APPENDIX A

Jorgensen Water Quality Pile Removal

JORGENSEN WATER QUALITY PILE REMOVAL

Duwamish Sediment Other Area and Southwest Bank

Corrective Measure and Habitat Project

Boeing Plant 2

Seattle/Tukwila, Washington

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JORGENSEN WATER QUALITY PILE REMOVAL

Duwamish Sediment Other Area and Southwest Bank
Corrective Measure and Habitat Project
Boeing Plant 2
Seattle/Tukwila, Washington

1.0 INTRODUCTION

In discussions between the Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) programs, the U.S. Environmental Protection Agency (EPA) decided that sediment samples should be collected adjacent to the water quality pile installed by The Boeing Company (Boeing) within the Earle M. Jorgensen Remedial Action Boundary (EMJ RAB). This sampling was required to address concerns about the possible release of sediments containing polychlorinated biphenyls (PCBs) above the Removal Action Level (of 12 parts per million organic carbon [ppm OC]) left in place following the EMJ RAB dredging in the vicinity of the pile. Boeing was directed to take three surface grab samples of the top 10 centimeters (cm) of the Jorgensen backfill within a 10-foot radius of the pile during pre- and post-removal sampling events. The samples were to be analyzed for selected metals and for PCBs. The proposed list of analytes would cover the list of EMJ chemicals of concern (COCs). The results from these samples would be used to assess whether any sediment impacts from PCBs or metals occurred during pile removal. Boeing provided EPA with a figure of the proposed sample locations prior to conducting the sampling.

2.0 BACKGROUND

Prior to the start of the in-water dredging during Construction Season 3, steel pile were installed upstream of the Duwamish Sediment Other Area (DSOA) and downstream of the Construction Season 3 dredge area for in-situ water quality monitoring instruments. The pile were installed using the standard procedures and Best Management Practices (BMPs) used during the installation of the temporary pile in Construction Seasons 1 and 2. The pile were installed using a vibratory hammer from a crane-equipped barge on September 18, 2014. The crane-equipped barge was moved on station using tugs and was held in position with spuds. Work platforms were attached to the top of the installed pile and the water quality instruments and telemetry systems were installed. The upstream water quality pile was installed following the completion of the dredging and backfilling in August and early September 2014 within the EMJ RAB. The pile was installed along the -9.5 foot mean lower low water (MLLW) depth contour and the top of the pile was at an elevation of +17.3 feet MLLW.

Boeing planned to remove the water quality pile following completion of the DSOA in-water construction work and before the end of the in-water work season on March 15, 2015. As discussed in Section 1.0 above, concerns raised by Jorgensen and the EPA CERCLA program about the removal of the water quality pile within the Jorgensen RAB and the possible spread of contamination to the surface of the backfill resulted in a re-evaluation of the pile removal plan. Various alternatives were proposed to reduce the potential for sediment disturbance. Boeing consulted with the EPA and agreed to institute additional procedures during pile extraction to reduce the chance of bringing potentially contaminated subsurface sediment ("z-layer" material) to the surface of the backfill. These additional procedures included monitoring the sediment height both inside and outside of the pile during extraction to ensure that sediment in the end of the pile was not brought to the surface during extraction. Boeing also did not place spuds or anchors within the Jorgensen backfill area. Boeing also positioned the crane-equipped barge with tugs and held the crane-equipped barge in position with a single spud. Boeing also agreed to conduct sediment sampling adjacent to the pile (Figure 1; sample locations approximately 10 feet from the pile location) before and after removal of the pile. Samples were analyzed for selected metals and PCBs identified as chemicals of concern at the Boeing Plant 2 and the Jorgensen sites. The methods used to monitor the pile removal at the north end of the site (located within the DSOA and conducted first) and the pile removal within the Jorgensen work area are summarized in Appendix A.

3.0 SAMPLE COLLECTION METHODS AND ANALYSES

Grab samples were collected using a 0.2-square (m^2) meter powered grab at three locations approximately 10 feet from the steel pile installed for the ambient water quality instrument upstream of the Boeing Plant 2 DSOA (Figure 2, Table 1). Samples were collected prior to the pile removal on the morning of March 9, 2015. Pile removal was completed in the evening of March 9, 2015. A second set of three samples was collected the morning of March 10, 2015. A single grab sample was collected at each sample location. Each grab was photographed (Appendix B) and a sediment description was recorded.

A sample for chemical analysis was collected from the top 10 cm of sediment. Large amounts of coarse gravel in the sediments resulted in some of the grabs showing signs of partial washing. The washing resulted in the loss of some of the finer sediments as the overlying water drained through a partially-closed sampler (larger rocks in the backfill inhibited complete closure of the grab sampler). Sample material was collected from areas that did not appear to be washed or disturbed. Larger gravel pieces (1- to 2-inch diameter) were not included in the sample. Approximately 1 liter of sediment was collected from each grab and analyzed for selected metals (arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc), PCBs, total organic carbon (TOC), and total solids (TS).

4.0 RESULTS

The sediment description is summarized in Table 1 along with the proposed and actual grab sample locations. The results for the chemical analysis are presented in Table 2. A data validation was conducted on the data package. All data are suitable for use as qualified. The data validation report is provided in Appendix C.

All of the metals results were below the Sediment Management Standards (SMS) Sediment Quality Standards (SQS). The sediments at location SD-JORPR01 had PCBs above the SQS in both the "before" and "after" removal samples (16.1 ppm OC and 18.9 ppm OC, respectively). The remaining two sample locations SD-JORPR02 and SD-JORPR03 were below the dry weight SQS before and after the pile removal. The sample results from SD-JORPR02 and SD-JORPR03 were compared against the dry weight SQS equivalents because the TOC levels were below 0.5 percent. Comparisons of carbon normalized PCB concentrations are inappropriate when TOC levels are below 0.5 percent.

5.0 SUMMARY

Measurement collected during the removal action showed that we did not bring subsurface sediment to the surface.

Sampling on the Jorgensen backfill before the start of in-water dredging at the south end of the DSOA (conducted on November 24, 2014) found levels of PCBs that ranged from 10.8 ppm OC to 28.1 ppm OC and 13.1 parts per billion (ppb) dry weight to 800 ppb dry weight. The concentration of PCBs in sediment samples collected before and after pile removal is within the range of PCB concentrations previously collected on the Jorgensen backfill.

TABLES

TABLE 1

JORGENSEN PRE- AND POST-PILE REMOVAL SAMPLING LOCATIONS

Jorgensen Water Quality Pile Removal
Duwamish Sediment Other Area and Southwest Bank
Corrective Measure and Habitat Project
Boeing Plant 2
Seattle/Tukwila, Washington

Location	Round	Date	Time	Planned State Plane Coordinates (WA SPC North NAD 83, Survey Feet)		Actual State Plane Coordinates (WA SPC North NAD 83, Survey Feet)		Elevation (Estimated Using Water Depth and Tide Tables)	Sample ID	Comments
				Easting	Northing	Easting	Northing	Feet MLLW		
SD-JORPR01	"Before"	3/9/2015	8:41	1275897	195334	1275898	195334	-9.9	SD-JORPR01-B	1-inch layer of surface silt over coarse sandy gravel
SD-JORPR02	"Before"	3/9/2015	9:04	1275913	195334	1275910	195334	-7.2	SD-JORPR02-B	Thin layer of surface silt over coarse sand with gravel
SD-JORPR03	"Before"	3/9/2015	9:21	1275905	195319	1275905	195321	-7.5	SD-JORPR03-B	Coarse sand with gravel, trace of silt throughout grab
SD-JORPR01	"After"	3/10/2015	8:50	1275897	195334	1275897	195330	-11.4	SD-JORPR01-A	1-inch layer of surface silt over coarse silty gravel
SD-JORPR02	"After"	3/10/2015	9:17	1275913	195334	1275917	195331	-5.5	SD-JORPR02-A	1/2-inch layer of surface silt over coarse sand with gravel
SD-JORPR03	"After"	3/10/2015	9:33	1275905	195319	1275905	195323	-7.7	SD-JORPR03-A	Trace of surface silt over coarse sand with gravel

Abbreviation(s)
NAD = North American Datum
WA SPC = Washington State Plane Coordinates

TABLE 2

PRE- AND POST-PILE REMOVAL SAMPLE RESULTS

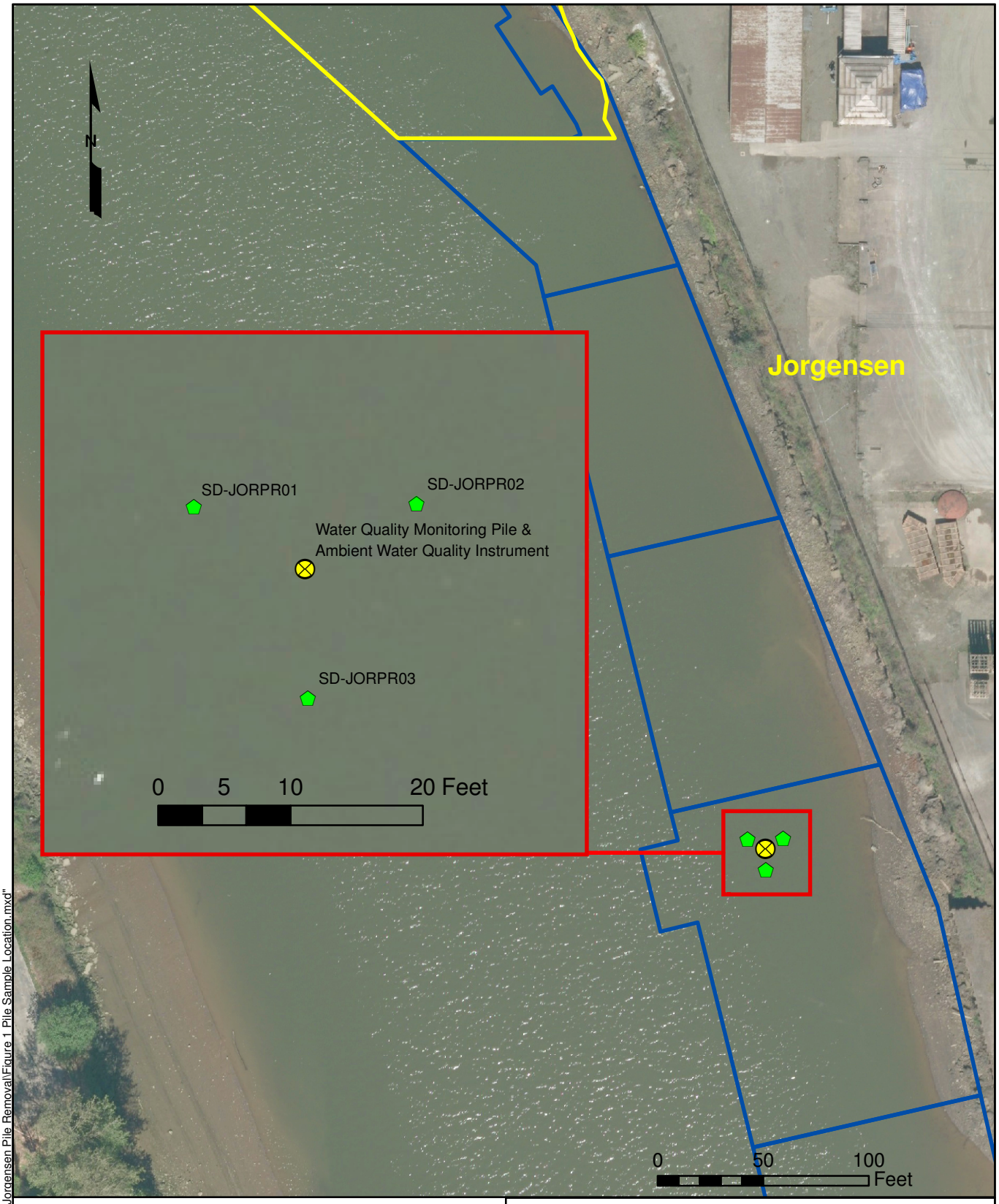
Jorgensen Water Quality Pile Removal
Duwamish Sediment Other Area and Southwest Bank
Corrective Measure and Habitat Project
Boeing Plant 2
Seattle/Tukwila, Washington

	SD-JORPR01-B			SD-JORPR01-A			SD-JORPR02-B			SD-JORPR02-A			SD-JORPR03-B			SD-JORPR03-A		
	"Before"			"After"			"Before"			"After"			"Before"			"After"		
Analyte	**Result**	**Q1 [1]**	**Q2 [2]**	**Result**	**Q1 [1]**	**Q2 [2]**	**Result**	**Q1 [1]**	**Q2 [2]**	**Result**	**Q1 [1]**	**Q2 [2]**	**Result**	**Q1 [1]**	**Q2 [2]**	**Result**	**Q1 [1]**	**Q2 [2]**
Total Organic Carbon	1.34		J	2.81		J	0.406		J	0.277		J	0.137		J	0.276		J
Total Solids	52.82			45.73			96.13			88.02			92.7			91.94		
Arsenic	11.4			15.6			2.3			2.7			1.6			1.3		
Cadmium	0.7			1			0.2	U		0.3			0.3			0.3		
Chromium	30			37			11.4			35.5			30.8			28.9		
Copper	48.1			59.7			18.7			32.6			46.3			32.5		
Lead	22			30			2	U		5			2	U		2	U	
Mercury	0.12			0.13			0.02	U		0.02	U		0.02	U		0.02	U	
Silver	0.6	U		0.6	U		0.3	U		0.3	U		0.3	U		0.3	U	
Zinc	95			118			20			34			33			25		
Aroclor 1016	20	U		19	U		3.8	U		20	U		3.8	U		3.7	U	
Aroclor 1221	20	U		19	U		3.8	U		20	U		3.8	U		3.7	U	
Aroclor 1232	20	U		19	U		3.8	U		20	U		3.8	U		3.7	U	
Aroclor 1242	20	U		19	U		3.8	U		20	U		3.8	U		3.7	U	
Aroclor 1248	62			170			3.8	U		25			3.8	U		3.7	U	
Aroclor 1254	93			240			3.4	J		53			7.5			6.3		
Aroclor 1260	61			120			3.8	U		22			4.2			3.2	J	
Total PCBs	216			530			3.4	J		100			11.7			9.5	J	
Total PCBs (OC Normalized)	16.1			18.9			NA			NA			NA			NA		

Note(s)

1. Laboratory data flags (Q1) are as follows:
   U = analyte not detected at the reporting limit provided.
   Y = analyte not detected at the reporting limit provided.
   The reporting limit is raised due to chromatographic interferences.
2. Validation qualifiers (Q2) are not available.
3. NA = no carbon normalized value calculated due to carbon being outside the normal carbon normalization range of 0.5 to 4.0 percent

FIGURES



Jorgensen DMUs

DSOA

Water Quality Monitoring Pile

Proposed Grab Sampling Locations

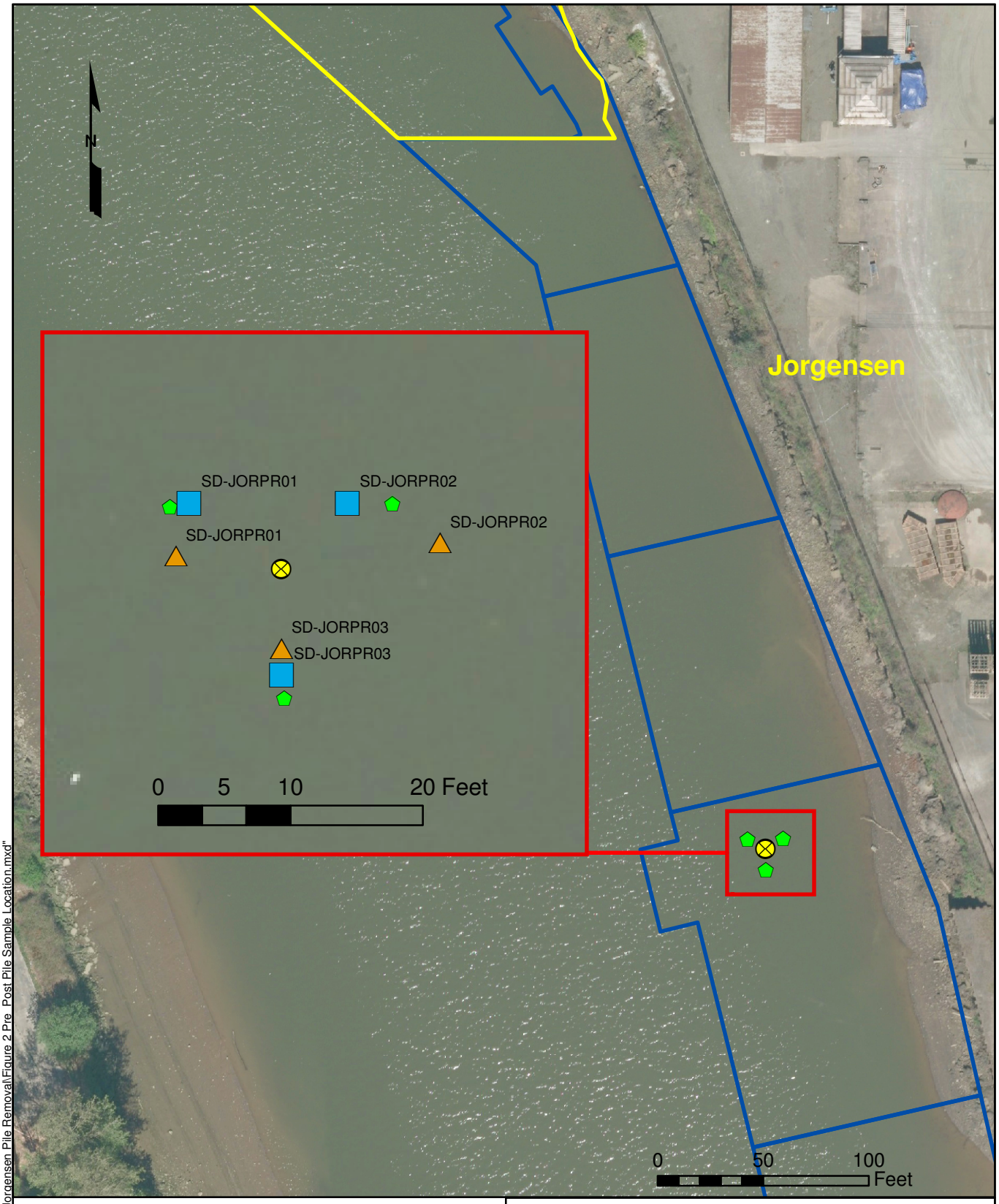
BOEING

JORGENSEN WATER QUALITY PILE REMOVAL SAMPLING LOCATIONS

Duwamish Sediment Other Area and Southwest Bank Corrective Measure and Habitat Project, Boeing Plant 2, Seattle/Tukwila, Washington

By: rhg	Date: 4/6/2015	Project No. 0131320090
		Figure 1

File path: "P:\BOEING\DESIGN\DATA\Jorgensen Pile Removal\Figure 1 Pile Sample Location.mxd"



Jorgensen DMUs

DSOA

Water Quality Monitoring Pile

Proposed Grab Sampling Locations

Pre-removal Sample Location

Post-removal Sample Location

BOEING

JORGENSEN WATER QUALITY PILE REMOVAL PRE- AND POST-REMOVAL SAMPLING LOCATIONS

Duwamish Sediment Other Area and Southwest Bank Corrective Measure and Habitat Project, Boeing Plant 2, Seattle/Tukwila, Washington

By: rhg	Date: 4/6/2015	Project No. 0131320090
		Figure 2

File path: "P:\BOEING\DESIGN\DATA\Jorgensen Pile Removal\Figure 2 Pre_Post Pile Sample Location.mxd"

ATTACHMENT A

Water Quality Monitoring Pile Extractions,
Boeing Duwamish Sediment Other Area Corrective Measure and Habitat Project

BOEING DUWAMISH SEDIMENT OTHER AREA CORRECTIVE MEASURE AND HABITAT PROJECT: WATER QUALITY MONITORING PILE EXTRACTIONS

Prepared For:

Boeing

DALTON OLMSTED FUGLEVAND

March 2015

I. INTRODUCTION

The purpose of this document is to detail the sequence of events and methods and procedures used to remove both the north water quality monitoring (WQM) pile, as well as the south WQM pile, which was on Jorgenson property, as part of demobilization activities for the Boeing Duwamish Sediment Other Area (DSOA) Corrective Measure and Habitat Project.

Prior to the start of dredging in the fall of 2014, the derrick barge (DB) Skookum equipped with an APE 150 vibratory hammer drove both WQM piles. The northern WQM pile was driven on September 3, 2014. Installation of the southern WQM pile was delayed until work on the Earl M Jorgensen (EMJ) Early Action Area (EAA) was complete. After receiving notification from the EMJ team on September 13, 2014 that all in-water activities were complete; the southern WQM pile was driven on September 16, 2014. Both WQM piles were driven at locations shown in the EPA approved Water Quality Monitoring Plan.

II. NORTH WQM PILE EXTRACTION

The north WQM pile (located at Northing 195585, Easting 1273630 within the Boeing DSOA project boundary)[1] was extracted on March 6, 2015. DOF personnel were present onsite to observe the extraction.

The derrick barge (DB) Skookum was positioned perpendicular to the shoreline, with the working end facing east towards Boeing property. The 135 barge was moored along the port side of the Skookum. A hydraulic vibratory hammer (model APE 150) was mounted to the crane and used for the extraction in order to fail the sediment surrounding the pile so that it could be removed with minimal disturbance to the surrounding area. Measurements of the mud line's surface both inside and outside of the pile were made during the extraction, as described in Section II.B below.

A. PILE EXTRACTION

Prior to the start of the pile removal DOF representatives measured and recorded distance from the top of the pile to the mud line inside and outside of the pile. A lead line was used for all measurements. Initially the pile was then driven 1.5 ft to 3 ft down and the direction of pile travel was then reversed without pause until the pile had been extracted approximately six feet from its initial elevation. The WQM pile was vibrated upwards in approximate five to six foot increments at a rate of about 1 foot per 3 minutes, after which inside and outside mud line measurements were made. Five measurements were collected and document that there wasn't a plug within the pile, and then the pile was extracted until it was fully removed from the sediment. The full length of the pile was 80 ft. The surface of the pile (both inside and outside) below the mud line was clean, with bright grey color with noticeable oxidation appearing within hour of extraction. Once recovered, the pile was placed into the 135 barge for pressure washing prior to leaving the project. There was no sign of a sediment plug found inside the pile when inspected, as expected based on mud line measurements from both inside and outside of the pile.

[1] Horizontal datum: State Plane Coordinate System Washington North NAD83, US Survey Feet

B. MUDLINE MEASUREMENTS

Table 1 shows the measurements taken during the north WQM pile extraction.

TABLE 1 NORTH WQM PILE MUD LINE MEASUREMENTS

Trial	Inside (ft)	Outside (ft)	Δ (In-Out) (ft)	Elevation (Top of Pile) (ft)	Elevation Mud line (outside) (ft)	Elevation Mud line (inside) (ft)
0	39.6	28.7	10.9	16.6	-12.1	-23.0
1	47.7	34.3	13.4	22.2	-12.1	-25.5
2	55.0	39.8	15.2	27.7	-12.1	-27.3
3	60.1	45.0	15.1	32.9	-12.1	-27.2
4	62.1	50.6	11.5	38.5	-12.1	-23.6

III. SOUTH WQM PILE EXTRACTION

The south WQM pile (located at Northing 195329.5, Easting 1275903.8 within the Jorgensen Forge Remediation Area (JFRA))[1] was extracted on March 9, 2015. This WQM station was installed after Jorgensen remediation project placed backfill and before the start of DSOA Construction Season 3 (CS3) dredging. The WQM station was removed upon completion of the DSOA CS3 in-water work. Spuds were not used within the Jorgensen Forge remediation area (verified by onboard RTK GPS rover and Skookum's positioning system). The north WQM station, located within DSOA work area (described above) was used as trial run. DOF personnel were present onboard to observe the extraction and collect data.

The same equipment used for the north WQM pile extraction was used, as described in Section II above.

During extraction of the south WQM pile, the Skookum was held on location with the back spud towards the west side of the navigation channel and outside of the Jorgensen work area (Northing 195306.5, Easting 1275802.7)[1]. The side spud, which was located over the Jorgensen project area, was locked out in the raised position using the steel traveling bar that keeps the spud in the raised position during transit by tug.

A. PILE EXTRACTION

Before the extractor was placed on the south WQM pile, a lead line meeting US Army Crps of Engineers specifications was used to measure the elevation of the mud line (both inside and outside of the pile) with respect to the top of the WQM pile. After the pre-extraction measurements were taken, the vibratory hammer was clamped onto the top of the pile and the pile was driven down 1.5 feet initially, then the pile was extracted at an approximate rate of 1 foot per two to six minutes in five to six foot increments. At each increment, measurements of the mud line inside and outside of the pile were taken and recorded by a DOF representative. A total of six measurements were taken. Once the pile was pulled up approximately 28 ft, and it

was clear from measurements that there was no longer a plug in the pile, the crane operator extracted the remaining length of the pile until it was completely clear of the water surface.

Once the tip of the pile was clear of the water surface, the Skookum continued to hold the pile. The back spud was raised and then the Skookum and the 135 barge were relocated to the DSOA work area. The steel traveling bar was then removed and the Skookum spudded down using both spuds. The south WQM pile was then placed in the 135 barge.

During extraction of the south WQM pile, there was no visible sign of turbidity in the water and both the inside and the outside of the pile below the mud line was clean with a bright grey bare steel color. There was no sign of the presence of a sediment plug inside the pile when inspected.

B. MUD LINE MEASUREMENTS

Table 2 shows the measurements taken during the south WQM pile extraction.

TABLE 2 SOUTH WQM PILE MUD LINE MEASUREMENTS

Trial	Inside (ft)	Outside (ft)	Δ (In-Out) (ft)	Elevation (Top of Pile) (ft MLLW)	Elevation Mud line (outside) (ft MLLW)	Elevation Mud line (inside) (ft MLLW)
0	36.5	26.8	9.7	17.3	-9.5	-19.2
1	45.8	33.3	12.5	23.8	-9.5	-22.0
2	51.8	39.0	12.8	29.5	-9.5	-22.3
3	52.6	44.7	7.9	35.2	-9.5	-17.4
4	49.9	49.4	0.5	39.9	-9.5	-10.0
5	55.2	54.5	0.7	45.0	-9.5	-10.2

IV. CONCLUSION

Based on the observations and mud line measurements, the removal of both piles was completed without bringing a sediment plug to the surface of the mud line. Once laid flat within the 135 barge, inspection of both piles supported these observations with no sign of a plug within either pile.

V. PHOTOS

Photograph 1. APE 150 vibratory hammer on the southern WQM pile.

Photograph 2. Southern WQM pile above mud line during extraction.

Photograph 3. B ottom end of the southern WQM pile below mud line during the extraction process.

Photograph 4. Bottom end of the southern WQM pile after. Photo taken the morning following pile extraction.

Photograph 5. Inside of the Southern WQM pile after extraction. No sign of sediment observed within the pile.

ATTACHMENT B

Grab Sample Photographs Water Quality Monitoring Pile Removal

ATTACHMENT B

GRAB SAMPLE PHOTOGRAPHS
Water Quality Monitoring Pile Removal

SD-JORPR01-B 'Before"

SD-JORPR01-A 'After"

ATTACHMENT B

GRAB SAMPLE PHOTOGRAPHS
Water Quality Monitoring Pile Removal

SD-JORPR02-B 'Before"

SD-JORPR02-A 'After"

ATTACHMENT B

GRAB SAMPLE PHOTOGRAPHS
Water Quality Monitoring Pile Removal

SD-JORPR03-B 'Before"

SD-JORPR03-A 'After"

ATTACHMENT C

Data Validation Report,
Boeing Plant 2 Pre- and Post-Removal Sediment Monitoring
for the Water Quality Monitoring Pile Data, March 2015

Sayler Data Solutions, Inc.
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DATA VALIDATION REPORT

Boeing Plant 2– Pre- and Post-removal Sediment Monitoring for the Water Quality Monitoring Pile Data, March 2015

Prepared for:
AMEC Foster Wheeler
3500 188th Street SW, Ste 601
Lynnwood, WA 98037-4763

June 11, 2015

1.0 Introduction

Data validation was performed on the following sediment data:

Sample ID	Sample Date/Time	Lab ID	Analyses
SD-JORPR01-A	03/09/2015 08:50	ZZ55F	PCBs, Metals, TOC, TS
SD-JORPR01-B	03/09/2015 08:41	ZZ55A	PCBs, Metals, TOC, TS
SD-JORPR02-A	03/09/2015 09:17	ZZ55D	PCBs, Metals, TOC, TS
SD-JORPR02-B	03/09/2015 09:04	ZZ55B	PCBs, Metals, TOC, TS
SD-JORPR03-A	03/09/2015 09:33	ZZ55E	PCBs, Metals, TOC, TS
SD-JORPR03-B	03/09/2015 09:21	ZZ55C	PCBs, Metals, TOC, TS

Analyses were performed by Analytical Resources, Inc. in Tukwila, Washington.

Validation: A summary validation was performed for these analyses. Validation was performed by Cari Sayler. Data qualifiers are summarized in section 5.0 of this report.

Analytical methods: Table 1 and table 2 of the QAPP specify the following analytical methods:

Analysis	Method
Polychorinated Biphenyls (PCBs)	EPA 8082 with 3665B/3660B cleanups
Metals(except mercury)	EPA 6010
Mercury	EPA 7471A
Total Organic Carbon (TOC)	EPA 9060
Total Solids (TS)	160.1

These methods were used with the following exceptions: The most recent versions of the methods for PCB (8082A) and metals (6010C) were used. Arsenic was analyzed by method 200.8. Total organic carbon analyses were performed by Plumb, 1981, and total solids analyses were performed by EPA method 2540G. These are considered acceptable substitutions. Additionally, PCB cleanups included silica gel in addition to the specified sulfur and acid.

Sample Receipt: Sample chain-of-custodies were reviewed. Requested analyses were performed.

Sample number transcription: Sample IDs in the electronic data deliverable (EDD) were compared to the chain-of-custody for each sample. Sample IDs matched the chain of custody.

2.0 PCB Analyses

Quality control analysis frequencies: The QAPP specifies that the following quality control samples be analyzed one per analytical batch or one per twenty samples, whichever is more frequent: method blank, and laboratory control sample (LCS). A matrix spike (MS) and MS duplicate (MSD) must be analyzed one per twenty samples and a regional reference material (RRM) must be analyzed one per fifty samples. In addition, surrogate compounds must be measured in each field and quality control sample.

A method blank, LCS, LCS duplicate (LCSD) and appropriate surrogates were included in this batch. No qualifiers are assigned based on the absence of the remaining quality control samples.

Holding times: Refrigerated sediment samples must be extracted within 14 days of collection. Frozen sediment samples must be extracted within 1 year of collection. Extracts must be analyzed within 40 days of extraction. These holding times were met.

Instrument calibration: Data usability criteria for calibrations include minimum correlation coefficients (R^2) of 0.990 or maximum RSDs of $\pm$20% for each initial calibration, and maximum % differences of $\pm$25% for each continuing calibration. These criteria were met.

Laboratory blank results: Criteria for blanks are that analyte concentrations must be below the RL, or below 10% of the lowest associated sample concentration. These criteria were met.

Surrogate recoveries: QAPP control limits were 34-141%. Surrogate recoveries were within QAPP and laboratory control limits.

LCS recoveries: An inconsistency was noted in the originally reported LCS/D recoveries, and the page was revised and resubmitted by the laboratory. QAPP control limits were 37-116%. LCS recoveries were within QAPP and laboratory control limits.

Laboratory flags: No qualifiers were added based on a review of the laboratory flags or report narrative.

Reporting limits: The reporting limit for each non-detect result was at or below the target level of 20 ug/Kg.

Overall assessment: With one correction, documentation was found to be clear and complete. Calibration data demonstrate acceptable instrument performance. Laboratory control sample results demonstrate acceptable accuracy and precision. PCB data are acceptable for use as reported.

3.0 Metals Analyses

Quality control analysis frequencies: The QAPP specifies that the following quality control samples be analyzed one per analytical batch or one per twenty samples, whichever is more

frequent: method blank, and laboratory control sample (LCS). A matrix spike (MS) and laboratory duplicate must be analyzed one per twenty samples. These frequencies were met.

Holding times: Total or dissolved mercury samples must be analyzed within 28 days of collection. Other metals samples must be analyzed with 180 days. These criteria were met.

Instrument calibration: Functional guidelines criteria for calibration verifications is a maximum % difference of +10% for ICP metals and +15% for mercury. QAPP criterion for calibration verifications is +10% for ICP metals and +20% for mercury. Criteria for calibration blanks are that analyte concentrations must be between the negative RL and the positive RL. Functional guidelines criterion for detection limit standard recovery is 70-130%, and the QAPP specifies this standard must be within one RL of the true value. These criteria were met.

Laboratory blank results: Criteria for method blanks are that analyte concentrations must be below the PQL, or below 10% of the lowest associated sample concentration. No contamination was detected in the method blanks.

LCS recoveries: QAPP control limits were 80-120%. LCS recoveries were within QAPP and laboratory control limits.

MS recoveries: QAPP control limits were 75-125%. Functional guidelines criteria for both ICP metals and mercury are 75-125%. MS recoveries were within QAPP and laboratory control limits.

Laboratory duplicate RPDs: QAPP control limits were <20%. For duplicates with concentrations above five times the reporting limit, RPDs were within QAPP and laboratory control limits. For sample/duplicate pairs with concentrations below five times the reporting limit, absolute differences were within two times the reporting limit.

Reporting limits: Some RLs were elevated above QAPP levels due to dry weight calculation or sample dilution:

Analyte	QAPP specified RL (mg/kg)	Highest Reported RL (mg/kg	SMS SQS (mg/kg)
Silver	0.3	0.6	6.1

Each elevated RL was below the screening level and the impact on data use is minimal. No qualifiers are assigned on the basis of elevated reporting limits.

Overall assessment: Documentation was found to be clear and complete. Calibration data demonstrate acceptable instrument performance. Method blank, LCS, MS and laboratory duplicate results demonstrate acceptable accuracy and precision.

Metals data are acceptable for use as reported.

4.0 General Chemistry Analyses

Quality control analysis frequencies: For total organic carbon, a method blank, SRM, LCS, MS, and laboratory duplicate were analyzed in this batch. For total solids, this batch included a method blank and laboratory triplicate. These quality control samples were sufficient to evaluate precision and accuracy as appropriate for the method.

Holding times: Holding times are as follows:

Analysis	Holding time if refrigerated	Holding time if frozen
TOC	28 days	6 months
Total Solids	14 days	6 months

Samples were analyzed within the holding times.

Instrument calibration: Instrument calibration criteria are as follows:

Analysis	Criteria
TOC	Initial calibration $R^2 > 0.990$ Continuing calibration recovery within 90-110%
Total Solids	Calibration mass within ± 0.1 g

These criteria were met.

Laboratory blank results: Criteria for method blanks are that analyte concentrations must be below the PQL, or below 10% of the lowest associated sample concentration. This criterion was met for all method blanks.

LCS recoveries: Control limits were 75-125% for TOC. These criteria were met.

SRM results: Control limits were not listed. The measured recovery of 106.4% demonstrated acceptable accuracy.

MS recoveries: Control limits were 75-125% for TOC. These criteria were met.

Laboratory duplicate and triplicate results: Control limits were 20% for TOC and total solids. This criterion was met for total solids. The TOC RPD exceeded the QAPP limit as follows:

QC ID	Analyte	RPD	Lab Control Limit
SD-JORPR01-B LR	Total Organic Carbon	25.4	20.0

The total organic carbon result in sample SD-JORPR01-B is qualified as estimated.

Overall assessment: Documentation was found to be clear and complete. Calibration data indicate acceptable performance. Method blank, LCS, and SRM results demonstrate acceptable laboratory accuracy. The laboratory triplicate result demonstrates acceptable laboratory precision for total solids. TOC sample results were qualified based on laboratory duplicate variability.

General chemistry results are acceptable for use as qualified.

5.0 Qualifier Summary Table

Client ID	Analyte(s)	Qualifier	Reason
General Chemistry Analyses			
SD-JORPR01-A	Total Organic Carbon	J	High duplicate RPD
SD-JORPR01-B	Total Organic Carbon	J	High duplicate RPD
SD-JORPR02-A	Total Organic Carbon	J	High duplicate RPD
SD-JORPR02-B	Total Organic Carbon	J	High duplicate RPD
SD-JORPR03-A	Total Organic Carbon	J	High duplicate RPD
SD-JORPR03-B	Total Organic Carbon	J	High duplicate RPD

6.0 Abbreviations and Definitions

DV Qualifier	Definition
U	The material was analyzed for, but was not detected above the level of the associated value.
UY	The reporting limit was elevated due to chromatographic overlap with related compounds. The material was analyzed for, but was not detected above the level of the associated value.
J	The analyte was positively identified. The associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.
UJ	The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
R	The sample result is rejected. The presence or absence of the analyte cannot be verified and data are not usable.
R1	This sample result has been rejected in favor of a more accurate and/or precise result. The other result should be used.

Abbreviation	Definition
DV	Data validation
LCS	Laboratory control sample
MS	Matrix spike
MSD	Matrix spike duplicate
NA	Not Applicable
RL	Reporting limit
RPD	Relative percent difference
RRM	Regional reference material
RSD	Relative standard deviations
SRM	Standard reference material

7.0 References

USEPA Contract Laboratory Program National Functional Guidelines For Superfund Organic Methods Data Review, Office of Superfund Remediation and Technology Innovation, U.S. Environmental Protection Agency, June 2008, USEPA-540-R-008-01.

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Construction and Post-Construction Sediment Monitoring Quality Assurance Project Plan, Duwamish Sediment Other Area and Southwest Bank Corrective Measure and Habitat Project, Boeing Plant 2. Prepared by AMEC Environment & Infrastructure Inc., et al. Prepared for: The Boeing Company, December 2012