

Memo

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Project: 8888.006.0
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Date: July 20, 2009

Subject: Building 4-82 Investigation Results
Boeing Renton Facility
Renton, Washington

1.0 INTRODUCTION

This memorandum summarizes additional investigational work conducted for the area adjacent to Building 4-82 (the Site) at the Boeing Renton Facility (the Facility) in Renton, Washington. The work was completed in accordance with the Building 4-82 Investigation Work Plan (AMEC, 2009) and email correspondence dated April 21, 2009, from Byung Maeng to Carl Bach requesting additional analytical data for the vicinity. Analytical results from soil samples collected during recent construction activities at the north end of the Renton Facility, east of Building 4-82, indicate a petroleum release may have occurred in soil in that area. The objective of the additional investigation work was to further define the nature and extent of petroleum-affected soil near the southeast corner of Building 4-82, and to determine the potential impact to groundwater quality. This was accomplished by completing five shallow push probes in the area surrounding the initial sampling location. Soil samples were collected from above and below the water table (approximately 3 to 4 feet below ground surface [bgs]) at each boring location, and grab groundwater samples were collected from two of the borings.

2.0 SITE BACKGROUND

Building 4-82 and the adjacent Building 4-81 are used for final assembly of Boeing 737 aircraft. While removing pavement near the southeast corner of Building 4-82 on November 25, 2008, workers noticed an odor indicative of a possible petroleum release. A soil sample was collected by Boeing staff and analyzed by Boeing's environmental analysis laboratory. The soil sample had a concentration of 6,300 milligrams per kilogram (mg/kg) of diesel.

3.0 SAMPLING AND ANALYSIS

This section describes the approach that was used to complete the investigations at Building 4-82. Figure 1 shows the location of this area and the approximate sampling locations.

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3.1 Direct-Push Sampling

On June 9 and 10, 2009, AMEC Geomatrix, Inc. (AMEC), oversaw completion of five direct-push borings (PP193 through PP197) in the area southeast of Building 4-82. One boring was installed in the vicinity of the sample collected by Boeing during construction activities. Four borings were placed surrounding the construction area to delineate petroleum-affected soil and groundwater. Drilling was completed with a direct-push drill rig operated by Cascade Drilling, Inc., of Woodinville, Washington.

Discrete soil cores were collected from each boring. Borings were logged in the field by an AMEC engineer, and soil samples were collected for laboratory analysis from each core. Cores were screened in the field for potential petroleum hydrocarbons using a photoionization detector (PID). One soil sample was collected from each boring from the depth interval with the highest concentration of petroleum hydrocarbons, as indicated by field screening using a PID, odor, sheen, and other visual indicators. A second soil sample was collected from each core at the depth interval just below the interval of suspected contamination, using the same indicators as above. In borings where no indication of petroleum contamination was observed, a soil sample was collected from the top of the water table. In two of the borings a temporary well was screened across the water table from approximately 4 to 8 feet bgs using a 4-foot section of 3/4-inch-diameter, Schedule 40 polyvinyl chloride (PVC) screen. One temporary well (PP196) was located in the suspected source area near the previous sample collected during construction activities. The second temporary well was located in the presumed downgradient direction (toward Lake Washington) from the construction (PP197). A grab groundwater sample was collected from each temporary well. Soil and groundwater samples were collected in laboratory-supplied sample jars, labeled, and stored in an ice-cooled chest for transport to the laboratory following chain-of-custody procedures.

Copies of the boring logs, including the soil descriptions and PID readings, are provided in Attachment A.

3.2 Field Procedures

Sample collection was conducted in accordance with the Ecology-approved Remedial Investigation (RI) Work Plan (Weston, 1998) as subsequently amended, which details field methods for sample collection, sample designation, equipment decontamination, and documentation. These methods include soil sampling procedures following U.S. Environmental Protection Agency (EPA) Method 5035A (EPA, 2002) and Ecology's Implementation Memo #5 (Ecology, 2004). Peristaltic pumps were used to collect groundwater samples from the temporary wells.

3.3 Analytical Methods

The samples were analyzed by Analytical Resources, Inc., of Tukwila, Washington. Soil samples collected were analyzed for the following analytes:

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- total petroleum hydrocarbons – hydrocarbon identification (TPH-HCID) by method NWTPH-HCID;
- benzene, toluene, ethylbenzene, and xylenes (BTEX) by EPA Method 8021; and
- semivolatile organic compounds (SVOCs) by EPA Method 8270.

Samples that tested positive for the presence of diesel or fuel oil were also analyzed for diesel-range petroleum hydrocarbons (TPH-Dx) by Method NWTPH-Dx. The soil sample with the highest petroleum concentration was also analyzed for extractable petroleum hydrocarbons (EPH) by the Washington EPH method.

Groundwater samples collected were analyzed for:

- TPH-HCID using Method NWTPH-HCID,
- SVOCs using EPA Method 8270, and
- volatile organic compounds (VOCs) by EPA Method 8260, low level 10 milliliter (mL) purge.

Samples that tested positive for the presence of diesel or fuel oil were also analyzed for TPH-Dx by Method NWTPH-Dx.

3.4 Quality Control

The quality assurance and quality control (QA/QC) procedures outlined in the Quality Assurance Project Plan (QAPP) presented in Section 6.0 of the approved RI Work Plan (Weston, 1998) were followed for sampling performed during this project. All analytical data generated by the laboratory were reviewed in accordance with the QAPP. The data validation memorandum and the analytical data are presented in Attachment B.

3.5 Waste Management

Management of wastes generated during field activities followed the guidelines described in the approved RI Work Plan (Weston, 1998). Soil cuttings, decontamination water, and groundwater from the push-probe sampling activities were managed by Boeing.

4.0 RESULTS

Results of laboratory analysis of soil and groundwater samples are presented in Tables 1 and 2, respectively, and summarized on Figure 1. Table 3 presents analytical results for detected analytes in soil, together with associated clean up levels based on Model Toxics Control Act (MTCA) criteria. The MTCA Method A cleanup levels for direct contact under unrestricted land use and industrial land use were used to evaluate soil analytical results. For constituents where MTCA Method A values were not available, the MTCA Method B standard value for direct contact (ingestion only) was used. Results evaluated using Ecology's MTCA TPH spreadsheets were evaluated using the MTCA Method C criteria. Although zoned for mixed use, the site is used for industrial manufacturing and will continue to be used as an industrial site for the

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foreseeable future. As a result, the MTCA cleanup levels for industrial land use are appropriate at this site.

As shown on Figure 1, no analytes were detected in groundwater samples, and all detection limits were below the MTCA Method A cleanup level for groundwater.

Ethylbenzene was detected in two soil samples collected from 3.5 feet bgs. Concentrations in PP195 (35 micrograms/kilogram [$\mu\text{g}/\text{kg}$]) and PP197 (54 $\mu\text{g}/\text{kg}$) are below the MTCA Method A unrestricted land use soil cleanup level of 6,000 $\mu\text{g}/\text{kg}$. Concentrations of ethylbenzene in soil samples collected from 5.5 feet bgs in PP195 and PP197 were below the detection limit. TPH-Dx was detected in the samples collected from 3.5 feet bgs at PP194 and PP195 at concentrations of 39 mg/kg and 650 mg/kg, respectively. Motor oil was detected in the samples from 3.5 feet bgs in PP194 and PP195 at concentrations of 57 mg/kg and 550 mg/kg, respectively. All detected concentrations of diesel and motor oil are below the MTCA Method A unrestricted land use soil cleanup level of 2,000 mg/kg. For all other soil samples, TPH and BTEX constituent concentrations were below the detection limit.

Three polycyclic aromatic hydrocarbon compounds (PAHs) were detected in the soil sample from 3.5 feet bgs at PP194. Detected concentrations of anthracene, fluorene, and pyrene ranged from 68 to 160 $\mu\text{g}/\text{kg}$. These concentrations are below the MTCA Method B standard values for direct contact. Fifteen PAHs were detected in the soil sample from 3.5 feet bgs at PP195. The calculated benzo(a)pyrene toxicity equivalent (BaP TEQ) for carcinogenic PAHs was 2,471 $\mu\text{g}/\text{kg}$, which exceeds the MTCA Method A industrial land-use cleanup level of 2,000 $\mu\text{g}/\text{kg}$ for benzo(a)pyrene. Due to this exceedance, cleanup levels for TPH were calculated using Ecology's MTCA TPH worksheets.

The results of the MTCA TPH worksheets indicate that the MTCA Method C human health direct contact cleanup levels would not be exceeded at the TPH and PAH concentrations present in the shallow sample from PP195. Due to these MTCA TPH worksheet results, the soil sample to be analyzed by Friedman and Bruya for hydrocarbon fingerprint analysis was not analyzed. The summary pages from the MTCA TPH worksheets are included in Attachment C. For all other soil samples, PAH concentrations were below the detection limits.

5.0 RECOMMENDATIONS

As described in Section 4.0, only carcinogenic PAHs exceeded the applicable cleanup criteria. However, the results of the MTCA TPH spreadsheet (Attachment C) indicate that the observed PAH concentrations would not exceed the MTCA Method C cleanup level. As a result, no further action is warranted at this site.

6.0 REFERENCES

AMEC, 2009, Building 4-82 Investigation Work Plan, Boeing Renton Facility, Renton, Washington: Prepared for the Boeing Company, April.

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Ecology (Washington State Department of Ecology), 2004, Implementation Memorandum #5, Collecting and Preparing Soil Samples for VOC Analysis, 04-09-087, June 17.

EPA (U.S. Environmental Protection Agency), 2002, EPA Method 5035A, Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples, EPA SW-846, July.

Weston (Roy F. Weston), 1998, Remedial Investigation Work Plan, Boeing Renton Plant, Renton, Washington.

Attachments: Table 1 – Soil Analytical Results
 Table 2 – Groundwater Analytical Results
 Table 3 – Soil Detected Concentrations and Cleanup Levels
 Figure 1 – Building 4-82 Investigation Site Map
 Attachment A – Boring Logs
 Attachment B – Data Validation Memorandum and Analytical Data
 Attachment C – MTCA TPH Worksheets

TABLES

TABLE 1

SOIL ANALYTICAL RESULTS

BUILDING 4-82 INVESTIGATION, JUNE 2009¹

Boeing Renton Facility
Renton, Washington

Location ID Sample ID Depth (ft. bgs)	PP193	PP194	PP194	PP195	PP195 (Duplicate)	PP196	PP197	PP197
	RI-SB-PP193-0-020 2.0	RI-SB-PP194-0-035 3.5	RI-SB-PP194-0-055 5.5	RI-SB-PP195-0-035 3.5	RI-SB-PP195-1-035 3.5	RI-SB-PP196-0-025 2.5	RI-SB-PP197-0-035 3.5	RI-SB-PP197-0-055 5.5
Analyte Sample Date	6/9/2009	6/10/2009	6/10/2009	6/9/2009	6/9/2009	6/9/2009	6/10/2009	6/10/2009
TPH-HCID ² (mg/kg)								
Diesel Range	< 50	> 50	< 50	> 60	> 50	< 50	< 50	< 50
Gas Range	< 20	< 20	< 20	> 24	< 20	< 50	< 20	< 20
Oil Range	< 100	> 100	< 100	> 120	> 100	< 100	< 100	< 100
TPH (mg/kg)								
Diesel Range Hydrocarbons	NA	39	NA	650	120	NA	NA	NA
Motor Oil	NA	57	NA	550	94	NA	NA	NA
BTEx (µg/kg)								
Benzene	18 U	16 U	24 U	18 U	19 U	20 U	17 U	15 U
Ethylbenzene	18 U	16 U	24 U	35	19 U	20 U	17 U	54
m,p-Xylene	36 U	32 U	48 U	36 U	38 U	40 U	34 U	30 U
o-Xylene	18 U	16 U	24 U	18 U	19 U	20 U	17 U	15 U
Toluene	18 U	16 U	24 U	18 U	19 U	20 U	17 U	15 U
EPH (µg/kg)								
C8-C10 Aliphatics	NA	NA	NA	22,000 U	NA	NA	NA	NA
C10-C12 Aliphatics	NA	NA	NA	22,000 U	NA	NA	NA	NA
C12-C16 Aliphatics	NA	NA	NA	140,000	NA	NA	NA	NA
C16-C21 Aliphatics	NA	NA	NA	190,000	NA	NA	NA	NA
C21-C34 Aliphatics	NA	NA	NA	430,000	NA	NA	NA	NA
C8-C10 Aromatics	NA	NA	NA	11,000 U	NA	NA	NA	NA
C10-C12 Aromatics	NA	NA	NA	66,000	NA	NA	NA	NA
C12-C16 Aromatics	NA	NA	NA	190,000	NA	NA	NA	NA
C16-C21 Aromatics	NA	NA	NA	630,000	NA	NA	NA	NA
C21-C34 Aromatics	NA	NA	NA	930,000	NA	NA	NA	NA
SVOCs (µg/kg)								
1,2,4-Trichlorobenzene	61 U	59 U	65 U	480 U	61 U	61 U	63 U	60 U
1,2-Dichlorobenzene	61 U	59 U	65 U	480 U	61 U	61 U	63 U	62 U
1,3-Dichlorobenzene	61 U	59 U	65 U	480 U	61 U	61 U	63 U	62 U
1,4-Dichlorobenzene	61 U	59 U	65 U	480 U	61 U	61 U	63 U	62 U
1-Methylnaphthalene	61 U	59 U	65 U	16,000	470	61 U	63 U	62 U
2,2'-Oxybis(1-Chloropropane)	61 U	59 U	65 U	480 U	61 U	61 U	63 U	62 U
2,4,5-Trichlorophenol	310 U	300 U	320 U	2,400 U	300 U	300 U	300 U	310 U
2,4,6-Trichlorophenol	310 U	300 U	320 U	2,400 U	300 U	300 U	300 U	310 U
2,4-Dichlorophenol	310 U	300 U	320 U	2,400 U	300 U	300 U	300 U	310 U
2,4-Dimethylphenol	61 U	59 U	65 U	480 U	61 U	61 U	63 U	62 U
2,4-Dinitrophenol	610 U	590 U	650 U	4,800 U	610 U	610 U	630 U	620 U
2,4-Dinitrotoluene	310 U	300 U	320 U	2,400 U	300 U	300 U	300 U	310 U
2,6-Dinitrotoluene	310 U	300 U	320 U	2,400 U	300 U	300 U	300 U	310 U

TABLE 1

SOIL ANALYTICAL RESULTS

BUILDING 4-82 INVESTIGATION, JUNE 2009¹

Boeing Renton Facility
Renton, Washington

Analyte	Location ID		PP193	PP194	PP194	PP195	PP195 (Duplicate)	PP195	PP196	PP197	PP197
	Sample ID	Sample ID	RI-SB-PP193-0-020	RI-SB-PP194-0-035	RI-SB-PP194-0-055	RI-SB-PP195-0-035	RI-SB-PP195-1-035	RI-SB-PP195-0-050	RI-SB-PP196-0-025	RI-SB-PP197-0-035	RI-SB-PP197-0-055
	Depth (ft. bgs)	Depth (ft. bgs)	2.0	3.5	5.5	3.5	3.5	5.0	2.5	3.5	5.5
Sample Date	Sample Date	Sample Date	6/9/2009	6/10/2009	6/10/2009	6/9/2009	6/9/2009	6/9/2009	6/9/2009	6/10/2009	6/10/2009
SVOCs (µg/kg) (Continued)											
Di-n-butyl phthalate			61 U	59 U	65 U	480 U	61 U	61 U	63 U	60 U	62 U
Di-n-octyl phthalate			61 U	59 U	65 U	480 U	61 U	61 U	63 U	60 U	62 U
Fluoranthene			61 U	59 U	65 U	2,000 J	61 U	61 U	63 U	60 U	62 U
Fluorene			61 U	68	65 U	7,600	200	61 U	63 U	60 U	62 U
Hexachlorobenzene			61 U	59 U	65 U	480 U	61 U	61 U	63 U	60 U	62 U
Hexachlorobutadiene			61 U	59 U	65 U	480 U	61 U	61 U	63 U	60 U	62 U
Hexachlorocyclopentadiene			310 U	300 U	320 U	2,400 U	300 U	300 U	310 U	300 U	310 U
Hexachloroethane			61 U	59 U	65 U	480 U	61 U	61 U	63 U	60 U	62 U
Indeno(1,2,3-cd)pyrene			61 U	59 U	65 U	480 U	61 U	61 U	63 U	60 U	62 U
Isophorone			61 U	59 U	65 U	480 U	61 U	61 U	63 U	60 U	62 U
Naphthalene			61 U	59 U	65 U	1,300 J	61 U	61 U	63 U	60 U	62 U
Nitrobenzene			61 U	59 U	65 U	480 U	61 U	61 U	63 U	60 U	62 U
N-Nitroso-di-N-propylamine			310 U	300 U	320 U	2,400 U	300 U	300 U	310 U	300 U	310 U
N-Nitrosodiphenylamine			61 U	59 U	65 U	480 U	61 U	61 U	63 U	60 U	62 U
Pentachlorophenol			310 U	300 U	320 U	2,400 U	300 U	300 U	310 U	300 U	310 U
Phenanthrene			61 U	59 U	65 U	34,000	990	61 U	63 U	60 U	62 U
Phenol			61 U	59 U	65 U	480 U	61 U	61 U	63 U	60 U	62 U
Pyrene			61 U	160	65 U	13,000	390	61 U	63 U	60 U	62 U
cPAHs BaP TEQ (ND = 1/2RL)			46	45	49	2,471	56	46	48	45	47

- Note
- Data qualifiers are as follows.
J = Analyte positively identified. Result shown is estimated concentration.
U = Analyte not detected at the reporting limit to the left.
UJ = Analyte note detected. Value indicated is estimated reporting limit.
 - Results from TPH-HCID are reported in form of greater than or less than specified reporting value; no absolute concentration is reported.

Abbreviations

µg/kg = micrograms per kilogram
BaP TEQ = benzo(a)pyrene toxicity equivalent
BTEx = benzene, toluene, ethylbenzene; and xylenes
cPAHs = carcinogenic polycyclic aromatic hydrocarbons
EPH = extractable petroleum hydrocarbons
ft. bgs = feet below ground surface
mg/kg = milligrams per kilogram
NA = not analyzed
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
TPH-HCID = total petroleum hydrocarbons - hydrocarbon identification

TABLE 2

GROUNDWATER ANALYTICAL RESULTS
BUILDING 4-82 INVESTIGATION, JUNE 2009¹

Boeing Renton Facility
Renton, Washington

Analyte	Location ID	PP196	PP197	PP197 (Duplicate)
	Sample ID	RI-GW-PP196-0-040	RI-GW-PP197-0-040	RI-GW-PP197-1-040
	Depth (ft bgs)	4	4	4
	Sample Date	6/9/2009	6/10/2009	6/10/2009
TPH-HCID² (mg/L)				
Diesel Range		< 0.63	< 0.63	< 0.63
Gas Range		< 0.25	< 0.25	< 0.25
Oil Range		< 0.63	< 0.63	< 0.63
VOCs (µg/L)				
1,1,1,2-Tetrachloroethane		0.2 U	0.2 U	0.2 U
1,1,1-Trichloroethane		0.2 U	0.2 U	0.2 U
1,1,2,2-Tetrachloroethane		0.2 U	0.2 U	0.2 U
1,1,2-Trichloro-1,2,2-trifluoroethane		0.2 U	0.2 U	0.2 U
1,1,2-Trichloroethane		0.2 U	0.2 U	0.2 U
1,1-Dichloroethane		0.2 U	0.2 U	0.2 U
1,1-Dichloroethene		0.2 U	0.2 U	0.2 U
1,1-Dichloropropene		0.2 U	0.2 U	0.2 U
1,2,3-Trichlorobenzene		0.5 U	0.5 U	0.5 U
1,2,3-Trichloropropane		0.5 U	0.5 U	0.5 U
1,2,4-Trichlorobenzene		0.5 U	0.5 U	0.5 U
1,2,4-Trimethylbenzene		0.2 U	0.2 U	0.2 U
1,2-Dibromo-3-chloropropane		0.5 U	0.5 U	0.5 U
1,2-Dichlorobenzene		0.2 U	0.2 U	0.2 U
1,2-Dichloroethane		0.2 U	0.2 U	0.2 U
1,2-Dichloropropane		0.2 U	0.2 U	0.2 U
1,3,5-Trimethylbenzene		0.2 U	0.2 U	0.2 U
1,3-Dichlorobenzene		0.2 U	0.2 U	0.2 U
1,3-Dichloropropane		0.2 U	0.2 U	0.2 U
1,4-Dichlorobenzene		0.2 U	0.2 U	0.2 U
2,2-Dichloropropane		0.2 U	0.2 U	0.2 U
2-Butanone		5.0 U	5.0 U	5.0 U
2-Chloroethyl vinyl ether		1.0 U	1.0 UJ	1.0 U
2-Chlorotoluene		0.2 U	0.2 U	0.2 U
2-Hexanone		5.0 U	5.0 UJ	5.0 U
4-Chlorotoluene		0.2 U	0.2 U	0.2 U
4-Isopropyltoluene		0.2 U	0.2 U	0.2 U
4-Methyl-2-pentanone (MIBK)		5.0 U	5.0 U	5.0 U
Acetone		5.0 U	5.0 U	5.0 U
Acrolein		5.0 U	5.0 U	5.0 U
Acrylonitrile		1.0 U	1.0 U	1.0 U
Benzene		0.2 U	0.2 U	0.2 U
Bromobenzene		0.2 U	0.2 U	0.2 U
Bromochloromethane		0.2 U	0.2 U	0.2 U
Bromodichloromethane		0.2 U	0.2 U	0.2 U

TABLE 2

GROUNDWATER ANALYTICAL RESULTS
BUILDING 4-82 INVESTIGATION, JUNE 2009¹

Boeing Renton Facility
 Renton, Washington

Analyte	Location ID	PP196	PP197	PP197 (Duplicate)
	Sample ID	RI-GW-PP196-0-040	RI-GW-PP197-0-040	RI-GW-PP197-1-040
	Depth (ft bgs)	4	4	4
	Sample Date	6/9/2009	6/10/2009	6/10/2009
VOCs (µg/L) (Continued)				
Bromoethane		0.2 U	0.2 U	0.2 U
Bromoform		0.2 U	0.2 U	0.2 U
Bromomethane		0.5 U	0.5 U	0.5 U
Carbon disulfide		0.2 U	0.2 U	0.2 U
Carbon tetrachloride		0.2 U	0.2 U	0.2 U
Chlorobenzene		0.2 U	0.2 U	0.2 U
Chloroethane		0.2 U	0.2 U	0.2 U
Chloroform		0.2 U	0.2 U	0.2 U
Chloromethane		0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene		0.2 U	0.2 U	0.2 U
cis-1,3-Dichloropropene		0.2 U	0.2 U	0.2 U
Dibromochloromethane		0.2 U	0.2 U	0.2 U
Dibromomethane		0.2 U	0.2 U	0.2 U
Ethylbenzene		0.2 U	0.2 U	0.2 U
Ethylene Dibromide		0.2 U	0.2 U	0.2 U
Hexachlorobutadiene		0.5 U	0.5 U	0.5 U
Isopropylbenzene		0.2 U	0.2 U	0.2 U
m,p-Xylene		0.4 U	0.4 U	0.4 U
Methyl iodide		1.0 U	1.0 U	1.0 U
Methylene chloride		0.5 U	0.5 U	0.5 U
Naphthalene		0.5 U	0.5 U	0.5 U
n-Butylbenzene		0.2 U	0.2 U	0.2 U
n-Propylbenzene		0.2 U	0.2 U	0.2 U
o-Xylene		0.2 U	0.2 U	0.2 U
sec-Butylbenzene		0.2 U	0.2 U	0.2 U
Styrene		0.2 U	0.2 U	0.2 U
tert-Butylbenzene		0.2 U	0.2 U	0.2 U
Tetrachloroethene		0.2 U	0.2 U	0.2 U
Toluene		0.2 U	0.2 U	0.2 U
trans-1,2-Dichloroethene		0.2 U	0.2 U	0.2 U
trans-1,3-Dichloropropene		0.2 U	0.2 U	0.2 U
trans-1,4-Dichloro-2-butene		1.0 U	1.0 U	1.0 U
Trichloroethene		0.2 U	0.2 U	0.2 U
Trichlorofluoromethane		0.2 U	0.2 U	0.2 U
Vinyl acetate		1.0 U	1.0 U	1.0 U
Vinyl chloride		0.2 U	0.2 U	0.2 U
SVOCs (µg/L)				
1,2,4-Trichlorobenzene		1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene		1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene		1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene		1.0 U	1.0 U	1.0 U
1-Methylnaphthalene		1.0 U	1.0 U	1.0 U

TABLE 2

GROUNDWATER ANALYTICAL RESULTS
BUILDING 4-82 INVESTIGATION, JUNE 2009¹

Boeing Renton Facility
Renton, Washington

Analyte	Location ID	PP196	PP197	PP197 (Duplicate)
	Sample ID	RI-GW-PP196-0-040	RI-GW-PP197-0-040	RI-GW-PP197-1-040
	Depth (ft bgs)	4	4	4
	Sample Date	6/9/2009	6/10/2009	6/10/2009
SVOCs (µg/L) (Continued)				
2,2'-Oxybis(1-chloropropane)		1.0 U	1.0 U	1.0 U
2,4,5-Trichlorophenol		5.0 U	5.0 U	5.0 U
2,4,6-Trichlorophenol		5.0 U	5.0 U	5.0 U
2,4-Dichlorophenol		5.0 U	5.0 U	5.0 U
2,4-Dimethylphenol		1.0 U	1.0 U	1.0 U
2,4-Dinitrophenol		10 U	10 U	10 U
2,4-Dinitrotoluene		5.0 U	5.0 U	5.0 U
2,6-Dinitrotoluene		5.0 U	5.0 U	5.0 U
2-Chloronaphthalene		1.0 U	1.0 U	1.0 U
2-Chlorophenol		1.0 U	1.0 U	1.0 U
2-Methylnaphthalene		1.0 U	1.0 U	1.0 U
2-Methylphenol		1.0 U	1.0 U	1.0 U
2-Nitroaniline		5.0 U	5.0 U	5.0 U
2-Nitrophenol		5.0 U	5.0 U	5.0 U
3,3'-Dichlorobenzidine		5.0 U	5.0 U	5.0 U
3-Nitroaniline		5.0 U	5.0 U	5.0 U
4,6-Dinitro-2-methylphenol		10 U	10 U	10 U
4-Bromophenyl phenyl ether		1.0 U	1.0 U	1.0 U
4-Chloro-3-methylphenol		5.0 U	5.0 U	5.0 U
4-Chloroaniline		5.0 U	5.0 U	5.0 U
4-Chlorophenyl phenyl ether		1.0 U	1.0 U	1.0 U
4-Methylphenol		1.0 U	1.0 U	1.0 U
4-Nitroaniline		5.0 U	5.0 U	5.0 U
4-Nitrophenol		5.0 U	5.0 U	5.0 U
Acenaphthene		1.0 U	1.0 U	1.0 U
Acenaphthylene		1.0 U	1.0 U	1.0 U
Anthracene		1.0 U	1.0 U	1.0 U
Benzidine		10 UJ	10 UJ	10 UJ
Benzo(a)anthracene		1.0 U	1.0 U	1.0 U
Benzo(a)pyrene		1.0 U	1.0 U	1.0 U
Benzo(b)fluoranthene		1.0 U	1.0 U	1.0 U
Benzo(g,h,i)perylene		1.0 U	1.0 U	1.0 U
Benzo(k)fluoranthene		1.0 U	1.0 U	1.0 U
Benzoic acid		10 U	10 U	10 U
Benzyl alcohol		5.0 U	5.0 U	5.0 U
bis(2-Chloroethoxy)methane		1.0 U	1.0 U	1.0 U
bis(2-Chloroethyl) ether		1.0 U	1.0 U	1.0 U
bis(2-Ethylhexyl) phthalate		1.0 U	1.0 U	1.0 U
Butyl benzyl phthalate		1.0 U	1.0 U	1.0 U

TABLE 2

**GROUNDWATER ANALYTICAL RESULTS
BUILDING 4-82 INVESTIGATION, JUNE 2009¹**

Boeing Renton Facility
Renton, Washington

Analyte	Location ID	PP196	PP197	PP197 (Duplicate)
	Sample ID	RI-GW-PP196-0-040	RI-GW-PP197-0-040	RI-GW-PP197-1-040
	Depth (ft bgs)	4	4	4
	Sample Date	6/9/2009	6/10/2009	6/10/2009
SVOCs (µg/L) (Continued)				
Carbazole		1.0 U	1.0 U	1.0 U
Chrysene		1.0 U	1.0 U	1.0 U
Dibenz(a,h)anthracene		1.0 U	1.0 U	1.0 U
Dibenzofuran		1.0 U	1.0 U	1.0 U
Diethyl phthalate		1.0 U	1.0 U	1.0 U
Dimethyl phthalate		1.0 U	1.0 U	1.0 U
Di-n-butyl phthalate		1.0 U	1.0 U	1.0 U
Di-n-octyl phthalate		1.0 U	1.0 U	1.0 U
Fluoranthene		1.0 U	1.0 U	1.0 U
Fluorene		1.0 U	1.0 U	1.0 U
Hexachlorobenzene		1.0 U	1.0 U	1.0 U
Hexachlorobutadiene		1.0 U	1.0 U	1.0 U
Hexachlorocyclopentadiene		5.0 U	5.0 U	5.0 U
Hexachloroethane		1.0 U	1.0 U	1.0 U
Indeno(1,2,3-cd)pyrene		1.0 U	1.0 U	1.0 U
Isophorone		1.0 U	1.0 U	1.0 U
Naphthalene		1.0 U	1.0 U	1.0 U
Nitrobenzene		1.0 U	1.0 U	1.0 U
N-Nitroso-di-N-propylamine		5.0 U	5.0 U	5.0 U
N-Nitrosodiphenylamine		1.0 U	1.0 U	1.0 U
Pentachlorophenol		5.0 U	5.0 U	5.0 U
Phenanthrene		1.0 U	1.0 U	1.0 U
Phenol		1.0 U	1.0 U	1.0 U
Pyrene		1.0 U	1.0 U	1.0 U
cPAHs BaP TEQ³		0.76 U	0.76 U	0.76 U

Note

1. Data qualifiers are as follows:

U = Analyte not detected at the reporting limit to the left.

UJ = Analyte not detected. Value indicated is estimated reporting limit.

2. Results from TPH-HCID are reported in form of greater than or less than specified reporting value; no absolute concentration is reported.

3. One-half of reporting limit was used for compounds not detected in calculating TEQ.

Abbreviations

µg/L = micrograms per liter

BaP TEQ = benzo(a)pyrene toxicity equivalent

cPAHs = carcinogenic polycyclic aromatic hydrocarbons

ft bgs = feet below ground surface

mg/L = milligrams per liter

SVOCs = semivolatile organic compounds

TPH-HCID = total petroleum hydrocarbons - hydrocarbon identification

VOCs = volatile organic compounds

TABLE 3

SOIL DETECTED CONCENTRATIONS AND CLEANUP LEVELS
BUILDING 4-82 INVESTIGATION, JUNE 2009
Boeing Renton Facility
Renton, Washington

Location ID	Sample ID	Depth (ft. bgs)	Sample Date	Analyte	Concentration	Method A Unrestricted Land Use ¹	Method A Industrial Land Use ²	Method B MTCA TPH Worksheet ³	Method C Industrial Worksheet ³	Method C Non-carcinogen ⁴	
TPH (mg/kg)											
PP194	RI-SB-PP194-0-035	3.5	6/10/2009	TPH Diesel	39	2,000	2,000	-- ⁵	--	--	
				TPH Motor Oil	57	2,000	2,000	--	--	--	
				SVOCs (µg/kg)							
				Anthracene	73	--	--	--	--	1.05E+09	
				Fluorene	68	--	--	--	--	1.40E+08	
				Pyrene	160	--	--	--	--	1.05E+08	
TPH (mg/kg)											
PP195	RI-SB-PP195-0-035	3.5	6/9/2009	TPH Diesel	650	2,000	--	--	--	--	
				TPH Motor Oil	550	2,000	--	--	--	--	
				BTEX (µg/kg)							
				Ethylbenzene	35	6,000	--	--	--	3.50E+08	
				SVOCs (µg/kg)							
				1-Methylnaphthalene	16,000	--	--	--	--	--	
				2-Methylnaphthalene	11,000	--	--	--	--	1.40E+07	
				Acenaphthene	3,700	--	--	--	--	2.10E+08	
				Anthracene	8,400	--	--	--	--	1.05E+09	
				Benzo(a)anthracene	4,300	--	--	--	--	--	
				Benzo(a)pyrene	1,900	100	2,000	--	--	--	
				Benzo(g,h,i)perylene	660	--	--	--	--	--	
				Carbazole	1,800	--	--	--	--	--	
				Chrysene	4,500	--	--	--	--	--	
				Dibenzofuran	1,200	--	--	--	--	7.00E+06	
Fluoranthene	2,000	--	--	--	--	1.40E+08					
Fluorene	7,600	--	--	--	--	1.40E+08					
Naphthalene	1,300	5,000	5,000	--	--	7.00E+07					
Phenanthrene	34,000	--	--	--	--	--					
Pyrene	13,000	--	--	--	--	1.10E+08					
cPAH BaP TEQ	2,471	--	2,000	--	--	--					
TPH calculated ⁶ (mg/kg)											
TPH-EPH					2,613.60	--	--	116	4,655.56		

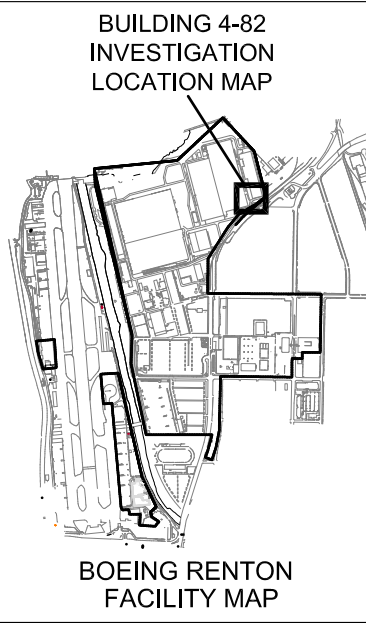
TABLE 3
SOIL DETECTED CONCENTRATIONS AND CLEANUP LEVELS
BUILDING 4-82 INVESTIGATION, JUNE 2009
Boeing Renton Facility
Renton, Washington

Location ID	Sample ID	Depth (ft. bgs)	Sample Date	Analyte	Concentration	Method A Unrestricted Land Use ¹	Method A Industrial Land Use ²	Method B MTCA TPH Worksheet ³	Method C Industrial Worksheet ³	Method C Non-Non-carcinogen ⁴
PP197	RI-SB-PP197-0-035	3.5	6/10/2009	BTEX (µg/kg) Ethylbenzene	54	6,000	--	--	--	--

Notes

1. Method A Soil Cleanup Levels for Unrestricted Properties from Table 740-1 from Washington State Department of Ecology, Toxic Cleanup Program, Model Toxic Control Act Statute and Regulation Publication No. 94-06, Revised November 2007 or from Cleanup Levels and Risk Calculations website (<https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>).
2. Method A Soil Cleanup Levels for Industrial Properties from Table 745-1 from Washington State Department of Ecology, Toxic Cleanup Program, Model Toxic Control Act Statute and Regulation Publication No. 94-06, Revised November 2007 or from Cleanup Levels and Risk Calculations website (<https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>).
3. Method B for Unrestricted Properties and Method C for Industrial Properties from Washington State Department of Ecology, Toxic Cleanup Program, Workbook for Calculating Cleanup Levels for Petroleum Contaminated Sites.
4. Method C Non-carcinogenic Soil Cleanup using standard formula from Cleanup Levels and Risk Calculations website (<https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>).
5. -- = constituent was either "Researched - No Data", "Not Researched", or clean up levels are not available.
6. TPH calculated value based on the result from MTCA TPH spreadsheet (Attachment C).

FIGURES



BUILDING 4-82

BUILDING 4-86

APPROXIMATE LOCATION OF CONCRETE PATCH

APPROXIMATE LOCATION OF BOEING GRAB SAMPLE

PP197	June 10, 2009	3.5' BGS	5.5' BGS
Ethylbenzene		54	19 U

PP197	June 10, 2008
No detected analytes in groundwater	

PP194	June 10, 2009	3.5' BGS	5.5' BGS
Anthracene		73	65 U
Fluorene		68.0	65 U
Pyrene		160	65 U
TPH Diesel		39 (mg/kg)	<50 (mg/kg)
TPH Motor Oil		57 (mg/kg)	<100 (mg/kg)

PP196	June 9, 2009	2.5' BGS
No detected analytes at 2.5' BGS		

PP196	June 9, 2008
No detected analytes in groundwater	

PP193	June 9, 2009	2.0' BGS
No detected analytes at 2.0' BGS		

PP195	June 9, 2009	3.5' BGS	5.0' BGS
Ethylbenzene		35	20 U
1-Methylnaphthalene		16,000	61 U
2-Methylnaphthalene		11,000	61 U
Acenaphthene		3,700	61 U
Anthracene		8,400	61 U
Benzo(a)anthracene		4,300	61 U
Benzo(a)pyrene		1,900 J	61 U
Benzo(g,h,i)perylene		660 J	61 U
Carbazole		1,800 J	61 U
Chrysene		4,500	61 U
Dibenzofuran		1,200 J	61 U
Fluoranthene		2,000 J	61 U
Fluorene		7,600	61 U
Naphthalene		1,300 J	61 U
Phenanthrene		34,000	61 U
Pyrene		13,000	61 U
cPAH BaP TEQ		2,471	46.1
TPH Diesel		650 (mg/kg)	<20 (mg/kg)
TPH Motor Oil		550 (mg/kg)	<100 (mg/kg)

EXPLANATION

- PP193 ⊕ PUSH-PROBE LOCATION
- ⊕ PREVIOUS SAMPLE LOCATION

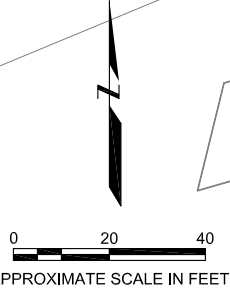
RED TEXT INDICATES SOIL ANALYTICAL DATA IN µg/kg UNLESS OTHERWISE NOTED.

BLUE TEXT INDICATES GROUNDWATER ANALYTICAL DATA

J = ANALYTE WAS POSITIVELY IDENTIFIED; THE VALUE SHOWN IS THE APPROXIMATE CONCENTRATION OF THE ANALYTE.

U = ANALYTE NOT DETECTED AT REPORTING LIMIT.

< = TPH FRACTION NOT DETECTED BY TPH-HCID ANALYSIS.



BUILDING 4-82 INVESTIGATION SITE MAP
Boeing Renton Facility
Renton, Washington

By: APS

Date: 07/17/09

Project No. 8888

AMEC Geomatrix

Figure 1

ATTACHMENT A

Boring Logs

ATTACHMENT B

Data Validation Memorandum and Analytical Data

ATTACHMENT C

MTCA TPH Worksheets