APPENDIX J.3

Soil Chemistry Validation Report

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Data Validation Report – EPA Stage 2A

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Project: King County Closed Landfills – Vashon Island

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This report summarizes the review of analytical results for 13 soil samples, one field duplicate sample, one equipment rinsate blank sample, and one trip blank sample collected on July 11, 2019. The samples were collected by Anchor QEA, LLC, and submitted to Analytical Resources, Inc. (ARI), in Tukwila, Washington. The following analytical parameter results were reviewed in this report:

- Volatile organic compounds (VOCs) by U.S. Environmental Protection Agency (USEPA) Method 8260C
- Diesel-range organics (DRO) and oil-range organics (ORO) by Northwest Total Petroleum Hydrocarbons – Diesel Range Extended (NWTPHDx)
- Gasoline-range organics (GRO) by Northwest Total Petroleum Hydrocarbons – Gasoline Range Extended (NWTPHGx)
- Metals by USEPA Methods 6010C, 7470A, and 7471B
- Total organic carbon (TOC) by USEPA Method 9060A
- Total solids (TS) by Standard Method 2540G
- Hexavalent chromium (Cr+6) by USEPA Method 7196A
- Grain size (GS) by ASTM International Method D422

ARI sample delivery group (SDG) number 19G0193 was reviewed in this report. Sample IDs, matrices, and analyses are presented in Table 1.

Table 1
Sample IDs, SDGs, Matrices, and Analyses

Sample ID	Lab Sample ID	Matrix	Analyses
SO-10-190711E	19G0163-01	Water	DRO, ORO, metals, Cr+6
SO-01-190711	19G0163-02	Soil	VOC, GRO, DRO, ORO, metals, TOC, TS, Cr+6, GS
SO-02-190711	19G0163-03	Soil	VOC, GRO, DRO, ORO, metals, TOC, TS, Cr+6, GS
SO-03-190711	19G0163-04	Soil	VOC, GRO, DRO, ORO, metals, TOC, TS, Cr+6, GS
SO-04-190711	19G0163-05	Soil	VOC, GRO, DRO, ORO, metals, TOC, TS, Cr+6, GS
SO-05-190711	19G0163-06	Soil	VOC, GRO, DRO, ORO, metals, TOC, TS, Cr+6, GS
SO-06-190711	19G0163-07	Soil	VOC, GRO, DRO, ORO, metals, TOC, TS, Cr+6, GS
SO-07-190711	19G0163-08	Soil	VOC, GRO, DRO, ORO, metals, TOC, TS, Cr+6, GS
SO-08-190711	19G0163-09	Soil	VOC, GRO, DRO, ORO, metals, TOC, TS, Cr+6, GS
SO-09-190711	19G0163-10	Soil	VOC, GRO, DRO, ORO, metals, TOC, TS, Cr+6, GS
SO-10-190711	19G0163-11	Soil	VOC, GRO, DRO, ORO, metals, TOC, TS, Cr+6, GS

Sample ID	Lab Sample ID	Matrix	Analyses
SO-10-190711D	19G0163-12	Soil	VOC, GRO, DRO, ORO, metals, TOC, TS, Cr+6, GS
SO-11-190711	19G0163-13	Soil	VOC, GRO, DRO, ORO, metals, TOC, TS, Cr+6, GS
SO-12-190711	19G0163-14	Soil	VOC, GRO, DRO, ORO, metals, TOC, TS, Cr+6, GS
SO-13-190711	19G0163-15	Soil	VOC, GRO, DRO, ORO, metals, TOC, TS, Cr+6, GS
TB-SO-190711	19G0163-16	Water	VOC, GRO

Data Validation and Qualifications

The following comments refer to the laboratory's performance in meeting the quality assurance/quality control guidelines outlined in the analytical procedures. Laboratory results were reviewed using the following guidelines:

- *Vashon Island Closed Landfill West Hillslope Soil Investigation Sampling and Analysis Plan for Terrestrial Ecological Evaluation* (SAP; Anchor QEA 2019)
- *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods* (USEPA 1986)
- *National Functional Guidelines for Organic Superfund Methods Data Review* (USEPA 2017a)
- *National Functional Guidelines for Inorganic Superfund Methods Data Review* (USEPA 201b)

Unless noted in this report, laboratory results for the samples listed in Table 1 were within quality control criteria.

Field Documentation

Field documentation was checked for completeness and accuracy. The chain-of-custody forms were signed by ARI at the time of sample receipt. Samples were received in good condition and within the recommended temperature range with one exception. Sample SO-10-190711E was received above the recommend temperature range at 15.8°C, but it was received the same day of collection, so data are not expected to be affected.

Sample Preservation and Holding Times

Samples were appropriately preserved and analyzed within holding times.

Laboratory Method Blanks and Calibration Blanks

Laboratory method blanks and calibration blanks were analyzed at the required frequencies as applicable to the method. All blanks were free of target analytes with the following exceptions:

- **VOCs:** In batch BHG0316, six analytes were detected in the method blank between the detection limit (DL) and the reporting limit (RL). In batch BHG0391, seven analytes were detected in the method blank between the DL and RL. In batch BHG0439,

1,2,3-trichlorobenzene was detected in the method blank between the DL and RL. Associated sample results that were not significantly greater than (greater than five times) the detected method blank results were qualified as non-detect.

- **Metals:** Chromium was detected in the soil method blank between the DL and RL. All associated sample results were significantly greater than (greater than five times) the result detected in the blank, so no data were qualified. Iron was detected in the water method blank between the DL and RL. The associated sample result was not significantly greater than the result detected in the blank, so it was qualified as non-detect.

Field Quality Control

Equipment Rinse Blank

One rinse blank was collected in association with this sample set and analyzed for DRO, ORO, metals, and Cr+6. Results were below detection with the exception of chromium, which was detected between the DL and the RL. Associated sample results were significantly greater than (greater than five times) the level detected in the blank, so no data were qualified.

Field Duplicates

One field duplicate was collected in association with this sample set. Detected results are summarized in Table 2. Results that were less than five times the RL were assessed by the difference between them instead of the relative percent difference (RPD) value. Field duplicate RPD values were assessed using the precision limits listed in Table 5 of the SAP (Anchor QEA 2019). Field duplicate difference values were assessed using ±2 x RL. Field duplicate RPD or difference values were within control limits with the exception of the percent retained 2,000-micron sieve (#10), acetone, and methyl ethyl ketone, which had RPDs above the project specified control limits. Associated parent and duplicate results have been qualified "J" to indicate they are estimated.

Table 2
Field Duplicate Summary

Analyte	SO-10-190711	SO-10-190711D	RPD	Difference	Control Limit
Percent passing 1.3-micron sieve	4.20%	4.21%	0.2%	--	--
Percent retained 1.3-micron sieve	4.20%	3.51%	18.0%	--	--
Percent retained 13-micron sieve	9.11%	8.42%	7.8%	--	--
Percent retained 150-micron sieve (#100)	8.45%	8.42%	0.3%	--	--
Percent retained 2,000-micron sieve (#10)	2.40%	3.33%	32.6%	--	--
Percent retained 22-micron sieve	11.21%	12.63%	11.9%	--	--

Analyte	SO-10-190711	SO-10-190711D	RPD	Difference	Control Limit
Percent retained 250-micron sieve (#60)	6.73%	6.73%	0.0%	--	--
Percent retained 3.2-micron sieve	7.01%	8.42%	18.4%	--	--
Percent retained 32-micron sieve	20.62%	17.61%	15.7%	--	--
Percent retained 425-micron sieve (#40)	3.99%	4.23%	6.0%	--	--
Percent retained 4,750-micron sieve (#4)	1.25%	1.02%	20.7%	--	--
Percent retained 7-micron sieve	4.20%	4.91%	15.6%	--	--
Percent retained 75-micron sieve (#200)	8.35%	8.58%	2.7%	--	--
Percent retained 850-micron sieve (#20)	3.37%	3.76%	10.8%	--	--
Percent retained 9-micron sieve	4.90%	4.21%	15.2%	--	--
Motor oil-range hydrocarbons	484 mg/kg	543 mg/kg	--	59 mg/kg	278 mg/kg
TS	71.7%	72.28%	0.8%	--	--
Arsenic	38.2D mg/kg	33.6D mg/kg	--	4.6 mg/kg	32.4 mg/kg
Cadmium	1.47D mg/kg	1.37D mg/kg	--	0.1 mg/kg	1.296 mg/kg
Chromium	27.6D mg/kg	24D mg/kg	14.0%	--	--
Iron	14800D mg/kg	12700D mg/kg	15.3%	--	--
Lead	85.5D mg/kg	86.9D mg/kg	1.6%	--	--
Manganese	573D mg/kg	565D mg/kg	1.4%	--	--
Mercury	0.221 mg/kg	0.225 mg/kg	1.8%	--	--
Acetone	651 µg/kg	1710 µg/kg	89.7%	--	--
Benzene	0.97J µg/kg	1.24J µg/kg	--	0.27 µg/kg	4.46 µg/kg
Cymene, p- (4-Isopropyltoluene)	2.23U µg/kg	1.07J µg/kg	--	1.16 µg/kg	4.46 µg/kg
Methyl ethyl ketone (2-Butanone)	43.6 µg/kg	118 µg/kg	92.1%	--	--
Toluene	0.61J µg/kg	1.31J µg/kg	--	0.7 µg/kg	4.46 µg/kg
TOC	10.6%	11.1%	4.6%	--	--

Notes:
--: not applicable
µg/kg: micrograms per kilogram
mg/kg: milligrams per kilogram

Surrogate Spike Recoveries

Surrogates recovered within laboratory control limits with some exceptions for the VOC analyses. The 4-bromofluorobenzene surrogate recovered below the laboratory control limit in samples SO-03-190711 and SO-10-190711D. Since the other three surrogates in both samples recovered within control limits, no data were qualified.

Laboratory Control Samples and Laboratory Control Sample Duplicates

Laboratory control samples (LCS) and laboratory control sample duplicates (LCSD) were analyzed at the required frequency and resulted in recoveries and/or RPD values within project-required control limits.

Matrix Spike and Matrix Spike Duplicate Samples

Matrix spike (MS) and matrix spike duplicate (MSD) samples were analyzed at the required frequency. No data were qualified when native sample concentrations were greater than four times the spike concentration. Recoveries and/or RPD values were within project-required control limits with the following exceptions:

- **VOCs:** 12 analytes in the MS and 10 analytes in the MSD recovered below the project-specified control limits. 2-chloroethylvinylether did not recover in the MS or the MSD. MS or MSD results that recovered greater than 20% were qualified "UJ" to indicate a low bias. MS or MSD results that recovered less than 20% or did not recover have been rejected. Additionally, six analytes in the MS/MSD had RPDs above the control limit. Associated results were non-detect, so no data were qualified.
- **Conventionals:** The first soil Cr+6 MS analyzed on sample SO-01-190711 did not recover, and the second Cr+6 MS analyzed on the same sample recovered below the project-specified control limits. Associated batch sample results were rejected.

Laboratory Duplicates

Laboratory duplicates were analyzed at the required frequency. Results that were less than five times the reporting limit were evaluated by the difference between them. Duplicate RPD or difference values were within project-required control limits.

Method Reporting Limits

DLs and RLs were acceptable as reported. All values were reported using the laboratory reporting limits. Values were reported as undiluted or when diluted, the reporting limit reflects the dilution factor.

Overall Assessment

As was determined by this evaluation, the laboratory followed the specified analytical methods, and all requested sample analyses were completed. Accuracy was acceptable as demonstrated by the surrogate, LCS/LCSD, and MS/MSD recovery values, with the exceptions noted in the previous sections. Precision was acceptable as demonstrated by the LCS/LCSD, MS/MSD, laboratory, and field duplicate RPDs or difference values, with the exceptions noted in the previous sections. Most data are acceptable as reported or qualified. Eighteen VOC and Cr+6 results were rejected. Table 3 summarizes the qualifiers applied to the sample results reviewed in this report.

Data Qualifier Definitions

J Indicates an estimated value

R Indicates the result is rejected and unusable

U Indicates the compound or analyte was analyzed for by not detected at or above the specified limit

UJ Indicates the compound or analyte was analyzed for but not detected and the specified limit reported is estimated

Table 3
Data Qualification Summary

Sample ID	Parameter	Analyte	Reported Result	Qualified Result	Reason
SO-01-190711	Metals	Cr+6	0.894U mg/kg	R	MS %R below control limit
	VOCs	Dichloromethane (Methylene chloride)	3.27J µg/kg	8.81U µg/kg	Method blank contamination
		1,2,3-Trichlorobenzene	1.45J µg/kg	R	Method blank contamination and MS %R below control limit
		1,2-Dibromo-3-chloropropane	22U µg/kg	22UJ µg/kg	MS %R below control limit
		n-Butylbenzene	4.4U µg/kg	4.4UJ µg/kg	
		1,2,4-Trichlorobenzene	22U µg/kg	R	MS/MSD %R below control limit
		1,2-Dichlorobenzene	4.4U µg/kg	4.4UJ µg/kg	
		1,3-Dichlorobenzene	4.4U µg/kg	4.4UJ µg/kg	
		1,4-Dichlorobenzene	4.4U µg/kg	4.4UJ µg/kg	
		2-Chloroethylvinyl ether	22U µg/kg	R	
		Acrolein	22U µg/kg	22UJ µg/kg	
		Hexachlorobutadiene (Hexachloro-1,3-butadiene)	22U µg/kg	22UJ µg/kg	
		Naphthalene	22U µg/kg	R	
		Styrene	4.4U µg/kg	4.4UJ µg/kg	
		Vinyl acetate	22U µg/kg	22UJ µg/kg	MSD %R below control limit
SO-02-190711	Metals	Cr+6	1.02U mg/kg	R	MS %R below control limit
	VOCs	Dichloromethane (Methylene chloride)	2.51J µg/kg	6.39U µg/kg	Method blank contamination
SO-03-190711	Metals	Cr+6	3.73U mg/kg	R	MS %R below control limit
SO-04-190711	Metals	Cr+6	4.6U mg/kg	R	MS %R below control limit
SO-05-190711	Metals	Cr+6	1.38U mg/kg	R	MS %R below control limit
	VOCs	Dichloromethane (Methylene chloride)	4.81J µg/kg	13.4U µg/kg	Method blank contamination

Sample ID	Parameter	Analyte	Reported Result	Qualified Result	Reason
SO-06-190711	Metals	Cr+6	17.2D mg/kg	R	MS %R below control limit
	VOCs	Dichloromethane (Methylene chloride)	2.07J µg/kg	5.75U µg/kg	Method blank contamination
SO-07-190711	Metals	Cr+6	0.66U mg/kg	R	MS %R below control limit
	VOCs	Dichloromethane (Methylene chloride)	1.78J µg/kg	4.12U µg/kg	Method blank contamination
SO-08-190711	Metals	Cr+6	1.02U mg/kg	R	MS %R below control limit
	VOCs	Dichloromethane (Methylene chloride)	3.1J µg/kg	8.06U µg/kg	Method blank contamination
SO-09-190711	Metals	Cr+6	0.689U mg/kg	R	MS %R below control limit
	VOCs	Dichloromethane (Methylene chloride)	1.79J µg/kg	4.25U µg/kg	Method blank contamination
SO-10-190711	Conventionals	Percent retained 2000 micron sieve (#10)	2.3959943415%	2.3959943415% J	Field duplicate RPD above control limit
	Metals	Cr+6	2.48D mg/kg	R	MS %R below control limit
	VOCs	Acetone	651 µg/kg	651J µg/kg	Field duplicate RPD above control limit
		Methyl ethyl ketone (2-Butanone)	43.6 µg/kg	43.6J µg/kg	
		1,2,3-Trichlorobenzene	0.85J µg/kg	11.1U µg/kg	Method blank contamination
		Dichloromethane (Methylene chloride)	1.5J µg/kg	4.46U µg/kg	
		Naphthalene	0.98J µg/kg	11.1U µg/kg	
SO-10-190711D	Conventionals	Percent retained 2000 micron sieve (#10)	3.3281025309%	3.3281025309% J	Field duplicate RPD above control limit
	Metals	Cr+6	5.37D mg/kg	R	MS %R below control limit
	VOCs	Acetone	1710 µg/kg	1710J µg/kg	Field duplicate RPD above control limit
		Methyl ethyl ketone (2-Butanone)	118 µg/kg	118J µg/kg	
SO-10-190711E	Metals	Iron	0.0088J mg/L	0.0500U mg/L	Method blank contamination
SO-11-190711	Metals	Cr+6	4.39U mg/kg	R	MS %R below control limit

Sample ID	Parameter	Analyte	Reported Result	Qualified Result	Reason
SO-12-190711	Metals	Cr+6	1.11U mg/kg	R	MS %R below control limit
	VOCs	Dichloromethane (Methylene chloride)	3.13J µg/kg	9.32U µg/kg	Method blank contamination
SO-13-190711	Metals	Cr+6	0.537U mg/kg	R	MS %R below control limit
	VOCs	Dichloromethane (Methylene chloride)	4.25U µg/kg	4.25U µg/kg	Method blank contamination

Notes:
%R: percent recovery
µg/kg: micrograms per kilogram
mg/kg: milligram per kilogram
mg/L: milligram per liter

References

Anchor QEA (Anchor QEA, LLC), 2019. *Vashon Island Closed Landfill West Hillslope Soil Investigation Sampling and Analysis Plan for Terrestrial Ecological Evaluation*. July 2019.

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