
To: Mohsen Kourehdar, Washington State Department of Ecology, TCP Site Manager

From: Aaron Waggoner, LG, LHG; Iain Wingard

Date: April 23, 2019

File: 0504-095-04

Subject: Aladdin Plating Groundwater Monitoring Event – February 2019

Introduction

This technical memorandum presents the results of groundwater monitoring completed by GeoEngineers on behalf of the Washington State Department of Ecology (Ecology) for the former Aladdin Plating Site located at 1657 Center Street in the Nalley Valley of Tacoma, Washington. A vicinity map showing the location of the site within the City of Tacoma is provided as Figure 1. The groundwater monitoring event was completed on February 6, 2019.

Background

The site was a metals plating facility that was shut down in the 1990s and was subsequently acquired by Pierce County. Ecology, on behalf of Pierce County coordinated the demolition of the site structures in 2005 and subsequently performed soil and groundwater investigations. Metals associated with the plating activities including total chromium, hexavalent chromium and nickel were identified as the contaminants of concern for site soil and groundwater.

The property underwent remedial action in 2018 using an Ecology-hired environmental contractor (Contractor) who excavated metals-contaminated soil within the limits of the former property to depths ranging from 2.5 feet below ground surface (bgs) to 16 feet bgs, transported the contaminated soil offsite for disposal, and backfilled and restored the property to near the original grade. Prior to initiating remedial excavation, the Contractor subcontracted Cascade Drilling to decommission the monitoring wells located on the property on September 18, 2018. The decommissioned wells included MW1s, MW2s, MW3s, MW4s and MW4d. Figure 2 shows the locations of all monitoring wells relative to the property boundaries and other surrounding features.

Following construction, two monitoring wells were installed, one on and one off the property, in December 2018. The well installed on the property was given the identification of MW4sR as a replacement well for MW4s and was installed in generally the same location as the original. The other well installed off the property, MW8s, was located west of South Asotin Street and east of the gated entrance to Bills Towing. MW8s was installed on private property with the permission of the property owner who signed an access agreement with Ecology.

Groundwater Monitoring Activities

GeoEngineers personnel visited the site on February 6, 2019 to collect depth to groundwater measurements from the five monitoring wells, MW4sR, MW-5s, MW-6s, MW7s and MW8s. In addition to the depth to groundwater, the total well depth and the depth of the top of the well casing below the ground surface was measured. The groundwater and well measurements are included in Table 1.

GeoEngineers subcontracted David Evans and Associates (DEA) of Tacoma, Washington to complete a professional survey of the well location and top of casing elevation of the five monitoring wells on

February 18, 2019. The top of casing elevation was surveyed from the north side of the PVC well casing. The location and elevation survey data are provided in Table 1. The groundwater elevation contours resulting from the depth to groundwater measurements and survey data are shown on Figure 3. Low-flow sampling equipment comprised of a pneumatic bladder pump rented from Field Environmental Instruments of Everett, Washington was used to purge groundwater, collect groundwater quality parameters and determine stabilization prior to sample collection from monitoring wells MW4sR, MW6s, MW7s and MW8s. Monitoring well MW-5s was not sampled due to its distant upgradient and somewhat cross gradient location relative to the site. Monitoring well MW6s was sampled using compressed nitrogen to lift water to the surface due to the well's location and depth. Groundwater was measured at 134.42 feet below the top of casing at MW-6s. The pneumatic compressor in the sampling equipment lacked the necessary pressure to lift water from this depth up to the ground surface for sampling. The groundwater monitoring field report and sampling forms are included in Attachment 1.

After the wells achieved stabilization, groundwater samples were collected from monitoring wells MW4sR, MW6s, MW7s and MW8s along with one duplicate sample from MW8s. The samples were transported under chain of custody to OnSite Environmental, Inc. of Renton, Washington (an Ecology-accredited laboratory) for chemical analysis of total and dissolved metals including chromium and nickel using Environmental Protection Agency (EPA) Method 200 series and hexavalent chromium by SM 3500-Cr B.

Groundwater that was purged during the monitoring event was placed in a 55 gallon drum that was labeled and stored within the fenced property. A sample was collected from the drum of purge water as well as the drums of decontamination water and well development water that were generated when monitoring wells MW4sR and MW8s were installed. The sample will be used to characterize and profile the drums for pickup and disposal at an approved disposal facility.

Groundwater Results

The groundwater monitoring results for wells MW4sR, MW6s, MW7s and MW8s are presented in Table 2 and summarized on Figure 4. The laboratory analytical report from OnSite Environmental, Inc. is included in Attachment 2. The memorandum presenting the results of the laboratory data validation is presented in Attachment 3. The results of the data validation indicate that the results are acceptable for the intended use.

AMW:IHW:ch

Attachments:

Figure 1. Vicinity Map

Figure 2. Site Plan

Figure 3. Groundwater Contour Map

Figure 4. Groundwater Analytical Results

Table 1. Groundwater and Well Measurements

Table 2. Analytical Results

Attachment 1. Field Files

Attachment 2. Laboratory Analytical Data

Attachment 3. Data Validation Report

Table 1

Groundwater and Well Measurements Aladdin Plating Site Tacoma, Washington

Exploration Location ¹	Date Measured	Top of Casing Elevation ⁴ (ft)	Depth to Groundwater (ft BTOC)	Groundwater Elevation (ft)	Horizontal Coordinates ⁴	
					Northing (ft)	Easting (ft)
MW4sR ²	2/6/2018	245.13	24.93	220.20	1154127.383	699228.804
MW5s	2/6/2018	248.01	27.03	220.98	1153783.195	699051.481
MW6s	2/6/2018	358.19	137.42	220.77	1154323.617	699665.392
MW7s	2/6/2018	242.57	23.53	219.04	1154572.961	699157.450
MW8s ³	2/6/2018	242.96	23.01	219.95	1154237.648	699195.698

Notes:

¹ Exploration locations shown on Figures 2 and 3.

² MW4s replacement monitoring well installed in December 2018.

³ New monitoring installed in December 2018.

⁴ Top of casing elevations and horizontal coordinates based on professional land survey by David Evans and Associates of Tacoma, WA on February, 18, 2019. Datums: Horizontal NAD83, Vertical NGVD29

ft = feet

BTOC = below top of casing

Table 2
Analytical Results
Aladdin Plating Site
Tacoma, Washington

Exploration Location ¹	Date Sampled	Metals ² (µg/L)	Total Chromium	Dissolved Chromium	Total Nickel	Dissolved Nickel	Hexavalent Chromium
		Groundwater Cleanup Levels ³	50		320 ⁴		48 ⁴
		Sample ID					
MW4sR	2/6/2018	MW4sR-190206	15	11	2,600	2,700	12
MW5s	--	--	--	--	--	--	--
MW6s	2/6/2018	MW6s-190206	8.1	1.0 U	12	8.0 U	10 U
MW7s	2/6/2018	MW7s-190206	2.1	1.0 U	8.9 U	8.0 U	10 U
MW8s	2/6/2018	MW8s-190206	32	27	13,000	13,000	31
		DUP-1-190206	32	28	14,000	13,000	32

Notes:

¹ Exploration locations shown on Figure 4.

² Total and dissolved metals analyzed by United States Environmental Protection Agency (EPA) 200.7/6010C.

³ Model Toxics Cleanup Act (MTCA) Method A Cleanup Level for groundwater.

⁴ No Method A Value exists for this metal, MTCA Method B Value was used in its place.

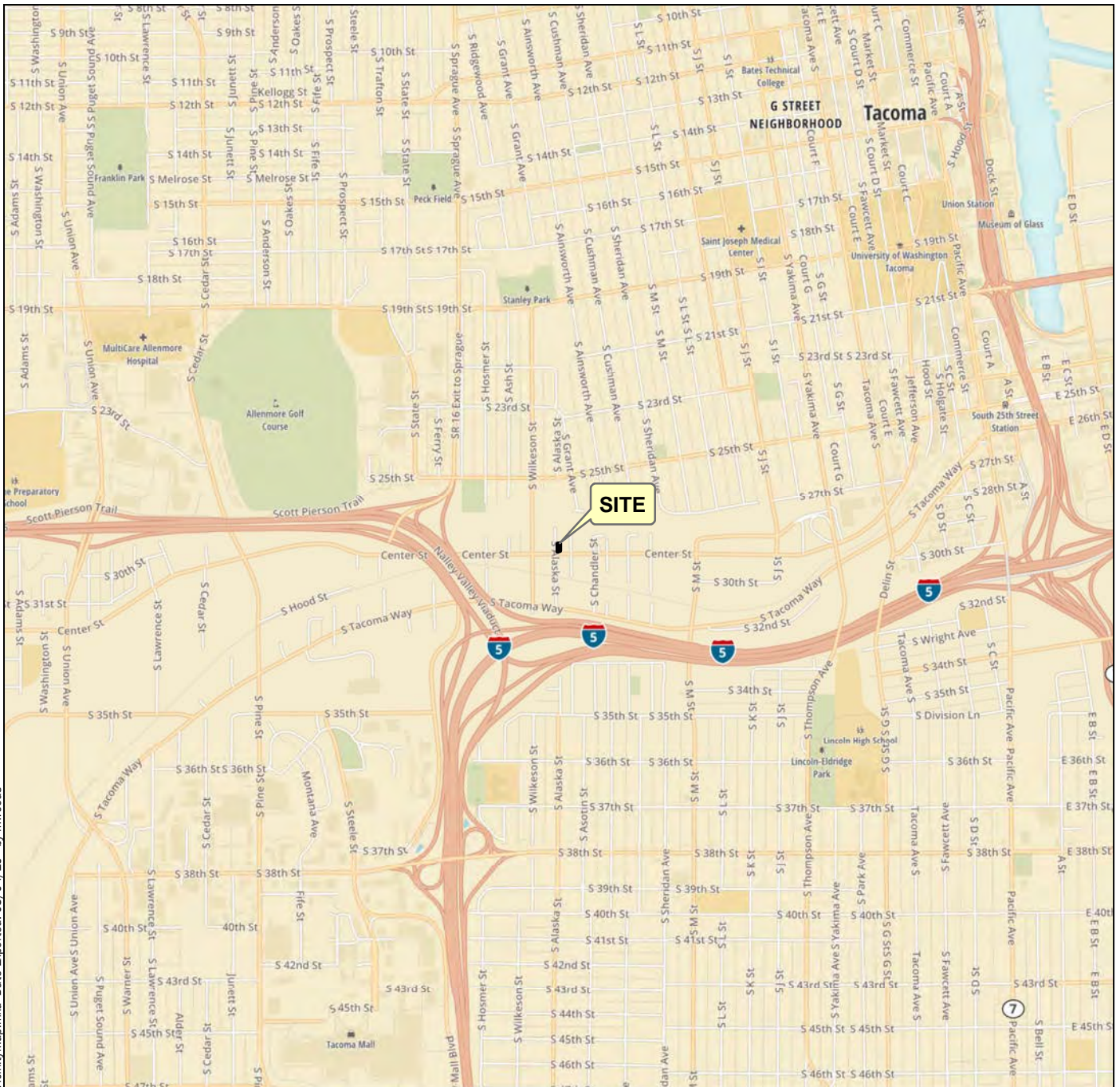
µg/L = micrograms per liter

U = Not detected greater than laboratory reporting limit

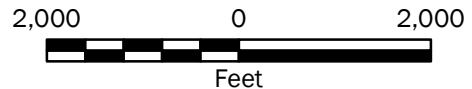
-- = Not Analyzed

Bolding indicates analyte was detected.

Yellow highlighting indicates exceedance of MTCA cleanup level.



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Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Mapbox Open Street Map, 2016

Projection: NAD 1983 UTM Zone 10N

Vicinity Map	
Aladdin Plating Tacoma, Washington	
	Figure 1

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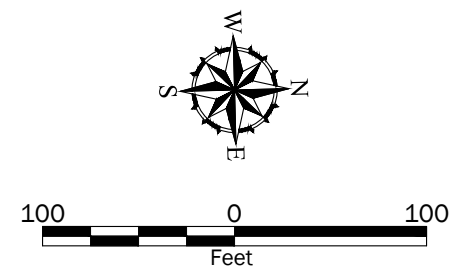


Legend

- Site Boundary
 - MW4sR ● Groundwater Monitoring Well
 - MW1s* ● Decommissioned Monitoring Well
- *Monitoring Well Decommissioned During Remedial Excavation Activities on 9/18/2018

- Notes:**
1. The locations of all features shown are approximate.
 2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Aerial from Google Earth Pro dated 5/13/2018.
 Projection: NAD83 Washington State Planes, South Zone, US Foot



Site Plan	
Aladdin Plating Tacoma, Washington	
	Figure 2



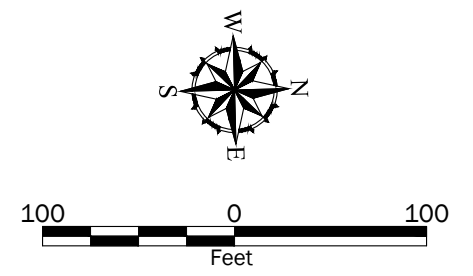
Legend

- Site Boundary
- Groundwater Elevation Contour (0.2-foot interval)
- Groundwater Flow Direction
- Monitoring Well and Groundwater Elevation

Notes:

1. The locations of all features shown are approximate.
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Data Source: Aerial from Google Earth Pro dated 5/13/2018.
 Projection: NAD83 Washington State Planes, South Zone, US Foot



Groundwater Contour Map	
Aladdin Plating Tacoma, Washington	
	Figure 3

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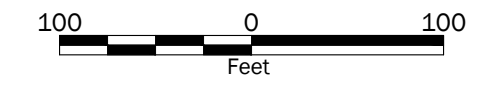
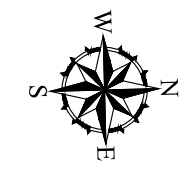


Legend

- Site Boundary
- MW4sR ● Groundwater Monitoring Well
- µg/L = micrograms per liter
- Bolding indicates analyte was detected.
- Gray Shading indicates exceedance of MTCA cleanup level.

- Notes:**
- The locations of all features shown are approximate.
 - This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Aerial from Google Earth Pro dated 5/13/2018.
 Projection: NAD83 Washington State Planes, South Zone, US Foot



Groundwater Analytical Results	
Aladdin Plating Tacoma, Washington	
	Figure 4

ATTACHMENT 1
Field Files



1101 Fawcett Avenue, Suite 200
Tacoma, Washington 98402
253.383.4940

Field Report

File Number:
0504-095-04

Project:
Aladdin Plating

Date:
02/06/2019

Owner:
Ecology

Time of Arrival:
0815

Report Number:
FR1

Prepared by:
Eric Knoedler

Location:
Tacoma, Washington

Time of Departure:
1640

Page:
1 of 2

Purpose of visit:
Groundwater Monitoring

Weather:
Clear, 30's

Travel Time:
0.5 hrs

Permit Number:
N/A

Upon arrival to the site I assessed personal safety hazards: Yes or Referred to Site Safety Plan and Safety Tailgate if applicable
Safety Hazards Were Addressed by: Staying Alert to Construction and Equipment Hazards Other (describe):

GeoEngineers representatives Eric Knoedler (ENK), Roger Chang (RC), and Aaron Waggoner (AMW) arrived at the Aladdin Plating site (site) located at 1657 Center Street in Tacoma, Washington at about 8:15 AM. The purpose of this site visit was to obtain groundwater samples from site monitoring wells MW4sR, MW6s, MW7s, and MW8s and measure the water level at monitoring well MW5s. Photos taken during this sampling event are available on the P-drive at the following link: <\\geoengineers.com\WAN\Projects\0\0504095\04\Photos\GW Sampling\20190206>.

Each monitoring well was purged following standard low-flow techniques and groundwater quality parameters were recorded to determine stabilization. Groundwater parameters monitored included:

- Temperature,
- Oxidation-reduction potential,
- Dissolved oxygen,
- Conductivity (recorded in microsiemens per centimeter [$\mu\text{S}/\text{cm}$]),
- pH, and
- Turbidity.

Stabilization was considered achieved when water quality parameters (except for conductivity and turbidity) varied by less than 10% through three consecutive readings. The stabilization criteria allowed for a 3% variation in conductivity through three consecutive readings and one turbidity reading equal to, or less than 25 nephelometric turbidity units (NTUs). Water levels were measured to the nearest 0.01 feet from the north side of the top of well casing.

Equipment

Equipment used for the purge and sampling procedures included:

- YSI ProPlus water quality meter with flow-through cell,
- Hach 2100Q turbidity meter,
- Waterline M200 electric water level meter,
- QED SamplePro bladder pump,
- QED MP50 compressor/controller, and
- Compressed nitrogen gas (for monitoring well MW6s only).

Decontamination

Durable and reusable equipment that directly or indirectly contacted potentially contaminated groundwater was decontaminated using an Alconox® wash followed by a distilled-water rinse. New, plastic tubing was used for each monitoring

THIS FIELD REPORT IS PRELIMINARY

A preliminary report is provided solely as evidence that field observation was performed. Observations and/or conclusions and/or recommendations conveyed in the final report may vary from and shall take precedence over those indicated in a preliminary report.

FIELD REPRESENTATIVE

Eric Knoedler

DATE

2/07/19

THIS FIELD REPORT IS FINAL

A final report is an instrument of professional service. Any conclusions drawn from this report should be discussed with and evaluated by the professional involved.

REVIEWED BY

Aaron Waggoner

DATE

02/07/19

This report presents opinions formed as a result of our observation of activities relating to our services only. We rely on the contractor to comply with the plans and specification throughout the duration of the project irrespective of the presence of our representative. Our work does not include supervision or direction of the work of others. Our firm will not be responsible for job or site safety of others on this project. **DISCLAIMER:** Any electronic form, facsimile or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

Attachments: Lab COC, Groundwater Sampling Forms

Distribution: Project File

well. Disposable materials (e.g., nitrile gloves, paper towels, etc.) used throughout this sampling event were considered *de minimus* and disposed of in a municipal waste bin.

Sampling

Samples obtained during this sampling event are listed in Table 1. Monitoring well construction details and current conditions are summarized in Table 2. Groundwater samples were obtained from each monitoring well following parameter stabilization by removing the flow-through cell and filling laboratory-supplied bottles directly from the sample tubing. Each sample comprised two 500-mL polyethylene bottles with nitric acid preservative and one 500-mL polyethylene bottle with no preservative. Groundwater filling one of the nitric acid-preserved bottles for each sample was filtered using a 0.45-micron in-line filter.

Samples were stored in a cooler on ice and transported to OnSite Environmental of Redmond, Washington under standard chain-of-custody procedures. Samples were submitted for chemical analysis of total and dissolved nickel, total and dissolved chromium, and total hexavalent chromium on a standard turnaround request. Samples were direct-dropped at the lab to meet the 24-hour hold time for the requested hexavalent chromium analysis.

Investigation-Derived Waste

About 15 gallons of purge water was generated during this sampling event. Purge water was transferred to a labeled 55-gallon steel drum stored on site. There are currently six 55-gallon drums with soil cuttings, and three 55-gallon drums with purge and decontamination water (one water drum is about ¼ full) on site.

GeoEngineers departed the site at about 4:40 PM.

Table 1 – Groundwater sample summary.

Monitoring Well ID	Sample Name	Time	Date
MW4sR	MW4sR-190206	1320	02/06/2019
MW6s	MW6s-190206	1100	02/06/2019
MW7s	MW7s-190206	1415	02/06/2019
MW8s	MW8s-190206	1605	02/06/2019

Table 2 – Summary of monitoring well construction and current conditions.

Monitoring Well ID	Static Water Level (ft. BTOC)	Total Depth (ft. BTOC)	Stickup (ft. bgs)	Screened Interval ¹ (ft. BTOC)	Monument and TOC Condition
MW4sR	24.93	37.11 (soft)	-0.40	24 to 39	Good
MW6s	137.42	153.29 (soft)	-0.28	144 to 145	Good
MW7s	23.53	41.65 (soft)	-0.41	32 to 42	Good
MW8s	23.01	39.26 (soft)	-0.44	24 to 39	Good
MW5s	27.03	-	-0.54	-	Missing one bolt

Notes:

¹ Screened interval for monitoring wells MW6s and MW7s are assumed. Screened interval for MW4sR and MW8s are reported on the respective boring logs.

ft. BTOC = feet below top of casing

ft. bgs = feet below ground surface

TOC = top of casing

“Good” condition indicates all monument bolts are accounted for and working, compression cap is functioning providing an adequate seal, and casing is not cracked or worn.

GROUNDWATER SAMPLE COLLECTION FORM

Project Aladdin Plating Job No. 0504-095-03 Collector ENK/RC Sample ID MW-5R-190206

PURGE DATA

Well Condition: Secure Yes No Describe Damage NONE (STUCK UP = 0.4 ft)
 (Padlock brand and number) _____
 Depth to Water (from top of well casing) 24.93
 Depth to Base of Well 37.11 Height of Water Column 12.18
 Well Casing Type/Diameter 2 in
 One Casing Volume (gal.) 1 well = 2.07 2 well = 6.21
 Purge Method Pump (type) Bladder Bailer (type) N/A
 Gallons Purged _____
 (Remove minimum of 3 well volumes or until field parameters stabilize)
 Purge Water Storage/Disposal Drum on site
 (Drum identification, sample analysis, sample results, storage location, etc.) _____

Diameter (in.)	OD	ID	Volume Gal./Linear Ft
2	2.375"	2.067"	0.17
3	3.500"	3.068"	0.38
4	4.500"	4.026"	0.66
6	6.625"	6.065"	1.5
8	8.625"	7.981"	2.6

SAMPLING DATA

Date Collected (mo/dy/yr) 2/6/19
 Sample Location and Depth 29 Time Collected 1320
 Tidal Cycle NA High Tide at _____ Low Tide at _____ Weather clear/cloudy
 Sample type (Groundwater, Product, Other) _____
 Sample Collected with Bailer Pump Other
 Made of Stainless Steel PVC Teflon Disposable LDPE Other
 Sampler Decon Procedure Alconox wash 10 min w/ DI water
 Sample Description (color, free product thickness, odor, turbidity, etc.) _____

FIELD PARAMETERS

Time	Depth to Water (feet)	Purge Volume (gallons)	pH	Conductivity (_____)	Turbidity (NTU)	Dissolved O ₂ (ppm)	Temperature (F/C)	ORP (mV)		
1218	<u>24.93</u>	<u>Start</u>	<u>7.69</u>	<u>57.20</u>	<u>738</u>	<u>7.31</u>	<u>9.7</u>	<u>75.6</u>		
<u>1219</u>	<u>24.93</u>		<u>7.49</u>	<u>54.5</u>	<u>893</u>	<u>5.26</u>	<u>11.4</u>	<u>85.5</u>		
<u>1223</u>	<u>24.93</u>		<u>7.53</u>	<u>56.5</u>	<u>689</u>	<u>4.75</u>	<u>11.5</u>	<u>89.1</u>		
<u>1227</u>	<u>-</u>	<u>0.75</u>	<u>7.58</u>	<u>56.4</u>	<u>537</u>	<u>4.94</u>	<u>11.6</u>	<u>76.9</u>		
<u>1231</u>	<u>-</u>		<u>7.60</u>	<u>56.3</u>	<u>437</u>	<u>4.52</u>	<u>11.6</u>	<u>79.8</u>		
<u>1235</u>	<u>-</u>		<u>7.53</u>	<u>56.1</u>	<u>345</u>	<u>4.90</u>	<u>11.4</u>	<u>83.7</u>		
<u>1239</u>	<u>-</u>	<u>1.25</u>	<u>7.97</u>	<u>55.9</u>	<u>295</u>	<u>4.89</u>	<u>11.6</u>	<u>87.0</u>		
<u>1243</u>	<u>-</u>		<u>7.46</u>	<u>56.0</u>	<u>182</u>	<u>4.46</u>	<u>11.6</u>	<u>89.9</u>		
<u>1248</u>	<u>-</u>		<u>7.46</u>	<u>56.1</u>	<u>148</u>	<u>4.85</u>	<u>11.6</u>	<u>86.8</u>		
<u>1253</u>	<u>-</u>	<u>2.5</u>	<u>7.46</u>	<u>56.2</u>	<u>97.0</u>	<u>4.87</u>	<u>11.6</u>	<u>82.7</u>		
<u>1258</u>	<u>-</u>		<u>7.53</u>	<u>56.0</u>	<u>83.1</u>	<u>4.89</u>	<u>11.6</u>	<u>83.2</u>		
<u>1307</u>	<u>-</u>		<u>7.51</u>	<u>56.0</u>	<u>65.8</u>	<u>4.91</u>	<u>11.6</u>	<u>82.1</u>		
<u>1304</u>	<u>-</u>		<u>7.50</u>	<u>55.9</u>	<u>55.5</u>	<u>4.90</u>	<u>11.6</u>	<u>82.3</u>		

Meters Used for Measurement YSI Pro Plus, Hach T-21
 pH/Con./DO Instrument Calibration Yes No E-Tape waterline m200

ADDITIONAL INFORMATION

Samples Composited Overtime, Distance _____
 Analyses, Number and Volume of Sample Containers 2x 500ml poly w/ nitric 1x 500ml poly w/ preservative
 Duplicate Sample Number(s) N/A
 Comments: (Filtered, Not Filtered, Calculations, etc.) -150ml/min

Signature [Signature] Date 2/6/19 Page 1 of 2

Check if additional information on back

GROUNDWATER SAMPLE COLLECTION FORM

Project Aladdin Plating Job No. 0504-095-03 Collector ENK/RC Sample ID MW-65-190206

PURGE DATA

Well Condition: Secure Yes No Describe Damage NONE (STUCK = 0.25 ft)
 (Padlock brand and number) 3 BOLTS - NO LOCK
 Depth to Water (from top of well casing) 137.42 @ 0850 @ 0938
 Depth to Base of Well 153.29 (V. SURE) Height of Water Column _____
 Well Casing Type/Diameter 2"
 One Casing Volume (gal.) _____
 Purge Method Pump (type) Bladder Bailer (type) N/A
 Gallons Purged ~4.5
 (Remove minimum of 3 well volumes or until field parameters stabilize)
 Purge Water Storage/Disposal Drum on site
 (Drum identification, sample analysis, sample results, storage location, etc.) _____

Diameter (in.)	OD	ID	Volume Gal./Linear Ft
2	2.375"	2.067"	0.17
3	3.500"	3.068"	0.38
4	4.500"	4.026"	0.66
6	6.625"	6.065"	1.5
8	8.625"	7.981"	2.6

SAMPLING DATA

Date Collected (mo/dy/yr) _____
 Sample Location and Depth 145 ft. RTDC - MID SCREEN Time Collected 1100
 Tidal Cycle NA High Tide at _____ Low Tide at _____ Weather Clear, 30's
 Sample type (Groundwater, Product, Other) _____
 Sample Collected with Bailer Pump Other Bladder - QED SAMPLE PRO
 Made of Stainless Steel PVC Teflon Disposable LDPE Other _____
 Sampler Decon Procedure ALANEX + RINSE & DEDICATED TUBING
 Sample Description (color, free product thickness, odor, turbidity, etc.) Clear, No Odor

FIELD PARAMETERS

Time	Depth to Water (feet)	Purge Volume (gallons)	pH	Conductivity (µS/cm)	Turbidity (NTU)	Dissolved O ₂ (ppm)	Temperature (F/C)	ORP (mV)		
0900	- START PURGE	-	-	-	-	-	-	-	-	-
0940	- RESTART PURGE	-	-	-	-	-	-	-	-	-
0945	137.42	0.25	7.62	201.7	321	7.61	8.5	46.7		
0950	137.42	1.0	7.98	210.3	247	5.42	10.3	27.4		
0955		1.81.25	8.18	211.0	183	2.52	10.5	8.1		W/L STABLE
1000		2.10.75	8.21	211.8	185	2.35	10.5	4.4		
1005		2.18.2.0	8.24	211.7	178	2.10	10.4	3.0		
1010		3.10.2.25	8.26	212.5	152	1.90	10.4	-1.8		
1015		3.18.2.5	8.25	214.1	117	1.75	10.5	-1.6		
1020		2.75	8.28	214.9	106	1.65	10.5	-1.5		
1025		3.0	8.32	215.9	85.2	1.56	10.6	-3.9		
1030		3.25	8.43	216.1	71.3	1.50	10.6	-12.0		
1035		3.50	8.50	216.2	65.0	1.43	10.4	-14.1		

Meters Used for Measurement VST ProPlus; Hitec 2100
 pH/Con./DO Instrument Calibration Yes No E-Tape WaterLogic

ADDITIONAL INFORMATION

Samples Composited Overtime, Distance ~ 115 mL / MIN
 Analyses, Number and Volume of Sample Containers 2 x 500mL POLYS w/ NITRIZ (1 Filtered); 1 x 500mL POLY UNFILTERED
 Duplicate Sample Number(s) _____
 Comments: (Filtered, Not Filtered, Calculations, etc.) - DEDICATED BLADDER PUMP - ; CYCLE 11/11 - NO DEDICATED PUMP - ; ESTIMATE FROM PURGE BUCKET

Signature _____ Date 2/6/19 Page 1 of 2

Check if additional information on back

GROUNDWATER SAMPLE COLLECTION FORM

Project Aladdin Plating Job No. 0504-095-03 Collector ENK/RC Sample ID MW 88-190206

PURGE DATA

Well Condition: Secure Yes No Describe Damage NOISE (STICK UP = 0.44 FE)
 (Padlock brand and number) _____
 Depth to Water (from top of well casing) 23.01
 Depth to Base of Well 39.26 Height of Water Column 16.25
 Well Casing Type/Diameter 2.0
 One Casing Volume (gal.) 1 well = 2.76 2 wells = 8.28
 Purge Method Pump (type) Bladder Bailer (type) N/A
 Gallons Purged ~5
 (Remove minimum of 3 well volumes or until field parameters stabilize)
 Purge Water Storage/Disposal Drum on site
 (Drum identification, sample analysis, sample results, storage location, etc.) _____

Diameter (in.)	OD	ID	Volume Gal./Linear Ft
2	2.375"	2.067"	0.17
3	3.500"	3.068"	0.38
4	4.500"	4.026"	0.66
6	6.625"	6.065"	1.5
8	8.625"	7.981"	2.6

SAMPLING DATA

Date Collected (mo/d/yr) 2/6/19
 Sample Location and Depth 34' Time Collected 1605
 Tidal Cycle NA High Tide at _____ Low Tide at _____ Weather clear 30s
 Sample type (Groundwater, Product, Other) _____
 Sample Collected with Bailer Pump Other _____
 Made of Stainless Steel PVC Teflon Disposable LDPE Other _____
 Sampler Decon Procedure Alconox Wash / DI Rinse
 Sample Description (color, free product thickness, odor, turbidity, etc.) _____

FIELD PARAMETERS

Time	Depth to Water (feet)	Purge Volume (gallons)	pH	Conductivity ($\mu S/cm$)	Turbidity (NTU)	Dissolved O ₂ (ppm)	Temperature (F/C)	ORP (mV)		
1446	23.01	Start	7.24	140.4	over	3.94	12.0	83.3		
1450	23.01		7.27	144.8	over	3.92	12.0	83.6		
1455	23.01		7.64	141.6	over	4.39	12.1	72.6		
1500	-		7.94	137.2	over	4.32	12.2	80.2		
1504	-	1.25	8.03	138.2		4.22	12.4	55.7		
1508	-		8.06	139.1	over	4.23	12.2	53.8		
1512	-		8.06	141.1	965	4.21	12.4	53.5		
1516	-		8.11	144.4	658	4.27	12.6	51.3		
1520	-		8.12	145.6	461	4.33	12.4	51.3		
1524	-	2.50	8.09	146.7	316	4.37	12.3	51.6		
1528	-		8.15	150.3	269	4.39	12.5	49.0		
1532	-		8.18	152.8	184	4.49	12.4	48.06		
1536	-	3.25	8.13	156.7	112	4.60	12.3	50.0		

Meters Used for Measurement YSI Pro Plus Hoch T-21
 pH/Con./DO Instrument Calibration Yes No E-Tape Waterline 1722

ADDITIONAL INFORMATION

Samples Composited Overtime, Distance _____
 Analyses, Number and Volume of Sample Containers 2 x 500 mL poly w/ nitric acid 1 x 500 mL poly
 Duplicate Sample Number(s) DUP-A-190206 @ 2000
 Comments: (Filtered, Not Filtered, Calculations, etc.) stick up! 0.435 ~ 220 mL/min

Signature [Signature] Date 2/6/19 Page 1 of 2
 Check if additional information on back

ATTACHMENT 2
Laboratory Analytical Data



14648 NE 95th Street, Redmond, WA 98052 • (425) 883-3881

February 14, 2019

Aaron Waggoner
GeoEngineers, Inc.
1101 Fawcett Avenue South, Suite 200
Tacoma, WA 98402

Re: Analytical Data for Project 504-095-04
Laboratory Reference No. 1902-037

Dear Aaron:

Enclosed are the analytical results and associated quality control data for samples submitted on February 6, 2019.

The standard policy of OnSite Environmental, Inc. is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

A handwritten signature in black ink, appearing to read "DB", with a long horizontal stroke extending to the right.

David Baumeister
Project Manager

Enclosures



OnSite Environmental, Inc. 14648 NE 95th Street, Redmond, WA 98052 (425) 883-3881

This report pertains to the samples analyzed in accordance with the chain of custody,
and is intended only for the use of the individual or company to whom it is addressed.

Date of Report: February 14, 2019
Samples Submitted: February 6, 2019
Laboratory Reference: 1902-037
Project: 504-095-04

Case Narrative

Samples were collected on February 6, 2019 and received by the laboratory on February 6, 2019. They were maintained at the laboratory at a temperature of 2°C to 6°C.

Please note that any and all soil sample results are reported on a dry-weight basis, unless otherwise noted below.

General QA/QC issues associated with the analytical data enclosed in this laboratory report will be indicated with a reference to a comment or explanation on the Data Qualifier page. More complex and involved QA/QC issues will be discussed in detail below.



Date of Report: February 14, 2019
Samples Submitted: February 6, 2019
Laboratory Reference: 1902-037
Project: 504-095-04

ANALYTICAL REPORT FOR SAMPLES

Client ID	Laboratory ID	Matrix	Date Sampled	Date Received	Notes
MW6s-190206	02-037-01	Water	2-6-19	2-6-19	
MW4sR-190206	02-037-02	Water	2-6-19	2-6-19	
MW7s-190206	02-037-03	Water	2-6-19	2-6-19	
MW8s-190206	02-037-04	Water	2-6-19	2-6-19	
DUP-1-190206	02-037-05	Water	2-6-19	2-6-19	



Date of Report: February 14, 2019
 Samples Submitted: February 6, 2019
 Laboratory Reference: 1902-037
 Project: 504-095-04

**HEXAVALENT CHROMIUM
 SM 3500-Cr B**

Matrix: Water
 Units: ug/L

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	MW6s-190206					
Laboratory ID:	02-037-01					
Hexavalent Chromium	ND	10	SM 3500-Cr B	2-7-19	2-7-19	
Client ID:	MW4sR-190206					
Laboratory ID:	02-037-02					
Hexavalent Chromium	12	10	SM 3500-Cr B	2-7-19	2-7-19	
Client ID:	MW7s-190206					
Laboratory ID:	02-037-03					
Hexavalent Chromium	ND	10	SM 3500-Cr B	2-7-19	2-7-19	
Client ID:	MW8s-190206					
Laboratory ID:	02-037-04					
Hexavalent Chromium	31	10	SM 3500-Cr B	2-7-19	2-7-19	
Client ID:	DUP-1-190206					
Laboratory ID:	02-037-05					
Hexavalent Chromium	32	10	SM 3500-Cr B	2-7-19	2-7-19	



Date of Report: February 14, 2019
 Samples Submitted: February 6, 2019
 Laboratory Reference: 1902-037
 Project: 504-095-04

**TOTAL METALS
 EPA 200.8**

Matrix: Water
 Units: ug/L (ppb)

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	MW6s-190206					
Laboratory ID:	02-037-01					
Chromium	8.1	1.1	EPA 200.8	2-13-19	2-13-19	
Nickel	12	8.9	EPA 200.8	2-13-19	2-13-19	

Client ID:	MW4sR-190206					
Laboratory ID:	02-037-02					
Chromium	15	1.1	EPA 200.8	2-13-19	2-13-19	
Nickel	2600	220	EPA 200.8	2-13-19	2-13-19	

Client ID:	MW7s-190206					
Laboratory ID:	02-037-03					
Chromium	2.1	1.1	EPA 200.8	2-13-19	2-13-19	
Nickel	ND	8.9	EPA 200.8	2-13-19	2-13-19	

Client ID:	MW8s-190206					
Laboratory ID:	02-037-04					
Chromium	32	1.1	EPA 200.8	2-13-19	2-13-19	
Nickel	13000	890	EPA 200.8	2-13-19	2-13-19	

Client ID:	DUP-1-190206					
Laboratory ID:	02-037-05					
Chromium	32	1.1	EPA 200.8	2-13-19	2-13-19	
Nickel	14000	890	EPA 200.8	2-13-19	2-13-19	



Date of Report: February 14, 2019
 Samples Submitted: February 6, 2019
 Laboratory Reference: 1902-037
 Project: 504-095-04

**DISSOLVED METALS
 EPA 200.8**

Matrix: Water
 Units: ug/L (ppb)

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	MW6s-190206					
Laboratory ID:	02-037-01					
Chromium	ND	1.0	EPA 200.8		2-12-19	
Nickel	ND	8.0	EPA 200.8		2-12-19	

Client ID:	MW4sR-190206					
Laboratory ID:	02-037-02					
Chromium	11	1.0	EPA 200.8		2-12-19	
Nickel	2700	200	EPA 200.8		2-13-19	

Client ID:	MW7s-190206					
Laboratory ID:	02-037-03					
Chromium	ND	1.0	EPA 200.8		2-12-19	
Nickel	ND	8.0	EPA 200.8		2-12-19	

Client ID:	MW8s-190206					
Laboratory ID:	02-037-04					
Chromium	27	1.0	EPA 200.8		2-12-19	
Nickel	13000	800	EPA 200.8		2-13-19	

Client ID:	DUP-1-190206					
Laboratory ID:	02-037-05					
Chromium	28	1.0	EPA 200.8		2-12-19	
Nickel	13000	800	EPA 200.8		2-13-19	



Date of Report: February 14, 2019
 Samples Submitted: February 6, 2019
 Laboratory Reference: 1902-037
 Project: 504-095-04

**HEXAVALENT CHROMIUM
 SM 3500-Cr B
 QUALITY CONTROL**

Matrix: Water
 Units: ug/L

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
METHOD BLANK						
Laboratory ID:	MB0207W1					
Hexavalent Chromium	ND	10	SM 3500-Cr B	2-7-19	2-7-19	

Analyte	Result	Spike Level	Source Result	Percent Recovery	Recovery Limits	RPD	RPD Limit	Flags
DUPLICATE								
Laboratory ID:	02-037-02							
	ORIG	DUP						
Hexavalent Chromium	12.3	13.0	NA	NA	NA	NA	6	20

MATRIX SPIKES

Laboratory ID:	02-037-02									
	MS	MSD	MS	MSD	MS	MSD				
Hexavalent Chromium	117	111	100	100	12.3	105	99	75-125	5	20

SPIKE BLANK

Laboratory ID:	SB0207W1									
	SB		SB		SB					
Hexavalent Chromium	99.9		100		NA	100		85-115	NA	NA



Date of Report: February 14, 2019
 Samples Submitted: February 6, 2019
 Laboratory Reference: 1902-037
 Project: 504-095-04

**TOTAL METALS
 EPA 200.8
 QUALITY CONTROL**

Matrix: Water
 Units: ug/L (ppb)

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
METHOD BLANK						
Laboratory ID:	MB0213WM1					
Chromium	ND	1.1	EPA 200.8	2-13-19	2-13-19	
Nickel	ND	8.9	EPA 200.8	2-13-19	2-13-19	

Analyte	Result		Spike Level		Source Result	Percent Recovery	Recovery Limits	RPD	RPD Limit	Flags
DUPLICATE										
Laboratory ID:	02-005-08									
	ORIG	DUP								
Chromium	ND	ND	NA	NA		NA	NA	NA	20	
Nickel	ND	ND	NA	NA		NA	NA	NA	20	

MATRIX SPIKES

Laboratory ID:	02-005-08									
	MS	MSD	MS	MSD		MS	MSD			
Chromium	272	257	111	111	ND	245	232	75-125	5	20
Nickel	271	258	111	111	ND	244	233	75-125	5	20



Date of Report: February 14, 2019
 Samples Submitted: February 6, 2019
 Laboratory Reference: 1902-037
 Project: 504-095-04

**DISSOLVED METALS
 EPA 200.8
 QUALITY CONTROL**

Matrix: Water
 Units: ug/L (ppb)

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
METHOD BLANK						
Laboratory ID:	MB0212D1					
Chromium	ND	1.0	EPA 200.8		2-12-19	
Nickel	ND	8.0	EPA 200.8		2-12-19	

Analyte	Result	Spike Level	Source Result	Percent Recovery	Recovery Limits	RPD	RPD Limit	Flags
DUPLICATE								
Laboratory ID:	02-044-05							
	ORIG	DUP						
Chromium	ND	ND	NA	NA	NA	NA	20	
Nickel	ND	ND	NA	NA	NA	NA	20	

MATRIX SPIKES

Laboratory ID:	02-044-05									
	MS	MSD	MS	MSD		MS	MSD			
Chromium	183	183	200	200	ND	91	92	75-125	0	20
Nickel	183	179	200	200	ND	92	89	75-125	2	20





Data Qualifiers and Abbreviations

- A - Due to a high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.
 - B - The analyte indicated was also found in the blank sample.
 - C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.
 - E - The value reported exceeds the quantitation range and is an estimate.
 - F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.
 - H - The analyte indicated is a common laboratory solvent and may have been introduced during sample preparation, and be impacting the sample result.
 - I - Compound recovery is outside of the control limits.
 - J - The value reported was below the practical quantitation limit. The value is an estimate.
 - K - Sample duplicate RPD is outside control limits due to sample inhomogeneity. The sample was re-extracted and re-analyzed with similar results.
 - L - The RPD is outside of the control limits.
 - M - Hydrocarbons in the gasoline range are impacting the diesel range result.
 - M1 - Hydrocarbons in the gasoline range (toluene-naphthalene) are present in the sample.
 - N - Hydrocarbons in the lube oil range are impacting the diesel range result.
 - N1 - Hydrocarbons in diesel range are impacting lube oil range results.
 - O - Hydrocarbons indicative of heavier fuels are present in the sample and are impacting the gasoline result.
 - P - The RPD of the detected concentrations between the two columns is greater than 40.
 - Q - Surrogate recovery is outside of the control limits.
 - S - Surrogate recovery data is not available due to the necessary dilution of the sample.
 - T - The sample chromatogram is not similar to a typical _____.
 - U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
 - U1 - The practical quantitation limit is elevated due to interferences present in the sample.
 - V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.
 - W - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.
 - X - Sample extract treated with a mercury cleanup procedure.
 - X1 - Sample extract treated with a sulfuric acid/silica gel cleanup procedure.
 - Y - The calibration verification for this analyte exceeded the 20% drift specified in method 8260C, and therefore the reported result should be considered an estimate. The overall performance of the calibration verification standard met the acceptance criteria of the method.
 - Z -
- ND - Not Detected at PQL
 PQL - Practical Quantitation Limit
 RPD - Relative Percent Difference





Mn OnSite Environmental Inc.

Analytical Laboratory Testing Services
14648 NE 95th Street • Redmond, WA 98052
Phone: (425) 883-3881 • www.onsite-env.com

Chain of Custody

Turnaround Request (in working days)

(Check One)

- Same Day 1 Day
- 2 Days 3 Days
- Standard (7 Days)
- _____ (other)

Laboratory Number: 02-037

Company: GET
 Project Number: 504-095-01
 Project Name: ARADON PARTS
 Project Manager: ARON WILSON
 Sampled by: EWK/RC

Lab ID 1 Sample Identification MW465-190206 Date Sampled 2/6/19 Time Sampled 1100 Matrix W Number of Containers 3

2 MW45R-190206 1320 W 3
3 MW75-190206 1415 W 3
4 MW85-190206 1605 W 3
5 DUP-1-190206 2/6/19 2000 W 3

NWTPH-HCID	
NWTPH-Gx/BTEX	
NWTPH-Gx	
NWTPH-Dx (<input type="checkbox"/> Acid / SG Clean-up)	
Volatiles 8260C	
Halogenated Volatiles 8260C	
EDB EPA 8011 (Waters Only)	
Semivolatiles 8270D/SIM (with low-level PAHs)	
PAHs 8270D/SIM (low-level)	
PCBs 8082A	
Organochlorine Pesticides 8081B	
Organophosphorus Pesticides 8270D/SIM	
Chlorinated Acid Herbicides 8151A	
Total RCRA Metals	
Total MTCA Metals	
TCLP Metals	
HEM (oil and grease) 1664A	
<u>HEX CHROMIUM</u>	
<u>TOTAL Ni</u>	
<u>DISSOLVED Ni</u>	
<u>TOTAL Cr</u>	
<u>DISSOLVED Cr</u>	
% Moisture	

Signature	Company	Date	Time	Comments/Special Instructions
	<u>GET</u>	<u>2/6/19</u>	<u>1800</u>	
	<u>OSRE</u>	<u>2/6/19</u>	<u>1800</u>	
Relinquished				
Received				
Relinquished				
Received				
Relinquished				
Received				
Relinquished				
Received				
Reviewed/Date	Reviewed/Date			

Data Package: Standard Level III Level IV
 Chromatograms with final report Electronic Data Deliverables (EDDs)

ATTACHMENT 3
Data Validation Report

Project: WA State Department of Ecology – Aladdin Plating 2019 Post-Construction Groundwater Monitoring

GEI File No: 0504-095-04

Date: March 25, 2019

This report documents the results of a United States Environmental Protection Agency (USEPA) defined Stage 2A data validation (USEPA Document 540-R-08-005; USEPA 2009) of the analytical data for groundwater samples collected as part of the 2019 monitoring event and the associated laboratory and field quality control (QC) samples. The samples were obtained from the Aladdin Plating Site located at 1657 Center Street in Tacoma, Washington.

Objective and Quality Control Elements

GeoEngineers, Inc. (GeoEngineers) completed the data validation consistent with the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review (USEPA 2017) (National Functional Guidelines) to determine if the laboratory analytical results meet the project objectives and are usable for their intended purpose. Data usability was assessed by determining if:

- The samples were analyzed using well-defined and acceptable methods that provide reporting limits below applicable regulatory criteria;
- The precision and accuracy of the data are well-defined and sufficient to provide defensible data; and
- The quality assurance/quality control (QA/QC) procedures utilized by the laboratory meet acceptable industry practices and standards.

In accordance with the Soil and Groundwater Sampling and Analysis Plan (GeoEngineers 2014), the data validation included review of the following QC elements:

- Data Package Completeness
- Chain-of-Custody Documentation
- Holding Times and Sample Preservation
- Method Blanks
- Matrix Spikes/Matrix Spike Duplicates
- Laboratory Control Samples
- Laboratory/Field Duplicates

Validated Sample Delivery Groups

This data validation included review of the sample delivery group (SDG) listed below in Table 1.

TABLE 1. SUMMARY OF VALIDATED SAMPLE DELIVERY GROUPS

Laboratory SDG	Samples Validated
1902-037	MW4sR-190206, MW6s-190206, MW7s-190206, MW8s-190206, DUP-1-190206

Chemical Analysis Performed

OnSite Environmental, Inc. (OnSite), located in Redmond, Washington, performed laboratory analysis on the samples using the following methods:

- Total and Dissolved Metals by Method EPA200.8; and
- Hexavalent Chromium by Method SM3500-Cr B

Data Validation Summary

The results for each of the QC elements are summarized below.

Data Package Completeness

OnSite provided the required deliverables for the data validation according to the National Functional Guidelines. The laboratory followed adequate corrective action processes and the identified anomalies were discussed in the relevant laboratory case narrative.

Chain-of-Custody Documentation

Chain-of-custody (COC) forms were provided with the laboratory analytical reports. The COCs were accurate and complete when submitted to the laboratory, with the following exception:

SDG 1902-037: The laboratory noted that Sample DUP-1-190206 was not listed on the COC. The sample was added to the COC by the laboratory.

Holding Times and Sample Preservation

The sample holding time is defined as the time that elapses between sample collection and sample analysis. Maximum holding time criteria exist for each analysis to help ensure that the analyte concentrations found at the time of analysis reflect the concentration present at the time of sample collection. Established holding times were met for each analysis. The sample cooler arrived at the laboratory at the appropriate temperatures of between two and six degrees Celsius.

Method Blanks

Method blanks are analyzed to ensure that laboratory procedures and reagents do not introduce measurable concentrations of the analytes of interest. A method blank was analyzed with each batch of samples, at a frequency of 1 per 20 samples. For the sample batches, method blanks for the applicable methods were analyzed at the required frequency. None of the analytes of interest were detected above the reporting limits in the method blanks.

Matrix Spikes/Matrix Spike Duplicates

Since the actual analyte concentration in an environmental sample is not known, the accuracy of a particular analysis is usually inferred by performing a matrix spike (MS) analysis on one sample from the

associated batch, known as the parent sample. One aliquot of the sample is analyzed in the normal manner and then a second aliquot of the sample is spiked with a known amount of analyte concentration and analyzed. From these analyses, a percent recovery is calculated. Matrix spike duplicate (MSD) analyses are generally performed for analyses as a precision check and analyzed in the same sequence as a matrix spike. Using the result values from the MS and MSD, the relative percent difference (RPD) is calculated. The percent recovery control limits for MS and MSD analyses are specified in the laboratory documents, as are the RPD control limits for MS/MSD sample sets.

One MS/MSD analysis should be performed for every analytical batch or every 20 field samples, whichever is more frequent. The frequency requirements were met for all analyses and the percent recovery and RPD values were within the proper control limits.

Laboratory Control Samples

A laboratory control sample (LCS) is a blank sample that is spiked with a known amount of analyte and then analyzed. An LCS is similar to an MS, but without the possibility of matrix interference. Given that matrix interference is not an issue, the LCS control limits for accuracy are usually more rigorous than for MS analyses. Additionally, data qualification based on LCS analyses would apply to all samples in the associated batch, instead of just the parent sample. The percent recovery control limits are specified in the laboratory documents.

One LCS analysis should be performed for every analytical batch or every 20 field samples, whichever is more frequent. The frequency requirements were met for all analyses and the percent recovery values were within the proper control limits.

Laboratory Duplicates

Internal laboratory duplicate analyses are performed to monitor the precision of the analyses. Two separate aliquots of a sample are analyzed as distinct samples in the laboratory and the RPD between the two results is calculated. Duplicate analyses should be performed once per analytical batch. If one or more of the samples used has a concentration less than five times the reporting limit for that sample, the absolute difference is used instead of the RPD. The RPD control limits are specified in the laboratory documents. Laboratory duplicates were analyzed at the proper frequency and the specified acceptance criteria were met.

Field Duplicates

In order to assess precision, field duplicate samples are collected and analyzed along with the reviewed sample batches. The duplicate samples are analyzed for the same parameters as the associated parent samples. Precision is determined by calculating the RPD between each pair of samples. If one or more of the sample analytes has a concentration less than five times the reporting limit for that sample, then the absolute difference is used instead of the RPD. The RPD control for water is 35 percent.

SDG 1902-037: One field duplicate sample pair, MW8s-190206 and DUP-1-190206, was submitted with this SDG. The precision criteria for the target analytes were met for this sample pair.

Overall Assessment

As was determined by this data validation, the laboratory followed the specified analytical methods. Accuracy was acceptable, as demonstrated by the LCS and MS/MSD percent recovery values. Precision was acceptable, as demonstrated by the MS/MSD and laboratory/field duplicate RPD values.

No analytical results were qualified. The data are acceptable for the intended use.

References

U.S. Environmental Protection Agency (USEPA). "Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use," EPA-540-R-08-005. January 2009.

U.S. Environmental Protection Agency (USEPA). "Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Methods Data Review," EPA-540-R-2017-001. January 2017.

GeoEngineers, Inc., "Soil and Groundwater Sampling and Analysis Plan", prepared for Washington State Department of Ecology. March 6, 2014.