Remedial Design Investigation Work Plan
Beckwith & Kuffel, Inc. Site
1313 South 96th Street
Seattle, Washington

April 21, 2022

Prepared for

Beckwith & Kuffel
Seattle, Washington

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1313 South 96th Street
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TABLE OF CONTENTS

FIGURES

TABLE

APPENDIX

LIST OF ABBREVIATIONS AND ACRONYMS

B&K ..... Beckwith & Kuffel, Inc.
bgs ..... below ground surface
cDCE cis-1,2-dichloroethene
CLARC ..... Cleanup Levels and Risk Calculation
cVOC ..... chlorinated volatile organic compound
Ecology ..... Washington State Department of Ecology
EPA ..... US Environmental Protection Agency
ESA ..... environmental site assessment
Eurofins ..... Eurofins Air Toxics, LLC
FMH ..... FMH Material Handling Solutions
ft ..... feet/foot (unit)
HASP ..... Health and Safety Plan
Landau ..... Landau Associates, Inc.
lbs ..... pounds (unit)
µg/L ..... micrograms per liter (unit)
µg/m^3 ..... micrograms per cubic meter (unit)
MW ..... monitoring well
Sea Mar ..... Sea Mar Community Health Centers
WB ..... Wooldridge Boats
Shannon & Wilson ..... Shannon & Wilson, Inc.
SIM ..... selected ion monitoring
Site ..... B&K property
TCE ..... trichloroethene
TWA ..... time-weighted average
VC ..... vinyl chloride

1.0 INTRODUCTION

At the request of Beckwith & Kuffel, Inc. (B&K), Landau Associates, Inc. (Landau) prepared this work plan for remedial design investigation activities to be conducted at the B&K property located at 1313 South 96th Street in Seattle, Washington (Site; Figure 1) and the adjoining Wooldridge Boats (WB) and Sea Mar Community Health Center (Sea Mar) properties. Remedial design investigation activities will refine the extent of chlorinated volatile organic compound (cVOC) contamination in Site groundwater targeted for treatment and evaluate soil vapor intrusion to occupied buildings. The cVOC groundwater contamination also extends on to the western portion of the Sea Mar property, as shown on Figure 2. Data collected will inform the design of additional remedial action. Activities will be conducted as part of the Washington State Department of Ecology (Ecology) Voluntary Cleanup Program (VCP). The Site VCP project number is NW3119.

This work plan describes a groundwater and vapor intrusion investigation. Further refinement of the extent of current groundwater contamination is needed to design an additional direct-push injection of bioremediation reagents. More confidence in the extent of the high contaminant concentration areas within the existing network of monitoring wells and prior borings will prevent reagent from being wasted in areas where treatment is not necessary. Monitoring well data indicate that groundwater contamination extends beneath the regularly-occupied industrial building on the WB property and is adjacent to the B&K industrial building. At Ecology's request, this investigation will include the collection of soil gas from beneath the buildings and compare results to soil gas screening levels protective of indoor air. If soil gas results exceed screening levels, indoor air samples will also be collected. Activities described in this work plan will be conducted in accordance with the procedures set forth in the revised Site Health and Safety Plan (HASP), provided in Appendix A.

1.1 Site Background

Prior to purchase of the Site in 2013, B&K contracted with Shannon & Wilson, Inc. (Shannon & Wilson) to complete a Phase I environmental site assessment (ESA) to identify potential environmental liabilities associated with the Site (Shannon & Wilson 2012). Based on research conducted for the Phase I ESA, the Site appears to have consisted of undeveloped land prior to 1977 and then of forklift maintenance companies (Clarklift of Washington and later FMH Material Handling Solutions [FMH]). In 2010, Industrial Materials Handling, which had previously purchased FMH, vacated the Site. The Site was vacant until B&K purchased it in 2013. B&K sells, distributes, and maintains pumps, blowers, and compressors.

Sampling conducted during Phase II ESA activities indicated that cVOCs including trichloroethene (TCE), cis-1,2-dichloroethene (cDCE), and vinyl chloride (VC) were present in groundwater at the southeast end of the Site in the vicinity of an old concrete wash pad with a severely cracked surface (Shannon & Wilson 2014). Based on the sampling results and the Site's prior use, it was assumed that the source of the cVOC contamination was TCE degreasing solvents used by the former Site occupants

to clean forklift parts at the wash pad; cDCE and VC are biodegradation breakdown products of TCE. Subsequently, evidence of historical use of TCE on the Wooldridge property by former owner Exotic Metals provides an additional release scenario for the observed TCE in groundwater. An arbitrated settlement was reached in early 2022 between current and prior owners/operators of the B&K and WB properties, creating a fund for remediation.

1.2 Previous Remedial Activities

In November 2013, Shannon & Wilson conducted an interim remedial action to remove the wash pad and excavate the underlying contaminated soil. The excavation extended to approximately 18 feet (ft) below ground surface (bgs) within the approximate extents shown on Figure 2. The northern half of the excavation was backfilled with pea gravel and the southern half with sand and gravel fill. Approximately 1,100 pounds (lbs) of Regenesis' 3D Microemulsion® electron donor product was added to the excavation during backfilling to stimulate biodegradation of the cVOCs in groundwater at the Site post-excavation (Shannon & Wilson 2014). This quantity of electron donor substrate (less than 150 gallons) was quite limited relative to the size of the excavation and remaining cVOC concentrations. Groundwater monitoring following the remedial excavation activities indicated a temporary reduction in cVOC concentrations in the immediate vicinity of the remedial excavation, followed by concentration rebound approximately 9 months after completion.

Landau conducted a bioremediation injection in 2018 to further enhance biodegradation of cVOCs in the vicinity of the wash pad excavation in general accordance with the work plan (Landau 2017). Approximately 480 gallons (4,400 lbs) of the electron donor substrate LactOil™ was injected on January 25, 2018 to existing monitoring well MW-7, located within the backfilled excavation. The injection was challenging due to short-circuiting of injection fluid into a broken underground storm drain line on the adjacent property; fluid was intercepted at the downstream manhole and discharged to the sanitary sewer. Although infiltration to the storm drain interfered with the desired distribution of electron donor areas, subsequent results indicate some treatment benefits of this injection, as described in the March 2021 progress report (Landau 2021). Results from 2021, shown with prior results on Figure 2, show significant decreases in TCE concentrations at injection well MW-7 and at downgradient wells MW-9 and SM-MW-21. Increases in the concentrations of degradation products cDCE and VC at these downgradient wells provided further evidence of biodegradation resulting from the 2018 injection.

In August 2019, Landau conducted tap water injection testing at WB wells MW-11 and MW-12 to evaluate the feasibility of injecting donor substrates in the area of highest TCE concentrations. During the test, injection rates were low and water "daylighted" at the ground surface near the test injection wells after a relatively small volume was injected. These results confirmed that injections of liquid donor substrate were infeasible due to the high silt and clay content of the contaminated water-bearing zone targeted for treatment, leading to the slurry injection approach described in the enhanced biotic and abiotic trichloroethene degradation work plan (EHC work plan; Landau 2020).

In October 2020, Landau conducted a direct-push injection of slurry substrate in accordance with the EHC work plan (Landau 2020). The substrate, EHC, is a powdered material composed of zero valent iron and fermentable organic materials used for stimulation of both biotic and abiotic degradation of TCE and its breakdown products. Approximately 13,400 lbs of EHC and 250 gallons of LactOil were injected to 36 locations in a 32-ft by 40-ft area at the Site (Figure 2). An average of 24 lbs of EHC slurry with water and LactOil were emplaced per vertical foot. Injection pressures were approximately 50 lbs per square inch. Challenges with surfacing of injected slurry and slow dissipation of back pressure were encountered due to the low-permeability soil within the treatment area. To address this challenge, the downhole tooling was capped and left in place overnight, if needed, after completing injection at a location; tooling was removed after the pressure subsided. An area of asphalt pavement that mounded during injection dissipated in a few weeks with no pavement damage.

1.3 Known Extent of Contamination

The results of prior data collection characterized the nature and maximum extent of cVOC contamination prior to bioremediation. A contiguous plume of TCE and breakdown products cDCE and VC occurs in the southeast corner of the B&K Site, the northeast corner of the WB property, and just over the Sea Mar property boundary (Figure 2). Previous depth-discrete sampling results indicated that the cVOC contamination in groundwater was generally limited to the uppermost 20 ft of an interbedded sand/silt/clay unit that underlies fill material at the Site.

Previous investigations determined that the highest concentrations of TCE existed off Site at the WB property. The highest concentrations of TCE (1,100 micrograms per liter [µg/L]) were detected at direct-push boring LB-10 and MW-11, located just south of the B&K Site boundary and the former wash pad. TCE was also detected above the 5 µg/L maximum contaminant level for drinking water at three other direct-push borings (LB-15, LB-16, and LB-18) and at well MW-12 on the WB property. An isoconcentration contour map of the extent of cVOC contamination at the Site and nearby properties, based on groundwater data from 2017 through March 2021, is presented on Figure 3. TCE contamination extends beneath the northeast corner of the WB building, but is bounded to the north, east, and west by borings and a well where TCE was not detected.

However, comparable concentrations of TCE were historically detected on the B&K property to both to the north (MW-5) and south (MW-11) of the former wash pad. Prior to the 2013 wash-pad excavation, the highest concentration of TCE in groundwater (1,320 µg/L) was detected in former monitoring well MW-5, within the footprint of the excavation. The current and historical distribution of TCE in groundwater is consistent with TCE release(s) that could have occurred at either the WB or B&K properties, or at both properties.

2.0 REMEDIAL DESIGN GROUNDWATER INVESTIGATION

The objective of additional groundwater investigation is to refine the extent of treatment areas for additional direct-push injection of EHC reagent in the vicinity of monitoring wells MW-8 and MW-12. Field investigation activities will involve the collection of depth-discrete groundwater samples within the confines of monitoring wells and prior borings. Results will be evaluated alongside the most recent performance monitoring results at existing Site monitoring wells.

Groundwater samples will be collected from eight borings advanced by a driller licensed in the State of Washington using a direct-push drill rig. Four borings will be located in the vicinity of MW-8 on the B&K and Sea Mar properties, and four borings will be located in the vicinity of MW-12 on the WB property. Approximate boring locations are shown on Figure 2. Final locations of borings will be determined following both public and private utility locates and evaluation of site access limitations.

Borings will be advanced to a maximum depth of 15 ft bgs; this depth was selected based on the results of previous investigations. Once the drill tooling reaches the desired depth, groundwater samples will be collected using a groundwater sampler consisting of a 4-ft-long, wire-wrapped, stainless-steel screen (0.010-inch slot size) with a retractable protective sheath. At depth, the sheath will be retracted to expose the stainless-steel screen to the formation. Based on field conditions, temporary well points may, instead, be constructed with polyvinyl chloride (PVC) screens in the boreholes and used for sample collection; temporary well points will be removed and decommissioned after sampling. Regardless of sampler type, borings will be decommissioned following sampling according to the Minimum Standards for Construction and Maintenance of Wells (Washington Administrative Code 173-160-460).

Low-flow sampling techniques will be used to collect groundwater samples from the temporary monitoring wells. In general, the procedure is as follows:

1. Measure depth to water from the ground surface.
2. Purge well using a peristaltic pump and dedicated sample collection tubing. Wells will be purged at less than 0.5 liters per minute. Purging will continue until field parameters reach stabilization or for 20 minutes, whichever is shortest.[1]
3. Collect samples and measure field parameters after field parameters stabilize. Field parameters will be recorded during purging and immediately before sampling. Field

[1] A time limit of 20 minutes will be set for monitoring field parameters during purging prior to sampling groundwater from temporary wells. Purging is typically considered to be complete when all field parameters become stable for three successive readings. This can take longer for grab samples, as the temporary well is not developed using traditional methods and the groundwater in the boring is not at equilibrium with the surrounding aquifer material. Per the US Environmental Protection Agency (EPA) groundwater sampling procedure (EPA 2017), "the longer a temporary well is in place and not sampled, the more stagnant the water column becomes and the more appropriate it becomes to apply standard permanent monitoring well purging criteria to achieve representative aquifer conditions in the sample." The sample will no longer be considered a grab sample if purging continues for too long in a temporary well.

parameters will include temperature, conductivity, pH, dissolved oxygen, and oxidation-reduction potential. Any significant problems or observations will also be recorded.

4. Store samples on ice until they are delivered to the laboratory or picked up by the laboratory.

Groundwater samples will be analyzed at Analytical Resources, Inc. in Tukwila, Washington for TCE, cDCE, and VC by EPA Method SW-846 8260D, as summarized in Table 1. Analysis will be on a standard 2-week turnaround time.

Non-dedicated sampling equipment (i.e., equipment used at multiple locations during sampling) will be decontaminated between sampling locations according to the procedures provided in the revised HASP (Appendix A). Groundwater collected in buckets during the purging and sampling process will be transferred to a designated 55-gallon drum and stored at the Site for disposal at an appropriate facility.

3.0 VAPOR INTRUSION INVESTIGATION

The objective of the vapor intrusion investigation is to determine if vapor intrusion of cVOCs is occurring from contaminated groundwater to indoor air. Field investigation activities will involve the installation of semi-permanent sampling ports (Vapor Pins®) through the building slab for collection of sub-slab soil gas samples from beneath the B&K and WB buildings. Soil gas results will be compared to screening levels protective of indoor air. If soil gas results exceed applicable screening levels, contingent indoor air samples will be collected. If indoor air results exceed applicable screening levels, resampling and mitigation measures may be recommended. Soil gas and indoor air screening levels are based on an industrial setting.

3.1 Screening Levels

Screening levels for the vapor intrusion investigation were developed for the B&K and WB buildings using the *Guidance for Evaluating Vapor Intrusion in Washington State: Investigation and Remedial Action* (Ecology 2022) and Ecology's Cleanup Levels and Risk Calculation (CLARC) data tables (Ecology 2021). Based on current Site use and property zoning, the Site is considered an industrial property and meets the requirements for use of Method C screening levels (King County; accessed April 7, 2022).

Screening levels are available in CLARC for TCE and VC, as shown below in Table A. If cancer and non-cancer values were available, the lower of the two screening levels was selected. Soil gas screening levels are higher than indoor air screening levels due to application of Ecology's slab attenuation factor.

Table A: Summary of Soil Gas and Indoor Air Screening Levels for B&K and WB Buildings

Contaminant	Screening Level	Value	Units
Trichloroethene	Sub-slab soil gas	67	µg/m^3
	Indoor air	2.0	µg/m^3
Vinyl Chloride	Sub-slab soil gas	95	µg/m^3
	Indoor air	2.8	µg/m^3

µg/m^3 = micrograms per cubic meter

3.2 Sub-Slab Soil Gas Sampling

Sub-slab soil gas sampling will be conducted at three locations (BK-VP1 through BK-VP3) in the B&K building and at three locations (WB-VP1 through WB-VP3) in the WB building. Vapor Pins will be located in the southeast corner of the B&K building nearest MW-8 and in the northeast corner of the WB building around MW-12; accessible locations will be determined in consultation with the building owners.

Semi-permanent sub-slab soil gas sampling ports (Vapor Pins) will be installed in each location and sampled per EPA operating procedures for soil gas sampling (EPA 2020). Once installed, sampling ports will be left overnight, and no less than 8 hours, before sampling to ensure a solid seal and re-equilibration of soil gas beneath the slab. Grab samples will be collected in 6-liter, laboratory-provided Summa canisters for analysis for TCE, cDCE, and VC by EPA Method TO-15 at Eurofins Air Toxics, LLC in Folsom, California (Eurofins). Estimated reporting limits for Method TO-15 are shown in Table B below (Tran 2021).

Table B: Estimated Reporting Limits for EPA Method TO-15

Analyte	Reporting Limit	Units
Trichloroethene	4	µg/m^3
cis-1,2-Dichloroethene	3	µg/m^3
Vinyl Chloride	1.9	µg/m^3

µg/m^3 = micrograms per cubic meter

3.3 Contingent Indoor Air Sampling

Contingent indoor air sampling and installation of additional soil gas Vapor Pins may be triggered if TCE or VC sub-slab soil gas concentrations exceed their respective screening levels. Indoor air samples would be collected from near the locations where soil gas samples exceeding screening levels were collected.

Prior to initiating any indoor air sampling, Landau will discuss the soil gas sampling results with both B&K and Ecology. If this contingency sampling is needed, it will consist of a follow-up Site mobilization during which up to two indoor air samples will be collected in each of the two buildings and one ambient air sample will be collected on the upwind side of each building to measure any background contributions to indoor air.

If needed, the indoor air and ambient samples will be collected as 8-hour time-weighted average (TWA) samples using 6-liter, laboratory-provided Summa canisters fitted with calibrated mass flow controllers needed for collection of the 8-hour TWA samples. Teflon® tubing will be connected to the indoor air sample canister inlet valves and fixed with the opening approximately 5 ft above the floor to sample air in the breathing space. Canisters will be clearly labeled with signs indicating that the canisters are not to be interfered with or moved. The Summa canisters will be used to collect a sample over an 8-hour period representative of normal building use and operations. Collection of the indoor and ambient air samples will be started one right after the other with the 8-hour sample periods running concurrently. The samples will be analyzed for TCE, cDCE, and VC by EPA Method TO-15 with selected ion monitoring (SIM) at Eurofins to obtain lower reporting limits for comparison to indoor air screening levels. Indoor air screening levels are shown in Table A above.

After collection of the 8-hour TWA samples indoors, collection of the ambient air sample, and removal of those sample canisters, the soil gas Vapor Pins that triggered the indoor air sampling will be resampled on the same day, or the following day, for comparison to indoor air results. All soil gas grab samples will be collected in 6-liter, laboratory-provided Summa canisters for analysis for TCE, cDCE, and VC by EPA Method TO-15 at Eurofins.

Estimated reporting limits for EPA Method TO-15 are shown in Table B above. Estimated reporting limits for EPA Method TO-15 SIM are shown in Table C below (Tran 2021).

Table C: Estimated Reporting Limits for EPA Method TO-15 SIM

Analyte	Reporting Limit	Units
Trichloroethene	0.16	µg/m^3
cis-1,2-Dichloroethene	0.12	µg/m^3
Vinyl Chloride	0.038	µg/m^3

µg/m^3 = micrograms per cubic meter

In the event that concentrations of TWA indoor air samples exceed screening levels, a longer 2-week sampling period using Radiello passive sorbent samplers may be recommended.

4.0 PROPOSED SCHEDULE

The remedial design investigation is scheduled to begin in May 2022. Field activities, data validation, and discussion of results are anticipated to be completed in May; contingency sampling is anticipated in June, if required. The proposed schedule is provided in detail in the table below. This schedule assumes that this work plan is approved by Ecology no later than April 30, 2022.

Task	Date
Private utility locates; select final groundwater sampling locations	May 2, 2022
Concrete coring and Vapor Pin installation	May 3, 2022
Groundwater sampling	May 4-5, 2022
Soil gas sampling	May 6, 2022
Provide data to Ecology, discuss results	May 27, 2022
Contingent indoor air sampling (if required)	June 6-7, 2022

5.0 USE OF THIS DOCUMENT

This work plan has been prepared for the exclusive use of Beckwith & Kuffel, Inc. and applicable regulatory agencies for specific application to the Beckwith & Kuffel, Inc. Site in Seattle, Washington. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau, shall be at the user's sole risk. Landau warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. Landau makes no other warranty, either express or implied.

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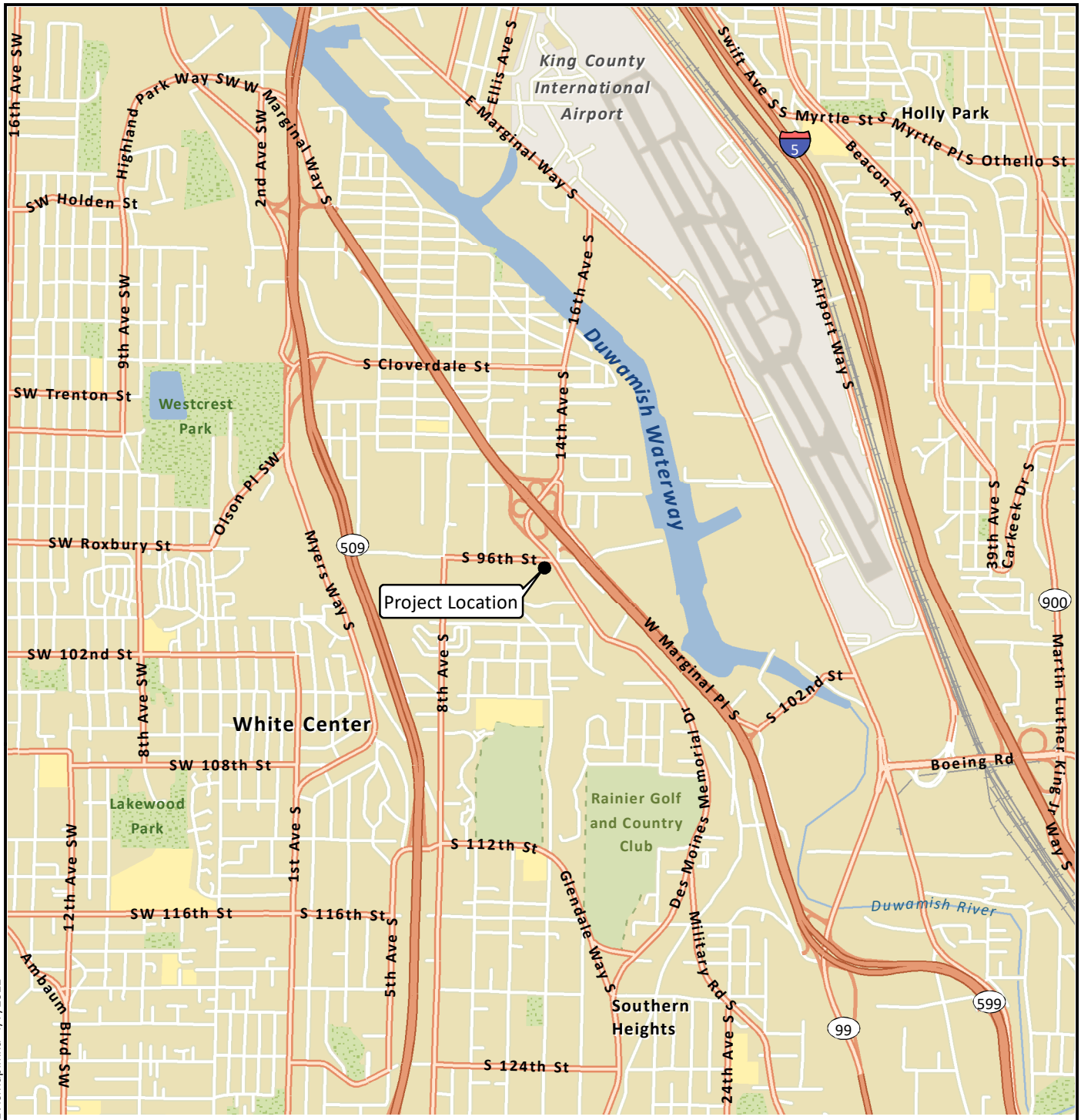

Data Source: Esri 2012

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Beckwith & Kuffel, Inc. Seattle, Washington	**Vicinity Map**	Figure 1

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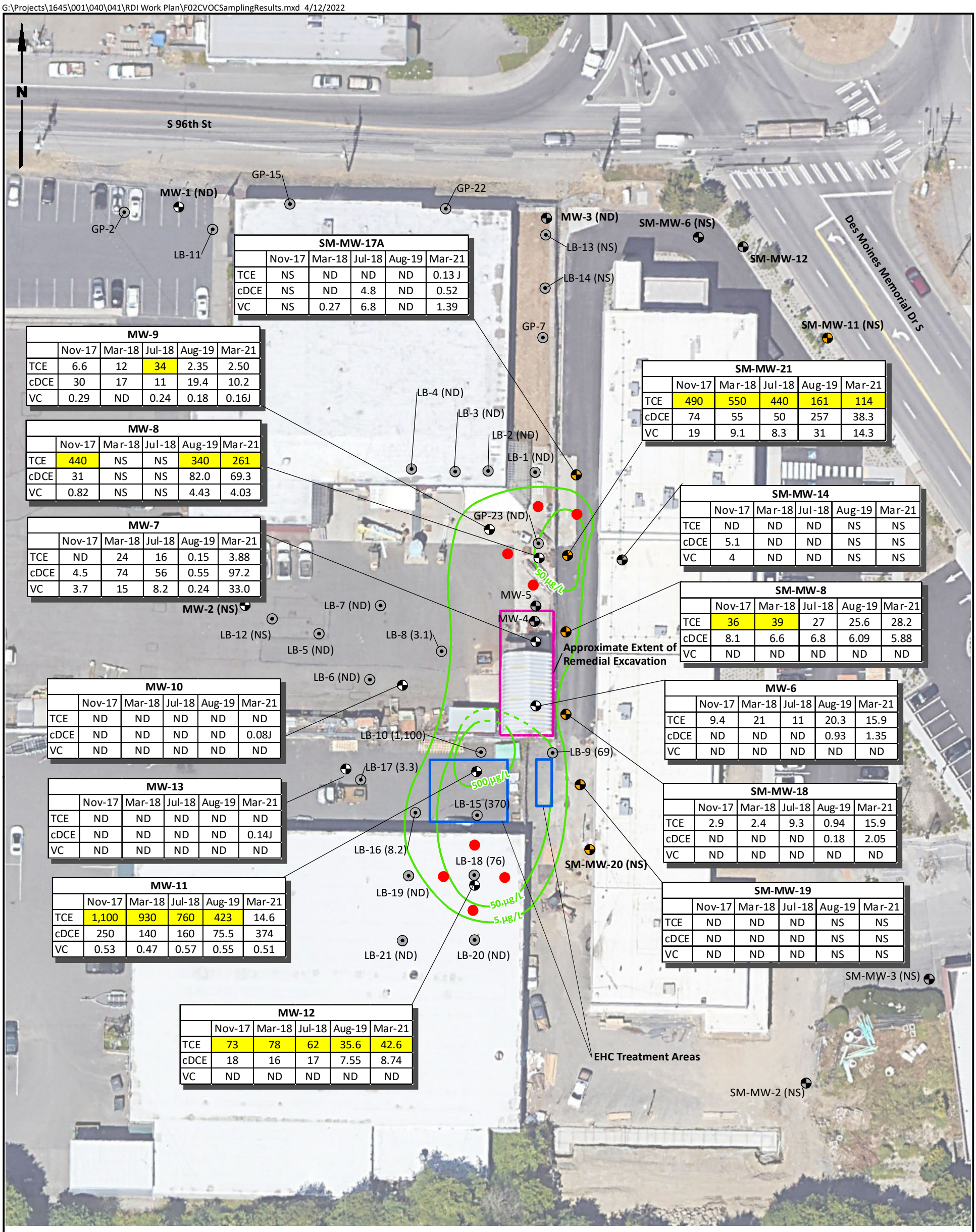

SM-MW-17A					
	Nov-17	Mar-18	Jul-18	Aug-19	Mar-21
TCE	NS	ND	ND	ND	0.13 J
cDCE	NS	ND	4.8	ND	0.52
VC	NS	0.27	6.8	ND	1.39

MW-9					
	Nov-17	Mar-18	Jul-18	Aug-19	Mar-21
TCE	6.6	12	34	2.35	2.50
cDCE	30	17	11	19.4	10.2
VC	0.29	ND	0.24	0.18	0.16J

SM-MW-21					
	Nov-17	Mar-18	Jul-18	Aug-19	Mar-21
TCE	490	550	440	161	114
cDCE	74	55	50	257	38.3
VC	19	9.1	8.3	31	14.3

MW-8					
	Nov-17	Mar-18	Jul-18	Aug-19	Mar-21
TCE	440	NS	NS	340	261
cDCE	31	NS	NS	82.0	69.3
VC	0.82	NS	NS	4.43	4.03

SM-MW-14					
	Nov-17	Mar-18	Jul-18	Aug-19	Mar-21
TCE	ND	ND	ND	NS	NS
cDCE	5.1	ND	ND	NS	NS
VC	4	ND	ND	NS	NS

MW-7					
	Nov-17	Mar-18	Jul-18	Aug-19	Mar-21
TCE	ND	24	16	0.15	3.88
cDCE	4.5	74	56	0.55	97.2
VC	3.7	15	8.2	0.24	33.0

SM-MW-8					
	Nov-17	Mar-18	Jul-18	Aug-19	Mar-21
TCE	36	39	27	25.6	28.2
cDCE	8.1	6.6	6.8	6.09	5.88
VC	ND	ND	ND	ND	ND

MW-10					
	Nov-17	Mar-18	Jul-18	Aug-19	Mar-21
TCE	ND	ND	ND	ND	ND
cDCE	ND	ND	ND	ND	0.08J
VC	ND	ND	ND	ND	ND

MW-6					
	Nov-17	Mar-18	Jul-18	Aug-19	Mar-21
TCE	9.4	21	11	20.3	15.9
cDCE	ND	ND	ND	0.93	1.35
VC	ND	ND	ND	ND	ND

MW-13					
	Nov-17	Mar-18	Jul-18	Aug-19	Mar-21
TCE	ND	ND	ND	ND	ND
cDCE	ND	ND	ND	ND	0.14J
VC	ND	ND	ND	ND	ND

SM-MW-18					
	Nov-17	Mar-18	Jul-18	Aug-19	Mar-21
TCE	2.9	2.4	9.3	0.94	15.9
cDCE	ND	ND	ND	0.18	2.05
VC	ND	ND	ND	ND	ND

MW-11					
	Nov-17	Mar-18	Jul-18	Aug-19	Mar-21
TCE	1,100	930	760	423	14.6
cDCE	250	140	160	75.5	374
VC	0.53	0.47	0.57	0.55	0.51

SM-MW-19					
	Nov-17	Mar-18	Jul-18	Aug-19	Mar-21
TCE	ND	ND	ND	NS	NS
cDCE	ND	ND	ND	NS	NS
VC	ND	ND	ND	NS	NS

MW-12					
	Nov-17	Mar-18	Jul-18	Aug-19	Mar-21
TCE	73	78	62	35.6	42.6
cDCE	18	16	17	7.55	8.74
VC	ND	ND	ND	ND	ND

Legend

- Proposed Direct-Push Boring
- MW-12 — Monitoring Well (LAI)
- SM-MW-11 — Monitoring Well (Sea Mar)
- MW-4 — Former Monitoring Well
- LB-1 — Former Direct-Push Boring
- TCE Baseline Iso-Concentration Contour (Approx.)
- TCE Baseline Iso-Concentration Contour

Boring Name — LB-16 (8.2) — Maximum TCE concentration detected in groundwater grab sample collected at time of drilling (2016)

MW-12			
	Nov-17	Mar-18	Jul-18
TCE	73	78	62

- Monitoring Well Designation
- Sampling Date
- Detected Concentration (µg/L)

Detected Analyte

0 50 100

Scale in Feet

Data Source: Sea Mar; Google Earth Imagery.

Notes

1. Iso-concentration contours also informed by prior results from temporary groundwater borings not shown.
2. Highlighed results exceed the 31 µg/L short-term TCE vapor intrusion screening level.
3. All detected concentrations are reported in micrograms per liter (µg/L).
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

cDCE = *cis*-1,2-dichloroethene
ND = not detected
NS = not sampled
TCE = trichoroethene
VC = vinyl chloride

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Beckwith & Kuffel, Inc.
Seattle, Washington

Chlorinated Volatile Organic Compound Sampling Results

Figure 2

Table 1
Investigation Sampling Summary
Beckwith and Kuffel, Inc. – Seattle, Washington

Exploration ID	Property	Description	Medium	No. of Samples	Compounds	Analytical Method	Laboratory
RDI-GW1	Beckwith & Kuffel	Direct-push boring in the vicinity of MW-8	Groundwater	1	TCE, cDCE, VC	SW-846 8260D	ARI
RDI-GW2	Beckwith & Kuffel	Direct-push boring in the vicinity of MW-8	Groundwater	1	TCE, cDCE, VC	SW-846 8260D	ARI
RDI-GW3	Beckwith & Kuffel	Direct-push boring in the vicinity of MW-8	Groundwater	1	TCE, cDCE, VC	SW-846 8260D	ARI
RDI-GW4	Beckwith & Kuffel	Direct-push boring in the vicinity of MW-8	Groundwater	1	TCE, cDCE, VC	SW-846 8260D	ARI
RDI-GW5	Wooldridge Boats	Direct-push boring in the vicinity of MW-12	Groundwater	1	TCE, cDCE, VC	SW-846 8260D	ARI
RDI-GW6	Wooldridge Boats	Direct-push boring in the vicinity of MW-12	Groundwater	1	TCE, cDCE, VC	SW-846 8260D	ARI
RDI-GW7	Wooldridge Boats	Direct-push boring in the vicinity of MW-12	Groundwater	1	TCE, cDCE, VC	SW-846 8260D	ARI
RDI-GW8	Wooldridge Boats	Direct-push boring in the vicinity of MW-12	Groundwater	1	TCE, cDCE, VC	SW-846 8260D	ARI
BK-VP1	Beckwith & Kuffel	Vapor Pin through building slab	Soil gas	1	TCE, cDCE, VC	TO-15	Eurofins
BK-VP2	Beckwith & Kuffel	Vapor Pin through building slab	Soil gas	1	TCE, cDCE, VC	TO-15	Eurofins
BK-VP3	Beckwith & Kuffel	Vapor Pin through building slab	Soil gas	1	TCE, cDCE, VC	TO-15	Eurofins
WB-VP1	Wooldridge Boats	Vapor Pin through building slab	Soil gas	1	TCE, cDCE, VC	TO-15	Eurofins
WB-VP2	Wooldridge Boats	Vapor Pin through building slab	Soil gas	1	TCE, cDCE, VC	TO-15	Eurofins
WB-VP3	Wooldridge Boats	Vapor Pin through building slab	Soil gas	1	TCE, cDCE, VC	TO-15	Eurofins
BK-AA1	Beckwith & Kuffel	*Contingency.* Background outdoor air sample.	Ambient air	--	TCE, cDCE, VC	TO-15 SIM	Eurofins
BK-IA1	Beckwith & Kuffel	*Contingency* . Sample of air in workspace.	Indoor air	--	TCE, cDCE, VC	TO-15 SIM	Eurofins
BK-IA2	Beckwith & Kuffel	*Contingency* . Sample of air in workspace.	Indoor air	--	TCE, cDCE, VC	TO-15 SIM	Eurofins
WB-AA1	Wooldridge Boats	*Contingency.* Background outdoor air sample.	Ambient air	--	TCE, cDCE, VC	TO-15 SIM	Eurofins
WB-IA1	Wooldridge Boats	*Contingency* . Sample of air in workspace.	Indoor air	--	TCE, cDCE, VC	TO-15 SIM	Eurofins
WB-IA2	Wooldridge Boats	*Contingency* . Sample of air in workspace.	Indoor air	--	TCE, cDCE, VC	TO-15 SIM	Eurofins

Abbreviations and Acronyms:

ARI = Analytical Resources, Inc.
cDCE = cis-1,2-dichloroethene
Eurofins = Eurofins Air Toxics, LLC
TCE = trichloroethene
VC = vinyl chloride

APPENDIX A

Revised Health and Safety Plan

LANDAU ASSOCIATES

WORK LOCATION PERSONNEL PROTECTION AND SAFETY EVALUATION FORM

Attach Pertinent Documents/Data
Fill in Blanks As Appropriate

Job No.:	1645001.010	Revised:	April 7, 2022
Prepared by:	Cody Johnson	Reviewed by:	Christine Kimmel
Date:	August 28, 2017	Date:	November 14, 2017

A. WORK LOCATIONS DESCRIPTION

1. **Project Name:** Beckwith & Kuffel
2. **Location:** 1313 South 96th Street, Seattle, Washington
3. **Anticipated Activities:** Activities covered under this plan include:
   - Groundwater sampling
   - Electron donor injection
   - Clear water injection testing
   - ISCR reagent direct-push injection
4. **Size:** Approximately 1 acre
5. **Surrounding Population:** Mixed industrial, commercial, and residential
6. **Buildings/Homes/Industry:** One industrial building, currently in use.
7. **Topography:** Mostly flat; gentle slope on west side.
8. **Anticipated Weather:** 30 to 75 degrees Fahrenheit
9. **Unusual Features:** None.
10. **Site History:** Site was previously occupied by a forklift maintenance facility. Chlorinated solvents were used at the southeast corner of the site resulting in release to soil and groundwater.

    Past remediation efforts have included excavation, backfilling with remediation amendments, and electron donor injection.

B. HAZARD DESCRIPTION

1. **Background Review:** ☒ Complete ☐ Partial

   If partial, why?

2. **Hazardous Level:** ☐ B ☐ C ☒ D ☐ Unknown

   Justification: Site monitoring results indicate contaminant concentrations in groundwater as high as 1,100 µg/L TCE; 200 µg/L cDCE; and 0.6 µg/L VC. There are no known hazards associated with the electron donor substrates (emulsified vegetable oil) or ISCR reagents (food-grade carbon and ZVI) to be used at the Site. There are minor health hazards associated with additives to be used for electron donor injection.

3. **Types of Hazards:** (Attach additional sheets as necessary)

   A. ☒ Chemical ☒ Inhalation ☐ Explosive
   ☐ Biological ☒ Ingestion ☐ O2 Def. ☒ Skin Contact

   Describe: Direct contact with contaminated soil or groundwater; accidental ingestion of contaminated soil or groundwater; or inhalation of vapors during drilling, sampling, and injection.

   B. ☒ Physical ☐ Cold Stress ☒ Noise ☐ Heat Stress ☐ Other

   Describe: Noise and physical hazards associated with working around pumps, hoses, drilling equipment, power tools, and other heavy equipment at the Site.

   C. ☐ Radiation

   Describe:

4. **Nature of Hazards:**

☒ Air	Describe: Potential for volatile constituents to be released from contaminated soil or groundwater and from openings in building slabs.
☒ Soil	Describe: Potential for contact with, or ingestion of, contaminated soil.
☐ Surface Water	Describe:
☒ Groundwater	Describe: Potential for contact with, or ingestion of, contaminated groundwater.
☒ Other	Describe: Powdered ISCR reagents can present an inhalation hazard if not used in a well-ventilated area. If reagents are stored when wet or when combined with water, the vessel must remain open to the air (i.e., vented) to prevent buildup of fermentation gasses.

5. Chemical Contaminants of Concern ☐ N/A

The primary chemical contaminants of concern are volatile organic compounds (VOCs). The table below lists information for these primary compounds and other potential contaminants.

Contaminant	PEL (ppm)	I.D.L.H. (ppm)	Source/Quantity Characteristics	Route of Exposure	Symptoms of Acute Exposure	Instruments Used to Monitor Contaminant
Trichloroethene	50 ppm	1,000 ppm	Present in groundwater	Inhalation, ingestion, dermal contact	Eye, nose, and throat irritation; headache; nausea	PID
Vinyl Chloride	1 ppm	NV	Present in groundwater	Inhalation, ingestion, dermal contact	Weakness, abdominal pain. Known carcinogen	Colorimetric tubes
cis-1,2-Dichloroethene	200 ppm	1,000 ppm	Present in groundwater	Inhalation, ingestion, dermal contact	Dizziness, nausea, dermatitis, irritation of mucous membranes	PID
Yeast Extract	N/A	N/A	Mixed with injection fluid	Inhalation, ingestion, eye/dermal contact	Eye, nose, skin, and throat irritation	Visual, dust
EHC® ISCR Reagent	N/A	N/A	Mixed with water	Inhalation, ingestion, eye/dermal contact	Throat irritation	Visual, dust

Notes:

IDLH = Immediately Dangerous to Life and Health
ISCR = *in situ* chemical reduction
N/A = Not Applicable
NV = No Value
PEL = Personal Exposure Limit
PID = Photoionization Detector
ppm = parts per million

6. Physical Hazards of Concern ☐ N/A

Hazard	Description	Location	Procedures Used to Monitor Hazard
Injection Equipment	Mechanical and electrical hazards associated with pumps; trip/slip hazards associated with pressurized hoses and wet surfaces	Within the injection work area	• Alert observation of surroundings • Shut off pumps for disassemble, etc. • Maintain dry and tidy work space • Conduct lockout/tagout of mechanical and/or electrical equipment in the direct vicinity of work area • Maintain three points of contact when climbing ladder of injection tank • Monitor pressures in hoses and valves • Aware of pressurized hose
Drilling Equipment	Mechanical and electrical hazards associated with drill rig; physical hazards associated with moving parts on drill rig	Within work area	• Alert observation of surroundings • Establish eye contact with drill rig operator before moving in front of or near rig • Wear hard hat and hearing protection at all times when in the vicinity of the drill rig • Maintain tidy work space
Slips, Trips, and Falls	Uneven terrain and drilling equipment	Around work area	• Visual observations of terrain and hazards • Keep work area clear of tools and debris
Travel to and from site	Operating motor vehicle in traffic on highways and rural roads	Route to and from site from Landau Associates office	• Operate motor vehicle while well rested, physically able to drive safely • Conduct pre-trip vehicle inspection, all vehicles to be maintained and in good working order • Obey all traffic laws (no cell phone use while driving) • Secure all cargo properly to avoid shifting • Allow sufficient time for travel to site at safe speeds • Engage emergency brake when parking vehicles • Establish a planned route prior to departure

7. Work Location Instrument Readings ☒ N/A

Location: ______	Date/Time: ______
Percent O_2: ______	Percent LEL: ______
Colorimetric tube VC (PPM): ______	PID: ______
Colorimetric tube PCE (PPM)	Other:
Location: ______	Date/Time: ______
Percent O_2: ______	Percent LEL: ______
Colorimetric tube VC (PPM): ______	PID: ______
Colorimetric tube PCE (PPM)	Other:
Location: ______	Date/Time: ______
Percent O_2: ______	Percent LEL: ______
Colorimetric tube VC (PPM): ______	PID: ______
Colorimetric tube PCE (PPM)	Other:
Location: ______	Date/Time: ______
Percent O_2: ______	Percent LEL: ______
Colorimetric tube VC (PPM): ______	PID: ______
Colorimetric tube PCE (PPM)	Other:
Location: ______	Date/Time: ______
Percent O_2: ______	Percent LEL: ______
Colorimetric tube VC (PPM): ______	PID: ______
Colorimetric tube PCE (PPM)	Other:
Location: ______	Date/Time: ______
Percent O_2: ______	Percent LEL: ______
Colorimetric tube VC (PPM):	PID: ______
Colorimetric tube PCE (PPM)	Other:
Location: ______	Date/Time: ______
Percent O_2: ______	Percent LEL: ______
Colorimetric tube VC (PPM): ______	PID: ______
Colorimetric tube PCE (PPM) ______	Other: ______

8. Hazards Expected In Preparation For Work Assignment ☒ N/A

Describe:

C. PERSONAL PROTECTIVE EQUIPMENT

1. Level of Protection

☐ A ☐ B ☐ C ☒ D

Location/Activity: All

☐ A ☐ B ☒ C ☐ D

Location/Activity:

- All Locations – Upgrade to Level C personal protective equipment (PPE) if ambient air conditions meet target monitoring level in Attachment A.
- Injection fluid mixing stations – All activities requiring handling/mixing of dry chemical additives will require wearing of safety glasses. If visual dust remains despite efforts to control dust, a half-face respirator with HEPA filter will be worn.
- ISCR reagent slurry mixing stations – All activities requiring handling/mixing of dry reagents will require wearing of safety glasses. A half-face respirator with HEPA filter will also be required if other control measures cannot adequately suppress dust created during handling/mixing.

2. Protective Equipment (specify probable quantity required)

Respirator ☐ N/A

- ☐ SCBA, Airline
- ☐ Full-Face Respirator
- ☒ Half-Face Respirator (Cart. organic vapor) (Only if upgrade to Level C)
- ☐ Escape mask
- ☐ None
- ☐ Other:
- ☐ Other:

Clothing ☐ N/A

- ☐ Fully Encapsulating Suit
- ☐ Chemically Resistant Splash Suit
- ☒ Safety Vests
- ☒ Tyvek Coverall (Only if upgrade to Level C)
- ☐ Saranex Coverall
- ☐ Coverall, Specify
- ☐ Other:

Head & Eye ☐ N/A

- ☒ Hard Hat
- ☒ Goggles (dry chemical handling and/or mixing
- ☐ Face Shield
- ☒ Safety Eyeglasses
- ☒ Other: Hearing protection

Hand Protection ☐ N/A

- ☐ Undergloves; Type:
- ☒ Gloves; Type: Nitrile
- ☐ Overgloves; Type:
- ☐ None
- ☐ Other:

Foot Protection ☐ N/A

☐ Neoprene Safety Boots with Steel Toe/Shank

☐ Disposable Overboots

☒ Other: Steel-toed work boots

3. Monitoring Equipment ☐ N/A

☐ CGI	☒ PID
☐ O^2 Meter	☐ FID
☐ Rad Survey	☐ Other
☒ Detector Tubes (Attachment A)	

Type: Colorimetric tubes

D. DECONTAMINATION (ATTACH DIAGRAM)

☒ Required ☐ Not Required

Avoid hand to mouth contact, no eating/drinking in exclusion zone. Wash hands and face after work shift and prior to breaks. Change disposable PPE frequently during work.

EQUIPMENT DECONTAMINATION (ATTACH DIAGRAM)

☒ Required ☐ Not Required

Groundwater sampling: Dedicated sampling equipment will be used when possible (e.g., tubing). Any equipment in contact with contaminated media that will be used at multiple locations (e.g., water level meters) must be decontaminated using a three-step procedure after each use:

- Alconox (or similar) rinse
- Tap water rinse
- Dionized water rinse.

ISCR reagent direct-push injection: Equipment used to measure downhole distances (e.g., tape measures, water level meters) that comes into contact with contaminated media must be decontaminated after each use following the three-step process described above. Downhole drilling equipment (e.g., rods, screens, other injection tools) must be pressure washed after each boring.

E. PERSONNEL

	Name	Work Location Title/Task	Medical Current	Fit Test Current
1.	Jenny Green	Field Engineer	☒	☒
2.	Jeovani Huerta-Avila	Field Scientist	☒	☒
3.	Katie Gauglitz	Field Geologist	☒	☒
4.	Armando Huerta-Avila	Field Technician	☒	☒
5.			☐	☐
6.			☐	☐
7.			☐	☐
8.			☐	☐
9.			☐	☐
10.			☐	☐

Site Safety Coordinator: Jenny Green

F. ACTIVITIES COVERED UNDER THIS PLAN

Task No.	Description	Preliminary Schedule
1	Well installation, development, groundwater sampling, initial donor injection	Fall 2017 – Early 2018
2	Groundwater Sampling	Fall 2017 – TBD
3	Clear water injection testing	Summer 2019
4	EHC reagent direct-push injection	Early 2020
5	Direct-push groundwater sampling (Remedial Design Investigation)	May 2022
6	Sub-slab soil gas sampling (Remedial Design Investigation)	May 2022
7	*Contingency*. Indoor air sampling (Remedial Design Investigation)	June 2022

SUBCONTACTOR EVALUATION ☐ N/A

Name and Address of Subcontractor: Anderson Environmental Contracting, LLC
705 Colorado Street
Kelso, WA 98626

EVALUATION CRITERIA

Item	Adequate	Inadequate	Comments
Medical Surveillance Program	☐	☐	
Personal Protective Equipment Availability	☐	☐	
Onsite Monitoring Equipment Availability	☐	☐	
Safe Working Procedures Specification	☐	☐	
Training Protocols	☐	☐	
Ancillary Support Procedures (if any)	☐	☐	
Emergency Procedures	☐	☐	
Evacuation Procedures Contingency Plan	☐	☐	
Decontamination Procedures Equipment	☐	☐	
Decontamination Procedures Personnel	☐	☐	

GENERAL HEALTH AND SAFETY PROGRAM EVALUATION: ☒ Adequate ☐ Inadequate

Additional Comments: Adequate based on Basic Agreement between Landau Associates and Anderson Environmental Contracting, LLC

Evaluation Conducted By: Christine Kimmel Date: 11/11/19

G. EMERGENCY FACILITIES AND NUMBERS

Nearest hospital: 7.3 miles (~22 minutes)

Swedish Emergency Room – Cherry Hill
540 16th Avenue
Seattle, WA 98122
206-320-2000

Emergency Contacts:

Name	Title	Phone Numbers
Clint Jacob	Landau Associates Project Manager	425-329-0304 office 360-536-2095 cell
Christine Kimmel	Landau Associates Health and Safety Manager	425-329-0254 office 206-786-3801 cell

In the event of an emergency, do the following:

1. Call for help as soon as possible. Call 911. Give the following information:
   - WHERE the emergency is – use cross streets or landmarks
   - PHONE NUMBER you are calling from
   - WHAT HAPPENED – type of injury
   - WHAT is being done for the victim(s)
   - YOU HANG UP LAST – let the person you called hang up first.

2. If the victim can be moved, paramedics will transport to the hospital. If the injury or exposure is not life threatening, decontaminate the individual first. If decontamination is not feasible, wrap the individual in a blanket or sheet of plastic prior to transport.

3. Notify the Project Manager (Clint Jacob, 360-536-2095).

Emergency Routes – Map – See last page

HEALTH AND SAFETY PLAN
APPROVAL/SIGN OFF FORMAT

I have read, understood, and agreed with the information set forth in this Health and Safety Plan (and attachments) and discussed in the Personnel Health and Safety briefing.

Name	Signature	Date
Armando Huerta-Avila		
Name	Signature	Date
Katie Gauglitz		
Name	Signature	Date
Jeovani Huerta-Avila		
Name	Signature	Date
Jenny Green		
Name	Signature	Date
Site Safety Coordinator	Signature	Date
Christine Kimmel	Christina Kimmel	11/11/2019
Landau Health and Safety Manager	Signature	Date
Evelyn Ives	Evelyn Ives	12/18/2019
Project Manager	Signature	Date

Personnel Health and Safety Briefing Conducted By:

Name	Signature	Date

ATTACHMENT A

ACTION LEVELS FOR RESPIRATORY PROTECTION

Monitoring Parameter	Reading	Level of Protection
VOCs	PID reading >2 ppm, check ambient air with VC colorimetric tube	Upgrade to Level C is colorimetric tube reading above 1 ppm
	PID reading >10 ppm in breathing zone for more than 5 minutes or >20 ppm for momentary peak.	Evacuate the area or upgrade to Level C - half-face respirator with organic vapor / HEPA cartridge.
	>10 ppm and <50 ppm	Temporarily stop work to allow vapors to return to baseline-proceed with upgrade to Level C
	>50 ppm	Stop Work, contact H&S Manager

Emergency Routes – Map