92
trans-1,2-Dichloroethene	98
Hexane	85
1,1-Dichloroethane	88
2-Butanone (Methyl Ethyl Ketone)	93
cis-1,2-Dichloroethene	96
Tetrahydrofuran	74
Chloroform	96
1,1,1-Trichloroethane	98
Cyclohexane	93
Carbon Tetrachloride	101
2,2,4-Trimethylpentane	89
Benzene	92
1,2-Dichloroethane	95
Heptane	94
Trichloroethene	98
1,2-Dichloropropane	88
1,4-Dioxane	96
Bromodichloromethane	101
cis-1,3-Dichloropropene	96
4-Methyl-2-pentanone	95
Toluene	99
trans-1,3-Dichloropropene	98

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: CCV

Lab ID#: 1002322-07B

MODIFIED EPA METHOD TO-15 GC/MS FULL SCAN

File Name:	**d022204**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 2/22/10 08:40 AM**

Compound	**%Recovery**
1,1,2-Trichloroethane	97
Tetrachloroethene	101
2-Hexanone	96
Dibromochloromethane	106
1,2-Dibromoethane (EDB)	100
Chlorobenzene	95
Ethyl Benzene	102
m,p-Xylene	102
o-Xylene	103
Styrene	105
Bromoform	112
Cumene	109
1,1,2,2-Tetrachloroethane	99
Propylbenzene	107
4-Ethyltoluene	111
1,3,5-Trimethylbenzene	110
1,2,4-Trimethylbenzene	112
1,3-Dichlorobenzene	113
1,4-Dichlorobenzene	113
alpha-Chlorotoluene	118
1,2-Dichlorobenzene	114
1,2,4-Trichlorobenzene	124
Hexachlorobutadiene	134 Q

Q = Exceeds Quality Control limits.

Container Type: NA - Not Applicable

Surrogates	**%Recovery**	**Method Limits**
Toluene-d8	103	70-130
1,2-Dichloroethane-d4	100	70-130
4-Bromofluorobenzene	102	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: LCS

Lab ID#: 1002322-08A

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**w022203**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 2/22/10 08:22 AM**

Compound	%Recovery
Freon 12	85
Freon 114	87
Chloromethane	74
Vinyl Chloride	85
1,3-Butadiene	85
Bromomethane	90
Chloroethane	87
Freon 11	89
Ethanol	75
Freon 113	82
1,1-Dichloroethene	74
Acetone	82
2-Propanol	65
Carbon Disulfide	87
3-Chloropropene	80
Methylene Chloride	74
Methyl tert-butyl ether	82
trans-1,2-Dichloroethene	87
Hexane	78
1,1-Dichloroethane	79
2-Butanone (Methyl Ethyl Ketone)	85
cis-1,2-Dichloroethene	77
Tetrahydrofuran	74
Chloroform	79
1,1,1-Trichloroethane	80
Cyclohexane	81
Carbon Tetrachloride	83
2,2,4-Trimethylpentane	79
Benzene	83
1,2-Dichloroethane	81
Heptane	87
Trichloroethene	81
1,2-Dichloropropane	79
1,4-Dioxane	79
Bromodichloromethane	80
cis-1,3-Dichloropropene	77
4-Methyl-2-pentanone	76
Toluene	79
trans-1,3-Dichloropropene	78

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: LCS

Lab ID#: 1002322-08A

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**w022203**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 2/22/10 08:22 AM**	

Compound	**%Recovery**
1,1,2-Trichloroethane	82
Tetrachloroethene	88
2-Hexanone	73
Dibromochloromethane	84
1,2-Dibromoethane (EDB)	82
Chlorobenzene	82
Ethyl Benzene	80
m,p-Xylene	82
o-Xylene	80
Styrene	86
Bromoform	96
Cumene	85
1,1,2,2-Tetrachloroethane	84
Propylbenzene	86
4-Ethyltoluene	87
1,3,5-Trimethylbenzene	79
1,2,4-Trimethylbenzene	86
1,3-Dichlorobenzene	85
1,4-Dichlorobenzene	88
alpha-Chlorotoluene	83
1,2-Dichlorobenzene	89
1,2,4-Trichlorobenzene	98
Hexachlorobutadiene	120

Container Type: NA - Not Applicable

Surrogates	**%Recovery**	**Method Limits**
1,2-Dichloroethane-d4	100	70-130
Toluene-d8	103	70-130
4-Bromofluorobenzene	120	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: LCS

Lab ID#: 1002322-08B

MODIFIED EPA METHOD TO-15 GC/MS FULL SCAN

File Name:	**d022203**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 2/22/10 08:22 AM**

Compound	%Recovery
Freon 12	97
Freon 114	97
Chloromethane	83
Vinyl Chloride	102
1,3-Butadiene	88
Bromomethane	95
Chloroethane	80
Freon 11	95
Ethanol	66
Freon 113	88
1,1-Dichloroethene	81
Acetone	74
2-Propanol	66
Carbon Disulfide	84
3-Chloropropene	84
Methylene Chloride	63 Q
Methyl tert-butyl ether	89
trans-1,2-Dichloroethene	92
Hexane	83
1,1-Dichloroethane	81
2-Butanone (Methyl Ethyl Ketone)	87
cis-1,2-Dichloroethene	89
Tetrahydrofuran	72
Chloroform	90
1,1,1-Trichloroethane	99
Cyclohexane	92
Carbon Tetrachloride	104
2,2,4-Trimethylpentane	84
Benzene	90
1,2-Dichloroethane	91
Heptane	92
Trichloroethene	96
1,2-Dichloropropane	87
1,4-Dioxane	94
Bromodichloromethane	99
cis-1,3-Dichloropropene	95
4-Methyl-2-pentanone	90
Toluene	93
trans-1,3-Dichloropropene	98

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: LCS

Lab ID#: 1002322-08B

MODIFIED EPA METHOD TO-15 GC/MS FULL SCAN

File Name:	**d022203**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 2/22/10 08:22 AM**

Compound	**%Recovery**
1,1,2-Trichloroethane	96
Tetrachloroethene	101
2-Hexanone	93
Dibromochloromethane	107
1,2-Dibromoethane (EDB)	104
Chlorobenzene	95
Ethyl Benzene	102
m,p-Xylene	103
o-Xylene	105
Styrene	107
Bromoform	118
Cumene	109
1,1,2,2-Tetrachloroethane	103
Propylbenzene	106
4-Ethyltoluene	111
1,3,5-Trimethylbenzene	113
1,2,4-Trimethylbenzene	116
1,3-Dichlorobenzene	113
1,4-Dichlorobenzene	115
alpha-Chlorotoluene	119
1,2-Dichlorobenzene	118
1,2,4-Trichlorobenzene	122
Hexachlorobutadiene	134 Q

Q = Exceeds Quality Control limits.

Container Type: NA - Not Applicable

Surrogates	**%Recovery**	**Method Limits**
Toluene-d8	105	70-130
1,2-Dichloroethane-d4	100	70-130
4-Bromofluorobenzene	99	70-130

Appendix D Field Logbook

DATE: 12/11/09

LOCATION: Boeing 2-10

Boeing Contact numbers:

Fred Wallace - Env. Field Contact
206.930.0461

Mark Hogan - Supervisor Bldg
206.662.4777
cell 206.391.5181

Brad Z. - Crate Mover
206.662.4834

DATE: 12/11/09

LOCATION: Boeing 2-10 G. Dawson

0740 Arrived on-site - to mobilize empty drums and equipment to South sheetpile area.
Checked in with building supervisors office - to notify we were onsite.
0900 Set-up on well PL7-254A for development. Screen interval 12.5-17.5 ft bgs, 7 ft saturated thickness x 0.163 gal/ft = 1.1 gal/well volume purged at least 2 volumes or until

DATE: 12/1/09

LOCATION: Boeing 2-10 G. Dawson

well water became clear.

A total of four (4) surge/purge cycles for a total of ~ 8 gallons.

1000 Moved to well PL2-255A for development

Screen interval is 12.5 - 17.5 ft bgs.

~7 ft of saturated zone @ 0.163 gal/ft = 1.1 gal/well volume.

Purged at least 2 well volumes or until water became clear for each purging.

Did a total of 4 purge/surge cycles.

DATE: 12/1/09

LOCATION: Boeing 2-10 G. Dawson

Total development water ~7 gal.

1030 Decanned.

1040 Mobilized to well PL2-252A

1100 Began developing well. Well screen is 12.5 - 17.5 ft bgs

~7 ft of saturated zone @ 0.163 gal/ft = 1.1 gal/well volume.

Purged at least 2 well volumes or until water was clear for each purging.

A total of 4 cycles was performed for total water volume ~ gal.

1135 Finished well, decanned pump.

DATE: 12/11/09

LOCATION: Boeing 2-10 G. Dawson

1215 Mobilized to well PL2-253A.

1218 Began developing well, well is screened 12.5-17.5 ft bgs. ~7 ft saturated zone @ 0.163 gal/ft = 1.1 gal/well volume. Purged at least 2 well volumes or until water became clear during each purge.

~~1205~~ 1250 Finished developing well, 3 purge/surge cycles ~ 8 gallons total development water. Deconned pump.

1300 Mobilized to well PL2-256A. Well is screened

DATE: 12/11/09

LOCATION: Boeing 2-10 G. Dawson

from 12.5'-17.5' ft bgs. ~7 ft saturated zone @ 0.163 gal/ft = 1.1 gal/well volume. Purged at least 2 well volumes or until water became clear during each purge.

1335 Finished developing well. ~9 gallons total water and 3 surge/purge cycles. Deconned pump.

1350 Mobilized to well PL2-257A. Well is screened 12.5-17.5 ft bgs ~7 ft saturated @

DATE: 12/11/09

LOCATION: Boeing 2-10 G. Dawson

0.163 gal/ft = 1.1 gal per well volume. During purge cycles at least 2 well volumes or until water became clear pumped by purge.

1355 - Began developing.

1420 - Finished developing well. 4 purge cycles with ~ 9 gallons total developed water. Deconned pump and mobilized to well PL2-209A

PL2-209A is screened from 8-18 ft bgs ~ 8 ft saturated zone @ 0.163 gal/ft

Cont →

DATE: 12/11/09

LOCATION: Boeing 2-10 G. Dawson

= 1.3 gal/well volume During purge cycle at least 2 well volumes or until water became clear pump duration.

1440 - Began developing PL2-209A *Note: Well is PVC whereas all others have been std so far. During pumping much more silt observed than in other wells so far.

A total of 5 cycles performed for an approx. 15 gallons.

1530 Finished developing

Cont →

DATE: 12/11/09

LOCATION: Boeing 2-10 G. Dawson

PL2. 209A and decomed pump. Mobilized to PL2-209B. Well is screened from 40-55 ft bgs @ 0.163 gal/ft and sat zone of ~ 45 ft = 7.3 gal/well volume.

1540 Began developing well. * Note this well is also PVC.

1615 Stopped developing Well. Submersible pump was becoming difficult to drop in well. Pulled pump and will configure to ensure pump is not stuck during developing

DATE: 12/11/09

LOCATION: Boeing 2-10 G. Dawson

Demobed equipment to storage area for the weekend

1645 Left Site

DATE: 12/14/09

LOCATION: Boeing 2-10 G. Dawson

0800 Tom Mckeon on-site and marked probe locations for APS utility clearance

0815 APS on-site to clear probe locations.

0915 Began developing well PL2-209B. well is screened from 40-55 ft. ~ 45 ft saturated for 7.3 gal/ well volume.

0930 Paused developing wells to verify APS clearing with utility drawing. Personnel involved: Mark Dalan -APS, Fred Wallace-Boeing, Tom Mckeon - Cabbre, and

Grant R

DATE: 12/14/09

LOCATION: Boeing 2-10 G. Dawson

Grant Dawson - Cabbre. Probe locations were adjusted if utilities were present.

Consulted the Mike Gleason sheetpile drawings, the "Floor and Truss Space Plan", and "Plan + Details of General Process Piping".

1100 - Resumed developing PL2-209B

1145 - Finished developing well PL2-209B. 3 purge/surge cycles and generated ~ 20 gal of water. Decomed pump.

Grant R

DATE: 12/14/09

LOCATION: Boeing 2-16 G. Dawson

1330 Began developing well PL2-266A. well is screened from 26-30 ft bgs with ~20 ft saturated @ 0.163 gal/ft or ~3.2 gal/well volume. Purged at least 2 volumes per cycle, 3 completed purge cycles and created ~20 gal of development water.

1420 Finished developing well PL2-266A and deconned pump.

1500 Mobilized and began developing

Cont R

DATE: 12/14/09

LOCATION: Boeing 2-10 G. Dawson

well PL2-212A. Well is screend from 6-16 ft bgs ~ 6 ft of saturated zone @ 0.163 gal/ft ≈ 1.0 gal/well volume.

A total of 5 surge/purge cycles were done for ~ 9 gallons of water.

1540 Finished developing well and deconned the pump.

1600 Mobilized and began developing well PL2-247A. Well is screened from 15-20 ft bgs

Cont R

DATE: 12/14/09

LOCATION: Boeing 2-10 G. Dawson

with a saturated zone of ~ 10 ft @ 0.163 gal/ft ≈ 1.6 gal/well volume. At least 2 well volumes were purged per purge cycle. A total of 3 cycles were done and created ~ 7 gallons of water. Well appeared developed after 2 cycles but an additional was done to follow protocols.

1625 Finished developing well PL2-247A and deconned pump.

1645 Left site for the day after storing equipment.

DATE: 12/15/09

LOCATION: Boeing 2-10 G. Dawson

1240 Arrived on-site to develop wells in congested northern shed pile area. Set up on well PL2-268AR.

1350 - Began developing well PL2-268AR. Well is screened from 30-34.5 ft bgs ~25 ft of saturated zone @ 0.163 gal/ft ≈ 4.0 gal/well volume. Well appeared clean fast, 3 cycles were done following protocols for ~ 12 gallons water pumped.

1415 - Finished developing well and deconned pump.

DATE: 12/15/09

LOCATION: Boeing 2-10 G. Dawson

Moved to ~~well 218B.~~ well 218 B.

1440 Began developing well PL2-218B, well is screened from 45-60 ft bgs. ≈ 8 gal/well volume. Performed 3 surge/purge cycles for approximately 25 gallons of water.

1506 Finished developing and deconed pump.

1510 Moved to well PL2-218A. Well is screened from 15-30 ft bgs.

1515 Began developing well PL2-218A

cont

DATE: 12/15/09

LOCATION: Boeing 2-10 G. Dawson

~ 20 ft of saturated zone or ≈ 3.2 gal/well volume. Performed 3 surge/purge cycles for a total of ≈ 10 gal.

1605 Finished developing PL2-218A and deconed pump. Moved to well PL2-245A, well is screened from 15-20 ft bgs.

1630 Began developing PL2-244A. Well volume per ft 0.163 gal/ft with ~ 10 ft saturated, total of 1.63 gal/well casing. Surge/Purged 3 times for ~ 12 gal.

cont

DATE: 12/15/09

LOCATION: Boeing 2-10 G. Dawson

1705 Finished developing PL2-244A and Deconned pump.

1710 Moved to PL2-245A and began development.

1740 Finished developing well PL2-245A. Well was screened from 15-20 ft. 3 surge/purge cycles and created approx 20 gallons of water. Deconned pump.

1745 Mobilized to well PL2-269A for development. Well is screened from 31-36 ft bgs. ~26 ft saturated zone for ~4.25 gal/well volume.

DATE: 12/15/09

LOCATION: Boeing 2-10 G. Dawson

1745 Began development. Performed 3 surge/purge cycles for a total of ~25 gallons of water.

1815 Finished developing well PL2-269A. Deconned pump and demobilized for the day.

1845 Left site for the day.

DATE: 12/16/09

LOCATION: Boeing 2-10 G. Dawson

1130 Arrived on-site, picked up four pallets to band development drums for transport. Mobilized to well PL2-249 A.

1200 Began developing well PL2-249A, well is screened from 15-20 ft bgs @ 0.163 gal/ft ≈ 1.6 gal/well volume (10 ft saturated).

Performed 3 surge/purge cycles for ~ 8 gal total development water.

1235 Finished development of well PL2-249 A, decomm pump.

DATE: 12/16/09

LOCATION: Boeing 2-10 G. Dawson

Could not locate well PL2-212 B, will develop another day after survey locations can be located.

1500 Left site after banding and palleting the 5 drums. Drums were placed at the South door entrance and fork lift called to take drums to the 2-49 water treatment area.

DATE: 12/21/09

LOCATION: Boeing 2-10 G. Dawson

0745 Tom Mckean on-site, calibrated the Thermo-electric PID, zeroed and calibrated to 100ppm tested at 101 ppm, within tolerance. RAE ppb was verified at 115ppm using 100ppm gas, reads 15% high.

0810 Coring of probe locations began.

SSL5 location (14" core completed), PID was background in and around hole.

DATE: 12/21/09

LOCATION: Boeing 2-10 G. Dawson

0945 Completed core (4") for SSL-6, PID reading of zero (0) ppm on the RAE.

Mobilized to SSL-7 location, 14" core. The coring contractor is Cascade Concrete Sawing and Drilling.

0955 Began coring SSL-7

1015 Completed the core for SSL-7.

Mobilized to Deep geoprobe location near column E-32 between sheetpiles.

1040 Started 4" core at deep probe location.

DATE: 12/21/09

LOCATION: Boeing 2-10 G. Dawson

1115 Finished coring, PID 25 0 ppb.
Mobilized to North sheetpile area.
1125 - Began coring the West/North deep geoprobe location (4" core)
1145 Finished the 4" coring, PID read 0ppb in the hole. Mobilized to location SSL-4 (14").
1150 Began coring SSL-4 location.
1224 Finished coring location SSL-4 (14" core, PID read 0ppb around the core.
Mobilized to location

DATE: 12/21/09

LOCATION: Boeing 2-10 G. Dawson

SSL-3 (4" core).
1235 Began coring SSL-3.
1245 Finished coring SSSL-3 (4"), PID read 0ppb.
Mobilized to SSL-2 location.
1255 Began coring SSL-2, core is a 4" core.
1305 Finished coring SSL-2, PID read 0 ppb.
Mobilized to SSL-1 location.
1310 Began coring SSL-1, core is 14" dia.
1345 Finished SSL-1 core, PID reads 0 ppb in hole.
Demobed for the day
1440 Left site.

DATE: 12/28/09

LOCATION: Boeing 2-10 G. Dawson

0700 Bought ice and arrived on-site for Geoprobe work.

0710 Cascade Drilling arrived on-site and walked probe points with Driller- Lynn Gobbels. Set-up for probe point at location SSL-5. Soil samples to be taken at 5 and 10 ft bgs. Verified PID calibrations, ppb RAE read 110 ppm for 100 ppm cal gas, Thermo electric PID calibrated @ 100 ppm.

0840 Began probe SSL 5.

Ant R

DATE: 12/28/09

LOCATION: Boeing 2-10 G. Dawson

Probes were logged in data sheets.

0945 Finished SSL 5, moved to SSL 6.

*Note SSL-5 had a vapor well installed well is 1" dia. and screened from 5-10 ft bgs.

1020 Began SSL-6 probe, soil samples to be taken at 5 and 10 ft bgs.

1025 S-091228-PL2-SSL6-05-0

1030 S-091228-PL2-SSL6-10-0

1040- Finished probe.

Appears to be a power steering fluid leak on probe rig. Exited building to troubleshoot.

Ant R

DATE: 12/28/09

LOCATION: Boeing 2-10 G. Dawson

1300 - New Geoprobe rig arrived on-site. Set-up at location SSL7, soil will be sampled at two depths (5 & 10' bgs).

1320S-091228-PL2-SSL7-05-0

1325S-091228-PL2-SSL7-10-0

1310 Began probe SSL7

1330 Went to depth and left tooling in to build vapor well, PVC on the other drill rig. Mobilized to deep geoprobe location between sheetpile areas. water sample is to be taken from ~50' bgs

[illegible]

DATE: 12/28/09

LOCATION: Boeing 2-10 G. Dawson

Labeled location as GP-1

1355 Began Geoprobe

1435 Sampled location GW-091228-PL2-GP1-50-0, Probe went to depth and did not take any soil samples. The concrete core had broken and so we had to use the probe rig to break up the remaining 5-inches of concrete in the hole.

1505 Finished Geoprobe GP-1. PID 0ppb. Mobilized to SSL4 location.

[illegible]

DATE: 12/28/09

LOCATION: Boeing 2-10 G. Dawson

1515 Started probe location SSL 4, well is to be sampled at 10 + ~15 ft bgs.

1545 S-091228-PL2-SSL4-10-0

1550S-091228-PL2-SSL4 -14-0

1645 Finished constructing vapor well. Also finished vapor well at SSL7 location, ~~well~~

1730 Left site.

GAD

DATE: 12/29/09

LOCATION: Boeing 2-10 G. Dawson

0735 Cascade Drilling arrived on-site and set-up at location SSL-2. Probe is to be sampled at 5', 10'.

0805 Began geoprobe.

0815 S-091229-PL2-SSL2-5-0

0825 S-091229-PL2-SSL2-10-0

0835 S-091229-PL2-SSL2-10-1

0835 Finished probe and moved to SSL3

0840 Began probe SSL3, one sample @ 10' bgs.

0850 S-091229-PL2-SSL3-10-0

0855 Finished Probe SSL3,

0920 started probe at GP-2, water sample only to be

DATE: 12/29/09

LOCATION: Boeing 2-10 G. Dawson

taken at ~85 ft bgs.

1010 GW-091229-PL2-GP2-85-0

1015 GW-091229-PL2-GP2-85-1

1040 Finished Probe GP-2, mobilized to SSL-1.

During water sampling purged for 15 minutes water stayed murky, purged approx. 1/2 gallon. Tube was 85' long with ID of 1/8" or ~0.22 gal/tube length. Purged to tube lengths.

1135 Started Geoprobe at location SSL-1, two samples to be taken at 5' and 10'

1150 S-091229-PL2-SSL1-05-0

1155 S-091229-PL2-SSL1-10-1

1200 S-091229-PL2-SSL1-10-0

DATE: 12/29/09

LOCATION: Boeing 2-10 G. Dawson

1230 Finished vapor well at SSL-1. Cleaned up area around probe locations.

1405 Left Boeing to deliver samples after palletizing and banding soil drum/ concrete slurry drum/ and concrete cores.

1420 Dropped samples at ARI labs.

DATE: 1/8/10

LOCATION: Boeing 2-10 G-Dawson

1400 Arrived on-site to locate well PC2-212B and develop.

Located well near coordinates and chipped concrete from around bolts. When well was opened it's total depth was only 16 ft bgs. Called boeing personel to try and locate or identify where well could be.

1700 Left-site

DATE: 1/12/10

LOCATION: Boeing 2-10 G. Dawson

1420 Arrived on-site to place PDB bags in wells PL2-212B (if located), PL2-218A and PL2-218B.

Bags placed in well PL2-218B at depths of 45 and 58 ft bgs.

1440 Placed bags in PL2-218B

1530 Placed two PDB's in 218A at 15 and 28 ft bgs.

545 Surged and pumped the two wells near area identified as PL2-212B, neither well gained sig. depth wells appear to

DATE: 1/12/10

LOCATION: Boeing 2-10 G. Dawson

be wells PL2-274A and PL2-274B. @ 16' bgs and 35' bgs.

Packed up equipment and put in storage area.

After direction from Tom Mckeon placed 2 pdb's in well 274A/B at 28 and 20 ft bgs. Total observed depth of well was 28' bgs.

1720 Left site

DATE: 2/8/10

LOCATION: Boeing 2-10 G. Dawson

0730 loaded sampling equipment into vehicle and prepped for GW sampling. Bought ice for coolers.

0945 Arrived at Boeing retrieved drum for purge water from 2-49 bldg.

1030 Spoke with Ed Rivera and notified him we would be sampling over the next three days.

Set-up on well PL2-254A. well will be sampled for VOC's sample ID

1126 GW-100208-PL2-254A-0

Cut R

DATE: 2/8/10

LOCATION: 2-10 sheetpiles G. Dawson

see sample data sheets for specific sampling details.

1220 Set-up at well PL2-255A

1243 GW-100208-PL2-255A-0

1300 Set-up at well PL2-256A

1327 GW-100208-PL2-256A-0

1400 Set-up on well PL2-257A after having forklift remove the crate preventing access.

1432 GW-100208-PL2-257A-0

1445 set-up at well PL2-262B, GW-100208-PL2-262B-0 was not taken yet as sample pump plugged / broke down. Replaced pump and will return tomorrow.

Cut R

DATE: 2/9/10

LOCATION: 2-10 Sheetpile G. Dawson

0800 Arrived on-site for continued GW sampling.

0900 Set-up on well PL2-209B.

0937 GW-100209-PL2-209B-0
VOCs, TOC, dissolved metals

0945 Set-up on well PL2-209A
VOCs, TOC, dissolved metals, dissolved gases, anions, cations, DHE.

1004 GW-100209-PL2-209A-0

1004 GW-100209-PL2-209A-1

1055 Set-up on well PL2-212A
VOCs, TOC, Dissolved metals, DHE, dissolved gases, Anions Cations

1126 GW-100209-PL2-212A-0

1130 GW-100209-PL2-212A-1

~~no ms/msd here GW as prior planned GW-100209-PL2~~

DATE: 2/9/10

LOCATION: 2-10 Sheetpile G. Dawson

1300 Set-up on PL2-218A
Diffusion bags for VOCs were set at 15' bgs + 28' bgs.

1357 GW-100209-PL2-218A-0
VOCs, TOC, DHE, Dissolved metals, dissolved gases, cations, anions.

1430 Set-up on well PL2-218B
VOCs, TOC, DHE, Dissolved metals, dissolved gases. VOC's by PDB @ 45' and 58' bgs.

1505 GW-100209-PL2-218B-0

1535 Set-up at well PL2-262B, VOCs.

1604 GW-100209-PL2-262B-0

Dropped samples to date at ARI labs and shipped DHE samples to microbial insights

DATE: 2/10/10

LOCATION: 2-10 sheetpile G. Dawson

0800 Arrived on-site for continued GW sampling, low tide 948 am, so will start at Eastern most well.

0900 Set-up at well PL2-249A. VOCs, TOC, dissolved metals

0925 GW-100210-PL2-249A-0

0945 Set-up at well PL2-247A VOCs only plus duplicate

1012 GW-100210-PL2-247A-0

1016 GW-100210-PL2-247A-1

1020 Set-up at well PL2-268AR VOCs only

1049 GW-100210-PL2-268AR-0

1150 Set-up at well PL2-269A VOCs only.

1210 GW-100210-PL2-269A-0

1220 Set-up at well

Cont R

DATE: 2/10/10

LOCATION: 2-10 sheetpile G. Dawson

PL2-245A. VOCs only

1246 GW-100210-PL2-245A-0

1255 Set-up on well PL2-244A, VOCs, TOC, and dissolved metals

1317 GW-100210-PL2-244A-0

1340 Set-up on well PL2-253A, VOCs, TOC, dissolved metals, dissolved gases, alkalinity, cations, anions

1404 GW-100210-PL2-253A-0

1410 Set-up at well PL2-252A, VOCs, TOC, and dissolved metals.

1434 GW-100210-PL2-252A-0

1445 Set-up at well PL2-266A VOCs w/ MS/MSD

1508 GW-100210-PL2-266A-0

1508 GW-100210-PL2-266A-4

Cont R

DATE: 2/10/10

LOCATION: 2-10 Sheetpile G. Dawson

1530 set-up at well PL2-259 B, VOCs

1556GW-100210-PL2-259B-0

Packaged samples and delivered to ARI labs.

1645 Samples dropped. Done for Day

DATE: 2/11/10

LOCATION: 2-10 Sheetpile

Set-up for soil vapor sampling at PL2-SSL 7.

1417 Began purging well casing after vacuum testing the sample train. See sample data sheets for details. GWD

1440 SV-100211-PL2-SSL7-08-0

@ sampling PID 814 ppb

SUMMA start - 30" Hg end - " Hg.

Moved to vapor point SSL-5.

1537 Began purging approx. 16 min Purge, end at 1553.

DATE: 2/11/10

LOCATION: 2-10 Sheetpile G. Dawson

1600 SV-100211-PL2-SSL5-8-0

re-started purge at 1543 after having helium detection new purge end time 1559. Tightened well top and valve in an effort to stop helium detection. All instruments (helium probe, O_2 meter, PID) were calibrated prior to sampling. O_2 + Helium by service center and PID in field by J. Neste.

1700 Packed up for the day, Left site.

DATE: 2/12/10

LOCATION: 2-10 Sheetpile G. Dawson

0830 Arrived on-site for continued vapor sampling. Checked calibration on PID, ok. Vacuum tested the sampling train. Start -60 kPa after 5 min -50 kPa after 10 min -38 kPa. Set-up at well SSL-1.

0905, 16 min purge followed by samples:

0922 SV-100212-PL2-SSL1-8-0

1003 SV-100212-PL2-SSL1-8-1

1052 SV-100212-PL2-SSL1-8-TD

Moved to location SSL-4.

1112 Began 16 min purge.

1128 SV-100212-PL2-SSL4-8-0

DATE 2/12/10

LOCATION: 2-10 Sheetpile G. Dawson

demobilized from site. Transferred drum of purge water from GW sampling to 2-49 bldg. Dropped Tedlar bag sample from SSL-1 at ARI for analysis. Shipped SUMMA canister samples to Air Toxics for analysis.

DATE: 3/30/10

LOCATION: 2-10 Sheetpile G. Dawson

0830 Arrived on-site to walk Geoprobe locations with Kris Addis of EPI. EPI was supervising the surveying of probe locations.

0900 Left-site.

Appendix E Design Calculations

CALIBRE DESIGN CALCULATIONS

Date:3/20/10
By: G Dawson
Checked by: TJM
Purpose: Calculate SVE Yield

Practical Approach to the Design, Oper. And Monit. of In situ SVE Systems, in Groundwater Monitoring Review,Spring 1990;pgs 159-178

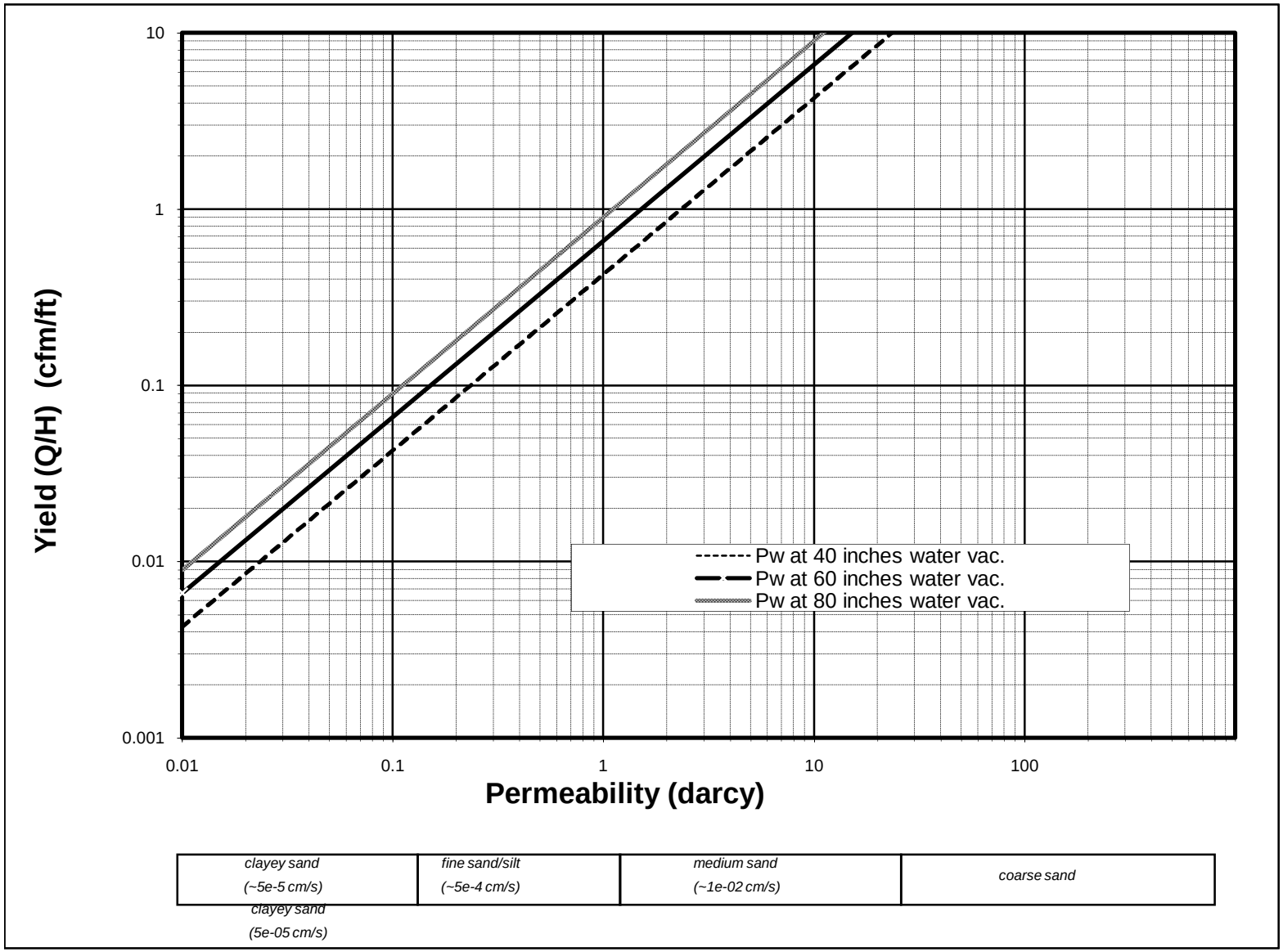
Q/H =Pi* k/u* Pw* (1-(Patm/Pw)^2) / (Ln(Rw/Rl))

2.26E-03	**conductivity cm/sec**
60	**vacuum level in well (in/water)**
4	**diameter of vent well inches**
30	**radius of influence in feet**

3.14E+00	Pi
1.00E+00	Patm atm
2.35	k darcy
0.853	Pw atm
5.08	Rw in cm
914.4	Rl in cm
1.80E-02	u viscos cp

flow rate per length	25.3	cm3/s/cm
	0.15	m3/min/m
	1.6	scfm/ft
	16	scfm per well
	10	ft of screen/well

Darcy	Pw at 20 inches water vac.	Pw at 40 inches water vac.	Pw at 60 inches water vac.	Pw at 80 inches water vac.
0.01	0.00208	0.004278	0.00662	0.009
1000	208.21	428.07	661.6	909


10
1
0.1
0.01
0.001
Yield (Q/H) (cfm/ft)
0.01
0.1
1
10
100
Permeability (darcy)
Pw at 40 inches water vac.
Pw at 60 inches water vac.
Pw at 80 inches water vac.
clayey sand (~5e-5 cm/s)
fine sand/silt (~5e-4 cm/s)
medium sand (~1e-02 cm/s)
coarse sand
clayey sand (5e-05 cm/s)

CALIBRE DESIGN CALCULATIONS
Date: 3/25/10
By: G Dawson
Checked by: TJM
Purpose: Estimate the required air flow for SVE operation

	North Sheetpile Area - North East Area		North Sheetpile Area - North West Area		South Sheetpile Area	
Area	10,787	ft^2	12,329	ft^2	14,358	ft^2
Vadose Zone Thickness	10	ft	10	ft	10	ft
Volume of Treatment Area	107,870	ft^3	123,290	ft^3	143,580	ft^3
Porosity	0.3		0.3		0.3	
Pore Volume of Treatment Area	32,361	ft^3	36,987	ft^3	43,074	ft^3
Required Pore Flushes	400		200		200	
Target Treatment Time	6	months	6	months	6	months
Required Total CFM	49	ft^3/min	28	ft^3/min	33	ft^3/min
Estimated CFM per well	16	ft^3/min	16	ft^3/min	16	ft^3/min
Number of Treatment Wells	3	wells	2	wells	2	wells
Total Wells in North Sheetpile Area	5	wells				
Total Wells in South Sheetpile Area	2	wells				

CALIBRE DESIGN CALCULATIONS
Date: 3/25/10
By: G Dawson
Checked by: TJM
Purpose: Calculate mass flux based on vapor concentr. for loading to off-gas treatment stream

North Sheetpile	South Sheetpile	
169.2	8.68	ppmv, from Soil Vapor Sampling
131.4	131.4	Molecular weight
5.62	5.62	conversion factor from ppmv to ug/L
950.3	48.7	TCE concentration ug/L
77	33	air flow rate cfm
950.3	48.7	TCE concentration ug/L
5.9E-05	3.0E-06	TCE in lb/ft3
4.6E-03	1.0E-04	TCE flux lbs/min
6.57	0.14	TCE flux lbs/day
0.5	24.3	days operation required for removal of 1 liter of TCE
1.87	0.04	liters/day
95.0%	95.0%	% removal on carbon
6.2	0.1	loading on carbon at 95% removal lb day
0.3	0.01	discharge at 5% lb day
83.2	1.8	Lb/day carbon consumed at .07 lbs TCE/lb carbon lbs/day
2580	57	Lb/month lbs carbon used/month
0.7	31.7	months/1800 lb vessel

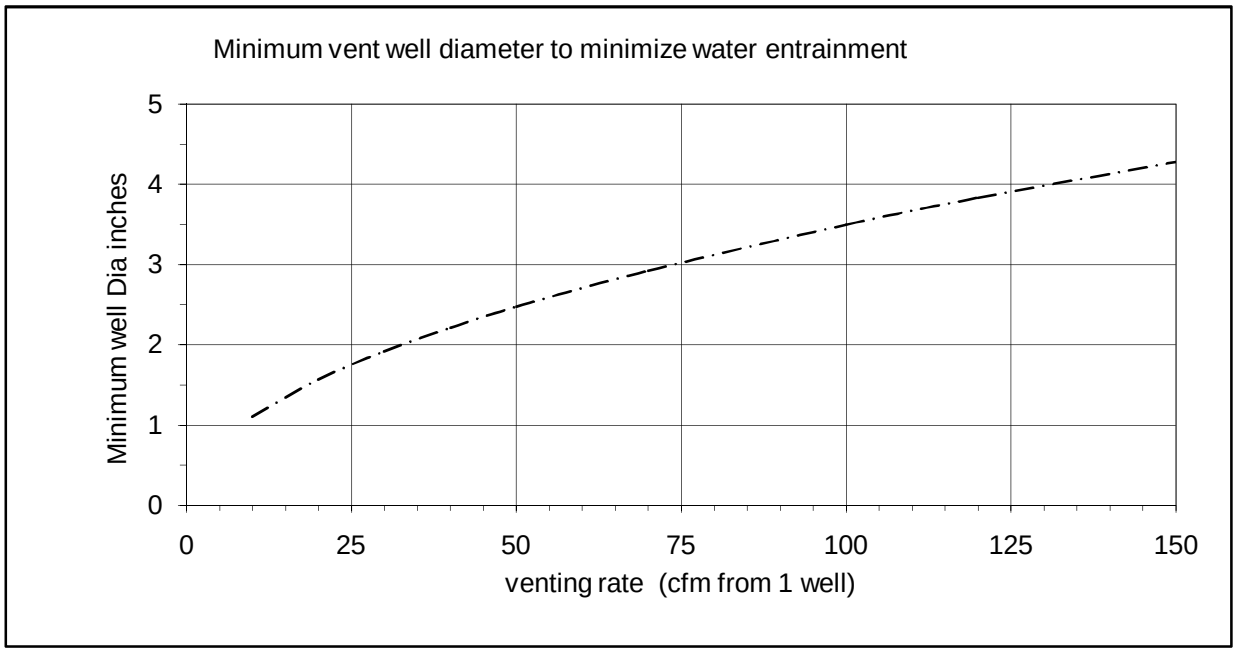
CALIBRE DESIGN CALCULATIONS
Date: 3/25/10
By: G Dawson
Checked by: TJM
Purpose: Determine air velocity in SVE vent well as funtion of air flow and well diameter. Select well size based on maintaining velocity below threshold for excessive entrainment of liquid.

2 in sched 40	**4 in sched 40**			
16	16	air flow cfm		
2.067	4.026	pipe ID inches	1.5	pipe ID inc 1 1/2 in sched 80
0.023	0.088	open area ft2	1.61	pipe ID inc 1 1/2 in sched 40
			1.959	pipe ID inc 2 in sched 80
			2.067	pipe ID inc 2 in sched 40
686.6	181.0	velocity ft/min	2.323	pipe ID inc 2 1/2 in sched 80
11.4	3.0	ft/sec	2.469	pipe ID inc 2 1/2 in sched 40
3.5	0.9	m/sec	4.026	pipe ID inc 4 in sched 40
			3.826	pipe ID inc 4 in sched 80

maximum air velocity to minimize entrainment

use 25 ft/sec 25 ft/sec

CFM air flow	minimum vent well diameter	
10	1.106	inches
20	1.564	inches
30	1.915	inches
40	2.211	inches
50	2.472	inches
70	2.925	inches
100	3.496	inches
120	3.830	inches
150	4.282	inches



Note: Either a 2" or 4" may be used for 2-10 IM, the 2" well is capable of 30 cfm which is double the conceptual design flowrate.

CALIBRE DESIGN CALCULATIONS
Date: 9/25/10
By: G Dawson
Checked by: TJM
Purpose: Estimate the required substrate mass

North Sheetpile Area

	North East - Inside Piling		North West - Inside Piling		Outside of Piling	
Area	17,514	ft^2	5,600	ft^2	1,800	ft^2
Saturated Thickness	35	ft	60	ft	70	ft
Volume of Treatment Area	612,990	ft^3	336,000	ft^3	126,000	ft^3
Porosity	0.3		0.3		0.3	
Volume of GW in Treatment Area	183,897	ft^3	100,800	ft^3	37,800	ft^3
Mass of GW	11,475,173	lbs	6,289,920	lbs	2,358,720	lbs
Substrate Conc.	500	ppm	500	ppm	1,000	ppm
Substrate Mass Req.'d	5,738	lbs	3,145	lbs	2,359	lbs
Substrate Injection Conc.	10%		10%		10%	
Injection Volume	6,913	gal	3,789	gal	2,842	gal
Gallons per IW	1,200	gal	1,200	gal	1,500	gal
Wells Needed	6	wells	3	wells	2	wells

Total Mass Substrate	11,241	lbs

CALIBRE DESIGN CALCULATIONS
Date: 3/25/10
By: G Dawson
Checked by: TJM
Purpose: Estimate the required substrate mass

South Sheetpile Area

	Inside of Piling		Outside of Piling	
Area	13,000	ft^2	1,000	ft^2
Saturated Thickness	15	ft	25	ft
Volume of Treatment Area	195,000	ft^3	25,000	ft^3
Porosity	0.3		0.3	
Volume of GW in Treatment Area	58,500	ft^3	7,500	ft^3
Mass of GW	3,650,400	lbs	468,000	lbs
Substrate Conc.	500	ppm	1,000	ppm
Substrate Mass Req.'d	1,825	lbs	468	lbs
Substrate Injection Conc.	10%		10%	
Injection Volume	2,199	gal	564	gal
Gallons per IW	500	gal	1,000	gal
Wells Needed	4	wells	1	wells
Total Mass Substrate	2,293	lbs		

Appendix F Standard Operating Procedures

ENHANCED REDUCTIVE DECHLORINATION (ERD) SUBSTRATE INJECTION SOPS AND CONTINGENCY PLAN CALIBRE STANDARD OPERATING PROCEDURES ADDENDUM

1.0 POLICY

It is the policy of CALIBRE that any individual engaging in ERD injections will abide by the procedures outlined in this document. These procedures include project specific addendums to the CALIBRE Contingency Plan and Emergency Procedures Standard Operating Procedures and are designed to meet or exceed applicable Occupational Safety and Health Administration (OSHA) standards for safe work practices.

2.0 PURPOSE

The following is an amendment to the Contingency Plan and Emergency Procedures (CALIBRE 2004) specifically relating to ERD operation and potential spills of ERD injection materials (specifically water with sugar, carbohydrates or chase water used to flush the wells after substrate injection). The amendment provides specific detailed steps to be followed in the case of a large or small spill, within or outside of the containment area. For each scenario, the following response actions will be taken. Prior to any work being conducted the following procedures will be followed by all on-site personnel.

1. All personnel must read and discuss this contingency plan prior to any day of work/activity in which fluids are to be processed/handled or injected.
2. Storm drains near the work area will be identified.
3. Storm drain covers will be located. These will placed on the storm drains before work proceeds except in inclement weather (significant precipitation where the covers would cause extensive pooling of water) when they will be kept close at hand.
4. Assemble all required spill control supplies and verify that all are functional.
5. Verify that power source is activated; find circuit breakers (for reset if required) or backup power.

3.0 SPILL CONTROL SUPPLIES

Shop vac
Extension cord(s)
Power supply
Multiple 5 gallon buckets
Broom
Storm drain covers
Flat-head shovel
Absorbent media (kitty litter)
Absorbent pads
Open top drum(s)
Wrench to open drums

4.0 PLANNING FOR POTENTIAL SPILL SCENARIOS

4.1 Small Spill within Containment Area

1. Stop the flow of the spill by shutting the valve or up-righting the hose or bucket from which the solution/fluid is coming.
2. Use the shop vac to clean up any remaining solution/fluid.
3. Repair or tighten any portion of the system that caused the small spill.

4.2 Large Spill within Containment Area

1. Stop the flow of the solution by unplugging the pump and closing valve at outlet of the Baker tank.
2. Place a bucket or other container under the spill to capture it
3. Vacuum spilled liquid and return to Baker tank, or other secure vessel.

4.3 Small Out of Containment Area Spill

1. Slow or stop the flow of the solution/fluid using the valve adjacent to the flow meter.
2. Sweep the solution/fluid back into the well head.
3. Vacuum any remaining solution/fluid.
4. Return solution/fluid to the system.

4.4 Large Out of Containment Area Spill

1. Stop the flow of the solution by unplugging the pump and closing the valve at outlet of the Baker tank.
2. Cover all storm drains with appropriate storm drain covers if not already done.
3. Vacuum spilled liquid and return to Baker tank or other secure vessel.
4. Call assigned Boeing project personnel to notify them of spill.

4.5 Spill that Discharges to Storm Drain

1. Stop the flow of the solution by unplugging the pump and closing valve at outlet of the Baker tank.
2. Cover all storm drains with appropriate storm drain covers if not already done.
3. Contact Boeing Fire and Security to notify them of the incident.
4. Vacuum spilled liquid and return to Baker tank or other secure vessel.
5. Call assigned Boeing project personnel to notify them of spill.

5.0 OPERATING PROCEDURES FOR ERD INJECTIONS

5.1 Startup Steps

1. Check that all cam-locks and hoses are fully connected.
2. Check that all well head connections are setup and tight.

3. Check that all hose-clamps are tight.
4. Verify that the correct filters are placed in housings (typical 10 micron or 50 micron).
5. Verify that all flow meters are zeroed.
6. Close all valves located to the left of flow meters, reopen a small fraction (~ 1/16 to 1/8 of a turn from the seated-valve condition).
7. Open valve at outlet of Baker tank.
8. Turn on pump.
9. Check and adjust flow rates to each well, initially set flows to no more than ~ 3 gpm/well (unless operational data from the specific wells indicate more or less is appropriate).
10. Check each well.
11. Check all lines for drips/leaks, tighten/repair as required.
12. Increase (or decrease) flow to each well as injection capacity is determined.

5.2 Flow Meters

The flow meters consist of 2 parts: Burkert type S030 inline fitting (the paddlewheel unit) and a Burkert type 8035 flow totalizer/transmitter; operation manuals are attached. The flow transmitter attaches to the inline fitting with a ¼ twist and is secured with the small set-screw on the inline fitting. Check that the inline fitting has both O-rings (one on each end). Take care not to lose or pinch the O-rings, if O-rings are missing the unit cannot be used. Check that the internal paddle wheel is clean and flows freely when you blow on it (small pieces of leaves/grit/paper will make it stick). Use toothbrush to clean (gently) if required.

Zero the totalizer/flow meter at the start of an injection using the following steps:

1. Press the center button (down arrow) once, wait till it blinks and press it again, the meter should display 0.0 GA/M
2. Hold the two right buttons (down arrow and Enter key) for approximately 5 seconds, this brings the flow meter into a setup menu with the following options; Language (English), unit (gpm), K—factor (284.82), filter (2), total , Res (toggle to YES by hitting the down arrow in order to reset to zero)
3. Press the Enter key twice
4. Meter should then read 0,0 GA/M and then shortly switch to 0 GA totalized flow.

The K factor of 284.82 is for a ¾ inch pipe and units of GPM, any other pipe size or flow units require a different K-Factor (see attached operations manual, check all units carefully when changing the K-factor).

In standard operation, the flow meter reads the totalized flow. When adjusting the flow valves it is necessary to toggle the flow meters to the flow rate setting (gallons per minute);

1. Press the center button (down arrow) once, wait till it blinks and press it again and
2. the meter will display the flow rate in GA/M,
3. If the center button is held down the GA/M display will remain.
4. After the center button is released the display will revert back to the totalized flow in approximately 10 seconds.

5.3 Filter changes

The frequency of filter changes will depend on the consistency of the solution and it will vary. Loss of flow on the flow meters, changes in pump or flow meter sound, and pressures of greater than approximately 80 psi on the filter housing are signs that the filters may require changing. The following steps describe the process of changing filters.

1. Identify flow through filter operation (parallel or serial flow).
2. Select filters to be placed in housings and verify size imprinted on outside of filter bag (typical 10 micron or 50 micron).
3. Turn off pump.
4. Close valve at outlet of Baker tank.
5. Slowly release pressure in filter housing by partially unscrewing the lid, allow all pressure to dissipate before removing lid.
6. Remove filter bag and cage to hold filter placing them into 5 gallon bucket.
7. Pour solution into open filter housing.
8. Remove filter and place in garbage bag.
9. Inspect the filters to determine which is plugging (based on slime layer on filter face), if both are plugging continue with same serial flow operation with 50 micron and 10 micron filters, if only the 2nd filter is plugging, switch to parallel flow with valving and use two 10 micron filter bags.
10. Replace with new filter and push the filter bag to bottom of cage.
11. Place cage and filter into the housing and push the top plastic ring to form a seal.
12. Open valve at outlet of Baker tank.
13. Allow the filters to refill and tighten the cap back on top of housing when the water level nears (within 3-4 inches) top of the housing.
14. If significant spills are present from the filter change, cleanup with shop vac.
15. Restart pump.
16. Check and adjust flow rates to each well.
17. Check each well.

5.4 Process and Finishing Steps

At the end of the event, record all the following data:

1. gallons/well for substrate
2. gallons/well for chase water

6.0 OTHER EQUIPMENT

The following equipment will be required, in adequate supply, for ERD injection:

1. pH probe
2. Brix meter
3. Pong filter bags, typically 10 and 50 micron
4. Trash pump for transfer
5. Injection pump and manifold/valves/flow-meters

Appendix G Prior Phase 1 Work Plan (including Conceptual Site Model, SAP, QAPP, included in attached CD)

Boeing Plant 2
Seattle/Tukwila, Washington

Interim Measure Work Plan for the North and South Sheetpiles in the 2-10 Building (AOC 2-10.3A and AOC 2-10.4A)

Phase 1: Data Collection

Prepared for

The Boeing Company
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Seattle, WA 98124-2207

Prepared by

CALIBRE
Our Success Follows Yours

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Agency Review Draft

October 9, 2009

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Figure 2.2 Typical Details Solvent Still, North and South Sheetpile Areas, Building 2-10

Figure 2.3 Historical Groundwater Data from 1992, North and South Degreasers, Building 2-10

Figure 2.4 Comparison of Historical VOC Concentrations, North Sheetpile Area, Building 2-10

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Figure 2.6 Cross Section of Monitoring Wells, North Sheetpile Area, Building 2-10

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List of Abbreviations and Acronyms

Acronym/Abbreviation	Definition
AOC	Area of Concern
AMSL	Above Mean Sea Level
ASTM	American Society for Testing and Materials
Boeing	The Boeing Company
bgs	Below ground surface
BHT	Butylated hydroxytoluene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1,2-DCE	cis-1,2-Dichloroethene
CMS	Corrective Measures Study
COC	Constituent of concern
CSM	Conceptual Site Model
DCE	Dichloroethylene
DGI	Data Gaps Investigation
DNAPL	Dense non-aqueous phase liquid
DO	Dissolved oxygen
DQO	Data quality objective
Ecology	Washington State Department of Ecology
EMF	Electronic Manufacturing Facility
EQL	Estimated quantitation limit
ERD	Enhanced reductive dechlorination
IDW	Investigation Derived Waste
IM	Interim Measure
LCS	Laboratory control sample
LDW	Lower Duwamish Waterway

Acronym/Abbreviation	Definition
LNAPL	Light non-aqueous phase liquid
MSDS	Material Safety Data Sheet
N/S	North and South
NAPL	Non-aqueous phase liquid
O&M	Operation and maintenance
O_2/LEL	oxygen/lower-explosive limit
ORP	Oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
PCE	Tetrachloroethene
PDB	Passive diffusion bag
PID	photoionization detector
PMCL	Preliminary target media cleanup level
PPE	Personal protective equipment
QA	Quality assurance
QAM	Quality Assurance Manager
QC	Quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RL	Reporting limit
RPD	Relative percent difference
SAP	Sampling and Analysis Plan
SL	Screening level
SOP	Standard operating procedure
SVE	Soil vapor extraction
TCA	1,1,2-Trichloroethane
TCE	Trichloroethene
TMCL	Target Media Cleanup Level
TOC	Total organic carbon
TPH	Total petroleum hydrocarbons
trans-1,2-DCE	trans-1,2-Dichloroethene
USEPA	U.S. Environmental Protection Agency
VC	Vinyl chloride
VOC	Volatile organic compound

1.0 Introduction

This Interim Measure (IM) Work Plan for the North and South Sheetpiles in the Building 2-10 Area (Area of Concern [AOC] 2-10.3A and AOC 2-10.4A) has been prepared on behalf of The Boeing Company (Boeing) to further remedial activities at Boeing Plant 2 in Seattle/Tukwila, Washington. This IM Work Plan has been prepared and the IM will be implemented under the Resource Conservation and Recovery Act (RCRA) Administrative Order on Consent, dated January 18, 1994, between Boeing and the U.S. Environmental Protection Agency (USEPA) Region 10 ([RCRA Docket No. 1092-01-22-3008[(h]).

Boeing plans to implement IMs for areas associated with the North and South (N/S) Sheetpiles in the 2-10 Building. A significant amount of characterization data has been collected in the areas in and around the 2-10 N/S Sheetpiles; however, much of the groundwater data are more than 7 years old and not appropriate in designing new IMs. This Work Plan (Phase 1: Data Collection) defines the objectives and procedures for additional data collection that is necessary for technology selection, design, and implementation of IMs at the 2-10 N/S Sheetpiles. A second Work Plan (Phase 2: IM Design and Implementation) will be submitted for approval and implementation once the IMs have been selected; that plan will summarize the data collected under this Work Plan and propose an IM for each sheetpile. It is anticipated that the same IM design will be applied to each sheetpile; however, it is possible different IM designs may be proposed for each sheetpile if indicated by the data collected under this Phase 1 plan.

1.1 FACILITY LOCATION AND BACKGROUND

Plant 2 is located on approximately 107 acres between the Duwamish Waterway and East Marginal Way South, in Seattle/Tukwila, Washington. The general location of Plant 2 is shown on Figure 1.1. Plant 2 began operating in 1936 and contains numerous manufacturing and process buildings related to aircraft fabrication. Plant 2 continues to support aerospace manufacturing. Figure 1.2 presents the location of the 2-10 Area, the N/S Sheetpile locations, and other features in the 2-10 Area.

The Plant 2 area lies within the Duwamish Valley. The hydrogeologic setting is an alluvial basin between bounding uplands to the east and west. In the local area, the aquifer within the alluvial valley flows in a westerly direction towards, and discharges to, the Duwamish Waterway. A general description of the site hydrogeology and summary of previous investigations is presented in the *RCRA Facility Investigation Groundwater Investigation Interim Report*, dated January 1996 (Weston 1996).

The 2-10 Building, one of the larger buildings at Plant 2, is located adjacent to the shoreline north of the 16th Avenue Bridge. Boeing's present use of the 2-10 Building is storage with some parts machining and handling in support of aircraft design and testing. Future planned uses include conversion of areas devoted to storage to additional active manufacturing. Renovations may include construction of additional machine foundations and desk stations for staff supporting operations.

Past work identified chlorinated solvents in soil and groundwater in some areas beneath the 2-10 Building that require remedial action. Expanding active uses in the building will impose access constraints for the required site investigation work and any corrective actions required. Accordingly, work to select, design, and implement any necessary remedial actions associated with the N/S Sheetpile areas is being expedited through the preparation and submittal of this Work Plan and approach. The manner in which Boeing intends to coordinate this work with other actions planned for the 2-10 Building and the surrounding 2-10 Area is addressed below.

1.2 OBJECTIVE AND COORDINATION OF PLANNED INTERIM MEASURES

1.2.1 Objective of the Interim Measures

The objective of the IMs is to remove (or destroy through degradation) the mass of solvent contamination within the vadose zone enclosed by the sheetpiles and in groundwater within and downgradient of the N/S Sheetpile areas of the 2-10 Building. Final cleanup levels have not been established for Plant 2 at this time. As an IM, this work is not intended to be a final remedy; therefore, the IM can proceed even though cleanup levels have not been finalized as has been the case for IMs at other locations at Plant 2. The Corrective Measures Study (CMS) for the 2-10 Area will evaluate whether additional work needs to be performed after the IM in order to complete corrective action for all media. The goals of the IMs are to:

- destroy or remove contaminant mass in order to decrease the residual contamination in the source area, and
- gather performance data from the mass removal IMs that will be useful in evaluating technologies and post-IM conditions for the CMS.

1.2.2 Objective of the Phase 1 Data Collection

Before the IMs can be designed or implemented, additional data needs to be collected to define current conditions. Specifically, the goals of the Phase 1 Data Collection effort are as follows:

- Collect soil and groundwater data to define the current nature and extent of solvent contamination in the source area, including any non-aqueous phase liquids that may be present.
- Collect soil gas data to use in combination with indoor air data being collected under the Vapor Intrusion Sampling Work Plan to assess the current potential for vapor intrusion into the 2-10 Building (refer to Section 1.2.3).

Two remedial technologies have been identified as the likely candidate remedies that may be implemented for one or both 2-10 Building Sheetpile IMs: soil vapor extraction (SVE) for treating volatile organic compounds (VOCs) in vadose zone soils, and enhanced reductive dechlorination (ERD) for treating VOCs in groundwater and saturated soils. These technologies have been implemented successfully at other areas of Plant 2 with similar contamination and conditions. SVE and ERD are currently considered the most likely IM technologies; however, data collected during Phase 1 will be used to confirm or correct that assumption. Other technologies briefly considered for VOCs in vadose zone soils included containment (as implemented in 1993/1994) and excavation. USEPA has designated SVE as a presumptive

remedy for VOCs in soil and the site conditions (VOCs in vadose zone soils) are well suited to this technology (USEPA 1996). Other technologies briefly considered for VOCs in groundwater included containment (as implemented in 1993/1994), in-well stripping, and in-situ chemical oxidation. Boeing has implemented these technologies, along with ERD, at other sites with very similar contamination and geochemical conditions in the Duwamish Valley. ERD is being proposed as a candidate technology to address VOCs in groundwater for both of the 2-10 Building Sheetpile IMs.

1.2.3 Coordination with Indoor Air Sampling

Site conditions and chemicals detected indicate the potential for vapor intrusion in the 2-10 Building, and Boeing has determined that indoor air sampling is warranted at this time given the changing use of the building. The indoor air data will be used to identify any necessary IMs and/or engineering controls in order to meet the requirements for worker exposure. The indoor air data is being collected as part of the *Work Plan for Vapor Intrusion Sampling, Building 2-10* (Golder 2008), which is being submitted concurrently for USEPA review and approval. Boeing intends that field work for the indoor air sampling and for the soil gas survey in this study will occur at approximately the same time.

1.3 COORDINATION WITH 2-10 AREA DATA GAPS INVESTIGATION

The sampling described in this Work Plan is solely focused on data required to support the IM objectives for the N/S Sheetpiles in the 2-10 Building and data needed to complete a broader solvent data gap investigation specific to the 2-10 Building. Submittal at this time in conjunction with the Indoor Air Sampling Work Plan is intended to assure their expedited and integrated implementation. Furthermore, this work is intended to be conducted independent of but in a parallel, integrated manner to the larger Data Gaps Investigation (DGI) for the 2-10 Area, which is nearing completion and submittal. Given improvements to this 2-10 Building-specific Work Plan to address USEPA comments, it is expected that the 2-10 Area DGI Work Plan, which was submitted to USEPA in December 2008, will require some refinement to fully integrate and link the two plans.

Soil and groundwater sampling and analysis of constituents of concern (COCs) in this IM Work Plan will use methods, procedures, and analyses consistent with those proposed in the 2-10 Area DGI Work Plan. Where appropriate, i.e., for the target COCs in this IM, the data collected herein will be used to satisfy corresponding data needs specific to the 2-10 Building, as part of the larger 2-10 Area DGI.

1.4 WORK PLAN ORGANIZATION

This Work Plan is organized as follows:

- Section 1.0: Introduction
- Section 2.0: Site Background Information and Data Needs Assessment
- Section 3.0: Planned Sampling to Support Interim Measures at the 2-10 Area N/S Sheetpiles

- Section 4.0: Reporting and Schedule
- Section 5.0: References
- Appendix A: Synopsis of Historical Sampling from Prior Investigations near the North and South Sheetpiles
- Appendix B: Sampling and Analysis Plan (including Standard Operating Procedures as an attachment to the SAP)
- Appendix C: Health and Safety Plan

2.0 Site Background Information and Data Needs Assessment

The purpose of this section is to describe the CSM, data quality objectives (DQOs), and data needs required for IM design and implementation. A brief summary of the degreasing units that were the source of VOC releases in the immediate area(s), existing hydrogeologic information, and water chemistry data is also included in order to provide an appropriate context for the CSM.

2.1 VAPOR DEGREASERS

Virtually all metal working industries (working, forming, plating, or welding of metals) apply a surface coating to the metals as part of the manufacturing process. Examples include a cutting oil used with a lathe or a grease/other surface coating used for corrosion protection. The coating material must then be cleaned for subsequent manufacturing steps. Vapor degreasing is a metal cleaning process used for both precision and general cleaning of metals that started in the early 1930s and remains widely used today.

Vapor degreasing is a physical method of removing solvent-soluble coatings and other solids trapped on metal, glass, and other objects by bringing the soiled article, which is at ambient temperature, in contact with hot solvent vapor (ASTM 1962). The hot solvent vapor condenses on the colder article to form a liquid flow that cleans the article as the solvent drains by gravity. Vapor degreasing has historically used halogenated solvents (usually perchloroethylene, trichloroethylene, or 1,1,1-trichloroethane) because they have desirable qualities such as they are not flammable and their vapors are much heavier than air. Parts to be cleaned are immersed in the hot vapor zone (with the parts initially at ambient temperature), and condensation continues until they are heated up to the vapor temperature. Parts may be solely cleaned by the condensation/dripping process or cleaning may be augmented with a spray or immersion step.

A typical vapor degreaser consists of a tank heated to generate solvent vapors (refer to Figure 2.1), an open-topped chamber to contain the heated vapors above the tank, a system to condense the vapors, and a system of racks or baskets to hold the parts to be cleaned (Woodard & Curran 2006). The height of the solvent vapors is controlled by condenser coils and/or a water jacket encircling the device. Solvent and ambient moisture are condensed on the upper coils to control vapor emissions. Water commonly enters a vapor degreaser system from several sources including (1) condensation noted above, (2) moisture on the parts being cleaned, (3) steam or cooling water leaks, and (4) water-soluble cutting oils (Kanegsberg 2001). Water mixed with the cleaning solvent has the undesirable characteristic that it can form an azeotrope[1]. These conditions can cause increased equipment corrosion, increased vapor losses, and decreased solvent life.

[1] A mixture of two or more liquids in a ratio that is not changed in distillation. When boiled, the resulting vapor has the same ratio of constituents as the original mixture and the boiling temperature of the mixture may be either increased or decreased from the initial liquids.

As a result of the conditions noted above, nearly all vapor degreasers are equipped with a water separator to extend the life of the cleaning solvent (USEPA 1995). The water separator allows the recovery of the solvent and also generates a waste-water stream that is saturated with the cleaning solvent (i.e., water with a dissolved concentration at the trichloroethene [TCE] solubility limit). A typical layout/flow diagram of a vapor degreaser is shown in Figure 2.1. Many vapor degreasers are installed in a pit so that the work area (for placing and removing parts) is at a convenient work height (or the work area is surrounded by an elevated decking for access). The spent solvent can be reclaimed by distillation that is usually completed in a separate recovery still. Oil, grease, and dirt are separated from the solvent as it is distilled. The pure solvent vapor is condensed, passed through a water separator, and is ready for recycling to the degreaser. The distillation can leave a heavy concentration of sludge in the bottom of the still and the still is typically designed with a convenient drain and cleanout system (as opposed to the base of a degreaser in a pit). A typical layout/flow diagram of a solvent recovery still is shown in Figure 2.2. The 2-10 Building degreasers were of this type.

2.1.1 North Degreaser

The degreaser within the North Sheetpile Area in Building 2-10 was placed in a concrete sump (with dimensions of 13 by 16 feet) located between columns E43 and F43. Equipment within the pit included a storage tank and the vapor degreaser. Steam heat was supplied to the vapor degreaser and cold water was used for chilling to provide vapor control. Used solvent was processed through a still (located adjacent to the pit) and recycled. The cleaning solvent (TCE) was delivered to the degreaser from an aboveground storage tank located in the southeast corner of Building 2-10. This degreaser was decommissioned in 1993 and all equipment has been removed.

2.1.2 South Degreaser

The two degreasers within the South Sheetpile Area in Building 2-10 included two concrete sumps (15 feet by 32 feet and 15 feet by 9 feet) located between Columns D14 and D17. Equipment within the pits included storage tanks and the vapor degreasers. Steam heat was supplied to the vapor degreasers and cold water was used for chilling to provide vapor control. Used solvent was processed through one still (located between the two pits) and recycled. The cleaning solvent was delivered to the degreaser from an aboveground storage tank located in the southeast corner of Building 2-10. These degreasers were decommissioned in 1993 and all equipment has been removed.

2.1.3 Other Degreaser

Another smaller vapor degreaser was present in Building 2-10 based on historical drawings (circa 1958). The degreaser was in a process area referred to as the Chem Mill area and included a concrete sump (with approximate dimensions of 15 by 10 feet) located near columns D32 and E33. Used solvent was processed through an adjacent still. This degreaser was decommissioned prior to 1993 (the specific date is unknown) and all equipment has been removed.

2.1.4 Potential Releases from Vapor Degreasers and Implications for the Interim Measures

The existing soil and groundwater sampling data from the areas near the North and South Degreasers provide empirical evidence of releases. No specific operational knowledge or records of a release from the degreasers exists. Based on general knowledge of degreaser operations, the types of plausible releases include a spill of the neat TCE solvent and/or a spill/discharge of TCE-contaminated water from the water separator.

A release of neat TCE solvent would represent a dense non-aqueous phase liquid (DNAPL) source in the soil/groundwater, potentially a deeper dissolved plume affected by the density driven sinking of a DNAPL, and potentially a larger inventory of TCE. A release of TCE-contaminated water from the water separator would result in a dissolved TCE plume, without the density effects of a DNAPL release and a smaller residual inventory of TCE.

Regarding implications for the planned IMs, the area/depth of the plume at concentrations greater than cleanup levels needs to be defined (regardless of the type of release) but the time frame required to achieve the cleanup levels would be longer with a neat TCE solvent release, due to the larger inventory with potential DNAPL presence.

2.2 SITE HYDROGEOLOGY

The site is within the Duwamish Valley and the hydrogeologic setting is an alluvial basin located between bounding uplands to the east and west. Within the alluvial basin, the groundwater aquifer flows in a direction toward (and discharges to) the Duwamish Waterway, as the waterway flows north, ultimately discharging to Elliott Bay. The regional geology and hydrogeology of the Duwamish Valley has been studied in a number of investigations, with the most complete summary provided in the Duwamish Hydrogeologic Pathways Project (Booth and Herman 1998). General characteristics of the relevant hydrostratigraphic units in the area are described below:

- **Fill.** Fill in the area is generally encountered within the top 20 feet (often much less, except near the river channel) and is considered to be material that was removed during the dredging and re-channelization of the Duwamish Waterway.
- **Younger Alluvium.** The younger alluvial deposits contain wood and other organic materials (plant matter from the tide flats) in a silt and sand matrix. The alluvial deposits have a relatively constant thickness and depth, and are located near the present day sea level.
- **Older Alluvium.** Older alluvium comprises estuarine deposits present throughout the area beneath the younger alluvium with variable basal depth (up to 100 feet in the center of the valley and appreciably thinner near the valley edges). The older alluvium is typically identified as sandy silt in the lower portions, and sand and silty sand in the upper portions.

The aquifer system within the Duwamish Valley is typically considered a single unit within the younger and older alluvium stratigraphic units. General estimates of the hydraulic conductivity range from 10^{-1} to 10^{-3} cm/second (280 to 2.8 feet/day) with the range highly dependent on the

silt content of the specific area and stratigraphic unit (Booth and Herman 1998). Using a typical gradient at Plant 2 of 0.002 and an effective porosity of 0.25 (Weston 1996), this would correspond to a range of pore velocities of 8.2 feet/year to 820 feet/year.

Within the alluvial aquifer (defined above as a single unit), further distinction is made between "upper" and "lower" groundwater zones, which are typically differentiated based on locally continuous silt aquitards, upward vertical gradients, and/or the occurrence of saline groundwater. Brackish groundwater conditions are encountered in the lower groundwater zone throughout much of the valley. The data from locations distant from the waterway suggest that the deeper brackish water is derived from the original sediment deposition in an estuarine environment. The density differences of the brackish water are expected to have significant impact on groundwater flow with the fresh groundwater from recent recharge tending to migrate above the higher density saline water (Booth and Herman 1998). This tendency is based on the observation that deeper zones remained brackish thousands of years after alluvial deposits filled the prior southern position of Elliott Bay.

The groundwater flow direction within the alluvial aquifer has been mapped at a regional scale and in numerous local areas. As expected in an alluvial river valley, the flow direction is from the valley edges (sources of recharge) toward the river (discharge point). In general, regional flow patterns appear approximately perpendicular to the river, with local variations due to changes in river alignment (bends in the river), recharge areas, and variations in subsurface materials. Near the Duwamish Waterway, tidal influences are observed that cause temporary changes in the water level and groundwater flow direction. The overall groundwater flow direction appears generally unchanged when the tidal variations are averaged over short-term tidal cycles.

For investigation purposes within Plant 2, the uppermost aquifer has been divided into three different levels that are designated as follows:

- A level—shallow, approximately 10 to 30 feet below ground surface (bgs)
- B level—intermediate, approximately 30 to 60 feet bgs
- C level—deeper, approximately 60 to 100 feet bgs

These levels are not separate aquifers but rather hydraulically connected zones that are defined primarily by depth below ground surface, rather than as separate hydrostratigraphic units. Each of the levels is tidally influenced, with water levels varying by approximately 2 to 4 feet over tidal cycles in the area of the 2-10 Sheetpiles.

Boeing has completed numerous hydrogeologic studies in the area, including an effectiveness evaluation for the IM sheetpile containment structures (Weston 2001). The IM effectiveness evaluation included continuous measurements of water level, temperature, and electrical conductivity in wells located within and around the sheetpiles and in the Duwamish Waterway. These data were used to evaluate density-dependent pressures and tidally averaged conditions at different levels in the area of the sheetpiles. This evaluation concluded that the net vertical gradient was upward due to the density differences of the more saline water that is present at greater depths (B level wells typically had salinity in the 10–20 part-per-thousand range). These results are consistent with regional hydrogeologic conditions (Booth and Herman 1998).

2.3 GROUNDWATER CHEMISTRY

Groundwater chemistry is available from multiple investigations that have been completed over the last 17 years:

- Initial RCRA Facility Investigation (RFI) activities from 1992 to 1996 (multiple phases)
- Performance monitoring at the completion of the sheetpile installation from 1994 to 1995
- Follow-up performance monitoring of the sheetpiles in 2001
- The Shoreline Monitoring Program at Plant 2 from 2001 to the present

Initial groundwater investigations were performed at AOC 2-10.3A and AOC 2-10.4A (two degreasers in the 2-10 Building) during the original RFI work performed from 1992 to 1996 (Weston 1996). The initial soil and groundwater sampling near these two AOCs started in early 1992 (Weston 1992a). The northern area (AOC 2-10.3A) consisted of one degreaser in a concrete containment sump. The southern area (AOC 2-10.4A) consisted of two degreasers (in close proximity to each other) both within concrete containment sumps. The initial Phase I site investigations (Weston 1992a) covered the entire 2-10 Area north of 16th Avenue South (including Buildings 2-10, 2-15, 2-09 and the fuel storage facilities near Building 2-13). In the areas near the North and South Degreasers within Building 2-10, the investigation included one soil boring (E-42) with one monitoring well (MW-12, later renamed PL2-212a) near the north degreaser and three soil borings (D-13, D-16, and D-17) with one monitoring well (MW-09, later renamed PL2-209A) near the south degreasers. Analytical results from soil and groundwater samples identified a release from these two units.

Expanded Phase II investigations with additional monitoring wells at these AOCs were completed in mid-1992 (Weston 1992b). Ten soil borings and five additional groundwater wells were installed near the North Degreaser. Fourteen soil borings and five additional groundwater wells were installed near the South Degreasers. Soil and groundwater samples were analyzed for VOCs, petroleum hydrocarbons, and metals. Analytical results from both of the areas near the degreasers were similar, with TCE, dichloroethene (DCE), vinyl chloride (VC), and several metals detected at multiple locations. Petroleum hydrocarbons were not detected in samples from locations near either unit. A general summary of key sampling data from the 1992 investigations is presented in Tables 2.1a and 2.1b. Additional information (copied directly from the 1992 reports and later) is included in Appendix A. Figure 2.3 presents a plan view of the 1992 groundwater sampling data near each of degreasers (before the sheetpiles were installed).

The 1992 investigations identified a release to soil and groundwater at the two degreaser areas in the 2-10 Building. Boeing elected to implement interim corrective measures at these two areas in 1993 (Weston 1993a and 1993b). A containment technology using a hanging sheetpile wall was constructed around each area using interlocking sheetpiles with sealed joints (a sealable sheetpile manufactured under license by Waterloo Groundwater Control Technologies). The work was initiated in late 1993 and completed in April 1994 (Weston 1994).

Performance monitoring following completion of N/S Sheetpile installation included new groundwater monitoring wells and sampling for 12 monthly events (October 1994 to September 1995).

An effectiveness evaluation of the two sheetpile structures was performed in 2001 (Weston 2001). This evaluation included installing new wells and sampling groundwater from existing wells. The new wells were installed to determine if VOC mass was escaping from the N/S Sheetpiles.

Sampling near the other degreaser (in the Chem Mill area near Column D32) has included soil samples collected in 1992 from the downgradient area of this degreaser. Those results indicated non-detect values for TCE and its degradation products at 1-foot and 10-foot depths. Groundwater sampling has also been conducted in the downgradient A level wells near this degreaser at monitoring wells PL2-210A, PL2-240A, and PL2-271A. The first two sampling events (at PL2-210A in February and March 1992) indicated low levels of TCE (2.5 and 8.3 µg/L) and all degradation products (e.g., DCE and VC) at non-detect levels (less than 1 and less than 2 µg/L, respectively). Subsequent sampling has found TCE at less than 1 µg/L and VC detected once at 0.022 µg/L. The next downgradient well in the A level, PL2-240A, was sampled eight times between late 1993 and 1996. Analytical results for VOCs indicated TCE at less than 1 µg/L in each event with cis-1,2-DCE detected once at 2.2 µg/L and at less than 1 µg/l for the other seven events. Vinyl chloride was detected twice at 0.054 and 0.21 µg/L, with concentrations for the remaining six events less than 2 µg/L). The next downgradient well in the A level, PL2-271A, is part of the Shoreline Monitoring Program and was sampled 16 times between 2001 and 2008. Analytical results for VOCs indicate TCE and DCE at less than 1 µg/L in each event. Vinyl chloride was detected four times at concentrations between 1 and 1.3 µg/L (two of the four samples are flagged with a J qualifier) with the concentrations for the remaining 12 sampling events less than 1 µg/L.

The Shoreline Monitoring Program includes Wells PL2-258A, PL2-258B, PL2-258C near the North Sheetpile, PL2-271A downgradient of the Chem Mill degreaser, and Wells PL2-214A, PL2-214B, and PL2-214C near the South Sheetpile. These boundary wells are located immediately downgradient of the 2-10 Area N/S Sheetpiles. Sampling and analysis of wells in the Shoreline Monitoring Program is now conducted semiannually but was performed quarterly from 2001 to 2002 and from 2003 through 2007.

The site characterization sampling in the area of the 2-10 N/S Sheetpiles has included approximately 950 samples for VOC analysis (including both soil and groundwater samples) completed over a period of 17 years. Conditions over this time period have changed (specifically VOC concentrations) due to various processes, including the following:

- Containment of the solvent source areas provided by the N/S Sheetpile IMs completed in 1994.
- Natural degradation processes, primarily reductive dechlorination, where the initial parent compound (TCE used in the degreasers) is broken down into the daughter products cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), VC, and ultimately ethene/ethane.

- Other attenuation processes that may remove or degrade the VOCs, including but not limited to dispersion, tidal flushing, and aerobic degradation processes (especially near the waterway).

Most of the sampling events have included selected wells/locations targeted for a specific monitoring objective (e.g., initial characterization, IM performance monitoring, the Shoreline Monitoring Program). As such, there are few snapshots that represent all monitoring wells (or most wells) in synoptic sampling events. The VOC concentrations for two monitoring events with coverage of most wells are shown in Figures 2.4 and 2.5 (for the North and South Sheetpiles, respectively). Data from the same sampling events are presented as vertical cross sections in Figures 2.6 and 2.7 (for the North and South Sheetpiles, respectively).

The general trends in VOC concentrations can also be evaluated across time in specific wells. The time series data are presented as total VOCs (sum of TCE, DCE, and VC) in order to capture and represent the known TCE degradation products. The data from the time series plots at specific wells can also be used to estimate a first-order degradation rate constant based on the rate of change in total VOC concentrations (USEPA 2002). Time series trends of VOC concentrations in selected wells are shown in Figures 2.8 and 2.9 (for the North and South Sheetpiles, respectively) along with calculated rate constants and corresponding degradation half-lives. The calculated half-lives represent all removal processes. Higher VOC loss rates (i.e., shorter half-lives) are generally apparent for wells located outside of the sheetpile structure. The higher loss rates are consistent with the presence of dispersion mechanisms outside the sheetpile enclosure that are not active within the enclosure. The calculated degradation half-lives are of a similar magnitude to the values derived from the Electronic Manufacturing Facility (EMF) VOC plume (prior to implementing ERD in the EMF plume).

2.4 CONCEPTUAL SITE MODEL

Soil and groundwater samples collected in conjunction with the RFI confirmed the presence of chlorinated ethenes beneath Building 2-10. The groundwater contamination was subsequently mapped to two discrete plumes associated with the operation of three vapor degreasing units. In 1993 and 1994, IMs in the form of sheetpile containment enclosures were installed around the source areas and a portion of the two plumes. A CSM was prepared in conjunction with the *RCRA Facility Investigation Groundwater Investigation Interim Report*, dated January 1996 (Weston 1996). Additional data were collected in 2001 and 2002 along with other related work in the Duwamish Valley (specifically the Duwamish Hydrogeologic Pathways Project and characterization data from the EMF VOC plume and other sites) that necessitate updating the CSM.

2.4.1 Conceptual Site Model Objective

The overall objective of a CSM is to provide a coherent summary of all existing data in a consistent framework that best describes the subject site and the fate and transport of any contamination at that site. The CSM is used as a tool to assist in subsequent project planning and implementation in the following manner:

1. Provide the basis for application of the DQOs process in which the project team defines the anticipated site decisions that need to be made and establishes data requirements necessary to support those decisions.
2. Identify and prioritize relevant site exposure pathways.
3. Identify data gaps (in existing site characterization data) that must be satisfied to support decisions.
4. Serve as a key instrument through which site data and decisions are communicated to stakeholders.

2.4.2 Key Elements of the Conceptual Site Model

Key elements of the CSM include the following:

1. Site history and background
2. Site setting and boundaries
3. Geologic and hydrogeologic conditions
4. Source(s) of chemical release(s)
5. Constituents of concern
6. Contaminant transport pathways from the site
7. Exposure pathways for human and ecological receptors
8. VOC plume boundaries
9. Remedial actions implemented to date
10. Performance metrics

The CSM is presented in Table 2.2. The CSM forms the basis for organizing all site data, testing the efficacy of proposed data collection efforts going forward, and ultimately, testing the performance of proposed and implemented remedies. As such, the CSM has been developed to reflect the best interpretation of all relevant site data presently available. As new data are collected, they will be tested for consistency with the CSM, and the CSM will be modified as appropriate. The CSM is intended to evolve with the understanding of the site conditions through collection of additional data and performance monitoring of remedial measures. Ultimately, the CSM is expected to transition into a Performance Model to which post-remediation monitoring data would be compared to determine if the IM is performing as expected.

A CSM has been developed for the site that discusses the key elements listed above based on data collected during prior site investigations and remedial actions (refer to Table 2.2).

Table 2.3 presents selected data (the specific soil and water samples with the highest TCE concentrations) from the initial investigations and an evaluation of the potential presence of TCE as a DNAPL. These data indicate that dissolved TCE concentrations near the water table are high enough to suspect a DNAPL as present, but the same data also suggest that TCE (if

released as a neat solution) was not able to penetrate the water table in sufficient quantity to form a deeper DNAPL pool (i.e., deeper soil and water samples show decreasing TCE concentrations and at levels orders of magnitude lower than would be expected in an area connected to TCE as DNAPL). As discussed in the summary of vapor degreaser operations and the CSM, it is possible that a release may have occurred from the water separators used with the vapor degreasers. A release from the water separators would have contained dissolved TCE at the solubility limit of 1,100 mg/L. It is also possible that a release could have occurred by both mechanisms. Regardless of the release mechanism(s), empirical evidence demonstrates that a release occurred, existing water quality data exceed applicable standards, and IMs to address the identified problems are recommended. Both of the remedial technologies proposed (SVE for the vadose zone and ERD for the saturated zone) have been effectively applied to sites with both dissolved plumes and those with a DNAPL source area.

2.5 ANTICIPATED PROJECT DECISIONS

Given the CSM, there are two objectives for data collection/evaluation efforts in this plan:

1. Determine current site conditions to evaluate the two primary pathways of concern (discharge to the adjacent waterway and potential exposure via indoor air).
2. Evaluate the feasibility of candidate technologies for implementing IMs to address VOCs in soil and groundwater. Two technologies have been identified as the most likely candidates for the next phase of IMs: SVE to remove any vadose zone contamination (and if necessary, manage any vapor intrusion risk), and ERD, to accelerate mass removal (through biodegradation) from the saturated zone.

With respect to the first objective, the decisions that need to be made regarding current conditions (nature and extent) are:

1a. Does vapor intrusion to indoor air pose an unacceptable risk?

1b. Do current VOCs in soil/soil vapor presently contribute to water quality contamination (within the contained sheetpiles)?

1c. Are current conditions changed from historical conditions relative to the identified contamination from the degreaser operations (i.e., how much have concentrations changed [increase or decrease] relative to historical data and do those changes impact the IM design)?

1d. Do the existing data adequately define the plume boundaries for IM design?

1e. Are VOC concentrations decreasing within the sheetpiling?

1f. Are VOC concentrations decreasing outside the sheetpiling?

With respect to the second objective, the decisions to be made regarding IM design and CM selection are contingent on the decisions made relevant by the first objective:

2a. If a vapor intrusion pathway exists (i.e., measured as a complete pathway), will SVE control it adequately?

2b. If VOCs are present in soil vapor at elevated levels, is SVE an appropriate means of controlling or eliminating the contaminant mass and what rate of VOC loading to activated carbon or other treatment technology should be expected from the SVE operation?

2c. If historical conditions have changed, will they change the identity or design of the IMs?

2d. How will ERD affect current degradation rates outside the sheetpile enclosure?

2e. How will ERD affect current degradation rates inside the sheetpile enclosure?

Some of these decisions can be made on the basis of existing characterization data and information, while others may require new data as discussed in Section 2.6.

2.6 DATA NEEDS

The anticipated IM design decisions with respect to elimination of VOC contamination associated with the former degreasers at the N/S Sheetpiles require new data. The new data that will be required are identified in a DQO process summarized in Table 2.4.

The IM data needs that are not met by the existing data will be filled through five specific data collection activities as follows:

Data Collection Activity	Purpose/Objective
1. Conduct indoor air sampling within 2-10 Building (refer to separate plan)	Evaluate exposure potential via indoor air
2. Conduct synoptic groundwater characterization sampling of existing wells	Establish current groundwater conditions
3. Collect water sample in targeted area within the North Sheetpile Area (near PL2-218B)	Supplement existing data to identify the base of the VOC plume and further evaluate the potential presence of DNAPL in the area
4. Conduct co-located characterization sampling and analysis of soil and soil vapor from selected locations near the degreaser pits within the sheetpile enclosures	Establish current soil conditions in expected hotspot areas and estimate total VOC inventory for SVE system design
5. Implement SVE IMs, if warranted, and monitor performance	Performance monitoring to evaluate progress
6. Implement ERD IMs, if warranted, and monitor performance	Performance monitoring to evaluate progress

The first activity (indoor air sampling) will be conducted by Golder & Associates and is addressed in a separate Work Plan. The second and third of these activities are the subject of this Phase 1 Work Plan. The final two activities will be initiated and proposed in a separate Phase 2 Work Plan. Based on the historical data, Boeing anticipates Phase 1 data will identify sufficient levels of contamination and warrant Phase 2 work.

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3.0 Planned Characterization Sampling

The IM characterization field work consists of sampling soil, soil vapor, and groundwater from selected locations and monitoring wells at positions inside and outside of the 2-10 Area N/S Sheetpiles. The objectives, number of samples, analyses planned, documentation and schedules associated with these IM monitoring elements are described in greater detail in the SAP (Appendix B). Additional details on methodologies and procedures to be implemented for sample collection are included as SOPs in Appendix C. The monitoring program is designed to collect data defined in Section 2.6 and is summarized in the following sections.

3.1 GROUNDWATER

The groundwater sampling will provide current data for VOCs, total organic carbon (TOC), and geochemical parameters in the A and B levels of the aquifer at the 2-10 Area N/S Sheetpiles. These data will be used to evaluate ERD as an IM for VOCs in site groundwater and to design ERD as a presumptive remedy if conditions are suitable and warrant an IM. These data will also serve to define baseline conditions or pre-IM conditions. In addition, two new Geoprobe sampling locations are planned; one new location (near PL2-218B within the North Sheetpile Area) will include a one-time Geoprobe sampling to define the depth of the plume in that area; the other location near PL2-210A will collect B level data in the area downgradient from the Chem Mill degreaser located near column D32. Table 3.1 lists the monitoring wells that will be sampled and analyzed for the specific compounds and analytes noted, including VOCs, TOC, selected dissolved metals (arsenic and manganese, two redox sensitive species), major cations (calcium, magnesium, potassium, and sodium), major anions (chloride, sulfate, and alkalinity [bicarbonate, carbonate, and hydroxide ion]), *Dehalococcoides* bacterial census count, dissolved gases (including ethane and ethene), and field parameters (dissolved oxygen, redox potential). Figure 3.1 shows the location of the existing groundwater monitoring wells to be sampled as part of the characterization effort. The analytes listed in Table 3.1 have been developed with two objectives in mind. The first is to collect the appropriate data needed for design, optimization, and performance monitoring of the planned IMs. The secondary objective is to collect data, where appropriate, that can be used to support the upcoming Data Gaps Investigation (DGI) in the 2-10s Area. The sampling described in this Work Plan (focused generally on the nature and extent of VOC plumes and other parameters for ERD remedial design) is not intended to replace the 2-10s DGI, but the data collected may be used to support the DGI where appropriate.

The list of selected analytes by well is not uniform (i.e., not all wells will be sampled for all analytes) based on the project objectives, anticipated decisions, and data needs developed following a DQO process. An example includes Wells PL2-209B and PL2-252A where existing data indicate very low or non–detect levels of the target VOCs. Based on these known conditions, analysis for dissolved gases (specifically looking for ethene as a degradation daughter product of VC) has not been included. The presence of ethene will not increase with ERD because insufficient VOCs are present to generate it (at measureable levels). Other examples are the wells selected for TOC and selected dissolved metals; these data are planned for IM design and monitoring, not to replace any of the data needs yet to be identified in the planned 2-10 Area DGI.

3.2 SOIL AND SOIL VAPOR

The soil and soil vapor sampling will provide current data for VOCs present in vadose zone soil (both soil and soil vapor) in the area of the 2-10 N/S Sheetpiles. The specific areas selected are locations that had previously exhibited the highest VOC concentrations in soil as determined by 1992–1994 characterization data from samples near the former degreaser pits at a depth of approximately 10 feet bgs. The soil and soil vapor sampling data will be used to evaluate SVE as an IM for VOCs in site vadose zone soils and to design SVE as a presumptive remedy if conditions are suitable and warrant an IM.

Tables 3.2 and 3.3 list the planned soil and soil vapor sampling locations, depth intervals, and the specific media to be sampled for VOC analysis. Figure 3.2 shows the location of the planned soil sampling locations.

3.3 OTHER SAMPLING

As noted previously, indoor air sampling will be conducted under a separate Work Plan. All work will be coordinated so that data are collected over similar time frames and comparable conditions.

Six of the wells in the vicinity of the N/S Sheetpiles are presently included in the Shoreline Monitoring Program (Wells PL2-258A, PL2-258B, and PL2-258C near the North Sheetpile and Wells PL2-214A, PL2-214B, and PL2-214C near the South Sheetpile). The six wells noted above (PL2-258A, PL2-258B, PL2-258C, PL2-214A, PL2-214B, and PL2-214C from the Shoreline Monitoring Program) will also be sampled as part of this IM. The field notes will record the sampling time and reporting will note the corresponding tidal stage during sampling of all monitoring wells.

4.0 Reporting and Schedule

The data collected under this Phase 1: Data Collection Work Plan will be used to develop the design for the IMs. The data and the proposed IM design will be presented in the Work Plan for Phase 2: IM Implementation. This Phase 2 Work Plan will be submitted 60 days after Phase 1 sampling, allowing time for analysis, quality assurance, data evaluation, and IM design work (including coordination with building users). The Phase 2 Work Plan will include the following:

- Tabulated summary of collected data
- Figures showing chlorinated VOC concentration and distribution
- Conclusions related to IM selection based on evaluation of the data
- Recommended IM technology (or technologies) for the 2-10 Area Sheetpiles
- Preliminary design of the IMs
- Schedule for the implementation of the IMs
- Performance monitoring requirements for the IMs

Specific schedule elements are listed below:

Task	Date
1. Submit draft IM Work Plan for Phase 1: Data Collection to USEPA for review	November 2008
2. Receive comments from USEPA	April 13, 2009
3. Re-submit plan for final review following comment resolution	Due June 18, 2009
4. USEPA approves final plan	TBD
5. Perform investigation, sample analysis and quality assurance of data	Begin within 30 days after Task 4[1]
6. Submit draft IM Work Plan for Phase 2: IM Implementation (including Phase 1 data) to USEPA for review	60 days after the completion of Task 5

Notes:

1 Task 6 schedule may be adjusted as needed based on the availability of drilling contractors and required coordination with building user requirements.

Abbreviations:

Days Calendar days
TBD To be determined

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5.0 References

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Boeing Plant 2
Seattle/Tukwila, Washington

North and South Sheetpiles in the 2-10 Building Interim Measure Work Plan (AOC 2-10.3A and AOC 2-10.4A)

Phase 1: Data Collection

Tables

AGENCY REVIEW DRAFT

Table 2.1a
Summary of Key VOC Data from 1992 Investigations near the North Degreaser in Building 2-10

SOIL		PL2-212A Depth (feet bgs)			PL2-212B Depth (feet bgs)						
Chemical	**Units**	**1**	**11**	**13**	**5**	**10**	**15**	**28**	**30**	**35**	**40**
TCE	µg/kg	28 J	1,000 J	23,000	540	48,000	6,900	2.4 J	2.2	15	3.3
cis-1,2-DCE	µg/kg	.9 J	11,000	44,000	90	6,400	44,000	5.70	1.8	1.2 U	3.9
VC	µg/kg	2.1 U	750	1,800	2.3 U	1,300 U	340	2.5 U	2.4 U	2.4 U	2.4 U

GROUNDWATER		PL2-212A Mar 1992	PL2-212B Aug 1992
Chemical	**Units**	**Screened 6–16 feet bgs**	**Screened 40–55 feet bgs**
TCE	µg/L	420,000	1 U
cis-1,2-DCE	µg/L	86,000	1.5
VC	µg/L	25,000	1 U

Abbreviations:

bgs Below ground surface
DCE Dichloroethene
TCE Trichloroethene
U Undetected
VC Vinyl chloride
VOC Volatile organic compound

Table 2.1b
Summary of Key VOC Data from 1992 Investigations near the South Degreaser in Building 2-10

SOIL		D 16 (soil boring closest to PL2-209A) Depth (feet bgs)			PL2-209B Depth (feet bgs)							
Chemical	**Units**	**2.5**	**7.5**	**12.5**	**5**	**10**	**15**	**20**	**33**	**45**	**50**	**55**
TCE	µg/kg	6	2.9	27,000	4	2.4	32,000	300	150	90	45	120
cis-1,2-DCE	µg/kg	1.1 U	1.0 U	560	1 U	1.1 U	ND	5.4 J	8.2 J	7.7 J	8.6	7.3
VC	µg/kg	2.1 U	1.9 U	44	2.1 U	2.3 U	410 J	11 U	11 U	11 U	11 U	10 U

GROUNDWATER		PL2-209A Feb 92	PL2-209B Aug 92
Chemical	**Units**	Screened 8–18 feet bgs	Screened 40–55 feet bgs
TCE	µg/L	32,000	1 U
cis-1,2-DCE	µg/L	840	1 U
VC	µg/L	160	2 U

Abbreviations:

bgs Below ground surface
DCE Dichloroethene
TCE Trichloroethene
U Undetected
VC Vinyl chloride
VOC Volatile organic compound

Table 2.2
Summary of Conceptual Site Model (CSM)
Volatile Organic Compound Plumes near the 2-10 Area Sheetpiles

CSM Element	Conditions Considered within the Conceptual Site Model
History and Background (Weston 1996)	• The 2-10 facility was used for aircraft production starting in the 1940s. Equipment included four vapor degreasers in three discrete locations, which were decommissioned and removed in 1993. Degreasers were installed with secondary containment including sumps. • Sheetpile walls were installed as an interim measure to encompass most of the contaminant mass in the two plumes (the source area and a portion of the volatile organic compound plumes) at the two main degreaser locations in 1994. • An effectiveness evaluation in 2001 concluded the sheet walls were effective at containing the volatile organic compound (VOC) plumes.
Setting and Boundaries (Weston 1996; Weston 2001; EPI 2008)	• Present land use continues to support aircraft production activities, with all major portions of the existing plumes lying beneath Building 2-10. Current building activities include small-scale manufacturing, parts testing, shipping/receiving functions, and storage. • Soil and groundwater contamination by VOCs is concentrated (and bounded) in two areas associated with decommissioned vapor degreasers: designated as AOC 2-10.3A North (the 2-10 North Sheetpile) and AOC 2-10.4A South (the 2-10 South Sheetpile). • The AOC 2-10.3A North plume covers an area approximately 450 feet (SW to NE in the direction of groundwater flow) by 250 feet (NW to SE in direction transverse to groundwater flow) beneath the north end of Building 2-10. The general footprint of the plume (approximately 450 by 250 feet) remains similar from 1992 to 2008 (refer to Figures 2.3 and 2.4); however, groundwater concentrations have attenuated during that time (refer to Figure 2.8). • The AOC 2-10.4A South plume covers an area approximately 250 feet (SW to NE in the direction of groundwater flow) by 150 feet (NW to SE in direction transverse to groundwater flow) beneath the north end of Building 2-10. The general footprint of the plume (approximately 250 by 150 feet) remains similar from 1992 to 2008 (refer to Figures 2.3, and 2.5); however, groundwater concentrations have attenuated during that time (refer to Figure 2.9).
Geology and Hydrogeology (Weston 1996; Weston 2001)	• Underlying soil matrix is alluvium deposited within a river valley, consisting of inter-bedded silts and sands. Locally, silty sand/sand extends to approximately 90 feet below ground surface (bgs). • Uppermost aquifer begins 10 feet bgs and extends to 80 to 100 feet bgs. Discontinuous silt zones exist at depth, but no aquitard was identified at depths to 100 feet bgs. • Groundwater flows west towards and discharges to the Lower Duwamish Waterway. For investigation purposes, this uppermost aquifer has been divided into three levels: A (shallow), B (intermediate), and C (deeper). There is limited mixing between the upper two levels (A and B) and the lower zone, with the deepest level being brackish relative to the other two. • The Lower Duwamish Waterway is a tidally influenced river estuary, with fresh river water discharging above a tidally influenced saltwater wedge from Elliot Bay. Tidal influence is seen in the aquifer for 300 to 600 feet inland with decreasing amplitude and increasing time lag. • Installation of sheetpiles isolated the bulk of the VOC plumes. Both sheetpiles are hanging walls that are not tied into a lower permeability formation or aquitard. Detailed analysis of potentiometric heads by Weston (including density differences and tidally averaged conditions) resulted in the conclusion that net vertical gradients at depth are upward to discharge into the Lower Duwamish Waterway. • The roof and floor slab of Building 2-10 caps the site, thus eliminating natural recharge. As a consequence, within the sheetpile enclosures, vertical movement is restricted primarily to tidal cycle pressure fluctuations and, beyond the sheetpiles near the Waterway, some bank storage effect as the surface water moves in and out with the tides in the Lower Duwamish Waterway.
Source(s) of Chemical Release (Weston 1992; ASTM 1962 and 1976 "Handbook of Vapor Degreasing", Dow and Diamond Shamrock manuals	• Trichloroethene (TCE) was used as the degreasing agent in the sheetpile area degreasers where releases have been identified (based on empirical data of TCE found in soil and groundwater). A fourth degreaser was used (in the Chem Mill Area) where a release has not been evident (based on empirical data indicating the absence of TCE in soil and groundwater). • The location and characteristics of the residual TCE suggest the releases were from within the degreaser pits (refer to Figure 2.3), and traveled down to 20 to 30 feet bgs. Below approximately 30 feet (refer to text and figures for details) concentrations drop quickly to the low and sub parts per billion range. • TCE residues in saturated soils act as an on-going release to groundwater through leaching. • TCE residues in the unsaturated soils (vadose zone) act as an on-going release to soil vapor beneath the 2-10 Building, which has the potential to intrude into the building through cracks in the foundation. • TCE residues are naturally degrading to form dichloroethenes (DCE) and vinyl chloride (VC).
Chemicals of Concern (Weston 1996)	• TCE and its degradation products, 1,1-dichloroethene (DCE), 1,2-DCE (both cis and trans isomers), and VC have been detected in site soil and groundwater at the northern plume. • TCE and its degradation products, 1,1-DCE, 1,2-DCE (both cis and trans isomers) and VC have been detected in site soil and groundwater at the southern plume. Much lower levels of 1,1,2-trichloroethane have also been observed in the southern plume. • TCE is documented as the degreasing solvent used at Plant 2 and there is no evidence of use of DCE or VC in the facility, suggesting that these chemicals are by-products of natural reductive dechlorination mechanisms in the subsurface environment.

CSM Element	Conditions Considered within the Conceptual Site Model
The Potential For DNAPL Occurrence	• The initial TCE concentrations in groundwater (highest) were 420,000 µg/L and 32,000 µg/L in 1992 for the north and south plumes, respectively. These values are consistent with either loss of pure phase solvent (a DNAPL) or discharge of the saturated solution from the degreaser water separator (refer to Section 2.1 and Figure 2.1 for discussion of vapor degreasers). If the former were the source (i.e., loss of pure phase solvent), dense non-aqueous phase liquids (DNAPL) would be expected and high dissolved concentrations would persist over time. If the latter were the source (i.e., release of a saturated aqueous solution), the concentrations would diminish faster over time due to natural degradation. • The 1992 characterization data (relevant to evaluating the potential presence of DNAPL) are summarized in Table 2.3 which indicated high concentrations in the shallow zone near the water table and decreasing concentrations at deeper depths. The 1992 investigations did not extend to the point of contact with the aquitard below the C level of the aquifer. Later (in 1995), a C-zone well was installed extending to the point of contact with the aquitard below the C zone just downgradient of the North Sheetpile (PL2-258C). In 2001 a similar C-zone well was installed at the South Sheetpile (PL2-214C extending to the point of contact with the aquitard below the C zone). Well PL2-258C has been sampled 21 times over the last 14 years and all results for TCE have been below the method detection limit (typically 1 U; one time at 0.2U). Well PL2-214C has been sampled 15 times over the last 8 years and all results for TCE have been below the method detection limit (typically 1 U; one time at 0.2U). Based on these results, there is no indication of DNAPL occurrence at the base of the aquifer. No DNAPL has been observed to date in the prior investigations. • TCE concentrations in groundwater have decreased since 1992 (significantly in the South Sheetpile area and more modestly in the North Sheetpile area, as of 2001 sampling), even though no active remedial action has been implemented within the 2-10 Building sheetpiles. In the South Sheetpile area TCE concentrations are no longer sufficiently high to indicate the present of DNAPL. In the North Sheetpile area, TCE concentrations are at 7.1% of TCE solubility (as of 2001) and may indicate the presence of DNAPL that would be present at depths from approximately 10 to 25 feet bgs (possibly as a trapped ganglia). It is also possible that the observed concentrations are due to the release of a saturated aqueous solution (from the degreaser water separators), rather than a release of free product TCE.
Fate and Transport Pathways (Weston 2000; trend analysis of VOC data from Boeing Plant 2 Database)	• Primary attenuation of TCE is through biological and chemical degradation by reductive dechlorination; secondary attenuation, especially in the vadose zone, includes volatilization. Convective transport in groundwater is limited due to the effect of the hanging wall as demonstrated in the 2001 effectiveness evaluation (Weston 2001). • Degradation is ongoing with production of cis-1,2-DCE (predominant isomer) and trans-1,2-DCE (at much lower concentrations), followed by their degradation to VC. Further reductive dechlorination of VC to harmless ethene may be occurring but has not been directly measured (ethene measurements have not been collected). • Volatilized chlorinated ethenes (TCE and its degradation products) could potentially enter indoor air primarily within the 2-10 Building as the plumes are overlain by the building. Once in the air, a host of oxidative, hydrolytic, and photolytic processes take over to degrade the compounds within hours to days (http://www.epa.gov/ttn/atw/hlthef/tri-ethy.html; Agency for Toxic Substances and Disease Registry [ATSDR] *Toxicological Profile for Trichloroethylene [Update]*. U.S. Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA. 1997). • Chlorinated ethenes in groundwater outside the sheetpiles will migrate towards the waterway and discharge in the Lower Duwamish Waterway. • The bulk of the residual chlorinated ethenes are present in soil and groundwater contained within the sheetpile structure with fairly limited mobility. • Reductive dechlorination processes benefit from the low dissolved oxygen and reducing conditions in the groundwater within the sheetpile structures. A best fit of degradation rates (1994 to 2002) for the reduction of total chlorinated ethenes yields rate constants of -0.0003 to -0.008 day^{-1} inside and around the North Sheetpile enclosure. Calculated degradation rate constants inside and around the South Sheetpile are -0.0005 to -0.002 day^{-1}. The calculated rates for the 2-10 VOC plumes are comparable to what has been observed at the Electronic Manufacturing Facility VOC plume prior to addition of substrate to accelerate reductive dechlorination.
Exposure Pathways (Weston 2001)	• Vapor intrusion into the 2-10 Building is a potential exposure pathway under current site conditions. A separate study is underway, with USEPA's pending approval, to evaluate the potential for exposure by this pathway. • The installation (and associated monitoring program) of the sheetpiles has controlled the groundwater discharge of majority of the released chlorinated ethenes to the waterway (Weston 2001). • Contamination that was outside the sheetpiles is being monitored as part of the Shoreline Monitoring Program. Recent data (EPI 2008) indicates that conditions at the South Sheetpile are contained (refer to Figures 2.5 and 2.6, results for PL2-214A, B, and C in Appendix A which indicate non detect values outside the South Sheetpile), while near the North Sheetpile area degradation products 1,2-DCE and vinyl chloride remain elevated, but decreasing, in PL2-258A and B. • Incomplete exposure pathways (based on present land use) include soil and on-site surface water drainage.
Corrective Measures Implemented to Date (Weston 2001)	• North Sheetpile structure installed in 1994 to contain plume associated with Resource Conservation and Recovery Act (RCRA) Unit AOC 2-10.3A North (the 2-10 North Sheetpile). Structure extends from near the ground surface to a depth of 30 feet bgs. • South Sheetpile structure installed in 1994 to contain plume associated with RCRA Unit AOC 2-10.3A South (the 2-10 South Sheetpile). Structure extends from near the ground surface to a depth of 25 feet bgs. • Long-term downgradient groundwater monitoring performed as part of Shoreline Monitoring Program since 2001.

CSM Element	Conditions Considered within the Conceptual Site Model
Performance Metrics	• Containment evaluation in 2001 concluded contaminants were not migrating out of the enclosures in groundwater. Concurrent work (Golder 2009) will evaluate whether vapor intrusion is occurring into the 2-10 Building. • Performance metrics for Interim Measure would include: 1. Is the contaminant mass declining at a rate that will eliminate unacceptable risk (indoor air and groundwater discharge) within a reasonable time frame? 2. Can the degradation/removal rate be accelerated?

Abbreviations:

bgs	Below ground surface
DCE	Dichloroethene
DNAPL	Dense non-aqueous phase liquid
RCRA	Resource Conservation and Recovery Act
TCE	Trichloroethene
TOC	Total organic carbon
VC	Vinyl chloride
VOC	Volatile organic compound

Table 2.3
Historical Groundwater and Soil Concentrations

Chemical	Chemical Properties							
	Typical Solubility (at 20–25 °C)		1% of Solubility (µg/L)	Form at Room Temp	Boiling Point	Specific Gravity (water = 1.0)	Vapor Pressure (mm Hg at 25)	Vapor Density (air = 1.0)
	mg/L	µg/L						
TCE	1,100	1,100,000	11,000	DNAPL	87°C	1.46	58	4.53
cis-1,2-DCE	3,500	3,500,000	35,000	DNAPL	55°C	1.28		3.34
VC	2,400	2,400,000	24,000	gas	-14°C (+7°F)	0.9121	2530	2.15

Predictors of DNAPL: North Sheetpile

GROUNDWATER[1]		PL2-212A Mar 1992		PL2-212A Apr 2001		PL2-212B Aug 1992		PL2-212B Apr 2001	
Chemical	Solubility (µg/L)	Worst Case Conc (µg/L)	Percent Effective Solubility (%)	Most Recent Data (µg/L)	Percent Effective Solubility (%)	Worst Case Conc (µg/L)	Percent Effective Solubility (%)	Worst Case Conc (µg/L)	Percent Effective Solubility (%)
TCE	1,100,000	420,000	38.18%	78,000	7.1%	1 U	0.00%	1 U	0.00%
cis-1,2-DCE	3,500,000	86,000	2.46%	35,000	1.0%	1.5	0.000043%	1 U	0.00%
VC	2,400,000	25,000	1.04%	9,800	0.41%	1 U	0.00%	1.5	0.0001%

SOIL[2]		PL2-212A 1992 Depth (feet bgs)			PL2-212B 1992 Depth (feet bgs)						
Chemical	Units	1	11	13	5	10	15	28	30	35	40
TCE	µg/kg	28 J	1,000 J	23,000	540	48,000	6,900	2.4 J	2.2	15	3.3
cis-1,2-DCE	µg/kg	0.9 J	11,000	44,000	90	6,400	44,000	5.70	1.8	1.2 U	3.9
VC	µg/kg	2.1 U	750	1,800	2.3 U	1,300 U	340	2.5 U	2.4 U	2.4 U	2.4 U

Predictors of DNAPL: South Sheetpile

GROUNDWATER[1]		PL2-209A Feb 1992		PL2-209A Apr 2001		PL2-209B Aug 1992		PL2-209B Apr 2001	
Chemical	µg/L								
TCE	1,100,000	32,000	2.91%	10	0.0009%	1 U	0.00%	1 U	0.00%
cis-1,2-DCE	3,500,000	840	0.02%	930	0.03%	1 U	0.00%	1 U	0.00%
VC	2,400,000	160	0.01%	100	0.00%	2 U	0.00%	1 U	0.00%

SOIL[2]		PL2-209A 1992 Depth (feet bgs)			PL2-209B 1992 Depth (feet bgs)							
Chemical	Units	2.5	7.5	12.5	5	10	15	20	33	45	50	55
TCE	µg/kg	6	2.9	27,000	4	2	32,000	300	150	90	45	120
cis-1,2-DCE	µg/kg	1.1 U	1.0 U	560	1 U	1.1 U	ND	5.4 J	8.2 J	7.7 J	8.6	7.3
VC	µg/kg	2.1 U	1.9 U	44	2.1 U	2.3 U	410 J	11 U	11 U	11 U	11 U	10 U

Notes:

1 Groundwater concentrations measured from wells and Geoprobes in the 2-10 Area from 1992 through 2008 were used.
- Groundwater concentrations are between 0.1% and 1.0% of solubility.
- Groundwater concentrations are between 1.0 % and 10% of solubility.
- Groundwater concentrations are greater than 10% of solubility.

2 Soil concentrations measured from soil samples with well installation and probes the 2-10 Area in 1992 (Febr- July)
- Soil concentrations greater than 1,000 mg/kg (1,000,000 µg/kg).
- Soil Concentrations greater than 10,000 mg/kg 10,000,000 µg/kg).

Abbreviations:

bgs	Below ground surface
Conc	Concentration
DNAPL	Dense non-aqueous phase liquid
DCE	Dichloroethene
TCE	Trichloroethene
U	Undetected
VC	Vinyl chloride
VOC	Volatile organic compound

Table 2.4
Data Needs Established Through Application of Data Quality Objectives

DQO Process Step	Application to 2-10 Building VOC Plumes	Existing Data	Additional Data Required to Support Interim Measures
The problems to be resolved	1. Contamination contained within the sheetpiles requires an on-going performance monitoring program for an unknown amount of time. 2. Contamination outside of the North Sheetpile is reaching the Duwamish and is being measured in Shoreline Monitoring Wells at elevated concentrations. 3. Contamination within or around the sheetpiles may pose a risk due to vapor intrusion into the 2-10 Building.	• Historical data throughout the 2-10 Building can be used to define the historical nature and extent of the plumes. Data also shows that reduction dechlorination is occurring. • 2001 study indicates that the sheetpiles were controlling sheetpile contaminant and groundwater migration from the plume area contained within the sheetpiles. • Shoreline monitoring results indicated that Wells PL2-258A and B continue to have elevated concentrations of DCE and VC.	• Data for groundwater within the sheetpile enclosures and the area immediately surrounding the enclosures is 7 years old. Given the rapid degradation rates observed between 1992 and 2002, the data needs to be updated to determine where contamination remains and at what levels. • Data is needed in soil and ambient air to access the potential for vapor intrusion into the 2-10 Building.
The boundaries of the study	Horizontal and vertical boundaries of VOC plumes from source areas (prior releases from 2-10 Building degreasers) to the discharge point at the Waterway and under-slab for potential vapor intrusion exposure pathway.	Historical data within and near north and south sheetpile enclosures. Shoreline monitoring results.	Data on current conditions. Indoor air vapor samples (see associated plan).
The decisions needed to resolve the problem: **1) Nature and extent**	1a. To what extent is vapor intrusion occurring into the 2-10 Building? Does it pose an unacceptable risk under the RCRA Order?	Historical VOC concentrations in soil and groundwater indicate the potential for vapor intrusion into the building. During the RFI, Boeing conducted indoor air sampling related to industrial exposure scenarios and determined that existing conditions (at that time) met the applicable industrial standards. Since that time, the science and understanding of physical processes associated with vapor migration into structures and monitoring for potential indoor air exposure have developed and evolved with new regulatory guidance.	Current indoor air samples are needed to reassess the pathway and potential risk. Unsaturated soil and soil vapor samples should also be collected in a similar time frame to assist in understanding the potential for a reservoir of contamination.
	1b. Do VOCs in the unsaturated zone (soil and soil vapor) act as a source of contamination to groundwater and/or indoor air?	Historical unsaturated soil data indicates that significant source materials may remain in the vadose zone.	Current soil samples, soil vapor and groundwater contamination levels must be measured within the enclosures to determine the current levels.
	1c. What are the geochemical conditions within and outside of the sheetpile structures and how will these support further reductive chlorination?	Selected wells for the two degreaser plumes were monitored through 2002; the Shoreline monitoring wells have been monitored through 2008. Existing data indicates downward trends in VOC concentrations due to reductive dechlorination.	Current groundwater geochemical conditions, both within and outside of the sheetpiles, need to be assessed to understand the existing biological processes and to predict the success of further enhanced biological processes.
	1d. Do the existing data adequately define the plume boundaries for IM design?	Historical and current VOC data from A and B-zone wells within the sheetpile enclosures, and A/B/C-zone wells just downgradient.	A data gap was identified within the North Sheetpile at the C level where a silt layer may be protecting the deeper PL2-258C well. A Geoprobe at the top of the deep silt layer would fill this potential data gap (and provide further information regarding the potential presence, or absence, of DNAPL). A data gap was identified near the former degreaser in the Chem Mill Area. Existing A-zone wells (PL2-210A, PL2-240A and PL2-271A) do not indicate a release but a one-time sampling of the B-zone is recommended. A Geoprobe at 50 ft near PL2-210A would fill this potential data gap.
	1e. Have decreasing trends for VOC contamination continued <u>within</u> the sheetpile enclosures?	Historical data establish degradation rates for the VOCs within the sheetpile enclosure through 2002.	Data are needed to determine if concentrations continued to decrease at the previous rate and what current conditions are within the source area.
	1f. Have decreasing trends for VOC contamination continued <u>outside</u> the sheetpile enclosures?	Historical data establish attenuation rates for VOCs through 2002 for the area immediately surrounding the sheetpile enclosures. Data are available through 2008 for the shoreline protection wells.	Data are needed to determine if concentrations continued to decrease at the previous rate and what the current conditions are outside the contained source area, especially at the North Sheetpile.
2) IM design and selection considerations	2a. If a vapor intrusion pathway exists, will SVE control it adequately?	Historical data for VOCs in soil and groundwater. No data are available on soil vapor concentrations or the viability of SVE within the sheetpile enclosures.	If a vapor intrusion pathway is or may become complete, an SVE IM is expected to be the most efficient and effective in controlling any vapor intrusion that may be occurring.
	2b. If VOCs are present in soil vapor at elevated levels, is SVE an appropriate means of controlling or eliminating the contaminant mass and what kind of VOC loading should be expected from SVE	Historical data for VOCs in soil and groundwater. No data are available on soil vapor concentrations or the viability of SVE within the sheetpile enclosures.	Soil vapor data for VOCs (TCE, DCE, and VC) are needed to determine inventory and design SVE and off-gas treatment system. This needs to be paired with soil data to estimate the ability of SVE to remove significant mass

DQO Process Step	Application to 2-10 Building VOC Plumes	Existing Data	Additional Data Required to Support Interim Measures
	operation?		from a vadose zone source.
	2c. How have groundwater geochemical conditions changed and is enhanced reductive dechlorination still the correct choice for the IM?	Historical data indicates that reductive dechlorination is occurring and can be enhanced by adding appropriate nutrients.	Current conditions are needed to both confirm the basic assumption and to design the appropriate nutrient amendments and treatment locations.
	2d. How will ERD affect current degradation rates inside the sheetpile enclosure?	Historical rates information is available.	Baseline measurements of CVOC concentrations, geochemical conditions, and nutrient status are needed both before and during the IM to assess how an IM is performing.
2) IM design and selection considerations (continued)	2e. How will ERD affect current degradation rates outside the sheetpile enclosure?	Historical rates information is available. In addition, Shoreline Monitoring data is available since 2001 for critical wells outside and downgradient of the sheetpiles.	Baseline measurements of CVOC concentrations, geochemical conditions, and nutrient status are needed both before and during the IM to access how an IM is performing.

Abbreviations:

CM	Corrective Measure
cVOC	Chlorinated VOC
DCE	Dichloroethenes
DNAPL	Dense non-aqueous phase liquid
ERD	Enhanced reductive dechlorination
IM	Interim Measure
RCRA	Resource Conservation and Recovery Act
SVE	Soil vapor extraction
TCE	Trichloroethene
VC	Vinyl chloride
VOC	Volatile organic compound

Table 3.1
Groundwater Monitoring Well Descriptions

North Sheetpile Area					Analyte Groups					
Well ID	Ground/slab Elevation (ft NVGD 29)	Screened Interval (feet bgs)	Total Depth (ft bgs)	Aquifer Level	VOCs[1]	TOC[2]	Selected Dissolved Metals[3]	Dissolved Gases[4]	DHE[5]	Major Cations and Anions[6]
PL2-212A	13	6–16	16	A	X	X	X	X	X	X
PL2-212B	13	40–55	55	B	X**	X	X			
PL2-218A	13.66	15–30	30	A	X**	X	X	X	X	X
PL2-218B	13.66	45–60	60	B	X**	X	X	X	X	
PL2-244A	13	15–20	20	A	X	X	X			
PL2-245A	13	15–20	20	A	X					
PL2-247A	13	15–20	20	A	X					
PL2-249A	13	15–20	20	A	X					
PL2-268AR	NA	30–34.5	34.5	A	X					
PL2-269A	13	31–36	36	A	X					
PL2-258A[7]	13.45	8–23	23	A	X[7]					
PL2-258B[7]	13.45	40–50	50	B	X[7]					
PL2-258C[7]	13.45	92–100	100	C	X[7]					
PL2-259B	13.4	40–50	50	B	X					
PL2-248A	12.36	15–20	20	A	X					
New probe Near PL2-218B	NA	~ 85	85	B-C	X					
New probe Near PL2-210A	NA	~ 50	50	B	X					
South Sheetpile Area					**Analyte Groups**					
Well ID	Ground/slab Elevation (ft NVGD 29)	Screened Interval (feet bgs)	Total Depth (ft bgs)	Aquifer Level	VOCs[1]	TOC[2]	Selected Dissolved Metals[3]	Dissolved Gases[4]	DHE[5]	Alkalinity[6]
PL2-209A	13	8–18	18	A	X	X	X	X	X	X
PL2-209B	13.68	40–55	55	B	X	X	X			
PL2-252A	12.63	12.5–17.5	17.5	A	X	X	X			
PL2-253A	13.14	12.5–17.5	17.5	A	X	X	X	X		X
PL2-254A	13.06	12.5–17.5	17.5	A	X					
PL2-255A	13.15	12.5–17.5	17.5	A	X					
PL2-256A	12.82	12.5–17.5	17.5	A	X					
PL2-257A	13.01	12.5–17.5	17.5	A	X					
PL2-266A	NA	26–30.2	30.2	A	X					
PL2-214A[7]	13	15–30	30	A	X[7]					
PL2-214B[7]	13	45–60	60	B	X[7]					
PL2-214C[7]	13	75.5–85.5	80	C	X[7]					
PL2-262B	13.49	40–50	50	B	X					

Notes:

** These selected wells will be sampled with passive diffusion bags (PDBs) for VOCs to identify stratification of the VOC plume (if any) over the screen interval; one PDB will be placed near the top of the screened interval; the other will be placed near the bottom of the screened interval. PDBs will be placed in the wells a minimum of 2 weeks before sample collection.

X Indicates planned sample/analysis.

1 VOCs by Method 8260B.

2 TOC by Method 415.1.

3 Dissolved metal for arsenic (Method 200.8) and manganese (Method 6010B).

4 Dissolved gases by RSK-175.

5 DHE by Bio-Dechlor Census Test RT-PCR.

6 Alkalinity by 300.1.

7 Sampled for VOCs in Shoreline monitoring program.

Abbreviations:

bgs Below ground surface

DHE *Dehalococcoides*

ft Feet

NA Not available

NGVD National Geodetic Vertical Datum, 1929

TOC Total organic carbon

VOC Volatile organic compound

Table 3.2
Soil Sampling Locations

Soil Sampling Location	Planned Sampling Depth (feet bgs)	Analytes[1] VOCs	Grain Size Analysis[2]	Location Description (Relative to Prior Soil Sampling)
North Sheetpile				
SSL1	5, 10	X	X	Near PL2-212A
SSL2	5, 10	X	X	Near PL2-212B
SSL3	10	X		Near D43
SSL4	10, 15[3]	X		Near PL2-218A
South Sheetpile				
SSL5	5, 10	X	X	Near PL2-209A
SSL6	5, 10	X		Near PL2-209B
SSL7	5, 10	X		Near E18

Notes:

X Indicates planned sample/analysis.
1 VOCs by 5035/8260B.
2 Grain size by ASTM D422.
3 Sample is to be taken from the tidal smear zone to determine if TCE residues are present. As noted above, this sample location is planned to be near/close to existing Well PL2-218A (screened from 15–30 ft bgs); Well PL2-218A will be sampled (groundwater sample) as part of this IM to collect representative data in this location (Table 3.1).

Abbreviations:

bgs Below ground surface
VOC Volatile organic compound

Table 3.3
Soil Vapor Sampling Locations

Soil Vapor Sampling Location	Planned Sampling Depth (feet bgs)	Analytes VOCs[1]	Description of Location (Relative to Prior Soil Sampling)
North Sheetpile			
SSL1	8	X	near PL2-212A
SSL4	8	X	near PL2-218A
South Sheetpile			
SSL5	8	X	near PL2-209A
SSL7	8	X	near E18

Notes:
X Indicates planned sample/analysis.
1 VOCs by TO-15.

Abbreviations:
bgs Below ground surface
VOC Volatile organic compound

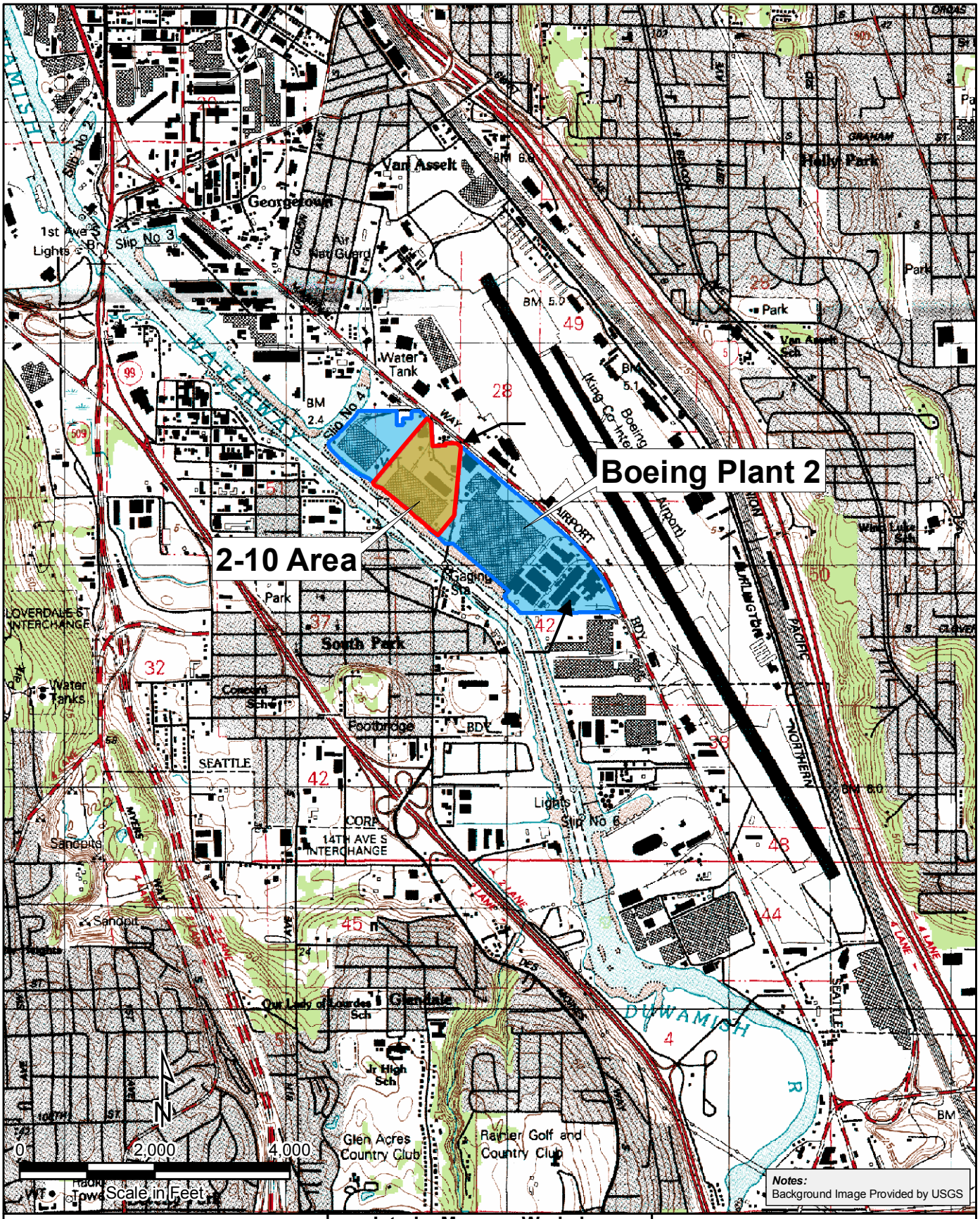
Boeing Plant 2
Seattle/Tukwila, Washington

North and South Sheetpiles in the 2-10 Building Interim Measure Work Plan (AOC 2-10.3A and AOC 2-10.4A)

Phase 1: Data Collection

Figures

AGENCY REVIEW DRAFT



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Interim Measure Workplan
North and South Sheetpiles
in the 2-10 Building
Boeing Plant 2
Seattle / Tukwila, Washington

Figure 1.1
Vicinity Map

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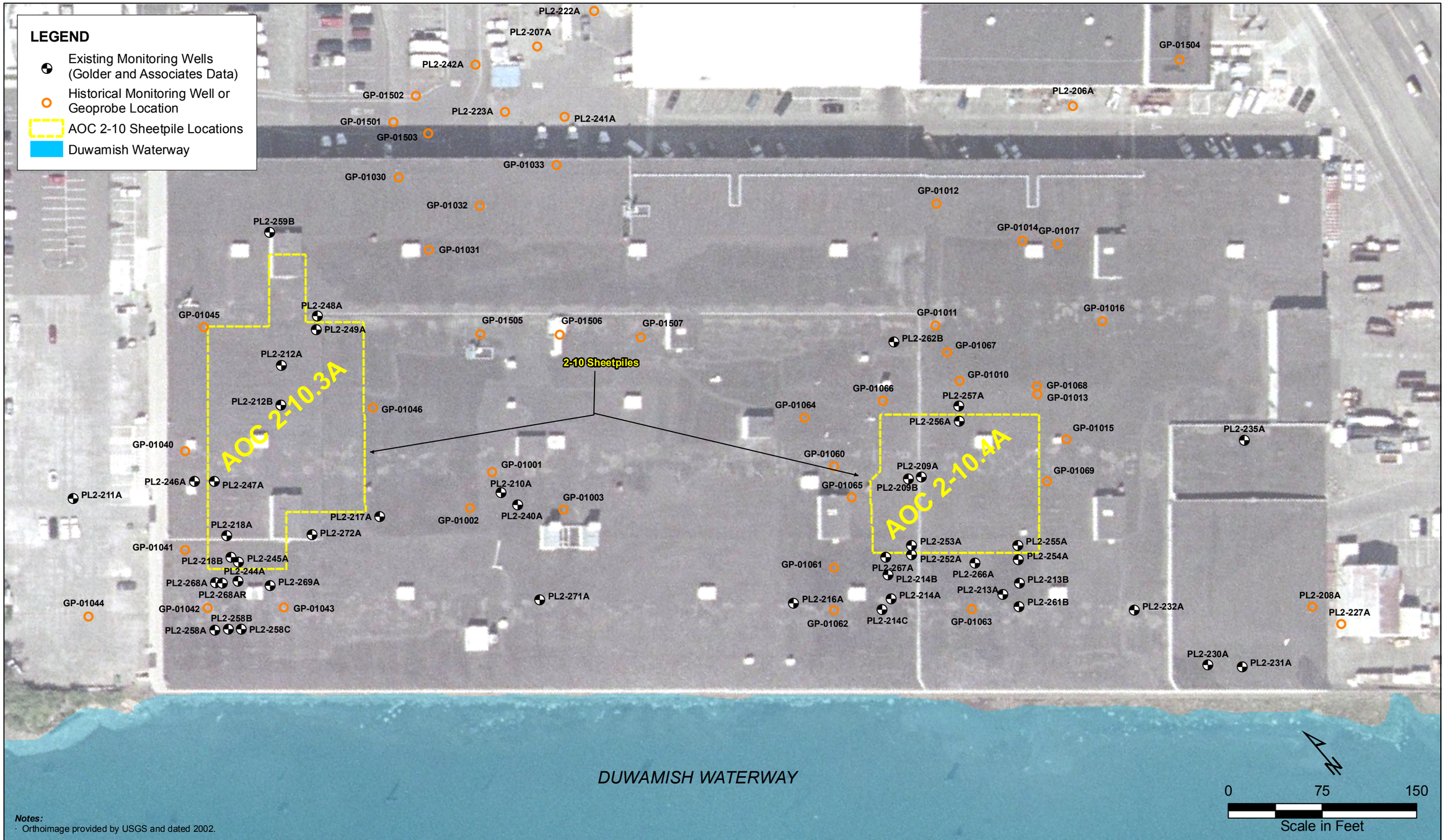
Date: 11/12/2008



Notes:
· Orthoimage provided by USGS and dated 2002.

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Interim Measure Work Plan
North and South Sheetpiles in the 2-10 Building
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Figure 1.2
North and South Sheetpile Locations and Building 2-10 Features

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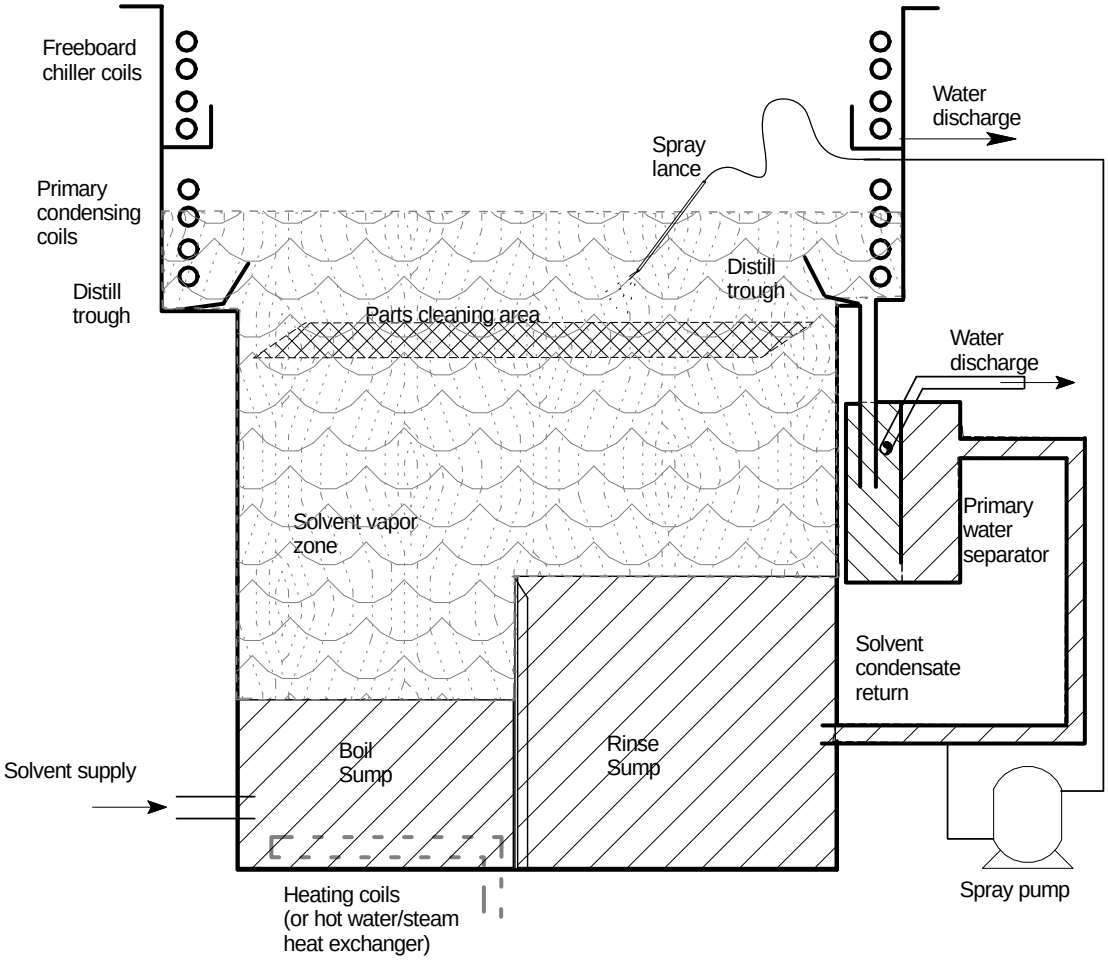

Adapted from ASTM, 1962. Handbook of Vapor Degreasers

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Interim Measure Work Plan for
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Boeing Plant 2
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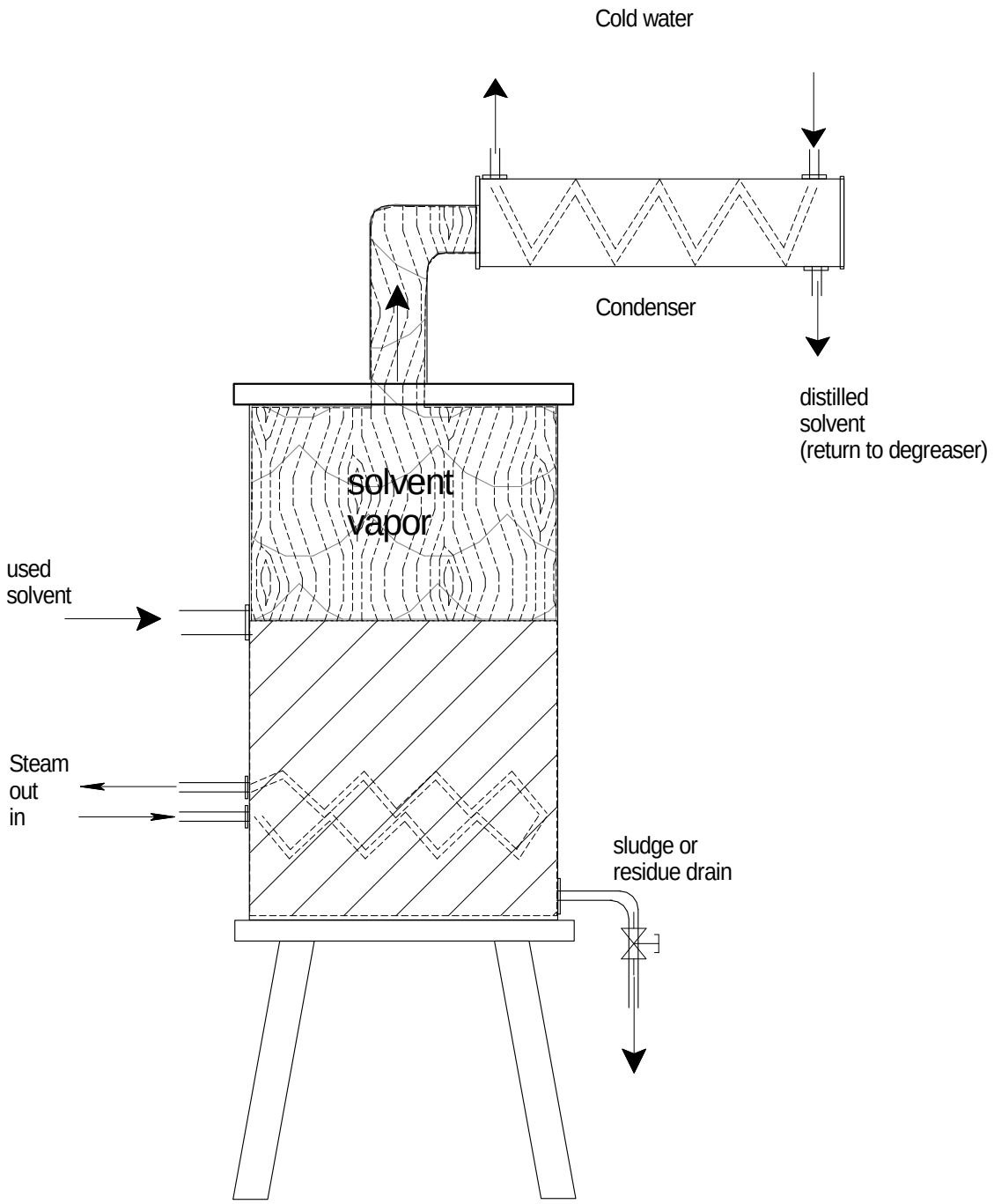
Figure 2.1
Typical Details Vapor Degreaser
North and South Sheetpile Areas
Building 2-10

Vapor Degreaser.SKF

5/20/2009



Adapted from Dow Chemical Company, undated. Dry Cleaning, A Basic Handbook

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Interim Measure Work Plan for
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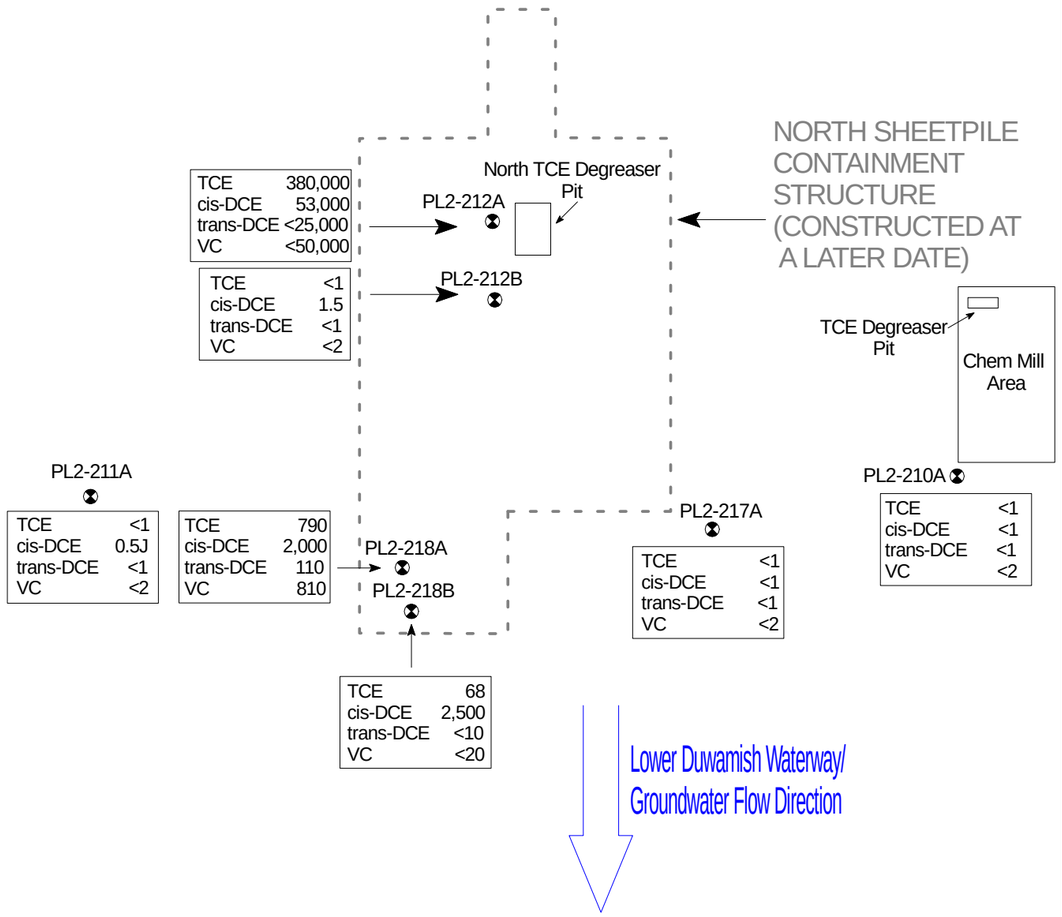
Figure 2.2
Typical Details Solvent Still
North and South Sheetpile Areas
Building 2-10

Solvent Still.SKF

5/20/2009

1992 North Degreaser



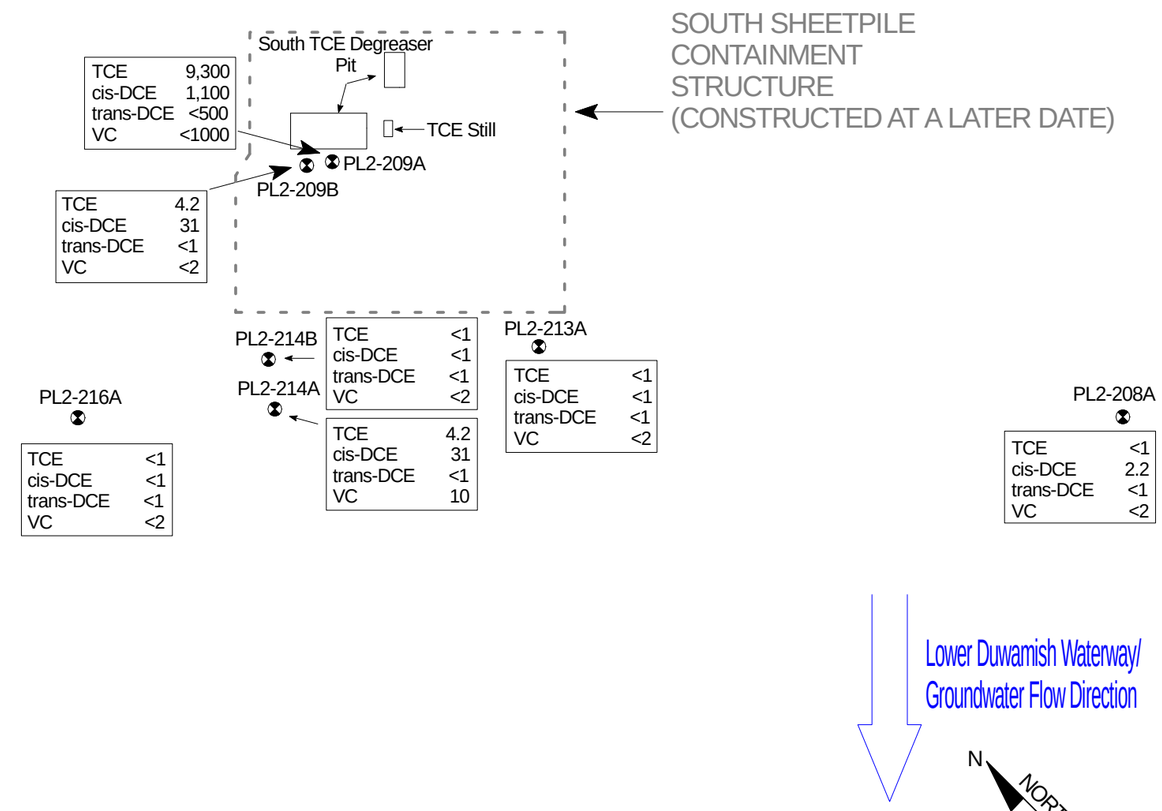
Concentrations (µg/L) shown are from August 1992

Note: PL2-212A was installed and sampled prior to the other wells in this area. Sampling results from March 1992.

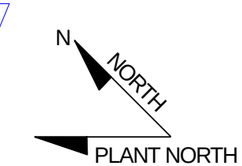
PL2-212A

TCE	420,000
cis-DCE	86,000
trans-DCE	2,500
VC	25,000

1992 South Degreasers



Concentrations (µg/L) shown are from August 1992



Note: PL2-209A was installed and sampled prior to the other wells in this area. Sampling results from February 1992.

PL2-209A

TCE	32,000
cis-DCE	840
trans-DCE	<500
VC	<1000

SCALE IN FEET

0 50 100 200

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Interim Measure Work Plan for
the North and South Sheetpiles in the 2-10 Building
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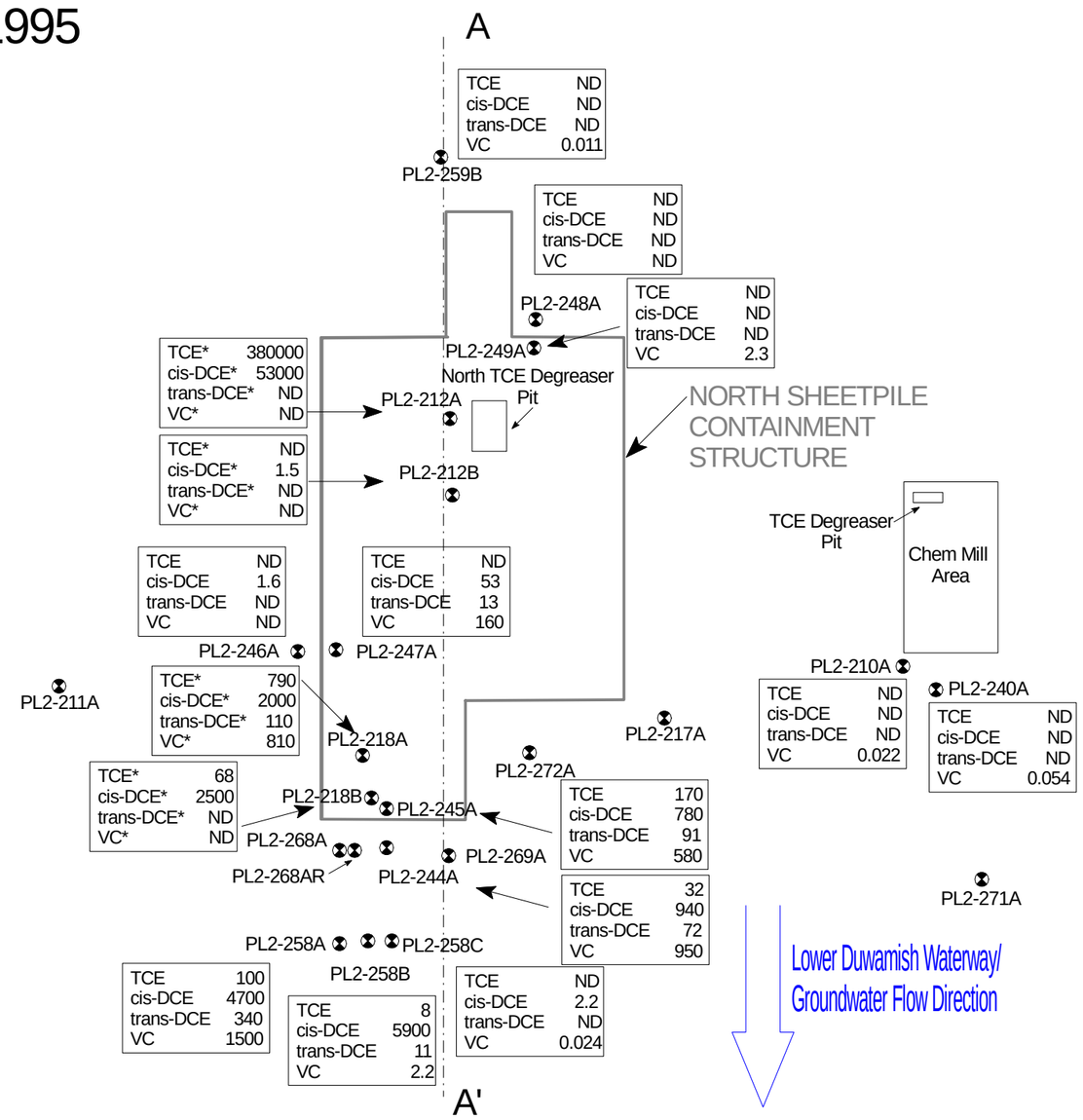
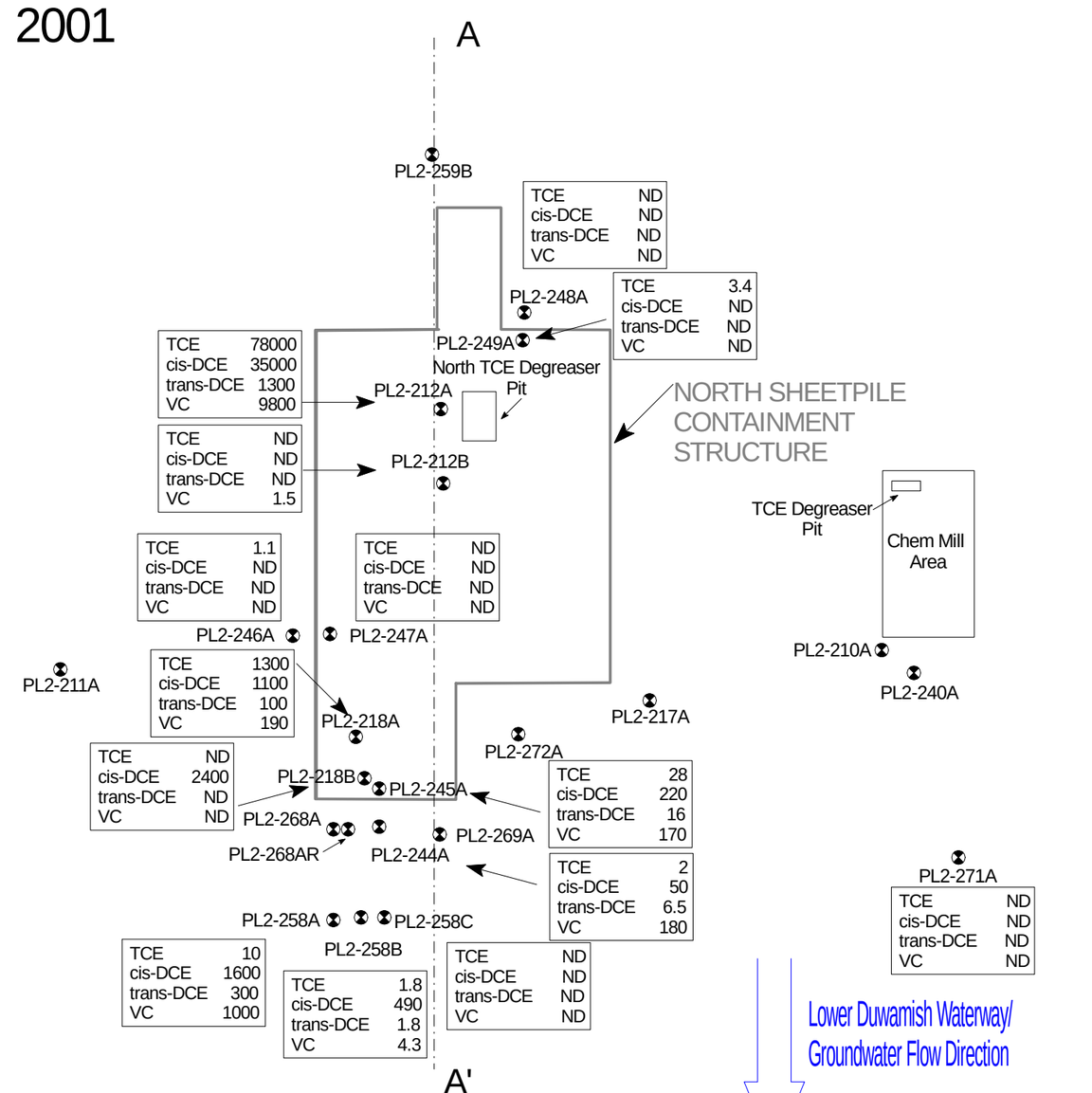
Figure 2.3
Historical Groundwater Data from 1992
North and South Degreasers
Building 2-10



Concentrations (µg/L) shown are from March 1995 unless otherwise noted with *, then August 1992 presented (if data not available for March 1995)



Concentrations (µg/L) shown are from April 2001

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Boeing Plant 2
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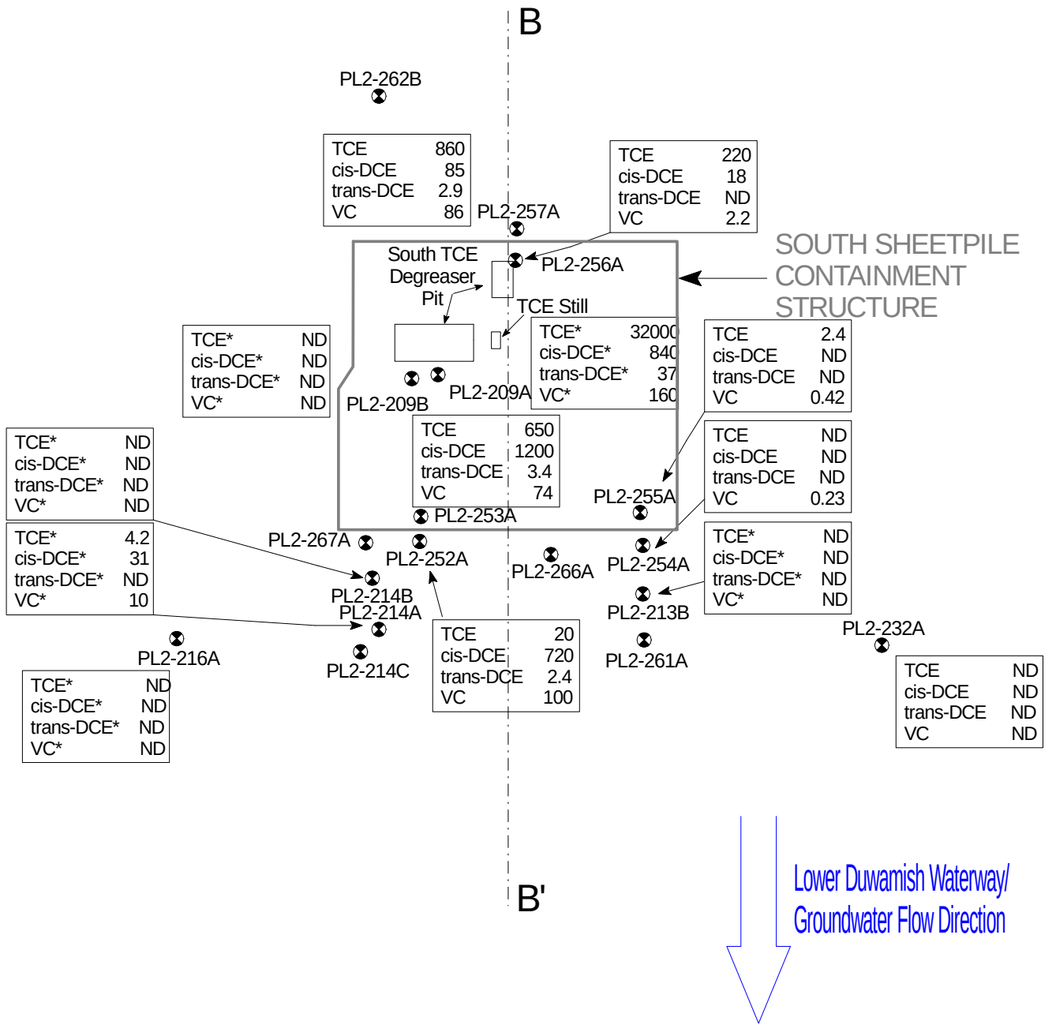
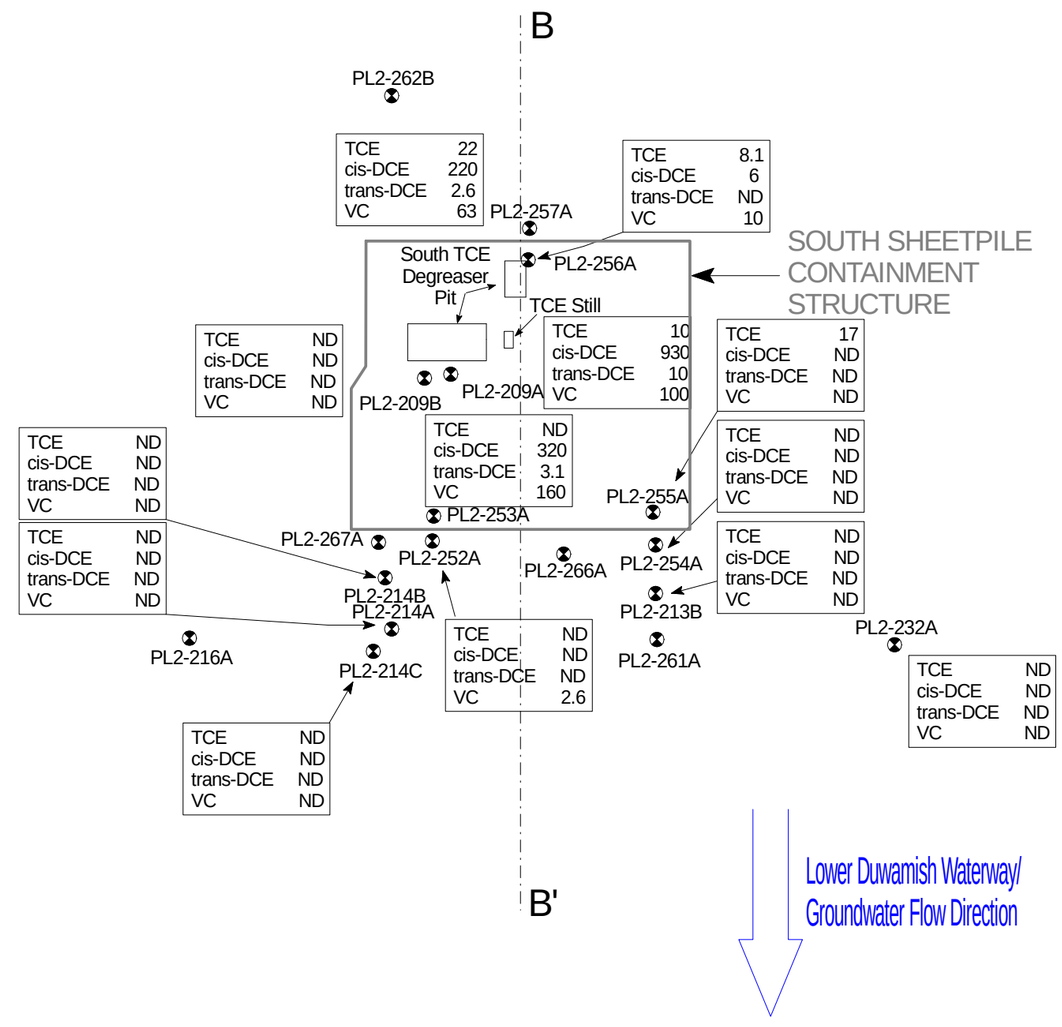
Figure 2.4
Comparison of Historical VOC Concentrations
North Sheetpile Area
Building 2-10



Concentrations (µg/L) shown are from October 1995 unless otherwise noted with *, then August 1992 presented (if data not available for October 1995)



Concentrations (µg/L) shown are from April 2001

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Interim Measure Work Plan for
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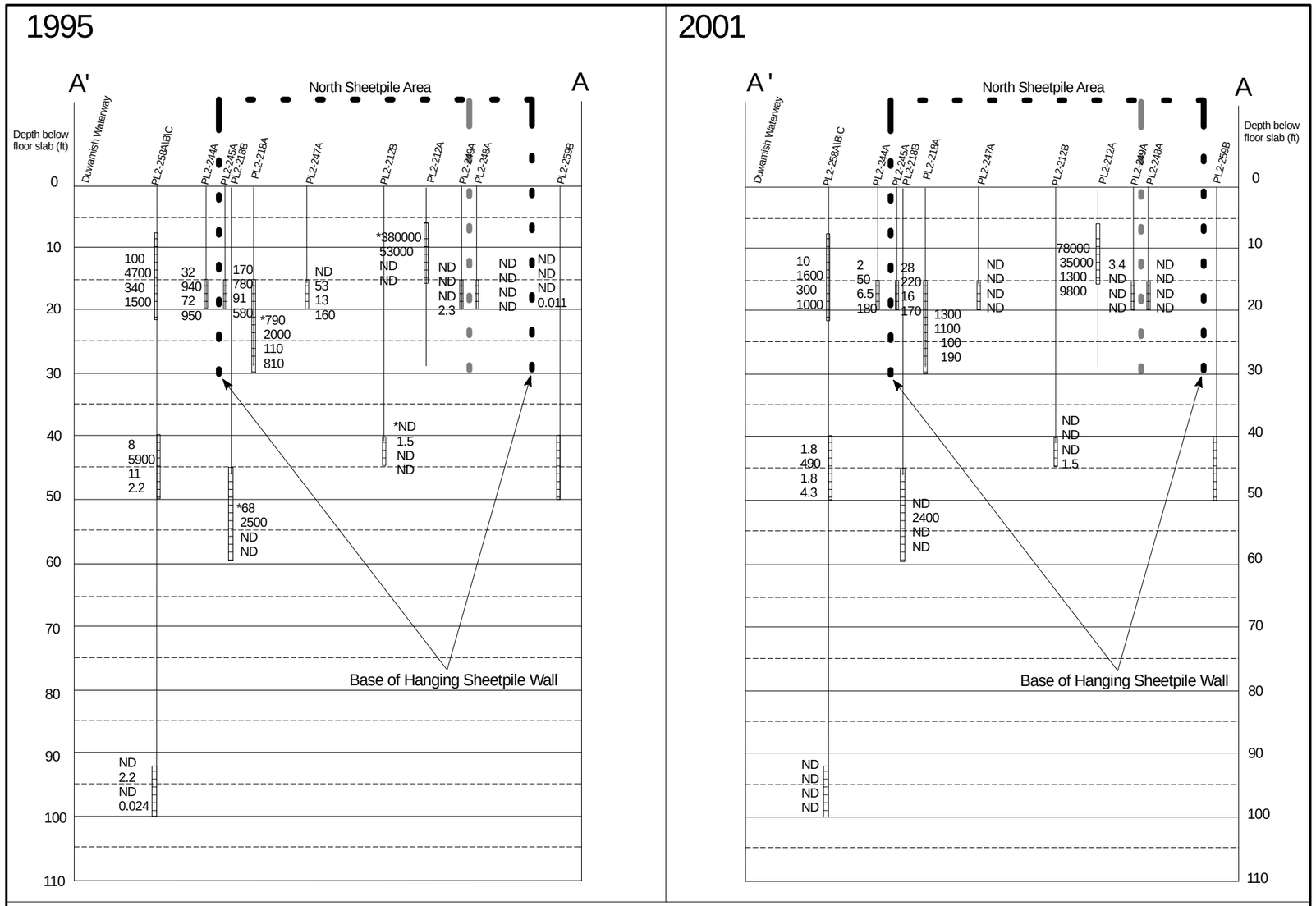
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 2.5
Comparison of Historical VOC Concentrations
South Sheetpile Area
Building 2-10



Concentrations (µg/L) shown are from March 1995 unless otherwise noted with *, then August 1992 presented (if data not available for March 1995)

Groundwater Flow Direction

Concentrations shown are from April 2001

Groundwater Flow Direction

LEGEND

5:1 Vertical Exaggeration

Horiz. Scale in Feet

0 20 40 80

VOC Concentrations in µg/L	
8	TCE
5900	c12DCE
11	t12DCE
2.2	VC

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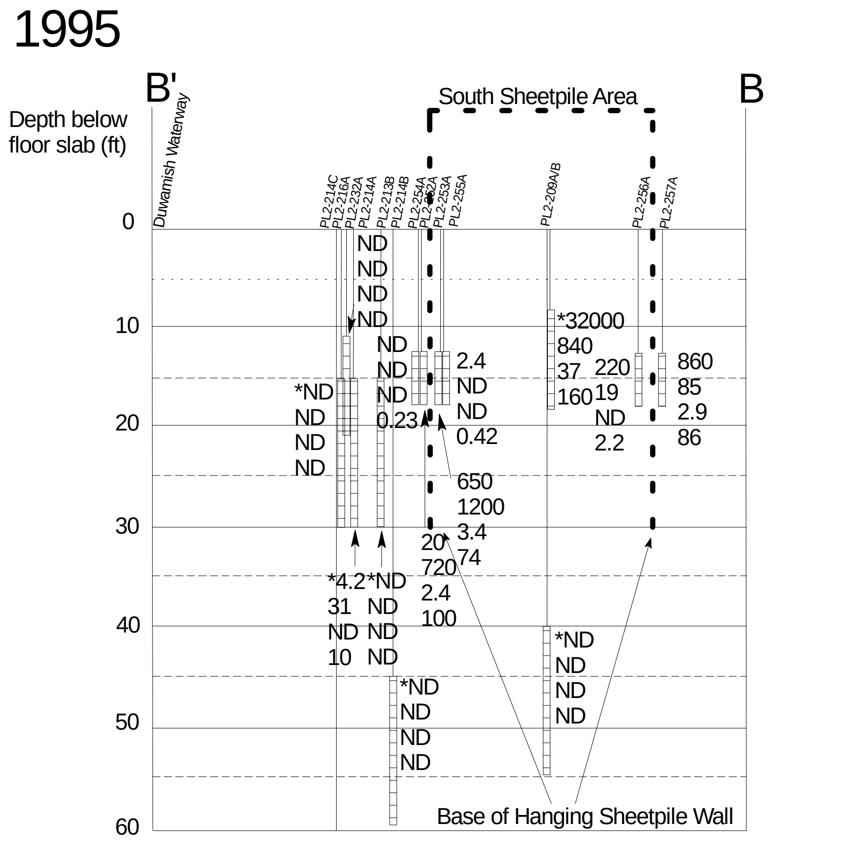
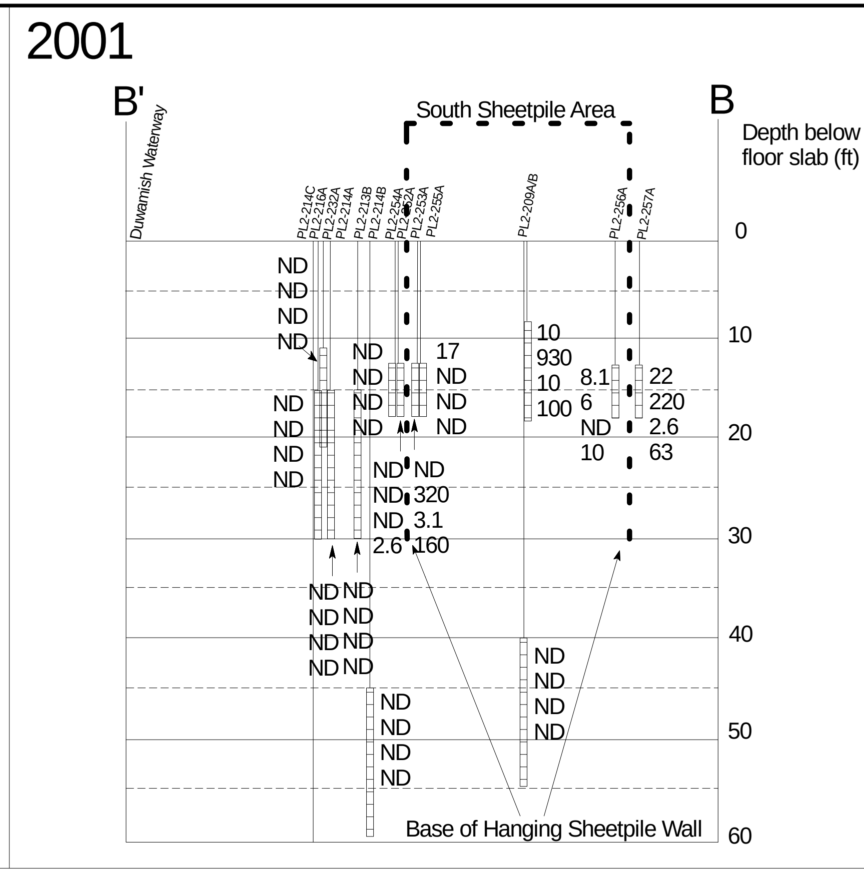
Interim Measure Work Plan
North and South Sheetpiles in the 2-10 Bldg
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 2.6
Cross Section of Monitoring Wells
North Sheetpile Area
Building 2-10





Concentrations (µg/L) shown are from October 1995 unless otherwise noted with *, then August 1992 data presented (if data not available for October 1995)

Concentrations shown are from April 2001

Groundwater Flow Direction

Groundwater Flow Direction

LEGEND

5:1 Vertical Exaggeration

Horiz. Scale in Feet

0 20 40 80

VOC Concentrations in µg/L	
8	TCE
5900	c12DCE
11	t12DCE
2.2	VC

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Interim Measure Work Plan
North and South Sheetpiles in the 2-10 Bldg
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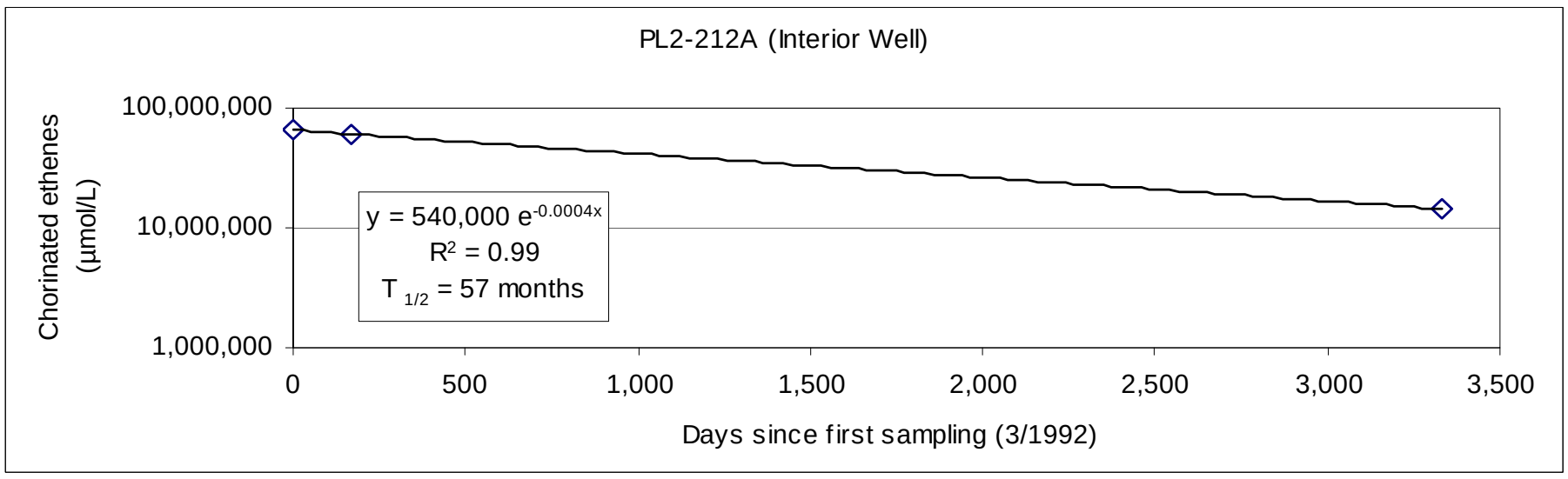
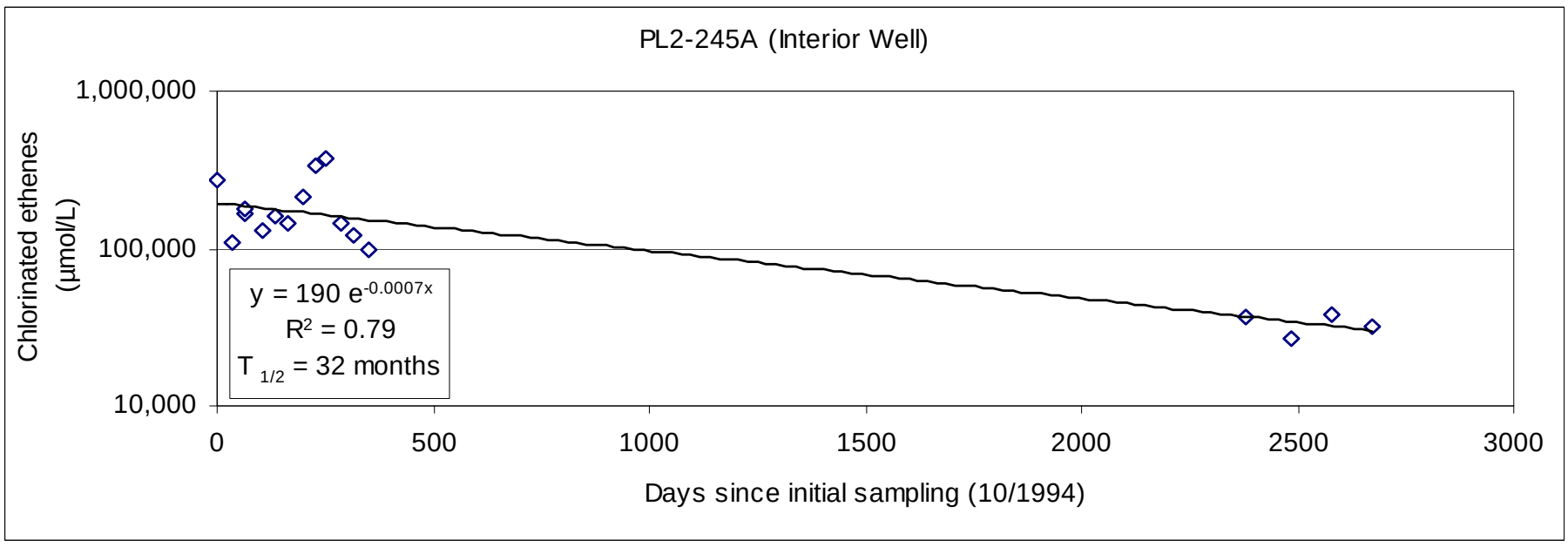
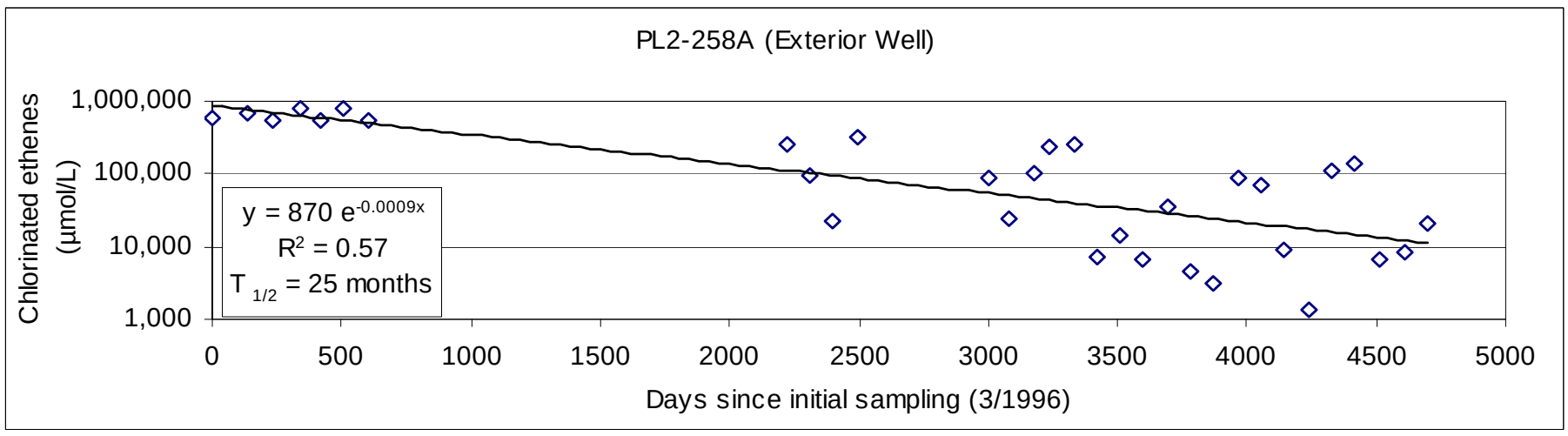
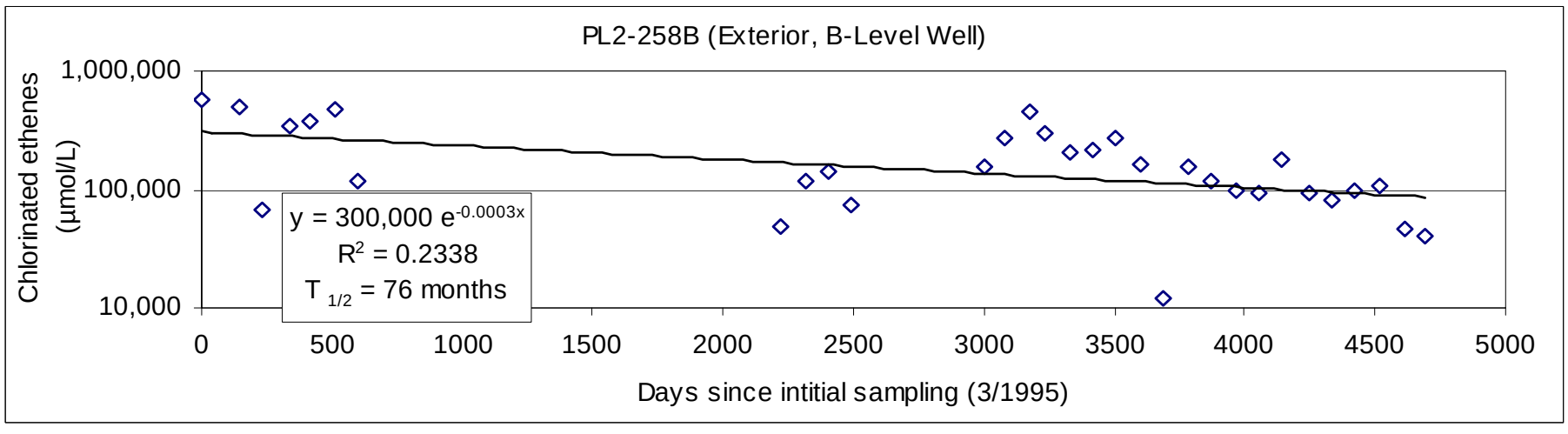
Figure 2.7
Cross Section of Monitoring Wells
South Sheetpile Area
Building 2-10









Note: Concentrations are the sum of the chlorinated ethenes expressed in units of µmoles/L and not µg/L.

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North and South Sheetpiles
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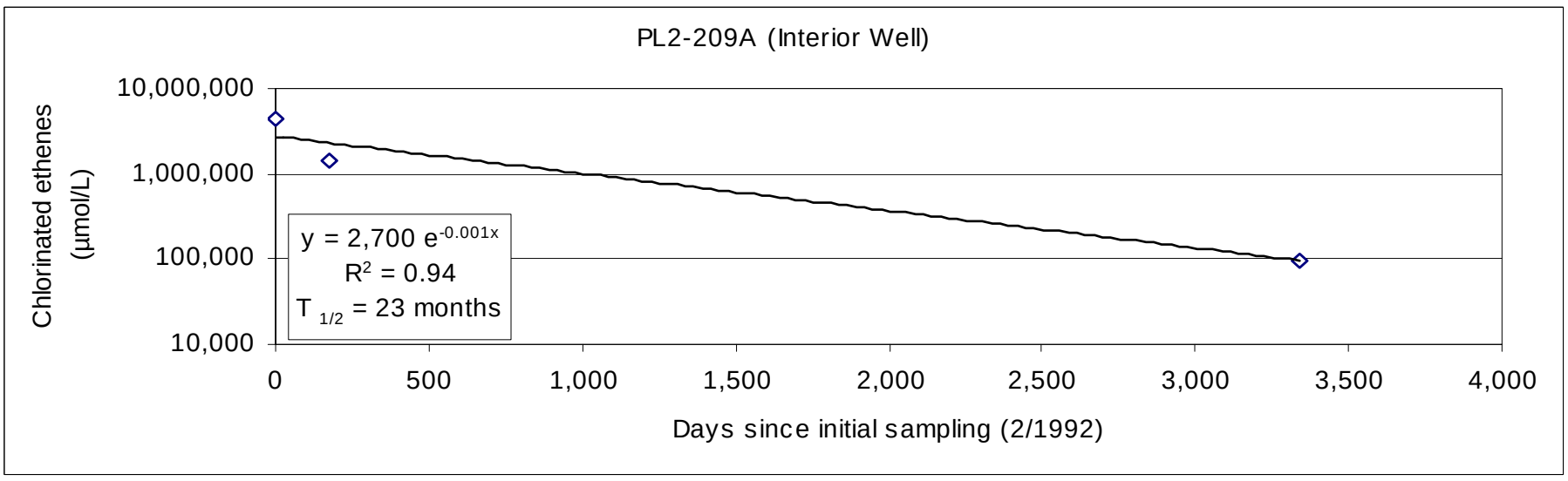
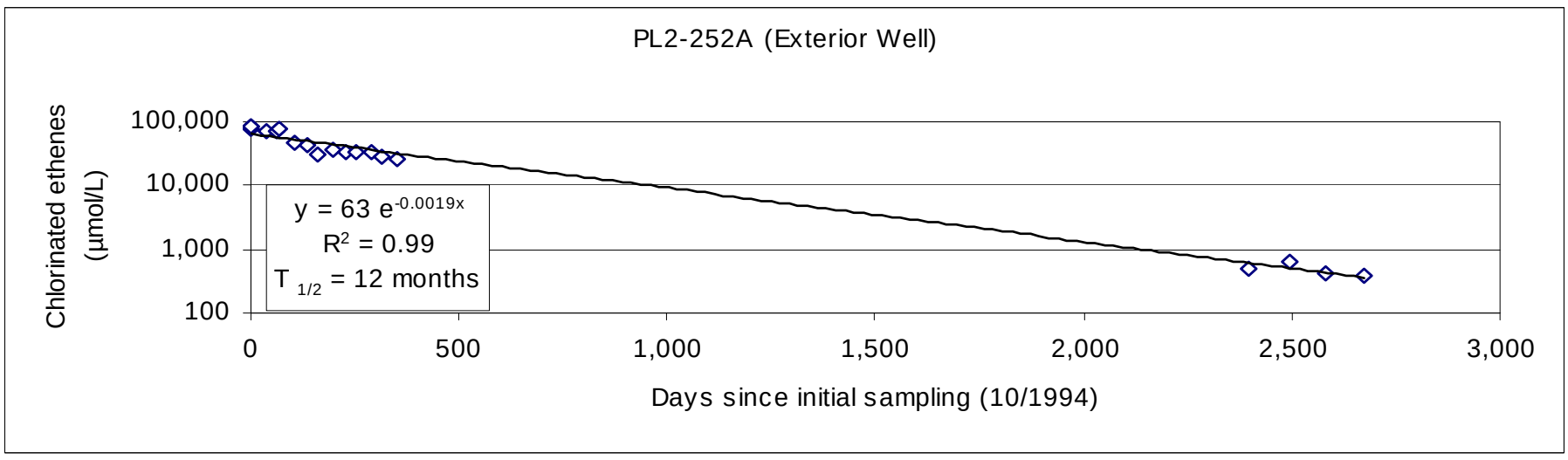
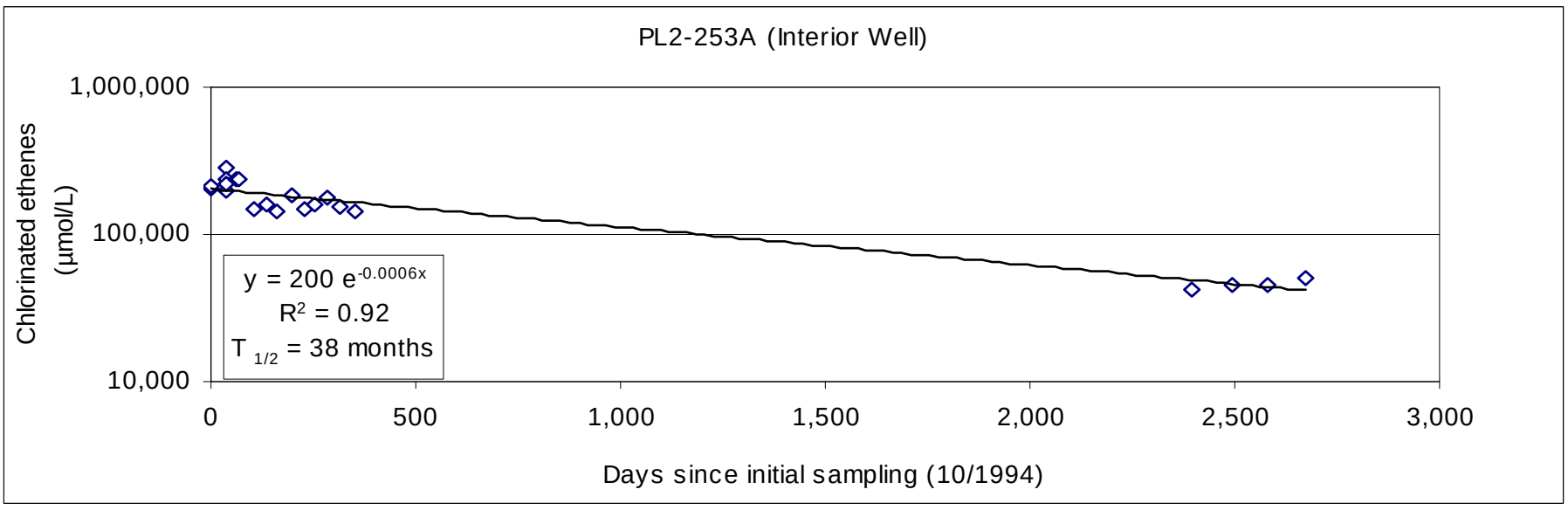
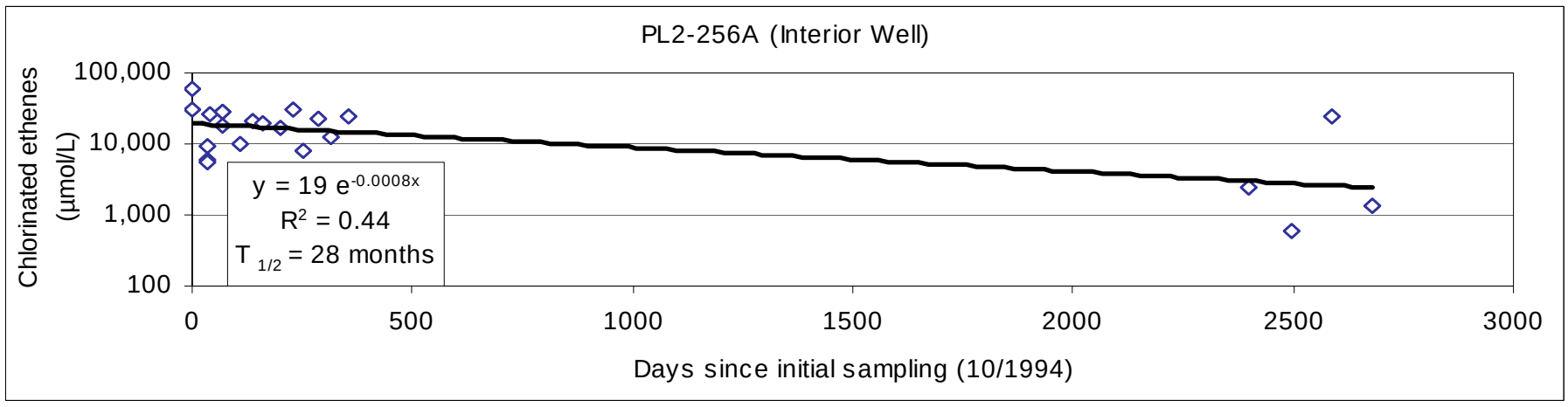
Figure 2.8
Concentration Trends and
Calculated Degradation Rates
North Sheetpile Area









Note: Concentrations are the sum of the chlorinated ethenes expressed in units of µmoles/L and not µg/L.

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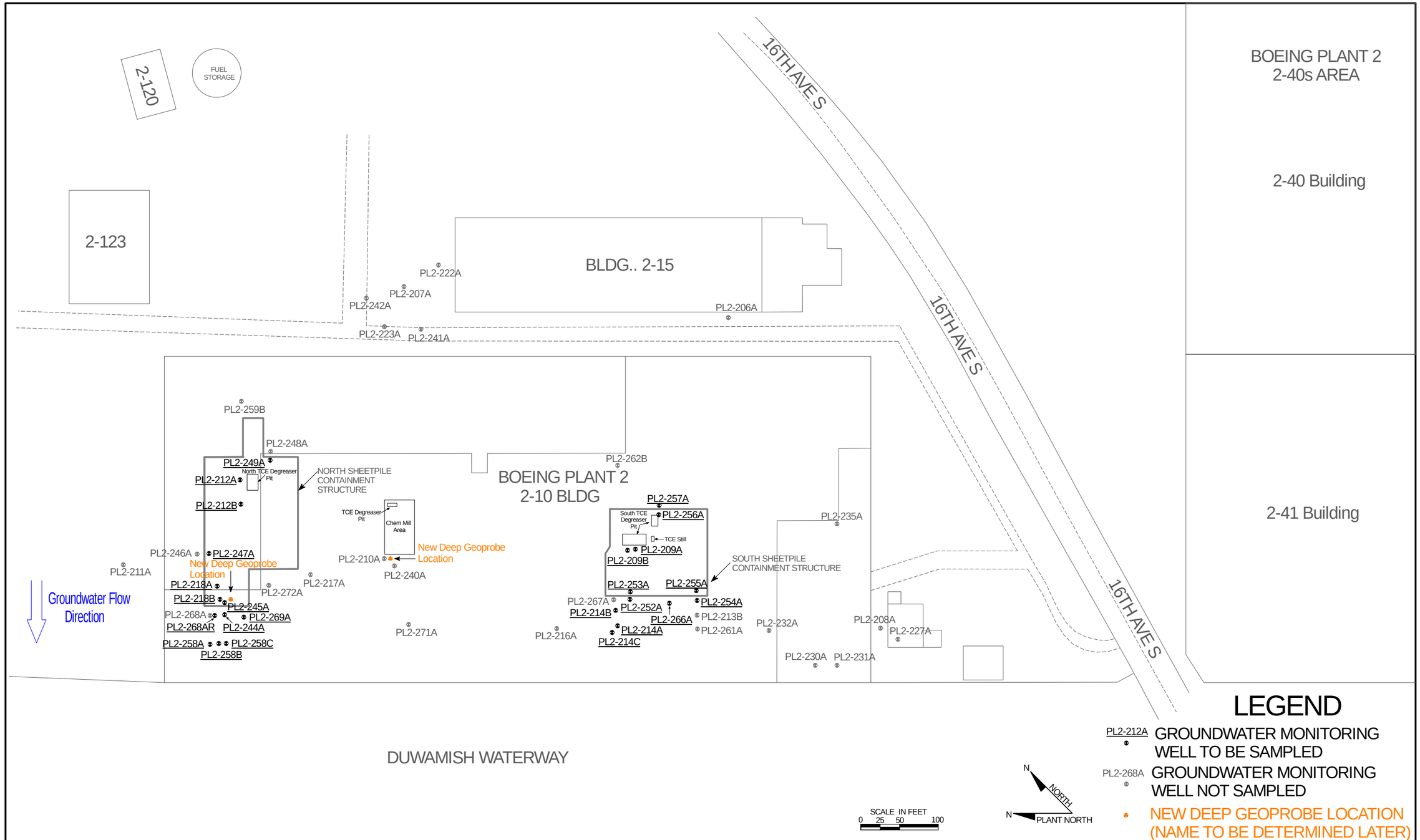
Figure 2.9
Concentration Trends and
Calculated Degradation Rates
South Sheetpile Area



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North and South Sheetpiles in the 2-10 Building
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Figure 3.1
Monitoring Well Locations for Phase 1 Sampling Event
North and South Sheetpiles
Building 2-10

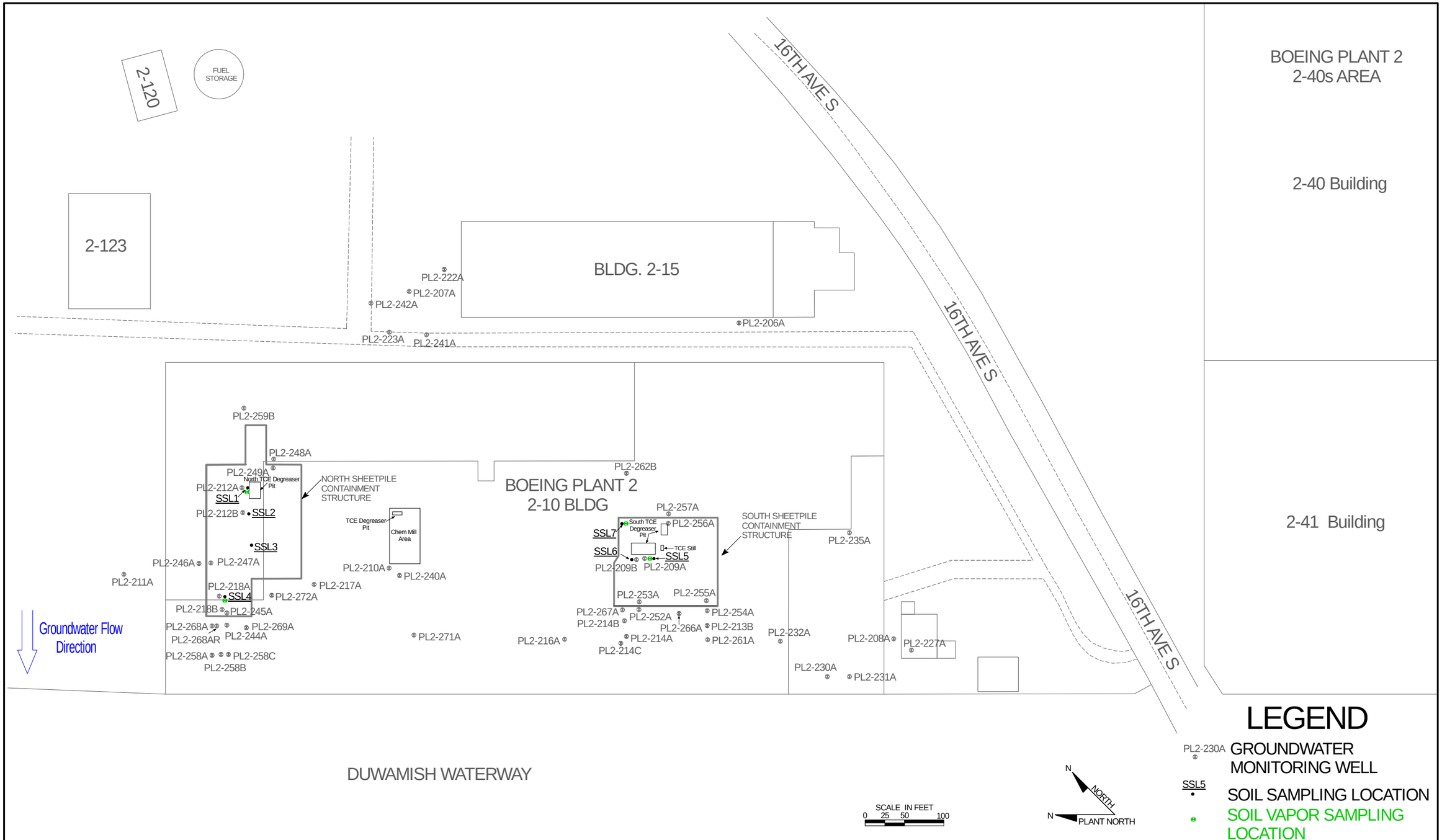

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Figure 3.2
Soil and Soil Vapor Sampling Locations for Phase 1 Sampling Event
North and South Sheetpiles
2-10 Building

WP Fig 3-2.SKF

9/30/2008

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North and South Sheetpiles in the 2-10 Building Interim Measure Work Plan (AOC 2-10.3A and AOC 2-10.4A)

Phase 1: Data Collection

Appendix A
Synopsis of Historical Sampling from Prior Investigations near the North and South Sheetpiles

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Table A.2 Soil Chlorinated Solvent Data Compilation from Monitoring Well Installation, Grouped by North and South Sheetpiles

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Figure A.1 Chlorinated VOC Groundwater Locations in the 2-10 Area

Figure A.2 Chlorinated VOC Soil Locations in the 2-10 Area

Attachments

EPI graphs (2-2d, 2-2e, 2-2f, and 2-2g) from the August 2008 Shoreline Monitoring Report show chlorinated VOC trends in groundwater.

Weston figures (8-1a, 8-2, and 8-3) from the RCRA Facility Investigation Groundwater Investigation Interim Report show TCE in groundwater cross-sections and the north and south TCE degreaser concentrations of TCE.

Boeing Plant 2
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North and South Sheetpiles in the 2-10 Building Interim Measure Work Plan (AOC 2-10.3A and AOC 2-10.4A)

Phase 1: Data Collection

Appendix A
Synopsis of Historical Sampling from Prior Investigations near the North and South Sheetpiles

Tables

AGENCY REVIEW DRAFT

Table A.1
Groundwater Data Compilation

Group 1: Area 2-10 North Steetpile

Groundwater Samples from Geoprobe				TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	VC
Location	Date	Top (ft)	Bottom (ft)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
GP-01001	7/12/1994	15	15	1 U	na	1 U	1 U	1,000 U
GP-01002	7/12/1994	15	15	1 U	na	1 U	1 U	1,000 U
GP-01003	7/12/1994	15	15	8	na	1 U	1 U	1,000 U
GP-01030	8/15/1994	14	14	1 U	1 U	1 U	1 U	0.034
GP-01030	8/15/1994	24	24	1 U	1 U	1 U	1 U	0.092
GP-01031	9/15/1994	13	13	1 U	1 U	1 U	1 U	0.055
GP-01031	9/15/1994	23	23	1 U	1 U	1 U	1 U	0.048
GP-01032	8/17/1994	14	14	1 U	1 U	1 U	1 U	1.1
GP-01032	8/17/1994	24	24	1 U	1 U	1 U	1 U	0.024
GP-01033	9/6/1994	13	13	1 U	1 U	1 U	1 U	0.02 U
GP-01033	9/6/1994	23	23	1 U	1 U	1 U	1 U	0.02 U
GP-01040	7/12/1994	15	15	1 U	na	1 U	1 U	1,000 U
GP-01040	7/12/1994	25	25	1 U	na	1 U	1 U	1,000 U
GP-01040	7/12/1994	45	45	1 U	na	1 U	1 U	1,000 U
GP-01041	7/11/1994	15	15	1 U	1 U	48	24	64
GP-01041	7/11/1994	25	25	1 U	na	1 U	1 U	
GP-01041	7/11/1994	45	45	1 U	na	1 U	1 U	
GP-01041	7/14/1994	55	55	1 U	1 U	260	1 U	0.37
GP-01042	7/11/1994	17	17	860	na	5,410	574	1,710
GP-01042	7/11/1994	25	25	1 U	na	1 U	1 U	1,000 U
GP-01042	7/11/1994	45	45	1 U	na	1 U	1 U	1,000 U
GP-01043	7/12/1994	17	17	1 U	na	1 U	1 U	1,000 U
GP-01043	7/12/1994	25	25	1 U	na	1 U	1 U	1,000 U
GP-01043	7/12/1994	45	45	1 U	1 U	1 U	1 U	0.2 U
GP-01044	7/25/1995	15	15	1 U	1 U	1 U	1 U	0.076
GP-01044	7/25/1995	25	25	1 U	1 U	1 U	1 U	0.71
GP-01044	7/25/1995	45	45	1 U	1 U	2.4	1 U	0.01 U
GP-01044	7/25/1995	65	65	1 U	1 U	1 U	1 U	0.01 U
GP-01045	4/4/2001	20	20	1 U	1 U	1 U	1 U	1.6
GP-01045	4/4/2001	30	30	1 U	1 U	1 U	1 U	1 U
GP-01045	4/4/2001	40	40	1 U	1 U	1 U	1 U	1 U
GP-01046	4/4/2001	20	20	1 U	1 U	1 U	1 U	1 U
GP-01046	4/4/2001	30	30	1 U	1 U	1 U	1 U	1 U
GP-01046	4/4/2001	40	40	1 U	1 U	1 U	1 U	1 U
GP-01501	9/14/1994	13	13	1 U	1 U	1 U	1 U	0.022
GP-01501	9/14/1994	23	23	1 U	1 U	1 U	1 U	0.042
GP-01502	9/14/1994	13	13	1 U	1 U	1 U	1 U	0.075
GP-01502	9/15/1994	23	23	1 U	1 U	1 U	1 U	0.075
GP-01503	9/14/1994	13	13	1 U	1 U	1 U	1 U	0.02 U
GP-01503	9/14/1994	23	23	1 U	1 U	1 U	1 U	0.14
GP-01505	2/17/1995	15	15	1 U	1 U	1 U	1 U	0.02 U
GP-01505	2/17/1995	25	25	1 U	1 U	1 U	1 U	0.02 U
GP-01506	2/17/1995	15	15	1 U	1 U	1 U	1 U	0.02 U
GP-01506	2/17/1995	25	25	1 U	1 U	1 U	1 U	0.02 U
GP-01507	2/17/1995	15	15	1 U	1 U	1 U	1 U	0.02 U
GP-01507	2/17/1995	25	25	1 U	1 U	1 U	1 U	0.02 U

Group 2: Area 2-10 South Steetpile

Groundwater Samples from Geoprobe				TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	VC
Location	Date	Top (ft)	Bottom (ft)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
GP-01060	7/12/1994	15	15	1 U	na	1 U	1 U	1,000 U
GP-01060	7/12/1994	25	25	1 U	na	1 U	1 U	1,000 U
GP-01060	7/12/1994	45	45	1 U	1 U	1 U	1 U	0.2 U
GP-01061	7/13/1994	15	15	1 U	na	1 U	1 U	1,000 U
GP-01061	7/13/1994	25	25	1 U	na	1 U	1 U	1,000 U
GP-01061	7/13/1994	45	45	1 U	na	1 U	1 U	1,000 U
GP-01062	7/13/1994	15	15	1 U	na	1 U	1 U	1,000 U
GP-01062	7/13/1994	25	25	1 U	na	1 U	1 U	1,000 U
GP-01062	7/13/1994	45	45	1 U	na	1 U	1 U	1,000 U
GP-01063	7/13/1994	15	15	1 U	na	1 U	1 U	1,000 U
GP-01063	7/13/1994	25	25	1 U	na	1 U	1 U	1,000 U
GP-01063	7/14/1994	45	45	1 U	1 U	1 U	1 U	0.2 U
GP-01064	2/16/1995	15	15	1 U	1 U	1 U	1 U	0.4
GP-01065	6/21/1995	15	15	1 U	1 U	1 U	1 U	0.34
GP-01065	4/3/2001	20	20	1.5	1 U	19	1 U	1 U
GP-01065	6/21/1995	25	25	1 U	1 U	1 U	1 U	0.02
GP-01065	4/3/2001	30	30	1 U	1 U	1 U	1 U	1 U
GP-01065	4/3/2001	40	40	1 U	1 U	1 U	1 U	1 U
GP-01065	6/21/1995	45	45	1 U	1 U	1 U	1 U	0.01 U
GP-01066	6/21/1995	15	15	1 U	1 U	1 U	1 U	0.01 U
GP-01066	4/3/2001	20	20	1 U	1 U	1 U	1 U	1 U
GP-01066	6/21/1995	25	25	1 U	1 U	1 U	1 U	0.01 U
GP-01066	4/3/2001	30	30	1 U	1 U	1 U	1 U	1 U
GP-01066	4/3/2001	40	40	1 U	1 U	1 U	1 U	1 U
GP-01066	6/21/1995	45	45	1 U	1 U	1 U	1 U	0.01 U
GP-01067	4/2/2001	20	20	1 U	1 U	1 U	1 U	1 U
GP-01067	4/2/2001	30	30	1 U	1 U	1 U	1 U	1 U
GP-01067	4/2/2001	40	40	1 U	1 U	1 U	1 U	1 U
GP-01068	4/3/2001	20	20	1 U	1 U	1 U	1 U	1 U
GP-01068	4/3/2001	30	30	1 U	1 U	1 U	1 U	1 U
GP-01068	4/3/2001	40	40	1 U	1 U	1 U	1 U	1 U
GP-01069	4/2/2001	20	20	1 U	1 U	1 U	1 U	1 U
GP-01069	4/2/2001	30	30	1 U	1 U	1 U	1 U	1 U
GP-01069	4/2/2001	40	40	1 U	1 U	1 U	1 U	1 U

Table A.1
Groundwater Data Compilation

Group 1: Area 2-10 North Steetpile

A Level Groundwater Wells				TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	VC
Location	Date	Top (ft)	Bottom (ft)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
HP-AL-20	8/20/1990	23	23	1 U	1 U	1 U	1 U	1 U
PL2-201A	2/25/1992	9	19	1 U	1 U	1 U	1 U	2 U
PL2-202A	2/25/1992	8	18	1 U	1 U	1 U	1 U	2 U
PL2-202A	8/24/1992	8	18	1 U	1 U	1.2	1 U	2 U
PL2-203A	2/26/1992	9	19	1 U	1 U	1 U	1 U	2 U
PL2-204A	2/26/1992	7.5	17.5	1 U	1 U	1 U	1 U	2 U
PL2-205A	2/26/1992	8	18	1 U	1 U	1 U	1 U	2 U
PL2-207A	2/26/1992	8	18	1 U	1 U	1 U	1 U	2 U
PL2-210A	3/5/1992	6	16	8.3	1 U	1 U	1 U	2 U
PL2-210A	8/20/1992	6	16	1 U	1 U	1 U	1 U	2 U
PL2-210A	3/13/1995	6	16	1 U	1 U	1 U	1 U	0.022
PL2-211A	2/25/1992	9	19	1 U	1 U	1 J	1 U	1.2 N
PL2-211A	8/26/1992	9	19	1 U	1 U	0.5 N	1 U	2 U
PL2-211A	8/9/2002	9	19	1 U	1 U	1 U	1 U	1 U
PL2-212A	3/5/1992	6	16	420,000	500	86,000	2,500	25,000
PL2-212A	8/20/1992	6	16	380,000	25,000 U	53,000	25,000 U	50,000 U
PL2-212A	4/18/2001	6	16	78,000	500 U	35,000	1,300	9,800
PL2-223A	8/11/1995	14	19	1 U	1 U	1 U	1 U	0.01 U
PL2-223A	11/14/1995	14	19	1 U	1 U	1 U	1 U	0.01 U
PL2-223A	2/28/1996	14	19	1 U	1 U	1 U	1 U	2 U
PL2-223A	8/22/1996	14	19	1 U	1 U	1 U	1 U	2 U
PL2-224A	11/30/1990	10	20	2 U	2 U			2 U
PL2-225A	11/30/1990	10	20	2 U	2.6			2 U
PL2-226A	11/30/1990	10	20	2 U	2 U			2 U
PL2-240A	12/15/1993	11.5	21.5	1 U	1 U	1 U	1 U	2 U
PL2-240A	8/14/1995	11.5	21.5	1 U	1 U	1 U	1 U	0.054
PL2-240A	11/17/1995	11.5	21.5	1 U	1 U	1 U	1 U	0.23
PL2-240A	2/27/1996	11.5	21.5	1 U	1 U	1 U	1 U	2 U
PL2-240A	5/20/1996	11.5	21.5	1 U	1 U	1 U	1 U	2 U
PL2-240A	8/21/1996	11.5	21.5	1 U	1 U	1 U	1 U	2 U
PL2-240A	11/18/1996	11.5	21.5	1 U	1 U	2.2	1 U	2 U
PL2-244A	10/7/1994	15	20	120	20 U	950	32	530
PL2-244A	10/7/1994	15	20	110	10 U	920	32	480
PL2-244A	10/7/1994	15	20	120	20 U	950	32	530
PL2-244A	11/11/1994	15	20	76	5 U	460	14	160
PL2-244A	12/9/1994	15	20	62	3.9	710	27	360
PL2-244A	12/9/1994	15	20	57	4.6	670	32	460
PL2-244A	1/21/1995	15	20	66 J	8.9 J	800	58 J	270
PL2-244A	2/17/1995	15	20	57	7.2	840	44	560
PL2-244A	3/17/1995	15	20	32	8	940	72	950
PL2-244A	4/21/1995	15	20	34	7.9	1,600	88	700
PL2-244A	5/24/1995	15	20	42	8	1,700	88	780
PL2-244A	6/15/1995	15	20	22	5.8	1,000	76	530
PL2-244A	7/19/1995	15	20	46	5	750	62	430
PL2-244A	8/17/1995	15	20	20	3.8	690	53	350
PL2-244A	9/22/1995	15	20	37	4.9	830	62	260
PL2-244A	4/16/2001	15	20	2	1 U	50	6.5	180
PL2-244A	7/30/2001	15	20	1 U	1 U	12	2.5	61
PL2-244A	10/29/2001	15	20	1 U	1 U	3.4	1.1	16
PL2-244A	1/31/2002	15	20	1 U	1 U	12	3.6	150
PL2-245A	4/16/2001	15	20	28	15 UJ	220	16	170 H

Group 2: Area 2-10 South Steetpile

A Level Groundwater Wells				TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	VC
Location	Date	Top (ft)	Bottom (ft)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
PL2-206A	2/28/1992	7.5	17.5	1 U	1 U	1 U	1 U	2 U
PL2-208A	3/18/1992	7	16.5	1 U	1 U	4.3	1 U	2 U
PL2-208A	8/20/1992	7	16.5	1 U	1 U	2.2	1 U	2 U
PL2-209A	2/28/1992	8	17.5	32,000 B	17	840	37	160
PL2-209A	8/20/1992	8	17.5	9,300	500 U	1,100	500 U	1,000 U
PL2-209A	4/19/2001	8	17.5	10 UJ	10 UJ	930	10 UJ	100
PL2-214A	8/18/1992	15	30	4.2	1 U	31	1 U	10
PL2-214A	3/13/1995	15	30	1 U	1 U	1 U	1 U	18
PL2-214A	8/7/1995	15	30	1 U	1 U	1 U	1 U	10
PL2-214A	11/16/1995	15	30	1 U	1 U	1 U	1 U	2.4
PL2-214A	2/27/1996	15	30	1 U	1 U	1.9	1 U	47
PL2-214A	5/21/1996	15	30	1 U	1 U	1 U	1 U	2.9
PL2-214A	8/21/1996	15	30	1 U	1 U	1 U	1 U	10
PL2-214A	11/18/1996	15	30	6.1	1 U	120	1 U	74
PL2-214A	4/25/2001	15	30	1 U	1 U	1 U	1 U	1 UJ
PL2-214A	7/25/2001	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	11/5/2001	15	30	1 U	1 U	1 U	1 U	1 UJ
PL2-214A	1/23/2002	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	6/19/2003	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	9/3/2003	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	12/10/2003	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	2/3/2004	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	5/11/2004	15	30	1 U	1 U	1 U	1 U	1 UJL
PL2-214A	8/4/2004	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	11/2/2004	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	1/31/2005	15	30	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
PL2-214A	5/4/2005	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	8/4/2005	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	11/1/2005	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	2/8/2006	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	5/3/2006	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	8/3/2006	15	30	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
PL2-214A	11/8/2006	15	30	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
PL2-214A	2/5/2007	15	30	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
PL2-214A	5/8/2007	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	8/7/2007	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	11/15/2007	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	2/7/2008	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	8/3/2008	15	30	1 U	1 U	1 U	1 U	1 U
PL2-214A	2/5/2009	15	30	1 U	1 U	1 U	1 U	1 U
PL2-216A	8/19/1992	15	30	1 U	1 U	1 U	1 U	2 U
PL2-227A	4/26/2001	6	16.5	1 U	1 U	1 U	1 U	1 UJ
PL2-227A	11/5/2001	6	16.5	1 U	1 U	1 U	1 U	1 U
PL2-227A	6/18/2003	6	16.5	1 U	1 U	1 U	1 U	1 U
PL2-227A	12/11/2003	6	16.5	1 U	1 U	1 U	1 U	1 U
PL2-227A	11/2/2004	6	16.5	1 U	1 U	1 U	1 U	1 U
PL2-227A	5/4/2005	6	16.5	1 U	1 U	1 U	1 U	1 U
PL2-227A	8/3/2005	6	16.5	1 U	1 U	1 U	1 U	1 U
PL2-227A	11/1/2005	6	16.5	1 U	1 U	1 U	1 U	1 U
PL2-227A	11/9/2006	6	16.5	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
PL2-227A	11/13/2007	6	16.5	1 U	1 U	1 U	1 U	1 U
PL2-227A	8/5/2008	6	16.5	1 U	1 U	1 U	1 U	1 U

Table A.1
Groundwater Data Compilation

Group 1: Area 2-10 North Steetpile

A Level Groundwater Wells, continued				TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	VC
Location	Date	Top (ft)	Bottom (ft)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
PL2-245A	10/7/1994	15	20	400	13	1,300	110	690
PL2-245A	10/7/1994	15	20	500	20 U	1,500	130	840
PL2-245A	11/11/1994	15	20	200	10 U	680	48	220
PL2-245A	12/9/1994	15	20	230	6.1	980	76	520
PL2-245A	12/9/1994	15	20	240	7	1,100	80	540
PL2-245A	1/21/1995	15	20	58	6.8	950	87	350
PL2-245A	2/17/1995	15	20	120	7.7	900	68	800
PL2-245A	3/17/1995	15	20	170	6.4	780	91	580
PL2-245A	4/21/1995	15	20	150	6.6	1,300	100	970
PL2-245A	5/24/1995	15	20	200	12	2,300	150	1,200
PL2-245A	6/15/1995	15	20	150	11	2,500	150	1,600
PL2-245A	7/19/1995	15	20	120	9.6	960	100	440
PL2-245A	8/17/1995	15	20	110	6.5	870	81	240
PL2-245A	9/22/1995	15	20	94	4.9	680	65	210
PL2-245A	7/30/2001	15	20	18	1 U	190	14	70
PL2-245A	10/29/2001	15	20	16	1 U	300	15	76
PL2-245A	1/31/2002	15	20	11	1 U	220	19	120
PL2-246A	10/7/1994	15	20	1 U	1 U	3.8	1 U	3.2
PL2-246A	10/7/1994	15	20	1 U	1 U	3.7	1.2	3.2
PL2-246A	10/7/1994	15	20	1 U	1 U	3.8	1 U	3.2
PL2-246A	11/11/1994	15	20	460	1 U	39	1.1	4.8
PL2-246A	12/9/1994	15	20	2.7	1 U	14	1 U	2 U
PL2-246A	12/9/1994	15	20	4.4	1 U	7.2	1 U	2 U
PL2-246A	1/20/1995	15	20	7.9	1 U	4.2	1 U	3.1
PL2-246A	2/17/1995	15	20	11	1 U	4.3	1 U	2 U
PL2-246A	3/17/1995	15	20	1 U	1 U	1.6	1 U	2 U
PL2-246A	4/21/1995	15	20	1 U	1 U	1.4	1 U	2 U
PL2-246A	5/24/1995	15	20	1 U	1 U	1.3	1 U	2 U
PL2-246A	6/15/1995	15	20	1 U	1 U	1.3	1 U	2 U
PL2-246A	7/19/1995	15	20	1 U	1 U	1.3	1 U	2 U
PL2-246A	8/17/1995	15	20	1 U	1 U	1.5	1 U	2 U
PL2-246A	9/22/1995	15	20	1 U	1 U	1.2	1 U	2 U
PL2-246A	4/26/2001	15	20	1.1	1 U	1 U	1 U	1 U
PL2-246A	8/1/2001	15	20	1 U	1 U	1 U	1 U	1 U
PL2-246A	10/25/2001	15	20	1 U	1 U	1 U	1 U	1.2
PL2-246A	1/29/2002	15	20	1 U	1 U	1 U	1 U	1
PL2-247A	10/7/1994	15	20	17	10 U	700	67	850
PL2-247A	10/7/1994	15	20	50 U	50 U	710	59	910
PL2-247A	11/11/1994	15	20	15	2	500	42	430
PL2-247A	12/9/1994	15	20	3.9	1.2	280	26	250
PL2-247A	1/21/1995	15	20	1.8	1 U	170	29	220
PL2-247A	2/17/1995	15	20	2.6	1 U	90	20	190
PL2-247A	3/17/1995	15	20	1 U	1 U	53	13	160
PL2-247A	4/21/1995	15	20	1 U	1 U	46	12	120
PL2-247A	5/24/1995	15	20	1 U	1 U	26	6.9	77
PL2-247A	6/15/1995	15	20	1 U	1 U	34	10	140
PL2-247A	7/19/1995	15	20	1 U	1 U	34	9.8	160
PL2-247A	8/17/1995	15	20	1 U	1 U	27	8.3	110
PL2-247A	9/22/1995	15	20	1 U	1 U	20	7	79
PL2-247A	4/16/2001	15	20	15 UJ	15 UJ	15 UJ	15 UJ	15 UJ
PL2-247A	8/1/2001	15	20	1 U	1 U	1 U	1 U	19

Group 2: Area 2-10 South Steetpile

A Level Groundwater Wells, continued				TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	VC
Location	Date	Top (ft)	Bottom (ft)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
PL2-230A	12/20/1993	5	20	1 U	1 U	1.8	1 U	2 U
PL2-231A	12/20/1993	5	20	1 U	1 U	1 U	1 U	2 U
PL2-231A	3/13/1995	5	20	1 U	1 U	1 U	1 U	0.45
PL2-232A	5/17/2001	5	20	1 U	1 U	1 U	1 U	1 U
PL2-232A	7/24/2001	5	20	1 U	1 U	1 U	1 U	1 U
PL2-232A	11/5/2001	5	20	1 U	1 U	1 U	1 U	1 U
PL2-232A	1/23/2002	5	20	1 U	1 U	1 U	1 U	1 U
PL2-232A	6/18/2003	5	20	1 U	1 U	1 U	1 U	1 U
PL2-232A	12/10/2003	5	20	1 U	1 U	1 U	1 U	1 U
PL2-232A	5/11/2004	5	20	1 U	1 U	1 U	1 U	1 UJL
PL2-232A	12/20/1993	5	20	1 U	1 U	1 U	1 U	3
PL2-232A	8/15/1995	5	20	1 U	1 U	1 U	1 U	3.4
PL2-232A	11/17/1995	5	20	1 U	1 U	1 U	1 U	2.3
PL2-232A	2/28/1996	5	20	1 U	1 U	1 U	1 U	3.5
PL2-232A	5/22/1996	5	20	1 U	1 U	1 U	1 U	2.3
PL2-232A	8/22/1996	5	20	1 U	1 U	1 U	1 U	4.7
PL2-232A	11/19/1996	5	20	1 U	1 U	1 U	1 U	2.4
PL2-232A	11/2/2004	5	20	1 U	1 U	1 U	1 U	1 U
PL2-232A	5/4/2005	5	20	1 U	1 U	1 U	1 U	1 U
PL2-232A	8/3/2005	5	20	1 U	1 U	1 U	1 U	1 U
PL2-232A	11/1/2005	5	20	1 U	1 U	1 U	1 U	1 U
PL2-232A	5/3/2006	5	20	1 U	1 U	1 U	1 U	1 U
PL2-232A	11/8/2006	5	20	0.2 U	0.2 U	0.2 U	0.2 U	0.4
PL2-232A	5/8/2007	5	20	1 U	1 U	1 U	1 U	1 U
PL2-232A	11/14/2007	5	20	1 U	1 U	1 U	1 U	1 U
PL2-232A	2/7/2008	5	20	1 U	1 U	1 U	1 U	1 U
PL2-232A	8/3/2008	5	20	1 U	1 U	1 U	1 U	1 U
PL2-232A	2/5/2009	5	20	1 U	1 U	1 U	1 U	1 U
PL2-252A	10/4/1994	13.5	18.5	20	1.8	720	2.4	100
PL2-252A	10/4/1994	13.5	18.5	47	1.8	760	2	34
PL2-252A	10/7/1994	13.5	18.5	47	1.8	760	2	34
PL2-252A	11/10/1994	13.5	18.5	19	2	720	1.4	32
PL2-252A	12/7/1994	13.5	18.5	25	1.1 N	700	1.1	11
PL2-252A	12/8/1994	13.5	18.5	21	2	750	1.3	25
PL2-252A	1/18/1995	13.5	18.5	24	1.2	450	1.1	22
PL2-252A	2/17/1995	13.5	18.5	20	1	410	1.1	26
PL2-252A	3/16/1995	13.5	18.5	19	1 U	290	1 U	15
PL2-252A	4/20/1995	13.5	18.5	6.6	1 U	350	1 U	34
PL2-252A	5/23/1995	13.5	18.5	8	1 U	320	1 U	16
PL2-252A	6/14/1995	13.5	18.5	7.3	1 U	320	1 U	12
PL2-252A	7/18/1995	13.5	18.5	3.8	1 U	320	1 U	30
PL2-252A	8/17/1995	13.5	18.5	1.8	1 U	260	1.4	30
PL2-252A	9/22/1995	13.5	18.5	2.2	1 U	260	1.3	15
PL2-252A	4/25/2001	13.5	18.5	1 U	1 U	1 U	1 U	2.6
PL2-252A	8/2/2001	13.5	18.5	1 U	1 U	3.6	1 U	1 U
PL2-252A	10/30/2001	13.5	18.5	1 U	1 U	1.4	1 U	1 U
PL2-252A	1/29/2002	13.5	18.5	1 U	1 U	1 U	1 U	1 U
PL2-253A	10/4/1994	12	17	650	5.6	1,200	3.4	74
PL2-253A	10/4/1994	12	17	920	4	960	1.6	12
PL2-253A	1/18/1995	12	17	270	5.2	1,100	2	84
PL2-253A	2/17/1995	12	17	290	4.3	1,200	1.6	44

Table A.1
Groundwater Data Compilation

Group 1: Area 2-10 North Steetpile

A Level Groundwater Wells, continued				TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	VC
Location	Date	Top (ft)	Bottom (ft)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
PL2-247A	12/9/1994	15	20	4	1.8	380	50	460
PL2-248A	10/7/1994	15	20	42	1 U	13	1 U	0.42
PL2-248A	10/7/1994	15	20	11	1 U	4	1 U	0.41
PL2-248A	10/7/1994	15	20	42	1 U	13	1 U	0.42
PL2-248A	11/11/1994	15	20	70	1 U	15	1 U	0.36
PL2-248A	12/9/1994	15	20	13 J	1 U	3.7 J	1 U	2 U
PL2-248A	12/9/1994	15	20	1.1	1 U	1.4	1 U	2 U
PL2-248A	1/19/1995	15	20	2.2	1 U	1.4	1 U	2 U
PL2-248A	2/17/1995	15	20	2.6	1 U	2.1	1 U	2 U
PL2-248A	3/17/1995	15	20	1 U	1 U	1 U	1 U	2 U
PL2-248A	4/21/1995	15	20	1 U	1 U	1.6	1 U	2 U
PL2-248A	5/24/1995	15	20	1 U	1 U	1.5	1 U	2 U
PL2-248A	6/15/1995	15	20	1 U	1 U	1 U	1 U	2 U
PL2-248A	7/19/1995	15	20	1 U	1 U	1 U	1 U	2 U
PL2-248A	8/17/1995	15	20	1 U	1 U	1 U	1 U	2 U
PL2-248A	9/22/1995	15	20	1 U	1 U	1.5	1 U	2 U
PL2-248A	4/27/2001	15	20	1 U	1 U	1 U	1 U	1 U
PL2-248A	8/7/2001	15	20	1 U	1 U	1 U	1 U	1 U
PL2-248A	10/30/2001	15	20	1 U	1 U	1 U	1 U	1 U
PL2-248A	1/30/2002	15	20	1 U	1 U	1 U	1 U	1 U
PL2-249A	10/7/1994	15	20	50	1 U	11	1 U	2.2
PL2-249A	10/7/1994	15	20	110	1 U	20	1.6	2.4
PL2-249A	10/7/1994	15	20	41	1 U	7.9	1 U	2.4
PL2-249A	10/7/1994	15	20	1 U	1 U	1 U	1 U	2 U
PL2-249A	11/11/1994	15	20	140	1 U	24	2	1.2
PL2-249A	12/9/1994	15	20	190	1 U	33	2.8	2 U
PL2-249A	12/9/1994	15	20	24	1 U	5.1	1 U	3.1
PL2-249A	1/19/1995	15	20	5.4 J	1 UJ	1.2 J	1 UJ	2 UJ
PL2-249A	2/17/1995	15	20	14	1 U	1.4	1 U	2.6
PL2-249A	3/17/1995	15	20	1 U	1 U	1 U	1 U	2.3
PL2-249A	4/21/1995	15	20	5.1	1 U	1.7	1 U	2 U
PL2-249A	5/24/1995	15	20	16	1 U	3.5	1 U	2 U
PL2-249A	6/15/1995	15	20	14	1 U	2.6	1 U	2.1
PL2-249A	7/19/1995	15	20	36	1 U	5.1	1 U	2.8
PL2-249A	8/17/1995	15	20	5.9	1 U	1.4	1 U	2 U
PL2-249A	9/22/1995	15	20	7.8	1 U	1.5	1 U	2 U
PL2-249A	4/18/2001	15	20	3.4	1 U	1 U	1 U	1 U
PL2-249A	8/7/2001	15	20	1 U	1 U	1 U	1 U	1 U
PL2-249A	10/30/2001	15	20	1 U	1 U	1 U	1 U	1 U
PL2-249A	1/30/2002	15	20	1 U	1 U	1 U	1 U	1.1
PL2-258A	4/24/2001	8	23	10 UJ	10 UJ	1,600	300	1,000
PL2-258A	7/26/2001	8	23	1 U	1 U	660	120	340
PL2-258A	10/23/2001	8	23	1 U	1 U	78	35	190
PL2-258A	1/24/2002	8	23	1 U	1.8	1,900	380	1,600
PL2-258A	6/19/2003	8	23	1 U	1 U	520	130	390
PL2-258A	9/3/2003	8	23	5 U	5 U	47	26	260
PL2-258A	12/10/2003	8	23	20 U	20 U	95	47	1,400
PL2-258A	2/4/2004	8	23	10 U	10 U	1,100	240	1,600
PL2-258A	5/11/2004	8	23	15 U	15 U	1,400	290	1,300 JL
PL2-258A	11/2/2004	8	23	1 U	1 U	5.4	22	180
PL2-258A	1/31/2005	8	23	1 UJ	1 UJ	2.7 J	8.4 J	84 J

Group 2: Area 2-10 South Steetpile

A Level Groundwater Wells, continued				TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	VC
Location	Date	Top (ft)	Bottom (ft)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
PL2-253A	5/23/1995	12	17	140	5.6	1,300	2.5	77
PL2-253A	6/14/1995	12	17	100	5.7	1,400	4.2	160
PL2-253A	7/18/1995	12	17	130	5.4	1,600	2	76
PL2-253A	8/17/1995	12	17	89	6.6	1,400	6.2	100
PL2-253A	9/22/1995	12	17	180	3.8	1,200	3.4	17
PL2-253A	4/25/2001	12	17	1 U	1.2	320	3.1	160
PL2-253A	8/2/2001	12	17	3.8	1 U	390	2.2	97
PL2-253A	10/30/2001	12	17	5 U	5 U	380	5 U	130
PL2-253A	1/29/2002	12	17	5 U	5 U	420	5 U	140
PL2-253A	11/8/1994	12	17	650	7.2	1,900	3	160
PL2-253A	11/9/1994	12	17	380	8.9	1,400	4.1	180
PL2-253A	11/10/1994	12	17	640	5.2	1,500	2	86
PL2-253A	11/11/1994	12	17	570	4.6	1,500	1.8	51
PL2-253A	12/7/1994	12	17	460	6.2	1,800	2.6	93
PL2-253A	12/8/1994	12	17	560	6.3	1,600	2.5	71
PL2-254A	10/4/1994	13.5	18.5	1 U	1 U	1 U	1 U	0.23
PL2-254A	10/4/1994	13.5	18.5	1 U	1 U	1 U	1 U	0.076
PL2-254A	10/7/1994	13.5	18.5	1 U	1 U	1 U	1 U	0.076
PL2-254A	11/10/1994	13.5	18.5	1 U	1 U	1 U	1 U	0.46
PL2-254A	12/7/1994	13.5	18.5	1 U	1 U	1 U	1 U	2 U
PL2-254A	12/8/1994	13.5	18.5	1 U	1 U	1 U	1 U	2 U
PL2-254A	1/19/1995	13.5	18.5	1 U	1 U	1 U	1 U	2 U
PL2-254A	2/17/1995	13.5	18.5	1 U	1 U	1 U	1 U	2 U
PL2-254A	3/16/1995	13.5	18.5	1 U	1 U	1 U	1 U	2 U
PL2-254A	4/20/1995	13.5	18.5	1 U	1 U	1 U	1 U	2 U
PL2-254A	5/24/1995	13.5	18.5	1 U	1 U	1 U	1 U	2 U
PL2-254A	6/15/1995	13.5	18.5	1 U	1 U	1 U	1 U	2 U
PL2-254A	7/18/1995	13.5	18.5	1 U	1 U	1 U	1 U	2 U
PL2-254A	8/17/1995	13.5	18.5	1 U	1 U	1 U	1 U	2 U
PL2-254A	9/22/1995	13.5	18.5	1 U	1 U	1 U	1 U	2 U
PL2-254A	4/25/2001	13.5	18.5	1 U	1 U	1 U	1 U	1 U
PL2-254A	8/3/2001	13.5	18.5	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
PL2-254A	11/1/2001	13.5	18.5	1 U	1 U	1 U	1 U	1 U
PL2-254A	1/31/2002	13.5	18.5	1 U	1 U	1 U	1 U	1 U
PL2-255A	10/4/1994	12.5	17.5	2.4	1 U	1 U	1 U	0.42
PL2-255A	10/4/1994	12.5	17.5	11	1 U	1 U	1 U	0.08
PL2-255A	11/10/1994	12.5	17.5	3.3	1 U	1 U	1 U	0.81
PL2-255A	12/7/1994	12.5	17.5	2.8	1 U	1 U	1 U	2 U
PL2-255A	12/8/1994	12.5	17.5	4.1	1 U	1 U	1 U	2 U
PL2-255A	1/19/1995	12.5	17.5	2.6	1 U	1 U	1 U	2 U
PL2-255A	2/17/1995	12.5	17.5	3.4	1 U	1.2	1 U	2 U
PL2-255A	3/16/1995	12.5	17.5	2.4	1 U	1 U	1 U	2 U
PL2-255A	4/20/1995	12.5	17.5	4.5	1 U	1 U	1 U	2 U
PL2-255A	5/24/1995	12.5	17.5	9.5	1 U	1 U	1 U	2 U
PL2-255A	6/15/1995	12.5	17.5	4.9	1 U	1 U	1 U	2 U
PL2-255A	7/18/1995	12.5	17.5	12	1 U	1 U	1 U	2 U
PL2-255A	8/17/1995	12.5	17.5	5.1	1 U	1 U	1 U	2 U
PL2-255A	9/22/1995	12.5	17.5	12	1 U	1 U	1 U	2 U
PL2-255A	4/25/2001	12.5	17.5	17	1 U	1 U	1 U	1 U
PL2-255A	8/3/2001	12.5	17.5	1 UJ	1 UJ	1.2 J	1 UJ	1 UJ
PL2-255A	11/6/2001	12.5	17.5	1 U	1 U	1 U	1 U	1 UJ
PL2-255A	1/31/2002	12.5	17.5	1 U	1 U	4.1	1 U	1.2

Table A.1
Groundwater Data Compilation

Group 1: Area 2-10 North Steetpile

A Level Groundwater Wells, continued				TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	VC
Location	Date	Top (ft)	Bottom (ft)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
PL2-258A	3/28/1995	8	23	100 U	100 U	4,700	340	1,500
PL2-258A	8/11/1995	8	23	3.5	58	6,000	310	1,500
PL2-258A	11/15/1995	8	23	3.3	47	4,900 JH	220 JH	890 JH
PL2-258A	2/28/1996	8	23	7.3	47	6,900	440	1,800
PL2-258A	5/20/1996	8	23	240	31 J	4,200	260	1,200
PL2-258A	8/20/1996	8	23	50 U	50 U	6,400	320	1,800
PL2-258A	11/18/1996	8	23	4	23	3,800	230	2,400
PL2-258A	8/4/2004	8	23	1 U	1 U	9.1	16	72
PL2-258A	5/4/2005	8	23	1 U	1 U	68	44	380
PL2-258A	8/4/2005	8	23	1 U	1 U	2.7	8.5	55
PL2-258A	11/1/2005	8	23	1 U	1 U	1.2	3	40
PL2-258A	2/8/2006	8	23	1 U	1 U	120	57	1,100
PL2-258A	5/3/2006	8	23	1 U	1 U	330	130	440
PL2-258A	8/2/2006	8	23	1.5 U	1.5 U	8.7	22	99
PL2-258A	11/8/2006	8	23	0.6 U	0.6 U	0.6 U	1.2	17
PL2-258A	2/5/2007	8	23	10 U	10 U	420	120	920
PL2-258A	5/3/2007	8	23	30 U	30 U	490	140	1,200
PL2-258A	8/7/2007	8	23	1 U	1 U	2.5	12	81
PL2-258A	11/15/2007	8	23	1 U	1 U	1 U	3.2	130
PL2-258A	2/1/2008	8	23	1 U	1 U	1.3	9.5	320
PL2-258A	8/1/2008	8	23	1 U	1 U	1 U	1 U	16
PL2-258A	2/5/2009	8	23	1 U	1 U	1 U	1.4	320
A/B Level Groundwater Wells				**TCE**	**1,1-DCE**	**cis-1,2-DCE**	**trans-1,2-DCE**	**VC**
Location	**Date**	**Top (ft)**	**Bottom (ft)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**
PL2-217A	8/19/1992	15	30	1 U	1 U	1 U	1 U	2 U
PL2-218A	8/14/1992	15	30	790	26	2,000	110	810
PL2-218A	4/16/2001	15	30	1,300	14	1,100	100	190
PL2-268A	4/26/2001	30	34.5	1 U	1 U	1 U	1 U	4.4
PL2-268A	8/1/2001	30	34.5	1 U	1 U	1 U	1 U	1 U
PL2-268AR	10/30/2001	30	34.5	1 U	1 U	1 U	1 U	1 U
PL2-268AR	1/30/2002	30	34.5	1 U	1 U	1 U	1 U	1.1
PL2-269A	4/26/2001	31	35.7	1 U	1 U	1 U	1 U	1 U
PL2-269A	7/30/2001	31	35.7	1 U	1 U	1 U	1 U	1 U
PL2-269A	10/30/2001	31	35.7	1 U	1 U	1 U	1 U	1 U
PL2-269A	1/30/2002	31	35.7	1 U	1 U	1 U	1 U	1 U
PL2-271A	4/25/2001	20.2	29.7	1 U	1 U	1 U	1 U	1 J
PL2-271A	7/26/2001	20.2	29.7	1 U	1 U	1 U	1 U	1
PL2-271A	11/5/2001	20.2	29.7	1 U	1 U	1 U	1 U	1.3 J
PL2-271A	1/23/2002	20.2	29.7	1 U	1 U	1 U	1 U	1.1
PL2-271A	6/19/2003	20.2	29.7	1 U	1 U	1 U	1 U	1 U
PL2-271A	12/10/2003	20.2	29.7	1 U	1 U	1 U	1 U	1 U
PL2-271A	5/11/2004	20.2	29.7	1 U	1 U	1 U	1 U	1 UJL
PL2-271A	11/2/2004	20.2	29.7	1 U	1 U	1 U	1 U	1 U
PL2-271A	5/4/2005	20.2	29.7	1 U	1 U	1 U	1 U	1 U
PL2-271A	8/4/2005	20.2	29.7	1 U	1 U	1 U	1 U	1 U
PL2-271A	11/1/2005	20.2	29.7	1 U	1 U	1 U	1 U	1 U
PL2-271A	5/3/2006	20.2	29.7	1 U	1 U	1 U	1 U	1 U
PL2-271A	11/8/2006	20.2	29.7	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
PL2-271A	5/3/2007	20.2	29.7	1 U	1 U	1 U	1 U	1 U
PL2-271A	11/14/2007	20.2	29.7	1 U	1 U	1 U	1 U	1 U
PL2-271A	2/1/2008	20.2	29.7	1 U	1 U	1 U	1 U	1 U
PL2-271A	8/1/2008	20.2	29.7	1 U	1 U	1 U	1 U	1 U
PL2-271A	2/5/2009	20.2	29.7	1 U	1 U	1 U	1 U	1 U

Group 2: Area 2-10 South Steetpile

A Level Groundwater Wells, continued				TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	VC
Location	Date	Top (ft)	Bottom (ft)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
PL2-256A	1/18/1995	13	18	58	1 U	24	1 U	3.4
PL2-256A	2/17/1995	13	18	99	1.3	81	1 U	7
PL2-256A	3/16/1995	13	18	130	1 U	20	1 U	2.7
PL2-256A	7/18/1995	13	18	50	2.8	130	1 U	66
PL2-256A	8/17/1995	13	18	23	1 U	37	1 U	88
PL2-256A	9/22/1995	13	18	58	2.6	130	1 U	57
PL2-256A	4/30/2001	13	18	8.1	1 U	6	1 U	10 J
PL2-256A	8/6/2001	13	18	1.7	1 U	1.8	1 U	1.8
PL2-256A	11/1/2001	13	18	3	1 U	200 J	2.4	72
PL2-256A	2/4/2002	13	18	1 U	1 U	4.4	1 U	11
PL2-256A	10/4/1994	13	18	220	1 U	18	1 U	2.2
PL2-256A	10/4/1994	13	18	420	1 U	36	1 U	4.6
PL2-256A	11/8/1994	13	18	30	1 U	19	1 U	1.7 J
PL2-256A	11/9/1994	13	18	30	1 U	15	1 U	2
PL2-256A	11/10/1994	13	18	56	1 U	19	1 U	2.6
PL2-256A	11/11/1994	13	18	180	1 U	22	1 U	4.5
PL2-256A	12/9/1994	13	18	190 J	1 U	26	1 U	4.1
PL2-256A	12/9/1994	13	18	200	1 U	28	1 U	4.1
PL2-256A	12/9/1994	13	18	110 J	1 U	28	1 U	5.4
PL2-256A	4/20/1995	13	18	78	1 U	64	1 U	8.3
PL2-256A	5/23/1995	13	18	68	1	200	1 U	22
PL2-256A	6/14/1995	13	18	46	1 U	18	1 U	5.9
PL2-257A	10/4/1994	13	18	860	9.6	85	2.9	86
PL2-257A	10/4/1994	13	18	1,100	9.6	92	3.4	82
PL2-257A	10/7/1994	13	18	1,100	9.5	92	1 U	82
PL2-257A	11/8/1994	13	18	320	2.9	51	2 U	39
PL2-257A	12/9/1994	13	18	480	4.9	71	1.3	67
PL2-257A	12/9/1994	13	18	450	5.6	82	1.5	83
PL2-257A	1/18/1995	13	18	410	6.8	97	1.4	100
PL2-257A	2/17/1995	13	18	820	12	130	3.1	110
PL2-257A	3/16/1995	13	18	450	4.4	150	1.4	38
PL2-257A	4/20/1995	13	18	650	4.8	220	1.9	32
PL2-257A	5/23/1995	13	18	610	8.4	300	3	60
PL2-257A	6/14/1995	13	18	190	3.8	300	1.5	39
PL2-257A	7/18/1995	13	18	370	7.1	480	2.4	70
PL2-257A	8/18/1995	13	18	200	4.4	350	2	67
PL2-257A	9/22/1995	13	18	940	10 U	320	10 U	26
PL2-257A	4/30/2001	13	18	22	1	220	2.6	63
PL2-257A	8/6/2001	13	18	12	5 U	190	5 U	42
PL2-257A	11/1/2001	13	18	1 U	1 U	1 U	1 U	1 U
PL2-257A	2/4/2002	13	18	2.8	1 U	190	2.7	66
PL2-266A	4/25/2001	26	30.2	1 U	1 U	1 U	1 U	1 U
PL2-266A	8/6/2001	26	30.2	1 U	1 U	1 U	1 U	1 U
PL2-266A	11/1/2001	26	30.2	1 U	1 U	1 U	1 U	1 U
PL2-266A	1/31/2002	26	30.2	1 U	1 U	1 U	1 U	1 U
PL2-267A	5/1/2001	26	30.5	1 U	1 U	1 U	1 U	1 U
PL2-267A	8/2/2001	26	30.5	1 U	1 U	1 U	1 U	1 U
PL2-267A	11/6/2001	26	30.5	1 U	1 U	1 U	1 U	1 UJ
PL2-267A	1/30/2002	26	30.5	1 U	1 U	1 U	1 U	1 U

Table A.1
Groundwater Data Compilation

Group 1: Area 2-10 North Steetpile

A/B Level Groundwater Wells, continued				TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	VC
Location	Date	Top (ft)	Bottom (ft)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
PL2-272A	4/26/2001	31.3	35.8	1 U	1 U	1 U	1 U	1 U
PL2-272A	8/1/2001	31.3	35.8	1 U	1 U	1 U	1 U	1 U
PL2-272A	10/29/2001	31.3	35.8	1 U	1 U	1 U	1 U	1.1
PL2-272A	1/29/2002	31.3	35.8	1 U	1 U	1 U	1 U	1 U
B Level Groundwater Wells				**TCE**	**1,1-DCE**	**cis-1,2-DCE**	**trans-1,2-DCE**	**VC**
Location	**Date**	**Top (ft)**	**Bottom (ft)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**
PL2-212B	8/18/1992	40	55	1 U	1 U	1.5	1 U	2 U
PL2-212B	8/16/1995	40	55	1 U	1 U	3	1 U	3.9
PL2-212B	11/16/1995	40	55	1 U	1 U	1 U	1 U	1.1
PL2-212B	3/5/1996	40	55	1 U	1 U	1 U	1 U	2 U
PL2-212B	5/21/1996	40	55	2	1 U	1 U	1 U	2 U
PL2-212B	8/20/1996	40	55	1 U	1 U	1 U	1 U	2 U
PL2-212B	11/18/1996	40	55	1 U	1 U	1 U	1 U	2.4
PL2-212B	4/27/2001	40	55	1 U	1 U	1 U	1 U	1.5
PL2-212B	8/3/2001	40	55	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
PL2-212B	10/25/2001	40	55	1 U	1 U	1 U	1 U	1 U
PL2-212B	2/5/2002	40	55	1 U	1 U	1 U	1 U	1 U
PL2-218B	8/18/1992	45	60	68	10 U	2,500	10 U	20 U
PL2-218B	4/16/2001	45	60	20 UJ	20 UJ	2,400	20 UJ	20 UJ
PL2-218B	7/30/2001	45	60	1.7	1 U	460	2.2	12
PL2-218B	10/29/2001	45	60	5 U	5 U	380	5 U	7.6
PL2-218B	1/31/2002	45	60	5 U	5 U	1,500	5.6	5 U
PL2-258B	3/28/1995	40	50	8	3.5	5,900	11	2.2
PL2-258B	8/15/1995	40	50	6.8	4.8	5,000	23	43
PL2-258B	11/15/1995	40	50	2.4	1 U	680	4.6	7.6
PL2-258B	2/28/1996	40	50	6	1.4	3,600	4.8	2 U
PL2-258B	5/20/1996	40	50	4.4	1.5	3,900	4.4	2 U
PL2-258B	8/20/1996	40	50	5.4	1.6	4,800	5.2	5.5
PL2-258B	4/25/2001	40	50	1.8	1 U	490	1.8	4.3 J
PL2-258B	7/26/2001	40	50	10 U	10 U	1,200	10 U	10 U
PL2-258B	10/23/2001	40	50	15 U	15 U	1,400	15 U	15 U
PL2-258B	1/24/2002	40	50	1.5	1 U	760	2.6	3.4
PL2-258B	6/19/2003	40	50	1.7	1 U	1,600	9.1	3.4
PL2-258B	9/3/2003	40	50	10 U	10 U	2,800	10 U	10 U
PL2-258B	12/10/2003	40	50	30 U	30 U	4,600	30 U	30 U
PL2-258B	2/4/2004	40	50	50 U	50 U	3,000	50 U	50 U
PL2-258B	5/11/2004	40	50	1.6	1 U	2,100	4.3	4.1 JL
PL2-258B	11/2/2004	40	50	25 U	25 U	2,700	25 U	25 U
PL2-258B	1/31/2005	40	50	30 UJ	30 UJ	1,600 J	30 UJ	30 UJ
PL2-258B	5/4/2005	40	50	1 U	1 U	120	1 U	1 U
PL2-258B	8/4/2005	40	50	10 U	10 U	1,600	10 U	10 U
PL2-258B	11/1/2005	40	50	1.2	1 U	1,200	3	3.3
PL2-258B	2/8/2006	40	50	10 U	10 U	960	10 U	10 U
PL2-258B	5/3/2006	40	50	10 U	10 U	940	10 U	10 U
PL2-258B	8/2/2006	40	50	10 U	10 U	1,800	10 U	10 U
PL2-258B	11/8/2006	40	50			950		
PL2-258B	11/8/2006	40	50	1 U	1 U		1 U	1 U
PL2-258B	2/5/2007	40	50	10 U	10 U	820	10 U	10 U
PL2-258B	5/3/2007	40	50	30 U	30 U	930	30 U	30 U
PL2-258B	8/7/2007	40	50	1.1	1 U	1,100	2	3.7
PL2-258B	11/15/2007	40	50	5 U	5 U	460	5 U	5 U
PL2-258B	2/1/2008	40	50	5 U	5 U	410	5 U	5 U
PL2-258B	8/1/2008	40	50	5 U	5 U	390	5 U	5 U
PL2-258B	2/5/2009	40	50	1 U	1 U	150	1 U	2.1

Group 2: Area 2-10 South Steetpile

B Level Groundwater Wells				TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	VC
Location	Date	Top (ft)	Bottom (ft)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
PL2-209B	8/19/1992	40	55	1 U	1 U	1 U	1 U	2 U
PL2-209B	8/11/1995	40	55	1 U	1 U	1 U	1 U	0.034
PL2-209B	11/16/1995	40	55	1 U	1 U	1 U	1 U	0.026
PL2-209B	2/27/1996	40	55	1 U	1 U	1 U	1 U	2 U
PL2-209B	5/24/1996	40	55	1 U	1 U	1 U	1 U	2 U
PL2-209B	8/21/1996	40	55	4.8	1 U	1 U	1 U	2 U
PL2-209B	11/19/1996	40	55	1 U	1 U	1 U	1 U	2 U
PL2-209B	4/19/2001	40	55	1 U	1 U	1 U	1 U	1 U
PL2-209B	8/2/2001	40	55	1 U	1 U	1 U	1 U	1 U
PL2-209B	10/31/2001	40	55	1 U	1 U	1 U	1 U	1 U
PL2-209B	1/30/2002	40	55	1 U	1 U	1 U	1 U	1 U
PL2-213B	8/19/1992	25.7	30.2	1 U	1 U	1 U	1 U	2 U
PL2-213B	5/1/2001	25.7	30.2	1 U	1 U	1 U	1 U	1 U
PL2-213B	8/3/2001	25.7	30.2	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
PL2-213B	11/1/2001	25.7	30.2	1 U	1 U	1 U	1 U	1 U
PL2-213B	1/31/2002	25.7	30.2	1 U	1 U	1 U	1 U	1 U
PL2-214B	8/18/1992	45	60	1 U	1 U	1 U	1 U	2 U
PL2-214B	3/15/1995	45	60	1 U	1 U	1 U	1 U	0.024
PL2-214B	8/16/1995	45	60	1 U	1 U	1 U	1 U	0.037 J
PL2-214B	11/16/1995	45	60	1 U	1 U	1 U	1 U	0.015
PL2-214B	2/27/1996	45	60	1 U	1 U	1 U	1 U	2 U
PL2-214B	5/22/1996	45	60	1 U	1 U	1 U	1 U	2 U
PL2-214B	8/21/1996	45	60	1 U	1 U	1 U	1 U	2 U
PL2-214B	11/19/1996	45	60	39	1 U	4.7	1 U	2 U
PL2-214B	4/25/2001	45	60	1 U	1 U	1 U	1 U	1 UJ
PL2-214B	7/25/2001	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	11/5/2001	45	60	1 U	1 U	1 U	1 U	1 UJ
PL2-214B	1/23/2002	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	6/19/2003	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	9/3/2003	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	12/10/2003	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	2/3/2004	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	5/11/2004	45	60	1 U	1 U	1 U	1 U	1 UJL
PL2-214B	8/4/2004	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	11/2/2004	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	1/31/2005	45	60	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
PL2-214B	5/4/2005	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	8/4/2005	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	11/1/2005	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	2/8/2006	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	5/3/2006	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	8/3/2006	45	60	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
PL2-214B	11/8/2006	45	60	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
PL2-214B	2/5/2007	45	60	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
PL2-214B	5/8/2007	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	8/7/2007	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	11/15/2007	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	2/7/2008	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	8/3/2008	45	60	1 U	1 U	1 U	1 U	1 U
PL2-214B	2/5/2009	45	60	1 U	1 U	1 U	1 U	1 U
PL2-261B	3/30/1995	40	50	1 U	1 U	1 U	1 U	0.058
PL2-262B	3/30/1995	40	50	1 U	1 U	1 U	1 U	0.54
PL2-262B	8/7/2002	40	50	1 U	1 U	1 U	1 U	1 U

Table A.1
Groundwater Data Compilation

Group 1: Area 2-10 North Steetpile

B Level Groundwater Wells, continued				TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	VC
Location	Date	Top (ft)	Bottom (ft)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
PL2-258B	11/18/1996	40	50	3.4	1 U	1,200	2.6	4.5
PL2-258B	8/4/2004	40	50	20 U	20 U	2,200	20 U	20 U
PL2-259B	3/29/1995	40	50	1 U	1 U	1 U	1 U	0.11
PL2-259B	8/19/2002	40	50	1 U	1 U	1 U	1 U	1 U
C Level Groundwater Wells				**TCE**	**1,1-DCE**	**cis-1,2-DCE**	**trans-1,2-DCE**	**VC**
Location	**Date**	**Top (ft)**	**Bottom (ft)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**
PL2-258C	3/29/1995	92	102	1 U	1 U	2.2	1 U	0.024
PL2-258C	11/15/1995	92	102	1 U	1 U	1 U	1 U	0.024
PL2-258C	2/29/1996	92	102	1 U	1 U	1 U	1 U	2 U
PL2-258C	5/21/1996	92	102	1 U	1 U	1 U	1 U	2 U
PL2-258C	8/20/1996	92	102	1 U	1 U	1 U	1 U	2 U
PL2-258C	11/18/1996	92	102	1 U	1 U	1 U	1 U	2 U
PL2-258C	4/25/2001	92	102	1 U	1 U	1 U	1 U	1 UJ
PL2-258C	7/26/2001	92	102	1 U	1 U	1 U	1 U	1 U
PL2-258C	10/23/2001	92	102	1 U	1 U	1 U	1 U	1 U
PL2-258C	1/24/2002	92	102	1 U	1 U	1 U	1 U	1 U
PL2-258C	6/19/2003	92	102	1 U	1 U	1 U	1 U	1 U
PL2-258C	12/10/2003	92	102	1 U	1 U	1 U	1 U	1 U
PL2-258C	5/11/2004	92	102	1 U	1 U	1 U	1 U	1 UJL
PL2-258C	11/2/2004	92	102	1 U	1 U	1 U	1 U	1 U
PL2-258C	5/4/2005	92	102	1 U	1 U	1 U	1 U	1 U
PL2-258C	11/1/2005	92	102	1 U	1 U	1 U	1 U	1 U
PL2-258C	5/3/2006	92	102	1 U	1 U	1 U	1 U	1 U
PL2-258C	11/8/2006	92	102	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
PL2-258C	5/3/2007	92	102	1 U	1 U	1 U	1 U	1 U
PL2-258C	11/15/2007	92	102	1 U	1 U	1 U	1 U	1 U
PL2-258C	2/1/2008	92	102	1 U	1 U	1 U	1 U	1 U
PL2-258C	8/1/2008	92	102	1 U	1 U	1 U	1 U	1 U
PL2-258C	2/5/2009	92	102	1 U	1 U	1 U	1 U	1 U

Group 2: Area 2-10 South Steetpile

C Level Groundwater Wells				TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	VC
Location	Date	Top (ft)	Bottom (ft)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
PL2-214C	4/25/2001	75.5	80	1 U	1 U	1 U	1 U	1 UJ
PL2-214C	7/25/2001	75.5	80	1 U	1 U	1 U	1 U	1 U
PL2-214C	11/5/2001	75.5	80	1 U	1 U	1 U	1 U	1 UJ
PL2-214C	1/23/2002	75.5	80	1 U	1 U	1 U	1 U	1 U
PL2-214C	6/19/2003	75.5	80	1 U	1 U	1 U	1 U	1 U
PL2-214C	12/10/2003	75.5	80	1 U	1 U	1 U	1 U	1 U
PL2-214C	5/11/2004	75.5	80	1 U	1 U	1 U	1 U	1 UJL
PL2-214C	11/2/2004	75.5	80	1 U	1 U	1 U	1 U	1 U
PL2-214C	5/4/2005	75.5	80	1 U	1 U	1 U	1 U	1 U
PL2-214C	11/1/2005	75.5	80	1 U	1 U	1 U	1 U	1 U
PL2-214C	5/3/2006	75.5	80	1 U	1 U	1 U	1 U	1 U
PL2-214C	11/8/2006	75.5	80	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
PL2-214C	5/8/2007	75.5	80	1 U	1 U	1 U	1 U	1 U
PL2-214C	11/15/2007	75.5	80	1 U	1 U	1 U	1 U	1 U
PL2-214C	2/7/2008	75.5	80	1 U	1 U	1 U	1 U	1 U
PL2-214C	8/3/2008	75.5	80	1 U	1 U	1 U	1 U	1 U
PL2-214C	2/5/2009	75.5	80	1 U	1 U	1 U	1 U	1 U

Abbreviations:

DCE Dichloroethene
ft Feet
H Value is likely to be higher than reported result; result may be biased high.
J Estimated
L Value is likely to be lower than reported result; result may be biased low.
N The analysis indicates the presence of an analyte for which there is preseumptive evidence to make a tentative identification.
TCE Trichloroethene
U Undetected
VC Vinyl chloride

Table A.2
Soil Data Compilation

Group 1: Area 2-10 North Steetpile

Soil Samples				TCE	cis-1,2-DCE	trans-1,2-DCE	VC	Chloroform	Methylene Chloride
Location	Date	Top (ft)	Bottom (ft)	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
2-10-012	1/17/2005	2	2	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	2.2 U
2-10-013	1/17/2005	2	2	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	2.1 U
B-17	8/15/1990	5	6.5	2 U	2 U	2 U	2 U	2 U	8 UJB
B-17	8/15/1990	7.5	9	2 U	2 U	2 U	2 U	2 U	5 UJB
B-18	8/15/1990	2.5	4	2 U	2 U	2 U	2 U	2 U	9 UJB
B-18	8/15/1990	7.5	9	2 U	2 U	2 U	2 U	2 U	8 UJB
B-19	8/16/1990	2.5	4	2 U	2 U	2 U	2 U	2 U	2 U
B-21	8/16/1990	2.5	4	2 U	2 U	2 U	2 U	2 U	2 U
B-22	8/17/1990	6.5	8	2	2 U	2 U	2 U	2 U	3 UJB
B-22	8/17/1990	15	16.5	2 U	2 U	2 U	2 U	2 U	4 UJB
C33	2/25/1992	1	1	1.1 U	1.1 U	1.1 U	3.1 U	1.1 U	1.3 JBU
C40	8/19/1992	5	5	1.2 U	1.9	1.2 U	2.3 U	1.2 U	3
C40	8/19/1992	10	10	1.1 U	1.1 U	1.1 U	2.2 U	1.1 U	2 J
C40	8/19/1992	15	15	1.2 U	1.2 U	1.2 U	2.5 U	1.2 U	2.5 U
C40	8/19/1992	20	20	1.3 U	1.3 U	1.3 U	2.6 U	1.7	2.6 U
C40	8/19/1992	25	25	1.3 U	1.3 U	1.3 U	2.5 U	1.3 U	2.5 U
D43	8/12/1992	5	5	160	100	2.7	2.2 U	1.1 U	2.5 JU
D43	8/12/1992	10	10	280	400	10	2.4 U	1.2 U	2.4 JU
D43	8/12/1992	15	15	1400	18000	790	1500	160 U	310 JU
D43	8/12/1992	20	20	470	190	8.4	45	5.8 U	12 JU
D43	8/12/1992	25	25	440	150	7.3	21	5.1 U	10 JU
E40	7/23/1992	5	5	12	1.3	1 U	2.1 U	1 U	2.1 U
E40	7/23/1992	10	10	330	250	2.3	2.5 U	1.2 U	2.5 U
E40	7/23/1992	18	18	1.3 U	1.3 U	1.3 U	2.6 U	1.3 U	2.6 U
E40	7/23/1992	20	20	1.9 J	7.4	1.3 U	2.6 U	1.3 U	4
E45	8/12/1992	5	5	1.1 U	1.1 U	1.1 U	2.2 U	1.1 U	2.2 JU
E45	8/12/1992	10	10	1.3 U	1.3 U	1.3 U	2.6 U	1.3 U	2.6 JU
E45	8/12/1992	15	15	1.4 U	110	1.6	360	1.4 U	2.7 JU
E45	8/12/1992	25	25	1.2 U	5.1	1.2 U	2.4 U	1.2 U	2.4 JU
F42	7/23/1992	5	5	2.1	1.1 U	1.1 U	2.3 U	1.1 U	2.3 U
F42	7/23/1992	10	10	110	6.3	1.2 U	2.4 U	1.2 U	2.4 U
F42	7/23/1992	15	15	1.3 U	1.3 U	2	99	1.3 U	2.7 U
F42	7/23/1992	22	22	5.4	14	9.4	13	1.3 U	2.5 U
F42	7/23/1992	25	25	1.2 U	1.2 U	1.2 U	2.5 U	1.2 U	2.5 U
G01	2/19/1992	1	1	1.1 U	1.1 U	1.1 U	3.4 U	1.1 U	2.7
G01	2/19/1992	5	5	1.1 U	1.1 U	1.1 U	3.3 U	1.1 U	1.1 J
G08	2/20/1992	1	1	1.1 U	1.1 U	1.1 U	3.3 U	1.1 U	7.2 BU
G08	2/20/1992	5	5	1.1 U	1.1 U	1.1 U	3.2 U	1.1 U	5.1 BU
G09	2/17/1992	1	1	1.1 U	1.1 U	1.1 U	3.2 U	1.1 U	2.7 BU
G09	2/17/1992	5	5	1.2 U	1.2 U	1.2 U	3.5 U	1.2 U	3.1 BU
G10	2/11/1992	1	1	1.3 U	1.3 U	1.3 U	3.8 U	1.3 U	2.5 U
G10	2/11/1992	5	5	1.2 U	1.2 U	1.2 U	3.7 U	1.2 U	2.5 U
PL2-210A	2/27/1992	1	1	1 BU	1 U	1 U	2 U	1 U	1.3 JBU
PL2-210A	2/27/1992	10	10	1.3 U	1.3 U	1.3 U	2.6 U	1.3 U	1.7 JBU
PL2-211A	2/10/1992	1	1	1.2 U	1.2 U	1.2 U	3.6 U	1.2 U	2.4 U
PL2-211A	2/10/1992	5	5	1.3 U	1.3 U	1.3 U	3.9 U	1.3 U	2.6 U
PL2-212A	2/28/1992	1	1	28 B	0.9 J	1.1 U	2.1 U	1.1 U	2.6 BU
PL2-212A	2/28/1992	5	5	1000 B	11000	300	750	6.3 U	19 BU
PL2-212A	2/28/1992	11	11	23000 B	44000	970	1800	170 U	530 BU
PL2-212B	7/24/1992	5	5	540	90	1.2 U	2.3 U	2.5	2.3 U
PL2-212B	7/24/1992	10	10	48000	6400	630 U	1300 U	630 U	2200 JU
PL2-212B	7/24/1992	15	15	6900	44000	380	340	13 U	26 U
PL2-212B	7/24/1992	28	28	2.4 J	5.7	1.3 U	2.5 U	2.1	2.5 U
PL2-212B	7/24/1992	30	30	2.2	1.8	1.2 U	2.4 U	1.2 U	3.5
PL2-212B	7/24/1992	35	35	15	1.2 U	1.2 U	2.4 U	1.5 J	3.7
PL2-212B	7/24/1992	45	45	3.3	3.9	1.3 U	2.5 U	2.1	4.9

Group 2: Area 2-10 South Steetpile

Soil Samples				TCE	cis-1,2-DCE	trans-1,2-DCE	VC	Chloroform	Methylene Chloride
Location	Date	Top (ft)	Bottom (ft)	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
C04	2/19/1992	5	5	1.3 U	1.3 U	1.3 U	3.8 U	1.3 U	2.7 BU
C04	2/19/1992	9.5	9.5	1.3 U	1.3 U	1.3 U	3.8 U	1.3 U	3.7 BU
C12	8/20/1992	5	5	2	1.1 U	1.1 U	2.1 U	1.1 U	2.1 U
C12	8/20/1992	10	10	77	1.3 U	1.3 U	2.6 U	1.3 U	2.6 U
C12	8/20/1992	15	15	1.2 U	1.2 U	1.2 U	2.4 U	1.2 U	2.4 U
C12	8/20/1992	20	20	8.2	1.1 U	1.1 U	2.2 U	1.1 U	2.7
C12	8/20/1992	25	25	1.3 U	1.3 U	1.3 U	2.5 U	1.3 U	2.5 U
C13	8/19/1992	5	5	1.1 U	1.1 U	1.1 U	2.2 U	1.1 U	2.2 U
C13	8/19/1992	10	10	1.3 U	1.3 U	1.3 U	2.6 U	1.3 U	2.6 U
C13	8/19/1992	15	15	1.3 U	1.3 U	1.3 U	2.6 U	1.3 U	2.6
C13	8/19/1992	23	23	1.3 U	1.3 U	1.3 U	2.5 U	1.5	6
C13	8/19/1992	25	25	1.2 U	1.2 U	1.2 U	2.4 U	1.3	4.9
C18	8/11/1992	5	5	1 U	1 U	1 U	2 U	1 U	2 JU
C18	8/11/1992	10	10	1 J	1.3 U	1.3 U	2.6 U	3.3	2.6 U
C18	8/11/1992	15	15	1.4	14	1.3 U	2.6 U	1.3 U	7.8 JU
C18	8/11/1992	20	20	79	77	1.2 U	47	1.2 U	2.4 U
C18	8/11/1992	25	25	15	9.8	1.2 U	4.5	1.2 U	2.4 U
D01	2/19/1992	1	1	1.3	1.1 U	1.1 U	3.3 U	1.1 U	1.3 J
D01	2/19/1992	5	5	1.4 U	1.4 U	1.4 U	4.1 U	1.4 U	2.5 J
D12	8/18/1992	5	5	1 U	1 U	1 U	2 U	1 U	1.9 J
D12	8/18/1992	10	10	36	1.3 U	1.3 U	2.5 U	1.3 U	2.5 U
D12	8/18/1992	15	15	1.3 U	1.3 U	1.3 U	2.6 U	1.3 U	2.6 U
D12	8/18/1992	23	23	1.3 U	1.3 U	1.3 U	2.6 U	1.8	4.6
D12	8/18/1992	25	25	1.3 U	1.3 U	1.3 U	2.5 U	1.8	3.6
D13	8/10/1992	5	5	2.7	1 U	1 U	2 U	1 U	2 JU
D13	8/10/1992	10	10	1600	1.3 U	1.3 U	2.7 U	8.5	2.7 JU
D13	8/10/1992	15	15	1.3 U	1.3 U	1.3 U	2.5 U	1.3 U	2.5 U
D13	8/10/1992	20	20	4.5	1.3 U	1.3 U	2.5 U	1.3 U	3 JU
D13	8/10/1992	25	25	5.7	1.2 U	1.2 U	2.5 U	1.5	2.5 U
D14	2/17/1992	5	5	20	1.2 U	1.2 U	3.5 U	1.2 U	5.4 BU
D14	2/17/1992	10	10	28	10	12	3.9 U	1.3 U	5.7 BU
D17	2/25/1992	2.5	2.5		1.1 U	1.1 U	3.4 U	1.1 U	1.9 JBU
D17	2/25/1992	2.5	2.5	170					
D17	2/25/1992	5	5	5.2	1 U	1 U	3.1 U	1 U	1.2 JBU
D17	2/25/1992	7.5	7.5	15	1.3 U	1.3 U	3.8 U	1.3 U	2.3 JBU
D17	2/25/1992	10	10	330	13	1.3 U	3.9 U	1.3 U	2.3 JBU
D19	8/11/1992	5	5	1 U	1 U	1 U	2 U	1 U	3.3 JU
D19	8/11/1992	10	10	1.3 U	1.3 U	1.3 U	2.7 U	1.3 U	5.1 JU
D19	8/11/1992	15	15	1.3 U	1.3 U	1.3 U	2.6 U	1.3 U	2.6 U
D19	8/11/1992	20	20	1.3 U	1.3 U	1.3 U	2.5 U	1.3 U	2.5 U
D19	8/11/1992	25	25	1.2 U	1.2 U	1.2 U	2.5 U	1.2 U	7.3 JU
E03	2/24/1992	1	1	1.3	1.1 U	1.1 U	3.4 U	1.1 U	2 JBU
E03	2/24/1992	5	5	1.1 U	1.1 U	1.1 U	3.3 U	1.1 U	1.4 JBU
E14	7/22/1992	5	5	280	130 U	130 U	250 U	130 U	250 JU
E14	7/22/1992	10	10	2400	150 U	150 U	300 U	150 U	940 JU
E14	7/22/1992	15	15	630	160 U	160 U	310 U	160 U	310 JU
E15	8/10/1992	5	5	55	1.1 U	1.1 U	2.2 U	1.1 U	2.2 U
E15	8/10/1992	10	10	4.2	1.1 U	1.1 U	2.2 U	1.1 U	2.2 U
E15	8/10/1992	15	15	35	1.3 U	1.3 U	2.5 U	1.3 U	2.5 U
E15	8/10/1992	20	20	65	1.2 U	1.2 U	2.5 U	1.2 U	2.5 U
E15	8/10/1992	25	25	11	1.2 U	1.2 U	2.4 U	1.2 U	2.4 U
E18	7/22/1992	5	5	14	5.5 U	5.5 U	11 U	5.5 U	13 J
E18	7/22/1992	8	8	3700	3.3 U	3.3 U	6.6 U	7.1	6.6 JU
E18	7/22/1992	15	15	1.2 JU	1.3 U	1.3 U	2.7 U	1.3 U	4.1 J
E20	2/25/1992	1	1	1.5	1 U	1 U	3.1 U	1 U	1.3 JBU
E20	2/25/1992	7.5	7.5	1.3 J	1.5 U	1.5 U	4.3 U	1.5 U	2.7 JBU

Table A.2
Soil Data Compilation

Group 1: Area 2-10 North Steetpile

Soil Samples				TCE	cis-1,2-DCE	trans-1,2-DCE	VC	Chloroform	Methylene Chloride
Location	Date	Top (ft)	Bottom (ft)	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PL2-217A	7/29/1992	5	5	1.1 U	1.1 U	1.1 U	2.2 U	1.1 U	3.6 J
PL2-217A	7/29/1992	10	10	1.3 U	1.3 U	1.3 U	2.5 U	1.3 U	2.5 U
PL2-217A	7/29/1992	15	15	1.2 U	1.2 U	1.2 U	2.5 U	1.2 U	2.8 J
PL2-217A	7/29/1992	20	20	1.3 U	1.3 U	1.3 U	2.5 U	3.6	3.7 J
PL2-217A	7/29/1992	28	28	1.3 U	1.3 U	1.3 U	2.5 U	4.3	2.5 U
PL2-218A	7/27/1992	5	5	1.8 J	6.4	2.5 U	5 U	2.5 U	13 J
PL2-218A	7/27/1992	10	10	38	56	3.3 U	6.5 U	3.3 U	45
PL2-218A	7/27/1992	15	15	480	1200	120	380	2.9 U	11 J
PL2-218A	7/27/1992	23	23	37	26	3	7.3	1.8	2.5 U
PL2-218A	7/27/1992	28	28	1.2 U	1.2 U	1.2 U	2.4 U	1.2 U	2.4 U
PL2-218B	8/6/1992	43	43	11	140	1.3 U	2.7 U	2.2	2.7 JU
PL2-218B	8/6/1992	50	50	7.5	98	1.3 U	2.6 U	3	2.6 JU
PL2-218B	8/6/1992	58	58	13	260	1.2 U	2.4 U	1.2 U	7.1 JU
PL2-244A	8/4/1994	11.5	11.5	36	19	1.2 U	2.4 U	1.2 U	4.5 BU
PL2-244A	8/4/1994	15	15	25	150	3	2.4 U	1.2 U	5.2 BU
PL2-244A	8/4/1994	20	20	3.6	10	1.2 U	2.5 U	1.2 U	4.7 BU
PL2-246A	8/4/1994	10	10	1.2 U	1.2 U	1.2 U	2.4 U	1.2 U	5 BU
PL2-246A	8/4/1994	15	15	1.3 U	1.3 U	1.3 U	2.6 U	1.3 U	5.8 BU
PL2-246A	8/4/1994	20	20	1.2 U	1.2 U	1.2 U	2.5 U	1.2 U	4.4 BU
PL2-248A	8/5/1994	10	10	52	1.5	1.2 U	2.4 U	1.2 U	3 BU
PL2-248A	8/5/1994	15	15	1.2 U	1.2 U	1.2 U	2.4 U	1.2 U	4.2 BU
PL2-248A	8/5/1994	20	20	1.2 U	1.2 U	1.2 U	2.5 U	1.2 U	3.7 BU
PL2C-2-10-A	9/7/2005	4	4	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	2 U
PL2C-2-10-B	9/7/2005	4	4	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	2 U
PL2C-2-10-E	9/9/2005	4.5	4.5	1 U	1 U	1 U	1 U	1 U	2.1 U
PL2C-2-10-F	9/9/2005	4.5	4.5	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	3.5
PL2C-2-10-G	9/14/2005	2.8	2.8	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	4.3
PL2C-2-10-G	9/14/2005	6	6	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	5.5
PL2C-2-10-H	9/13/2005	3.5	3.5	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	4.5
PL2C-2-10-I	9/20/2005	8	8	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	2.2 U
PL2C-2-10-L	10/4/2005	3.5	3.5	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	9.6
PL2C-2-10-O	7/26/2006	4.5	4.5	1 U	1 U	1 U	1 U	1 U	11
PL2C-PL52-Bott-0105	9/27/2006	10.25	10.5	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	3.6
PL2CS-2-120-01	9/27/2006	5.75	6	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	2.4 U
PL2CS-2-120-02	9/27/2006	5.75	6	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	2.5 U
SB-01016	8/16/1994	1.5	1.5	1.1 U	1.1 U	1.1 U	2.2 U	1.1 U	2.2 U
SB-01016	8/16/1994	3.5	3.5	1.4 U	1.4 U	1.4 U	2.8 U	1.4 U	2.8 U
SB-01017	8/16/1994	1.5	1.5	1.3 U	1.3 U	1.3 U	2.6 U	1.3 U	2.6 U
SB-01017	8/16/1994	3.5	3.5	1.3 U	1.3 U	1.3 U	2.6 U	1.3 U	2.6 U
SB-01023	8/11/1994	6	6	1 U	1 U	1 U	2.1 U	1 U	2.1 U
SB-01023	8/11/1994	12	12	1.3 U	1.3 U	1.3 U	2.6 U	1.3 U	4.9
SB-01024	8/10/1994	1	1	1.1 U	1.1 U	1.1 U	2.1 U	1.1 U	8.1
SB-01024	8/10/1994	6	6	1.8	1 U	1 U	2.1 U	1 U	5.5
SB-01024	8/10/1994	11.5	11.5	1.3 U	1.3 U	1.3 U	2.6 U	1.3 U	3.5
SB-01039	8/10/1994	1	1	1.1 U	1.1 U	1.1 U	2.1 U	1.1 U	4.3
SB-01039	8/10/1994	6	6	2.5	1.2 U	1.2 U	2.3 U	1.2 U	3.9
SB-01039	8/10/1994	9.5	9.5	1.3 U	1.3 U	1.3 U	2.6 U	1.3 U	3.7
SB-01042	2/16/1995	11	11	1.3 U	1.3 U	1.3 U	2.7 U	1.3 U	2.7 U
SB-01043	2/16/1995	11	11	1.4 U	1.4 U	1.4 U	2.8 U	1.4 U	2.8 U
SB-01505	3/31/1994	1	1	1.1 U	1.1 U	1.1 U	2.2 U	1.1 U	2.2 U
SB-01505	3/31/1994	2	2	1.4 U	1.4 U	1.4 U	2.8 U	1.4 U	2.8 U
SB-01505	3/31/1994	6	6	1.3 U	1.3 U	1.3 U	2.7 U	1.3 U	2.7 U
SB-01506	3/31/1994	11	11	1.3 U	1.3 U	1.3 U	2.6 U	1.3 U	2.6 U
SB-01507	4/1/1994	9	9	1.1 U	1.1 U	1.1 U	2.1 U	1.1 U	2.1 U
SB-01508	4/1/1994	1	1	1.1 U	1.1 U	1.1 U	2.1 U	1.1 U	2.1 U
SB-01508	4/1/1994	6.5	6.5	1.4 U	1.4 U	1.4 U	2.8 U	1.4 U	3
SB-01508	4/1/1994	11	11	1.3 U	1.3 U	1.3 U	2.6 U	1.3 U	2.6 U

Group 2: Area 2-10 South Steetpile

Soil Samples				TCE	cis-1,2-DCE	trans-1,2-DCE	VC	Chloroform	Methylene Chloride
Location	Date	Top (ft)	Bottom (ft)	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
F10	2/17/1992	5	5	1 U	1 U	1 U	3.1 U	1 U	2.5 BU
F10	2/17/1992	10	10	1.2 U	1.2 U	1.2 U	3.7 U	1.2 U	3.4 BU
F16	2/18/1992	1	1	1.2 U	1.2 U	1.2 U	3.6 U	1.2 U	5.9 BU
F16	2/18/1992	9.5	9.5	1.3 U	1.3 U	1.3 U	4 U	1.3 U	6.8 BU
G02	2/20/1992	1	1	1.2 U	1.2 U	1.2 U	3.6 U	1.2 U	6.1 BU
G02	2/20/1992	5	5	1.1 U	1.1 U	1.1 U	3.1 U	1.1 U	3.2 BU
G02	2/20/1992	9.5	9.5	1.3 U	1.3 U	1.3 U	3.9 U	1.3 U	2.5 JBU
G03	2/17/1992	1	1	1.1 U	1.1 U	1.1 U	3.2 U	1.1 U	3.7 BU
G03	2/17/1992	5	5	1.2 U	1.2 U	1.2 U	3.6 U	1.2 U	4.6 BU
G05	2/19/1992	1	1	1.1 U	1.1 U	1.1 U	3.2 U	1.1 U	1.2 JBU
G05	2/17/1992	5	5	1.1 U	1.1 U	1.1 U	3.3 U	1.1 U	1.4 JBU
G05	2/17/1992	10	10	1.3 U	1.3 U	1.3 U	3.8 U	1.3 U	4.5 BU
G07	2/14/1992	1	1	1.1 U	1.1 U	1.1 U	3.4 U	1.1 U	4.4 BU
G07	2/14/1992	5	5	1.2 U	1.2 U	1.2 U	3.5 U	1.2 U	2.2 JBU
G07	2/14/1992	12	12	1.4 U	1.4 U	1.4 U	4.1 U	1.4 U	1.8 JBU
H19	2/18/1992	1	1	1.1 U	1.1 U	1.1 U	3.2 U	1.1 U	3.3 BU
H19	2/18/1992	5	5	1 U	1 U	1 U	3 U	1 U	1.5 JBU
H19	2/18/1992	12.5	12.5	1.3 U	1.3 U	1.3 U	3.9 U	1.3 U	4.7 BU
HL1	2/19/1992	5	5	1.1 U	1.1 U	1.1 U	3.3 U	1.1 U	2.2 U
HL1	2/19/1992	9.5	9.5	1.2 U	1.2 U	1.2 U	3.7 U	1.2 U	2 JBU
HP-AL-20	8/20/1990	2.5	4	5 U	5 U	5 U	5 U	5 U	5 UJB
P2CS-2-10-T-M	8/17/2005	3	3	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	2.3 U
P2CS-2-10-T-N	8/17/2005	3	3	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	2.1 U
P2CS-2-10-T-S	8/17/2005	3	3	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	2.4 U
PL2-201A	2/11/1992	1	1	1.1 U	1.1 U	1.1 U	3.4 U	1.1 U	7.9 BU
PL2-201A	2/11/1992	5	5	1.1 U	1.1 U	1.1 U	3.3 U	1.1 U	1.3 JBU
PL2-202A	2/12/1992	1	1	1.2 U	1.2 U	1.2 U	3.5 U	1.2 U	4.5 BU
PL2-202A	2/12/1992	5	5	1.1 U	1.1 U	1.1 U	3.4 U	1.1 U	3.8 BU
PL2-203A	2/11/1992	1	1	1.2 U	1.2 U	1.2 U	3.7 U	1.2 U	2.5 U
PL2-203A	2/11/1992	5	5	1.3 U	1.3 U	1.3 U	3.9 U	1.3 U	2.6 U
PL2-204A	2/13/1992	1	1	1.2 U	1.2 U	1.2 U	3.6 U	1.2 U	1.5 JBU
PL2-204A	2/13/1992	5	5	1.1 U	1.1 U	1.1 U	3.4 U	1.1 U	1.4 JBU
PL2-206A	2/14/1992	1	1	1.1 U	1.1 U	1.1 U	3.4 U	1.1 U	4.8 BU
PL2-206A	2/14/1992	5	5	1.4 U	1.4 U	1.4 U	4.1 U	1.4 U	1.1 JBU
PL2-209A	2/20/1992	1	1	6	1.1 U	1.1 U	2.1 U	1.1 U	2.2 BU
PL2-209A	2/20/1992	5	5	2.9	1 U	1 U	1.9 U	1 U	2.1 BU
PL2-209A	2/20/1992	9.5	9.5	27000	560	19	44	1.4 B	2.5 BU
PL2-209B	7/30/1992	5	5	4	1 U	1 U	2.1 U	1 U	3.1 JU
PL2-209B	7/30/1992	10	10	2.4	1.1 U	1.1 U	2.3 U	1.1 U	2.3 JU
PL2-209B	7/30/1992	15	15	32000	4800	67	410 J	1.3 U	2.6 JU
PL2-209B	7/30/1992	20	20	300	160	5.4 U	11 U	5.4 J	11 JU
PL2-209B	7/30/1992	33	33	150	66	5.4 U	11 U	8.2 J	11 JU
PL2-209B	7/30/1992	45	45	90	37	5.7 U	11 U	7.7 J	11 JU
PL2-209B	7/30/1992	50	50	45	13	5.4 U	11 U	8.6	11 JU
PL2-209B	7/30/1992	55	55	120	51	5.1 U	10 U	7.3	81
PL2-213B	8/7/1992	5	5	1 U	1 U	1 U	2 U	1 U	2.4
PL2-213B	8/7/1992	10	10	1.3 U	1.3 U	1.3 U	2.7 U	1.3 U	2.7 U
PL2-213B	8/7/1992	15	15	1.3 U	1.3 U	1.3 U	2.7 U	1.3 U	3.6
PL2-213B	8/7/1992	20	20	1.3 U	1.3 U	1.3 U	2.6 U	2.4 J	9.4
PL2-213B	8/7/1992	27	27	1.2 U	1.2 U	1.2 U	2.5 U	1.3 J	5.9
PL2-213B	8/7/1992	30	30	1.3 U	1.3 U	1.3 U	2.5 U	1.5 J	2.5 U
PL2-214A	7/31/1992	5	5	1 U	1 U	1 U	2.1 U	1 U	11 JU
PL2-214A	7/31/1992	10	10	1.2 U	1.2 U	1.2 U	2.4 U	1.2 U	4.5 JU
PL2-214A	7/31/1992	15	15	14	33	1.3 U	2.7 U	1.3 U	5 JU
PL2-214A	7/31/1992	20	20	2.5	8.8	1.3 U	2.6 U	4	3 JU
PL2-214B	8/3/1992	28	28	1.2 U	4.4	1.2 U	2.5 U	2.6 JU	2.5 U
PL2-214B	8/3/1992	35	35	1.2 U	2.4	1.2 U	2.4 U	2.4 B	2.4 U

Table A.2
Soil Data Compilation

Group 1: Area 2-10 North Steetpile

Soil Samples				TCE	cis-1,2-DCE	trans-1,2-DCE	VC	Chloroform	Methylene Chloride
Location	Date	Top (ft)	Bottom (ft)	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
SB-01509	4/1/1994	7	7	1.2 U	1.2 U	1.2 U	2.3 U	1.2 U	2.3 U
SB-01509	4/1/1994	11.5	11.5	1.4 U	1.4 U	1.4 U	2.7 U	1.4 U	2.7 U
T08	2/18/1992	1	1	1.1 U	1.1 U	1.1 U	3.4 U	1.1 U	5.1 BU
T08	2/18/1992	5	5	1.1 U	1.1 U	1.1 U	3.2 U	1.1 U	5.8 BU
T2C	2/21/1992	1	1	0.8 J	1.1 U	1.1 U	2.2 U	1.1 U	2.5 BU
T2C	2/21/1992	5	5	1 U	1 U	1 U	1.9 U	1 U	0.8 NBU
T2C	2/21/1992	9.5	9.5	1.2 U	1.2 U	1.2 U	2.4 U	1.2 U	1.8 JBU
T2D	2/19/1992	1	1	1.2 U	1.2 U	1.2 U	3.6 U	1.2 U	2.8
T2D	2/19/1992	5	5	1.3 U	1.3 U	1.3 U	3.8 U	1.3 U	2 J
T53	2/20/1992	1	1	1 U	1 U	1 U	3.1 U	1 U	4.2 BU
T53	2/20/1992	5	5	1 U	1 U	1 U	3.1 U	1 U	3.2 BU
T64	2/18/1992	1	1	1.2 U	1.2 U	1.2 U	3.5 U	1.2 U	
T64	2/18/1992	1	1						5.1 BU
T64	2/18/1992	5	5	1.1 U	1.1 U	1.1 U	3.2 U	1.1 U	3.1 BU

Group 2: Area 2-10 South Steetpile

Soil Samples				TCE	cis-1,2-DCE	trans-1,2-DCE	VC	Chloroform	Methylene Chloride
Location	Date	Top (ft)	Bottom (ft)	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PL2-214B	8/3/1992	43	43	1.2 U	2.9	1.2 U	2.4 U	2.1 J	2.4 U
PL2-214B	8/3/1992	50	50	1.4 U	1.4 U	1.4 U	2.7 U	1.4 U	2.7 U
PL2-214B	8/3/1992	60	60	1.2 U	1.2 U	1.2 U	2.5 U	1.7	2.5 U
PL2-216A	8/4/1992	5	5	1 U	1 U	1 U	2 U	1 U	7.1
PL2-216A	8/4/1992	10	10	1.2 U	1.2 U	1.2 U	2.3 U	1.2 U	3
PL2-216A	8/4/1992	15	15	1.4 U	1.4 U	1.4 U	2.7 U	1.4 U	2.7 U
PL2-216A	8/4/1992	30	30	1.2 U	1.2 U	1.2 U	2.5 U	2.3 J	2.9

Boeing Plant 2
Seattle/Tukwila, Washington

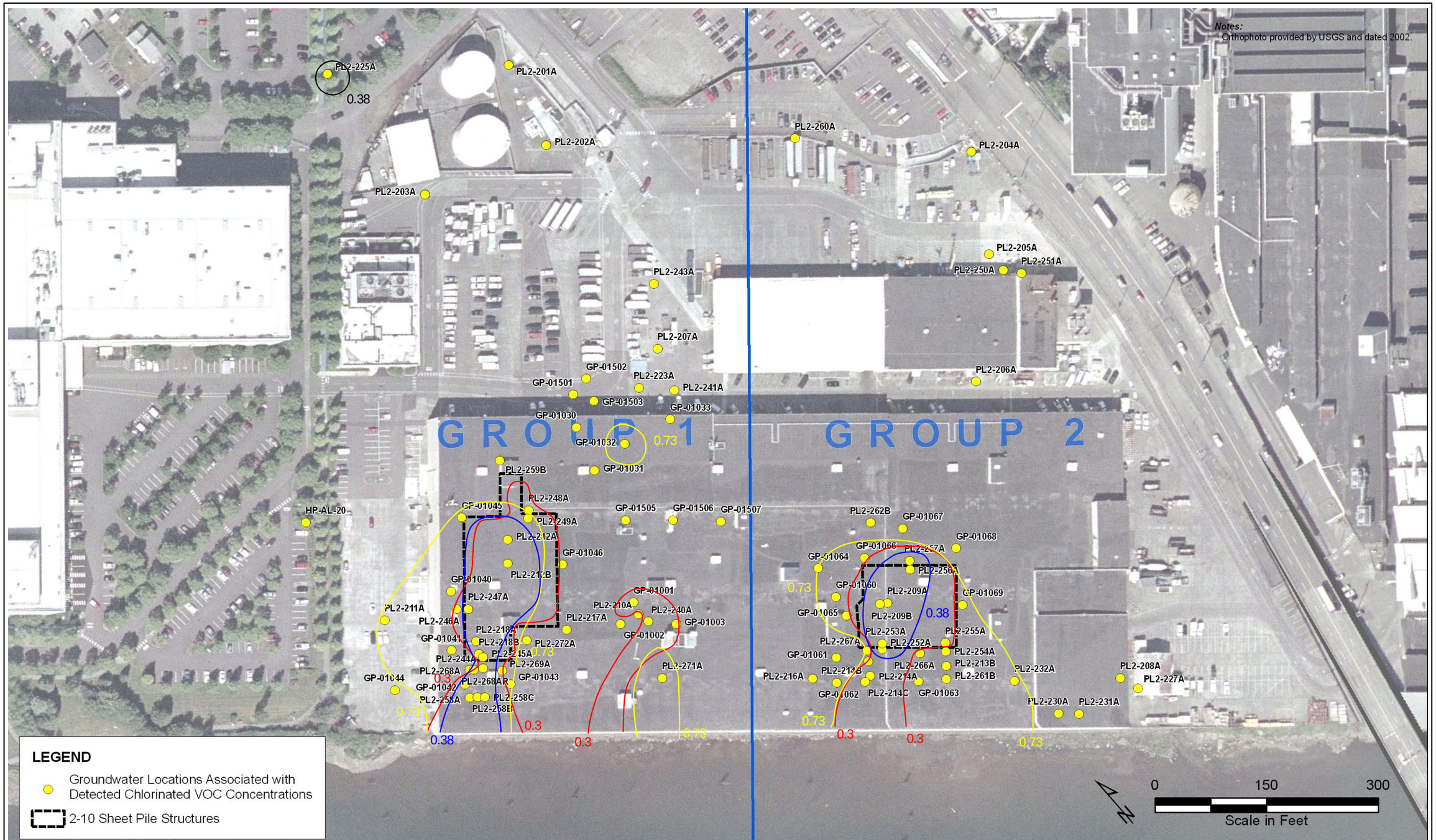
North and South Sheetpiles in the 2-10 Building Interim Measure Work Plan (AOC 2-10.3A and AOC 2-10.4A)

Phase 1: Data Collection

Appendix A
Synopsis of Historical Sampling from Prior Investigations near the North and South Sheetpiles

Figures

AGENCY REVIEW DRAFT



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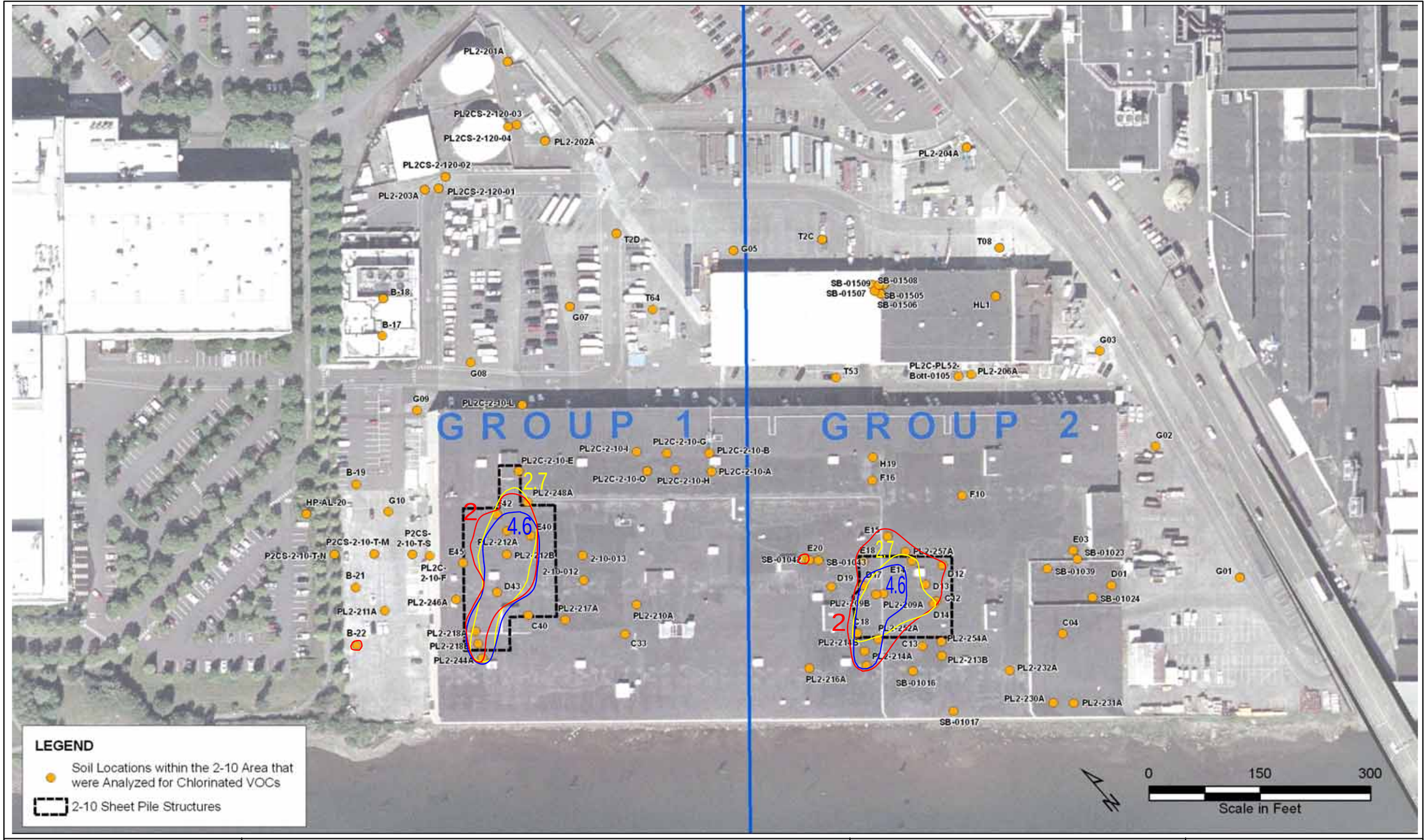
All of the interpreted contour lines shown above are based on historical data ranging from 1992 to 2009, current conditions may be different

Trichloroethene isoconcentration line exceeding Groundwater Screening Level = 0.3 ug/L
1,1-Dichloroethene isoconcentration line exceeding Groundwater Screening Level = 0.38 ug/L
Vinyl Chloride isoconcentration line exceeding Groundwater Screening Level = 0.73 ug/L

Interim Measure Work Plan
North and South Sheetpiles in the 2-10 Building
Boeing Plant 2
Seattle, Washington

Figure A.1
Chlorinated VOC Groundwater Locations in the 2-10 Area



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CALIBRE
Our Success Follows Yours

All of the interpreted contour lines shown above are based on historical data ranging from 1990 to 2006, current conditions may be different. All data from sampling interval with highest VOC concentration.

- Trichloroethene isoconcentration line exceeding Soil Screening Level = 2 ug/kg
- Dichloroethene isoconcentration line exceeding Soil Screening Level = 2.73 ug/kg (1,1DCE as surrogate including both 1,1DCE and cis1,2DCE isomers because most soil samples for 1,1DCE are non detect)
- Vinyl Chloride isoconcentration line exceeding Soil Screening Level = 4.59 ug/kg

Interim Measure Work Plan
North and South Sheetpiles in the 2-10 Building
Boeing Plant 2
Seattle, Washington

Figure A.2
Chlorinated VOC Soil Sample Locations in the 2-10 Area

Boeing Plant 2
Seattle/Tukwila, Washington

North and South Sheetpiles in the 2-10 Building Interim Measure Work Plan (AOC 2-10.3A and AOC 2-10.4A)

Phase 1: Data Collection

Appendix A
Synopsis of Historical Sampling from Prior Investigations near the North and South Sheetpiles

Attachments

AGENCY REVIEW DRAFT

ENVIRONMENTAL PARTNERS INC

295 NE Gilman Blvd. Suite 201 Issaquah, Washington 98027 ph 425.395.0010 fax 425.395.0011

CMS Phase Semi-Annual Shoreline Groundwater Monitoring Report, August 2008

Boeing Plant 2
Seattle/Tukwila, Washington

Prepared For:

The Boeing Company
P.O. Box 3707
M/C 1W-12
Seattle, WA 98124

November 4, 2008

Prepared By:

Environmental Partners, Inc.
295 NE Gilman Blvd., Suite 201
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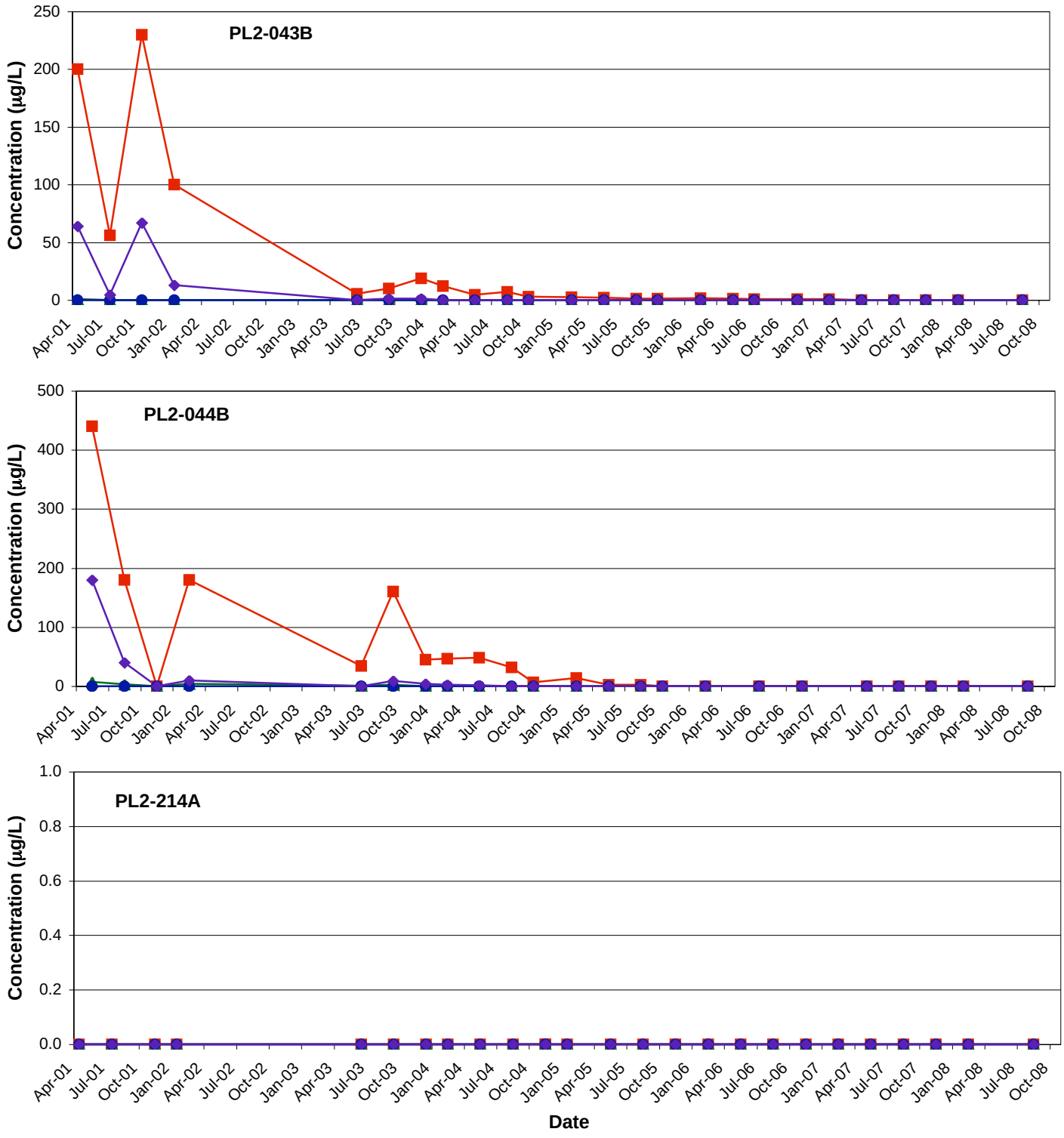
Douglas Kunkel, LG, LHG
Principal Hydrogeologist

Project Number: 17510.1

State of Washington
Hydrogeologist
260
Licensed Geologist
DOUGLAS C. KUNKEL



Legend

- cis-1,2-Dichloroethene
- trans-1,2-Dichloroethene
- Trichloroethene
- Vinyl Chloride

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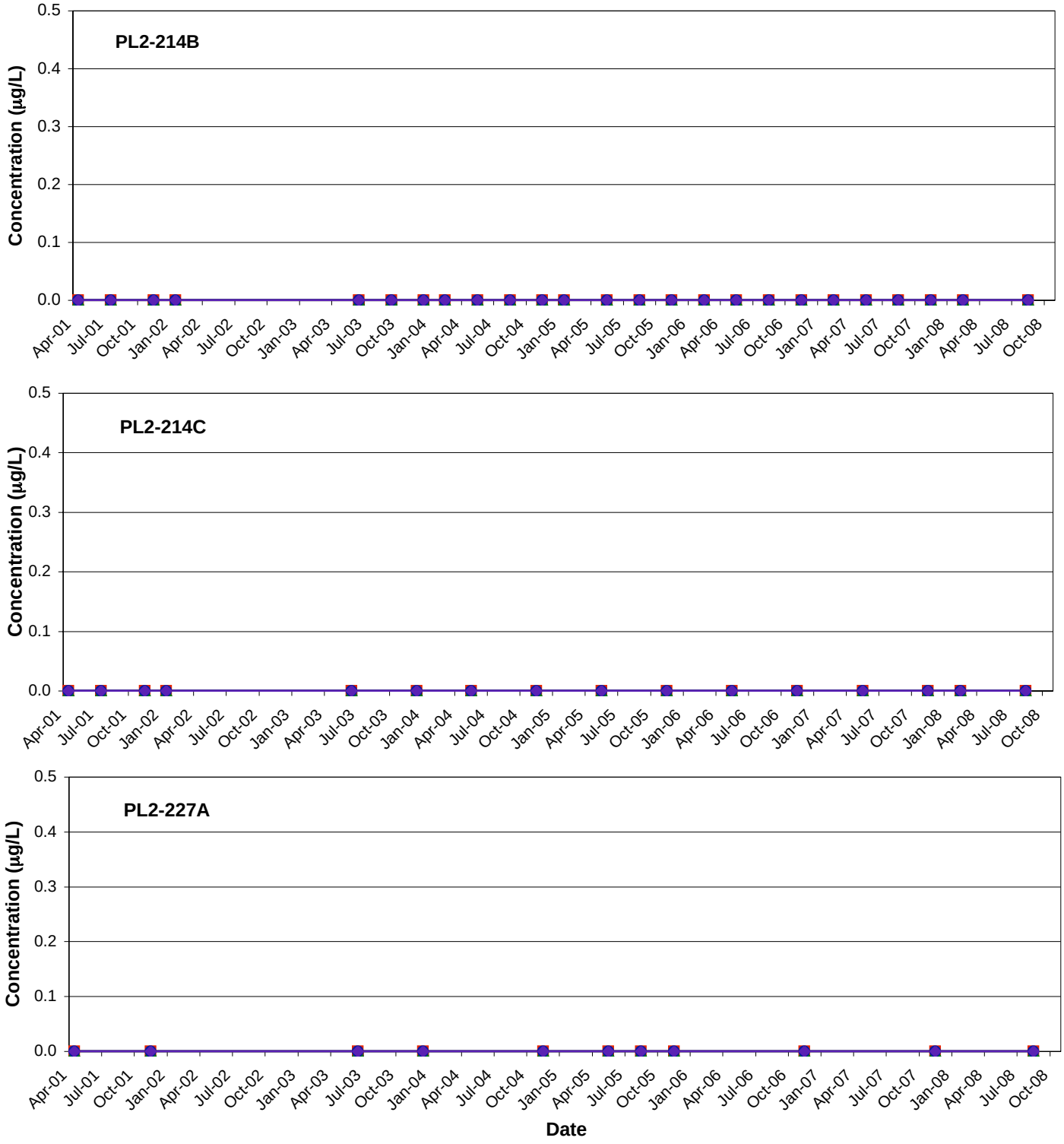
Issaquah, Washington 98027

FIGURE 2-2d
CHLORINATED VOC TRENDS AT
PL2-043B, PL2-044B, AND PL2-214A

Project	Boeing Plant 2		
Prepared For	The Boeing Company		
Location	7725 East Marginal Way Seattle/Tukwila, Washington		
	Drawn By DCK	Reviewed By DCK	Date 9/08



Legend

- cis-1,2-Dichloroethene
- trans-1,2-Dichloroethene
- Trichloroethene
- Vinyl Chloride

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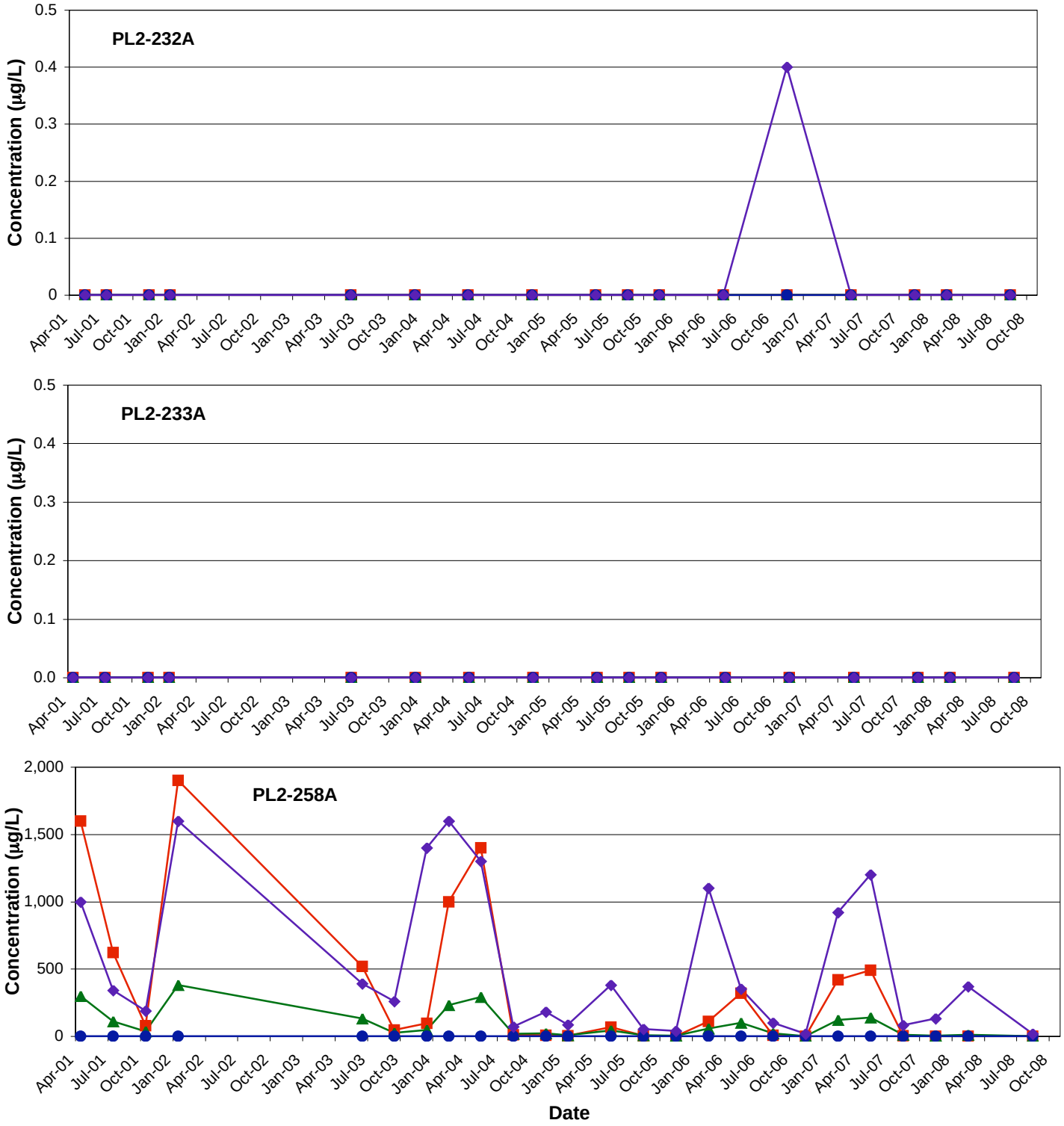
Issaquah, Washington 98027

FIGURE 2-2e
CHLORINATED VOC TRENDS AT
PL2-214B, PL2-214C, AND PL2-227A

Project	Boeing Plant 2		
Prepared For	The Boeing Company		
Location	7725 East Marginal Way Seattle/Tukwila, Washington		
	Drawn By DCK	Reviewed By DCK	Date 9/08



Legend

- cis-1,2-Dichloroethene
- trans-1,2-Dichloroethene
- Trichloroethene
- Vinyl Chloride

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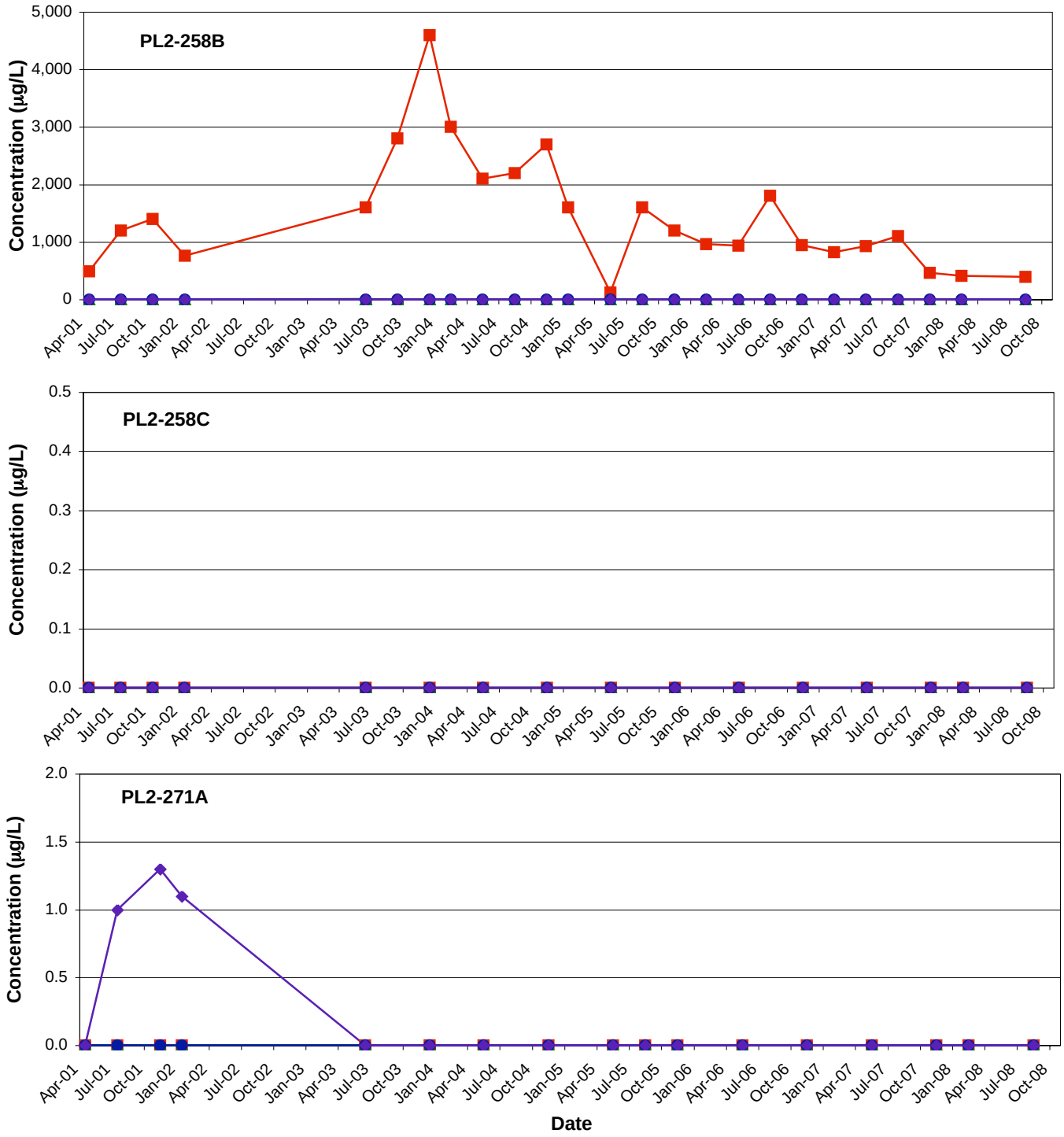
Issaquah, Washington 98027

FIGURE 2-2f
CHLORINATED VOC TRENDS AT
PL2-232A, PL2-233A, AND PL2-258A

Project	Boeing Plant 2		
Prepared For	The Boeing Company		
Location	7725 East Marginal Way Seattle/Tukwila, Washington		
	Drawn By DCK	Reviewed By DCK	Date 9/08



Legend

- cis-1,2-Dichloroethene
- trans-1,2-Dichloroethene
- Trichloroethene
- Vinyl Chloride

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Issaquah, Washington 98027

FIGURE 2-2g
CHLORINATED VOC TRENDS AT
PL2-258B, PL2-258C, AND PL2-271A

Project	Boeing Plant 2
Prepared For	The Boeing Company
Location	7725 East Marginal Way Seattle/Tukwila, Washington

Drawn By	Reviewed By	Date
DCK	DCK	9/08

RCRA Facility Investigation
Groundwater Investigation
Interim Report

Boeing—Plant 2
Seattle/Tukwila, Washington

Submitted to:

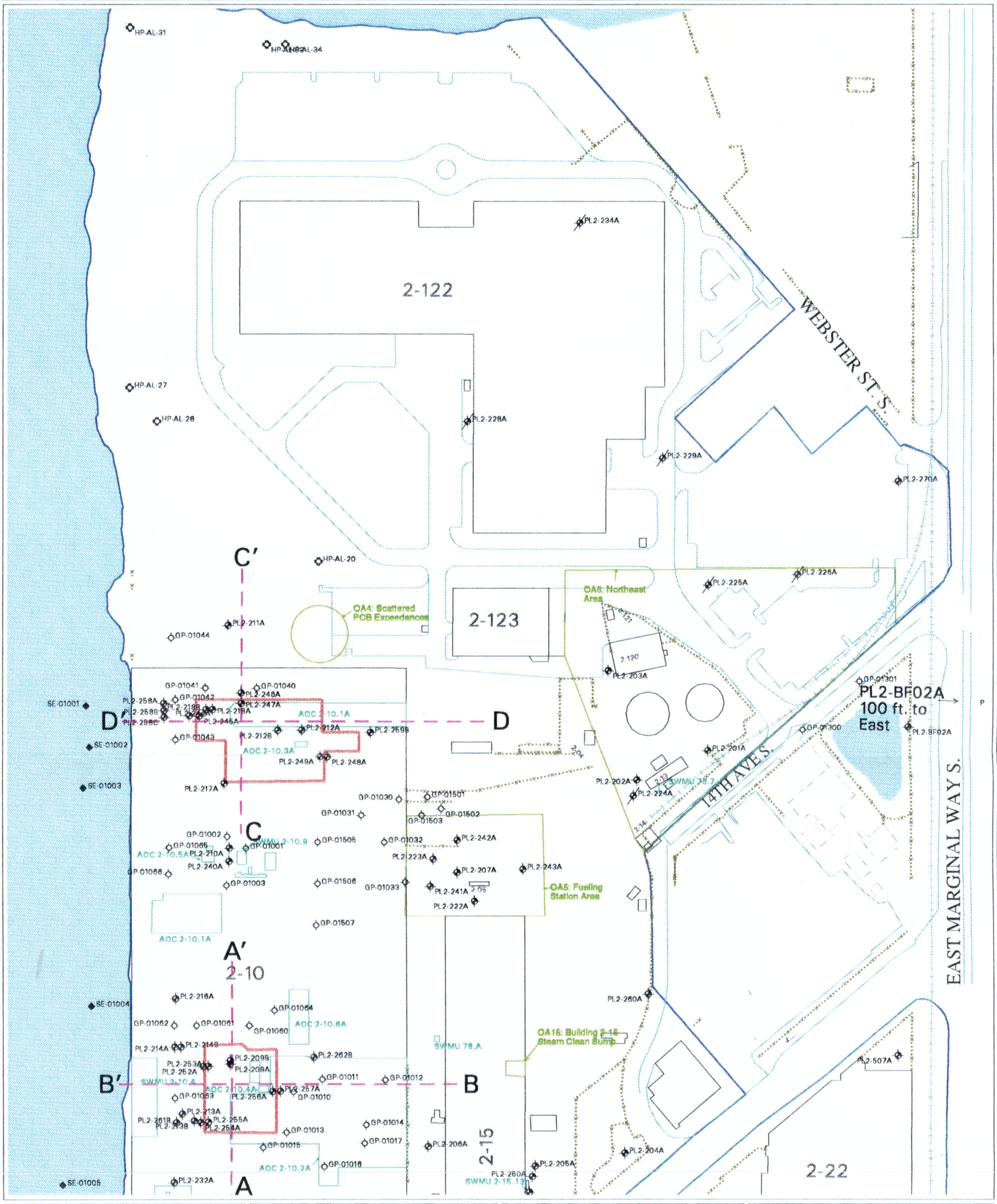
The Boeing Company
Boeing Information Support Services
Safety, Health, and Environmental Affairs
Seattle, Washington

August 1997

Prepared by:

Roy F. Weston, Inc.
700 Fifth Avenue
Suite 5700
Seattle, Washington 98104

WO 3709-034-300-3920

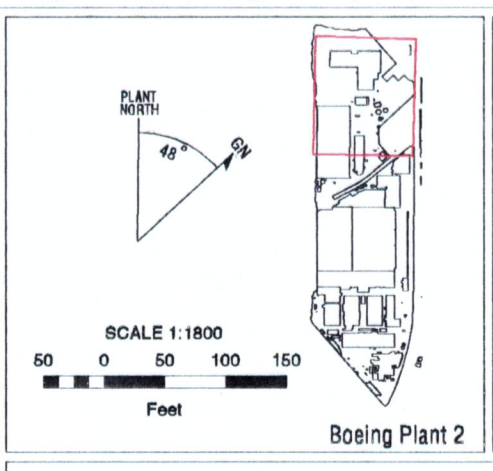


BASEMAP EXPLANATION

- Facility Boundary
- SWMU/AOC
- Building
- Former Boeing Building
- Non-Boeing Building
- Building Bulkhead
- Sheet Pile Alignment
- Fence

SYMBOL EXPLANATION

- Monitoring well
- Piezometer
- Geoprobe water
- Hydropunch
- Abandoned well
- SWMU/AOC
- Approx. located SWMU/AOC
- Other Area



NOTES

WESTON
MANAGERS DESIGNERS/CONSULTANTS

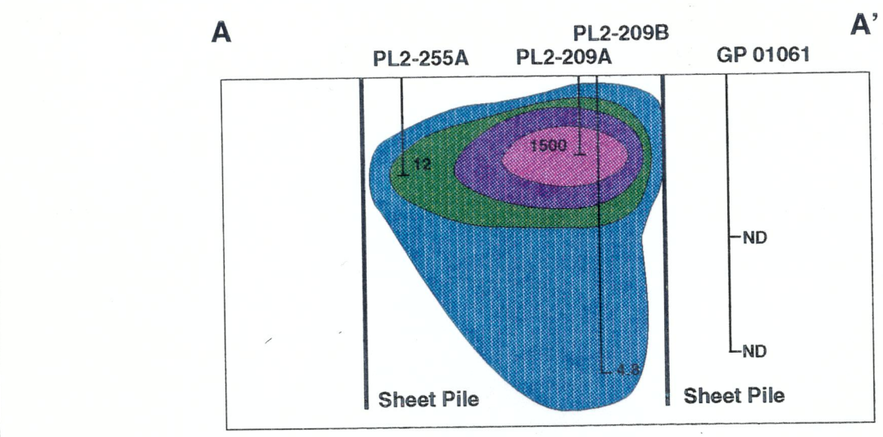
DATE: August 18, 1997 5:55 PM
JOB NUMBER: 03709-034-300-3920
LEAD GIS ANALYST: K. Palmer
VIEW FILE: basestnids.view

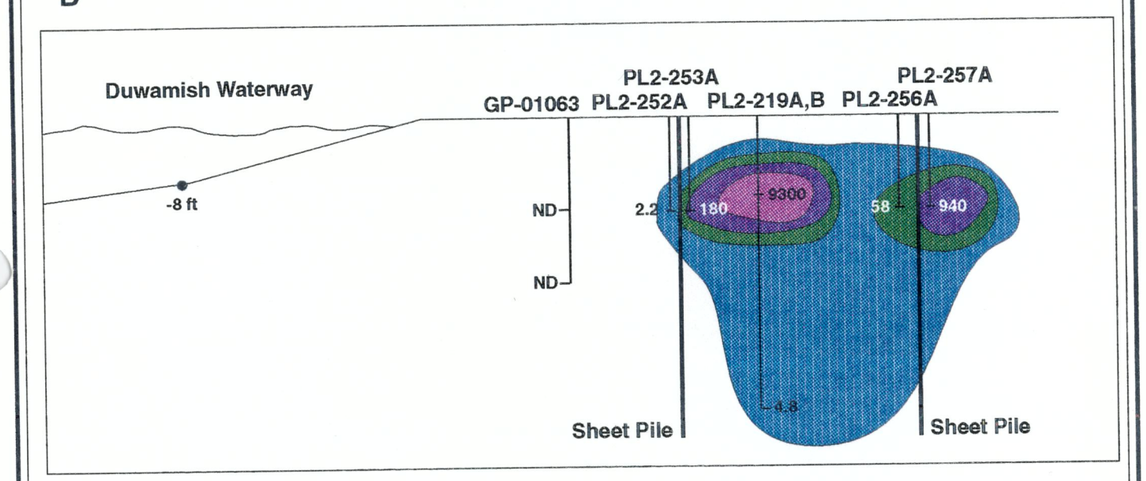
CHECKED BY: _____

APPROVED BY: _____

TCE in Groundwater Cross-Section Locations

Figure 8-1a





Explanation

100,000 ug/L	10,000 ug/L
1,000 ug/L	100 ug/L
10 ug/L	1 ug/L
ND Nondetect	

Vertical Exaggeration= 3X

0 75
Scale in Feet

South TCE Degreaser(AOC 2-10.4A) Concentration of TCE Cross-Sections A - A' and B - B'

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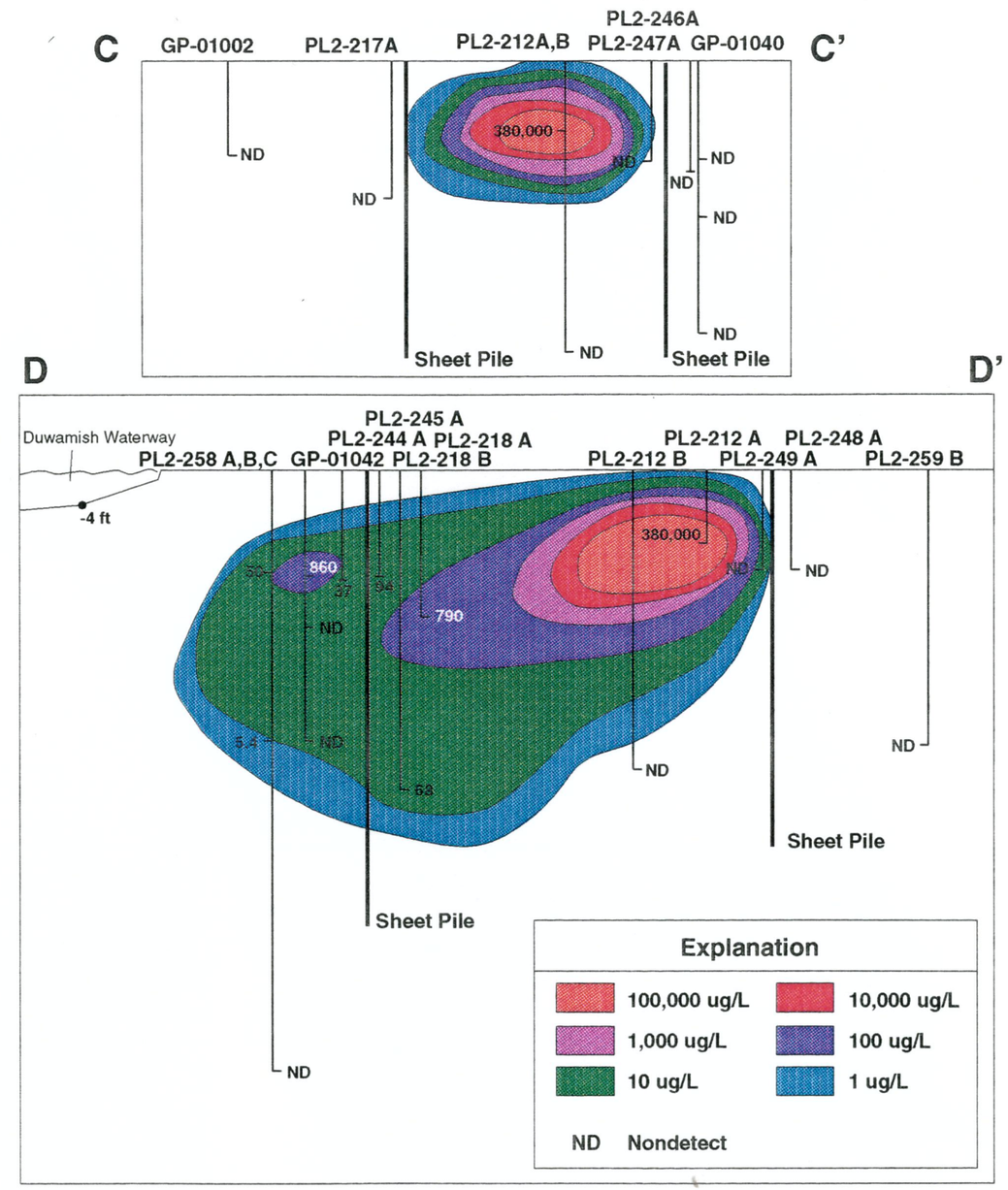
3709-34-300-3920
August 1997

FIGURE
8-2



0 75
Scale in Feet

Vertical Exaggeration= 3X

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MANAGERS DESIGNERS/CONSULTANTS

3709-34-300-3920
August 1997

North TCE Degreaser (AOC 2-10.3A)
Concentration of TCE
Cross-Sections C - C' and D -D'

FIGURE
8-3

Boeing Plant 2
Seattle/Tukwila, Washington

North and South Sheetpiles in the 2-10 Building Interim Measure Work Plan (AOC 2-10.3A and AOC 2-10.4A)

Phase 1: Data Collection

Appendix B
Sampling and Analysis Plan

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Table B.7 Soil Vapor Sampling Locations

Table B.8 Soil Vapor Sampling Objectives by Analyte

Table B.9 Soil Vapor Sampling Bottles and Preservatives

List of Attachments

Attachment 1 Standard Operating Procedures

1.0 Introduction

This Sampling and Analysis Plan (SAP) was developed for The Boeing Company (Boeing). The SAP describes the protocols that will be followed for the planned environmental sampling associated with Interim Measures (IMs) for the 2-10 Area north and south (N/S) sheetpiles.

The Quality Assurance Project Plan (QAPP) has been prepared as a separate document. The QAPP describes the necessary Quality Assurance (QA) procedures, documents the results of the project's technical planning process, identifies the data quality objectives, and identifies key project personnel.

This SAP has been prepared as an integral part of the Work Plan and is to be combined with the Work Plan and the project-specific Health and Safety Plan (HASP, Appendix C) for project implementation. The Work Plan (and the associated Appendices including the SAP and the HASP) along with the QAPP have been prepared under The Administrative Order on Consent (Order) issued by the United States Environmental Protection Agency (USEPA) Region 10 (RCRA Docket Number 1092-01-22-3008[h] January 18, 1994).

1.1 BACKGROUND

The project location, background, relevant history and sampling objectives are defined in the Work Plan (Refer to Sections 1.0 and 2.0 of the Work Plan). Refer to Work Plan Figures 1.1 and 1.2 for a general location of Plant 2 and the sheetpile locations at the site, respectively.

This SAP defines the sampling procedures for collection of soil, soil vapor and groundwater samples that will be collected in the area of the 2-10 N/S sheetpiles for IM planning and implementation.

1.2 PURPOSE

The IM characterization field work consists of sampling soil, soil vapor and groundwater from selected locations and monitoring wells at positions inside and outside of the N/S sheetpiles in the 2-10 Area to assist in the technology selection for the IMs. The purpose of this SAP is to describe the soil, soil vapor, and groundwater sample collection, handling, and analytical requirements to be used as part of the IM characterization work.

The objectives of the sampling program are summarized below:

- **Groundwater:** Characterize current site conditions with respect to the potential for reductive dechlorination of chlorinated volatile organic chemicals (CVOCs).
- **Vadose Soil and Soil Vapor:** Characterize the current occurrence of VOCs present in soil and soil vapor in the areas of the 2-10 sheetpiles that had previously exhibited the highest VOC concentrations in soil with respect to the potential for solvent vapor extraction as a remedial technology.

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2.0 Monitoring Methodologies, Procedures, and Schedules

2.1 GROUNDWATER

2.1.1 Groundwater Sampling and Analysis

Groundwater sampling will be performed at 19 of the 25 monitoring wells listed in Table B.1 and shown in Figure 3.1 of the Work Plan. Six of the monitoring wells listed in Table B.1, including Wells PL2-258A, PL2-258B, PL2-258C, PL2-214A, PL2-214B, and PL2-214C are sampled regularly as part of the Shoreline Monitoring Program and will not be sampled as part of this Work Plan. Well construction details, relevant elevations from top of casing measurement point and planned analyses for each of the monitoring wells are also summarized in Table B.1.

All groundwater samples will be analyzed for VOCs. Limited sampling and analyses will be done for TOC, selected dissolved metals (arsenic and manganese, two redox sensitive species), major cations (calcium, magnesium, potassium, and sodium), major anions (chloride, sulfate, and alkalinity [biocarbonate, carbonate, and hydroxide ion]), *Dehalococcoides* (DHE) bacterial census count, dissolved gases (including ethane and ethene) and field parameters (dissolved oxygen and redox potential). Sampling parameters are listed by well in Table B.1. Groundwater monitoring objectives by analyte are described in Table B.2.

Analytical methods, bottle types, and preservatives are summarized in Table B.3. All environmental sample containers will be laboratory-prepared and pre-cleaned to standards as required under USEPA SW 846 protocols. Analytical results for samples collected as part of the monitoring program will be validated following Level I data review procedures.

2.1.2 Groundwater Sampling Schedule

Groundwater sampling will be conducted once according to the schedule in the Work Plan.

2.1.3 Groundwater Sampling Procedures

The groundwater sampling will follow the procedure listed in the SOPs (refer to Attachment 1) and include the following steps: well inspection, water level measurement, low-flow purging (or sampling with a passive diffusion bag),, field parameter stabilization measurements during purging, and sample collection for laboratory analysis. The groundwater sampling will use low flow sampling procedures unless otherwise noted.

Three of the wells (PL2-212B, PL2-218A, PL2-218B) have relatively long screens that will be sampled for VOCs at two discrete depths using passive diffusion bags (PDBs) in order to identify any stratifications of the VOC plume over the intervals tested. For Well PL2-212B PDB samples will be collected at 40 and 53 ft bgs; for PL2-218A PDB samples will be collected at 15 and 28 ft bgs; for PL2-218B PDB samples will be collected at 45 and 58 ft bgs. PDBs will be placed in the wells a minimum of two weeks before sample collection. The long sampling interval will also have the effect of removing any short term variability due to tidal fluctuations at the two depths.

Three other monitoring wells in the area also have relatively long screen intervals (PL2-209B, PL2-214A, and PL2-214B, each with a 15 feet screen interval length). Existing data from each of these wells (PL2-209B, PL2-214A, and PL2-214B) indicate VOC concentrations at less than method detection limits (with detection limits ranging from 0.2 to 2 µg/L) in multiple sampling events spanning several years. Based on the existing data, additional sampling of these wells at multiple depth intervals is not necessary for the IM design, these wells will be sampled using standard low-flow sampling procedures.

2.2 SOIL

2.2.1 Soil Sampling and Analysis

Soil sampling will be performed at the seven locations listed in Table B.4 and shown in Figure 3.2 of the Work Plan. All soil samples will be analyzed for VOCs, and select samples will be analyzed for grain size distribution. Soil sampling objectives by analyte are described in Table B.5. Analytical methods, bottle types, and preservatives are summarized in Table B.6. Analytical results for samples collected as part of the monitoring program will be validated following Level I data review procedures.

2.2.2 Soil Sampling Schedule

Soil sampling will be conducted once according to the schedule in the Work Plan.

2.2.3 Soil Sampling Procedures

The soil samples will be collected with either a direct push rig or, potentially by hand auger, if suitable direct push access is not feasible. The soil sampling will follow the procedures listed in the SOPs (refer to Attachment 1). Soil sampling for lithologic logging will be conducted and selected samples will be collected for grain size analysis. Grain size samples will be collected in 1 gallon baggies and appropriately labeled to identify the location and depth at which they were collected. Some additional soil samples for waste characterization associated with Investigation Derived Waste (IDW) may also be collected. These samples will be collected in accordance with the SOPs in Attachment 1.

Soil samples for VOCs analysis will be collected using a split-spoon core or acetate sleeve (unless hand coring is required). A field photo ionization detector (PID) will be used to scan the length of the recovered sample and identify any layers or lenses with a higher PID response (indicating the presence of organic vapors). One or more soil samples will be collected from the recovered soil core. The soil samples for VOCs will be sampled in accordance with Method 5035A.

2.3 SOIL VAPOR

2.3.1 Soil Vapor Sampling and Analysis

Soil vapor sampling will be performed at four locations listed in Table B.7 and shown in Figure 3.2 of the Work Plan. All soil vapor samples will be analyzed for VOCs. Soil vapor sampling analytes and sampling objectives are described in Table B.8. Analytical methods, container

types, and preservatives are summarized in Table B.9. Analytical results for samples collected as part of the monitoring program will be validated following Level I data review procedures.

2.3.2 Soil Vapor Sampling Schedule

Soil vapor sampling will be conducted once in accordance with the schedule in the Work Plan.

2.3.3 Soil Vapor Sampling Procedures

The soil vapor sampling will follow the procedures listed in the SOPs (refer to Attachment 1) and include the following steps: measure the water level from the nearest well to establish the depth to water and target soil vapor sampling interval; auger to the target depth for vapor collection; place probe in borehole; fill annular space with sand pack and bentonite surface seal; test for surface seal leakage using helium tracer; purge probe of appropriate volume to flush the lines; and collect sample for laboratory analysis.

2.4 SAMPLE IDENTIFICATION NUMBERING

All samples collected will be assigned a unique identification code based on a sample designation scheme that is consistent with the existing database maintained by Golder and Associates. Each sample label will be affixed to the bottle and covered with clear tape. Tape is not required if waterproof labels are used. A sample tracking record will be kept as each sample is collected. The following will be recorded: location, matrix, sample number, and observations.

All groundwater sample numbers will consist of four components separated by a dash. These components are media code, date, well ID, and sample type. The sample designation scheme is as follows:

Media Code	Date	Well ID	Sample Type
GW	yy/mm/dd	PL2-xxxx	T

All soil and soil vapor sample numbers will consist of five components separated by a dash. These components are media code, date, location ID, depth, and sample type. The sample designation scheme is as follows:

Media Code	Date	Location ID	Sample Depth	Sample Type
SV	yy/mm/dd	PL2-xxxx	xx	T

Where the following are allowable contents for the fields:

- **Media Code.** The media code for groundwater sampling is GW, soil sampling is S, and soil vapor sampling is SV.
- **Date.** The date begins with the two-digit year, followed by the two-digit month and two-digit day.
- **Well ID:** The site ID of "PL2," followed by the unique 3 digit well number followed by A, B or C to designate the aquifer level in which the well is screened.
- **Location and Depth ID:** (used for soil or soil vapor samples from borings/probes) The site ID of "PL2," followed by the unique 4 digit boring number, followed by the starting depth in (feet)..
- **Sample Type:** The single character "T" indicates a sample type having one of the following values:

  0 Primary field sample

  1 Field duplicate sample

  2 VOC trip blank

  3 Equipment blank

  4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Character groups will be separated by a "-" dash. Examples of a completed sample identification number are as follows:

GW-080929-PL2-212A-0 Primary groundwater sample Boeing Plant 2 monitoring well PL2-212A collected on September 29, 2008

S-080929-PL2-SSL1-10-0 Primary soil sample, Boeing Plant 2 boring SSL1, 10 feet depth, collected on September 29, 2008

Sample numbers will be recorded in the field notebook, on sample container labels, and chain-of-custody forms. Other information recorded on the sample container label will include:

- time and date of sample collection,
- initials of sampler(s),
- laboratory analyses to be performed,

- preservatives used.

More detailed information regarding sample labels, sample handling, chain-of-custody, custody seals, and sample shipping are documented in the SOPs (Refer to Attachment 1).

2.5 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Duplicate Samples: Laboratory and field sampling precision will be evaluated by collecting blind field duplicate samples. One field duplicate sample will be collected per every 10 percent or fraction thereof of the total number of groundwater samples per sampling event. The field duplicate sample will be collected under conditions as close as possible to the original sample. The field duplicate samples will be labeled like standard samples as noted in Section 2.1 (the difference being the sample type flag as the last digit). The field duplicate sample will be distinguished as a duplicate only in the field notes and will be analyzed for the same constituent list as the original sample.

Co-located soil samples: One co-located soil sample will be collected per every 10 percent or fraction thereof of the total number of soil samples per sampling event. The co-located field sample will be collected under conditions as close as possible to the original sample. The co-located field samples will be labeled like standard samples as noted in Section 2.1 (the difference being the sample type flag as the last digit). The field duplicate sample will be distinguished as a co-located field sample only in the field notes and will be analyzed for the same constituent list as the original sample.

Trip Blank Samples: The potential for VOC contamination from the ambient air will be evaluated using trip blank samples. The trip blank will originate at the laboratory and be re-labeled upon arrival at this site. Trip blank samples accompany one cooler of samples during sampling and shipping for each day during a sampling event.

Matrix Spike/Matrix Spike Duplicate Samples: Potential interferences from the sample matrix will be evaluated with MS/MSD samples. Triplicate volumes of sample will be collected at locations specified on the sample matrix. One MS/MSD sample will be obtained for every 5 percent (or fraction thereof) of the total number of samples collected per event. MS/MSD samples will be given sample names identical to the original field sample but will have "MS/MSD" written next to the analysis requested on the sample bottle label and will also be noted on the chain-of-custody. MS/MSD samples will be analyzed for the same constituent groups as the original sample.

2.6 INTRUSIVE INVESTIGATION WORK: DRILLING OPERATIONS AND SAMPLING METHODS

This section summarizes the planning activities required for intrusive work such as well drilling/construction and direct push probe sampling. Specific steps for the planned work include utility clearance and site preparation, permitting, and drilling/borehole logging. Borings will be drilled to collect both soil and soil vapor samples. The groundwater wells to be sampled will be redeveloped prior to sampling. While not apart of the current work, installation of monitoring wells may be included in future work at the site and a description of this activity is also included below.

2.6.1 Utilities Clearance and Site Preparation

Underground utility (gas, water, sewer, power, communication, other) clearance is the initial step prior to any intrusive/drilling work. CALIBRE staffs will conduct a field inspection of the site and review available subsurface utility drawings. The Utility Notification Center (UNC) will be notified at least 48 hours prior to initiation of subsurface investigation so that subscribers can mark their nearby utilities.

In addition, CALIBRE will retain an independent utility locator to assess the potential presence of subsurface utilities and structures that are not covered by UNC in the vicinity of the proposed borings. Subsurface anomalies detected during the utility survey will be marked with paint and/or flagging. The area around each location will be cleared to a minimum of 5 feet from the marked location to allow for alternate locations in case of refusal during drilling at the primary location.

After utilities have been cleared at the proposed boring locations, a subcontractor will core the concrete at each location. If the area indicates many nearby utilities, a vacuum truck equipped with an air knife will be used to clear each boring location to an approximate depth of 6- to 8-feet prior to drilling. If a subsurface utility or other obstruction is encountered, the boring locations will be adjusted as necessary.

2.6.2 Permitting

Any wells to be constructed will meet the minimum standards for construction and maintenance of wells as outlined in Chapter 173-160 WAC. All drilling and well installation will be performed by a State of Washington licensed Water Well Operator.

A notification fee and documentation in the form of a Start Notification (Start Card) will be provided to the Washington Department of Ecology before construction begins, and a well log will be filed upon completion.

2.6.3 Drilling and Borehole Logging

During the initial phase of field work, borings will be advanced using the direct-push method. The anticipated boring depths are 10-15 feet; the actual boring depth may change in the field if it is determined that greater depths would provide useful characterization data, based on the presence of VOC-impacted media from field screening, and the lithology encountered.

Prior to arriving at the site, the drill rig, tools, and accessories will be decontaminated with a pressure washer/steam cleaner. Down-hole drilling tools and sampling equipment, such as bits, augers, rods, and split spoons will be manually washed/rinsed, pressure washed, and/or steam cleaned between boreholes/wells at a designated decontamination area. All decontamination wash/rinse water will be collected on-site and containerized for disposal/treatment in accordance with applicable regulations.

The CALIBRE field geologist/engineer who supervises the drilling/well installation will prepare lithologic logs of the borings using the Unified Soil Classification System (USCS) following the general guidelines of ASTM Standard D-2488 (Description and Identification of Soils). The field

geologist/engineer will keep a detailed log for each sample location including the date sampling occurred and the location, depth, standard penetration test/blow counts (if applicable), lithologic description (including grain size, relative proportion of grains, angularity, moisture, and color) in accordance with the USCS, screening results, and estimate of percent sample recovery. Visual indications of staining or field screening are also recorded on the borehole sample/core log.

Following sample collection, each direct push probe boring will be backfilled with bentonite chips placed from the total depth of each boring to ground surface. The tops of the borings will be patched with concrete or asphalt as appropriate to match the surrounding surface.

2.6.4 Monitoring Well Design and Installation

Well casing diameter and screen length is dependent on the purpose of the well, the amount and size of downhole equipment that must be accommodated, and the lithology intercepted by the screened interval. The general design and construction of the wells will follow ASTM Standard D-5092 (Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers). Details of the well design (i.e., the specific position and targeted screen interval) will be based upon a review of prior characterization data in the area including the existing (and revised) plume maps/profiles, data from existing wells, and direct push probe sampling points. Any wells to be installed will be constructed with either 2- or 4-inch diameter, Schedule 40 PVC well casing.

Two Geoprobe samples will be completed in the relatively deeper water bearing zone (B zone for probe location near PL2-210A, at 50 ft bgs, and lower B zone for probe location near, PL2-218B, at 85 ft bgs; refer to Table 3.1). Following sample collection, these sample locations will be closed in an appropriate manner to isolate contamination (present in the upper water bearing zone) from migration into the deeper water bearing zone.

The locations of the new borings or monitoring wells will be surveyed by a surveyor licensed in the State of Washington. Each location will be surveyed to determine its map coordinates with reference to the State Plane Coordinate System. All horizontal points will have an accuracy of ± 1 foot. The measuring point elevation on the top of the PVC well casing will be surveyed for the new monitoring wells. The elevations will be surveyed to within 0.01 foot and referenced to the National Geodetic Vertical Datum, 1929 Adjustment (NGVD29).

A well construction diagram for each well will be completed in the field on a CALIBRE well log form by the field geologist/engineer. Well installation and construction data will be summarized in the daily field log and subsequently transcribed to a well completion diagram.

2.6.5 Well Development

Well development will follow general guidelines in ASTM Standard D-5092 (Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers). Each well will be developed by performing surge and pump cycles until the water is substantially clear. Surging over the length of the screened interval will be performed for a set period of time or a minimum of ten surges. The well will then be pumped until the water clears significantly. These surge and pump cycles will be repeated until the water is substantially clear shortly after the start of pumping. Other wells in the Plant 2 area have typically been developed using 4 to 6 surge and

pump cycles with approximately 50-150 gallons removed. Development water will be contained on-site in drums for appropriate characterization/ disposal/ treatment.

3.0 Equipment Operation and Maintenance

Sampling pumps and field instruments for measuring water quality parameters and organic vapors will be operated and maintained and calibrated according to manufacturer's specifications.

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4.0 Field Documentation and Sample Management

Sample documentation and control are required to ensure that the data are defensible and to verify that appropriate field (and data review) procedures are followed during all phases of the project. The field procedures to be followed for documentation, control, and transport of environmental samples are described in this section.

4.1 FIELD DOCUMENTATION

Field notes will be kept in bound field logbooks and entries will be made with indelible ink. Logbook pages will not be removed from the logbook. Incorrect entries will be noted by striking the incorrect entry with a single line, adding the correct entry, and dating and initialing the change. Field logbook entries will include factual information (free of conjecture and subjective language) and include sufficient detail such that another person (not the field sampling team) reading the logbook entries is able to understand the sampling situation based on the recorded information. Sampling information that should be entered into the field logbook includes the following:

- Date and time of sampling
- Weather conditions
- Names or initials of sampling personnel
- Well or location identification number
- General condition of well (if noteworthy)
- Static water level
- Total depth of well
- Manufacturer, model number, serial number, and calibration notes for any instrument used for static water level measurement, health and safety, or field parameter analysis
- Well purge volume calculations
- Well purge start time, finish time, and total volume purged
- Field parameter measurements made during low-flow purging
- Miscellaneous comments or observations
- Health and safety monitoring instrument readings (if applicable)

4.2 FIELD CALIBRATION PROCEDURES

All equipment will be calibrated according to the manufacturer's guidelines and the calibration will be documented in the field notebook. Equipment that fails calibration or becomes inoperable during use will be removed from service and repaired or replaced. Data collected with equipment that later fails re-calibration will be evaluated. If the data appear to have been affected, the results of the evaluation will be documented and the project manager notified.

4.3 SAMPLE CHAIN-OF-CUSTODY AND TRANSPORT

Sample possession will be traceable from the time of sample collection until receipt of samples at the analytical laboratory. Sample chain-of-custody will be documented following the procedures (and documentation) outlined below.

4.3.1 Field Custody

Samples collected will be in the custody of the field sampler(s) from the time of sample collection until the samples are transferred. Soil and groundwater samples will be retained in coolers with sufficient bagged ice (or blue ice) to maintain an internal temperature of 4 degrees Celsius. The Project Manager will evaluate whether proper custody procedures were followed during the fieldwork by reviewing the documentation and discussing procedures with sampling personnel. It will be the responsibility of the Project Manager to decide if additional samples are necessary.

4.3.2 Sample Transfer of Custody and Transport

A chain-of-custody record will accompany samples. When transferring custody of the samples, the individual relinquishing and receiving the samples will sign, date, and note the time of transfer on the chain-of-custody record.

Samples that are hand-delivered to the laboratory may use one chain-of-custody record for all the coolers delivered. Hand-delivered sample coolers do not need to be sealed with fiber tape or custody seals. It is anticipated that most samples will be delivered to Analytical Resources, Inc. (ARI) for analysis after each day of sampling following standard chain-of-custody procedures. If sampling is conducted on days when ARI is closed, the samples will be hand-delivered the next business day. ARI's address is given below.

4611 South 134th Place, Suite 100
Tukwila, WA 98168
Contact: Ms. Kelly Bottem, 206-695-6211

5.0 Decontamination and Waste Management Plan

5.1 DECONTAMINATION

Purging and sampling equipment that comes into direct contact with sample media, sample containers, or the inside of a monitoring well will be either dedicated equipment (assigned to and used at only one well) or single-use, disposable equipment that is replaced between each sampling location. If the sampling equipment is not single-use, disposable equipment, or dedicated equipment, it will be decontaminated between each sampling event as described in the following sections.

5.1.1 Aqueous Sampling Equipment Decontamination

If non-dedicated, multiple-use sampling equipment is used for groundwater sampling, it will be decontaminated prior to use and between each sample according to the following steps:

1. Wash in a solution of Liquinox™ (or equivalent) and potable tap water
2. Rinse with potable tap water
3. Rinse with reagent-grade isopropyl alcohol
4. Rinse with distilled water

5.1.2 Non-aqueous Sampling Equipment Decontamination

If non-dedicated, multiple-use sampling equipment is used for soil or soil vapor sampling, it will be decontaminated prior to use and between each sample according to the following steps:

1. Wash in a solution of Liquinox™ (or equivalent) and potable tap water
2. Rinse with potable tap water
3. Rinse with distilled water

5.1.3 Decontamination of Workers and Personal Protective Equipment

It is anticipated that work associated with the IMs at Boeing Plant 2 will be conducted in modified Level D personal protective equipment (PPE). Requirements for upgrading to Level C protection are outlined in the HASP (Appendix C).

Modified Level D protection includes the following components:

- cotton or Tyvek™ coveralls
- Steel-toed, steel-shank leather or rubber boots
- Safety glasses or equivalent
- Nitrile inner and outer gloves, or equivalent
- Hearing protection when appropriate (i.e., while drilling or probing)

- Hard hat (when working around drilling or probe rigs)

5.2 DISPOSAL OF INVESTIGATION-DERIVED WASTE

Drill cuttings, sample spoils, well development water/purge water, decontamination water and other investigation-derived waste (IDW) will be retained on-site in properly labeled Washington State Department of Transportation (WSDOT) approved steel drums pending characterization for disposal. Boeing will coordinate characterization of drum contents. Disposal of all IDW will be coordinated with Boeing. Hazardous wastes will be managed per all applicable regulations. Wastes will be manifested to a facility permitted to accept the material or treated on-site in Boeing's permitted Groundwater Treatment System.

Boeing Plant 2
Seattle/Tukwila, Washington

North and South Sheetpiles in the 2-10 Building Interim Measure Work Plan (AOC 2-10.3A and AOC 2-10.4A)

Phase 1: Data Collection

Appendix B
Sampling and Analysis Plan

Tables

AGENCY REVIEW DRAFT

Table B.1
Groundwater Monitoring Well Descriptions

North Sheetpile Area					Analyte Groups					
Well ID	Ground/slab Elevation (feet NVGD 29)	Screened Interval (feet bgs)	Total Depth (feet bgs)	Aquifer Level	VOCs[1]	TOC[2]	Selected Dissolved Metals[3]	Dissolved Gases[4]	DHE[5]	Major Cations and Anions[6]
PL2-212A	13	6–16	16	A	X	X	X	X	X	X
PL2-212B	13	40–55	55	B	X**	X	X			
PL2-218A	13.66	15–30	30	A	X**	X	X	X	X	X
PL2-218B	13.66	45–60	60	B	X**	X	X	X	X	
PL2-244A	13	15–20	20	A	X	X	X			
PL2-245A	13	15–20	20	A	X					
PL2-247A	13	15–20	20	A	X					
PL2-249A	13	15–20	20	A	X					
PL2-268AR	NA	30–34.5	34.5	A	X					
PL2-269A	13	31–36	36	A	X					
PL2-258A[7]	13.45	8–23	23	A	X[7]					
PL2-258B[7]	13.45	40–50	50	B	X[7]					
PL2-258C[7]	13.45	92–100	100	C	X[7]					
PL2-259B	13.4	40–50	50	B	X					
PL2-248A	12.36	15–20	20	A	X					
New probe Near PL2-218B	NA	~ 85	85	B-C	X					
New probe Near PL2-210A	NA	~ 50	50	B	X					
South Sheetpile Area					**Analyte Groups**					
Well ID	Ground/slab Elevation (feet NVGD 29)	Screened Interval (feet bgs)	Total Depth (feet bgs)	Aquifer Level	VOCs[1]	TOC[2]	Dissolved Metals[3]	Dissolved Gases[4]	DHE[5]	Alkalinity[6]
PL2-209A	13	8–18	18	A	X	X	X	X	X	X
PL2-209B	13.68	40–55	55	B	X	X	X			
PL2-252A	12.63	12.5–17.5	17.5	A	X	X	X			
PL2-253A	13.14	12.5–17.5	17.5	A	X	X	X	X		X
PL2-254A	13.06	12.5–17.5	17.5	A	X					
PL2-255A	13.15	12.5–17.5	17.5	A	X					
PL2-256A	12.82	12.5–17.5	17.5	A	X					
PL2-257A	13.01	12.5–17.5	17.5	A	X					
PL2-266A	NA	26–30.2	30.2	A	X					
PL2-214A[7]	13	15–30	30	A	X[7]					
PL2-214B[7]	13	45–60	60	B	X[7]					
PL2-214C[7]	13	75.5–85.5	80	C	X[7]					
PL2-262B	13.49	40–50	50	B	X					

Notes:

** These selected wells will be sampled with passive diffusion bags (PDBs) for VOCs to identify stratification of the VOC plume (if any) over the screen interval; one PDB will be placed near the top of the screened interval; the other will be placed near the bottom of the screened interval. PDBs will be placed in the wells a minimum of 2 weeks before sample collection.

Notes (continued):

x Indicates planned sample/analysis.
1 VOCs by Method 8260B.
2 TOC by Method 415.1.
3 Dissolved metal for arsenic (Method 200.8) and manganese (Method 6010B).
4 Dissolved gases by RSK-175.
5 DHE by Bio-Dechlor Census Test RT-PCR.
6 Alkalinity by 300.1.
7 Sampled for VOCs in Shoreline monitoring program.

Abbreviations:

bgs Below ground surface
DHE *Dehalococcoides*
NA Not available
NGVD National Geodetic Vertical Datum, 1929
VOC Volatile organic compound

Table B.2
Groundwater Monitoring Objectives by Analyte

Analysis	Objective
VOCs	Establish baseline or pre-IM VOC concentrations for interim measure
TOC	Evaluate the baseline or pre-IM levels of organic carbon supplying substrate for dechlorination
Selected Metals (dissolved): Arsenic and Manganese	Provide baseline or pre-IM concentrations of those metals potentially released during ERD
DHE Census Count	Evaluate site conditions for the presence of specific dechlorinating bacteria
Major Cations and Major Anions	Evaluate the hardness of site groundwater to consider natural buffering capacity
Dissolved Gases (ethene/ethane)	Establish baseline or pre-IM concentrations for demonstration of complete dechlorination

Abbreviations:

DHE *Dehalococcoides*
ERD Enhanced reductive dechlorination
IM Interim Measure
TOC Total organic carbon
VOC Volatile organic compound

Table B.3
Groundwater Monitoring Sample Bottles and Preservatives

Constituent Group	Analytical Method[1]	Bottle Type	Preservative	Number of Samples
VOC	USEPA 8260B	(3) 40-ml VOA vials	Ice (4°C) HCl (pH<2)	35[2]
Total Organic Carbon	USEPA 415.1	250-ml amber	Cool 4°C, 2 ml 9N H_2SO_4 to pH $\leq$ 2	11[3]
Metals (dissolved): Arsenic and Manganese	USEPA 200.8 and 6010B	500-ml HDPE	Field filter, cool to 4°C HNO_3 to pH$\leq$2	11[3]
Major Cations: Ca, Mg, Na, K)	USEPA 6010	500-ml HDPE	Cool to 4°C HNO_3 to pH$\leq$2	4
Major Anions: Chloride and Sulfate	300.0	500-ml HDPE	Cool 4°C	4
Major Anions: Alkalinity	SM 2320	500-ml HDPE	Cool 4°C	4
DHE census count	RT-PCR	1 L	Cool 4°C, 24 hours till filtration	3
Dissolved gases	RSK-175	(3) 40ml glass vials	Cool 4°C (no preservative)	5

Notes:

1 Samples will undergo Level I data validation. **Please note this on Chain-of-Custody forms.**
2 25 field samples, 3 duplicates, 1 Matrix Spike, 1 Matrix Spike Duplicate, and 3 trip blanks.
3 9 field samples, 1 duplicate, 1 Matrix Spike, and 1 Matrix Spike Duplicate.

Abbreviations:

DHE *Dehalococcoides*
H_2SO_4 Sulfuric acid
HCl Hydrochloric acid
HDPE High density polyethylene
HNO_3 Nitric Acid
SM Standard Methods
USEPA U.S. Environmental Protection Agency
VOA Volatile organics analysis
VOC Volatile organic compound

Table B.4
Soil Sampling Locations

Soil Sampling Location	Planned Sampling Depth (ft bgs)	Analytes[1] VOCs	Grain Size Analysis[2]	Location Description (Relative to Prior Soil Sampling)
North Sheetpile				
SSL1	5, 10	X	X	near PL2-212A
SSL2	5, 10	X	X	near PL2-212B
SSL3	10	X		near D43
SSL4	10, 15[3]	X		near PL2-218A
South Sheetpile				
SSL5	5, 10	X	X	near PL2-209A
SSL6	5, 10	X		near PL2-209B
SSL7	5, 10	X		near E18

Notes:

X Indicates planned sample/analysis.
1 VOCs by 5035/8260B.
2 Grain size by ASTM D422.
3 Sample is to be taken from the tidal smear zone to determine if residual TCE is present.

Abbreviations:

bgs Below ground surface
VOC Volatile organic compound

Table B.5
Soil Sampling Objectives by Analyte

Analysis	Objective
VOCs	Establish baseline VOC concentrations prior to interim measure implementation.
Grain size	Evaluate grain size in differing geologic layers in order to estimate soil permeability and corresponding SVE yield.

Abbreviations:

VOC Volatile organic compound
SVE Soil vapor extraction

Table B.6
Soil Sampling Sample Bottles and Preservatives

Constituent Group	Analytical Method[1]	Container Type	Preservative	Number of Samples
VOCs (soil)	USEPA 8260B/5035A (short list)	Encore sampler	Ice (4°C), 24 hours to lab preservation	16[2]
Grain size	ASTM D422	1 gallon baggies	None	6

Notes:
1 Samples will undergo Level I data validation. Please note this on Chain-of-Custody forms.
2 14 field samples and 2 co-located splits.

Abbreviations:
ASTM American Society for Testing and Materials
USEPA U.S. Environmental Protection Agency
VOC Volatile organic compound

Table B.7
Soil Vapor Sampling Locations

Soil Vapor Sampling Location	Planned Sampling Depth (feet bgs)	Analytes VOCs[1]	Description of Location (Relative to Prior Soil Sampling)
North Sheetpile			
SSL1	8	X	near PL2-212A
SSL4	8	X	near PL2-218A
South Sheetpile			
SSL5	8	X	near PL2-209A
SSL7	8	X	near E18

Notes:
X Indicates planned sample/analysis.
1 VOCs by TO-15.

Abbreviations:
bgs Below ground surface
VOC Volatile organic compound

Table B.8
Soil Vapor Sampling Objectives by Analyte

Analysis	Objective
VOCs	Establish baseline VOC concentrations prior to Interim Measure implementation.

Abbreviations:
VOC Volatile organic compound

Table B.9
Soil Vapor Sampling Sample Bottles and Preservatives

Constituent Group	Analytical Method	Container Type	Preservative	Number of Samples
VOCs	TO-15[1]	6 L SUMMA® canister	None	6[2]

Notes:
1 Samples will undergo Level I data validation. **Please note this on Chain-of-Custody forms.**
2 4 field samples, 1 duplicate, 1 trip blank. Because the use of SUMMA canisters does not allow for "spiking" air samples, a matrix spike/matrix spike duplicate analysis cannot be performed on the soil-gas sample.

Abbreviations:
VOC Volatile organic compound
SUMMA Registered trademark of Melectrics Corporation for a stainless steel canister whose interior has been polished and passivated for use in air sampling.

Boeing Plant 2
Seattle/Tukwila, Washington

North and South Sheetpiles in the 2-10 Building Interim Measure Work Plan (AOC 2-10.3A and AOC 2-10.4A)

Phase 1: Data Collection

Appendix B: Attachment 1 Standard Operating Procedures

AGENCY REVIEW DRAFT

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CONTINGENCY PLAN AND EMERGENCY PROCEDURES
CALIBRE STANDARD OPERATING PROCEDURES

1.0 POLICY

It is the policy of CALIBRE that any individual engaging in conducting field work on job sites will abide by the procedures outlined in this document. These emergency procedures are designed to meet or exceed applicable the Occupational Safety and Health Administration (OSHA) standards for safe work practices.

2.0 PURPOSE

The purpose of this contingency plan is to lessen the potential impact on the public health and the environment in the event of an emergency circumstance, including a fire, explosion, or unplanned release of dangerous waste or dangerous waste constituents to air, soil, surface water, or ground water. This contingency plan has been developed to eliminate or minimize potential impacts of such emergency circumstances, and the elements of this plan are to be implemented immediately in emergency circumstances.

3.0 RESPONSE ACTIONS

The key response actions to be taken in an emergency situation include the following:

1) In the event of a fire, worker will immediately notify the local fire department. If this person has been trained in the proper use of fire extinguishers, he or she may then attempt to extinguish the fire if this can be done safely, but only after first notifying the local fire department.

2) In the event of a small spill, the worker will immediately act to contain the spill using the on-site spill response materials. After the spill has been contained, the worker will arrange cleanup of the spill residuals and notify the client contact. For any larger spills, the worker will contact local Fire and Security.

3) In the event of a fire, explosion, or other release that could threaten human health outside the facility or that has reached waters of the state, the worker must notify Boeing Fire and Security. Note the following:

    - The date, time, and type of incident;
    - The quantity and type of dangerous waste involved in the incident;
    - The extent of injuries, if any; and
    - The estimated quantity and disposition of recovered materials, if any.

All employees performing operation and maintenance activities at the site will understand proper waste handling and emergency procedures relative to their job responsibilities. As noted above, because of the limited number of employees working on the site, all employees will be responsible for reviewing and understanding the required procedures for management of process waste streams before they are allowed to work on site.

1) Description of Actions Which O&M Workers Must Take in Case of Emergency

Actions to be taken if any event occurs during operation of the project that is an emergency circumstance, including a fire, explosion, or unplanned release of waste or waste constituents to air, soil, surface water, or ground water will include:

- The equipment is to be shutdown immediately.
- If a fire exists, notify the fire department, use the on-site fire extinguisher.
- If a discharge exists, take immediate actions stop the discharge (shut off valve or other mechanism), call 911, use spill containment equipment to contain and cleanup any materials spilled.
- Notify client contacts and other project contacts (Attachment A).

2) Local Emergency Facilities

The Project Heath and Safety Plan (present on site) describes the route to a hospital.

3) Emergency Equipment at the Facility

The emergency equipment located on site includes:

- fire extinguisher
- spill control equipment (storm drain cover, absorbent pads and bulk media, shop-vac and extension cord, brooms, storage drum, decontamination equipment).

This list will be updated as appropriate.

4) Copies of Contingency Plan

A copy of this contingency plan and all revisions to the plan will be maintained at the facility and submitted to all local emergency response teams that may be called upon to provide emergency services.

5) Amendments

The owner/operator will review and amend the contingency plan, if necessary, whenever any of the following occur:

- Applicable regulations or the facility permit are revised
- The plan fails in an emergency
- The facility changes (in its design, construction, operation, maintenance, or other circumstances) in a way that materially increases the potential for fires, explosions, or releases of dangerous waste or dangerous waste constituents, or in a way that changes the response necessary in an emergency
- The list of emergency coordinators changes
- The list of emergency equipment changes

Review and Signature

The following operations staff have reviewed this contingency plan (and the primary O&M Manual) and hereby certify that they understand the objectives and requirements of this plan.

Name	Date

DECONTAMINATION OF SAMPLING EQUIPMENT
CALIBRE STANDARD OPERATING PROCEDURES

1.0 POLICY

It is the policy of CALIBRE that any individual engaging in field work requiring the decontamination of field equipment or instruments will abide by the procedures outlined in this document. These procedures are designed to meet or exceed applicable Occupational Safety and Health Administration (OSHA) standards for safe work practices.

2.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide the methods and procedures for decontamination of sampling or field equipment used in the collection of environmental samples and/or used for field activities at known or potentially contaminated sites.

3.0 SCOPE AND APPLICATION

This SOP should be used for decontaminating all disposable and non-disposable equipment used during field work. Items requiring decontamination may include personal protective equipment, sample equipment (shovels, trowels, pumps, tubing, depth to water probe, etc.) and heavy equipment (backhoes, direct-push probes, and drill rig augers). Upon completion of decontamination procedure, record that the decontamination activities have occurred in the field logbook and/or sample data record sheet.

4.0 EQUIPMENT

1. Potable water supply.
2. Liquinox or other specified cleaning agent.
3. Deionized (DI) water.
4. Buckets/tubs for wash and rinse.
5. Other decontamination liquids/solvents specified in site-specific plans.
6. Drums (55-gallon) or other containers for containerizing decontamination fluids.
7. Pressure washer and containment pad for heavy equipment.
8. Sample containers for sampling decontamination fluids (if required).

5.0 DECONTAMINATION PROCEDURES

5.1 Decontamination Procedures for Water Level Meters and the Water Quality Field Parameter Sensors

The electronic water level indicator probe/steel tape and the water-quality field parameter sensors will be decontaminated by the following procedures:

- The water level meter will be hand washed with phosphate free detergent and a scrubber, then thoroughly rinsed with distilled water.
- Water quality field parameter sensors and flow-through cell will be rinsed with distilled water between sampling locations. No other decontamination procedures are necessary or recommended for these probes since they are sensitive. After the sampling event, the flow cell and sensors must be cleaned and maintained per the manufacturer's requirements.

- Containerize, label, and sample (if required) all decontamination fluids for appropriate disposal.

5.2 Decontamination Procedure for Sampling Pumps

Upon completion of the groundwater sample collection the sampling pump must be properly decontaminated between monitoring wells. The pump and discharge line including support cable and electrical wires which were in contact with the groundwater in the well casing must be decontaminated by the following procedure:

- The outside of the pump, tubing, support cable and electrical wires must be pressured sprayed with soapy water, tap water and distilled water. Spray inside and outside of tubing and pump until water is flowing off of tubing after each rinse. Use bristle brush to help remove visible dirt and contaminants.
- Place the sampling pump in a bucket or in a short PVC casing (4-in. diameter) with one end capped. The pump placed in this device must be completely submerged in the water. A small amount of phosphate free detergent must be added to the potable water (tap water).
- Remove the pump from the bucket or 4-in. casing and scrub the outside of the pump housing and cable.
- Place pump and discharge line back in the 4-in. casing or bucket, start pump and re-circulate this soapy water for 2 minutes (wash).
- Re-direct discharge line to a 55-gallon drum; continue to add 5 gallons of potable water (tap water) or until soapy water is no longer visible.
- Turn pump off and place pump into a second bucket or 4-in. casing which contains tap water, continue to add 5-gallons of tap water (rinse).
- Turn pump off and place pump into a third bucket or 4-in. casing which contains distilled/deionized water, continue to add three to five gallons of distilled/deionized water (final rinse).
- If a hydrophobic contaminant is present (such as separate phase, high levels of PCB's, etc.), an additional decontamination step, or steps, may be added. For example, an organic solvent, such as reagent-grade isopropanol alcohol may be added as a first spraying/bucket prior to the soapy water rinse/bucket.
- Containerize, label, and sample (if required) all decontamination fluids for appropriate disposal.

5.3 Decontamination Procedures for General Field Sampling Equipment and PPE

Field sampling tools such as shovels, trowels, and PPE will be cleaned using the following procedures:

- Spray/rinse off excess dirt, mud, or other residue with potable water.
- Scrub sampling equipment and soiled PPE in potable water and Liquinox or other non-phosphate detergent.
- Rinse with potable water.
- Rinse reusable sampling equipment with deionized water, air dry, and store in aluminum foil.
- Rinse with methanol, hexane, isopropanol, nitric acid, or other cleaning agents if specified in QAPP or SAP.
- Dispose of all cleaned equipment/PPE appropriately.

- Containerize, label, and sample (if required) all decontamination fluids for appropriate disposal.

5.4 Decontamination Procedures for Heavy Equipment

Heavy equipment requiring decontamination may include drill rigs, drill augers, direct-push rods and samplers, backhoes, and other equipment that has contacted potentially contaminated media. The procedures include the following:

- Construct a lined containment pad for collection of all soil, residue, and decontamination fluids.
- Pressure wash equipment with potable water until clean.
- Rinse sampling equipment (such as direct-push split spoon or sampler) in DI water, air dry, and store in clean container (such as aluminum foil). Use other cleaning agents if specified in QAPP or SAP.
- Containerize all sediments/soils and decontamination fluids in 55-gallon drums. Separate media (soil, water) if possible and sample for appropriate disposal. Label all containers with contents, date, location, and contact information.
- Decontaminate containment pad or pad liner. Dispose of all non-reusable items appropriately after thoroughly decontaminated.
- Containerize, label, and sample (if required) all decontamination fluids for appropriate disposal.

6.0 HEALTH AND SAFETY CONSIDERATIONS

Follow all requirements of the project Health and Safety Plan (HASP). Ensure all field equipment has been decontaminated in accordance with the site-specific HASP and this SOP.

DIRECT-PUSH AND MONITORING WELL GROUNDWATER SAMPLING
CALIBRE STANDARD OPERATING PROCEDURES

1.0 PURPOSE

This Standard Operating Procedure (SOP) provides instructions that are to be followed in collecting direct-push groundwater samples.

2.0 GROUNDWATER SAMPLING

The following sections describe sampling procedure to be used in the collection of direct-push groundwater samples from direct-push boreholes and monitoring wells.

2.1 Direct Push Groundwater Sampling

When the desired depth interval is reached, a push-rod is inserted into the center of the drill-string. Sections are added until the push-rod contacts the Direct-push point. After threading the rod on to the end cone and releasing it from the drill-string, the drill-string is retracted while holding the push-rod in place exposing the screen. The push-rod is withdrawn and fresh (unused) tygon tubing with a foot valve on the end is lowered to a point where it is centered in the screen. A groundwater sample is extracted either with the use of a peristaltic pump or by applying a quick up and down motion to the tube until water comes out of the end of the tube.

2.2 Monitoring Well Groundwater Sampling

Groundwater may be sampled in monitoring wells by use of Waterra pumps, peristaltic pumps, submersible pumps, or bailers. Regardless of the system employed, the point of collection (i.e. pump or foot valve) is placed at the mid-screen interval. Groundwater is withdrawn from the well until three well casing volumes have been removed and groundwater parameters (pH, temperature, conductivity, etc.) have stabilized. At that point, sample containers may be filled in accordance with project specific Field Sampling Plan procedures.

2.3 Sample Handling

When the sample water appears, use the following the sequence of steps described below:

(1) Label all bottles with required tags and labels. Fill out all information except the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for QA/QC samples.

(2) Note depth and bore location of the sample in the field logbook or sample data sheet.

(3) At the time of individual sample collection, record date and time on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(4) Hold bottle so that water pours into it without the lip of the bottle touching the tube.

(5) If the samples are being analyzed for volatile organic compounds (VOCs), collect the VOC fraction first. VOC vials should be filled to the top with a meniscus above the lip of the vial, leaving no airspace in the bottle when the lid is screwed on.

(6) Fill the remaining bottles up to the shoulder of the bottle and seal with the cap.

(7) Wipe off the outside of the bottle/vial and place it in a bubble baggie. Place the bagged bottle in a cooler, with ice if the sample plan calls for ice.

(8) Decontaminate the sampling equipment for the next sample if sampling equipment is not dedicated or disposable.

2.4 Waste

Insure that all purge water and decontamination water, which may be contaminated, are handled and disposed of properly.

GROUNDWATER SAMPLING
CALIBRE STANDARD OPERATING PROCEDURES

1.0 POLICY

It is the policy of CALIBRE that any individual engaging in collection of groundwater samples at job sites will abide by the procedures outlined in this document. These procedures are designed to meet or exceed guidelines set forth by the Environmental Protection Agency (EPA) for the collection of groundwater samples at Superfund or Resource Conservation and Recovery Act (RCRA) sites.

2.0 PURPOSE

This Standard Operating Procedure (SOP) provides instructions that are to be followed in collecting groundwater samples.

2.0 GROUNDWATER SAMPLING

The following sections describe sampling procedures to be used in the collection of groundwater samples from direct-push boreholes and monitoring wells.

2.1 Direct-Push Groundwater Sampling

When the desired depth interval is reached, a push-rod is inserted into the center of the drill-string. Sections are added until the push-rod contacts the direct-push point. After threading the rod on to the end cone and releasing it from the drill-string, the drill-string is retracted while holding the push-rod in place exposing the screen. The push-rod is withdrawn and fresh (unused) tygon tubing with a foot valve on the end is lowered to a point where it is centered in the screen. A groundwater sample is extracted either with the use of a peristaltic pump or by applying a quick up and down motion to the tube until water comes out of the end of the tube.

2.2 Monitoring Well Groundwater Sampling

Groundwater may be sampled in monitoring wells by use of Waterra pumps, peristaltic pumps, submersible pumps, or bailers. Regardless of the system employed, the point of collection (i.e. pump or foot valve) is placed at the mid-screen interval. Groundwater is withdrawn from the well until three well casing volumes have been removed and groundwater parameters (pH, temperature, conductivity, etc.) have stabilized. At that point, sample containers may be filled in accordance with project specific Field Sampling Plan procedures.

2.3 Sample Handling

When the sample water appears, use the sequence of steps described in the following list:

1) Label all bottles with required tags and labels. Fill out all information except the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for QA/QC samples.

2) Note depth and bore location of the sample in the field logbook or sample data sheet.

3) At the time of individual sample collection, record date and time on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

4) Hold bottle so that water pours into it without the lip of the bottle touching the tube.

5) If the samples are being analyzed for volatile organic compounds (VOCs), collect the VOC fraction first. VOC vials should be filled to the top with a meniscus above the lip of the vial, leaving no airspace in the bottle when the lid is screwed on.

6) Fill the remaining bottles up to the shoulder of the bottle and seal with the cap.

7) Wipe off the outside of the bottle/vial and place it in a bubble baggie. Place the bagged bottle in a cooler, with ice if the sample plan calls for ice.

8) If sampling equipment is not dedicated or disposable, then decontaminate the sampling equipment for the next sample.

2.4 Waste

Insure that all purge water and decontamination water, which may be contaminated, are handled and disposed of properly.

LOW-FLOW GROUNDWATER SAMPLE COLLECTION
CALIBRE STANDARD OPERATING PROCEDURES

1.0 POLICY

It is the policy of CALIBRE that any individual engaging in collection of low-flow groundwater samples at job sites will abide by the procedures outlined in this document. These procedures are designed to meet or exceed guidelines set forth by the Environmental Protection Agency (EPA) for the collection of low-flow groundwater samples at Superfund or Resource Conservation and Recovery Act (RCRA) sites.

2.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide a method that minimizes the impact the purging process has on the groundwater chemistry during sample collection and minimizes the volume of water that is being purged and disposed. The flow rate at which the pump will be operating will depend on both hydraulic conductivity of the aquifer and the drawdown, with the goal of minimizing the drawdown within the monitoring well. The flow rate from the pump during purging and sampling is targeted at a rate that will not compromise the integrity of the analyte that is being sampled. The operating flow of groundwater to the pump will depend on the hydraulic conductivity of the aquifer within the screen interval. In order to minimize the drawdown in the monitoring well, a low-flow rate must be utilized. Low-flow refers to the velocity with which water enters the pump intake from the surrounding formation in the immediate vicinity of the well screen. This SOP was developed to be consistent with guidelines from the Superfund/ RCRA Groundwater Forum and draws directly from a USEPA Groundwater Issue Paper, Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers (Yeskis and Zavala, 2002).

3.0 SCOPE AND APPLICATION

This SOP should be used primarily at monitoring wells which have a screen or an open interval with a length of ten feet (typically) or less and can accept a sampling device that minimizes the disturbance to the aquifer or the water column in the well casing. The groundwater samples that are collected using this procedure are acceptable for the analyses of groundwater contaminants that may be found at typical groundwater contamination sites (CERCLA, RCRA and other sites). The analytes may be volatile organic compounds, semi-volatile organic compounds, pesticides, PCBs, metals and other inorganic compounds. The screened interval should be located within the contaminant plume(s) and the pump intake should be placed at or near the known source of the contamination within the screened interval. It is critical to place the pump intake in the same exact location or depth for each sampling event (indicating an obvious preference for permanently installed sampling devices where possible). If dedicated sampling pump is not possible, then the placement of the pump intake should be positioned with a pre-measured sampling pump hose. The pump intake should not be placed near the bottom of the screened interval to avoid disturbing any sediment that typically accumulates on the bottom of the well.

Water-quality indicator parameters (and water levels if feasible) must be measured during purging, prior to sample collection. Stabilization of the water quality parameters as well as monitoring water levels are prerequisites to sample collection. The water-quality indicator parameters that are recommended include: specific conductance, dissolved oxygen, oxidation-reduction potential, pH, and temperature. Turbidity may be useful but is not a required parameter. Also, when samples are

collected for metals, semi-volatile organic compounds, and pesticides, every effort must be made to reduce turbidity to 10 NTUs or less (not just the stabilization of turbidity) prior to the collection of the water sample. In addition to the measurement of the above parameters, depth to water should be measured (if feasible) during purging. However, recognizing that many groundwater monitoring wells are two-inch diameter, the pump assembly may not allow access for a depth to water probe.

Proper well construction, development, and maintenance are essential for any groundwater sampling procedure. Prior to conducting the field work, information on the construction of the well and well development should be obtained and that information factored into the site-specific sampling procedure. The attached Pre-Sampling Checklist is an example of the general type of information that is useful.

Stabilization of the water-quality indicator parameters is the criterion for sample collection. But if stabilization is not occurring and the procedure has been followed, then sample collection can take place once three (minimum) to six (maximum) casing volumes of groundwater have been removed from the well. The specific information on what took place during purging must be recorded in the field notebook or in the Well Sampling Data Sheet. This SOP is not to be used where non-aqueous phase liquids (immiscible fluids) are present in the monitoring well.

4.0 EQUIPMENT

1) Depth-to-water measuring device - An electronic water-level indicator (E-tape) or steel tape and chalk, with marked intervals of 0.01 foot. Interface probe for determination of non-aqueous phase liquids (NAPL) (if needed).
2) Steel tape and weight - Used for measuring total depth of well. Lead weight should not be used. If the wells are less than 75 feet deep, the E-tape may suffice for this total depth measurement, deeper wells may need steel tape and weight.
3) Sampling pump - Submersible or bladder pumps with adjustable rate controls are preferred. Pumps are to be constructed of inert materials, such as stainless steel and Teflon. Pump types that are acceptable include gear and helical driven, centrifugal (low-flow type) and air-activated piston.
4) Adjustable rate, peristaltic pump can be used when the depth to water is 20 feet or less.
5) Tubing - Teflon or Teflon lined polyethylene tubing is preferred when sampling for organic compounds. Polyethylene tubing can be used when sampling inorganics.
6) Power Source - If a combustion type (gasoline or diesel driven) generator is used, it must be placed downwind of the sampling area.
7) Flow measurement supplies - flow meter, graduated cylinder and a stop watch.
8) Multi-parameter meter with flow-through-cell. This can be one instrument or more contained in a flow-through cell. The water-quality indicator parameters which must be monitored are pH, oxidation-reduction potential (ORP), dissolved oxygen (DO), specific conductance, and temperature. The inlet of the flow cell must be located near the bottom of the flow cell and the outlet near the top. The size of the flow cell should be kept to a minimum and a closed cell is preferred. The flow cell must not contain any air or gas bubbles when monitoring for the water-quality indicator parameters.
9) Calibration fluids for all instruments. There needs to be sufficient volume of calibration solution for daily calibration throughout the sampling event.
10) Decontamination Supplies - Including a reliable and documented source of deionized (DI) or distilled water and any solvents (if used). Pressure sprayers, buckets, or decontamination tubs for pumps, brushes, and non-phosphate soap will also be needed.

11) Sample bottles, sample preservation supplies, sample tags or labels, and chain of custody forms.
12) Field Sampling and Quality Assurance Project Plan.
13) Well construction data, field and water quality data and water levels from the previous sampling event.
14) Well keys, tools to open well head monuments, and map of well locations.
15) Field notebook, Well Sampling Data Sheets/forms (attached), and calculator.
16) Filtration equipment (if needed for dissolved metals analyses). An in-line disposable filter is recommended.
17) Polyethylene sheeting which will be placed on ground around the well head.
18) Personal protective equipment specified in the site Health and Safety Plan, including any air monitoring equipment specified in the site Health and Safety Plan.
19) Tool box - All tools required for access to wells and for all site equipment used.
20) A 55-gallon drum or other appropriate container to contain the purged water.

Construction materials of the sampling equipment (bladders, pumps, tubing, and other equipment that comes in contact with the sample) should be limited to inert materials (such as stainless steel, Teflon, or other inert materials). This will reduce the chance of the sampling materials altering the groundwater where concentrations of the site contaminants are expected to be near the detection limits. The sample tubing diameter thickness should be maximized and the tubing length should be minimized so that the loss of contaminants into and through the tubing walls may be reduced and the rate of stabilization of groundwater parameters is maximized. The tendency of low level organics to sorb into and out of material makes the appropriate selection of sample tubing material critical for trace analyses.

5.0 CALIBRATION OF WATER QUALITY INSTRUMENTS

All water quality instruments to be used need to be calibrated (daily) following procedures in the instrument specific user manual.

6.0 DEPTH TO WATER AND PRE-SAMPLING ACTIVITIES (Non-dedicated and dedicated system)

1) Sampling events must begin at the monitoring well with the least contamination, generally up-gradient or farthest from the site or suspected source. Then proceed systematically to the monitoring wells with the most contaminated groundwater. Depth to water measurements should be collected in the same order.
2) Check and record the condition of the monitoring well for damage or evidence of tampering. Lay out polyethylene sheeting around the well to minimize the likelihood of contamination of sampling/purging equipment from the soil. Place monitoring, purging, and sampling equipment on the sheeting.
3) Unlock well head. Record location, time, date, and appropriate information in a field logbook or on the Well Sampling Data Sheet (See attached Well Sampling Data Sheet).
4) Remove well casing cap and observe any apparent pressure changes within the casing, if the cap is under vacuum or pressure allow the well time to equilibrate before measuring water levels .
5) As appropriate, monitor the headspace of the monitoring well at the rim of the casing for volatile organic compounds (VOC) with a photoionization detector (PID) or flame ionization detector (FID), and record in the logbook. If the existing monitoring well has a

history of positive readings of the headspace, then the sampling must be conducted in accordance with the Health and Safety Plan.

6) Measure the depth to water (water level must be measured to nearest 0.01 feet) relative to a reference measuring point on the well casing with an E-tape or steel tape and record in logbook or Well Sampling Data Sheet. If no reference point is found, measure relative to the top of the inner casing, then mark that reference point and note that location in the field logbook. Record information on depth to groundwater in the field logbook or Well Sampling Data Sheet.
7) Measure the depth to water a second time to confirm initial measurement; measurement should agree within 0.01 feet or re-measure.
8) Check the available well information or field information for the total depth of the monitoring well. Use the information from the depth of water in step 6 and the total depth of the monitoring well to calculate the volume of the water in the monitoring well or the volume of one casing. Record information in field logbook or Well Sampling Data Sheet.

7.0 PURGING AND SAMPLING PROCEDURES

The following describes the purging and sampling procedures for the Low Flow method for the collection of groundwater samples. These procedures also describe steps for dedicated and non-dedicated systems.

7.1 Purging and Sampling Activities

Non-dedicated system - Place the pump and support equipment at the wellhead and slowly lower the pump and tubing down into the monitoring well until the location of the pump intake is set at a pre-determined location within the screen interval. The placement of the pump intake should be positioned with a calibrated sampling pump hose, sounded with a weighted-tape, or using a pre-measured discharge tubing. Refer to the available monitoring well information to determine the depth and length of the screen interval. Measure the depth of the pump intake while lowering the pump into location. Record pump location in field logbook or Well Sampling Data Sheet.

Dedicated system - Pump has already been installed, refer to the available monitoring well information and record the depth of the pump intake in the field logbook or Well Sampling Data Sheet.

Non-dedicated system and dedicated system
Measure the water level (water level must be measured to nearest 0.01 feet) and record information on the Well Sampling Data Sheet, leave water level indicator probe in the monitoring well (if sufficient space in casing).

Connect the discharge line from the pump to a flow-through cell. The discharge line from the flow-through cell must be directed to a container to contain the purge water during the purging and sampling of the monitoring well.

Start pumping the well at a low flow rate (0.2 to 0.5 liters per minute) and slowly increase the pumping rate. Check the water level if feasible: Note if the groundwater monitoring well is two-inch diameter, the pump assembly (pump, support cable, discharge hose, electrical supply, and pump booster stages in some cases) may fill the entire well casing access and a depth-to-water probe may not fit within the well casing. Field personnel need to exercise extreme care and good

judgment when adding a probe to the tight space within a well. Equipment jammed or locked deep in a well casing may be lost/destroyed and future sampling access eliminated.

Maintain a steady flow rate while maintaining a drawdown of less than 0.33 feet (USEPA 2002). If drawdown is greater than 0.33 feet, lower the flow rate. The maximum drawdown of 0.33 feet is a goal to help guide with the flow rate adjustment. It should be noted that this goal may not be feasible under a number hydrogeologic conditions (relatively thin aquifers and/or low permeability soils). If this goal is not feasible, the sampling approach will require adjustment based on site-specific conditions and personal experience.

Measure the discharge rate of the pump with a graduated cylinder and a stop watch. Also, measure the water level, if feasible, and record both flow rate and water level on the Well Sampling Data Sheet. Continue purging, monitor and record water level and pump rate every three to five minutes during purging. Pumping rates should be kept at minimal flow to ensure minimal drawdown in the monitoring well.

During the purging, a minimum of one tubing volume (including the volume of water in the pump and flow cell) must be purged prior to recording the water-quality indicator parameters. Then monitor and record the water-quality indicator parameters every three to five minutes.

The water-quality indicator field parameters are pH, specific electrical conductance, ORP, dissolved oxygen, temperature, and turbidity. The ORP may not always be an appropriate stabilization parameter, and will depend on site-specific conditions. However, readings should be recorded because of its value as a double check for oxidizing conditions. The stabilization criterion is based on three successive readings of the water quality field parameters; the following are the criteria to be used :

Table 1. Parameter Stabilization Criteria Reference

pH	Conductance	ORP	DO	Temperature	Turbidity
+/- 0.1 pH unit	+/- 5% mS/cm	+/- 10 millivolts	+/- 0.3 mg/L	+/- 5% degrees Centigrade	+/- 10% NTUs (when greater than 10 NTUs)

Once the criteria have been successfully met indicating that the water quality indicator parameters have stabilized, then sample collection can take place. If a stabilized drawdown in the well can't be maintained at 0.33 feet and the water level is approaching the top of the screened interval, reduce the flow rate or turn the pump off (for 15 minutes) and allow for recovery to 90% of the height of the original water column. It should be noted whether or not the pump has a check valve. A check valve is required if the pump is shut off. Under no circumstances should the well be pumped dry. Begin pumping at a lower flow rate, if the water draws-down to the top of the screened interval again turn pump off and allow for recovery. If two tubing volumes (including the volume of water in the pump and flow cell) have been removed during purging then sampling can proceed the next time the pump is turned on. This information should be noted in the field notebook or Well Sampling Data Sheet with a recommendation for a different purging and sampling procedure.

Maintain the same pumping rate or reduce slightly for sampling (0.2 to 0.5 liter per minute) in order to minimize disturbance of the water column. Samples should be collected directly from the discharge port of the pump tubing prior to passing through the flow-through cell. Disconnect the

pump's tubing from the flow-through-cell so that the samples are collected directly from the pump's discharge tubing.

For samples collected for dissolved gases or Volatile Organic Compound (VOC) analyses, the pump's tubing needs to be completely full of groundwater to prevent the groundwater from being aerated as the groundwater flows through the tubing. The sequence of the samples is immaterial unless filtered (dissolved) samples are collected and they must be collected last. All sample containers should be filled with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container. When filling the VOC samples a meniscus must be formed over the mouth of the vial to eliminate the formation of air bubbles and head space prior to capping. In the event that the groundwater is turbid (greater then 10 NTUs), samples for metals should include a filtered metal (dissolved) sample.

If filtered metal sample is to be collected, then an in-line filter is fitted at the end of the discharge tubing and the sample is collected after the filter. The in-line filter must be pre-rinsed with groundwater following manufacturer's recommendations and if there are no recommendations for rinsing, a minimum of 0.5 to 1 liter of groundwater from the monitoring well must pass through the filter prior to sampling.

Non-dedicated system
Remove the pump from the monitoring well. Decontaminate the pump and tubing and dispose of non-dedicated tubing.

Dedicated system
Disconnect the tubing that extends from the discharge cap at the wellhead (or cap) and decontaminate and dispose of any non-dedicated discharge tubing.

Non-dedicated and dedicated system - Close and lock the well.

8.0 DECONTAMINATION PROCEDURES

Follow decontamination procedures from appropriate SOP. Sensors in the field water quality instruments are sensitive and rinsing with distilled water between sampling locations is the only decontamination recommended.

9.0 FIELD QUALITY CONTROL

Quality control (QC) samples must be collected to verify that sample collection and handling procedures were performed adequately and that sampling procedures have not compromised the quality of the groundwater samples. Follow all requirements of the site-specific Quality Assurance Project Plan (QAPP), typically to include some version of the following:

- Field duplicates (1 per 20 samples)
- Matrix spike/spike duplicate (extra volume at 1 per 20 samples or sample delivery group)
- Equipment blank (depends on sampling equipment use)
- Trip blank (for VOCs, 1 per sample cooler)
- Temperature blank (1 per sample cooler)
- Field Blank (as required in QAPP or 1 per sampling event)

10.0 HEALTH AND SAFETY CONSIDERATIONS

Follow all requirements of the project Health and Safety Plan. Ensure all field equipment has been decontaminated and stored appropriately.

11.0 POST-SAMPLING ACTIVITIES

Several activities need to be completed and documented once ground-water sampling has been completed. These activities include, but are not limited to:

1) If any equipment problems are noted, notify the CALIBRE Equipment Pool Manager before the item is returned to storage. Determine where the equipment item should be shipped.
2) Ensure that all field equipment has been decontaminated and returned to proper storage location. Once the individual field equipment item has been decontaminated, tag it with date of cleaning, site name, and name of individual responsible.
3) All field data should be complied for site records.
4) All sample paperwork should be processed, including copies provided to the project manager, project files and any other project required sample handling and tracking facility.
5) All analytical data when processed by the analytical laboratory, should be verified against field sheets to ensure all planned data collection has been received from the laboratory.

12.0 REFERENCES

USEPA 2002. D. Yeskis and B. Zavala, Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. EPA 542.S-02-001. May 2002.

Puls, R.W. and M.J. Barcelona, 1996, Low-Flow (Minimal

PRE-SAMPLING CHECKLIST

Well Identification:
Map of Site Included: Y or N
Wells Clearly Identified w/ Roads: Y or N
Well Construction Diagram Attached: Y or N
Well Construction:
Details of well monument/cap security; specific keys/tools to open: Any traffic or pedestrian control requirements (if needed):
Diameter of Borehole: Diameter of Casing:
Casing Material: Screen Material:
Screen Length: Total Depth:
Approximate Depth to Water: and prior date:
Maximum Well Development Pumping Rate:
Date of Last Well Development:
Previous Sampling Information:
Was the Well Sampled Previously: Y or N
(If Sampled, Fill Out Table Below)
Table of Previous Sampling Information
Parameters Previously Sampled:
Number of Times Sampled:
Maximum Concentrations:
Notes (include previous purge rates):

Well Sampling Data Sheet

Date		Site Location	
Samplers		Well ID	
Casing Material		Constructed Depth	
Casing Diameter		Condition of Well	

Field Measurements:

Time		Depth Measured From:	
Depth to Water			Top of access port
			Mark on PVC casing
			Mark of protective casing
			Other

Purging Information:

Pump:		Dedicated		Non-dedicated		
Bailer:		PVC		Stainless Steel		Other:
Purge Start Time			Purge End Time			
Approximate Gallons Purged						

Water Monitoring Conditions:

Time							
pH							
Conductivity							
Turbidity							
D.O.							
Temperature							
ORP							
Purge Rate							
Gallons Purged							

Sampling Data:

Time		Sample ID	
pH		Duplicates	
Conductivity		QA/QC Volumes	
Turbidity			
D.O.			
Temperature			
ORP			

Sampling Device:

PVC Bailer		SS Bailer		Dedicated Pump		Teflon Bailer	

Analyses to be Performed:

Volatile Organics			SVOCs 8270C		Other	
Total Metals			SVOCs 8270C/SIM		Other	
Dissolved Metals			Ions, NO3, NH4, K		Other	

Sampling Notes:

	Well Diameter — Well Volume (Gal/ft)
	1 inch — 0.041
	2 inch — 0.163
	4 inch — 0.653
	6 inch — 1.469
	Or:(total depth(ft) - DTW(ft)) x Well Dia^2 x 0.0408 = 1 Well Volume

PASSIVE DIFFUSION BAG SAMPLERS
CALIBRE STANDARD OPERATING PROCEDURES

1.0 POLICY

It is the policy of CALIBRE that any individual engaging in groundwater sampling using passive diffusion bag samples will abide by the procedures outlined in this document. These procedures are designed to meet or exceed applicable regulatory procedures for sampling volatile organic compounds (VOCs) in groundwater using passive diffusion bag (PDB) samplers.

2.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide the methods and procedures for sampling groundwater for VOCs using PDB samplers.

3.0 SCOPE AND APPLICATION

Diffusion sampling is a relatively new technology designed to utilize passive diffusion sampling techniques without the need for well purging. Specifically, a diffusive membrane capsule is filled with deionized/distilled water, sealed, suspended in a well installation device, and lowered to a specified depth in a monitoring well. Over time (normally a minimum of 14 days), the volatile organic compounds (VOCs) in the groundwater diffuse across the membrane and reach equilibrium with the water inside the sampler. The sampler is subsequently removed from the well, and the water within the diffusion sampler is transferred to a sample container and submitted for laboratory analysis. Some benefits of using PDB samplers include reduced sampling costs and reduced generation of investigation-derived waste (IDW). The PDBs' ability to reflect dissolved VOC concentrations in the adjacent aquifer allows determination of stratification and vertical concentration gradients of VOC contaminants.

The PDB samplers were developed in the late 1990's and they have become a widely accepted technique for determining concentrations of VOCs in groundwater monitoring wells. PDB samplers are commercially available and several brand names are available. The procedures for installing and retrieving PDB samplers may vary somewhat depending on the type of sampler that is being used. This SOP provides general methods and procedures for passive or polyethylene diffusion bag samplers; however, the specific procedures for each type of PDB you are using should be reviewed to ensure the procedures followed are in accordance with the manufacturer's procedure specific to the sampler being used.

PDB samplers are made of low density polyethylene (typically 4mils thick) film which serves as a semi-permeable membrane. The membrane is formed into the shape of a tube to create a sample chamber which is filled with de-ionized water and sealed. Various configurations are commercially available either pre-filled and sealed at both ends at the factory, or with a fill port and plug for filling at the factory, in the field, or at the user's lab. PDB samplers are typically 18 to 24 inches long and 1.25 to 1.75 inches in diameter to fit into a 2-inch diameter and larger monitoring wells. These dimensions provide 200 to 350 ml of sample for multiple VOA samples and duplicates. Other diameters and lengths are available to fit smaller diameter wells or to provide specific sample volumes. PDBs are available with an exterior polyethylene mesh that protects against abrasion.

Advantages of PDB samplers include:

- do not generate purge water
- only sample for VOC compounds
- effective in low yield wells
- allow for rapid installation and sample collection
- easy to use
- inexpensive to purchase and use
- samples discrete interval or can integrate sample over longer vertical interval
- multiple, stacked samplers provide a vertical contaminant profile
- collect samples from discrete intervals in surface water bodies and tanks

4.0 EQUIPMENT

1. PDB Sampling Forms.
2. Depth to water probe.
3. Rope or string to hold samplers.
4. Plastic sheeting.
5. Stainless steel weights.
6. Nylon zip-ties.
7. Scissors or device for opening samplers.
8. Decontamination supplies.
9. Drums (55-gallon) or other containers for containerizing excess groundwater or decontamination fluids.

5.0 SAMPLING PROCEDURES

New and clean nitrile gloves should be worn by any sampling personnel who will be in direct contact with any material that will, or that has the potential to, contact the groundwater.

5.1 Installing Passive Diffusion Bag Samplers

1. Measure the water elevation in the monitoring well in accordance with applicable site-specific SOPs. This will be used to determine how much of the well screen is in the saturated zone (i.e., saturated well-screen length). Note this depth on the Sampling Form.

2. Measure the total well depth and compare the measured depth with the depth to the reported bottom of the well screen on the PDB Sampling Form. This will provide information on whether sediment has accumulated in the bottom of the well or whether there is a blank section of pipe (sump) below the well screen.

3. Determine if the well screen is completely saturated. If not, determine the length of well screen that is saturated.

4. One sampler will be installed in each well unless specified differently by the Work Plan.

5. The PDB sampler should be placed in the center of the saturated screen interval (or as specified in the project Work Plan) and should be completely submerged throughout the equilibration period. If anticipated water elevation changes (based on historical data) may expose the top of the sampler to air, the diffusion sampler should be placed deeper.

6. If assembly work is conducted on the ground, prepare the ground surface near the well for assembly of the diffusion sampler string, place clean plastic sheeting near the well and sample string construction area. If assembly is completed in vehicle, verify work area is clean.

7. Attach the stainless steel weight to the sampling assembly/line (a weight and weight hanger slides over the bag and the top of the bag is snapped on the suspension line, which is 60# braided fishing line, or other assembly procedure depending on the PDB bag and model).

8. Lower the PDB and assembly into the well to the target interval (typically to the bottom of the well then raised back up 5 ft, or other procedure/interval defined in the work plan).

9. Use a total of two zip-ties per PDB sampler. Finally, place a knot or a zip-tie at the location on the rope that corresponds to the top of the well casing.

10. Record in the field logbook and the PDB Sampling Form the depth at which each sampler is to be installed.

11. Attach the top and bottom of the diffusion sampler to the rope using the zipties that were inserted into the rope in Step 9 above. If no obvious hook exists on the sampler to which to attach the sampler to the rope using the zip-tie, attach the sampler to the rope by weaving the zip-tie through the mesh tubing of the diffusion sampler. The zip-ties should be threaded through the mesh tubing in a way that prevents the polyethylene diffusion bag from sliding out of the mesh and in a way that prevents slack from developing in the rope between the bottom and top of the sampler.

12. Samples that will be collected in duplicate for quality control (QC) purposes may require additional sample volume to fill the required sample containers. In these instances, utilize either oversized, longer samplers (for 2-inch diameter wells) or attach two regular samplers to the same depth interval on the rope (for wells with a casing diameter larger than 2-inches). Check the volume of the sampler and laboratory volume requirements to determine if an additional sampler is required.

13. Using decontaminated scissors (see Decontamination SOP), trim the excess from the zip-ties before placing the sampling string down the well.

14. Gently lower the diffusion sampling string into the well (weight first) until the weight rests on the bottom and the upper knot or zip-tie (indicating the top of the well casing) is even with the top of the well casing. The diffusion sampler should now be positioned at the correct depths.

15. Secure the rope or string at the wellhead in this position. A suggested method is to attach the rope to a hook (if one exists) on the inside of the well cap or the cap can be fitted over the rope to hold the rope at the desired depth.

16. If the well cap cannot be installed over the rope, install a temporary cover over the well casing to prevent debris from entering the well.

17. Close and lock the well protective covering.

18. Leave the sampling string in place for at least 14 days (or as specified in the Work Plans).

5.2 Diffusion Sampler Recovery and Sample Collection

This section describes the procedures for retrieving PDB samplers from groundwater monitoring wells. Following the equilibration period, the diffusion sampling string will be retrieved and samples will be collected for field screening and laboratory analysis using the following procedures.

1. Measure the water level in the monitoring well in accordance with applicable site-specific SOPs. Note this depth on the sample collection form and verify that the top of the PDB sampler is completely submerged below the water level.

2. Gently but quickly reel up (or pull) the sampler on the string.

3. Cut the cable ties and remove the diffusion sampler from the rope. Examine the surface of the diffusion sampler for evidence of algae or a film that could affect the performance of the diffusion membrane. Note any observations in the sampling field book and on the PDB Sampling Form.

5. Cut open the diffusion sampler using a properly decontaminated pair of scissors and gently pour the water into three (3) 40-mL VOA vials (or as specified in the Work Plans). As an alternative to using scissors, a fill kit may be provided by the PDB supplier for transferring water from the PDB to the sample container. Regardless of the method of transference, the water should be carefully poured down the inner walls of the sample bottle to minimize aeration of the sample. WATER NEEDS TO BE TRANSFERRED FROM THE DIFFUSION SAMPLERS TO THE VOA VIALS AS QUICKLY AS POSSIBLE TO MINIMIZE CONTAMINANT VOLATILIZATION.

6. Once filled to the brim, sample bottles will be sealed in a manner such that there is no headspace (i.e., no air bubbles).

7. Sample bottle preservation, labeling, and shipment will be performed according to the procedures detailed in the Sample Packaging and Shipment SOP.

8. Excess water from the diffusion samplers will be collected in sealable plastic buckets or steel drums for containment until it is disposed of. All investigation derived waste (IDW), including excess sample water, spent diffusion samplers, disposable sampling equipment, and personal protective equipment will be managed according to the criteria specified in the IDW plan specified in the site Work Plan.

6.0 HEALTH AND SAFETY CONSIDERATIONS

Follow all requirements of the project Health and Safety Plan (HASP). Ensure all field equipment has been decontaminated in accordance with the site-specific HASP and the decontamination SOP.

7.0 Selected References

ITRC 2004. Technical and Regulatory Guidance for Using Polyethylene Diffusion Bag Samplers to Monitor Volatile Organic Compounds in Groundwater.

Parsons 2004. Final Comprehensive Results Report for the Passive Diffusion Bag Sampler Demonstration.

ITRC— Technical Overview of Passive Sampler Technologies March 2006

Vroblesky, D. A. 2001. User's Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compounds Concentrations in Wells, Part 1 and 2.

US Geological Survey Water Resources Investigation Reports 01-4060 and 01-4061.
ITRC, Diffusion Sampler Information Center (DSIC),
http://diffusionsampler.itrcweb.org/common/default.asp

NJDEP, August 2005, Field Sampling Procedures Manual, Chapters 5 and 6.
http://www.state.nj.us/dep/srp/guidance/fspm/

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PHOTOIONIZATION DETECTOR (PID) CALIBRATION AND USE
CALIBRE STANDARD OPERATING PROCEDURES

1.0 POLICY

It is the policy of CALIBRE that any individual engaging in the use of a photoionization detector (PID) on jobsites will abide by the procedures outlined in this document. These procedures are designed to meet or exceed applicable OSHA standards for safe work practices.

2.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the procedures for using a photoionization detector (PID).

3.0 SCOPE AND APPLICATION

The PID is a portable, nonspecific, vapor/gas detector employing the principle of photoionization to detect a variety of chemical compounds, both organic and inorganic, in air. This procedure is applicable to the PIDs used for air monitoring. These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and reported.

4.0 METHOD SUMMARY

The PID is a useful general survey instrument at hazardous waste sites. A PID is capable of detecting and measuring real-time concentrations of many organic and inorganic vapors in air. A PID is similar to a flame ionization detector (FID) in application; however, the PID has somewhat broader capabilities in that it can detect certain inorganic vapors. Conversely, the PID is unable to respond to certain low molecular weight hydrocarbons, such as methane and ethane that are readily detected by FID instruments.

The PID employs the principle of photoionization. The analyzer will respond to most vapors that have an ionization potential less than or equal to that supplied by the ionization source, which is an ultraviolet (UV) lamp. Photoionization occurs when an atom or molecule absorbs a photon of sufficient energy to release an electron and form a positive ion. This will occur when the ionization potential of the molecule in electron volts (eV) is less than the energy of the photon. The sensor is housed in a probe and consists of a sealed ultraviolet light source that emits photons with an energy level high enough to ionize many trace organics, but not enough to ionize the major components of air (e.g., nitrogen, oxygen, carbon dioxide). The ionization chamber exposed to the light source contains a pair of electrodes, one a bias electrode, and the second the collector electrode. When a positive potential is applied to the bias electrode, an electro-magnetic field is created in the chamber. Ions formed by the adsorption of photons are driven to the collector electrode. The current produced is then measured and the corresponding concentration displayed on a meter, directly, in units above background. Several probes are available for the PID, each having a different eV lamp and a different ionization potential. The selection of the appropriate probe is essential in obtaining useful field results. Though it can be calibrated to a particular compound, the instrument cannot distinguish between detectable compounds in a mixture of gases and, therefore, indicates an integrated response to the mixture.

Three probes, each containing a different UV light source, are available for many PIDs. Energies are 9.5, 10.2, and 11.7 eV. All three detect many aromatic and large molecular hydrocarbons. The 10.2 eV and 11.7 eV probes, in addition, detect some smaller organic molecules and some halogenated hydrocarbons. The 10.2 eV probe is the most useful for environmental response work, as it is more durable than the 11.7 eV probe and detects more compounds than the 9.5 eV probe.

Gases with ionization potentials near to or less than that of the lamp will be ionized. These gases will thus be detected and measured by the analyzer. Gases with ionization potentials higher than that of the lamp will not be detected. Ionization potentials for various atoms, molecules, and compounds are given in standard references (see attached in Appendix A).

5.0 INTERFERENCES AND POTENTIAL PROBLEMS

5.1 PID Instrument Limitations

1) The PID is a nonspecific total vapor detector. It cannot be used to identify unknown substances; it can only roughly quantify them.
2) The PID must be calibrated to a specific compound (or including a conversion factor for equivalent response such as isobutylene)
3) The PID does not respond to certain low molecular weight hydrocarbons, such as methane and ethane. In addition, the PID does not detect a compound if the probe has a lower energy than the compound's ionization potential.
4) Certain toxic gases and vapors, such as carbon tetrachloride and hydrogen cyanide, have high ionization potentials and cannot be detected with a PID.
5) Certain models of PID instruments are not designed for use in potentially flammable or combustible atmospheres.
6) The lamp window must be periodically cleaned to ensure ionization of the new compounds by the probe (i.e., new air contaminants).
7) The PID measures concentrations are not linear over this entire range. For example, if calibrated to benzene, the response is linear from about 0-600 units above background. This means the PID reads a true concentration of benzene only between 0 and 600.
8) This instrument is not to be exposed to precipitation (rain). The units are not designed for this service. Significant humidity may impair the accuracy of the PID.
9) Do not use this instrument for head space analysis where liquids can inadvertently be drawn into the probe.

5.2 Regulatory Limitations

Transport of calibration gas cylinders by passenger and cargo aircraft must comply with International Air Transport Association (IATA) Dangerous Goods Regulations or the U.S. Code of Federal Regulations, 49 CFR Parts 100-177. A typical calibration gas included with a PID is isobutylene. It is classified as a non-flammable gas, UN #1556 and the proper shipping name is Compressed Gas. It must be shipped by cargo aircraft only.

6.0 EQUIPMENT/APPARATUS

The following equipment is required for PID operation:

1) PID
2) Operating manual
3) Probes: 9.5 eV, 10.2 eV, or 11.7 eV
4) Battery charger for PID
5) Spare batteries
6) Jeweler's screwdriver for adjustments
7) Tygon tubing
8) NBS traceable calibration gas (isobutylene) or other gas when calibrating to specific compound
9) "T" valve for calibration
10) Field Data Sheets/Site Logbook
11) Intake assembly extension
12) Strap for carrying PID
13) Teflon tubing for downhole measurements
14) Plastic bags for protecting the PID from moisture and dirt
15) Mild soap solution for cleaning unit surfaces, Methanol for cleaning ionization chamber (GC grade), and Light source cleaning compound (if applicable)

Note: Battery charge status - This instrument may be kept on continuous charge without battery damage.

The PID is calibrated in accordance with the operations manual using isobutylene as the calibration standard. The operations manual may also be referred to for alternate calibration to a specific compound.

7.0 PROCEDURES

7.1 Preparation

Check out and ensure the proper operation of the PID, as appropriate, using the equipment checklist provided in Sections 6.0 and the steps listed below.

7.2 Start-Up Procedures

1) Allow the temperature of the unit to equilibrate to its surrounding. This should take about five minutes.
2) Attach the probe to the unit.
3) Turn the instrument to ON.
4) Zero the instrument per the operations manual
5) Check the SPAN with calibration gas
6) Set the PID to the desired range (i.e., 0-20, 0-200, 0-2000, if applicable based on unit).
7) Listen for the vacuum pump operation to verify function.
8) Check instrument with a point calibration gas, and other source, such as a magic marker, prior to survey to verify instrument function.
9) Routinely during the day, verify the unit calibration and recalibrate the instrument if necessary

7.3 Field Calibration and Operation

7.3.1 Field Calibration

Follow the start-up procedure in Section 7.2. Set the FUNCTION switch to the range setting which includes the concentration of the calibration gas. Calibrate as follows:

1. Attach a regulator to a disposable cylinder of calibration gas. Connect the regulator to the probe of the PID with a piece of clean tygon tubing. Open the valve on the regulator.
2. After 15 seconds, the meter reading should equal the response value as indicated on the calibration gas cylinder used. If the reading is within ±15% of the response value, then the instrument can be field calibrated to the response value using the external SPAN ADJUSTMENT control. The SPAN ADJUSTMENT control should be adjusted to a lower setting until the correct reading has been obtained. The lower the number on the SPAN ADJUSTMENT control, the greater the instrument sensitivity. If the SPAN ADJUSTMENT control has to be adjusted below a setting of 4.00, the unit should be red-tagged and returned for repairs.
3. If the meter reading is greater than ±15% of the response value of the calibration gas used, then the instrument should be red-tagged and returned for repair.
4. Record the calibration of instrument in the instrument calibration log and field logbook including: instrument model and ID number, date, time, initial and final span settings, and concentration and type of calibration gas.
5. In some field applications, with the exception of the probe's inlet and exhaust, the PID should be wrapped in clear plastic to prevent it from becoming contaminated and to prevent water from getting inside in the event of precipitation.

7.3.2 Operation

1. All readings are to be recorded in the site logbook. Readings should be recorded as "units above background," not ppm.
2. As with any field instrument, accurate results depend on the operator being completely familiar with the operator's manual. The instructions in the operating manual should be followed explicitly in order to obtain accurate results.
3. Position the probe assembly close to the area to be monitored because the low sampling rate allows for only very localized readings. Under no circumstances should the probe tip assembly be immersed in fluid.
4. While taking care to prevent the PID from being exposed to excessive moisture, dirt, or contamination, monitor the work activity as specified in the site Health and Safety Plan. The PID survey should be conducted at a slow to moderate rate of speed and the intake assembly (the probe) slowly swept from side to side. There is a three to five second delay in the read-out depending upon the instruments sensitivity to the contaminant.
5. During drilling activities, PID monitoring is to be performed at regular intervals downhole and in the breathing zone. When opening monitoring wells readings should be taken at the wellhead and in the breathing zone. Always follow the air monitoring requirements specified in the site-specific Health and Safety Plan.

7.4 Post Operation

1. Turn FUNCTION Switch to OFF.

2. Return the PID to a secure area and check the calibration (Section 7.3.1.) before charging. Connect the instrument to charger and plug in the charger. The probe must be connected to the readout unit to charge the HNU type PID.
3. Complete logbook entries, verifying the accuracy of entries, and sign/initial all pages.

8.0 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following general QA procedures apply:
1. All data must be documented on field data sheets or within site logbooks.
2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

9.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and site-specific Health and Safety practices.

CORRECTION FACTORS, IONIZATION ENERGIES*, AND CALIBRATION CHARACTERISTICS

Correction Factors and Ionization Energies

RAE Systems PIDs can be used for the detection of a wide variety of gases that exhibit different responses. In general, any compound with ionization energy (IE) lower than that of the lamp photons can be measured.* The best way to calibrate a PID to different compounds is to use a standard of the gas of interest. However, correction factors have been determined that enable the user to quantify a large number of chemicals using only a single calibration gas, typically isobutylene. In our PIDs, correction factors can be used in one of three ways:

1) Calibrate the monitor with isobutylene in the usual fashion to read in isobutylene equivalents. Manually multiply the reading by the correction factor (CF) to obtain the concentration of the gas being measured.

2) Calibrate the unit with isobutylene in the usual fashion to read in isobutylene equivalents. Call up the correction factor from the instrument memory or download it from a personal computer and then call it up. The monitor will then read directly in units of the gas of interest.

3) Calibrate the unit with isobutylene, but input an equivalent, "corrected" span gas concentration when prompted for this value. The unit will then read directly in units of the gas of interest.

* *Some inorganic compounds like H_2O_2 and NO_2 give weak response at photon energies well above those of their ionization energies. The term "ionization energy" replaces the old term "ionization potential."*

Example 1:

With the unit calibrated to read isobutylene equivalents, the reading is 10 ppm with a 10.6 eV lamp. The gas being measured is butyl acetate, which has a correction factor of 2.6. Multiplying 10 by 2.6 gives an adjusted butyl acetate value of 26 ppm. Similarly, if the gas being measured were trichloroethylene (CF = 0.54), the adjusted value with a 10 ppm reading would be 5.4 ppm.

Example 2:

With the unit calibrated to read isobutylene equivalents, the reading is 100 ppm with a 10.6 eV lamp. The gas measured is m-xylene (CF = 0.43). After downloading this factor, the unit should read about 43 ppm when exposed to the same gas, and thus read directly in m-xylene values.

Example 3:

The desired gas to measure is ethylene dichloride (EDC). The CF is 0.6 with an 11.7 eV lamp. During calibration with 100 ppm isobutylene, insert 0.6 times 100, or 60 at the prompt for the calibration gas concentration. The unit then reads directly in EDC values.

Conversion to mg/m^3

To convert from ppm to mg/m^3, use the following formula:

$$\text{Conc. (mg/m}^3) = \frac{[\text{Conc.(ppmv) x mol. wt. (g/mole)}]}{\text{molar gas volume (L)}}$$

For air at 25 °C (77 °F), the molar gas volume is 24.4 L/mole and the formula reduces to:

$$\text{Conc.(mg/m}^3) = \text{Conc.(ppmv) x mol. wt. (g/mole) x } 0.041$$

For example, if the instrument is calibrated with a gas standard in ppmv, such as 100 ppm isobutylene, and the user wants to display to read in mg/m3 of hexane, whose m.w. is 86 and CF is 4.3, the overall correction factor would be 4.3 x 86 x 0.041 equals 15.2.

Correction Factors for Mixtures

The correction factor for a mixture is calculated from the sum of the mole fractions Xi of each component divided by their respective correction factors CFi:

$$CFmix = 1 / (X_1/CF_1 + X_2/CF_2 + X_3/CF_3 + \ldots X_i/CF_i)$$

Thus, for example, a vapor phase mixture of 5% benzene and 95% n-hexane would have a CFmix of
CFmix = 1 / (0.05/0.53 + 0.95/4.3) = 3.2. A reading of 100 would then correspond to 320 ppm of the total mixture, comprised of 16 ppm benzene and 304 ppm hexane.

For a spreadsheet to compute the correction factor and TLV of a mixture see the appendix at the end of the CF table.

TLVs and Alarm Limits for Mixtures

The correction factor for mixtures can be used to set alarm limits for mixtures. To do this one first needs to calculate the exposure limit for the mixture. The Threshold Limit Value (TLV) often defines exposure limits. The TLV for the mixture is calculated in a manner similar to the CF calculation:

$$TLV\ mix = 1 / (X_1/TLV_1 + X_2/TLV_2 + X_3/TLV_3 + \ldots X_i/TLV_i)$$

In the above example, the 8-h TLV for benzene is 0.5 ppm and for n-hexane 50 ppm. Therefore the TLV of the mixture is TLVmix = 1 / (0.05/0.5 + 0.95/50) = 8.4 ppm, corresponding to 8.0 ppm hexane and 0.4 ppm benzene. For an instrument calibrated on isobutylene, the reading corrsponding to the TLV is:

$$\text{Alarm Reading} = TLVmix / CFmix = 8.4 / 3.2 = 2.6 \text{ ppm}$$

A common practice is to set the lower alarm limit to half the TLV, and the higher limit to the TLV. Thus, one would set the alarms to 1.3 and 2.6 ppm, respectively.

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Calibration Characteristics

a) Flow Configuration. PID response is essentially independent of gas flow rate as long as it is sufficient to satisfy the pump demand. Four main flow configurations are used for calibrating a PID:

1) **A pressurized gas cylinder (Fixed-flow regulator):** The flow rate of the regulator should match the flow demand of the instrument pump or be slightly higher.
2) **A pressurized gas cylinder (Demand-flow regulator):** A demand-flow regulator better matches pump speed differences, but results in a slight vacuum during calibration and thus slightly high readings.
3) **A collapsible gas bag:** The instrument will draw the calibration gas from the bag at its normal flow rate, as long as the bag valve is large enough. The bag should be filled with enough gas to allow at least one minute of flow (~ 0.6 L for a MiniRAE, ~0.3 L for MultiRAE).
4) **The T (or open tube) method:** The T method uses a T-junction with gas flow higher than the pump draw. The gas supply is connected to one end of the T, the instrument inlet is connected to a second end of the T, and excess gas flow escapes through the third, open end of the T. To prevent ambient air mixing, a long tube should be connected to the open end, or a high excess rate should be used. Alternatively, the instrument probe can be inserted into an open tube slightly wider than the probe. Excess gas flows out around the probe.

The first two cylinder methods are the most efficient in terms of gas usage, while the bag and T methods give slightly more accurate results because they match the pump flow better.

b) Pressure. Pressures deviating from atmospheric pressure affect the readings by altering gas concentration and pump characteristics. It is best to calibrate with the instrument and calibration gas at the same pressure as each other and the sample gas. (Note that the cylinder pressure is not relevant because the regulator reduces the pressure to ambient.) If the instrument is calibrated at atmospheric pressure in one of the flow configurations described above, then 1) pressures slightly above ambient are acceptable but high pressures can damage the pump and 2) samples under vacuum may give low readings if air leaks into the sample train.

c) Temperature. Because temperature effects gas density and concentration, the temperature of the calibration gas and instrument should be as close as possible to the ambient temperature where the unit will be used. We recommend that the temperature of the calibration gas be within the instrument's temperature specification (typically 14°-113° F or -10°- 45° C). Also, during actual measurements, the instrument should be kept at the same or higher temperature than the sample temperature to avoid condensation in the unit.

d) Matrix. The matrix gas of the calibration compound and VOC sample is significant. Some common matrix components, such as methane and water vapor can affect the VOC signal. PIDs are most commonly used for monitoring VOCs in air, in which case the preferred calibration gas matrix is air. For a MiniRAE, methane, methanol, and water vapor reduce the response by about 20% when their concentration is 15,000 ppm and by about 40% at 30,000 ppm. Despite earlier reports of oxygen effects, RAE PID responses with 10.6 eV lamps are independent of oxygen concentration, and calibration gases in a pure nitrogen matrix can be used. H_2 and CO_2 up to 5 volume % also have no effect.

e) Concentration. Although RAE Systems PIDs have electronically linearized output, it is best to calibrate in a concentration range close to the actual measurement range. For example, 100 ppm standard gas for anticipated vapors of 0 - 250 ppm, and 500 ppm standard for expected concentrations of 250 - 1000 ppm.

f) Filters. Filters affect flow and pressure conditions and therefore all filters to be used during sampling should also be in place during calibration. Using a water trap (hydrophobic filter) greatly reduces the chances of drawing water aerosols or dirt particles into the instrument. Regular filter replacements are recommended because dirty filters can adsorb VOCs and cause slower response time and shifts in calibration.

Table Abbreviations:

CF =Correction Factor (multiply by reading to get corrected value for the compound when calibrated to isobutylene)
NR =No Response
IE =Ionization Energy (values in parentheses are not well established)
C =Confirmed Value; all others are preliminary or estimated values and are subject to change
ne =Not Established ACGIH 8-hr. TWA
C## =Ceiling value, given where 8-hr.TWA is not available

Disclaimer:

Actual readings may vary with age and cleanliness of lamp, relative humidity, and other factors. For accurate work, the instrument should be calibrated regularly under the operating conditions used. The correction factors in this table were measured in dry air at room temperature.

Updates:

The values that are indicated by a "plus" sign in the "C" columns are confirmed values; all others are preliminary and subject to change. Watch for updates of this table on the Internet at **http://www.raesystems.com**

IE data are taken from the CRC Handbook of Chemistry and Physics, 73rd Edition, D.R. Lide (Ed.), CRC Press (1993) and NIST Standard Ref. Database 19A, NIST Positive Ion Energetics, Vers. 2.0, Lias, et.al., U.S. Dept. Commerce (1993). Exposure limits (8-h TWA and Ceiling Values) are from the 1997 ACGIH TLVs and BEIs, Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. ACGIH, Cincinnati, OH 1997.

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Acetaldehyde		75-07-0	C_2H_4O	NR	+	6	+	3.3	+	10.23	C25
Acetic Acid	Ethanoic Acid	64-19-7	$C_2H_4O_2$	NR	+	22	+	2.6	+	10.66	10
Acetic Anhydride	Ethanoic Acid Anhydride	108-24-7	$C_4H_6O_3$	NR	+	6.1	+	2.0	+	10.14	5
Acetone	2-Propanone	67-64-1	C_3H_6O	1.2	+	1.1	+	1.4	+	9.71	500
Acetonitrile	Methyl cyanide, Cyanomethane	75-05-8	C_2H_3N					100		12.19	40
Acetylene	Ethyne	74-86-2	C_2H_2					2		11.40	ne
Acrolein	Propenal	107-02-8	C_3H_4O	42	+	3.9	+	1.4	+	10.10	0.1
Acrylic Acid	Propenoic Acid	79-10-7	$C_3H_4O_2$			12	+	2.0	+	10.60	2
Acrylonitrile	Propenenitrile	107-13-1	C_3H_3N			NR	+	1.2	+	10.91	2
Allyl alcohol		107-18-6	C_3H_6O			2.4	+	1.7		9.67	2
Allyl chloride	3-Chloropropene	107-05-1	C_3H_5Cl			4.3		0.7		9.9	1
Ammonia		7664-41-7	H_3N	NR	+	9.7	+	5.7	+	10.16	25
Amyl acetate	mix of n-Pentyl acetate & 2-Methylbutyl acetate	628-63-7	$C_7H_{14}O_2$	11	+	2.3	+	0.95	+	<9.9	100
Amyl alcohol	1-Pentanol	75-85-4	$C_5H_{12}O$			5				10.00	ne
Aniline	Aminobenzene	62-53-3	C_7H_7N	0.50	+	0.48	+	0.47	+	7.72	2
Anisole	Methoxybenzene	100-66-3	C_7H_8O			0.8				8.21	ne
Arsine	Arsenic trihydride	7784-42-1	AsH_3			1.9	+			9.89	0.05
Benzaldehyde		100-52-7	C_7H_6O					1		9.49	ne
Benzene		71-43-2	C_6H_6	0.55	+	0.53	+	0.6	+	9.25	0.5
Benzonitrile	Cyanobenzene	100-47-0	C_7H_5N			1.6				9.62	ne
Benzyl alcohol	α-Hydroxytoluene, Hydroxymethylbenzene, Benzenemethanol	100-51-6	C_7H_8O	1.4	+	1.1	+	0.9	+	8.26	ne
Benzyl chloride	α-Chlorotoluene, Chloromethylbenzene	100-44-7	C_7H_7Cl	0.7	+	0.6	+	0.5	+	9.14	1
Benzyl formate	Formic acid benzyl ester	104-57-4	$C_8H_8O_2$	0.9	+	0.73	+	0.66	+		ne
Boron trifluoride		7637-07-2	BF_3	NR		NR		NR		15.5	C1
Bromine		7726-95-6	Br_2	NR	+	1.30	+	0.74	+	10.51	0.1
Bromobenzene		108-86-1	C_6H_5Br			0.6		0.5		8.98	ne
2-Bromoethyl methyl ether		6482-24-2	C_3H_7OBr			0.84	+			~10	ne
Bromoform	Tribromomethane	75-25-2	$CHBr_3$	NR	+	2.5	+	0.5	+	10.48	0.5
Bromopropane,1-	n-Propyl bromide	106-94-5	C_3H_7Br	150	+	1.5	+	0.6	+	10.18	ne
Butadiene	1,3-Butadiene, Vinyl ethylene	106-99-0	C_4H_6	0.8		0.85	+	1.1		9.07	2
Butadiene diepoxide, 1,3-	1,2,3,4-Diepoxybutane	298-18-0	$C_4H_6O_2$	25	+	3.5	+	1.2		~10	ne
Butane		106-97-8	C_4H_{10}			67	+	1.2		10.53	800
Butanol, 1-	Butyl alcohol, n-Butanol	71-36-3	$C_4H_{10}O$	70	+	4.7	+	1.4	+	9.99	20
Butanol, t-	tert-Butanol, t-Buty alcohol	75-65-0	$C_4H_{10}O$	6.9	+	2.9	+			9.90	100
Butene, 1-	1-Butylene	106-98-9	C_4H_8			0.9				9.58	ne
Butoxyethanol, 2-	Butyl Cellosolve, Ethylene glycol monobutyl ether	111-76-2	$C_6H_{14}O_2$	1.8	+	1.2	+	0.6	+	<10	25
Butyl acetate, n-		123-86-4	$C_6H_{12}O_2$			2.6	+			10	150
Butyl acrylate, n-	Butyl 2-propenoate, Acrylic acid butyl ester	141-32-2	$C_7H_{12}O_2$			1.6	+	0.6	+		10
Butylamine, n-		109-73-9	$C_4H_{11}N$	1.1	+	1.1	+	0.7	+	8.71	C5
Butyl cellosolve	see 2-Butoxyethanol	111-76-2									
Butyl hydroperoxide, t-		75-91-2	$C_4H_{10}O_2$	2.0	+	1.6	+			<10	1
Butyl mercaptan	1-Butanethiol	109-79-5	$C_4H_{10}S$	0.55	+	0.52	+			9.14	0.5
Carbon disulfide		75-15-0	CS_2	4	+	1.2	+	0.44		10.07	10
Carbon tetrachloride	Tetrachloromethane	56-23-5	CCl_4	NR	+	NR	+	1.7	+	11.47	5
Carbonyl sulfide	Carbon oxysulfide	463-58-1	COS							11.18	
Cellosolve see 2-Ethoxyethanol											
CFC-14 see Tetrafluoromethane											
CFC-113 see 1,1,2-Trichloro-1,2,2-trifluoroethane											
Chlorine		7782-50-5	Cl_2					1.0	+	11.48	0.5
Chlorine dioxide		10049-04-4	ClO_2	NR	+	NR	+	NR	+	10.57	0.1
Chloro-1,3-butadiene, 2-	Chloroprene	126-99-8	C_4H_5Cl			3					10

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Chlorobenzene	Monochlorobenzene	108-90-7	C_6H_5Cl	0.44	+	0.40	+	0.39	+	9.06	10
Chloro-1,1-difluoroethane, 1-	(R-142B)	75-68-3	$C_2H_3ClF_2$			NR		NR		12.0	ne
Chlorodifluoromethane	HCFC-22, R-22	75-45-6	$CHClF_2$	NR		NR		NR		12.2	1000
Chloroethane	Ethyl chloride	75-00-3	C_2H_5Cl	NR	+	NR	+	1.1	+	10.97	100
Chloroethanol	Ethylene chlrohydrin	107-07-3	C_2H_5ClO							10.52	C1
Chloroethyl ether, 2-	bis(2-chloroethyl) ether	111-44-4	$C_4H_8Cl_2O$	8.6	+	3.0	+				5
Chloroethyl methyl ether, 2-	Methyl 2-chloroethyl ether	627-42-9	C_3H_7ClO			3					ne
Chloroform	Trichloromethane	67-66-3	$CHCl_3$	NR	+	NR	+	3.5	+	11.37	10
Chloropicrin		76-06-2	CCl_3NO_2	NR	+	~400	+	7	+	?	0.1
Chlorotoluene, o-	o-Chloromethylbenzene	95-49-8	C_7H_7Cl			0.5		0.6		8.83	50
Chlorotoluene, p-	p-Chloromethylbenzene	106-43-4	C_7H_7Cl					0.6		8.69	ne
Chlorotrimethylsilane		75-77-4	C_3H_9ClSi	NR		NR		0.82	+	10.83	ne
Crotonaldehyde	*trans*-2-Butenal	123-73-9 4170-30-3	C_4H_6O	1.5	+	1.1	+	1.0	+	9.73	2
Cumene	Isopropylbenzene	98-82-8	C_9H_{12}	0.58	+	0.54	+	0.4	+	8.73	50
Cyanogen bromide		506-68-3	CNBr	NR		NR		NR		11.84	ne
Cyanogen chloride		506-77-4	CNCl	NR		NR		NR		12.34	C0.3
Cyclohexane		110-82-7	C_6H_{12}	3.3	+	1.4	+	0.64	+	9.86	300
Cyclohexanol	Cyclohexyl alcohol	108-93-0	$C_6H_{12}O$					1.1		9.75	50
Cyclohexanone		108-94-1	$C_6H_{10}O$	1.0	+	0.9	+	0.7	+	9.14	25
Cyclohexene		110-83-8	C_6H_{10}			0.8	+			8.95	300
Cyclohexylamine		108-91-8	$C_6H_{13}N$			1.2				8.62	10
Cyclopentane 85% 2,2-dimethylbutane 15%		287-92-3	C_5H_{10}	NR	+	15	+	1.1		10.33	600
Cyclopropylamine	Aminocyclpropane	765-30-0	C_3H_7N	1.1	+	0.9	+	0.9	+		ne
Decane		124-18-5	$C_{10}H_{22}$	4.0	+	1.4	+	0.35	+	9.65	ne
Diacetone alcohol	4-Methyl-4-hydroxy-2-pentanone	123-42-2	$C_6H_{12}O_2$			0.7					50
Dibromochloromethane	Chlorodibromomethane	124-48-1	$CHBr_2Cl$	NR	+	5.3	+	0.7	+	10.59	ne
Dibromoethane, 1,2-	EDB, Ethylene dibromide, Ethylene bromide	106-93-4	$C_2H_4Br_2$	NR	+	1.7	+	0.6	+	10.37	ne
Dichlorobenzene, o-	1,2-Dichlorobenzene	95-50-1	$C_6H_4Cl_2$	0.54	+	0.47	+	0.38	+	9.08	25
Dichlorodifluoromethane	CFC-12	75-71-8	CCl_2F_2			NR	+	NR	+	11.75	1000
Dichlorodimethylsilane		75-78-5	$C_2H_6Cl_2Si$	NR		NR		1.1	+	>10.7	ne
Dichloroethane, 1,2-	EDC, 1,2-DCA, Ethylene dichloride	107-06-2	$C_2H_4Cl_2$			NR	+	0.6	+	11.04	10
Dichloroethene, 1,1-	1,1-DCE, Vinylidene chloride	75-35-4	$C_2H_2Cl_2$			0.82	+	0.8	+	9.79	5
Dichloroethene, c-1,2-	*c*-1,2-DCE, *cis*-Dichloroethylene	156-59-2	$C_2H_2Cl_2$			0.8				9.66	200
Dichloroethene, t-1,2-	*t*-1,2-DCE, *trans*-Dichloroethylene	156-60-5	$C_2H_2Cl_2$			0.45	+	0.34	+	9.65	200
Dichloro-1-fluoroethane, 1,1-	R-141B	1717-00-6	$C_2H_3Cl_2F$	NR	+	NR	+	2.0	+		ne
Dichloromethane	see Methylene chloride										
Dichloropentafluoropropane	AK-225, mix of ~45% 3,3-dichloro-1,1,1,2,2-pentafluoro-propane (HCFC-225ca) & ~55% 1,3-Dichloro-1,1,2,2,3-pentafluoropropane (HCFC-225cb)	442-56-0 507-55-1	$C_3HCl_2F_5$	NR	+	NR	+	25	+		ne
Dichloropropane, 1,2-		78-87-5	$C_3H_6Cl_2$					0.7		10.87	75
Dichloro-1-propene, 1,3-		542-75-6	$C_3H_4C_{12}$	1.3	+	0.96	+			<10	1
Dichloro-1-propene, 2,3-		78-88-6	$C_3H_4Cl_2$	1.9	+	1.3	+	0.7	+	<10	ne
Dichloro-1,1,1-trifluoroethane, 2,2-	R-123	306-83-2	$C_2HCl_2F_3$	NR	+	NR	+	10.1	+	11.5	ne
Dichloro-2,4,6-trifluoropyridine, 3,5-	DCTFP	1737-93-5	$C_5Cl_2F_3N$	1.1	+	0.9	+	0.8	+		ne
Dichlorvos	Vapona; O,O-dimethyl O-dichlorovinyl phosphate	62-73-7	$C_4H_7Cl_2O_4P$			0.9	+			<9.4	0.1

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Dicyclopentadiene	DCPD, Cyclopentadiene dimer	77-73-6	$C_{10}H_{12}$	0.57	+	0.48	+	0.43	+	8.8	5
Diesel Fuel		68334-30-5	m.w. 226			0.9	+				11
Diesel Fuel #2 (Automotive)		68334-30-5	m.w. 216			0.7	+	0.4	+		11
Diethylamine		109-89-7	$C_4H_{11}N$			1	+			8.01	5
Diethylaminopropylamine, 3-		104-78-9	$C_7H_{18}N_2$			1.3					ne
Diethylbenzene	See Dowtherm J										
Diethylmaleate		141-05-9	$C_8H_{12}O_4$			4					ne
Diethyl sulfide	see Ethyl sulfide										
Diisopropylamine		108-18-9	$C_6H_{15}N$	0.84	+	0.74	+	0.5	+	7.73	5
Diketene	Ketene dimer	674-82-8	$C_4H_4O_2$	2.6	+	2.0	+	1.4	+	9.6	0.5
Dimethylacetamide, N,N-	DMA	127-19-5	C_4H_9NO	0.87	+	0.8	+	0.8	+	8.81	10
Dimethylamine		124-40-3	C_2H_7N			1.5				8.23	5
Dimethyl carbonate	Carbonic acid dimethyl ester	616-38-6	$C_3H_6O_3$	NR	+	~70	+	1.7	+	~10.5	ne
Dimethyl disulfide	DMDS	624-92-0	$C_2H_6S_2$	0.2	+	0.20	+	0.21	+	7.4	ne
Dimethyl ether	see Methyl ether										
Dimethylethylamine	DMEA	598-56-1	$C_4H_{11}N$	1.1	+	1.0	+	0.9	+	7.74	~3
Dimethylformamide, N,N-	DMF	68-12-2	C_3H_7NO			0.8				9.13	10
Dimethylhydrazine, 1,1-	UDMH	57-14-7	$C_2H_8N_2$			0.8	+	0.8	+	7.28	0.01
Dimethyl methylphosphonate	DMMP, methyl phosphonic acid dimethyl ester	756-79-6	$C_3H_9O_3P$	NR	+	4.3	+	0.74	+	10.0	ne
Dimethyl sulfate		77-78-1	$C_2H_6O_4S$	~23		~20	+	2.3	+		0.1
Dimethyl sulfide	see Methyl sulfide										
Dimethyl sulfoxide	DMSO, Methyl sulfoxide	67-68-5	C_2H_6OS			1.4	+			9.10	ne
Dioxane, 1,4-		123-91-1	$C_4H_8O_2$			1.3				9.19	25
Dioxolane, 1,3-	Ethylene glycol formal	646-06-0	$C_3H_6O_2$	4.0	+	2.3	+	1.6	+	9.9	20
Dowtherm A see Therminol®											
Dowtherm J (97% Diethylbenzene)		25340-17-4	$C_{10}H_{14}$			0.5					
DS-108F Wipe Solvent	Ethyl lactate/Isopar H/ Propoxypropanol ~7:2:1	97-64-3 64742-48-9 1569-01-3	m.w. 118	3.3	+	1.6	+	0.7	+		ne
Epichlorohydrin	ECH Chloromethyloxirane, 1-chloro2,3-epoxypropane	106-89-8	C_2H_5ClO	~200	+	8.5	+	1.4	+	10.2	0.5
Ethane		74-84-0	C_2H_6			NR	+	15	+	11.52	ne
Ethanol	Ethyl alcohol	64-17-5	C_2H_6O			10	+	3.1	+	10.47	1000
Ethanolamine	MEA, Monoethanolamine	141-43-5	C_2H_7NO	5.6	+	1.6	+			8.96	3
Ethene	Ethylene	74-85-1	C_2H_4			9	+	4.5	+	10.51	ne
Ethoxyethanol, 2-	Ethyl cellosolve, Ethylene glycol monoethyl ether	110-80-5	$C_4H_{10}O_2$			1.3				9.6	5
Ethyl acetate		141-78-6	$C_4H_8O_2$			4.6	+			10.01	400
Ethyl acrylate		140-88-5	$C_5H_8O_2$			2.4	+	1.0	+	<10.3	5
Ethylamine		75-04-7	C_2H_7N			0.8				8.86	5
Ethylbenzene		100-41-4	C_8H_{10}	0.52	+	0.52	+	0.51	+	8.77	100
Ethylene glycol	1,2-Ethanediol	107-21-1	$C_2H_6O_2$			16	+	6	+	10.16	C100
Ethylene glycol dimethyl ether	1,2-Dimethoxyethane, Monoglyme	110-71-4	$C_4H_{10}O_2$	1.1		0.86		0.7		9.2	ne
Ethylene oxide	Oxirane, Epoxyethane	75-21-8	C_2H_4O			13	+	3.5	+	10.57	1
Ethyl ether	Diethyl ether	60-29-7	$C_4H_{10}O$			1.1	+			9.51	400
Ethyl 3-ethoxypropionate	EEP	763-69-9	$C_7H_{14}O_3$	1.2	+	0.75	+				ne
Ethyl formate		109-94-4	$C_3H_6O_2$					1.9		10.61	100
Ethyl hexyl acrylate, 2-	Acrylic acid 2-ethylhexyl ester	103-11-7	$C_{11}H_{20}O_2$			1.1	+	0.5	+		ne
Ethyl (S)-(-)-lactate see also DS-108F	Ethyl lactate, Ethyl (S)-(-)-hydroxypropionate	687-47-8 97-64-3	$C_5H_{10}O_3$	13	+	3.2	+	1.6	+	~10	ne
Ethyl mercaptan	Ethanethiol	75-08-1	C_2H_6S	0.60	+	0.56	+			9.29	0.5
Ethyl sulfide	Diethyl sulfide	352-93-2	$C_4H_{10}S$			0.5	+			8.43	ne
Formaldehyde	Formalin	50-00-0	CH_2O	NR	+	NR	+	1.6	+	10.87	C0.3
Formamide		75-12-7	CH_3NO			6.9	+	4		10.16	10
Formic acid		64-18-6	CH_2O_2	NR	+	NR	+	9	+	11.33	5

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Furfural	2-Furaldehyde	98-01-1	$C_5H_4O_2$			0.92	+	0.8	+	9.21	2
Furfuryl alcohol		98-00-0	$C_5H_6O_2$			0.80	+			<9.5	10
Gasoline #1		8006-61-9	m.w. 72			0.9	+				300
Gasoline #2, 92 octane		8006-61-9	m.w. 93	1.3	+	1.0	+	0.5	+		300
Glutaraldehyde	1,5-Pentanedial, Glutaric dialdehyde	111-30-8	$C_5H_8O_2$	1.1	+	0.8	+	0.6	+		C0.05
Halothane	2-Bromo-2-chloro-1,1,1-trifluoroethane	151-67-7	$C_2HBrClF_3$					0.6		11.0	50
HCFC-22 see Chlorodifluoromethane											
HCFC-123 see 2,2-Dichloro-1,1,1-trifluoroethane											
HCFC-141B see 1,1-Dichloro-1-fluoroethane											
HCFC-142B see 1-Chloro-1,1-difluoroethane											
HCFC-134A see 1,1,1,2-Tetrafluoroethane											
HCFC-225 see Dichloropentafluoropropane											
Heptane, n-		142-82-5	C_7H_{16}	45	+	2.8	+	0.60	+	9.92	400
Hexamethyldisilazane, 1,1,1,3,3,3-	HMDS	999-97-3	$C_6H_{19}NSi_2$			0.2	+	0.2	+	~8.6	
Hexane, n-		110-54-3	C_6H_{14}	350	+	4.3	+	0.54	+	10.13	50
Hexanol, 1-	Hexyl alcohol	111-27-3	$C_6H_{14}O$	9	+	2.5	+	0.55	+	9.89	ne
Hexene, 1-		592-41-6	C_6H_{12}			0.8				9.44	30
Hydrazine		302-01-2	H_4N_2	>8	+	2.6	+	2.1	+	8.1	0.01
Hydrazoic acid	Hydrogen azide		HN_3							10.7	
Hydrogen	Synthesis gas	1333-74-0	H_2	NR	+	NR	+	NR	+	15.43	ne
Hydrogen cyanide	Hydrocyanic acid	74-90-8	HCN	NR	+	NR	+	NR	+	13.6	C4.7
Hydrogen peroxide		7722-84-1	H_2O_2	NR	+	NR	+	NR	+	10.54	1
Hydrogen sulfide		7783-06-4	H_2S	NR	+	3.3	+	1.5	+	10.45	10
Iodine		7553-56-2	I_2	0.1	+	0.1	+	0.1	+	9.40	C0.1
Iodomethane	Methyl iodide	74-88-4	CH_3I	0.21	+	0.22	+	0.26	+	9.54	2
Isoamyl acetate	Isopentyl acetate	123-92-2	$C_7H_{14}O_2$	10.1		2.1		1.0		<10	100
Isobutane	2-Methylpropane	75-28-5	C_4H_{10}			100	+	1.2	+	10.57	ne
Isobutanol	2-Methyl-1-propanol	78-83-1	$C_4H_{10}O$	19	+	3.8	+	1.5		10.02	50
Isobutene	Isobutylene, Methyl butene	115-11-7	C_4H_8	1.00	+	1.00	+	1.00	+	9.24	ne
Isobutyl acetate		110-19-0	$C_6H_{12}O_2$			2.6					150
Isobutyl acrylate	Isobutyl 2-propenoate, Acrylic acid Isobutyl ester	106-63-8	$C_7H_{12}O_2$			1.5	+	0.60	+		ne
Isoflurane	1-Chloro-2,2,2-trifluoroethyl difluoromethyl ether, forane	26675-46-7	$C_3H_2ClF_5O$							~11.7	ne
Isooctane	2,2,4-Trimethylpentane	540-84-1	C8H18			1.2				9.86	ne
Isopar E Solvent	Isoparaffinic hydrocarbons	64741-66-8	m.w. 121	1.7	+	0.8	+				ne
Isopar G Solvent	Photocopier diluent	64742-48-9	m.w. 148			0.8	+				ne
Isopar K Solvent	Isoparaffinic hydrocarbons	64742-48-9	m.w. 156	0.9	+	0.5	+	0.27	+		ne
Isopar L Solvent	Isoparaffinic hydrocarbons	64742-48-9	m.w. 163	0.9	+	0.5	+	0.28	+		ne
Isopar M Solvent	Isoparaffinic hydrocarbons	64742-47-8	m.w. 191			0.7	+	0.4	+		ne
Isopentane	2-Methylbutane	78-78-4	C_5H_{12}			8.2					ne
Isophorone		78-59-1	$C_9H_{14}O$					3		9.07	C5
Isoprene	2-Methyl-1,3-butadiene	78-79-5	C_5H_8	0.69	+	0.63	+	0.60	+	8.85	ne
Isopropanol	Isopropyl alcohol, 2-propanol, IPA	67-63-0	C_3H_8O	500	+	6.0	+	2.7		10.12	400
Isopropyl acetate		108-21-4	$C_5H_{10}O_2$			2.6				9.99	250
Isopropyl ether	Diisopropyl ether	108-20-3	$C_6H_{14}O$			0.8				9.20	250
Jet fuel JP-4	Jet B, Turbo B, Wide cut type aviation fuel	8008-20-6 + 64741-42-0	m.w. 115			1.0	+	0.4	+		ne
Jet fuel JP-5	Jet 5, Kerosene type aviation fuel	8008-20-6 + 64747-77-1	m.w. 167			0.6	+	0.5	+		15
Jet fuel JP-8	Jet A-1, Kerosene type aviation fuel	8008-20-6 + 64741-77-1	m.w. 165			0.6	+	0.3	+		15
Jet fuel A-1 (JP-8)	Kerosene type aviation fuel	8008-20-6 + 64741-77-1	m.w. 145			0.67					15

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Limonene, D-	(R)-(+)-Limonene	5989-27-5	$C_{10}H_{16}$			0.33	+			~8.2	ne
Kerosene C10-C16 petro.distillate – see Jet Fuels		8008-20-6									
MDI – see 4,4'-Methylenebis(phenylisocyanate)											
Mesitylene	1,3,5-Trimethylbenzene	108-67-8	C_9H_{12}	0.36	+	0.35	+	0.3	+	8.41	25
Methane	Natural gas	74-82-8	CH_4	NR	+	NR	+	NR	+	12.61	ne
Methanol	Methyl alcohol, carbinol	67-56-1	CH_4O	NR	+	NR	+	2.5	+	10.85	200
Methoxyethanol, 2-	Methyl cellosolve, Ethylene glycol monomethyl ether	109-86-4	$C_3H_8O_2$	4.8	+	2.4	+	1.4	+	10.1	5
Methoxyethoxyethanol, 2-	2-(2-Methoxyethoxy)ethanol Diethylene glycol monomethyl ether	111-77-3	$C_7H_{16}O$	2.3	+	1.2	+	0.9	+	<10	ne
Methyl acetate		79-20-9	$C_3H_6O_2$	NR	+	6.6	+	1.4	+	10.27	200
Methyl acrylate	Methyl 2-propenoate, acrylic acid methyl ester	96-33-3	$C_4H_6O_2$			3.7	+	1.2	+	(9.9)	2
Methylamine	Aminomethane	74-89-5	CH_5N			1.2				8.97	5
Methyl bromide	Bromomethane	74-83-9	CH_3Br	110	+	1.7	+	1.3	+	10.54	1
Methyl t-butyl ether	MTBE, *tert*-Butyl methyl ether	1634-04-4	$C_5H_{12}O$			0.9	+			9.24	40
Methyl cellosolve	see 2-Methoxyethanol										
Methyl chloride	Chloromethane	74-87-3	CH_3Cl	NR	+	NR	+	0.74	+	11.22	50
Methylcyclohexane		107-87-2	C_7H_{14}	1.6	+	0.97	+	0.53	+	9.64	400
Methylene bis(phenyl-isocyanate), 4,4'-	MDI, Mondur M		$C_{15}H_{10}N_2O_2$	Very slow ppb level response							0.005
Methylene chloride	Dichloromethane	75-09-2	CH_2Cl_2	NR	+	NR	+	0.89	+	11.32	25
Methyl ether	Dimethyl ether	115-10-6	C_2H_6O	4.8	+	3.1	+	2.5	+	10.03	ne
Methyl ethyl ketone	MEK, 2-Butanone	78-93-3		0.86	+	0.9	+	1.1	+	9.51	200
Methylhydrazine	Monomethylhydrazine, Hydrazomethane	60-34-4	$C_2H_6N_2$	1.4	+	1.2	+	1.3	+	7.7	0.01
Methyl isobutyl ketone	MIBK, 4-Methyl-2-pentanone	108-10-1	$C_6H_{12}O$	0.9	+	0.8	+	0.6	+	9.30	50
Methyl isocyanate	CH3NCO	624-83-9	C_2H_3NO	NR	+	4.6	+	1.5		10.67	0.02
Methyl isothiocyanate	CH3NCS	551-61-6	C_2H_3NS	0.5	+	0.45	+	0.4	+	9.25	ne
Methyl mercaptan	Methanethiol	74-93-1	CH_4S	0.65		0.54		0.66		9.44	0.5
Methyl methacrylate		80-62-6	$C_5H_8O_2$	2.7	+	1.5	+	1.2	+	9.7	100
Methyl nonafluorobutyl ether	HFE-7100DL	163702-08-7, 163702-07-6	$C_5H_3F_9O$			NR	+	~35	+		ne
Methyl-1,5-pentane-diamine, 2- (coats lamp)	Dytek-A amine, 2-Methyl pentamethylenediamine	15520-10-2	C6H16N2			~0.6	+			<9.0	ne
Methyl propyl ketone	MPK, 2-Pentanone	107-87-9	$C_5H_{12}O$			0.93	+	0.79	+	9.38	200
Methyl-2-pyrrolidinone, N-	NMP, N-Methylpyrrolidone, 1-Methyl-2-pyrrolidinone, 1-Methyl-2-pyrrolidone	872-50-4	C_5H_9NO	1.0	+	0.8	+	0.9	+	*9.17*	ne
Methyl salicylate	Methyl 2-hydroxybenzoate	119-36-8	C_8H_8O3	1.3	+	0.9	+	0.9	+	~9	ne
Methylstyrene, α-	2-Propenylbenzene	98-83-9	C_9H_{10}			0.5				8.18	50
Methyl sulfide	DMS, Dimethyl sulfide	75-18-3	C_2H_6S	0.49	+	0.44	+	0.46	+	8.69	ne
Mineral spirits	Stoddard Solvent, Varsol 1, White Spirits	8020-83-5 8052-41-3 68551-17-7	m.w. 144			0.7	+	0.39	+		100
Mineral Spirits - Viscor 120B Calibration Fluid, b.p. 156-207°C		8052-41-3	m.w. 142	1.0	+	0.7	+	0.3	+		100
Monoethanolamine - see Ethanolamine											
Mustard	HD, Bis(2-chloroethyl) sulfide	505-60-2 39472-40-7 68157-62-0	$C_4H_8Cl_2S$			0.6					0.0005
Naphtha - see VM & P Naptha											
Naphthalene	Mothballs	91-20-3	$C_{10}H_8$	0.45	+	0.42	+	0.40	+	8.13	10
Nickel carbonyl (in CO)	Nickel tetracarbonyl	13463-39-3	C_4NiO_4			0.18				<8.8	0.001
Nitric oxide		10102-43-9	NO	~6		5.2	+	2.8	+	9.26	25
Nitrobenzene		98-95-3	$C_6H_5NO_2$	2.6	+	1.9	+	1.6	+	9.81	1
Nitroethane		79-24-3	$C_2H_5NO_2$					3		10.88	100
Nitrogen dioxide		10102-44-0	NO_2	23	+	16	+	6	+	9.75	3

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Nitrogen trifluoride		7783-54-2	NF_3	NR		NR		NR		13.0	10
Nitromethane		75-52-5	CH_3NO_2					4		11.02	20
Nitropropane, 2-		79-46-9	$C_3H_7NO_2$					2.6		10.71	10
Nonane		111-84-2	C_9H_{20}			1.4				9.72	200
Norpar 12	n-Paraffins, mostly C_{10}-C_{13}	64771-72-8	m.w. 161	3.2	+	1.1	+	0.28	+		ne
Norpar 13	n-Paraffins, mostly C_{13}-C_{14}	64771-72-8	m.w. 189	2.7	+	1.0	+	0.3	+		ne
Octane, n-		111-65-9	C_8H_{18}	13	+	1.8	+			9.82	300
Pentane		109-66-0	C_5H_{12}	80	+	8.4	+	0.7	+	10.35	600
Peracetic acid	Peroxyacetic acid, Acetyl hydroperoxide	79-21-0	$C_2H_4O_3$	NR	+	NR	+	2.3	+		ne
Peracetic/Acetic acid mix	Peroxyacetic acid, Acetyl hydroperoxide	79-21-0	$C_2H_4O_3$			50	+	2.5	+		ne
Perchloroethene	PCE, Perchloroethylene, Tetrachloroethylene	127-18-4	C_2Cl_4	0.69	+	0.57	+	0.31	+	9.32	25
PGME	Propylene glycol methyl ether, 1-Methoxy-2-propanol	107-98-2	$C_6H_{12}O_3$	2.4	+	1.5	+	1.1	+		100
PGMEA	Propylene glycol methyl ether acetate, 1-Methoxy-2-acetoxypropane, 1-Methoxy-2-propanol acetate	108-65-6	$C_6H_{12}O_3$	1.65	+	1.0	+	0.8	+		ne
Phenol	Hydroxybenzene	108-95-2	C_6H_6O	1.0	+	1.0	+	0.9	+	8.51	5
Phosgene	Dichlorocarbonyl	75-44-5	CCl_2O	NR	+	NR	+	8.5	+	11.2	0.1
Phosgene in Nitrogen	Dichlorocarbonyl	75-44-5	CCl_2O	NR	+	NR	+	6.8	+	11.2	0.1
Phosphine		7803-51-2	PH_3	28		3.9	+	1.1	+	9.87	0.3
Photocopier Toner	Isoparaffin mix					0.5	+	0.3	+		ne
Picoline, 3-	3-Methylpyridine	108-99-6	C_6H_7N			0.9				9.04	ne
Pinene, α-		2437-95-8	$C_{10}H_{16}$			0.31	+	0.47		8.07	ne
Pinene, β-		18172-67-3	$C_{10}H_{16}$	0.38	+	0.37	+	0.37	+	~8	100
Piperylene, isomer mix	1,3-Pentadiene	504-60-9	C_5H_8	0.76	+	0.69	+	0.64	+	8.6	100
Propane		74-98-6	C_3H_8			NR	+	1.8	+	10.95	2500
Propanol, n-	Propyl alcohol	71-23-8	C_3H_8O			5		1.7		10.22	200
Propene	Propylene	115-07-1	C_3H_6	1.5	+	1.4	+	1.6	+	9.73	ne
Propionaldehyde	Propanal	123-38-6	C_3H_6O			1.9				9.95	ne
Propyl acetate, n-		109-60-4	$C_5H_{10}O_2$			3.5				10.04	200
Propylamine, n-	1-Propylamine, 1-Aminopropane	107-10-8	C_3H_9N	1.1	+	1.1	+	0.9	+	8.78	ne
Propylene carbonate		108-32-7	$C_4H_6O_3$			62	+	1	+	10.5	ne
Propylene glycol	1,2-Propanediol	57-55-6	$C_3H_8O_2$	18		5.5	+	1.6	+	<10.2	ne
Propylene oxide	Methyloxirane	75-56-9 16088-62-3 15448-47-2	C_3H_6O	~240		6.6	+	2.9	+	10.22	20
Propyleneimine	2-Methylaziridine	75-55-8	C_3H_7N	1.5	+	1.3	+	1.0	+	9.0	2
Propyl mercaptan, 2-	2-Propanethiol, Isopropyl mercaptan	75-33-2	C_3H_8S	0.64	+	0.66	+			9.15	ne
Pyridine		110-86-1	C_5H_5N	0.78	+	0.7	+	0.7	+	9.25	5
Pyrrolidine (coats lamp)	Azacyclohexane	123-75-1	C_4H_9N	2.1	+	1.3	+	1.6	+	~8.0	ne
RR7300 (PGME/PGMEA)	70:30 PGME:PGMEA (1-Methoxy-2-propanol:1-Methoxy-2-acetoxypropane)	107-98-2	$C_4H_{10}O_2$ / $C_6H_{12}O_3$			1.4	+	1.0	+		ne
Sarin	GB, Isopropyl methylphosphonofluoridate	107-44-8 50642-23-4	$C_4H_{10}FO_2P$			~3					
Stoddard Solvent - see Mineral Spirits		8020-83-5									
Styrene		100-42-5	C_8H_8	0.45	+	0.40	+	0.4	+	8.43	20
Sulfur dioxide		7446-09-5	SO_2			NR	+	NR	+	12.32	2
Sulfur hexafluoride		2551-62-4	SF_6	NR		NR		NR		15.3	1000
Sulfuryl fluoride	Vikane	2699-79-8	SO_2F_2	NR		NR		NR		13.0	5
Tabun	Ethyl N, N-dimethylphosphoramidocyanidate	77-81-6	$C_5H_{11}N_2O_2P$			0.8					15ppt

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Tetrachloroethane, 1,1,1,2-		630-20-6	$C_2H_2Cl_4$					1.3		~11.1	ne
Tetrachloroethane, 1,1,2,2-		79-34-5	$C_2H_2Cl_4$	NR	+	NR	+	0.60	+	~11.1	1
Tetrachlorosilane		10023-04-7	$SiCl_4$	NR		NR		15	+	11.79	ne
Tetraethyllead	TEL	78-00-2	$C_8H_{20}Pb$	0.4		0.3		0.2		~11.1	0.008
Tetraethyl orthosilicate	Ethyl silicate, TEOS	78-10-4	$C_8H_{20}O_4Si$			0.7	+	0.2	+	~9.8	10
Tetrafluoroethane, 1,1,1,2-	HFC-134A	811-97-2	$C_2H_2F_4$			NR		NR			ne
Tetrafluoroethene	TFE, Tetrafluoroethylene, Perfluoroethylene	116-14-3	C_2F_4			~15				10.12	ne
Tetrafluoromethane	CFC-14, Carbon tetrafluoride	75-73-0	CF_4			NR	+	NR	+	>15.3	ne
Tetrahydrofuran	THF	109-99-9	C_4H_8O	1.9	+	1.7	+	1.0	+	9.41	200
Tetramethyl orthosilicate	Methyl silicate, TMOS	681-84-5	$C_4H_{12}O_4Si$	10	+	1.9	+			~10	1
Therminol VP-1®	Dowtherm,3:1 Diphenyl oxide:	101-84-8	$C_{12}H_{10}O$			0.4	+				ne
	Biphenyl	92-52-4	$C_{12}H_{10}$								
Toluene	Methylbenzene	108-88-3	C_7H_8	0.54	+	0.50	+	0.51	+	8.82	50
Tolylene-2,4-diisocyanate	TDI, 4-Methyl-1,3-phenylene-2,4-diisocyanate	584-84-9	$C_9H_6N_2O_2$	1.4	+	1.4	+	2.0	+		0.002
Trichlorobenzene, 1,2,4-	1,2,4-TCB	120-82-1	$C_6H_3Cl_3$	0.7	+	0.46	+			9.04	C5
Trichloroethane, 1,1,1-	1,1,1-TCA, Methyl chloroform	71-55-6	$C_2H_3Cl_3$			NR	+	1	+	11	350
Trichloroethane, 1,1,2-	1,1,2-TCA	79-00-5	$C_2H_3Cl_3$	NR	+	NR	+	0.9	+	11.0	10
Trichloroethene	TCE, Trichoroethylene	79-01-6	C_2HCl_3	0.62	+	0.54	+	0.43	+	9.47	50
Trichloromethylsilane	Methyltrichlorosilane	75-79-6	CH_3Cl_3Si	NR		NR		1.8	+	11.36	ne
Trichlorotrifluoroethane, 1,1,2-	CFC-113	76-13-1	$C_2Cl_3F_3$			NR		NR		11.99	1000
Triethylamine	TEA	121-44-8	$C_6H_{15}N$	0.95	+	0.9	+	0.65	+	7.3	1
Triethyl borate	TEB; Boric acid triethyl ester, Boron ethoxide	150-46-9	$C_6H_{15}O_3B$			2.2	+	1.1	+	~10	ne
Triethyl phosphate	Ethyl phosphate	78-40-0	$C_6H_{15}O_4P$	~50	+	3.1	+	0.60	+	9.79	ne
Trifluoroethane, 1,1,2-		430-66-0	$C_2H_3F_3$					34		*12.9*	ne
Trimethylamine		75-50-3	C_3H_9N			0.9				7.82	5
Trimethylbenzene, 1,3,5- - see Mesitylene		108-67-8									25
Trimethyl borate	TMB; Boric acid trimethyl ester, Boron methoxide	121-43-7	$C_3H_9O_3B$			5.1	+	1.2	+	10.1	ne
Trimethyl phosphate	Methyl phosphate	512-56-1	$C_3H_9O_4P$			8.0	+	1.3	+	9.99	ne
Trimethyl phosphite	Methyl phosphite	121-45-9	$C_3H_9O_3P$			1.1	+		+	*8.5*	2
Turpentine	Pinenes (85%) + other diisoprenes	8006-64-2	$C_{10}H_{16}$	0.4	+	0.3	+			~8	100
Undecane		1120-21-4	$C_{11}H_{24}$			2				9.56	ne
Varsol – see Mineral Spirits											
Vinyl actetate		108-05-4	$C_4H_6O_2$	1.5	+	1.2	+	1.0	+	9.19	10
Vinyl bromide	Bromoethylene	593-60-2	C_2H_3Br			0.4				9.80	5
Vinyl chloride	Chloroethylene, VCM	75-01-4	C_2H_3Cl			2.0	+	0.6	+	9.99	5
Vinyl-1-cyclohexene, 4-	Butadiene dimer, 4-Ethenylcyclohexene	100-40-3	C_8H_{12}	0.6	+	0.56	+			9.83	0.1
Vinylidene chloride - see 1,1-Dicholorethene											
Vinyl-2-pyrrolidinone, 1-	NVP, N-vinylpyrrolidone, 1-ethenyl-2-pyrrolidinone	88-12-0	C_6H_9NO	1.0	+	0.8	+	0.9	+		ne
Viscor 120B - see Mineral Spirits - Viscor 120B Calibration Fluid											
V. M. & P. Naphtha	Ligroin; Solvent naphtha; Varnish maker's & painter's naptha	64742-89-8	m.w. 111 (C_8-C_9)			~1					300
Xylene, m-	1,3-Dimethylbenzene	108-38-3	C_8H_{10}	0.50	+	0.43	+	0.40	+	8.56	100
Xylene, o-	1,2-Dimethylbenzene	95-47-6	C_8H_{10}	0.57	+	0.59	+	0.69		8.56	100
Xylene, p-	1,4-Dimethylbenzene	106-42-3	C_8H_{10}			0.45	+	0.62	+	8.44	100
None				1		1		1			
Undetectable				1E+6		1E+6		1E+6			

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Appendix I:

Example of Automatic Calculation of Correction Factors, TLVs and Alarm Limits for Mixtures

(Calculations performed using Excel version of this database, available on request)

Compound	CF 9.8 eV	CF 10.6 eV	CF 11.7eV	Mol. Frac	Conc ppm	TLV ppm	STEL Ppm
Benzene	0.55	0.53	0.6	0.01	1	0.5	2.5
Toluene	0.54	0.5	0.51	0.06	10	50	150
Hexane, n-	300	4.3	0.54	0.06	10	50	150
Heptane, n-	45	2.8	0.6	0.28	50	400	500
Styrene	0.45	0.4	0.42	0.06	10	20	40
Acetone	1.2	1.1	1.4	0.28	50	750	1000
Isopropanol	500	6	2.7	0.28	50	400	500
None	1	1	1	0.00	0	1	
Mixture Value:	2.1	1.5	0.89	1.00	181 ppm	56 ppm	172 ppm
TLV Alarm Setpoint when Calibrated to Isobutylene:	26 ppm	37 ppm	62 ppm				
STEL Alarm Setpoint, same Calibration	86 ppm	115 ppm	193 ppm				

SAMPLE PACKAGING AND SHIPMENT
CALIBRE STANDARD OPERATING PROCEDURES

1.0 POLICY

It is the policy of CALIBRE that any individual labeling, packing and shipping packages samples from job sites will abide by the procedures outlined in this document. These procedures are designed to meet or exceed guidelines set forth by the Department of Transportation (DOT) for the shipment of potentially hazardous samples from environmental sites.

2.0 PURPOSE

This Standard Operating Procedure (SOP) provides instructions that are to be followed in the packaging, labeling, and shipment of samples collected during field operations.

3.0 INTRODUCTION

As with all field work, the ease and efficiency with which sample handling is conducted is proportional to the amount of preparation before entering the field. Organization and a thorough understanding of the sampling plan are essential for the person designated to complete paperwork and ship samples. Sufficient amounts of packaging materials must be assembled, shipping requirements determined, and shipping offices located before the trip.

While the completion of some of the paperwork in the office is advisable, this practice must be tempered by judgment. The completion of too much paperwork can be a problem if sampling plans or circumstances change in the field. Each person must determine the balance between too much and too little pre-field paperwork and preparation through experience.

Sample packaging, labeling, and shipment procedures are designed (1) to preserve sample quality so that analyses will yield results representative of site conditions, (2) to protect and inform sample handlers, including shippers and laboratory personnel, and (3) to provide a paper trail to allow cross referencing of sample collection locations with analytical results. For the purpose of sample packaging and shipment, samples are categorized as “hazardous” samples unless it can be reasonably assumed that dioxins are not present and all other contaminants are at concentrations below 10 ppm. If both these conditions are met, the sample can be packaged and shipped as an “environmental” sample. If the contaminants are known, higher limits may qualify as “environmental” samples. Procedures for handling these two types of samples follow.

4.0 PREPARATION FOR FIELD WORK

- Determine sample locations.
- Determine number of samples (including QA/QC samples).
- Determine analyses required.
- Number stations unambiguously.
- Determine probable concentrations of samples.
- Determine number and type of sample bottles required.
- Determine packaging materials required (e.g., strapping tape, ice chests, bubble wrap, etc.).
- Contact all interested parties (e.g., USACE, EPA, state agencies, site owners, site operators, etc.).

- Assemble sample bottles and packaging materials.
- Check applicable United States Department of Transportation (USDOT) shipping regulations.
- Make plans for sample shipments (e.g., locate Fed-Ex, obtain laboratory address, etc.).
- To avoid confusion, prior to sampling, bottles can be temporarily numbered with station numbers.
- Plan for likely site conditions (e.g., hazards on the site, weather, accessibility of the site, etc.).

5.0 SAMPLE HANDLING

Once samples have been sealed in the ice chests, they are to be expeditiously transported to the analytical laboratory. If the laboratory is located near the sampling site, the sampling team may drive the samples to the laboratory. Otherwise, samples are to be routinely shipped by the overnight service.

There are two types of airbills, the nonrestricted materials airbill for the shipment of environmental samples and the restricted articles airbill for the shipment of hazardous materials. Environmental samples are generally collected from sources not expected to show significant contamination, e.g., ponds, streams, and off-site soils. Samples from obviously contaminated sources such as on-site soils and groundwater, drums, leachate, and tanks must be considered as hazardous materials and shipped according to USDOT regulation. If enough information is known about a site to determine that any contamination is present at sufficiently low concentrations, then samples from these sources may be shipped as low level environmental samples.

5.1 Packaging

Samples suspected of containing dioxins at any concentrations, or suspected of containing other hazardous contaminants at concentrations over 10 ppm are to be overpacked and shipped according to USDOT regulations. The following procedure is to be used for environmental sample packaging.

- Decontaminate outside of sample containers.
- Affix sample labels to corresponding sample containers.
- Add preservatives to water samples as required.
- Use ziplock bubble baggies to protect glass sample bottles and jars.
- Enclose all other sample containers in sealed ziplock baggies.
- Place bagged sample containers in an ice chest lined with bubble wrap, checking against chain-of-custody record to ensure all samples are listed and are in the correct ice chest.
- Fill 1 to 3 ziplock bags with ice and include in the ice chest shipment if required by sampling and analysis plan. All ice should be double bagged in heavy-duty ziplock bags.
- Add packing material to ice chest to fill any remaining space.
- Detach and retain the pink copy of the chain-of-custody form.
- Seal remaining two copies of the chain-of-custody in a ziplock bag. Tape the bag to the inside of the ice chest lid.
- Affix airbill or airbill sticker to outside of the ice chest.
- Ensure “This End Up” is written or affixed onto all four sides of the ice chest.
- Ensure “Fragile” is written on two sides of the ice chest.

- Seal the ice chest with two custody seals (one on the front and one on the back). Place one layer of clear packaging tape over the custody seals.
- Tape ice chest shut using three rounds of strapping tape on either end.
- Affix shipping labels to all ice chests.
- Remove extraneous stickers from the ice chest.
- Ensure that ice chests have a return address on them.

Before relying on a shipping service, call that service to locate the drop off point nearest the site, then call that site to obtain the business hours and prepare them for your shipment. Occasionally, service operators are not aware that they can ship environmental or hazardous samples and it is inconvenient to have them attempt to learn the procedures just before the shipment deadline. Also, the shipping deadline for laboratories on the East Coast may be several hours earlier than the West Coast deadline. Calling in advance can identify these considerations.

5.2 Custody Seal

This form is used to show that no tampering of the samples has occurred between the time the samples leave the field personnel and the time when they arrive at the laboratory.

5.3 Environmental Samples Airbill

Federal Express is used to ship the vast majority of samples to analytical laboratories. This section describes the procedures used when shipping samples via Federal Express. However, this does not prevent samplers from utilizing other carriers.
Federal Express requires a completed "Nonrestricted Materials Airbill" for the shipment of environmental samples. A separate airbill is required for each destination but multiple ice chests can be shipped under one airbill if they are being sent to the same laboratory. The Federal Express Nonrestricted Materials Airbill is completed as follows.

(1)	Date	The date the samples are shipped.
	Sender's FedEx Account Number	CALIBRE FedEx account number should be printed here.
	Sender's Name	Sample team leader's name.
	Phone	Phone number of sample team's office.
	Company	CALIBRE followed by sample team office address.
(2)	Internal Billing Reference	Project/task number.
(3)	Recipient	Name of laboratory contact, laboratory name, phone number, and address.
(4)	Service	Check "FedEx Standard Overnight" box.
(5)	Packaging	Check "Other Pkg." Box.
(6)	Special Handling	Check "No" box.

(7)	Payment	Check "Sender" box.
(8)	Release Signature	Leave blank, do not sign.

5.4 Hazardous Materials Airbills

Unlike the regular airbill, the Dangerous Goods or Restricted Articles airbill has two parts. In addition to the upper portion, which is identical to the regular airbill, the Restricted Articles airbill has a lower portion entitled "Shipper's Certification for Dangerous Goods". Every effort must be made to fill out this portion correctly, as shippers may be subject to fines for the improper transport of restricted articles.

(1-5)	These sections are filled out in the same way as the regular airbill.	
(6)	Check the box labeled "49 CFR".	
(7)	Write in the number of ice chests being shipped on that airbill.	
(8)	Proper Shipping Name	One of the following will usually apply; Solid, NOS", "Flammable Liquid, NOS", "Flammable Solid, NOS", "Compressed Gas, NOS", "Corrosive", or "Hydrogen". Regulations require that the hazardous constituents must be entered along with the NOS designation (i.e., "Compressed Gas, NOS [0.1% hexane in air]).
(9)	Class or Division	One of the following will usually apply;" Nonflammable Gas", "Flammable Liquid", "Flammable Solid", or "Flammable Gas".
(10)	UN or NA Number	Consult USDOT Tables for proper UN or NA number. UN numbers should be written "UN1992" not "1992".
(11)	Subsidiary Risk	This column is filled out when the substance has more than one hazard as listed in USDOT Tables.
(12)	Total Net Quantity	Write the total quantity of hazardous materials in the shipment in appropriate units.
(13)	Radioactive Materials	Check box if materials are radioactive.
(14)	Transport Details	Shipping limitations as follows: a. Flammable Liquids • Less than 32 oz. – Passenger aircraft • 32 oz. to 10 gal. – Cargo aircraft b. Flammable Solids

- Less than 25 lbs. – Passenger or cargo aircraft
- 25 lbs. To 1,000 lbs. – Cargo aircraft
- Greater than 1,000 lbs. requires more extensive procedures.

Twenty five lbs. being the total weight of the ice chest (an empty ice chest weighs approximately 18 lbs.).

(15) Print shipper's name and title.

(16) Write in name of the city the shipment is being made from.

(17) Write in telephone number of 24 hour emergency response contractor.

(18) Shipper's signature.

5.5 Carrier Sticker

The carrier sticker is attached by carrier employees to the additional ice chests when more than one is going to the same laboratory. These are bar code stickers that are adhesive backed and are easily attached to the outside of the ice chest.

5.6 Warning Labels

USDOT regulations require warning labels for hazardous materials. USDOT regulations must be consulted and adhered to for all shipments.

6.0 SAMPLE SHIPMENT

When shipping hazardous materials (which may include samples or equipment), personnel must be aware that specific regulations govern the packaging, labeling, and transport of these items. Hazardous materials are defined by the Hazardous Materials Regulation Board and set forth in 49 CFR Parts 171-178, and must be shipped in strict accordance with USDOT procedures. CALIBRE staff members should be aware that regulatory agencies have the authority to levy substantial financial penalties on violators. These regulations apply to shipment by non-commercial (i.e., personal, rented, or company vehicles) as well as by commercial carrier. Persons making shipments should remember that only designated air carrier offices will accept hazardous materials.

6.1 Environmental Samples

Samples that are not expected to contain significant levels of contamination, such as those taken from streams, ponds, and off-site soils are considered environmental samples. That is, all low concentration samples are shipped as "Environmental Samples". These samples have no packaging, labeling, or shipping requirements beyond the usual procedures. Most air carriers require an address of the sender and of the receiver to be on the ice chest. The primary concern in the case of "Environmental Samples" is that the samples reach their destination in a timely and undamaged state.

6.2 Hazardous Materials Samples

Samples taken from such potentially contaminated sources as on-site soils, drums, storage tanks, impoundments, lagoons, or leachates or from obviously contaminated locations must be treated as hazardous material samples and be shipped accordingly. If there is any doubt, a sample should be shipped as hazardous material. Both medium and high concentration samples are shipped as hazardous materials.

Hazardous materials must be packaged differently than the more common environmental samples. The sample is placed in a bubble baggie then placed in a metal paint can, one sample per can. The dead air space is filled with vermiculite and the can is sealed with metal clips. The paint cans are labeled with the following: Sample Tag#, Project Name, date, and any applicable warning labels. The cans are then shipped in an appropriately labeled ice chest.

6.3 Known Materials

Hazardous materials are further divided into known materials and unknown materials depending on the situation at the site. If <u>all</u> the hazardous substances in the sample are known or can be accurately identified, the sample is packaged, labeled, and shipped according to the instructions for that material, as detailed in the USDOT Hazardous Materials Table, 49 CFR 172.101 and the HM181 Rule – new package requirements. These change too frequently to include here.

6.4 Unknown Materials

When one or more substances in the sample cannot be identified, the sample must be shipped as an "unknown material". The appropriate transportation procedures are determined by classifying the sample through a process of elimination using the USDOT Hazardous Materials Table.

<u>Radioactive Materials</u>. If radiation survey instruments indicate, or there is a reasonable suspicion the samples contain radioactive materials, they must be shipped as radioactive materials. Regulations governing transport of radioactive materials are given in 49 CFR parts 173.389 to 173.398.

<u>Poison A</u>. USDOT defines Poison A as extremely dangerous non-radioactive poisonous gas or liquid of such a nature that a very small amount of gas or vapor of the liquid will be dangerous to life. Most Poison A materials are gases and would not be commonly found in field activities. All samples found in closed containers do not have to be shipped as Poison A. Judgment based on available information must be used to decide if a sample is Poison A. Special efforts to be familiar with all regulations governing transport of Poison A samples should be made <u>personally</u> by all team leaders expecting to ship such samples. Begin with 49 CFR 173.2.

<u>Flammable Liquids</u>. The next two categories in the USDOT classification are flammable gas and non-flammable gas. In usual circumstances, sampling does not include gases, nor are sampling containers expected to contain a significant amount of gas in their airspace. For samples containing unknown materials, other classifications listed below flammable liquid are not usually considered. In order to classify a substance as non-flammable, a flash point test is required. Such tests would be impractical or even dangerous in the field. Thus, unknown hazardous samples are usually shipped as flammable liquids. The phrase "flammable liquid" does not necessarily mean the sample is either flammable or a liquid; it merely refers to a shipping classification in accordance with USDOT

regulations. If the sample is a solid or a sludge, it may be shipped as a "flammable solid". Any unknown material that is not classified as Poison A, flammable gas, or nonflammable gas should be shipped as a flammable liquid or a flammable solid.

"Flammable liquid" and "flammable solid" samples must be packed in paint cans as "high" or "medium" concentration samples for shipment. The following information must be placed on each paint can:

- Laboratory name and address.
- "FLAMMABLE LIQUID, NOS UN1993" or "FLAMMABLE SOLID, NOS UN1325 (NOS means Not Otherwise Specified or Not Otherwise Stated).
- "DANGEROUS WHEN WET" if applicable.
- Sample Tag #.
- The date.

The ice chest in which the paint cans are packed should have the following labels:

- Laboratory name and address.
- "FLAMMABLE LIQUID, NOS UN1993" or "FLAMMABLE SOLID, NOS UN1325.
- "DANGEROUS WHEN WET" if applicable.
- "CARGO AIRCRAFT ONLY".
- "LABORATORY SAMPLES".
- "INSIDE PACKAGES COMPLY WITH PRESCRIBED SPECIFICATIONS".
- "THIS END UP".

Unknown hazardous materials can be transported by truck, rail, or overnight carriers, but must not be transported by passenger carrying aircraft.

7.0 SHIPMENT COORDINATION

Once samples have been shipped to the analytical laboratory, the sample team leader must notify the appropriate client and/or laboratory contact. Notification must be on the day of the shipment and if after hours, the team leader may need to leave a detailed message. The following information is to be provided:

- Team leader name.
- Telephone number for following day contact.
- Site or project name.
- Exact number of samples shipped by matrix and environmental or hazardous concentrations.
- Shipping company and airbill numbers.
- Method of shipment (overnight).
- Date of shipment.
- Analyses requested to be performed by laboratory and sample matrix.
- Any irregularities or problems with samples including special handling instructions.
- Status of sampling mission (i.e., final shipment or future sampling schedule).

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Collecting and Preparing Soil Samples for VOC Analysis

Implementation Memorandum #5

To: Interested Parties

From: Tim Nord, Section Manager

Date: June 17, 2004

Re: Collecting and Preparing Soil Samples for VOC Analysis

Intent of this Memorandum

The purpose of this technical memorandum is to set forth guidance regarding the implementation of Method 5035A[1]. This technical memorandum provides detailed guidance on:

- How to collect soil volatile organic compound (VOC) samples;
- How to prepare and preserve soil VOC samples; and
- How to store soil VOC samples.

This guidance contains information on four methods that you may use to collect and prepare soil VOC samples for analysis. If you are collecting soil VOC samples, then you will need to use one or any combination of these four methods:

1. On-site laboratory,
2. Lab preservation,
3. Field preservation, and
4. Alternative methods.

[1] Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples, EPA SW-846.

Details on each of these four methods are provided in the body of this tech memo.

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What is Method 5035A?

EPA Method 5035A sets forth the requirements and procedures applicable to the collection and preparation of soil samples for volatile organic compound (VOC) analysis, including:

- Recommended or required sampling equipment (e.g., 40-mL volatile organic compound analysis (VOA) vials, etc.);
- How to collect undisturbed soil samples;
- How to preserve samples in the field by chemical (e.g., methanol) or physical (e.g., freezing) methods;
- How to transport and store samples; and
- Analytical options (i.e., low-level vs. high-level method).

Method 5035A was developed and approved for use in July 2002 by the U.S. Environmental Protection Agency (EPA). The method was included by EPA as a new method under SW-846, "Test Method for Evaluating Solid Wastes: Physical/Chemical Methods" (3rd Ed.).

When Should I Use Method 5035A?

WAC 173-340-830(3) specifies acceptable analytical methods for sites where a remedial action[2] is being conducted under the Model Toxics Control Act (MTCA) regulation[3]. EPA Method 5035A, which sets forth the requirements and procedures for the collection and preparation of soil samples for VOC analysis, is one of those methods.

Therefore, you must comply with the requirements of Method 5035A if:

- You are conducting remedial action under the MTCA cleanup regulation; and

[2] A "remedial action" includes remedial investigation /feasibility study (RI/FS) or site characterization (WAC 173-340-350).
[3] Chapter 173-340 WAC

- As part of that remedial action, you are collecting soil samples for VOC analysis.

Who is the Intended Audience for this Guidance?

The intended users of this guidance are those individuals involved in the collection and preparation of soil samples for VOC analysis, including:

- Site managers;
- Field sampling personnel;
- Laboratory analysts;
- Quality assurance personnel; and
- Data quality assessors.

The target audience for this guidance is anyone conducting petroleum- or chlorinated hydrocarbon investigations or cleanups. For example, you must use this sampling protocol for volatile hazardous substances such as benzene or trichloroethylene (TCE).

Why Do Soil VOC Samples Need to be Preserved?

A significant body of scientific evidence has found that VOCs will volatilize and biodegrade during sample collection and transport, which typically results in significant losses of initial VOC concentrations. Consequently, the consensus opinion of EPA and the scientific community is that you must take significant precautions when collecting and preparing soil samples for VOC analysis, including the use of preservation techniques, to limit the impacts of volatilization and biodegradation. Both of these mechanisms are discussed in more detail below.

Volatilization[4]

With respect to volatilization, when VOCs are released to the soil, they immediately start to partition from the liquid phase to the gaseous phase. This rate of volatilization is compound specific. Various soil properties also impact this rate of volatilization, including grain size, moisture content, and porosity. VOCs within disaggregated or disturbed soil samples also tend to volatilize at faster rates.

In most solid materials, the molecular diffusion coefficients of VOCs in the gaseous phase are high enough to allow for the immediate volatilization of those VOCs from a freshly exposed sample surface, resulting in a loss to the surrounding atmosphere. If the sample matrix is porous, these losses will continue as VOCs below the surface diffuse outward.

In summary, the primary goal of VOC sample collection and preservation techniques is to minimize or eliminate the loss of the compounds of concern through direct volatilization to the atmosphere.

Biodegradation[5]

The biodegradation of VOCs involves compound loss by biological processes mediated by naturally-occurring organisms found within the sample. Aerobic processes

[4] See Refs 1, 7, 9, 11, 18, 0, 27.
[5] See Refs 8, 10, 13, 16, 17, 24.

are of greatest concern, but anaerobic organisms can also result in significant compound loss. The rate of biodegradation is dependent upon several factors, including indigenous microbes, the chemical properties of the soil VOC, the original VOC concentration, and temperature.

Most soil sample collection procedures involve intrusive sampling operations that can create or enhance aerobic conditions within a sample. Aerobic conditions can occur by disaggregation of the soil particles or by simple exposure to the air. Once collected, soil VOC samples must be preserved or immediately placed in a sealed container. This must be done to minimize VOC losses from uncontrolled aerobic processes. If you do not take these precautions, then aerobic conditions will persist during handling and storage.

What is the Definition of VOC?

VOCs[6] are organic chemicals that easily vaporize at room temperature. This includes low molecular weight aromatics, hydrocarbons, halogenated hydrocarbons, ketones, acetates, nitriles, acrylates, ethers and sulfides. Most VOCs typically have boiling points in the range of 150-200° C.

[6] See also WAC 173-340-200 definition of VOC and EPA VOC definition in Method 5035A, Appendix A, Section A.1.1.

Should I Use this Sampling Method for Semi-volatiles?

No, you do not have to use this sampling method for semi volatiles (e.g., benzo(a)pyrene). The EPA Method 8270C is used for analyzing semi-volatiles.

Development of EPA Method 5035A

EPA Method 5035 was first published in Update III of the third edition of SW-846 on June 13, 1997. Since that time, the scientific community has continued to conduct research on soil sampling methods that minimize VOC losses. In this same time period (1997-03), EPA has also continued to provide information on issues related to Method 5035A.

On August 7, 1998, EPA published a clarification memorandum[7] on the use of SW-846 methods, including Method 5035. In the Aug-98 memorandum, EPA recommended the following:

- As a matter of policy, all soil VOC samples should be preserved in some manner, whenever possible.
- Do not use sodium bisulfate as a preservative in calcareous soil. Use the EnCore® Sampler instead.
- If methanol is used as a preservative, then check for losses by re-weighing, in the field, sample vials that were previously weighed in the laboratory.

[7] See Ref 6.

If the difference between the laboratory/field weight is > 0.2 g, then methanol loss may have occurred and the vial should not be used.

- Use a soil-to-solvent ratio of 1:1, e.g., 5 g soil and 5 mL of methanol.

In July 2002, EPA published an update to Method 5035 in the fourth update of SW-846. The updated method is now known as Method "5035A". The updated (Jul-02) Method 5035A now contains an appendix with 32 pages of additional information.

For further information regarding the requirements of Method 5035A as well as the basis for those requirements, please refer to the method, which is available electronically (EPA 5035A).

Which Soil VOC Sampling Method Should I Select?

You will need to use one or any combination of the following four methods: 1) on-site laboratory, 2) lab preservation, 3) field preservation or 4) alternative methods. **Detailed instructions on how to collect and preserve soil VOC samples using methanol or sodium bisulfate are provided in Appendix A: Soil VOC Sampling Instructions (p. 14).** Advantages and limitations of each of these four methods are discussed below.

Option 1: Mobile or On-site Labs

- The key advantage of this option is that you ***don't need to preserve*** any samples. You also get quantitative information in real time, which is extremely helpful for site characterizations. The one possible disadvantage of this option is cost.

Option 2: Lab Preservation

- If you opt for lab preservation, then you will collect ***unpreserved*** soil VOC samples, place them on ice @ 4 ± 2° C and ship them to the lab for preservation and analysis. Under Method 5035A, you will ship all unpreserved samples to the lab and the lab will receive and extract the samples ***within 48 hours of sample collection.*** Some sampling devices (e.g., **En Core® Sampler)** require you to submit samples to the lab within 48 hours.

- **Sample containers.** You may use some type of zero headspace extraction (ZHE) container (e.g., **En Core® Sampler**) or an empty 40-mL VOA vial with 0.25 mm thick PTFE-lined septa. *Do not use core barrel liners or sample cores wrapped in aluminum foil - this will not prevent volatilization!*

- **Preservation methods.** Once the samples arrive at the lab, they must either be ***preserved*** or ***analyzed*** within 48 hours from the time of sample collection. The chemical preservation method that is used will depend on the type of analysis, i.e., low- (sodium bisulfate) or high- (methanol) concentration method. Samples that are chemically preserved in the lab must then be

analyzed within required holding times (normally 14 days). You may also, as an option, utilize a physical preservation method by having the lab **freeze**[8] **non-preserved** soil VOC samples to **< -7° C** for up to **14 days**.

Note: If you do have the lab freeze samples, then the samples must be extracted with methanol only. You cannot freeze samples for the low-concentration (sodium bisulfate) method.

Advantages of Lab Preservation

- You do not need to bring preservative chemicals to the field. Also, you do not need to weigh samples prior to and after collection. Lastly, if you opt for preservation by freezing, it's convenient for the lab because the sample can be stored in a cooler for the 14-day holding time.

Limitations on Lab Preservation

- The one limitation of lab preservation is you must ship samples to the lab within ***48 hours from the time of sample collection!*** This does not mean, however, that the sample must be analyzed within 48 hours. What it does mean is that you must ship samples to the lab within 48 hours. The lab must then preserve the sample with sodium bisulfate, methanol, or by freezing to < -7° C. If this is done within 48 hours, the holding time is 14 days.

Option 3: Field Preservation

- If you opt for field preservation, then you will collect soil VOC samples and preserve in the field by chemical preservation methods using sodium bisulfate or methanol, or by a physical preservation method such as freezing.

- **Sample containers.** If you opt for chemical field preservation, then you will be using 40-mL VOA vials with PTFE-lined septa. The vials may be pre-preserved and pre-weighed in the lab, or, you can do this in the field.

- **Preservation methods.** The chemical preservation method that you use will depend on whether you use the low- or high-concentration method. If you plan to use the low-concentration method, you must add 5 mL of sodium bisulfate to a 5 g soil sample. If you use the high-concentration method, you must add 5 mL of laboratory-grade methanol to a 5 g soil sample.

Advantages of Field Preservation

- The main advantage of field preservation is that the lab does not need to receive the samples within 48 hours.

Limitations on Field Preservation

- The main disadvantage of field preservation is that you must, in the field, do things that are normally done in laboratory. Thus, a lot more things can go wrong; however, field

[8] See Appendix A of Method 5035, Section A.8.2.1.

preservation is certainly not an impossible task, and it can be easily accomplished if you are careful and pay attention to details. For example, you must try to add a precise quantity (~ 5 mL) of preservative and soil (~ 5 g). You must also weigh sample vials prior to and after sample collection.

- You can significantly reduce error by using field kits with pre-preserved and pre-weighed vials; however, these kits can be fairly costly.

- Methanol is a toxic flammable liquid, which presents issues when collecting and shipping samples.

Option 4: Alternative Methods

- Ecology may, on a case-by-case basis, approve of alternative soil VOC sampling methods. This option is designed primarily for future changes in soil VOC sampling technology. *However, Ecology expects that as a matter of policy, all soil VOC samples must be collected in a manner that minimizes volatilization and biodegradation!*

Low- vs. High-Concentration Method: Which One Should I Select?

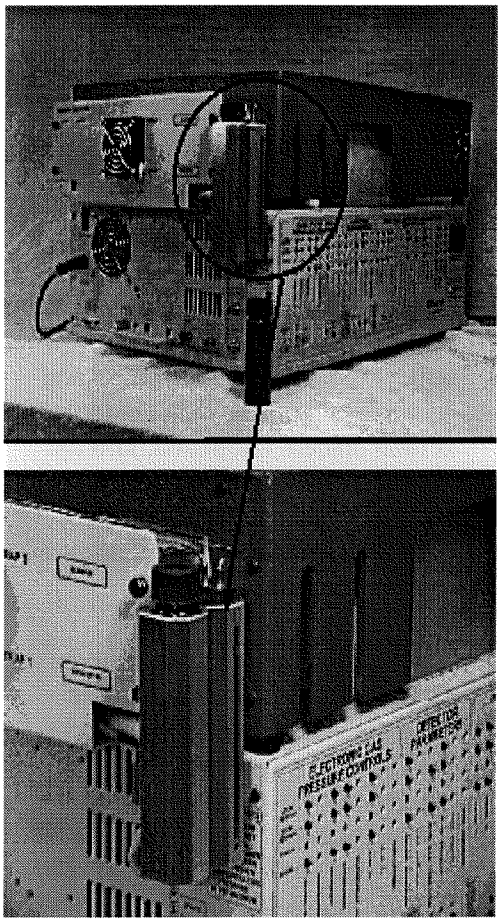
EPA Method 5035A has two main components: a "low-concentration" method and a "high–concentration" method. A brief synopsis of each is as follows:

- The low-concentration method uses sodium bisulfate as a preservative. Detection limits of < 200 ug/kg can be obtained with this method provided soil VOC concentration are < 200 ug/kg.

- The low-concentration method is designed to minimize VOC losses by using the sample container as the "purging" device (hence the name closed-system-purge and trap). Here's how this works: when you collect the sample, it is sealed and sent to the lab. The entire sample vial is then placed, unopened, into the purge and trap "instrument carousel" (Figure 1, p.8). The vial is then heated to 40°C and the volatiles are purged into a "trap".

- The high-concentration method uses methanol as a preservative. The high-concentration method works best for soil VOCs with concentrations > 200 ug/kg. In the high-concentration method, the lab will take a small aliquot (~ 50-100 uL) of the soil-methanol solution and inject it directly into the gas chromatograph (GC). EPA Method 8021B or 8260B is then used for analysis.

Figure 1: EPA Method 5035A "Low-Concentration" Method.



Source: SRI INSTRUMENTS, 20720 Earl Street, Torrance, Calif. 90503 U.S.A.

1. UPPER PHOTO. The 40-mL VOA Vial is inserted into a Gas Chromatograph (GC) with an "Adjustable Temperature Thermostatted Sleeve".

2. LOWER PHOTO. Two needles puncture the septum, one allowing the sparge gas (helium) to enter the vial, the other exhausts the sample into the adsorbent traps.

The advantages and limitations of these two preparation procedures are as follows:

Low-Concentration Method Advantages

- The key advantage of this method is that it allows you to quantify soil VOCs at low concentrations, i.e., < 200 ug/kg. In particular, since you are not adding methanol, there is no dilution factor in the sample extract.

Limitations

- You are not supposed to use this method if soil VOC concentrations are > 200 ug/kg (they will likely exceed the working range of the analytical instrument).

- Because it is a closed-system-purge and trap, the lab can analyze each sample only one time. Thus, it is recommended that you collect 2-3 samples per sample location.

- Calcareous (or sandy) soil will react with the acid solution, which can result in broken or shattered VOA vials.

- Sodium bisulfate is not an efficient extraction medium for VOCs, which impacts recovery rates. This is because VOCs are less likely to dissolve into an acid solution comprised of sodium bisulfate and water.

- Recent studies[9] found that the sodium bisulfate acid solution may oxidize naturally-occurring soil waxes and humic material, which results in increased soil acetone levels.

High-Concentration Method Advantages

- The key advantage of this method is that VOCs will readily dissolve into methanol, which makes it a very efficient extraction medium. Studies[10] on methanol extraction have found that results tended to be more accurate when compared to results from the low-concentration purge and trap method.

- Unlike the low-concentration method, the lab can analyze the sample more than once if necessary.

Limitations

- Prior to analysis, the lab must ***dilute***[11] the sample, which means practical quantitation limits (PQLs)[12] will be ***higher***. For example, if you mix add 5 mL of methanol with 5 g of soil and the lab extracts 100 uL for analysis, the dilution is 50 (5,000 uL/100 uL = 50). With a dilution of 50, you can probably expect to achieve laboratory reporting limits/ PQLs of ~ 25-50 ug/kg.

- Methanol is a highly flammable and toxic liquid, which presents issues for shipping and sample collection. Also, methanol can be easily contaminated by atmospheric sources of VOCs, e.g., car exhaust.

How Do I Know if Soil VOC Concentrations are < or > 200 ug/kg?

If you opt for the low-concentration method, you will need to check and make sure that soil VOC concentrations are < 200 ug/kg. To do this, you may use field screening instruments[13], or you may instruct the lab to screen samples. Also, before you make any decisions about which method to use, you should always check Ecology's soil cleanup standards. Cleanup levels for nine (9) common VOCs are provided in Table 1.

Table 1: State of Washington Method A Soil VOC Cleanup Levels (Unrestricted Land Use).

Volatile Organic Compound (VOC)	Cleanup Level (ug/kg)
Benzene	30
Ethyl Benzene	6,000
MTBE	100
Naphthalene	10,000
Tetrachloroethylene	50
Toluene	7,000
Trichloroethane-1,1,1	50
Trichloroethylene	30
Xylene	9,000

Source: Table 740-1 (Chapter 173-340 WAC)

[9] See Refs 3, 17, 26.
[10] See Refs 1, 14, 15, 18, 19, 22, 0.
[11] See also EPA 5035A, Section 8.2.2.

[13] See Ref 19.

WASHINGTON DEPARTMENT OF ECOLOGY

EPA Method 5035A

SOIL VOC SAMPLING

START

USE ONE OR ANY COMBINATION OF THE FOLLOWING METHODS:

MOBILE LAB

SOIL VOC SAMPLES ARE ANALYZED **ON-SITE**. YOU DO NOT NEED TO PRESERVE SAMPLES; HOWEVER, YOU MUST MINIMIZE VOLATILIZATION.

LAB PRESERVATION

YOU COLLECT **NON-PRESERVED** SAMPLES. YOU MUST TRANSPORT TO LAB WITHIN 48-HRS. THE LAB MUST EITHER: 1) PRESERVE FOR 14-DAY HOLDING TIME, OR 2) ANALYZE WTIHIN 48-HRS.

FIELD PRESERVATION

YOU COLLECT SOIL VOC SAMPLES AND **PRESERVE IN THE FIELD**.

ALTERNATIVE METHODS

ECOLOGY REVIEWS ON A **SITE-SPECIFIC** BASIS. INTENDED FOR FUTURE CHANGES IN SOIL VOC SAMPLING TECHNOLOGY.

1. Asakari et al. (1996). Effectiveness of Purge-and-Trap for Measurement of Volatile Organic Compounds in Aged Soils. Analytical Chemistry, 68, pp. 3431-3433.

2. ASTM Method D 6418-04: Standard Practice for Using the Disposable EnCore Sampler for Sampling and Storing Soil for Volatile Organic Analysis.

3. Clausen et al. (2000). Acetone Production as a Result of Sodium Bisulfate Preservation using EPA Method 5035A.

4. Crumbling, Deana (2002). In Search of the Representativeness: Evolving the Environmental Data Quality Model. Quality Assurance, 9, pp. 179-190.

5. En Novative Technologies, Inc. ("En Core®" Soil Core Sampler)
1241 Bellevue Street
Green Bay, WI 54302 (En Novative)

6. EPA 7-Aug-98 Internal Memorandum: Clarifying Use of SW-846 Methods; from Elisabeth Cortsworth, Office of EPA Solid Waste.

7. EPA Method 5035A, Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples, EPA SW-846. Draft Revision 1, July-02. (EPA 5035A).

8. Hewitt et al. (1995). Collection, Handling and Storage: Keys to Improved Data Quality for Volatile Organic Compounds in Soil. American Env. Lab (Feb-95).

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11. Hewitt, A.D. (1995). Determining Volatile Organic Compound Stability in Soil. Proceedings of the 11th Annual Waste Testing and QA Symposium, U.S. EPA, Washington, D.C., pp. 173-185.

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Research and Engineering Laboratory, Hanover, NH

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Appendix A: Soil VOC Sampling Instructions

OVERVIEW

The instructions provided here are **guidelines**. You are, however, legally obligated to follow and meet the criteria specified in WAC 173-340-830. We recognize and understand that sampling protocols vary and that how you do things will vary. Ecology also recognizes that with respect to analytical methods, the "performance based"[14] approach is now gaining widespread acceptance. Ecology compiled these instructions based on a review of other state 5035A policies, the instructions in Method 5035A itself and consultation with others who had historical knowledge of how best to implement Method 5035A.

SOIL VOC SAMPLING INSTRUCTIONS PLEASE NOTE

If you opt for lab preservation, then you may skip STEPS 1-6 and go directly to STEP 7. *The instructions provided in this tech memo are only for the sampling and preservation of soil VOC samples when using methanol or sodium bisulfate as the preservative. The instructions do not include a description of other sampling or preservation procedures, including those involving the freezing of the soil samples. For a complete description of sampling and preservation procedures see EPA Method 5035A.*

[14] EPA defines this is as "a set of processes wherein the data quality needs, mandates or limitations of a program or project are specified, and serve as criteria for selecting appropriate methods to meet those specified needs in a cost effective manner."

WHAT EQUIPMENT WILL I NEED?

Laboratory Preservation

- **Sample containers.** You may use a zero Headspace Extraction (ZHE) container (e.g., **En Core® Sampler)** or other equivalent container.

- **Shipping arrangements.** Products like the En Core® sampler must be shipped to the lab within 48 hours. ***Depending upon the product you use, you must make shipping arrangements ahead of time!***

Field Preservation

- **Vials.** You must use 40-mL "VOA" glass vials with septum sealed Teflon-lined screw caps. All vials must be pre-weighed to the nearest 0.1 g. Record the vial tare weight on the sample label. You can either have the lab do this or you can do it in the field with your field balance.

- **Preservative**. If you are using the **low-concentration method**, then you must use sodium bisulfate ((NaHSO4) preservative. You must mix the preservative (~ 1 g) with at least 5 mL of organic-free reagent water so that the pH of the acid-water solution is ≤ 2. You can either have the lab do this or you can do it in the field. If you are using the **high-concentration method**, then you will need to use laboratory-grade methanol (CH3OH).

- *NOTE: Ecology recommends that you use pre-preserved and pre-weighed vials.*

- **Safety equipment.** Methanol is a toxic and flammable liquid. You will need to wear rubber gloves and other appropriate safety equipment.

- **Soil Sampling Syringes.** Ecology recommends that you use syringes to collect soil samples. Syringes have three distinct advantages: 1) they essentially allow you to collect ***undisturbed samples***, 2) they are calibrated with marks or lines that allow you to pre-determine how much sample is equal to 5 g, and 3) most syringes are designed to prevent ***headspace air*** above the sample contents. You may use several types of commercially available syringes, including: En Novative Technologies Inc. EasyDraw® syringe and Powerstop Handle®, Environmental Sampling Supply (ESS) "Lock N' Load", etc.

- **Balance.** You will need a portable "field" balance that is capable of weighing to 0.1 g. You will also need reference weights so that you can periodically check the balance for accuracy.

SOIL VOC SAMPLING INSTRUCTIONS

- *Note: If you opt for lab preservation, then you may skip STEPS 1-6 and go directly to STEP 7. The following instructions are only for the sampling and preservation of soil VOC samples when using methanol or sodium bisulfate as the preservative. The following instructions do not include a description of other sampling or preservation procedures, including those involving the freezing of the soil samples. For a complete description of sampling and preservation procedures see EPA Method 5035A.*

STEP 1. CHECK LOCATION

- If you are using methanol, then select an area that is free of car exhaust (it will contaminate the methanol).

STEP 2. CHECK SAFETY GEAR

- You should always wear gloves, goggles and other appropriate safety gear.
- *NOTE: methanol (Chemical Abstract Number 67-56-1) is a toxic and flammable liquid. You will need to use proper safety precautions. Ecology recommends that you wear Nitrile Rubber or Viton gloves. Avoid inhalation and make sure you store and use the methanol in a ventilated area, away from ignition sources. In the event of eye contact, flush with large volumes of water and seek medical attention immediately!*

STEP 3. CHECK FIELD BALANCE, AND FIELD-WEIGH 40-mL VOA VIALS

a) Check the calibration of your field balance. Follow manufacturer's instructions and record the check in your field notebook.

b) Reweigh each 40-mL VOA vial that you will be using that day. ***If the difference between the lab tare weight and the field weight is > 0.2 g, then do not use the vial!***

STEP 4. PREPARE METHANOL BLANKS

a) Ecology recommends preparing at least one methanol blank per sample cooler. Here's how this works: while you are collecting your soil VOC samples, you will leave the blank methanol vial open to check for any atmospheric VOCs. When you are done collecting soil samples, you will cap the blank vial and ship it to the lab along with the other samples.

b) **Preparing a methanol blank:** check with the lab about a methanol preservation sampling kit. You will need a tube of methanol and a pre-weighed 40-mL vial. When you are ready in the field, cut off the top of the methanol tube and carefully pour the contents into the 40-mL vial. Affix a label entitled "methanol field blank". Record the identification number in your field notebook. While collecting soil VOC samples, leave the blank methanol vial open. When done collecting soil samples, cap the blank vial and ship it to the lab along with the other samples.

STEP 5. CALIBRATE SOIL SYRINGE

a) If the syringe is already calibrated for 5 g (e.g., EasyDraw Syringe® and Powerstop Handle®; Figure 4, p. 21), then load or insert the syringe into the handle slot that is marked "5 g".

b) If you do not have a pre-calibrated syringe, then do this:

- Weigh an empty syringe on your field balance and record the weight,
- Insert the empty syringe into the soil and collect ~ 5 g soil. Cap the syringe. Make sure you wipe off any excess dirt.
- Reweigh (syringe + soil) and subtract syringe weight to determine soil weight.
- If the soil weight is ~ 5 g, then record how far you had to insert the syringe into the soil to achieve ~ 5 g. Use a trial-and-error method until you determine how far you must insert the syringe.

STEP 6. CHECK FOR CALCAREOUS SOILS

- *NOTE: this step applies only if you are using sodium bisulfate as a preservative. If you are preserving with methanol, then skip this step and go to STEP 7. If you are working in calcareous or carbonate soils, then do not use the sodium bisulfate preservative! The acid solution will react with the soil, which may result in excessive gas buildup and a shattered or broken VOA vial. If you do encounter calcareous soil, then use distilled water as a preservative! If you want to check to see if the soil contains carbonates, then squirt a few drops of hydrochloric acid (HCL) onto the soil. If it fizzes or effervesces, then the soil is calcareous.*

STEP 7. COLLECT SOIL SAMPLES

a) As a general rule of thumb, you should probably **collect at least two samples for every one location you sample**. This is particularly true for the low-concentration (sodium bisulfate) method, as the lab can analyze the sample only one time.

b) If you are using a methanol blank to check for contamination, then open it and place it in a secure area. Cap the vial when you are done collecting samples.

c) If you are using a syringe (e.g., En Core EasyDraw®) to collect samples, you will need to collect an undisturbed soil sample from a freshly exposed surface. To do this, gently push the syringe into the soil to a depth that is ≅ 5 g soil (see Figure 2, p. 20). Remove the syringe from the soil and quickly wipe the barrel end clean. Immediately cap the syringe. Make sure you wipe off any excess dirt.

- *NOTE: the En Core EasyDraw® syringe is not the same device as the En Core® Sampler! The syringe is supposed to be used only to collect and extrude soil into the VOA vial.*

d) If you are using the En Core® Sampler, use the steel T-handle to push the sampler into the soil. Skip Step 8 and go to STEP 10.

e) If the syringe or En Core® Sampler does not penetrate the soil, use a stainless steel spatula or scoop. Try to scoop or remove ~ 5 g soil. Once you've collected your sample, gently fill your 40-mL VOA vial with the appropriate preservative. Go to STEP 8.

STEP 8. EXTRUDE SOIL SAMPLES TO VOA VIALS AND RE-WEIGH.

a) Remove the syringe cap and extrude the 5 g soil sample from the syringe into the 40-mL VOA vial (Figure 3, p. 20). Quickly brush off any soil from the vial threads and **immediately seal the vial with septum and screw-cap!**

- *NOTE: once you've collected the soil sample, you must try to extrude it into the VOA vial with within 10 seconds! Before you screw the cap on, make sure you inspect the VOA vial threads and wipe off any dirt!*

b) **Low-concentration Method.** If you are using the *low-concentration* method (soil VOCs < 200 ug/kg), then you must, for a 5 g soil sample, add ~ 1 g of sodium bisulfate ($NaHSO4$) to each 40-mL vial. If you are collecting soil samples significantly < or > 5 g, then add ~ 0.2 g of preservative for 1 g of sample, e.g., 25 g sample = 5 g preservative. Add at least 5 mL of organic-free reagent water so that the pH of the acid-water solution is ≤ 2.

c) **High-concentration Method.** If you are using the *high-concentration* method (soil VOCs > 200 ug/kg), then you must add 5 g of soil with 5 mL of laboratory grade methanol ($CH3OH$).

d) Gently swirl the vial for ~ 10 seconds to break up the soil particles. DO NOT SHAKE!

e) **Re-weigh** the 40-mL vial. **Your target weight is 5 ± 0.5 g.** Record the sample weight to the nearest 0.1 g in your field notebook. **Do not record the weight on the sample label!**

- *NOTE: **do not** open the vial if you've added too much (or too little) soil. The lab can add more methanol to achieve a 1:1 ratio. The desired ratio of grams soil / mL methanol is 1:1, within a tolerance of +/- 25%. Ratios outside this range may be acceptable, depending upon data quality objectives. In all cases, however, the soil sample must be completely immersed in methanol.*

STEP 9. COLLECT ADDITIONAL SOIL SAMPLES FOR MOISTURE CONTENT ANALYSIS

a) ***For every one location you sample, you must collect at least one soil sample for moisture content analysis!*** The lab must have this information so that it can normalize the soil VOC concentration to a dry-weight basis. You should collect ~ 10 g of soil for moisture content analysis. Do not add preservative to the sample designated for moisture content analysis. Use the EasyDraw® syringe, a 4-oz wide mouth glass jar, a 40-mL VOA vial, or other suitable container for your moisture content analysis. Make sure you label the vial so that the lab knows it's for moisture content analysis!

- *NOTE: Because water is completely miscible with methanol, naturally-occurring soil moisture may result in under-reporting of the true, dry-weight VOC concentrations. As a general rule of thumb, a 1% increase in moisture content (by weight) will result in a negative bias of ~ 1%; however, moisture contents < 25% by weight are generally not considered significant by most labs.*

STEP 10. ICE SAMPLES AND SHIP TO LAB

a) **Once they are sealed and weighed, immediately place all samples on ice @ 4 ± 2° C!**

b) If you are shipping methanol-preserved samples, you must comply with the following requirements:

Methanol Shipping Requirements

- Each 40-mL vial must have < 30 mL of methanol (30 mL falls under the federal exemption for small quantities of flammable liquids).

- The "cooler" or container that you use for shipping must have a total methanol volume of < 500 mL (that's 50 samples @ 10 mL of methanol each).

- You must have sufficient absorbent material in the cooler in case one of the vials breaks. You must have enough to completely absorb the vial's contents.
- The cooler or package weight must not exceed 64 pounds.
- Each cooler or container must be clearly labeled as containing < 500 ml methanol.
- The shipping of methanol is regulated by the U.S. Department of Transportation, Title 49 of the Code of Federal Regulations. The DOT number is UN 1230.

Figure 2: Using a Syringe to Collect the Soil Sample.

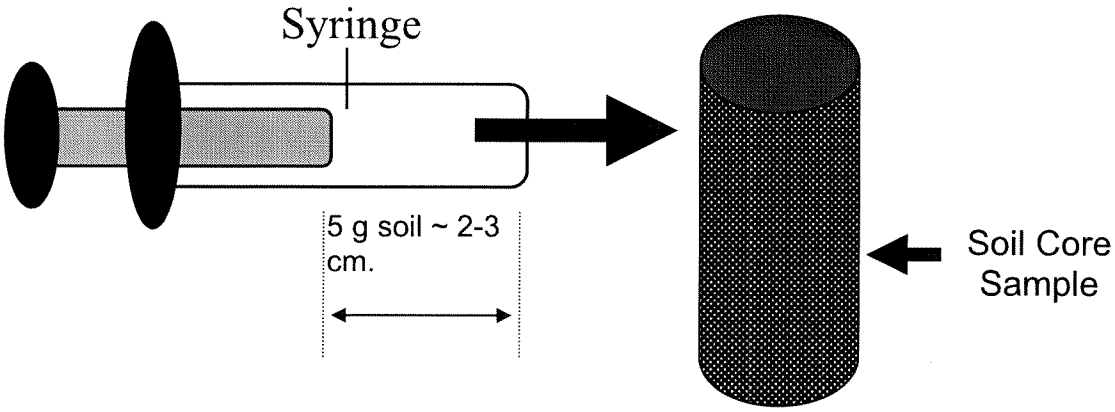


Figure 3: Vial and Sample.

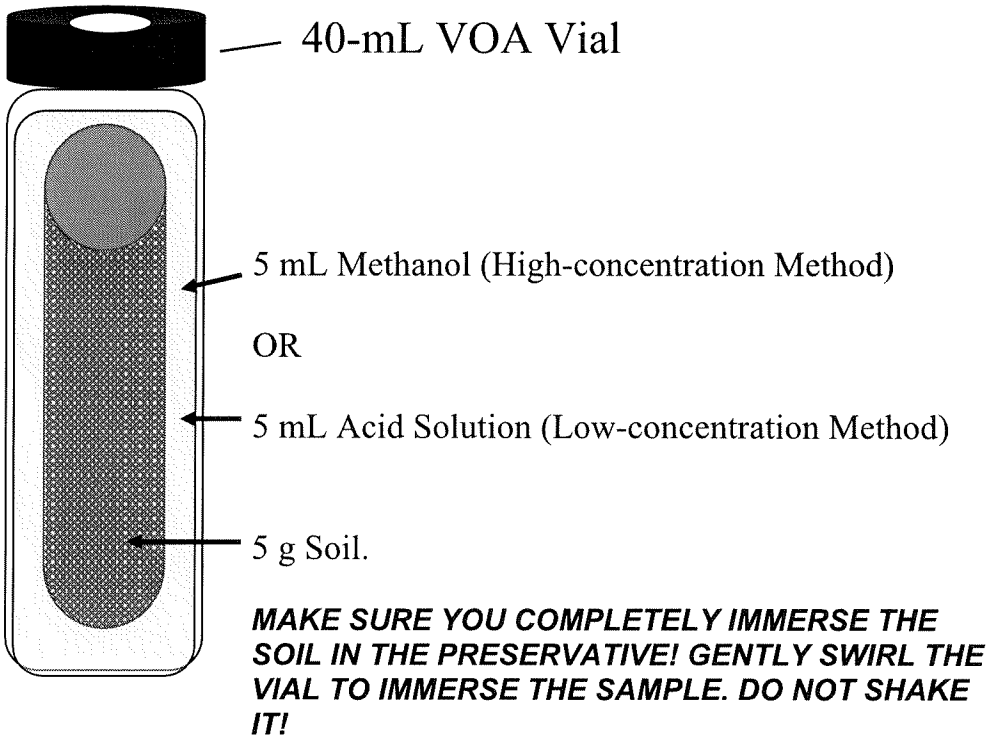
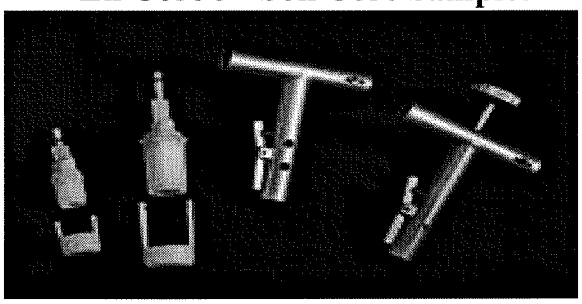


Figure 4: Sample Collection Equipment.

40-mL VOA Vial and Plastic Syringe

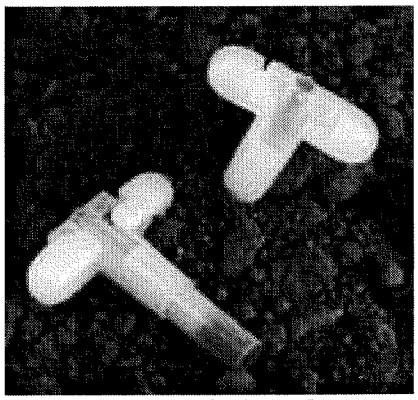
"EasyDraw® Syringe & Powerstop Handle®

"En Core®" Soil Core Sampler



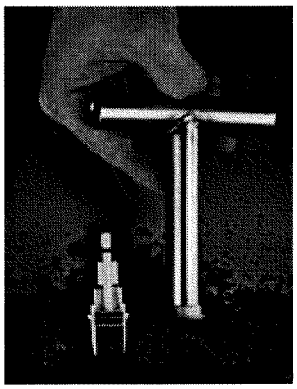
En Novative Technologies, Inc.

Terra Core™ Soil Sampler



En Novative Technologies, Inc.

"En Core®" T-Handle



En Novative Technologies, Inc.

Field Balance

Portable Scout* Series Electronic Balance by Ohaus*

SOIL SAMPLING
CALIBRE STANDARD OPERATING PROCEDURES

1.0 POLICY

It is the policy of CALIBRE that any individual engaging in collection of soil samples at job sites will abide by the procedures outlined in this document. These procedures are designed to meet or exceed guidelines set forth by the Environmental Protection Agency (EPA) for the collection of representative soil samples used to determine whether concentrations of specific pollutants exceed established action levels, or if the concentrations of pollutants present a risk to public health, welfare, or the environment.

2.0 PURPOSE

This Standard Operating Procedure (SOP) provides instructions that are to be followed in collecting samples of either soil or sediments.

3.0 SOIL SAMPLING

Soil samples may be collected by either using hand tools, i.e., disposable scoop, trowel, shovel, bucket auger, or by a power driven sampling device such as a split spoon. The sample collection method should be noted in the field logbook. Samples collected for volatile organic compound analysis should be taken with Encore samplers using encore techniques.

Once the sampling location has been selected, any vegetation and/or loose material shall be removed from a circular area approximately 2 feet in diameter. The purpose of this step is to prohibit surface material from falling into the sample hole and possibly contaminating the sample. Also, a level surface will facilitate hole depth measurements.

To prevent potential surface contamination from any subsurface sample contaminants, plastic sheeting should be placed adjacent to the sample location. All subsurface material that is collected must be placed on this sheeting.

2.1 Shovel and Trowel/Scoop

When the prescribed sample depth is reasonably shallow (down to approximately 4 feet), a decontaminated shovel and disposable scoop or trowel can be used following the sequence of steps described below:

1) Label all jars with required tags and labels. Fill out all information except the actual date and time. Sort jars, one set per sampling location with additional sets as needed for QA/QC samples.

2) Note exact location of the sample in the field logbook. If possible, photograph the location.

3) At the time of individual sample collection, record date and time on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

4) Use a decontaminated shovel to remove the overburden to the prescribed depth and place excavated material on the plastic sheeting.

5) If the samples are being analyzed for volatile organic compounds (VOCs), collect the VOC fraction first. VOC sample containers should be tightly packed using a disposable scoop, leaving no airspace in the jar.

6) Using the scoop, fill the remaining jars at least ¾ full.

7) Wipe off the outside of the jar and place it in a bubble baggie. Place the bagged jar in a cooler, with ice if the sample plan calls for ice.

8) Replace excavated material from the plastic sheeting into hole and cap with removed vegetation or other material.

9) Decontaminate the sampling equipment for the next sample.

10) Field soil sample duplicates are to be collected either by compositing the soil in a gallon baggie (a composite field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

2.2 Bucket Auger

A bucket auger may be used for sample collections at intermediate depths depending on surficial geologic conditions (1 to 15 feet). Augers do not work well in rocky soils.

1) Label all jars with required tags and labels. Fill out all information except the actual date and time. Sort jars, one set per sampling location with additional sets as needed for QA/QC samples.

2) Note exact location of the sample in the field logbook. If possible, photograph the location.

3) At the time of individual sample collection, record date and time on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

4) On the auger, use a tape measure to locate the sample depth up from the bottom of the auger head and mark it.

5) Place the auger above the selected sample location and turn the “T” handle to screw the auger into the soil.

6) Remove the soil and repeat until sample depth is reached. Expel the soil plug by holding the auger upside down and tapping the handle on the ground. Place excavated material on a plastic sheet.

7) After reaching the desired depth, decontaminate the auger and remove one more soil plug. Collect the sample and place into sample containers using a disposable scoop.

8) If the samples are being analyzed for volatile organic compounds (VOCs), collect the VOC fraction first. VOC sample containers should be tightly packed using a disposable scoop, leaving no airspace in the jar.

9) Using the scoop, fill the remaining sample containers at least ¾ full.

10) Wipe off the outside of the jar and place it in a bubble baggie. Place the bagged jar in a cooler, with ice if the sample plan calls for ice.

11) Replace excavated material from the plastic sheeting or use bentonite and cement grout if downward migration of contaminants is a concern.

12) Decontaminate the sampling equipment for the next sample.

13) Field soil sample duplicates are to be collected either by compositing the soil in a gallon baggie (a composite field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

2.3 Split Spoon

A split spoon sampler is used to take subsurface soil samples by being forcefully driven into the soil at the bottom of a bore hole. Samples may be retrieved along the entire length of the bore hole to obtain an unbroken record of the subsurface layers or at selected intervals.

The split spoon is threaded on to the end of the drill rod in place of the drill bit. The bore hole may contain casing (steel or plastic pipe), depending on future use of the hole and the rigidity of the penetrated formation. The sampler is lowered on the drill rod to the bottom of the boring by heavy steel cable connected to the drilling mast. The sampler is forced into the soil by a drive weight that is dropped repeatedly onto the drive head located at the top of the drill rod. Weights up to 350 pounds are available but the most commonly used for a two-inch diameter sampler is a 140-pound weight. The weight is typically allowed to fall a distance of 30 inches. The sampler is driven into the soil to a depth that is about 6 inches shorter than the length of the sampler itself. Split spoon samplers are manufactured in 18-inch and 24-inch lengths with 2-inch to 3-inch outside diameters.

Occasionally, bedrock or extremely compacted soils are encountered that make further advance of the sampler extremely difficult or impossible without damage to the sampler. This is known as “refusal” and is defined as “penetration of less than 1 foot for 100 blows”; a blow being the act of striking the drive rod with the drive weight. Six inches for 50 blows is also commonly recognized as refusal. Upon refusal, the bore hole is to be either abandoned or the sampler removed and replaced by a drill bit.

Split spoon sample collection procedure:

1) Label all jars with required tags and labels. Fill out all information except the actual date and time. Sort jars, one set per sampling location with additional sets as needed for QA/QC samples.

2) Note exact location of the sample in the field logbook. If possible, photograph the location.

3) At the time of individual sample collection, record date and time on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

4) Receive sampler from driller and place on a secure bench or rack for opening.

5) Separate the sample tube (a flat-blade screwdriver is useful) exposing the sample or, if used, brass liners.

6) Run a knife between the liners to separate and immediately seal the cut ends with Teflon film if VOCs analysis is required. Wrap with Teflon plumber's tape, cap with plastic lids, and wrap with grey duct tape. Apply sample label.

7) If no liner is used, the sample may be collected from the open spoon using a disposable scoop.

8) If the samples are being analyzed for volatile organic compounds (VOCs), collect the VOC fraction first. VOC sample containers should be tightly packed using a disposable scoop, leaving no airspace in the jar.

9) Using the scoop, fill the remaining sample containers at least ¾ full.

10) Wipe off the outside of the jar and place it in a bubble baggie. Place the bagged jar in a cooler, with ice if the sample plan calls for ice.

11) Replace excavated material or use bentonite and cement grout if downward migration of contaminants is a concern.

12) Decontaminate the sampling equipment for the next sample.

13) Field soil sample duplicates are to be collected either by compositing the soil in a gallon baggie (a composite field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

2.4 Tube Sampler

A tube sampler may be used for collecting sediment samples underneath water. Depending on the volume of sample material desired, tubes ranging from ½ to 2 inches can be used. The tube can be made of glass, clear plastic, PVC, or other material as appropriate for the sediment composition being sampled.

If taking both a water sample and a sediment sample, the water sample must be taken first because turbidity created in the water while taking the sediment sample would result in a non-representative water sample.

Split spoon sample collection procedure:

1) Label all jars with required tags and labels. Fill out all information except the actual date and time. Sort jars, one set per sampling location with additional sets as needed for QA/QC samples.

2) Note exact location of the sample in the field logbook. If possible, photograph the location.

3) At the time of individual sample collection, record date and time on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

4) Insert the tube into the sediment to the prescribed depth. Seal the top end of the tube with a gloved hand or a cap and remove the tube. The suction created causes the sediment to remain in the tube. Place sediment in the tube on plastic sheeting by removing the gloved hand or cap from the top of the tube and allowing the sediment to flow out.

5) If the samples are being analyzed for volatile organic compounds (VOCs), collect the VOC fraction first. VOC sample containers should be tightly packed using a disposable scoop, leaving no airspace in the jar.

6) Using the scoop, fill the remaining jars at least ¾ full.

7) Wipe off the outside of the jar and place it in a bubble baggie. Place the bagged jar in a cooler, with ice if the sample plan calls for ice.

8) Replace sediment from the plastic sheeting into hole.

9) Decontaminate the sampling equipment for the next sample.

10) Field sediment sample duplicates are to be collected either by compositing the sediment in a gallon baggie (a composite field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

2.5 Encore Sampling

The following attachment describes the procedures to use in Encore sampling:

UTILITY CLEARANCE REQUIRED PRIOR TO INTRUSIVE INVESTIGATION OR REMEDIATION ACTIVITIES
CALIBRE STANDARD OPERATING PROCEDURES

1.0 POLICY

It is the policy of CALIBRE that any individual engaging in any intrusive investigation or remediation work (well/test boring, drilling, direct push sampling, test pit excavations or similar subsurface investigation work) at job sites will abide by the procedures outlined in this document. These procedures are designed to meet or exceed guidelines set forth by the Washington Utilities Coordinating Council (WUCC) or other similar agencies in different states.

2.0 PURPOSE

This Standard Operating Procedure (SOP) provides instructions that are to be followed for utility clearance prior to starting intrusive investigation or remediation work. Underground utility clearance (gas, water, sewer, power, communication, other) is an initial step prior to any intrusive/drilling work, all steps must be completed and documented.

3.0 STEPS FOR UTILITY CLEARANCE

Subsurface utility drawings must be requested from the client/property owner or other appropriate entity. Personnel will conduct a field inspection of the site and review available subsurface utility drawings. The field inspection must look for obvious (or potential) signs of utilities such as alignment of storm drains, location of utility meters, power lines connecting down from power poles, power lines connecting up to service connections, or saw cuts in the surface cover. Field locations will then be marked on the ground and on a suitable base map that can be provided to other parties. Detailed information on the locations must be recorded (map page from Thomas Guide, cross streets that are nearby, and distance from easily identified reference locations such as corner of a specific building).

Prior to the installation of any new wells a utility clearance will be performed and the utility clearance SOP reviewed. The utility clearance will be performed using the following steps:

1) Review available as-built drawings of utility locations,
2) Complete any client-specific review/permitting required (dig permits or other),
3) Call the Utility Notification Center (UNC) at least 48 hours prior to drilling,
4) Engage third party utility survey/clearance in moderate or high risk areas, and
5) If necessary, hand dig the first 2-5 feet.

3.1 COMPLETE ANY CLIENT-SPECIFIC UTILITY CLEARANCE PROCESSES

Various customers/clients may have existing processes in place for utility clearance on their property (such as dig permits or other). The project Work Plan needs to determine any client-specific (or locality-specific) processes/documentation required and the required steps followed and documented. The client-specific requirements may overlap with the subsequent steps listed below, however both are required if they do not overlap.

3.2 CONTACT UTILITY NOTIFICATION CENTER

The Utility Notification Center (UNC) will be notified at least 48 hours prior to initiation of subsurface investigation or remediation so that subscribers can mark their nearby utilities. The call will be documented (time, date and reference number provided). Any return information provided will be documented (typically a return phone call from various utility providers that local utilities have been marked and that specific utilities are present or not present in the area).

3.3 INDEPENDENT UTILITY SURVEY

Many project locations are on private property where limited (if any) clearance is provided by the UNC service. As appropriate based on the UNC information, as-built drawings and the general nature of development in the area, CALIBRE will retain an independent utility locator to assess the potential presence of subsurface utilities and structures in the area (beyond the as-built utility review and UNC clearance noted above). Subsurface anomalies detected during the utility survey will be marked with paint and/or flagging. The area around each location will be cleared to a minimum of 5 feet from the marked location to allow for alternate locations in case of refusal during drilling at the primary location.

3.4 MANUAL CLEARANCE IN CONGESTED AREAS

If the area indicates many nearby utilities, a manual clearance of utilities (visual inspection within the hole) must be completed. Two options (potentially more) exist for this: manually dig down with a post-hole digger or contract with a vacuum truck equipped with an air knife to clear each boring location. In most soils a post-hole digger can be used to clear to a depth of 3 to 4 feet. A vacuum truck with an air knife can clear to an approximate depth of 6- to 8-feet (potentially deeper). If a subsurface utility or other obstruction is encountered, the boring locations will be adjusted as necessary. During preparation of the site-specific health and safety plan (HASP), a determination will be made as to the depth of manual clearance required for any given boring.

4.0 DOCUMENTATION

All steps noted above are to be documented in site logbooks and retained in the project files.

VAPOR SAMPLING
CALIBRE STANDARD OPERATING PROCEDURES

1.0 POLICY

It is the policy of CALIBRE that any individual engaging in collection of vapor samples at job sites will abide by the procedures outlined in this document. These procedures are designed to meet or exceed guidelines set forth by the Environmental Protection Agency (EPA) for the collection of vapor samples.

2.0 PURPOSE

This Standard Operating Procedure (SOP) provides instructions that are to be followed in the collection of vapor samples (gas phase) for laboratory or field analysis of volatile organic compounds (VOCs). The purpose of this SOP is to define the use of several different air sampling techniques that can be used for soil gas monitoring, indoor air monitoring and remediation system monitoring of VOCs present as a vapor phase in air. The sampling methods discussed include sample collection with Tedlar bags, sample collection using SUMMA canisters and field testing using a Photo Ionization Detector (PID) and other vapor monitoring instruments.

3.0 INTRODUCTION

Vapor samples may be collected as part of remediation systems performance monitoring, soil gas monitoring or indoor air monitoring to provide a means of detecting volatile organic compounds (VOCs) in the specific sampling matrix. This SOP outlines the methods to be used for the collection of vapor samples using Tedlar bags and SUMMA canisters and measurement of organic vapor levels in samples using a PID.

4.0 METHOD SUMMARY

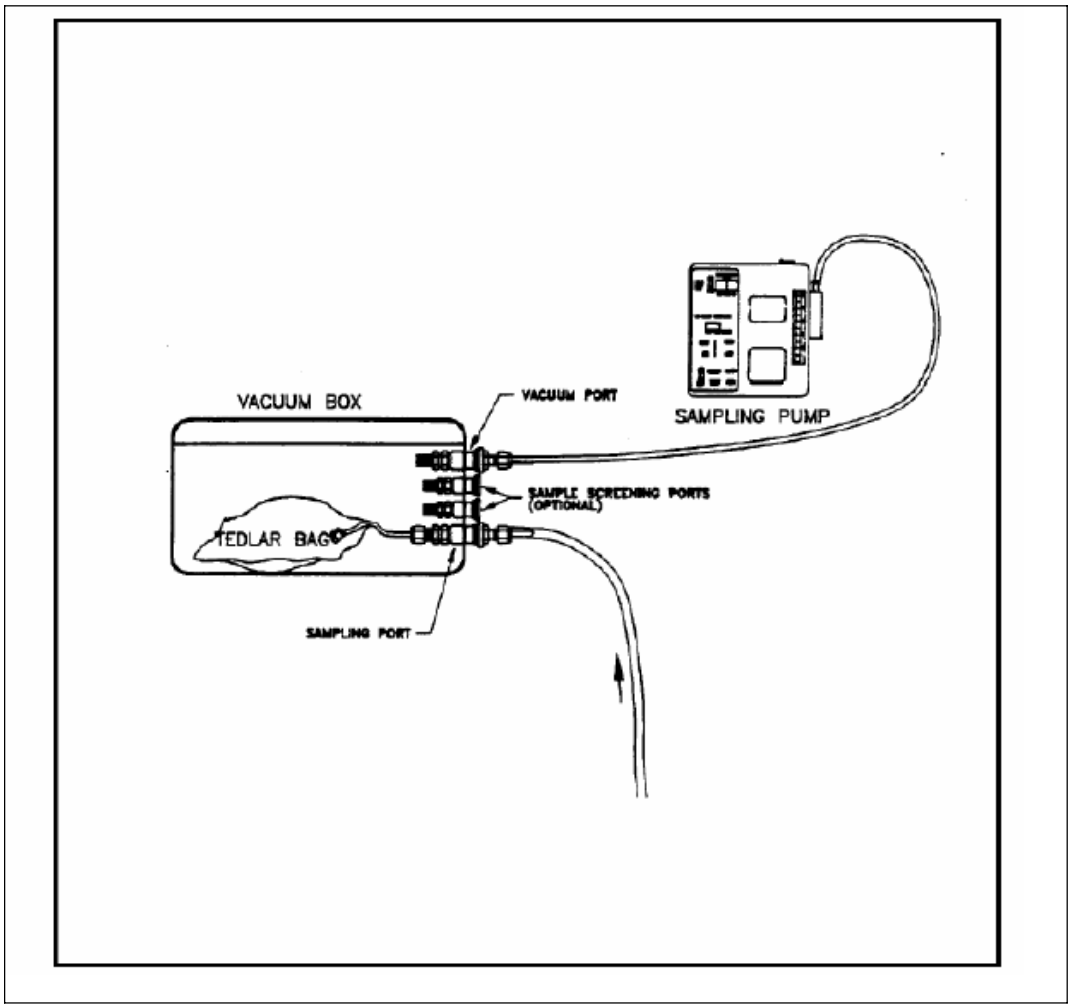
The objective of the vapor sampling procedures described herein is to collect representative gas samples of the targeted media and analyze the gas for the presence of VOCs. Typically, a low volume air pump is used to pull a sample through the sampling train.

The sample may be collected in Tedlar bags using a vacuum box (see Figure 1), or directly to the Tedlar bag depending on the sampling point (lines under pressure do not need to use a vacuum box). An air pump is not required to fill a SUMMA canister; sampling is achieved by equilibration with the evacuated SUMMA canister, however a vacuum pump may still be necessary to flush the sampling train. The sample container may then be shipped to a laboratory for analysis of VOC present.

The common laboratory analytical procedures used for analysis of VOCs in gas samples are EPA methods 8260B, T015. Both of these analytical methods utilize a GC/MS analysis. Typical detection limits for the 8260B analysis are VOCs in the range of 5-100 ug/m^3. Typical detection limits for the T015 analysis are VOCs in the range of 1-10 ug/m^3. Typical detection limits for the PID analysis using a Rae Systems ppb PID are the range of 100-1,000 ug/m^3 (as total organic vapors).

A PID employs the principle of photoionization to detect and quantify the concentration of organic vapors present in a gas phase sample. The analyzer will respond to most vapors that have an ionization potential (IP) less than or equal to that supplied by the ionization source used in the PID, an ultraviolet (UV) lamp. Photoionization occurs when an atom or molecule absorbs a photon of sufficient energy to release an electron and form a positive ion.

Figure 1 Sampling setup using Tedlar bag in evacuated box



The ionization chamber exposed to the light source contains electrodes to create an electro-magnetic field in the chamber. Ions formed by the VOC adsorption of photons are driven to an electrode and the current produced is then measured and the corresponding concentration displayed on the meter, directly, in the units used for calibration, typically parts per million volume (ppmv) or parts per billion volume (ppbv). Though it can be calibrated to a particular compound, the instrument cannot distinguish between detectable compounds in a mixture of gases and, therefore, indicates an integrated response to the mixture (i.e., the measurement is for the total organic vapors present).

Field air monitoring devices include a Rae Systems ppb PID that reads in ppbv and a variety of other PID instruments that typically read in ppmv. Sampling with field instruments is typically completed with the sample first collected in a container, such as a Tedlar bag, and the PID instrument (or other) used to read the total organic vapor concentration in the sample.

5.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

5.1 Tedlar Bags

Vapor samples are generally collected in 1-liter (L) Tedlar bags. Bagged samples should be stored in the dark (i.e., in opaque containers) and protected from mechanical damage during transit to the laboratory. Further, samples should be maintained at ambient temperature by placing them in coolers, and out of direct ultra-violet (UV) light. Samples should be analyzed as soon as possible, particularly, if the stability of the compound is unknown. Under some conditions (typically considered to be high VOC concentrations), loss may occur either because of diffusion through the Tedlar bag or adsorption onto it.

A typical holding time for VOC analysis (using Tedlar bags for sampling) is no more than 48 hours. Because of this short holding-time, it is critical that the sampling event and shipping be coordinated with the laboratory prior to sample collection. In general, Tedlar bag samples collected for laboratory analysis must be collected on Monday/Tuesday and delivered by overnight courier to the laboratory (unless other specific arrangements have been made with the laboratory for the delivery date).

5.2 SUMMA Canisters

The SUMMA canisters used for vapor sampling have a 6-liter sample capacity and are certified clean by GC/MS analysis before being used in the field. After sampling is completed, the samples are shipped in travel cases for off-site laboratory analysis. Most VOCs can be recovered from canisters with minimal loss up to 14 days.

5.3 Field Sampling with PID (and other instruments)

A PID instrument may be used for on-site testing of the sample collected. A PID is typically used in conjunction with sample collection in a Tedlar bag. Other field instruments that may be used (depending on the site conditions, contamination present and sampling objectives) include oxygen/lower explosive limit (O_2/LEL) meters, Flame Ionization Detectors (FIDs). Examples of other field air monitoring instruments include: combustible gas indicator (MSA CGI/0_2 Meter, Model 260), organic vapor analyzer (Foxboro OVA, Model 128, Thermo electron OVA model 580), and a variety of other instruments by various manufacturers. For any instrument used on a

project, each must have the model-specific O&M manual which will specify the key details on calibration, resolution, interferences, etc.

6.0 INTERFERENCES AND POTENTIAL PROBLEMS

6.1 Factors Affecting the Sample Collected with Tedlar Bags or SUMMA Canisters

Standard laboratory analytical methods will detect VOCs at levels less than 1 part per billion volume (ppbv) in vapor phase samples. As a consequence, the potential for inadvertent sample contamination is a significant concern since many of the compounds in question are commonly used in commercial products, industries and residential settings. In order to minimize the risk of cross contamination, the following factors should be considered:

1) Proximity of the containers (bags/canisters) to source(s) of potential contamination during transportation and storage. Containers and the sampling train (tubing, pumps, or other) must be kept away from potential source(s) to the maximum extent feasible to minimize the chances of external contamination. All bags should remain in clean sealed containers until the time of use.

2) A variety of common products (many used in field sampling) will contain compounds that may be detected in the analysis. Examples include marking paint, marking pens (sharpies), fuel, adhesives, tape, and decontamination solutions from other sampling/well purging. The utmost care must be taken to minimize the potential for inadvertent contamination of the samples and sampling train.

3) Containers must be attached only to clean Teflon tubing.

4) For Tedlar bags, attach the sample label to the bag using a string or zip-tie through the eyelet on the Tedlar bag. Common adhesives found in the label may potentially permeate the bag if placed on the body of the bag.

5) Fill out labels using only a ballpoint pen; permanent markers contain volatile compounds that may contaminate the sample.

6) Due to the chemical structure of Tedlar, highly polar compounds may adhere to the inner surface of the bag. Also, low molecular weight compounds may permeate the bag.

6.2 PID Measurements

A number of factors specific to vapors associated with remediation systems and soil/indoor air vapor monitoring can affect the response of a PID. The most common problem in using a PID is rapid temperature fluctuations which may cause the PID lamp to fog; high humidity can also cause lamp fogging and decreased sensitivity. This can occur when the relative humidity of the sample collected is high such as soil vapor samples from moist/wet soils. The critical step to minimize problems associated PID lamp fogging is to keep the PID warm (such as in the heated cab of a field vehicle) if ambient conditions are wet or cold. High and low temperature, and naturally occurring compounds, such as terpene hydrocarbons in wooded areas, can affect instrument response. Always follow instructions in the instrument manual (see references or manual).

Specific considerations in the use of a PID include the following:

1) The PID is a nonspecific total organic vapor detector. It cannot be used to identify unknown substances; it can only quantify the total organic vapors (as calibrated to isobutylene response).
2) The PID must be calibrated to a specific compound (or more typically include a conversion factor for equivalent response as isobutylene).
3) The PID does not respond to certain low molecular weight hydrocarbons, such as methane and ethane, in addition, the PID does not detect a compound if the probe has a lower energy than the compound's IP. Specific compounds (e.g., carbon tetrachloride and hydrogen cyanide, have high IPs and cannot be detected with a PID.
4) Certain models of PID instruments are not designed for use in potentially flammable or combustible atmospheres.
5) The lamp window must be periodically cleaned to ensure effective ionization of the compounds by the probe (although this step has been largely eliminated with the self cleaning process implemented the Rae Systems ppb PID).
6) The PID measures concentration linearly over the calibrated range, any response outside of the calibrated range cannot be reliably quantified. The Rae Systems ppb PID requires special procedures for the zero calibration.
7) The instrument should not to be exposed to precipitation.
8) Do not use the instrument for head space analysis where liquids can inadvertently be drawn into the probe.

Transport of calibration gas cylinders by passenger and cargo aircraft must comply with International Air Transport Association (IATA) Dangerous Goods Regulations or the U.S. Code of Federal Regulations, 49 CFR Parts 100-177. A typical calibration gas included with a PID is isobutylene. It is classified as a non-flammable gas, UN #1556 and the proper shipping name is Compressed Gas. It must be shipped by cargo aircraft only.

6.3 Factors Affecting the Concentrations of Organic Compounds in Soil Gas

Concentrations of organic compounds in vapor can be affected by the physical and chemical characteristics of the soil, soil moisture, and nature of the target compound. Important factors to consider include the compounds' vapor pressure, solubility and soil partitioning (typically estimated from the organic carbon adsorption coefficient K_{oc}). Soil porosity and permeability will affect the movement of soil gas and the recharge rate of the soil gas into a well. The movement of organic vapors through fine textured soil may be very slow, thus limiting the sample volume available and the use of this technique.

The presence of a high or perched water table, or of an impermeable underlying layer (such as a clay lens or layer of buried slag) may interfere with the movement and sampling of the soil gas.

7.0 EQUIPMENT/APPARATUS

7.1 Tedlar Bag Sample Collection

The following equipment must be available and operational to perform Tedlar bag sampling:

1) Vacuum box must be clean, Teflon tubing replaced, and equipped with extra O-rings

2) Pump(s) must be charged, in good working order, and set with the appropriate flow rate of 3 liters per minute
3) Tedlar bags must be new.
4) Sample documentation (sample labels, field data sheets, logbook, chain of custody records, custody seals, etc.)
5) Small zip-ties to affix label through eyelet on bag
6) Air sampling worksheets
7) Opaque trash bags
8) PID or other field air monitoring devices
9) Cooler(s)

7.2 SUMMA Canister Sample Collection

The following equipment must be available and operational to perform sampling with SUMMA canisters:

1) Pump(s) must be charged, in good working order, and set with the appropriate flow rate of 3 liters per minute
2) SUMMA canisters must be certified clean.
3) Sample documentation (sample labels, field data sheets, logbook, chain of custody records, custody seals, etc.)
4) Air sampling worksheets
5) PID or other field air monitoring devices

7.3 Field Measurement of VOCs with PID (or other field instrument)

The following equipment must be available and operational to perform Field Testing of VOCs with a PID:

1) PID instrument, user's manual, calibration gas and regulator, zero gas, or virgin charcoal tubing). The PID must be fully charged the night before (and include spare batteries if feasible).
2) Tedlar bags must be new.
3) Sample documentation (sample labels, field data sheets, logbook, chain of custody records, etc.).
4) Air sampling worksheets
5) Opaque trash bags
6) Any other equipment defined in section 6.1

8.0 REAGENTS

1) Calibration gases, typically isobutylene at 10 ppm for a Rae ppb PID or 100 ppm for other PIDs.
2) Materials required to zero the PID instrument (sealed virgin charcoal tubes for the Rae ppb PID or Ultra-zero grade compressed air for other PIDs).

9.0 PROCEDURES

9.1 Flushing the Volume of the Sampling Train

The sampling train will contain a volume of ambient air that must be flushed from the system before the sample is collected. The flushing volume may be determined by a volume calculation and/or by using a field instrument to verify that the initial volume has been purged. Teflon tubing (not Tygon tubing) should be used for the sampling train. Typically three volume flushes should be sufficient for removing ambient air from the sampling train.

9.2 Sample Collection with Tedlar Bag

1) Follow Section 8.1, to evacuate the volume of the sampling train. If PID/FID readings were taken prior to taking a sample, additional evacuation is not necessary.
2) Use the vacuum box and sampling train (Figure 1) to collect the sample. The sampling train must be designed to minimize the introduction or loss of contaminants due to adsorption and other factors. All parts used are either Teflon or stainless steel, and a vacuum is drawn indirectly to avoid contamination from sample pumps.
3) Place the Tedlar bag inside the vacuum box, attach it to the sampling port and open the valve. The sample probe is attached to the sampling port via Teflon tubing and a "Quick Connect" fitting.
4) Draw a vacuum around the outside of the bag, using a pump connected to the vacuum box evacuation port, via Tygon tubing and a "Quick Connect" fitting. The negative pressure inside the box causes the bag to inflate, drawing the sample into the bag.
5) Break the vacuum by removing the Tygon line from the pump. Remove the bagged sample from the box and close the valve. Record the date, time, sample location identification, and the PID instrument reading (if used) on the sample bag's label, and on the appropriate data sheet or in the site logbook(s). Bags should not be labeled directly with a marker or pen (particularly those containing volatile solvents) or should adhesive labels be affixed directly to the bags. Inks and adhesive may diffuse through the bag material and contaminate the sample. Labels should be tied to the metal eyelets provided on the bags.
6) Complete chain of custody records.

This sampling approach (Tedlar bag sampling) is straightforward and relatively easy. However, there are several things to be aware of when sampling.

1) The seals of the vacuum box must be air tight in order for the sample collection system to work.
2) Check the O-ring gasket to see if it is in place with the proper fit. O-rings that have been stretched out will not remain in place, thus requiring constant realignment.
3) Check that all the fittings associated with the vacuum joints are securely in place. The fittings can be pushed loose when inserting the valve stem into the Teflon tubing.
4) Occasionally, a corner of the Tedlar bag will stick out between the two halves of the vacuum box causing a poor seal.
5) Since the Tedlar bags will only hold a finite volume (e.g. - liter Tedlar bag), over-inflation will burst the bag.

9.3 Sample Collection with SUMMA Canister

1) Follow Section 8.1, to evacuate the volume of the sampling train. If PID/FID readings were taken prior to taking a sample, additional evacuation is not necessary.
2) Attach a certified clean, evacuated 6-L SUMMA canister via the ¼" Teflon tubing.
3) Open the valve on the SUMMA canister. The vapor sample is drawn into the canister by pressure equilibration.
4) Record the date, time, sample location identification, and the PID instrument reading (if used) on the sample label (use ball point pen only), and on the appropriate data sheet or in the site logbook(s).
5) Complete chain of custody records.

9.4 Remediation System Sampling

The sampling procedure to be used for a remediation system depends upon the sampling point.

1) If the sampling point is under vacuum (such as a sampling port at the well head on an SVE system); follow the sample collection procedure defined in Sections 8.2 or 8.3.
2) If the sampling point is under pressure (such as the discharge side of a blower for a SVE system); use the following procedure:
   a) Attach a piece of Teflon tubing to the sampling port.
   b) Open the valve on the sampling port.
   c) Flush the tubing in the line for an appropriate number of volumes.
   d) Connect Tedlar bag (or SUMMA canister) to the Teflon tubing and fill via the line pressure.
   e) Remove sample from the tubing. Record the date, time, sample location identification, and the PID instrument reading (if used) on the sample bag's label, and on the appropriate data sheet or in the site logbook(s). Bags should not be labeled directly with a marker or pen (particularly those containing volatile solvents) nor should adhesive labels be affixed directly to the bags. Inks and adhesive may diffuse through the bag material and contaminate the sample. Labels should be tied to the metal eyelets provided on the bags.
   f) Complete chain of custody records.

9.5 Field Measurement of Organic Vapor Levels with PID

The manufacturers' manual must be consulted for the correct use and calibration of all instruments. Pumps should be calibrated prior to use in the field.

1) Collect a sample following the procedures defined in Sections 8.2 or 8.4.
2) Connect the PID probe to the sample container using a section of Teflon tubing
3) Use the PID to read the organic vapor level present in the sample.
4) Record the date, time, sample location identification, and the PID instrument reading on the appropriate data sheet or in the site logbook(s).
5) Repeat the sample collection and PID reading from the same sampling point to verify repeatability (the same Tedlar bag may be reused on this same sampling point for this repeat sampling).
6) Retest the instrument calibration after 4 hours of operation and at the end of day.

Readings may be above or below the range set on the field instrument. The range may be reset, or the response recorded as a greater than or less than the response range.

10.0 CALCULATIONS

10.1 Field Screening Instruments

Instrument readings are usually read directly from the meter. For example, PID readings are expressed in units of parts per million (ppmv) or part per billion (ppbv) depending on the PID unit. In some cases, it may be appropriate to subtract the background reading from the sample reading.

10.2 Correction Factors

A PID instrument will (typically) be calibrated to isobutylene as a calibration gas. Therefore a correction factor must be used when converting the PID response to the actual VOC concentration present in the sample. Using a PID, the instrument responds to the total organic vapors present in sample and conversion to a specific VOC concentration may be made when a specific compound present is known (based on prior sampling or other site operational knowledge). Typical PID correction factors for several for the common VOCs encountered are shown in Table 1. See reference Technical Note TN-106 from Rae Systems which presents a list of chemical compounds and their PID response correction factors (from conversion from isobutylene calibrated response to VOC concentration).

Table 1 Ionization Potential and Correction Factors for Common Compounds

Compound	Ionization Potential (eV)	Correction factor for response relative to isobutylene calibration (for 10.6 v lamp)
Acetone	9.71	1.1
Methyl ethyl ketone	9.51	0.5
Benzene	9.25	0.53
Ethylbenzene	8.77	0.52
Toluene	8.82	0.50
o-Xylene	8.56	0.59
Tetrachloroethene	9.32	0.57
Trichloroethene	9.47	0.54
Vinyl chloride	9.99	2.0
cis 1-2 dichloroethene	9.66	0.8
Isobutylene	9.24	1.0

10.3 Unit Conversions

Two common units are used to express vapor phase concentrations:

- mass per unit volume basis (e.g., ug/m^3 and ug/L); and
- volume/volume basis (ppbv, ppmv).

Field instrument readings (read directly from the meter) are typically on a volume/volume basis. Laboratory results may be presented in either units (or both).

The conversion between units is as follows:

$1\ ug/m^3 = [(273.3+T)*0.082/MW]\ ppbv$

Where T is temperature in degrees C and MW is molecular weight.

11.0 QUALITY ASSURANCE/QUALITY CONTROL

11.1 Sample Probe Contamination

Sample probe contamination is checked between each sample by drawing ambient air through the probe using a vacuum pump (e.g., Gilian pump) and checking the response of the PID. If readings are higher than background, replacement or decontamination is necessary. Sample probes may be decontaminated simply by drawing ambient air through the probe until the PID reading is at background. Contamination can also be removed by decontaminating with methanol and deionized water, then air drying. For persistent contamination, use of a portable propane torch may be needed. Using a pair of pliers to hold the probe, run the torch up and down the length of the sample probe for approximately one to two minutes. Having multiple probes per sample team will reduce lag times between sample stations while probes are decontaminated.

11.2 Sample Train Contamination

The Teflon line forming the sample train from the probe to the Tedlar bag should be changed on a daily basis. If visible contamination (soil or water) is drawn into the sampling train, it must be changed immediately. When sampling in highly contaminated areas, the sampling train should be purged with ambient air, via a vacuum pump (e.g, Gilian pump), for approximately 30 seconds between each sample. After purging, the sampling train can be checked using a PID, or other field monitoring device, to establish the cleanliness of the Teflon line.

11.3 PID Calibration and Testing

1) All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan.
2) Equipment checkout and calibration activities must occur prior to sampling/operation, they must be documented.
3) All data must be documented on field data sheets and/or within site logbooks.

11.4 Trip Blanks, Field Blanks, Duplicates, Lot Blanks

The project QA plan needs to define the appropriate level of trip blanks, field blanks, duplicates, and lot blanks to meet the sampling objectives. Typical examples that should be considered in the QA plan development include;

- A trip blank or field blank to detect any sample contamination during shipping and storage.
- A trip standard used to determine any changes in concentrations of the target compounds during the course of the sampling day (e.g., migration through the sample bag, sample degradation, or adsorption to the bag's surface).
- A lot test sample from each lot of Tedlar bags to be used for sampling and checked for possible contamination (filled with ultra-zero grade air) and analyzed.

- A lot test of cleaned SUMMA canisters used for a GC/MS certification check. If the canister passes certification, it is re-evacuated and all canisters from that lot are available for sampling. If the chosen canister is contaminated, the entire lot of SUMMA canisters must be re-cleaned, and a single canister re-analyzed by GC/MS for certification.

12.0 DATA VALIDATION

If the same profile or pattern of VOCs found in the samples is observed in the blanks, the collection method and storage procedures must be evaluated. Depending on the levels observed, the data may be qualified as estimated or not usable (not valid).

13.0 REFERENCES

Gilian Instrument Corp. 1983. Instruction Manual for Hi Flow Sampler: HFS113, HFS 113 T, HFS 113U HFS 113 UT.

International Air Transport Association Dangerous Goods Regulations

New Jersey Department of Environmental Protection. 1992. Field Sampling Procedures Manual.

Rae Systems, Parts per Billion VOC Monitor PGM-7240 Operation and Maintenance Manual

Rae Systems, Technical Note TN-106, PID Correction Factors, Ionization Energies, and Calibration Characteristics

U.S. Environmental Protection Agency. 1984. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods. 2nd ed. EPA-600/4-84-076.

U.S. Environmental Protection Agency. 1995. Superfund Program Representative Sampling Guidance. Volume 2: Air (Short-Term Monitoring). EPA 540-R-95/140.

WELL CONSTRUCTION AND DEVELOPMENT
CALIBRE STANDARD OPERATING PROCEDURES

1.0 POLICY

It is the policy of CALIBRE that any individual engaging in well construction and development at job sites will abide by the procedures outlined in this document. These procedures are designed to meet or exceed guidelines set forth by the Washington Administrative Code (WAC 173-160) or other state agency for monitoring well construction and development.

2.0 PURPOSE

This Standard Operating Procedure (SOP) provides instructions that are to be followed in construction and development of wells.

3.0 WELL CONSTRUCTION MATERIALS

The following materials will be used in the construction of groundwater monitoring wells, soil vapor extraction wells, enhanced reductive dechlorination injection wells, and dual phase extraction wells.

- 2, 4, or 6-inch I.D. schedule 40 PVC flush threaded blank casing
- 2, 4, or 6-inch I.D. schedule 40 PVC slotted casing (screen) of appropriate slot size
- 2, 4, or 6-inch I.D. schedule 40 PVC threaded and slip caps
- Stainless steel well centralizers
- Mild steel protective casing of appropriate diameter
- Locking standpipe cap
- Traffic-rated watertight flush mount well housing enclosure
- Steel bollards
- Locking compression plugs or seals
- Shale trap
- Combination or key lock
- Filter pack sand
- Type I or II Portland cement
- Concrete
- Bentonite powder, pellets, or chips

4.0 WELL DEVELOPMENT EQUIPMENT

The following materials and equipment are needed for development of wells:

- 2, 4, or 6-inch surge block
- Appropriate high volume pump (centrifugal, submersible, etc.)
- DOT approved 55-gallon drums
- Teflon, PVC, or stainless steel bailer with cord or cable

5.0 WELL CONSTRUCTION PROCEDURES

The following steps describe the typical procedure for construction of a groundwater well:

1) All wells are to be constructed in accordance with the regulations of the state in which they are constructed and with ASTM Procedure D-5092.

2) A monitoring well consists of a PVC Schedule 40 well casing, slotted screen, threaded or slip bottom cap, and compression plug. Following completion of the boring, install the monitoring well through the center of the hollow stem auger, drive casing, or open boring. The casing string must be centered in the borehole and held in tension during installation. Other types of wells are similar with additional components as shown on the design diagrams.

3) Place clean, well graded silica sand around the well screen to serve as the filter pack. The grade of the sand is chosen on the basis of the aquifer units encountered. The filter pack is emplaced as the auger or temporary casing is withdrawn from the boring. Caution must be taken to prevent the sand from bridging when it is being emplaced. The filter pack must extend a little above the top of the screen.

4) Place a 2-foot to 3-foot thick pellet or chipped bentonite seal above the sand pack as the auger or casing is withdrawn. Bentonite seals should not be placed in the vadose zone as they will desiccate, losing their ability to seal. If the screen extends into the vadose zone, use a tremie pipe to slurry in Portland cement for the seal.

5) Fill the remainder of the annulus between the well casing and the borehole with cement/bentonite grout (approximately 5% bentonite) or a high-solids bentonite slurry (11 – 13 pounds per gallon) to the approximate depth of frost penetration, or no higher than one foot below ground surface. If the water level is higher than the seal, use a tremie pipe to place the grout. At depths greater than 15 feet, use of a tremie pipe is advisable.

6) Install either a threaded cap or a locking watertight compression seal on the monitoring well.

7) Place a protective steel casing with locking cap over the well casing set in concrete to a depth approximately equal to frost penetration or at least two feet below ground surface. In traffic areas, place a traffic-rated flush mount enclosure over the well set in concrete. The top of the flush mount should be approximately one inch above grade to prevent runoff from entering the well. A concrete apron should be constructed to grade down to the existing asphalt or concrete surface.

8) For above ground completions, ensure that the well casing extends two to three feet above ground and is surrounded by traffic bollards set three feet deep in concrete.

6.0 WELL DEVELOPMENT PROCEDURES

The following steps describe the typical procedure for construction of a groundwater well:

1) Prior to development, measure the depth in each well to static water level and total casing depth to a mark on the top of the well casing. Well development should not commence until 24 hours after completion of well construction to allow for grout and concrete to cure.

2) Each well development cycle consists of surging and pumping. Surging should consist of a minimum of ten surges with an appropriately sized surge block over the full length of the screen. In the case where the screen extends to above the water table, water may have to be added to the well to develop the top of the filter pack.

3) After surging, water is pumped out of the well until the pumped stream starts to clear. At that point, stop pumping and initiate another surge cycle. When the pumped water clears substantially in less than a minute, the well may be deemed to be developed. Perform a minimum of three surge and pump cycles.

4) Surging should not be performed on wells completed in fine-grained materials due to the potential for formation erosion.

5) During development of each well and at the completion of development, record the following field parameters and observations:

   - Depth to water
   - Development time and volume
   - Development flow rate
   - Other observations (color, odors, sheen)

7.0 WELL CONSTRUCTION AND DEVELOPMENT WASTE

Place all drill cuttings and development water in appropriately labeled DOT approved drums for characterization and proper disposal by client.

Boeing Plant 2
Seattle/Tukwila, Washington

North and South Sheetpiles in the 2-10 Building Interim Measure Work Plan (AOC 2-10.3A and AOC 2-10.4A)

Phase 1: Data Collection

Appendix C
Health and Safety Plan

AGENCY REVIEW DRAFT

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Abbreviations and Acronyms

Acronym/Abbreviation	Definition
ACGIH	American Conference of Governmental Industrial Hygienists
AOC	Area of Concern
APR	Air-Purifying Respirator
bgs	Below ground surface
CFR	Code of Federal Regulations
DCE	Dichloroethene
Ecology	Washington State Department of Ecology
FID	Organic Vapor Analyzer
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSO	Health and Safety Officer
IDLH	Immediately dangerous to life and health
MTCA	Model Toxics Control Act
MSDS	Material Safety Data Sheet
MUL	Maximum use level
NIOSH	National Institute for Occupational Safety and Health
PCE	Tetrachloroethene
PEL	Permissible exposure limit
PID	Photo Ionization Detector
PM	Project Manager
PPE	Personal protective equipment
PVC	Polyvinyl chloride
QAPP	Quality Assurance Project Plan
OSHA	Occupational Safety and Health Administration
SAP	Sampling and Analysis Plan
SCBA	Self-contained breathing apparatus
SSO	Site Safety Officer
SVOC	Semivolatile organic compound

Acronym/Abbreviation	Definition
TBD	To Be Determined
TCE	Trichloroethene
TCLP	Toxic Characteristic Leaching Procedure
TLV	Threshold Limit Value
USEPA	U.S. Environmental Protection Agency
VC	Vinyl chloride
VOC	Volatile organic compound
WAC	Washington Administrative Code

1.0 Health and Safety Plan

1.1 INTRODUCTION AND OBJECTIVES

CALIBRE and Floyd|Snider have developed this Health and Safety Plan (HASP) defining the requirements to allow employees to safely conduct investigation activities, groundwater monitoring, and installing and operating groundwater remediation systems at the Boeing Plant 2, 2-10 Sheetpile site in Seattle, Washington (Figure 1.1). This plan has been prepared in accordance with CALIBRE's Corporate Health and Safety Program Plan (CALIBRE 2006) and Floyd|Snider's Corporate Health and Safety Program.

The Boeing Plant 2 (Plant 2) 2-10 North and South (N/S) Sheetpile site consists of a groundwater plume containing primarily the volatile organic compounds (VOCs) trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and vinyl chloride (VC). The VOC plume is predominantly contained within the two sheetpile enclosures. The Duwamish Waterway is located approximately 165 feet southwest of the Boeing Plant 2, 2-10 Sheetpile areas.

The protection of employees, subcontractors, and the public is the first concern during activities at contaminated sites. Health and safety concerns that require evaluation and mitigation at the 2-10 N/S Sheetpile area site include well drilling and construction, direct-push borings and sampling, operation of remedial systems, groundwater monitoring, site security, toxic, flammable and/or oxygen deficient atmospheres; electrical hazards; compressed gases; noise; traffic and heavy equipment operation; and other physical hazards.

1.2 HEALTH AND SAFETY ORGANIZATION AND KEY PERSONNEL

The IM Project Manager (PM) and Site Manager (SM), Mr. Tom McKeon of CALIBRE, will assign a field operations manager for each task. The field operations manager will be responsible for ensuring full implementation of the appropriate requirements of this plan. The field operations manager will also assign one qualified staff member as the site safety officer (SSO) for the duration of each project task involving field work on-site. The SSO will have responsibility for day-to-day implementation of the safety program at that site. The corporate safety manager will provide technical assistance to the PM and SSO to comply with the health and safety requirements of this plan.

In the event that unexpected conditions that pose health and safety concerns are encountered during field operations, the SSO will suspend work until appropriate modifications to the safety plan are prepared. The SSO will immediately notify the installation PM in the event of such a work suspension. If the SSO and the IM PM do not concur on either the need for the work suspension or the apparent required modification(s) to the safety plan, the SSO and the IM PM will immediately contact the corporate safety manager for resolution of the issue.

Subcontractors will be responsible for implementing their own safety program and providing their own protective equipment in accordance with the requirements of this plan and their own corporate health and safety program.

1.3 HAZARD ASSESSMENT

The procedures for investigative activities, including soil and groundwater sampling, direct-push sampling, well drilling and installation, and installing and operating various remediation systems are presented in the Standard Operating Procedures (SOPs) as an attachment to Appendix B, QAPP.

General safety concerns and apparent hazards associated with each field task are discussed in the following sections. Note that this procedural discussion presumes that contaminant source control (e.g., tank removal, free product recovery, etc.) already has been successfully implemented prior to on-site field work.

1.3.1 Slip, Trip, and Fall Hazards

Slipping, tripping, and falling in the field are common causes of injuries to personnel. These hazards can be minimized by awareness and alertness on the part of employees. All personnel should wear proper footwear (e.g., leather or rubber work boots with traction soles) to minimize slipping. The PM and SSO must ensure that employees follow good housekeeping practices to prevent development of these hazards. During site preparation, trip and fall hazards should be removed, or, in the case of unmovable objects (e.g., surface pipelines, etc.), the hazards should be clearly marked and identified.

1.3.2 Weather Related/Heat Stress Hazards

Common sense must prevail when assessing weather conditions. In conditions of extreme heat, the SSO must ensure that all personnel drink adequate quantities of liquids (e.g., 1 to 2 gallons of water per person per day) and adjust the work schedule to prevent heat stress. An area near the site will be used as a shaded cool-down location for breaks. Whenever impervious clothing is in use, the threat of heat stress among field staff increases dramatically. Workers can suffer heat stress in relatively low temperatures when wearing impervious clothing. All staff must be alert for the signs of heat stress in themselves and other staff. Personnel working in impermeable protective clothing are to be monitored whenever ambient temperatures exceed 70 degrees F. A thermometer with disposable covers will be included in the Site first aid kit. Personnel whose oral temperatures exceed 100.4 degrees F will discontinue working until their temperatures return to a normal range of approximately 96.8 degrees F to 100.4 degrees F.

If winter conditions create potential hazards due to inclement cold weather, site personnel will bring rain suits to the Site and wear adequately layered/insulated clothing for protection. If cold conditions warrant it, personnel will be instructed to seek warm shelter from the weather (either in a heated car or in a building).

If dangerous adverse weather conditions such as electrical storms, high winds, or heavy rain create conditions which make field activities unsafe, the SSO will terminate field work until conditions improve.

1.3.3 Chemical Exposure Hazards

The primary chemical hazards expected to be present at the Site are VOCs (refer to Section 9.0 for specific compounds, concentrations, and action levels). In addition to the VOCs in groundwater that are the focus of Site investigations and remedial actions, contaminants may include metals, or VOCs in soils, metals dissolved in surface or groundwater, free volatiles in the atmosphere, reactive chemicals in drums and tanks, etc. Potential chemical hazards experienced by field personnel fall into three major categories: process chemicals, waste chemicals, and naturally-occurring chemicals. Personnel involved in field operations may encounter any or all of these types of chemicals simultaneously. Field personnel should be able to recognize potential chemical hazard conditions and take appropriate precautions. These precautions include respiratory protection, dermal protection, and control of equipment contamination. This discussion is not intended to be a detailed statement of chemical hazard protection, but rather a presentation of the types of situations where chemical hazards may be encountered. Field personnel should not work in potential chemical hazard areas unless they are fully trained in evaluating chemical hazards and taking appropriate protective measures, and are adequately equipped with personal protective equipment.

All field personnel must have a working knowledge of the levels of hazard associated with various concentrations of chemicals to which exposure is possible. These benchmark concentrations include:

- Immediately Dangerous to Life and Health (IDLH)—Exposure of unprotected workers to IDLH concentrations will result in death or serious, permanent, injury.
- Permissible Exposure Limit (PEL) and Threshold Limit Value (TLV)—In general, PELs and TLVs are time-weighted average concentrations to which a worker may be exposed for 8 hours per day, 40 hours per week, and experience no detrimental health effects (published by the National Institute for Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH), respectively).
- Action Level—the concentration of COCs, that, when encountered, results in a specified, pre-determined response from field personnel. Such a response may include donning air-purifying respirators (APRs), exchanging APR for self-contained breathing apparatus (SCBA), or evacuation of the area. Action levels and appropriate responses are specified in Section 8.5.2 of this plan.
- Maximum Use Level (MUL)—the maximum concentration of a specific chemical for which a specific respiratory protection device will provide adequate worker protection.

For specific chemical products used during sampling and system operations (e.g., sample preservatives, acids), personnel must obtain and review the appropriate material safety data sheets (MSDS) for those products.

1.3.4 Site Preparation Hazards

Hazards associated with site preparation activities are primarily physical hazards. A summary of common site preparation hazards for installation of remedial systems, well drilling, groundwater monitoring, and direct-push sampling are summarized in the table below.

1.3.5 Well Construction and Direct-Push Hazards

Well drilling, construction, and direct-push borings will be performed by a drilling subcontractor licensed to perform such work in the State of Washington. Hazards common to well drilling and construction and direct-push sampling can be found in the Hazards Summary Chart, below. Drilling and boring operations will require area controls in the vicinity of the drill rig to keep non-essential personnel at a safe distance (traffic cones and flagging).

Hazards Summary

Hazard	Description
Site Preparation Hazards	Electrical and telephone utility installation
	Placement of temporary project support facilities
Well Construction and Direct-Push Hazards	Overhead hazards from drill rig
	Mechanical hazards of drilling and excavation
	Slope/cave-in hazards of excavation
	VOC exposure hazards when drilling or sampling (vapor, soil, or water)
	Underground and overhead utilities
Facility Installation Hazards	Mobilization/setup of the mechanical systems trailer
	Pressure and vacuum hazards of air and vacuum lines
	Electrical hazards

Hazard	Description
System Operation Hazards	VOCs in off-gas
	Pressure and vacuum in air supply lines
	High voltage in controls system
	High pressure gas bottles
Chemical Exposure Hazards	Acid used as pH control in sample preservation and/or injected into wells
	VOCs in water, soil, and air
	Other nutrients added to injection system (e.g., sucrose, lactate, baking soda, other)
Slip, Trip, and Fall Hazards	Slippery surfaces
	Surface pipes/hoses as tripping hazards
	Falling from ladders, steps or elevated platforms
Weather Related/Heat Stress Hazards	Dehydration due to loss of fluids
	Elevated body temperature due to work in hot conditions
	Working in impermeable clothing
	Hypothermia from exposure in cold conditions
	Dangerous weather conditions (electrical storms, ice)

1.3.6 Remedial System Installation Hazards

Installation of above-ground facilities for a remedial system, such as an in-well stripping system, involves the placement of blowers and air stream treatment systems and assembly of air supply distribution lines and vacuum lines between the well(s) and the blowers and treatment system. This activity will require placing and leveling of an equipment trailer for motors, blowers, and controls. Air and vacuum lines from the wells to the trailer will be placed at the ground surface. Electrical connections completed between the equipment trailer and the utility line must be made by a licensed electrician. Additional electrical wiring may be required to connect system monitoring devices in the wells. Facility installation hazards are listed in the above table.

1.3.7 Remedial System Start-up, Operation, and Maintenance Hazards

System start-up will involve testing the operation of mechanical systems and testing all air and vacuum distribution lines for tightness and function. When all of the mechanical systems are confirmed to be operational, the final connections will be made at the well head and the system will be started. The system will be monitored regularly during the initial startup period. During

this time the operators will observe the function of all systems and confirm proper system operation.

Operation and maintenance of the system will include routine service of the blower system per the manufacturer's recommendations. The air stream treatment system will require routine service and maintenance based on the type of treatment installed (e.g., granular activated carbon). During operation and maintenance activities, personnel must be aware that the air stream and treatment system (particularly sorptive systems, such as granular activated carbon) may contain relatively high concentrations of the COCs (e.g., VOCs such as TCE, DCE, VC, and others). These compounds are toxic and precautions will be necessary to minimize employee exposures to them. Change-out of carbon sorption systems will require the use of a forklift or other heavy equipment. Maintenance of a well may require a drill rig or pump service rig for removal of the down-hole devices.

The process equipment trailer, while not technically a confined space, must be allowed to ventilate prior to entry. The contaminant concentration in the air stream from the vapor extraction well(s) may be greater than exposure limits. Because of the potential for piping or other air conveyance system in the trailer to develop a leak, the air in the trailer will be allowed to ventilate prior to entry. Any potential confined space entry requires a confined space permit that will be developed on a site-specific basis prior to the entry.

2.0 Procedures and Practices to Limit Exposure Potential

The following procedures and practices should be used for all field activities at the Site, including drilling, well construction, direct-push sampling, groundwater monitoring, and other field activities as appropriate.

2.1 ENGINEERING CONTROLS

The installation project manager and SSO will evaluate the need for engineered controls to reduce exposures to airborne contaminants before initiating upgraded respiratory protection programs. Engineered controls can be as simple as setting up a drill rig or conducting soil or groundwater sampling so that personnel are working on the upwind side. Alternative engineered controls include the use of enhanced ventilation at a work site (e.g., the use of electric fans) to reduce contaminant concentration by dilution, where appropriate. Enhanced ventilation is particularly useful around drill rigs and bore holes. Shielding may be used in some instances to protect workers from contaminants. Shielding can work by physically deflecting a flow of contaminants away from workers, or, as in the case of ionizing radiation, the shielding can physically reduce the amount of radiation reaching the workers. Exposures can also be reduced by drumming, or otherwise containerizing contaminated drill cuttings or other materials.

When drilling in areas of known or suspected high levels of subsurface contamination, the SSO will ensure that the drillers have sufficient bentonite plug material available to securely plug the bore hole in the event of a discharge of high levels of volatiles or other air borne contaminants.

2.2 CONTAMINATION AVOIDANCE

Most casual chemical exposures can be prevented by individual employees through contamination avoidance. The following practices will minimize the potential for casual exposure:

1. No unauthorized personnel will be allowed to enter areas of known or suspected environmental contamination.
2. All personnel will practice good personal hygiene during field operations. This includes washing face and hands after leaving any work area and before eating. Dirty and potentially contaminated work clothing will be decontaminated at the site and cleaned before re-use.
3. No personnel will be allowed to eat, chew gum or tobacco, or smoke in any area of known or suspected contamination.
4. All personnel and equipment will be decontaminated when leaving any area of known or suspected contamination.

2.3 PERSONAL PROTECTIVE EQUIPMENT

All personnel will use appropriate personal protective equipment (PPE) to prevent injury and chemical exposure when working in areas of known or suspected contamination. Although a wide variety of PPE is available from many manufacturers, experience has shown that maintaining a specific inventory of versatile equipment will enhance employee safety. The following equipment will be available on-site for use when appropriate:

- Approved hard hat
- Safety glasses (with side shields) or goggles
- Approved hearing protection (e.g., muffs or ear plugs)
- Neoprene, nitrile/latex, and/or leather gloves
- Steel toe work boots
- High visibility coveralls, jacket, or vest
- Impermeable coveralls (e.g., Tyvek or Saranex)

The selection of PPE requirements will depend on the task and chemical hazards present (refer to Section 9.0 for action levels). This equipment may include both enhanced dermal protection and respiratory protection.

2.3.1 Dermal Protection

Dermal protection (i.e., protection of the skin) will be provided by using appropriate protective clothing. General site construction work will be performed wearing work boots and leather gloves. This level of PPE is appropriate where no splash hazards exist and potential exposures are limited to concentrations of chemicals below established exposure limits.

When working with highly-contaminated soils or water, personnel will wear impermeable coveralls, impermeable gloves (neoprene or nitrile/latex), and impermeable footwear. The garment joints at wrist and ankle will be sealed to the gloves and footwear with tape. For work with most soils and dilute aqueous solutions, the recommended garment is Saranex-coated Tyvek. This material is available in a wide variety of sizes and configurations. Recommended gloves are inner gloves of thin nitrile or latex rubber, with outer gloves of neoprene rubber. These materials are appropriate for most contaminated soils and dilute aqueous solutions. Required footwear is steel-toed boots made of either neoprene rubber or polyvinyl chloride (PVC). Both of these materials are highly resistant to most contaminants. The PM and SSO will assess the compatibility of these recommended materials with site contaminants and determine the need for modifications in PPE requirements.

Employees must be aware of, and alert for, the signs of heat stress that may be associated with the use of any impermeable garment. These garments reduce the body's natural ability to dissipate excess body heat and un-monitored exertion when wearing them can result in severe heat stress.

If splash hazards exist, additional splash protection may be required. This may include full-face shields over goggles or respirators, and the use of special chemical splash suits.

2.3.2 Respiratory Protection

Project staff are expected to perform most system installation work in Level D respiratory protection (i.e., no respiratory protection equipment required with routine air monitoring). Occasionally, the use of Level C protection (i.e., air purifying respirators) may be required. Field personnel will keep APRs at the work site for use if Level C action levels are exceeded. Level A or B protection (i.e., self-contained or supplied air breathing apparatus) is not expected to be required on this site.

Appropriate respiratory protection will be used by employees whenever the concentration of airborne chemicals in the workers' breathing zone exceeds the action levels defined in Section 4.0. Workers will keep to the upwind side of possible airborne contaminant sources whenever possible. A flag or ribbon will be posted at each work area to indicate the wind direction.

When APRs are required, employees will use either MSA full-face Ultra-Twin or Advantage 1000 respirators equipped with appropriate approved cartridges. If an employee cannot be fitted in either of these APRs, then they may wear another comparable respirator that provides proper fit. Half mask APRs will not be used unless specific site conditions pose increased hazards if full-face APRs are used (e.g., under some weather conditions, fogging of APR face pieces may occur, causing reduced visibility and increased risk of injury). Under such conditions, half-face APRs may be used if they provide adequate protection and can be used with face shields to provide full dermal coverage. All personnel using APRs must be FIT tested prior to using respiratory protection equipment and have clearance by a medical professional to wear a respirator.

2.3.3 Area Access Controls

Whenever specific dangerous activities are occurring as part of the planned work, access controls will be used to demarcate areas where only essential project personnel may enter. When drill rigs are operating the controlled access area will be an area around the rig with a radius at least as high as the mast on the drill rig (where feasible). The controlled access area will be marked with cones and a high visibility tape. Site personnel will also be responsible to notify any other workers in the immediate vicinity of the controlled access area. Passage into and out of the controlled access area will be through a zone with appropriate decontamination facilities as necessary.

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3.0 Personnel and Subcontractor Training

All personnel assigned to field implementation of environmental restoration projects have completed, at a minimum, the appropriate formal training courses and maintained the appropriate refresher training. The Occupational Safety and Health Administration (OSHA) has determined that activities related to investigation and restoration activities potential and known hazardous waste sites (e.g., CERCLA or Superfund sites), fall under the scope of 29 CFR 1910.120. That standard requires 40 hours of initial training of the Hazardous Waste Operations and Emergency Response (HAZWOPER) and 8 hours annual refresher training, plus three days supervised on-site training for workers. An additional 8 hours of training are required for supervisors.

All subcontractor personnel will have completed the minimum training in compliance with 29 CFR 1910.120, as appropriate, in addition to any requirements specified by other regulations, or this plan.

Daily safety meetings, detailing specific hazards of the work to be performed and safety precautions and procedures for each project task, will be conducted by the SSO at the beginning of each shift and will be documented in writing.

The SSO will record the credentials of all on-site personnel. In order to be qualified for duty in exclusion zones or any other area where there is a potential for exposure to chemical contaminants, the following items must be current (i.e., conducted within the last 12 months preceding the expected date of completion of field operations):

- 8-Hour Annual Refresher Training (if 40-hour training was received more than 12 months prior);
- Respirator Fit Test and medical clearance (if APR are used).

Copies of all training and FIT testing will be presented by personnel and kept on file.

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4.0 Site Monitoring

Air monitoring will be an essential element of site safety for all field activities where there exists potential for exposure to airborne contaminants. The nature of the site contaminants (i.e., VOCs) indicates the need for a rigorous air monitoring program during specific phases of field work. Well drilling and construction, direct-push sampling, and remedial operations may be conducted in areas of elevated concentrations of volatile contaminants in groundwater and possibly soil.

The specific air monitoring requirements that are appropriate will depend on the conditions encountered and the type of work to be completed. A sample checklist for activity specific monitoring requirements is listed in Section 8. A summary of the action levels associated with different monitoring parameters is presented in the chart Monitoring Equipment and Action Levels, below. The project manager and SSO will confirm that the appropriate required air monitoring instruments are identified in the safety plan and are made available and used properly during site operations. All air monitoring instruments will be operated in accordance with manufacturer's operating instructions. All monitoring instruments used during installation and operation activities will be intrinsically safe.

For specific chemicals, three action levels will be defined, based on the need for enhanced respiratory protection. The initial action level will be 50 percent of the exposure limit measured in the breathing zone of the site workers. At the initial action level (also known as the Level C action level), the on-site personnel will take the appropriate response with enhanced personal protective equipment or modified work practices (e.g., engineered controls such as enhanced ventilation) to prevent worker exposures above the action level. The response to the initial action level will generally be the use of air-purifying respirators (provided that the SSO has determined that an appropriate, approved respirator is available). At this time, the SSO will also assess the need for enhanced dermal protection.

The second action level for respiratory protection will be specified at 50 percent of the maximum use limit of the appropriate air-purifying respirator, measured in the site workers' breathing zone for a minimum period of 15 minutes. At this action level (also known as the Level B action level), the SSO will assess the practicality of enhancing engineered controls (e.g., ventilation) to reduce concentrations. This plan will be modified if supplied air or self-contained breathing apparatus is required for site workers.

At any time during site operations when any action level is exceeded, the SSO will immediately implement additional air monitoring at the work area, or exclusion zone boundary to ensure that the initial, or Level D, action level is not exceeded at the boundary. If the Level D action level is exceeded at the boundary of the exclusion zone, the SSO will enlarge the exclusion zone adequately to prevent exposure of unprotected individuals.

Monitoring Equipment and Action Levels

Monitoring Equipment	Readings[1]	Action
Explosimeter	< 5 % Lower explosive limit (LEL)	Continue with caution
	5-15 % LEL	Implement mechanical control measures such as forced ventilation, continue with caution
	> 15 % LEL	Stop work and evacuate area until readings are below 10 %LEL
Oxygen (O_2) meter	19.5–21% O_2	Continue operations
	Needle deflects upward then drops to zero	Stop work and evacuate area until readings are approximately 20% O_2
	< 19.5% O_2	Stop work and evacuate area until readings are approximately 20% O_2
	> 21% O_2	Stop work and evacuate area until readings are approximately 20% O_2
PID	< 1 ppmv	Continue operations in level D PPE
	>1 and < 10 ppmv intermittent	Upgrade to Level C PPE. Identify VOC type with colorimetric detector tube and attempt to locate source; monitor continuously. Resume work only if detector tube indicates VOC below PEL in breathing zone (refer to Section 9). Use engineered controls if necessary.
	> 10 ppmv	Stop operations, evacuate area.
Sound Level Meter	85 dBA	Continue operations
	> 85 dBA	Wear hearing protection to attenuate noise level below 85 dBA
	> 120 dBA	Continue operations if hearing protection attenuates noise levels below 85 dBA; continue to monitor, implement acoustical control measures (noise buffers)

Note:

1 All readings are greater than background and taken in the breathing/hearing zone of field personnel.

Abbreviations:

dBA Decibels
Ppmv Parts per million by volume

Routine air monitoring of the workers' breathing zone will be conducted every 30 minutes under all levels of protection. If odors or irritation of eyes or mucous membranes are noted by any

personnel, work will be suspended and monitoring performed immediately to ensure the proper level of protection. Additional monitoring will be conducted during drilling when sample cores or sampling devices are tripped from the boring.

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5.0 Medical Surveillance

Workers will be instructed to report any illness or physical discomfort to the SSO, who will evaluate the situation and take appropriate action. Physiological reactions to solvents (characterized by dizziness and nausea) are grounds to remove the affected worker from the work site and have the worker undergo medical surveillance and clearance by a physician. Air monitoring of a site will be performed and documented after air-borne exposure episodes occur, and respiratory protective equipment will be upgraded as necessary.

Another potential medical hazard is heat stroke in hot weather and frostbite in cold weather. Workers should be aware of the symptoms of the on-set of both of these ailments. A shaded area and drinking water will be made available at the site during hot weather, and a heating hut or similar provisions should be nearby in the winter. All medical episodes will be recorded.

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6.0 Decontamination and Disposal Procedures

6.1 CONTAMINATION PREVENTION

One of the most important aspects of decontamination is the prevention of contamination. Good contamination prevention should minimize worker exposure and help ensure valid sample results by precluding cross-contamination. Procedures for contamination avoidance include the following precautions:

- Do not walk through areas of obvious or known contamination.
- Do not handle or touch contaminated materials directly.
- Make sure all personal protective equipment has no cuts or tears prior to donning.
- Fasten all closures on suits, covering with tape, if necessary.
- Take particular care to protect any skin injuries.
- Stay upwind of airborne contaminants.
- Do not carry cigarettes, gum, etc. into contaminated areas.

Equipment and Samples

- Take care to limit the amount of contamination that comes in contact with heavy equipment and vehicles.
- If contaminated tools are to be placed on non-contaminated equipment/vehicles for transport to the decontamination pad, use plastic to keep the equipment clean.
- Bag sample containers prior to emplacement of sample material.

The PM and SSO will specify the decontamination requirements for personnel and equipment to be implemented for each task. The exclusion zone and the work site in general must include an established support area and personnel and equipment decontamination areas. The minimum decontamination that will be required for all field operations will consist of Level D decontamination as described below.

6.2 DECONTAMINATION

The majority of field activities and sampling are expected to be conducted using Level D PPE. Decontamination for activities requiring Level D protection will consist of the following (note that not all of the equipment described below must be used for Level D PPE):

- Remove gloves and dispose of gloves
- Remove, wash, and rinse hard hat (if soiled)
- Remove, wash, and rinse goggles

- Remove safety boots or shoes
- Wash and rinse face and hands

Although unlikely, if an upgrade to Level C is required, more extensive decontamination will also be required as described in the following table.

Minimum Decontamination Measures for Level C Personal Protective Equipment

Station Number	Operation	Procedure
1	Equipment Drop	Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, a cool down station may be set up within this area.
2	Outer Garment, Boots, and Gloves Wash and Rinse	Scrub outer boots, outer gloves, and splash suit with decontamination solution or detergent water. Rinse off using copious amounts of water.
3	Outer Boot and Glove Removal	Remove outer boots and gloves. Deposit in container with plastic liner.
4	Canister or Mask Change	If worker leaves exclusion zone to change canister or mask, this is the last step in the decontamination procedure. Worker's canister or mask is exchanged, new outer gloves and boot covers donned, joints taped, and worker returns to duty.
5	Boot, Glove, and Outer Garment Removal	Boots, chemical-resistant splash suit, and inner gloves are removed and deposited in separate containers lined with plastic.
6	Face Piece Removal	Face piece is removed. Avoid touching face piece with fingers. Face piece deposited on plastic sheet.
7	Field Wash	Hands and face are thoroughly washed. Shower as soon as possible.

Personnel decontamination corridors will be established at each exclusion zone. All personnel will decontaminate when leaving the exclusion zone.

Vehicle and large equipment decontamination generally requires construction of a temporary or permanent decontamination station. A simple containment may be built of heavy-gauge polyethylene sheeting over a solid base surrounded by wood blocks (such as railroad ties) to form a full containment area. After equipment cleaning, decontamination solutions from the pad will be pumped into drums at the side of the pad. Equipment and vehicle decontamination generally consists of pressure washing with detergent solution followed by potable water rinse.

6.3 DISPOSAL

The project manager will make arrangements for proper disposal of all waste materials generated at the site during all field activities. It is the project policy that the disposal of any hazardous wastes generated during remedial actions at a client's facility is the responsibility of the client. Three categories of waste may be generated during an installation:

1. Non-regulated solid waste
2. Undesignated solid waste that may be regulated
3. Designated regulated waste

CALIBRE and Floyd|Snider personnel will segregate all non-regulated solid waste materials from regulated or potentially-regulated materials. Field personnel will maintain clearly-identified containers for each of the three categories of waste. The project manager will ensure that drums and other containers of regulated or potentially-regulated materials are clearly labeled with the contents. The project manager will ensure that all containers of potentially-regulated materials are sampled and analyzed prior to determination of the designation of the wastes as regulated or non-regulated.

Non-regulated dry solid wastes will be disposed properly by packaging them in garbage bags and disposing of them as instructed by the facility operator (e.g., in a facility dumpster if available, or transporting them to the nearest solid waste disposal facility). Specific requirements for used and decontaminated disposable PPE (e.g., coveralls and gloves) are to cut the items into pieces (e.g., cut off arms and legs of coveralls and bisect the torsos, cut used rubber gloves in half) to prevent scavenging and re-use, bag the items, and dispose as solid waste. Heavily contaminated personal protective equipment may require sampling and analysis prior to designation. Non-regulated aqueous waste materials will be disposed to the facility sanitary sewer, providing the wastes meet any pre-treatment standards or other requirements. The project manager will confirm the requirements for discharge of aqueous materials to the facility sewers.

All purge water and/or decontamination solutions will be containerized and sampled prior to disposal if contaminants are known or suspected to be present in the solutions. Sampling and analysis will be conducted to determine if the solutions contain regulated contaminants that would cause the solutions to be regulated as hazardous waste. Because the solutions are generally aqueous solutions with some suspended particulates, the most appropriate analysis will be the Toxic Characteristic Leaching Procedure (TCLP) with analysis of the extract for the site-specific contaminants of concern.

No wastes, either regulated or non-regulated, will be disposed on-site by burial, burning, or discharge to any water body.

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7.0 Emergency Procedures and Contacts

The following general emergency procedures are applicable to almost every activity:

In the event of personnel exposure to hazardous materials, all work will stop immediately, and all personnel will assemble at the support area. Procedures for specific types of exposure are as follows:

- Skin Contact—flush the area with copious quantities of cold water for at least 15 minutes. Do not let contamination spread to other personnel. Seek medical attention. If injuries are severe, summon an ambulance.
- Eye Contact—wash/rinse affected area for at least 15 minutes. An emergency eye wash system will be present on-site. Seek medical attention.
- Inhalation—remove the person from further exposure. Summon an ambulance, contact the hospital, and be prepared to provide respiratory support if the person has difficulty breathing.
- Ingestion—dilute the material with large quantities of water. Summon an ambulance and contact the hospital or poison control center immediately for further instructions.

In the event of personal injury at the site, all work will stop and first aid will be rendered as needed. If necessary, call an ambulance using the local ambulance number listed in the emergency information section of the plan.

In the event of potential or actual fire or explosion, or actual uncontrolled release of hazardous materials, all work will stop and all personnel will evacuate the site to the upwind direction. Call the local fire department and/or HazMat team and notify other personnel at the site and neighboring locations. If a fire is small and appears to be readily contained, personnel should use the on-site fire-fighting equipment (e.g., fire extinguishers, shovels, or water, as appropriate) to extinguish the fire. If the fire is extensive, or involves structures or vehicles, personnel will evacuate the site, warning the occupants of neighboring facilities, and await the arrival of fire department personnel. Site workers will provide fire department personnel with as much information regarding the fire as possible. Critical information required by the fire department upon arrival will include the nature, location, and type of any hazardous or flammable materials present and any other hazards present.

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8.0 Site-specific Health and Safety

8.1 SITE IDENTIFICATION AND PROJECT MANAGEMENT

The site information is given in the chart below.

Site Identification

Project Number	CALIBRE # MM002001
Site Name	Boeing Plant 2, 2-10 Sheetpile Site
Site Address	The Boeing Company 7755 East Marginal Way South Seattle, WA 98108
Contact Person for Boeing Plant 2, 2-10 N/S Sheetpile Site	Jennifer Parsons
Planned work dates: Start: August 2009 Stop: 2012	

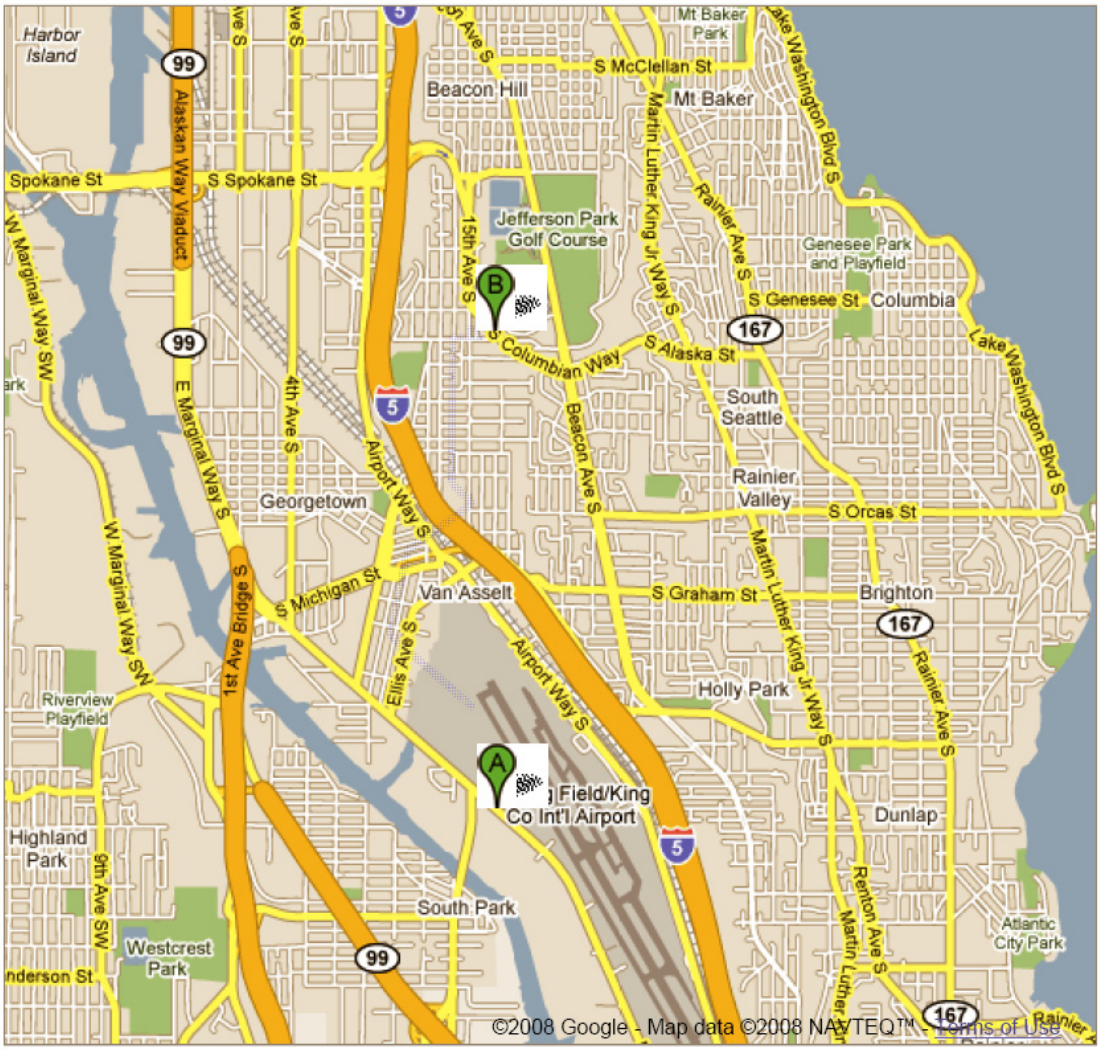
Project management responsibilities are given in the chart below.

Project Management Assignments			
Personnel	**Position**	**Telephone**	**Responsibility**
Teri Floyd	Floyd|Snider Oversight Manager	(206)292-2078	Project Management and Oversight
John Frerich	CALIBRE Health and Safety Officer	(425)226-6435	Task Management and Oversight and Corporate Health and Safety
Tom McKeon	CALIBRE PM and Site Manager	(425)643-4634	Planning, design, and scheduling
Grant Dawson	The Field Supervisor (FS) and Field Engineer/Scientist (FES)	(253)277-0739	Management of field operations, also including Health and Safety

8.2 SITE EMERGENCY INFORMATION FORM

Company or Emergency Agency	Action
For Boeing Plant 2 property, 2-10 Sheetpile Site	(206) 655-2222 Provide the location of the Boeing Plant 2 2-10 Sheetpile Site: Building 2-10 7755 East Marginal Way South Seattle, WA 98103
Fire/Rescue/Ambulance/Police	(206) 655-2222—Boeing Emergency Number
Veterans Affairs Medical Center 1660 S Columbian Way, Seattle 98108	(206) 762 1010 (refer to attached map)
Directions to Hospital: 1. Turn **NORTHWEST** onto East Marginal Way South, 2. Turn **RIGHT** at Ellis Ave S, 3. **Continue** on South Albro Place, 4. Turn **LEFT** at Swift Ave South, 5. **Continue** on 15th Ave South, 6. Turn **RIGHT** at South Snoqualmie Street, 7. End by taking a **SHARP LEFT** onto S Columbia Way. Distance is about 2.6 miles and takes ~8 minutes to drive.	
Utilities	(800) 424-5555
In case of emergency, also notify	CALIBRE Health and Safety Officer, John Frerich (425) 226-6435

8.3 MEDICAL FACILITY ACCESS ROUTE MAP



8.4 SITE CHARACTERIZATION FORM

8.4.1 General

Estimated Volume: N/A, the Site is within a large groundwater plume			
Potential Hazards: Check all that apply			
	Product		Lead hazard
	Waste	X	Flammable
X	Liquid		Corrosive
	Sludge		Reactive
X	Solid	X	Toxic
Other: Site groundwater contains VOCs, soil/drill cuttings are expected to contain VOCs			
Compounds expected include: TCE, DCE, and VC			

8.4.2 Utilities

Utilities	Telephone	Date Cleared	Utility Present? (Y/N)
Electric Company	1-800-424-5554		
Water Company			
Gas Company			
Phone Company			
Facility Drawings Reviewed for Underground Structures/Utilities? (Y/N?)			

8.5 PROTECTIVE EQUIPMENT

8.5.1 Minimum Personal Protective Equipment

The following is required on-site PPE:

- Hard hat
- Safety glasses/goggles
- Steel toe/shank boots
- Coveralls or work clothes
- Hearing protection
- Leather gloves

8.5.2 Protective Equipment by Task

Fill out this section for each task. Complete additional sheets as needed.

Task # _____

Respiratory Equipment Form

Respiratory Protection Required? No Refer to Air Monitoring Action Levels, Section 8.5.2.

Check all that apply:	✓		
SCBA			
Airline			
Airline with Egress			
Air purifying respirator (FF)	✓On-site	Cartridges	Organic Vapor
Air purifying respirator (HF)		Cartridges	
Gas Mask or Powered APR for Level C		Cartridges	

Protective Clothing Form

Protective Clothing Required? Yes, if there is a potential for contact with contaminants in air, water, or soil.

Protective Clothing Form						
Check all that apply:						
Heavy Splash Suit	PVC		Neoprene		Other	
Medium Splash Suit	PVC		Neoprene		Other	
Light Splash Suit	PVC		Neoprene		Other	
	Tyvek	✓	Saranex		PE	
Gloves	PVC	✓	Neoprene		Other	
Boots	PVC	✓	Neoprene		Other	
Boot Covers	PVC		Other		Other	
Face Shield					Other	
Hard Hat		✓				

8.6 AIR MONITORING INSTRUMENTATION FORM AND ACTION LEVELS

8.6.1 Air Monitoring Instrumentation Form

Monitoring instruments must be used for all operations unless appropriate rationale or restrictions are provided).

Air Monitoring Instrumentation Form	
Check all that apply:	
	Organic vapor analyzer (FID)
✓	Photo ionization detector (PID) Minimum lamp energy; 10.2 eV
✓	Combustible Gas Indicator (CGI)
✓	Oxygen Meter
✓	Detector tubes (specify): Draeger tube (or equivalent) for vinyl chloride
	Other, specify:

If monitoring instruments are not used, specify rationale or justification or activity/area restrictions in the space below.

8.6.2 Air Monitoring Action Levels

Level	Action
If the PID or FID indicates airborne volatile concentrations of less than 1 ppm and/or the indicator tubes indicate less than 1 ppm.	Work may proceed in Level D without respiratory protection. If required, use engineering controls (fans) to get breathing zone to background levels.
If the PID or FID indicates airborne volatile concentrations are greater than 1 ppm but less than 10 ppm (and/or the indicator tubes indicate greater than 1 ppm vinyl chloride but less than 10 ppm.)	Upgrade to Level C with organic vapor cartridges and identify the source with indicator tubes. Use engineering controls (fans) to get breathing zone to background levels. If the source is VC, work can not resume until less than 1 ppm is indicated in the breathing zone. If other VOC is the source, work can not resume until below the PEL for the detected compound (refer to Section 9.0).
If the PID or FID indicates airborne volatile concentrations are greater than 10 ppm, and/or the indicator tubes indicate greater than 10 ppm, STOP WORK and evacuate the area.	If readings exceed 10 ppm in the breathing zone, stop operations and evacuate the area and notify Safety Manager. Use engineered controls as required.

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9.0 Chemical Properties Data for Expected On-site Contaminants

9.1 ANALYTICAL RESULTS OF CONTAMINANTS OF CONCERN IN GROUNDWATER

Analytical results from several wells in the Boeing Plant 2, 2-10 Sheetpile site VOC plume are shown below.

Contaminants of Concern in Groundwater (µg/L)[1]

Location	Level/ depth[2]	Well ID	TCE	Cis-1,2 DCE	VC	Total VOCs
North Sheetpile Wells	A	PL2-212A	78,000	35,000	9,800	124,100
	A	PL2-218A	1,300	1,100	190	2,690
	A	PL2-258A	10	1,600	1,000	2,910
	B	PL2-258B	1.8	490	4.3	497.9
South Sheetpile Wells	A	PL2-209A	10	930	100	1050
	A	PL2-253A	ND	320	160	483.1
	A	PL2-252A	ND	ND	2.6	2.6
	B	PL2-214B	ND	ND	ND	ND
Permissible Exposure Limit (ppm)			25	50	200	1

Notes:

1 Data are from sampling taken in April 2001.
2 Sampling interval depths vary by location: A Level is typically 5-20 ft bgs; B Level is typically 40-55 ft bgs.

Abbreviations:

Ppm parts per million
ND non detect
TCE Trichloroethylene
VC Vinyl chloride
VOC Volatile organic compound

9.2 EXPECTED CONTAMINANTS CHEMICAL AND PHYSICAL PROPERTIES

The chemical and physical properties for the expected COCs on-site are summarized as follows.

SUBSTANCE:	1,2-Dichloroethene
SYNONYMS:	1,2-DCE, Acetylene dichloride, dioform, 1,2-dichloroethylene, sym-dichloroethylene
CAS NUMBER:	156-59-2 (cis); 156-60-5 (trans)
PHYSICAL STATE @ STP:	Liquid
DOT HAZARD CLASS:	Flammable Liquid
PEL:	200 ppm
IDLH:	1000 ppm
ODOR THRESHOLD:	Not applicable; Odorless
CARCINOGEN STATUS:	No
REPRODUCTIVE HAZARD:	No
FIRE HAZARD:	Flammable
REACTIVITY:	Contact between 1,2-DCE and strong oxidizers, strong alkalies, potassium hydroxide, or copper may cause violent reactions.
VAPOR PRESSURE:	273 mm Hg (cis); 395 mm Hg (trans)
SPECIFIC GRAVITY:	1.26 (cis); 1.28 (trans)
IONIZATION POTENTIAL:	9.66 eV
ACUTE TOXICITY:	Narcosis, drowsiness, tremor, incoordination, dizziness, and weakness. Nausea, vomiting, and epigastric distress. CMS depression.
CHRONIC TOXICITY:	1,2-DCE is a defatting agent, and repeated skin exposure may cause irritation and dermatitis. Potential to cause liver, circulatory and nervous system damage.
OCCURRENCE AND USES:	Used as a solvent for waxes, resins, and acetylcellulose; in the extraction of rubber; as a refrigerant; in the manufacture of pharmaceuticals and artificial pearls and in the extraction of oils and fats from fish and meat; as a chemical intermediate for making chlorinated compounds.

SUBSTANCE:	Trichloroethylene
SYNONYMS:	Trichloroethene, TCE, 1,1,2-Trichloroethyelene
CAS NUMBER:	79-01-6
PHYSICAL STATE @ STP:	Liquid
DOT HAZARD CLASS:	ORM-A
PEL:	50 ppm
IDLH:	1000 ppm
ODOR THRESHOLD:	20 ppm
CARCINOGEN STATUS:	IARC-3, CAL 65
REPRODUCTIVE HAZARD:	NE
FIRE HAZARD:	No

REACTIVITY:	Stable
VAPOR PRESSURE:	50 mm Hg
SPECIFIC GRAVITY:	1.46
IONIZATION POTENTIAL:	9.5 eV
ACUTE TOXICITY:	Narcosis, irritant, CNS depression, may cause cardiac sensitization.
CHRONIC TOXICITY:	Headache, nausea, anorexia, alcohol intolerance, cardiac arrhythmia, liver, kidney and brain damage. Reproductive effects in animals.
OCCURRENCE AND USES:	Use currently restricted. Widely used in the past as a degreaser, solvent, dry cleaning, paint diluent, and textile processing.

SUBSTANCE:	Vinyl chloride
SYNONYMS:	Chloroethene, chloroethylene, VC, VCM
CAS NUMBER:	108-06-17
PHYSICAL STATE @ STP:	Liquid
DOT HAZARD CLASS:	Flammable Liquid
PEL:	1 ppm
IDLH:	1000 ppm
ODOR THRESHOLD:	100 ppm
CARCINOGEN STATUS:	Carcinogenic
REPRODUCTIVE HAZARD:	NE
FIRE HAZARD:	Flammable
REACTIVITY:	Stable
VAPOR PRESSURE:	3.3 atm.
SPECIFIC GRAVITY:	1.24
IONIZATION POTENTIAL:	9.99 eV
ACUTE TOXICITY:	Eye, nose and throat irritation, CNS depression.
CHRONIC TOXICITY:	Liver and kidney damage, neurological effects, cardiovascular effects, reproductive abnormalities in some animal species.
OCCURRENCE AND USES:	Widely used in production of plastics (PVC)

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10.0 Health and Safety Plan Verification Form

The plan verification is an essential part of the plan and forms the basis for obligating personnel to comply with the safety requirements presented in the plan.

The following personnel have read and understand this plan and will perform all field work in compliance with the plan and other policies of CALIBRE and Floyd|Snider:

Signature	Company	Date
Signature	Company	Date
Signature	Company	Date
Signature	Company	Date
Signature	Company	Date
Signature	Company	Date
Signature	Company	Date
Signature	Company	Date

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11.0 General Health and Safety References

The references listed below provide information regarding the technical and regulatory standards and guidance for systems installation and operations and other activities related to operations at environmentally-contaminated sites.

ACGIH. *Threshold Limit Values and Biological Exposure Indices* (updated annually) (this is an excellent exposure reference with practical guidelines for exposure limits for many things which are either not addressed, or are addressed only in passing by OSHA).

American Petroleum Institute (API). 1985. *API Publication 201: Cleaning Petroleum Storage Tanks.*

_____. 1982. *Supplement to API Publications 2015A: A Guide for Controlling the Lead Hazard Associated with Tank Entry and Cleaning.*

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Boeing Plant 2
Seattle/Tukwila, Washington

Interim Measures for the North and South Sheetpiles in the 2-10 Building Area (AOC 2-10.3A and AOC 2-10.4A)

Quality Assurance Project Plan

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October 9, 2009

AGENCY REVIEW DRAFT

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List of Abbreviations and Acronyms

Acronym/Abbreviation	Definition
AOC	Area of Concern
ASTM	American Society for Testing and Materials
Boeing	The Boeing Company
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, xylene
BHT	Butylated hydroxytoluene
cis-1,2-DCE	cis-1,2-Dichloroethene
CLP	Contract Laboratory Program
COC	Constituent of concern
CSM	Conceptual Site Model
DCE	Dichloroethylene
DHE	*Dehalococcoides*
DO	Dissolved oxygen
DOC	Dissolved organic carbon
DQO	Data quality objective
Ecology	Washington State Department of Ecology
EQL	Estimated quantitation limit
FES	Field Engineer/Scientist
FS	Field Supervisor
FT	Field Technician
IM	Interim Measure
LCS	Laboratory control sample
LDW	Lower Duwamish Waterway
LPM	Laboratory Project Manager
MDL	Method detection limit
MS/MSD	Matrix spike/matrix spike duplicate

Acronym/Abbreviation	Definition
MTCA	Washington State Model Toxics Control Act
N/S	North and South
O_2/LEL	oxygen/lower-explosive limit
ORP	Oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
PAH	Polynuclear aromatic hydrocarbon
PCE	Tetrachloroethene
PCB	Polychlorinated biphenyl
PID	photoionization detector
PM	Project Manager
QA	Quality assurance
QAM	Quality Assurance Manager
QC	Quality control
RCRA	Resource Conservation and Recovery Act
RL	Reporting limit
RPD	Relative percent difference
SAP	Sampling and Analysis Plan
SL	Screening level
SM	Site Manager
SOP	Standard operating procedure
SVOC	Semivolatile organic compound
TCA	1,1,2-Trichloroethane
TCE	Trichloroethene
TMCL	Target Media Cleanup Level
TOC	Total organic carbon
TPH	Total petroleum hydrocarbons
trans-1,2-DCE	trans-1,2-Dichloroethene
TSS	Total suspended solids
USEPA	U.S. Environmental Protection Agency
VC	Vinyl chloride
VOA	Volatile organic analyte
VOC	Volatile organic compound

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1.0 Project Description

This document presents the quality assurance procedures that will be followed during the Interim Measure (IM) North and South Sheetpile Areas in the 2-10 Building (AOC 2-10.3A and AOC 2-10.4A) at Boeing Company Plant 2 in Seattle/Tukwila, Washington.

1.1 INTRODUCTION

This Quality Assurance Project Plan (QAPP) is associated with the IM Work Plan for the IM at the Building 2-10 North and South (N/S) Sheetpile Areas. The IM Work Plan was prepared by Floyd|Snider and CALIBRE for the Boeing Company (2009). The QAPP provides the following:

- Describes the organization, objectives, planned activities, and quality assurance/quality control (QA/QC) procedures associated with the IM Work Plan.
- Presents analytical methods and associated QA/QC procedures selected to meet Data Quality Objectives (DQOs).
- Discusses specific protocols for environmental sampling, sample handling and storage, chain-of-custody, analytical DQOs, field and laboratory analytical procedures, and data quality evaluation criteria.

The QAPP is used in conjunction with the IM Sampling and Analysis Plan (SAP, refer to Appendix B of the IM workplan) during monitoring for the IM Work Plan for the N/S Sheetpile area.

1.2 BACKGROUND

The Plant 2 property is located in south Seattle in the Duwamish Industrial corridor. The facility is situated between East Marginal Way and the Duwamish Waterway (see Figure 1.1 in the Work Plan). Past industrial activities at the property resulted in the release of trichloroethene (TCE) to the ground and to groundwater beneath the property. This Volatile Organic Compound (VOC) plume has been transported by natural groundwater movement southwest towards the Lower Duwamish Waterway (LDW) located at the edge of the property.

The site consists of the 2-10 Building and the portions of adjacent and down-gradient properties above the VOC plume that is located in a west- to southwest direction from the N/S Sheetpile areas in the 2-10 Building (refer to Figure 1.2 in the Work Plan). The downgradient boundary of the site is the LDW. The contaminants of concern (COCs) that have been identified in the VOC plume are TCE, tetrachloroethene (PCE), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and vinyl chloride (VC).

The site characterization data, exposure pathways, and Plant 2 screening levels were used to develop a Conceptual Site Model (CSM). As reflected in the CSM, the historical site data indicated that the contamination in the VOC plume was in excess of applicable standards and remedial action was required, the initial IM in 1993 was to install the sheetpile containment

structure. The site IMs need to address contamination in a way that ensures against any unacceptable risks and makes progress toward meeting the final site cleanup goals.

The boundaries of the study (necessary to define the DQOs) are that portion of the Duwamish Valley watershed that is impacted by releases from the 2-10 sheetpile areas from the sheetpile areas to the ultimate discharge at the LDW.

1.3 PROJECT OBJECTIVES

This QAPP describes activities that will be implemented to assure integration of applicable QA/QC requirements into sampling activities conducted in support of field investigations and remediation optimization.

1.3.1 Specific Objectives and Associated Tasks

The objectives of this QAPP are to present procedures, organization, functional activities, and specific QA/QC activities to assure that data collected during field activities are of known and sufficient quality to meet work plan goals. Specific sampling activities are expected to include soil sampling, groundwater sampling from wells or borings, and soil vapor sampling. Details for each sampling event are presented in the SAP (Appendix B of the IM Work Plan) that defines DQOs, specific sampling locations, tasks, and requirements.

1.3.2 Sampling Schedule

The IM Work Plan sampling events will commence following EPA approval of the IM Work Plan (refer to Section 4.0 of the IM Work Plan.) The proposed sampling schedule is presented in Section 2.0 of the SAP. Groundwater, soil, and soil vapor sampling will be conducted once during the IM. Monitoring reports will be prepared and submitted according to the schedule outlined in Section 4 of the Work Plan.

1.3.3 Project Target Parameters and Intended Data Usage

Project target parameters for IM monitoring are:

- Groundwater——VOCs, total organic carbon (TOC), metals (dissolved–Arsenic and Manganese), bacterial census for dehalococcoides (DHE), alkalinity, and dissolved gases.
- Soil——VOCs and grain size.
- Soil Vapor——VOCs by EPA Method TO-15.
- General water quality parameters (pH, conductivity, dissolved oxygen (DO), temperature, and oxidation/reduction potential (ORP) using field instruments).

1.3.4 Data Quality Objectives

Data must be of sufficient quality to meet the DQOs noted above and detailed in the Work Plan. Identifying the intended use of the data is necessary to establish the data requirements and corresponding quality objectives. Identifying the intended use of the data is necessary to establish a variety of the data requirements and corresponding quality objectives. For the 2-10 N/S Sheetpiles IM, two types of intended use are expected: decision-making and estimation.

1.3.4.1 Decision Making

In this context, decision making is defined as making a choice between two alternative conditions. The primary decision anticipated is whether or not an exposure point concentration exceeds established criteria. Examples include

1. Does the discharge concentration from the VOC plume exceed the target media cleanup level (TMCL) and/or screening level (SL)?
2. Does the groundwater concentration at a point near a structure exceed criteria that would indicate a potential risk from vapor intrusion?

Other decision making uses of the data are expected but these two examples describe the general form that is anticipated.

1.3.4.2 Estimation

In this context, estimation is defined as data use to evaluate the magnitude or more general interpretation of some environmental parameter or characteristic. Examples applied to this project include such parameters as:

1. Relevant hydrogeological conditions (groundwater flow direction and velocity).
2. Relevant geochemical conditions in the aquifer (pH, DO content, redox level).
3. The plume position and boundary (the peak concentrations in the central area of the plume and general boundaries defining the plume edges).
4. Performance evaluation of remedial actions implemented (performance data such as time series of VOC concentrations at a monitoring point).

All of these parameters will require monitoring data for estimation and are known or expected to vary in space and time. However, the estimated parameter (and the monitoring data used to estimate it), is not generally to be compared with a regulatory threshold as a pass/fail decision based on an established criteria. The defining characteristic of an estimation problem (versus a decision-making problem) is that the intended use of the estimate is not directly associated with a well-defined decision. Uncertainty in estimates is unavoidable due to a variety of factors, such as imperfect measurements, inherent variability in the characteristics of interest of the parameters measured, and limits on the number of, or position of, samples that can be collected.

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2.0 Project Organization and Responsibility

The Boeing Company has overall responsibility for the IM. Project management, QA, laboratory, and field responsibilities of essential project personnel are defined below.

2.1 PROJECT ORGANIZATION CHART

Main contact names and the project management organization are depicted in Figure 1.

2.2 MANAGEMENT, QUALITY ASSURANCE, FIELD, AND LABORATORY RESPONSIBILITIES

Ms. Christy Brown is the USEPA Project Manager. Mr. William Ernst is the Project Manager for Environmental Health Services (EHS) Remediation at Boeing Plant 2. Dr. Teri A. Floyd is Oversight Manager for the investigation and IM work at the 2-10s N/S Sheetpiles. Mr. Tom McKeon is the Site Manager and Project Manager for the 2-10s N/S Sheetpile IM.

The IM Project Manager (PM) and Site Manager (SM), Mr. Tom McKeon of CALIBRE, is responsible for overseeing project performance, budget, and schedule to ensure contract compliance and for implementing all necessary actions and adjustments to accomplish program objectives. The PM directs, coordinates, and monitors the efforts of the Project Team members to assure the technical quality of the work and accurate reporting to management. The PM will be in direct contact with the Boeing Project Manager, Floyd|Snider Oversight Manager, and EPA Project Manager.

Specific responsibilities related to QA/QC include:

- assure availability of technical standard operating procedures (SOPs) and training of staff to SOPs,
- prepare project work plans,
- assure that project activities are conducted according to SOPs/QAPP,
- review and evaluate data and verify data quality,
- implement corrective actions resulting from QA audits,
- report QA problems to required,
- supervise preparation of project deliverables.

The SM reports any quality issues to the Quality Assurance Manager (QAM) and technical issues to the Project Engineer (Grant Dawson, P.E) in the Environmental Technology Solutions (ETS) division at CALIBRE Systems.

The QAM, John Frerich of CALIBRE, is responsible for developing and implementing the project QA program. The QAM prepares the project QAPP and its subsequent revisions. The QAM will

communicate QA responsibilities to all project staff and provide guidance for implementation of the QAPP. The QAM has authority to terminate specific project activities if the quality of data to be collected is jeopardized. Specific responsibilities of the QAM related to QA /QC include:

- Serve as point-of-contact for all matters involving QA.
- Provide guidance and technical information concerning QA issues to project staff.
- Review project activities for proper implementation of the Work Plan and SOPs.
- Plan and conduct QA audits.
- Identify QA deficiencies to the SM and assist in identification of corrective actions.

The Field Supervisor (FS) and Field Engineer/Scientist (FES), Mr. Grant Dawson of CALIBRE, is responsible for providing day-to-day supervision of all field sampling and analysis activities. Specific responsibilities of the FS related to QA/QC include:

- Supervise all field sampling and analysis activities to assure proper implementation of SOPs.
- Supervise sample collection, logging, and documentation of field activities and test results.
- Assure all field activities identified in work plans are implemented, required environmental and QC samples are collected, and required field measurements are taken.
- Coordinate with analytical laboratory(ies) for scheduling of analyses and receipt of samples.
- Supervise subcontractor staff involved with field activities.
- Coordinate transfer of field data and records to SM for data reduction and validation.

The FS/FES reports to the SM. If the FS is not present during specific field activities (i.e., based on the number of personnel required to complete the work), the SM will designate an alternate FS for those activities. The alternate FS will have all responsibilities identified above.

The FES performs field activities including sampling, well logging, supervising installation of wells, performing aquifer tests, and installing and starting up treatment and test equipment. Specific responsibilities of the FES include:

- Conduct activities in accordance with the Work Plan and applicable SOPs;
- Coordinate activities SM to assure integration of field operations; and
- Generate and maintain documentation of field activities and test results.

The Field Technicians (FT), Jeff Dawson, Katarina Mahutova, and Justin Neste of CALIBRE, report to and perform field sampling and analysis activities under the supervision of the FS. Responsibilities of the FT related to QA/QC include:

- Prepare and maintain records of field activities.

The Laboratory Project Manager (LPM), Kelly Bottem of Analytical Resources, Inc. (ARI), a State of Washington Ecology-accredited laboratory, is responsible for the timely completion of the required fixed-laboratory analyses with adherence to the SW-846 procedures and any additional project-specific SOPs and program requirements. Other specialty laboratories may be used as necessary (e.g., Air Toxics Ltd for TO-15 analysis of vapor samples and Microbiological Insights for RT-PCR analysis). The appropriate manager(s) of those other labs (if used) are responsible for the timely completion of the required specialty-laboratory analyses with adherence to applicable procedures and any additional project-specific SOPs and program requirements.

2.3 SPECIAL TRAINING REQUIREMENTS AND CERTIFICATIONS

All field personnel will be trained as required by the Occupational Safety and Health Administration's Hazardous Waste Operations and Emergency Response (OSHA-HAZWOPER) regulations. Additional specialized training/certification for field sampling and analyses is not identified as necessary for this project, but appropriate experience is a requirement.

No field sampling activities will be implemented unless one or more of the staff have prior experience with the specific procedures, equipment, and methods necessary to complete the work. Accreditation is required for the analytical laboratory, and for any project elements which require engineering or geologic interpretation/judgment (professional engineer or geologist/hydrogeologist).

The CALIBRE SM will be responsible for ensuring that all members of the field team have valid and current training required by the OHSA/WISHA regulations for work associated with sampling at sites that contain hazardous materials. The CALIBRE Health and Safety Officer will ensure that all CALIBRE personnel meet the required training requirements for work performed. All personnel are required to be familiar with and possess a copy of SOPs for the specific work activity planned, and be familiar with and possess a copy of the appropriate waste management procedures.

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3.0 Quality Assurance Objectives for Measurement Data

Measurements will be made to collect data for both decision making and estimation needed to meet project objectives. Some data to support estimation data will be collected using field analytical methods. Some data to support estimation and virtually all decision making will be made using data from approved laboratory analytical methods (e.g., SW-846 or ASTM protocols). Examples of measurements commonly performed and the procedures/basis for use in decision making and/or estimation are summarized in Table 1.

The DQOs for the IM Work Plan define the decisions necessary to resolve the defined site problem (from the problem statement) and describe the quality of data needed to meet project objectives. Analytical data will be used to identify the areal extent and types and concentrations of contaminants. Parameters associated with data quality are: precision, accuracy, representativeness, completeness, comparability, and sensitivity/quantitation limit. These are discussed below and calculations for these parameters are presented in Attachment 2.

3.1 PRECISION

Analytical precision is calculated by expressing, as a percentage, the difference between the results of analysis of duplicate samples relative to the average of those results for a given analyte. Precision is expressed as the relative percent difference (RPD).

3.2 ACCURACY

Analytical accuracy is calculated by expressing, as a percent, the recovery of a standard reference material or an analyte that has been added to the sample (or standard matrix) at a known concentration before analysis. Examples of the required recovery are specified in Table 2. The spiked (fortified) concentration used will be specified by laboratory quality control requirements as detailed in the analytical method. Samples for matrix spikes will be collected at the frequency specified in the project objectives.

3.3 REPRESENTATIVENESS

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Data representativeness will be attained through the proper design of the sampling program.

3.4 COMPLETENESS

Completeness is a measure of the relative number of analytical data points that meet all the acceptance criteria for accuracy, precision, and any other criterion required by the specific analytical methods used. Data completeness may be affected by unplanned loss of samples such as container breakage during shipment, laboratory accidents, insufficient sample volume,

or other factors that result in incomplete sample data sets (relative to the work plan). The QA objective for analytical data completeness is 95 percent. To assure completeness, the following steps will be implemented:

- Project sampling work plans will define the number of locations, samples, and bottle types for the planned analysis.
- Samples will be labeled appropriately.
- Samples will be packaged to minimize potential for breakage.
- At the completion of a sampling event, the planned sample collection as defined in above (first bullet) will be re-reviewed to verify completeness.
- Chain-of-custody forms will be used to document and trace possession of samples from the time of collection through delivery to the analytical laboratory.

3.5 COMPARABILITY

Comparability expresses the confidence with which one data set can be compared to another. Data comparability will be achieved through the use of standard sampling procedures defined in SOPs (refer to Appendix B of the IM Work Plan) and analytical procedures (such as SW-846 methods or other approved standards). Data results will be reported in appropriate units consistent with existing site data and applicable regulatory levels.

3.6 SENSITIVITY/QUANTITATION LIMIT

The sensitivity of an analytical method is expressed as the quantitation limit. In order for analytical data to be of sufficient quality, the quantitation limit of the analytical method used must be less than the quantitation limit required to meet project objectives. The former depends on site-specific matrix effects and is commonly expressed as the reporting limit (RL) or sometimes the estimated quantitation limit (EQL). Examples of RLs for the methods and matrices specified for this project, and additional methods that may be used in future investigations, are summarized in Table 2.

The required quantitation limit is related to the use of the data. It is necessary to select and utilize analytical methods (and corresponding RLs) that can be used to support the likely project decisions at the concentration levels suitable for planned risk characterization/remedial performance evaluation. The anticipated range of threshold criteria (i.e., applicable concentration based regulatory criteria) for primary Site COCs in groundwater are presented in Table 3. The RLs listed in Table 2 are sufficiently low to evaluate the site conditions relative to the threshold criteria listed in Table 3.

4.0 Sampling Procedures

Sampling procedures are consistent with the project objectives described in Section 1.3. Environmental sampling will be conducted in accordance with the event-specific SAP and applicable CALIBRE sampling SOPs. Details for each sampling event are presented in the SAP (Appendix B of the IM Work Plan) which defines the specific sampling locations, tasks, and requirements. The SAP includes the following elements:

- Number, type, and location of samples
- Number of composites (if any)
- Justification for the sample location
- Number of QC samples (field replicates, etc.)
- Description of how samples will be obtained and handled before shipping to the laboratory for analysis

4.1 MONITORING GROUNDWATER, SOIL, AND SOIL VAPOR

Environmental samples collected at the site will be analyzed for various parameters as described in Section 1.3.3. Sampling locations are shown in the SAP along with the specified sample locations and analyses to be conducted on samples at each sample location are detailed in the SAP. The sampling procedures for all media to be sampled are described in the SOPs (e.g., groundwater sampling, soil sampling, and soil vapor sampling, see Appendix B of the IM Work Plan).

Tables 4 and 5 summarize typical analyses that may be conducted, and requirements for sample containers, sample preservation, and sample holding times for groundwater and soil samples, respectively. Table 6 presents the typical analytical methods and target RL for the analyses that may be conducted. Additional analytes (beyond the planned VOCs, dissolved gasses, soil vapor, and metals) are included in Tables 4, 5, and 6 in the event that they are deemed necessary during the project. Tables in the SAP specify the sampling locations for groundwater, soil, and soil vapor samples.

Field analytical methods will include the use of calibrated instruments typically used for measuring specific water quality parameters (e.g., a Horiba or YSI water quality meter) and/or total organic vapor levels (e.g., a photo ionization detector [PID]). A field instrument will be used for a direct reading of water quality to determine DO levels, ORP, pH, specific conductance, and temperature of groundwater samples. Prior to a groundwater sampling event, the water quality meter will be calibrated daily according to the manufacturers' specifications to ensure accuracy of parameters.

4.2 SAMPLE HANDLING, CONTAINERS, PRESERVATION, AND HOLDING TIMES

Sample handling will be conducted in accordance with applicable CALIBRE SOPs (included in the SAP). Collected samples will be checked to ensure all required data have been recorded on the label and chain-of-custody form and will then be transported to the laboratory for analysis. Whenever feasible (local laboratory), samples will be hand delivered to the laboratory. When hand delivery is not feasible (out-of-town laboratory), the SOPs for sample packing and shipping will be followed with particular care to minimize sample loss due to breakage in transport.

Sample containers, preservatives, storage requirements, and holding times are summarized in Tables 4 and 5. All samples collected will be assigned a unique identification code based on a sample designation scheme that is consistent with the existing Site database. Each sample label will be affixed to the bottle and covered with clear tape. Tape is not required if waterproof labels are used. A sample tracking record will be kept as each sample is collected.

The field team leader will be responsible for inspecting sample containers before leaving for the field. Only new sample containers accompanied by the manufacturer's certification of pre-cleaning will be used. The sample containers will also be inspected for cracks, ill-fitting lids, and other obvious defects before use and will be discarded if defects are found to be present.

Sample containers will be supplied by the analytical laboratory. The ARI LPM will be responsible for inspecting sample containers upon receipt from the manufacturer. The manufacturer's specifications for product performance and purity will be used as the acceptance criteria.

4.3 COORDINATION WITH ANALYTICAL LABORATORY

CALIBRE will work closely with the project laboratory to ensure that samples are handled and analyzed following procedures described in the QAPP. A schedule of fieldwork and sampling will be established approximately 2 weeks before commencement of fieldwork. To ensure that holding times are met, CALIBRE will plan and schedule sampling events in advance by coordinating with field personnel and ARI.

4.4 FIELD QUALITY CONTROL SAMPLES

Quality control activities for field sampling provide a means of evaluating the integrity of a sample from the time of collection through analysis at the analytical laboratory. Field sampling quality control activities involve maintenance of chain-of-custody, documentation of activities, use of appropriate sample containers and preservatives, submission of samples to laboratories in a timely manner, use of a consistent sample numbering system, and collection of appropriate quality control samples.

The field QC checks are accomplished through the analysis of specific samples that are provided to the laboratory from the field. Field duplicates, matrix spike/matrix spike duplicates (MS/MSDs), and trip blanks will be collected and submitted to the project laboratory, where applicable, to provide a means of assessing the quality of data resulting from the field sampling

program. Dedicated equipment is planned to be used for collection of samples and the collection of equipment rinsate blanks is not anticipated; however, a description of these QC samples is included below. Ambient condition blanks, if required, are included in the discussion of trip blanks.

4.4.1 Field Duplicates

Field duplicate samples are used to check for sampling and analysis reproducibility. Field duplicates are submitted to the project laboratory at a frequency of at least one per 20 samples or one per analytical batch, whichever is more frequent. Control limits for field duplicate samples are described in Table 8. Duplicate soil, water, and gas samples will be given a unique alphanumeric identifier and submitted to the laboratory.

4.4.2 Matrix Spike/Matrix Spike Duplicates

Additional sample volume will be collected for the laboratory to perform matrix spikes and matrix spike duplicates (MS/MSD) analyses. Samples for MS/MSD will consist of three times the normal sample volume or as specified by the laboratory. Samples for MS/MSD will be collected at a frequency of one per 20 samples or one per analytical batch, whichever is more frequent. Control limits for MS/MSD recoveries are presented in Attachments 3 and 4.

4.4.3 Trip Blanks

Trip blanks are prepared in the laboratory and consists of laboratory grade (organic-free) water (e.g., reverse osmosis) that is placed in the same type of sample container as the groundwater samples. The trip blanks are transported to the field and handled and packaged in the same manner as the regular samples. Trip blanks serve as a check on sample contamination originating from sample transport, shipping, and from site conditions. Trip blanks will be included for analysis of samples for VOCs. If required by the SAP, ambient blanks are collected by pouring laboratory grade water into a sample container in the field at the time and location of sampling. These blanks are used to assess the potential for contamination of samples by ambient sources.

4.4.4 Equipment Rinsate Blanks

Equipment (rinsate) blanks will be included as part of the field QA/QC program if non-dedicated sampling equipment is decontaminated and reused for sample collection. These samples will serve as a check on the sampling device cleanliness. Rinsate samples are collected by pouring and/or rinsing field sampling equipment with laboratory grade water and collecting the rinsate into sample containers. The rinsate blanks are analyzed for the sample parameters as the regular samples.

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5.0 Sample Custody Procedures

All samples collected during this investigation represent physical evidence collected from the field. Because of the potential use of these samples as evidence, their possession must be traceable from collection until the data are ultimately used. Chain-of-custody procedures are used to maintain and document sample possession. The principal documents used are:

- Sample labels
- Sample custody seals
- Field sampling records
- Chain-of-custody forms

Strict chain-of-custody procedures will be followed to insure sample integrity and accountability during the project. The chain-of-custody will begin when the sample is collected and will be maintained until final disposal of the sample.

5.1 SAMPLE IDENTIFICATION AND LABELS

Each sample container will be labeled with a unique and appropriate sample number and designation code. The protocol for sample numbering and labeling is included in Section 2.4 of the SAP.

5.2 FIELD CUSTODY AND CHAIN-OF-CUSTODY FORMS

The SM or designed representative is responsible for the custody of the samples until they are formally transferred to another party or delivered to the analytical laboratory. For purposes of this project, a sample is under a person's custody if the sample meets any of the following:

- Is in possession of the field QA officer/designated representative
- Is in a person's plain view after being in his/her possession
- Is in a cooler in a person's plain view
- Is inside any locked space, such as a locked vehicle, to which the field representative has the only immediately available key

Any transfer of samples will be accompanied by a properly completed chain-of-custody form. When transferring the possession of samples, both the individuals relinquishing and receiving the samples will sign, date, and record the time on the chain-of-custody form. This record is signed by the sampler and any others who subsequently hold custody of the samples, including another person, or permanent laboratory. A copy of the chain-of-custody form will be retained by the sampler and maintained in the project files. The original form will accompany the samples.

The chain-of custody form will contain, at the minimum, the following information:

- Sample identification
- Signature or initials of the sampler
- Date and time of sample collection
- Sample matrix
- Signatures of all persons involved in the chain of possession
- Inclusive dates and times of possession

The chain-of-custody form will also be used to indicate what analyses are to be performed on each sample. This enables the laboratory to ascertain at the time of sample receipt whether all of the samples that are expected have arrived.

5.3 SAMPLE HANDLING AND TRANSPORTATION

Sample handling will be conducted in accordance with applicable CALIBRE SOPs (refer to the SAP). Collected samples will be checked to ensure all required data has been recorded on the label and chain-of-custody form and will then be transported to the laboratory for analyses. Whenever feasible (local laboratory), samples will be hand delivered to the laboratory. When hand delivery is not feasible (out-of-town laboratory), the SOPs for sample packing and shipping will be followed with particular care to minimize sample loss due to breakage in transport.

5.4 LABORATORY CUSTODY

A designated laboratory sample custodian accepts custody of the samples and verifies the chain-of-custody form matches the samples received. Samples are logged in and assigned a unique laboratory sample identification number. Samples and sample aliquots, including sample extracts, are tracked through laboratory analysis using laboratory sampling routing forms. Detail of the analytical laboratory's sample control, record-keeping, and document control are presented in ARI's QA Manual.

5.5 SAMPLE DOCUMENTATION

The records for this project may include field logs and field data worksheets, drawings, photographs, calculations, chain-of-custody forms, laboratory analytical reports, correspondence, and technical memorandums for each sampling event. Field logs will be recorded with the minimum required data according to the relevant SOP. All original field records and laboratory data reports will be stored at the project office (Floyd|Snider).

The analytical data reports will include an original signed report of the analytical results, a narrative report about the analysis, original complete chain-of-custody forms, and any other documentation received with the samples. A summary of the calibration data and laboratory quality control data will also be included in the analytical report. The raw analytical data (e.g.,

instrument printouts and manual records) will be available upon request. The narrative report will describe at least:

- the dates of sample receipt, preparation, and analysis,
- the condition of the samples upon receipt,
- sample preparation and analytical procedures,
- any problems encountered during sample handling, storage, preparation, or analysis, and their solutions,
- any deviations from SOPs,
- a discussion of the quality of the reported analytical data.

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6.0 Instrument Calibration and Maintenance

6.1 FIELD MEASUREMENT CALIBRATION PROCEDURES

Before any instrument is used as a measuring device, the instrument response to known reference materials must be determined. The manner in which various instruments are calibrated is dependent on the particular type of instrument and its intended use. All sample measurements will be made within the calibrated range of the instrument.

All instruments and equipment used to perform field measurements will be operated, calibrated, and maintained according to manufacturer's guidelines and recommendations. Operation, calibration, and maintenance will be performed by personnel who have appropriate experience in these procedures. All field instruments that require calibration (water quality meters, PIDs, oxygen/lower-explosive limit (O_2/LEL) meters) will be calibrated in accordance with the project SOPs and manufacturers' requirements (both the frequency and the procedures).

Continuing calibration usually includes measurement of the instrument response to one or more calibration standards and requires instrument response to compare within certain limits (e.g., ± 10 percent of the initial measured response or true value of standard.) of the initial measured instrument response. Continuing calibration is performed at least once per operating shift for all field analyses.

6.2 LABORATORY INSTRUMENT CALIBRATION

Routine calibration standards will be used in the analytical laboratory(ies) to demonstrate that the performance of an instrument does not cause unnecessary error in the analysis. This calibration will indicate instrument stability and sensitivity. The methods for verification and documentation of instrument conditions prior to and during testing will be described by the analytical laboratory(ies) in specific laboratory procedures and analytical methods.

Laboratory instrument calibrations typically consist of two types, initial calibration and continuing calibration. Initial and continuing calibration criteria must meet the method acceptance criteria before sample analysis can begin. Initial calibration procedures establish the calibration range of the instrument and determine instrument response over that range. Typically, three to five analyte concentrations are used to establish instrument response over a concentration range. The instrument response over that range is expressed as a correlation coefficient (e.g., for atomic absorption, inductively coupled plasma, UV-visible/infrared spectrophotometry, ion chromatography) or by a response factor, amount/response (e.g., for gas chromatography, gas chromatography/mass spectrometry, high performance liquid chromatography).

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7.0 Analytical Procedures

7.1 LABORATORY ANALYTICAL METHODS

Water, soil, and soil vapor samples will be analyzed according to standard methods such as EPA Method 8260B and other analytical methods defined in Tables C.4., C.5, C.6, and C.7, as well as Section 2.0 of the SAP. Any changes or modifications to procedures will be documented thoroughly in the narrative summary for the data package. All parameters specified by the analytical methods will be determined unless a shortened list is approved by the lead regulatory agency.

All analytical methods/procedures used are to follow methods presented in the most current version of SW-846 (EPA 2002), where applicable. Tables 6 and 7 show the target RL for each analytical method. The laboratory analyses will be completed by Analytical Resources Inc. (ARI). ARI is a Washington State accredited/certified laboratory. Other labs will be used for specialized analyses as necessary.

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8.0 Internal Quality Control Samples

The section describes field and laboratory QC checks.

8.1 FIELD QUALITY CONTROL CHECK

The initial responsibility for monitoring the quality of field measurements and observations lies with the field personnel. The FS is responsible for verifying that all quality control procedures are followed. This requires that the FS assess the correctness of field methods and the ability to meet QA objectives. If a deficiency occurs that might jeopardize the integrity of the project or cause some specific QA objective not to be met, it is the responsibility of all project staff to report the noted deficiency to their immediate supervisor (on this project) and propose corrective actions to remedy the problem/deficiency.

Assessment of field sampling precision and bias will be made by collecting field QC samples for laboratory analysis as described in Section 4.

8.2 LABORATORY QUALITY CONTROL CHECKS

Laboratory QC checks are accomplished through analyzing initial and continuing calibration samples, method blanks, surrogate spikes, laboratory control samples, and laboratory duplicate samples. Method-specific QC samples are describes in the laboratory SOPs and applicable analytical methods. Quality control criteria for analysis specific to this project are presented in Attachments 3 and 4, and include limits for surrogate, LCS, matrix spike, and duplicate sample recoveries.

8.2.1 Initial and Continuing Calibration

Laboratory instrument calibration and maintenance requirements are discussed in Section 6.2.

8.2.2 Method Blanks

Method blanks are used to check for laboratory contamination and instrument bias. Laboratory method blanks will be analyzed at a minimum frequency of 5 percent or one per analytical batch for all chemical parameter groups.

Quality control criteria require that no contaminants be detected the blank(s) at or above the method RL. If a chemical is detected, the action taken will follow the laboratory SOPs. Blank samples will be analyzed for the same parameters as the associated field samples.

8.2.3 Surrogate Spikes

Accuracy of an analytical measurement is evaluated by using surrogate spikes. Surrogate compounds are compounds not expected to be found in environmental samples: however, they are chemically similar to several compounds analyzed in the methods and behave similarly in extracting solvents. Samples for organics analysis will be spiked with surrogate compounds consistent the requirements described in the laboratory SOPs and analytical method.

Percent recovery of surrogates is calculated concurrently with the analytes of interest. Since sample characteristics will affect the percent recovery, the percent recovery is a measure of accuracy of the overall analytical method on each individual sample.

8.2.4 Laboratory Control Samples

Laboratory control samples (LCS) are used to monitor the laboratory's day-to-day performance of routine analytical methods, independent of matrix effects. The LCS is prepared by spiking reagent water with standard solutions prepared independently of those used in establishing instrument calibration. The LCSs are extracted and analyzed with each batch of samples. Results are compared on a per-batch basis to established control limits and are used to evaluate laboratory performance for precision and accuracy. The LCSs may also be used to identify any background contamination of the analytical system that may lead to the reporting of elevated concentration levels of false-positive measurements.

8.2.5 Laboratory Duplicate Samples

Precision of the analytical system is evaluated by using laboratory duplicates. Laboratory duplicated are two portions of a single homogeneous sample analyzed for the same parameter. Laboratory duplicates are prepared and analyzed with normal project samples.

9.0 Data Reduction, Validation, and Reporting

Data reduction consists of those activities involving conversion of raw data to reportable units, transfer of data between recording media, and computation of summary statistics, standard errors, confidence intervals, tests of hypotheses relative to the parameters, and model validation. Statistically acceptable data analysis procedures will be implemented for all data reduction steps.

9.1 FIELD DATA

Field technical data (i.e., non-laboratory generated) can generally be characterized as either objective or subjective data. Objective data include all direct measurements such as field analyses and water level measurements. Subjective data include descriptions and observations. Some activities, for example, test boring and well logs, include both types of data in that the data recorded in the field are descriptive but can be reduced using the standardized soil or lithologic coding system.

All field data necessary to meet project objectives will be recorded by field personnel. Subjective data will be filed as hard copies for incorporation into technical reports as appropriate.

Validation of objective field and technical data will be performed at two different levels. On the first level, data will be validated at the time of collection by following standard procedures and quality control checks. At the second level, data will be validated by the SM or his designee who will review the data to ensure that the correct codes and units have been included. After data reduction into tables or arrays, the SM will review data sets for anomalous values.

Subjective field and technical data will be validated by the SM, who will review field reports for reasonableness and completeness. Whenever possible, peer review will also be incorporated into the data validation process, particularly for subjective data, to maximize consistency among field personnel.

Once the data results are compiled, the CALIBRE QAM will review the data to determine if they fall within the acceptance limits as defined in this QAPP. Completeness will also be evaluated to determine if the completeness goal for this project has been met. If data quality indicators do not meet the project's requirements as outlined in this QAPP, the PM will evaluate the cause of the failure (if possible) and make the decision to discard the data and re-sample. If the failure is tied to the analysis, calibration and maintenance techniques will be reassessed as identified by the appropriate personnel.

9.2 LABORATORY DATA

9.2.1 In-laboratory Data Reduction and Verification

Data reduction is the process by which analytical measurements are converted or reduced to a specified format or unit for reporting of final results. Data reduction may be performed manually (calculator, hand-entry to worksheet, hand-entry to computer templates) or electronically (transfer of raw data from instrument to computer system(s) with established calculations). Data reduction requires that all aspects of sample preparation be taken into account in the final result, including sample volumes, extract or digest volumes, dilution factors, and calibration factors. It is the responsibility of laboratory analyst to perform these data reductions and document data reduction requirements in the associated data analytical report. If performed electronically, all software used must be demonstrated to be true and free from unacceptable error. All data are subject to further review by the laboratory data reviewer, the laboratory PM, the CALIBRE PM and QAM and possibly independent reviewers.

The ARI Laboratory QA Program requires that 100 percent of the data generated the ARI undergo four levels of review. The levels of review consist of analyst, peer, supervisory, and administrative. Additionally, QA personnel review 10 percent or more of the completed data packages for accuracy, overall compliance, and completeness.

9.2.2 Laboratory Data Reporting

The standard analytical laboratory data reports for organic and inorganic analyses will consist of a transmittal letter and the following, as appropriate for the analyses performed:

- Cover page describing data qualifiers, sample collection, sample receipt, extraction and analysis dates, and a description of any technical problems encountered with the analyses.
- Copies of the chain-of-custody forms.
- Copies of the analytical forms.
- Spreadsheet sample analytical results and quality control summaries.
- Calculated recoveries for all quality control samples, method duplicate or duplicate spike and method blank results.
- All laboratory quality control data including method blank, method blank spike, matrix spike, laboratory duplicate or spike duplicate, and surrogate recovery data.
- Method quantitation limits for all parameters and dilutions.
- Five-peak library search report for detected GC/MS volatiles and semivolatile target compounds.

Analytical results will be reported in µg/L for aqueous samples, mg/kg for soil samples, and parts per billion by volume (ppbv) for gas samples.

All raw laboratory data will be held on file at the laboratory for a period of 10 years, data files are also archived on tape and compact disk, the lifetime of these media is not yet known. All project laboratory summary data will be maintained at the project Administrative Documentation files in accordance with the Resource Conservation and Recovery Act (RCRA) Administrative Order on Consent, dated January 18, 1994, between Boeing and USEPA Region 10.

9.2.3 Data Review

The PM will assign a QA reviewer to evaluate all analytical data reports. The data review process quantifies the data quality, both technical and evidentiary, verifies that adequate documentation was performed, and determines whether the analytical data is usable and meets analytical DQOs. Technical reviews require comparison of QC to the required control limits. The following QC elements will be reviewed (as appropriate):

- Comparison with the QAPP.
- Proper sample collection and handling procedures.
- Holding times and sample receipt conditions.
- The laboratory data package for transcription errors, misidentifications, or miscalculations.
- Quantitation and reported detection limits.
- Blank summary results.
- Duplicate analyses.
- MS/MSDs.
- Field QC results.
- The reliability of the data based on the QC sample results.
- Data qualifiers assigned by the laboratory.
- Data completeness and format.
- Overall assessment of data for the project.

The data quality review process will follow the procedures in EPA's Functional Guidelines, as appropriate, applicable to SW-846, as specified in this QAPP, method SOPs, and professional judgment.

9.2.4 Data Review Reporting

All reports will include a summary description of all project activities, a summary of all data, a discussion of any problems encountered and associated corrective actions, a discussion of the conclusions drawn from the results of this project and the rationale for those conclusions, and the results of the data quality assessment. Data reports will include discussion on the usability

of the analytical data and whether collected data meets the project DQOs. Data review reports may be combined into investigation reports (e.g., RI or monitoring reports).

10.0 Performance and System Audits

Performance and systems audits may be conducted to determine whether:

- The QA program has been documented in accordance with the specified requirements.
- The documented program has been implemented.
- Any non-conformances were identified and corrective action was implemented.

The project QA/QC Officer is responsible for initiating audits and overseeing audit implementation and, if necessary, corrective action.

10.1 DATA QUALITY AUDITS

Data generated by the laboratory undergoes laboratory QA review as specified in Section 9.2. Laboratory data will be evaluated for compliance with the DQOs, and with procedural requirements contained in the QAPP. The detailed scope of this review and verification is presented in Section 9.

10.2 LABORATORY AUDITS

The ARI Laboratory is certified by the State of Washington Department of Ecology and State of Washington Department of Health to perform the analytical methods specified for this project. ARI also participates in the EPA Contract Laboratory Program (CLP), multiple performance evaluation programs, and is subject to the QC requirements and audits of these programs. For this reason, no laboratory audits are currently planned in conjunction with this project. If a problem is identified, a systems or performance audit of the laboratory will be conducted in order to identify and correct specific problems.

10.3 FIELD AUDITS

Field activities will be monitored by the project SM and QAM to ensure compliance with the requirements of this QAPP. Selected projects undergo field audits as determined by the QAM based on the complexity and duration of field sampling activities. The focus of an audit will be on actual QC activities of data collection, and will use the QAPP as a reference. The following specific activities will be reviewed in an audit:

- Sample collection and analytical activities
- Equipment calibration techniques and records
- Decontamination and equipment cleaning
- Equipment suitability and maintenance/repair
- Compliance with applicable SOPs

- Background and training of personnel
- QC samples
- Sample containers, preservation techniques, and chain-of-custody
- Field quality audits reports will be completed by the QAM and describe activities audited, compliance with the QAPP, problems identified, and corrective actions.

11.0 Preventative Maintenance

11.1 FIELD INSTRUMENTS

The field equipment for water quality measurements is the Horiba U-22 water quality meter, which requires testing, inspection, and maintenance. Other water quality testing instruments (that are functionally equivalent) may be substituted as appropriate. The water quality instrument will be used to measure pH, temperature, redox potential, DO, and conductivity for water samples while in the field. The project SOP for groundwater sampling describes the procedures for testing and inspecting the meter. These procedures include a battery check, verification that the meter was successfully calibrated before its use, and confirmation that preventative maintenance has been completed per the manufacturer's recommendations.

Vapor measurements of total organic vapors or O_2/LEL may be conducted with a PID. Various PIDs may be used including a RAE Systems part per billion PID and a Thermoelectron 580B PID. The project may also use a RAE Systems Multi-meter for O_2/LEL measurements. The project SOPs describe the procedures for testing and inspecting these field instruments. These procedures include a battery check, verification that the meter was successfully calibrated prior to its use, and confirmation that preventative maintenance has been completed per the manufacturer's recommendations.

Manufacturer's instructions will be followed for any additional field equipment that may be required for the project.

11.2 LABORATORY INSTRUMENTS

All laboratory instruments will be maintained according to the manfacturers' instructions as specified in ARI's QA Plan.

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12.0 Corrective Actions

Corrective action is initiated when the following situations arise:

- Specific requirements of the analysis method or sampling/analysis procedure are not met.
- DQOs for precision, accuracy, and completeness are not achieved.
- Laboratory or field data review indicates that data are incomplete or that improper calculation, methodology, or technique was employed, or that an instrument malfunction has occurred.

When deficiencies are found, the QAM and SM will determine if the data in question are essential to the project and what corrective action will be taken. Corrective action may include one or more of the following:

- Additional information or recalculations are supplied.
- Instrument operation and calibration are checked. Calibration standards are checked and new standards are obtained, if necessary. Instrument malfunctions are corrected.
- Personnel repeat the task using the same procedure.
- A different individual repeats the task using the same procedure.
- Samples are re-analyzed (if holding time permits).
- Sampling and/or analytical procedures are evaluated and amended.
- Personnel repeat the task using a validated new or modified procedure.
- If practical, a new sample is collected and analyzed.

If the anomaly is not resolved after the above steps are taken, the data are reported with qualifying statements. In some cases, depending on the nature and degree of deviation, no data may be reported.

12.1 LABORATORY CORRECTIVE ACTION

The initial responsibility for monitoring the quality of an analytical system lies with the analyst. The analyst will verify that all quality control procedures are followed and that the results of analysis of quality samples are within acceptance criteria. This requires that the analyst assess the correctness of all the following items, as appropriate:

- Sample preparation procedures
- Initial calibration
- Calibration verification

- Method blank result
- Laboratory control standard

If the assessment by the analyst reveals that any of the quality control acceptance criteria, as defined by the most recent edition and updates of the analytical method are not met, the analyst must immediately assess the analytical system to correct the deficiency. The analyst must notify his/her supervisor and the laboratory QA coordinator of the deficiency and, if possible, identity potential causes and corrective action. Analytical data quality concerns that may require corrective action will be documented and reported as specified in the laboratory data reports.

The nature of the corrective action depends on the nature of the deficiency. For example, if continuing calibration verification is determined to be out of control, the corrective action may require recalibration of the analytical system and re-analysis of all samples since the last acceptable continuing calibration standard.

Quality control samples (e.g., matrix spikes and matrix spike duplicates) provide an indication of matrix affects on analyses. Failure to achieve method specific performance on quality control samples will trigger corrective action or additional re-analysis, as appropriate.

When the appropriate corrective action measures have been defined and the analytical system is determined to be in control, the analyst will document the problem, the corrective action, and the data demonstrating that the analytical system is in control. Copies of this documentation will be provided to the laboratory supervisor and the laboratory QA coordinator.

12.2 FIELD CORRECTIVE ACTION

The initial responsibility for monitoring the quality of field measurements and observations lies with the field personnel. The FS is responsible for verifying that all quality control procedures are followed. This requires that the FS assess the correctness of field methods and the ability to meet QA objectives. If a deficiency occurs that might jeopardize the integrity of the project or cause some specific QA objective not to be met, it is the responsibility of all project staff to report the noted deficiency to their immediate supervisor (on this project) and propose corrective actions to remedy the problem/deficiency.

12.3 RECONCILIATION WITH USER REQUIREMENTS

The project QC officer and PM will review the field and laboratory data generated for this project to ensure that all project QA objectives are met. If any non-conformances are found in the field procedures, sample collection procedures, field documentation procedures, laboratory analytical and documentation procedures, and/or data evaluation and quality review procedures, the impact of those non-conformances on the overall project QA objectives will be assessed. Appropriate actions, including re-sampling and re-analysis, may be recommended to the PM so that project objectives can be accomplished.

13.0 Quality Control Reports

All QC reports will include a summary description of all project activities, a summary of all data, a discussion of any problems encountered and associated corrective actions, a discussion of the conclusions drawn from the results of this project and the rationale for those conclusions, and the results of the data quality assessment. Any significant QA problems encountered in the laboratory or in the field, as deemed by the LPM or the CALIBRE QA Manager (respectively), will be reported immediately to the CALIBRE SM and Floyd|Snider Manager. A summary of the QC report will be included in task-specific reporting documents (e.g., RI report, monitoring report, or IM report).

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14.0 References

Floyd|Snider and CALIBRE. 2009. *North and South Sheetpiles in the 2-10 Building Interim Measure Work Plan (AOC 2-10.3A and AOC 2-10.4A), Phase 1: Data Collection, Agency Review Draft.* Prepared for the Boeing Company, Tukwila/Seattle, Washington. 9 October.

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Boeing Plant 2
Seattle/Tukwila, Washington

Interim Measures for the North and South Sheetpiles in the 2-10 Building Area (AOC 2-10.3A and AOC 2-10.4A)

Quality Assurance Project Plan

Tables

AGENCY REVIEW DRAFT

Table 1
Examples of Measurements

Measurement Type	Data Collected[1]	Intended Data Use
Laboratory Analytical Measurements	Concentrations of VOCs in water samples	Decision[2] & Estimation[3]
	Concentrations of semivolatile organics in water samples	Decision[2] & Estimation[3]
	Concentrations of metals in water samples	Decision[2] & Estimation[3]
	Concentrations of VOCs in soil/sediment/air. samples	Decision[2] & Estimation[3]
	Concentrations of semivolatiles in soil/sediment samples	Decision[2] & Estimation[3]
	Concentrations of metals in soil/sediment samples	Decision[2] & Estimation[3]
Field Analytical Measurements	Concentration of DO in groundwater samples	Estimation[4]
	Hydrogen ion activity (pH) of groundwater samples	Estimation[4]
	ORP of groundwater samples	Estimation[4]
	Specific conductance of groundwater samples	Estimation[4]
	Temperature of groundwater samples	Estimation[4]
	PID reading of headspace and soil cores for field screening	Estimation[4]
Field Physical Measurements	Instantaneous discharge rate of groundwater	Estimation[4]
	Piezometric head-in monitoring wells	Estimation[4]
	Air injection and extraction rates	Estimation[4]

Notes:

1. Prior sampling in and around the 2-10 Sheetpiles has included over 950 samples to characterize the TCE release and VOC plumes by USEPA Method 8260B (or prior equivalent methods). Based on the existing data, the COCs within the plume are known and include the compounds TCE, cis-1,2-DCE, trans-1,2-DCE, PCE, and vinyl chloride, all of which are included in the target list for VOC reporting for the 8260B analysis.
2. Data from samples analyzed by an analytical laboratory with QA/QC documentation, following standard methods such as USEPA SW-846.
3. Data from calibrated analytical instrument for contaminant delineation such as field GC, portable XRF, or PID analysis for vapors to include added quality assurance such as calibration curves, field duplicates, custody documentation (field sample tracking sheets) and a representative sample (typically 10 percent) submitted for laboratory verification.
4. Data from calibrated field instruments such as a water quality meter for DO, pH, temperature, or PID for organic vapors.

Abbreviations:

COC	Constituent of concern
DO	Dissolved oxygen
GC	Gas chromatograph
ORP	Oxidation reduction potential
PID	Photoionization detector
PCE	Tetrachloroethene
TCE	Trichloroethene
USEPA	U.S. Environmental Protection Agency
VOC	Volatile organic compound
XRF	X-ray fluorescent

Table 2
Examples of Laboratory Analytical Methods, Performance, and Quality Goals[1]

Analyte	Matrix	Method	Reporting Limit[2]	Precision[3]		Accuracy[3]	
				LCS/LCSD RPD	MS/MSD RPD	LCS % Recovery	MS % Recovery
Volatile Organic Compounds	Water	SW8260C	0.2 µg/L	<55	<27	50–150	50–125
Semivolatiles	Water	SW8270D	5 µg/L	<50	<25	50–150	50–125
Total Organic Carbon	Water	USEPA 415.1	1.5 mg/L	<20	<20	75–125	75–125
Metals, in general	Water	SW6010/200.8	0.1–50 µg/L[3]	<20	<20	75–125	75–125
Dissolved gases (methane, ethane, ethane)	Water	USEPA method RSK-175	1.0 µg/L	<55	<28	50–150	50–125
Iron, ferrous	Water	SM 3500-FED	0.04 mg/L	<20	<20	75–125	75–125
Anions	Water	300.0	0.1mg/L	<20	<20	75–125	75–125
Alkalinity	Water	SM 2320	1.0mg/L	<20	<20	75–125	75–125
Bacterial Census for *Dehalococcoides*	Water	RT-PCR	100 cells	NA	NA	NA	NA
Metals, in general[5]	Soil/sediment	SW6010/3050 200.8	0.02–20 mg/kg[4]	<30	Note[3]	75–125	Note[3]
Volatiles * RLs subject to change based on low level/ med level method limitations	Soil/sediment	8260C/5035	0.1 mg/kg	<30	Note[3]	75–125	Note[3]
Semi-volatiles	Soil/sediment	8270D/3540	67 µg/kg	<30	Note[3]	76–110	Note[3]
PCBs (aroclors)	Soil/sediment	8082	10 µg/kg	<30	Note[3]	26–167	Note[3]
Volatile Organic Compounds	Soil Vapor/Gas	8260 Modified	0.5–45 ppbv	<35	<30	70–130	70–130
Volatile Organic Compounds	Soil Vapor/Gas	TO-15 SIM	0.3–1 ppbv	<30	<20	65–135	65–135

Soil Property/Geotechnical Tests			
Physical Property	**Test Method**	**Physical Property**	**Test Method**
USCS soil classification	ASTM D2487 (may also require Atterberg ASTM-D-4318)	Organic carbon content	Plumb (1981) or LOI ASTM- D-2974
Density	ASTM D-2937 or EPA 9100	Moisture content	ASTM D2216
		Grain size distribution	ASTM D422/421

Notes:

1. RPD and recovery limits are typical ranges for the published analytical methods. Where applicable laboratory specific limits specified in SOPs will be used.
2. Target values for RLs are listed above; actual values may vary for some analytes if high levels of VOCs in sample require dilution.
3. Values for RPD and percent recovery for Precision and Accuracy are typical ranges for the analytical methods, details for specific analytes are included in Attachment 2. For analytes not currently included in Attachment 2, criteria for RPD and percent recovery will be reviewed and approved prior to sample collection. Once approved, any new criteria shall be included at the end of Attachment 2. Alternately, the criteria may be included in the SAP for any specific sampling plan.
4. Refer to Table 6 for specific reporting limits for individual metals.
5. Precision and accuracy information for metals MS/MSDs is provided in Attachment 4.

Abbreviations:

LCS/LCSD Laboratory control sample/laboratory control sample duplicate
MS/MSD Matrix spike/matrix spike duplicate
NA Not applicable
RPD Relative percent difference

Table 3
Applicable Criteria and Laboratory Reporting Limits for Groundwater

COC in Groundwater CAS Number	Constituent	Federal Standards		State Standards	Applicable Standard or Criteria[3] (µg/L)	Plant 2 Screening Levels (µg/L)	Lab Reporting Limits (µg/L)
		National Toxics Rule[1] 40 CFR 131 (µg/L)	National Recommended Water Quality Criteria[1] CWA §304(a) (µg/L)	MTCA Method B Surface Water[2] (if applicable) WAC 173-340-730 (µg/L)			
Volatile Organic Compounds							
156-59-2	cis-1,2-dichloroethene					1,550	0.2
156-60-5	trans-1,2-dichloroethene	14,000	10,000		10,000		0.2
79-01-6	Trichloroethene	81	30	1.5[4]	1.5[4]	0.3	0.2
75-01-4	Vinyl chloride	525	2.4	3.7	2.4	0.7	0.2
79-00-5	1,1,2-trichloroethane	42	16	25	16	5	0.2
127-18-4	Tetrachloroethylene	8.9	3.3	8.85	8.85		0.2

Notes:

1. Human health criteria set for consumption of organisms only based on non-potable water.
2. MTCA risk-based formula for non-potable water; only applies if other protective regulations have not been established (i.e., promulgated State or Federal standards do not exist or are not considered protective).
3. Based on established standards and MTCA risk-based formula (when applicable); all human health values listed are lower than applicable criteria set for protection of aquatic species.
4. The MTCA risk-based formula for TCE is based on a provisional oral cancer potency factor of 0.4 kg-dy/mg, this value is under review and has not yet been accepted in IRIS. This value may change.

Abbreviations:

COC Constituent of concern
MTCA Washington State Model Toxics Control Act
TCE Trichloroethene

Table 4
Water Sample Analytical Methods, Sample Quantities, Containers, Preservation, and Holding Times

Parameter	Method Reference	Method	Minimum Sample Amount	Container Type	Preservation	Extraction Holding Time	Analysis Holding Time
VOCs	SW-846	8260C and 8260-SIM	20 mL	5-40 mL VOA glass vials with teflon septum [2] (No Headspace)	HCl pH<2, cool to 4ºC Or unpreserved	NA	14 days 7 days if not preserved
SVOCs and 1,4-Dioxane	SW-846	8270D	500 mL	4-500 mL amber glass, Teflon lined cap	Cool to 4ºC	7 days	40 days[1]
PAHs	SW-846	8270-SIM	500 mL	2-500 mL amber glass, Teflon lined cap	Cool to 4ºC	7 days	40 days[1]
PAHs Low-level	SW-846	8270-SIM (Low-level)	500 mL	2- 500 mL amber glass, Teflon lined cap	Cool to 4ºC	7 days	40 days[1]
Phosphate Based Hydraulic Oil Compounds and BHT	SW-846	8270D Mod. & 8270-SIM	1 L	2-1 L amber glass, Teflon lined cap	Cool to 4ºC	7 days	40 days[1]
PCBs	SW-846	8082 (standard and MTCA)	500 mL	2-500 mL amber glass, Teflon lined cap	Cool to 4ºC	7 days	40 days[1]
PCBs Low-level	SW-846	8082 Low-level (1-liter hexane extraction)	1 L	2-1 L amber glass, Teflon lined cap	Cool to 4ºC	7 days	40 days[1]
Gasoline-Range TPHs	Ecology	NWTPH-Gx	5 mL	2-40 mL VOA glass vials with teflon septum (No Headspace)	HCl pH <2, cool to 4ºC	NA	14 days
Diesel-, Jet A Fuel- and Heavy Oil-Range TPHs	Ecology	NWTPH-Dx	500 mL	2-500 mL amber glass, Teflon lined cap	Cool to 4ºC	7 days	40 days[1]
Purgeable Aromatic Compounds [3] (BETX)	SW-846	USEPA 8021B	5 mL	2-40 mL VOA glass vials with teflon septum (No Headspace)	HCl pH <2, cool to 4º C	NA	14 days
Total and Dissolved Metals[4]	SW-846	USEPA 6010B/200.8 / 7000A Series	250 mL	500 mL HDPE	HNO_3 to pH <2, cool to 4º C	NA	6 months (Mercury is 28 days)
Alkalinity (total, bicarbonate, carbonate)	USEPA	SM 2320	150 mL	500 mL poly (small OJ)	Cool to 4ºC, no headspace	NA	14 days
Chloride[5]	USEPA	USEPA 300.0	100 mL	500 mL poly (small OJ)	Cool to 4º C	NA	28 days
Nitrate[5]	USEPA	USEPA 300.0	100 mL	500 mL poly (small OJ)	Cool to 4º C	NA	48 hours
Sulfate[5]	USEPA	USEPA 300.0	100 mL	500 mL poly (small OJ)	Cool to 4º C	NA	28 days
Iron, Ferrous	SM	SM 3500-FED	500 mL	500 mL amber glass	HCL to pH <2.0	NA	On Receipt
TOC	USEPA	USEPA 415.1	150 mL	250 mL amber glass	H_2S0_4	NA	28 days
DOC (See footnote 4)	USEPA	USEPA 415.1	150 mL	250 mL amber glass	See #4	NA	28 days
TSS	USEPA	USEPA 160.3	1,000 mL	1,000 mL poly (large OJ)	Cool to 4ºC	NA	7 days

Notes:

1. Days from extraction date.
2. If analyses for VOCs and low level VOCs are required on the same sample, collect 5-40ml vials.
3. Compounds include benzene, toluene, ethylbenzene, and xylenes.
4. Samples for dissolved metals or DOC will be filtered in the field prior to chemical preservation.
5. Sample volume for chloride, nitrate, and sulfate can be combined into one sample bottle; however, nitrate analysis must be performed within the 48-hour holding time.

Abbreviations:

BETX	Benzene, ethylbenzene, toluene, and xylene
BHT	Butylated hydroxytoluene
DOC	Dissolved organic carbon
Ecology	Washington State Department of Ecology
H_2SO_4	Sulfuric acid
HDPE	High density polyethylene
NA	Not applicable
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
TOC	Total organic carbon
TPH	Total petroleum hydrocarbons
TSS	Total suspended solids
SVOC	Semivolatile organic compound
VOA	Volatile organic analyte
VOCs	Volatile organic compounds

Table 5
Soil and Soil Vapor Sample Analytical Methods,
Sample Quantities, Containers, Preservation, and Holding Times

Parameter	Method Reference	Method	Minimum Sample Amount	Container Type[3]	Preservation	Extraction Holding Time	Analysis Holding Time
VOCs	SW-846	8260C and 8260-SIM	5 g	2-40 mL VOA vials with sodium bisulfate (from Easy-Draw Syringe), 1-40 mL VOA vial with MeOH (from Easy-Draw Syringe), and 2-oz glass jar with teflon-lined lid (minimize headspace)	Sodium Bisulfate (for VOA vial) Methanol (for VOA vial) No headspace (for 2-oz glass jar) Cool to 4ºC (5 gms of sample for 5 mLs of preservative)	NA	14 days
SVOCs and 1,4-Dioxane	SW-846	8270D	30 g	8-oz glass jar with teflon-lined lid	Cool to 4ºC	14 days	40 days[1]
PAHs	SW-846	8270-SIM	30 g	8-oz glass jar with teflon-lined lid	Cool to 4ºC	14 days	40 days[1]
Phosphate Based Hydraulic Oil Compounds and BHT	SW-846	8270D Mod.	30 g	8-oz glass jar with teflon-lined lid	Cool to 4ºC	14 days	40 days[1]
PCBs	SW-846	8082	30 g	8-oz glass jar with teflon-lined lid	Cool to 4ºC	14 days	40 days[1]
Gasoline-Range TPHs	Ecology	NWTPH-Gx	10 g	2-40 mL VOA vials w/MeOH (from Easy-Draw Syringe) and 2-oz glass jar with teflon-lined lid (minimize headspace)	Methanol (for VOA vial) No headspace (for 2-oz glass jar) Cool to 4ºC (5 g of sample to 5 mL of preservative)	NA	14 days
Diesel-, Jet A Fuel- and Heavy Oil-range TPHs	Ecology	NWTPH-Dx	30 g	8-oz glass jar with teflon-lined lid	Cool to 4ºC	14 days	40 days[1]
Purgeable Aromatic Compounds[2] (BETX)	SW-846	USEPA 8021B	5 g	2-40 mL VOA vials w/MeOH (from Easy-Draw Syringe) and 2-oz glass jar with teflon-lined lid (minimize headspace)	Methanol (for VOA vial) No headspace (for 2-oz glass jar) Cool to 4ºC (5 g of sample to 5 mL of preservative)	NA	14 days
Metals	SW-846	USEPA 6010B / 200.8/7000 A Series	5 g	4-oz glass jar with teflon-lined lid	Cool to 4ºC	NA	6 months (28 days for Mercury)
TOC	Plumb, 1981	Plumb, 1981	2 g	4-oz glass jar with teflon-lined lid	Cool to 4ºC	NA	28 days
Soil Vapor VOCs (Tedlar bags)	SW-846	8260C	0.5 L	1L Tedlar Bag	Ambient Temperature	NA	3 days
Soil Vapor VOCs (SUMMA)	SW-846	TO-15 SIM	1 L	6L SUMMA Canister	Ambient Temperature	NA	14 days

Notes:

1 Days from extraction date.
2 Compounds include benzene, toluene, ethylbenzene, and xylenes.
3 Other allowable containers for soil samples include stainless steel rings with teflon-lined plastic caps for analyses other than volatile parameters.

Abbreviations:

BETX Benzene, ethylbenzene, toluene, and xylene
BHT Butylated hydroxytoluene
DOC Dissolved organic carbon
Ecology Washington State Department of Ecology
NA Not applicable
PAH Polynuclear aromatic hydrocarbons
PCB Polychlorinated biphenyl
TOC Total organic carbon
TPH Total petroleum hydrocarbon
TSS Total suspended solids
SUMMA Registered trademark of Melectrics Corporation for a stainless steel canister whose interior has been polished and passivated for use in air sampling
SVOC Semivolatile organic compound
VOA Volatile organic analyte
VOCs Volatile organic compounds

Table 6
Parameters of Interest and Project Data Quality Objectives
Soils/Accumulated Solids and Water

Parameter Method USEPA 8260C	MDL 10mL Purge		RL 10mL Purge		MDL 5 mL Purge		RL 5 mL Purge	
Volatile Organic Compounds		**Water µg/L**		**Water µg/L**	**Soil/Solids 5 gram µg/kg**	**Water µg/L**	**Soil/Solids µg/kg**	**Water µg/L**
Acetone		0.622		5.0	2.221	2.954	5.0	5.0
Benzene		0.043		0.2	0.218	0.252	1.0	1.0
Bromodichloromethane		0.035		0.2	0.481	0.192	1.0	1.0
Bromoform		0.062		0.2	0.491	0.286	1.0	1.0
Bromomethane		0.094		1.0	0.400	0.427	1.0	1.0
2-Butanone		1.152		5.0	0.960	1.959	5.0	5.0
Carbon Disulfide		0.071		0.2	0.352	0.176	1.0	1.0
Carbon Tetrachloride		0.089		0.2	0.396	0.233	1.0	1.0
Chlorobenzene		0.032		0.2	0.098	0.145	1.0	1.0
Chloroethane		0.055		0.2	0.436	0.186	1.0	1.0
2-Chloroethylvinylether		0.135		1.0	0.453	0.218	5.0	5.0
Chloroform		0.048		0.2	0.347	0.192	1.0	1.0
Chloromethane		0.096		1.0	0.094	0.134	1.0	1.0
Dibromochloromethane		0.047		0.2	0.295	0.227	1.0	1.0
1,1-Dichloroethane		0.072		0.2	0.129	0.211	1.0	1.0
1,2-Dichloroethane		0.051		0.2	0.351	0.244	1.0	1.0
1,1-Dichloroethene		0.075		0.2	0.184	0.305	1.0	1.0
cis-1,2-Dichloroethene		0.054		0.2	0.110	0.130	1.0	1.0
trans-1,2-Dichloroethene		0.063		0.2	0.208	0.201	1.0	1.0
1,2-Dichloropropane		0.040		0.2	0.357	0.227	1.0	1.0
cis-1,3-Dichloropropene		0.046		0.2	0.199	0.230	1.0	1.0
trans-1,3-Dichloropropene		0.043		0.2	0.138	0.204	1.0	1.0
Ethylbenzene		0.054		0.2	0.087	0.182	1.0	1.0
2-Hexanone		0.481		5.0	0.823	0.927	5.0	5.0
Methylene Chloride		0.112		0.5	0.706	0.190	2.0	2.0
4-Methyl-2-pentanone		0.199		5.0	0.952	0.370	5.0	5.0
Styrene		0.030		0.2	0.230	0.121	1.0	1.0
1,1,2,2-Tetrachloroethane		0.082		0.2	0.218	0.135	1.0	1.0
Tetrachloroethene		0.056		0.2	0.400	0.091	1.0	1.0
Toluene		0.041		0.2	0.225	0.183	1.0	1.0
1,1,1-Trichloroethane		0.057		0.2	0.123	0.183	1.0	1.0
1,1,2-Trichloroethane		0.055		0.2	0.253	0.262	1.0	1.0
Trichloroethene		0.088		0.2	0.510	0.293	1.0	1.0
Trichlorofluoromethane		0.056		0.2	0.384	0.182	1.0	1.0
1,1,2-Trichloro-1,2,2-trifluoroethane		0.083		0.2	0.383	0.184	2.0	2.0
Vinyl Acetate		0.089		1.0	0.326	0.222	5.0	5.0
Vinyl Chloride		0.067		0.2	0.157	0.249	1.0	1.0
m,p-Xylene		0.062		0.4	0.263	0.357	1.0	2.0
o-Xylene		0.043		0.2	0.205	0.221	1.0	1.0

Notes:

MDLs and RLs will vary based on purge volume (water) or sample weight (soil and accumulated solids). Limits shown are for 10 mL purge (water, 8260C), and 5 gram sample weight (soil and accumulated solids). Target values for MDLs, and RLs are listed above, actual values may vary for some analytes if high levels of VOCs in sample require dilution. The RLs for some compounds may have to be reduced pending final cleanup levels.

Abbreviations:

MDL Method detection limit
NA Not applicable
RL Reporting limit
USEPA U.S. Environmental Protection Agency

Table 7
Metals (Dissolved and Total)
Method Detection Limits and Reporting Limits for Soils/Water

Metals (Dissolved and Total)		MDL 6010/6020/ 7000 series		RL 6010/6020/ 7000 series	
Parameter	**USEPA Method 6000/6020/7000 Series**	**mg/kg**	**mg/L**	**mg/kg**	**mg/L**
Antimony	6010	0.454	0.00297	5	0.05
Antimony	200.8	0.008	0.000003	0.2	0.0002
Arsenic	6010B	0.198	0.00535	5	0.05
Arsenic	6020	0.038	0.00002	0.2	0.0002
Beryllium	6010B	0.006	0.00013	0.1	0.001
Beryllium	6020	0.022	0.000022	0.2	0.0002
Cadmium	6010B	0.039	0.00047	0.2	0.002
Cadmium	6020	0.011	0.000008	0.2	0.0002
Chromium	6010B	0.105	0.0018	0.5	0.005
Chromium	6020	0.75	0.000032	0.5	0.0005
Copper	6010B	0.063	0.00061	0.2	0.002
Copper	6020	0.150	0.000059	0.5	0.0005
Iron	6010B	0.313	0.00836	5	0.05
Iron	6020		0.01239	20	0.02
Lead	6010B	0.037	0.00149	2	0.02
Lead	200.8	0.263	0.000127	1.0	0.001
Manganese	6010B	0.013	0.00025	0.1	0.001
Manganese	6020	0.026	0.000265	0.5	0.0005
Mercury	7471A/7470A	0.0053	0.000011	0.05	0.0001
Nickel	6010B	0.245	0.00507	1.0	0.01
Nickel	6020	0.119	0.000059	0.5	0.0005
Selenium	6010B	0.64	0.00633	5	0.05
Selenium	6020	0.102	0.000105	0.5	0.0005
Silver	6010B	0.064	0.00054	0.3	0.003
Silver	200.8	0.009	0.000008	0.2	0.0002
Thallium	6010B	0.588	0.00502	5	0.05
Thallium	6020	0.005	0.000003	0.2	0.0002
Vanadium	6010B	0.063	0.00047	0.3	0.003
Vanadium	6020	0.027	0.000022	0.2	0.0002
Zinc	6010B	0.61	0.00145	1	0.01
Zinc	6020	0.637	0.000379	4	0.004

Analysis	Method	Target Reporting Limit
VOCs (Soil Vapor with Tedlar Bag)	USEPA 8260 Modified	0.5–45 ppbv
VOCs (Soil Vapor with SUMMA canister)	USEPA TO-15 SIM	0.3–1 ppbv
TOC	USEPA 415.1	1.5 mg/L
Dissolved gases	USEPA RSK-175	1.0µg/L
Anions	300.0	0.1 mg/L
Bio-Dechlor Census Test	RT-PCR	~10^2 organisms/mL

Abbreviations:

MDL Method detection limit
ppbv Parts per billion by volume
RL Reporting limit
TOC Total organic carbon
USEPA U.S. Environmental Protection Agency
VOC Volatile organic compound

Table 8
Summary of Field Quality Control Samples

Quality Control Sample Type	Sample Matrix	Applicable Analysis	Frequency	Purpose	Acceptance Criteria[1]	Corrective Action
Field Duplicate	Water	SW8260C	One per 20 samples or sample batch	Monitor sample variability	<50% RPD	Evaluate source of variability. Evaluate whether sampling frequency needs to be increased.
		SW8270D			<50% RPD	
		SW6010/6020			<30% RPD	
Ambient Blank	Water	SW8260C	As specified in SAP/QAPP	Monitor potential for contamination from ambient sources	Note[2]	Evaluate source of contamination and determine procedure changes, if needed.
Equipment Rinseate Blank	Water	SW8260C	One per sampling event when sampling with non-dedicated equipment	Monitor decon effectiveness and sample cross-contamination	Note[2]	Evaluate source of contamination and determine procedure changes, if needed.
		SW8270D				
		SW6010/6020				
		E300.0				
Trip Blank	Water	SW8260C	One per sample shipment with VOC analysis	Monitor contamination from sample handling and shipment	Note[2]	Evaluate source of contamination and determine procedure changes, if needed.

Notes:

1 Blank acceptance criteria will be based on the most recent published Functional Guidelines. Data may be qualified if sample results are less than five times the associated blank result.

2 Sample must exhibit contaminant at a level equal to or greater than the method detection limit to be considered detectable.

Abbreviations:

RPD Relative percent difference

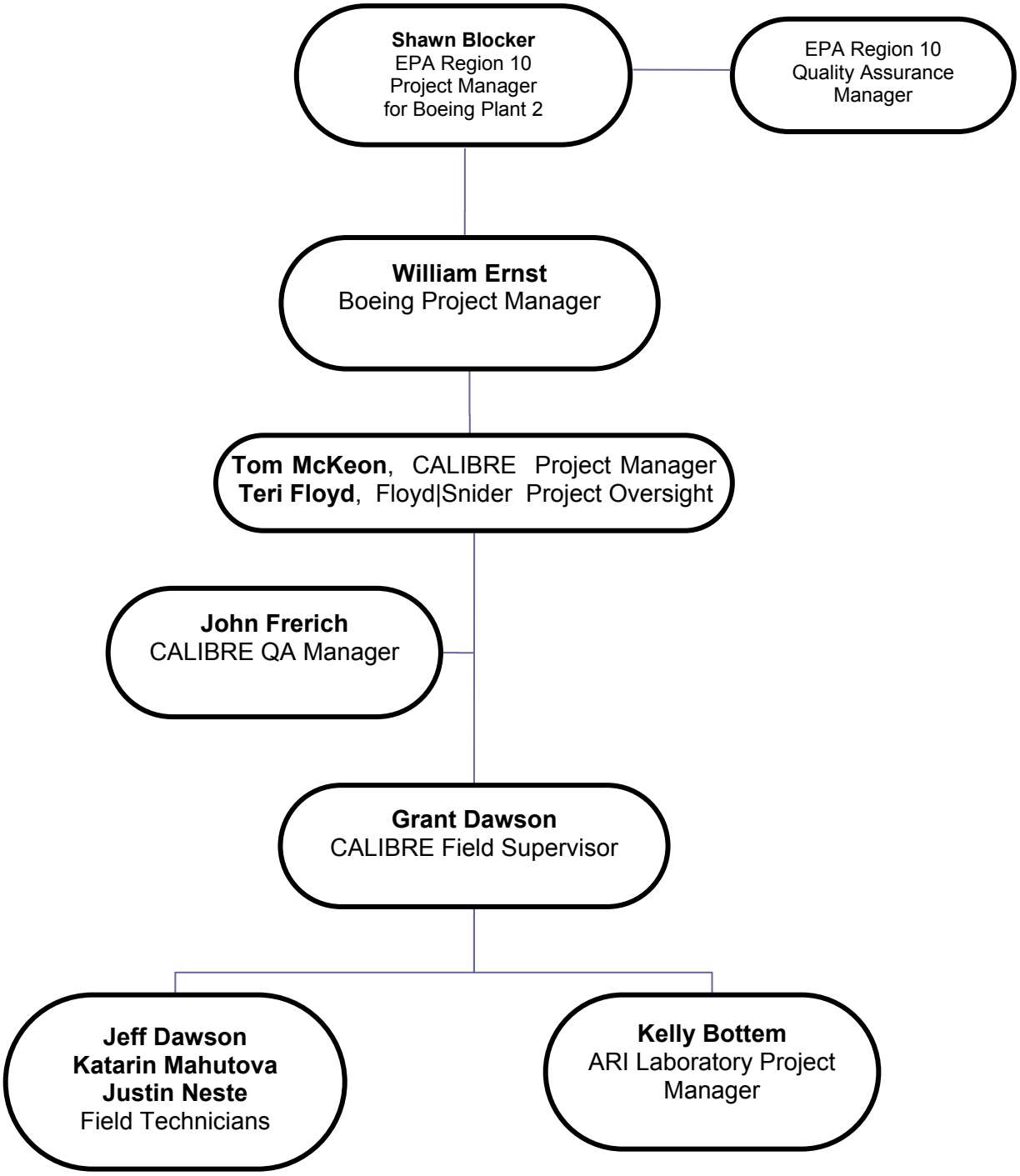
Boeing Plant 2
Seattle/Tukwila, Washington

Interim Measures for the North and South Sheetpiles in the 2-10 Building Area (AOC 2-10.3A and AOC 2-10.4A)

Quality Assurance Project Plan

Figure

AGENCY REVIEW DRAFT



FLOYD I SNIDER CALIBRE Systems	**North and South Sheetpiles in the 2-10 Building QAPP Boeing Plant 2 Seattle/Tukwila, Washington**	Figure 1 Project Organization Chart

Boeing Plant 2
Seattle/Tukwila, Washington

Interim Measures for the North and South Sheetpiles in the 2-10 Building Area (AOC 2-10.3A and AOC 2-10.4A)

Quality Assurance Project Plan

Attachments

AGENCY REVIEW DRAFT

Attachment 1
Distribution List

Official copies of this QAPP, accompanying documents, and any subsequent revisions will be provided to:

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Attachment 2
Formulas for Evaluating Precision, Accuracy, Completeness, and Sensitivity

Performance criteria discussed in Appendix C, Section 3.0 (precision, accuracy, completeness, and sensitivity) will be evaluated and calculated in accordance with methods and/or procedures specified in Appendix C, Section 3.0, or as specified below.

Analytical Precision. Analytical precision of the laboratory procedure will be expressed as the relative percent difference (RPD) between a sample and its field duplicate. RPD is calculated as follows:

$$RPD = \left| \frac{X_1 - X_2}{(X_1 + X_2)/2} \right| \bullet 100\%$$

where: X_1 = measured concentration in the first sample, and

X_2 = measured concentration in the second sample.

Analytical Accuracy. The accuracy of the laboratory procedure will be estimated from the analyses of the percent recovery of the MS/MSD sample. Accuracy is calculated based on the percentage of the spike recovered (REC) in the analysis as follows:

$$\%REC = \left(\frac{Xs - Xu}{SA}\right) \bullet 100\%$$

where: X_s = measured amount in the spiked sample;

X_u = measured amount in the unspiked sample; and

SA = spiked amount.

Several EPA methods do not include a MS/MSD analysis. The accuracy for analytical procedures that do not include a MS analysis will be monitored by the percent difference of the true value for a laboratory control sample from its measured value. Accuracy is calculated based on the percentage difference of the laboratory control sample in the analysis as follows:

$$\%D = (TV - R)/TV \bullet 100\%$$

where: *TV* = true value of laboratory control sample

R = result

Completeness. Completeness will be calculated and expressed as the percentage of number of samples that were judged to be valid, i.e., not rejected, and acceptable for all intended data use. Completeness (%C) is calculated for each type of measurement/analysis as follows:

$$\%C = \frac{(SE - SR)}{SE} \bullet 100\%$$

where: *SE* = number of samples collected; and

SR = number of samples rejected

Sensitivity. Sensitivity is to be expressed in terms of detection and quantitation limits for each type of measurement/analysis.

The analytical laboratory is to notify the SM and QAM if the laboratory anticipates or experiences any difficulties in achieving the detection/quantitation limits specified in the approved QAPP.

Matrix effects should be considered in assessing the analytical laboratory's compliance with sensitivity specifications. The laboratory is to provide a detailed discussion of all failures to meet sensitivity specifications in the data package narrative.

If a sample dilution results in non-detect values for analytes that had been detected in the original analysis, then the results of the original run and the dilution are to be reported with the appropriate notations in the data package narrative.

Attachment 3
Quality Control Criteria for Data Quality Assessment—Water

Method	Analyte	Quality Control Parameter	Water 5 mL Purge Lower Control Limit[2]	Water 5 mL Purge Upper Control Limit[2]	Water 5 mL Purge RPD Limit	Water 20 mL Purge Lower Control Limit	Water 20 mL Purge Upper Control Limit	Water 20 mL Purge RPD Limit
VOLATILE ORGANIC COMPOUNDS								
Surrogate Recoveries								
8260B	d4-1,2-Dichloroethane	Sample Surrogate	80	120	30	64	146	30
8260B	d8-Toluene	Sample Surrogate	80	120	30	78	125	30
8260B	4-Bromofluorobenzene	Sample Surrogate	76	120	30	71	120	30
8260B	d4-1,2-Dichlorobenzene	Sample Surrogate	80	124	30	80	120	30
8260B	d4-1,2-Dichloroethane	MB/LCS Surrogate	79	120	30	70	131	30
8260B	d8-Toluene	MB/LCS Surrogate	80	120	30	80	120	30
8260B	4-Bromofluorobenzene	MB/LCS Surrogate	80	120	30	74	121	30
8260B	d4-1,2-Dichlorobenzene	MB/LCS Surrogate	80	120	30	80	120	30
Laboratory Control Sample Recoveries								
8260B	Vinyl Chloride	LCS	63	128	30	53	132	30
8260B	trans-1,2-dichloroethene	LCS	72	121	30	68	127	30
8260B	cis-1,2-dichloroethene	LCS	80	120	30	70	120	30
8260B	Trichloroethene	LCS	80	120	30	80	117	30
8260B	All Other Analytes	LCS	50	150	30	50	150	30
Matrix Spike Recoveries[1]								
8260B	Vinyl Chloride	MS	63	128	30	53	132	30
8260B	1,1-Dichloroethene	MS	73	120	30	66	127	30
8260B	Chloroform	MS	79	120	30	75	121	30
8260B	Benzene	MS	80	120	30	80	121	30
8260B	Trichloroethene	MS	80	120	30	80	117	30
8260B	1,2-Dichloropropane	MS	78	120	30	78	120	30
8260B	Toluene	MS	80	121	30	80	120	30
8260B	Chlorobenzene	MS	80	120	30	80	121	30
8260B	Ethylbenzene	MS	80	130	30	72	130	30
8260B	All Other Analytes	MS	50	150	30	50	150	30
CONVENTIONAL PARAMETERS								
Duplicate Analysis								
EPA 310.1	Alkalinity (total, bicarbonate, carbonate)	Duplicate Analysis	NA	NA	NA	NA	NA	20
EPA 300.0	Chloride	Duplicate Analysis	NA	NA	NA	NA	NA	20
SM 3500-FED	Iron, Ferrous	MS	NA	NA	NA	NA	NA	20
EPA 300.0	Nitrate	Duplicate Analysis	NA	NA	NA	NA	NA	20
EPA 300.0	Sulfate	Duplicate Analysis	NA	NA	NA	NA	NA	20
EPA 415.1	Total Organic Carbon (TOC)	Duplicate Analysis	NA	NA	NA	NA	NA	20
LCS Recoveries								
EPA 310.1	Alkalinity (total, bicarbonate, carbonate)	LCS	NA	NA	NA	75	125	20
EPA 300.0	Chloride	LCS	NA	NA	NA	75	125	20
SM 3500-FED	Iron, Ferrous	MS	NA	NA	NA	75	125	20
EPA 300.0	Nitrate	LCS	NA	NA	NA	75	125	20
EPA 300.0	Sulfate	LCS	NA	NA	NA	75	125	20
EPA 415.1	Total Organic Carbon (TOC)	LCS	NA	NA	NA	75	125	20
Matrix Spike Recoveries[1]								
EPA 310.1	Alkalinity (total, bicarbonate, carbonate)	MS	NA	NA	NA	75	125	20
EPA 300.0	Chloride	MS	NA	NA	NA	75	125	20
EPA 300.0	Nitrate	MS	NA	NA	NA	75	125	20
SM 3500-FED	Iron, Ferrous	MS	NA	NA	NA	75	125	20
EPA 300.0	Sulfate	MS	NA	NA	NA	75	125	20
EPA 415.1	Total Organic Carbon (TOC)	MS	NA	NA	NA	75	125	20

Method	Analyte	Quality Control Parameter	Water 5 mL Purge Lower Control Limit[2]	Water 5 mL Purge Upper Control Limit[2]	Water 5 mL Purge RPD Limit	Water 20 mL Purge Lower Control Limit	Water 20 mL Purge Upper Control Limit	Water 20 mL Purge RPD Limit
PROPANE, METHANE, ETHANE, ETHENE								
Method Blank/ LCS Surrogate Recoveries								
EPA RSK-175	Propane	Surrogate	NA	NA	NA	80	120	NA
LCS Recoveries								
EPA RSK-175	Methane	LCS	NA	NA	NA	68	126	NA
	Ethane	LCS	NA	NA	NA	80	120	NA
	Ethene	LCS	NA	NA	NA	80	120	NA
Matrix Spike Recoveries[1]								
EPA RSK-175	Methane	MS	NA	NA	NA	24	183	NA
	Ethane	MS	NA	NA	NA	67	124	NA
	Ethene	MS	NA	NA	NA	73	121	NA

Notes:

1 Matrix spike recoveries are target limits. If limits are not met, corrective action may or may not be performed and will be assessed on a case-by-case basis.

2 Control limits are subject to change based on method updates and control charts for VOCs.

Abbreviations:

MB Method blank
MS Matrix spike
NA Not applicable
RPD Relative percent difference
VOC Volatile organic compound

Attachment 3
Quality Control Criteria for Data Quality Assessment—Soil

Method	Analyte	Quality Control Parameter	Soil Low Level Lower Control Limit[2]	Soil Low Level Upper Control Limit[2]	Soil Low Level RPD Limit	Soil Medium Level Lower Control Limit	Soil Medium Level Upper Control Limit	Soil Medium Level RPD Limit
VOLATILE ORGANIC COMPOUNDS								
Surrogate Recoveries								
8260B	d4-1,2-Dichloroethane	Sample Surrogate	72	134	30	69	120	30
8260B	d8-Toluene	Sample Surrogate	78	124	30	80	120	30
8260B	4-Bromofluorobenzene	Sample Surrogate	66	120	30	76	128	30
8260B	d4-1,2-Dichlorobenzene	Sample Surrogate	79	120	30	80	120	30
8260B	d4-1,2-Dichloroethane	MB/LCS Surrogate	75	120	30	76	120	30
8260B	d8-Toluene	MB/LCS Surrogate	80	122	30	80	120	30
8260B	4-Bromofluorobenzene	MB/LCS Surrogate	79	120	30	80	120	30
8260B	d4-1,2-Dichlorobenzene	MB/LCS Surrogate	80	120	30	80	120	30
Laboratory Control Sample Recoveries								
8260B	Vinyl Chloride	LCS	25	145	30	25	128	30
8260B	trans-1,2-dichloroethene	LCS	80	126	30	78	125	30
8260B	cis-1,2-dichloroethene	LCS	80	124	30	80	125	30
8260B	Trichloroethene	LCS	80	129	30	80	120	30
8260B	All Other Analytes	LCS	50	150	30	50	150	30
Matrix Spike Recoveries[1]								
8260B	Vinyl Chloride	MS	25	145	30	36	132	30
8260B	1,1-Dichloroethene	MS	73	135	30	73	133	30
8260B	Chloroform	MS	80	125	30	80	124	30
8260B	Benzene	MS	80	126	30	80	120	30
8260B	Trichloroethene	MS	80	129	30	80	125	30
8260B	1,2-Dichloropropane	MS	80	124	30	80	122	30
8260B	Toluene	MS	80	127	30	80	122	30
8260B	Chlorobenzene	MS	80	124	30	80	121	30
8260B	Ethylbenzene	MS	80	135	30	80	126	30
8260B	All Other Analytes	MS	50	150	30	50	150	30

Notes:

1 Matrix spike recoveries are target limits. If limits are not met, corrective action may or may not be performed and will be assessed on a case-by-case basis.

2 Control limits are subject to change based on method updates and control charts for VOCs.

Abbreviations:

MB Method blank
MS Matrix spike
NA Not applicable
RPD Relative percent difference
VOC Volatile organic compound

Attachment 4
Quality Control Criteria for Data Quality Assessment
Total and Dissolved Metals

Method	Analyte	Quality Control Parameter	Water/Soil/Sediment			
			Lower Control Limit	Upper Control Limit	Water RPD Limit	Soil/ Sediment RPD Limit
Duplicate Analyses						
6000/6020/7000 Series	All Metals	Duplicate Analyses	NA	NA	20	35
LCS Recoveries						
6000/6020/7000 Series	All Metals	Duplicate Analyses	80	120	20	35
Matrix Spike Recoveries[1]						
6000/6020/7000 Series	All Metals	Duplicate Analyses	75	125	20	35

Notes:

1 Matrix spike recoveries are target limits. If limits are not met, corrective action may or may not be performed and will be assessed on a case-by-case basis.

Abbreviations:

NA Not applicable
RPD Relative percent difference