Technical Memorandum

TO: Mr. Kenneth Thiessen, Oregon Department of Environmental Quality
Ms. Deborah Taege, The Boeing Company

FROM: Christine Kimmel, LG; Clint Jacob, PE, LG; Erin Waibel, RG

DATE: May 4, 2020

RE: **Addendum No. 4**
Source Area Bioremediation Work Plan
Combined Treatment of TGA Source Wells and Permeable Reactive Barrier
Building 85-001 Former Vapor Degreaser Source Area
Boeing Portland Facility
Project No. 025116.120
ECSI #13

Introduction

This technical memorandum presents Addendum No. 4 to the above-indicated work plan (Landau Associates, Inc. [LAI] 2013) for bioremediation at the Troutdale Groundwater Aquifer (TGA) Former Vapor Degreaser Source Area (FVDSA) in the northwest portion of Building 85-001 at The Boeing Company (Boeing) Facility in Gresham, Oregon. The FVDSA is an area of the TGA with the highest chlorinated volatile organic compound (VOC) concentrations and has responded favorably to bioremediation, as evidenced by the reduced plume size and the lowering of trichloroethene (TCE) concentrations to near the cleanup level. TCE is the predominant VOC and is evaluated to measure the progress of the TGA remedy. The Former Vapor Degreaser Source Area is located inside the 85-001 Building (Figure 1) at the location of two former degreaser pits and based on the investigation results, the area of the site with the highest VOC concentrations.

This addendum provides procedures to conduct an additional injection event to accelerate TGA groundwater remedy cleanup. This addendum describes a fifth injection event of electron donor substrate solution (donor solution) to source area wells and a seventh injection event of donor solution to maintain the permeable reactive barrier (PRB) on the downgradient edge of the source area. In addition to applying the previously approved high-retention vegetable oil (HRO) substrate as a donor, this work plan includes the use of colloidal zero-valent iron (cZVI) to be injected to three identified source wells to focus additional treatment in the areas of highest VOC concentrations where TCE breakdown products concentrations have been observed to be increasing. The increase in TCE breakdown products is an indication that additional donor material is needed to maintain the enhanced dechlorinating process at optimal conditions. This Addendum No. 4 incorporates the previously Oregon Department of Environmental Quality (ODEQ) -approved work plan and addenda described below. Background and investigation results are presented in prior documents (LAI 2017b, 2018, 2019, 2020). This work plan addendum is submitted on behalf of Boeing Company under the ODEQ Order on Consent (Order) DEQ No. LQSR-NWR-04-12.

Previous Injections Summary and Results

The source area bioremediation program consists of injection of donor solution to seven source wells (BOP-78[i], BOP-79[i], and BOP-84[i] through BOP-88[i]) located near the location of two former vapor degreasers pits. In addition to the seven source area wells, the PRB is established on the downgradient edge of the source zone and downgradient of the former vapor degreasers by the injection of donor solution to well BOP-74(i). The PRB serves to treat downgradient locations (e.g., monitoring wells BOP-80[i] through BOP-83[i]) with higher concentrations of TCE (i.e., above cleanup levels) and breakdown products that often result from enhanced desorption during bioremediation. Two PRB injection events (described in the prior PRB work plan [LAI 2011] and PRB Addendum No. 1 [LAI 2012]) occurred before initial injections began at source wells. The source area bioremediation work plan (LAI 2013) describes the initial injection to source area wells and presents a combined groundwater monitoring program to monitor the effects of both PRB injection and injection of source area wells. As described in Source Area Bioremediation Work Plan Addendums No. 1, No. 2, and No. 3 (LAI 2014, 2015, 2017a), subsequent injection events for the FVDSA include both PRB and source area wells. In January 2018 (most recent injection), upgradient monitoring well BOP-75(i) also received donor solution to increase the width of the treatment zone to the west and address low, but persistent, VOC concentrations at the well located on the fringe of the source area. Table 1 presents a summary of the injection events.

As designed, injection of the PRB well and source area wells has resulted in a comingled treatment zone. The treatment zone has extended to the northwest due to downgradient transport of electron donor by the flow of groundwater. The resulting treatment zone is approximately 140 feet (ft) wide (north to south) and 150–160 ft thick (east to west). Well locations and the estimated treatment zone are presented on Figure 1.

The progress of the bioremediation remedy within and downgradient of the treatment zone is primarily demonstrated by enhanced reductive dechlorination, which is evidenced by the decrease in TCE concentrations and the sequential increase in breakdown daughter products (cis-1,2-dichloroethene [cDCE] and vinyl chloride [VC]), and non-toxic end products ethane and ethene. Sequential reductive dechlorination is evident on the time versus concentration plot for BOP-73(i) presented on Figure 2. Data from monitoring well BOP-73(i) is helpful in understanding the progression of treatment in the source area because the highest TCE concentrations were consistently detected at this well, the well has not received donor material, and it is centrally located within the extent of source area contamination.

Conditions favorable for bioremediation are also indicated by groundwater data that indicate increased availability of electron donor and enhanced aquifer redox conditions. Presence of electron donor is indicated by increased total organic carbon (TOC) concentrations. More reduced aquifer redox conditions conducive to anaerobic reductive dechlorination are indicated by increased ferrous

iron and methane and decreased nitrate and sulfate. Evaluation of ferrous iron and sulfate data must also take into account increases in both due to the inclusion of ferrous sulfate in the injection fluid for the July 2014 and June 2015 injections. The most recent evaluation of monitoring results is presented in the 2019 Annual Report (LAI 2020). The cumulative results through February 2020 are presented in Table 2.

Planned 2020 Injection of PRB and Source Area Wells

Donor solution will be injected into PRB injection well BOP-74(i) and the seven source area wells (BOP-78[i], BOP-79[i] and BOP-84[i] through BOP-88[i]) in 2020 to continue to maintain optimal bioremediation conditions in the source and downgradient areas. The prior injection performed in January 2018 was just over 2 years ago and the beneficial effects of that injection event are waning. A primary indicator of the need for an additional injection is the rebound in TCE breakdown products observed during three quarterly sampling events conducted in 2019 (May, August, and November 2019) and the February 2020 event at the historically highest-concentration well BOP-73(i) (Figure 2). cDCE concentrations increased from 35 µg/L in February 2019 to 1,400 µg/L by May 2019 and increased steadily to 2,100 µg/L in November 2019; concentrations observed in February 2020 had decreased to 780 µg/L. VC concentrations also increased from 86 µg/L in February 2019 to 1,300 µg/L by May 2019; and concentrations from August 2019 through February 2020 ranged from 1,300 µg/L to 1,700 µg/L. Additionally, TCE concentrations were detected in February 2020 for the first time since November 2018 at a concentration of 4.2 µg/L. Complete reductive dechlorination continues at BOP-73(i), as indicated by concentrations of more than 2,500 µg/L of ethene+ethane and continued ethene+ethane predominance on a molar basis (73 percent molar fraction) in February 2020. However, this recent rebound in TCE breakdown products is evidence that additional source zone treatment is needed and treatment has become less than optimal because of consumption of previously injected substrates.

Donor Design

The proposed 2020 injection will be similar to the injection completed in 2018 (see Table 1), except additional nutrients will be provided in the donor solution, cZVI will also be injected to three identified wells, and BOP-75(i) will not be included in the injection event. Injection solution for the combined injection event will again contain emulsified vegetable oil and glycerin. This combination of slow- and fast-release donors optimizes donor availability and longevity. Both electron donors will be fermented by microorganisms to form hydrogen needed for reductive dechlorination and to maintain the highly reduced redox conditions required for biological reductive dechlorination. Nitrate and phosphorus nutrients will be added in addition to yeast extract provided during prior injections to promote the growth and health of natural bacteria. cZVI will be added to the injection solution at three identified source wells (BOP-78[i], BOP-87[i], and BOP-88[i]). cZVI strongly stimulates the abiotic degradation process, which was previously stimulated through addition of ferrous sulfate during the

2014 and 2015 injections. Abiotic (i.e., chemical) degradation is a concurrent and complimentary degradation mechanism to biological reductive dechlorination being stimulated though donor and nutrient amendment. The predominant abiotic reaction is reductive elimination (or β-elimination) whereby iron chemically reduces TCE and cDCE to chloroacetylene and acetylene, respectively, without formation of VC. These non-toxic intermediates break down quickly to ethene and ethane under anaerobic conditions (Butler and Hayes 2001). Because of its high reactivity, acetylene is rarely detected, or detected at very low concentrations, even when reductive elimination is actively occurring. These three identified source wells were chosen based on their proximity to the former vapor degreaser units and well BOP-73(i) where the rebound in concentrations has been observed. The total injection solution volume for the combined injection will be approximately 47,100 gallons (approximately the same as the 2015 and 2018 injection events). The target injection volumes are 19,100 gallons for the PRB well (BOP-74 [i]) and 28,000 gallons for the seven source wells.[1] BOP-75(i), injected in 2018, was deemed unnecessary for injection in 2020 because TCE and breakdown products have remained below the maximum contaminant level since the 2018 injection. This injection solution design is further described in the following paragraphs and summarized in Table 3.

The primary injection substrates will consist of Newman Zone HRO™ (HRO) and crude glycerin. HRO is a 100 percent fermentable electron donor product containing 90 percent by weight (%wt) vegetable oil and 10%wt oleaginous surfactants. Crude glycerin is a regionally sourced byproduct of biodiesel production from recycled fryer oil and is completely soluble. The donor solution will consist of tap water mixed with 3.3 percent volume (%vol) HRO and 5.6%vol glycerin.[2]

For the 2020 injection, nutrients will consist of yeast extract plus nitrogen and phosphorus. Yeast extract has been provided since the first injection as the source of micronutrients (i.e., trace nutrients). Given the extended period of treatment that has occurred in the source zone, the macronutrients nitrogen and phosphorus will be added to address potential nutrient limitations to the degradation of TCE and breakdown products. Phosphorus and nitrogen are required by microorganisms for cellular growth and reproduction; a shortage of these nutrients will cause microbiological growth and transformation processes to slow down. These macronutrients will be provided in the form of monoammonium phosphate (MAP) and calcium ammonium nitrate (CAN-27). Phosphorus was provided by prior injections in 2014 and 2015, which utilized Textrol BR because the lecithin emulsifier in Textrol BR contained phosphorus. Nutrients will be provided at the following rates and total quantities:

[1] These targets are consistent with the June 2015 injection event, when reduced injection flow rates at BOP-74(i) was the reason for redistribution of 10,000 gallons intended for this PRB well to the seven source wells. In 2018, BOP-74(i) received 19,000 gallons and the source area wells received a total of 31,200 gallons, not including BOP-75(i).

[2] The glycerin vendor has changed from Whole Energy to SeQuential, resulting in a crude glycerin concentration difference. The volume required was modified to account for different glycerin concentrations in the two products.

- Yeast extract: 1 pound (lb) per 1,000 gallons of solution; rounded to 50 lbs total
- MAP: 5.85 lb per 1,000 gallons of solution; rounded to 275 lbs total
- CAN-27: 9.55 lb per 1,000 gallons of solution; rounded to 450 lbs total.

Quantities of MAP and CAN-27 were determined by considering the nutrient requirements of the microbial community (Ammary 2004). Using this approach, the estimated C:N:P ratio for this injection event is 683:5:1 on a molar basis. This ratio was used to calculate the mass of nitrogen and phosphorus required by the microbial community to utilize 100 percent of the HRO and glycerin injected.

The three source wells identified for additional treatment (BOP-78[i], BOP-87[i], and BOP-88[i]) will be injected with cZVI in the form of the remediation product Regenesis S-MicroZVI. Each well will receive 1 drum (33 gallons, 500 lbs) of the S-MicroZVI product, which is equivalent to 0.8%vol of the injection solution. This dosing will provide a total of 600 lbs of zero-valent iron (ZVI) to the highest concentration portion of the source zone.

S-MicroZVI consists of colloidal iron particles from 1 to 3 microns (µm) in diameter; the particles remain suspended in the injection fluid and transmit easily through aquifer pore space (Freim 2018). This relatively new product is a substantial improvement over nano-scale ZVI (0.2 µm) and micro-scale ZVI (50 µm). Nano-scale ZVI tends to agglomerate in large clusters that are not easily transmitted through the aquifer, is very expensive, and is consumed quickly. Micro-scale ZVI must be injected as a slurry using hydrofracturing techniques, which precludes the use of this product for repeated injections through monitoring wells. S-MicroZVI contains sulfidated ZVI, meaning the ZVI is passivated with a layer of ferrous sulfide to prevent it from losing reactive capacity during storage and delivery (REGENESIS 2018).

Injection Process

Each injection well will receive a flush of clear water prior to and post-injection to assist with clearing the well screens of any accumulated debris. The clear water injections will consist of approximately 200–300 gallons for each well.

Mixing and injection will occur at the mixing station setup inside the building near the source area. The mixing station consists of a potable water tap; a 4,000-gallon batch tank; an electric pump (120-volt); a donor staging area; and a multi-well injection manifold. The injection manifold connects to sub-grade conveyance lines leading to the seven source wells; the PRB well (BOP-74[i]) will be injected through an individual hose run. The 4,000-gallon batch tank was cleaned thoroughly to remove dried residue of injection fluid after the 2018 injection. To remove potential particulates in

the crude glycerin,[3] crude glycerin and water will be passed through a bag filter (10-µm) during the mixing process, consistent with the 2018 injection, as described below. Secondary containment is provided for the mixing station to contain any spills for cleanup, as shown on Figure 3.

Injection solution for PRB well BOP-74(i) and four of the source wells will be mixed in 14 batches in the 4,000-gallon storage tank. The three targeted source wells (BOP-78[i], BOP-87[i], BOP-88[i]) will be batched and injected separately because of the additional cZVI substrate.

The injection solution will be mixed for 10 of the 14 batches (non-ZVI locations) as follows:

- Mixing tank will be filled with approximately 3,198 gallons of potable water.
- Tank water will be dechlorinated by adding a pond water dechlorinating product containing sodium thiosulfite (Chlor-No-More, www.PondRX.com) per product directions.
- While recirculating water from the tank through the filter and back to the tank with the electric pump, 0.75 totes (196 gallons) of glycerin will be added using a hose and drop tube extended from the suction side of the pump. A small amount of liquid, food-grade defoaming agent (*NO FOAM* distributed by Wilbur-Ellis) will be added, as needed, to minimize foaming of the injection solution.
- While recirculating water from the tank pre-dissolved MAP (20.53 lbs) and CAN-27 (33.52 lbs) will be added using a hose and drop tube extended from the suction side of the pump.[4]
- Following addition of glycerin, MAP, and CAN-27, and adequate recirculation for mixing, the tank contents will be injected to the wells, with valves adjusted to bypass the filter. During injection, the following substrates will added inline to the flow (i.e., metered in on the suction side of the pump); substrates will be added proportionally during the injection period:
  - Approximately 0.45 totes (116 gallons) of HRO. Passing water and HRO together through the pump will create the vegetable oil emulsion for injection. In-line mixing and direct injection minimizes any standing time for the emulsion to coalesce into larger oil droplets. HRO will be added at an approximate rate of 3.43 gallons per 100 gallons of tank mixture.
  - 3.51 lbs of yeast extract.

The cZVI injection solution will be mixed separately for the three identified source wells (BOP-78[i], BOP-87[i], BOP-88[i]). As a result, four of the 14 batches (described above) will be mixed and injected with the following volume modifications:

- Mixing tank will be filled with approximately 2,708 gallons of potable water.

[3] Soft particles were observed in injection fluid during the 2015 injections that may have been from the crude glycerin or dried flakes of donor residue in the batch tank from prior injections.

[4] Dry CAN-27 and MAP will be pre-dissolved in drums or totes prior to addition to the mixing tanks. CAN-27 contains about 10 percent by weight of dolomite as an inert solid, which will settle out as the product dissolves. The liquid from the drums or totes will be added to the mixing tanks and the settled dolomite will be retained for disposal.

- While recirculating water from the tank through the filter and back to the tank with the electric pump, 0.64 totes (167 gallons) of glycerin will be added.
- While recirculating water from the tank, pre-dissolved MAP (17.55 lbs) and CAN-27 (28.65 lbs) will be added.
- Substrates will be added proportionally during the injection period:
  - Approximately 0.38 totes (99 gallons) of HRO at an approximate rate of 3.46 gallons per 100 gallons of tank mixture.
  - 3.0 lbs of yeast extract mixed with water.
  - Approximately 0.75 drums (25 gallons) of ZVI at an approximate rate of 4.35 gallons per 500 gallons of tank mixture.

Precautions will be taken to prevent unplanned leaks of injection fluid. A tank level alarm will be utilized for all tank filling operations. Injection hose Camlock connections will be strapped closed and the hose will be monitored for leaks. The well seal of injection wells and surrounding floor and any nearby subsurface vaults will be monitored for potential water discharge indicative of injection short-circuiting to the surface. If any potential, minor leaks occur when disconnecting hoses, these will be collected and contained using buckets and a wet/dry vacuum. Potential incidental spills inside the secondary containment caused by mixing operations will be cleaned up using the wet/dry vacuum. When feasible, donor fluid and rinsate water will be added back into the batch tank for injection into a well or will be disposed of offsite. A spill kit will be set up at the injection location and will contain: cat litter, adsorbent pads, and berming material to contain larger spills.

Performance Groundwater Monitoring and Reporting

Performance groundwater monitoring for wells located in and downgradient of the source area will continue on a semiannual basis (February and August). Additionally, within the source area, groundwater sampling will continue on a quarterly basis (February, May, August, and November) to evaluate injection effectiveness and longevity of treatment. Groundwater monitoring parameters will include analysis of chemicals of concern, aquifer redox, and electron donor, as summarized in Table 4.

Annual reports will document and evaluate the results of the groundwater monitoring events for that calendar year. The report for each year will be submitted in the first quarter of the following calendar year. The 2020 injection will be documented in the 2020 annual report.

Schedule

Injection activities are currently planned to occur in late spring or early summer 2020 depending on facility operations and safety concerns associated with COVID-19 response.

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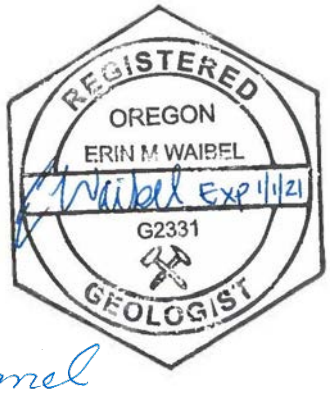

Erin M. Waibel, RG
Sr. Project Geologist

Christine B. Kimmel, LG
Sr. Associate Geologist

Clint L. Jacob, PE, LG
Principal Engineer

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Attachments

Figure 1:	Former Vapor Degreaser Source Area Bioremediation Injection Wells
Figure 2:	Time versus Concentration Plot – BOP-73(i)
Figure 3:	Injection and Mixing Station
Table 1:	Summary of Injection Events
Table 2:	Bioremediation Progress Results
Table 3:	Injection Design
Table 4:	Bioremediation Monitoring Parameters

References

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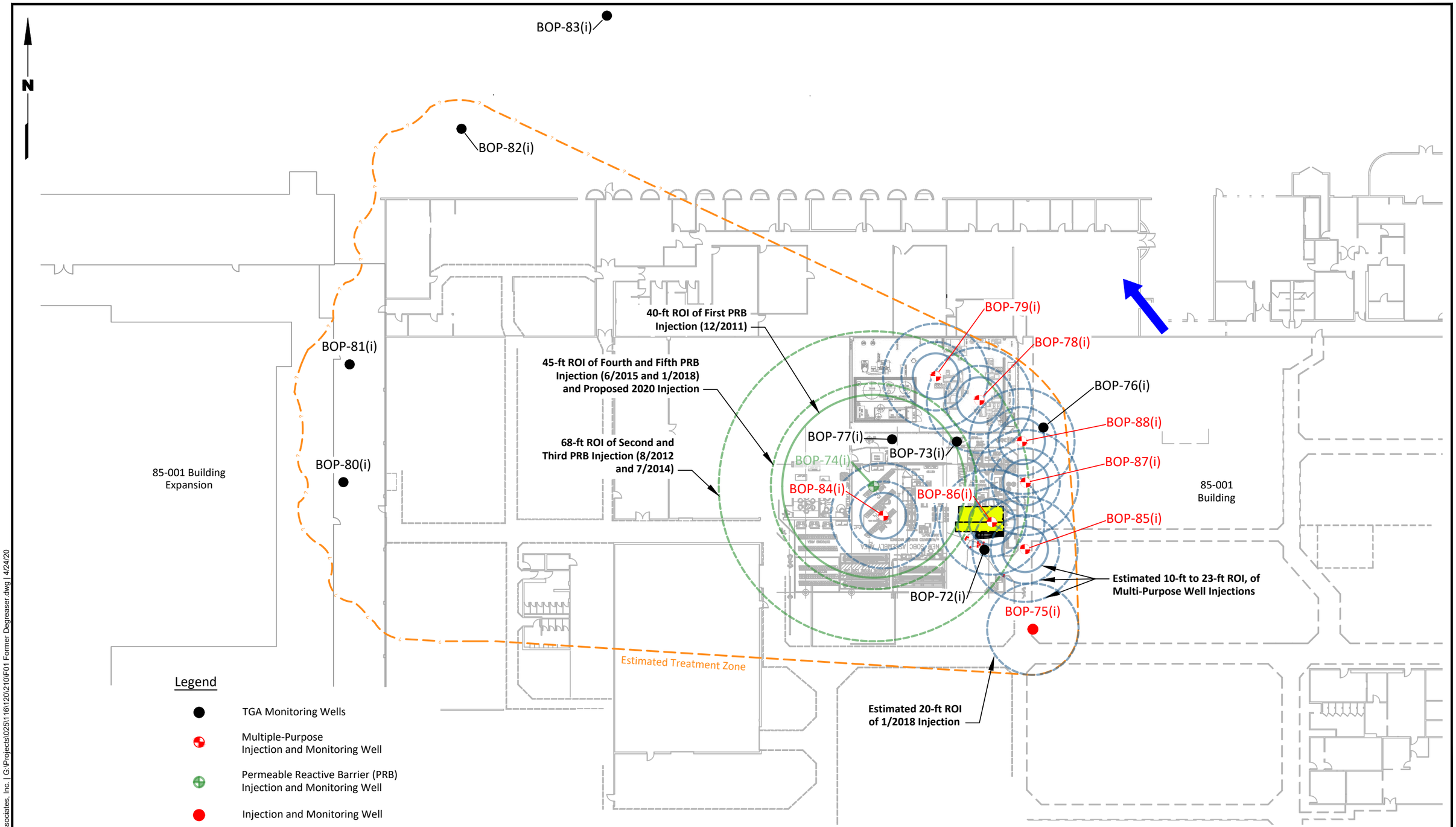

Data Source: The Boeing Company

Boeing Portland Gresham, Oregon	**Former Vapor Degreaser Source Area Bioremediation Injection Wells**	Figure 1

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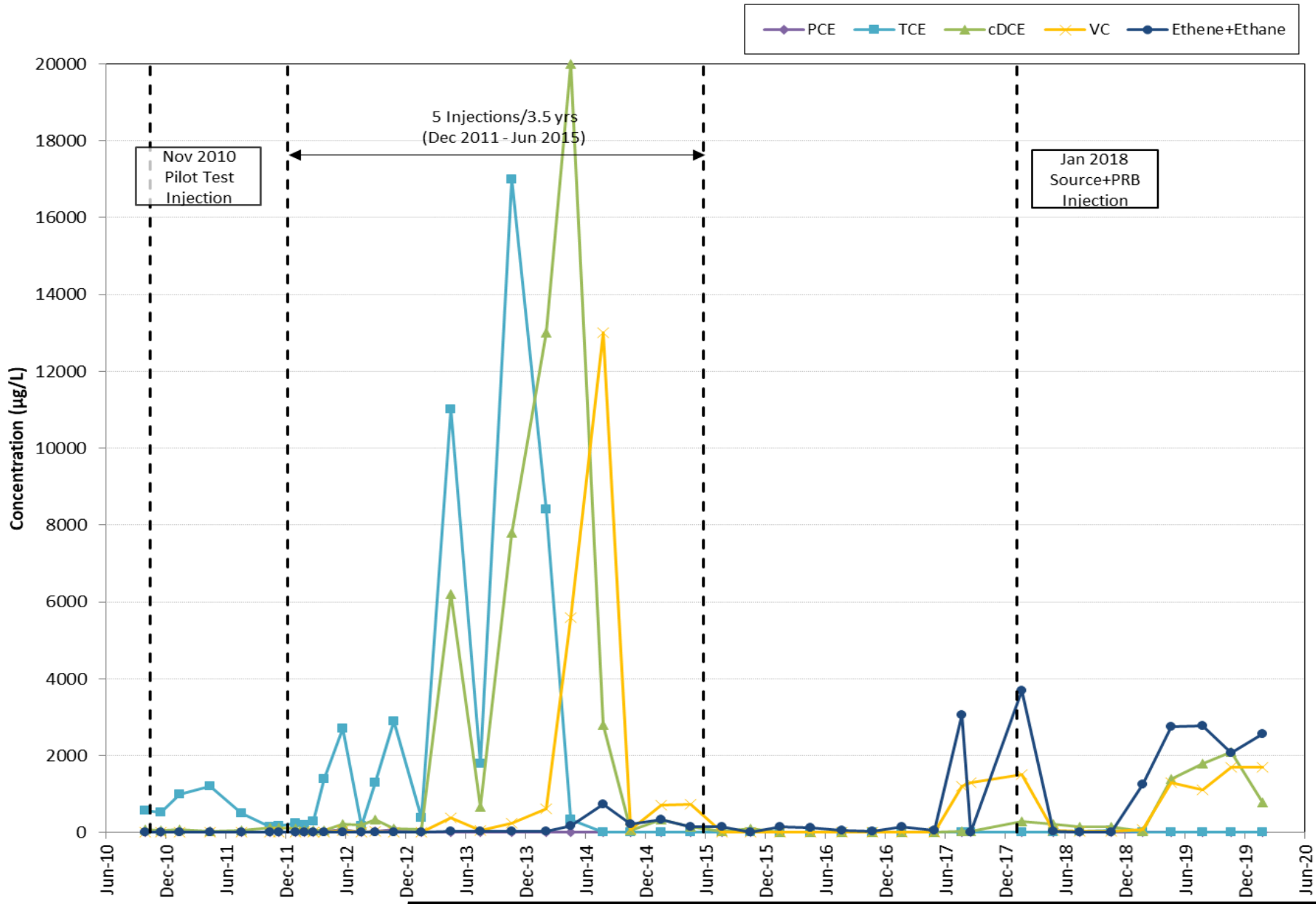

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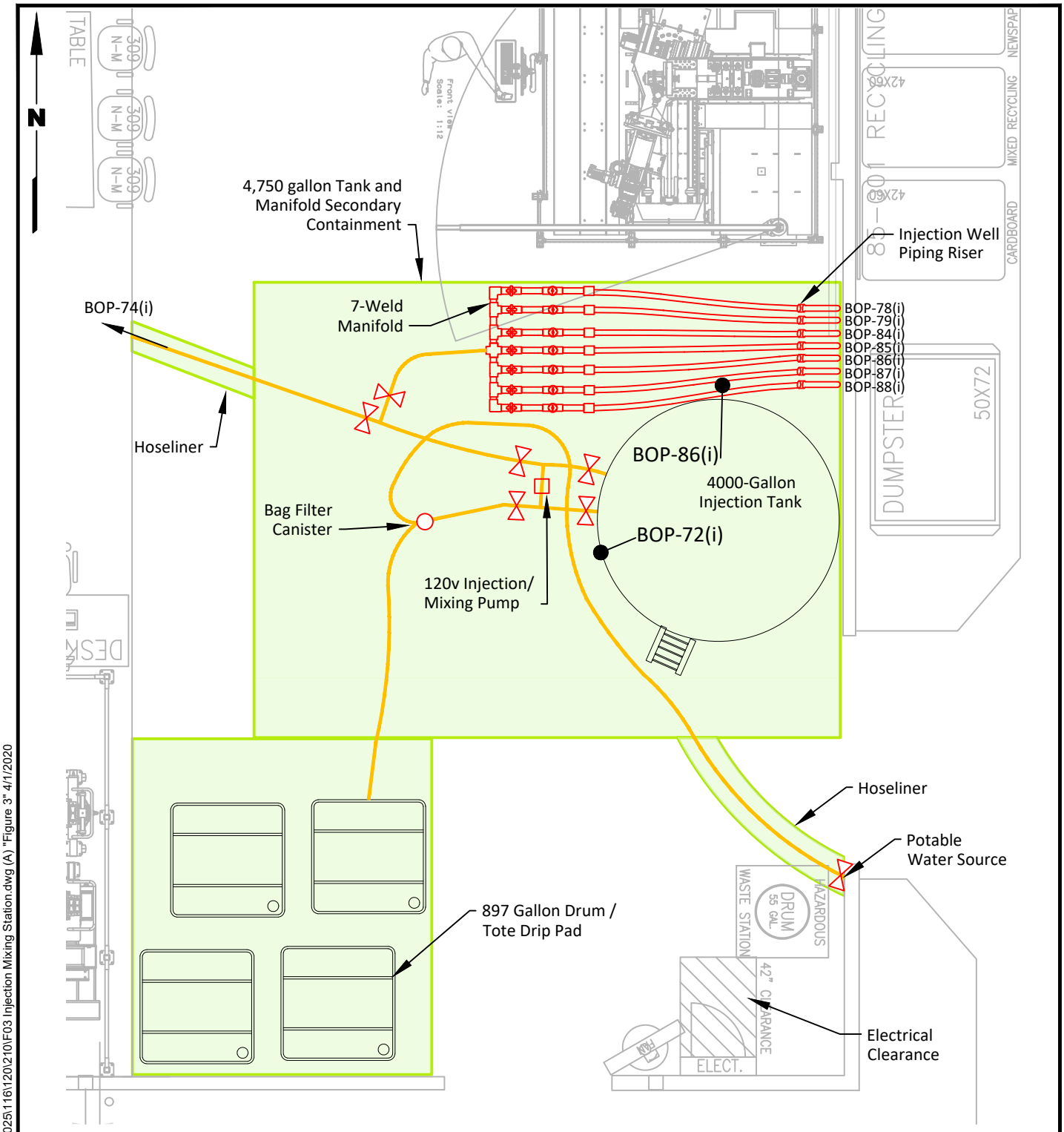
Boeing Portland
Gresham, Oregon

Time versus Concentration Plot
BOP-73(i)

Figure
2



Legend

- Valve
- Injection Hose
- Above Ground Injection Piping
- Secondary Containment Area

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

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Scale in Feet

Landau Associates, Inc. | G:\Projects\025\116\120\210\F03 Injection Mixing Station.dwg (A) "Figure 3" 4/1/2020

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Boeing Portland
Gresham, Oregon

Injection and Mixing Station

Figure 3

Table 1
Summary of Injection Events
Former Vapor Degreaser Source Area
Boeing Portland

Injection Event	Well(s)	Amount of Injection Solution (Electron Donor + Potable Water)
November 2010 (Pilot Injection)	BOP-72(i)	Pilot Well: 900 gallons (LactOil)
December 2011 (PRB)	BOP-74(i)	PRB: 15,000 gallons (LactOil)
August 2012 (PRB)	BOP-74(i)	PRB: 30,000 gallons (LactOil)
July 2013 (Source Wells)	BOP-78(i), BOP-79(i), and BOP-84(i) though BOP-88(i)	Source Wells: 9,200 gallons (LactOil)
July 2014 (PRB + Source Wells)	BOP-74(i), BOP-78(i), BOP-79(i), and BOP-84(i) though BOP-88(i)	PRB: 30,000 gallons Source Wells: 20,000 gallons Total: 50,000 gallons (Glycerin, Ferrous Sulfate, and Textrol BR)
July 2015 (PRB + Source Wells)	BOP-74(i), BOP-78(i), BOP-79(i), and BOP-84(i) though BOP-88(i)	PRB: 20,000 gallons Source Wells: 30,000 gallons Total: 50,000 gallons (Glycerin, Ferrous Sulfate, and Textrol BR)
January 2018 (PRB + Source Wells)	BOP-74(i), BOP-78(i), BOP-79(i), BOP-84(i) though BOP-88(i), and BOP-75(i)	PRB: 19,000 gallons Source Wells: 35,000 gallons Total: 54,000 gallons (Glycerin and HRO)
PROPOSED: **Spring/Summer 2020 (PRB + Source Wells)**	**PROPOSED:** **BOP-74(i), BOP-78(i), BOP-79(i), and BOP-84(i) through BOP-88(i)**	**PROPOSED:** **PRB: 19,100 gallons** **Source Wells: 28,000 gallons** **Total: 47,100 gallons (Glycerin and HRO; also cZVI to three targeted source wells)**

Notes:
Textrol BR = vegetable oil substrate
HRO = RNAS high-retention oil vegetable oil substrate
PRB = permeable reactive barrier
cZVI = colloidal zero-valent iron

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	Elapsed Time from Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-72(i)	10/19/2010		3.1	28	10	<1.0	<1.0	--	--	--	1.2	--	12.9	0.106	1.77		0.06	0.64	0.31	0.00	0.00	0.00
Monitoring Well	12/6/2010		<2.0	3.6	<2.0	<2.0	30.4	--	2.81	-26.2	<5.0	3.2	<5.0	0.849	3020	6.88	0.00	0.02	0.00	0.00	0.81	0.16
BOP-72(i)	2/2/2011		<20	<20	<20	<20	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	0.00	--	--
BOP-72(i)	5/5/2011		<1.0	<1.0	6.3	<1.0	--	--	0.21	163	--	--	--	--	--	6.79	0.00	0.00	1.00	0.00	--	--
BOP-72(i)	8/10/2011		<1.0	<1.0	10	<1.0	<1.1	<1.1	0.26	-151.6	<0.1	2.4	1.5	7.7	263	6.77	0.00	0.00	1.00	0.00	0.00	0.00
BOP-72(i)	11/3/2011		<1.0	<1.0	3.0	6.8	--	--	0.09	-138.8	--	--	--	--	--	6.71	0.00	0.00	0.22	0.78	--	--
BOP-72(i)	2/8/2012		<2.0	<2.0	<2.0	7.5	--	--	0.31	-317.5	--	--	--	--	--	7.46	0.00	0.00	0.00	1.00	--	--
BOP-72(i)	5/4/2012		<2.0	<2.0	<2.0	9.0	--	--	0.86	-65.7	--	--	--	--	--	6.69	0.00	0.00	0.00	1.00	--	--
BOP-72(i)	8/9/2012		<1.0	<1.0	<1.0	10	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--
BOP-72(i)	11/8/2012		<0.2	<0.2	0.2	5.1	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.02	0.98	--	--
BOP-72(i)	2/5/2013		<0.2	<0.2	0.3	3.4	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.05	0.95	--	--
BOP-72(i)	5/2/2013		<0.2	<0.2	0.2	3.3	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.04	0.96	--	--
BOP-72(i)	8/6/2013		<0.2	<0.2	0.7	2.7	5	<5.0	0.58	-148.8	<0.10	3.0	<5.0	13	47.4	6.66	0.00	0.00	0.03	0.19	0.78	0.00
BOP-72(i)	11/7/2013		<0.2	<0.2	0.3	1.9	<5.0	<5.0	0.62	-113.4	<0.10	2.5	<1.0	11	41.7	6.68	0.00	0.00	0.09	0.91	0.00	0.00
BOP-72(i)	2/5/2014		<0.2	<0.2	0.2	1.9	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.06	0.94	--	--
BOP-72(i)	5/7/2014		<0.2	<0.2	<0.2	1.5	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--
BOP-72(i)	8/13/2014		<0.2	<0.2	0.2	1.1	<5.0	<5.0	0.43	68.2	<0.10	3.0	<1.0	14	36.6	6.12	0.00	0.00	0.10	0.90	0.00	0.00
BOP-72(i)	11/6/2014		<0.2	<0.2	0.3	1.9	<5.0	<5.0	0.26	-147.7	<0.10	3.0	2.8	14	13.6	6.56	0.00	0.00	0.09	0.91	0.00	0.00
BOP-72(i)	2/5/2015		<0.2	<0.2	1.2	3.3	6.2	<5.0	0.25	-113.1	<0.10	5.5	16.2	13	8.6	6.34	0.00	0.00	0.04	0.18	0.77	0.00
BOP-72(i)	5/6/2015		<0.2	2.0	5.4	9.1	<5.0	<5.0	0.97	-91.2	<0.10	4.5	16.8	11	6.7	6.33	0.00	0.07	0.26	0.67	0.00	0.00
BOP-72(i)	8/10/2015		<0.2	<0.2	0.4	1.9	<5.0	<5.0	1.37	-167.7	<0.10	7.0	1.1	15	161.0	6.45	0.00	0.00	0.12	0.88	0.00	0.00
BOP-72(i)	11/4/2015		<0.2	<0.2	1.1	2.9	<5.0	<5.0	1.09	-100.5	<0.10	7.0	6.9	18	3.7	6.54	0.00	0.00	0.20	0.80	0.00	0.00
BOP-72(i)	2/3/2016		<0.2	<0.2	2.1	3.2	<5.0	<5.0	1.78	-57.7	<0.10	7.0	4.7	6	3.2	7.23	0.00	0.00	0.30	0.70	0.00	0.00
BOP-72(i)	5/4/2016		<0.2	1.0	2.2	2.9	<5.0	<5.0	1.59	-119.1	<0.10	7.0	9.7	16	3.9	6.29	0.00	0.10	0.30	0.60	--	--
BOP-72(i)	8/9/2016		<0.2	2.7	6.5	5.2	<5.0	<5.0	0.38	-124.8	<0.10	7.0	16.5	9.9	<1.0	6.32	0.00	0.12	0.39	0.49	0.00	0.00
BOP-72(i)	11/10/2016		<0.2	6.7	14	3.0	<5.0	<5.0	0.70	-38.80	<0.10	7.0	17.7	20	2.2	6.34	0.00	0.21	0.59	0.20	0.00	0.00
BOP-72(i)	2/7/2017		<0.2	4.9	16	2.7	<5.0	<5.0	0.89	-76.3	<0.10	7.0	16.4	18	3.4	6.51	0.00	0.15	0.67	0.18	0.00	0.00
BOP-72(i)	5/16/2017		<0.2	1.8	16	6.4	<5.0	<5.0	0.79	6.78	<0.10	1.0	13.7	25	7.0	6.30	0.00	0.05	0.59	0.36	0.00	0.00
BOP-72(i)	8/9/2017	-168	<0.2	1.8	17	8.3	<5.0	<5.0	0.8	-42.7	<0.10	7.0	14.2	9.1	5.7	6.2	0.00	0.04	0.54	0.41	0.00	0.00
BOP-72(i)	2/8/2018	16	<0.2	0.2	2.3	1.4	<5.0	<5.0	0.33	55.6	0.56	3.5	195	16	6530	4.93	0.00	0.03	0.50	0.47	0.00	0.00
BOP-72(i)	5/15/2018	111	<0.2	1	5.5	1	<5.0	<5.0	0.52	38.9	<0.10	7.0	14.6	19	2630	5.14	0.00	0.09	0.71	0.20	0.00	0.00
BOP-72(i)	8/3/2018	191	<0.2	0.4	3	0.8	<5.0	<5.0	0.27	-38.5	0.23	7.0	9.9	17	1440	5.56	0.00	0.07	0.66	0.27	0.00	0.00
BOP-72(i)	2/12/2019	384	<0.2	<0.2	1.4	1.1	<5.0	<5.0	0.20	-73.2	<0.50	2.0	2.0	11	<50.0	5.90	0.00	0.00	0.45	0.55	0.00	0.00
BOP-72(i)	5/9/2019	470	<0.2	<0.2	0.8	0.8	<5.0	<5.0	0.9	-83.03	<0.10	6.0	<1.0	15	13.9	6.00	0.00	0.00	0.39	0.61	0.00	0.00
BOP-72(i)	8/13/2019	567	<0.2	<0.2	0.5	0.5	<5.0	<5.0	0.43	-62.4	<0.10	4.5	1.3	18	11.6	6.16	0.00	0.00	0.39	0.61	0.00	0.00
BOP-72(i)	11/8/2019	654	<0.2	<0.2	0.6	0.8	<5.0	<5.0	0.34	-109.4	<0.10	4.0	1.1	12	12.9	6.13	0.00	0.00	0.33	0.67	0.00	0.00
BOP-72(i)	2/11/2020	749	<0.2	<0.2	2.3	1.1	<5.0	<5.0	0.42	-65	<0.10	6.0	<1.0	17	13.2	7.04	0.00	0.00	0.57	0.43	0.00	0.00
BOP-73(i)	10/19/2010		12	560	90	<1.0	<1.0	--	--	--	0.7	--	11	0.0599	1.6	--	0.01	0.81	0.18	0.00	0.00	0.00
Monitoring Well	12/6/2010		19	520	59	<2.0	<2.0	--	3.20	14.6	1.0	2.8	10.3	--	2.24	6.94	0.02	0.85	0.13	0.00	0.00	0.00
BOP-73(i)	2/2/2011		37	1000	78	<1.0	--	--	0.45	-14.8	--	--	--	--	--	6.37	0.03	0.88	0.09	0.00	--	--
BOP-73(i)	5/5/2011		43	1200	42	<3.0	--	--	0.64	15.6	--	--	--	--	--	6.29	0.03	0.93	0.04	0.00	--	--
BOP-73(i)	8/10/2011		18	510	48	<1.0	<1.1	<1.1	0.54	-24.9	1.0	2.4	11.8	1.01	1.88	6.30	0.02	0.87	0.11	0.00	0.00	0.00
BOP-73(i)	11/3/2011		4.7	160	130	<1.0	--	--	0.10	-42.9	--	--	--	--	--	6.33	0.01	0.47	0.52	0.00	--	--
BOP-73(i)	12/1/2011		5.0	180	120	<1.0	<1.1	<1.1	--	--	--	--	9.5	0.759	1.93	6.71	0.01	0.52	0.47	0.00	0.00	0.00
BOP-73(i)	1/19/2012		7.8	240	100	12	--	--	0.41	249	0.3	1.8	8.8	--	9.26	7.04	0.02	0.59	0.33	0.06	--	--
BOP-73(i)	2/16/2012		4.0	190	59	24	<1.1	<1.1	0.66	-235.3	0.3	2.2	11.5	1.35	<1.50	7.74	0.01	0.59	0.25	0.16	0.00	0.00

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	Elapsed Time from Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-73(i)	3/15/2012		6.4	290	53	13	<1.1	<1.1	0.80	-220	0.8	1.9	11.2	0.535	2.14	6.90	0.01	0.74	0.18	0.07	0.00	0.00
BOP-73(i)	4/17/2012		26	1400	50	14	<1.1	<1.1	1.23	-244.1	1.0	1.5	10.7	0.438	<1.50	7.66	0.01	0.92	0.04	0.02	0.00	0.00
BOP-73(i)	6/12/2012		72	2700	220	45	2.8	<1.1	0.70	28.3	0.9	2.0	9.7	0.787	1.61	6.37	0.02	0.85	0.09	0.03	0.00	0.00
BOP-73(i)	8/9/2012		2.2	180	190	13	--	--	--	--	--	--	--	--	219	--	0.00	0.39	0.55	0.06	--	--
BOP-73(i)	9/18/2012		41	1300	340	38	<5.0	<5.0	0.45	-119	0.28	1.6	8.4	1.6	5.2	6.31	0.02	0.69	0.25	0.04	0.00	0.00
BOP-73(i)	11/14/2012		83	2900	110	2.6	<5.0	<5.0	0.83	122.5	0.89	0.5	10.2	3.2	<1.0	6.57	0.02	0.93	0.05	0.00	0.00	0.00
BOP-73(i)	2/6/2013		13	390	77	4.7	<5.0	<5.0	0.52	56.4	0.11	0.5	8.9	1.4	--	6.26	0.02	0.76	0.20	0.02	0.00	0.00
BOP-73(i)	5/7/2013		16	11000	6200	380	29	<5.0	2.75	-28.6	<0.10	2.0	7.8	2.8	--	6.39	0.00	0.54	0.41	0.04	0.01	0.00
BOP-73(i)	8/6/2013		6.5	1800	670	65	27	<5.0	0.52	-120.5	<0.10	1.5	10.2	4.8	2.4	6.18	0.00	0.60	0.31	0.05	0.04	0.00
BOP-73(i)	11/7/2013		<4.0	17000	7800	250	30	<5.0	1.13	-75.5	<0.10	3.0	8.6	1.9	2.0	6.41	0.00	0.60	0.37	0.02	0.00	0.00
BOP-73(i)	2/20/2014		<40	8400	13000	610	21	<5.0	1.23	23.0	<0.10	4.0	6.9	2.6	1.5	6.54	0.00	0.31	0.64	0.05	0.00	0.00
BOP-73(i)	5/8/2014		<20	340	20000	5600	180	<5.0	0.50	-43.5	<0.10	2.5	<1.0	3.4	7.2	6.92	0.00	0.01	0.68	0.29	0.02	0.00
BOP-73(i)	8/13/2014		<2.0	<2.0	2800	13000	730	<5.0	1.14	17.3	<0.10	4.5	1.4	4.8	32.9	5.87	0.00	0.00	0.11	0.79	0.10	0.00
BOP-73(i)	11/6/2014		<0.2	1.7	47	73	210	<5.0	0.15	-108.1	<0.10	3.0	4.1	5.6	11.9	6.41	0.00	0.00	0.05	0.13	0.82	0.00
BOP-73(i)	2/5/2015		<2.0	<2.0	340	720	347.1	<5.0	0.45	-103.3	<0.10	5.0	1.1	8.4	4.3	6.41	0.00	0.00	0.13	0.42	0.44	0.01
BOP-73(i)	5/6/2015		<2.0	<2.0	150	730	160	<5.0	1.08	-86.1	<0.10	5.0	1.4	13	7.2	6.35	0.00	0.00	0.08	0.62	0.30	0.00
BOP-73(i)	8/10/2015		<0.2	1.3	24	20	140	<5.0	0.66	-200.4	<0.10	7.0	4.8	12	28.4	6.27	0.00	0.00	0.04	0.06	0.90	0.00
BOP-73(i)	11/4/2015		<0.2	5.8	92	19	18.6	<5.0	0.51	-79.6	<0.10	7.0	10.9	7.5	5.1	6.36	0.00	0.02	0.49	0.16	0.16	0.17
BOP-73(i)	2/3/2016		<0.2	0.4	2.5	8.8	149	<5.0	1.11	-45.7	<0.10	7.0	2.4	15	9.6	7.18	0.00	0.00	0.00	0.03	0.52	0.45
BOP-73(i)	5/4/2016		<0.2	<0.2	<0.2	<0.2	120	<5.0	0.92	-153.3	<0.10	7.0	1.6	20.0	3.7	6.34	0.00	0.00	0.00	0.00	0.19	0.81
BOP-73(i)	8/9/2016		<0.2	0.7	2.7	2.6	54	<5.0	0.26	-124.8	<0.10	7.0	8.0	6.8	2.3	6.37	0.00	0.00	0.01	0.02	0.00	0.96
BOP-73(i)	11/10/2016		<0.2	1.5	5.1	3.2	32	<5.0	0.30	-60.1	<0.10	7.0	7.3	2.9	2.5	6.39	0.00	0.01	0.04	0.04	0.00	0.90
BOP-73(i)	2/7/2017		<0.2	1.4	5.7	3.4	145	<5.0	0.49	-54.9	<0.10	7.0	4.4	11	5.0	6.45	0.00	0.00	0.01	0.01	0.59	0.39
BOP-73(i)	5/16/2017		<0.2	<0.2	1.3	1.9	65	<5.0	0.51	-24.9	<0.10	2.0	9.3	6.1	3.9	6.41	0.00	0.00	0.01	0.01	0.35	0.63
BOP-73(i)	8/9/2017		<0.2	<0.2	24	1200	3070	<5.0	0.6	-43.1	<0.10	7.0	2.2	19	15.4	6.4	0.00	0.00	0.00	0.15	0.78	0.07
BOP-73(i)	9/5/2017	-141	<0.2	0.8	31	1300	--	NS	1.2	-30.6	NS	NS	NS	NS	NS	6.5	0.00	0.00	0.02	0.98	0.00	0.00
BOP-73(i)	2/8/2018	16	<0.2	0.9	280	1500	3683	<5.0	0.18	21.2	<0.50	2.0	1.1	22	370	5.68	0.00	0.00	0.02	0.15	0.81	0.02
BOP-73(i)	5/15/2018	111	<0.2	1.5	210	62	21.7	<5.0	0.51	-35.1	<0.10	7.0	<1.0	7	17.8	6.40	0.00	0.00	0.55	0.25	0.08	0.11
BOP-73(i)	8/3/2018	192	<0.2	38	150	22	5.1	<5.0	0.19	-18.0	<0.10	3.5	11.2	1.4	3.4	6.32	0.00	0.12	0.65	0.15	0.08	0.00
BOP-73(i)	11/7/2018	288	<0.2	47	140	24	9.4	<5.0	7.70	-32.0	<0.10	6.5	11.4	1.2	2.9	6.50	0.00	0.14	0.57	0.15	0.13	0.00
BOP-73(i)	2/12/2019	384	<0.2	<0.2	35	86	1249	<5.0	2.42	110.7	<0.50	1.5	<1.0	3.9	8.8	5.32	0.00	0.00	0.01	0.03	0.93	0.04
BOP-73(i)	5/8/2019	470	<4.0	<4.0	1400	1300	2751	<5.0	1.03	25.30	<0.50	3.0	<1.0	15	3.9	6.55	0.00	0.00	0.11	0.16	0.72	0.01
BOP-73(i)	8/13/2019	567	<4.0	<4.0	1800	1100	2785	<5.0	0.30	-48.8	<0.10	2.5	<1.0	17	2.5	6.27	0.00	0.00	0.14	0.13	0.71	0.02
BOP-73(i)	11/8/2019	653	<4.0	<4.0	2100	1700	2063	<5.0	0.72	-102.1	<0.10	2.5	<1.0	12	3.4	6.89	0.00	0.00	0.18	0.22	0.58	0.02
BOP-73(i)	2/11/2020	749	<4.0	4.2	780	1700	2559	<5.0	0.39	-22.9	<0.10	3.5	<1.0	16	2.9	7.25	0.00	0.00	0.06	0.22	0.71	0.02
BOP-74(i)	10/19/2010		1.0	38	8.0	<1.0	<1.0	--	--	--	0.9	--	9.1	0.1	<1.50	--	0.02	0.77	0.22	0.00	0.00	0.00
PRB Well	12/6/2010		<1.0	24	6.5	<1.0	<1.0	--	3.07	53.3	0.2	0.2	9.9	--	2.79	6.61	0.00	0.73	0.27	0.00	--	--
BOP-74(i)	2/2/2011		2.6	44	3.8	<1.0	--	--	0.42	81.0	--	--	--	--	--	6.22	0.04	0.86	0.10	0.00	--	--
BOP-74(i)	5/5/2011		2.0	26	8.0	<1.0	--	--	0.25	56.5	--	--	--	--	--	6.23	0.04	0.68	0.28	0.00	0.00	0.00
BOP-74(i)	8/10/2011		<1.0	8.9	7.2	<1.0	<1.1	<1.1	0.50	-124.9	<0.1	2.0	6.6	4.3	2.69	6.42	0.00	0.48	0.52	0.00	0.00	0.00
BOP-74(i)	11/3/2011		<1.0	3.1	16	<1.0	--	--	0.10	-21.2	--	--	--	--	--	6.46	0.00	0.13	0.87	0.00	--	--
BOP-74(i)	12/1/2011		<1.0	8.6	17	<1.0	<1.1	<1.1	0.01	-302.2	<0.1	1.6	6.7	1.8	3.03	7.03	0.00	0.27	0.73	0.00	0.00	0.00
BOP-74(i)	1/19/2012		<1.0	11	18	<1.0	1.6	<1.1	0.21	-170	<1.0	2.0	<1.0	2.6	1450	5.48	0.00	0.26	0.58	0.00	0.00	0.16
BOP-74(i)	2/16/2012		<1.0	2.4	44	1.6	<1.1	<1.1	0.93	-154	<0.5	3.8	<0.5	6.68	668	5.23	0.00	0.04	0.91	0.05	0.00	0.00
BOP-74(i)	3/15/2012		<1.0	1.4	210	3.2	<1.1	<1.1	0.10	-244	<0.5	4.8	<0.5	8.41	330	6.40	0.00	0.00	0.97	0.02	0.00	0.00
BOP-74(i)	4/17/2012		<5.0	<5.0	79	50	<1.1	<1.1	0.13	-276.9	<0.1	1.8	0.8	8.8	72.0	6.83	0.00	0.00	0.50	0.50	0.00	0.00

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	Elapsed Time from Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-74(i)	6/12/2012		<1.0	<1.0	1.2	14	<1.1	<1.1	0.72	-9.9	<0.1	4.8	<0.1	5.72	67.6	5.78	0.00	0.00	0.05	0.95	0.00	0.00
BOP-74(i)	8/9/2012		<1.0	<1.0	<1.0	1.9	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--
BOP-74(i)	9/19/2012		<0.2	4.5	60	2.9	<5.0	<5.0	1.20	18.0	<0.10	4.0	<1.0	13	1280	4.86	0.00	0.05	0.88	0.07	0.00	0.00
BOP-74(i)	11/14/2012		<0.2	0.6	6.9	18	<5.0	<5.0	5.92	93.6	<0.10	4.0	<1.0	22	145	5.96	0.00	0.01	0.20	0.79	0.00	0.00
BOP-74(i)	2/6/2013		<0.2	0.5	1.7	2.9	<5.0	<5.0	0.28	-21.3	<0.10	5.0	<1.0	27	83.7	6.15	0.00	0.06	0.26	0.68	0.00	0.00
BOP-74(i)	5/7/2013		<0.2	4.0	2.7	1.8	<5.0	<5.0	1.21	-53.0	<0.10	3.0	<1.0	21	128	6.04	0.00	0.35	0.32	0.33	0.00	0.00
BOP-74(i)	8/6/2013		<0.2	0.6	14	8.1	<5.0	<5.0	2.35	-25.0	<0.10	3.5	<1.0	26	669	5.07	0.00	0.02	0.52	0.47	0.00	0.00
BOP-74(i)	11/7/2013		<0.2	<0.2	3.6	1.6	7.3	<5.0	1.49	95.6	<0.10	3.5	<1.0	17	330	6.05	0.00	0.00	0.11	0.08	0.81	0.00
BOP-74(i)	2/20/2014		<0.2	<0.2	2.4	0.9	5	<5.0	0.92	-71.6	<0.10	6.0	<1.0	22	66.2	6.37	0.00	0.00	0.12	0.07	0.00	0.81
BOP-74(i)	5/8/2014		<0.2	<0.2	2.8	3.3	5.9	<5.0	1.15	-33.7	<0.10	3.0	<1.0	19	32.8	6.58	0.00	0.00	0.10	0.18	0.72	0.00
BOP-74(i)	11/6/2014		<0.2	0.3	11	2.1	<5.0	<5.0	0.12	-134.5	0.63	7.0	501	21	2860	4.16	0.00	0.02	0.76	0.22	0.00	0.00
BOP-74(i)	2/6/2015		<0.2	0.4	15	1.9	<5.0	<5.0	0.23	-95.9	0.54	7.0	626	21	2230	4.86	0.00	0.02	0.82	0.16	0.00	0.00
BOP-74(i)	5/6/2015		<0.2	0.5	15	1.6	<5.0	<5.0	0.79	-107.6	0.27	7.0	247		1240	4.92	0.00	0.02	0.84	0.14	0.00	0.00
BOP-74(i)	11/4/2015		<0.2	<0.2	5.3	2.9	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.54	0.46	--	--
BOP-74(i)	2/3/2016		<0.2	<0.2	11	3.1	<5.0	<5.0	1.68	60.4	<1.0	7.0	1460	21	4200	5.5	0.00	0.00	0.70	0.30	0.00	0.00
BOP-74(i)	5/4/2016		<0.2	0.2	11	2.6	<5.0	<5.0	0.52	-21.6	<1.0	7.0	601.0	19.0	2480	4.57	0.00	0.01	0.72	0.27	--	--
BOP-74(i)	8/9/2016		<0.2	0.2	11	1.6	<5.0	<5.0	--	-36.9	0.45	7.0	453	18	1840	4.72	0.00	0.01	0.81	0.18	0.00	0.00
BOP-74(i)	11/10/2016		<0.2	0.2	9.9	1.3	<5.0	<5.0	0.34	-9.0	0.16	7.0	225	22	1430	4.87	0.00	0.01	0.82	0.17	0.00	0.00
BOP-74(i)	2/7/2017		<0.2	0.2	8.7	1.3	<5.0	<5.0	0.33	-18.1	0.24	7.0	110	23	1690	5.00	0.00	0.01	0.80	0.19	0.00	0.00
BOP-74(i)	5/16/2017		<0.2	<0.2	7.5	1.1	<5.0	<5.0	0.39	-35.7	0.26	2.0	147	28	1580	5.04	0.00	0.00	0.81	0.19	0.00	0.00
BOP-74(i)	8/9/2017	-167	<0.2	<0.2	7.1	1	<5.0	<5.0	0.4	-22.3	0.19	7.0	42.2	23	1310	5.0	0.00	0.00	0.82	0.18	0.00	0.00
BOP-74(i)	2/27/2018	35	<0.2	<0.2	2.1	1	<5.0	<5.0	0.67	5.2	0.83	7.0	158	23	7320	4.86	0.00	0.00	0.58	0.42	0.00	0.00
BOP-74(i)	5/15/2018	112	<0.4	<0.4	3.2	0.7	<5.0	<5.0	0.43	32.1	<0.10	7.0	67.1	20	2000	5.06	0.00	0.00	0.75	0.25	0.00	0.00
BOP-74(i)	8/8/2018	197	<0.2	<0.2	3.6	0.8	31	<5.0	0.36	-28.9	<0.10	2.0	77.9	20	2550	4.5	0.00	0.00	0.03	0.01	0.60	0.35
BOP-74(i)	2/12/2019	384	<0.2	<0.2	3.2	2.7	<5.0	<5.0	0.35	67.4	<0.50	3.5	30.7	12	2070	4.9	0.00	0.00	0.43	0.57	0.00	0.00
BOP-74(i)	5/9/2019	470	<0.2	0.2	3.6	3.5	<5.0	<5.0	0.00	43.43	<0.10	4.0	20.3	22	1410	4.84	0.00	0.02	0.39	0.59	0.00	0.00
BOP-74(i)	8/13/2019	567	<0.2	<0.2	3.1	1.8	6.7	<5.0	0.21	-20.7	<0.10	2.0	48.9	27	1150	4.90	0.00	0.00	0.11	0.10	0.80	0.00
BOP-74(i)	11/8/2019	653	<0.2	<0.2	3.1	1.6	17.7	<5.0	0.32	51.6	<0.10	2.0	97.9	18	1510	4.69	0.00	0.00	0.05	0.04	0.58	0.33
BOP-74(i)	2/12/2020	749	<0.2	<0.2	2.8	1.6	13.6	<5.0	0.55	-4.7	<0.10	3.5	10.3	22	752	5.45	0.00	0.00	0.06	0.05	0.35	0.54
BOP-75(i)	2/2/2011		2.5	87	11	<1.0	--	--	--	--	--	--	--	--	--	--	0.02	0.84	0.14	0.00	--	--
Upgradient Well	5/5/2011		1.1	52	11	<1.0	--	--	--	--	--	--	13.5	--	4.77	--	0.01	0.77	0.22	0.00	--	--
BOP-75(i)	8/10/2011		1.6	59	11	<1.0	<1.1	<1.1	1.76	-16.3	1.1	2.4	--	<0.0007	--	6.24	0.02	0.78	0.20	0.00	0.00	0.00
BOP-75(i)	11/3/2011		1.2	58	10	<1.0	--	--	--	--	--	--	--	--	--	--	0.01	0.80	0.19	0.00	--	--
BOP-75(i)	2/8/2012		1.3	55	9.7	<1.0	--	--	--	--	--	--	--	--	--	--	0.01	0.80	0.19	0.00	--	--
BOP-75(i)	5/4/2012		<1.0	52	10	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	0.79	0.21	0.00	--	--
BOP-75(i)	8/9/2012		1.6	39	7.2	<1.0	--	--	--	--	--	--	--	--	--	--	0.03	0.78	0.20	0.00	--	--
BOP-75(i)	11/8/2012		1.0	35	6.9	<0.2	--	--	--	--	--	--	--	--	--	--	0.02	0.78	0.21	0.00	--	--
BOP-75(i)	2/5/2013		1.0	54	9.5	<0.2	--	--	--	--	--	--	--	--	--	--	0.01	0.80	0.19	0.00	--	--
BOP-75(i)	5/2/2013		0.8	42	7.5	<0.2	--	--	--	--	--	--	--	--	--	--	0.01	0.80	0.19	0.00	--	--
BOP-75(i)	6/17/2013		0.7	35	9.8	<0.2	<5.0	<5.0	1.91	73.6	1.7	0.0	13.6	<0.005	2.3	6.25	0.01	0.72	0.27	0.00	0.00	0.00
BOP-75(i)	8/6/2013		0.2	1.3	37	0.2	<5.0	<5.0	2.32	-159.5	<0.10	3.0	<1.0	0.39	51.3	6.43	0.00	0.02	0.96	0.01	0.00	0.00
BOP-75(i)	11/7/2013		<0.2	2.2	2.4	25	<5.0	<5.0	0.77	-167.0	<0.10	3.5	4.5	12	5.5	6.55	0.00	0.04	0.06	0.91	0.00	0.00
BOP-75(i)	2/5/2014		<0.2	2.6	1.3	18	--	--	--	--	--	--	--	--	--	--	0.00	0.06	0.04	0.90	--	--
BOP-75(i)	5/7/2014		<0.2	7.4	2.7	14	--	--	--	--	--	--	--	--	--	--	0.00	0.18	0.09	0.73	--	--
BOP-75(i)	8/13/2014		<0.2	6.2	9.5	10	<5.0	<5.0	0.40	-30.2	<0.10	7.0	27.7	9.9	258	5.38	0.00	0.15	0.32	0.52	0.00	0.00
BOP-75(i)	11/5/2014		<0.2	<0.2	4.3	11	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.20	0.80	--	--

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

		Elapsed Time from Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
Well	Date	Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-75(i)	2/6/2015		<0.2	9.1	8.6	4.2	<5.0	<5.0	0.26	-117.3	<0.10	--	3.4	14	3.9	6.11	0.00	0.31	0.39	0.30	0.00	0.00
BOP-75(i)	5/4/2015		<0.2	13	6.4	4.3	--	--	--	--	--	--	--	--	--	--	0.00	0.42	0.28	0.29	--	--
BOP-75(i)	8/10/2015		<0.2	1.5	4.2	3.3	<5.0	<5.0	0.50	-217.3	<0.10	7.0	255	15	1170	5.34	0.00	0.11	0.40	0.49	0.00	0.00
BOP-75(i)	11/6/2015		<0.2	0.4	4.7	4.2	--	--	--	--	--	--	--	--	--	--	0.00	0.03	0.41	0.57	--	--
BOP-75(i)	2/3/2016		<0.2	1.1	3.5	4.3	<5.0	<5.0	1.51	-65.6	<0.10	7.0	5.5	18	2.5	7.26	0.00	0.07	0.32	0.61	0.00	0.00
BOP-75(i)	5/5/2016		<0.2	2.0	3.9	5.4	--	--	--	--	--	--	--	--	--	--	0.00	0.11	0.28	0.61	--	--
BOP-75(i)	8/9/2016		<0.2	1.0	3.0	4.7	<5.0	<5.0	0.38	-125.9	<0.10	7.0	6.0	18	1.9	6.19	0.00	0.07	0.27	0.66	0.00	0.00
BOP-75(i)	11/4/2016		<0.2	6.2	3.0	3.4	--	--	--	--	--	--	--	--	--	--	0.00	0.36	0.23	0.41	--	--
BOP-75(i)	2/7/2017		<0.2	4.9	2.9	4.1	<5.0	<5.0	0.44	-67.1	<0.10	7.0	11.6	11	2.7	6.32	0.00	0.28	0.23	0.49	0.00	0.00
BOP-75(i)	5/16/2017		<0.2	5.3	3.2	3.4	--	--	--	--	--	--	--	--	--	--	0.00	0.32	0.26	0.43	0.00	0.00
BOP-75(i)	8/9/2017	-168	<0.2	8.4	4.9	3.4	<5.0	<5.0	0.5	-50.9	<0.10	7.0	16.1	6.5	2.4	6.2	0.00	0.38	0.30	0.32	0.00	0.00
BOP-75(i)	2/27/2018	34	<0.2	<0.2	0.3	0.2	<5.0	<5.0	0.19	-98.7	<1.0	7.0	31.7	1.2	3450	4.92	0.00	0.00	0.49	0.51	0.00	0.00
BOP-75(i)	5/15/2018	111	<0.2	<0.2	0.6	0.4	<5.0	<5.0	1.1	63.2	0.35	7.0	23.6	16	3630	4.78	0.00	0.00	0.49	0.51	0.00	0.00
BOP-75(i)	8/3/2018	192	<0.2	<0.2	0.9	0.8	14.2	<5.0	0.33	-9.6	0.54	6.5	28.8	19	2560	5.27	0.00	0.00	0.42	0.58	0.00	0.00
BOP-75(i)	11/7/2018	287	<0.2	0.2	1.1	0.6	<5.0	<5.0	8.4	0.3	0.71	7.0	28.7	20	2100	5.5	0.00	0.07	0.50	0.43	0.00	0.00
BOP-75(i)	2/12/2019	384	<0.2	0.2	1.7	0.5	<5.0	<5.0	0.2	21.6	<0.50	1.5	<1.0	13	373	5.6	0.00	0.06	0.65	0.30	0.00	0.00
BOP-75(i)	5/8/2019	470	<0.2	<0.2	1.9	0.2	<5.0	<5.0	0.91	47.10	<0.50	2.0	<1.0	25	56.8	6.06	0.00	0.00	0.86	0.14	0.00	0.00
BOP-75(i)	8/13/2019	566	<0.2	<0.2	1.4	0.2	<5.0	<5.0	0.70	-108.8	<0.10	2.5	1.3	21	39.2	6.12	0.00	0.00	0.82	0.18	0.00	0.00
BOP-75(i)	11/8/2019	654	<0.2	<0.2	0.7	0.3	<5.0	<5.0	0.33	-94.8	<0.10	5.0	1.6	27	64.1	6.08	0.00	0.00	0.60	0.40	0.00	0.00
BOP-75(i)	2/11/2020	749	<0.2	<0.2	0.6	0.6	<5.0	<5.0	0.5	-36.8	<0.10	6.0	1.1	21	63.6	6.73	0.00	0.00	0.39	0.61	0.00	0.00
BOP-76(i)	2/2/2011		1.7	8.5	<1.0	<1.0	--	--	--	--	--	--	--	--	--	--	0.14	0.86	0.00	0.00	--	--
Monitoring Well	5/5/2011		<1.0	6.8	1.2	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	0.81	0.19	0.00	--	--
BOP-76(i)	8/10/2011		1.2	13	4.6	<1.0	<1.1	<1.1	3.59	110	3.8	1.1	10.2	<0.0007	2.37	6.20	0.05	0.64	0.31	0.00	0.00	0.00
BOP-76(i)	11/3/2011		1.4	27	1.6	<1.0	--	--	--	--	--	--	--	--	--	--	0.04	0.89	0.07	0.00	--	--
BOP-76(i)	2/8/2012		<1.0	2.1	<1.0	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--
BOP-76(i)	5/4/2012		<1.0	9.2	1.5	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	0.82	0.18	0.00	--	--
BOP-76(i)	8/9/2012		1.1	33	2.2	<1.0	--	--	--	--	--	--	--	--	--	--	0.02	0.90	0.08	0.00	--	--
BOP-76(i)	11/8/2012		0.8	9.8	1.7	<0.2	--	--	--	--	--	--	--	--	--	--	0.05	0.77	0.18	0.00	--	--
BOP-76(i)	2/5/2013		0.8	11	1.5	<0.2	--	--	--	--	--	--	--	--	--	--	0.05	0.80	0.15	0.00	--	--
BOP-76(i)	5/2/2013		1.4	22	1.7	<0.2	--	--	--	--	--	--	--	--	--	--	0.04	0.87	0.09	0.00	--	--
BOP-76(i)	6/17/2013		1.1	26	1.9	<0.2	<5.0	<5.0	1.34	75.5	3.7	0.0	11.0	<0.005	1.6	6.18	0.03	0.88	0.09	0.00	0.00	0.00
BOP-76(i)	8/6/2013		<0.2	1.0	100	8.3	<5.0	<5.0	2.24	-130.0	<0.10	3.5	<1.0	3.4	111	6.14	0.00	0.01	0.88	0.11	0.00	0.00
BOP-76(i)	11/7/2013		2.4	140	37	42	<5.0	<5.0	1.51	-204.2	<0.10	3.5	3.5	11	6.9	6.44	0.01	0.50	0.18	0.31	0.00	0.00
BOP-76(i)	2/5/2014		1.0	45	5.8	8.5	--	--	--	--	--	--	--	--	--	--	0.01	0.63	0.11	0.25	--	--
BOP-76(i)	5/7/2014		<0.2	7.2	1.2	4.6	--	--	--	--	--	--	--	--	--	--	0.00	0.39	0.09	0.52	--	--
BOP-76(i)	8/13/2014		0.3	13	24	4.1	<5.0	<5.0	0.45	1.8	<0.10	7.0	3.2	7.6	170	5.27	0.00	0.24	0.60	0.16	0.00	0.00
BOP-76(i)	11/6/2014		<0.2	1.4	9.5	2.1	15	<5.0	0.20	-104.7	0.20	1.5	3.2	21	51.2	5.88	0.00	0.02	0.14	0.05	0.79	0.00
BOP-76(i)	2/5/2015		<0.2	1.0	7.0	2.2	30	<5.0	0.23	-154.7	0.21	2.75	5.1	19	12.7	6.08	0.00	0.01	0.06	0.03	0.90	0.00
BOP-76(i)	5/7/2015		<0.2	0.6	6.6	3.9	<5.0	<5.0	1.52	-124.1	<0.10	4.0	5.5	20	7.5	6.14	0.00	0.03	0.50	0.46	0.00	0.00
BOP-76(i)	8/10/2015		<0.2	2.2	14	2.0	<5.0	<5.0	0.43	-190.8	<0.10	7.0	108	12	659	5.54	0.00	0.09	0.75	0.17	0.00	0.00
BOP-76(i)	11/4/2015		<0.2	0.9	14	2.0	<5.0	<5.0	0.83	-86.1	<0.10	7.0	4.0	15	115	6.15	0.00	0.04	0.79	0.17	0.00	0.00
BOP-76(i)	2/3/2016		<0.2	1.0	9.8	1.6	<5.0	<5.0	1.13	-85.0	<0.10	7.0	6.3	16	5.0	7.16	0.00	0.06	0.75	0.19	0.00	0.00
BOP-76(i)	5/4/2016		<0.2	0.5	10	3.8	<5.0	<5.0	8.65	-227.8	<0.10	7.0	4.5	18	26.4	6.15	0.00	0.02	0.61	0.36	--	--
BOP-76(i)	8/9/2016		<0.2	1.1	11	4.2	<5.0	<5.0	0.81	-136.0	<0.10	7.0	6.7	14	7.8	6.13	0.00	0.04	0.60	0.36	0.00	0.00
BOP-76(i)	11/10/2016		<0.2	3.5	7.4	2.5	<5.0	<5.0	0.40	-31.5	<0.10	7.0	21.9	14	3.4	6.14	0.00	0.19	0.53	0.28	0.00	0.00
BOP-76(i)	2/7/2017		<0.2	4.8	4.6	1.8	<5.0	<5.0	0.57	-0.4	<0.10	7.0	21.2	12	4.1	6.31	0.00	0.32	0.42	0.26	0.00	0.00

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	Elapsed Time from Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-76(i)	5/16/2017		<0.2	2.1	5.3	2.5	<5.0	<5.0	0.75	-12.1	<0.10	3.0	17.8	17	4.6	6.29	0.00	0.14	0.49	0.36	0.00	0.00
BOP-76(i)	8/9/2017	-168	<0.2	1.7	5.1	2.5	<5.0	<5.0	1.0	-51.5	<0.10	7.0	16.6	13	4.6	6.1	0.00	0.12	0.50	0.38	0.00	0.00
BOP-76(i)	2/8/2018	16	<0.2	<0.2	0.7	0.8	<5.0	<5.0	0.19	29.3	<0.50	7.0	140	13	6860	5.19	0.00	0.00	0.36	0.64	0.00	0.00
BOP-76(i)	5/15/2018	111	<0.2	0.9	2.1	1.1	<5.0	<5.0	0.54	18.6	0.19	7.0	30.8	20	3670	5.38	0.00	0.15	0.47	0.38	0.00	0.00
BOP-76(i)	8/3/2018	192	<0.2	1.1	2.7	1.8	15	<5.0	0.21	-30.3	0.29	4.5	32.4	14	2970	5.20	0.00	0.13	0.43	0.44	0.00	0.00
BOP-76(i)	11/7/2018	288	<0.2	1.2	2.9	2.1	<5.0	<5.0	10.1	16.9	0.25	7.0	33.1	17	2660	5.3	0.00	0.13	0.41	0.46	0.00	0.00
BOP-76(i)	2/12/2019	384	<0.2	1.5	3.6	2.8	21.1	<5.0	0.3	21.0	<0.50	2.5	<5.0	14	2020	5.0	0.00	0.12	0.40	0.48	0.00	0.00
BOP-76(i)	5/9/2019	471	<0.2	1.5	3.7	4.2	7.7	<5.0	0.35	13.1	<0.10	3.5	<1.0	15	1350	5.35	0.00	0.10	0.33	0.58	0.00	0.00
BOP-76(i)	8/13/2019	566	<0.2	1.1	4.6	2.1	7.8	<5.0	0.54	-52.5	<0.10	2.0	<1.0	15	653	5.64	0.00	0.09	0.53	0.38	0.00	0.00
BOP-76(i)	11/7/2019	653	<0.20	0.6	6	1.4	<5.0	<5.0	0.54	-69.8	0.25	4.0	<1.0	19	310	5.87	0.00	0.05	0.70	0.25	0.00	0.00
BOP-76(i)	2/12/2020	749	<0.2	0.2	3.4	1.5	<5.0	<5.0	0.5	-36.8	0.21	6.0	<1.0	19	370	6.73	0.00	0.03	0.58	0.40	0.00	0.00
BOP-77(i)	2/2/2011		1.7	88	2.7	<1.0	--	--	--	--	--	--	--	--	--	--	0.01	0.95	0.04	0.00	--	--
Monitoring Well	5/5/2011		<1.0	41	3.8	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	0.89	0.11	0.00	--	--
BOP-77(i)	8/10/2011		1.8	17	1.6	<1.0	--	--	--	--	--	--	--	--	--	--	0.07	0.83	0.11	0.00	--	--
BOP-77(i)	11/3/2011		<1.0	11	6.7	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	0.55	0.45	0.00	--	--
BOP-77(i)	12/1/2011		1.1	32	7.1	<1.0	<1.1	<1.1	0.0	-274.8	0.2	0.8	8.4	<0.0007	2.41	6.77	0.02	0.75	0.23	0.00	0.00	0.00
BOP-77(i)	12/28/2011		--	--	--	--	--	--	--	--	--	--	--	--	12100	--	--	--	--	--	--	--
BOP-77(i)	12/28/2011		--	--	--	--	--	--	--	--	--	--	--	--	13800	--	--	--	--	--	--	--
BOP-77(i)	1/19/2012		<20	21	<20	<20	--	--	1.09	-154.4	<1.0	2.1	4.0	--	3800	5.40	0.00	1.00	0.00	0.00	--	--
BOP-77(i)	2/16/2012		<1.0	8.4	48	1.8	<1.1	<1.1	0.58	-154.4	<0.5	5.0	<0.5	6.6	884	5.69	0.00	0.11	0.84	0.05	0.00	0.00
BOP-77(i)	3/15/2012		<1.0	2.2	120	4.6	<1.1	<1.1	0.72	-261.9	<0.5	4.4	<0.5	10	148	6.96	0.00	0.01	0.93	0.06	0.00	0.00
BOP-77(i)	4/17/2012		<3.0	<3.0	21	62	<1.1	<1.1	0.40	-274.5	<0.1	5.6	0.6	12.2	208	7.12	0.00	0.00	0.18	0.82	0.00	0.00
BOP-77(i)	6/12/2012		<1.0	1.4	1.2	60	<1.1	<1.1	0.67	-50.4	<0.1	4.3	<0.1	0.314	314	6.36	0.00	0.01	0.01	0.98	0.00	0.00
BOP-77(i)	8/9/2012		<1.0	<1.0	<1.0	59	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--
BOP-77(i)	8/16/2012		--	--	--	--	--	--	--	--	--	--	--	--	23,800	--	--	--	--	--	--	--
BOP-77(i)	9/18/2012		<4.0	<4.0	28	4.1	<5.0	<5.0	0.78	25.8	<0.50	3.8	6.3	9.2	4670	4.66	0.00	0.00	0.81	0.19	0.00	0.00
BOP-77(i)	11/14/2012		<0.2	17	150	15	<5.0	<5.0	1.49	160.5	<1.0	3.5	<10.0	22	2270	5.66	0.00	0.07	0.81	0.13	0.00	0.00
BOP-77(i)	2/6/2013		<0.4	11	31	3.2	5.5	<5.0	0.35	6.4	<0.10	2.5	4.1	15	1136	5.76	0.00	0.13	0.49	0.08	0.30	0.00
BOP-77(i)	5/7/2013		<0.2	18	17	11	13	<5.0	1.52	-74.9	<0.10	2.5	<1.0	23	112	6.15	0.00	0.14	0.184	0.18	0.49	0.00
BOP-77(i)	8/6/2013		<0.2	0.7	14	13	8.6	<5.0	1.14	-44.3	<0.10	3.5	<1.0	17	888	5.38	0.00	0.01	0.217	0.31	0.46	0.00
BOP-77(i)	11/7/2013		<0.2	<0.2	9.5	19	22	<5.0	0.91	-106.7	<0.10	3.5	<1.0	20	111	6.21	0.00	0.00	0.083	0.26	0.66	0.00
BOP-77(i)	2/20/2014		<0.2	2.7	6.1	7.6	22	<5.0	1.14	-8.9	<0.10	3.5	<1.0	19	40	6.29	0.00	0.02	0.064	0.12	0.79	0.00
BOP-77(i)	5/8/2014		<0.2	0.2	5.1	14	64.4	<5.0	0.76	-16.4	<0.10	3.0	<1.0	23	36.4	6.41	0.00	0.00	0.021	0.09	0.81	0.08
BOP-77(i)	8/13/2014		<0.2	0.6	81	17	24	<5.0	0.88	71.4	<0.50	6.0	2750	15	10100	4.32	0.00	0.00	0.42	0.14	0.43	0.00
BOP-77(i)	11/6/2014		<0.2	2.7	200	24	63	<5.0	0.17	-165.8	<0.50	7.0	1850	22	4920	4.13	0.00	0.00	0.44	0.08	0.48	0.00
BOP-77(i)	2/6/2015		<0.2	4.2	120	24	58	<5.0	0.83	-38.7	<0.50	7.0	855	26	4330	4.78	0.00	0.01	0.33	0.10	0.56	0.00
BOP-77(i)	5/6/2015		<0.2	6.2	220	20	52.6	<5.0	0.98	-85.9	1.0	7.0	519	19	3030	4.84	0.00	0.01	0.50	0.07	0.37	0.04
BOP-77(i)	8/10/2015		<0.2	6.2	86	11	81.8	<5.0	0.94	-73.3	<1.0	7.0	3830	15	9110	4.30	0.00	0.01	0.22	0.04	0.67	0.06
BOP-77(i)	11/4/2015		<0.2	8.2	72	13	27.1	<5.0	0.59	34.5	<5.0	7.0	2860	15	6350	4.55	0.00	0.03	0.38	0.11	0.40	0.09
BOP-77(i)	2/3/2016		<0.2	6.2	61	8.7	21	<5.0	1.87	35.2	<1.0	--	1530	20	4650	5.80	0.00	0.03	0.41	0.09	0.37	0.11
BOP-77(i)	5/4/2016		<0.2	4.9	44	6.7	39	<5.0	0.73	-103.0	<1.0	7.0	892.0	17.0	2990	4.71	0.00	0.02	0.23	0.06	0.38	0.31
BOP-77(i)	8/9/2016		0.4	2.7	33	2.1	6	<5.0	0.22	-88.5	0.51	7.0	165	16	1450	4.99	0.00	0.03	0.57	0.06	0.00	0.33
BOP-77(i)	11/10/2016		<0.2	2.6	15	1.5	8.5	<5.0	0.35	-36.3	0.12	7.0	5.3	29	265	5.53	0.00	0.04	0.31	0.05	0.60	0.00
BOP-77(i)	2/7/2017		<0.2	0.3	20	2.2	8	<5.0	0.63	-49.6	<0.10	7.0	<1.0	27	85.1	6.00	0.00	0.00	0.40	0.07	0.00	0.52
BOP-77(i)	5/16/2017		<0.2	<0.2	13	2.6	24.6	<5.0	0.71	-60.2	<0.10	1.5	<1.0	17	38.3	6.09	0.00	0.00	0.13	0.04	0.20	0.63
BOP-77(i)	8/9/2017	-168	<0.2	<0.2	0.8	4.8	15	<5.0	0.9	-37.3	<0.10	7.0	<1.0	32	39.6	5.9	0.00	0.00	0.01	0.13	0.41	0.45

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	Elapsed Time from Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-77(i)	2/8/2018	16	<0.2	<0.2	1.4	0.7	14	<5.0	0.92	47.7	<0.50	2.0	192	18	9600	4.65	0.00	0.00	0.03	0.02	0.00	0.95
BOP-77(i)	5/15/2018	112	<0.2	0.4	6.3	1.1	12	<5.0	0.62	43.7	0.12	7.0	39.8	19	6260	4.80	0.00	0.01	0.13	0.04	0.00	0.82
BOP-77(i)	8/3/2018	192	<0.2	0.9	8.9	1.7	12	<5.0	0.45	-12.4	0.68	3.0	93.7	15	5600	4.68	0.00	0.01	0.17	0.05	0.00	0.76
BOP-77(i)	11/8/2018	288	<0.2	1.1	6.6	0.6	12	<5.0	2.0	23.4	0.47	7.0	88.7	21	4340	4.76	0.00	0.02	0.14	0.02	0.00	0.82
BOP-77(i)	2/12/2019	384	<0.2	1.1	6.1	0.9	11	<5.0	0.6	144.4	<0.50	1.0	11	5.6	3360	4.66	0.00	0.02	0.14	0.03	0.00	0.81
BOP-77(i)	5/8/2019	470	<0.2	1	5.9	0.6	5.5	<5.0	1.19	69.83	<0.50	7.0	41.9	21	2140	4.90	0.00	0.03	0.23	0.04	0.00	0.70
BOP-77(i)	8/13/2019	566	<0.2	1.1	5.4	0.5	7.2	<5.0	0.64	29.8	0.17	4.0	<1.0	20	943	4.87	0.00	0.03	0.18	0.03	0.00	0.77
BOP-77(i)	11/8/2019	653	<0.20	0.6	5.6	1.1	5.3	<5.0	0.41	-54.9	<0.10	3.5	<1.0	21	1030	5.32	0.00	0.02	0.21	0.07	0.70	0.00
BOP-77(i)	2/11/2020	749	<0.2	0.5	6.5	3.2	8.5	<5.0	0.41	21	0.22	--	2.1	22	703	5.97	0.00	0.01	0.16	0.12	0.71	0.00
BOP-78(i)	11/21/2011		1.7	37	6.1	<1.0	--	--	--	--	--	--	--	--	--	--	0.03	0.79	0.18	0.00	--	--
Injection Well	8/9/2012		1.1	30	9.3	<1.0	--	--	--	--	--	--	--	--	--	--	0.02	0.69	0.29	0.00	--	--
BOP-78(i)	11/8/2012		<0.2	0.3	7.2	51	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.08	0.91	--	--
BOP-78(i)	2/6/2013		<0.2	0.3	11	78	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.08	0.92	--	--
BOP-78(i)	5/2/2013		<0.2	0.3	0.6	19	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.02	0.97	--	--
BOP-78(i)	8/7/2013		0.2	5.5	120	98	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.43	0.55	--	--
BOP-78(i)	11/8/2013		<0.2	<0.2	1.1	17	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.04	0.96	--	--
BOP-78(i)	2/5/2014		<0.2	1.0	1.3	3.0	--	--	--	--	--	--	--	--	--	--	0.00	0.11	0.19	0.70	--	--
BOP-78(i)	5/7/2014		<0.2	3.6	2.7	1.7	--	--	--	--	--	--	--	--	--	--	0.00	0.33	0.34	0.33	--	--
BOP-78(i)	11/5/2014		<0.2	1.7	23	2.6	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.81	0.14	--	--
BOP-78(i)	2/5/2015		<0.2	3.2	12	1.8	--	--	--	--	--	--	--	--	--	--	0.00	0.14	0.70	0.16	--	--
BOP-78(i)	5/4/2015		<0.2	1.0	7.8	2.4	--	--	--	--	--	--	--	--	--	--	0.00	0.06	0.64	0.30	--	--
BOP-78(i)	11/6/2015		<0.2	0.2	3.1	1.4	--	--	--	--	--	--	--	--	--	--	0.00	0.03	0.57	0.40	--	--
BOP-78(i)	2/4/2016		<0.2	0.3	4.2	2.2	--	--	--	--	--	--	--	--	--	--	0.00	0.03	0.54	0.44	--	--
BOP-78(i)	5/5/2016		<0.2	0.4	10	6.1	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.51	0.48	--	--
BOP-78(i)	8/8/2016		<0.2	0.9	24	13	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.54	0.45	--	--
BOP-78(i)	11/4/2016		<0.2	0.7	12	7.5	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.50	0.48	--	--
BOP-78(i)	2/8/2017		<0.2	0.6	10	11	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.36	0.62	--	--
BOP-78(i)	5/16/2017		<0.2	0.7	8.8	11	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.33	0.65	--	--
BOP-78(i)	8/9/2017	-167	<0.2	1.3	16	18	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.36	0.62	--	--
BOP-78(i)	2/12/2018	20	<0.2	0.3	4	21	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.11	0.89	--	--
BOP-78(i)	5/15/2018	112	<0.2	0.5	6.6	5.5	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.43	0.55	--	--
BOP-78(i)	8/2/2018	191	<0.2	0.5	6.3	6.2	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.39	0.59	--	--
BOP-78(i)	11/7/2018	288	<0.2	0.5	5.4	5.2	--	--	2.0	23.4	--	7.0	--	--	--	--	0.00	0.03	0.39	0.58	--	--
BOP-78(i)	2/8/2019	380	0.2	<0.2	1.2	6.5	--	--	--	--	--	--	--	--	--	--	0.01	0.00	0.11	0.88	--	--
BOP-78(i)	5/7/2019	468	<0.2	0.5	1.8	6.6	--	--			--		--	--	--	--	0.00	0.03	0.15	0.83	--	--
BOP-78(i)	8/16/2019	570	<0.2	0.3	2.9	8.8	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.17	0.81	--	--
BOP-78(i)	11/8/2019	653	<0.20	0.5	6.1	17	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.19	0.80	--	--
BOP-78(i)	2/7/2020	745	<0.2	0.4	4	11	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.19	0.80	--	--
BOP-79(i)	11/21/2011		1.8	42	5.0	<1.0	--	--	--	--	--	--	--	--	--	--	0.03	0.84	0.13	0.00	--	--
Injection Well	8/9/2012		2.2	95	12	<1.0	--	--	--	--	--	--	--	--	--	--	0.02	0.84	0.14	0.00	--	--
BOP-79(i)	11/8/2012		<0.2	0.2	3.7	68	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.03	0.96	--	--
BOP-79(i)	2/6/2013		<0.2	0.2	0.6	5.7	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.06	0.92	--	--
BOP-79(i)	5/2/2013		<0.2	0.4	24	41	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.27	0.72	--	--
BOP-79(i)	8/7/2013		<0.2	1.0	37	20	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.54	0.45	--	--
BOP-79(i)	11/8/2013		<0.2	1.9	13	16	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.33	0.63	--	--
BOP-79(i)	2/5/2014		<0.2	3.4	17	7.2	--	--	--	--	--	--	--	--	--	--	0.00	0.08	0.55	0.36	--	--

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	Elapsed Time from Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-79(i)	5/7/2014		0.9	58	43	15	--	--	--	--	--	--	--	--	--	--	0.00	0.39	0.39	0.21	--	--
BOP-79(i)	11/7/2014		<0.2	1.5	21	5.6	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.68	0.28	--	--
BOP-79(i)	2/5/2015		<0.2	2.1	10	3.8	--	--	--	--	--	--	--	--	--	--	0.00	0.09	0.57	0.34	--	--
BOP-79(i)	5/4/2015		<0.2	0.4	2.2	2.0	--	--	--	--	--	--	--	--	--	--	0.00	0.05	0.39	0.55	--	--
BOP-79(i)	11/6/2015		<0.2	0.5	8.6	4.3	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.55	0.43	--	--
BOP-79(i)	2/4/2016		<0.2	0.4	4.5	3.5	--	--	--	--	--	--	--	--	--	--	0.00	0.03	0.44	0.53	--	--
BOP-79(i)	5/5/2016		<0.2	0.5	3.6	3.6	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.38	0.58	--	--
BOP-79(i)	8/8/2016		<0.2	0.7	4.2	3.4	--	--	--	--	--	--	--	--	--	--	0.00	0.05	0.42	0.53	--	--
BOP-79(i)	11/4/2016		<0.2	0.6	4.7	3.7	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.43	0.53	--	--
BOP-79(i)	2/8/2017		<0.2	0.5	3.9	4.0	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.37	0.59	--	--
BOP-79(i)	5/16/2017		<0.2	0.7	5.2	4.8	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.40	0.57	--	--
BOP-79(i)	8/9/2017	-167	<0.2	0.7	4.0	3.3	--	--	--	--	--	--	--	--	--	--	0.00	0.05	0.42	0.53	--	--
BOP-79(i)	2/12/2018	19	<0.2	0.3	4.4	2.5	--	--	--	--	--	--	--	--	--	--	0.00	0.03	0.52	0.46	--	--
BOP-79(i)	5/15/2018	112	<0.2	0.5	11.0	8.8	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.44	0.55	--	--
BOP-79(i)	8/2/2018	191	<0.2	0.4	6.6	6.7	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.38	0.60	--	--
BOP-79(i)	11/7/2018	288	<0.2	0.3	5.8	4.4	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.45	0.53	--	--
BOP-79(i)	2/8/2019	380	0.2	<0.2	0.5	1.3	--	--	--	--	--	--	--	--	--	--	0.04	0.00	0.19	0.77	--	--
BOP-79(i)	5/7/2019	468	<0.2	<0.2	0.8	1.5	--	--			--		--	--	--		0.00	0.00	0.26	0.74	--	--
BOP-79(i)	8/16/2019	570	<0.2	<0.2	0.3	0.4	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.33	0.67	--	--
BOP-79(i)	11/8/2019	653	<0.2	<0.2	0.9	0.6	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.49	0.51	--	--
BOP-79(i)	2/7/2020	745	<0.2	0.2	0.7	0.3	--	--	--	--	--	--	--	--	--	--	0.00	0.11	0.53	0.35	--	--
BOP-80(i)	11/21/2011		<1.0	2.4	7.0	7.0	--	--	--	--	--	--	--	--	--	--	0.00	0.09	0.36	0.55	--	--
Downgradient Well	12/1/2011		<1.0	15	6.1	5.3	2.9	<1.1	0.0	-272.8	<0.1	2.4	3.8	3.97	2.43	6.74	0.00	0.31	0.17	0.23	0.28	0.00
BOP-80(i)	1/9/2012		<1.0	<1.0	<1.0	1.4	--	--	0.15	-255	0.2	1.7	0.4	--	4.93	6.80	0.00	0.00	0.00	1.00	--	--
BOP-80(i)	2/16/2012		<1.0	<1.0	<1.0	<1.0	2.2	<1.1	0.29	-237	0.1	2.7	2.4	7.44	3.28	7.14	0.00	0.00	0.00	0.00	0.00	1.00
BOP-80(i)	3/15/2012		<1.0	<1.0	<1.0	1.7	4	<1.1	0.43	-241	<0.1	4.0	0.5	7.98	4.72	6.99	0.00	0.00	0.00	0.17	0.35	0.49
BOP-80(i)	4/17/2012		<1.0	<1.0	<1.0	<1.0	<1.1	<1.1	0.28	-263.4	<0.1	3.6	1.0	12.8	2.89	7.04	ND	ND	ND	ND	ND	ND
BOP-80(i)	6/12/2012		<1.0	<1.0	<1.0	1.7	7.3	<1.1	0.24	12.8	<0.1	2.3	0.1	10.4	2.50	6.01	0.00	0.00	0.00	0.10	0.37	0.53
BOP-80(i)	9/18/2012		2.0	160	35	14	7.1	<5.0	0.28	-160.1	<0.10	2.9	1.9	14	13.9	6.35	0.01	0.59	0.18	0.11	0.00	0.12
BOP-80(i)	11/14/2012		3.0	610	240	33	6.1	<5.0	1.47	76.0	<0.10	2.5	3.1	7.5	1.5	6.48	0.00	0.59	0.31	0.07	0.00	0.03
BOP-80(i)	2/6/2013		<0.2	1.4	<0.2	0.4	5.2	<5.0	0.40	-7.0	0.15	3.0	<1.0	23	1.2	6.44	0.00	0.06	0.00	0.03	0.00	0.91
BOP-80(i)	5/9/2013		<0.2	0.8	<0.2	0.7	12	<5.0	0.57	-13.5	0.11	2.5	<1.0	20	1.3	6.31	0.00	0.01	0.00	0.03	0.00	0.96
BOP-80(i)	8/19/2013		<0.2	<0.2	<0.2	0.4	9.7	<5.0	1.16	-54.0	0.36	2.5	2.3	17	1.5	5.53	0.00	0.00	0.00	0.02	0.00	0.98
BOP-80(i)	11/11/2013		<0.2	<0.2	<0.2	0.2	14	<5.0	0.57	-64.8	<0.10	4.5	<1.0	22	1.4	5.99	0.00	0.00	0.00	0.01	0.00	0.99
BOP-80(i)	2/21/2014		2.7	23	0.4	<0.2	<5.0	<5.0	2.59	114.5	3.8	0.5	17.6	0.45	2.6	6.59	0.08	0.90	0.02	0.00	0.00	0.00
BOP-80(i)	5/7/2014		<0.2	2.0	<0.2	<0.2	17	<5.0	1.19	-26.0	0.19	2.5	1.0	16	3.8	6.73	0.00	0.03	0.00	0.00	0.00	0.97
BOP-80(i)	8/14/2014		<0.2	0.5	1.1	3.1	9	<5.0	1.14	-113.5	0.29	4.0	293	13	909	5.28	0.00	0.01	0.03	0.14	0.00	0.82
BOP-80(i)	11/6/2014		0.8	65	360	63	<5.0	<5.0	0.45	-74.0	<0.10	2.5	10.9	2.9	1.4	6.82	0.00	0.09	0.71	0.19	0.00	0.00
BOP-80(i)	2/6/2015		<0.2	<0.2	<0.2	0.3	5.6	<5.0	0.30	-121.9	<0.10	7.0	1.4	15	2.7	6.17	0.00	0.00	0.00	0.03	0.00	0.97
BOP-80(i)	5/6/2015		<0.2	<0.2	0.2	0.6	15	<5.0	1.54	-73.2	<0.10	4.0	<1.0	21	2.4	6.29	0.00	0.00	0.00	0.02	0.00	0.98
BOP-80(i)	8/10/2015		3.0	91	430	11	<5.0	<5.0	0.30	-171.0	<0.10	7.0	8.2	3.6	1.6	6.30	0.00	0.13	0.83	0.03	0.00	0.00
BOP-80(i)	11/4/2015		<0.2	<0.2	0.5	2.1	8.9	<5.0	1.20	-58.7	<0.10	7.0	1.6	20	2.3	6.35	0.00	0.00	0.02	0.10	0.00	0.88
BOP-80(i)	2/3/2016		<0.2	<0.2	<0.2	0.2	<5.0	<5.0	2.00	-24.2	<0.10	5.0	1.4	27	1.1	6.90	0.00	0.00	0.00	1.00	0.00	0.00
BOP-80(i)	5/4/2016		<0.2	<0.2	<0.2	0.4	6.7	<5.0	0.90	-33.2	<0.10	7.0	<1.0	15.0	<1.0	6.15	0.00	0.00	0.00	1.00	--	--
BOP-80(i)	8/11/2016		<0.2	<0.2	0.2	0.7	9	<5.0	0.19	-97.5	<0.10	7.0	<1.0	21	2.5	6.13	0.00	0.00	0.01	0.04	0.00	0.96
BOP-80(i)	11/11/2016		<0.2	<0.2	<0.2	0.3	10	<5.0	0.68	-9.2	<0.10	7.0	<1.0	20	2.7	6.19	0.00	0.00	0.00	0.01	0.00	0.99

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

		Elapsed Time from Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
Well	Date	Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-80(i)	2/7/2017		<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	1.07	20.1	<0.10	2.0	<1.0	26	2.8	6.11	ND	ND	ND	ND	ND	ND
BOP-80(i)	5/16/2017		<0.2	0.5	0.5	0.6	14	<5.0	0.35	-15.6	<0.10	0.5	<1.0	29	2.8	6.05	0.00	0.01	0.01	0.02	0.00	0.96
BOP-80(i)	8/10/2017	-166	<0.2	<0.2	<0.2	0.3	<5.0	<5.0	0.2	32.7	<0.10	2.0	<1.0	18	3.4	6.2	0.00	0.00	0.00	1.00	0.00	0.00
BOP-80(i)	2/8/2018	15	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.14	29.8	<0.10	2.0	1.7	28	41.1	6.33	ND	ND	ND	ND	ND	ND
BOP-80(i)	8/8/2018	196	<0.2	19	150	29	9.5	<5.0	0.42	-34.4	<0.10	3.0	<1.0	22	5.1	6.21	0.00	0.06	0.63	0.19	0.00	0.13
BOP-80(i)	2/14/2019	386	<0.2	<0.2	<0.2	<0.2	6.6	<5.0	0.35	-32.0	<0.10	3.0	<1.0	21	4.5	6.05	0.00	0.00	0.00	0.00	0.00	1.00
BOP-80(i)	8/13/2019	567	<0.2	<0.2	<0.2	<0.2	12	<5.0	0.44	-82.4	<0.10	2.5	<1.0	27	2.6	6.03	0.00	0.00	0.00	0.00	0.00	1.00
BOP-80(i)	2/11/2020	748	<0.2	<0.2	<0.2	<0.2	14	<5.0	0.65	-41.1	<0.10	3.8	<1.0	18	5.1	6.90	0.00	0.00	0.00	0.00	0.00	1.00
BOP-81(i)	11/21/2011		<1.0	<1.0	1.6	6.2	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.14	0.86	--	--
Downgradient Well	12/1/2011		<1.0	<1.0	1.0	4.1	4.2	<1.1	0.0	-279.8	<0.1	1.1	0.5	8.3	2.38	6.76	0.00	0.00	0.05	0.30	0.32	0.33
BOP-81(i)	12/28/2011		--	--	--	--	--	--	--	--	--	--	--	--	4.71	--	--	--	--	--	--	--
BOP-81(i)	1/9/2012		<1.0	<1.0	<1.0	1.9	--	--	0.33	-238.4	0.2	1.5	0.5	--	2.65	6.69	0.00	0.00	0.00	1.00	0.00	0.00
BOP-81(i)	2/16/2012		<1.0	<1.0	<1.0	<1.0	<1.1	<1.1	0.23	-242.8	<0.1	1.9	0.5	16.4	3.26	7.21	ND	ND	ND	ND	ND	ND
BOP-81(i)	3/15/2012		<1.0	<1.0	<1.0	<1.0	<1.1	<1.1	0.31	-245.8	0.1	2.7	0.3	24.7	3.00	6.96	ND	ND	ND	ND	ND	ND
BOP-81(i)	4/17/2012		<1.0	<1.0	<1.0	<1.0	<1.1	<1.1	0.28	-270.8	<0.1	2.6	0.2	23.4	2.51	6.77	ND	ND	ND	ND	ND	ND
BOP-81(i)	6/12/2012		<1.0	<1.0	<1.0	<1.0	1.8	<1.1	0.36	-1.8	<0.1	4.3	<0.1	20.9	2.34	6.10	0.00	0.00	0.00	0.00	0.00	1.00
BOP-81(i)	8/16/2012		--	--	--	--	--	--	--	--	--	--	--	--	3.2	--	--	--	--	--	--	--
BOP-81(i)	9/18/2012		<0.2	<0.2	<0.2	0.6	8.4	<5.0	0.21	-125	<0.10	1.7	<1.0	18.0	3.0	6.49	0.00	0.00	0.00	0.03	0.00	0.97
BOP-81(i)	11/14/2012		<0.2	<0.2	<0.2	0.5	8.6	<5.0	0.60	42.7	0.11	2.0	1.4	15.0	<1.0	6.49	0.00	0.00	0.00	0.03	0.00	0.97
BOP-81(i)	2/6/2013		<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.56	-93.4	0.12	2.0	2.0	30.0	<1.0	6.55	ND	ND	ND	ND	ND	ND
BOP-81(i)	5/9/2013		<0.2	0.3	<0.2	0.5	<5.0	<5.0	2.65	-18.1	0.39	1.5	7.4	7.1	<1.0	6.49	0.00	0.22	0.00	0.78	0.00	0.00
BOP-81(i)	8/19/2013		<0.2	<0.2	<0.2	0.9	<5.0	<5.0	3.96	-24.4	1.2	0.0	16.4	3.4	<1.0	6.74	0.00	0.00	0.00	1.00	0.00	0.00
BOP-81(i)	11/11/2013		<0.2	<0.2	<0.2	0.4	8.9	<5.0	0.42	-75.1	0.26	4.5	3.8	20.0	1.2	6.04	0.00	0.00	0.00	0.02	0.00	0.98
BOP-81(i)	2/21/2014		0.6	0.6	<0.2	<0.2	<5.0	<5.0	3.55	74.1	0.61	0.5	13.5	0.33	1.4	6.14	0.44	0.56	0.00	0.00	0.00	0.00
BOP-81(i)	5/7/2014		<0.2	0.2	<0.2	<0.2	5.2	<5.0	0.65	-49.9	<0.10	2.0	2.3	24.0	2.0	6.73	0.00	0.01	0.00	0.00	0.00	0.99
BOP-81(i)	8/14/2014		<0.2	<0.2	<0.2	0.4	6	<5.0	1.17	-140.9	<0.10	4.5	49.7	12.0	225	5.76	0.00	0.00	0.00	0.03	0.00	0.97
BOP-81(i)	11/6/2014		<0.2	<0.2	<0.2	0.3	11	<5.0	0.50	-85.6	<0.10	2.5	<1.0	25.0	1.5	6.33	0.00	0.00	0.00	0.01	0.00	0.99
BOP-81(i)	2/6/2015		<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.10	-128.8	<0.10	5.0	6.7	20.0	1.0	6.34	ND	ND	ND	ND	ND	ND
BOP-81(i)	5/6/2015		<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.82	-74.0	<0.10	7.0	2.5	22.0	<1.0	6.33	ND	ND	ND	ND	ND	ND
BOP-81(i)	8/11/2015		<0.2	<0.2	0.6	1.2	<5.0	<5.0	1.49	-130.0	0.14	7.0	4.2	13.0	1.6	6.19	0.00	0.00	0.24	0.76	0.00	0.00
BOP-81(i)	11/4/2015		<0.2	<0.2	0.3	0.7	5.4	<5.0	0.54	-42.6	<0.10	6.5	1.7	20.0	1.6	6.34	0.00	0.00	0.02	0.06	0.00	0.93
BOP-81(i)	2/4/2016		<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	1.93	-4.5	<0.10	5.0	7.1	10	<1.0	6.90	ND	ND	ND	ND	ND	ND
BOP-81(i)	5/4/2016		<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	2.88	-47.0	<0.10	7.0	3.8	21.0	<1.0	6.15	ND	ND	ND	ND	--	--
BOP-81(i)	8/11/2016		<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.25	-83.7	<0.10	7.0	<1.0	22	2.1	6.12	ND	ND	ND	ND	ND	ND
BOP-81(i)	11/11/2016		<0.2	<0.2	<0.2	0.3	<5.0	<5.0	0.51	17.4	<0.10	7.0	1.2	23	1.3	6.22	0.00	0.00	0.00	1.00	ND	ND
BOP-81(i)	2/7/2017		<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	1.56	4.0	<0.10	1.5	5.4	11	1.5	6.26	ND	ND	ND	ND	ND	ND
BOP-81(i)	5/16/2017		<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.23	-7	<0.10	1.5	5.2	11	1.3	6.36	ND	ND	ND	ND	ND	ND
BOP-81(i)	8/10/2017	-166	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.4	40.1	<0.10	7.0	<1.0	23	1.6	6.2	ND	ND	ND	ND	ND	ND
BOP-81(i)	2/8/2018	15	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.21	63.8	<0.10	2.5	5.1	16	1.4	6.41	ND	ND	ND	ND	ND	ND
BOP-81(i)	8/8/2018	196	<0.2	<0.2	<0.2	0.2	7.8	<5.0	0.47	-28.0	<0.10	3.5	<1.0	23	3.1	6.00	ND	ND	0.00	ND	ND	0.99
BOP-81(i)	2/14/2019	386	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.29	-47.7	<0.10	6.5	<1.0	22	3.4	6.16	ND	ND	ND	ND	ND	ND
BOP-81(i)	8/14/2019	568	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.12	-43.9	<0.50	3.0	<1.0	19	3.9	6.11	ND	ND	ND	ND	ND	ND
BOP-81(i)	2/11/2020	748	<0.2	<0.2	<0.2	<0.2	--	<5.0	0.59	-47.6	<0.10	3.0	<1.0	20	4.1	6.80	ND	ND	ND	ND	ND	ND
BOP-82(i)	11/21/2011		4.6	91	1.6	<1.0	--	--	--	--	--	--	--	--	--	--	0.04	0.94	0.02	0.00	--	--
Downgradient Well	12/1/2011		4.0	66	1.4	<1.0	<1.1	<1.1	0.0	-152.8	3.3	1.1	9.4	<0.0007	<1.50	6.36	0.04	0.93	0.03	0.00	0.00	0.00
BOP-82(i)	12/28/2011		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	Elapsed Time from Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-82(i)	1/9/2012		2.6	47	1.0	<1.0	--	--	0.31	-238.8	<0.2	2.1	7.3	--	9.81	6.74	0.04	0.93	0.03	0.00	--	--
BOP-82(i)	2/16/2012		1.9	38	6.8	<1.0	<1.1	<1.1	1.61	-196.5	1.7	0.1	10.3	0.0144	4.85	6.94	0.03	0.78	0.19	0.00	0.00	0.00
BOP-82(i)	3/15/2012		2.0	36	11	<1.0	<1.1	<1.1	0.82	-183.5	1.3	1.5	10.0	<0.0007	3.25	6.97	0.03	0.69	0.28	0.00	0.00	0.00
BOP-82(i)	4/17/2012		1.6	29	4.5	<1.0	<1.1	<1.1	1.29	-219.3	1.8	0.6	10.6	<0.0007	2.46	6.78	0.03	0.80	0.17	0.00	0.00	0.00
BOP-82(i)	6/12/2012		1.3	24	2.5	<1.0	<1.1	<1.1	2.76	145.6	1.8	0.1	9.9	<0.0007	2.56	5.54	0.04	0.84	0.12	0.00	0.00	0.00
BOP-82(i)	8/16/2012		--	--	--	--	--	--	--	--	--	--	--	--	1.6	--	--	--	--	--	--	--
BOP-82(i)	9/18/2012		1.0	19	1.6	0.5	<5.0	<5.0	2.75	-0.5	1.8	1.0	9.9	<0.015	1.4	6.45	0.03	0.83	0.09	0.05	0.00	0.00
BOP-82(i)	11/14/2012		1.6	24	1.6	0.3	<5.0	<5.0	3.03	72.7	1.8	0.0	10.3	0.036	<1.0	6.61	0.05	0.86	0.08	0.02	0.00	0.00
BOP-82(i)	2/6/2013		1.5	15	1.8	0.4	<5.0	<5.0	3.53	93.9	1.3	0.0	10.7	0.036	<1.0	6.50	0.06	0.77	0.13	0.04	0.00	0.00
BOP-82(i)	5/6/2013		1.1	17	0.9	0.3	<5.0	<5.0	4.24	202.8	1.0	0.0	11.6	0.48	<1.0	6.26	0.04	0.86	0.06	0.03	0.00	0.00
BOP-82(i)	8/19/2013		1.4	19	0.5	<0.2	<5.0	<5.0	--	14.2	1.1	0.0	11.5	0.11	<1.0	6.24	0.05	0.91	0.03	0.00	0.00	0.00
BOP-82(i)	11/7/2013		1.1	17	0.5	<0.2	--	--	--	--	--	--	--	--	--	--	0.05	0.92	0.04	0.00	--	--
BOP-82(i)	2/21/2014		1.0	14	0.4	<0.2	<5.0	<5.0	3.15	189.6	0.88	0.5	9.2	1.3	2.5	6.08	0.05	0.91	0.04	0.00	0.00	0.00
BOP-82(i)	5/7/2014		0.7	12	0.5	<0.2	<5.0	<5.0	1.29	82.9	0.30	0.0	8.4	1.0	1.9	6.25	0.04	0.91	0.05	0.00	0.00	0.00
BOP-82(i)	8/14/2014		1.0	12	0.6	<0.2	<5.0	<5.0	0.45	-135.4	<0.10	7.0	8.8	1.5	36.4	5.82	0.06	0.88	0.06	0.00	0.00	0.00
BOP-82(i)	11/7/2014		0.6	8.1	2.7	0.7	--	--	--	--	--	--	--	--	--	--	0.03	0.59	0.27	0.11	--	--
BOP-82(i)	2/6/2015		0.7	11	1.7	0.5	<5.0	<5.0	0.68	-62.7	0.36	3.0	13.2	3.0	1.8	6.25	0.04	0.74	0.15	0.07	0.00	0.00
BOP-82(i)	5/4/2015		0.7	9.7	1.3	<0.2	--	--	--	--	--	--	--	--	--	--	0.05	0.81	0.15	0.00	--	--
BOP-82(i)	8/11/2015		0.6	8.6	1.4	0.6	<5.0	<5.0	1.06	-186.1	<0.10	7.0	5.5	7.5	9.5	6.26	0.04	0.70	0.16	0.10	0.00	0.00
BOP-82(i)	11/6/2015		0.3	6.0	2.5	1.2	--	--	--	--	--	--	--	--	--	--	0.02	0.49	0.28	0.21	--	--
BOP-82(i)	2/4/2016		0.5	8.5	1.4	0.4	<5.0	<5.0	1.83	35.9	0.22	3.0	11.5	2.3	<1.0	7.02	0.03	0.73	0.16	0.07	0.00	0.00
BOP-82(i)	5/3/2016		0.6	8.3	0.9	<0.2	--	--	--	--	--	--	--	--	--	--	0.05	0.83	0.12	0.00	--	--
BOP-82(i)	8/11/2016		0.6	8.7	0.6	<0.2	<5.0	<5.0	0.75	15.0	0.40	1.5	13.4	1.0	1.3	6.09	0.05	0.87	0.08	0.00	0.00	0.00
BOP-82(i)	11/16/2016		0.5	8.7	0.6	<0.2	--	--	--	--	--	--	--	--	--	--	0.04	0.88	0.08	0.00	--	--
BOP-82(i)	2/13/2017		0.4	7.1	0.6	<0.2	<5.0	<5.0	0.91	173.5	0.43	2.5	14.8	0.580	1.6	6.50	0.04	0.86	0.10	0.00	0.00	0.00
BOP-82(i)	5/12/2017		0.4	7.1	0.5	<0.2	--	--	--	--	--	--	--	--	--	--	0.04	0.88	0.08	0.00	0.00	0.00
BOP-82(i)	8/10/2017	-166	0.3	5.8	0.7	<0.2	<5.0	<5.0	0.5	60.0	0.63	0.5	16.3	<0.0050	1.1	6.4	0.03	0.83	0.14	0.00	0.00	0.00
BOP-82(i)	2/7/2018	15	0.4	6	0.4	<0.2	<5.0	<5.0	0.33	136.6	<0.10	5.0	8.2	0.35	6.7	6.52	0.05	0.87	0.08	0.00	0.00	0.00
BOP-82(i)	8/8/2018	196	0.3	4.5	0.8	<0.2	<5.0	<5.0	0.49	-24.9	<0.10	1.0	9.5	7.8	4.6	6.03	0.04	0.77	0.19	0.00	0.00	0.00
BOP-82(i)	2/14/2019	386	0.4	4.3	0.6	<0.2	<5.0	<5.0	0.28	-4.3	0.12	1.5	7.6	1.9	1.9	6.06	0.06	0.79	0.15	0.00	0.00	0.00
BOP-82(i)	8/12/2019	565	0.4	4.1	0.5	<0.2	<5.0	<5.0	0.45	13.5	0.11	2.5	10.4	1.2	3.7	6.38	0.06	0.80	0.13	0.00	0.00	0.00
BOP-82(i)	2/11/2020	748	0.3	3.4	0.6	<0.2	5.3	<5.0	0.44	-28.5	0.18	1.0	7.8	0.99	3.4	6.67	0.01	0.12	0.03	0.00	0.00	0.84
BOP-83(i)	11/21/2011		<1.0	31	<1.0	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--
Downgradient Well	12/1/2011		<1.0	16	<1.0	<1.0	<1.1	<1.1	0.0	-149.7	8.0	1.0	20.0	<0.0007	<1.50	6.73	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	12/28/2011		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BOP-83(i)	1/9/2012		1.8	36	<1.0	<1.0	--	--	6.18	-200.7	7.2	0.1	19.7	--	<1.5	6.70	0.04	0.96	0.00	0.00	--	--
BOP-83(i)	2/16/2012		2.6	58	2.5	<1.0	<1.1	<1.1	5.38	-181.3	6.6	0.1	24.5	<0.0007	2.73	7.10	0.03	0.91	0.05	0.00	0.00	0.00
BOP-83(i)	3/15/2012		1.1	19	<1.0	<1.0	<1.1	<1.1	6.44	-164.7	7.5	0.1	16.7	<0.0007	1.90	6.87	0.04	0.96	0.00	0.00	0.00	0.00
BOP-83(i)	4/17/2012		<1.0	7.3	<1.0	<1.0	<1.1	<1.1	3.56	-205.5	5.2	0.1	13.8	<0.0007	<1.50	6.34	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	6/12/2012		<1.0	3.1	<1.0	<1.0	<1.1	<1.1	8.16	147.4	6.8	0.1	14.2	<0.015	<1.50	5.98	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	8/16/2012		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BOP-83(i)	9/18/2012		0.5	9.7	0.3	<0.2	<5.0	<5.0	5.14	65.7	6.6	0.0	13.6	<0.015	1.2	6.07	0.04	0.92	0.04	0.00	0.00	0.00
BOP-83(i)	11/14/2012		<0.2	5.3	<0.2	<0.2	<5.0	<5.0	6.95	110.3	6.3	0.0	12.2	0.0064	<1.0	6.69	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	2/6/2013		1.2	21	0.9	<0.2	<5.0	<5.0	7.73	152.7	5.9	0.0	11.5	<0.005	<1.0	6.63	0.04	0.91	0.05	0.00	0.00	0.00
BOP-83(i)	5/6/2013		0.8	14	0.6	<0.2	<5.0	<5.0	9.40	206.6	6.0	0.0	11.8	<0.005	<1.0	6.32	0.04	0.91	0.05	0.00	0.00	0.00
BOP-83(i)	8/22/2013		<0.2	3.4	<0.2	<0.2	<5.0	<5.0	7.13	171.6	5.7	0.0	11.5	<0.005	<1.0	6.35	0.00	1.00	0.00	0.00	0.00	0.00

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	Elapsed Time from Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-83(i)	11/7/2013		<0.2	2.4	<0.2	<0.2	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--
BOP-83(i)	2/21/2014		<0.2	2.3	<0.2	<0.2	<5.0	<5.0	4.09	177.4	5.4	0.5	11.3	<0.005	<1.0	6.33	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	5/7/2014		0.4	5.7	0.4	<0.2	<5.0	<5.0	6.91	136.0	4.3	0.0	11.1	0.19	1.2	6.43	0.05	0.87	0.08	0.00	0.00	0.00
BOP-83(i)	8/14/2014		<0.2	2.2	<0.2	<0.2	<5.0	<5.0	7.68	-80.8	4.6	0.5	11.6	0.041	1.5	6.05	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	11/11/2014		<0.2	2.1	<0.2	<0.2	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--
BOP-83(i)	2/6/2015		0.4	12	1.0	<0.2	<5.0	<5.0	7.69	52.6	3.6	0.0	8.9	0.38	<1.0	6.35	0.02	0.88	0.10	0.00	0.00	0.00
BOP-83(i)	5/4/2015		<0.2	2.0	<0.2	<0.2	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--
BOP-83(i)	8/11/2015		<0.2	2.0	<0.2	<0.2	<5.0	<5.0	7.66	50.1	4.2	0.5	10	0.1	<1.0	6.47	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	11/6/2015		<0.2	1.9	<0.2	<0.2	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--
BOP-83(i)	2/4/2016		<0.2	1.7	<0.2	<0.2	<5.0	<5.0	7.46	51.8	3.3	1.0	7.5	0.36	<1.0	7.33	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	5/6/2016		<0.2	2.4	<0.2	<0.2	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--
BOP-83(i)	8/11/2016		<0.2	2.6	<0.2	<0.2	<5.0	<5.0	7.02	89.5	3.3	0.5	9.1	0.0069	<1.0	6.01	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	11/16/2016		0.5	10	4.5	<0.2	--	--	--	--	--	--	--	--	--	--	0.02	0.61	0.37	0.00	--	--
BOP-83(i)	2/13/2017		<0.2	2.7	<0.2	<0.2	<5.0	<5.0	6.24	176.8	2.7	0.5	9.4	<0.005	<1.0	6.56	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	5/12/2017		0.3	3.2	<0.2	<0.2	--	--	--	--	--	--	--	--	--	--	0.07	0.93	0.00	0.00	0.00	0.00
BOP-83(i)	8/10/2017	-166	0.2	3.3	<0.2	<0.2	<5.0	<5.0	3.1	58.6	2.1	0.5	8.9	<0.0050	<1.0	6.4	0.05	0.95	0.00	0.00	0.00	0.00
BOP-83(i)	2/7/2018	15	0.4	8.6	13	0.7	<5.0	<5.0	2.58	252.4	1.3	0.5	5.6	0.055	2	6.27	0.01	0.31	0.63	0.05	0.00	0.00
BOP-83(i)	8/8/2018	197	0.2	3	<0.2	<0.2	<5.0	<5.0	0.87	44.5	3	0.5	9.4	0.052	2.2	4.69	0.05	0.95	0.00	0.00	0.00	0.00
BOP-83(i)	2/14/2019	386	0.2	5.6	14	0.2	<5.0	<5.0	0.65	-6.5	0.54	1.0	3.2	0.76	2.0	5.99	0.01	0.22	0.75	0.02	0.00	0.00
BOP-83(i)	8/15/2019	569	0.2	3.3	7.7	<0.2	<5.0	<5.0	1.78	158.4	1.7	2.0	8.2	0.056	1.9	6.13	0.01	0.24	0.75	0.00	0.00	0.00
BOP-83(i)	2/10/2020	748	<0.2	16	3.8	<0.2	<5.0	<5.0	1.33	-1.5	0.14	0.5	2.2	0.19	3.2	6.41	0.00	0.76	0.24	0.00	0.00	0.00
BOP-84(i)	2/8/2012		<1.0	7.1	55	1.4	--	--	--	--	--	--	--	--	--	--	0.00	0.08	0.88	0.03	--	--
Injection Well	5/4/2012		<1.0	<1.0	1.8	150	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.01	0.99	--	--
BOP-84(i)	6/12/2012		<1.0	<1.0	1.2	14	13.6	<1.1	0.65	-37.3	<0.1	3.7	<0.1	9.82	16.7	6.33	0.00	0.00	0.02	0.31	0.67	0.00
BOP-84(i)	8/9/2012		<1.0	<1.0	1.3	8.4	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.09	0.91	--	--
BOP-84(i)	8/16/2012		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BOP-84(i)	9/19/2012		<0.4	4.1	69	2.9	<5.0	<5.0	0.28	17.7	<0.10	3.5	<1.0	14	2620	4.57	0.00	0.04	0.90	0.06	0.00	0.00
BOP-84(i)	11/8/2012		<0.2	0.5	11	35	5.7	<5.0	--	--	<0.10	--	<1.0	22	276	--	0.00	0.00	0.13	0.65	0.00	0.22
BOP-84(i)	11/9/2012		--	--	--	--	--	--	0.81	131.2	--	3.0	--	--	--	6.36	--	--	--	--	--	--
BOP-84(i)	2/5/2013		<0.2	0.5	0.7	2.3	<5.0	<5.0	0.97	-43.9	<0.10	2.0	<1.0	26	80.5	6.29	0.00	0.08	0.15	0.77	0.00	0.00
BOP-84(i)	5/6/2013		<0.2	0.4	0.5	1.6	<5.0	<5.0	1.92	-75.2	<0.10	2.0	<1.0	21	102	6.12	0.00	0.09	0.15	0.76	0.00	0.00
BOP-84(i)	8/7/2013		<0.2	2.2	18	15	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.42	0.54	--	--
BOP-84(i)	11/8/2013		<0.2	0.7	3.3	1.3	--	--	--	--	--	--	--	--	--	--	0.00	0.09	0.57	0.35	--	--
BOP-84(i)	2/5/2014		<0.2	0.2	2.5	0.6	<5.0	<5.0	2.03	-118.7	<0.10	5.5	<1.0	19	378	6.54	0.00	0.04	0.70	0.26	0.00	0.00
BOP-84(i)	5/8/2014		<0.2	<0.2	2.0	1.9	7.4	<5.0	1.16	-32.6	<0.10	--	<1.0	14	40.1	6.61	0.00	0.00	0.07	0.10	0.84	0.00
BOP-84(i)	11/7/2014		<0.2	<0.2	8.0	2.9	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.64	0.36	--	--
BOP-84(i)	2/3/2015		<0.2	0.5	15	3.4	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.73	0.26	--	--
BOP-84(i)	5/4/2015		<0.2	0.3	8.9	3.1	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.64	0.35	--	--
BOP-84(i)	11/6/2015		<0.2	<0.2	2.8	2.1	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.46	0.54	--	--
BOP-84(i)	2/4/2016		<0.2	<0.2	3.4	2.0	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.52	0.48	--	--
BOP-84(i)	5/5/2016		<0.2	<0.2	3.8	2.2	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.53	0.47	--	--
BOP-84(i)	8/8/2016		<0.2	<0.2	4.6	1.7	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.64	0.36	--	--
BOP-84(i)	11/4/2016		<0.2	<0.2	4.6	1.5	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.66	0.34	--	--
BOP-84(i)	2/8/2017		<0.2	0.2	4.0	2.3	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.52	0.46	--	--
BOP-84(i)	5/16/2017		<0.2	0.3	4.3	2.1	--	--	--	--	--	--	--	--	--	--	0.00	0.03	0.55	0.42	--	--
BOP-84(i)	8/9/2017	-167	<0.2	0.2	4.1	1.5	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.62	0.35	--	--

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	Elapsed Time from Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-84(i)	2/12/2018	19	<0.2	<0.2	0.9	0.7	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.45	0.55	--	--
BOP-84(i)	5/17/2018	114	<0.2	0.2	1.9	0.8	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.58	0.38	--	--
BOP-84(i)	8/2/2018	191	<0.2	0.2	1.8	0.8	--	--	--	--	--	--	--	--	--	--	0.00	0.05	0.56	0.39	--	--
BOP-84(i)	2/8/2019	380	<0.2	0.2	1.4	3.1	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.22	0.76	--	--
BOP-84(i)	5/7/2019	468	<0.2	<0.2	1.3	4.2	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.17	0.83	--	--
BOP-84(i)	8/16/2019	570	0.2	<0.2	1.2	1.6	--	--	--	--	--	--	--	--	--	--	0.03	0.00	0.32	0.65	--	--
BOP-84(i)	11/8/2019	654	<0.20	<0.20	0.8	1.1	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.32	0.68	--	--
BOP-84(i)	2/7/2020	745	<0.2	<0.2	0.6	0.9	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.30	0.70	--	--
BOP-85(i)	2/8/2012		1.6	33	6.5	<1.0	--	--	--	--	--	--	--	--	--	--	0.03	0.77	0.20	0.00	--	--
Injection Well	5/4/2012		<1.0	29	6.5	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	0.77	0.23	0.00	--	--
BOP-85(i)	8/9/2012		1.2	32	5.7	<1.0	--	--	--	--	--	--	--	--	--	--	0.02	0.79	0.19	0.00	--	--
BOP-85(i)	11/8/2012		0.9	20	4.3	<0.2	--	--	--	--	--	--	--	--	--	--	0.03	0.75	0.22	0.00	--	--
BOP-85(i)	2/6/2013		0.8	37	7.0	<0.2	--	--	--	--	--	--	--	--	--	--	0.01	0.79	0.20	0.00	--	--
BOP-85(i)	5/2/2013		1.1	30	5.8	<0.2	--	--	--	--	--	--	--	--	--	--	0.02	0.77	0.20	0.00	--	--
BOP-85(i)	8/7/2013		0.5	1.5	22	0.8	--	--	--	--	--	--	--	--	--	--	0.01	0.04	0.89	0.05	--	--
BOP-85(i)	11/8/2013		<0.2	0.2	2.4	2.1	--	--	--	--	--	--	--	--	--	--	0.00	0.03	0.41	0.56	--	--
BOP-85(i)	2/5/2014		<0.2	<0.2	<0.2	1.3	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--
BOP-85(i)	5/7/2014		<0.2	<0.2	<0.2	1.5	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--
BOP-85(i)	11/5/2014		<0.2	1.6	3.4	0.4	--	--	--	--	--	--	--	--	--	--	0.00	0.23	0.65	0.12	--	--
BOP-85(i)	2/3/2015		<0.2	1.4	5.2	0.3	--	--	--	--	--	--	--	--	--	--	0.00	0.15	0.78	0.07	--	--
BOP-85(i)	5/4/2015		<0.2	0.8	5.1	0.4	--	--	--	--	--	--	--	--	--	--	0.00	0.09	0.81	0.10	--	--
BOP-85(i)	11/6/2015		<0.2	<0.2	0.4	0.3	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.46	0.54	--	--
BOP-85(i)	2/4/2016		<0.2	<0.2	0.7	0.5	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.47	0.53	--	--
BOP-85(i)	5/5/2016		<0.2	<0.2	1.0	0.9	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.42	0.58	--	--
BOP-85(i)	8/8/2016		<0.2	0.3	1.3	0.9	--	--	--	--	--	--	--	--	--	--	0.00	0.08	0.45	0.48	--	--
BOP-85(i)	11/4/2016		<0.2	0.3	1.3	0.9	--	--	--	--	--	--	--	--	--	--	0.00	0.08	0.45	0.48	--	--
BOP-85(i)	2/8/2017		<0.2	0.3	1.3	1.1	--	--	--	--	--	--	--	--	--	--	0.00	0.07	0.40	0.53	--	--
BOP-85(i)	5/16/2017		<0.2	0.3	1.5	1.1	--	--	--	--	--	--	--	--	--	--	0.00	0.06	0.44	0.50	--	--
BOP-85(i)	8/9/2017	-167	<0.2	0.4	1.4	0.9	--	--	--	--	--	--	--	--	--	--	0.00	0.10	0.45	0.45	--	--
BOP-85(i)	2/12/2018	20	<0.2	<0.2	0.3	<0.2	--	--	--	--	--	--	--	--	--	--	0.00	0.00	1.00	0.00	--	--
BOP-85(i)	5/15/2018	111	<0.2	0.2	0.6	0.3	--	--	--	--	--	--	--	--	--	--	0.00	0.12	0.49	0.38	--	--
BOP-85(i)	8/2/2018	191	<1.0	<1.0	<1.0	<1.0	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	ND	--	--
BOP-85(i)	11/7/2018	288	<0.2	0.2	0.8	0.5	--	--	--	--	--	--	--	--	--	--	0.00	0.09	0.46	0.45	--	--
BOP-85(i)	2/8/2019	380	<0.2	0.2	0.9	0.8	--	--	--	--	--	--	--	--	--	--	0.00	0.06	0.39	0.54	--	--
BOP-85(i)	5/6/2019	468	<0.2	0.3	0.9	0.6	--	--			--		--	--	--	--	0.00	0.11	0.44	0.45	--	--
BOP-85(i)	8/16/2019	569	<0.2	0.3	1.1	0.7	--	--	--	--	--	--	--	--	--	--	0.00	0.09	0.46	0.45	--	--
BOP-85(i)	11/8/2019	654	<0.20	0.4	1.1	0.9	--	--	--	--	--	--	--	--	--	--	0.00	0.11	0.39	0.50	--	--
BOP-85(i)	2/7/2020	745	<0.2	0.3	0.9	0.9	--	--	--	--	--	--	--	--	--	--	0.00	0.09	0.36	0.55	--	--
BOP-86(i)	2/8/2012		1.2	21	17	<1.0	--	--	--	--	--	--	--	--	--	--	0.02	0.47	0.51	0.00	--	--
Injection Well	5/4/2012		<1.0	28	5.2	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	0.80	0.20	0.00	--	--
BOP-86(i)	8/9/2012		1.0	39	7.7	<1.0	--	--	--	--	--	--	--	--	--	--	0.02	0.78	0.21	0.00	--	--
BOP-86(i)	11/8/2012		0.9	20	4.6	0.5	--	--	--	--	--	--	--	--	--	--	0.03	0.71	0.22	0.04	--	--
BOP-86(i)	2/6/2013		0.6	31	6.2	<0.2	--	--	--	--	--	--	--	--	--	--	0.01	0.78	0.21	0.00	--	--
BOP-86(i)	5/2/2013		0.7	35	7.4	<0.2	--	--	--	--	--	--	--	--	--	--	0.01	0.77	0.22	0.00	--	--
BOP-86(i)	8/7/2013		0.6	9.1	15	1.0	--	--	--	--	--	--	--	--	--	--	0.01	0.28	0.64	0.07	--	--
BOP-86(i)	11/8/2013		<0.2	1.4	2.0	2.6	--	--	--	--	--	--	--	--	--	--	0.00	0.15	0.28	0.57	--	--

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	Elapsed Time from Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-86(i)	2/5/2014		0.3	0.4	0.4	0.6	--	--	--	--	--	--	--	--	--	--	0.10	0.16	0.22	0.52	--	--
BOP-86(i)	5/7/2014		<0.2	0.4	1.3	0.8	--	--	--	--	--	--	--	--	--	--	0.00	0.10	0.46	0.44	--	--
BOP-86(i)	11/5/2014		<0.2	0.6	4.6	3.0	--	--	--	--	--	--	--	--	--	--	0.00	0.05	0.47	0.48	--	--
BOP-86(i)	2/3/2015		<0.2	0.9	5.5	3.5	--	--	--	--	--	--	--	--	--	--	0.00	0.06	0.47	0.47	--	--
BOP-86(i)	5/4/2015		<0.2	3.5	5.0	2.8	--	--	--	--	--	--	--	--	--	--	0.00	0.22	0.42	0.36	--	--
BOP-86(i)	11/6/2015		<0.2	0.3	1.6	2.8	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.26	0.70	--	--
BOP-86(i)	2/4/2016		<0.2	0.3	1.9	2.2	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.34	0.62	--	--
BOP-86(i)	5/5/2016		<0.2	0.4	2.0	<0.2	--	--	--	--	--	--	--	--	--	--	0.00	0.13	0.87	0.00	--	--
BOP-86(i)	8/8/2016		<0.2	0.6	2.5	1.7	--	--	--	--	--	--	--	--	--	--	0.00	0.08	0.45	0.47	--	--
BOP-86(i)	11/4/2016		<0.2	0.6	2.3	1.6	--	--	--	--	--	--	--	--	--	--	0.00	0.08	0.44	0.48	--	--
BOP-86(i)	2/8/2017		<0.2	0.6	2.2	1.3	--	--	--	--	--	--	--	--	--	--	0.00	0.10	0.47	0.43	--	--
BOP-86(i)	5/16/2017		<0.2	0.7	2.4	0.9	--	--	--	--	--	--	--	--	--	--	0.00	0.12	0.56	0.32	--	--
BOP-86(i)	8/9/2017	-167	<0.2	0.6	2.0	0.9	--	--	--	--	--	--	--	--	--	--	0.00	0.12	0.52	0.36	--	--
BOP-86(i)	2/12/2018	19	<0.2	<0.2	0.4	0.2	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.56	0.44	--	--
BOP-86(i)	5/15/2018	111	<0.2	0.5	0.6	0.5	--	--	--	--	--	--	--	--	--	--	0.00	0.21	0.34	0.44	--	--
BOP-86(i)	8/2/2018	191	<0.2	1.1	0.4	0.5	--	--	--	--	--	--	--	--	--	--	0.00	0.41	0.20	0.39	--	--
BOP-86(i)	2/8/2019	380	<0.2	2.3	1.0	0.7	--	--	--	--	--	--	--	--	--	--	0.00	0.45	0.26	0.29	--	--
BOP-86(i)	5/7/2019	468	<0.2	2.6	1.1	0.5	--	--			--		--	--	--		0.00	0.51	0.29	0.20	--	--
BOP-86(i)	8/16/2019	569	<0.2	2.1	0.9	0.4	--	--	--	--	--	--	--	--	--	--	0.00	0.50	0.29	0.20	--	--
BOP-86(i)	11/8/2019	654	<0.20	1.3	0.7	0.4	--	--	--	--	--	--	--	--	--	--	0.00	0.42	0.31	0.27	--	--
BOP-86(i)	2/7/2020	745	<0.2	0.7	0.5	0.4	--	--	--	--	--	--	--	--	--	--	0.00	0.32	0.31	0.38	--	--
BOP-87(i)	2/8/2012		1.3	14	1.8	<1.0	--	--	--	--	--	--	--	--	--	--	0.06	0.80	0.14	0.00	--	--
Injection Well	5/4/2012		<1.0	24	1.4	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	0.93	0.07	0.00	--	--
BOP-87(i)	8/9/2012		2.2	52	2.6	<1.0	--	--	--	--	--	--	--	--	--	--	0.03	0.91	0.06	0.00	--	--
BOP-87(i)	11/8/2012		1.2	9.7	1.6	<0.2	--	--	--	--	--	--	--	--	--	--	0.07	0.76	0.17	0.00	--	--
BOP-87(i)	2/6/2013		0.4	8.5	1.2	<0.2	--	--	--	--	--	--	--	--	--	--	0.03	0.81	0.16	0.00	--	--
BOP-87(i)	5/2/2013		0.2	7.1	1.2	<0.2	--	--	--	--	--	--	--	--	--	--	0.02	0.80	0.18	0.00	--	--
BOP-87(i)	8/7/2013		0.7	21	6.3	0.3	--	--	--	--	--	--	--	--	--	--	0.02	0.68	0.28	0.02	--	--
BOP-87(i)	11/8/2013		<0.2	0.6	6.2	0.6	--	--	--	--	--	--	--	--	--	--	0.00	0.06	0.82	0.12	--	--
BOP-87(i)	2/5/2014		<0.2	0.3	1.2	1.0	--	--	--	--	--	--	--	--	--	--	0.00	0.07	0.40	0.52	--	--
BOP-87(i)	5/7/2014		<0.2	<0.2	0.3	0.5	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.28	0.72	--	--
BOP-87(i)	11/5/2014		<0.2	0.6	1.5	0.8	--	--	--	--	--	--	--	--	--	--	0.00	0.14	0.47	0.39	--	--
BOP-87(i)	2/3/2015		<0.2	2.1	2.2	0.9	--	--	--	--	--	--	--	--	--	--	0.00	0.30	0.43	0.27	--	--
BOP-87(i)	5/4/2015		<0.2	1.4	2.8	0.7	--	--	--	--	--	--	--	--	--	--	0.00	0.21	0.57	0.22	--	--
BOP-87(i)	11/6/2015		<0.2	<0.2	0.3	0.5	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.28	0.72	--	--
BOP-87(i)	2/4/2016		<0.2	<0.2	0.5	0.6	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.35	0.65	--	--
BOP-87(i)	5/5/2016		<0.2	0.2	0.6	1.0	--	--	--	--	--	--	--	--	--	--	0.00	0.06	0.26	0.67	--	--
BOP-87(i)	8/8/2016		<0.2	0.3	0.9	0.8	--	--	--	--	--	--	--	--	--	--	0.00	0.09	0.38	0.53	--	--
BOP-87(i)	11/4/2016		<0.2	0.3	1.0	0.8	--	--	--	--	--	--	--	--	--	--	0.00	0.09	0.41	0.50	--	--
BOP-87(i)	2/8/2017		<0.2	0.4	1.3	1.1	--	--	--	--	--	--	--	--	--	--	0.00	0.09	0.39	0.52	--	--
BOP-87(i)	5/16/2017		<0.2	0.5	1.9	1	--	--	--	--	--	--	--	--	--	--	0.00	0.10	0.50	0.41	--	--
BOP-87(i)	8/9/2017	-167	<0.2	0.4	1.6	0.9	--	--	--	--	--	--	--	--	--	--	0.00	0.09	0.49	0.42	--	--
BOP-87(i)	2/12/2018	20	<0.2	<0.2	0.2	<0.2	--	--	--	--	--	--	--	--	--	--	0.00	0.00	1.00	0.00	--	--
BOP-87(i)	5/15/2018	112	<0.2	<0.2	1.1	0.5	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.59	0.41	--	--
BOP-87(i)	8/2/2018	191	<0.2	<0.2	0.8	4.2	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.11	0.89	--	--
BOP-87(i)	11/7/2018	288	<0.2	0.2	0.6	3.7	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.09	0.88	--	--

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	Elapsed Time from Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-87(i)	2/8/2019	380	<0.2	0.3	0.9	30	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.02	0.98	--	--
BOP-87(i)	5/7/2019	468	<0.2	0.5	1.2	68	--	--			--		--	--	--	--	0.00	0.00	0.01	0.99	--	--
BOP-87(i)	8/16/2019	570	<0.2	0.3	1.8	65	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.02	0.98	--	--
BOP-87(i)	11/8/2019	654	<0.20	0.4	2.1	86	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.02	0.98	--	--
BOP-87(i)	2/27/2020	764	<0.2	3.7	<0.2	62	--	--	--	--	--	--	--	--	--	--	0.00	0.03	0.00	0.97	--	--
BOP-88(i)	2/8/2012		2.0	26	2.2	<1.0	--	--	--	--	--	--	--	--	--	--	0.05	0.85	0.10	0.00	--	--
Injection Well	5/4/2012		<1.0	19	2.5	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	0.85	0.15	0.00	--	--
BOP-88(i)	8/9/2012		2.8	130	8.9	<1.0	--	--	--	--	--	--	--	--	--	--	0.02	0.90	0.08	0.00	--	--
BOP-88(i)	11/8/2012		1.2	11	1.5	<0.2	--	--	--	--	--	--	--	--	--	--	0.07	0.79	0.15	0.00	--	--
BOP-88(i)	2/6/2013		0.9	11	1.4	0.2	--	--	--	--	--	--	--	--	--	--	0.05	0.78	0.14	0.03	--	--
BOP-88(i)	5/2/2013		0.6	14	2.2	1.2	--	--	--	--	--	--	--	--	--	--	0.02	0.70	0.15	0.13	--	--
BOP-88(i)	8/7/2013		0.8	7.8	11	0.2	<5.0	<5.0	1.19	-133.4	<0.10	2.0	<1.0	1.9	294	5.88	0.03	0.33	0.63	0.02	0.00	0.00
BOP-88(i)	11/11/2013		<0.2	0.2	85	4.1	<5.0	<5.0	1.21	-90.1	<0.10	4.0	<1.0	17	458	6.20	0.00	0.00	0.93	0.07	0.00	0.00
BOP-88(i)	2/5/2014		<0.2	0.9	3.0	27	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.07	0.92	--	--
BOP-88(i)	5/7/2014		<0.2	1.0	3.5	7.7	--	--	--	--	--	--	--	--	--	--	0.00	0.05	0.22	0.74	--	--
BOP-88(i)	11/11/2014		<0.2	1.9	30	4.2	<5.0	<5.0	1.36	-208.2	<1.0	4.0	276	13	3150	4.56	0.00	0.04	0.79	0.17	0.00	0.00
BOP-88(i)	2/9/2015		0.3	12	90	4.0	<5.0	<5.0	0.46	-94.9	<1.0	7.0	243	12	3990	4.90	0.00	0.08	0.86	0.06	0.00	0.00
BOP-88(i)	5/6/2015		1.0	28	150	8.5	7.4	<5.0	0.82	-97.0	<1.0	7.0	138	16	3370	4.82	0.00	0.10	0.71	0.06	0.12	0.00
BOP-88(i)	11/4/2015		<0.2	0.8	8.7	2.4	--	--	--	--	--	--	--	--	--	--	0.00	0.05	0.67	0.29	--	--
BOP-88(i)	2/4/2016		<0.2	1.6	24	4.1	7.2	<5.0	1.68	58.4	<1.0	7.0	2270	11	8570	5.64	0.00	0.02	0.43	0.11	0.44	0.00
BOP-88(i)	5/5/2016		<0.2	3.3	65	6.8	7.9	<5.0	1.12	9.7	<1.0	7.0	2370	15.0	8780	4.67	0.00	0.02	0.62	0.10	0.26	0.00
BOP-88(i)	8/9/2016		<0.2	8.9	100	7.0	9.3	<5.0	0.39	-43.7	4.8	7.0	2330	14	10000	4.67	0.00	0.04	0.67	0.07	0.21	0.00
BOP-88(i)	11/8/2016		<0.4	6.2	110	7.4	11	<5.0	0.92	115.1	1.1	7.0	2620	12	9830	4.44	0.00	0.03	0.67	0.07	0.23	0.00
BOP-88(i)	2/8/2017		0.3	11	120	8.9	14	<5.0	4.62	113.1	<1.0	6.0	2510	13	9030	4.45	0.00	0.04	0.63	0.07	0.25	0.00
BOP-88(i)	5/17/2017		<0.4	6.3	120	6.1	11	<5.0	3.69	111.6	1.5	7.0	2600	13	9290	4.79	0.00	0.03	0.70	0.05	0.22	0.00
BOP-88(i)	8/9/2017	-167	<0.4	2.1	41	4.8	18	<5.0	0.6	58.6	1.3	7.0	2330	18	8410	4.6	0.00	0.01	0.37	0.07	0.55	0.00
BOP-88(i)	2/20/2018	27	<0.4	3	10	0.9	8.3	<5.0	0.18	29.1	<0.50	5.0	90	13	7760	4.90	0.00	0.05	0.24	0.03	0.68	0.00
BOP-88(i)	5/15/2018	112	<0.4	6.8	35	2.9	9.4	<5.0	0.38	51.5	<0.10	7.0	91	14	3980	5.03	0.00	0.07	0.45	0.06	0.42	0.00
BOP-88(i)	8/9/2018	198	<0.4	2	12	1.1	8.8	<5.0	0.12	-0.13	<1.0	5.0	239	11	10900	4.95	0.00	0.03	0.26	0.04	0.67	0.00
BOP-88(i)	11/8/2018	288	<0.4	3.9	19	2.6	18	<5.0	0.85	21.1	<0.50	7.0	207	15	13600	4.84	0.00	0.03	0.22	0.05	0.71	0.00
BOP-88(i)	2/14/2019	386	<0.4	6.0	36	5.7	29	<5.0	0.69	-21.5	<2.0	7.0	225	15	16000	4.84	0.00	0.03	0.24	0.06	0.67	0.00
BOP-88(i)	5/9/2019	471	<0.4	8.5	53	6.6	14	<5.0	0.41	33.15	<1.0	7.0	224	8.8	15600	4.79	0.00	0.05	0.45	0.09	0.41	0.00
BOP-88(i)	8/14/2019	568	<0.4	9.9	72	7.2	38	<5.0	0.51	100.8	<2.0	7.0	9.9	20	15200	4.81	0.00	0.03	0.32	0.05	0.59	0.00
BOP-88(i)	11/7/2019	653	0.7	24	160	22	48	<5.0	0.59	40.8	1.6	5.5	286	12	16100	4.76	0.00	0.05	0.42	0.09	0.44	0.00
BOP-88(i)	2/12/2020	750	0.9	24	140	23	49	<5.0	3.72	44.3	2.1	6.5	290	15	17000	5.04	0.00	0.05	0.39	0.10	0.47	0.00

Abbreviations and Acronyms:

µg/L = micrograms per liter
cDCE = cis-1,2-dichloroethene
DO = dissolved oxygen
E+E = ethane and ethene
mg/L = milligrams per liter
mV = millivolt
ORP = oxidation reduction potential
PCE = tetrachloroethene
PRB = permeable reactive barrier
TCE = trichloroethene
TOC = total organic carbon
VC = vinyl chloride

Table 3
Injection Design
Former Vapor Degreaser Source Area
Boeing Portland

Well ID	Injection Solution Composition										Combined Injection Solution Volume (gallons) (b)	Resulting Injection Fluid Concentrations		
	HRO (gallons)	HRO (totes)	Glycerin (gallons)	Glycerin (totes)	ZVI (gallons) (a)	ZVI (drums)	Yeast Extract (lb)	MAP (lb)	CAN-27 (lb)	Potable Water (gallons)		HRO (%vol)	Glycerin (%vol) (c)	ZVI (%vol)
BOP-74(i)	635	2.44	1,065	4.06	---	---	19	111.5	182.5	17,400	19,100	3.3%	5.6%	---
BOP-79(i)	133	0.51	223	0.85	---	---	4	23.4	38.2	3,644	4,000	3.3%	5.6%	---
BOP-84(i)	133	0.51	223	0.85	---	---	4	23.4	38.2	3,644	4,000	3.3%	5.6%	---
BOP-85(i)	133	0.51	223	0.85	---	---	4	23.4	38.2	3,644	4,000	3.3%	5.6%	---
BOP-86(i)	133	0.51	223	0.85	---	---	4	23.4	38.2	3,644	4,000	3.3%	5.6%	---
BOP-78(i)	133	0.51	223	0.85	33	1.00	4	23.4	38.2	3,611	4,000	3.3%	5.6%	0.8%
BOP-87(i)	133	0.51	223	0.85	33	1.00	4	23.4	38.2	3,611	4,000	3.3%	5.6%	0.8%
BOP-88(i)	133	0.51	223	0.85	33	1.00	4	23.4	38.2	3,611	4,000	3.3%	5.6%	0.8%
Totals	1,563	6.0	2,626	10.0	100	3.0	47	275	450	42,811	47,100			

Acronyms/Abbreviations:

% = percent
HRO = high-retention oil
ID = identification
lb = pounds
vol = volume
wt = weight
ZVI = zero-valent iron

Notes:

(a) Added for the first time during 2020 injection. Does not include pre- and post-injection potable water flushes.
(b) Does not include pre- and post-injection potable water flushes.
(c) The glycerin vendor changed from Whole Energy to SeQuential, resulting in a crude glycerin concentration difference. The volume required was scaled up to match previous concentrations used.

Table 4
Bioremediation Monitoring Parameters
Former Vapor Degreaser Source Area
Boeing Portland

Field Parameters	Information Provided
Dissolved Oxygen (DO) [field meter] (a)	Aquifer is considered anaerobic at DO concentrations less than 1.0 milligram per liter (mg/L).
Oxidation Reduction Potential (Redox) [field meter] (a)	Negative values indicate reducing conditions.
pH [field meter] (a)	May decrease due to injected donor. Considered acceptable for reductive dechlorination when greater than 4.0 at injection wells and greater than 5 at monitoring wells (Suthersan et al. 2002).
Iron (II) [Hach test kit]	Concentrations above background indicate iron reducing conditions.

Laboratory Analyses	Information Provided
Volatile Organic Compounds (VOCs) [Method 8260][3-40 mL VOA-HCl] (b)	Concentrations of chlorinated VOCs and breakdown products are indicative of reductive dechlorination and pathways.
Total Organic Carbon (TOC) [Method SM 5310 C-2000][250 mL Amber-H2SO4]	Levels will increase due to arrival of volatile fatty acids released from injected donor substrate.
Nitrate (c) [IC Method E300][500 mL poly]	Decreasing concentrations indicate nitrate-reducing conditions.
Sulfate [IC Method E300][500 mL poly]	Decreasing concentrations indicate sulfate-reducing conditions.
Ethene/Ethane/Methane/Acetylene [Method 8015 Mod][3-40 mL VOA] (b)	Concentrations of ethene and ethane are indicative of reductive dechlorination and pathways. Increasing methane concentrations indicate methanogenic aquifer redox conditions. Presence of acetylene is definitive evidence of destruction of TCE and cDCE by abiotic degradation pathway (reductive elimination).
Total and Dissolved Iron [Method SW 846 6010C][2-250 mL poly-NHO3]	Increasing concentrations will complex with sulfide and precipitate resulting in abiotic degradation.

Abbreviations and Acronyms:

AFCEE = Air Force Center for Environmental Excellence
cDCE = cis-1,2-dichloroethene
ESTCP = Environmental Security Technology Certification Program
mL = milliliter
TCE = trichloroethene

Notes:

(a) Measured using a flow-through cell.
(b) Care to be taken during sample collection to minimize aeration and volatilization. Sample collected with no headspace.
(c) Nitrate sample can be combined with sulfate sample; nitrate analysis to be performed within 48 holding time.

Information Sources:

Suthersan, S.S., C.C. Lutes, P.L. Palmer, F. Lenzo, F.C. Payne, D.S. Liles, and J. Burdick. 2002. *Final Technical Protocol for Using Soluble Carbohydrates to Enhance Reductive Dechlorination of Chlorinated Aliphatic Hydrocarbons.* Submitted to ESTCP and AFCEE under Contract #41624-99-C-8032. December 19.