2015 Annual Progress &Performance Report
Troutdale Gravel Aquifer
Boeing Portland Facility
Gresham, Oregon
ECSI #13

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Prepared for

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LIST OF ABBREVIATIONS AND ACRONYMS

%Vol	Percent by Volume
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
µg/kg	Micrograms per Kilogram
µg/L	Micrograms per Liter
$\mu g/m^3$	Micrograms per Cubic Meter
yd^3	Cubic Yards
1,1-DCE	1,1-Dichloroethene
Boeing	The Boeing Company
BGS	Below Ground Surface
CAOs	Corrective Action Objectives
cDCE	cis-1,2-DCE
CFM	Cubic Feet Per Minute
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
COPC	Constituents of Potential Concern
DNAPL	Dense Nonaqueous Phase Liquid
EPA	US Environmental Protection Agency
FOG	Fats, Oil, and Grease
ft	Feet
GAC	Granular Activated Carbon
gpm	gallons per minute
GWTS	Groundwater Treatment System
HDPE	High-density Polyethylene
HOA	Hand/Off/Auto
HP	Horsepower
ICP	Institutional Controls Plan
ICAs	Interim Corrective Actions
IRAM	Interim Remedial Action Measure
lbs	Pounds
LGAC	Liquid-phase GAC
MCLs	Maximum Contaminant Levels
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
OODEQ	Oregon Department of Environmental Quality
PCE	Tetrachloroethene
PRB	Permeable Reactive Barrier
psi	Per Square Inch
RCRA	Resource Conservation and Recovery Act
RBC	Risk-based Cleanup Levels
RFI	RCRA Facilities Investigation
ROI	Radius of Injection
SCADA	Supervisory Control and Data Acquisition
STS	Sump Treatment System
SVE	Soil Vapor Extraction
TBR	Textrol BR
TCA	Trichloroethane
TCE	Trichloroethene
tDCE	trans-1,1-DCE
TGA	Troutdale Gravel Aquifer
TGWTS	Temporary Groundwater Treatment System
TOC	Total Organic Carbon
TPH-Dx	Total Petroleum Hydrocarbon – Diesel Range
TSA	Troutdale Sandstone Aquifer
VC	Vinyl Chloride
VOCs	Volatile Organic Compounds
VOW	Vapor Observation Well

1.0 INTRODUCTION

This 2015 annual report summarizes the Troutdale Gravel Aquifer (TGA) remedy currently being conducted by The Boeing Company (Boeing) at the Boeing Portland facility in Gresham, Oregon (Figure 1). This report summarizes annual activities, analytical testing results, and provides an evaluation of the TGA remedy progress and performance that entails a review of data collected throughout the calendar year (January 1 through December 31, 2015).

This report is submitted as required under Order on Consent No. LQSR-NWR-04-12(h) issued to Boeing by the Oregon Department of Environmental Quality (OODEQ 2008a). The ODEQ Order on Consent requires Boeing to continue to perform the Site remedial actions included within the final remedy specified in the US Environmental Protection Agency (EPA) Order on Consent (EPA 1994), the Decision and Response to Comments (Final Decision; EPA 1997a), and the Statement of Basis (EPA 1997b). In addition to the consent order-driven corrective measures, additional measures such as bioremediation have been implemented to improve remedy performance and decrease the projected remedy timeframe.

This report provides an evaluation of TGA remedy performance including:

- Remedy background information (Section 2.0)
- Significant issues, events, and actions (Section 3.0)
- Summary of remedy progress monitoring data (Section 4.0)
- An assessment of remedy performance and aquifer restoration progress (Section 5.0)
- Recommendations to optimize remedy performance (Section 6.0).

2.0 REMEDY BACKGROUND

Boeing has conducted investigations and implemented corrective measures to address volatile organic compounds (VOCs) in soil and groundwater at the Boeing facility since 1986. Corrective measures consist of interim corrective actions (ICAs); consent order-driven corrective measures; and additional corrective measures, such as bioremediation; implemented to improve remedy performance and decrease the projected remedy timeframe.

ICAs were the earliest corrective measures undertaken by Boeing beginning in 1986 to stabilize VOCs in the soil and groundwater at the Boeing Portland facility and to address protection of human health and the environment. These ICAs included: providing an alternate water supply to owners of impacted wells; decommissioning supply wells; excavating impacted soil; installing and phased expansion of the groundwater extraction and treatment system (GWTS); and installing and testing of a soil vapor extraction (SVE) system and a dual-phase extraction system. These ICAs were previously documented in the interim measures evaluation report (Landau Associates [LAI] 1995a) and summarized in the Phase 2 corrective measures study (CMS; LAI 1996).

2.1 CONSENT ORDER CORRECTIVE MEASURES OBJECTIVES AND CLEANUP LEVELS

Subsequent to implementation of ICAs, the Phase 2 CMS, the EPA Final Decision, and the EPA Statement of Basis identified areas of the Boeing Facility where corrective measures were to be implemented. These corrective action areas were based on the known or potential presence of VOCs in soil and groundwater, and on the evaluation of the source areas identified in the Phase III Resource Conservation and Recovery Act (RCRA) Facility Investigation Report (RFI; LAI 1995b). These corrective action areas and the current groundwater remedy wells (extraction and monitoring wells) are shown on Figure 2, and are described in detail in the Phase 2 CMS and the TGA corrective measures implementation (CMI) work plan (LAI 1997).

Consent Order corrective measures have been implemented at the Boeing facility to address VOC contamination in the TGA, specifically to provide protection of human health and the environment from exposure to the TGA VOC plume through ingestion, dermal contact, or inhalation pathways. These objectives were confirmed in the EPA Final Decision (EPA 1997a) and provided the basis for corrective action implementation (LAI 1997). The Corrective Action Objections (CAOs) to be achieved by the corrective measures for the TGA, as presented in the Final Decision, are as follows:

CAO-a. Decrease VOC concentrations (i.e., mass removal) throughout the Site to achieve maximum contaminant levels (MCLs). If this is not feasible, then minimize the areal extent of groundwater contamination that exceeds MCLs and provide long-term containment for those areas with concentrations above MCLs.

CAO-b. Prevent exposure to TGA groundwater that contains VOCs at concentrations above MCLs.

CAO-c. Protect environmental receptors by preventing discharge of TGA groundwater to surface water at VOC contaminant concentrations that may exceed ambient water quality criteria.

CAO-d. Prevent further spread of contamination in the TGA (i.e., prevent the migration of groundwater containing VOCs above MCLs).

CAO-e. Protect groundwater quality in the Troutdale Sandstone Aquifer (TSA).

CAO-f. Facilitate existing uses of groundwater resources in eastern Multnomah County.

CAO-g. Reduce concentrations of VOCs and minimize migration of VOCs from vadose zone soil to the TGA that could compromise satisfying CAO-a for groundwater.

The EPA Final Decision and Statement of Basis establish constituents of potential concern (COPC) and target groundwater cleanup levels for the TGA corrective measures based on MCLs as follows:

Constituent	Cleanup Level (micrograms per liter [µg/L])
1,1-Dichloroethene (1,1-DCE)	7
cis-1,2-Dichloroethene (cDCE)	70
Trichloroethane (TCA)	200
Trichloroethene (TCE)	5
Tetrachloroethene (PCE)	5
Vinyl chloride (VC)	2

2.2 CONSENT ORDER CORRECTIVE MEASURES

TGA consent order corrective measures consist of several components: dual-phase extraction, soil vapor extraction, groundwater pump and treat, performance monitoring, well decommissioning to reduce liability and potential pathways, and the implementation of the Institutional Controls Plan (ICP; LAI 2005). These components are discussed in the following sections.

2.2.1 DUAL-PHASE AND SOIL VAPOR EXTRACTION SYSTEMS

Dual-phase extraction system pilot tests were conducted during the late 1990s and the results indicated that TGA soil was not conducive to this type of system. Therefore, well DP-1 was converted from a dual-phase extraction to a groundwater extraction well, and well DP-4 was incorporated into the Central and West Corrective Action Areas SVE system. The Central and West Corrective Action Areas SVE system consisted of 8 vapor extraction wells, DP-4, and 14 shallow and deep vapor observation wells (VOWs).

The SVE system operated between 1994 and 2009 and removed approximately 3,750 pounds (lbs) of VOCs from the unsaturated zone. SVE system mass recovery declined with time and, in 2009, ODEQ approved the decommissioning of the system because VOC mass removal rates were below the shutoff criterion of 0.1 lbs/day (ODEQ 2009). Three VOWs [VOW-4(s,d), VOW-6(s,d), and VOW-9(s,d)] were decommissioned in March 2010. A total of 7 VOWs [VOW-5(s,d), VOW-7(s,d), VOW-8(s,d), VOW-10(s,d), VOW-11(s,d), VOW-12(s,d), and VOW-14(s,d)] and two vapor extraction wells (VE-6 and VE-7) were decommissioned in March 2011.

2.2.2 GROUNDWATER TREATMENT SYSTEM

The GWTS and its predecessor, the former ICA groundwater extraction and treatment system, began operation in 1989 and has operated full-time with only minor shutdowns for maintenance or construction modifications. The locations of the extraction wells and the conveyance piping system are shown on Figure 3. In 2000, the pumping at E-1 was suspended due to achievement of groundwater cleanup goals (LAI 2000) and was subsequently decommissioned in June 2004.

The operational shutdown of individual extraction wells E-5 through E-9 was recommended in the 2000 TGA annual performance evaluation report due to low mass removal rates (LAI 2001). The operational shutdown of E-5 through E-9 was approved by EPA and conducted in October 2002 (LAI 2002); since the cessation of the extraction pumping, the wells have operated periodically for maintenance and monitoring purposes.

Additional extraction wells E-10, E-11, E-14, E-15, and E-16 were shut down to facilitate bioremediation injection activities in late 2008 (LAI 2009). Extraction wells E-10 and E-14 were decommissioned, with ODEQ approval (ODEQ 2008b), during the first quarter of 2010 in preparation for the Building 85-001 expansion project. Extraction wells E-15 and E-16 resumed pumping on December 20, 2012 after 4 years of pilot shutdown following injection of donor to these wells during the 2008 bioremediation injection program within the West Corrective Action Area. Extraction well E-11 remains shut down due to the presence of donor material.

On July 7, 2015, extraction wells E-2 and E-3 were shut down with ODEQ approval (ODEQ 2015a) to minimize the amount of bio-solid accumulation associated with pumping in preferred pathways from the Former Degreaser Source Control Area where bioremediation activities are ongoing. An extraction well that is shut down for purposes of facilitating a pilot test at the Site is referred to herein as being "pilot shutdown". Extraction wells E-2 and E-3 will likely remain pilot shutdown until TCE concentrations rebound to above the MCLs, at which point resumed pumping of the extraction wells will be evaluated and discussed with ODEQ.

Currently, the following wells are actively pumping as part of the TGA groundwater extraction and treatment system (Figure 3):

- E-4, E-12, and E-13 (located in the Downgradient Corrective Action Area)
- E-15 and E-16 (located in the West Corrective Action Area)
- DP-1 (located in the Central Correct Action Area).

In August 2014, a structural component of the air stripper tower failed and a temporary groundwater tray stripper system was installed as summarized in the 2014 Progress and Performance Evaluation Report (LAI 2015a). In October 2015, Boeing purchased the temporary groundwater tray stripper system and it now operates as the permanent groundwater treatment system. Modifications were made to the groundwater treatment system to meet Site requirements and system longevity, as summarized in Section 3.1.

2.2.3 GROUNDWATER PERFORMANCE MONITORING PROGRAM

The groundwater performance monitoring program consists of groundwater level measurements, collection of representative groundwater quality samples, and collection of influent and effluent samples from the GWTS. The current groundwater monitoring program is summarized in Table 1.

The groundwater performance monitoring program is evaluated yearly and modified based on the continued performance of the dissolved VOC plume remedy and with ODEQ's approval. Criteria for modifying the monitoring program have been established (LAI 2010a) and are summarized in Table 2.

2.2.4 INSTITUTIONAL CONTROLS PLAN

The ICP (LAI 2005) was developed as part of the selected corrective measures for the TGA. The ICP provides measures to restrict the potential ingestion of TGA groundwater exceeding the MCLs; provides a worker protection institutional control to restrict the potential exposure of workers during surface/subsurface disturbances within certain areas of the Site (referred to as Source Areas); and provides a restrictive covenant for the facility. The groundwater use institutional control regulates groundwater use in the area by granting the lead agency the authority to review any proposed actions involving the installation of wells or modifications of existing well water use within the dissolved-VOC plume. The worker protection institutional control provides procedures for notification to the lead agency of proposed worker activities within the source areas. Workers shall conduct activities under guidance of an approved health and safety plan, and disposal criteria will be coordinated with the lead agency.

2.3 ADDITIONAL CORRECTIVE MEASURES

Additional corrective measures have been incorporated into the TGA remedy to decrease the remedy timeframe and to improve the remedy performance. The GWTS system continues to provide hydraulic capture while the additional corrective measures (i.e,, SVE system and *in situ* bioremediation) reduce VOC concentrations in the TGA. Additional corrective measures currently being utilized at the Site are discussed in the following sections.

2.3.1 COOLANT RELEASE REMEDY AREA

In 2006, coolant material was discovered in the 85-105 building footing drain sump (sump). Immediately after the coolant release, Boeing disconnected the sump discharge from the GWTS and routed the accumulated water to temporary storage tanks for batch testing and processing through the facility treatment system for disposal to the sanitary sewer. Between August 2007 and August 2012, water collected in the 85-105 building footing sump was recovered and treated using the Sump Treatment System (STS). The STS consisted of a conveyance line that transported the accumulated water from the sump vault to Building 85-124, where the water was routed through an oil/water separator, then monitored by an in-line fats, oil, and grease (FOG) monitor. Water was discharged to the sanitary sewer, with automatic routing through a granular activated carbon (GAC) vessel for pre-treatment when FOG concentrations were elevated. Based on STS influent groundwater concentrations being consistently below the stormwater discharge criteria, the system was shut down in August 2012 with approval by ODEQ (ODEQ 2012a). Accumulated water in the sump was re-routed to the GWTS (pre-2006 coolant release occurrence treatment method) prior to discharge to the Storm Drain Creek.

An investigation was conducted to evaluate the vertical and horizontal extent of the release to the TGA by monitoring existing nearby wells and installing eight monitoring wells (LAI-1 through LAI-8). The results of the investigation indicated that the petroleum-based coolant, which floated on the water table, did not migrate far from the area of release because the building footing drain and sump acted as a collection system for the released coolant. The investigation also confirmed that nearby Upper TSA wells did not show evidence of impacts due to the coolant release (LAI 2007a).

To address the isolated coolant impacts to the shallow TGA, five injection wells (IW-1 through IW-5) were installed directly upgradient of the release area to allow for stimulation of aerobic biodegradation as an interim remedial action measure (IRAM; LAI 2007b). The ODEQ-approved (ODEQ 2007) interim remedial action plan detailed the process and procedures for using an oxygen-releasing compound (EHC-O^{TM}) injected as slurry with water to enhance the aerobic biodegradation of the petroleum-based contaminant. In 2008, two EHC-O injections events were conducted. Annual EHC-O injections were conducted in 2010, 2011, 2012, 2013, and 2015 (July). An EHC-O injection was not conducted in 2014

because concentrations in the monitoring wells were below the Site-specific cleanup levels. The performance of the corrective measures for the Coolant Release Area is discussed in Section 5.2 of this report.

2.3.2 SOURCE CONTROL AREA INVESTIGATIONS

In 1995, six potential TGA contaminant source areas were identified based on earlier investigations and current or past Site uses (LAI 1995a). These source areas were identified as the West Source Control Area, Central Source Control Area, Southwest Source Control Area, Former Vapor Degreaser Source Control Area, East Yard Source Control Area, and East Source Control Area, as shown on Figure 4. Restrictions on intrusive activities within the source areas and the use of groundwater are provided in the ICP.

Investigations have been conducted within all of the source areas and, based on these results, ODEQ has either approved of additional corrective actions or the removal of the particular source area from the ICP. Based on these investigations, the West Source Control Area, Southwest Source Control Area and the Central Source Control Area have been approved by ODEQ (ODEQ 2011, 2012b, and 2014a) to be removed from the ICP. The Former Degreaser Source Control Area investigations and additional corrective measures are discussed in Section 2.3.2.1 of this report.

During August 2015, investigations were conducted in the East Yard Source Control Area and the East Source Control Area (LAI 2015b). The results of the investigations indicated no COPC concentrations above the risk-based cleanup levels (RBC) soil vapor screening levels for intrusion into indoor air in an occupational setting and, therefore, the two areas were recommended for removal from the ICP (LAI 2015b). ODEQ is in the process of reviewing the recommendations.

2.3.2.1 Former Degreaser Source Control Area Investigations

Historical releases of TCE from two former vapor degreasers inside Building 85-001 constitute a primary source of TCE contamination in the TGA. Prior to 2009, the area of the former degreasers was deemed inaccessible for soil and groundwater investigation due to limited access for drilling inside the active manufacturing building and difficult geologic conditions (dense to very dense soil with cobbles and boulders) that require specialized drilling equipment. Recent advancement in limited-access roto-sonic drilling techniques allowed for the investigation to occur, with three phased investigations conducted within the area between 2009 and 2011 (LAI 2010b, 2011, and 2012a). During the investigation phases, a total of 17 groundwater wells, 3 soil vapor observations wells, and 9 sub-slab vapor pins (i.e., shallow vapor sampling devices installed directly below the building concrete slab) were installed in the source zone and downgradient of the area. Seven wells installed in 2011 [BOP-78(i), BOP-79(i), and BOP-84(i) through

BOP-88(i)] are multiple-purpose sampling and remediation wells with a well screen section in the vadose zone and a screen section below the water table. The multiple-purpose wells are utilized for SVE operation, groundwater quality monitoring, and aquifer injection for *in situ* bioremediation. Well locations are shown on Figures 5 and 6.

The investigations collected representative samples of soil vapor and groundwater. Soil vapor samples were collected sub-slab and from variable depths in the vadose zone. Groundwater samples were collected at various depths from wells that were installed through the TGA to terminate in the upper 2 ft of the confining layer between the TGA and the underlying TSA [i.e., within the second siltstone unit in confining layer (CU1)]. Based upon the findings of the investigations, two additional corrective actions are under way for source remediation. These corrective actions, consisting of enhanced *in situ* bioremediation and SVE, are described in the following sections.

2.3.3 ENHANCED *IN SITU* BIOREMEDIATION

Enhanced *in situ* bioremediation is currently being implemented in conjunction with the GWTS (provides hydraulic capture of dissolved plume) to remediate the more persistent areas of groundwater contamination. *Aerobic* biodegradation is being utilized to treat the petroleum-based coolant material release at the 85-105 building. *Anaerobic* bioremediation is being utilized for reductive dechlorination of TCE and its breakdown products (cDCE and VC) to non-toxic end products (ethane/ethene) in the Former Degreaser Source Control Area (LAI 2012b, 2013, 2014a, 2015c) and in the Downgradient Corrective Action Area (LAI 2009).

The following bioremediation injections have been conducted within the Former Degreaser Source Control Area:

- In November 2010, a pilot test injection was conducted at well BOP-72(i). During the injection a total of 900 gallons of LactOil electron donor substrate and potable water mixture was injected. A larger injection volume was intended, but low injection rates due to low hydraulic conductivity conditions in the direct vicinity of the well prevented injection of additional volume.
- In December 2011, a Permeable Reactive Barrier (PRB) was created on the downgradient edge of the source area by injecting electron donor substrates to well BOP-74(i). BOP-74(i) is located directly downgradient of the former vapor degreaser(s) and in the area of maximum TCE concentrations in the groundwater. Well BOP-74(i) has a high injection flow rate [50 to 80 gallons per minute (gpm)], which indicates the well is located in a preferential flow path of higher hydraulic conductivity and groundwater flux from the source. During this initial injection, the PRB well was injected with 15,000 gallons of injection solution, achieving a radius of injection (ROI) of approximately 40 ft (LAI 2014a). The injection solution consisted of 15 drums of LactOil and sodium lactate mixed with potable water. Lactoil donor substrate consists of ethyl lactate [36 percent by volume (%vol)] and vegetable oil (41 %vol), with the remaining balance consisting of surfactants and water.

- In August 2012, a second PRB injection was conducted to maintain conditions conducive to treatment, create a larger ROI, achieve more extensive downgradient treatment, and increase the longevity of treatment between injection events. To achieve these objectives, the second injection utilized double the volume of the first injection and a 40 percent higher concentration of electron donor. Approximately 27,800 gallons of potable water was mixed with 40 drums of LactOil to create 30,000 gallons of 7.3 percent LactOil solution that was injected to well BOP-74(i). Monitoring results indicated that the second PRB injection resulted in a ROI of at least 60 ft and less than 80 ft.
- In July 2013, an initial injection was completed of seven source area wells located upgradient of PRB injection well BOP-74(i) and immediately adjacent to the former vapor degreasers (source zone). The injection was conducted at the seven multiple-purpose source area wells [BOP-78(i), BOP-79(i), and BOP-84(i) through BOP-88(i)]. The injection event utilized a dedicated mixing and injection area created near the SVE unit and the sub-grade conveyance piping installed during the installation of the sub-grade SVE piping. Packers installed between the two screened intervals of each well were inflated during the injection to deliver injection fluid to the aquifer and not the vadose zone. A manifold at the mixing station allowed for simultaneous injection of the seven wells while measuring individual flow rates and pressures. The injection solution was delivered by gravity feed from the mixing tank due to relatively slow flow rates of individual wells (4.8 to 11.7 gpm). Each of the seven wells was injected with approximately 1,400 gallons of injection solution. A total of 9,800 gallons of injection solution consisted of approximately 9,200 gallons of potable water and 550 gallons of LactOil (5.6 %vol).
- In July 2014, a combined injection event delivered donor injection fluid both to the PRB and to source area wells. This event constituted the third injection to the PRB [well BOP-74(i)] and the second injection to the seven source area wells. The PRB injection volume was the same as the prior injection (30,000 gallons) and the total volume injected to the source area wells was doubled to 20,000 gallons, for a total of 50,000 gallons injected. The volume for source area injection wells was increased based on injection rates achieved during the first injection event and to increase the resulting extent of treatment. The injection solution was modified to utilize glycerin, a local and sustainable byproduct of biodiesel production, in place of the ethyl lactate component of LactOil used for prior injections. Ferrous sulfate was also added to the injection solution to promote complementary abiotic degradation of TCE and cDCE.
- In June 2015, a combined injection event delivered donor injection fluid both to the PRB and to source area wells. The target PRB injection volume was 30,000 gallons, but the actual injection volume was only 20,000 gallons due to reduced injection flow rates. The target volume injected to the source area wells was 20,000 gallons; however, a total of 30,000 gallons were injected (source well target volume plus the extra volume from the PRB injection). The injection solution was the same as the prior injection (glycerin, ferrous sulfate, and Textrol BR (TBR). The performance of this additional corrective active is provided in Section 5.3.

2.3.4 SOIL VAPOR EXTRACTION TREATMENT

To address soil vapor in the Former Degreaser Source Control Area, the SVE system previously utilized in the Central and West Corrective Action Areas was modified and installed in the Former Degreaser Source Control Area during August and September 2012 (LAI 2012a). The vadose zone well screen interval of the multiple-purpose wells [BOP-78(i), BOP-79(i), and BOP-84(i) through BOP-88(i)] are connected to the SVE system through sub-grade conveyance piping to allow the SVE system to operate

full time with minimal disruption to facility operations. Three VOWs (VOW-16 through VOW-18) and nine sub-slab vapor pins (VP-1 through VP-9) were installed around the former vapor degreasers, as access would allow to monitor remedy progress within the vadose zone and sub-slab intervals.

The SVE system consists of a control panel, Rotron regenerative blower, condensate pump, knockout tank, and two 2,000-lb GAC vessels for vapor treatment. The SVE system operates in accordance with the Boeing Portland facility-wide air discharge permit at an extraction rate of approximately 250 cubic feet per minute. Exhaust piping is routed from the GAC vessels to a roof stack for venting.

The SVE system operated on a full-time basis between September 2012 and July 2014, when the system switched to pulse pump operation, as approved by ODEQ (ODEQ 2014b). Quarterly sub-slab vapor and at-depth soil vapor sample results are utilized to determine the pulse operation timeframe for the system. Based on the vapor sample results, the SVE system has operated at the following schedule:

Date Range	SVE Operation Cycle
September 17, 2012 to June 21, 2013	Full-time operation of system
June 21, 2013 to July 22, 2013	Temporarily down to facilitate bioinjection activities
July 22, 2013 to July 2, 2014	Full-time operation of system
July 2, 2014	Receive ODEQs approval to shut down system and start pulse-pump operation.
July 2, 2014 to January 29, 2015	System shut down
January 29, 2015 to June 8, 2015	Resume full-time operation of system due to increased TCE concentrations in either the sub-slab or at-depth sampling intervals
June 8, 2015 to June 29, 2015	Temporarily down to facilitate bioinjection activities
June 29 to October 9, 2015	Resume full-time operation of system
October 9, 2015 to current	System shut down

3.0 SIGNIFICANT ISSUES, EVENTS, AND ACTIONS

This section of the report summarizes significant issues, events, and actions taken during this annual reporting period (January 1 – December 31, 2015).

3.1 GROUNDWATER TREATMENT SYSTEM SELECTION AND MODIFICATION

Since September 4, 2014, a temporary groundwater treatment system consisting of two air stripper tray units (H2 Oil Recovery Equipment, model number TS-600-3) running in parallel has been in operation with a combined capacity to treat between 130 to 140 gpm.

An evaluation of potential GWTS alternatives was conducted to replace the oversized stripping tower in an effort to meet future estimated flow rates and to operate in a more energy-efficient manner (LAI 2014b). The evaluation included four potential alternatives: a) keep the air stripper tower, but replace the 25 horsepower (hp) blower with a 5 hp version, b) replace air stripper system with a liquid-phase granular activated carbon (LGAC) system, c) replace air stripper tower with a new low profile air stripper tray unit, or d) replace air stripper tower with the rental tray units. To evaluate the potential use of LGAC, a pilot test was conducted using procedures described in the work plan (LAI 2015d). During March and April 2015, approximately 10 gpm of groundwater was diverted from the treatment influent and routed through two 25-micron bag filters prior to routing to two 55-gallon LGAC drums. Over the duration of the pilot test, bag filters required changeout every 2 to 3 days due to biofouling accumulation. The pilot test data was included in the treatment system evaluation.

Based on effective treatment, lifetime operation and maintenance (O&M) costs, and energy efficiency, the two rented low-profile air stripper tray units were selected and purchased as the GWTS alternative. The low-profile air stripper tray units were modified to meet Site requirements and system design life goals. Modification included installation of aboveground conveyance pipe to replace temporary hose. All aboveground conveyance pipe includes double-walled containment, heat trace, and exterior insulation. A floor-mounted rotating jib crane was also installed within the 85-124 building in between the two air stripper tray units to assist with tray removal during routine cleaning operations. On January 15, 2016, the old 40-ft air stripper tower was demolished and transferred to the Hillsboro Landfill, with ODEQ approval (ODEQ 2016).

As part of the GWTS modifications, the Supervisory Control and Data Acquisition (SCADA) system was upgraded from the old and non-supported software to the latest Wonderware software program and processing system. A new SCADA computer and backup system were also installed. The SCADA system underwent troubleshooting and testing prior to full time operation.

3.2 GROUNDWATER EXTRACTION WELL OPERATION

The groundwater extraction wells were operated during 2015 with the following exceptions:

- Extraction wells E-2 and E-3 were down between January 28 and 30, 2015 and between April 22 and 24, 2015 due to malfunctioning pump motors and plugged pump inlets, which resulted in reduced extraction pump rates. During each event, the extraction well screen was cleaned using sonar techniques and the wells were redeveloped to remove solids by removing approximately 12,000 gallons and 3,000 gallons from E-2 and E-3, respectively, with a high volume temporary pump. Upon completion of the well redevelopment process, new extraction pumps were installed and full-time operation of the wells resumed. Redevelopment water was transferred by a vacuum truck to a temporary storage tank to allow solids to settle prior to decanting the clear water to the GWTS. Solids generated from the redevelopment activities were transferred to 55-gallon drums and disposed by Boeing. Extraction wells E-2 and E-3 were pilot shutdown in July 2015 per ODEQs approval.
- All extraction wells were down between June 19 and July 7, 2015 due to a malfunction of the GWTS, which resulted in approximately 100 to 300 gallons of treated water being released from the building's secondary containment and to the ground. An investigation was conducted and the system was modified with redundant high-level alarms, a building sump alarm, replacement of floats gauges impacted with biofouling, and upgrade of the SCADA communication system (LAI 2015e).
- All extraction wells were down between November 26 and November 30, 2015, due to a Site facility power shutdown.
- Extraction well E-12 was down between November 26 and December 10, 2015 due to flooding of the well vault. During the Site facility power shutdown, the sump pump lost power and the vault flooded with surface water accumulation. The electrical panel inside the extraction well vault underwent troubleshooting protocols carried out by an electrician; no damage was observed. The extraction pump motor was confirmed to be malfunctioning and the well pump and motor were replaced prior to resuming operation.
- The SP-2 sump pump was down between December 9 and 15, 2015 due to pump failure. A temporary pump was installed and operation was resumed. During the shutdown period, accumulated water levels were monitored to ensure the sump did not overflow, and approximately 15,000 gallons of water was removed from the sump by vacuum truck to the remediation yard decontamination pad for treatment through the GWTS.

3.2.1 WELL DECOMMISSIONING

In December 2015, monitoring wells BOP-11(i) and BOP-12(i) were decommissioned in accordance with the ODEQ-approved work plan (LAI 2015f).

3.3 FORMER DEGREASER SOURCE CONTROL AREA REMEDIATION

As discussed in Section 2.3.3, a combined bioremediation injection was conducted within the Former Degreaser Source Control Area during this reporting period. The injection was conducted between June 8 and 19, 2015 using procedures described in the Addendum No. 2 Work Plan (LAI 2015c), as approved by ODEQ (2015b). The injection solution contained both fast- and slow-release electron donors, at similar concentrations to previous injections, but was modified to include glycerin and ferrous sulfate. Glycerin and TBR were substituted for the LactOil used for prior injections to achieve bioremediation in a more sustainable way. Glycerin, a fast-release donor similar to the ethyl lactate component of LactOil, is a locally produced and sustainable byproduct of biodiesel production from used fryer oil. TBR replaced the vegetable oil component of LactOil. Ferrous sulfate was added to the injection solution to promote *in situ* production of iron-sulfide minerals for abiotic degradation of TCE and cDCE through reductive elimination. Reductive elimination is a concurrent and complementary mass destruction reaction to biological reductive dechlorination.

The injection solutions contained 2.6%vol TBR, 4.4%vol glycerin, and 8.3%vol (2%wt) ferrous sulfate, with the following breakdown:

- 42,455 gallons of potable water
- 1,290 gallons of TBR donor substrate, which consists of soy oil and soil lecithin surfactants
- 2,200 gallons of glycerin
- 4,145 gallons of 25%wt ferrous sulfate heptahydrate solution.

Each of the seven multiple-purpose wells received an average of 4,512 gallons of donor mixture at average injection rates ranging from 0.9 to 3.8 gpm. The PRB well received a total of 20,000 gallons of donor mixture at an injection rate ranging from 5.5 to 15.1 gpm.

4.0 REMEDY PROGRESS DATA

This section of the report presents a summary of remedy progress monitoring data collected during this reporting period (January 1 through December 31, 2015), including TGA and Upper TSA groundwater quality data, groundwater level data, groundwater extraction well performance data, and GWTS influent and effluent water quality data.

Laboratory reports and data validation memoranda for data collected during this reporting period are provided in Appendix A. Historical TGA and select Upper TSA data are presented in Appendix B.

4.1 TGA GROUNDWATER QUALITY

Groundwater quality monitoring for TGA wells and select Upper TSA monitoring wells was conducted in accordance with the Groundwater Performance Monitoring Program (Table 1). Sampling frequency for actively operated extraction wells was performed on a quarterly basis, while extraction wells in shutdown mode were sampled on an annual basis. Groundwater samples from each sampling event were analyzed for VOCs and select wells were additionally analyzed for bioremediation monitoring parameters (total organic carbon [TOC], nitrate, sulfate, sulfide, total and dissolved iron, and dissolved gasses). Wells associated with the coolant release area were also analyzed for diesel-range petroleum hydrocarbons (TPH-Dx). The analytical results for the VOC COPCs at each TGA well, select Upper TSA wells, and the GWTS are presented in Table 3. Historical TGA and Upper TSA water quality data are summarized in Appendix B, Table B-1. The interpreted extent of the Site-wide dissolved VOC plume in the TGA, based on the results from August 2015 (more inclusive annual event), is shown on Figure 5 and for the Former Degreaser Source Control Area on Figure 6. TCE continues to be the predominant COPC in the TGA outside of the area of bioremediation in the Former Degreaser Source Control Area and will continue to be used to benchmark remediation progress.

The TGA dissolved-VOC plume continues to exhibit decreasing concentrations and aerial extent. Analytical results for the TGA wells indicate TCE concentrations have steadily decreased since operation of the GWTS began in March 1989. Groundwater quality for each of the Corrective Action Areas is discussed below.

4.1.1 EAST CORRECTIVE ACTION AREA

Extraction well E-8 was originally installed to assist with remediation within the East Area; however, active operation of the extraction well was discontinued in 2002 and, since its shutdown, the well has only operated for annual groundwater quality monitoring purposes. Analytical results for the August 2015 sampling event indicate TCE concentrations have decreased from the historical maximum 140 µg/L

(December 1991) to 7.0 µg/L, which is slightly above the MCL (5 µg/L). PCE was detected at a concentration of 6.1 µg/L, which is slightly above the MCL (5 µg/L), but below the 19 µg/L historical maximum concentration observed in September 1997. All other COPC concentrations at E-8 are below the respective MCLs.

4.1.2 EAST YARD CORRECTIVE ACTION AREA

The groundwater quality in the East Yard Corrective Action Area is currently evaluated using data from monitoring well BOP-48(i) and extraction well E-9. Active pumping at E-9 was ceased in 2002 due to low mass removal rates and is currently operated intermittently for groundwater quality sampling and maintenance purposes only. TCE concentrations at both wells have consistently been below the MCL since November 2007 for E-9 and February 2006 for BOP-48(i). Other COPC concentrations are below either the respective MCLs or the laboratory reporting limits.

4.1.3 CENTRAL CORRECTIVE ACTION AREA

The 2015 groundwater quality data within the Central Corrective Action Area indicate COPC concentrations continue to decline; however, a number of wells contain COPC concentrations above MCL cleanup levels:

- TCE concentrations at all Central Corrective Action Area wells [BOP-10(i), BOP-56(i), BOP-59(i), E-6, E-7, and DP-1] remained above the MCL with concentrations ranging from 7.0 to 35 µg/L during 2015. TCE concentrations in the wells were highest at DP-1 (35 µg/L); however, concentrations have decreased over time at this well from the historical maximum concentration of 1,000 µg/L in October 1998.
- PCE was above the MCL (5 µg/L) at BOP-10(i), BOP-59(i), E-6, E-7, and DP-1 with concentrations ranging from 7.0 to 75 µg/L. PCE concentration trends continue to decrease within the Central Area with the exception of extraction well DP-1. PCE concentrations at DP-1 have historically fluctuated with concentrations above the MCL (May 2003 through February 2007) to below the MCL (May 2007 through August 2011) only to increase to above the MCL since 2012. PCE concentrations since 2012 have decreased from 24 to 14 µ/L.
- During this reporting period, cDCE concentrations consistently exceeded the MCL (70 µg/L) at extraction well DP-1 with concentrations ranging from 97 to 120 µg/L; however, concentration trends have decreased over time from 850 µg/L in October 1998.
- All other COPC concentrations were below the MCLs or not detected at the respective laboratory reporting limits.

4.1.4 WEST CORRECTIVE ACTION AREA

The groundwater remedy for the West Corrective Action Area is monitored at wells BOP-16(i) and BOP-57(ia,ib), shutdown extraction wells E-5 and E-11, and operating extraction wells E-15, and E-16.

The 2015 analytical results indicate COPC concentrations continue to decline; however, a number of wells contain COPC concentrations above MCL cleanup levels:

- 1,1-DCE concentrations at BOP-57(ib) ranged from 33 to 35 µg/L, which are above the MCL (7 µg/L) but below the historical maximum of 56 µg/L (August 2010).
- TCE concentrations were above the MCL at BOP-16(i), BOP-57(ib), and E-16 with concentrations ranging from 5.8 µg/L [BOP-16(i)] to 42 µg/L [BOP-57(ib)].
- VC concentrations were above the MCL (2 µg/L) at monitoring wells BOP-16(i), E-15, and E-16 with concentrations ranging from 2.2 to 5.6 µg/L.

Extraction well E-16 continues to show an increasing trend in TCE concentrations above the MCL since November 2012. Well pair BOP-57(ia) (screened at the base of the TGA) and BOP-57(ib) (screened in the first layer of the CU1) are located near former supply well A-2, which was screened within the TGA and the underlying TSA before being decommissioned in 1988. The well A-2 investigation and decommissioning activities are summarized in the RFI (LAI 1995b). Data from the well A-2 investigation suggested the former supply well was a conduit for contamination to migrate from the TGA to the underlying Upper TSA (i.e., contaminant source to the TSA) prior to well decommissioning.

4.1.5 SOUTHWEST CORRECTIVE ACTION AREA

Groundwater quality in the Southwest Corrective Action Area is characterized by monitoring well BOP-9(i). The August 2015 results for BOP-9(i) indicate a TCE concentration of 40 µg/L, which increased from February 2015 event (33 µg/L); however, concentrations remain significantly lower than the historical maximum concentration (1,600 µg/L) in January 1989. All other COPCs were below either the respective laboratory reporting limit or MCLs.

4.1.6 DOWNGRADIENT CORRECTIVE ACTION AREA

The groundwater remedy progress for the Downgradient Corrective Action Area is characterized by wells BOP-7(i), D-7(i), D-8(i), D-11(i), D-12(i), and extraction wells E-2, E-3, E-4, E-12, and E-13. The analytical results for 2015 indicate COPC concentrations continue to decline; however, a number of wells contain COPC concentrations above MCL cleanup levels:

- 1,1-DCE concentrations at BOP-7(i) were consistently above the MCL (7 µg/L) with concentrations ranging from 7.3 to 23 µg/L; however, concentrations decreased to below the MCL during the August 2015 sampling event. Extraction well E-4 reported 1,1-DCE at 28 µg/L during the November 2015 sampling event.
- PCE was detected at well BOP-7(i) and extraction well E-4 with concentrations of 5.8 and 7.4 µg/L during the November sampling event, respectively.

- TCE concentrations continue to be above the MCL for all the wells in the Downgradient Corrective Action Area except D-11(i), D-12(i), E-2, and E-3 (last two consecutive quarters of 2015 and since the well was pilot shutdown with ODEQ approval). TCE concentrations at BOP-7(i) range from 50 to 400 µg/L during 2015, which is well below the maximum concentration (1,500 µg/L in June 1990). TCE concentrations at D-8(i) have steadily decreased from 570 µg/L (November 1988) to 7.4 µg/L in August 2015; however, concentrations remain above the MCL. TCE concentrations at extraction wells E-3 decreased from 10 µg/L to below the MCL during 2015, while concentrations at E-4 fluctuated between 18 and 200 µg/L. TCE concentrations at E-12, and E-13 range from 8.7 to 19µg/L during this reporting period.
- VC was detected above the MCL (2 µg/L) at extraction well E-3 with the highest concentration coming from the August sampling event 4.4 µg/L.
- All other COPC concentrations were below the MCLs or not detected at the respective laboratory reporting limits.

4.1.7 FORMER DEGREASER SOURCE CONTROL AREA

The groundwater remedy progress for the Former Degreaser Source Control Area is characterized by wells BOP-72(i) through BOP-88(i). The Former Degreaser Source Control Area was investigated between 2009 and 2011. Based on elevated TCE concentration in the groundwater, additional corrective measures including bioremediation have been conducted. Groundwater analytical data for 2015 indicate concentrations of COPCs continue to decline to levels below either the laboratory reporting limit or the respective MCLs; however, a number of wells contain COPC concentrations above MCL cleanup levels:

- 1,1-DCE concentrations were above the MCL (7 µg/L) at BOP-80(i) with a concentration of 15 µg/L during the August sampling event.
- cDCE concentrations were above the MCL (70 µg/L) at four monitoring wells [BOP-73(i), BOP-77(i), BOP-80(i), and BOP-88(i)]; concentrations range from 72 to 430 µg/L with the highest concentration observed at BOP-80(i). Increased concentrations of cDCE have resulted from reductive dechlorination of TCE stimulated by bioremediation injections.
- TCE concentrations at seven wells [BOP-73(i), BOP-75(i), BOP-77(i), BOP-80(i), BOP-82(i), BOP-83(i), and BOP-88(i)] were above the MCL with concentrations ranging from 5.8 to 91 µg/L. The highest TCE concentration (91 µg/L) was reported at BOP-80(i) during the August 2015 sampling event. This data compares to 14 wells with TCE concentrations above the MCL during baseline source area monitoring in November 2011 and February 2012. Well BOP-73(i) is utilized to characterize remedy progress in the source area because the well is located directly downgradient of the two former degreasers and has not been utilized as an injection well during bioremediation activities. TCE concentrations at BOP-73(i) have decreased from the historical maximum concentration of 17,000 µg/L (November 2013) to ranging from non-detect at the laboratory reporting limit to 5.8 µg/L during 2015.
- VC concentrations above the MCL (2 µg/L) were reported at 12 wells [BOP-72(i) through BOP-80(i), BOP-84(i), BOP-86(i), and BOP-88(i)]. VC concentrations above the MCL ranged from 2.1 µg/L at both BOP-80(i) and BOP-84(i) to 730 µg/L at BOP-73(i). Increased concentrations of VC have resulted from reductive dechlorination of TCE through cDCE stimulated by bioremediation injections.

4.1.8 COOLANT RELEASE AREA

To monitor the extent of the coolant release and to monitor the effects of the EHC-O injections, groundwater samples were collected semiannually in 2015 from three TGA coolant release monitoring wells (LAI-4, LAI-7, and LAI-8), and annually from eight monitoring wells (LAI-1 through LAI-8). Wells LAI-4 and LAI-7 are also analyzed semiannually for TGA COPCs. TPH-Dx results for groundwater from these wells are summarized in Table 4, and shown on Figure 7. Historical total TPH-Dx concentrations are summarized in Appendix B, Table B-2. TGA COPCs data for this reporting period are summarized in Table 3 and TCE concentrations are shown on Figure 5. Historical COPC concentrations are summarized in Appendix B, Table B-1.

The 2015 analytical results for the coolant release area for petroleum hydrocarbons and VOCs are as follows:

- TCE was reported at well LAI-7 at 7.2 µg/L during the February 2015 sampling event, which is above the MCL. All other TGA COPCs were below either the respective laboratory reporting limit or MCL.
- TPH-Dx was detected above the Site-specific cleanup level (1.35 milligrams per liter [mg/L]) at monitoring well LAI-4 (6.0 mg/L and 96 mg/L) during the February and August 2015 sampling events, respectively. The August 2015 TPH-Dx results represent the highest detection from LAI-4 since February 2009 (102 mg/L); however, concentrations are below the historical maximum concentration of 31,800 mg/L (September 2006). It should be noted the February 2016 TPH-Dx concentration (0.86 mg/L) was below the Site-specific cleanup level, which indicates the August 2015 data may be an outlier.

4.2 UPPER TSA GROUNDWATER QUALITY MONITORING DATA

Per the Consent Order, TSA groundwater quality data at six Upper TSA wells [BOP-22R(ds), BOP-60R(ds), BOP-61(ds), BOP-62(ds), BOP-65(ds), and BOP-66(ds)] were reviewed to evaluate possible migration of groundwater from the TGA downward through the CU1 to the underlying Upper TSA. The Upper TSA VOC analytical results from the August 2015 event are summarized in Table 3 and the TCE concentrations are shown on Figure 5. Historical TSA water quality data for the above-mentioned wells are summarized in Appendix B, Table B-1.

TCE concentrations at the six Upper TSA wells were below either the reporting limit or below the MCL, with the exception of BOP-61(ds). TCE concentrations at BOP-61(ds) ranged from 5.1 to 8.7 µg/L, which is slightly above the MCL in 2015. TCE concentrations at BOP-61(ds) have fluctuated near the MCL for the past 3 to 5 years. TGA wells in the direct vicinity of BOP-61(ds) include E-9 and BOP-48(i), where TCE results are near the reporting limit and do not indicate a source for the observed concentrations at BOP-61(ds). TSA extraction well EW-23, located 330 ft northeast of BOP-61(ds), is operated to capture and remediate groundwater in the vicinity of BOP-61(ds) as part of the East Multnomah County Cleanup project.

4.3 TGA GROUNDWATER LEVEL MONITORING

Groundwater levels in the TGA and Upper TSA wells measured during the quarterly 2015 sampling events are presented in Table 5. The more inclusive August 2015 measurements were used to develop the water level contours presented on Figure 8. The TGA groundwater flow continues to be observed toward the northwest in areas not included in the ROI of the extraction wells. Observations from the data are as follows:

- Groundwater contour data indicate that the active pumping at extraction wells in the Downgradient Corrective Action Area (E-2, E-3, E-4, E-12, and E-13), Central Corrective Action Area (DP-1), and West Corrective Action Area (E-15 and E-16) continue to be effective in maintaining capture of the TGA plume. It should be noted that extraction wells E-2 and E-3 were pilot shutdown on July7, 2015 to minimize preferential pathways of bioenhanced groundwater away from the upgradient Former Degreaser Source Area and minimize damage to extraction well pumps.
- An upward vertical gradient was observed at each of the six Upper TSA wells [BOP-22R(ds), BOP-60(ds), BOP-61(ds), BOP-62(ds), BOP-65(ds), and BOP-66(ds)] compared to the corresponding nearby TGA wells.

4.4 FORMER DEGREASER SOURCE AREA-VAPOR DATA

During the Former Degreaser Source Area investigations, vapor sampling was conducted within the sub-slab interval and at-depth intervals throughout the vadose zone, as reported in Section 2.3.2.1. The results of the investigations indicate the highest at-depth vapor concentrations were observed between 45 to 60 ft bgs. At-depth vapor TCE concentrations ranged from 340 to 230,000 micrograms per cubic meter ($\mu g/m^3$) during the baseline monitoring. Baseline TCE concentrations within the sub-slab interval ranged from 3,200 to 850,000 $\mu g/m^3$. Based on investigation vapor results being above the TCE screening level (2,900 $\mu g/m^3$) and above the hot spot evaluation criteria (290,000 $\mu g/m^3$), the existing Site SVE system (formerly utilized in the Central and West Corrective Action Area) was modified (replaced damaged equipment and installed new blowers) and installed within the source area, as shown on Figure 9. The SVE system operated full time between September 2012 and July2, 2014 with minimal downtime for sampling and to facilitate bioremediation injection purposes. ODEQ approved the shut down of the system on July 2, 2014 with the understanding that vapor samples would continue to be collected in the source area and if TCE concentrations increased to above the MCL for two consecutive quarters, the SVE system would resume operation. In 2015, the SVE system operated between January 29 and October 9.

At-depth vapor COPC concentrations for samples collected during this reporting period are summarized in Table 6 and TCE concentrations are shown on Figure 9. Sub-slab vapor samples collected

during 2015 are summarized in Table 7 and TCE concentrations are shown on Figure 10. Historical vapor data for the source area are included in Appendix B.

During this reporting period, low-level TCE vapor concentrations from the at-depth sampling intervals ranged from 6.2 to 1,500 µg/m^3, which is below the screening level (2,900 µg/m^3).

Sub-slab vapor sample results from this reporting period indicate TCE vapor concentrations ranged from 8.4 to 21,000 µg/m^3, which is above the screening level. The maximum TCE vapor concentrations (21,000 µg/m^3) was reported at vapor pin VP-2 during the November sampling event. It should be noted that the February 2016 sampling results for VP-2 indicate the TCE vapor concentration 150,000 µg/m^3, therefore, based on the ODEQ approved process, the SVE system resumed operation on April 7, 2015.

5.0 SYSTEM PERFORMANCE EVALUATION

This section evaluates the performance of the various corrective measures.

5.1 GROUNDWATER EXTRACTION SYSTEM

Groundwater extraction system monitoring data includes VOC analytical data and flow rate data from sampling the discharge of each individual TGA extraction well. The actively operated extraction wells (E-2, E-3, E-4, E-12, E-13, E-15, E-16, and DP-1) are sampled on a quarterly basis and flow rate data are collected monthly. The shutdown extraction wells (E-5 through E-9) are sampled on an annual basis, with the exception of E-11, which is sampled on a semiannual basis. These data are presented and evaluated in this section in terms of an average daily mass removal rate in pounds per day (lbs/day), total gallons extracted at each extraction well, and the average yield in gpm for each extraction well.

Average total mass removal rates (lbs/day) of VOCs (TCE, PCE, TCA, and total DCE) from each TGA groundwater extraction well for 2015 are presented on Figure 11. The mass removed for other COPCs is not presented because the constituents contributed less than 10 percent of the total VOC mass removed. Extraction well E-13, located in the Downgradient Corrective Action Area, continues to provide the highest average mass removal rate (0.0107 lbs/day), compared to the other TGA extraction wells, which range from 0.0001 lbs/day (E-15 and E-16) to 0.0040 lbs/day (DP-1). In 2015, the TGA extraction system removed approximately 5.41 lbs of VOCs.

Data from each extraction well is provided for evaluation of the GWTS performance. The average pump rates are based on the total gallons removed during each measurement period divided by the number of minutes in the measurement period that the well was actively pumping. The average pump rate for each operating extraction well is summarized in Table 8. Well E-15 had the lowest average pump rate during 2015 (between 0.50 and 1.10 gpm), while E-13 continues to pump at the highest average rate (between 50.90 and 72.00 gpm). Extraction wells E-5 through E-9 have been shut down since 2002, with the exception of brief operation for sample collection and maintenance. Extraction well E-11 has been shut down since it was utilized in the 2008 *in situ* bioremediation injection; this well continues to indicate elevated TOC concentrations (259 mg/L in August 2015 compared to 940 mg/L in May 2009) and is recommended to remain shut down (Table 8). Extraction wells E-2 and E-3 were suspended from operation in July 2015 to aid injection donor desorption into formation, from bioremediation activities at the Former Degreaser Source Control Area. TOC concentrations at E-2 and E-3 remain elevated at between 71.4 and 175 mg/L and TCE concentrations are below the MCL; therefore, we recommend the wells remain shut down.

The treatment system has been operating since 1989 and has extracted approximately 4,558 million gallons and removed a total of 4,295 lbs of VOC mass from the TGA aquifer. The VOC mass removed has reached an asymptotic level relative to the first 15 years of groundwater treatment as shown on Figure 12. Over the past few years, the benefit of operating the GWTS has shifted more from providing VOC mass removal to providing hydraulic control of the dissolved plume. As the additional corrective measures continue to remove mass (i.e., SVE system in the vadose zone and enhanced *in situ* bioremediation in selected areas of the Site), the continued operation of individual extraction wells for the GWTS may be modified.

In compliance with Boeing Portland's National Pollutant Discharge Elimination System (NPDES) permit (NPDES number 101761), quarterly samples of the GWTS/temporary GWTS (TGWTS) effluent were collected for chemical analysis. The 2015 GWTS analytical results for events are summarized in Table 3. TCE concentrations for the system influent ranged from 9.4 to 18 µg/L during this reporting period, while the system effluent remained below the discharge limit. All the NPDES permit requirements were met during this reporting period.

5.2 COOLANT RELEASE-AEROBIC BIOREMEDIATION

With the exception of well LAI-4, TPH-Dx was either not detected at the laboratory reporting limits or was below the Site-specific cleanup level (1.35 mg/L) at coolant release monitoring wells during this reporting period. Prior to bioremediation treatment, the TPH-Dx concentrations were above the cleanup level at LAI-1 and LAI-4 through LAI-8. However, well LAI-6 has been below the cleanup level since 2007, LAI-5 since 2006, and LAI-7 since 2008. Total TPH-Dx concentrations at LAI-8 have frequently been above the cleanup level since injections began; however, dry conditions at this well since November 2011 have prevented the collection of data from this well. The TPH-Dx concentrations at LAI-1 have been below the cleanup level since 2007; however, during August 2014, TPH-Dx concentrations increased to above the cleanup level (2.78 mg/L) only to decrease to below the cleanup level in 2015. TPH-Dx concentrations remained above the cleanup level during 2015 at LAI-4, where TPH impacts have been most persistent. TPH-Dx concentrations at LAI-4 were initially 31,800 mg/L (September 2006); however, after seven EHC- O™ injections (February 2008, October 2008, June 2010, June 2011, April 2012, April 2013, and July 2015), concentrations have decreased to near the cleanup level with the exception of the August 2015 (96 mg/L) results.

5.3 FORMER DEGREASER SOURCE CONTROL AREA

The additional corrective measure utilized at the Former Degreaser Source Control Area includes the operation of a SVE system to address vapor concentrations in both the sub-slab interval and the deeper

vadose zone, and the stimulation of *in situ* bioremediation to address VOC concentrations in the groundwater.

5.3.1 SVE SYSTEM

During this reporting period, the SVE system continued to operate on a pulse-pump mode, based on quarterly vapor data from the sub-slab and at-depth intervals. During this reporting period, the system operated between January 29 and October 9, with 46.5 days being shut down for either sampling purposes or to facilitate the June 2015 bioremediation injection activity. The system has been shut down since October 9, 2015 with ODEQ approval (ODEQ 2015c) based on VOC concentrations being below the RBC screening level for both the sub-slab and at-depth vapor intervals. The November 2015 and February 2016 analytical results indicate TCE concentrations were above the RBC screening level at sub-slab location VP-2. Based on the observed rebound of TCE concentrations at VP-2, the SVE system resumed operation on April 7, 2016. Rebound of TCE concentrations are not unexpected and quarterly monitoring of sub-slab and at-depth soil vapor will continue; the SVE system will continue to operate in a pulse-pump operation mode. The cycle time of the pulse-pump operation will be based on quarterly vapor sample results from the monitoring wells and sub-slab vapor points

During 2015, the SVE system mass removal rates from the seven multiple-purpose wells, wells screened in both the vadose zone for SVE operation and saturated zone for bioremediation injection/monitoring [BOP-78(i), BOP-79(i), and BOP-84(i) through BOP-88(i)] ranged from 0.02618 lbs/day [at BOP-84(i)] to 0.00020 lbs/day [at BOP-78(i)], as summarized in Table 6. To date, a cumulative total VOC mass of 10.47 lbs has been removed from the vadose zone.

5.3.2 AQUIFER BIOREMEDIATION

Aquifer bioremediation at the Former Degreaser Source Area continues to consist of the PRB created through electron donor injection to well BOP-74(i) on the downgradient edge of the source area, and source area treatment resulting from donor injection to the seven multiple-purpose wells [BOP-78(i), BOP-79(i), and BOP-84(i) through BOP-88(i)]. PRB injections occurred in 2011, 2012, 2014, and an additional injection conducted during June 2015. Injection of the seven multiple-purpose wells was performed in 2013, 2014, and a third injection was conducted in June 2015 (concurrent with the PRB injection). Well locations and estimated ROI are shown on Figure 13.

The PRB injections and multiple-purpose source area well injections continue to yield a commingled treatment zone with overlapping ROI of injected donor. The PRB ROI extends from injection well BOP-74(i) to overlap with the ROI from upgradient multiple-purpose injection wells. Following the 2012 and 2014 PRB injection, elevated TOC observed at nearby monitoring wells and upgradient multiple-

purpose injection wells (first injected in 2013) indicated an approximate PRB ROI of 70 ft; the volume and expected ROI of the June 2015 PRB injection are the same. The ROI of multiple-purpose wells is 10 to 15 ft based on injection volumes and observations at non-injected wells BOP-72(i) and BOP-76(i). The combined treatment zone of overlapping ROI is approximately 140 ft wide (north to south) and 150 to 160 ft thick (east to west), as shown on Figure 13. Increased TOC at well BOP-75(i) following the July 2013 injection (multiple-purpose wells only), and July 2014 and June 2015 injections (PRB and multiple-purpose wells) indicates that overlapping injection ROI extend to this well.

The progress of the bioremediation remedy within the immediate source zone is primarily demonstrated by the decrease in TCE concentrations and the increase in breakdown products (cDCE and VC), and in non-toxic end products ethene and ethane. The presence of injected donor and enhanced aquifer redox conditions for bioremediation are indicated by increasing TOC, ferrous iron, sulfide, and methane; and decreasing nitrate and sulfate. Evaluation of ferrous iron and sulfate data must also take into account increases in both due to inclusion of ferrous sulfate in the injection fluid for the July 2014 and June 2015 injections. Bioremediation monitoring data for the Former Degreaser Source Control Area are summarized in Table 9. The following highlights some observations of enhanced biodegradation in and downgradient of the source zone:

- Enhanced dechlorination, evidenced by decreasing concentrations of TCE concurrent with increasing concentrations of breakdown products, is observed at most wells:
  - TCE concentrations exceed the MCL at 7 of 17 wells monitored within and downgradient of the source area, compared to the earlier data (baseline sampling in November 2011 and February 2012) where 14 of 17 wells reported TCE concentrations above the MCL. Following the June 2015 injection, TCE concentrations have generally decreased.
  - With the exception of downgradient wells BOP-82(i) and BOP-83(i), the predominant COPC at the 17 monitored wells has transitioned from the parent product (TCE) to breakdown products (cDCE and VC) or end products (ethene and ethane). This is a favorable result indicating progression of reductive dechlorination through breakdown products to non-toxic end products. The transition from TCE to breakdown and end products can be seen in the highlighting of the predominant ethene (i.e., COPC with the highest molar fraction) in Table 9.
- Following injection events, TCE concentrations often increase as a result of enhanced desorption of mass from the aquifer soil. Notable concentration increases due to enhanced desorption have occurred at well BOP-73(i) in the source zone and at downgradient well BOP-80(i) following injection events. Enhanced desorption is desired as it liberates mass from the sorbed phase to the aqueous phase where it can be treated *in situ* or extracted for treatment by the GWTS. The increasing concentrations of TCE, cDCE, and VC observed at downgradient well BOP-80(i) in August are the result of enhanced desorption in the source zone.
- Aquifer redox conditions have become more reducing due to bioremediation injections. This is evidenced by a decrease in baseline nitrate detections, increased ferrous iron and methane, and decreased sulfate.

- Five source area wells [BOP-72(i), BOP-73(i), BOP-75(i), BOP-76(i), and BOP-77(i)] are utilized for monitoring purposes only and are not injected with electron donor. Data from these wells is important for understanding changes in the bulk aquifer due to donor injection at some distance from injection wells. Data from monitoring well BOP-73(i) (located 50 ft northwest of the former degreasers) is particularly helpful in understanding the progression of treatment in the source area, as the highest TCE concentrations were consistently detected at this well. BOP-73(i) is also located centrally within the extent of source area contamination and centrally to the injected multiple-purpose wells. Some observations at BOP-73(i) are as follows:
  - Enhanced desorption is nearing an end as evidenced by the drop in TCE and breakdown product concentrations in 2015. In late 2013 and early 2014, peak concentrations of TCE (17,000 µg/L), cDCE (7,800), and VC (13,000) were observed 2 orders of magnitude higher than the baseline concentrations reported prior to donor injections. Drastic decreases were observed in 2015 data: TCE (5.8 µg/L), cDCE (340 µg/L), and VC (730 µg/L). TCE concentrations were below the MCL in February, May, and August.
  - TCE predominance on a molar basis (evaluated by molar fraction) continues to show a transition to cDCE, VC, and end product ethane predominance as observed at five of the area wells [BOP-73(i), BOP-76(i), BOP-77(i), BOP-80(i), and BOP-81(i)], The non-toxic end product ethene, which was not detected during baseline sampling, increased to a maximum of 340 µg/L at BOP-73(i) in February. Ethene was predominant over TCE and breakdown products in February and August with a molar fraction of 0.44 and 0.90 (i.e., 44 and 90 percent of total ethenes), respectively (Table 9).
  - Enhanced desorption and the progression of TCE reductive dechlorination through breakdown products to end products continues to be evident on a time versus concentration plot for BOP-73(i) groundwater presented on Figure 14. Several peaks in TCE concentration show enhanced desorption effects following injection events. TCE then declines followed by sequential peaks in cDCE, VC, and ethene+ethane concentrations.
  - The progression of TCE predominance to ethene+ethane predominance continues to be evident in the molar fraction plot presented on Figure 15. The baseline condition (October 2010) of mostly TCE with some cDCE progresses through repeated enhanced desorption events (i.e., increased TCE) to mostly cDCE (February and May 2014), mostly VC (August 2014 and May 2015), and mostly ethene+ethane (November 2014 and August 2015).
  - The occurrence of substantial desorption followed by sequential reductive dechlorination of TCE through breakdown products to the non-toxic end product ethene continues to demonstrate that optimal conditions for source area biotreatment have been achieved.

The treatment zone continues to extend downgradient due to donor transport by groundwater flow. The downgradient extent of treatment includes downgradient wells BOP-80(i), BOP-81(i), and BOP-82(i). The downgradient treatment zone is evidenced by increased TOC concentrations following injection events and more reduced redox conditions consisting of decreased sulfate (increased following the June 2015 injection of ferrous sulfate) and increased methane. Increases in TCE, cDCE, VC, and ethane concentrations have been observed at downgradient well BOP-80(i). At well BOP-81(i), TCE, cDCE, and VC concentrations have remained low or below the laboratory reporting limits; however, low levels of ethane have been periodically reported. Increased TOC and methane concentrations observed in August indicate inclusion of well BOP-82(i) in the downgradient treatment zone. At monitoring well BOP-83(i), the

northernmost in the line of downgradient monitoring wells, TOC and redox changes have not been observed, but TCE concentrations have decreased substantially from a baseline of 31 µg/L to 1.9 µg/L in November; this well is considered to be outside of the treatment zone, but within an area of concentration reduction resulting from donor injections. The downgradient extent of treatment is shown on Figure 13.

6.0 RECOMMENDATIONS

This section presents recommendations based on the data and evaluations presented in this report. Recommendations include:

- Continued water quality and soil vapor monitoring. The following are recommended modifications to the groundwater monitoring program as presented in Table 1:
    1. Modify both groundwater elevation measurements and groundwater quality monitoring from quarterly to semiannually at extraction wells E-2 and E-3. The two extraction wells were placed in pilot shutdown in July 2015 due to low-level TCE concentrations at or near the MCL and to reduce the preferential pathway from the upgradient Former Degreaser Source Control Area to enhance the bio strata desorption process.
    2. Modify frequency of groundwater elevation measurements at shutdown extraction wells (E-5 through E-9, and E-11) from quarterly to semiannual.
- Continued operation of the GWTS.
- Potentially conduct an additional EHC-O injection in the Coolant Release Area to address rebound in TPH-Dx. Continued monitoring at the area wells to monitor remedy. Based on current data, an EHC-O injection may be conducted in late fall to early winter 2016.
- Ongoing periodic injections of donor substrates to maintain adequate electron donor and the required reduced aquifer redox conditions for continued treatment of TCE and breakdown products in the Former Degreaser Source Control Area. The next bio injection event to the PRB [well BOP-74(i)] and multiple-purpose source area wells is anticipated to be in 2017, based on quarterly groundwater sample results.
- Continued pulse-pump operation of the SVE system in the Former Degreaser Source Control Area. The cycle interval of the operation will be based on analytical results from the sub-slab vapor points and the at-depth vapor samples collected from the multiple-purpose wells on a quarterly basis.

7.0 USE OF THIS REPORT

This report has been prepared for the exclusive use of Boeing for specific application to the TGA remedy at the Portland facility. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau Associates. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk. Landau Associates warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

This document has been prepared under the supervision and direction of the following key staff

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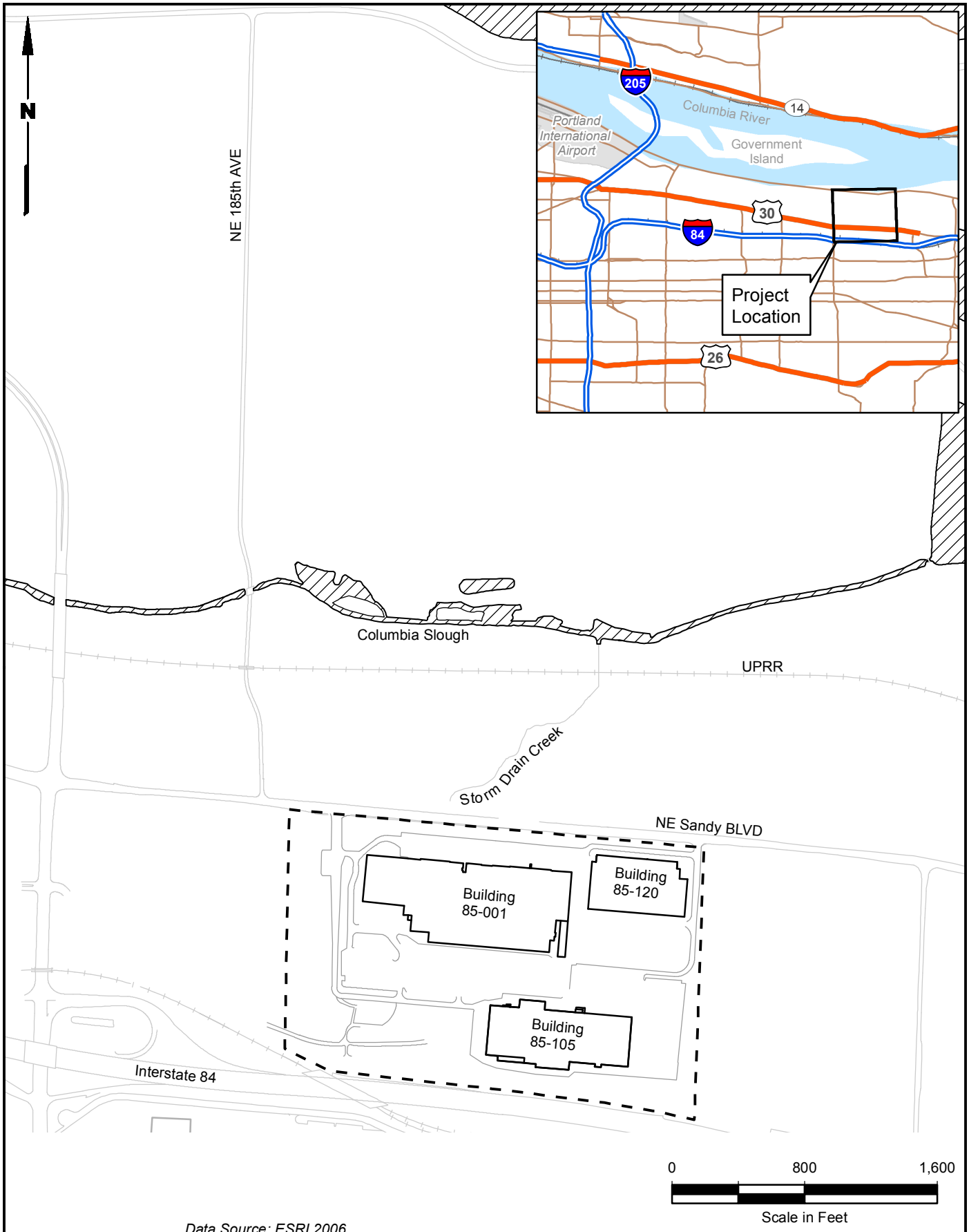

Data Source: ESRI 2006

G:\Projects\025\116\115\430\2015 Prog-Perf Report\Figure 01 VicMap.mxd 1/18/2016

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Boeing Portland Gresham, Oregon	**Boeing Portland Site Map**	Figure 1

G:\Projects\025\116\115\430\2015 Prog-Perf Report\Figure 02 TGA GW Locations and Action Areas.mxd 1/18/2016

N

Legend

- TGA Extraction Well
- TGA Injection Well
- TGA Monitoring Well
- TGA Multiple-Purpose Well
- TSA Monitoring Well

Notes

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.
2. Corrective Action Areas defined in Phase 2 Corrective Measures Study (1996).

NE 185t

Approximate Limit of the TGA

Columbia Slough

D-7(i) D-8(i) D-12(i) E-13

Downgradient Area

Storm Drain Creek

D-11(i)

NE SANDY BLVD

E-12 E-4 BOP-7(i) E-3 BOP-22R(ds) BOP-83(i) BOP-82(i) E-2 BOP-80(i) BOP-81(i) BOP-16(i) BOP-74(i) BOP-84(i) BOP-77(i) BOP-79(i) BOP-78(i) BOP-88(i) BOP-76(i) BOP-87(i) BOP-86(i) BOP-85(i) BOP-75(i) BOP-72(i) BOP-73(i) E-15 BOP-60R(ds) E-16 BOP-57(i) E-11 E-5

East Yard Area

West Area

Southwest Area

E-9 BOP-48(i) BOP-61(ds) BOP-56(i) E-8 BOP-65(ds) LAI-2 LAI-1 BOP-10(i) E-7 LAI-3 E-6 LAI-8 LAI-7 LAI-4 IW-2 LAI-6 IW-3 BOP-59(i) DP-1 LAI-5 IW-1 IW-5 IW-4 BOP-9(i) BOP-62(ds)

THE BOEING COMPANY

Central Area

East Area

INTERSTATE 84

0 350 700

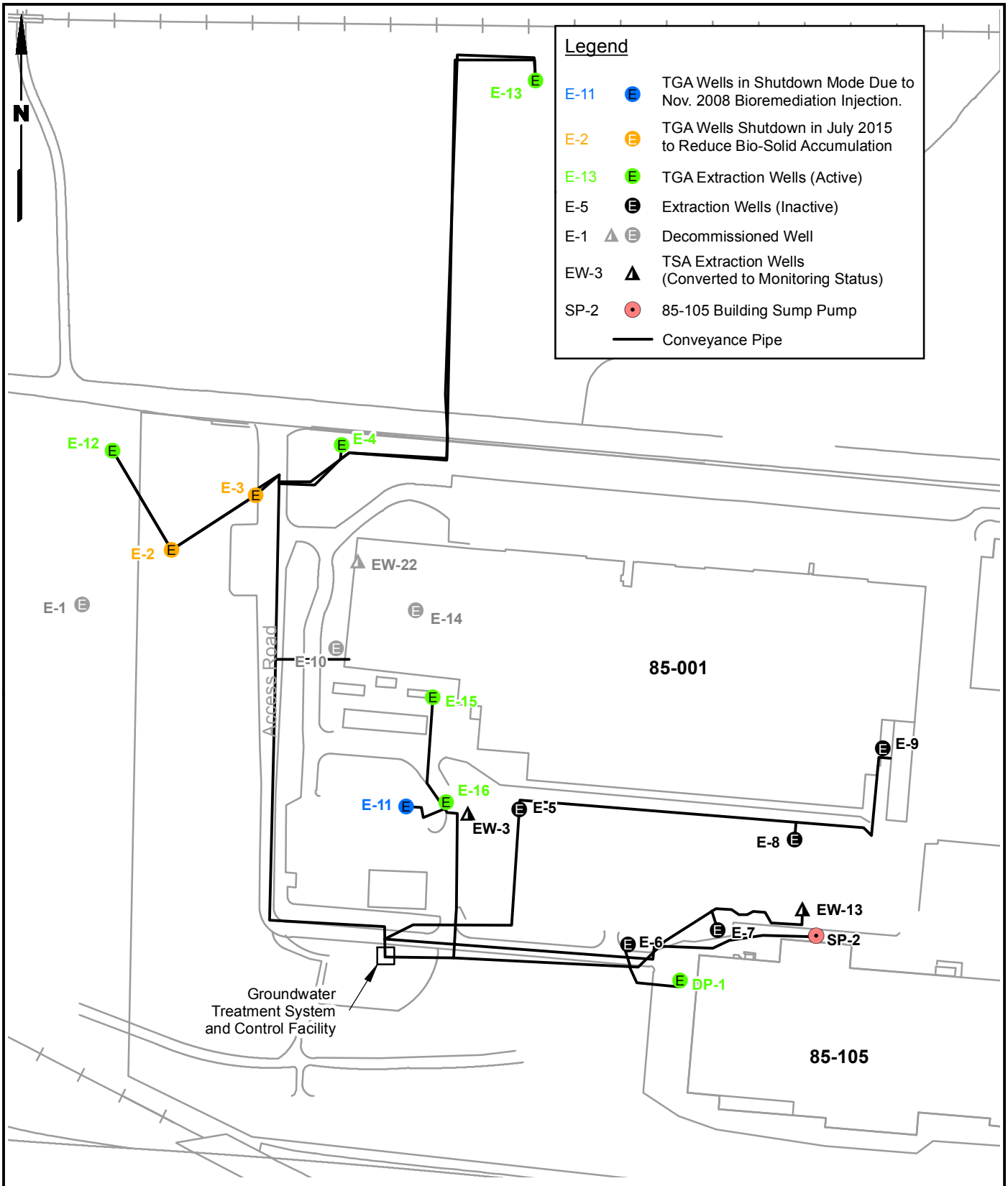
Scale in Feet

LANDAU ASSOCIATES

Boeing Portland
Gresham, Oregon

TGA Groundwater Performance Monitoring Locations

Figure 2



Notes
1. E-1 decommissioned June 2004.
2. E-10, E-14, and EW-22 decommissoned February 2010.

0 300 600
Scale in Feet

G:\Projects\025\116\115\430\2015 Prog-Perf Report\Figure 03 GW Extraction.mxd 4/6/2016

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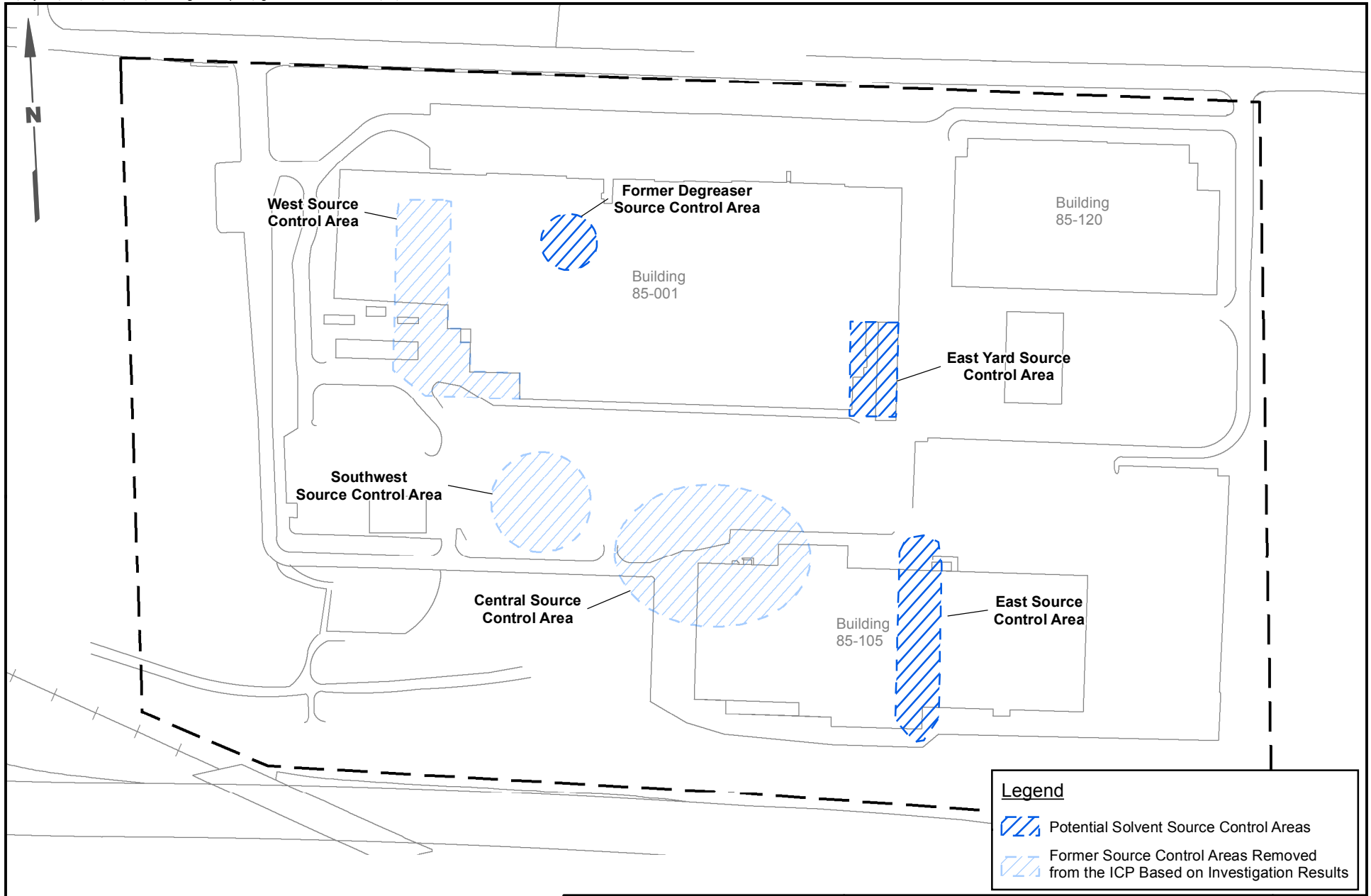
Boeing Portland
Gresham, Oregon

Groundwater Extraction and Treatment System Configuration- April 2016

Figure 3

G:\Projects\025\116\115\430\2015 Prog-Perf Report\Figure 04 ICP Source.mxd 3/21/2016



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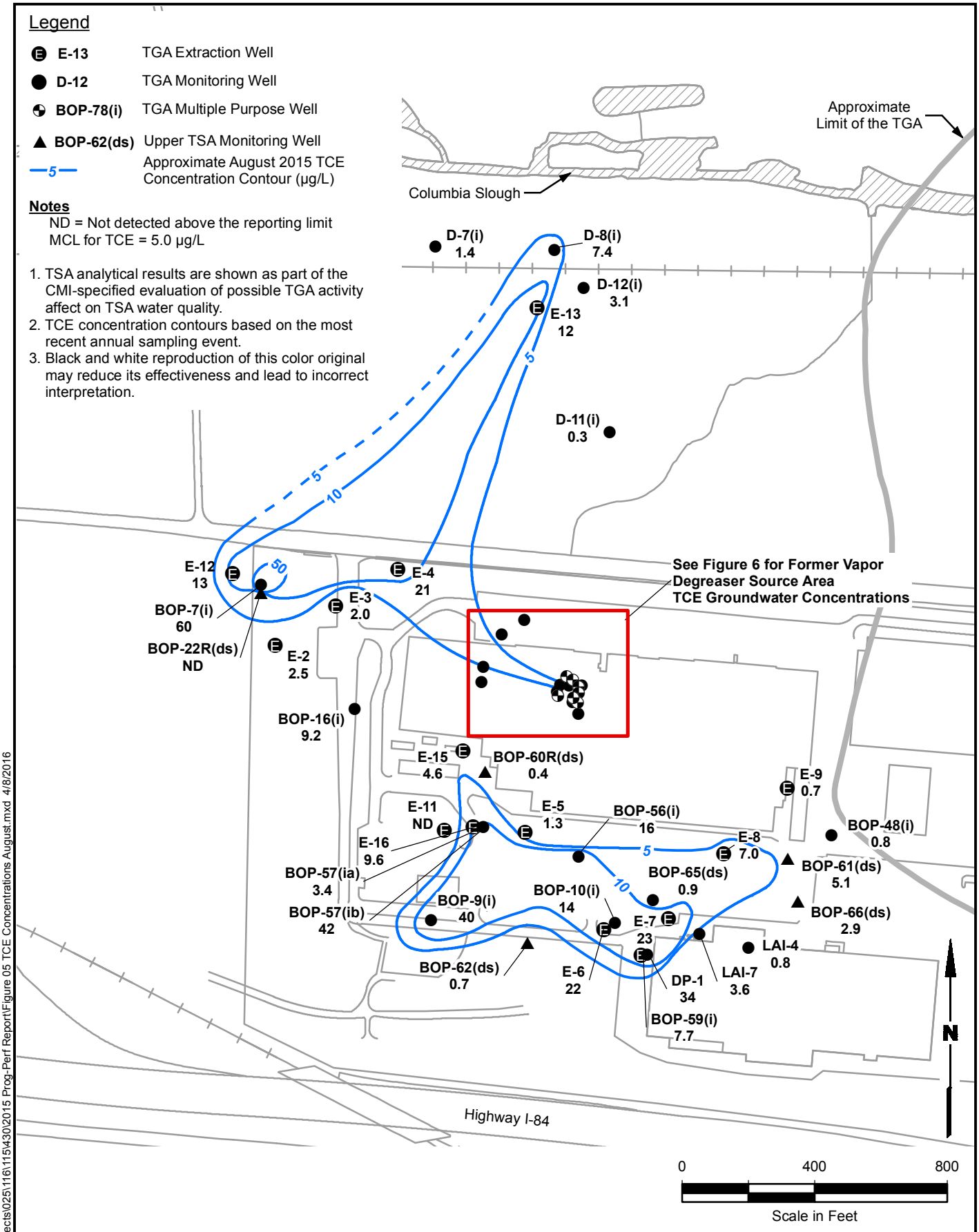
Boeing Portland
Gresham, Oregon

ICP: Source Control Areas

Figure
4



G:\Projects\025\116\115\4302015 Prog-Perf Report\Figure 05 TCE Concentrations August.mxd 4/8/2016

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Boeing Portland
Gresham, Oregon

TCE Groundwater Results in TGA August 2015

Figure 5

Legend

BOP-80(i) TGA Monitoring Well Location

BOP-84(i) Multiple-Purpose Well Location

VOW-16 Vapor Observation Well Location

Approximate Location of Former Degreaser

BOP- 78(i)	
Date	69.5
08/2012	160
08/2015	NA

Sample Depth (Feet Below Ground Surface)
Historical date and Maximum TCE Concentration
Collection Date and TCE Concentration (µg/L)

ND Not Detected at Reporting Limit

NA Not Sampled, Well Utilized for Bioremediation Injection Event (June 2015)

5 Approximate August 2015 TCE Concentration Contour (µg/L) and MCL

BOP-83(i)	
Date	79.5
02/2012	58
02/2015	12
05/2015	2.0
08/2015	2.0
11/2015	1.9

BOP-82(i)	
Date	72.5
11/2011	91
02/2015	11
05/2015	9.7
08/2015	8.6
11/2015	6.0

BOP-81(i)	
Date	98.5
11/2011	25
02/2015	ND
05/2015	ND
08/2015	ND
11/2015	ND

BOP-80(i)	
Date	102.5
11/2012	610
02/2015	ND
05/2015	ND
08/2015	91
11/2015	ND

BOP-73(i)	
Date	78
11/2013	17,000
02/2015	ND
05/2015	ND
08/2015	1.3
11/2015	5.8

BOP-79(i)	
Date	69.5
08/2012	99
02/2015	2.1
05/2015	0.4
08/2015	NA
11/2015	0.5

BOP-78(i)	
Date	69.5
08/2012	160
02/2015	3.2
05/2015	1.0
08/2015	NA
11/2015	0.2

BOP-88(i)	
Date	70.5
08/2012	130
02/2015	12
05/2015	28
08/2015	NA
11/2015	0.8

BOP-77(i)	
Date	78.7
02/2011	690
02/2015	4.2
05/2015	6.2
08/2015	6.2
11/2015	8.2

BOP-76(i)	
Date	68.7
11/2013	140
02/2015	1.0
05/2015	0.6
08/2015	2.2
11/2015	0.9

BOP-87(i)	
Date	73.5
08/2012	52
02/2015	2.1
05/2015	1.4
08/2015	NA
11/2015	ND

BOP-74(i)	
Date	71
05/2010	74
02/2015	0.4
05/2015	0.5
08/2015	NA
11/2015	ND

BOP-86(i)	
Date	69
08/2012	42
02/2015	0.9
05/2015	3.5
08/2015	NA
11/2015	ND

BOP-84(i)	
Date	75
02/2012	15
02/2015	0.5
05/2015	0.3
08/2015	NA
11/2015	ND

BOP-72(i)	
Date	67
02/2010	49
02/2015	ND
05/2015	2.0
08/2015	ND
11/2015	ND

BOP-75(i)	
Date	68.7
02/2011	87
02/2015	9.1
05/2015	13
08/2015	1.5
11/2015	0.4

BOP-85(i)	
Date	68.5
02/2013	37
02/2015	1.4
05/2015	0.8
08/2015	NA
11/2015	ND

Vitra Deburr Machinery Area

VOW-16

VOW-17

VOW-18

Location of Former Degreasers

85-001 Building Expansion

85-001 Building

Notes

1. Values shown in RED are above the MCL (5 µg/L)
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 40 80
Scale in Feet

Data Source: The Boeing Company

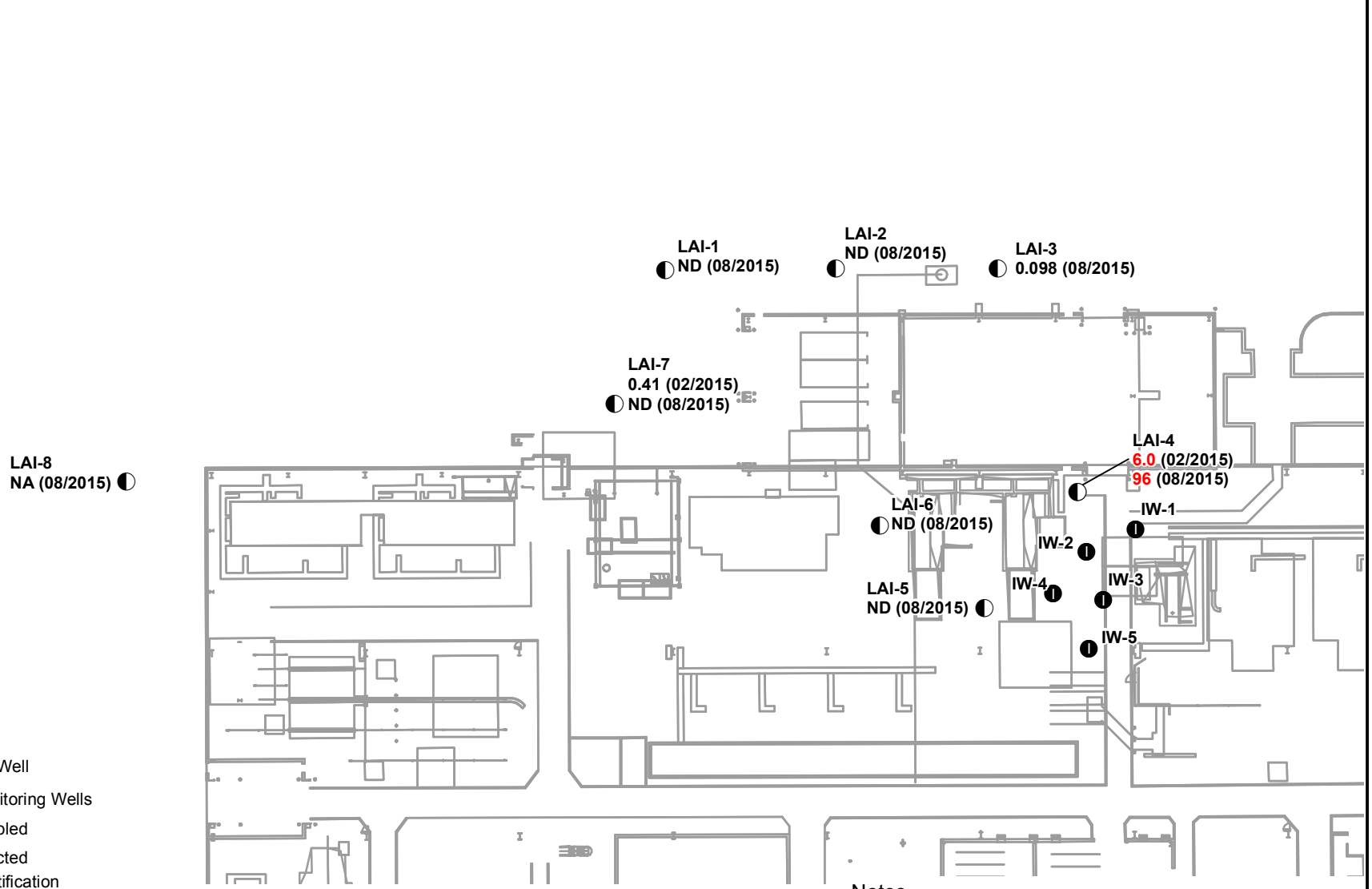
LANDAU ASSOCIATES

Boeing Portland
Gresham, Oregon

Historical Maximum and 2015 TCE Groundwater Results Former Degreaser Source Control Area

Figure 6

G:\Projects\025\116\115\430\2015 Prog-Perf Report\Figure 07 Coolant Release Results.mxd



Legend

- Injection Well
- TGA Monitoring Wells
- **NA** Not Sampled
- **ND** Not Detected
- **LAI-4** Well Identification
- 6.0 02/2015 Total diesel- and Motor Oil-Range
- 96 08/2015 Petroleum Hydrocarbons For February/August 2015

Notes

1. Red values are above the site-specific cleanup level (1.35 mg/L).
2. Figure only shows west portion of building.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Adapted from: Boeing 2006

0 50 100

Scale in Feet

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Boeing Portland
Gresham, Oregon

Coolant Release Groundwater Results February/August 2015

Figure 7

G:\Projects\025\116\115\430\2015 Prog-Perf Report\Figure 08 TGA Groundwater Contours - August.mxd

Legend

E	E-3 22.11	TGA Extraction Well and Groundwater Elevation August 2015
●	BOP-7(i) 23.21	TGA Monitoring Well and Groundwater Elevation August 2015
▲	BOP-22R(ds) 8.70	Upper TSA Monitoring Well and Groundwater Elevation August 2015
◒	BOP-84(i)	TGA Multiple-Purpose Wells
—5—		Approximate Groundwater Elevation Contour (ft. MSL)

N

Note

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

Approximate Limit of the TGA

Columbia Slough

D-7(i) 11.45
D-8(i) 10.82
D-12(i) 10.96
E-13 5.13
D-11(i) 13.01

Approximate Limit of the TGA

NE SANDY BLVD

E-12 -15.43
BOP-7(i) 23.21
E-4 15.80
E-3 22.11
BOP-22R(ds) 8.70
E-2 27.64
BOP-82(i) 27.05
BOP-83(i) 27.41
BOP-79(i) 26.24
BOP-78(i) 28.88
BOP-77(i) 35.87
BOP-81(i) 30.82
BOP-74(i) 21.78
BOP-76(i) 39.27
BOP-88(i) 28.57
BOP-80(i) 31.20
BOP-84(i) 25.42
BOP-87(i) 30.38
BOP-73(i) 37.49
BOP-16(i) 30.18
E-15 0.40
BOP-85(i) 31.97
BOP-72(i) 39.36
BOP-60R(ds) 9.12
BOP-75(i) 40.20
BOP-86(i) 22.99
E-9 72.89
THE BOEING COMPANY
BOP-57(ib) 34.28
BOP-60(ds) 8.43
E-11 59.21
E-16 33.01
E-5 33.86
BOP-56(i) 41.14
E-8 82.62
BOP-48(i) 80.96
BOP-57(ia) 35.05
BOP-65(ds) 9.56
LAI-1 84.45
BOP-10(i) 71.49
E-7 78.03
LAI-2 87.28
BOP-9(i) 33.88
BOP-62(ds) 9.05
E-6 46.37
LAI-3 90.10
LAI-7 83.96
LAI-4 90.43
LAI-8 Dry
DP1 50.49
BOP-59(i) 70.91
LAI-6 90.74
LAI-5 91.22

-15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85

0 300 600
Scale in Feet

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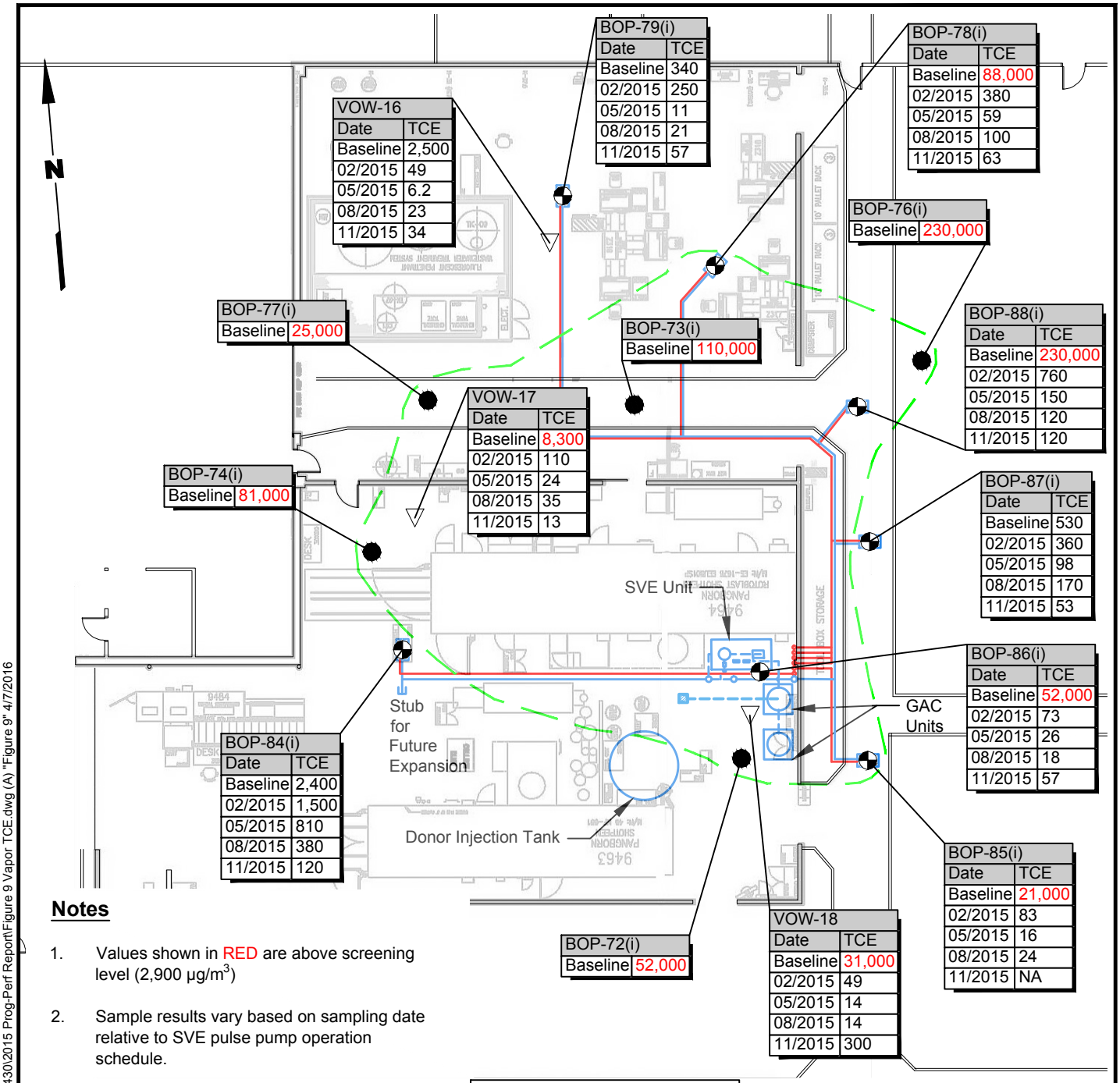
Boeing Portland
Gresham, Oregon

TGA Groundwater Elevation Contours - August 2015

Figure 8



Notes

1. Values shown in RED are above screening level (2,900 µg/m^3)
2. Sample results vary based on sampling date relative to SVE pulse pump operation schedule.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

SVE Pulse Pump Schedule
Full time operation: 9/17/12 to 7/2/14
System off cycle: 7/2/14 to 1/29/15
System on cycle: 1/29/15 to 10/9/15

Legend

- TGA Monitoring Well Location
- Multiple-Purpose SVE and Monitoring Well Location
- Vapor Observation Well Location
- Below-ground Donor Injection Piping
- Below-ground SVE Piping
- Above-ground SVE Piping
- Baseline 2012 Concentrations Above Screening Levels
- NA Not Analyzed

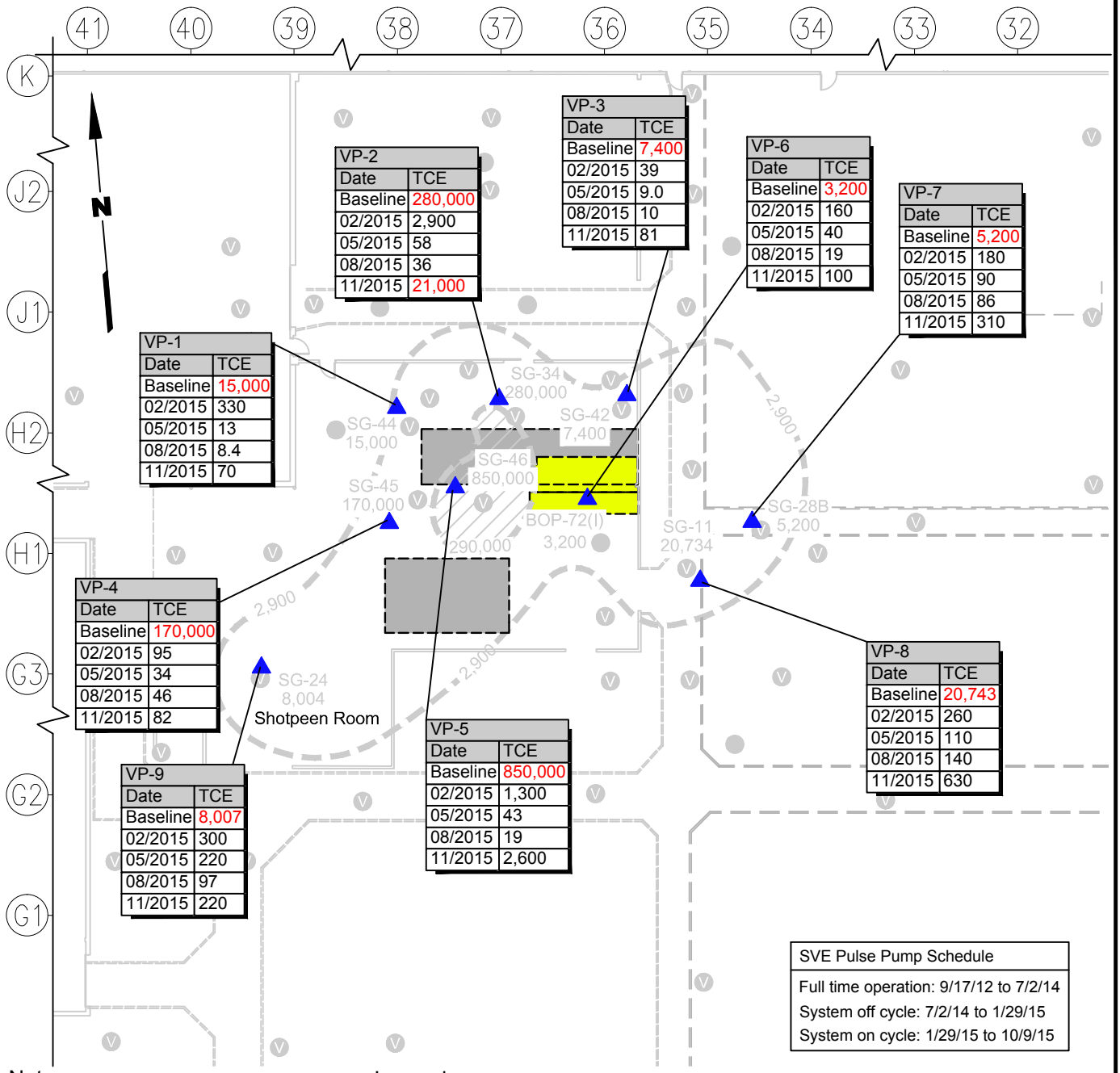
BOP-84(i)
Date TCE
08/2015 380
— Collection Data and TCE Concentration (µg/m^3)

0 20 40
Scale in Feet

Source: The Boeing Company

LANDAU ASSOCIATES

Boeing Portland Gresham, Oregon	**TCE Vapor Results - SVE System**	Figure 9



SVE Pulse Pump Schedule
Full time operation: 9/17/12 to 7/2/14
System off cycle: 7/2/14 to 1/29/15
System on cycle: 1/29/15 to 10/9/15

Notes

1. Values shown in Red are above the RBC screening level of 2,900 µg/m^3.
2. Hot spot defined by DEQ as 100 times greater than the RBC.
3. Sample results vary based on sampling date relative to SVE pulse pump operation schedule.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Legend

- BOP-74(i) — TGA Monitoring Well and Sub-Slab Vapor Sampling Location and Designation
- VP-1 — Sub-Slab Vapor Pin Location
- SG-05 — Sub-Slab Vapor Grab Sampling Location
- ND — TCE Not Detected above Laboratory Reporting Limits
- 1,490 — TCE Concentration (µg/m^3)
- Baseline 2012 TCE Isoconcentration Contours
- Baseline 2012 Hot Spot
- Approximate Location of Basements
- Approximate Location of Former Degreasers

0 — 30 — 60
Scale in Feet

VP-1	
Date	TCE
08/2015	8.4

Sample Location
Collection Data and TCE Concentration (µg/m^3)

Source: Boeing 2009

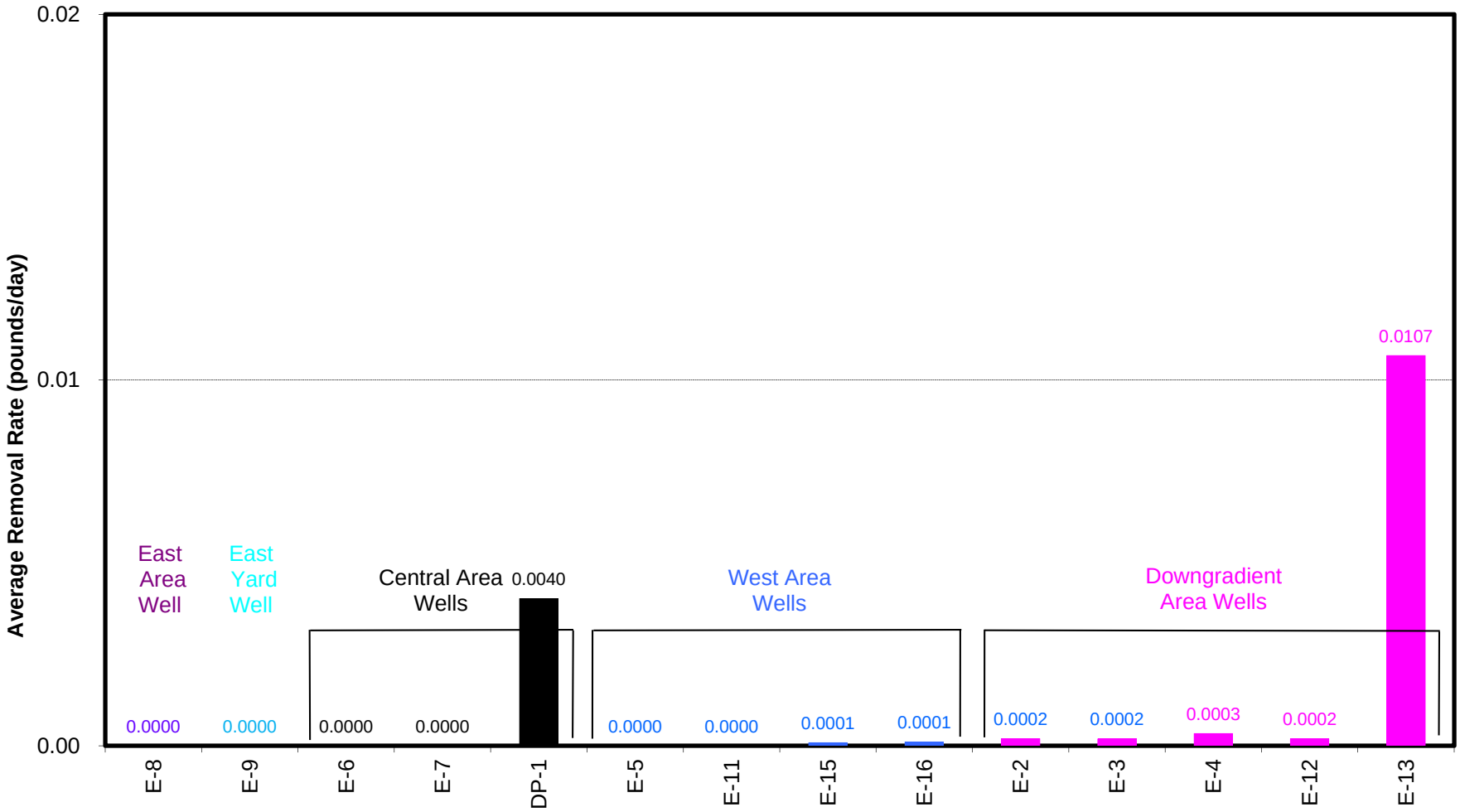
Landau Associates, Inc. | G:\Projects\025\116\115\430\2015 Prog-Perf Report\Figure 10 Vapor TCE SubSlab.dwg (A) "Figure 10" 4/7/2016

LANDAU ASSOCIATES

Boeing Portland
Gresham, Oregon

Sub-Slab TCE Vapor Results - Former Degreaser Source Control Area

Figure 10



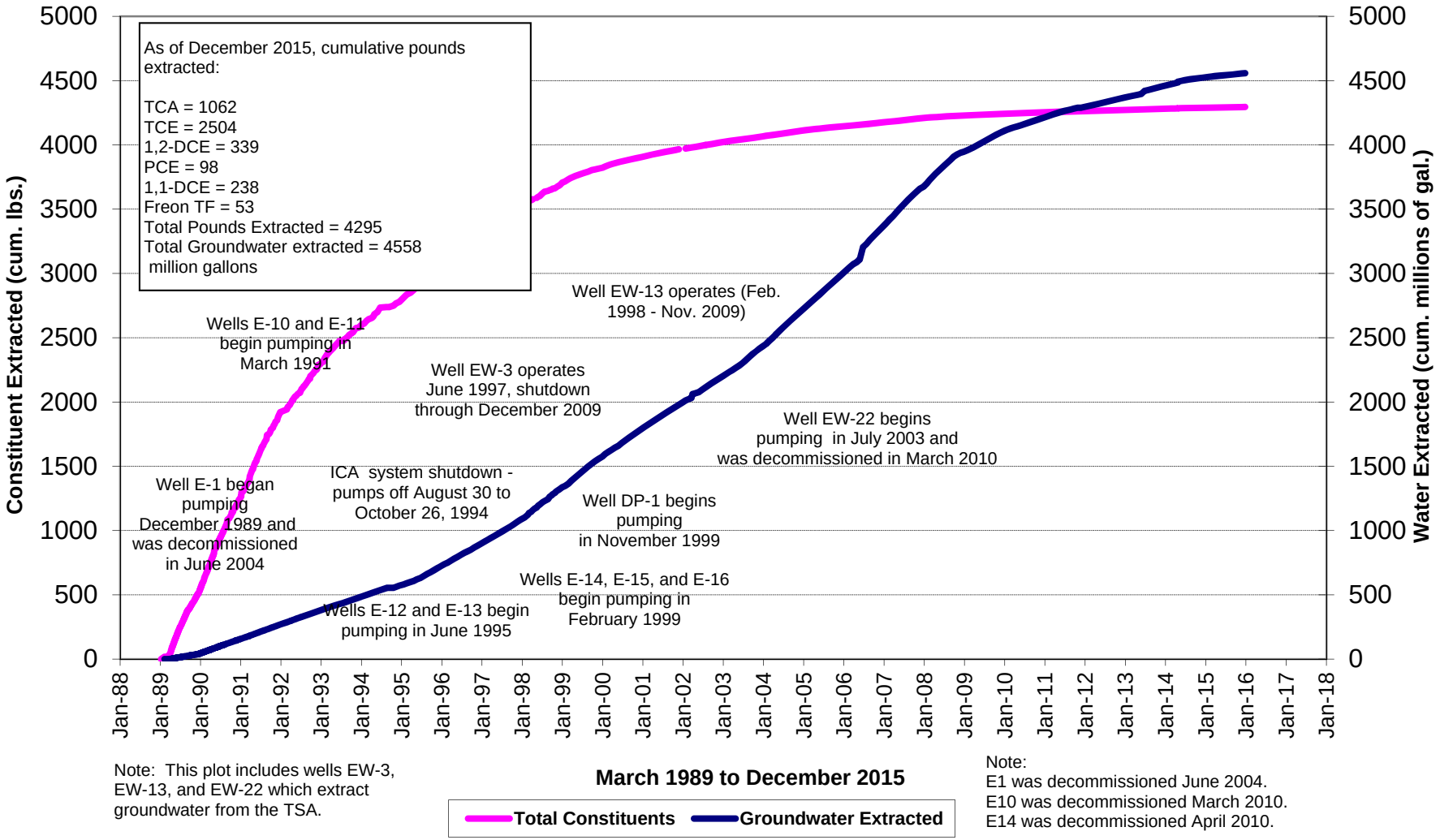
Notes: 1. Total VOCs include the following constituents: TCA, TCE, total 1,2-DCE, PCE, and 1,1-DCE.
2. Pumping operations at Well E-1 were suspended on 4/13/2000, well decommissioned on 6/29/2004.
3. Pumping operations at Wells E-5 through E-9 were suspended on 7/8/2002.
4. Extraction well E-10 was decommissioned on 3/29/2010.
5. Extraction well E-14 was decommissioned on 4/1/2010.
6. Pumping operations at wells E-2 and E-3 were suspended on 7/7/2015.

LANDAU ASSOCIATES

Boeing Portland
Gresham, Oregon

Average Total Mass Removal Rates 2015

Figure
11



Note: This plot includes wells EW-3, EW-13, and EW-22 which extract groundwater from the TSA.

Note:
E1 was decommissioned June 2004.
E10 was decommissioned March 2010.
E14 was decommissioned April 2010.

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Boeing Portland Gresham, Oregon	**Groundwater Treatment System Performance**	Figure 12

Legend

- TGA Monitoring Wells
- Multiple-Purpose Injection and Monitoring Wells
- Approximate Location of Former Degreasers

N

BOP-83(i)
BOP-82(i)
BOP-81(i)
BOP-80(i)
BOP-79(i)
BOP-78(i)
BOP-77(i)
BOP-73(i)
BOP-76(i)
BOP-88(i)
BOP-87(i)
BOP-74(i)
BOP-84(i)
BOP-86(i)
BOP-72(i)
BOP-85(i)
BOP-75(i)

Vitra Deburr Machinery Area

40-ft ROI of First PRB Injection (Conducted 12/2011)

68-ft ROI of Second Third, and Fourth PRB Injection (Conducted 8/2012, 7/2014, and 6/2015)

Estimated 10-ft to 15-ft ROI, of Multi-Purpose Well Injections

Estimated Treatment Zone

85-001 Building Expansion

85-001 Building

Data Source: The Boeing Company

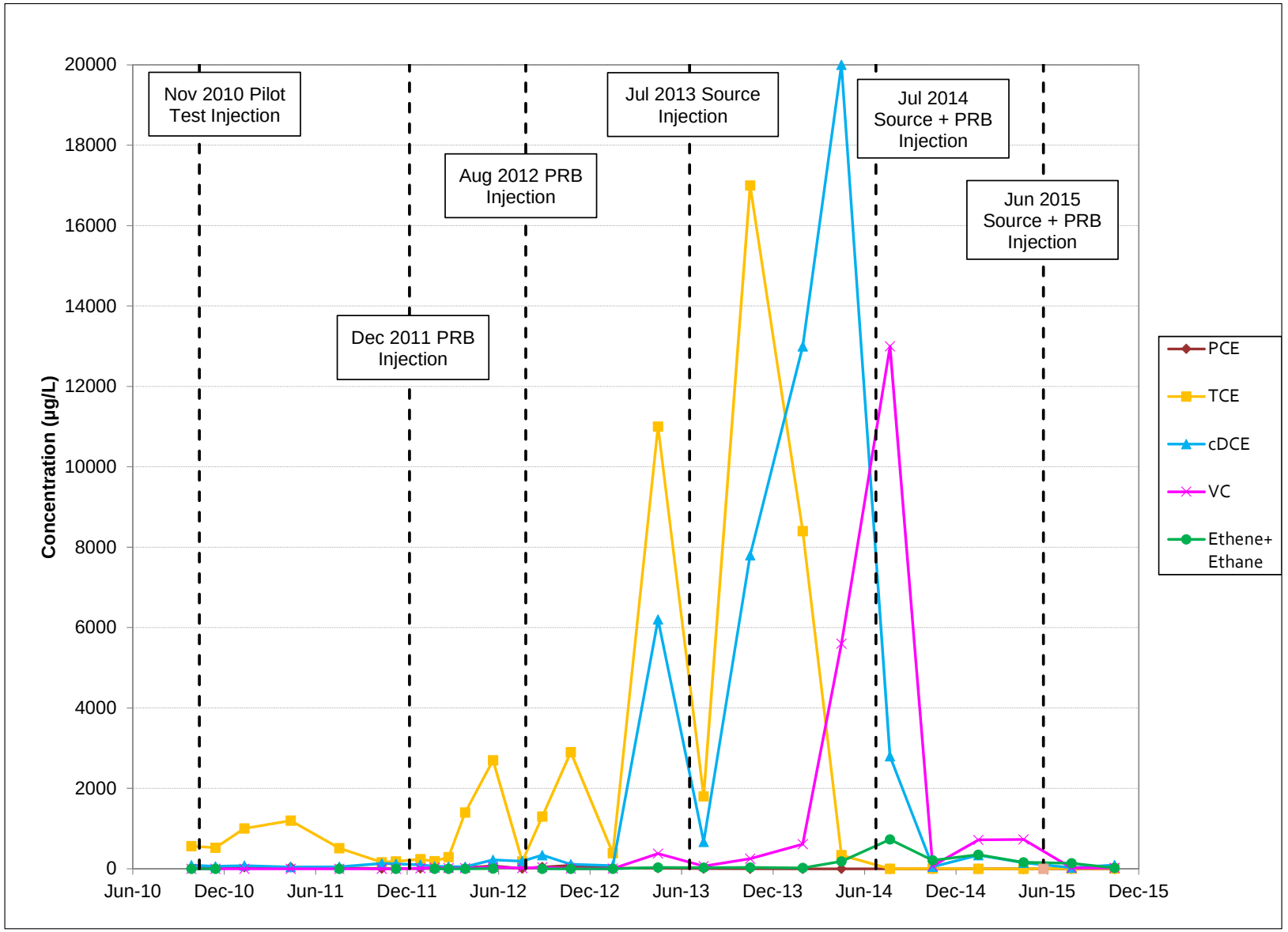
0 40 80

Scale in Feet

LANDAU ASSOCIATES

Boeing Portland Gresham, Oregon	**Former Degreaser Source Control Area Bioremediation Injection Wells**	Figure 13

Source: \\edmdata01\projects\025\116\WIP\T\TGA\Former Degreaser Area Investigation\Groundwater MASTER.xlsx



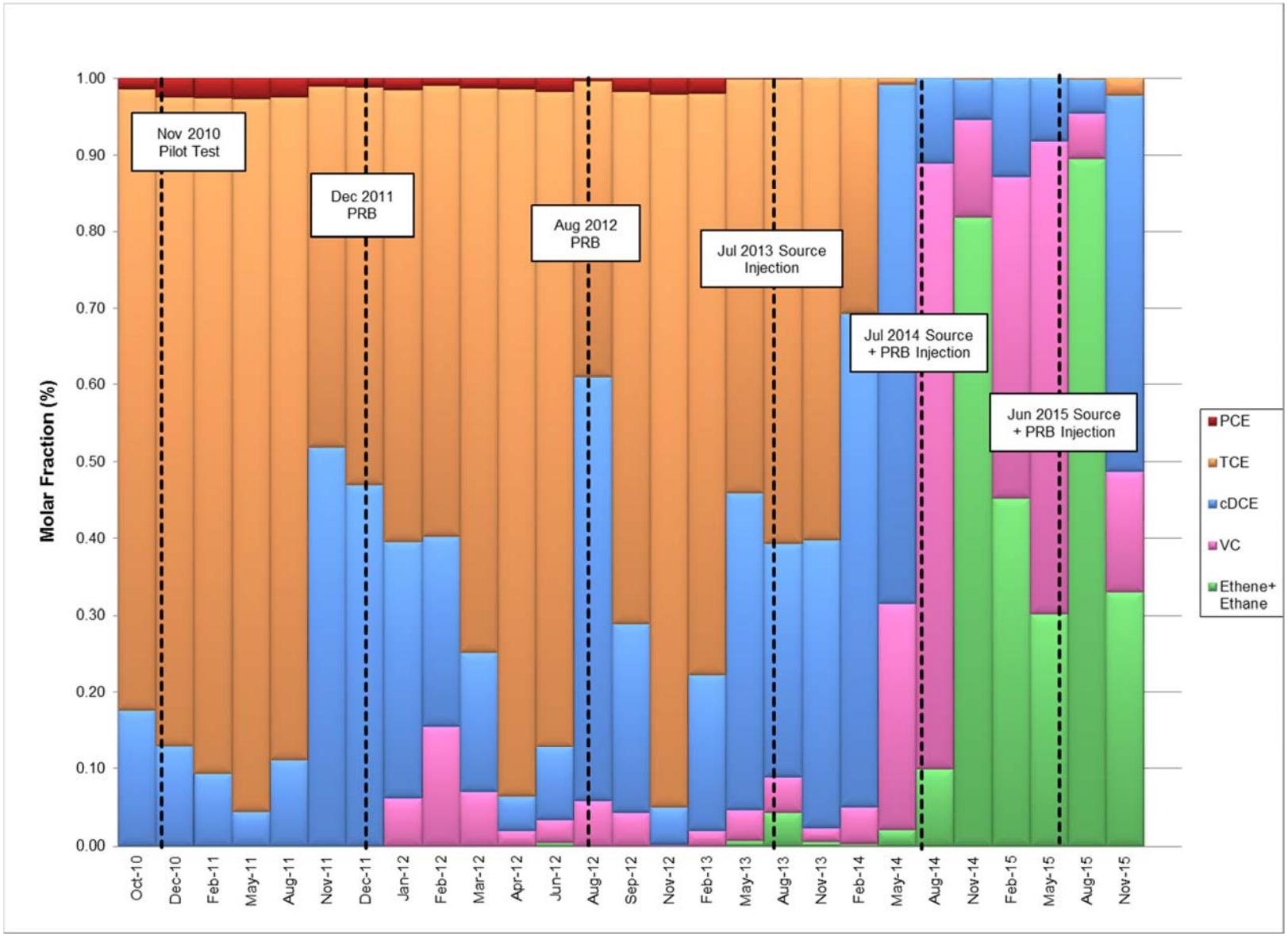
LANDAU ASSOCIATES

Boeing Portland
Gresham, Oregon

Time verses Concentration Plot-BOP-73(i)

Figure
14

Source: \\edmdata01\projects\025\116\WIP\T\TGA\Former Degreaser Area Investigation\Groundwater MASTER.xlsx



LANDAU ASSOCIATES

Boeing Portland
Gresham, Oregon

Molar Fraction Plot-BOP-73(i)

Figure
15

TABLE 1
GROUNDWATER PERFORMANCE MONITORING PROGRAM (a)

Aquifer and Well Use	Location	Sampling Frequency July - December 2015		Sampling Frequency Proposed	
		Groundwater Elevation	Groundwater Quality	Groundwater Elevation	Groundwater Quality
TGA Well	BOP-16(i)	S	Q	S	Q
TGA Well	BOP-57(ia)	S	S	S	S
TGA Well	BOP-57(ib)	S	S	S	S
TGA Extraction Well	E-5	Q	A	S	A
TGA Extraction Well	E-11	Q	A	S	A
TGA Extraction Well	E-15	Q	Q	Q	Q
TGA Extraction Well	E-16	Q	Q	Q	Q
Upper TSA Well	BOP-60R(ds) (b)	A	A	A	A
Central Area					
TGA Well	BOP-10(i)	S	S	S	S
TGA Well	BOP-56(i)	S	S	S	S
TGA Well	BOP-59(i)	S	S	S	S
TGA Extraction Well	E-6	Q	A	S	A
TGA Extraction Well	E-7	Q	A	S	A
TGA Extraction Well	DP-1	Q	Q	Q	Q
Upper TSA Well	BOP-65(ds) (b)	A	A	A	A
East Yard					
TGA Well	BOP-48(i)	S	A	S	A
TGA Extraction Well	E-9	Q	A	S	A
Upper TSA Well	BOP-61(ds) (b)	A	A	A	A
East Area					
TGA Extraction Well	E-8	Q	A	S	A
Southwest Area					
TGA Well	BOP-9(i)	S	S	S	S
Upper TSA Well	BOP-62(ds) (b)	A	A	A	A
Downgradient Area					
TGA Well	BOP-7(i)	S	Q	S	Q
TGA Well	D-7(i)	S	A	S	A
TGA Well	D-8(i)	S	S	S	S
TGA Well	D-11(i)	S	A	S	A
TGA Well	D-12(i)	S	S	S	S
TGA Extraction Well	E-2	Q	Q	S	S
TGA Extraction Well	E-3	Q	Q	S	S
TGA Extraction Well	E-4	Q	Q	Q	Q
TGA Extraction Well	E-12	Q	Q	Q	Q
TGA Extraction Well	E-13	Q	Q	Q	Q
Upper TSA Well	BOP-22R(ds) (b)	A	A	A	A

TABLE 1
GROUNDWATER PERFORMANCE MONITORING PROGRAM (a)

Aquifer and Well Use	Location	Sampling Frequency July - December 2015		Sampling Frequency Proposed	
		Groundwater Elevation	Groundwater Quality	Groundwater Elevation	Groundwater Quality
Former Degreaser Source Control Area					
	BOP-72(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-73(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-74(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-75(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-76(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-77(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-78(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-79(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-80(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-81(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-82(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-83(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-84(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-85(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-86(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-87(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-88(i)	Q (c)	Q (c)	Q (c)	Q (c)
Coolant Release					
	LAI-1	Q	C-A	A	C-A
	LAI-2	Q	C-A	A	C-A
	LAI-3	Q	C-A	A	C-A
	LAI-4	Q	S/C-S	S	S/C-S
	LAI-5	Q	C-A	A	C-A
	LAI-6	Q	C-A	A	C-A
	LAI-7	Q	S/C-S	S	S/C-S
	LAI-8	Q	S/C-S	S	S/C-S

TGA = Troutdale Gravel Aquifer
TSA = Troutdale Sandstone Aquifer
VOC = volatile organic compound

S = Semiannual; Q = Quarterly; A = Annual; -- = No Data; C = Coolant
S/C-S = Well sampled for multiple purposes. First abbreviation indicates sampling frequency for VOC remedy/second abbreviation indicates sampling frequency for coolant release.

Red colored text indicates proposed modification to monitoring frequency.

(a) From Table 3-3 of the *Troutdale Gravel Aquifer Corrective Measure Five-Year Performance Evaluation, January 2001* through December 2005, Boeing Portland Facility, Gresham, Oregon, prepared by Landau Associates March 31, 2006, based on the *Phase 2 Corrective Measures Study, Boeing Portland, Gresham, Oregon* , prepared by Landau Associates September 13, 1996.
(b) TSA water quality data collected to evaluate remedy performance as part of TGA corrective measure performance. Diffusion Bag Samples (DBS) to be utilized for TSA sample collection.
(c) Well monitored rountinely on a quarterly basis or increased to monthly for post-bioremediation injection monitoring purposes.

TABLE 2
REMEDY WELL NETWORK CRITERIA
BOEING OF PORTLAND

This table summarizes the Troutdale Gravel Aquifer (TGA) criteria for extraction well pilot shutdown, well decommissioning, monitoring well network modifications, and changes in sampling frequency. These criteria were approved by the Oregon Department of Environmental Quality (ODEQ) and are summarzed for ongoing reference.

Criteria for Increasing Sampling Frequency

1. If constituents of potential concern (COPC) concentrations increase to detectable levels for two consecutive sampling events, after having been below detection limits for 2 or more years.
2. If COPC concentrations increase to above the respective maximum contaminant levels (MCLs) for two consecutive sampling events, after having been below the MCLs for 2 or more years.

Criteria for Reducing Sampling Frequency

1. If COPC concentrations have been consistently below detection limits for the prior 2 years. A well that meets this criterion could also be recommended for removal from the monitoring program.
2. If COPC concentrations have been stable to declining for the prior 2 years.

Criteria for Discontinuing Monitoring

1. COPC concentrations have been consistently below detection limits for 2 or more years.
2. The well is located outside the limits of the plume and is no longer needed to monitor hydraulic plume control or progress of aquifer restoration.
3. The location of the well duplicates another well better suited to evaluate hydraulic control and progress of aquifer restoration.

Confirmation Sampling Event

1. Wells that meet the above criteria for discontinued monitoring and have been removed from the Monitoring Program will have a confirmation sample collected for evaluation of possible decommissioning.

TABLE 3
GROUNDWATER QUALITY SUMMARY
TGA AND SELECT TSA WELLS
JANUARY 1 THROUGH DECEMBER 31, 2015

Area	Location	Sample Type	Date	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	1,1,1-TCA	PCE	TCE	Vinyl chloride
		MCL Cleanup Level:		**7**	**70**	**70**	**200**	**5**	**5**	**2**
East Area-TGA										
	E-8	Grab	8/13/2015	ND	0.8	ND	ND	6.1	7.0	ND
East Yard-TGA										
	BOP-48(i)	Purge	8/5/2015	ND	ND	ND	ND	ND	0.8	ND
	E-9	Grab	8/13/2015	ND	ND	ND	ND	0.3	0.7	ND
Central Area-TGA										
	BOP-10(i)	Purge	2/3/2015	ND	1.8	ND	ND	8.0	13	ND
	BOP-10(i)	Purge	8/5/2015	ND	1.9	ND	ND	9.0	14	ND
	BOP-56(i)	Purge	2/3/2015	ND	2.1	ND	ND	2.5	16	ND
	BOP-56(i)	Purge	8/4/2015	ND	1.7	ND	ND	3.7	16	ND
	BOP-59(i)	Purge	2/3/2015	ND	6.1	ND	ND	ND	4.2	ND
	BOP-59(i)-Dup	Purge	2/3/2015	ND	6.4	ND	ND	ND	4.3	ND
	BOP-59(i)	Purge	8/4/2015	ND	2.5	ND	ND	7.0	7.0	ND
	BOP-59(i)-Dup	Purge	8/4/2015	ND	2.7	ND	ND	7.6	7.7	ND
	E-6	Grab	8/5/2015	ND	3.5	ND	ND	22	22	ND
	E-7	Grab	8/12/2015	ND	7.7	ND	ND	75	23	ND
	DP-1	Grab	2/5/2015	0.3	99	1.3	ND	20	32	ND
	DP-1	Grab	5/7/2015	0.3	120	1.5	ND	19	35	ND
	DP-1	Grab	8/4/2015	ND	120	6.0	ND	14	34	ND
	DP-1	Grab	11/6/2015	0.2	97	2.4	ND	14	28	ND
West Area-TGA										
	BOP-16(i)	Purge	2/9/2015	0.5	1.6	ND	ND	0.3	8.3	3.0
	BOP-16(i)	Purge	5/7/2015	0.2	0.9	ND	ND	ND	4.6	2.2
	BOP-16(i)	Purge	8/11/2015	0.6	1.8	ND	ND	0.6	9.2	1.1
	BOP-16(i)	Purge	11/6/2015	0.4	1.4	ND	ND	0.5	5.8	2.8
	BOP-57(ia) (a)	Purge	2/3/2015	ND	0.3	ND	ND	ND	1.7	ND
	BOP-57(ia) (a)	Purge	8/4/2015	ND	0.8	ND	ND	ND	3.4	ND
	BOP-57(ib) (a)	Purge	2/3/2015	33	8.8	ND	19	0.7	35	0.2
	BOP-57(ib) (a)	Purge	8/4/2015	35	9.5	ND	21	0.9	42	0.3
	E-5	Grab	8/13/2015	ND	0.3	ND	ND	ND	1.3	ND
	E-11	Grab	2/4/2015	ND	1.9	ND	ND	ND	ND	ND
	E-11	Grab	8/5/2015	ND	0.3	ND	ND	ND	ND	ND
	E-15	Grab	2/4/2015	0.6	3.3	ND	ND	ND	0.8	1.8
	E-15	Grab	5/7/2015	1.6	7.6	ND	ND	ND	3.1	5.6
	E-15	Grab	8/5/2015	1.8	7.9	ND	ND	ND	4.6	5.6
	E-15	Grab	11/6/2015	1.4	7.3	ND	ND	ND	0.9	5.2
	E-16	Grab	2/4/2015	0.2	1.3	ND	ND	2.1	9.8	ND
	E-16	Grab	5/7/2015	0.2	1.3	ND	ND	1.7	8.5	ND
	E-16	Grab	8/5/2015	0.2	1.5	ND	ND	2.1	9.6	ND
	E-16	Grab	11/6/2015	1.4	7.2	ND	ND	ND	0.9	5.3

TABLE 3
GROUNDWATER QUALITY SUMMARY
TGA AND SELECT TSA WELLS
JANUARY 1 THROUGH DECEMBER 31, 2015

Area	Location	Sample Type	Date	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	1,1,1-TCA	PCE	TCE	Vinyl chloride
		MCL Cleanup Level:		**7**	**70**	**70**	**200**	**5**	**5**	**2**
Southwest Area - TGA										
	BOP-9(i)	Purge	2/3/2015	1.5	11	ND	0.6	3.3	33	ND
	BOP-9(i)	Purge	8/5/2015	1.5	12	ND	ND	2.9	40	ND
Downgradient Area TGA										
	BOP-7(i)	Purge	2/9/2015	23	17	ND	3.5	6.5	400	ND
	BOP-7(i)-Dup	Purge	2/9/2015	20	17	ND	3.3	5.8	360	ND
	BOP-7(i)	Purge	5/8/2015	7.3	54	0.3	1.8	0.5	73	ND
	BOP-7(i)-Dup	Purge	5/8/2015	8.9	52	0.3	2.0	0.6	61	ND
	BOP-7(i)	Purge	8/11/2015	4.3	12	ND	ND	1.1	50	ND
	BOP-7(i)-Dup	Purge	8/11/2015	4.9	12	ND	0.9	1.2	60	0.3
	BOP-7(i)	Purge	11/5/2015	17 J	17 J	ND	8.8 J	4.7 J	310 J	ND
	BOP-7(i)-Dup	Purge	11/5/2015	23 J	21 J	0.4	3.5 J	5.8 J	250 J	ND
	D-7(i)	Purge	8/7/2015	0.3	ND	ND	ND	ND	1.4	ND
	D-8(i)	Purge	2/6/2015	1.4	0.8	ND	ND	0.7	23	ND
	D-8(i)	Purge	8/7/2015	0.7	0.4	ND	ND	0.3	7.4	ND
	D-11(i)	Purge	8/7/2015	ND	ND	ND	ND	ND	0.3	ND
	D-12(i)	Purge	2/3/2015	0.6	ND	ND	ND	ND	2.7	ND
	D-12(i)	Purge	8/7/2015	0.6	ND	ND	ND	ND	3.1	ND
	E-2	Grab	2/4/2015	0.5	0.5	ND	ND	0.4	2.1	0.3
	E-2	Grab	5/7/2015	0.5	0.5	ND	ND	0.4	2.4	0.3
	E-2-Dup	Grab	5/7/2015	0.5	0.5	ND	ND	0.4	2.4	0.3
	E-2	Grab	7/13/2015	0.5	1.4	ND	ND	0.4	3.6	0.6
	E-2	Grab	8/5/2015	0.4	1.7	ND	ND	0.4	2.5	0.7
	E-2	Grab	11/5/2015	0.4	0.9	ND	ND	0.5	3.1	ND
	E-2-Dup	Grab	11/5/2015	0.4	1.0	ND	ND	0.5	2.9	0.3
	E-3	Grab	2/4/2015	1.1	2.3	ND	ND	0.8	10	0.5
	E-3	Grab	5/7/2015	1.1	2.3	ND	ND	0.6	9.2	0.6
	E-3	Grab	7/10/2015	1.3	5.0	ND	ND	ND	8.2	4.1
	E-3	Grab	8/5/2015	0.9	5.6	ND	ND	ND	2.0	4.4
	E-3	Grab	11/6/2015	1.2	7.1	ND	ND	ND	3.6	4.1
	E-4	Grab	2/4/2015	4.5	1.4	ND	ND	1.3	25	ND
	E-4	Grab	5/7/2015	4.1	1.3	ND	ND	0.9	18	ND
	E-4	Grab	8/5/2015	4.0	1.3	ND	ND	1.0	21	ND
	E-4	Grab	11/9/2015	28	7.0	ND	1.2	7.4	200	0.5
	E-12	Grab	2/4/2015	1.0	0.4	ND	ND	0.3	8.7	ND
	E-12	Grab	5/7/2015	1.3	0.5	ND	ND	0.4	11	ND
	E-12	Grab	8/5/2015	1.5	2.2	ND	ND	0.4	13	0.4
	E-12	Grab	11/5/2015	1.9	1.7	ND	ND	0.6	19	0.3
	E-13	Grab	2/5/2015	2.6	1.4	ND	ND	0.5	12	ND
	E-13	Grab	5/7/2015	3.3	1.7	ND	ND	0.5	16	ND
	E-13	Grab	8/7/2015	2.9	2.2	ND	ND	0.5	12	ND
	E-13	Grab	11/5/2015	2.1	1.3	ND	ND	0.4	11	ND

TABLE 3
GROUNDWATER QUALITY SUMMARY
TGA AND SELECT TSA WELLS
JANUARY 1 THROUGH DECEMBER 31, 2015

Area	Location	Sample Type	Date	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	1,1,1-TCA	PCE	TCE	Vinyl chloride
		MCL Cleanup Level:		**7**	**70**	**70**	**200**	**5**	**5**	**2**
GWTS Influent/Effluent										
	Tower Influent	Grab	2/4/2015	2.0	1.3	ND	ND	0.5	9.7	ND
	Tower Influent Dup	Grab	2/4/2015	1.9	1.4	ND	ND	0.5	9.4	ND
	Tower Influent	Grab	5/5/2015	2.4	1.8	ND	ND	0.6	12	ND
	Tower Influent Dup	Grab	5/5/2015	2.4	1.7	ND	ND	0.6	11	ND
	Tower Influent	Grab	7/8/2015	2.7	12	ND	ND	0.8	18	ND
	Tower Influent	Grab	8/4/2015	3.3	4.2	ND	ND	0.6	15	ND
	Tower Influent Dup	Grab	8/4/2015	3.2	4.3	ND	ND	0.6	14	ND
	Tower Influent	Grab	11/5/2015	2.3	2.1	ND	ND	0.5	12	ND
	Tower Influent Dup	Grab	11/5/2015	2.3	2.0	ND	ND	0.5	11	ND
	Tower Effluent	Grab	2/4/2015	ND	0.7	ND	ND	ND	1.0	ND
	Tower Effluent Dup	Grab	2/4/2015	ND	0.7	ND	ND	ND	1.1	ND
	Tower Effluent	Grab	5/5/2015	ND	1.1	ND	ND	ND	1.6	ND
	Tower Effluent Dup	Grab	5/5/2015	ND	1.1	ND	ND	ND	1.6	ND
	Tower Effluent	Grab	5/15/2015	ND	0.9	ND	ND	ND	1.3	ND
	Tower Effluent	Grab	7/8/2015	ND	2.3	ND	ND	ND	2.1	ND
	Tower Effluent	Grab	8/4/2015	ND	ND	ND	ND	ND	ND	ND
	Tower Effluent Dup	Grab	8/4/2015	ND	ND	ND	ND	ND	ND	ND
	Tower Effluent	Grab	11/5/2015	ND	ND	ND	ND	ND	ND	ND
	Tower Effluent Dup	Grab	11/5/2015	ND	ND	ND	ND	ND	ND	ND
Upper TSA Monitoring Wells										
	BOP-22R(ds)	DBS	8/6/2015	ND	ND	ND	ND	ND	ND	ND
	BOP-22R(ds)	DBS	11/5/2015	ND	ND	ND	ND	ND	ND	ND
	BOP-60R(ds)	DBS	8/6/2015	ND	ND	ND	ND	ND	0.4	ND
	BOP-61(ds)	Purge	2/9/2015	ND	1.3	ND	ND	0.4	8.7	ND
	BOP-61(ds)	Purge	8/6/2015	ND	0.4	ND	ND	0.2	5.1	ND
	BOP-62(ds)	Purge	8/6/2015	ND	ND	ND	ND	ND	0.7	ND
	BOP-65(ds)	Purge	2/11/2015	ND	0.4	ND	ND	ND	1.3	ND
	BOP-65(ds)	Purge	8/6/2015	ND	0.2	ND	ND	ND	0.9	ND
	BOP-66(ds)	Purge	2/11/2015	ND	ND	ND	ND	ND	3.6	ND
	BOP-66(ds)	Purge	8/6/2015	ND	ND	ND	ND	ND	2.9	ND
Coolant Release Wells										
	LAI-4	Purge	2/9/2015	ND	ND	ND	ND	ND	0.4	ND
	LAI-4	Purge	8/12/2015	ND	0.3	ND	ND	ND	0.8	ND
	LAI-7	Purge	2/9/2015	ND	3.4	ND	ND	4.6	7.2	ND
	LAI-7	Purge	8/12/2015	ND	1.6	ND	ND	1.5	3.6	ND
Former Degreaser Source Control Area										
	BOP-72(i)	DBS	2/5/2015	ND	1.2	ND	ND	ND	ND	3.3
	BOP-72(i)	DBS	5/6/2015	0.2	5.4	0.2	ND	ND	2.0	9.1
	BOP-72(i)	DBS	8/10/2015	ND	0.4	ND	ND	ND	ND	1.9
	BOP-72(i)	DBS	11/4/2015	ND	1.1	ND	ND	ND	ND	2.9
	BOP-73(i)	DBS	2/5/2015	ND	340	24	ND	ND	ND	720
	BOP-73(i)	DBS	5/6/2015	ND	150	40	ND	ND	ND	730
	BOP-73(i)	DBS	8/10/2015	ND	24	5.6	ND	ND	1.3	20
	BOP-73(i)	DBS	11/4/2015	0.5	92	1.2	ND	ND	5.8	19
	BOP-74(i)	DBS	2/6/2015	0.3	15	ND	ND	ND	0.4	1.9
	BOP-74(i)	DBS	5/6/2015	0.3	15	ND	ND	ND	0.5	1.6

TABLE 3
GROUNDWATER QUALITY SUMMARY
TGA AND SELECT TSA WELLS
JANUARY 1 THROUGH DECEMBER 31, 2015

Area	Location	Sample Type	Date	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	1,1,1-TCA	PCE	TCE	Vinyl chloride
		MCL Cleanup Level:		**7**	**70**	**70**	**200**	**5**	**5**	**2**
	BOP-74(i)	DBS	11/4/2015	ND	5.3	ND	ND	ND	ND	2.9
	BOP-75(i)	DBS	2/6/2015	1.1	8.6	ND	ND	ND	9.1	4.2
	BOP-75(i)	DBS	5/4/2015	0.4	6.4	ND	ND	ND	13	4.3
	BOP-75(i)	DBS	8/10/2015	0.3	4.2	ND	ND	ND	1.5	3.3
	BOP-75(i)	DBS	11/6/2015	0.3	4.7	ND	ND	ND	0.4	4.2
	BOP-76(i)	DBS	2/5/2015	0.5	7.0	ND	ND	ND	1.0	2.2
	BOP-76(i)	DBS	5/7/2015	0.3	6.6	ND	ND	ND	0.6	3.9
	BOP-76(i)	DBS	8/10/2015	0.6	14	ND	ND	ND	2.2	2.0
	BOP-76(i)	DBS	11/4/2015	0.5	14	ND	ND	ND	0.9	2.0
	BOP-77(i)	DBS	2/6/2015	0.3	120 J	1.3	ND	ND	4.2	24
	BOP-77(i)	DBS	5/6/2015	0.3	220	1.9	ND	ND	6.2	20
	BOP-77(i)	DBS	8/10/2015	ND	86	1.1	ND	ND	6.2	11
	BOP-77(i)	DBS	11/4/2015	ND	72	4.4	ND	ND	8.2	13
	BOP-78 (i)	DBS	2/5/2015	ND	12	0.7	ND	ND	3.2	1.8
	BOP-78 (i)	DBS	5/4/2015	ND	7.8	0.4	ND	ND	1.0	2.4
	BOP-78 (i)	DBS	11/6/2015	ND	3.1	ND	ND	ND	0.2	1.4
	BOP-79(i)	DBS	2/5/2015	ND	10	0.7	ND	ND	2.1	3.8
	BOP-79(i)	DBS	5/4/2015	ND	2.2	0.4	ND	ND	0.4	2.0
	BOP-79(i)	DBS	11/6/2015	ND	8.6	0.3	ND	ND	0.5	4.3
	BOP-80(i)	DBS	2/6/2015	ND	ND	0.4	ND	ND	ND	0.3
	BOP-80(i)	DBS	5/6/2015	ND	0.2	0.5	ND	ND	ND	0.6
	BOP-80(i)	DBS	8/10/2015	15	430	5.0	ND	3.0	91	11
	BOP-80(i)	DBS	11/4/2015	ND	0.5	0.4	ND	ND	ND	2.1
	BOP-81(i)	DBS	2/6/2015	ND	ND	ND	ND	ND	ND	ND
	BOP-81(i)	DBS	5/6/2015	ND	ND	ND	ND	ND	ND	ND
	BOP-81(i)	DBS	8/11/2015	ND	0.6	0.2	ND	ND	ND	1.2
	BOP-81(i)	DBS	11/4/2015	ND	0.3	0.2	ND	ND	ND	0.7
	BOP-82(i)	DBS	2/6/2015	0.7	1.7	ND	ND	0.7	11	0.5
	BOP-82(i)	DBS	5/4/2015	0.6	1.3	ND	ND	0.7	9.7	ND
	BOP-82(i)	DBS	8/11/2015	0.7	1.4	ND	ND	0.6	8.6	0.6
	BOP-82(i)	DBS	11/6/2015	0.7	2.5	ND	ND	0.3	6.0	1.2
	BOP-83(i)	DBS	2/6/2015	0.2	1.0	ND	ND	0.4	12	ND
	BOP-83(i)	DBS	5/4/2015	ND	ND	ND	ND	ND	2.0	ND
	BOP-83(i)	DBS	8/11/2015	ND	ND	ND	ND	ND	2.0	ND
	BOP-83(i)	DBS	11/6/2015	ND	ND	ND	ND	ND	1.9	ND
	BOP-84(i)	DBS	2/3/2015	0.3	15	0.8	ND	ND	0.5	3.4
	BOP-84(i)	DBS	5/4/2015	ND	8.9	0.4	ND	ND	0.3	3.1
	BOP-84(i)	DBS	11/6/2015	ND	2.8	ND	ND	ND	ND	2.1
	BOP-85(i)	DBS	2/3/2015	ND	5.2	1.0	ND	ND	1.4	0.3
	BOP-85(i)	DBS	5/4/2015	ND	5.1	0.5	ND	ND	0.8	0.4
	BOP-85(i)	DBS	11/6/2015	ND	0.4	ND	ND	ND	ND	0.3
	BOP-86(i)	DBS	2/3/2015	ND	5.5	2.9	ND	ND	0.9	3.5
	BOP-86(i)	DBS	5/4/2015	ND	5.0	1.9	ND	ND	3.5	2.8
	BOP-86(i)	DBS	11/6/2015	ND	1.6	0.4	ND	ND	0.3	2.8
	BOP-87(i)	DBS	2/3/2015	ND	2.2	1.2	ND	ND	2.1	0.9
	BOP-87(i)	DBS	5/4/2015	ND	2.8	0.7	ND	ND	1.4	0.7
	BOP-87(i)	DBS	11/6/2015	ND	0.3	ND	ND	ND	ND	0.5

TABLE 3
GROUNDWATER QUALITY SUMMARY
TGA AND SELECT TSA WELLS
JANUARY 1 THROUGH DECEMBER 31, 2015

Area	Location	Sample Type	Date	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	1,1,1-TCA	PCE	TCE	Vinyl chloride
		MCL Cleanup Level:		**7**	**70**	**70**	**200**	**5**	**5**	**2**
	BOP-88(i)	DBS	2/9/2015	0.2	90	0.8	ND	0.3	12	4.0
	BOP-88(i)	DBS	5/6/2015	0.4	150	0.8	ND	1.0	28	8.5
	BOP-88(i)	DBS	11/4/2015	ND	8.7	ND	ND	ND	0.8	2.4

µg/L = micrograms per liter
MCL = Maximum Contaminant Level
DCE = dichloroethene
TCA = trichloroethane
PCE = tetrachloroethene
TCE = trichloroethene
DBS = Diffusion Bag Sampler Type.
ND = Not detected.
TGA = Troutdale Gravel Aquifer
TSA = Troutdale Sandstone Aquifer

J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
Boxed value indicates concentration above the cleanup level.

(a) West Area wells BOP-57(ia, ib) are installed with short (5 ft) screens. BOP-57(ia) is screened at the base of the TGA, while BOP-57(ib) is screened within the first layer of the Confining Unit 1 (CU1).

Notes:
1. TSA water quality data collected as part of the TGA remedy implementation.
2. Data are parts per billion (µg/L).
3. Box indicates exceedance of MCL Cleanup Level.

TABLE 4
WATER ANALYTICAL RESULTS
TPH-Dx AND FIELD PARAMETERS
COOLANT RELEASE INVESTIGATION, 2015
BOEING OF PORTLAND FACILITY

		NWTPH-Dx (mg/L) (a)			Field Parameters		
				Total		Dissolved	
		Diesel	Motor Oil	TPH-Dx	pH	Oxygen (mg/L)	ORP (mV)
TGA Wells							
LAI-1	8/12/2015	0.095 U	0.24 U	ND	5.85	7.17	13.0
LAI-2	8/12/2015	0.095 U	0.24 U	ND	6.04	4.19	48.2
LAI-3	8/12/2015	0.098	0.24 U	0.098	6.50	6.21	-51.1
LAI-4	2/9/2015	2.0	4.0	6.0	6.30	5.08	-14.2
LAI-4	8/12/2015	29.0 J	67.0 J	96	9.55	1.26	-257.9
LAI-5	8/12/2015	0.094 U	0.24 U	ND	6.25	5.63	-48.3
LAI-6	8/12/2015	0.094 UJ	0.24 UJ	ND	6.44	6.45	-49.8
LAI-7	2/9/2015	0.10	0.31	0.41	6.20	4.76	-13.9
LAI-7	8/12/2015	0.094 U	0.24 U	ND	6.04	6.10	-19.9
LAI-8	8/18/2014	**Dry in August 2015**					
		Cleanup Level (b)		1.35			

TPH-Dx = total petroleum hydrocarbons-diesel range
ORP oxygen reduction potential
mg/L = milligrams per liter
mV = millilvolts
ND = Not detected.
ODEQ = Oregon Department of Environmental Quality

U = Indicates compound was analyzed for, but was not detected at the given reporting limit.
UJ = Analyte was not detected in the sample; the reported sample reporting limit is an estimate.
J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
Box = Exceedance of Cleanup Level.

(a) Samples analyzed after September 27, 2006 had silica gel and acid wash preparation steps conducted.
(b) Site-specific ODEQ Risk-Based cleanup standard based on sum of diesel and motor oil components.

TABLE 5
GROUNDWATER ELEVATION DATA
TGA MONITORING WELLS
JANUARY 1 THROUGH DECEMBER 31, 2015

	Date	Time	Reference Elev. (a) (ft, MSL)	Depth to Water (ft)	Groundwater Elevation (ft)
TGA WELLS					
BOP-7(i)	2/2/2015	13:58	83.08	61.11	21.97
BOP-7(i)	8/3/2015	9:20	83.08	59.87	23.21
BOP-9(i)	2/2/2015	11:03	114.74	81.52	33.22
BOP-9(i)	8/3/2015	10:32	114.74	80.86	33.88
BOP-10(i)	2/2/2015	12:01	109.19	37.82	71.37
BOP-10(i)	8/3/2015	12:04	109.19	37.70	71.49
BOP-16(i)	2/2/2015	13:36	89.08	59.83	29.25
BOP-16(i)	8/3/2015	10:00	89.08	58.90	30.18
BOP-48(i)	2/2/2015	10:52	94.17	11.38	82.79
BOP-48(i)	8/3/2015	9:43	94.17	13.21	80.96
BOP-56(i)	2/2/2015	8:00	99.07	58.67	40.40
BOP-56(i)	8/3/2015	9:35	99.07	57.93	41.14
BOP-57(ia) (b)	2/2/2015	10:44	95.45	60.34	35.11
BOP-57(ia) (b)	8/3/2015	9:40	95.45	60.40	35.05
BOP-57(ib) (b)	2/2/2015	10:48	94.57	60.67	33.90
BOP-57(ib) (b)	8/3/2015	10:52	94.57	60.29	34.28
BOP-59(i)	2/2/2015	9:30	110.20	39.02	71.18
BOP-59(i)	8/3/2015	11:55	110.20	39.29	70.91
D-7(i)	2/2/2015	9:37	45.38	32.35	13.03
D-7(i)	8/3/2015	14:13	45.38	33.93	11.45
D-8(i)	2/2/2015	7:50	29.30	16.52	12.78
D-8(i)	8/3/2015	14:20	29.30	18.48	10.82
D-11(i)	2/2/2015	8:48	77.11	62.70	14.41
D-11(i)	8/3/2015	9:57	77.11	64.10	13.01
D-12(i)	2/2/2015	8:55	33.51	21.13	12.38
D-12(i)	8/3/2015	9:53	33.51	22.55	10.96
COOLANT RELEASE WELLS					
LAI-1	8/3/2015	10:03	109.86	25.41	84.45
LAI-2	8/3/2015	9:58	109.89	22.61	87.28
LAI-3	8/3/2015	9:50	109.85	19.75	90.10
LAI-4	2/2/2015	10:20	110.71	15.17	95.54
LAI-4	8/3/2015	10:18	110.71	20.28	90.43
LAI-5	8/3/2015	10:15	110.56	19.34	91.22
LAI-6	8/3/2015	10:10	110.65	19.91	90.74
LAI-7	2/2/2015	10:04	109.90	25.18	84.72
LAI-7	8/3/2015	10:23	109.90	25.94	83.96
LAI-8	8/3/2015	10:26	110.59	Dry	Dry
TSA WELLS					
BOP-22R(ds)	2/2/2015	13:55	82.91	68.85	14.06
BOP-22R(ds)	8/3/2015	9:24	82.91	74.21	8.70
BOP-60R(ds)	2/2/2015	10:08	82.80	69.04	13.76
BOP-60R(ds)	8/3/2015	10:17	82.80	73.68	9.12
BOP-61(ds)	2/2/2015	11:19	94.64	83.30	11.34
BOP-61(ds)	8/3/2015	11:30	94.64	86.21	8.43
BOP-62(ds)	2/2/2015	11:17	112.29	98.84	13.45

TABLE 5
GROUNDWATER ELEVATION DATA
TGA MONITORING WELLS
JANUARY 1 THROUGH DECEMBER 31, 2015

	Date	Time	Reference Elev. (a) (ft, MSL)	Depth to Water (ft)	Groundwater Elevation (ft)
BOP-62(ds)	8/3/2015	8:15	112.29	103.24	9.05
BOP-65(ds)	2/2/2015	11:57	104.22	90.75	13.47
BOP-65(ds)	8/3/2015	8:48	104.22	94.66	9.56
BOP-66(ds)	2/2/2015	12:08	102.97	90.03	12.94
BOP-66(ds)	8/3/2015	8:55	102.97	92.78	10.19
FORMER VAPOR DEGREASER AREA WELLS					
BOP-72(i)	2/2/2015	15:50	83.64	45.23	38.41
BOP-72(i)	5/1/2015	9:26	83.64	39.16	44.48
BOP-72(i)	8/3/2015	14:02	83.64	44.28	39.36
BOP-72(i)	11/2/2015	16:59	83.64	45.11	38.53
BOP-73(i)	2/2/2015	7:15	83.65	46.63	37.02
BOP-73(i)	5/1/2015	10:25	83.65	45.92	37.73
BOP-73(i)	8/3/2015	15:00	83.65	46.16	37.49
BOP-73(i)	11/2/2015	17:05	83.65	47.17	36.48
BOP-74(i)	2/2/2015	17:10	83.69	49.93	33.76
BOP-74(i)	5/1/2015	10:50	83.69	49.58	34.11
BOP-74(i)	8/3/2015	15:20	83.69	61.91	21.78
BOP-74(i)	11/2/2015	16:42	83.69	59.82	23.87
BOP-75(i)	2/2/2015	7:08	83.70	44.32	39.38
BOP-75(i)	5/1/2015	9:40	83.70	34.41	49.29
BOP-75(i)	8/3/2015	14:08	83.70	43.50	40.20
BOP-75(i)	11/2/2015	14:40	83.70	43.55	40.15
BOP-76(i)	2/2/2015	16:32	83.65	44.65	39.00
BOP-76(i)	5/1/2015	10:05	83.65	44.20	39.45
BOP-76(i)	8/3/2015	15:25	83.65	44.38	39.27
BOP-76(i)	11/2/2015	16:55	83.65	44.53	39.12
BOP-77(i)	2/2/2015	7:28	83.68	48.22	35.46
BOP-77(i)	5/1/2015	10:40	83.68	47.93	35.75
BOP-77(i)	8/3/2015	15:05	83.68	47.81	35.87
BOP-77(i)	11/2/2015	17:08	83.68	48.95	34.73
BOP-78(i)	2/2/2015	16:45	83.16	46.82	36.34
BOP-78(i)	5/1/2015	10:10	83.16	45.75	37.41
BOP-78(i)	8/3/2015	14:30	83.16	54.28	28.88
BOP-78(i)	11/2/2015	12:20	83.16	51.26	31.90
BOP-79(i)	2/2/2015	17:20	83.34	47.32	36.02
BOP-79(i)	5/1/2015	10:32	83.34	46.83	36.51
BOP-79(i)	8/3/2015	14:50	83.34	57.10	26.24
BOP-79(i)	11/2/2015	11:24	83.34	55.41	27.93
BOP-80(i)	2/2/2015	7:36	83.60	51.03	32.57
BOP-80(i)	5/1/2015	14:50	83.60	50.53	33.07
BOP-80(i)	8/3/2015	10:40	83.60	52.40	31.20
BOP-80(i)	11/2/2015	12:00	83.60	53.66	29.94
BOP-81(i)	5/1/2015	14:53	83.57	50.80	32.77
BOP-81(i)	8/3/2015	10:45	83.57	52.75	30.82
BOP-81(i)	11/2/2015	12:05	83.57	54.29	29.28
BOP-82(i)	2/2/2015	14:53	81.10	52.44	28.66
BOP-82(i)	5/1/2015	14:45	81.10	51.38	29.72
BOP-82(i)	8/3/2015	10:49	81.10	54.05	27.05

TABLE 5
GROUNDWATER ELEVATION DATA
TGA MONITORING WELLS
JANUARY 1 THROUGH DECEMBER 31, 2015

	Date	Time	Reference Elev. (a) (ft, MSL)	Depth to Water (ft)	Groundwater Elevation (ft)
BOP-82(i)	11/2/2015	12:10	81.10	56.20	24.90
BOP-83(i)	2/2/2015	14:47	80.42	52.08	28.34
BOP-83(i)	5/1/2015	14:40	80.42	51.29	29.13
BOP-83(i)	8/3/2015	15:57	80.42	53.01	27.41
BOP-83(i)	11/2/2015	17:00	80.42	55.05	25.37
BOP-84(i)	2/2/2015	16:57	83.67	51.42	32.25
BOP-84(i)	5/1/2015	10:45	83.67	53.38	30.29
BOP-84(i)	8/3/2015	15:10	83.67	58.25	25.42
BOP-84(i)	11/2/2015	11:06	83.67	62.35	21.32
BOP-85(i)	2/2/2015	16:04	83.69	44.12	39.57
BOP-85(i)	5/1/2015	9:42	83.69	43.16	40.53
BOP-85(i)	8/3/2015	14:20	83.69	51.72	31.97
BOP-85(i)	11/2/2015	13:36	83.69	52.65	31.04
BOP-86(i)	2/2/2015	15:45	83.70	47.17	36.53
BOP-86(i)	5/1/2015	9:18	83.70	40.15	43.55
BOP-86(i)	8/3/2015	13:48	83.70	55.71	27.99
BOP-86(i)	11/2/2015	14:21	83.70	57.38	26.32
BOP-87(i)	2/2/2015	16:13	83.68	44.48	39.20
BOP-87(i)	5/1/2015	9:51	83.68	43.85	39.83
BOP-87(i)	8/3/2015	15:38	83.68	53.30	30.38
BOP-87(i)	11/2/2015	13:19	83.68	56.85	26.83
BOP-88(i)	2/2/2015	16:22	83.67	45.10	38.57
BOP-88(i)	5/1/2015	9:58	83.67	44.98	38.69
BOP-88(i)	8/3/2015	15:30	83.67	55.10	28.57
BOP-88(i)	11/2/2015	12:53	83.67	56.54	27.13

ft = feet
MSL = mean sea level
TGA = Troutdale Gravel Aquifer
TSA = Troutdale Sandstone Aquifer
PVC = polyvinyl chloride

(a) Reference Elevation for the top of PVC well casing.
(b) West Area wells BOP-57(ia, ib) are installed with short (5 ft) screens. BOP-57(ia) is screened at the base of the TGA, while BOP-57(ib) is screened within the first layer of the Confining Unit 1 (CU1).

TABLE 6
VAPOR WELL ANALYTICAL RESULTS
FORMER VAPOR DEGREASER SOURCE CONTROL AREA
BOEING OF PORTLAND

VOLATILES (Method TO-15)

Location	Lab ID	Date Collected	Cumulative days since SVE startup 9/17/2012	Days of Shutdown (since previous sample collection)	Vinyl Chloride (µg/m3)	1,1-DCE (µg/m3)	1,1,1-TCA (µg/m3)	cis-DCE (µg/m3)	TCE (µg/m3)	PCE (µg/m3)	1,1-DCA (µg/m3)	VOC Removal Rate (lbs/day)	Operational Days (since previous sample collection)	Mass Removal (lbs)
		Screening Level (a)			2,800	880,000	22,000,000		2,900	47,000				
VOW-16		1/29/2015							SVE System Resumed Operation					
VOW-16	1502274-08A	2/13/2015	879		2.9 U	4.5 U	6.2 U	4.5 U	49	27	NA	--	--	--
VOW-16	1505125-11A	5/5/2015	960		3.0 U	4.6 U	6.4 U	4.6 U	6.2 J	20	NA	--	--	--
VOW-16	1508227-22A	8/7/2015	1054		3.1 U	4.8 U	19	4.8 U	23	86	NA	--	--	--
VOW-16		10/29/2015							SVE System Shutdown					
VOW-16	1511156-08A	11/3/2015	1142		2.7 U	4.1 U	14	4.1 U	34	28	NA	--	--	--
VOW-17		1/29/2015							SVE System Resumed Operation					
VOW-17	1502274-09A	2/13/2015	879		3.0 U	4.7 U	6.5 U	4.7 U	110	110	NA	--	--	--
VOW-17	1505125-12A	5/5/2015	960		3.2 U	5.0 U	6.9 U	5.0 U	24	120	NA	--	--	--
VOW-17	1508227-10A	8/7/2015	1054		3.1 U	4.8 U	16	4.8 U	35	120	NA	--	--	--
VOW-17		10/29/2015							SVE System Shutdown					
VOW-17	1511156-09A	11/3/2015	1142		3.1 U	4.8 U	8.2	4.8 U	13	55	NA	--	--	--
VOW-18		1/29/2015							SVE System Resumed Operation					
VOW-18	1502274-10A	2/13/2015	879		3.0 U	4.6 U	21	4.6 U	49	180	NA	--	--	--
VOW-18	1505125-13A	5/5/2015	960		3.0 U	4.6 U	6.4 U	4.6 U	14	230	NA	--	--	--
VOW-18	1508227-06A	8/7/2015	1054		3.0 U	4.6 U	6.3 U	4.6 U	14	160	NA	--	--	--
VOW-18		10/29/2015							SVE System Shutdown					
VOW-18	1511156-10A	11/3/2015	1142		3.2 U	5.0 U	42	10 J	300	300	NA	--	--	--
BOP-78(i)		1/29/2015							SVE System Resumed Operation					
BOP-78(i)	1502274-01A	2/13/2015	879	85 (b)	3.0 U	4.7 U	15	4.7 U	380	82	NA	0.00360	16	0.028
BOP-78(i)	1505125-04A	5/5/2015	960	0	3.1 U	4.8 U	6.7 U	4.8 U	59	30	NA	0.00040	81	0.160
BOP-78(i)	1508227-17A	8/7/2015	1054	20.5 (c)	3.0 U	4.7 U	14	4.7 U	100	87	NA	0.00050	74	0.034
BOP-78(i)		10/29/2015							SVE System Shutdown					
BOP-78(i)	1511156-01A	11/3/2015	1142	26 (d)	3.2 U	5.0 U	26	5.0 U	63	82	NA	0.00020	62	0.024
BOP-79(i)		1/29/2015							SVE System Resumed Operation					
BOP-79(i)	1502274-02A	2/13/2015	879	85 (b)	15	4.5 U	22	29	250	42	NA	0.00267	16	0.021
BOP-79(i)	1505125-04A	5/5/2015	960	0	2.9 U	4.6 U	6.3 U	4.6 U	11	22	NA	0.00042	81	0.125
BOP-79(i)	1508227-15A	8/7/2015	1054	20.5 (c)	5.8 U	8.9 U	12 U	8.9 U	21	58	NA	0.00114	74	0.057
BOP-79(i)		10/29/2015							SVE System Shutdown					
BOP-79(i)	1511156-02A	11/3/2015	1142	26 (d)	3.3 U	5.1 U	21	5.1 U	57	53	NA	0.00043	62	0.049
BOP-84(i)		1/29/2015							SVE System Resumed Operation					
BOP-84(i)	1502274-03A	2/13/2015	879	85 (b)	3.1 U	4.8 U	12	4.8 U	1500	230	NA	0.02618	16	0.209
BOP-84(i)	1505125-04A	5/5/2015	960	0	3.0 U	4.6 U	6.4 U	4.6 U	810	160	NA	0.00275	81	1.172
BOP-84(i)	1508227-09A	8/7/2015	1054	20.5 (c)	3.0 U	4.6 U	12	4.6 U	380	120	NA	0.00102	74	0.139
BOP-84(i)		10/29/2015							SVE System Shutdown					
BOP-84(i)	1511156-03A	11/3/2015	1142	26 (d)	3.1 U	4.8 U	12	4.8 U	120	150	NA	0.00087	62	0.059
VOW-16		1/29/2015							SVE System Resumed Operation					
BOP-85(i)	1502274-04A	2/13/2015	879	85 (b)	3.0 U	4.6 U	23	4.6 U	83	240	NA	0.00142	16	0.011
BOP-85(i)	1505125-04A	5/5/2015	960	0	3.0 U	4.6 U	6.4 U	4.6 U	16	120	NA	0.00193	81	0.136
BOP-85(i)	1508227-21A	8/7/2015	1054	20.5 (c)	3.1 U	4.8 U	6.6 U	4.8 U	24	180	NA	0.00048	74	0.089
		10/29/2015							SVE System Shutdown					
BOP-85(i)	(e)	11/3/2015	1142	26 (d)	---	---	---	---	---	---	---	0.00000	62	0.015

TABLE 6
VAPOR WELL ANALYTICAL RESULTS
FORMER VAPOR DEGREASER SOURCE CONTROL AREA
BOEING OF PORTLAND

VOLATILES (Method TO-15)

Location	Lab ID	Date Collected	Cumulative days since SVE startup 9/17/2012	Days of Shutdown (since previous sample collection)	Vinyl Chloride (µg/m3)	1,1-DCE (µg/m3)	1,1,1-TCA (µg/m3)	cis-DCE (µg/m3)	TCE (µg/m3)	PCE (µg/m3)	1,1-DCA (µg/m3)	VOC Removal Rate (lbs/day)	Operational Days (since previous sample collection)	Mass Removal (lbs)
		Screening Level (a)			2,800	880,000	22,000,000		2,900	47,000				
BOP-86(i)		1/29/2015			SVE System Resumed Operation									
BOP-86(i)	1502274-05A	2/13/2015	879	85 (b)	3.2 U	5.0 U	6.9 U	5.0 U	73	84	NA	0.00132	16	0.011
BOP-86(i)	1505125-04A	5/5/2015	960	0	7.7 U	12 U	16 U	12 U	26	300	NA	0.00087	81	0.089
BOP-86(i)	1508227-08A	8/7/2015	1054	20.5 (c)	3.2 U	4.9 U	6.8 U	4.9 U	18	130	NA	0.00051	74	0.051
BOP-86(i)		10/29/2015			SVE System Shutdown									
BOP-86(i)	1511156-05A	11/3/2015	1142	26 (d)	2.6 U	4.1 U	15	4.1 U	57	220	NA	0.00055	62	0.033
BOP-87(i)		1/29/2015			SVE System Resumed Operation									
BOP-87(i)	1502274-06A	2/13/2015	879	85 (b)	3.0 U	4.6 U	79	4.6 U	360	120	NA	0.00323	16	0.026
BOP-87(i)	1505125-04A	5/5/2015	960	0	3.0 U	4.7 U	12	4.7 U	98	65	NA	0.00071	81	0.160
BOP-87(i)	1508227-19A	8/7/2015	1054	20.5 (c)	3.1 U	4.8 U	12	4.8 U	170	130	NA	0.00315	74	0.142
BOP-87(i)		10/29/2015			SVE System Shutdown									
BOP-87(i)	1511156-06A	11/3/2015	1142	26 (d)	3.2 U	5.0 U	68	5.0 U	53	98	NA	0.00079	62	0.122
BOP-88(i)		1/29/2015			SVE System Resumed Operation									
BOP-88(i)	1502274-07A	2/13/2015	879	85 (b)	8.1	4.8 U	66	7.9	760	93	NA	0.00583	16	0.047
BOP-88(i)	1505125-04A	5/5/2015	960	0	3.0 U	4.7 U	25	4.7 U	150	46	NA	0.00059	81	0.260
BOP-88(i)	1508227-16A	8/7/2015	1054	20.5 (c)	2.9 U	4.5 U	18	4.5 U	120	92	NA	0.00128	74	0.069
BOP-88(i)		10/29/2015			SVE System Shutdown									
BOP-88(i)	1511156-07A	11/3/2015	1142	26 (d)	3.9 U	6.0 U	160	6.6 J	120	89	NA	0.00043	62	0.053

µg/m3 = micrograms per cubic meter
TCA = trichloroethane
TCE = trichloroethene
PCE = tetrachloroethene
DCA = dichloroethane
VOC = volatile organic compound
NA = Not analyzed
SVE = soil vapor extraction

Cumulative VOC Mass Removed (lbs) 10.47

U = Indicates compound was analyzed for, but was not detected at the given reporting limit.
J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
Bold = Detection
Box = Results are greater than the screening level.

Notes:
(a) Soil gas screening levels were developed by the Oregon Department of Environmental Quality (DEQ) by multiplying the Risk-Based Concentration for air in an occupational setting by an attenuation factor of 1,000 to account for vapor intrusion through building slab (screening levels updated June 7, 2012).
(b) SVE system started pulse-pump operation on July 2, 2014, DEQ approval. System off cycle between July 2 2014 and January 29, 2015.
(c) The SVE system was shutdown between June 8 and 29, 2015 for bioremediation activities.
(d) Shutdown system after operation for 6 months operation, with DEQ approval. The SVE system has been shutdown since October 9, 2015.
(e) Sample BOP-85i-1115 arrived at ambient vacuum, and its valve was slightly open. Analysis was cancelled.
Box = Results are greater than the screening level.

(a) Soil gas screening levels were developed by the Oregon Department of Environmental Quality (DEQ) by multiplying the Risk-Based Concentration for air in an occupational setting by an attenuation factor of 1,000 to account for vapor intrusion through building slab (screening levels updated June 7, 2012).
(b) SVE system started pulse-pump operation on July 2, 2014, DEQ approval. System off cycle between July 2 2014 and January 29, 2015.
(c) The SVE system was shutdown between June 8 and 29, 2015 for bioremediation activities.
(d) Shutdown system after operation for 6 months operation, with DEQ approval. The SVE system has been shutdown since October 9, 2015.
(e) Sample BOP-85i-1115 arrived at ambient vacuum, and its valve was slightly open. Analysis was cancelled.

TABLE 7
SUB-SLAB VAPOR WELL ANALYTICAL RESULTS
FORMER VAPOR DEGREASER SOURCE AREA
BOEING OF PORTLAND

VOLATILES (Method TO-15)

Location	Date Collected	Vinyl Chloride (µg/m3)	1,1-DCE (µg/m3)	1,1,1-TCA (µg/m3)	cis-DCE (µg/m3)	TCE (µg/m3)	PCE (µg/m3)
	Screening Level (a)	2,800	880,000	22,000,000		2,900	47,000
VP-1	**Baseline**	29 U	44 U	61 U	44 U	15,000	NA
VP-1	1/29/2015	SVE System Resumed Operation					
VP-1	2/13/2015	3.0 U	4.7 U	6.5 U	4.7 U	330	80
VP-1	5/5/2015	3.1 U	4.9 U	6.7 U	4.9 U	13	81
VP-1	8/7/2015	2.5 UJ	3.9 UJ	5.4 UJ	3.9 U	8.4 J	42 J
VP-1	10/29/2015	SVE System Shutdown					
VP-1	11/3/2015	3.1 U	4.8 U	6.6 U	4.8 U	70	61
VP-2	**Baseline**	200 U	310 U	NA	1100	280,000	NA
VP-2	1/29/2015	SVE System Resumed Operation					
VP-2	2/13/2015	6.1 U	9.4 U	13 U	9.4 U	2900	92
VP-2	5/5/2015	2.9 U	4.5 U	6.2 U	4.5 U	58	73
VP-2	8/7/2015	3.0 U	4.7 U	6.5 U	4.7 U	36	67
VP-2	10/29/2015	SVE System Shutdown					
VP-2	11/3/2015	32 U	49 U	67 U	52	21,000	220
VP-3	**Baseline**	14 U	90	4700	27	7,400	NA
VP-3	1/29/2015	SVE System Resumed Operation					
VP-3	2/13/2015	3.0 U	4.6 U	100	4.6 U	39	65
VP-3	5/5/2015	3.0 U	4.6 U	21	4.6 U	9.0	75
VP-3	8/7/2015	3.0 U	4.6 U	26	4.6 U	10	56
VP-3	10/29/2015	SVE System Shutdown					
VP-3	11/3/2015	3.3 U	5.1 U	220	5.1 U	81	58
VP-4	**Baseline**	290 U	440 U	610 U	660	170,000	NA
VP-4	1/29/2015	SVE System Resumed Operation					
VP-4	2/13/2015	3.0 U	4.7 U	6.5 U	4.7 U	95	110
VP-4	5/5/2015	3.1 U	4.9 U	6.7 U	4.9 U	34	100
VP-4	8/7/2015	2.9 U	4.6 U	6.3 U	4.6 U	46	70
VP-4	10/29/2015	SVE System Shutdown					
VP-4	11/3/2015	3.3 U	5.1 U	7.0 U	5.1 U	82	74
VP-5	**Baseline**	1100	1700	2400	3800	850,000	NA
VP-5	1/29/2015	SVE System Resumed Operation					
VP-5	2/13/2015	3.9 U	6.0 U	8.3 U	6.0 U	1300	69
VP-5	5/5/2015	3.1 U	4.9 U	6.7 U	4.9 U	43	54
VP-5	8/7/2015	2.8 U	4.4 U	6.1 U	4.4 U	19	32
VP-5	10/29/2015	SVE System Shutdown					
VP-5	11/3/2015	5.1 U	7.8 U	50	7.8 U	2600	74
VP-6	**Baseline**	13 U	59	7600	160	3,200	NA
VP-6	1/29/2015	SVE System Resumed Operation					
VP-6	2/13/2015	2.9 U	4.6 U	99	4.6 U	160	110
VP-6	5/5/2015	3.0 U	4.6 U	120	16	40	150
VP-6	8/7/2015	2.9 U	4.5 U	31	4.6	19	94
VP-6	10/29/2015	SVE System Shutdown					
VP-6	11/3/2015	3.2 U	4.9 U	180	6.2	100	120

TABLE 7
SUB-SLAB VAPOR WELL ANALYTICAL RESULTS
FORMER VAPOR DEGREASER SOURCE AREA
BOEING OF PORTLAND

VOLATILES (Method TO-15)

Location	Date Collected	Vinyl Chloride (µg/m3)	1,1-DCE (µg/m3)	1,1,1-TCA (µg/m3)	cis-DCE (µg/m3)	TCE (µg/m3)	PCE (µg/m3)
	Screening Level (a)	2,800	880,000	22,000,000		2,900	47,000
VP-7	**Baseline**	30 U	3200	NA	1900	5,200	NA
VP-7	1/29/2015	SVE System Resumed Operation					
VP-7	2/13/2015	3.0 U	69	2200	66	180	130
VP-7	5/5/2015	3.0 U	31	930	39	90	77
VP-7	8/7/2015	3.0 U	33	870	32	86	60
VP-7	10/29/2015	SVE System Shutdown					
VP-7	11/3/2015	6.1 U	110	3500	120	310	88
VP-8	**Baseline**	100 U	14273	190975	7414	20,743	NA
VP-8	1/29/2015	SVE System Resumed Operation					
VP-8	2/13/2015	6.3 U	230	4800	110	260	140
VP-8	5/5/2015	3.0 U	100	2400	39	110	140
VP-8	8/7/2015	6.0 U	140	2800	41	140	91
VP-8	10/29/2015	SVE System Shutdown					
VP-8	11/3/2015	21 U	530	14000	230	630	150
VP-9	**Baseline**	100 U	103 U	186	103 U	8,007	NA
VP-9	1/29/2015	SVE System Resumed Operation					
VP-9	2/13/2015	2.9 U	4.5 U	38	4.5 U	300	160
VP-9	5/5/2015	3.1 U	4.8 U	18	4.8 U	220	140
VP-9	8/7/2015	3.0 U	4.6 U	10	4.6 U	97	90
VP-9	10/29/2015	SVE System Shutdown					
VP-9	11/3/2015	3.0 U	4.6 U	28	4.6 U	220	120

µg/m3 = micrograms per cubic meter
NA = Not analyzed
DCE = dichloroethene
TCA = trichloroethane
TCE = trichloroethene
PCE = tetrachloroethene
VOC = volatile organic compound

U = Indicates compound was analyzed for, but was not detected at the given reporting limit.
UJ = Analyte was not detected in the sample; the reported sample reporting limit is an estimate.
J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
Box = Results are greater than the screening level.

(a) Soil gas screening levels were developed by the Oregon Department of Environmental Quality (DEQ) by multiplying the Risk-Based Concentration for air in an occupational setting by an attenuation factor of 1,000 to account for vapor intrusion through building slab. Screening levels updated June 7, 2012.
(b) Total VOC concentration reduction percentages are developed from baseline concentrations.

TABLE 8
EXTRACTION WELL SUMMARY
GROUNDWATER TREATMENT SYSTEM

	January 2015				February 2015				March 2015			
Location	Gallons Pumped	Run Time Operational Minutes	Pump Rate (gpm)	Avg. Yield (gpm)	Gallons Pumped	Run Time Operational Minutes	Pump Rate (gpm)	Avg. Yield (gpm)	Gallons Pumped	Run Time Operational Minutes	Pump Rate (gpm)	Avg. Yield (gpm)
E-2	317,580	40,200	7.90	7.11	408,960	19,200	21.30	9.16	418,950	44,100	9.50	9.39
E-3	19,440	38,880	0.50	0.44	221,760	39,600	5.60	4.97	103,914	44,100	2.36	2.33
E-4	47,388	43,080	1.10	1.06	43,692	39,720	1.10	0.98	48,312	43,920	1.10	1.08
E-5	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-6	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-7	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-8	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-9	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-11	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-12	71,616	22,380	3.20	1.60	31,776	39,720	0.80	0.71	39,690	44,100	0.90	0.89
E-13	2,730,600	44,400	61.50	61.17	2,454,696	39,720	61.80	54.99	2,598,360	44,040	59.00	58.21
E-15	22,200	44,400	0.50	0.50	16,800	21,000	0.80	0.38	39,960	44,400	0.90	0.90
E-16	31,080	44,400	0.70	0.70	47,520	39,600	1.20	1.06	48,510	44,100	1.10	1.09
EW-3	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
EW-13	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
DP-1	111,000	44,400	2.50	2.49	99,300	39,720	2.50	2.22	115,440	44,400	2.60	2.59
Total	**3,350,904**				**3,324,504**				**3,413,136**			

TABLE 8
EXTRACTION WELL SUMMARY
GROUNDWATER TREATMENT SYSTEM

	April 2015				May 2015				June 2015			
Location	Gallons Pumped	Run Time Operational Minutes	Pump Rate (gpm)	Avg. Yield (gpm)	Gallons Pumped	Run Time Operational Minutes	Pump Rate (gpm)	Avg. Yield (gpm)	Gallons Pumped	Run Time Operational Minutes	Pump Rate (gpm)	Avg. Yield (gpm)
E-2	161,568	31,680	5.10	3.74	584,640	28,800	20.30	13.10	211,680	14,400	14.70	4.90
E-3	37,440	37,440	1.00	0.87	132,480	28,800	4.60	2.97	38,880	14,400	2.70	0.90
E-4	46,860	42,600	1.10	1.08	31,680	28,800	1.10	0.71	15,708	14,280	1.10	0.36
E-5	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-6	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-7	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-8	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-9	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-11	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-12	68,160	42,600	1.60	1.58	54,948	28,920	1.90	1.23	23,970	14,100	1.70	0.55
E-13	2,585,820	42,600	60.70	59.86	1,481,190	29,100	50.90	33.18	807,840	14,400	56.10	18.70
E-15	25,524	42,540	0.60	0.59	31,680	28,800	1.10	0.71	12,960	14,400	0.90	0.30
E-16	42,600	42,600	1.00	0.99	28,800	28,800	1.00	0.65	12,960	14,400	0.90	0.30
EW-3	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
EW-13	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
DP-1	107,850	43,140	2.50	2.50	133,860	29,100	4.60	3.00	34,704	14,460	2.40	0.80
Total	**3,075,822**				**2,479,278**				**1,158,702**			

TABLE 8
EXTRACTION WELL SUMMARY
GROUNDWATER TREATMENT SYSTEM

Location	July 2015 Gallons Pumped	July 2015 Run Time Operational Minutes	July 2015 Pump Rate (gpm)	July 2015 Avg. Yield (gpm)	August 2015 Gallons Pumped	August 2015 Run Time Operational Minutes	August 2015 Pump Rate (gpm)	August 2015 Avg. Yield (gpm)	September 2015 Gallons Pumped	September 2015 Run Time Operational Minutes	September 2015 Pump Rate (gpm)	September 2015 Avg. Yield (gpm)
E-2	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-3	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-4	31,680	28,800	1.10	0.71	58,128	41,520	1.40	1.30	44,712	41,400	1.08	1.00
E-5	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-6	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-7	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-8	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-9	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-11	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-12	54,948	28,920	1.90	1.23	66,432	41,520	1.60	1.49	53,836	42,060	1.28	1.21
E-13	1,481,190	29,100	50.90	33.18	2,347,380	41,400	56.70	52.58	2,649,600	41,400	64.00	59.35
E-15	31,680	28,800	1.10	0.71	45,672	41,520	1.10	1.02	36,432	41,400	0.88	0.82
E-16	28,800	28,800	1.00	0.65	45,672	41,520	1.10	1.02	24,012	41,400	0.58	0.54
EW-3	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
EW-13	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
DP-1	133,860	29,100	4.60	3.00	66,720	41,700	1.60	1.49	100,536	42,600	2.36	2.25
Total	**1,762,158**				**2,630,004**				**2,909,128**			

TABLE 8
EXTRACTION WELL SUMMARY
GROUNDWATER TREATMENT SYSTEM

Location	October 2015				November 2015				December 2015			
	Gallons Pumped	Run Time Operational Minutes	Pump Rate (gpm)	Avg. Yield (gpm)	Gallons Pumped	Run Time Operational Minutes	Pump Rate (gpm)	Avg. Yield (gpm)	Gallons Pumped	Run Time Operational Minutes	Pump Rate (gpm)	Avg. Yield (gpm)
E-2	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-3	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-4	44,340	44,340	1.00	0.99	31,416	28,560	1.10	0.70	34,931	37,440	0.93	0.78
E-5	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-6	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-7	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-8	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-9	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-11	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-12	20,424	44,400	0.46	0.46	18,600	37,200	0.50	0.42	70,992	24,480	2.90	1.59
E-13	2,974,800	44,400	67.00	66.64	2,678,400	37,200	72.00	60.00	1,944,000	36,000	54.00	43.55
E-15	39,906	44,340	0.90	0.89	33,426	37,140	0.90	0.75	20,592	37,440	0.55	0.46
E-16	10,728	35,760	0.30	0.24	18,600	37,200	0.50	0.42	4,260	42,600	0.10	0.10
EW-3	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
EW-13	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
DP-1	102,396	44,520	2.30	2.29	86,112	37,440	2.30	1.93	115,344	42,720	2.70	2.58
Total	**3,192,594**				**2,866,554**				**2,190,119**			

gpm = gallons per minute
Avg = average

Notes:

1. Average yield reflects total gallons pumped divided by total minutes for the measuring period.
2. The following wells have been decommissioned and are no longer shown: E-1 (June 2004); E-10 (March 2010); E-14 (April 2010); and Troutdale Sandstone Aquifer (TSA) well EW-22 (March 2010).
3. EW-3 and EW-13 are TSA extraction wells.
4. Wells E-5 through E-9 and E-11 were not operated this quarter except for sampling.
5. Oregon Department of Environmental Quality (ODEQ) approved the pilot shutdown of EW-3 in December 2009 and EW-13 in November 2009.
6. ODEQ approved the shutdown of E-2 and E-3 on 7/7/15. The wells will remain shut down.

TABLE 9
BIOREMEDIATION SUMMARY
FORMER VAPOR DEGREASER SOURCE CONTROL AREA
BOEING OF PORTLAND

Well	Date	Elapsed Time from Injections (a) (days)	Elapsed Time from Injection (b) (days)	Elapsed Time from Injection (c) (days)	Elapsed Time from Injection (d) (days)	Elapsed Time from Injection (e) (days)	Elapsed Time from Injection (f) (days)	Volatile Organic Compounds Analytical Results							Aquifer Redox Conditions									Donor Indicators		Molar Fraction						
		Pilot Injection	PRB 1st Injection	PRB 2nd Injection	Source Zone Wells 1st Injection	Source Zone Wells + PRB Injection	Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	CIS (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Iron, Tot (mg/L)	Iron, Diss (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	CIS	VC	Ethene	Ethane	Total
BOP-72(i)	10/19/2010	-16						3.1	28	10	<1.0	<1.0	<2.0	--	--	--	1.2	--	--	--	12.9	--	0.106	1.77		0.06	0.64	0.31	0.00	0.00	0.00	1.00
Monitoring Well	12/6/2010	32						<2.0	3.6	<2.0	<2.0	25	5.4	--	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	1.00
BOP-72(i)	2/2/2011	90						<20	<20	<20	<20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	0.00	--	--	0.00
BOP-72(i)	5/5/2011	182						<1.0	<1.0	6.3	<1.0	--	--	--	0.21	163	--	--	--	--	--	--	--	--	6.79	0.00	0.00	1.00	0.00	--	--	1.00
BOP-72(i)	8/10/2011	279						<1.0	<1.0	10	<1.0	<1.1	<1.2	<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	1.00
BOP-72(i)	11/3/2011	364	-55					<1.0	<1.0	3.0	6.8	--	--	--	0.09	-138.8	--	--	--	--	--	--	--	--	6.71	0.00	0.00	0.22	0.78	--	--	1.00
BOP-72(i)	2/8/2012	461	42					<2.0	<2.0	<2.0	7.5	--	--	--	0.31	-317.5	--	--	--	--	--	--	--	--	7.46	0.00	0.00	0.00	1.00	--	--	1.00
BOP-72(i)	5/4/2012	547	128					<2.0	<2.0	<2.0	9.0	--	--	--	0.86	-65.7	--	--	--	--	--	--	--	--	6.69	0.00	0.00	0.00	1.00	--	--	1.00
BOP-72(i)	8/9/2012	644	225	-7				<1.0	<1.0	<1.0	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--	1.00
BOP-72(i)	11/8/2012	735	316	84				<0.2	<0.2	0.2	5.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.02	0.98	--	--	1.00
BOP-72(i)	2/5/2013	824	405	173				<0.2	<0.2	0.3	3.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.05	0.95	--	--	1.00
BOP-72(i)	5/2/2013	910	491	259	-68			<0.2	<0.2	0.2	3.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.04	0.96	--	--	1.00
BOP-72(i)	8/6/2013	1006	587	355	28			<0.2	<0.2	0.7	2.7	5.0	<5.0	<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	1.00
BOP-72(i)	11/7/2013	1099	680	448	121			<0.2	<0.2	0.3	1.9	<5.0	<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	1.00
BOP-72(i)	2/5/2014	1189	770	538	211			<0.2	<0.2	0.2	1.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.06	0.94	--	--	1.00
BOP-72(i)	5/7/2014	1280	861	629	302	-70		<0.2	<0.2	<0.2	1.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--	1.00
BOP-72(i)	8/13/2014	1378	959	727	400	28		<0.2	<0.2	0.2	1.1	<5.0	<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	1.00
BOP-72(i)	11/6/2014	1463	1044	812	485	113		<0.2	<0.2	0.3	1.9	<5.0	<5.0	<5.0	0.26	-147.7	<0.10	3.0	9.75	9.38	2.8	<2.0	14	13.6	6.56	0.00	0.00	0.09	0.91	0.00	0.00	1.00
BOP-72(i)	2/5/2015	1554	1135	903	576	204		<0.2	<0.2	1.2	3.3	6.2	<5.0	<5.0			<0.10		17.6	15.0	16.2	<2.0	13	8.6		0.00	0.00	0.04	0.18	0.77	0.00	1.00
BOP-72(i)	5/6/2015	1644	1225	993	666	294	-44	<0.2	2.0	5.4	9.1	<5.0	<5.0	<5.0	0.97	-91.2	<0.10	4.5	15.4	14.9	16.8	<2.0	11	6.7	6.33	0.00	0.07	0.26	0.67	0.00	0.00	1.00
BOP-72(i)	8/10/2015	1740	1321	1089	762	390	52	<0.2	<0.2	0.4	1.9	<5.0	<5.0	<5.0	1.37	-167.7	<0.10	7.0	36.2	29.7	1.1	24.5	15	161.0	6.45	0.00	0.00	0.12	0.88	0.00	0.00	1.00
BOP-72(i)	11/4/2015	1826	1407	1175	848	476	138	<0.2	<0.2	1.1	2.9	<5.0	<5.0	<5.0	1.09	-100.5	<0.10	7.0	18.7	18.3	6.9	<2.0	18	3.7	6.54	0.00	0.00	0.20	0.80	0.00	0.00	1.00
BOP-73(i)	10/19/2010	-16						12	560	90	<1.0	<1.0	<2.0	--	--	--	0.7	--	--	--	11	--	0.0599	1.6		0.01	0.81	0.18	0.00	0.00	0.00	1.00
Monitoring Well	12/6/2010	32						19	520	59	<2.0	<2.0	<5.0	--	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	1.00
BOP-73(i)	2/2/2011	90						37	1000	78	<1.0	--	--	--	0.45	-14.8	--	--	--	--	--	--	--	--	6.37	0.03	0.88	0.09	0.00	--	--	1.00
BOP-73(i)	5/5/2011	182						43	1200	42	<3.0	--	--	--	0.64	15.6	--	--	--	--	--	--	--	--	6.29	0.03	0.93	0.04	0.00	--	--	1.00
BOP-73(i)	8/10/2011	279						18	510	48	<1.0	<1.1	<1.2	<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	1.00
BOP-73(i)	11/3/2011	364						4.7	160	130	<1.0	--	--	--	0.10	-42.9	--	--	--	--	--	--	--	--	6.33	0.01	0.47	0.52	0.00	--	--	1.00
BOP-73(i)	12/1/2011	392	-27					5.0	180	120	<1.0	<1.1	<1.2	<1.1	--	--	--	--	--	--	9.5	--	0.759	1.93	6.71	0.01	0.52	0.47	0.00	0.00	0.00	1.00
BOP-73(i)	1/19/2012	441	22					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	--	--	1.00
BOP-73(i)	2/16/2012	469	50					4.0	190	59	24	<1.1	<1.2	<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	1.00
BOP-73(i)	3/15/2012	497	78					6.4	290	53	13	<1.1	<1.2	<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	1.00
BOP-73(i)	4/17/2012	530	111					26	1400	50	14	<1.1	<1.2	<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	1.00
BOP-73(i)	6/12/2012	586	167					72	2700	220	45	2.8	<1.2	<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	1.00
BOP-73(i)	8/9/2012	644	225	-7				2.2	180	190	13	--	--	--	--	--	--	--	--	--	--	--	--	219	--	0.00	0.39	0.55	0.06	--	--	1.00
BOP-73(i)	9/18/2012	684	265	33				41	1300	340	38	<5.0	<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	1.00
BOP-73(i)	11/14/2012	741	322	90				83	2900	110	2.6	<5.0	<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	1.00
BOP-73(i)	2/6/2013	825	406	174				13	390	77	4.7	<5.0	<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	1.00
BOP-73(i)	5/7/2013	915	496	264	-63			16	11000	6200	380	29	<5.0	<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	1.00
BOP-73(i)	8/6/2013	1006	587	355	28			6.5	1800	670	65	27	<5.0	<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	1.00
BOP-73(i)	11/7/2013	1099	680	448	121			<4.0	17000	7800	250	30	<5.0	<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	1.00
BOP-73(i)	2/20/2014	1204	785	553	226			<40	8400	13000	610	21	<5.0	<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	1.00
BOP-73(i)	5/8/2014	1281	862	630	303			<20	340	20000	5600	180	<5.0	<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	1.00
BOP-73(i)	8/13/2014	1378	959	727	400	28		<2.0	<2.0	2800	13000	730	<5.0	<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	1.00
BOP-73(i)	11/6/2014	1463	1044	812	485	113		<0.2	1.7	47	73	210	<5.0	<5.0	0.15	-108.1	<0.10	3.0	16.4	16.1	4.1	<2.0	5.6	11.9	6.41	0.00	0.00	0.05	0.13	0.82	0.00	1.00
BOP-73(i)	2/5/2015	1554	1135	903	576	204		<2.0	<2.0	340	720	340	7.1	<5.0			<0.10		19.3	17.1	1.1	<2.0	8.4	4.3		0.00	0.00	0.13	0.42	0.44	0.01	1.00
BOP-73(i)	5/6/2015	1644	1225	993	666	294	-44	<2.0	<2.0	150	730	160	<5.0	<5.0	1.08	-86.1	<0.10	5.0	22.6	19.5	1.4	<2.0	13	7.2	6.35	0.00	0.00	0.08	0.62	0.30	0.01	1.00
BOP-73(i)	8/10/2015	1740	1321	1089	762	390	52	<0.2	1.3	24	20	140	<5.0	<5.0	0.66	-200.4	<0.10	7.0	27.0	25.5	4.8	<2.0	12	28.4	6.27	0.00	0.00	0.04	0.06	0.90	0.00	1.00
BOP-73(i)	11/4/2015	1826	1407	1175	848	476	138	<0.2	5.8	92	19	8.7	9.9	<5.0	0.51	-79.6	<0.10	7.0	12.4	11.2	10.9	<2.0	7.5	5.1	6.36	0.00	0.02	0.49	0.16	0.16	0.17	1.00
BOP-74(i)	10/19/2010	-16						1.0	38	8.0	<1.0	<1.0	<2.0	--	--	--	0.9	--	--	--	9.1	--	0.1	<1.50		0.02	0.77	0.22	0.00	0.00	0.00	1.00
PRB Well	12/6/2010	32						<1.0	24	6.5	<1.0	<1.0	<2.0	--	3.07	53.3	0.2	0.2	--	--	9.9	--	--	2.79	6.61	0.00	0.73	0.27	0.00	--	--	1.00
BOP-74(i)	2/2/2011	90						2.6	44	3.8	<1.0	--	--	--	0.42	81.0	--	--	--	--	--	--	--	--	6.22	0.04	0.86	0.10	0.00	--	--	1.00
BOP-74(i)	5/5/2011	182						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	1.00
BOP-74(i)	8/10/2011	279						<1.0	8.9	7.2	<1.0	<1.1	<1.2	<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	--	--	1.00
BOP-74(i)	11/3/2011	364						<1.0	3.1	16	<1.0	--	--	--	0.10	-21.2	--	--	--	--	--	--	--	--	6.46	0.00	0.13	0.87	0.00	0.00	0.00	1.00
BOP-74(i)	12/1/2011	392	-27					<1.0	8.6	17	<1.0	<1.1	<1.2	<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	1.00
BOP-74(i)	1/19/2012	441	22					<1.0	11	18	<1.0	<1.1	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	1.00

TABLE 9
BIOREMEDIATION SUMMARY
FORMER VAPOR DEGREASER SOURCE CONTROL AREA
BOEING OF PORTLAND

Well	Date	Elapsed Time from Injections (a) (days)	Elapsed Time from Injection (b) (days)	Elapsed Time from Injection (c) (days)	Elapsed Time from Injection (d) (days)	Elapsed Time from Injection (e) (days)	Elapsed Time from Injection (f) (days)	Volatile Organic Compounds Analytical Results							Aquifer Redox Conditions									Donor Indicators		Molar Fraction					
		Pilot Injection	PRB 1st Injection	PRB 2nd Injection	Source Zone Wells 1st Injection	Source Zone Wells + PRB Injection	Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	CIS (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Iron, Tot (mg/L)	Iron, Diss (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	CIS	VC	Ethene	Ethane	Total
BOP-74(i)	2/16/2012	469	50					<1.0	2.4	44	1.6	<1.1	<1.2	<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	1.00
BOP-74(i)	3/15/2012	497	78					<1.0	1.4	210	3.2	<1.1	<1.2	<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	1.00
BOP-74(i)	4/17/2012	530	111					<5.0	<5.0	79	50	<1.1	<1.2	<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	1.00
BOP-74(i)	6/12/2012	586	167					<1.0	<1.0	1.2	14	<1.1	<1.2	<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	1.00
BOP-74(i)	8/9/2012	644	225	-7				<1.0	<1.0	<1.0	1.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--	1.00
BOP-74(i)	9/19/2012	685	266	34				<0.2	4.5	60	2.9	<5.0	<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	1.00
BOP-74(i)	11/14/2012	741	322	90				<0.2	0.6	6.9	18	<5.0	<7.0	<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	1.00
BOP-74(i)	2/6/2013	825	406	174				<0.2	0.5	1.7	2.9	<5.0	<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	1.00
BOP-74(i)	5/7/2013	915	496	264	-63			<0.2	4.0	2.7	1.8	<5.0	<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	1.00
BOP-74(i)	8/6/2013	1006	587	355	28			<0.2	0.6	14	8.1	<5.0	<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	1.00
BOP-74(i)	11/7/2013	1099	680	448	121			<0.2	<0.2	3.6	1.6	7.3	<5.0	<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	1.00
BOP-74(i)	2/20/2014	1204	785	553	226			<0.2	<0.2	2.4	0.9	<5.0	5.0	<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	1.00
BOP-74(i)	5/8/2014	1281	862	630	303	-69		<0.2	<0.2	2.8	3.3	5.9	<5.0	<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	1.00
BOP-74(i)	11/6/2014	1463	1044	812	485	113		<0.2	0.3	11	2.1	<5.0	<5.0	<5.0	0.12	-134.5	0.63	7.0	592	578	501	10.5	21	2860	4.16	0.00	0.02	0.76	0.22	0.00	0.00	1.00
BOP-74(i)	2/6/2015	1555	1136	904	577	205		<0.2	0.4	15	1.9	<5.0	<5.0	<5.0	0.23	-95.9	0.54	7.0	291	317	626	4.0	--	2230	4.86	0.00	0.02	0.82	0.16	0.00	0.00	1.00
BOP-74(i)	5/6/2015	1644	1225	993	666	294	-44	<0.2	0.5	15	1.6	<5.0	<5.0	<5.0	0.79	-107.6	0.27	7.0	228	226	247	9.0	21	1240	4.92	0.00	0.02	0.84	0.14	0.00	0.00	1.00
BOP-74(i)	11/4/2015	1826	1407	1175	848	476	138	<0.2	<0.2	5.3	2.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.54	0.46	0.00	0.00	1.00
BOP-75(i)	2/2/2011	90						2.5	87	11	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	0.84	0.14	0.00	--	--	1.00
Upgradient Well	5/5/2011	182						1.1	52	11	<1.0	--	--	--	--	--	--	--	--	--	13.5		--	4.77	--	0.01	0.77	0.22	0.00	--	--	1.00
BOP-75(i)	8/10/2011	279						1.6	59	11	<1.0	<1.1	<1.2	<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	1.00
BOP-75(i)	11/3/2011	364	-55					1.2	58	10	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01	0.80	0.19	0.00	--	--	1.00
BOP-75(i)	2/8/2012	461	42					1.3	55	9.7	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01	0.80	0.19	0.00	--	--	1.00
BOP-75(i)	5/4/2012	547	128					<1.0	52	10	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.79	0.21	0.00	--	--	1.00
BOP-75(i)	8/9/2012	644	225	-7				1.6	39	7.2	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.03	0.78	0.20	0.00	--	--	1.00
BOP-75(i)	11/8/2012	735	316	84				1.0	35	6.9	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	0.78	0.21	0.00	--	--	1.00
BOP-75(i)	2/5/2013	824	405	173				1.0	54	9.5	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01	0.80	0.19	0.00	--	--	1.00
BOP-75(i)	5/2/2013	910	491	259				0.8	42	7.5	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01	0.80	0.19	0.00	--	--	1.00
BOP-75(i)	6/17/2013	956	537	305	-22			0.7	35	9.8	<0.2	<5.0	<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	1.00
BOP-75(i)	8/6/2013	1006	587	355	28			0.2	1.3	37	0.2	<5.0	<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	1.00
BOP-75(i)	11/7/2013	1099	680	448	121			<0.2	2.2	2.4	25	<5.0	<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	1.00
BOP-75(i)	2/5/2014	1189	770	538	211			<0.2	2.6	1.3	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.06	0.04	0.90	--	--	1.00
BOP-75(i)	5/7/2014	1280	861	629	302	-70		<0.2	7.4	2.7	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.18	0.09	0.73	--	--	1.00
BOP-75(i)	8/13/2014	1378	959	727	400	28		<0.2	6.2	9.5	10	<5.0	<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	1.00
BOP-75(i)	11/5/2014	1462	1043	811	484	112		<0.2	<0.2	4.3	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.20	0.80	--	--	1.00
BOP-75(i)	2/6/2015	1555	1136	904	577	205		<0.2	9.1	8.6	4.2	<5.0	<5.0	<5.0	0.26	-117.3	<0.10	--	12.4	10.8	3.4	<2.0	--	3.9	6.11	0.00	0.31	0.39	0.30	--	--	1.00
BOP-75(i)	5/4/2015	1642	1223	991	664	292	-46	<0.2	13	6.4	4.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.42	0.28	0.29	--	--	1.00
BOP-75(i)	8/10/2015	1740	1321	1089	762	390	52	<0.2	1.5	4.2	3.3	<5.0	<5.0	<5.0	0.50	-217.3	<0.10	7.0	196	189	255	10.4	15	1170.0	5.3	0.00	0.11	0.40	0.49	--	--	1.00
BOP-75(i)	11/6/2015	1828	1409	1177	850	478	140	<0.2	0.4	4.7	4.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.03	0.41	0.57	--	--	1.00
BOP-76(i)	2/2/2011	90						1.7	8.5	<1.0	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.14	0.86	0.00	0.00	--	--	1.00
Monitoirng Well	5/5/2011	182						<1.0	6.8	1.2	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.81	0.19	0.00	--	--	1.00
BOP-76(i)	8/10/2011	279						1.2	13	4.6	<1.0	<1.1	<1.2	<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	1.00
BOP-76(i)	11/3/2011	364	-55					1.4	27	1.6	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.04	0.89	0.07	0.00	--	--	1.00
BOP-76(i)	2/8/2012	461	42					<1.0	2.1	<1.0	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--	1.00
BOP-76(i)	5/4/2012	547	128					<1.0	9.2	1.5	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.82	0.18	0.00	--	--	1.00
BOP-76(i)	8/9/2012	644	225	-7				1.1	33	2.2	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	0.90	0.08	0.00	--	--	1.00
BOP-76(i)	11/8/2012	735	316	84				0.8	9.8	1.7	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	0.77	0.18	0.00	--	--	1.00
BOP-76(i)	2/5/2013	824	405	173				0.8	11	1.5	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	0.80	0.15	0.00	--	--	1.00
BOP-76(i)	5/2/2013	910	491	259				1.4	22	1.7	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.04	0.87	0.09	0.00	--	--	1.00
BOP-76(i)	6/17/2013	956	537	305	-22			1.1	26	1.9	<0.2	<5.0	<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	1.00
BOP-76(i)	8/6/2013	1006	587	355	28			<0.2	1.0	100	8.3	<5.0	<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	1.00
BOP-76(i)	11/7/2013	1099	680	448	121			2.4	140	37	42	<5.0	<5.0	<5.0	1.51	-204.2	<0.10	3.5	--	--	3.5	--	11.0	6.9	6.44	0.01	0.50	0.18	0.31	0.00	0.00	1.00
BOP-76(i)	2/5/2014	1189	770	538	211			1.0	45	5.8	8.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01	0.63	0.11	0.25	--	--	1.00
BOP-76(i)	5/7/2014	1280	861	629	302	-70		<0.2	7.2	1.2	4.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.39	0.09	0.52	--	--	1.00
BOP-76(i)	8/13/2014	1378	959	727	400	28		0.3	13	24	4.1	<5.0	<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	1.00
BOP-76(i)	11/6/2014	1463	1044	812	485	113		<0.2	1.4	9.5	2.1	15	<5.0	<5.0	0.20	-104.7	0.20	1.5	14.4	14.5	3.2	<2.0	21	51.2	5.88	0.00	0.02	0.14	0.05	0.79	0.00	1.00
BOP-76(i)	2/5/2015	1554	1135	903	576	204		<0.2	1.0	7.0	2.2	30	<5.0	<5.0			0.21		10.1	8.99	5.1	<2.0	19	12.7		0.00	0.01	0.06	0.03	0.90	0.00	1.00
BOP-76(i)	5/7/2015	1645	1226	994	667	295	-43	<0.2	0.6	6.6	3.9	<5.0	<5.0	<5.0	1.52	-124.1	<0.10	4.0	17.0	14	5.5	2.2	20	7.5	6.14	0.00	0.03	0.50	0.46	0.00	0.00	1.00
BOP-76(i)	8/10/2015	1740	1321	1089	762	390	52	<0.2	2.2	14	2.0	<5.0	<5.0	<5.0	0.43	-190.8	<0.10	7.0	126.0	121	108	6.00	12	659	5.54	0.00	0.09	0.75	0.17	0.00	0.00	1.00
BOP-76(i)	11/4/2015	1826	1407	1175	848	476	138	<0.2	0.9	14	2.0	<5.0	<5.0	<5.0	0.83	-86.1	<0.10	7.0	26.2	28'	4.0	2.7	15	115	6.15	0.00	0.04	0.79	0.17	0.00	0.00	1.00

TABLE 9
BIOREMEDIATION SUMMARY
FORMER VAPOR DEGREASER SOURCE CONTROL AREA
BOEING OF PORTLAND

Well	Date	Elapsed Time from Injections (a) (days)	Elapsed Time from Injection (b) (days)	Elapsed Time from Injection (c) (days)	Elapsed Time from Injection (d) (days)	Elapsed Time from Injection (e) (days)	Elapsed Time from Injection (f) (days)	Volatile Organic Compounds Analytical Results							Aquifer Redox Conditions									Donor Indicators		Molar Fraction						
		Pilot Injection	PRB 1st Injection	PRB 2nd Injection	Source Zone Wells 1st Injection	Source Zone Wells + PRB Injection	Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	CIS (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Iron, Tot (mg/L)	Iron, Diss (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	CIS	VC	Ethene	Ethane	Total
BOP-77(i)	2/2/2011	90						1.7	88	2.7	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01	0.95	0.04	0.00	--	--	1.00
Monitoring Well	5/5/2011	182						<1.0	41	3.8	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.89	0.11	0.00	--	--	1.00
BOP-77(i)	8/10/2011	279						1.8	17	1.6	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.07	0.83	0.11	0.00	--	--	1.00
BOP-77(i)	11/3/2011	364	-55					<1.0	11	6.7	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.55	0.45	0.00	--	--	1.00
BOP-77(i)	12/1/2011	392	-27					1.1	32	7.1	<1.0	<1.1	<1.2	<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	1.00
BOP-77(i)	12/28/2011	419	0					--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12100	--	--	--	--	--	--	--	0.00
BOP-77(i)	12/28/2011	419	0					--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13800	--	--	--	--	--	--	--	0.00
BOP-77(i)	1/19/2012	441	22					<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	--	--	1.00
BOP-77(i)	2/16/2012	469	50					<1.0	8.4	48	1.8	<1.1	<1.2	<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	1.00
BOP-77(i)	3/15/2012	497	78					<1.0	2.2	120	4.6	<1.1	<1.2	<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	1.00
BOP-77(i)	4/17/2012	530	111					<3.0	<3.0	21	62	<1.1	<1.2	<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	1.00
BOP-77(i)	6/12/2012	586	167					<1.0	1.4	1.2	60	<1.1	<1.2	<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	1.00
BOP-77(i)	8/9/2012	644	225					<1.0	<1.0	<1.0	59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--	1.00
BOP-77(i)	8/16/2012	651	232					--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	23,800	--	--	--	--	--	--	--	--
BOP-77(i)	9/18/2012	684	265	33				<4.0	<4.0	28	4.1	<5.0	<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	1.00
BOP-77(i)	11/14/2012	741	322	90				<0.2	17	150	15	<5.0	<6.0	<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	1.00
BOP-77(i)	2/6/2013	825	406	174				<0.4	11	31	3.2	5.5	<5.0	<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	1.00
BOP-77(i)	5/7/2013	915	496	264	-63			<0.2	18	17	11	13	<5.0	<5.0	1.52	-74.9	<0.10	2.5	--	--	<1.0	--	23	112	6.15	0.00	0.14	0.18	0.18	0.49	0.00	1.00
BOP-77(i)	8/6/2013	1006	587	355	28			<0.2	0.7	14	13	8.6	<5.0	<5.0	1.14	-44.3	<0.10	3.5	--	--	<1.0	--	17	888	5.38	0.00	0.01	0.22	0.31	0.46	0.00	1.00
BOP-77(i)	11/7/2013	1099	680	448	121			<0.2	<0.2	9.5	19	22	<5.0	<5.0	0.91	-106.7	<0.10	3.5	--	--	<1.0	--	20	111	6.21	0.00	0.00	0.08	0.26	0.66	0.00	1.00
BOP-77(i)	2/20/2014	1204	785	553	226			<0.2	2.7	6.1	7.6	22	<5.0	<5.0	1.14	-8.9	<0.10	3.5	--	--	<1.0	--	19	40	6.29	0.00	0.02	0.06	0.12	0.79	0.00	1.00
BOP-77(i)	5/8/2014	1281	862	630	303	-69		<0.2	0.2	5.1	14	58	6.4	<5.0	0.76	-16.4	<0.10	3.0	--	--	<1.0	--	23	36.4	6.41	0.00	0.00	0.02	0.09	0.81	0.08	1.00
BOP-77(i)	8/13/2014	1378	959	727	400	28		<0.2	0.6	81	17	24	<5.0	<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	1.00
BOP-77(i)	11/6/2014	1463	1044	812	485	113		<0.2	2.7	200	24	63	<5.0	<5.0	0.17	-165.8	<0.50	7.0	961	981	1850	11.3	22	4920	4.13	0.00	0.00	0.44	0.08	0.48	0.00	1.00
BOP-77(i)	2/6/2015	1555	1136	904	577	205		<0.2	4.2	120	24	58	<5.0	<5.0	0.83	-38.7	<0.50	7.0	727	596	855	4.0	--	4330	4.78	0.00	0.01	0.33	0.10	0.56	0.00	1.00
BOP-77(i)	5/6/2015	1644	1225	993	666	294	-44	<0.2	6.2	220	20	47	5.6	<5.0	0.98	-85.9	1.0	7.0	541	536	519	9.5	19	3030	4.84	0.00	0.01	0.50	0.07	0.37	0.04	1.00
BOP-77(i)	8/10/2015	1740	1321	1089	762	390	52	<0.2	6.2	86	11	75	6.8	<5.0	0.94	-73.3	<1.0	7.0	2120	2080	3830	4.1	15	9110	4.30	0.00	0.01	0.22	0.04	0.67	0.06	1.00
BOP-77(i)	11/4/2015	1826	1407	1175	848	476	138	<0.2	8.2	72	13	22	5.1	<5.0	0.59	34.5	<5.0	7.0	1580	1510	2860	12.3	15	6350	4.55	0.00	0.03	0.38	0.11	0.40	0.09	1.00
BOP-78(i)	11/21/2011	382	-37					1.7	37	6.1	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.03	0.79	0.18	0.00	--	--	1.00
Injection Well	8/9/2012	644	225	-7				1.1	30	9.3	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	0.69	0.29	0.00	--	--	1.00
BOP-78(i)	11/8/2012	735	316	84				<0.2	0.3	7.2	51	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.08	0.91	--	--	1.00
BOP-78(i)	2/6/2013	825	406	174				<0.2	0.3	11	78	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.08	0.92	--	--	1.00
BOP-78(i)	5/2/2013	910	491	259	-68			<0.2	0.3	0.6	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.02	0.97	--	--	1.00
BOP-78(i)	8/7/2013	1007	588	356	29			0.2	5.5	120	98	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.43	0.55	--	--	1.00
BOP-78(i)	11/8/2013	1100	681	449	122			<0.2	<0.2	1.1	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.04	0.96	--	--	1.00
BOP-78(i)	2/5/2014	1189	770	538	211			<0.2	1.0	1.3	3.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.11	0.19	0.70	--	--	1.00
BOP-78(i)	5/7/2014	1280	861	629	302	-70		<0.2	3.6	2.7	1.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.33	0.34	0.33	--	--	1.00
BOP-78(i)	11/5/2014	1462	1043	811	484	112		<0.2	1.7	23	2.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.81	0.14	--	--	1.00
BOP-78(i)	2/5/2015	1554	1135	903	576	204		<0.2	3.2	12	1.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.14	0.70	0.16	--	--	1.00
BOP-78(i)	5/4/2015	1642	1223	991	664	292	-46	<0.2	1.0	7.8	2.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.06	0.64	0.30	--	--	1.00
BOP-78(i)	11/6/2015	1828	1409	1177	850	478	140	<0.2	0.2	3.1	1.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.03	0.57	0.40	--	--	1.00
BOP-79(i)	11/21/2011	382	-37					1.8	42	5.0	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.03	0.84	0.13	0.00	--	--	1.00
Injection Well	8/9/2012	644	225	-7				2.2	95	12	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	0.84	0.14	0.00	--	--	1.00
BOP-79(i)	11/8/2012	735	316	84				<0.2	0.2	3.7	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.03	0.96	--	--	1.00
BOP-79(i)	2/6/2013	825	406	174				<0.2	0.2	0.6	5.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.06	0.92	--	--	1.00
BOP-79(i)	5/2/2013	910	491	259	-68			<0.2	0.4	24	41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.27	0.72	--	--	1.00
BOP-79(i)	8/7/2013	1007	588	356	29			<0.2	1.0	37	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.54	0.45	--	--	1.00
BOP-79(i)	11/8/2013	1100	681	449	122			<0.2	1.9	13	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.33	0.63	--	--	1.00
BOP-79(i)	2/5/2014	1189	770	538	211			<0.2	3.4	17	7.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.08	0.55	0.36	--	--	1.00
BOP-79(i)	5/7/2014	1280	861	629	302	-70		0.9	58	43	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.39	0.39	0.21	--	--	1.00
BOP-79(i)	11/7/2014	1464	1045	813	486	114		<0.2	1.5	21	5.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.68	0.28	--	--	1.00
BOP-79(i)	2/5/2015	1554	1135	903	576	204		<0.2	2.1	10	3.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.09	0.57	0.34	--	--	1.00
BOP-79(i)	5/4/2015	1642	1223	991	664	292	-46	<0.2	0.4	2.2	2.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.05	0.39	0.55	--	--	1.00
BOP-79(i)	11/6/2015	1828	1409	1177	850	478	140	<0.2	0.5	8.6	4.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.55	0.43	--	--	1.00

TABLE 9
BIOREMEDIATION SUMMARY
FORMER VAPOR DEGREASER SOURCE CONTROL AREA
BOEING OF PORTLAND

Well	Date	Elapsed Time from Injections (a) (days)	Elapsed Time from Injection (b) (days)	Elapsed Time from Injection (c) (days)	Elapsed Time from Injection (d) (days)	Elapsed Time from Injection (e) (days)	Elapsed Time from Injection (f) (days)	Volatile Organic Compounds Analytical Results							Aquifer Redox Conditions									Donor Indicators		Molar Fraction						
		Pilot Injection	PRB 1st Injection	PRB 2nd Injection	Source Zone Wells 1st Injection	Source Zone Wells + PRB Injection	Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	CIS (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Iron, Tot (mg/L)	Iron, Diss (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	CIS	VC	Ethene	Ethane	Total
BOP-80(i)	11/21/2011	382						<1.0	2.4	7.0	7.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.09	0.36	0.55	--	--	1.00
Downgradient Well	12/1/2011	392	-27					<1.0	15	6.1	5.3	2.9	<1.2	<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	1.00
BOP-80(i)	1/9/2012	431	12					<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	--	--	1.00
BOP-80(i)	2/16/2012	469	50					<1.0	<1.0	<1.0	<1.0	<1.1	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	1.00
BOP-80(i)	3/15/2012	497	78					<1.0	<1.0	<1.0	1.7	1.6	2.4	<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	1.00
BOP-80(i)	4/17/2012	530	111					<1.0	<1.0	<1.0	<1.0	<1.1	<1.2	<1.1	0.28	-263.4	<0.1	3.6	--	--	1.0	--	12.8	2.89	7.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOP-80(i)	6/12/2012	586	167	-65				<1.0	<1.0	<1.0	1.7	2.9	4.4	<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	1.00
BOP-80(i)	9/18/2012	684	265	33				2.0	160	35	14	<5.0	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	1.00
BOP-80(i)	11/14/2012	741	322	90				3.0	610	240	33	<5.0	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	1.00
BOP-80(i)	2/6/2013	825	406	174				<0.2	1.4	<0.2	0.4	<5.0	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	1.00
BOP-80(i)	5/9/2013	917	498	266	-61			<0.2	0.8	<0.2	0.7	<5.0	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	1.00
BOP-80(i)	8/19/2013	1019	600	368	41			<0.2	<0.2	<0.2	0.4	<5.0	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	1.00
BOP-80(i)	11/11/2013	1103	684	452	125			<0.2	<0.2	<0.2	0.2	<5.0	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	1.00
BOP-80(i)	2/21/2014	1205	786	554	227			2.7	23	0.4	<0.2	<5.0	<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	1.00
BOP-80(i)	5/7/2014	1280	861	629	302	-70		<0.2	2.0	<0.2	<0.2	<0.5	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	1.00
BOP-80(i)	8/14/2014	1379	960	728	401	29		<0.2	0.5	1.1	3.1	<5.0	9.0	<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	1.00
BOP-80(i)	11/6/2014	1463	1044	812	485	113		0.8	65	360	63	<5.0	<5.0	<5.0	0.45	-74.0	<0.10	2.5	11.8	4.21	10.9	<2.0	2.9	1.4	6.82	0.00	0.09	0.71	0.19	0.00	0.00	1.00
BOP-80(i)	2/6/2015	1555	1136	904	577	205		<0.2	<0.2	<0.2	0.3	<5.0	5.6	<5.0	0.30	-121.9	<0.10	7.0	12.5	12.6	1.4	<2.0	15	2.7	6.17	0.00	0.00	0.00	0.03	0.00	0.97	1.00
BOP-80(i)	5/6/2015	1644	1225	993	666	294	-44	<0.2	<0.2	0.2	0.6	<5.0	15	<5.0	1.54	-73.2	<0.10	4.0	18.0	11.9	<1.0	<2.0	21	2.4	6.29	0.00	0.00	0.00	0.02	0.00	0.98	1.00
BOP-80(i)	8/10/2015	1740	1321	1089	762	390	52	3.0	91	430	11	<5.0	<5.0	<5.0	0.30	-171.0	<0.10	7.0	10.0	5.59	8.2	<2.0	3.6	1.6	6.30	0.00	0.13	0.83	0.03	0.00	0.00	1.00
BOP-80(i)	11/4/2015	1826	1407	1175	848	476	138	<0.2	<0.2	0.5	2.1	<5.0	8.9	<5.0	1.20	-58.7	<0.10	7.0	15.6	11.9	1.6	<2.0	20	2.3	6.35	0.00	0.00	0.02	0.10	0.00	0.88	1.00
BOP-81(i)	11/21/2011	382						<1.0	<1.0	1.6	6.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.14	0.86	0.00	0.00	1.00
Downgradient Well	12/1/2011	392	-27					<1.0	<1.0	1.0	4.1	2.0	2.2	<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	1.00
BOP-81(i)	12/28/2011	419	0					--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.71	--	--	--	--	--	--	--	0.00
BOP-81(i)	1/9/2012	431	12					<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	1.00
BOP-81(i)	2/16/2012	469	50					<1.0	<1.0	<1.0	<1.0	<1.1	<1.2	<1.1	0.23	-242.8	<0.1	1.9	--	--	0.5	--	16.4	3.26	7.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOP-81(i)	3/15/2012	497	78					<1.0	<1.0	<1.0	<1.0	<1.1	<1.2	<1.1	0.31	-245.8	0.1	2.7	--	--	0.3	--	24.7	3.00	6.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOP-81(i)	4/17/2012	530	111					<1.0	<1.0	<1.0	<1.0	<1.1	<1.2	<1.1	0.28	-270.8	<0.1	2.6	--	--	0.2	--	23.4	2.51	6.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOP-81(i)	6/12/2012	586	167	-65				<1.0	<1.0	<1.0	<1.0	<1.1	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	1.00
BOP-81(i)	8/16/2012	651	232	0				--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.2		--	--	--	--	--	--	--
BOP-81(i)	9/18/2012	684	265	33				<0.2	<0.2	<0.2	0.6	<5.0	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	1.00
BOP-81(i)	11/14/2012	741	322	90				<0.2	<0.2	<0.2	0.5	<5.0	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	1.00
BOP-81(i)	2/6/2013	825	406	174				<0.2	<0.2	<0.2	<0.2	<5.0	<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	ND
BOP-81(i)	5/9/2013	917	498	266	-61			<0.2	0.3	<0.2	0.5	<5.0	<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	1.00
BOP-81(i)	8/19/2013	1019	600	368	41			<0.2	<0.2	<0.2	0.9	<5.0	<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	1.00
BOP-81(i)	11/11/2013	1103	684	452	125			<0.2	<0.2	<0.2	0.4	<5.0	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	1.00
BOP-81(i)	2/21/2014	1205	786	554	227			0.6	0.6	<0.2	<0.2	<5.0	<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	1.00
BOP-81(i)	5/7/2014	1280	861	629	302	-70		<0.2	0.2	<0.2	<0.2	<5.0	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	1.00
BOP-81(i)	8/14/2014	1379	960	728	401	29		<0.2	<0.2	<0.2	0.4	<5.0	6.0	<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	1.00
BOP-81(i)	11/6/2014	1463	1044	812	485	113		<0.2	<0.2	<0.2	0.3	<5.0	11	<5.0	0.50	-85.6	<0.10	2.5	21.4	10.9	<1.0	<2.0	25.0	1.5	6.33	0.00	0.00	0.00	0.01	0.00	0.99	1.00
BOP-81(i)	2/6/2015	1555	1136	904	577	205		<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	<5.0	0.10	-128.8	<0.10	5.0	10.1	3.71	6.7	<2.0	20.0	1.0	6.34	ND	ND	ND	ND	ND	ND	ND
BOP-81(i)	5/6/2015	1644	1225	993	666	294	-44	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	<5.0	0.82	-74.0	<0.10	7.0	11.6	4.58	2.5	<2.0	22.0	<1.0	6.33	ND	ND	ND	ND	ND	ND	ND
BOP-81(i)	8/11/2015	1741	1322	1090	763	391	53	<0.2	<0.2	0.6	1.2	<5.0	<5.0	<5.0	1.49	-130.0	0.14	7.0	33.5	9.9	4.2	<2.0	13.0	1.6	6.19	ND	ND	0.24	0.76	ND	ND	ND
BOP-81(i)	11/4/2015	1826	1407	1175	848	476	138	<0.2	<0.2	0.3	0.7	<5.0	5.4	<5.0	0.54	-42.6	<0.10	6.5	29.2	10.5	1.7	<2.0	20.0	1.6	6.34	0.00	0.00	0.02	0.06	0.00	0.93	ND
BOP-82(i)	11/21/2011	382						4.6	91	1.6	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.04	0.94	0.02	0.00	--	--	1.00
Downgradient Well	12/1/2011	392	-27					4.0	66	1.4	<1.0	<1.1	<1.2	<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	1.00
BOP-82(i)	12/28/2011	419	0					--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.12	--	--	--	--	--	--	--	0.00
BOP-82(i)	1/9/2012	431	12					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	--	--	1.00
BOP-82(i)	2/16/2012	469	50					1.9	38	6.8	<1.0	<1.1	<1.2	<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	1.00
BOP-82(i)	3/15/2012	497	78					2.0	36	11	<1.0	<1.1	<1.2	<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	1.00
BOP-82(i)	4/17/2012	530	111					1.6	29	4.5	<1.0	<1.1	<1.2	<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	1.00
BOP-82(i)	6/12/2012	586	167	-65				1.3	24	2.5	<1.0	<1.1	<1.2	<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	1.00
BOP-82(i)	8/16/2012	651	232	0				--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.6		--	--	--	--	--	--	--
BOP-82(i)	9/18/2012	684	265	33				1.0	19	1.6	0.5	<5.0	<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	1.00
BOP-82(i)	11/14/2012	741	322	90				1.6	24	1.6	0.3	<5.0	<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	1.00
BOP-82(i)	2/6/2013	825	406	174				1.5	15	1.8	0.4	<5.0	<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	1.00
BOP-82(i)	5/6/2013	914	495	263	-64			1.1	17	0.9	0.3	<5.0	<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	1.00
BOP-82(i)	8/19/2013	1019	600	368	41			1.4	19	0.5	<0.2	<5.0	<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	1.00
BOP-82(i)	11/7/2013	1099	680	448	121			1.1	17	0.5	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	0.92	0.04	0.00	--	--	1.00
BOP-82(i)	2/21/2014	1205	786	554	227			1.0	14	0.4	<0.2	<5.0	<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	1.00
BOP-82(i)	5/7/2014	1280	861	629	302	-70		0.7	12	0.5	<0.2	<5.0	<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	1.00
BOP-82(i)	8/14/2014	1379	960	728	401	29		1.0	12	0.6	<0.2	<5.0	<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	1.00

TABLE 9
BIOREMEDIATION SUMMARY
FORMER VAPOR DEGREASER SOURCE CONTROL AREA
BOEING OF PORTLAND

Well	Date	Elapsed Time from Injections (a) (days)	Elapsed Time from Injection (b) (days)	Elapsed Time from Injection (c) (days)	Elapsed Time from Injection (d) (days)	Elapsed Time from Injection (e) (days)	Elapsed Time from Injection (f) (days)	Volatile Organic Compounds Analytical Results							Aquifer Redox Conditions										Donor Indicators		Molar Fraction					
		Pilot Injection	PRB 1st Injection	PRB 2nd Injection	Source Zone Wells 1st Injection	Source Zone Wells + PRB Injection	Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	CIS (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Iron, Tot (mg/L)	Iron, Diss (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	CIS	VC	Ethene	Ethane	Total
BOP-82(i)	11/7/2014	1464	1045	813	486	114		0.6	8.1	2.7	0.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.03	0.59	0.27	0.11	--	--	1.00
BOP-82(i)	2/6/2015	1555	1136	904	577	205		0.7	11	1.7	0.5	<5.0	<5.0	<5.0	0.68	-62.7	0.36	3.0	8.96	2.09	13.2	<2.0	3.0	1.8	6.25	0.04	0.74	0.15	0.07	--	--	1.00
BOP-82(i)	5/4/2015	1642	1223	991	664	292	-46	0.7	9.7	1.3	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	0.81	0.15	0.00	--	--	1.00
BOP-82(i)	8/11/2015	1741	1322	1090	763	391	53	0.6	8.6	1.4	0.6	<5.0	<5.0	<5.0	1.06	-186.1	<0.10	7.0	6.87	4.67	5.5	<2.0	7.5	9.5	6.26	0.04	0.70	0.16	0.10	0.00	0.00	1.00
BOP-82(i)	11/6/2015	1828	1409	1177	850	478	140	0.3	6.0	2.5	1.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	0.49	0.28	0.21	0.00	0.00	1.00
BOP-83(i)	11/21/2011	382						<1.0	31	<1.0	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--	1.00
Downgradient Well	12/1/2011	392	-27					<1.0	16	<1.0	<1.0	<1.1	<1.2	<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	1.00
BOP-83(i)	12/28/2011	419	0					--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.87	--	--	--	--	--	--	--	0.00
BOP-83(i)	1/9/2012	431	12					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	--	--	1.00
BOP-83(i)	2/16/2012	469	50					2.6	58	2.5	<1.0	<1.1	<1.2	<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	1.00
BOP-83(i)	3/15/2012	497	78					1.1	19	<1.0	<1.0	<1.1	<1.2	<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	1.00
BOP-83(i)	4/17/2012	530	111					<1.0	7.3	<1.0	<1.0	<1.1	<1.2	<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	1.00
BOP-83(i)	6/12/2012	586	167	-65				<1.0	3.1	<1.0	<1.0	<1.1	<1.2	<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	1.00
BOP-83(i)	8/16/2012	651	232	0				--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1.0	--	--	--	--	--	--	--	--
BOP-83(i)	9/18/2012	684	265	33				0.5	9.7	0.3	<0.2	<5.0	<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	1.00
BOP-83(i)	11/14/2012	741	322	90				<0.2	5.3	<0.2	<0.2	<5.0	<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	1.00
BOP-83(i)	2/6/2013	825	406	174				1.2	21	0.9	<0.2	<5.0	<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	1.00
BOP-83(i)	5/6/2013	914	495	263	-64			0.8	14	0.6	<0.2	<5.0	<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	1.00
BOP-83(i)	8/22/2013	1022	603	371	44			<0.2	3.4	<0.2	<0.2	<5.0	<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	1.00
BOP-83(i)	11/7/2013	1099	680	448	121			<0.2	2.4	<0.2	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--	1.00
BOP-83(i)	2/21/2014	1205	786	554	227			<0.2	2.3	<0.2	<0.2	<5.0	<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	1.00
BOP-83(i)	5/7/2014	1280	861	629	302	-70		0.4	5.7	0.4	<0.2	<5.0	<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	1.00
BOP-83(i)	8/14/2014	1379	960	728	401	29		<0.2	2.2	<0.2	<0.2	<5.0	<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	1.00
BOP-83(i)	11/11/2014	1468	1049	817	490	118		<0.2	2.1	<0.2	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--	1.00
BOP-83(i)	2/6/2015	1555	1136	904	577	205		0.4	12	1.0	<0.2	<5.0	<5.0	<5.0	7.69	52.6	3.6	0.0	11.9	<0.400	8.9	<2.0	0.38	<1.0	6.35	0.02	0.88	0.10	0.00	--	--	1.00
BOP-83(i)	5/4/2015	1642	1223	991	664	292	-46	<0.2	2.0	<0.2	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--	1.00
BOP-83(i)	8/11/2015	1741	1322	1090	763	391	53	<0.2	2.0	<0.2	<0.2	<5.0	<5.0	<5.0	7.66	50.1	4.2	0.5	30.0	1.22	10	<2.0	0.1	<1.0	6.47	0.00	1.00	0.00	0.00	--	--	1.00
BOP-83(i)	11/6/2015	1828	1409	1177	850	478	140	<0.2	1.9	<0.2	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--	1.00
BOP-84(i)	2/8/2012	461	42					<1.0	7.1	55	1.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.08	0.88	0.03	--	--	1.00
Injection Well	5/4/2012	547	128					<1.0	<1.0	1.8	150	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.01	0.99	--	--	1.00
BOP-84(i)	6/12/2012	586	167					<1.0	<1.0	1.2	14	13.6	<1.2	<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	1.00
BOP-84(i)	8/9/2012	644	225	-7				<1.0	<1.0	1.3	8.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.09	0.91	--	--	1.00
BOP-84(i)	8/16/2012	651	232	0				--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BOP-84(i)	9/19/2012	685	266	34				<0.4	4.1	69	2.9	<5.0	<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	1.00
BOP-84(i)	11/8/2012	735	316	84				<0.2	0.5	11	35	<5.0	5.7	<5.0	--	--	<0.10	--	--	--	<1.0	--	22	276		0.00	0.00	0.13	0.65	0.00	0.22	1.00
BOP-84(i)	11/9/2012	736	317	85				--	--	--	--	--	--	--	0.81	131.2	--	3.0	--	--	--	--	--	--	6.36	--	--	--	--	--	--	--
BOP-84(i)	2/5/2013	824	405	173				<0.2	0.5	0.7	2.3	<5.0	<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	1.00
BOP-84(i)	5/6/2013	914	495	263	-64			<0.2	0.4	0.5	1.6	<5.0	<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	1.00
BOP-84(i)	8/7/2013	1007	588	356	29			<0.2	2.2	18	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.42	0.54	--	--	1.00
BOP-84(i)	11/8/2013	1100	681	449	122			<0.2	0.7	3.3	1.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.09	0.57	0.35	--	--	1.00
BOP-84(i)	2/5/2014	1189	770	538	211			<0.2	0.2	2.5	0.6	<5.0	<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	1.00
BOP-84(i)	5/8/2014	1281	862	630	303	-69		<0.2	<0.2	2.0	1.9	7.4	<5.0	<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	1.00
BOP-84(i)	11/7/2014	1464	1045	813	486	114		<0.2	<0.2	8.0	2.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.64	0.36	--	--	1.00
BOP-84(i)	2/3/2015	1552	1133	901	574	202		<0.2	0.5	15	3.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.73	0.26	--	--	1.00
BOP-84(i)	5/4/2015	1642	1223	991	664	292	-46	<0.2	0.3	8.9	3.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.64	0.35	--	--	1.00
BOP-84(i)	11/6/2015	1828	1409	1177	850	478	140	<0.2	<0.2	2.8	2.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.46	0.54	--	--	1.00
BOP-85(i)	2/8/2012	461	42					1.6	33	6.5	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.03	0.77	0.20	0.00	--	--	1.00
Injection Well	5/4/2012	547	128					<1.0	29	6.5	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.77	0.23	0.00	--	--	1.00
BOP-85(i)	8/9/2012	644	225	-7				1.2	32	5.7	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	0.79	0.19	0.00	--	--	1.00
BOP-85(i)	11/8/2012	735	316	84				0.9	20	4.3	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.03	0.75	0.22	0.00	--	--	1.00
BOP-85(i)	2/6/2013	825	406	174				0.8	37	7.0	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01	0.79	0.20	0.00	--	--	1.00
BOP-85(i)	5/2/2013	910	491	259	-68			1.1	30	5.8	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	0.77	0.20	0.00	--	--	1.00
BOP-85(i)	8/7/2013	1007	588	356	29			0.5	1.5	22	0.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01	0.04	0.89	0.05	--	--	1.00
BOP-85(i)	11/8/2013	1100	681	449	122			<0.2	0.2	2.4	2.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.03	0.41	0.56	--	--	1.00
BOP-85(i)	2/5/2014	1189	770	538	211			<0.2	<0.2	<0.2	1.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--	1.00
BOP-85(i)	5/7/2014	1280	861	629	302	-70		<0.2	<0.2	<0.2	1.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--	1.00
BOP-85(i)	11/5/2014	1462	1043	811	484	112		<0.2	1.6	3.4	0.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.23	0.65	0.12	--	--	1.00
BOP-85(i)	2/3/2015	1552	1133	901	574	202		<0.2	1.4	5.2	0.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.15	0.78	0.07	--	--	1.00
BOP-85(i)	5/4/2015	1642	1223	991	664	292	-46	<0.2	0.8	5.1	0.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.09	0.81	0.10	--	--	1.00
BOP-85(i)	11/6/2015	1828	1409	1177	850	478	140	<0.2	<0.2	0.4	0.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.46	0.54	--	--	1.00

TABLE 9
BIOREMEDIATION SUMMARY
FORMER VAPOR DEGREASER SOURCE CONTROL AREA
BOEING OF PORTLAND

Well	Date	Elapsed Time from Injections (a) (days)	Elapsed Time from Injection (b) (days)	Elapsed Time from Injection (c) (days)	Elapsed Time from Injection (d) (days)	Elapsed Time from Injection (e) (days)	Elapsed Time from Injection (f) (days)	Volatile Organic Compounds Analytical Results							Aquifer Redox Conditions										Donor Indicators		Molar Fraction						
		Pilot Injection	PRB 1st Injection	PRB 2nd Injection	Source Zone Wells 1st Injection	Source Zone Wells + PRB Injection	Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	CIS (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Iron, Tot (mg/L)	Iron, Diss (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Methane (mg/L)	TOC (mg/L)	pH	PCE	TCE	CIS	VC	Ethene	Ethane	Total
BOP-86(i)	2/8/2012	461	42					1.2	21	17	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	0.47	0.51	0.00	--	--	1.00
Injection Well	5/4/2012	547	128					<1.0	28	5.2	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.80	0.20	0.00	--	--	1.00
BOP-86(i)	8/9/2012	644	225	-7				1.0	39	7.7	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	0.78	0.21	0.00	--	--	1.00
BOP-86(i)	11/8/2012	735	316	84				0.9	20	4.6	0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.03	0.71	0.22	0.04	--	--	1.00
BOP-86(i)	2/6/2013	825	406	174				0.6	31	6.2	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01	0.78	0.21	0.00	--	--	1.00
BOP-86(i)	5/2/2013	910	491	259	-68			0.7	35	7.4	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01	0.77	0.22	0.00	--	--	1.00
BOP-86(i)	8/7/2013	1007	588	356	29			0.6	9.1	15	1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01	0.28	0.64	0.07	--	--	1.00
BOP-86(i)	11/8/2013	1100	681	449	122			<0.2	1.4	2.0	2.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.15	0.28	0.57	--	--	1.00
BOP-86(i)	2/5/2014	1189	770	538	211			0.3	0.4	0.4	0.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.10	0.16	0.22	0.52	--	--	1.00
BOP-86(i)	5/7/2014	1280	861	629	302	-70		<0.2	0.4	1.3	0.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.10	0.46	0.44	--	--	1.00
BOP-86(i)	11/5/2014	1462	1043	811	484	112		<0.2	0.6	4.6	3.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.05	0.47	0.48	--	--	1.00
BOP-86(i)	2/3/2015	1552	1133	901	574	202		<0.2	0.9	5.5	3.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.06	0.47	0.47	--	--	1.00
BOP-86(i)	5/4/2015	1642	1223	991	664	292	-46	<0.2	3.5	5.0	2.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.22	0.42	0.36	--	--	1.00
BOP-86(i)	11/6/2015	1828	1409	1177	850	478	140	<0.2	0.3	1.6	2.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.26	0.70	--	--	1.00
BOP-87(i)	2/8/2012	461	42					1.3	14	1.8	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.06	0.80	0.14	0.00	--	--	1.00
Injection Well	5/4/2012	547	128					<1.0	24	1.4	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.93	0.07	0.00	--	--	1.00
BOP-87(i)	8/9/2012	644	225	-7				2.2	52	2.6	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.03	0.91	0.06	0.00	--	--	1.00
BOP-87(i)	11/8/2012	735	316	84				1.2	9.7	1.6	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.07	0.76	0.17	0.00	--	--	1.00
BOP-87(i)	2/6/2013	825	406	174				0.4	8.5	1.2	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.03	0.81	0.16	0.00	--	--	1.00
BOP-87(i)	5/2/2013	910	491	259	-68			0.2	7.1	1.2	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	0.80	0.18	0.00	--	--	1.00
BOP-87(i)	8/7/2013	1007	588	356	29			0.7	21	6.3	0.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	0.68	0.28	0.02	--	--	1.00
BOP-87(i)	11/8/2013	1100	681	449	122			<0.2	0.6	6.2	0.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.06	0.82	0.12	--	--	1.00
BOP-87(i)	2/5/2014	1189	770	538	211			<0.2	0.3	1.2	1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.07	0.40	0.52	--	--	1.00
BOP-87(i)	5/7/2014	1280	861	629	302	-70		<0.2	<0.2	0.3	0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.28	0.72	--	--	1.00
BOP-87(i)	11/5/2014	1462	1043	811	484	112		<0.2	0.6	1.5	0.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.14	0.47	0.39	--	--	1.00
BOP-87(i)	2/3/2015	1552	1133	901	574	202		<0.2	2.1	2.2	0.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.30	0.43	0.27	--	--	1.00
BOP-87(i)	5/4/2015	1642	1223	991	664	292	-46	<0.2	1.4	2.8	0.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.21	0.57	0.22	--	--	1.00
BOP-87(i)	11/6/2015	1828	1409	1177	850	478	140	<0.2	<0.2	0.3	0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.28	0.72	--	--	1.00
BOP-88(i)	2/8/2012	461	42					2.0	26	2.2	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	0.85	0.10	0.00	--	--	1.00
Injection Well	5/4/2012	547	128					<1.0	19	2.5	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.85	0.15	0.00	--	--	1.00
BOP-88(i)	8/9/2012	644	225	-7				2.8	130	8.9	<1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	0.90	0.08	0.00	--	--	
BOP-88(i)	11/8/2012	735	316	84				1.2	11	1.5	<0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.07	0.79	0.15	0.00	--	--	1.00
BOP-88(i)	2/6/2013	825	406	174				0.9	11	1.4	0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	0.78	0.14	0.03	--	--	1.00
BOP-88(i)	5/2/2013	910	491	259	-68			0.6	14	2.2	1.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	0.70	0.15	0.13	--	--	1.00
BOP-88(i)	8/7/2013	1007	588	356	29			0.8	7.8	11	0.2	<5.0	<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	1.00
BOP-88(i)	11/11/2013	1103	684	452	125			<0.2	0.2	85	4.1	<5.0	<5.0	<5.0	1.21	-90.1	<0.10	4.0	--	--	<1.0		17.0	458	6.20	0.00	0.00	0.93	0.07	0.00	0.00	1.00
BOP-88(i)	2/5/2014	1189	770	538	211			<0.2	0.9	3.0	27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.07	0.92	--	--	1.00
BOP-88(i)	5/7/2014	1280	861	629	302	-70		<0.2	1.0	3.5	7.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.05	0.22	0.74	--	--	1.00
BOP-88(i)	11/11/2014	1468	1049	817	490	118		<0.2	1.9	30	4.2	<5.0	<5.0	<5.0	1.36	-208.2	<1.0	4.0	639	624	276	9.7	13.0	3150	4.56	0.00	0.04	0.79	0.17	0.00	0.00	1.00
BOP-88(i)	2/9/2015	1558	1139	907	580	208		0.3	12	90	4.0	<5.0	<5.0	<5.0	0.46	-94.9	<1.0	7.0	829	775	243	16.5	12.0	3990	4.90	0.00	0.08	0.86	0.06	0.00	0.00	1.00
BOP-88(i)	5/6/2015	1644	1225	993	666	294	-44	1.0	28	150	8.5	7.4	<5.0	<5.0	0.82	-97.0	<1.0	7.0	611	603	138	15.6	16.0	3370	4.82	0.00	0.10	0.71	0.06	0.12	0.00	1.00
BOP-88(i)	11/4/2015	1826	1407	1175	848	476	138	<0.2	0.8	8.7	2.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.05	0.67	0.29	0.00	0.00	1.00

µg/L = micrograms per liter
mg/L = milligrams per liter
gpm = gallons per minute
PCE = tetrachloroethene
PRB = permeable reactive barrier
TCE = trichloroethene
cis = 1,2-dichloroethene
VC = vinyl chloride
DO = dissolved oxygen
ORP = oxygen reduction potential
Diss = dissolved
TOC = total organic carbon
-- Data not collected or analyzed

Note: Blue highlighted values indicate the compound with the highest micromoles per event, ethene and ethane combined are considered for maximum molar fraction. Compounds within 2 percent of maximum compound are also highlighted due to potential laboratory variability.

Injection Notes
a) November 4-9, 2010: Conducted pilot injection test at BOP-72(i) with 900 gallons of water mixed with 3/4 drum of Wilclear sodium lactate.
b) December 28, 2011: Performed PRB injection at BOP-74(i). Injected 15 drums of LactOil, Newman Zone vegetable oil emulsion, and Wilclear sodium lactate with 15,000 gallons of water. Injection rates were between 70 to 80 gpm.
c) August 18, 2012: Conducted PRB injection at BOP-74(i) with 30,000 gallons of LactOil and water mixture.
d) July 2-9, 2013: Conducted gravity feed injection at seven source area zone injection wells (BOP-78, BOP-79, 84, BOP-85, BOP-86, BOP-87, and BOP-88). Injection consisted of 540 gallons LactOil donor and water. Average injection rates ranged from 4.8 to 11.7 gpm.
e) July 12-16, 2014: Conducted source area zone injection by gravity feel to seven multiple-purpose injection wells. Injection consisted of 50,000-gallon mixture of water, LactOil, Textrol BR, glycerin, and ferrous sultate.
f) June 8-19, 2015: Conducted source area zone injection by gravity feel to seven multiple-purpose injection wells. Injection consisted of 50,000-gallon mixture of water, LactOil, Textrol BR, glycerin, and ferrous sultate.

APPENDIX A

Data Validation Memoranda and Laboratory Results

APPENDIX B

Historical TGA and Select TSA Groundwater Quality Data