ANALYSIS OF BROWNFIELD CLEANUP ALTERNATIVES

Heritage Square
1153 Duane Street
Astoria, Oregon
Cooperative Agreement BF-00J67901
ECSI #4075

Prepared for:

City of Astoria
Community Development Department
1095 Duane Street
Astoria, Oregon 97103

Prepared by:

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September 21, 2015

Project No. 3-61M-128230.03

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City of Astoria
Community Development Department
1095 Duane Street
Astoria, Oregon 97103

Attention: Mr. Jeff Harrington

Subject: Analysis of Brownfield Cleanup Alternatives
Heritage Square
1153 Duane Street, Astoria, Oregon

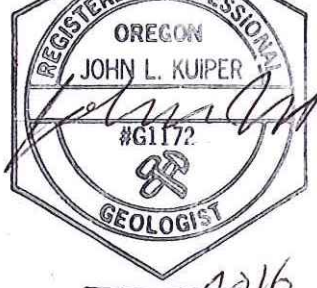
Dear Jeff:

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) is pleased to submit this Analysis of Brownfield Cleanup Alternatives for the Heritage Square property located in Astoria, Oregon.

We appreciate the opportunity to serve you on this project. If you have any questions or require further information, please feel free to contact us at (503) 639-3400.

Sincerely,

Amec Foster Wheeler
Environment & Infrastructure, Inc.



12/31/2016

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1153 Duane Street
Astoria, Oregon

1.0 INTRODUCTION

On behalf of the City of Astoria, Oregon (City), Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) has prepared this Analysis of Brownfield Cleanup Alternatives (ABCA) for property located at 1153 Duane Street in Astoria, Oregon (Site). The City was awarded a United States Environmental Protection Agency (EPA) multi-purpose brownfield pilot grant in 2012 for assessment and cleanup of the Site. The Site is identified on the Oregon Department of Environmental Quality (DEQ) Environmental Cleanup Site Information (ECSI) database as site #4075.

Amec Foster Wheeler conducted a Phase II Environmental Site Assessment (ESA) at the Site in June 2014. The assessment methodology and findings were presented in a Phase II ESA report, the final revision of which was presented on June 9, 2015 (Amec Foster Wheeler, 2015). The Phase II ESA report (earlier revision) was approved by the Environmental Protection Agency (EPA) on February 19, 2015 and by the DEQ on July 1, 2015.

The objective of this ABCA is to present cleanup alternatives for the Site and to guide selection of a remedy based on a systematic evaluation of the alternatives. Each alternative is evaluated using the following factors: 1) effectiveness, 2) long-term reliability, 3) implementability, 4) implementation risk, and 5) reasonableness of cost. This ABCA was completed in general accordance with EPA guidelines for conducting removal actions [NCP 300.415(a)(4)(i)] and DEQ removal authority (Oregon Administrative Rules (OAR) 340-122-0040). The recommended remedy (which includes a soil removal) will be implemented upon EPA and DEQ approval of the ABCA, and following a 30-day public comment period and incorporation of comments into the final cleanup plan. The soil removal will be completed as an interim remedial action. A Removal Action Plan (RAP) will be submitted to EPA and DEQ for review and approval prior to beginning the removal action.

1.1 SITE LOCATION AND DESCRIPTION

The 1.37-acre Site is located in a commercial area of downtown Astoria, Oregon, three blocks (approximately 500 feet) south of the Columbia River (Figure 1). The Site is located within an area of Astoria that historically was constructed on pilings over Columbia River tidal flats. After a fire that

destroyed much of Astoria in 1922, portions of the Site and surrounding downtown area were filled with Columbia River dredge sand. The eastern end of the Site, and surrounding downtown areas, remain on pilings.

The Site occupies an entire city block with the exception of a 0.11-acre portion in the southwestern quarter of the block, which is owned and occupied by the American Legion. The western area of the Site is occupied by a public park (Garden of Surging Waves) and a small asphalt-paved parking lot. This area of the Site is underlain by dredge sand fill to the ground surface. The central area of the Site was occupied by a Safeway grocery store that was demolished in 2005. The former Safeway store's elevated concrete pad footprint collapsed in 2010, leaving a depression to approximately 10 feet below street level (bsl). The eastern area of the Site is a parking deck elevated on pilings over a void that extends to the ground surface located at approximately 10 feet bsl. The sidewalks surrounding the Site are "hollow" and are elevated on pilings over a void that extends to the ground surface at approximately 10 feet bsl. Currently, the central portion of the Site is being used to stockpile approximately 1,200 cubic yards of soil that was removed from the western portion of the Site during the construction of the Garden of Surging Waves. The soil contains low levels of contaminants, including petroleum hydrocarbon constituents and metals. Figure 2 is a recent aerial photograph (2014) of the Site.

1.2 SITE BACKGROUND

Prior to the 1880s, the Site was located within the Columbia River tidal flats. In the late 1800s, the Site was developed on pilings over the river. From the late 1800s through the early 1900s, the Site was occupied by a hotel, church, homes, a school, and a blacksmith. In 1922, a fire destroyed much of downtown Astoria, including the Site. The Site subsequently was rebuilt, and in the 1930s and 1940s, the Site was occupied by a variety of businesses including an automotive service garage, a printer, and a dry cleaner. From 1941 to 1957, a Safeway grocery store was located on the west side of the Site. In 1957, the Safeway relocated to the center of the block, where it remained until 2002 when the store was relocated out of downtown Astoria. In 2003, the City of Astoria acquired the vacant Site.

1.3 ASSESSMENT HISTORY

Several phases of environmental assessment have been conducted at the Site from 2003 through 2015. The assessments are listed below. Assessment findings are summarized in Section 3.0.

- **Phase I Environmental Site Assessment:** 1.48-Acre Safeway/American Legion Property, 1153 Duane Street and 1132 Exchange Street, Astoria, Oregon; January 17, 2003; Hahn and Associates, Inc. (HAI).
- **Phase II Environmental Site Assessment:** 1.48-Acre Safeway/American Legion Property, 1153 Duane Street and 1132 Exchange Street, Astoria, Oregon; April 14, 2003; HAI.
- **Subsurface Investigation Report:** Safeway Property, 1153 Duane Street, Astoria, Oregon; December 16, 2003; HAI.
- **Tank Decommissioning Report:** Safeway Property, 1153 Duane Street, Astoria, Oregon; December 17, 2003; HAI.
- **Technical Memorandum:** Data Evaluation and Scope of Work Development, Former Safeway Property, 1153 Duane Street (Tax Lot 100) American Legion Property, 1132 Exchange Street (Tax Lot 400), Astoria, Oregon; April 5, 2012; HAI.
- **Site Investigation Report:** Heritage Square, Astoria, Oregon (ECSI #4075); June 29, 2012; GeoEngineers, Inc.
- **Phase II Environmental Site Assessment:** Heritage Square, Astoria, Oregon; June 9, 2015; Amec Foster Wheeler.

2.0 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) defines the potentially complete exposure pathways by which human or ecological receptors could be exposed to Site contaminants under current or future land uses. A CSM diagram is presented as Figure 3. The CSM shows potential exposure routes and is used to select appropriate screening criteria for assessing potential risk to human health and the environment from Site conditions. Information on current zoning and land use, and assumptions about potential future land uses made for the purposes of developing the CSM are described in Sections 2.1 and 2.2. Screening levels selected to evaluate potential risk from Site conditions are discussed in Section 2.3.

2.1 LAND USE AND ZONING

The Site currently is zoned as a C-4 Central Commercial Zone. The Site's zoning designation is not expected to change, and allows for commercial and urban residential development. The C-4 zone allows for residential development above or below the first floor, with commercial facilities on the first floor of existing structures. The proposed development plan for the Site is primarily a paved public open space, a public building (possible library and commercial ground floor with upper-floor residential) and isolated areas of soft landscaping. Based on current zoning and proposed future

use, potential current and future receptors at the Site are park users, public and commercial workers, urban residents, and construction and excavation workers.

2.2 BENEFICIAL WATER USE DETERMINATION

A beneficial water use determination (BWUD) for the Site was developed as part of the 2012 Phase II ESA conducted by GeoEngineers, Inc. For this work, GeoEngineers, Inc. conducted a door-to-door survey in the Site vicinity, and a review of Oregon Water Resources Department well logs to assess the presence of water supply wells. No water supply wells were identified in the Site vicinity.

According to the City of Astoria's 2013 Water Quality Report, the City obtains drinking water from surface waters within the Bear Creek watershed located approximately 12 miles east of the City. The water is transferred via pipeline to storage reservoirs and tanks in the City. Based on the distant source of municipal drinking water and the results of the door-to-door survey and well log search conducted by GeoEngineers, Inc., groundwater in the Site vicinity is not used for drinking water, industrial purposes, or other uses.

As groundwater is not being used as a supply of water for human use, the groundwater to surface water pathway is the only potential beneficial use of groundwater at the Site. Groundwater from the Site could potentially migrate to the Columbia River, located 500 feet to the north. As a result, exposure of aquatic organisms to Site groundwater contaminants is considered a potentially complete exposure pathway, as is human exposure to Site groundwater contaminants via fish consumption.

2.3 SCREENING LEVEL SELECTION

Based on the zoning designation, potential future development plans, and the absence of water supply wells in the Site vicinity, the exposure pathways described below were identified as potentially complete routes by which Site users could be exposed to contaminants identified in Site soil and groundwater. Screening criteria were selected to evaluate potential risk to human health and the environment from exposure through each potentially complete pathway identified in the CSM. DEQ Risk-Based Concentrations (RBCs) were selected to evaluate potential risk to human health (DEQ 2012). DEQ guidance was followed to select screening criteria protective of ecological receptors in the Columbia River (DEQ, 2007; DEQ 2014a). The selected screening criteria are discussed below.

Direct contact with soil: This pathway is not currently complete because all soils with concentrations above RBCs at the Site are located greater than three feet below street level, and therefore, people other than construction and excavation workers would not likely come into contact with the soil. [Note: Since contaminated soils beneath the parking deck could be encountered by other types of workers, this area is secure (i.e. locked door) and can only be accessed by City personnel]. Although contaminated soils are greater than three feet below street level, future park users, urban residents, and/or occupational users could come into direct contact with soil if the Site is developed so that soil is within three feet of the final Site surface (e.g. parking deck were to be removed thereby exposing the underlying soils). Construction and excavation workers are likely to come into direct contact with Site soil during redevelopment. To evaluate risk from this pathway, Site Chemical of Interest (COI) data were compared to their respective DEQ RBCs for direct contact with soil.

Inhalation of vapors from soil or groundwater, indoor and outdoor: The indoor vapor inhalation pathway may become complete if future development includes constructing buildings on the Site. If buildings are constructed on the Site, future park users, urban residents, and/or occupational users could be exposed to indoor vapors from volatile contaminants in soil or groundwater. The outdoor vapor inhalation pathway is currently complete at the Site, and will likely be complete when the Site is redeveloped. To evaluate risk from the indoor and outdoor vapor inhalation pathways, Site data were compared to DEQ RBCs for indoor and outdoor vapor inhalation.

Direct contact with groundwater: Groundwater is not used for drinking water or industrial purposes at the Site or in the vicinity. The only potential for direct contact with groundwater at the Site is by excavation workers who may encounter groundwater during Site construction. To evaluate risk to workers from Site groundwater, Site data were compared to DEQ RBCs for exposure to groundwater in an excavation.

Contact with water from the Columbia River: Groundwater from the Site could potentially migrate to the Columbia River located approximately 500 feet north of the Site. There is the potential for contaminants in Site groundwater to migrate with the groundwater and impact fish and other organisms in the river, as well as people who eat fish from the river. To evaluate potential risks to human health and ecological receptors from groundwater migrating to the river from the Site, groundwater data were compared to EPA and DEQ screening values for fish consumption and ecological receptors (DEQ, 2014b; EPA, 2014).

Other Screening Levels: Site sampling data have been compared to DEQ-published background metals concentrations in soil to assess whether concentrations on Site are elevated above regional

concentrations (DEQ, 2013). Site data also have been compared to the DEQ's Clean Fill Standards (DEQ, 2014c).

If contaminant concentrations exceed one or more of the screening criteria outlined above, then depending on concentrations, the DEQ may allow reuse of the soil on-site (if appropriately capped), or as fill material at an off-site property that remains under the control of the City. Transport to such an off-site facility likely will require a Solid Waste Letter of Authorization (SWLA). Soil exceeding Clean Fill Standards (and/or RBCs) that is removed from the Site and cannot be placed at another City-controlled property pursuant to an SWLA must be disposed at a properly licensed landfill.

Cleanup oversight will be by DEQ's Voluntary Cleanup Division. The cleanup also will be documented by a registered geologist, or environmental professional working under the direction of a registered geologist from Amec Foster Wheeler. Appropriate permits will be obtained, utility notifications conducted, and the site-specific Health and Safety Plan updated prior to commencement of work. Work will be performed in accordance with 40 CFR and OAR-340-122.

The City of Astoria has no code on book for soil cleanup, but instead defers to DEQ for such issues. Likewise Clatsop County has no additional regulations. The Clatsop County Standards Document refers to DEQ for solid and hazardous waste, and to EPA for special hazardous waste control (e.g., underground injection). The Davis-Bacon Act does apply to soil cleanup for the purpose of site remediation.

3.0 ASSESSMENT SUMMARY

3.1 SITE GEOLOGY AND HYDROGEOLOGY

The Site is underlain by sand fill from the Columbia River. Boring logs from assessments conducted at the Site show that soil is comprised mostly of sand with traces of silt. During previous investigations (2003, 2012, and 2014), boring logs indicated sand fill to depths of 18 to 20 feet bsl, underlain by gravel, sand, and silt. Wood debris, including some that appeared to be charred, has been identified in soil borings at the Site. First occurring groundwater typically is encountered at approximately12 to 12.5 feet bsl (approximately 1.5 to 2 feet below ground surface in area beneath parking deck). Based on the location of the Columbia River, approximately 500 feet north of the Site, groundwater flow is tidally influenced, and is anticipated to move in a northerly direction.

3.2 SOIL

Results of soil sampling indicate that low-level concentrations of diesel-range and oil-range petroleum hydrocarbons, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and select heavy metals, are present/widespread in soils at the Site. These substances are likely associated with a variety of sources, as described below. Several analytes (PAHs, metals) were detected above DEQ direct contact soil RBCs. No analytes were detected at concentrations that exceed DEQ indoor or outdoor inhalation RBCs.

The petroleum hydrocarbons detected in soil are likely associated with leaks and spills from former Site operations such as automotive repair. No diesel-range petroleum hydrocarbons were detected above DEQ direct contact RBCs. The DEQ has not published RBCs for heavy oil-range petroleum hydrocarbons.

PAHs detected in Site soil may be associated with petroleum products, or could be associated with charred organic materials such as wood, present on Site as a result of Astoria's historical fires. PAHs exceed urban residential, occupational, and construction and excavation worker direct contact RBCs, primarily in the area beneath the northern half of the raised parking deck. PAHs were detected at particularly high concentrations in a sample from SB-6 located beneath the parking deck (Figure 4). The PAH benzo(a)pyrene was detected at a concentration greater than 100 times the DEQ urban residential direct contact RBC in SB-6, indicating that the sampling location is an urban residential hot spot as defined by the DEQ. The boring log for SB-6 shows that charred wood was observed where the sample was collected. Because PAHs are generated by the incomplete burning of organic material, it is likely that the charred wood is the source of the elevated benzo(a)pyrene concentration. The DEQ has a preference for removing hot spots in soil.

PCBs in soil exceed urban residential and occupational RBCs, primarily in the area beneath the northern half of the raised parking deck. PCBs may be associated with transformer oil or hydraulic oil from former Site operations, or from PCB-containing paint historically used on Site buildings.

Select metals (e.g. cadmium, lead) may be associated with leaks and spills of waste oil or materials associated with former printing operations. Metals also may be associated with natural sources. The volcanic origins of Oregon soils have resulted in naturally higher metals concentrations than are found in non-volcanic areas. The DEQ has published a study of region-specific background metals concentrations, many of which exceed DEQ cleanup standards. Several metals detected in soil samples from the Site exceed DEQ-published background values. Some of these metals, primarily arsenic and lead, also exceed DEQ Risk-Based Concentrations (RBCs) protective of urban residential, occupational, and construction and excavation workers who

could come into direct contact with soil at the Site. These exceedances occur primarily in the northern half of the area beneath the raised parking deck, with particularly high concentrations found beneath the northwest corner of the parking deck. Elevated arsenic also was detected in soil in the southwest corner of the Site near the intersection of Exchange Street and 11th Street. The elevated metals concentrations in each of these locations are at approximately 10 feet bsl (Figure 4).

Seven soil samples were submitted for Toxicity Characteristic Leaching Procedure (TCLP) analysis to assess whether metals concentrations classify the soil as a toxicity-characteristic hazardous waste under the Resource Conservation and Recovery Act (RCRA). TCLP analysis identified lead in leachate from a soil sample (SB-1) collected beneath the northwest corner of the raised parking deck at a concentration that exceeds the RCRA toxicity characteristic standard of 5 milligrams per liter (mg/L). This soil sample was collected via a push probe drilling rig positioned on top of the parking deck over the vicinity of the small soil pile, and it is likely that the collected sample is from within the soil pile. No other metals were detected in the soil samples above the RCRA toxicity characteristic standards.

Two stockpiles of soil generated during construction of the Garden of Surging Waves are located in the central area of the Site, at the former Safeway store location. A third soil stockpile is present beneath the northwest corner of the parking deck. Soil stockpile locations are shown on Figure 4. Contaminant concentrations (metals) in the stockpiles exceed urban residential, occupational, and construction worker direct contact RBCs. A composite sample from each stockpile was submitted for TCLP analysis. TCLP analysis identified lead in leachate from the soil pile beneath the parking deck at a concentration that exceeds the RCRA toxicity characteristic standard. No other metals were detected in the soil piles above the RCRA toxicity characteristic standards.

On July 21 and 22, 2015, additional soil samples were collected from all three soil stockpiles and from selected locations beneath the northern half of the parking deck. The purpose of the sampling was to provide additional data for use in refining estimates of contaminated soil volume, and in the event soils are removed from the Site, to allow for a determination as to appropriate management and disposal options. The analytical results of the July soil sampling event are included in the updated Soil Analytical Data Summary Tables (Tables 1A, 1B, 1C, 1D, 1E, and 1F). These results will be discussed in the forthcoming Remedial Action Plan (RAP).

3.3 GROUNDWATER

Metals and chlorinated solvents have been detected in groundwater at the Site and in Duane Street located downgradient of the northern Site boundary, at concentrations that do not exceed

applicable RBCs protective of human health. Data indicate that two separate areas of chlorinated solvent (VOC) impacted groundwater are present beneath the Site: One plume appears to originate off-site to the south or southwest, possibly from beneath Exchange or 11th Streets, and has migrated beneath the western end of the Site. While characterization of this plume is not complete, the existing data from beneath the streets suggests that the plume is localized. A separate plume appears to originate in the northeastern area of the Site near where a dry cleaner formerly was located. This northeastern plume extends from the Site into Duane Street to the north.

Groundwater data were compared to ecological screening criteria as outlined in the DEQ document titled: *Ecological Screening Level Hierarchy (Replaces 1998, 2000 and 2001 DEQ Guidance) As of January 2014* (DEQ, 2014a). The solvent trichloroethylene (TCE) exceeds the ecological screening criteria in one of seven groundwater samples collected at the Site. No analytes were detected above the ecological screening levels in groundwater samples (see Table C1) collected within Duane Street.

Groundwater data were compared to DEQ and EPA screening values protective of human health from exposure through consumption of fish from the Columbia River (DEQ, 2014b; EPA 2014a). Tetrachloroethylene (PCE), TCE, and vinyl chloride concentrations in groundwater from one on-Site sample location (SB-1) and two sample locations in Duane Street (SB-7 and SB-8) exceed the fish consumption screening level.

The fish consumption and ecological screening values are intended for comparison to concentrations in the transition zone where groundwater mixes with surface water; therefore, comparison of on-Site groundwater concentrations to these standards is overly conservative as concentrations will decrease between the Site and the river. In order to more realistically assess the potential risk to human health and ecological receptors from exposure to chlorinated solvents via the groundwater to surface water migration pathway, the BIOCHLOR screening model was used to estimate attenuation of chlorinated solvents between the Site and the Columbia River. BIOCHLOR simulates remediation by natural attenuation of dissolved solvents. The software simulates advection, dispersion, adsorption, and biotransformation via reductive dechlorination. The BIOCHLOR modeling results indicated that, given the highest chlorinated solvent concentrations detected at the Site, chlorinated solvents might reach the river at concentrations that exceed the DEQ Ambient Water Quality Criteria (AWQC), however the concentrations would not exceed the EPA National Recommended Water Quality Criteria (NRWQC).

Dissolved arsenic exceeds the human health standard for consumption of fish from the river in the three deeper groundwater samples collected in Duane Street. With the exception of very low-level

detections of dissolved arsenic in historical on-Site samples, dissolved arsenic was not detected in groundwater beneath the Site. Based on the lack of dissolved arsenic detections on the Site, it is likely that the concentrations in Duane Street are associated with a localized off-Site source beneath the street.

Dissolved metals were not detected in groundwater from the Site at concentrations above ecological screening values, with the exception of barium. The range of dissolved barium concentrations in groundwater samples collected from the Site are comparable to concentrations in off-Site samples from Duane Street, and lower than a sample collected from Exchange Street located upgradient of the Site. This indicates that barium concentrations in groundwater at the Site are comparable to local background concentrations.

3.4 SOIL GAS

During the assessment conducted by GeoEngineers in 2012, three soil gas samples and a duplicate sample were collected from 5 feet bsl in the western area of the Site and submitted for analysis of volatile organic compounds (VOCs). VOCs were not detected above applicable soil gas RBCs.

4.0 ANALYSIS OF BROWNFIELD CLEANUP ALTERNATIVES

The purpose of this ABCA is to define and evaluate cleanup alternatives that reduce contaminant concentrations to levels that are protective of human health and the environment. This ABCA contains the following elements:

1. Remedial action area.
2. Evaluation of proposed cleanup alternatives.
3. Presentation of the recommended alternative.
4. Discussion of the residual risks associated with the recommended alternative.

4.1 REMEDIAL ACTION AREA AND OBJECTIVES

The remedial action area consists of:

- Soil with TPH, PAHs, PCBs, and metals located beneath the raised parking deck, extending from approximately 9 to 12 feet below street level.
- Soil with elevated levels of arsenic located in the southwestern corner of the Site at a depth of 10 feet below street level.

- Two soil stockpiles with TPH, PAHs, PCBs, and metals located in the former Safeway basement area and one soil stockpile with TPH, PAHs, PCBs, and metals (including leachable lead) beneath the northwest corner of the raised parking deck.
- Groundwater with VOCs beneath the northwest corner of the parking deck and adjacent area of Duane Street.

The remedial action objectives include:

- Prevent direct contact between human receptors and soil exceeding applicable risk-based concentrations;
- Remediate/remove hot spots of contamination to the extent feasible;
- Remove potential sources of groundwater contamination to protect aquatic ecological receptors and recreational fishers; and
- Utilize green remediation/removal strategies to the maximum extent practicable.

4.2 DEFINITION AND EVALUATION OF REMEDIAL ALTERNATIVES

The remedial alternatives are defined and discussed below. A quantitative comparison of the soil remedial alternatives is provided in Table 1. Groundwater remedial alternatives also are discussed below; however, due to the limited number of realistic options for groundwater, preparation of a summary table to rank the options is not necessary.

Under DEQ removal authority (OAR 340-122-0040) and EPA guidance, remedial alternatives are evaluated using the following criteria:

- Effectiveness,
- Long-term Reliability,
- Implementability,
- Implementation Risk,
- Sustainability,
- Reasonableness of Cost, and
- Susceptibility to Climate Change.

4.2.1 Proposed Remedial Alternatives

The objective of each alternative is to reduce chemical concentrations present at the Site to levels protective of human health and the environment. Because of the structures present at the Site, the

nature of the contaminants, their persistence in the environment, and the media in which the contaminants occur, only a few remedial alternatives warrant detailed evaluation. For this reason, the following remedial alternatives are evaluated for soil and groundwater in this ABCA:

The general response actions for soil are:

- No action
- Institutional and engineering controls
- Removal and transport to local quarry area or licensed landfill (Hillsboro or Arlington, Oregon)
  - Safeway Stockpiles only
  - Safeway Stockpiles plus stockpile and hot spot beneath parking deck
  - All stockpiles, hot spot, and soils beneath parking deck exceeding RBCs

The general response actions for groundwater are:

- No action
- Institutional and engineering controls
- Monitoring (to track plume stability)

Specific details for each of the soil and groundwater alternatives, and associated scoring of the evaluation criteria, are presented below.

Soil

- Alternative 1 - No Action: No action (e.g. leaving the Site in its current state) is the baseline against which all other alternatives will be measured.
- Alternative 2 - Institutional and Engineering Controls: Institutional controls (e.g. land use zoning change) and engineering controls (e.g. fencing) would be placed on the Site to preclude human contact.
- Alternative 3a - Soil Removal (Safeway Stockpiles only): Removal of two soil stockpiles in the former Safeway basement; placement of an engineering control in the form of a surface cap preventing direct contact with Site soil, wherever RBCs are exceeded; and placement of an institutional control (deed restriction) that restricts groundwater use, outlines requirements for capping remaining contaminated soil, and requires development of a Contaminated Media Management Plan (CMMP) to guide soil and groundwater handling and disposal during future construction on the Site. If residual contamination is present

following the removal, an abbreviated residual risk assessment will be required prior to installation of an engineering control to address excess site risk.

- Alternative 3b - Removal (Safeway Stockpiles Plus Stockpile and Hotspot Beneath Parking Deck): Removal of two soil stockpiles in the former Safeway basement; removal of soil pile located beneath northwest corner of parking deck; remove soil at SB-6 hot spot; placement of an engineering control in the form of a surface cap preventing direct contact with Site soil, wherever RBCs are exceeded; and placement of an institutional control (deed restriction) that restricts groundwater use, outlines requirements for capping remaining contaminated soil, and requires development of a CMMP. If residual contamination is present following the removal, an abbreviated residual risk assessment will be required prior to installation of an engineering control to address excess site risk.
- Alternative 3c - Removal (Safeway Stockpiles, Stockpile and Hotspot Beneath Parking Deck, and removal of soil that exceeds RBCs in the area beneath the parking deck): Removal of two soil stockpiles in the former Safeway basement; removal of soil pile located beneath northwest corner of parking deck; remove soil at SB-6 hot spot, and removal of soil that exceeds RBCs in the area beneath the parking deck (estimated to extend to top of water table approximately 1.5 to 2 feet below the soil surface); and placement of an institutional control (deed restriction) that restricts groundwater use, outlines requirements for capping remaining contaminated soil, and requires development of a CMMP. If residual contamination is present following the removal, an abbreviated residual risk assessment will be required prior to installation of an engineering control to address excess site risk.

Groundwater

- Alternative 4 - No Action: No action (e.g. leaving the Site in its current state) is the baseline against which all other alternatives will be measured.
- Alternative 5 - Institutional Control: Placement of an institutional control (deed restriction) that restricts groundwater use.
- Alternative 6 - Groundwater Monitoring with Institutional and Engineering Controls: Installation of a groundwater monitoring well near some of the highest detected concentrations of VOCs (northern portion of Site) and performing monitored natural attenuation (MNA). Purpose of the MNA will be to better evaluate conditions at the down-gradient portion of the Site, monitor concentrations leaving the Site, and documenting plume stability and/or reduction in size/mass over time. This alternative also would include placement of an institutional control (deed restriction) that restricts groundwater use.

4.2.2 Sustainability Considerations

Sustainability has been considered in the design and selection of a cleanup plan for the Site:

- The greenhouse gas emissions and fuel consumption associated with each cleanup alternative are presented in Table 4, and were considered in selection of a preferred cleanup plan.
- Trucking contractors hired to transport contaminated soil from the Site will be encouraged to use diesel fuel blended with 10% biofuel, particularly if transport distances are large.
- The on-site separation of recyclable/reusable materials (concrete, gravel, etc.) from the soil stockpiles was considered as an alternative to transport of all stockpiled material to a landfill. However, this option was not retained in final cleanup plans due to the associated noise impacts and dust generation, as well as the cost and complexity of staging the necessary equipment in a limited area.
- Local disposal/reuse options (requiring a BUD or SWLA were evaluated and retained in the final plan. Specifics of what portion of material may qualify will not be known until DEQ makes a determination. However, laboratory data from the July 21 and 22, 2015 sampling event suggests that all soil, with the exception of Stockpile #3, should qualify for local disposal/resuse.

4.2.3 Changing Climate Concerns

Changing climate concerns have been considered in the design and selection of a cleanup plan for the Site (EPA, 2014b; EPA 2015). Considerations are based on predications of long-term changes to Pacific Northwest climate which include: increase in average temperature of up to 5 degrees Fahrenheit by the 2080s, reduced winter snow pack, rising sea level (several inches to a couple feet by end of century), and possibility of enhanced seasonal precipitation cycle (wetter autumn/winter and drier summer) and more intense rainfall events (CIG, 2009).

4.2.4 Major Assumptions

The major assumptions listed below apply to the alternatives:

- The cost estimates presented in this ABCA are engineering cost estimates with a precision of +50%/-30%.
- The extent of the soil contamination, and thus the basis of the preliminary cost estimate, is defined in the June 9, 2015 Phase II ESA (Amec Foster Wheeler, 2015).
- Costs for installing a cap are not included in this ABCA. If a cap will be required as part of the selected cleanup alternative, the requirement will be documented in the deed restriction, and implemented during Site construction*. [Note: If a protective cap is required, an NFA will*

not be considered by DEQ until after an abbreviated risk assessment is performed and the cap is installed].

- Costs assume that the stockpiles in the Safeway basement can be disposed as non-hazardous waste and that the soil pile beneath the northwest corner of the parking deck and the SB-6 hot spot will be disposed as characteristic hazardous waste.
- All costs are presented as 2015 dollars, with no discounting.
- Complete groundwater plume delineation and active groundwater remediation will not be required.

4.3 SOIL ALTERNATIVES (ALTERNATIVES 1, 2, 3A, 3B, 3C)

4.3.1 Alternative 1: No Action

Alternative 1 is the baseline against which all other soil actions are compared.

Under this alternative, soil that exceeds RBCs protective of potential future park users, residents, and occupational Site users will be left in place within the former Safeway footprint (stockpile soils), beneath the raised parking deck (stockpile, hot spot, and other soils), and in the southwestern corner of the Site near the intersection of Exchange Street and 11th Street.

Effectiveness: Alternative 1 does not eliminate the potential for Site users to come into direct contact with contaminated soil. While a combination of fencing, plastic sheeting, and the parking deck wall currently prevent access, without purposeful maintenance of these features the soils will eventually become progressively more accessible, and therefore effectiveness of the alternative will decrease over time. Alternative 1 leaves soil in place under the northwest corner of the raised parking deck and beneath the southwest corner of the Site. This soil may come into contact with groundwater, and may continue to act as a potential source of groundwater contamination. The soil stockpiles in the former Safeway area are underlain by a concrete slab and would not be expected to leach to groundwater.

Long-term Reliability: Alternative 1 does not remove contamination or eliminate human or ecological exposure pathways, and therefore is unreliable in the long-term.

Implementability: Alternative 1 is considered easy to implement as it requires no action.

Implementation Risk: Alternative 1 implementation risk is low, because no activities are conducted.

Sustainability: Alternative 1 is not sustainable in that contaminated soils (particularly the stockpiles) are considered a blight by the local community. The continued presence of this visual nuisance is likely to have long-term negative socioeconomic impacts on the community.

Climate Change Concerns: No Site-specific risk factors have been identified for the Site or for this alternative with respect to potential climate change. The only climate change effect likely to be noticeable at the Site would be sea level rise. The Site was constructed over tidal flats and groundwater is only one or two feet below the soil surface in the area beneath the parking deck. Therefore, a hypothetical rise in sea level over the ensuing decades could allow additional contaminated soils beneath the parking deck to come into contact with groundwater or stormwater outfall back-up. However, an additional one to two foot thickness of soil contacting groundwater is not anticipated to result in significantly increased groundwater contamination, as the contaminants in soil (metals, heavy oil, PAHs, PCBs) have low solubility.

Cost: The cost estimate to implement this alternative is zero.

4.3.2 Alternative 2: Institutional and Engineering Controls

Under Alternative 2, soil that exceeds RBCs protective of potential future park users, residents, and occupational Site users will be left in place: 1) within the former Safeway footprint (stockpile soils), 2) beneath the raised parking deck (stockpile, hot spot, and other soils), and 3) in the southwestern corner of the Site near the intersection of Exchange Street and 11th Street.

Institutional and engineering controls would be used to mitigate residual risk on the Site. An institutional control in the form of an Easement and Equitable Servitude (EES), or deed restriction, would be recorded with the Site deed. The EES would document the following requirements:

- Groundwater at the Site will not be extracted for drinking water, industrial use, or other purposes.
- Site use for residential or park use will not be allowed.
- During Site development, a surface cap will be installed and maintained over soils with contamination exceeding applicable RBCs. Applicable RBCs will be determined based on the final development plan.
- A CMMP will be developed that will outline the location, and proper handling and disposal of soil and groundwater during construction activities at the Site.

Effectiveness: Alternative 2 is effective in that institutional controls (e.g. re-zoning to preclude residential or park use), and engineering controls (fencing, plastic sheeting/covers) reduce the potential for Site users to come into direct contact with contaminated soil. Alternative 2 leaves soil

in place under the northwest corner of the raised parking deck and beneath the southwest corner of the Site. This soil may come into contact with groundwater, and may continue to act as a potential source of groundwater contamination. The soil stockpiles in the former Safeway area are underlain by a concrete slab and would not be expected to leach to groundwater.

Long-term Reliability: Alternative 2 does nothing to remove contamination (only caps contamination) and therefore is unreliable in the long-term. This alternative also presents future risk to Site users and potential aquatic ecological receptors and recreational fishers.

Implementability: Alternative 2 is considered easy to implement as it requires only administrative action and installation of barriers (fencing, plastic sheeting).

Implementation Risk: Alternative 2 implementation risk is low.

Sustainability: Alternative 2 is not sustainable in that contaminated soils, particularly the stockpiles are seen as a blight by the local community. The continued presence of this visual nuisance is likely to have long-term negative socioeconomic impacts on the community. Assuming 5 gallons of gasoline (light duty truck) used per year for maintenance activities for 30 years, 150 gallons of gasoline would be consumed, resulting in 1.3 metric tons of carbon dioxide equivalent emissions.

Cost: The cost estimate to implement this alternative is negligible, because fencing and plastic have already been installed at the site. Some minor maintenance costs (perhaps $2,000/year) would be required.

Climate Change Concerns: Similar to Alternative 1, no Site -specific risk factors have been identified for the Site or this alternative.

4.3.3 Alternative 3a: Safeway Basement Stockpiles Removal and Institutional/Engineering Controls

Alternative 3a will consist of removing the soil stockpiles from the former Safeway basement. The soil stockpiles contain approximately 1,200 cubic yards (approximately 1,800 tons) of soil and construction debris. The stockpiled material sampling results indicate that the stockpiles are not a RCRA hazardous waste; therefore, the stockpile soils can be disposed at a Subtitle D (non-hazardous) waste landfill, or potentially a local “re-use” site owned by the City. The nearest Subtitle D landfill to the Site is located in Hillsboro, Oregon. *[Note: On July 21 and 22, 2015, the Safeway stockpiles were re-sampled (discreet sampling versus the prior composite sampling) in an effort to better characterize the levels of contaminants within these stockpiles].*

Under this alternative, soil that exceeds RBCs (and/or hot spot levels (SB-6)) protective of potential future park users, residents, and occupational Site users will be left in place beneath the raised parking deck and in the southwestern corner of the Site near the intersection of Exchange Street and 11th Street. Institutional and engineering controls would be used to mitigate residual risk on the Site. An EES would document the following requirements:

- Groundwater at the Site will not be extracted for drinking water, industrial use, or other purposes.
- During Site development, a surface cap will be installed and maintained over soils with contamination exceeding applicable RBCs. Applicable RBCs will be determined based on the final development plan.
- A CMMP will be developed that will outline the location, and proper handling and disposal of soil and groundwater during construction activities at the Site.

Effectiveness: Alternative 3a effectively eliminates the potential for current and future Site users to come into direct contact with contaminated soil by removing the soil off-Site and requiring installation and maintenance of a surface cap over soils that will remain on Site. At least one hot spot soil location would remain at the site. DEQ has preference for removal of hot spots. Alternative 3a leaves soil in place under the northern half of the raised parking deck and beneath the southwest corner of the Site. This soil may come into contact with groundwater, and may continue to act as a potential source of groundwater contamination.

Long-term Reliability: Alternative 3a permanently removes a large portion of contaminated soil and eliminates the potential for direct contact with remaining soil, and therefore is moderately reliable in the long-term. However, source area soils (including a hot spot) will remain in place under the parking structure and will require ongoing maintenance and inspection to ensure residual soil does not present a risk to Site users. In addition, source area soil that could adversely impact groundwater would remain at the Site.

Implementability: Alternative 3a is considered easy to implement. It will require readily available equipment, materials, and services.

Implementation Risk: Alternative 3a implementation risk is low. Subcontractors hired to conduct the soil removal will be current in the US Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operator (HAZWOPER) training. Work would be performed under a site specific Health and Safety Plan (HASP).

Sustainability: Transporting the two soil stockpiles would require 67 trucks to travel 172 miles roundtrip from Astoria to the Hillsboro Landfill in Hillsboro, Oregon. Assuming a fuel efficiency of 9 miles per gallon, transport of the soil would consume approximately 1,280 gallons of diesel fuel and emit approximately 13 metric tons of carbon dioxide to the atmosphere. For comparison, data collected by the World Bank shows that the average American is responsible for approximately 17.6 metric tons of carbon dioxide emissions per year. Transport contractors will be encouraged to use diesel that includes 10% biofuel. If a portion (or all) of these soils are able to be placed at local City-owned property instead (e.g. backfill of former quarry located approximately three miles from Site), then the carbon footprint of Alternative 3a would be mostly eliminated, and the alternative made much more sustainable.

Cost: The cost estimate to implement this alternative ranges from approximately $69,181 to $203,392, depending upon amount of material transported to the Hillsboro Landfill versus the amount of the material reused as backfill at a local City-owned site. All tasks required to complete this alternative are eligible for funding by the City's EPA multi-purpose brownfield pilot grant. It is anticipated that there is sufficient grant funding to fully fund this alternative.

Climate Change Concerns: Similar to Alternatives 1 and 2, no Site-specific risk factors have been identified for the Site or this alternative.

4.3.4 Alternative 3b: Safeway Basement and Parking Deck Stockpile Removal, Targeted Soil Excavation, and Institutional/Engineering Controls

In addition to the measures described in Alternative 3a, Alternative 3b incorporates removal of the small soil pile under the northwest corner of the parking deck (approximately 60 cubic yards), and the urban residential hot spot of soil at sampling location SB-6 (approximately 5 cubic yards or less) (65 cubic yards total). Our calculations assume that the small stockpile under the parking deck will be handled and disposed as RCRA hazardous waste based on sampling data collected during the 2014 and 2015 environmental assessments. The hot spot material does not contain the lead concentrations typical of the Stockpile #3, and therefore is not a hazardous waste. However, the SB-6 hot spot has significantly elevated PAHs, likely due to its location directly beneath a parking lot catch basin and the presence of burned wood at this location. Therefore the SB-6 hotspot will be treated separately from the approximately 180 cubic yards of surficial soil (non-stockpile) material exceeding RBCs, most of which is located beneath the northern end of the parking deck. Hot-spot material from SB-6 likely will be transported along with the Stockpile #3 material to Arlington. Alternatively, the SB-6 material may be transported to Hillsboro Landfill.

As with Alternative 3a, Alternative 3b will leave soil that exceeds RBCs protective of potential future park users, residents, and occupational Site users in place beneath the raised parking deck (mostly

the northern half) and in the southwestern corner of the Site near the intersection of Exchange Street and 11th Street. The same institutional and engineering controls described under Alternative 3a (e.g. groundwater restrictions, cap, CMMP) would be used to mitigate this residual risk under Alternative 3b.

Effectiveness: Alternative 3b eliminates the potential for direct contact with the most contaminated soil at the Site, removes a soil hot spot, and reduces a potential source of groundwater contamination. However, this alternative does allow for some soils to remain in place that are above RBCs, thereby posing potential excess risk.

Long-term Reliability: Alternative 3b permanently removes contaminated soil and eliminates/reduces the potential for direct contact with remaining soil, and therefore is reliable in the long-term. However, it does not eliminate potential contact with all residual contaminated soil.

Implementability: Alternative 3b is considered easy to implement. It will require readily available equipment, materials, and services.

Implementation Risk: Alternative 3b implementation risk is low. Subcontractors hired to conduct the soil removal will be current in the OSHA 40-Hour HAZWOPER training.

Sustainability: As described under Alternative 3a, transport of the two Safeway basement stockpiles will consume approximately 1,280 gallons of diesel fuel and emit approximately 13 metric tons of carbon dioxide to the atmosphere (unless local reuse at City-owned property can be arranged). Under Alternative 3b, an additional 65 cubic yards of soil will be transported from Astoria, Oregon to the Arlington Landfill in Arlington, Oregon. However, it is possible that (like Alternative 3a) some or all of this material might be reused locally at City-owned property. Transport of the soil to Arlington (454 mile round trip) will consume an additional 151 gallons of diesel fuel, and result in an additional 1.5 metric tons of carbon dioxide-equivalent emissions. Transport contractors will be encouraged to use diesel that includes 10% biofuel.

Cost: The cost estimate to implement this alternative is approximately $114,743 to $248,954 (depending on amount of savings to be realized by local reuse of stockpiled soil). All tasks required to complete this alternative are eligible for funding by the City's EPA multi-purpose brownfield pilot grant, although the upper-end range of this estimate may exceed available grant funds.

Climate Change Concerns: Similar to Alternatives 1, 2, and 3a, no Site-specific risk factors have been identified for the Site or this alternative. Removal of the hot spot material beneath the parking

deck potentially would result in less contaminated soil contacting groundwater in the future, should sea level rise one to two feet.

4.3.5 Alternative 3c: Stockpile Removal, Soil Excavation to 12 Inches below Ground Surface, and Institutional/Engineering Controls

Alternative 3c includes all remediation measures outlined under Alternative 3b, with the addition of removing soil (estimated at 180 cubic yards total) that exceeds RBCs. This includes the SB-6 area beneath the catch basin in the area beneath the northern end of the raised parking deck and a smaller area beneath the southern end of the parking deck (see Figure 5). Soils beneath the parking deck will be excavated to the base of the contamination and/or the top of the water table (1.5 to 2 feet below soil surface). In some areas excavation may be limited to the depth of the column footings that support the raised parking deck (approximately 1 foot below soil surface). Transport of the soil will be to either Hillsboro Landfill (disposal) or a local City-owned Site (reuse). Actual volume of soil will be calculated following evaluation of laboratory data from the July 21 and 22, 2015 sampling event.

Confirmation soil samples will be collected from the base and sides of the excavation to assess post-excavation contaminant concentrations. If post-excavation sampling shows that contaminant concentrations are below applicable RBCs, a deed restriction requiring capping of soil beneath the parking deck will not be necessary in this area. If confirmation sampling shows that concentrations exceed applicable RBCs, a deed restriction requiring capping of areas where exceedances are present will be required. An abbreviated residual risk assessment will be performed prior to capping.

Soil that exceeds RBCs protective of potential future park users, residents, occupational workers, and construction workers will be left in place in the southwestern corner of the Site near the intersection of Exchange Street and 11th Street. Under Alternative 3c, a deed restriction consisting of the following requirements (identical to that required for all soil Alternatives) would be placed on the Site:

- Groundwater at the Site may not be extracted for drinking water, industrial use, or other purposes;
- A cap must be installed and maintained over soils that exceed applicable RBCs. Applicable RBCs will be determined based on the final development plan; and
- A CMMP must be developed that will outline the location, and proper handling and disposal of soil and groundwater during construction activities at the Site.

Effectiveness: Alternative 3c eliminates the potential for direct contact with the most contaminated soil at the Site, removes a soil hot spot, and reduces a potential source of groundwater contamination. Residual risk beneath the parking deck (if present) would be managed by a protective cap.

Long-term Reliability: Alternative 3c permanently removes the most contaminated soil identified at the Site, and therefore is reliable long-term. A CMMP would be prepared for the removal activities, and to guide future construction activities that might encounter contaminants beneath capped areas. In the event residual contaminated soils are capped, and there is a potential for erosion or future construction activities to breach the cap, then an annual inspection of the capped areas should be performed. If during such inspection, it is determined that the integrity of the protective cap has been compromised, then the cap must be repaired appropriately.

Implementability: Alternative 3c is more complex to implement than the other Alternatives due to the need for engineering consultation and possible need to construct a support system for the raised parking deck during soil excavation.

Implementation Risk: Alternative 3c involves an increased implementation risk due to the potential need for a support system for the raised parking deck during soil excavation. An engineering subcontractor would be retained to design a construction support system if needed.

Sustainability: Transport of all soils described under Alternative 3c would consume the same amount of fuel and have the same carbon footprint as Alternative 3b, with the exception that there would be an incremental fuel usage for additional excavated soil beneath the parking deck. The additional fuel usage (depending upon the volume of soil removed) could result in up to an additional 210 gallons of diesel consumed and associated carbon dioxide emissions of up to 2.1 metric tons.

Cost: The cost estimate to implement Alternative 3c is a range of approximately $156,611 to $309,611, based on 1) volume of material excavated beneath the parking deck, 2) destination of excavated material, and 3) cost involved with supporting parking structure. All tasks required to complete this alternative are anticipated to be eligible for funding by the City's EPA multi-purpose brownfield pilot grant. [Note that costs associated with supporting the parking lot structure should be eligible in that the work would be necessary to support the remedial effort]. However, the upper range of these estimated costs clearly exceeds cleanup funds available through the City's EPA multi-purpose brownfield pilot grant.

Climate Change Concerns: Similar to all of the soil alternatives, no Site-specific risk factors have been identified for the Site or this alternative. Removal of the hot spot material and soils exceeding RBCs beneath the parking deck potentially would result in less contaminated soil contacting groundwater in the future, should sea level rise one to two feet.

4.4 GROUNDWATER ALTERNATIVES (ALTERNATIVES 4, 5, 6)

4.4.1 Alternative 4: No Action

Alternative 4 is the baseline against which all other groundwater actions are compared. Under this alternative, groundwater with VOCs exceeding screening levels will remain at the Site. The locations of this VOC-impacted groundwater are 1) the southwest corner of the former Safeway, and 2) the northwest corner of the parking deck, extending north beneath Duane Street. Screening levels exceeded include:

- Potentially applicable human health screening criterial for consumption of fish from the Columbia River, and
- Potentially applicable ecological screening values protective of aquatic receptors in the Columbia River.

It is important to note that DEQ RBCs are not exceeded by these groundwater VOC concentrations.

Effectiveness: Alternative 4 does not eliminate the potential for contaminated groundwater to migrate to the potential receptor contact point, which is the Columbia River.

Long-term Reliability: Alternative 4 does nothing to remove contamination or eliminate human or ecological exposure pathways, and therefore is unreliable in the long-term.

Implementability: Alternative 4 is considered easy to implement as it requires no action.

Implementation Risk: Alternative 4 implementation risk is low, because no activities are conducted.

Sustainability: Alternative 4 is sustainable because VOC concentrations in the groundwater are expected to decrease over time.

Climate Change Concerns: No Site-specific risk factors have been identified for the Site or for this alternative with respect to potential climate change. The only climate change effect likely to be

noticeable at the Site would be a modest sea level rise of one to two feet over many decades. This is not anticipated to have a material effect on the groundwater plume.

Cost: The cost estimate to implement this alternative is zero.

4.4.2 Alternative 5: Institutional and Engineering Controls

Under Alternative 5, groundwater with VOCs exceeding screening levels (identified above) will remain at the Site. This alternative involves placement of an institutional control (EES or deed restriction) that restricts groundwater use. The deed restriction would document the following requirement:

- Groundwater at the Site will not be extracted for drinking water, industrial use, or other purposes.

Effectiveness: Alternative 5 is effective in that institutional controls would prevent use of groundwater at the Site. However this alternative is not effective for protecting ecological aquatic receptors and recreational fishers.

Long-term Reliability: Alternative 5 does nothing to remove contamination, however the EES would prevent use, or contact, of impacted groundwater, and therefore overall reliability is anticipated to be moderate over the long-term. This alternative is not effective for protecting ecological aquatic receptors and recreational fishers.

Implementability: Alternative 5 is considered easy to implement as it requires only administrative action.

Implementation Risk: Alternative 5 implementation risk is low.

Sustainability: Alternative 5 is sustainable because resources would not be consumed; no VOC source area has been identified and concentrations in the groundwater are expected to decrease over time.

Cost: The cost estimate to implement this alternative is minimal.

Climate Change Concerns: Similar to Alternative 4, no Site -specific risk factors have been identified for the Site or this alternative.

4.4.3 Alternative 6: Groundwater Monitoring and Institutional / Engineering Controls

Under Alternative 6, groundwater with VOCs exceeding screening levels (identified above) will remain at the Site. However, impacted groundwater will be monitored to provide a higher degree of confidence as to whether or not the exceedance of screening levels is significant and/or constitutes a risk. Alternative 6 will consist of installing a groundwater monitoring well within the area of the highest detected concentrations of VOCs (northern portion of Site) and performing monitored natural attenuation (MNA). The MNA will be designed to better evaluate conditions at the down-gradient portion of the Site, monitor concentrations of VOCs potentially exiting the Site, and document plume stability and/or reduction in plume size/mass over time. Specific elements of the groundwater monitoring aspect of Alternative 6 will include:

- Installation and development of one groundwater monitoring well near the northwest portion of the property next to Duane Street (near SB-1). This would be completed following the soil removal action.
- Sampling of the monitoring well (initial sampling) for VOCs and natural attenuation parameters.
- Follow-on quarterly (or minimum of bi-annual) sampling events for VOCs to evaluate trends in groundwater concentrations.
- Preparation of report with updated BIOCHLOR model results.

This alternative also would include placement of an institutional control that restricts groundwater use. The deed restriction would document the following requirement:

- Groundwater at the Site will not be extracted for drinking water, industrial use, or other purposes.

Effectiveness: Alternative 6 is effective in that institutional controls would prevent use of groundwater at the Site.

Long-term Reliability: Alternative 6 would provide supplementary data to be used in updating the BIOCHLOR model outputs (results). As such, long-term reliability of the model results and associated fate and transport conclusions would be improved.

Implementability: Alternative 6 is considered easy to implement. It will require readily available equipment, materials, and services. Multiple phases of drilling have already occurred at the Site without encountering problems.

Implementation Risk: Alternative 6 implementation risk is low. Subcontractors hired to conduct the well installation will be current in the US Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operator (HAZWOPER) training. Activities would be performed in accordance with a HASP.

Sustainability: Installation of a monitoring well for MNA is sustainable, particularly when compared with groundwater containment and/or treatment options.

Cost: The cost estimate to implement this alternative is approximately $20,000. All tasks required to complete this alternative are eligible for funding by the City's EPA multi-purpose brownfield pilot grant, although depending upon the final cost for implementing the chosen soil alternative, remaining grant funds may or may not be insufficient to complete Alternative 6.

5.0 PREFERRED REMEDIAL ALTERNATIVES FOR SOIL AND GROUNDWATER

The preferred remedial alternatives are Alternative 3c for soil and Alternative 6 for groundwater.

For soil the total scores for Alternatives 3a, 3b, and 3c are nearly the same, with the slight preferences for Alternatives 3a and 3b in terms of implementability, implementation risk, and cost, being outweighed by the greater effectiveness, reliability, sustainability, and climate change resilience of removing most/all of the accessible areas of contaminated soil from beneath the parking deck under Alternative 3c. Alternative 3c also is anticipated to result in a quicker timeframe to secure a No Further Action (NFA) finding from the DEQ for the Site. While cost is a consideration in evaluating the alternatives, a budget (EPA grant plus City matching funds) have been established for the remediation scope of work, and Alternatives 3a, 3b, and 3c all likely fall near or within that budget, provided a substantial amount of the material can be reused at a City-owned site. If it turns out (based on pending sampling results) that insufficient material can be reused locally and/or the amount of soil removal needed beneath the parking deck to achieve RBCs is too large (e.g., requires major bracing or need to demolish part of the structure), then costs for Alternative 3c may exceed the available funds, making that option less feasible. If this occurs, then alternatives 3a or 3b would be recommended.

For groundwater, all alternatives are believed to be protective of human health. However, Alternative 6 (MNA) provides more certainty regarding groundwater contaminant concentrations and potential for off-Site migration. Therefore Alternative 6 is the preferred alternative.

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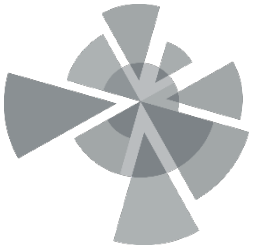
LIMITATIONS

This Analysis of Brownfield Cleanup Alternatives report was prepared exclusively for the City of Astoria (City) by Amec Foster Wheeler Environment & Infrastructure, Inc. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in Amec Foster Wheeler services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This Analysis of Brownfield Cleanup Alternatives report is intended to be used by the City for the Heritage Square Site only, subject to the terms and conditions of its contract with Amec Foster Wheeler. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

The findings contained herein are relevant to the dates of the Amec Foster Wheeler Site visits and should not be relied upon to represent conditions at later dates. In the event that changes in the nature, usage, or layout of the property or nearby properties are made, the conclusions and recommendations contained in this report may not be valid. If additional information becomes available, it should be provided to Amec Foster Wheeler so the original conclusions and recommendations can be modified as necessary.



TABLES

TABLE 1A
Total Petroleum Hydrocarbon Soil Analytical Data Summary Table
Heritage Square - Astoria, Oregon

				Diesel	Heavy Oil
			Urban Residential Direct Contact RBC	2,200	5,700
			Occupational Direct Contact RBC	14,000	36,000
			Construction Worker Direct Contact RBC	4,600	11,000
			Urban Residential Leaching to Groundwater RBC	9,500	>Max
			Occupational Leaching to Groundwater RBC	>Max	>Max
			Clean Fill Standards	NA	NA
Location Group	**Sample ID**	**Depth (ft bsl)**	**Sample Date**	(mg/kg)	(mg/kg)
Below parking deck	B-6	10.5	2/20/2003	16 U	**448**
Below parking deck	SS-1	11.0	3/18/2003	**238**	**1,010**
Below parking deck	SS-2	11.0	3/18/2003	**2,000**	**6,390**
Below parking deck	SS-3	11.0	3/18/2003	**129**	**110**
Below parking deck	SS-4	11.0	3/18/2003	15.6 U	**124**
Below parking deck	SS-5	11.0	3/18/2003	195 U	**2,520**
Below parking deck	SS-7	10.5	10/31/2003	**251**	**1,230**
Below parking deck	SS-8	10.5	10/31/2003	**134**	**704**
Below parking deck	SS-9	10.5	10/31/2003	**28.6**	**201**
Below parking deck	SS-10	10.5	10/31/2003	**473**	**2,850**
Below parking deck	SS-11	10.5	10/31/2003	**55.4**	**364**
Below parking deck	SS-12	10.5	10/31/2003	**22.1**	**118**
Below parking deck	SS-13	10.5	10/31/2003	**479**	**1,850**
Below parking deck	SS-14	10.5	10/31/2003	17 U	**57.3**
Below parking deck	SS-15	10.5	10/31/2003	**133**	**983**
Below parking deck	SS-16	10.5	10/31/2003	**18.9**	**121**
Below parking deck	SS-17	10.5	10/31/2003	**200**	**1,320**
Below parking deck	SS-18	10.5	10/31/2003	**33.9**	**196**
Below parking deck	SS-19	10.5	10/31/2003	**19.2**	**146**
Below parking deck	DP-13	10.0	5/17/2012	**102**	**887**
Below parking deck	DP-14	11.0	5/17/2012	**36.1**	**313**
Below parking deck	DP-15	9.5	5/17/2012	8 U	**71.8**
Below parking deck	DP-16	10.3	5/17/2012	8.5 U	38.4J
Below parking deck	DP-17	9.5	5/17/2012	**26.2**	**199**
Below parking deck	DP-18	9.5	5/17/2012	10.6 U	42.3 U
Below parking deck	SB-2	8	6/4/2014	25.0 U	**50.1 J**
Below parking deck	SB-3	8	6/4/2014	25.0 U	**53.3**
Below parking deck	SB-4	9	6/4/2014	25.0 U	**253**
Below parking deck	SB-5	9	6/4/2014	25.0 U	**614**
Below parking deck	SB-6	9	6/4/2014	265 U	**1,990 J**
Below parking deck	SB-13	9	6/4/2014	25.0 U	50.0 U
Stockpile 1	SC-1	-	6/4/2014	215 U	**459**
Stockpile 1	S-1-2	8.5	7/21/2015	7.9 U	**230**
Stockpile 1	S-2-2	8.5	7/21/2015	**13**	**260**
Stockpile 1	S-3-2	8.5	7/21/2015	7.8 U	**170**
Stockpile 1	S-4-2	8.5	7/21/2015	**11**	**180**
Stockpile 1	S-5-2	8.5	7/21/2015	8 U	**140**
Stockpile 2	HA-2	9.0	5/16/2012	9.1 U	36.4 U
Stockpile 2	SC-2	-	6/6/2014	25.0 U	**115**
Stockpile 2	SC-2	-	6/6/2014	25.0 U	**115**
Stockpile 2	S-10-0-7	0-7	7/21/2015	8.3 U	21 U
Stockpile 2	S-11-7-10	7-10	7/21/2015	**9.3**	**170**
Stockpile 2	S-12-0-7	0-7	7/21/2015	8.2 U	**30**
Stockpile 2	S-13-7-10	7-10	7/21/2015	7.9 U	**68**
Stockpile 2	S-14-0-3	0-3	7/21/2015	8.1 U	**50**
Stockpile 2	S-15-3-10	3-10	7/21/2015	8.2 U	**100**
Stockpile 2	S-16-0-3	0-3	7/21/2015	8.2 U	**61**
Stockpile 2	S-17-0-2.5	2.5	7/21/2015	8.1 U	**73**
Stockpile 2	S-18-2.5-5.5	5.5	7/21/2015	**17**	**100**
Stockpile 2	S-19-5.5-10	5.5-10	7/21/2015	8 U	**290**
Stockpile 2	S-20-0-2.5	2.5	7/21/2015	7.8 U	**58**
Stockpile 2	S-20-0-2.5-dup	2.5	7/21/2015	7.8 U	**54**
Stockpile 2	S-21-2.5-10	2.5-10	7/21/2015	8.2 U	**92**
Stockpile 2	S-22-0-2	0-2	7/21/2015	8.1 U	**68**
Stockpile 2	S-23-2-10	2-10	7/21/2015	**11**	**140**

TABLE 1A
Total Petroleum Hydrocarbon Soil Analytical Data Summary Table
Heritage Square - Astoria, Oregon

				Diesel	Heavy Oil
			Urban Residential Direct Contact RBC	2,200	5,700
			Occupational Direct Contact RBC	14,000	36,000
			Construction Worker Direct Contact RBC	4,600	11,000
			Urban Residential Leaching to Groundwater RBC	9,500	>Max
			Occupational Leaching to Groundwater RBC	>Max	>Max
			Clean Fill Standards	NA	NA
Location Group	**Sample ID**	**Depth (ft bsl)**	**Sample Date**	(mg/kg)	(mg/kg)
Stockpile 2	S-24-0-4	0-4	7/21/2015	7.9 U	**51**
Stockpile 2	S-47-4-10	4-10	7/21/2015	8.2 U	**28**
Stockpile 2	S-48-0-8	0-8	7/21/2015	8 U	**56**
Stockpile 2	S-49-8-10	8-10	7/21/2015	7.8 U	**40**
Stockpile 3	SS-6	10.5	10/31/2003	**367**	**1,980**
Stockpile 3	DP-12	9.5	5/16/2012	8.2 U	32.8 U
Stockpile 3	DP-19	10.3	5/17/2012	**216**	**1,450**
Stockpile 3	DP-19	10.3	5/17/2012	**216**	**1,450**
Stockpile 3	SC-3	-	6/6/2014	242 U	**2,010**
Duane Street	DP-01	1.5	5/15/2012	8.7 U	35 U
Duane Street	DP-02	15.0	5/16/2012	8.4 U	33.7 U
Duane Street	DP-03	10.0	5/16/2012	8.5 U	34.1 U
Duane Street	DP-04	3.0	5/16/2012	10.1 U	40.5 U
Duane Street	DP-05	2.0	5/17/2012	10.9 U	43.7 U
Exchange Street	DP-11	3.0	5/16/2012	11.8 U	47.2 U
Beneath Safeway Basement Floor	B-29	11.5	10/30/2003	18.4 U	61.2 U
Beneath Safeway Basement Floor	B-31	11.5	10/30/2003	16.1 U	55.4 U
Former Safeway	HA-1	10.0	5/16/2012	10.8 U	43 U
Garden of Surging Waves	DP-06	3.0	5/15/2012	**10J**	33.8 U
Garden of Surging Waves	DP-07	2.0	5/15/2012	**27.5**	**163**
Garden of Surging Waves	DP-08	10.0	5/15/2012	11.3 U	45.1 U
Garden of Surging Waves	DP-09	2.0	5/15/2012	**28.5**	**260**
Garden of Surging Waves	DP-10	10.0	5/16/2012	10.5 U	42.1 U
			Stockpile 1 Average	23.9	239.8
			Stockpile 1 Count	6	6
			Stockpile 2 Average	6.0	81.8
			Stockpile 2 Count	22	22
			Stockpile 3 Average	229.4	1,771
			Stockpile 3 Count	5	5
			Below parking deck Average	151.9	815
			Below parking deck Count	31	31

Notes:
Bold = constituent detected at or above the method reporting limit
J = estimated result
U = constituent not detected at or above the reporting limit shown
UJ = not detected at or above the stated level, which is an approximate value
>Max = The constituent RBC for this pathway is calculated as greater than 1,000,000 mg/kg or 1,000,000 mg/L.
Therefore, this substance is deemed not to pose risks in this scenario.

Red Text exceeds Urban Residential Direct Contact RBC
exceeds Clean Fill Standard
exceeds Occupational Direct Contact RBC
exceeds Construction Worker Direct Contact RBC
exceeds Urban Residential Leaching to Groundwater RBC

Average calculations by location group were done using the detections and half the reporting limit.
ft bsl = feet below street level
Stockpile 1 was measured on July 21, 2015 to be 3.5 feet tall. 6.5 feet were added to each sample depth to convert to bsl.
Stockpile 2 was measured on July 21, 2015 to be 10 feet tall, equal to bsl.
Stockpile 3 was measured on July 21, 2015 to be 3 feet tall. 5.5 feet were added to each sample depth to convert to bsl.
The area beneath the parking deck was measured on July 21, 2015 to be 8 feet below bsl. 8 feet was added to each sample depth to convert to bsl.
µg/kg = microgram per kilogram
NA = No RBC has been published by DEQ for this analyte by this exposure pathway
ND = not detected, none of the results in the average calculation was detected
NT = Not Tested
RBC = Risk-Based Screening Concentrations
DEQ Risk Based Concentrations, June 2012
Clean Fill Standards, June 2014

TABLE 1B
Polycyclic Aromatic Hydrocarbon Soil Analytical Data Summary Table
Heritage Square - Astoria, Oregon

				Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b+k)fluoranthene(s)	Benzo(g,h,i)perylene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	1-Methylnaphthalene	2-Methylnaphthalene
Urban Residential Direct Contact RBC				9,400,000	NA	47,000,000	340	34	340	NA	32,000	34	4,600,000	6,300,000	340	25,000	NA	3,400,000	NA	NA
Occupational Direct Contact RBC				61,000,000	NA	310,000,000	2,700	270	2,700	NA	250,000	270	29,000,000	41,000,000	2,700	23,000	NA	21,000,000	NA	NA
Construction Worker Direct Contact RBC				19,000,000	NA	93,000,000	21,000	2,100	21,000	NA	2,100,000	2,100	8,900,000	12,000,000	21,000	580,000	NA	6,700,000	NA	NA
Urban Residential Leaching to Groundwater RBC				NA	NA	NA	10,000	2,000	NA	NA	NA	NA	NA	NA	NA	470	NA	NA	NA	NA
Occupational Leaching to Groundwater RBC				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	440	NA	NA	NA	NA
Clean Fill Standards				29,000	--	29,000	150	15	150	--	14,000	15	29,000	29,000	150	87	--	1,700,000	738	310,000
Location Group	**Sample ID**	**Depth (ft bsl)**	**Sample Date**	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)
Below parking deck	SS-9	9.5 - 10.5	10/31/2003	6.67 U	**8.67**	6.67 U	**14**	**30**	**62**	**54.7**	**18.7**	**8.67**	**34.7**	6.67 U	**37.3**	**16.7**	**26.7**	**32.7**	6.67 U	6.67 U
Below parking deck	DP-13	10.0	5/17/2012	9 U	**37**	**40.8**	**53.4**	**71.3**	**116.1**	**42.7**	**66.4**	**11.7**	**94.7**	9 U	**44.9**	**44 B**	**103**	**69.4**	9 U	17 B
Below parking deck	DP-14	11.0	5/17/2012	71.1 U	71.1 U	71.1 U	71.1 U	71.1 U	71.1 U	71.1 U	71.1 U	71.1 U	71.1 U	71.1 U	71.1 U	71.1 U	71.1 U	71.1 U	71.1 U	71.1 U
Below parking deck	DP-15	9.5	5/17/2012	7.1 U	7.1 U	7.1 U	7.1 U	7.1 U	7.1 U	**8.7**	7.1 U	7.1 U	7.1 U	7.1 U	7.1 U	7.1 U	7.1 U	7.1 U	7.1 U	7.1 U
Below parking deck	DP-17	9.5	5/17/2012	69.5 U	69.5 U	69.5 U	69.5 U	69.5 U	69.5 U	69.5 U	69.5 U	69.5 U	69.5 U	69.5 U	69.5 U	69.5 U	69.5 U	69.5 U	69.5 U	69.5 U
Below parking deck	SB-2	8	6/4/2014	47.7 U	47.7 U	47.7 U	47.7 U	**53.9**	**98.9**	**57.4**	**59.8**	47.7 U	**76.4**	47.7 U	**51.7**	47.7 U	47.7 U	**89.1**	NT	NT
Below parking deck	SB-3	8	6/4/2014	99.2 U	**203**	99.2 U	**230**	**450**	**710**	**389**	**365**	99.2 U	**194**	99.2 U	**394**	99.2 U	99.2 U	**273**	NT	NT
Below parking deck	SB-4	9	6/4/2014	90.2 U	90.2 U	90.2 U	90.2 U	**180**	**265**	**218**	**118**	90.2 U	90.2 U	90.2 U	**212**	90.2 U	90.2 U	**103**	NT	NT
Below parking deck	SB-5	9	6/4/2014	10.7 U	**10.7**	**18.8**	**60.4**	**87.3**	**164**	**90.3**	**105**	**10.9**	**176**	10.7 U	**80.1**	**22.1**	**131**	**192**	NT	NT
Below parking deck	SB-6	9	6/4/2014	608 U	**1,490**	**1,560**	**14,900**	**38,700**	**48,600**	**47,200**	**20,500**	**4,020**	**29,100**	608 U	**37,000**	**3,590**	**8,700**	**41,300**	NT	NT
Below parking deck	SB-13	9	6/4/2014	9.76 U	9.76 U	9.76 U	9.76 U	9.76 U	19.5 U	9.76 U	9.76 U	9.76 U	**10.7**	9.76 U	9.76 U	9.76 U	9.76 U	**11.6**	NT	NT
Below parking deck	S-25-1	9	7/22/2015	93 U	93 U	93 U	**420**	**550**	**2,100**	**1,500**	**750**	**180**	**590**	93 U	**940**	93 U	**160**	**820**	93 U	93 U
Below parking deck	S-26-1	9	7/22/2015	96 U	96 U	96 U	96 U	96 U	96 U	**54 J**	96 U	96 U	96 U	96 U	96 U	96 U	96 U	96 U	96 U	96 U
Below parking deck	S-27-1	9	7/22/2015	120 U	120 U	**76 J**	**670**	**1,500**	**1,800**	**2,000**	**830**	**190**	**1,300**	120 U	**1,300**	**64 J**	**310**	**1,800**	120 U	120 U
Below parking deck	S-28-1	9	7/22/2015	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U
Below parking deck	S-29-2	10	7/22/2015	130 U	130 U	130 U	130 U	130 U	**59 J**	**61 J**	130 U	130 U	130 U	130 U	130 U	130 U	130 U	**58 J**	130 U	130 U
Below parking deck	S-30-2	10	7/22/2015	100 U	100 U	100 U	100 U	**43 J**	**57 J**	**77 J**	100 U	100 U	100 U	100 U	**51 J**	100 U	100 U	100 U	100 U	100 U
Stockpile 1	SC-1	-	6/4/2014	43.5 U	43.5 U	43.5 U	43.5 U	43.5 U	87.0 U	43.5 U	43.5 U	43.5 U	43.5 U	43.5 U	43.5 U	43.5 U	43.5 U	43.5 U	NT	NT
Stockpile 1	S-1-2	8.5	7/21/2015	93 U	93 U	93 U	93 U	93 U	**41 J**	**43 J**	93 U	93 U	**46 J**	93 U	93 U	93 U	93 U	**46 J**	93 U	93 U
Stockpile 1	S-2-2	8.5	7/21/2015	96 U	96 U	96 U	**85 J**	**110**	**170**	**110**	**78 J**	96 U	**150**	96 U	**80 J**	96 U	**86 J**	**150**	96 U	96 U
Stockpile 1	S-3-2	8.5	7/21/2015	99 U	99 U	99 U	**44 J**	**43 J**	**63 J**	**57 J**	**40 J**	99 U	**71 J**	99 U	99 U	99 U	**58 J**	**65 J**	99 U	99 U
Stockpile 1	S-4-2	8.5	7/21/2015	97 U	97 U	97 U	**44 J**	**42 J**	**54 J**	**61 J**	**44 J**	97 U	**65 J**	97 U	**39 J**	97 U	**82 J**	**71 J**	97 U	97 U
Stockpile 1	S-5-2	8.5	7/21/2015	92 U	92 U	**52 J**	**120**	**110**	**192**	**76 J**	**120**	92 U	**180**	92 U	**62 J**	92 U	**130**	**170**	92 U	92 U
Stockpile 2	SC-2	-	6/6/2014	61.6 U	**115 J**	**100 J**	**200 J**	**188 J**	**320 J**	**120 J**	**203 J**	61.6 U	**324 J**	61.6 U	**118 J**	**63.4**	**379 J**	**301 J**	NT	NT
Stockpile 2	SC-2 (Soil Dup)	-	6/6/2014	12.5 U	**40.6 J**	**24.5 J**	**47.8 J**	**55.1 J**	**85.4 J**	**47.6 J**	**58.6 J**	12.5 U	**75.0 J**	12.5 U	**41.0 J**	**13**	**73.8 J**	**74.7 J**	NT	NT
Stockpile 2	S-10-0-7	0-7	7/21/2015	100 U	100 U	100 U	**110**	**91 J**	**165**	**43 J**	**120**	100 U	**160**	100 U	**45 J**	100 U	**85 J**	**160**	100 U	100 U
Stockpile 2	S-11-7-10	7-10	7/21/2015	95 U	95 U	95 U	95 U	**40 J**	**46 J**	**50 J**	95 U	95 U	**40 J**	95 U	95 U	95 U	95 U	**38 J**	95 U	95 U
Stockpile 2	S-12-0-7	0-7	7/21/2015	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
Stockpile 2	S-13-7-10	7-10	7/21/2015	100 U	**110**	**190**	**220**	**240**	**420**	**270**	**240**	**55 J**	**480**	100 U	**200**	100 U	**160**	**390**	100 U	100 U
Stockpile 2	S-14-0-3	0-3	7/21/2015	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
Stockpile 2	S-15-3-10	3-10	7/21/2015	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
Stockpile 2	S-16-0-3	0-3	7/21/2015	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
Stockpile 2	S-17-0-2.5	2.5	7/21/2015	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U
Stockpile 2	S-18-2.5-5.5	5.5	7/21/2015	**350**	**110**	**530**	**430**	**470**	**760**	**370**	**550**	**68 J**	**1,200**	**550**	**300**	**240**	**1,900**	**820**	**170**	**290**
Stockpile 2	S-19-5.5-10	5.5-10	7/21/2015	96 U	96 U	96 U	**82 J**	**110**	**181**	**120**	**88 J**	96 U	**140**	96 U	**83 J**	96 U	**69 J**	**130**	96 U	96 U
Stockpile 2	S-20-0-2.5	2.5	7/21/2015	92 U	92 U	92 U	92 U	92 U	92 U	92 U	92 U	92 U	92 U	92 U	92 U	92 U	92 U	92 U	92 U	92 U
Stockpile 2	S-21-2.5-10	2.5-10	7/21/2015	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U
Stockpile 2	S-22-0-2	0-2	7/21/2015	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U	98 U
Stockpile 2	S-23-2-10	2-10	7/21/2015	100 U	100 U	100 U	100 U	100 U	100 U	100 U	**56 J**	100 U	**49 J**	100 U	100 U	100 U	100 U	**48 J**	100 U	100 U
Stockpile 2	S-24-0-4	0-4	7/21/2015	93 U	93 U	93 U	93 U	93 U	93 U	93 U	93 U	93 U	93 U	93 U	93 U	93 U	93 U	93 U	93 U	93 U
Stockpile 2	S-47-4-10	4-10	7/21/2015	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U	110 U
Stockpile 2	S-48-0-8	0-8	7/21/2015	100 U	100 U	100 U	**70 J**	**68 J**	**80 J**	100 U	**76 J**	100 U	**92 J**	100 U	100 U	100 U	**45 J**	**93 J**	100 U	100 U
Stockpile 2	S-49-8-10	8-10	7/21/2015	98 U	98 U	98 U	**38 J**	**40 J**	**64 J**	**43 J**	**40 J**	98 U	**57 J**	98 U	98 U	98 U	98 U	**45 J**	98 U	98 U

TABLE 1B
Polycyclic Aromatic Hydrocarbon Soil Analytical Data Summary Table
Heritage Square - Astoria, Oregon

				Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b+k)fluoranthene(s)	Benzo(g,h,i)perylene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	1-Methylnaphthalene	2-Methylnaphthalene
Urban Residential Direct Contact RBC				9,400,000	NA	47,000,000	340	34	340	NA	32,000	34	4,600,000	6,300,000	340	25,000	NA	3,400,000	NA	NA
Occupational Direct Contact RBC				61,000,000	NA	310,000,000	2,700	270	2,700	NA	250,000	270	29,000,000	41,000,000	2,700	23,000	NA	21,000,000	NA	NA
Construction Worker Direct Contact RBC				19,000,000	NA	93,000,000	21,000	2,100	21,000	NA	2,100,000	2,100	8,900,000	12,000,000	21,000	580,000	NA	6,700,000	NA	NA
Urban Residential Leaching to Groundwater RBC				NA	NA	NA	10,000	2,000	NA	NA	NA	NA	NA	NA	NA	470	NA	NA	NA	NA
Occupational Leaching to Groundwater RBC				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	440	NA	NA	NA	NA
Clean Fill Standards				29,000	--	29,000	150	15	150	--	14,000	15	29,000	29,000	150	87	--	1,700,000	738	310,000
Location Group	**Sample ID**	**Depth (ft bsl)**	**Sample Date**	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)
Stockpile 3	SS-6	9.5 - 10.5	10/31/2003	6.67 U	**131**	**119**	**337**	**761**	**1,121**	**380**	**391**	**52**	**1,450**	**28.7**	**276**	**670**	**966**	**1,650**	6.67 U	6.67 U
Stockpile 3	DP-19	10.3	5/17/2012	117 U	**169**	**120**	**125**	**369**	**454**	**688**	**160**	117 U	**149**	117 U	**543**	**268**	117 U	**226**	117 U	**126**
Stockpile 3	DP-19	10.3	5/17/2012	83.7 U	**860**	**666**	**720**	**2,400**	**2,708**	**2,860**	**963**	**341**	**848**	83.7 U	**2,230**	**494**	**624**	**1,040**	**93.2**	**334**
Stockpile 3	SB-1	6	6/4/2014	42.3 U	42.3 U	42.3 U	**53.6**	**59.5**	**132**	169 U	**168**	169 U	**111**	42.3 U	169 U	**45.3 J**	**68.9**	**140**	NT	NT
Stockpile 3	SC-3	-	6/6/2014	53.5 U	53.5 U	**58.5**	**154**	**205**	**340**	**298**	**335**	53.5 U	**388**	53.5 U	**223**	**163**	**279**	**463**	NT	NT
Duane Street	DP-5	15.0	5/17/2012	6.7 U	6.7 U	6.7 U	6.7 U	6.7 U	6.7 U	6.7 U	6.7 U	6.7 U	6.7 U	6.7 U	6.7 U	6.7 U	6.7 U	6.7 U	6.7 U	6.7 U
Garden of Surging Waves	DP-7	2.0	5/15/2012	7.7 U	**13.7**	7.7 U	**37.9**	**33.5**	**66.2**	**22.1**	**27.3**	7.7 U	**49.3**	7.7 U	**20.4**	7.7 U	**15**	**53.1**	7.7 U	7.7 U
Garden of Surging Waves	DP-9	2.0	5/17/2012	7.9 U	7.9 U	7.9 U	7.9 U	**24.5**	**15.6**	**12.4**	**15.3**	7.9 U	**9.8**	7.9 U	7.9 U	7.9 U	**8.2**	**13.5**	7.9 U	7.9 U
Stockpile 1 Average				43.4	43.4	44.4	60.2	62.2	93.9	61.5	58.4	43.4	89.0	43.4	49.8	43.4	70.7	87.3	47.7	47.7
Stockpile 1 Count				6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5
Stockpile 2 Average				61.6	58.5	82.0	89.8	92.6	133.6	83.2	99.0	47.8	155.9	71.6	74.2	58.1	167.9	130.0	56.4	63.1
Stockpile 2 Count				20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	18	18
Stockpile 3 Average				30.3	241.6	196.9	277.9	758.9	951.0	862.1	403.4	112.6	589.2	35.4	671.3	328.1	399.3	703.8	51.7	154.4
Stockpile 3 Count				5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	3
Below parking deck Average				49.4	130.7	127.1	983.1	2465.4	3189.3	3051.9	1359.4	284.5	1877.3	49.4	2374.0	247.0	579.2	2645.6	36.9	38.1
Below parking deck Count				17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	11	11

Notes:
Bold = constituent detected at or above the method reporting limit
J = estimated result
U = constituent not detected at or above the reporting limit shown
UJ = not detected at or above the stated level, which is an approximate value
>Max = The constituent RBC for this pathway is calculated as greater than 1,000,000 mg/kg or 1,000,000 mg/L.
Therefore, this substance is deemed not to pose risks in this scenario.
Red Text exceeds Urban Residential Direct Contact RBC
exceeds Clean Fill Standard
exceeds Occupational Direct Contact RBC
exceeds Construction Worker Direct Contact RBC
exceeds Urban Residential Leaching to Groundwater RBC
Average calculations by location group were done using the detections and half the reporting limit.
ft bsl = feet below street level
Stockpile 1 was measured on July 21, 2015 to be 3.5 feet tall. 6.5 feet were added to each sample depth to convert to bsl.
Stockpile 2 was measured on July 21, 2015 to be 10 feet tall, equal to bsl.
Stockpile 3 was measured on July 21, 2015 to be 3 feet tall. 5.5 feet were added to each sample depth to convert to bsl.
The area beneath the parking deck was measured on July 21, 2015 to be 8 feet below bsl. 8 feet was added to each sample depth to convert to bsl.
µg/kg = microgram per kilogram
NA = No RBC has been published by DEQ for this analyte by this exposure pathway
ND = not detected, none of the results in the average calculation was detected
NT = Not Tested
RBC = Risk-Based Screening Concentrations
DEQ Risk Based Concentrations, June 2012
Clean Fill Standards, June 2014

TABLE 1C
Polychlorinated Biphenyl Soil Analytical Data Summary Table
Heritage Square - Astoria, Oregon

				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total PCBs
Urban Residential Direct Contact RBC				NA	NA	NA	NA	NA	NA	NA	310
Occupational Direct Contact RBC				NA	NA	NA	NA	NA	NA	NA	560
Construction Worker Direct Contact RBC				NA	NA	NA	NA	NA	NA	NA	4,400
TSCA Hazardous Waste Value				NA	NA	NA	NA	NA	NA	NA	50,000
Urban Residential Leaching to Groundwater RBC				NA	NA	NA	NA	NA	NA	NA	550
Occupational Leaching to Groundwater RBC				NA	NA	NA	NA	NA	NA	NA	620
DEQ Clean Fill Standard				NA	NA	NA	NA	NA	NA	NA	200
Location Group	**Sample ID**	**Depth (ft bsl)**	**Sample Date**	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)
Below parking deck	SS-9	10.5	10/31/2003	NT	NT	NT	NT	NT	NT	NT	**386**
Below parking deck	DP-13	10.0	5/17/2012	NT	NT	NT	NT	NT	NT	NT	22.9 U
Below parking deck	DP-14	11.0	5/17/2012	NT	NT	NT	NT	NT	NT	NT	18 U
Below parking deck	DP-15	9.5	5/17/2012	NT	NT	NT	NT	NT	NT	NT	**47.8**
Below parking deck	DP-17	9.5	5/17/2012	NT	NT	NT	NT	NT	NT	NT	17.8 U
Below parking deck	SB-2	8	6/4/2014	9.59 U	9.59 U	9.59 U	9.59 U	9.59 U	**36.8 J**	**10.4 J**	**47.2**
Below parking deck	SB-3	8	6/4/2014	9.97 U	9.97 U	9.97 U	9.97 U	9.97 U	**12.9 J**	**127 NJ**	**139.9**
Below parking deck	SB-4	9	6/4/2014	10.8 U	10.8 U	10.8 U	10.8 U	10.8 U	**77.2 J**	**31.2 J**	**108.4**
Below parking deck	SB-5	9	6/4/2014	10.5 U	10.5 U	10.5 U	10.5 U	10.5 U	10.5 U	10.5 U	10.5 U
Below parking deck	SB-6	9	6/4/2014	12.6 U	12.6 U	12.6 U	12.6 U	12.6 U	**16.5**	12.6 U	**16.5**
Below parking deck	SB-13	9	6/4/2014	10.5 U	10.5 U	10.5 U	10.5 U	10.5 U	10.5 U	10.5 U	10.5 U
Stockpile 1	SC-1	-	6/4/2014	11.1 U	11.1 U	11.1 U	11.1 U	11.1 U	**523 NJ**	11.1 U	**523**
Stockpile 1	S-1-2	8.5	7/21/2015	10 U	10 U	10 U	10 U	10 U	**270**	50 U	**270**
Stockpile 1	S-2-2	8.5	7/21/2015	10 U	10 U	10 U	10 U	10 U	**320**	50 U	**320**
Stockpile 1	S-3-2	8.5	7/21/2015	10 U	10 U	10 U	10 U	10 U	**280**	51 U	**280**
Stockpile 1	S-4-2	8.5	7/21/2015	10 U	10 U	10 U	10 U	10 U	**210**	51 U	**210**
Stockpile 1	S-5-2	8.5	7/21/2015	10 U	10 U	10 U	10 U	10 U	**200**	50 U	**200**
Stockpile 2	SC-2	-	6/6/2014	12.2 U	12.2 U	12.2 U	12.2 U	12.2 U	12.2 UJ	12.2 U	12.2 U
Stockpile 2	SC-2 Dup	-	6/6/2014	11.7 U	11.7 U	11.7 U	11.7 U	11.7 U	**25.4 J**	11.7 U	**25.4**
Stockpile 3	SS-6	10.5	10/31/2003	NT	NT	NT	NT	NT	NT	NT	**1,304**
Stockpile 3	DP-19	10.3	5/17/2012	NT	NT	NT	NT	NT	NT	NT	30 U
Stockpile 3	DP-19	10.3	5/17/2012	NT	NT	NT	NT	NT	NT	NT	**26.7**
Stockpile 3	SB-1	6	6/4/2014	9.84 U	9.84 U	9.84 U	9.84 U	9.84 U	**331**	9.84 U	**331**
Stockpile 3	SC-3	-	6/6/2014	11.1 U	11.1 U	11.1 U	11.1 U	11.1 U	**676**	11.1 U	**676**
Stockpile 3	S-31-1.5	7	7/22/2015	10 U	10 U	10 U	10 U	10 U	**610**	40 U	**610**
Stockpile 3	S-32-4	9.5	7/22/2015	10 U	10 U	10 U	10 U	10 U	**310**	50 U	**310**
Stockpile 3	S-33-6	11.5	7/22/2015	10 U	10 U	10 U	10 U	10 U	**710**	100 U	**710**
Stockpile 3	S-34-1	6.5	7/22/2015	10 U	10 U	10 U	10 U	10 U	**150**	20 U	**150**
Stockpile 3	S-35-1	6.5	7/22/2015	10 U	10 U	10 U	10 U	10 U	**21**	20 U	**21**
Stockpile 3	S-36-1	6.5	7/22/2015	10 U	10 U	10 U	10 U	10 U	**1,000**	100 U	**1,000**
Stockpile 3	S-37-1	6.5	7/22/2015	10 U	10 U	10 U	10 U	10 U	**20**	10 U	**20**

TABLE 1C
Polychlorinated Biphenyl Soil Analytical Data Summary Table
Heritage Square - Astoria, Oregon

				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total PCBs
Urban Residential Direct Contact RBC				NA	NA	NA	NA	NA	NA	NA	310
Occupational Direct Contact RBC				NA	NA	NA	NA	NA	NA	NA	560
Construction Worker Direct Contact RBC				NA	NA	NA	NA	NA	NA	NA	4,400
TSCA Hazardous Waste Value				NA	NA	NA	NA	NA	NA	NA	50,000
Urban Residential Leaching to Groundwater RBC				NA	NA	NA	NA	NA	NA	NA	550
Occupational Leaching to Groundwater RBC				NA	NA	NA	NA	NA	NA	NA	620
DEQ Clean Fill Standard				NA	NA	NA	NA	NA	NA	NA	200
Location Group	**Sample ID**	**Depth (ft bsl)**	**Sample Date**	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)
Duane Street	DP-05	15.0	5/17/2012	NT	NT	NT	NT	NT	NT	NT	16.9 U
Garden of Surging Waves	DP-07	2.0	5/15/2012	NT	NT	NT	NT	NT	NT	NT	19.5 U
Garden of Surging Waves	DP-09	2.0	5/15/2012	NT	NT	NT	NT	NT	NT	NT	20.1 U
Stockpile 1 Average				5.1 ND	5.1 ND	5.1 ND	5.1 ND	5.1 ND	300.5	21.9	300.5
Stockpile 1 Count				6	6	6	6	6	6	6	6
Stockpile 2 Average				6 ND	6 ND	6 ND	6 ND	6 ND	15.75	5.975	15.75
Stockpile 2 Count				2	2	2	2	2	2	2	2
Stockpile 3 Average				5.1 ND	5.1 ND	5.1 ND	5.1 ND	5.1 ND	425.33	20.1	431.1
Stockpile 3 Count				9	9	9	9	9	9	9	12
Below parking deck Average				5.3 ND	5.3 ND	5.3 ND	5.3 ND	5.3 ND	25.65	30.9	72.4
Below parking deck Count				6	6	6	6	6	6	6	11

TABLE 1C
Polychlorinated Biphenyl Soil Analytical Data Summary Table
Heritage Square - Astoria, Oregon

				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total PCBs
Urban Residential Direct Contact RBC				NA	NA	NA	NA	NA	NA	NA	310
Occupational Direct Contact RBC				NA	NA	NA	NA	NA	NA	NA	560
Construction Worker Direct Contact RBC				NA	NA	NA	NA	NA	NA	NA	4,400
TSCA Hazardous Waste Value				NA	NA	NA	NA	NA	NA	NA	50,000
Urban Residential Leaching to Groundwater RBC				NA	NA	NA	NA	NA	NA	NA	550
Occupational Leaching to Groundwater RBC				NA	NA	NA	NA	NA	NA	NA	620
DEQ Clean Fill Standard				NA	NA	NA	NA	NA	NA	NA	200
Location Group	**Sample ID**	**Depth (ft bsl)**	**Sample Date**	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)

Notes:
Bold = constituent detected at or above the method reporting limit
J = estimated result
U = constituent not detected at or above the reporting limit shown
NJ = The analyte was tentatively identified and the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = not detected at or above the stated level, which is an approximate value
>Max = The constituent RBC for this pathway is calculated as greater than 1,000,000 mg/kg or 1,000,000 mg/L.
Therefore, this substance is deemed not to pose risks in this scenario.
Red Text exceeds Urban Residential Direct Contact RBC
exceeds Clean Fill Standard
exceeds Occupational Direct Contact RBC
exceeds Construction Worker Direct Contact RBC
exceeds Urban Residential Leaching to Groundwater RBC
Average calculations by location group were done using the detections and half the reporting limit.
ft bsl = feet below street level
Stockpile 1 was measured on July 21, 2015 to be 3.5 feet tall. 6.5 feet were added to each sample depth to convert to bsl.
Stockpile 2 was measured on July 21, 2015 to be 10 feet tall, equal to bsl.
Stockpile 3 was measured on July 21, 2015 to be 3 feet tall. 5.5 feet were added to each sample depth to convert to bsl.
The area beneath the parking deck was measured on July 21, 2015 to be 8 feet below bsl. 8 feet was added to each sample depth to convert to bsl.
µg/kg = microgram per kilogram
NA = No RBC has been published by DEQ for this analyte by this exposure pathway
ND = not detected, none of the results in the average calculation was detected
NT = Not Tested
RBC = Risk-Based Screening Concentrations
DEQ Risk Based Concentrations, June 2012
Clean Fill Standards, June 2014

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TABLE 1D
Metals Soil Analytical Data Summary Table
Heritage Square - Astoria, Oregon

				Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Urban Residential Direct Contact RBC				1.0	31,000	78	230,000	400	47	NA	780
Occupational Direct Contact RBC				1.7	190,000	510	>Max	800	310	NA	5,100
Construction Worker Direct Contact RBC				13	60,000	150	460,000	800	93	NA	1,500
Urban Residential Leaching to Groundwater RBC				NA	NA	NA	NA	30	NA	NA	NA
Occupational Leaching to Groundwater RBC				NA	NA	NA	NA	30	NA	NA	NA
DEQ Clean Fill Standards				12	840	0.54	240	34	0.11	1.5	--
Oregon DEQ Background Concentration				12	840	0.54	240	34	0.11	1.5	0.41
Location Group	**SampleID**	**Depth (ft bsl)**	**Sample Date**	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Below parking deck	SS-9	10.5	10/31/2003	1.72 U	**93.7**	**1.18**	**11.3**	**133**	**0.119**	1.72 U	1.72 U
Below parking deck	DP-13	10.0	5/16/2012	**2.79**	**299**	**0.371**	**12**	**313 B**	**0.053 J**	**0.482 J**	0.19 U
Below parking deck	DP-14	11.0	5/16/2012	**1.38**	**63.6**	**0.242**	**10.1**	**57.2 B**	**0.04 J**	**0.36 J**	0.138 U
Below parking deck	DP-15	9.5	5/16/2012	**1.5**	**59.8**	**0.276**	**8.87**	**33.3 B**	**0.019 J**	**0.442 J**	**0.205 J B**
Below parking deck	DP-16	10.3	5/16/2012	**3.8**	**116**	**0.318**	**17.2**	**1,930 B**	**0.042 J**	**0.448**	0.161 U
Below parking deck	DP-17	9.5	5/16/2012	**2.86**	**159**	**361**	**15.1**	**183 B**	**0.093**	**0.678**	0.167 U
Below parking deck	DP-18	9.5	5/16/2012	**1.47**	**42.5**	**0.0343 J**	**10.9**	**7 B**	**0.0099 J**	**0.448 J**	0.182 U
Below parking deck	SB-2	8	6/4/2014	**1.65**	**107 J**	**0.622**	**9.77**	**205**	0.0816 U	2.04 U	0.204 U
Below parking deck	SB-3	8	6/4/2014	**2.10**	**63.7**	**0.703**	**7.10**	**205**	0.0908 U	0.227 U	0.227 U
Below parking deck	SB-4	9	6/4/2014	**1.50**	**80.0**	**0.706**	**9.78**	**125**	0.0896 U	2.24 U	0.224 U
Below parking deck	SB-5	9	6/4/2014	**2.94**	**192**	**1.15**	**13.4**	**171**	0.0926 U	0.231 U	0.231 U
Below parking deck	SB-6	9	6/4/2014	**5.94**	**756**	**1.17**	**17.5**	**2,770**	**0.363**	2.75 U	**0.770**
Below parking deck	SB-13	9	6/4/2014	**4.77**	**162**	**0.234**	**11.0**	**1,590**	0.0936 U	0.234 U	0.234 U
Below parking deck	S-25-1	9	7/22/2015	NT	NT	NT	NT	**12**	NT	NT	NT
Below parking deck	S-26-1	9	7/22/2015	NT	NT	NT	NT	**11**	NT	NT	NT
Below parking deck	S-27-1	9	7/22/2015	NT	NT	NT	NT	**61.4**	NT	NT	NT
Below parking deck	S-28-1	9	7/22/2015	NT	NT	NT	NT	**373**	NT	NT	NT
Below parking deck	S-29-2	10	7/22/2015	NT	NT	NT	NT	**790**	NT	NT	NT
Below parking deck	S-30-2	10	7/22/2015	NT	NT	NT	NT	**121**	NT	NT	NT
Below parking deck	S-30-2-dup	10	7/22/2015	NT	NT	NT	NT	**148**	NT	NT	NT
Below parking deck	S-38-1	9	7/22/2015	NT	NT	0.5 U	NT	**5.2**	NT	NT	NT
Below parking deck	S-39-1	9	7/22/2015	NT	NT	0.5 U	NT	**87.1**	NT	NT	NT
Below parking deck	S-40-1	9	7/22/2015	NT	NT	0.5 U	NT	**20**	NT	NT	NT
Below parking deck	S-41-1	9	7/22/2015	NT	NT	0.5 U	NT	**33.1**	NT	NT	NT
Below parking deck	S-42-2	10	7/22/2015	NT	NT	0.5 U	NT	**47.6**	NT	NT	NT
Below parking deck	S-43-1	9	7/22/2015	NT	NT	NT	NT	**134**	NT	NT	NT
Below parking deck	S-44-2	10	7/22/2015	NT	NT	NT	NT	**22.9**	NT	NT	NT
Below parking deck	S-45-1	9	7/22/2015	NT	NT	NT	NT	**44.8**	NT	NT	NT
Below parking deck	S-46-2	10	7/22/2015	NT	NT	NT	NT	**20**	NT	NT	NT
Stockpile 1	SC-1	-	6/4/2014	**2.21**	**148**	**0.522**	**8.11**	**181**	0.0907 U	2.27 U	0.227 U
Stockpile 1	S-1-2	8.5	7/21/2015	NT	NT	NT	NT	**176**	NT	NT	NT
Stockpile 1	S-2-2	8.5	7/21/2015	NT	NT	NT	NT	**367**	NT	NT	NT
Stockpile 1	S-3-2	8.5	7/21/2015	NT	NT	NT	NT	**202**	NT	NT	NT
Stockpile 1	S-4-2	8.5	7/21/2015	NT	NT	NT	NT	**222**	NT	NT	NT
Stockpile 1	S-5-2	8.5	7/21/2015	NT	NT	NT	NT	**189**	NT	NT	NT
Stockpile 2	HA-2	9.0	5/15/2012	**4.1**	**104**	**0.07 J**	**11.6**	**19.4**	**0.07 J**	**0.54 J**	0.22 U
Stockpile 2	SC-2	-	6/6/2014	**7.29**	**138**	**0.413**	**16.6**	**60.6**	0.114 U	5.70 U	0.285 U
Stockpile 2	SC-2 (Soil Dup)	-	6/6/2014	**6.80**	**168**	**0.502**	**16.8**	**60.7**	0.106 U	5.28 U	0.264 U
Stockpile 2	S-10-0-7	0-7	7/21/2015	NT	NT	NT	NT	**11**	NT	NT	NT
Stockpile 2	S-11-7-10	7-10	7/21/2015	NT	NT	NT	NT	**530**	NT	NT	NT
Stockpile 2	S-12-0-7	0-7	7/21/2015	NT	NT	NT	NT	**16.9**	NT	NT	NT
Stockpile 2	S-13-7-10	7-10	7/21/2015	NT	NT	NT	NT	**281**	NT	NT	NT
Stockpile 2	S-14-0-3	0-3	7/21/2015	NT	NT	NT	NT	**31.9**	NT	NT	NT
Stockpile 2	S-15-3-10	3-10	7/21/2015	NT	NT	NT	NT	**57.3**	NT	NT	NT
Stockpile 2	S-16-0-3	0-3	7/21/2015	NT	NT	NT	NT	**16.5**	NT	NT	NT
Stockpile 2	S-17-0-2.5	0-2.5	7/21/2015	NT	NT	NT	NT	**16.4**	NT	NT	NT
Stockpile 2	S-18-2.5-5.5	2.5-5.5	7/21/2015	NT	NT	NT	NT	**94.6**	NT	NT	NT
Stockpile 2	S-18-2.5-5.5-dup	2.5-5.5	7/21/2015	NT	NT	NT	NT	**95.4**	NT	NT	NT
Stockpile 2	S-19-5.5-10	5.5-10	7/21/2015	NT	NT	NT	NT	**299**	NT	NT	NT
Stockpile 2	S-20-0-2.5	0-2.5	7/21/2015	NT	NT	NT	NT	**66.7**	NT	NT	NT
Stockpile 2	S-20-0-2.5-dup	0-2.5	7/21/2015	NT	NT	NT	NT	**62.7**	NT	NT	NT
Stockpile 2	S-21-2.5-10	2.5-10	7/21/2015	NT	NT	NT	NT	**289**	NT	NT	NT
Stockpile 2	S-22-0-2	0-2	7/21/2015	NT	NT	NT	NT	**32.9**	NT	NT	NT
Stockpile 2	S-23-2-10	2-10	7/21/2015	NT	NT	NT	NT	**35.1**	NT	NT	NT
Stockpile 2	S-24-0-4	2-10	7/21/2015	NT	NT	NT	NT	**24**	NT	NT	NT
Stockpile 2	S-47-4-10	4-10	7/21/2015	NT	NT	NT	NT	**15**	NT	NT	NT
Stockpile 2	S-48-0-8	0-8	7/21/2015	NT	NT	NT	NT	**19.3**	NT	NT	NT
Stockpile 2	S-49-8-10	8-10	7/21/2015	NT	NT	NT	NT	**1,120**	NT	NT	NT

TABLE 1D
Metals Soil Analytical Data Summary Table
Heritage Square - Astoria, Oregon

				Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Urban Residential Direct Contact RBC				1.0	31,000	78	230,000	400	47	NA	780
Occupational Direct Contact RBC				1.7	190,000	510	>Max	800	310	NA	5,100
Construction Worker Direct Contact RBC				13	60,000	150	460,000	800	93	NA	1,500
Urban Residential Leaching to Groundwater RBC				NA	NA	NA	NA	30	NA	NA	NA
Occupational Leaching to Groundwater RBC				NA	NA	NA	NA	30	NA	NA	NA
DEQ Clean Fill Standards				12	840	0.54	240	34	0.11	1.5	--
Oregon DEQ Background Concentration				12	840	0.54	240	34	0.11	1.5	0.41
Stockpile 3	SS-6	10.5	10/31/2003	1.67 U	**51.6**	**0.2**	**9.29**	**92.2**	**0.109**	1.67 U	1.67 U
Stockpile 3	DP-12	9.5	5/16/2012	**1.31**	**112**	**0.53**	**8.2**	**201 B**	**0.006 J**	**0.396 J**	**0.191 J B**
Stockpile 3	DP-19	10.3	5/16/2012	**116**	**539**	**24.2**	**50.7**	**2,850 B**	**5.3**	**1.31**	**0.512 J B**
Stockpile 3	DP-19	10.3	5/16/2012	**4.28**	**939**	**13.7**	**32.2**	**2,790 B**	**3.3**	**0.949**	**0.421 J B**
Stockpile 3	SB-1	6	6/4/2014	**2.38**	**232**	**1.81**	**9.88**	**706**	**0.147**	0.227 U	**0.374**
Stockpile 3	SC-3	-	6/6/2014	**3.07**	**547**	**3.03**	**11.1**	**943**	**0.134**	5.35 U	**0.347**
Stockpile 3	S-31-1.5	7	7/22/2015	NT	NT	NT	NT	**2,560**	NT	NT	NT
Stockpile 3	S-32-4	9.5	7/22/2015	NT	NT	NT	NT	**1,150**	NT	NT	NT
Stockpile 3	S-33-6	11.5	7/22/2015	NT	NT	NT	NT	**114**	NT	NT	NT
Stockpile 3	S-34-1	6.5	7/22/2015	NT	NT	NT	NT	**268**	NT	NT	NT
Stockpile 3	S-35-1	6.5	7/22/2015	NT	NT	NT	NT	**192**	NT	NT	NT
Stockpile 3	S-37-1	6.5	7/22/2015	NT	NT	NT	NT	**316**	NT	NT	NT
Stockpile 3	S-36-1	6.5	7/22/2015	NT	NT	NT	NT	**11,000**	NT	NT	NT
Stockpile 3	S-37-1-dup	6.5	7/22/2015	NT	NT	NT	NT	**293**	NT	NT	NT
Duane Street	DP-01	1.5	5/14/2012	**2.1**	**19.7**	0.023 U	**15.6**	**2.5 B**	0.0024 U	**0.43 J**	0.18 U
Duane Street	DP-02	15.0	5/15/2012	**2.6**	**58.8**	**0.043 J**	**10.4**	**107**	**0.006 J**	**0.35 J**	0.19 U
Duane Street	DP-03	10.0	5/15/2012	**1.8**	**47.5**	**0.04 J**	**9.4**	**13.5 B**	0.0021 U	**0.34 J**	**0.27 J B**
Duane Street	DP-04	3.0	5/15/2012	**3**	**43.3**	**0.039 J**	**10.8**	**94.1 B**	0.002 U	**0.29 J**	0.19 U
Duane Street	DP-05	2.0	5/16/2012	**8.48**	**108**	**0.122**	**32.7**	**14.9 B**	**0.08 J**	**1.64**	0.225 U
Exchange Street	DP-11	3.0	5/15/2012	**19.7**	**55.9**	**0.067 J**	**47.8**	**24.9**	**0.028 J**	**2.4**	0.28 U
Former Safeway	HA-1	10.0	5/15/2012	**2.5**	**58.2**	**0.045 J**	**10.5**	**2.2**	**0.0053 J**	**0.33 J**	0.23 U
Garden of Surging Waves	DP-06	3.0	5/14/2012	**3.2**	**65.5**	**1.6**	**14.8**	**27.1 B**	0.0019 U	**0.48**	0.16 U
Garden of Surging Waves	DP-07	2.0	5/14/2012	**4.4**	**174**	**0.51**	**17**	**183 B**	0.0023 U	**0.59**	0.18 U
Garden of Surging Waves	DP-08	10.0	5/14/2012	**10.4**	**79.2**	**0.14**	**43.5**	**15.1 B**	**0.085 J**	**1.9**	0.2 U
Garden of Surging Waves	DP-09	2.0	5/14/2012	**2.1**	**61.8**	**0.19**	**11.1**	**85.3 B**	**0.046 J**	**0.72**	0.21 U
Garden of Surging Waves	DP-10	10.0	5/15/2012	**15.3**	**164**	**0.32**	**32.1**	**15.4**	**0.072 J**	**2**	0.25 U
Garden of Surging Waves	SB-10	2	6/6/2014	**8.78**	NT	NT	NT	NT	NT	NT	NT
Garden of Surging Waves	SB-10	10	6/6/2014	**16.2**	NT	NT	NT	NT	NT	NT	NT
Garden of Surging Waves	SB-11	2	6/6/2014	1.41 U	NT	NT	NT	NT	NT	NT	NT
Garden of Surging Waves	SB-11	10	6/6/2014	**13.7**	NT	NT	NT	NT	NT	NT	NT
Garden of Surging Waves	SB-12	2	6/6/2014	**1.40**	NT	NT	NT	NT	NT	NT	NT
Garden of Surging Waves	SB-12	10	6/6/2014	**11.3**	NT	NT	NT	NT	NT	NT	NT
Stockpile 1 Average				2.2	148.0	0.5	8.1	222.8	0.05 ND	1.1	0.1
Stockpile 1 Count				1	1	1	1	6	1	1	1
Stockpile 2 Average				6.1	136.7	0.3	15.0	141.5	0.1	2.0	0.1
Stockpile 2 Count				3	3	3	3	23	3	3	3
Stockpile 3 Average				21.3	403.4	7.2	20.2	1676.8	1.5	1.0	0.4
Stockpile 3 Count				6	6	6	6	14	6	6	6
Below parking deck Average				2.6	168.8	20.5	11.8	332.9	0.1	0.6	0.2
Below parking deck Count				13	13	18	13	29	13	13	13

TABLE 1D
Metals Soil Analytical Data Summary Table
Heritage Square - Astoria, Oregon

	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Urban Residential Direct Contact RBC	1.0	31,000	78	230,000	400	47	NA	780
Occupational Direct Contact RBC	1.7	190,000	510	>Max	800	310	NA	5,100
Construction Worker Direct Contact RBC	13	60,000	150	460,000	800	93	NA	1,500
Urban Residential Leaching to Groundwater RBC	NA	NA	NA	NA	30	NA	NA	NA
Occupational Leaching to Groundwater RBC	NA	NA	NA	NA	30	NA	NA	NA
DEQ Clean Fill Standards	12	840	0.54	240	34	0.11	1.5	--
Oregon DEQ Background Concentration	12	840	0.54	240	34	0.11	1.5	0.41

Notes:
Bold = constituent detected at or above the method reporting limit
J = estimated result
U = constituent not detected at or above the reporting limit shown
UJ = not detected at or above the stated level, which is an approximate value
>Max = The constituent RBC for this pathway is calculated as greater than 1,000,000 mg/kg or 1,000,000 mg/L.
Therefore, this substance is deemed not to pose risks in this scenario.
Red Text exceeds Urban Residential Direct Contact RBC and DEQ background concentration
The red text for arsenic is screened against the Oregon DEQ background concentration
exceeds DEQ Background Concentration & Clean Fill Standard
exceeds Occupational Direct Contact RBC
exceeds Construction Worker Direct Contact RBC
exceeds Urban Residential Leaching to Groundwater RBC
Average calculations by location group were done using the detections and half the reporting limit.
ft bsl = feet below street level
Stockpile 1 was measured on July 21, 2015 to be 3.5 feet tall. 6.5 feet were added to each sample depth to convert to bsl.
Stockpile 2 was measured on July 21, 2015 to be 10 feet tall, equal to bsl.
Stockpile 3 was measured on July 21, 2015 to be 3 feet tall. 5.5 feet were added to each sample depth to convert to bsl.
The area beneath the parking deck was measured on July 21, 2015 to be 8 feet below bsl. 8 feet was added to each sample depth to convert to bsl.
mg/kg = milligrams per kilogram
NA = No RBC has been published by DEQ for this analyte by this exposure pathway
ND = not detected, none of the results in the average calculation was detected
NT = Not Tested
RBC = Risk-Based Screening Concentrations
DEQ Risk Based Concentrations, June 2012
Clean Fill Standards, June 2014

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TABLE 1F
Volatile Organic Compound Soil Analytical Data Summary Table
Heritage Square - Astoria, Oregon

				Benzene	2-Butanone	Acetone	Bromomethane	Tetrachloroethene	Toluene	Trichloroethene
Urban Residential Vapor Intrusion RBC				27	NA	NA	1.3	6.6	NA	0.32
Occupational Vapor Intrusion RBC				50	NA	NA	17	36	NA	2.8
Construction Worker Direct Contact RBC				9,500	NA	NA	9,200	1,600	NA	120
Urban Residential Leaching to Groundwater RBC				0.042	NA	NA	0.20	2.80	140	0.099
Occupational Leaching to Groundwater RBC				0.053	NA	NA	0.41	3.70	280	0.21
DEQ Clean Fill Standard				0.0093	NA	59.52	0.098	2.4	200	0.02
Location Group	**Sample ID**	**Depth (ft bsl)**	**Sample Date**	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Below parking deck	DP14-2.5	11	5/17/2012	**0.002 J**	0.0063 U	**0.124**	0.0019 U	0.0019 U	0.0019 U	0.0019 U
Below parking deck	DP15-1.5	9.5	5/17/2012	0.0076 U	0.0253 U	**0.174**	0.0076 U	0.0076 U	0.0076 U	**0.0137 J**
Excavation area	DP13-2	10	5/17/2012	0.0026 U	0.0086 U	**0.0239**	0.0026 U	0.0026 U	0.0026 U	0.0026 U
Excavation area	DP17-1.5	9.5	5/17/2012	0.0021 U	0.0070 U	**0.0117 J**	0.0021 U	**0.0068**	0.0021 U	0.0021 U
Stockpile 3	DP19-2.5	10.3	5/17/2012	0.0025 U	**0.0358**	**0.253**	**0.0031 J**	**0.0025 J**	0.0025 U	0.0025 U
Stockpile 3	SOILDUP3	10.3	5/17/2012	0.0046 U	**0.0436**	**0.321**	0.0046 U	**0.0057 J**	0.0046 U	0.0046 U
Stockpile 3	S-31-1.5	7	7/22/2015	0.0014 U	0.0014 U	**0.011 J**	0.0014 U	0.0014 U	**0.0097**	0.0014 U
Stockpile 3	S-32-4	9.5	7/22/2015	0.0055 U	0.0055 U	0.0055 U	0.0055 U	0.0055 U	0.0055 U	0.0055 U
Stockpile 3	S-33-6	11.5	7/22/2015	0.0013 U	0.0013 U	**1.1 J**	0.0013 U	0.0013 U	**0.014**	0.0013 U
Stockpile 3	S-34-1	6.5	7/22/2015	0.0013 U	0.0013 U	**0.74 J**	0.0013 U	0.0013 U	**0.014**	0.0013 U
Stockpile 3	S-35-1	6.5	7/22/2015	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.0013 U	**0.0045**	0.0013 U
Stockpile 3	S-36-1	6.5	7/22/2015	0.0014 UJ	0.0014 U	**0.026 J**	0.0014 U	**0.0019 J**	**0.014 J**	0.0014 UJ
Stockpile 3	S-37-1	6.5	7/22/2015	0.0014 U	0.0014 U	**0.73 J**	0.0014 U	0.0014 UJ	**0.016 J**	0.0014 UJ
Garden of Surging Waves	DP07-2	2	5/15/2012	0.0017 U	0.0055 U	0.0055 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U
Garden of Surging Waves	DP09-2	2	5/15/2012	0.0055 U	0.0055 U	0.0016 U	0.0016 U	0.0016 U	0.0016 U	0.0016 U
Stockpile 3 Average				0.001 ND	0.0072	0.354	0.0014	0.0018	0.0087	0.0012 ND
Stockpile 3 Count				9	9	9	9	9	9	9
Excavation area Average				0.001 ND	0.004 ND	0.0178	0.001 ND	0.004	0.001 ND	0.001 ND
Excavation area Count				2	2	2	2	2	2	2

Notes:
Bold = constituent detected at or above the method reporting limit
J = estimated result
U = constituent not detected at or above the reporting limit shown
UJ = not detected at or above the stated level, which is an approximate value
>Max = The constituent RBC for this pathway is calculated as greater than 1,000,000 mg/kg or 1,000,000 mg/L.
Therefore, this substance is deemed not to pose risks in this scenario.

Red Text exceeds Urban Residential Direct Contact RBC
exceeds Clean Fill Standard
exceeds Occupational Direct Contact RBC
exceeds Construction Worker Direct Contact RBC
exceeds Urban Residential Leaching to Groundwater RBC

Average calculations by location group were done using the detections and half the reporting limit.
ft bsl = feet below street level
Stockpile 1 was measured on July 21, 2015 to be 3.5 feet tall. 6.5 feet were added to each sample depth to convert to bsl.
Stockpile 2 was measured on July 21, 2015 to be 10 feet tall, equal to bsl.
Stockpile 3 was measured on July 21, 2015 to be 3 feet tall. 5.5 feet were added to each sample depth to convert to bsl.
The area beneath the parking deck was measured on July 21, 2015 to be 8 feet below bsl. 8 feet was added to each sample depth to convert to bsl.
µg/kg = microgram per kilogram
NA = No RBC has been published by DEQ for this analyte by this exposure pathway
ND = not detected, none of the results in the average calculation was detected
NT = Not Tested
RBC = Risk-Based Screening Concentrations
DEQ Risk Based Concentrations, June 2012
Clean Fill Standards, June 2014

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TABLE 1E
Metal TCLP Soil Analytical Data Summary Table
Heritage Square - Astoria, Oregon

				Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Maximum Concentrations of Contaminants for the Toxicity Characteristic				5.0	100.0	1.0	5.0	5.0	0.2	1.0	5.0
Location Group	**Sample ID**	**Depth (ft bsl)**	**Sample Date**	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Below parking deck	SB-2	8	6/4/2014	0.100 U	0.500 U	0.0500 U	0.100 U	**0.458**	0.00400 U	0.100 U	0.0500 U
Below parking deck	SB-3	8	6/4/2014	0.100 U	**0.592**	0.0500 U	0.100 U	**0.232**	0.00400 U	0.100 U	0.0500 U
Below parking deck	SB-4	9	6/4/2014	0.100 U	**0.614**	0.0500 U	0.100 U	**0.770**	0.00400 U	0.100 U	0.0500 U
Below parking deck	SB-5	9	6/4/2014	0.100 U	**0.590**	0.0500 U	0.100 U	0.0500 U	0.00400 U	0.100 U	0.0500 U
Below parking deck	SB-6	9	6/4/2014	0.100 U	**0.829**	0.0500 U	0.100 U	**0.442**	0.00400 U	0100 U	0.0500 U
Below parking deck	SB-13	9	6/4/2014	0.100 U	**0.656**	0.0500 U	0.100 U	**0.674**	0.00400 U	0.100 U	0.0500 U
Stockpile 1	SC-1	-	6/4/2014	0.100 U	**0.752**	0.0500 U	0.100 U	**0.358**	0.00400 U	0.100 U	0.0500 U
Stockpile 2	SC-2	-	6/6/2014	0.100 U	0.500 U	0.0500 U	0.100 U	0.0500 U	0.00400 U	0.100 U	0.0500 U
Stockpile 2	SC-2 Dup	-	6/6/2014	0.100 U	0.500 U	0.0500 U	0.100 U	0.0500 U	0.00400 U	0.100 U	0.0500 U
Stockpile 3	SB-1	6	6/4/2014	0.100 U	**0.851**	**0.0690**	0.100 U	**13.9**	0.00400 U	0.100 U	0.0500 U
Stockpile 3	SC-3	-	6/6/2014	0.100 U	**0.864**	0.0500 U	0.100 U	**5.55**	0.00400 U	0.100 U	0.0500 U
			Stockpile 1 Average	0.1 ND	0.752	0.05 ND	0.1 ND	0.358	0.004 ND	0.1 ND	0.05 ND
			Stockpile 1 Count	1	1	1	1	1	1	1	1
			Stockpile 2 Average	0.1 ND	0.25	0.05 ND	0.1 ND	0.025	0.004 ND	0.1 ND	0.05 ND
			Stockpile 2 Count	2	2	2	2	2	2	2	2
			Stockpile 3 Average	0.1 ND	0.8575	0.0595	0.1 ND	9.725	0.004 ND	0.1 ND	0.05 ND
			Stockpile 3 Count	2	2	2	2	2	2	2	2
			Below parking deck Average	0.1 ND	0.25	0.05 ND	0.1 ND	0.4335	0.004 ND	0.1 ND	0.05 ND
			Below parking deck Count	6	6	6	6	6	6	6	6

Notes:
Bold = constituent detected at or above the method reporting limit
U = constituent not detected at or above the reporting limit shown
Red text = Exceeds RCRA Toxicity Characteristic
mg/L = milligrams per liter
ft bsl = feet below street level
Maximum Concentrations of Contaminants for TCLP from Table 1, 40 CFR 261.30
Average calculations by location group were done using the detections and half the reporting limit.
ND = not detected, none of the results in the average calculation was detected

TABLE 2A
Volatile Organic Compound Groundwater Analytical Data Summary Table
Heritage Square - Astoria, Oregon

Location Grouop	Sample ID	Sample Depth (ft bsl)	Sample Date	1,1-Dichloroethene (µg/L)	Benzene (µg/L)	Chloromethane (µg/L)	cis-1,2-Dichloroethene (µg/L)	Isopropylbenzene (µg/L)	Tetrachloroethene (PCE) (µg/L)	Toluene (µg/L)	trans-1,2-Dichloroethene (µg/L)	Trichloroethene (TCE) (µg/L)	Vinyl chloride (µg/L)
Human Health Screening Values													
Urban Residential Vapor Intrusion Into Building RBC				27,000	510	26,000	>S	>S	5,900	>S	28,000	380	22
Occupational Vapor Intrusion Into Building RBC				340,000	2,800	320,000	>S	>S	32,000	>S	350,000	3,300	910
Groundwater in an Excavation RBC				43,000	1,700	22,000	24,000	>S	5,400	210,000	14,000	430	1,200
Oregon DEQ Human Health AWQC, Organism Only[1]				710	1.4	NA	NA	NA	0.33	1,500	1,000	3.0	0.24
EPA NRWQC Human Health, Organism Only[2]				7,100	51	NA	NA	NA	3.3	15,000	10,000	30	2.4
Ecological Screening Values[3]													
EPA NRWQC, Aquatic Life (DEQ Hierarchy Reference 1)				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Oak Ridge Tier II Chronic Values (DEQ Hierarchy Reference 2)				25	130	NA	NA	NA	98	10	NA	47	NA
EPA Region III BTAG Screening Criteria, 2006 (DEQ Hierarchy Reference 3)				25	370	NA	NA	3	111	2	970	21	930
EPA Region V Ecological Screening Levels (DEQ Hierarchy Reference 4)				65	114	NA	NA	NA	45	253	970	47	930
Below Parking Deck	SB-1	12 - 17	6/5/2014	**2.05**	0.250 U	5.00 U	**30.0**	1.00 U	**72.5**	1.00 U	0.500 U	**64.2**	**11.5**
	SB-1	16.5 - 21.5	6/5/2014	0.500 U	0.250 U	5.00 UJ	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	0.500 U	**0.620**
	SB-1 Dup	16.5 - 21.5	6/5/2014	0.500 U	0.250 U	5.00 U	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	0.500 U	**0.600**
	SB-3	12 - 17	6/5/2014	0.500 U	0.250 U	5.00 U	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	0.500 U	0.500 U
	SB-4	12 - 17	6/6/2014	0.500 U	0.250 U	5.00 U	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	0.500 U	0.500 U
	DP-13	10-15	5/17/2012	ND	0.1 U	0.1 U	0.1 U	0.1 U	**0.8**	ND	0.1 U	0.1 U	0.1 U
	DP-19	10-15	5/17/2012	ND	0.1 U	0.1 U	**0.1**	0.1 U	0.1 U	ND	0.1 U	**11.6**	**2.7**
	B-6	9.5-14.5	2/20/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	1 U
Duane Street	SB-7	15 - 20	6/4/2014	0.500 U	0.250 U	5.00 U	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	0.500 U	0.500 U
	SB-7	25 - 30	6/4/2014	0.500 U	0.250 U	5.00 U	**11.8**	1.00 U	0.500 U	**1.42**	0.500 U	0.500 U	**20.6**
	SB-8	11 - 17	6/4/2014	0.500 U	0.250 U	5.00 U	**0.880**	1.00 U	0.500 U	1.00 U	0.500 U	0.500 U	**2.50**
	SB-8	25 - 30	6/4/2014	0.500 U	0.250 U	5.00 U	**1.71**	1.00 U	0.500 U	1.00 U	0.500 U	0.500 U	**1.34**
	SB-9	12 - 17	6/5/2014	0.500 U	0.250 U	5.00 U	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	0.500 U	0.500 U
	SB-9	25 - 30	6/5/2014	0.500 U	0.250 U	5.00 U	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	0.500 U	0.500 U
	B-14	12-16	3/18/2003	ND	0.4 U	1 U	**2.51**	1 U	1 U	ND	1 U	1 U	**15.1**
	B-15	12-16	3/18/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	1 U
	B-19	17-21	10/30/2003	ND	0.4 U	1 U	**1.07**	1 U	1 U	ND	1 U	1 U	**7.28**
	B-19	26-30	10/30/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	1 U
Exchange Street	B-16	12-16	3/18/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	1 U
	B-17	12-16	3/18/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	1 U
	B-24	15.5-19.5	10/30/2003	ND	0.4 U	1 U	1 U	**65.5**	1 U	ND	1 U	1 U	1 U
	B-24	26-30	10/30/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	1 U
	B-25	16-20	10/30/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	1 U

TABLE 2A
Volatile Organic Compound Groundwater Analytical Data Summary Table
Heritage Square - Astoria, Oregon

Location Grouop	Sample ID	Sample Depth (ft bsl)	Sample Date	1,1-Dichloroethene (µg/L)	Benzene (µg/L)	Chloromethane (µg/L)	cis-1,2-Dichloroethene (µg/L)	Isopropylbenzene (µg/L)	Tetrachloroethene (PCE) (µg/L)	Toluene (µg/L)	trans-1,2-Dichloroethene (µg/L)	Trichloroethene (TCE) (µg/L)	Vinyl chloride (µg/L)
Human Health Screening Values													
Urban Residential Vapor Intrusion Into Building RBC				27,000	510	26,000	>S	>S	5,900	>S	28,000	380	22
Occupational Vapor Intrusion Into Building RBC				340,000	2,800	320,000	>S	>S	32,000	>S	350,000	3,300	910
Groundwater in an Excavation RBC				43,000	1,700	22,000	24,000	>S	5,400	210,000	14,000	430	1,200
Oregon DEQ Human Health AWQC, Organism Only[1]				710	1.4	NA	NA	NA	0.33	1,500	1,000	3.0	0.24
EPA NRWQC Human Health, Organism Only[2]				7,100	51	NA	NA	NA	3.3	15,000	10,000	30	2.4
Ecological Screening Values[3]													
EPA NRWQC, Aquatic Life (DEQ Hierarchy Reference 1)				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Oak Ridge Tier II Chronic Values (DEQ Hierarchy Reference 2)				25	130	NA	NA	NA	98	10	NA	47	NA
EPA Region III BTAG Screening Criteria, 2006 (DEQ Hierarchy Reference 3)				25	370	NA	NA	3	111	2	970	21	930
EPA Region V Ecological Screening Levels (DEQ Hierarchy Reference 4)				65	114	NA	NA	NA	45	253	970	47	930
Garden of Surging Waves	B-8	12-16	3/18/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	**3.12**
	B-9	12-16	3/18/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	1 U
	B-10	12-16	3/18/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	1 U
	B-11	12-16	3/18/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	**3.04**
	B-13	12-16	3/18/2003	ND	**3.75**	1 U	1 U	1 U	1 U	ND	1 U	1 U	1 U
	B-20	16-20	10/31/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	1 U
	B-21	17-21	10/31/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	**3.73**
	B-21	26-30	10/31/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	1 U
	B-22	15-19	10/30/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	1 U
	B-23	16-20	10/30/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	1 U
	DP-07	10-15	5/15/2012	ND	**0.21 J,B**	0.1 U	**0.17 J**	0.1 U	0.1 U	ND	0.1 U	0.1 U	0.1 U
	DP-07	10-15	5/15/2012	ND	0.1 U	0.1 U	**0.17 J**	0.1 U	0.1 U	ND	0.1 U	0.1 U	**0.4 J**
	DP-09	10-15	5/15/2012	ND	**0.18 J,B**	0.1 U	0.1 U	0.1 U	0.1 U	ND	0.1 U	0.1 U	0.1 U

TABLE 2A
Volatile Organic Compound Groundwater Analytical Data Summary Table
Heritage Square - Astoria, Oregon

Location Grouop	Sample ID	Sample Depth (ft bsl)	Sample Date	1,1-Dichloroethene (µg/L)	Benzene (µg/L)	Chloromethane (µg/L)	cis-1,2-Dichloroethene (µg/L)	Isopropylbenzene (µg/L)	Tetrachloroethene (PCE) (µg/L)	Toluene (µg/L)	trans-1,2-Dichloroethene (µg/L)	Trichloroethene (TCE) (µg/L)	Vinyl chloride (µg/L)
Human Health Screening Values													
Urban Residential Vapor Intrusion Into Building RBC				27,000	510	26,000	>S	>S	5,900	>S	28,000	380	22
Occupational Vapor Intrusion Into Building RBC				340,000	2,800	320,000	>S	>S	32,000	>S	350,000	3,300	910
Groundwater in an Excavation RBC				43,000	1,700	22,000	24,000	>S	5,400	210,000	14,000	430	1,200
Oregon DEQ Human Health AWQC, Organism Only[1]				710	1.4	NA	NA	NA	0.33	1,500	1,000	3.0	0.24
EPA NRWQC Human Health, Organism Only[2]				7,100	51	NA	NA	NA	3.3	15,000	10,000	30	2.4
Ecological Screening Values[3]													
EPA NRWQC, Aquatic Life (DEQ Hierarchy Reference 1)				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Oak Ridge Tier II Chronic Values (DEQ Hierarchy Reference 2)				25	130	NA	NA	NA	98	10	NA	47	NA
EPA Region III BTAG Screening Criteria, 2006 (DEQ Hierarchy Reference 3)				25	370	NA	NA	3	111	2	970	21	930
EPA Region V Ecological Screening Levels (DEQ Hierarchy Reference 4)				65	114	NA	NA	NA	45	253	970	47	930
Former Safeway	B-2	13.5-18.5	2/19/2003	ND	0.4 U	**17.6**	**81.4**	1 U	1 U	ND	**1.27**	1 U	**90**
	B-3	10.5-14.5	2/20/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	1 U
	B-4	9.5-14.5	2/20/2003	ND	0.4 U	**3.96**	**3.1**	1 U	**7.42**	ND	1 U	**3.29**	1 U
	B-7	9.5-14.5	3/18/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	1 U
	B-28	15.5-19.5	10/30/2003	ND	0.4 U	1 U	1 U	1 U	1 U	ND	1 U	1 U	**1.03**
	HA-2	10-15	5/16/2012	ND	0.1 U	0.1 U	0.1 U	0.1 U	**4.1**	ND	0.1 U	**0.3 J**	0.1 U

Notes:
Bold = constituent detected at or above the method reporting limit
B = compound detected in associated laboratory blank
J = detected concentration between the method reporting limit and method detection limit. Value is considered an estimate.
U = constituent not detected at or above the method reporting limit shown
UJ = not detected at or above the stated level, which is an approximate value
µg/L = micrograms per Liter
bsl = below street level
DEQ = Oregon Department of Environmental Quality
NA = No screening value has been established for this analyte
Red text = Exceeds most conservative human health screening value.
Exceeds ecological screening criteria (in order of hierarchy)
Indicates shallow groundwater sample

[1] DEQ Ambient Water Quality Criteria (AWQC) Table 40, April 2014.
[2] United States Environmental Protection Agency (EPA) National Recommended Water Quality Criteria (NRWQC).
[3] Ecological screening values are shown in order outlined in DEQ's Ecological Screening Level Hierarchy, January 2014.
RBC = DEQ Risk Based Concentrations, June 2012.

TABLE 2B
Total Metals Groundwater Analytical Data Summary Table
Heritage Square - Astoria, Oregon

Location Group	Sample ID	Depth (ft bsl)	Sample Date	TOC mg/L	Arsenic µg/L	Barium µg/L	Cadmium µg/L	Chromium µg/L	Lead µg/L	Mercury µg/L	Selenium µg/L	Silver µg/L
Human Health Screening Values												
Groundwater in an Excavation RBC				NA	5,800	2.50E+07	57,000	>S	>S	>S	NA	1.00E+06
Oregon DEQ Human Health AWQC, Organism Only[1]				NA	2.1	NA	NA	NA	NA	NA	420	NA
EPA NRWQC Human Health, Organism Only[2]				NA	0.14	NA	NA	NA	NA	NA	4,200	NA
Ecological Screening Values[3]												
EPA NRWQC, Aquatic Life Freshwater Chronic (DEQ Hierarchy Reference 1)				NA	150	NA	0.25	74	2.5	NA	5	NA
Suter and Tsao Tier II Chronic Values (DEQ Hierarchy Reference 2)				NA	3.1	4	NA	NA	NA	1.3	NA	0.36
EPA Region III BTAG Freshwater Screening Criteria, 2006 (DEQ Hierarchy Reference 3)				NA	3.1	4	0.25	85	2.5	0.026	1	3.2
EPA Region V Ecological Screening Levels (DEQ Hierarchy Reference 4)				NA	148	220	0.15	42	1.17	1.E-03	5	0.12
Below parking deck	SB-1	12-17	6/5/2014	**2.8**	10.0 U	**85.0**	2.00 U	10.0 U	**11.0**	0.800 U	10.0 U	2.00 U
	SB-1	16.5-21.5	6/5/2014	**7.0**	**2.59**	**154 J**	0.200 U	**12.0**	**6.87**	0.0800 UJ	1.00 U	0.200 U
	SB-1 Dup	16.5-21.5	6/5/2014	**6.9**	**1.62**	**94.3 J**	0.200 U	**9.22**	**5.28**	0.0800 UJ	1.00 U	0.200 U
	SB-3	12-17	6/5/2014	**2.9**	1.00 U	**37.6**	0.200 U	**5.72**	**3.02**	0.0800 UJ	1.00 U	0.200 U
	SB-4	12-17	6/6/2014	**2.4**	**2.38**	**75.6**	**0.222**	**7.50**	**23.9**	0.0800 UJ	1.00 U	0.200 U
	DP12-051712	13.5-18.5	5/15/2012	NT	**1.3**	**56.4**	**0.67**	**2.3**	**43.6 B**	**0.037**	**1.7**	**0.36**
	DP13-051712	13.5-18.5	5/17/2012	NT	**3.2 B**	**38.5**	**0.1**	**4.6**	**20.1**	0.01 U	0.22 U	0.25 U
	DP14-051712	13.5-18.5	5/17/2012	NT	**1.5 B**	**34.3**	**0.051**	**1.8**	**3.5**	0.01 U	0.22 U	0.25 U
	DP15-051712	13.5-18.5	5/17/2012	NT	**0.93 B**	**28.6**	**0.12**	**1.1**	**8.4**	0.01 U	0.22 U	0.25 U
	DP16-051712	13.5-18.5	5/17/2012	NT	**0.55 B**	**34.8**	**0.03**	**0.65**	**6.1**	0.01 U	0.22 U	0.25 U
	DP17-051712	13.5-18.5	5/17/2012	NT	**0.72 B**	**23.5**	0.028 U	**0.28**	**0.66 B**	0.01 U	0.22 U	0.25 U
	DP19-051712	13.5-18.5	5/17/2012	NT	**1.6 B**	**34.6**	**0.13**	**2.3**	**8.4**	**0.011**	0.22 U	0.25 U
Duane Street	SB-7	15-20	6/4/2014	**1.92**	10.0 U	**226**	2.00 U	**25.6**	**14.4**	0.800 U	10.0 U	2.00 U
	SB-7	25-30	6/4/2014	**6.57**	**29.6**	**242**	**0.356**	**37.6**	**16.9**	0.0800 UJ	**2.31**	0.200 U
	SB-8	11-17	6/4/2014	**2.68**	10.0 U	**26.0**	2.00 U	10.0 U	2.00 U	0.800 U	10.0 U	2.00 U
	SB-8	25-30	6/4/2014	**13.3**	**17.0**	**87.7**	2.00 U	**18.3**	**9.67**	0.800 U	10.0 U	2.00 U
	SB-9	12-17	6/5/2014	**3.41**	10.0 U	**192**	2.00 U	**20.2**	**146**	0.800 U	10.0 U	2.00 U
	SB-9	25-30	6/5/2014	**5.91**	**20.1**	**66.9**	2.00 U	**24.7**	**25.6**	0.800 U	10.0 U	2.00 U
	DP01-051512	7.2-17.2	5/15/2012	NT	**2 B**	**35.8**	**0.053 J**	**3.3**	**1.7**	0.010 U	**0.30 J**	**0.45 J**
	DP2D-051612	25-30	5/16/2012	NT	**21.6**	**37.6**	0.200 U	**5.4**	**7.01**	0.010 U	1.00 U	0.200 U
	DP2S-051612	18-23	5/16/2012	NT	**1.16**	**43.1**	0.200 U	**2.92**	**39.3**	0.010 U	1.00 U	0.200 U
	DP03-051612	12-17	5/16/2012	NT	**2 B**	**44.3**	**0.042 J**	**4.2**	**8.4**	0.010 U	0.22 U	**0.32 J**
	DP04-051612	12.5-17.5	5/16/2012	NT	**1.5 B**	**34.1**	**0.036 J**	**3.8**	**2.2**	**0.016 J**	0.22 U	0.25 U
Garden of Surging Waves	DP5-051712	11-16	5/17/2012	NT	1.00 U	**20.1**	0.200 U	**0.974**	**0.618 J**	0.010 U	1.00 U	0.200 U
	DP06-051512	23.8-28.8	5/15/2012	NT	**44 B**	**357**	**0.82**	**85.4**	**62.7**	**0.024 J**	**3.5**	**0.33 J**
	DP07D-051512	35-40	5/15/2012	NT	**0.81 B**	**23.2**	0.028 U	**0.24 J**	**0.62**	0.010 U	0.22 U	0.25 U
	DP07S-051512	11.7-16.7	5/15/2012	NT	**1.2 B**	**42.1**	0.028 U	**3.7**	**3.1**	0.010 U	0.22 U	0.25 U
	DUP07SDUP-051512	11.7-16.7	5/15/2012	NT	**1.6 B**	**56.6**	**0.028 J**	**6**	**3.6**	0.010 U	0.22 U	0.25 U
	DP08-051512	11.3-16.3	5/15/2012	NT	**0.81 B**	**37.3**	0.028 U	**2.3**	**1.1**	0.010 U	0.22 U	0.25 U
	DP09-051512	13-18	5/15/2012	NT	**1.1 B**	**37.9**	**0.038 J**	**2.6**	**4.6**	0.010 U	0.22 U	0.25 U
	DP10-051612	11.5-16.5	5/16/2012	NT	**0.515 J**	**50.1**	0.200 U	**1.36**	**30**	0.010 U	1.00 U	0.200 U

TABLE 2B
Total Metals Groundwater Analytical Data Summary Table
Heritage Square - Astoria, Oregon

Location Group	Sample ID	Depth (ft bsl)	Sample Date	TOC	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
				mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Human Health Screening Values												
Groundwater in an Excavation RBC				NA	5,800	2.50E+07	57,000	>S	>S	>S	NA	1.00E+06
Oregon DEQ Human Health AWQC, Organism Only[1]				NA	2.1	NA	NA	NA	NA	NA	420	NA
EPA NRWQC Human Health, Organism Only[2]				NA	0.14	NA	NA	NA	NA	NA	4,200	NA
Ecological Screening Values[3]												
EPA NRWQC, Aquatic Life Freshwater Chronic (DEQ Hierarchy Reference 1)				NA	150	NA	0.25	74	2.5	NA	5	NA
Suter and Tsao Tier II Chronic Values (DEQ Hierarchy Reference 2)				NA	3.1	4	NA	NA	NA	1.3	NA	0.36
EPA Region III BTAG Freshwater Screening Criteria, 2006 (DEQ Hierarchy Reference 3)				NA	3.1	4	0.25	85	2.5	0.026	1	3.2
EPA Region V Ecological Screening Levels (DEQ Hierarchy Reference 4)				NA	148	220	0.15	42	1.17	1.E-03	5	0.12
Former Safeway	HA1-051612	14.5-19.5	5/16/2012	NT	**2.2**	**42.1**	**0.046 J**	**4.5**	**12.6**	0.010 U	**0.53**	0.25 U
	HA2-051612	13-18	5/16/2012	NT	**0.7**	**13.2**	0.028 U	**0.78**	**5.7**	0.010 U	**0.25 J**	0.25 U

Notes:
Bold = constituent detected at or above the method reporting limit
B = compound detected in associated laboratory blank
J = detected concentration between the method reporting limit and method detection limit. Value is considered an estimate.
UJ = not detected at or above the stated level, which is an approximate value
U = constituent not detected at or above the method reporting limit shown
mg/L = milligram per liter
µg/L = micrograms per liter
bsl = below street level
NA = No screening value has been established for this analyte
NC = Not calculated because no site-specific hardness value is available.
NT = Not tested
NV = The chemical is considered non-volatile
TOC = Total organic carbon
Red text = Exceeds most conservative human health screening value.
Exceeds ecological screening criteria (in order of hierarchy)

[1] Oregon Department of Environmental Quality (DEQ) Ambient Water Quality Criteria (AWQC) Table 40, April 2014.
[2] United States Environmental Protection Agency (EPA) National Recommended Water Quality Criteria.
[3] Ecological screening values are shown in order outlined in DEQ's Ecological Screening Level Hierarchy, January 2014.
RBC = DEQ Risk Based Concentrations, June 2012.

TABLE 2C
Filtered Metals Groundwater Analytical Data Summary Table
Heritage Square - Astoria, Oregon

Location Group	Sample ID	Filter Size (micron)	Sample Depth (ft bsl)	Sample Date	Arsenic µg/L	Barium µg/L	Cadmium µg/L	Chromium µg/L	Lead µg/L	Mercury µg/L	Selenium µg/L	Silver µg/L
Human Health Screening Values												
				Groundwater in an Excavation RBC	5,800	2.50E+07	57,000	>S	>S	>S	NA	1.00E+06
				Oregon DEQ Human Health AWQC, Organism Only[1]	2.1	NA	NA	NA	NA	NA	420	NA
				EPA NRWQC Human Health, Organism Only[2]	0.14	NA	NA	NA	NA	NA	4,200	NA
Ecological Screening Values[3]												
				EPA NRWQC, Aquatic Life (DEQ Hierarchy Reference 1)	150	NA	0.25	74	2.5	NA	5	NA
				Suter and Tsao Tier II Chronic Values (DEQ Hierarchy Reference 2)	3.1	4	NA	NA	NA	1.3	NA	0.36
				EPA Region III BTAG Freshwater Screening Criteria, 2006 (DEQ Hierarchy Reference 3)	3.1	4	0.25	85	2.5	0.026	1	3.2
				EPA Region V Ecological Screening Levels (DEQ Hierarchy Reference 4)	148	220	0.15	42	1.17	1.E-03	5	0.12
Below parking deck	SB-1	0.45	12 - 17	6/5/2014	1.00 U	**21.1**	0.200 U	1.00 U	0.200 U	0.0800 U	1.00 U	0.200 U
	SB-1	10	12 - 17	6/5/2014	1.00 U	**22.4**	0.200 U	**1.02**	**0.422**	0.0800 U	1.00 U	0.200 U
	SB-1	0.45	16.5 - 21.5	6/5/2014	1.00 U	**43.1**	0.200 U	**1.10**	0.200 U	0.0800 UJ	1.00 U	0.200 U
	SB-1-Dup	0.45	16.5 - 21.5	6/5/2014	1.00 U	**40.6**	0.200 U	**1.10 J**	0.200 U	0.0800 UJ	1.00 U	0.200 U
	SB-1	10	16.5 - 21.5	6/5/2014	1.00 U	**45.0**	0.200 U	**2.32**	0.200 U	0.0800 U	1.00 U	0.200 U
	SB-1-Dup	10	16.5 - 21.5	6/5/2014	1.00 U	**43.2**	0.200 U	**2.27**	0.200 U	0.0800 U	1.00 U	0.200 U
	SB-3	0.45	12 - 17	6/5/2014	1.00 U	**4.44**	0.200 U	1.00 U	0.200 U	0.0800 UJ	1.00 U	0.200 U
	SB-3	10	12 - 17	6/5/2014	1.00 U	**6.93**	0.200 U	**1.03**	**0.211**	0.0800 U	1.00 U	0.200 U
	SB-4	0.45	12 - 17	6/6/2014	1.00 U	**7.33**	0.200 U	1.00 U	**0.200**	0.0800 UJ	1.00 U	0.200 U
	SB-4	10	12 - 17	6/6/2014	1.00 U	**9.68**	0.200 U	1.00 U	**0.911**	0.0800 U	1.00 U	0.200 U
	DP17-051712	unknown	13.5-18.5	5/17/2012	**0.62 B**	**21.6**	0.028 U	**0.17**	**0.17 B**	0.01 U	0.22 U	**0.3**
Duane Street	SB-7	0.45	15 - 20	6/4/2014	1.00 U	**10.3**	0.200 U	**1.09**	0.200 U	0.0800 U	1.00 U	0.200 U
	SB-7	10	15 - 20	6/4/2014	1.00 U	**11.1**	0.200 U	**1.06**	0.200 U	0.0800 U	1.00 U	0.200 U
	SB-7	0.45	25 - 30	6/4/2014	**2.83**	**97.2**	0.200 U	1.00 U	0.200 U	0.0800 UJ	1.00 U	0.200 U
	SB-7	10	25 - 30	6/4/2014	**3.11**	**102**	0.200 U	**2.22**	0.200 U	0.0800 U	1.00 U	0.200 U
	SB-8	0.45	11 - 17	6/4/2014	1.00 U	**19.6**	0.200 U	1.00 U	0.200 U	0.0800 U	1.00 U	0.200 U
	SB-8	10	11 - 17	6/4/2014	1.00 U	**19.4**	0.200 U	1.00 U	0.200 U	0.0800 U	1.00 U	0.200 U
	SB-8	0.45	25 - 30	6/4/2014	**4.66**	**31.0**	0.200 U	**2.79**	0.200 U	0.0800 U	1.00 U	0.200 U
	SB-8	10	25 - 30	6/4/2014	**4.68**	**31.3**	0.200 U	**2.83**	0.200 U	0.0800 U	**1.18**	0.200 U
	SB-9	0.45	12 - 17	6/5/2014	1.00 U	**49.1**	0.200 U	1.00 U	0.200 U	0.0800 U	1.00 U	0.200 U
	SB-9	10	12 - 17	6/5/2014	1.00 U	**52.2**	0.200 U	1.00 U	0.200 U	0.0800 U	1.00 U	0.200 U
	SB-9	0.45	25 - 30	6/5/2014	**2.40**	**15.1**	0.200 U	**1.97**	0.200 U	0.0800 U	1.00 U	0.200 U
	SB-9	10	25 - 30	6/5/2014	**2.43**	**15.0**	0.200 U	**2.18**	**0.211**	0.0800 U	1.00 U	0.200 U

TABLE 2C
Filtered Metals Groundwater Analytical Data Summary Table
Heritage Square - Astoria, Oregon

Location Group	Sample ID	Filter Size (micron)	Sample Depth (ft bsl)	Sample Date	Arsenic µg/L	Barium µg/L	Cadmium µg/L	Chromium µg/L	Lead µg/L	Mercury µg/L	Selenium µg/L	Silver µg/L
Human Health Screening Values												
				Groundwater in an Excavation RBC	5,800	2.50E+07	57,000	>S	>S	>S	NA	1.00E+06
				Oregon DEQ Human Health AWQC, Organism Only[1]	2.1	NA	NA	NA	NA	NA	420	NA
				EPA NRWQC Human Health, Organism Only[2]	0.14	NA	NA	NA	NA	NA	4,200	NA
Ecological Screening Values[3]												
				EPA NRWQC, Aquatic Life (DEQ Hierarchy Reference 1)	150	NA	0.25	74	2.5	NA	5	NA
				Suter and Tsao Tier II Chronic Values (DEQ Hierarchy Reference 2)	3.1	4	NA	NA	NA	1.3	NA	0.36
				EPA Region III BTAG Freshwater Screening Criteria, 2006 (DEQ Hierarchy Reference 3)	3.1	4	0.25	85	2.5	0.026	1	3.2
				EPA Region V Ecological Screening Levels (DEQ Hierarchy Reference 4)	148	220	0.15	42	1.17	1.E-03	5	0.12
Garden of Surging Waves	DP07D-051512	unknown	35-40	5/15/2012	**17.3 B**	**43.9**	0.028 U	**0.11 J**	**0.12 B**	0.010 U	0.22 U	0.25 U
	DP07S-051512	unknown	11.7-16.7	5/15/2012	**0.27 JB**	**15.3**	0.028 U	**0.15 J**	**0.099 JB**	0.010 U	0.22 U	**0.27 J**
	DUP07SDUP-051512	unknown	11.7-16.7	5/15/2012	**0.34 JB**	**15.7**	**0.071 J**	**0.30 J**	**0.22 B**	0.010 U	0.22 U	0.25 U
Exchange Street	DP11-051612	unknown	17-22	5/16/2012	**0.75 B**	**73.4**	0.028 U	**0.19 J**	**0.052 J**	0.010 U	0.22 U	0.25 U

Notes:
Bold = constituent detected at or above the method reporting limit
B = compound detected in associated laboratory blank
J = detected concentration between the method reporting limit and method detection limit. Value is considered an estimate.
U = constituent not detected at or above the method reporting limit shown
UJ = not detected at or above the stated level, which is an approximate value
µg/L = micrograms per liter
bsl = below street level
DEQ = Oregon Department of Environmental Quality
ERA = Ecological risk assessment
NA = No screening value has been established for this analyte
NC = Not calculated because no site-specific hardness value is available.
NV = The chemical is considered non-volatile
RBC = Risk-Based Screening Concentrations
SLV = Screening level value
Red text = Exceeds most conservative human health screening value.
Exceeds ecological screening criteria (in order of hierarchy)

[1] DEQ Ambient Water Quality Criteria (AWQC) Table 40, April 2014.
[2] EPA National Recommended Water Quality Criteria (NRWQC).
[3] Ecological screening values are shown in order outlined in DEQ's Ecological Screening Level Hierarchy, January 2014.
RBC = DEQ Risk Based Concentrations, June 2012.

TABLE 3
Ranking of Soil Remedial Alternatives
Heritage Square
Astoria, Oregon

Alternative	Remediation Plan	RANKING														Total Score
		Effectiveness 1 = low effectiveness 10 = high effectiveness		Reliability 1 = low reliability 10 = high reliability		Implementability 1 = complex implementability 10 = easy implementability		Implementation Risk 1 = high risk 10 = low risk		Sustainability[1] 1 = low sustainability 10 = high sustainability		Climate Change 1 = low remedial resilience 10 = high remedial resilience		Estimated Cost 1 = high cost 10 = low cost		
1	No Action	1	Leaves soil in place, does not eliminate the potential for direct contact with soil or soil contact with groundwater.	1	Unreliable in long-term.	10	Easy	10	Low risk.	3	Not sustainable in long-term, visual nuisance; no related CO2 emissions.	7	Generally resilient to climate change, although soil remains in place and could be affected by rising sea level.	10	$0	42
2	Engineering and institutional controls	3	Leaves soil in place, institutional controls and engineering controls reduce the potential for Site users to come into direct contact with soil; potential for soil contact with groundwater remains.	2	Unreliable in long-term.	9	Easy	9	Minimal worker exposure risk.	4	Not sustainable in long-term, visual nuisance; relatively minimal CO2 emissions related to maintenance activities (1.3 metric tons CO2 equivalent).	7	Generally resilient to climate change, although soil remains in place and could be affected by rising sea level.	8	$60,000 (assuming maintenance costs of $2,000 per year for 30 years. Does not include cap installation)	42
3a	Safeway basement stockpile removal; Engineering and institutional controls	7	Removes large volume of contaminated soil, leaves some soil in place but engineering controls reduce the potential for Site users to come into direct contact with soil; potential for soil contact with groundwater remains.	7	Permanently removes contaminated soil stockpiles but leaves some contaminated soil in place and inaccessible.	8	Relatively easy	9	Minimal worker exposure risk.	6	Up to 13 metric tons CO2-equivalent emissions; up to 1,280 gallons diesel consumed; removal of visual nuisance.	8	Generally resilient to climate change, although some soil remains in place and could be affected by rising sea level.	6	Approximately $69,181 to $203,392 (Does not include cap installation)	51
3b	Safeway basement stockpile removal; Removal of soil pile and hotspot below parking deck; Engineering and institutional controls	9	Removes contaminated soil, leaves some soil in place but mostly inaccessible to Site users; removes some soil acting as potential source of groundwater impacts.	8	Permanently removes contaminated soil stockpiles and most highly contaminated soil under parking deck, but leaves some soil in place and inaccessible.	7	Moderately complex	7	Increased worker exposure to contaminants, confined space entry.	6	Up to 14.6 metric tons CO2-equivalent emissions; up to 1,432 gallons diesel consumed; removal of visual nuisance.	9	More resilient to climate change because additional soil has been removed and is therefore less likely to be affected by rising sea level.	5	Approximately $114,743 to $248,954 (Does not include cap installation)	51
3c	Safeway basement stockpile removal; Removal of soil pile and hotspot below parking deck; Removal of soil above RBCs under northern end of parking deck to depth of 12 inches; Engineering and institutional controls	10	Removes contaminated soil, leaves minimal soil in place but inaccessible to Site users; removes most soil acting as potential source of groundwater impacts.	9	Permanently removes contaminated soil stockpiles and most highly contaminated soil under parking deck, but leaves some soil in place and inaccessible.	6	Complex	6	Increased worker exposure to contaminants, confined space entry, may require support system for raised parking deck.	7	UP to 16.7 metric tons CO2-equivalent emissions; up to 1,642 gallons diesel consumed; removal of visual nuisance; potentially reduces groundwater contamination.	10	Most resilient to climate change because most contaminated soil has been removed, reducing affects of rising sea level.	4	Approximately $156,611 to $309,611 (Cap installation not likely required)	52

Notes:
1 - See Table 4 for CO2 calculations

TABLE 4
Greenhouse Gas Emissions Calculations for Soil Remedial Alternatives

Alternative Number	Alternative Description	CY of Soil	Number of Trucks[1]	Miles per Round Trip[2]	Total Miles	MPG[3]	Fuel Consumption per Truck (gallons)	Total Fuel Consumption (gallons)[4]	CO2-Equivalent Emissions (kilograms)[5]	CO2-Equivalent Emissions (pounds)	CO2-Equivalent Emissions (metric tons)[5]
1	No Action	0	0	0	0	0	0	0	0	0	0
2	Institutional and Engineering Controls (zoning change/fencing)	0	0	0	0	0	0	150	1,317	2,904	1.3
3a	Safeway Basement Stockpiles Removal and Institutional/Engineering Controls (RCRA D Landfill - **Component 1 below**)	1,200	67	172	11,524	9	19	1,280	13,068	28,815	13.1
3b	Safeway Basement and Parking Deck Stockpile Removal, Targeted soil Excavation, and Institutional/Engineering Controls (RCRA C and D Landfills - **Components 1+2 below**)	1,250	70	626	12,886	9	70	1,432	14,610	32,214	14.6
3c	Stockpile Removal, Soil Excavation to 12 Inches Below Ground Surface, and Institutional/Engineering Controls (RCRA C and D landfills - **Components 1+2+3 below**)	1,443	81	798	14,778	9	89	1,642	16,754	36,942	16.7
3d	Safeway Basement and Parking Deck Stockpile Removal, Targeted soil Excavation, and Institutional/Engineering Controls (50 CY to Arlington and 1,200 CY to local quarry - **Components 2+4 below**)	1,250	70	460	1,764	9	51.1	196	2,001	4,413	2
Alternative 3 Component Supporting Calculations											
Component 1	Transport Two Large Safeway Stockpiles to Hillsboro Landfill (Nonhazardous)	1,200	67	172	11524	9	19	1,280	13,068	28,815	13.1
Component 2	Transport Small Stockpile and Hot Spot Soil to Arlington (Hazardous)	50	3.0	454	1362	9	50	151	1,542	3,399	1.5
Component 3	Transport of soil beneath northern end of raised parking deck to Hillsboro Landfill (Nonhazardous)	193	11.0	172	1892	9	19	210	2,144	4,728	2.1
Component 4	Transport Two Large Safeway Stockpiles to Local Quarry (Nonhazardous)	1,200	67	6	402	9	0.67	45	460	1,013	0.5

Notes:

[1] Assume 18 cubic yards per truck; number of trucks rounded up.

[2] Mileage assumes one round-trip per truck from Astoria to landfills or the local quarry.

[3] Source: Oak Ridge National Laboratory (http://cta.ornl.gov/vtmarketreport/pdf/chapter3_heavy_trucks.pdf)

[4] For Alternative 2, assume 5 gallons gasoline per year in light-duty truck for maintenance, for 30 years.

[5] Source: EPA Center for Corporate Climate Leadership Simplified GHG Emissions Calculator (SGEC) Version 3.2 June 2014

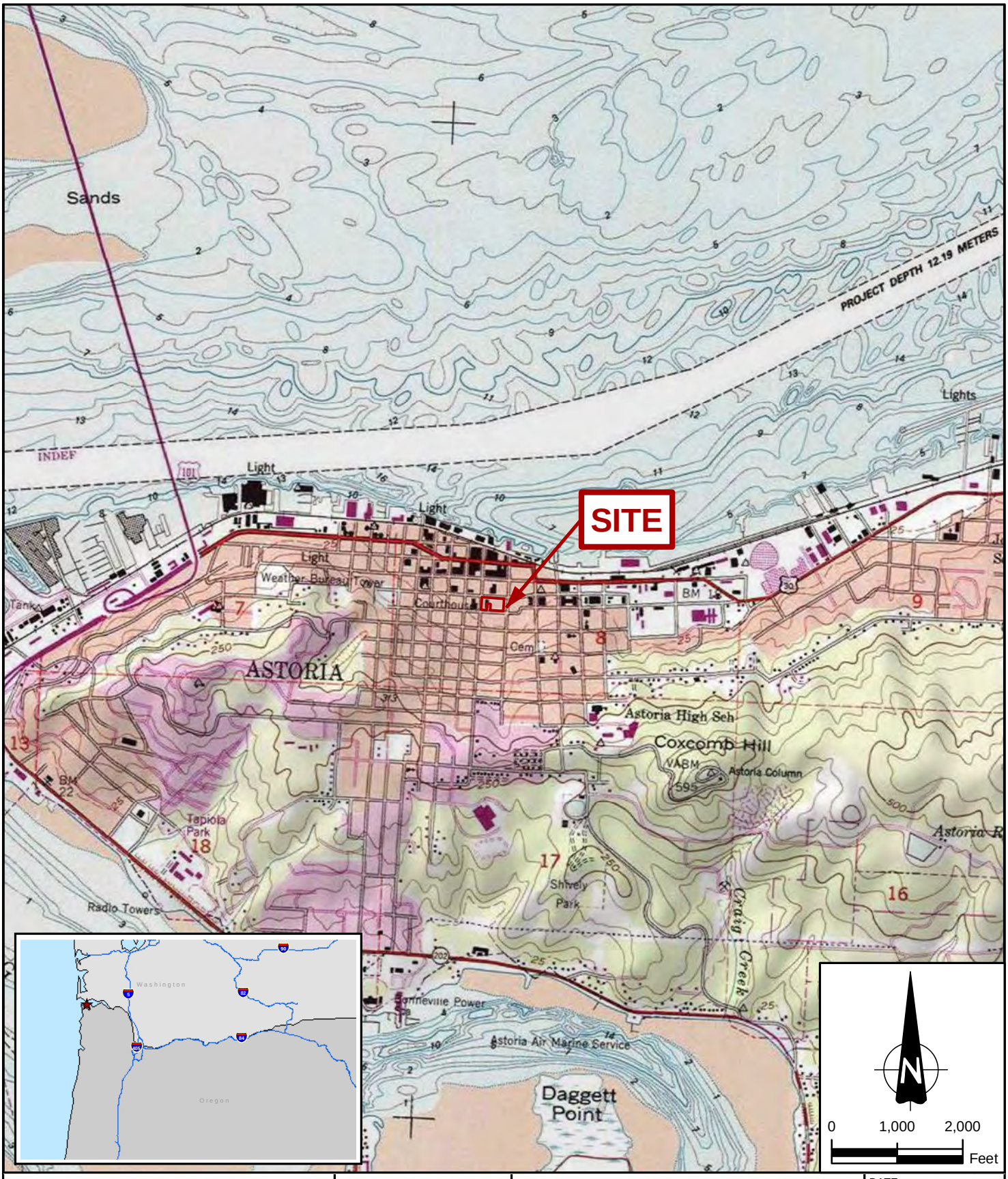
CO2 = Carbon dioxide

MPG = miles per gallon

Roundtrip mileage for Hillsboro Landfill is 172 miles.

Roundtrip mileage for Chemical Waste Arlington Landfill is 454 miles.

FIGURES



CITY OF ASTORIA		ANALYSIS OF BROWNFIELD CLEANUP ALTERNATIVE HERITAGE SQUARE	DATE: AUGUST 2015 SCALE: 1 " = 2,000 '
Amec Foster Wheeler Environment & Infrastructure, Inc. 7376 S.W. Durham Road Portland, OR 97224	amec foster wheeler	SITE VICINITY MAP	PROJECT NO.: 3-61M-128230.03 FIGURE: 1

DRAWN BY: SD CHECKED BY: JK

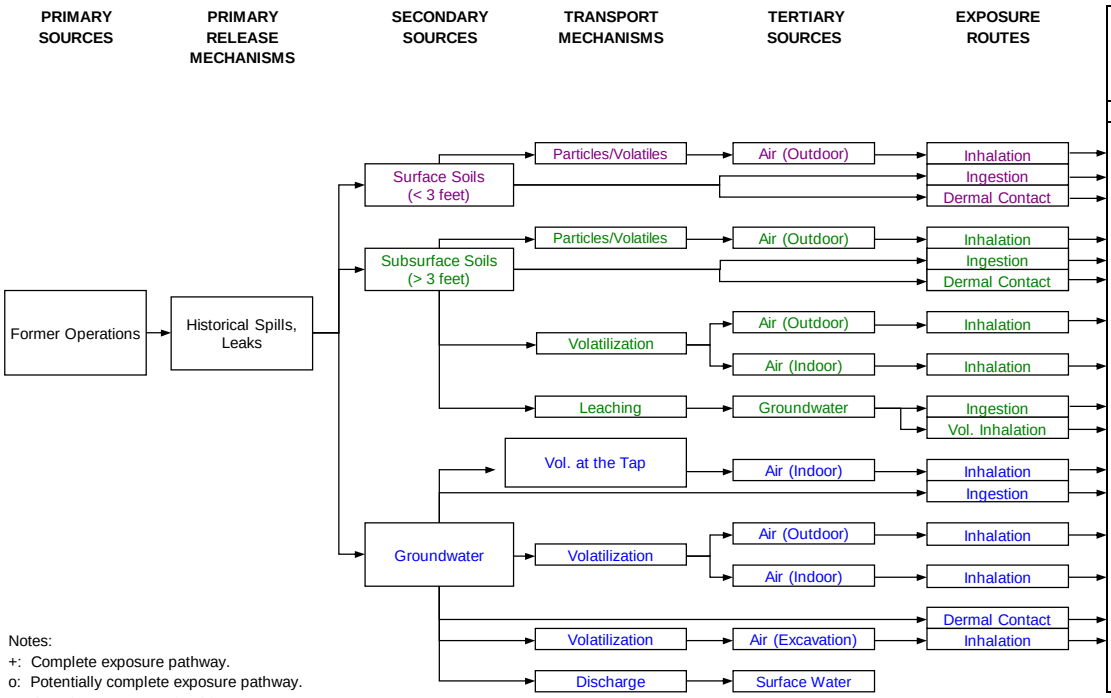
K:\12000\12800\12823\128230\DWG_Brownfield_Cleanup_Alternatives\Figure 1 - Site Vicinity Map.mxd - stephane.descombes - 8/10/2015 - 3:06:41 PM

CITY OF ASTORIA	amec foster wheeler	ANALYSIS OF BROWNFIELD CLEANUP ALTERNATIVE HERITAGE SQUARE	DATE: AUGUST 2015
			SCALE: 1 " = 75 '
Amec Foster Wheeler Environment & Infrastructure, Inc. 7376 S.W. Durham Road Portland, OR 97224		AERIAL PHOTO SHOWING EXISTING SITE FEATURES (7/30/2014)	PROJECT NO. 3-61M-128230.03
			FIGURE 2

DRAWN BY: SD CHECKED BY: JK

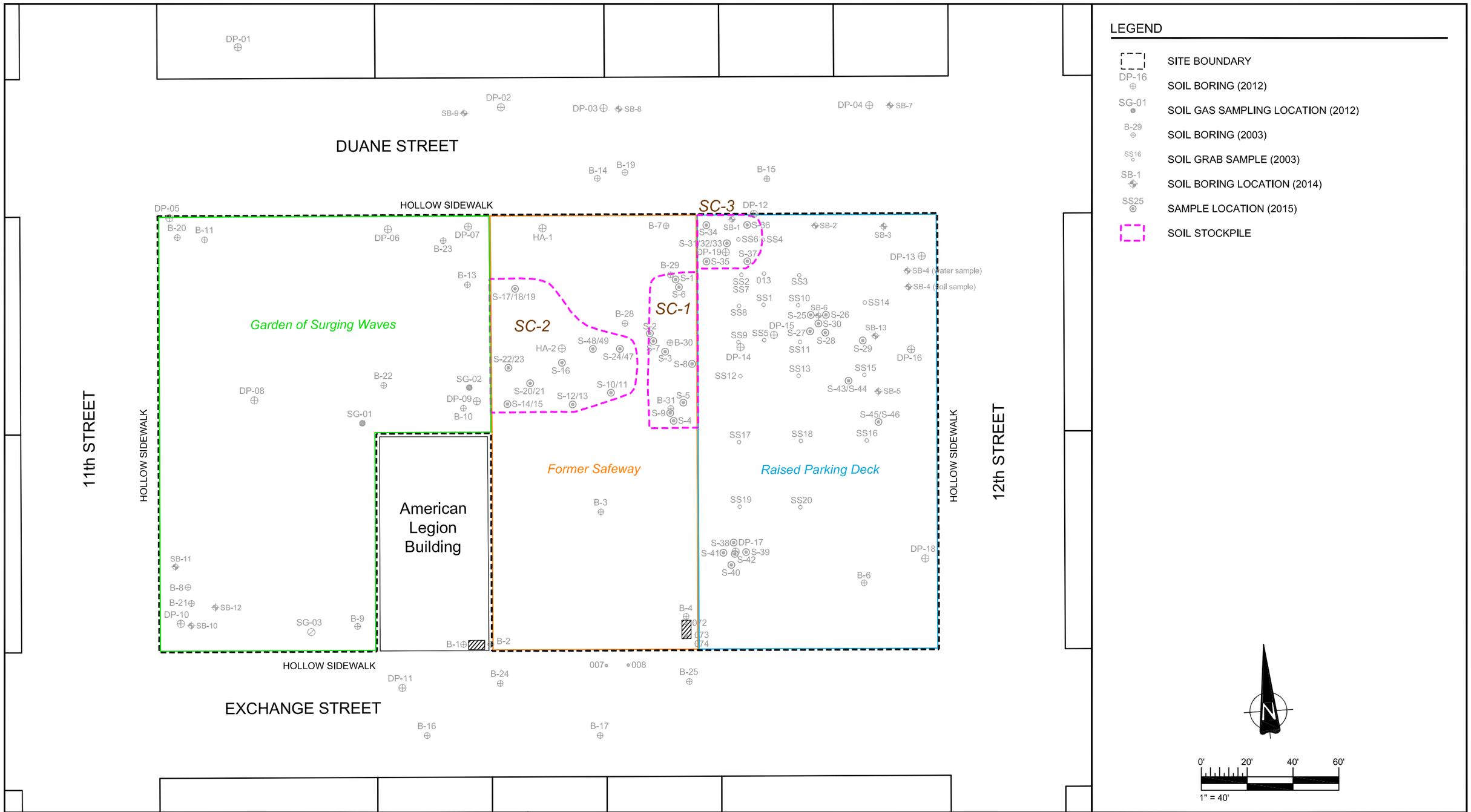
K:\12000\12800\12823\128230\DWG_Brownfield_Cleanup_Alternatives\Figure 2 - Site Aerial.mxd - stephane.descombes - 8/10/2015 - 2:53:32 PM

FIGURE 3
Conceptual Site Model
Heritage Square, Astoria, Oregon



Park User	Urban Residential	Occupational	Construction & Excavation		Ecological Receptors (Aquatic, Columbia River)
Future	Future	Future	Current	Future	
+	+	+	+	+	-
+	+	+	+	+	-
+	+	+	+	+	-
-	-	-	+	+	-
-	-	-	+	+	-
-	-	-	+	+	-
+	+	+	+	+	-
-	+	+	-	-	-
-	-	-	+	+	-
+	+	+	+	+	-
-	-	-	-	-	-
-	-	-	+	+	-
+	+	+	+	+	-
-	+	+	-	-	-
-	-	-	+	+	-
-	-	-	+	+	-
-	-	-	-	-	o

Notes:
+: Complete exposure pathway.
o: Potentially complete exposure pathway.
-: There is no exposure by this route.



CITY OF ASTORIA

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Environment & Infrastructure, Inc.
7376 S.W. Durham Road
Portland, OR 97224

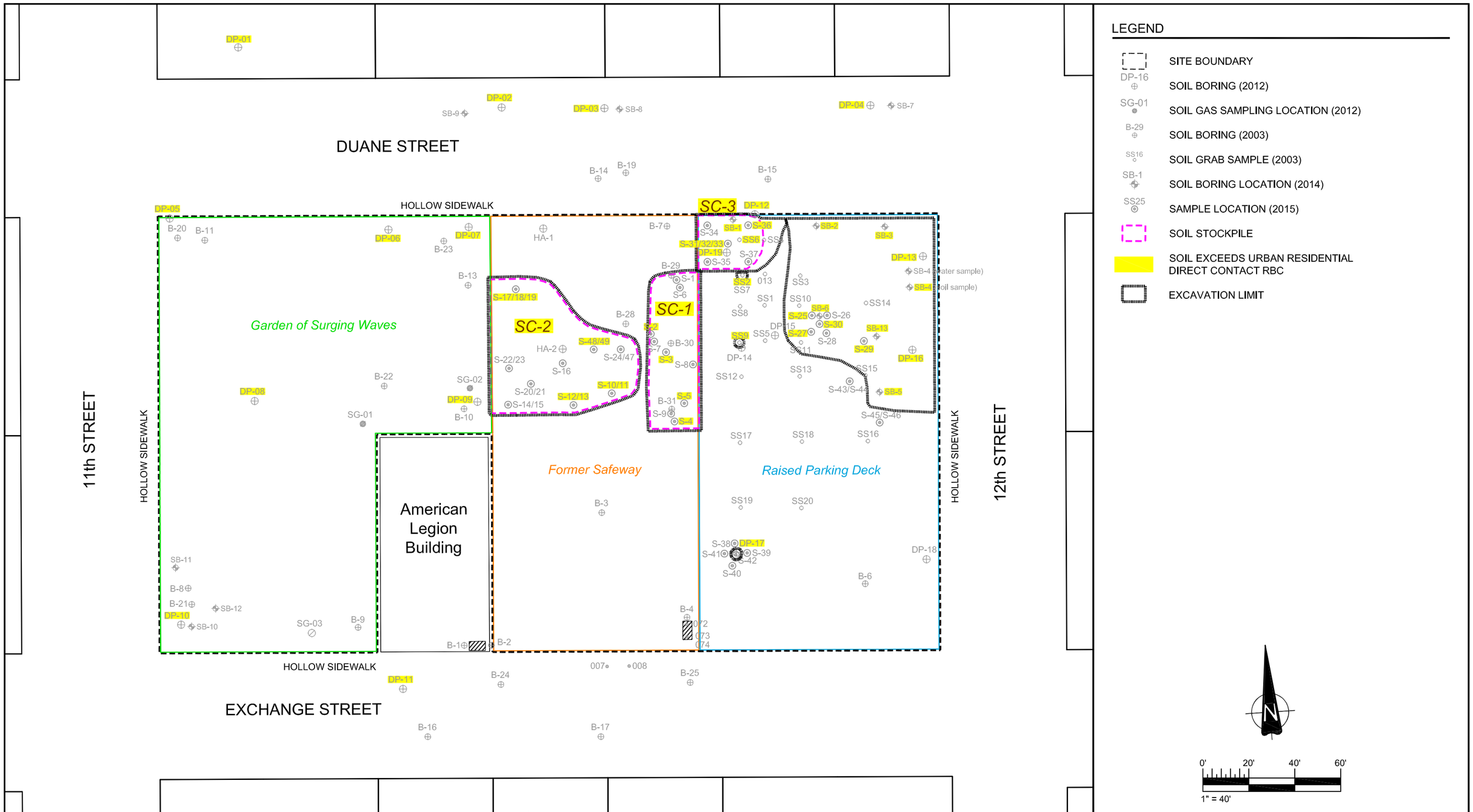
ANALYSIS OF BROWNFIELD CLEANUP ALTERNATIVES HERITAGE SQUARE

SOIL STOCKPILES, SAMPLING LOCATIONS, AND RELEVANT HISTORICAL DEVELOPMENT FEATURES

DATE: AUGUST 2015
SCALE: 1" = 40'
PROJECT NO.: 3-61M-128230.03
FIGURE: 4

DRAWN BY: PM CHECKED BY: JKH

K:\12000\12800\12823\128230\DWG_Brownfield_Cleanup_Alternatives\Figure 4 – Soil Stockpiles and Sampling Locations.dwg – – – Sep. 08, 2015 8:42am – stephane.descombes



LEGEND

- SITE BOUNDARY
- DP-16 — SOIL BORING (2012)
- SG-01 — SOIL GAS SAMPLING LOCATION (2012)
- B-29 — SOIL BORING (2003)
- SS16 — SOIL GRAB SAMPLE (2003)
- SB-1 — SOIL BORING LOCATION (2014)
- SS25 — SAMPLE LOCATION (2015)
- SOIL STOCKPILE
- SOIL EXCEEDS URBAN RESIDENTIAL DIRECT CONTACT RBC
- EXCAVATION LIMIT

CITY OF ASTORIA

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Portland, OR 97224

ANALYSIS OF BROWNFIELD CLEANUP ALTERNATIVES HERITAGE SQUARE

AREA OF SOIL TO BE REMOVED BENEATH PARKING DECK

DATE: AUGUST 2015
SCALE: 1" = 40'
PROJECT NO.: 3-61M-128230.03
FIGURE: 5

DRAWN BY: PM CHECKED BY: JKH

K:\12000\12800\12823\128230\DWG_Brownfield_Cleanup_Alternatives\Figure 5 – Area of Soil to be Removed Beneath Parking Deck.dwg – – – Sep. 10, 2015 9:26am – stephane.descombes