Cleanup Action Plan

Olympia Dry Cleaners Site
606 Union Ave SE
Olympia, Washington

FS ID: 1446
Cleanup Site ID: 4722

Prepared by the
Washington State
Department of Ecology

October 29, 2014

Table of Contents

List of Tables

List of Figures

List of Appendices

List of Abbreviations/Acronyms

Acronym/ Abbreviation	Definition
ARAR	Applicable or relevant and appropriate requirements
bgs	Below ground surface
CDF	Controlled-density fill
cis-1,2-DCE	cis-1,2-dichloroethene
cm/sec	Centimeters per second
COC	Chemical of concern
DCA	Disproportionate cost analysis
CAP	Cleanup Action Plan
DRPH	Diesel-range petroleum hydrocarbons
Ecology	Washington State Department of Ecology
FS	Feasibility Study
FS Addendum	Feasibility Study Addendum
GRPH	Gasoline-range petroleum hydrocarbons
LOTT	LOTT Clean Water Alliance
mg/kg	Milligrams per kilogram
MNA	Monitored natural attenuation
MTCA	Model Toxics Control Act
NPDES	National Pollutant Discharge Elimination System
ORPH	Oil-range petroleum hydrocarbons
PCE	Tetrachloroethene
POC	Point of compliance
PQL	Practical quantitation limit
RAWP	Remedial Action Work Plan
RI	Remedial Investigation
ROW	Right-of-way
SEPA	State Environmental Policy Act
Site	Former Olympia Dry Cleaners Site
STEL	Short-Term Exposure Limits
TCE	Trichloroethene
trans-1,2-DCE	trans-1,2-dichloroethene
µg/L	Micrograms per liter
$\mu g/m^3$	Micrograms per cubic meter
WAC	Washington Administrative Code

1.0 Introduction

This Cleanup Action Plan (CAP) describes the proposed cleanup action selected by the Washington State Department of Ecology (Ecology) for the Former Olympia Dry Cleaners Site (Site). The Site is located at 606 Union Avenue Southeast in Olympia, Washington (refer to Figure 1). It is Ecology's determination that the proposed cleanup action described in this document, together with prior remedial actions, complies with Washington Administrative Code (WAC) 173-340-360 of the Model Toxics Control Act (MTCA).

This CAP was developed using information presented in the Revised Draft Remedial Investigation (RI) Report for the Site, prepared by Sound Environmental Strategies Corporation in 2009; the Revised Draft Feasibility Study (FS) Report for the Site, prepared by SoundEarth Strategies, Inc. in 2013; and in the Feasibility Study Addendum (FS Addendum) for the Site, prepared by Floyd|Snider in 2013.

The objective of this document is to satisfy the MTCA requirements for cleanup action plans set forth in WAC 173-340-380(1). Consistent with the requirement of that chapter, this CAP provides the following information:

- Site description, background, prior remedial actions, and environmental conditions
- Cleanup standards for each hazardous substance in each media of concern
- A brief summary of the cleanup action alternatives considered in the FS Report and the FS Addendum
- A description of the selected cleanup action, including justification for the selection
- Environmental covenants and site use restrictions
- Applicable state and federal laws for the selected cleanup action
- An implementation schedule for the selected cleanup action

Ecology held a public comment period on the draft CAP from September 18–October 17, 2014. The comments Ecology received during the comment period did not result in any changes to the draft CAP. This final CAP will be implemented under a consent decree.

2.0 Site Description, Background, and Environmental Conditions

2.1 SITE DESCRIPTION

The Site is defined by the lateral and vertical extent of contamination that has resulted from the operation of a former dry cleaning facility on the Former Olympia Dry Cleaners Property, in accordance with WAC Chapter 173-340. Based on the extent of contamination, the Site includes a portion of the Former Olympia Dry Cleaners Property, a portion of the property located adjacent to the north (the Cherry Street Q-Tip Trust Property), and a portion of the Cherry Street Southeast right-of-way (ROW; Figure 2). The Site covers approximately 3,700 square feet, based on the extent of tetrachloroethene (PCE) in affected soil and groundwater.

The Former Olympia Dry Cleaners Property is located at 606 Union Avenue Southeast in Olympia, Washington (Figure 2). The property is located at the intersection of Union Avenue Southeast and Cherry Street Southeast. Improvements to this property include the one-story, slab-on-grade Former Olympia Dry Cleaners Building (2,584 square feet in area) and asphalt-paved areas, which serve as parking, along the west and south perimeters (Figure 2). An unpaved alley (the North Alley), approximately 6 feet in width, borders the north side of the Former Olympia Dry Cleaners Building. A dry cleaning drop-off and pick-up facility currently operates in this building; however, it does not perform dry cleaning activities or use PCE as a cleaning solvent.

In addition, the Site encompasses a portion of the adjacent Cherry Street Q-Tip Trust Property, located at 1000 Cherry Street Southeast. This Cherry Street Q-Tip Trust Property is located north of the Former Olympia Dry Cleaners Property and across the North Alley (Figure 2). The western portion of this property is developed with a one-story building (Cherry Street Q-Tip Trust Building) that includes a basement beneath its northern portion. The building has historically been used as office space. The eastern and northern portions of this property are asphalt-paved and used as parking areas. The North Alley borders the south side of the Cherry Street Q-Tip Trust Building (Figure 2).

2.2 HISTORICAL PROPERTY LAND USE

Based on available records, Mr. Frank Burleson purchased the Former Olympia Dry Cleaners Property in 1970. Prior to construction of the building, imported fill was placed in the northern portion of the property to bring the property to its present grade (Stemen Environmental 2005). Mr. Burleson operated a full-service dry cleaner business from 1970 to 1981. A dry cleaning machine that used PCE was installed in 1970 at the north-central portion of the Former Olympia Dry Cleaners Building, approximately 1 foot north of the existing dry cleaning machine (Figure 2).

Mr. Gaylor Bolton began leasing the Former Olympia Dry Cleaners Property from Mr. Burleson in 1981 and continued to operate a full-service dry cleaner under the name Olympia Dry Cleaners. Mr. Bolton continued operating Olympia Dry Cleaners until 1995 (Stemen Environmental 2005). The cleaning methods and chemicals used during Mr. Bolton's operations are unknown. Mr. Howard McCullough subsequently leased the Former Olympia Dry Cleaners Property from 1996 to approximately 2002 and operated a clothes washing and pressing service under the name Howard's Cleaners. In addition, Mr. McCullough reportedly used the Former

Olympia Dry Cleaners Property as a drop shop for dry cleaning services to be performed at another location off the Former Olympia Dry Cleaners Property. Mr. McCullough reportedly did not operate the dry cleaning machine that was present in the Former Olympia Dry Cleaners Building (Stemen Environmental 2005).

Mr. Tony Anderson leased the Former Olympia Dry Cleaners Property in 2002 to operate a full-service dry cleaner under the name TMC Cleaners (Stemen Environmental 2005). In August 2004, Mr. Anderson reportedly discontinued use of PCE as the active dry cleaning agent on the Former Olympia Dry Cleaners Property and began using aliphatic hydrocarbons as part of his operations (Stemen Environmental 2005). The current dry cleaning machine is located approximately 1 foot south of the former dry cleaning machine. Trichloroethene (TCE) was reportedly used as a stain remover in conjunction with the new dry cleaning process (Stemen Environmental 2005). Mr. Anderson continued operating TMC Cleaners until approximately 2007. In 2007, Mr. McCullough began leasing the Former Olympia Dry Cleaners Property and operates a full-service dry cleaner called Howard's Cleaners. Howard's Cleaners uses the same PCE-free dry cleaning machine used by TMC Cleaners.

2.3 PHYSICAL SETTING AND HYDROGEOLOGY

A summary of the Site's physical setting and local geology and hydrology is provided below.

2.3.1 Physical Setting

The topography of the Site slopes downward toward the north. The slope is greater in the north-central and northwestern portions at the Former Olympia Dry Cleaners Property. Based on the survey performed during the RI, the ground surface elevation at the Site ranges from approximately 32 feet above mean sea level near Union Avenue Southeast down to approximately 26 feet above mean sea level near 10th Avenue Southeast.

2.3.2 Geology

The uppermost native soils in the local area consist of the Latest Vashon fine-grained sediments (Qgof) geologic unit (WSDNR 2003, Pacific Groundwater Group 2007). The Qgof unit consists predominantly of silt and clay with interbeds of silt, clay, clayey silt, and silty sand. These soil types generally have relatively low hydraulic conductivity ranges from 10^{-3} to 10^{-6} centimeters per second (cm/sec; Freeze and Cherry 1979). The maximum thickness of the Qgof unit in the region is approximately 95 feet (Pacific Groundwater Group 2007). Underlying the Qgof unit is a geologic unit referenced as the latest Vashon recessional sand and minor silt (Qgos). The Qgos unit consists predominantly of fine- to medium-grained sand with interbedded silt. These soil types generally have moderate hydraulic conductivity ranges from 10^{-1} to 10^{-5} cm/sec (Freeze and Cherry 1979). The thickness of the Qgos unit may exceed 400 feet (Pacific Groundwater Group 2007).

As noted in the RI Report (Sound Environmental Strategies, 2009), fill material at the Site consists of gravelly silt with clay to well-graded silty sand with gravel. Fill thickness is generally 0 to 4 feet except in the soil excavation area where backfill extends to a depth of approximately 9 feet below ground surface (bgs). The RI Report also noted that, based on the artesian conditions observed in groundwater monitoring wells, native deposits transition from the Qgof unit to the Qgos unit starting at the depth of 12 to 15 feet bgs.

2.3.3 Hydrology

The nearest surface water body to the Site is Capitol Lake, which is a freshwater lake located approximately 2,400 feet to the west (Figure 1). Regional deep (Qgos) groundwater flows toward Budd Inlet, which is a saltwater inlet located approximately 3,000 feet to the north (Pacific Groundwater Group 2007). Locally at the Site, a shallow groundwater-bearing zone is observed from approximately 0 to 15 feet bgs. The lithologies within the shallow groundwater zone generally consist of silt and clay, silty sand, and sandy silt. These soil types are characteristic of the Qgof unit, which is considered an aquitard based on its limited capacity to transmit groundwater (i.e., low hydraulic conductivity; Pacific Groundwater Group 2007). Based on aquifer test results, the estimated hydraulic conductivity of the excavation backfill area is 6.8 x 10^{-3} centimeters per second (SoundEarth Strategies 2013). The hydraulic conductivity of the shallow aquifer is likely lower due to its finer grain size. Potentiometric surface data indicate that shallow groundwater flows to the north and west with an average lateral hydraulic gradient of 0.04 feet per foot and there is an upward vertical hydraulic gradient of 0.15 feet per foot from the Qgos aquifer to the shallow (Qgof) aquifer, based on data from Wells MW-12 and MW-10 (SoundEarth Strategies 2013). A groundwater seep (referred to in this document as the Seep) is located approximately 13 feet west of the southwest corner of the Cherry Street Q-Tip Trust Building (Figure 2). In addition, artesian conditions have been observed in six monitoring wells (MW-07 through MW-09, MW-11, MW-12, and MW-14) located on or in the vicinity of the Site and in a private water supply well located along the west side of the Former Olympia Dry Cleaners Building (identified as the Artesian Supply Well on Figure 2). The artesian conditions are attributed to pressure applied by the Qgof unit that confines or partially confines groundwater in the underlying Qgos unit (Pacific Groundwater Group 2007). The Artesian Supply Well is not currently used as a potable water source, but instead is used for boiler water and other non-potable uses required by the current cleaning operation.

2.4 PRIOR REMEDIAL ACTIONS

In 2006, an interim remedial action, which involved the excavation of some of the accessible contaminated soil at the Site, was conducted near the northwest corner of the Former Olympia Dry Cleaners Property. The objective of this interim remedial action was to remove the primary source and predominant mass of PCE and its degradation compounds within this area. However, the limits of the interim action excavation were constrained by existing aboveground structures and Cherry Street Southeast and associated concerns related to the integrity of these structures. The location and approximate lateral extent of the 2006 interim action excavation is depicted on Figure 3. The depth of the excavation was reported to range from approximately 8 to 10 feet bgs. A total of 311 tons of soil was excavated from the site and disposed of in an approved treatment, storage, and disposal (TSD) facility. The excavation was backfilled with well-graded silty fine- to coarse-grained sand and gravel and restored to the surrounding surface grade.

Soil samples collected from the bottom and sidewalls of the excavation limits indicated that residual soil with elevated concentrations of PCE was left in place at the Site. The highest PCE concentration detected in these soil samples was 96 milligrams per kilogram (mg/kg) and was detected in a soil sample located along the western sidewall adjacent to Cherry Street Southeast.

Additionally, SoundEarth Strategies constructed a Seep Collection and Treatment System in 2007 and 2008 to collect and treat the water from the Seep that is contaminated by PCE and its

degradation compounds. The continuous operation of the treatment system prevents the contaminated seep water from flowing away from the Site and into nearby stormwater drains. In addition, temporary fencing is placed around the Seep and associated surface water to prevent direct contact until a cleanup action is completed at the Site.

2.5 CHEMICALS OF CONCERN AND AFFECTED MEDIA

Soil, groundwater, surface water, and air are the media of concern at the Site. The chemicals of concern (COCs) for the Site are the chemical compounds associated with dry cleaning activities that were detected in soil, groundwater, and surface water (i.e., the Seep) at concentrations exceeding the applicable MTCA cleanup levels. Air is also an affected media for the Site due to elevated soil vapor (soil gas) sample results from beneath the slab of the dry cleaners building (sub-slab sample).

The following COCs were identified for the Site:

Table 1 Chemicals of Concern

Chemical	Soil	Groundwater	Surface Water (Seep)	Air
PCE	✓	✓	✓	✓
TCE	✓	✓	✓	✓
cis-1,2-Dichloroethene (cis-1,2-DCE)	✓	✓	✓	✓
trans-1,2-Dichloroethene (trans-1,2-DCE)	✓	✓	✓	✓
1,1-Dichloroethene (1,1-DCE)	✓	✓	✓	✓
Vinyl Chloride	✓	✓	✓	✓

The suspected source of PCE and its degradation compounds (TCE, cis-1,2-DCE, and vinyl chloride) are associated with former dry cleaning operations in the Former Olympia Dry Cleaners Building and the possibility of historical unreported spills in the North Alley on the Former Olympia Dry Cleaners Property.

2.5.1 Soil

RI soil samples collected from the Site in 2008 had concentrations of PCE and TCE exceeding their MTCA Method A cleanup levels at multiple locations. Therefore, PCE, TCE, and their associated degradation products, including cis-1,2-DCE, trans-1,2-dichloroethene (trans-1,2-DCE), 1,1-dicloroethene (1,1-DCE), and vinyl chloride have been retained as soil COCs for the Site.

Oil-range petroleum hydrocarbons (ORPH) were detected in only one shallow soil sample (1 foot bgs) collected from the Site in 2001. Due to the age of this soil data and the frequency of detection for ORPH in soil at the Site, ORPH has not been retained as a soil COC.

2.5.2 Groundwater

PCE, TCE, cis-1,2-DCE, and vinyl chloride have been detected at levels greater than their applicable MTCA Method A or B groundwater cleanup levels in multiple wells during the last three rounds of groundwater sampling at the Site, conducted in 2008, 2010, and 2013. Therefore, PCE, TCE, cis-1,2-DCE, and vinyl chloride have been retained as groundwater COCs for the Site. The only other PCE degradation compound previously detected in groundwater at the Site was trans-1,2-DCE. It was detected in Well MW-02 in 2001 and 2002, but was not detected in the 2003 and 2004 groundwater samples collected from this well, and this well was later decommissioned due to the 2006 interim remedial action. However, trans-1,2-DCE and 1,1-DCE will continue to be retained as groundwater COCs because they are PCE degradation products.

Reconnaissance groundwater samples collected from three borings in 1995 had ORPH concentrations that exceeded the MTCA Method A cleanup level. The groundwater analytical results from two of these borings, along with the one detection of ORPH in soil noted above, indicate that a release of ORPH occurred to the surface and shallow subsurface within a limited area near the northeast corner of the Former Olympia Dry Cleaners Building and North Alley. The other boring had both ORPH and gasoline-range petroleum hydrocarbons (GRPH) detected at levels greater than the MTCA Method A cleanup level in 1995; however, this boring was located within the excavation area that was part of the 2006 interim remedial action. Similarly, diesel-range petroleum hydrocarbons (DRPH) was detected in one boring collected in 2001; however, this boring was also located within the 2006 interim remedial action excavation area. No other reconnaissance groundwater samples collected from the Site have had detections of ORPH, DRPH, or GRPH. Areas of DRPH- and GRPH-impacted groundwater have been addressed by the 2006 interim remedial action source removal and were not retained as groundwater COCs. Due to the age of the ORPH data and the limited area of impact in the northeast corner of the Former Olympia Dry Cleaners Building, ORHP was also not retained as a groundwater COC.

2.5.3 Surface Water

Seep concentrations for PCE, TCE, and vinyl chloride exceeded the applicable MCTA Method B cleanup levels in samples collected in 2007 and 2008. Therefore, these three chemicals were retained as surface water COCs for the Site. The associated PCE degradation products are also included as surface water COCs.

2.5.4 Air

June 2011 sub-slab soil vapor sample results from the Olympia Dry Cleaners building showed concentrations of PCE and TCE at levels greater than Ecology's guidance screening levels for protection of the vapor intrusion exposure pathway (SoundEarth Strategies 2013). Vapor intrusion occurs when volatile hazardous substances migrate from the subsurface to indoor air. Therefore, PCE, TCE, and the associated PCE degradation products are included as air COCs for the Olympia Dry Cleaners building portion of the Site.

Based on 2010 and previous indoor air sampling results, the vapor intrusion pathway for the Cherry Street Q-Tip Trust Building is considered to be incomplete (SoundEarth Strategies 2013).

2.6 CONTAMINANT DISTRIBUTION BY MEDIA

2.6.1 Soil

Soil on the Site is impacted by PCE and TCE. The soil analytical data collected from the RI, previous investigations, and the 2006 interim remedial action demonstrate that the concentrations of PCE and TCE in soil decrease with distance away from the confirmed and suspected source areas. Contours of the PCE concentrations in soil at the Site are shown on Figure 4. Elevated concentrations of PCE in soil are present at approximately 5 to 8 feet bgs along the western portion of the North Alley near the northwest corner of the Former Olympia Dry Cleaners Property; however, concentrations of PCE in soil attenuate to less than the practical quantitation limits (PQLs) at depths greater than 10 feet bgs in this area. In addition, concentrations of PCE in soil in excess of the cleanup level are also present in the eastern portion of the North Alley at depths of approximately 1 to 5 feet bgs. The concentrations of PCE exceeding the MTCA Method A cleanup level site-wide range from 0.062 to 96 mg/kg. As stated earlier, the highest PCE concentration was detected in a sidewall soil sample collected from the western wall of the 2006 interim remedial action excavation limits, adjacent to Cherry Street Southeast. TCE exceedances in the soil samples show a similar pattern to the PCE exceedances in soil but at much lower concentrations.

The lateral extent of soil with concentrations of PCE that exceed the MTCA Method A cleanup level covers an area of approximately 1,600 square feet (Figure 4). The vertical thickness of soil with concentrations of PCE in this area ranges from approximately 0 to 10 feet bgs. Based on the lateral extent of soil with elevated concentrations of PCE and the average thickness ranges of elevated PCE concentrations in soil, the estimated total volume of soil with concentrations of PCE that exceed the MTCA Method A cleanup level is 266 cubic yards.

2.6.2 Groundwater

The groundwater analytical data collected from reconnaissance borings and monitoring wells indicate that concentrations of PCE and its degradation compounds, TCE, cis-1,2-DCE, and vinyl chloride, decrease significantly both laterally and vertically with distance from the confirmed and suspected source areas. Any downward vertical migration of PCE from the source areas appears to be restricted by the upward vertical hydraulic gradient caused by artesian conditions at the Site. The highest concentrations of PCE in groundwater are present near the northwest corner of the Former Olympia Dry Cleaners Property in the suspected source area. The vertical extent of the dissolved-phase PCE plume is approximately 20 feet bgs. Contours of the PCE concentrations in groundwater at the Site based on groundwater monitoring data collected in 2008 and earlier are shown on Figure 5. More recent groundwater monitoring data from 2010 and 2013 are not shown on this figure, but this more recent data suggests that groundwater concentrations are decreasing.

2.6.3 Seep

Upward vertical flow of groundwater through the backfill material in the 2006 interim action soil excavation area is the result of the artesian conditions commonly observed in this area. This causes the Seep discharge located within the soil excavation area, approximately 13 feet west of the southwest corner of the Cherry Street Q-Tip Trust Building. The Seep has elevated concentrations of PCE, TCE, and vinyl chloride as expected, given that the Seep reflects contaminant conditions in groundwater within the suspected source area.

2.6.4 Air

As mentioned above, the Olympia Dry Cleaners building has the potential for vapor intrusion because of June 2011 sub-slab soil vapor sample results that showed concentrations of PCE and TCE above Ecology's guidance screening levels for protection of the vapor intrusion exposure pathway.

3.0 Cleanup Standards

Cleanup standards are established for the Site in this section. Two factors control designation of appropriate cleanup standards for specific sites: specification of cleanup levels (the chemical concentrations that are protective of human health and the environment) for each COC in each impacted media; and identification of the point of compliance (POC; the location on the Site where the cleanup levels must be attained). Table 3 identifies the site-specific numerical cleanup levels, based on the applicable cleanup levels by media for each specific COC identified in Section 2.4 above.

Table 2 Cleanup Levels[a]

Chemical	Soil	Groundwater	Surface Water (Seep)	Indoor Air-Residential[g]	Indoor Air-Commercial[h]
PCE	0.05 mg/kg	5 µg/L	3.3 µg/L[d]	9.6 µg/m^3	32 µg/m^3
TCE	0.03 mg/kg	5 µg/L	30 µg/L[d]	0.37 µg/m^3	2 µg/m^3
cis-1,2-DCE	0.03 mg/kg[b]	16 µg/L[c]	NA	NA	
trans-1,2-DCE	0.043 mg/kg[b]	100 µg/L[e]	10,000 µg/L[d]	27 µg/m^3	60 µg/m^3
1,1-DCE	0.03 mg/kg[b]	7 µg/L[e]	3.2 µg/L[f]	91 µg/m^3	670 µg/m^3
Vinyl Chloride	0.03 mg/kg[b]	0.2 µg/L	2.4 µg/L[d]	0.28 µg/m^3	0.9 µg/m^3

Notes:
- a Cleanup levels are MTCA Method A unless otherwise noted. Values taken from a query of Ecology's CLARC website on January 10, 2014 and CLARC Guidance documents for TCE, PCE, cis- and trans-1,2-DCE, 1,1-DCE, and vinyl chloride.
- b MTCA Method B calculated value for protection of the soil-to-groundwater pathway (adjusted up to the soil PQL as appropriate).
- c MTCA Method B non-carcinogen Standard Formula Value.
- d Surface Water ARAR – Human Health, Marine, Clean Water Act.
- e Ground Water ARAR – State and Federal Maximum Contaminant Level.
- f Surface Water ARAR – Human Health, Marine, National Toxics Rule.
- g MTCA Standard Method B Indoor Air Cleanup Level.
- h MTCA Modified Method B to account for current commercial land use. Refer to Appendix A.

Abbreviations:
- CLARC Cleanup Levels and Risk Calculation
- µg/L Micrograms per liter
- µg/m^3 Micrograms per cubic meter
- mg/kg Milligram per kilogram
- NA Not applicable or no cleanup level has been established

3.1 SOIL CLEANUP LEVELS

Soil Cleanup Levels for Unrestricted Land use were used for PCE and TCE. MTCA Method A concentrations are conservative and protective of all pathways of exposure. MTCA Method A concentrations are used at sites undergoing a routine cleanup action with relatively few hazardous substances as is the case at the Site. Because MTCA Method A cleanup levels are

not available for cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, and vinyl chloride, MTCA Method B cleanup levels were calculated for the protection of the soil-to-groundwater pathway. The calculated cleanup levels were adjusted upward to equal the laboratory PQL if the calculated value was less than the PQL.

3.2 GROUNDWATER CLEANUP LEVELS

Groundwater cleanup levels are based on MTCA Method A concentrations for PCE, TCE, and vinyl chloride. MTCA. Method A concentrations are conservative and protective of all pathways of exposure. MTCA Method A concentrations are used at sites undergoing a routine cleanup action with relatively few hazardous substances as is the case at the Site. For cis-1,2-DCE, trans-1,2-DCE, and 1,1-DCE, MTCA Method A concentrations are not available; therefore, the lowest (most conservative) published numerical values were selected from available state and federal criteria.

3.3 SURFACE WATER CLEANUP LEVELS

Given that the seep discharges to storm drains that lead to Budd Inlet, a salt water body (i.e., not used for drinking purposes), the cleanup levels are based on protection of marine aquatic life and human consumption of marine aquatic organisms that have bioaccumulated these compounds. In these cases, federal water quality criteria are applicable and have been chosen as protective cleanup levels.

3.4 AIR CLEANUP LEVELS

The current land use is commercial but future land use could be either commercial or residential. Therefore, cleanup levels are necessary to be developed for both land use scenarios. Ecology's Vapor Intrusion Guidance (Ecology 2009) allows for adjustment of the exposure assumptions in such situations (applied to Equation 750-2). Appendix A contains calculations that modify the standard MTCA Method B indoor air cleanup levels for the commercial use scenario. The exposure assumptions adjustments made to Equation 750-2 included a reduction in the exposure frequency to reflect a conservative commercial work exposure scenario (10 hours per day, for 5 days per week, for 52 weeks per year, for 30 years). These modified MTCA Method B concentrations will be applied as the cleanup levels for indoor air at the former Olympia Dry Cleaners building, as these concentrations take into account the current commercial use of the property. These adjustments result in the Modified MTCA Method B cleanup levels for the Site as shown in Table 2.

However, if the Site is converted to residential use, the Modified Method B Cleanup Level will be revised downward to standard MTCA Method B cleanup levels that are shown on Table 2.

3.5 POINTS OF COMPLIANCE

The Site qualifies for Terrestrial Ecological Evaluation exclusion in accordance with WAC 173-340-7491 (Sound Environmental Strategies 2009). Therefore, mitigating the potential human health risk associated with exposure to PCE and its degradation compounds in the affected media at the Site will be the primary objective of the cleanup action implemented.

Direct contact of soil with concentrations of PCE and its degradation compounds at levels greater than the applicable MTCA cleanup levels is limited to potential human receptors via

dermal contact or ingestion. The standard POC for the direct contact pathway for soil is all soils at the Site up to a depth of 15 feet bgs, which represents a reasonable depth that could be accessed during normal redevelopment activities (WAC 173-340-740(6)(d)). As noted above, contaminant concentrations are not thought to exist below 10 to 12 feet bgs.

Regional groundwater flows toward Budd Inlet, which is located approximately 3,000 feet to the north of the Site (Pacific Groundwater Group 2007). The groundwater to surface water pathway is considered incomplete for these surface water bodies, because the dissolved-phase PCE plume does not migrate to these surface water bodies. However, the Seep, should it discharge to nearby storm drains, can conceivably lead to a completed exposure pathway for surface water. Therefore, the discharge of contaminants from the Seep to stormwater drains should be controlled by the cleanup action. The POC for attaining the surface water cleanup levels will not exceed the property boundary where the Seep is currently located.

The potential exposure pathways for groundwater consist of direct exposure via dermal contact, ingestion, and/or inhalation of groundwater with concentrations of PCE and its degradation compounds exceeding the Site cleanup levels. The shallow groundwater-bearing zone at the Site is located within the Qgof geologic unit, which is characterized as an aquitard (Pacific Groundwater Group 2007). The shallow groundwater-bearing zone is not currently used as a drinking water source although it could represent a future drinking water source. The deeper Qgos geologic unit underlying the Qgof geologic unit also qualifies as a future potential source of potable water. The analytical results from groundwater samples collected from Monitoring Well MW-12 and the Artesian Supply Well screened in the Qgos geologic unit indicate groundwater quality has not been affected by the historical releases of PCE to the subsurface at the Site. The Artesian Supply Well is not currently used as a potable water source at the Site. However, the Artesian Supply Well may present a potential risk for future exposure if used as a potable water source prior to completion of the cleanup action at the Site.

Therefore, the groundwater to drinking water pathway for groundwater is considered to be potentially complete Under MTCA, the standard POC for groundwater is throughout the Site from the uppermost level of the saturated zone extending vertically to the lowest depth that could potentially be affected by the Site.

3.6 APPLICABLE REGULATORY REQUIREMENTS

MTCA requires that all cleanup actions shall comply with applicable state and federal laws and legally applicable technical and procedural requirements (WAC 173-340-710). These additional requirements as a group are referred to as “applicable or relevant and appropriate requirements” (ARARs). Table 3 presents the ARARs identified as being applicable at this Site.

4.0 Selected Cleanup Action

4.1 CLEANUP ACTION ALTERNATIVES CONSIDERED

Seven potential cleanup action alternatives for the Site, Cleanup Action Alternatives 1 through 5, and 6A and 6B, were evaluated in the Revised Draft FS Report (SoundEarth Strategies 2013). One additional cleanup action alternative, Modified Cleanup Action Alternative 6A, was also evaluated in the FS Addendum (Floyd|Snider 2014). A brief summary of each of the cleanup action alternatives considered for the Site is provided below.

- **Cleanup Action Alternative 1: Bioremediation—Edible Oil Injection.** This alternative involves the injection of edible oil into the subsurface to provide a substrate as a food source for the existing microbial population and to promote the bioremediation of COCs present within the source area and dissolved-phase plume.
- **Cleanup Action Alternative 2: Chemical Oxidation—Permanganate Injection.** This alternative involves the direct injection of sodium permanganate into the subsurface to oxidize the COCs present in the source area and the dissolved-phase plume.
- **Cleanup Action Alternative 3: Chemical Oxidation—Recirculation System.** This alternative involves the injection and subsequent recirculation of sodium permanganate in the subsurface to oxidize the COCs present in the source and the dissolved-phase plume. The tight nature of the soils where the source is present makes this alternative challenging for implementation.
- **Cleanup Action Alternative 4: Dual-Phase Extraction.** This alternative involves the installation of a dual-phase extraction remediation system to reduce concentrations of COCs in soil and groundwater to levels less than cleanup levels. The treatment area would be capped with asphalt to minimize surface water infiltration.
- **Cleanup Action Alternative 5: Permeable Reactive Barrier.** This alternative involves the installation of a permeable reactive barrier to intercept contaminated groundwater coming from the Site. As groundwater flows through the reactive material in the barrier, zerovalent iron, it acts as a strong reducing agent to dechlorinate the COCs. This is a passive treatment technology for dissolved-phase COCs and does not involve source control.
- **Cleanup Action Alternative 6A: Limited Excavation with Shoring.** This alternative involves a limited excavation to remove known and accessible soil contamination outside the footprints of the two existing buildings on the Site and within the public ROW using a shoring system near the existing building foundations and along the ROW.
- **Modified Cleanup Action Alternative 6A: Limited Excavation Using Slot Trenches.** This alternative involves the excavation of almost all of the known and accessible soil contamination from the Site using slot trenches to help provide the necessary shoring. Excavation would occur outside the footprints of the two existing buildings on the Site and would involve a limited amount of excavation within the public ROW. The slot trenches would be backfilled with controlled-density fill (CDF) to form a low-permeability barrier to groundwater flow.

- **Cleanup Action Alternative 6B: Extensive Excavation with Shoring.** This alternative involves an extensive excavation, removing accessible soil contamination outside the Cheery Street Q-Tip Trust Building footprint and within the public ROW and demolition of the Former Olympia Dry Cleaners Building. A shoring system would be required along the ROWs to the west of the Site, along the northern portion of the excavation near the existing building foundation and the southern limits of excavation.

Monitored natural attenuation (MNA) was retained as a component of each cleanup action alternative for final polishing after the alternative has been implemented. MNA parameters will be evaluated as part of the groundwater quality assessment following the cleanup action. Additionally, each of the cleanup action alternatives includes capping of the Seep.

Additional details on these cleanup action alternatives, including cost estimates, are provided in the Revised Draft FS Report (SoundEarth Strategies 2013) and the FS Addendum (Floyd|Snider 2014).

4.2 EVALUATION METHODOLOGY

The cleanup action alternatives developed in the Revised Draft FS Report and the FS Addendum were evaluated in accordance with the process outlined by MTCA for evaluating cleanup action alternatives. As a first step, the alternatives were evaluated with respect to the threshold requirements that must be met under MTCA. Cleanup action alternatives that do not comply with these criteria are not considered suitable cleanup actions under MTCA. As provided in WAC 173-340-360(2)(a), the four threshold requirements for cleanup actions are to:

- Protect human health and the environment.
- Comply with cleanup standards.
- Comply with applicable state and federal laws.
- Provide for compliance monitoring.

While these criteria represent the minimum standards for an acceptable cleanup action, WAC 173-340-360(2)(b) also requires that the cleanup action alternative satisfy the following criteria:

- Use permanent solutions to the maximum extent practicable
- Provide for a reasonable restoration time frame
- Consider public concerns on the proposed cleanup action alternative

To evaluate which of the cleanup action alternatives that meet the MTCA threshold requirements are permanent to the maximum extent practicable, the cleanup action alternatives are then evaluated in accordance with the MTCA disproportionate cost analysis (DCA). This analysis involves comparing the costs and benefits of alternatives and selecting the alternative with incremental costs that are not disproportionate to the incremental benefits. The criteria used to evaluate and compare the applicable cleanup action alternatives when conducting the DCA were derived from WAC 173-340-360(3)(f) and include the following:

- Protectiveness
- Permanence

- Effectiveness over the long-term
- Management of short-term risks
- Technical and administrative implementability
- Public concerns
- Cost

4.3 EVALUATION AND COMPARISON OF ALTERNATIVES

This section provides a brief summary of the evaluation of the cleanup action alternatives using the MTCA DCA evaluation criteria. Numerical values for the evaluation criteria for each of the cleanup action alternatives are shown in Table 4. Figure 6 also illustrates the total ranking score for each alternative along with cost.

All of the cleanup action alternatives provide a measure of protectiveness for human health and the environment. Alternative 6A, Modified Alternative 6A, and Alternative 6B exhibit a greater degree of protectiveness than Alternatives 1 through 5 due to the permanent removal and disposal of the contaminated media. Alternatives 1 through 5 rely on in-situ techniques to address COCs. Alternative 6B would provide an even greater degree of protectiveness in comparison to Alternative 6A and Modified Alternative 6A because it would remove more contaminated soil, and Alternative 6A would be more protective than Modified Alternative 6A as it would remove more soil in the public ROW.

All cleanup action alternatives provide a permanent reduction of toxicity, mobility, and volume of COCs through biological breakdown, chemical destruction, or physical removal. Alternative 6A, Modified Alternative 6A, and Alternative 6B would achieve the cleanup levels in soil more quickly than Alternatives 1 through 4. Alternative 6A, Modified Alternative 6A, and Alternative 6B address the remaining dissolved-phase groundwater plume through monitored natural attenuation. Alternatives 1 through 4 address soil and groundwater contamination, but require a longer period of time. Alternative 5 has the lowest score because it only addresses groundwater contamination. Alternative 6A, Modified Alternative 6A, and Alternative 6B score the highest because they each involve the physical removal of the soil source.

The long-term effectiveness of Alternatives 1 through 4 would be less than that of Alternative 6A, Modified Alternative 6A, and Alternative 6B. Alternatives 1 through 4 also score lower than the three excavation alternatives due to uncertainties in the subsurface conditions beneath the Site. Alternative 5 scores the lowest of the alternatives because it does not affect the source material in soil. Alternative 6A, Modified Alternative 6A, and Alternative 6B would be the most effective of the alternatives because they each include the physical removal of the contaminated source material.

Modified Alternative 6A has greater short-term risks to construction workers during cleanup work compared to Draft FS Alternatives 1 through 5 because it involves the use of trench boxes, excavation (including in the public ROW), and transport and handling of hazardous materials. However, it has fewer short-term risks to construction workers during cleanup work compared to Draft FS Alternatives 6A and 6B, which both excavate more soil and involve installation of sheetpile shoring. Sheetpile shoring installation is more complex and difficult than the installation of trench boxes.

Alternatives 1 and 3 are the most readily implementable technologies. Alternatives 6A and 6B are the most difficult to implement due to the complexity of shoring one or both of the buildings and working in the public ROW. Modified Alternative 6A, which uses the slot trench methodology, would be considerably easier to implement in comparison to Alternatives 6A and 6B where sheetpile shoring is involved. All of the cleanup action alternatives involve permitting, but both Alternatives 6A and 6B would have extensive engineering and geotechnical design activities. All cleanup action alternatives depend on access from the adjacent property owner for successful implementation.

The present worth cost of Modified Alternative 6A is estimated to be $335,000, whereas present worth costs for the other cleanup action alternatives were considerably higher, ranging from $737,000 for Alternative 3 to $2,530,000 for Alternative 6B. Costs are considered disproportionate to benefits if the incremental costs of one alternative versus a less expensive alternative exceed the incremental degree of benefit achieved by the more expensive alternative. The extra $402,000 cost for Alternative 3 compared to Modified Alternative 6A is disproportionate to the incremental degree of benefit.

4.4 SELECTED SITE CLEANUP ACTION AND JUSTIFICATION FOR SELECTION

Based on the comparative analysis and the ranking of the proposed alternatives in accordance with the MTCA evaluation criteria, Modified Alternative 6A is the selected cleanup action alternative for the Site. Modified Alternative 6A is comparable to many of the other alternatives in terms of its short-term risks and ease of implementation, and it would be considerably easier and less risky in the short-term than the shoring assumed for Alternatives 6A and 6B. It would provide greater protectiveness, permanence, and long-term effectiveness compared with many of these other alternatives and is comparable to Alternative 6A. A small amount of residual contamination would remain in the Cherry Street Southeast ROW and possibly under the two buildings at the Site with Modified Alternative 6A. However, the presence of soil exceeding the cleanup levels under the buildings has not been verified.

The selection of this cleanup action is also justified as it meets the following minimum requirements for selection of a cleanup action under MTCA WAC 173-340-360(2)(a):

- **Protect Human Health and the Environment.** The selected remedy will protect human health and the environment in both the short- and long-term. The remedy will permanently reduce the risks presently posed to human health (exposure to soil and the Seep) through the excavation of almost all known and accessible areas of PCE- and TCE-contaminated soil. It is anticipated that the Seep will be eliminated as its current location would be excavated and filled with CDF. Impacted groundwater will undergo monitoring following the soil excavation.
- **Comply with Cleanup Standards.** The selected remedy is expected to comply with the cleanup levels for soil, groundwater, and surface water.
- **Comply with Applicable State and Federal Laws.** The selected remedy is expected to comply with all state and federal laws and regulations.
- **Provide Compliance Monitoring.** The selected remedy will include compliance monitoring for soil, groundwater, and the Seep, if it reappears. Compliance monitoring is discussed in more detail in Section 5.1.3.

The selected remedy also meets the other requirements for selection under MTCA WAC 173-340-360(2)(b), which include the following:

- **Using Permanent Solutions to the Maximum Extent Practicable.** As discussed in Section 4.3, the selected remedy utilizes permanent solutions to the maximum degree practicable.
- **Providing for Reasonable Restoration Time Frame.** Excavation for the selected remedy will require less than a year to implement. Following excavation, cleanup levels in soil are expected to be attained in all accessible areas of the Site (outside of the two building footprints) with the exception of one location beneath Cherry Street Southeast. This will achieve restoration of soil for protection of human health (via direct contact to soil). Following removal of this source material, contaminant concentrations in groundwater at the Site are expected to continue to decline by natural attenuation to concentrations less than cleanup levels within 5- to- 10 years. During this time period, the attenuation in groundwater concentrations will be monitored by periodic analyses of groundwater samples from a network of wells (refer to Section 5.1.3). Management of institutional controls in the form of environmental covenants is required for the contaminated soil left in place beneath the buildings and beneath Cherry Street (refer to Section 5.1.4).
- **Considering Public Concerns.** This document will be presented to the public and stakeholders through a public comment process. A public meeting will be held if sufficient requests are received. Ecology may elect to prepare a responsiveness summary that documents how each of the public comments were considered and addressed.

5.0 Selected Cleanup Action Implementation

The general details of the selected cleanup action are presented below. Additional details will be provided in the Remedial Action Work Plan (RAWP), which will be prepared for Ecology review and approval prior to cleanup action implementation.

5.1 DESCRIPTION OF SELECTED CLEANUP ACTION

5.1.1 Soil Removal

The selected cleanup action would remove almost all of the known and reasonably accessible residual source mass soil from the Site. It would limit the extent of excavation to outside the footprints of the two existing buildings on the Site and would involve a limited amount of excavation within the public ROW. Excavation work would be performed in two areas. The approximate excavation footprints are shown on Figure 7. The estimated mass of soil to be excavated in these two areas would be approximately 400 tons.

The main excavation area is located near the northwest corner of the Former Olympia Dry Cleaners Property. This is the same area in which an excavation occurred as part of the 2006 interim remedial action; however, the area previously excavated did not cover as large of a footprint, nor was it as deep as the excavation that will occur as part of the selected cleanup action. The remaining soil at the limits of the 2006 interim remedial action contained PCE concentrations as high as 96 mg/kg, which indicates that a significant residual source mass of PCE was left in place. The existing soil data show that the bulk of the residual source mass soil in this area is located primarily at depths of 4 to 10 feet bgs within the sidewall limits of the prior excavation. Figure 8 shows a cross section of the selected cleanup action excavation areas, the interim remedial action excavation area, and PCE concentrations within the soil. The selected cleanup action would remove all the known and accessible soil in this area with residual PCE concentrations equal to or greater than the PCE MTCA Method A cleanup level of 0.05 mg/kg with a single exception. That exception lies well within Cherry Street Southeast at Boring B05, where a single soil sample from the boring at 7 feet bgs contained PCE at a concentration of 2.9 mg/kg. PCE was not detected in soil samples collected from this boring above and below that depth, at 3 feet, 11 feet, and 14 feet bgs. The soil data from Boring B05 indicate that at that distance from the source, the PCE has been constrained to soil stringers and represents very little source mass. Given this low concentration of PCE in Boring B05, the small amount of affected area and the difficulties associated with excavating into the public ROW, the proposed excavation limit for the selected cleanup action would extend approximately 5 feet into Cherry Street Southeast. This main excavation footprint would also include the Seep location. Soil would be removed up to a depth of approximately 10 to12 feet bgs.

The second excavation area for this alternative is located near the northeast corner of the Former Olympia Dry Cleaners Property. This shallow (5 feet bgs or less) excavation area would address an area of historical PCE concentrations in soil that slightly exceeded the MTCA Method A cleanup level.

Following abandonment of the monitoring wells in the excavation area, slot trenches would be used to remove the contaminated soil within the main excavation area, but are likely not necessary in the second smaller excavation area. The slot trench methodology involves the use of a trench box to dig a series of parallel 4-foot-wide trenches across the excavation area. The trench box would provide the necessary temporary shoring. A conceptual layout of these slot

trenches within this excavation area is shown in the inset on Figure 7. The conceptual layout of these slot trenches is shown with the trenches running perpendicular to Cherry Street Southeast, but these trenches could also be laid out parallel to Cherry Street Southeast. The actual slot trench layout would be determined during remedial design. Regardless of the layout, the edges of the slot trenches would be placed approximately a foot away from the edge of the current buildings to avoid any exposure of or damage to the foundation elements of these buildings. Because only one slot would be dug at a time with the use of the trench box for shoring, there would be no risk to adjacent building foundations.

The conceptual excavation sequencing using the slot trenches is shown in the inset on Figure 7. The slot trench areas shown in green would be excavated first by digging out soil within each of the trench boxes to a depth of up to 12 feet bgs. After each green trench is dug, the trench would be backfilled with CDF to within 4 feet of the ground surface. CDF is essentially lean concrete with a high proportion of sand. During the CDF hardening process, the trench box would be removed. Once the CDF cures, it leaves behind a solid low-permeability wall. After the backfilling of each of the green slot trench areas, the yellow slot trench areas would be excavated; however, use of the trench box would no longer be necessary because support would be provided by the adjacent cured CDF walls. Once excavated, these trenches would also be backfilled with CDF to within 4 feet of the ground surface. The final 4 feet of this entire excavation area would be backfilled with either site overburden soil that has tested as clean or with imported granular fill.

Dewatering is not expected to be required during excavation because saturated soil could be removed within the trench segment and the trench box would prevent the sidewall soil from collapsing. Additionally, the current Artesian Supply Well would be run at its maximum capacity to lower the artesian pressure in that area. Some amount of water control would be required to avoid displacement of groundwater outside the trench box while the trench is being filled with CDF. Soil draining would have to occur on-site to allow the wet soils to properly drain prior to offsite transport and disposal.

Following excavation, the properties would be restored to their original grades, then paved and landscaped. The sidewalk and a portion of Cherry Street Southeast would be repaved to City of Olympia standards.

The key advantages of the slot trench methodology are: (1) it allows work to be performed to depth near buildings without shoring, and (2) it leaves in place a large area of low-permeability CDF. The CDF backfill would greatly reduce or divert the flow of artesian groundwater up into or through the excavated area. This would greatly improve groundwater quality in this area compared to the current conditions.

The Seep would be eliminated because its location would be excavated and filled with CDF. However, there would still be a possibility of another seep emerging once groundwater flow is reestablished around the excavated area. As a contingency action, a French drain system will be installed around the perimeter of the excavated area to capture any further seepage around the excavation area. The French drain would be plumbed to the sanitary sewer. Prior to discharge, the effluent from the French drain will be sampled for the Site surface water COCs (refer to Table 1 in Section 2.5). If the discharge is determined to be contaminated, which is considered unlikely given that the soil source is going to be removed, it shall be captured, treated as necessary, and then disposed of appropriately (such as an authorized discharge to the sanitary sewer). Depending on the concentrations of volatile organic compounds (VOCs) in

the new seep, some form of pretreatment, such as granular activated carbon, may be required before discharge.

5.1.2 Soil Disposal

Contaminated soil would be drained, placed into roll-off boxes, and characterized for proper off-site disposal. Water drained from the soil shall not be allowed to drain into the excavation. Instead, all drainage liquids and dewatering effluent shall be contained, tested, pre-treated as necessary, and then sent to an appropriate disposal facility. To the degree possible, cleaner overburden (such as the soil placed after the interim action) would be segregated from soil coming from areas of known contamination and separately stockpiled.

5.1.3 Compliance Monitoring

Within the main excavation area on the Site, compliance soil sampling would be performed at up to two bottom locations within each trench segment to confirm that the contaminated soil has been removed from the bottom of the excavation. Additional compliance soil sampling would also be performed along the vertical ends of some of the slot trenches to confirm the removal of contaminated soil or to document the remaining PCE concentrations in soil that will be considered inaccessible; however, sidewall sampling along the length of each trench will not be possible due to the use of the trench boxes. Compliance soil sampling would also be performed in the second smaller excavation area to confirm the removal of contaminated soil. Details on the compliance soil sampling will be provided in the RAWP.

After the active remedy elements have been completed, a long-term groundwater monitoring plan and vapor intrusion monitoring plan will be submitted to Ecology for review and approval. The long-term groundwater monitoring plan will include monitoring for the presence of seeps during each groundwater sampling event and the sampling of all seeps. Quarterly groundwater monitoring will occur for the first year following the cleanup action. Depending on the results, Ecology may agree to reduce the frequency to semi-annual, and eventually to annual, groundwater monitoring in a network that, at a minimum, will include five downgradient wells (MW-6, MW-11, MW-13, MW-14, and MW-09). These wells are shown on Figure 7.

The vapor intrusion monitoring plan shall describe how indoor air, sub-slab soil vapor, and/or ambient air samples will be collected from the former Olympia Dry Cleaners building. Ecology is currently developing Short-Term Exposure Limits (STELs) for TCE. The vapor intrusion monitoring plan will also include sampling to determine mean short-term TCE indoor air concentrations.

Should the monitoring results for indoor air indicate an exceedance of the cleanup levels or STELs, the nature of any follow-on contingency actions at the Site will depend on the magnitude of the exceedance, and may include physical modification to ventilation systems, sealing of floors and foundation cracks, or installation of a passive or active building or sub-slab ventilation system.

5.1.4 Permission, Access, and Institutional Controls

Any utilities currently located within the excavation footprint, including the existing natural gas line, will be rerouted before excavation and replaced when the excavation is completed.

Cleanup action work performed on the Cherry Street Q-Tip Trust Property will require access from the Cherry Street Q-Tip Trust.

Following excavation of the accessible contaminated soil on the Site, institutional controls shall be implemented to prevent the exposure to remaining contaminated soil, groundwater, and soil vapor at the Site. For example, as shown in Figures 4 and 5, contaminated soil and groundwater will remain beneath a portion of the Cherry Street Q-Tip Trust and former Olympia Dry Cleaners buildings and beneath the Cherry Street Southeast roadway. These institutional controls shall be primarily described in the environmental covenants. Environmental covenants shall be recorded for the Cherry Street Q-Tip Trust parcel and the former Olympia Dry Cleaners parcels. Institutional controls (in the form of environmental covenants) shall include the following categories of restrictions and requirements:

- No activities shall take place that interfere with the remedial action and the operation, maintenance, inspection, or monitoring of the remedial action without prior written approval from Ecology.
- No activities shall occur that will affect the continued protection of human health and the environment. This includes the prohibiting of any activity that results in the release or exposure.
- Notifications to Ecology if the properties are sold or transferred.
- Notification to and approval by Ecology for any proposed use that is inconsistent with the covenant.
- Restriction on groundwater use.
- Restrictions on the handling of soil from beneath the two buildings during any future redevelopment.
- Consent to continued access to the properties for groundwater, soil vapor, and seep monitoring.

Prior to the establishment of environmental covenants on these properties, the local government (City of Olympia and/or Thurston County) will be notified and allowed to comment on the environmental covenants. The local government will also be provided a copy of the finalized environmental covenants.

5.2 PERMITS AND OTHER REQUIREMENTS

The cleanup action will be conducted under an Ecology Agreed Order or Consent Decree and thus will meet the permit exemption provisions of MTCA (WAC 173-340-710(9)). This means that, although the procedural requirements of most state and local laws are exempted, there remains the requirement that the cleanup action comply with the substantive requirements of these laws. Additionally, the exemption is not applicable if Ecology determines that the exemption would result in the loss of approval from a federal agency that may be necessary for the state to administer any federal law.

5.2.1 State Environmental Policy Act

The State Environmental Policy Act (SEPA) as authorized by the Revised Code of Washington (RCW) 43.21C and WAC 197-11 and other SEPA procedures (WAC 173-802) are intended to

ensure that State and local government considers environmental values when making decisions. A SEPA checklist shall be prepared by the PLP or consultant and reviewed by the lead agency (Ecology) as part of the permitting process for the cleanup action. Ecology will then issue a determination.

5.2.2 Effluent Discharge Authorization

A discharge authorization permit shall be requested from the LOTT Clean Water Alliance if groundwater seeps or other water effluent is to be discharged to the sanitary sewer. LOTT's Budd Inlet Treatment Plant and discharge of treated water to Budd Inlet are regulated under a National Pollutant Discharge Elimination System (NPDES) Permit. LOTT operates under an Ecology-issued NPDES Permit because treated effluent is released into Budd Inlet.

5.2.3 City of Olympia Requirements

Prior to excavating in the Cherry Street Southeast right-of-way, the substantive requirements of all applicable City of Olympia permits (such as Street Use Permit, Traffic Control Plan, Right-of-Way Obstruction, Excavation, and Grading Permits) shall be met. The City of Olympia also requires additional bonding and insurance requirements for contractors performing work in the street right-of-way. The sidewalk and pavement shall be restored to meet the Olympia Engineering Design and Development Standards Manual requirements listed in Chapter 4 (Transportation) Sections 4B.175 (Pavement Restoration) and 4C (Sidewalks and Curbs). The City of Olympia's Engineering Design and Development Standards Manual is available online at: http://www.codepublishing.com/wa/olympia/?edds/OlympiaEDDSNT.html. The City Engineer shall also be consulted to see if additional Site-specific requirements apply.

5.3 FIVE-YEAR REVIEW

Because the cleanup action outlined in this CAP will result in hazardous substances remaining at the Site at concentrations exceeding cleanup levels and because environmental covenants are included as part of the remedy, Ecology will review the selected cleanup action described in this CAP every 5 years to ensure protection of human health and the environment. Consistent with the requirements of WAC 173-340-420, the 5-year review shall include the following:

- A review of the title of the real property subject to the environmental covenant to verify that the covenant is properly recorded;
- A review of available monitoring data to verify the effectiveness of completed cleanup actions and institutional controls in limiting exposure to hazardous substances remaining at the Site;
- A review of new scientific information for individual hazardous substances or mixtures present at the Site;
- A review of new applicable state and federal laws for hazardous substances present at the Site;
- A review of current and projected future land and resource uses at the Site;
- A review of the availability and practicability of more permanent remedies; and
- A review of the availability of improved analytical techniques to evaluate compliance with cleanup levels.

Ecology will publish a notice of all periodic reviews in the Site Register and will provide an opportunity for review and comment by the potentially liable persons and the public. If Ecology determines that substantial changes in the cleanup action are necessary to protect human health and the environment at the Site, a revised CAP will be prepared and provided for public review and comment in accordance with WAC 173-340-380 and 173-340-600.

5.4 IMPLEMENTATION SCHEDULE AND REQUIRED FOLLOW-ON DOCUMENTATION

Ecology held a public comment period on the draft CAP from September 18–October 17, 2014. The comments Ecology received during the comment period did not result in any changes to the draft CAP. This final CAP will be implemented under a consent decree.

The Draft RAWP will be prepared and submitted within 30 days of Ecology's issuance of the Final CAP. The RAWP will include additional details on how the cleanup action will be performed, and will also include a soil handling plan, a traffic control plan, an erosion control and stormwater management plan, and a soil compliance monitoring plan.

Field work for the selected remedy will commence following final approval of the RAWP and once required construction permits are obtained. It is anticipated that construction activities will be completed within 3 weeks.

A Construction Completion Report, which will include drawings and a report documenting construction of the cleanup action, will be submitted to Ecology within 90 days of completion of activities. A long-term groundwater monitoring plan and vapor intrusion monitoring plan shall also be submitted to Ecology for review and approval within 30 days of the completion of construction activities.

6.0 References

Floyd|Snider. 2014. *Feasibility Study Addendum, Former Olympia Dry Cleaners, Olympia, Washington*. 3 January.

Freeze, Allan and John A. Cherry (Freeze and Cherry). 1979. *Groundwater*. Prentice-Hall, Inc., Englewood, Cliffs, New Jersey.

Pacific Groundwater Group. 2007. Letter Regarding Deep Aquifer Hydrogeology, Cascade Pole Site, Olympia, Washington. From Stephen Swope, Pacific Groundwater Group, to Don Bache, Port of Olympia. 11 October.

SoundEarth Strategies. 2013. *Revised Draft Feasibility Study, Former Olympia Dry Cleaners, Olympia, Washington*. 26 February.

Sound Environmental Strategies. 2009. *Revised Draft Remedial Investigation Report, Former Olympia Dry Cleaners, Olympia, Washington*. 9 October.

Stemen Environmental, Inc. 2005. *Draft Remedial Investigations and Associated Interim Remedial/Corrective Actions Report, Former Olympia Dry Cleaners, 606 East Union Avenue, Olympia, Washington*. 10 January.

Washington State Department of Ecology (Ecology). 2009. *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action.* Draft Version. October.

Washington State Department of Natural Resources (WSDNR). 2003. *Geologic Map of the Lacey 7.5-minute Quadrangle, Thurston County, Washington*.

Former Olympia Dry Cleaners Site

Cleanup Action Plan

Tables 3 and 4

TABLE 3
SITE SPECIFIC ARARS
CLEANUP ACTION PLAN
OLYMPIA DRY CLEANERS SITE, OLYMPIA, WASHINGTON

Authorizing Statute	Implementing Regulation	Description	Rationale
Potential Chemical-Specific ARARs			
National Toxics Rule; 33 USC 1251	Water Quality Standards; 40 CFR 131.36(b)(1)	Establishes surface water quality standards that protect aquatic life and human health. Washington adopted these standards in Chapter 173-201A WAC.	Potentially applicable to surface water and potentially relevant and appropriate to groundwater that is likely to impact surface water quality.
WA Water Pollution Control Act; Chapter 90.48 RCW	Water Quality Standards for Surface Waters; Chapter 173-201A WAC	Establishes narrative and numeric surface water quality standards for waters of the state.	Potentially applicable to surface water and potentially relevant and appropriate to groundwater that is likely to impact surface water quality.
Clean Water Act; 33 USC 1251-1387	Section 304a of the Clean Water Act; WAC 173-340-730(2)(b)(i)(B)	Establishes surface water quality standards that protect aquatic life and human health. Washington adopted these standards in Chapter 173-201A WAC.	Potentially applicable to surface water and potentially relevant and appropriate to groundwater that is likely to impact surface water quality.
Hazardous Waste Management; Chapter 70.105D RCW	Washington Model Toxics Control Act Cleanup Regulation; Chapter 173-340 WAC	Establishes groundwater, surface water, and soil cleanup levels.	Potentially applicable to surface water and potentially relevant and appropriate to groundwater that is likely to impact surface water quality and to soils at the site.
Potential Action-Specific ARARs			
Hazardous Waste Management; Chapter 70.105D RCW	Selection of Cleanup Actions; WAC 173-340-350	Minimum requirements and procedures for conducting remedial investigation and feasibility studies.	Applicable to remedial action selection and implementation.
Hazardous Waste Management; Chapter 70.105D RCW	Institutional Controls; WAC 173-340-440	Institutional control requirements.	Potentially applicable to remedial action selection and implementation.
Hazardous Waste Management; Chapter 70.105D RCW	Compliance Monitoring Requirements; WAC 173-340-410, -720(9), -730(7), -740(7), and -745(8)	Compliance monitoring requirements for groundwater, surface water, and soil.	Potentially applicable to remedial action selection and implementation.
Potential Action-Specific ARARs			
Ecology Area of Contamination Policy	8/20/1991 Interprogram Policy	Allows movement/placement of excavated contaminated material within the regulated site without triggering dangerous waste designation.	Could be applicable for containment remedial alternatives.
Ecology Construction Stormwater General Permit	State of Washington Water Pollution Control Law; RCW Chapter 90.48	Applies to construction activities that disturb 1 or more acres.	Substantive requirements could be addressed through project stormwater pollution prevention plan.
Water Well Construction; Chapter 18.104 RCW	Minimum Standards for Construction and Maintenance of Wells; Chapter 173-160 WAC	Applies to the construction and maintenance of monitoring wells	Potentially applicable to wells constructed for groundwater withdrawal and monitoring and decommissioning of existing or future wells.

TABLE 3
SITE SPECIFIC ARARS
CLEANUP ACTION PLAN
OLYMPIA DRY CLEANERS SITE, OLYMPIA, WASHINGTON

Authorizing Statute	Implementing Regulation	Description	Rationale
Potential Action-Specific ARARs			
Hazardous Waste Management; Chapter 70.105 RCW	Dangerous Waste Regulations; Chapter 173-303 WAC	Applies if dangerous wastes are generated during remedial program	These regulations must be fully complied with for any off site disposal of waste determined to be dangerous waste.
WA Water Pollution Control; Chapter 90.48 RCW	NPDES Permit Program; Chapter 173-220 WAC	Applicable to the discharge of pollutants and other wastes and materials to the surface waters of the state	NPDES may be required for discharges related to ongoing remedial actions or discharge of stormwater/drainage.
State Environmental Policy Act (SEPA); Chapter 43.21C.110 RCW	SEPA Rules; Chapter 197-11 WAC	Applies if future construction/remedial action occurs at the site	Applies if future construction/ remedial action occurs at the site.
Solid Waste Management Chapter 43.21A RCW	Minimum Functional Standards for Solid Waste Handling WAC 173-304	Establishes minimum functional standards for the handling of solid waste.	Applies if non-dangerous wastes are generated during remedial program
Transportation of Hazardous Material; 49 USC 5101-5127	Hazardous Materials Regulations; 49 CFR Parts 171 through 180	Regulations that govern the transportation of hazardous materials.	Applies to any hazardous materials transported off-site as part of remediation.
Hazardous Waste-Land Disposal Restrictions; USEPA	40 CFR 268/22 CCR 66268	Establishes land disposal restrictions and treatment standards for hazardous wastes applicable to generators.	Any hazardous wastes generated as a result of on-site activities or by treatment systems must meet land disposal restriction requirements.
Washington Industrial Safety and Health Act, Chapter 49.17 RCW	Safety Standards for Construction Work, WAC 296-155	Safety requirements for construction work.	Applicable to all remedial alternatives. Part N - Excavation, Trenching, and Shoring is particularly applicable to Alternatives 5, 6A, Modified 6A, and 6B.
Underground Utilities, RCW 19.122.010	General Proteciton Requirements, WAC 296-155-655	Requirement to locate utilities prior to drilling or excavation.	Applicable to all remedial alternatives.
WA Water Pollution Control; Chapter 90.48 RCW	Federal Water Pollution Control Act Certification; Chapter 173-225 WAC	Applies to activities that may result in a discharge into navigable waters.	Substantive compliance with this requirement will be potentially applicable to alternatives where substantive compliance with NPDES or Section 404 permit is required.
Washington Clean Air Act; Chapter 70.94 RCW	General Requirements for Air Pollution Sources; Chapter 173-400 WAC. Controls for New Sources of Toxic Air Pollutants; Chapter 173-460 WAC	Establishes technically feasible and reasonably attainable standards and rules generally applicable to the control and/or prevention of the emission of air contaminants.	May apply to remedial alternatives that produce emissions to air.

Table 4
Cleanup Action Alternatives Screening Summary

Cleanup Action Alternatives	Alternative Details[1]	Washington State Department of Ecology Evaluation Criteria/Relative Ranking (1 = Low 10 = High)						Ranking Score[2]
		Weighting Factors for Evaluation Criteria						
		20%	20%	20%	20%	20%	0%	
		Protectiveness	Permanence	Effectiveness over the Long Term	Management of Short Term Risks	Technical and Administrative Implementability	Consideration of Public Concerns	
Alternative 1: Bioremediation - Edible Oil Injection	Injection of edible oil substrate to promote anaerobic biodegradation of the COCs in soil and groundwater. Cap and seal the seep.	7	8	7	6	8	NA	**7.2**
Alternative 2: Chemical Oxidation - Permanganate	Injection of permanganate to oxidize the COCs in saturated soil and groundwater. Cap and seal the seep.	6	8	7	7	7	NA	**7.0**
Alternative 3: Chemical Oxidation - Recirculation	Injection of permanganate to oxidize the COCs in saturated soil and groundwater. Cap and seal the seep.	6	8	7	8	8	NA	**7.4**
Alternative 4: Dual-Phase Extraction	Use of dual-phase extraction to recover contaminated vapor and groundwater. Asphalt cover over the treatment area to minimize surface water infiltration. Cap and seal the seep.	7	6	6	6	7	NA	**6.4**
Alternative 5: Permeable Reactive Barrier	Installation of an iron wall barrier to treat COCs in groundwater migrating from source area.	6	4	3	7	4	NA	**4.8**
Alternative 6A: Limited Excavation with Shoring	Excavate the soil with concentrations of COCs in excess of their cleanup levels outside the building footprints and within the adjacent ROW. Install shoring to protect building foundations and along the ROW.	9	9	8	3	2	NA	**6.2**
Modified Alternative 6A: Limited Excavation Using Slot Trenches	Excavate the soil with concentrations of COCs in excess of their cleanup levels outside the building footprints and within the adjacent ROW using slot trenches for shoring.	8	9	8	5	6	NA	**7.2**
Alternative 6B: Extensive Excavation with Shoring	Excavate the soil with concentrations of COCs in excess of their cleanup levels beneath the dry cleaner property (including demolition of the dry cleaner building) and the adjacent ROW. Install shoring to protect building foundations and along the ROW.	10	10	9	1	1	NA	**6.2**

Notes:

1 Monitored natural attenuation of COCs is retained for all cleanup action alternatives.

2 The ranking score for each alternative is the average of the weighted score for five of the six evaluation criteria. Consideration of Public Concerns in not included in the ranking score.

Abbreviations:

COCs Chemicals of Concern

NA Not Applicable

ROW Right-of-way

Former Olympia Dry Cleaners Site

Cleanup Action Plan

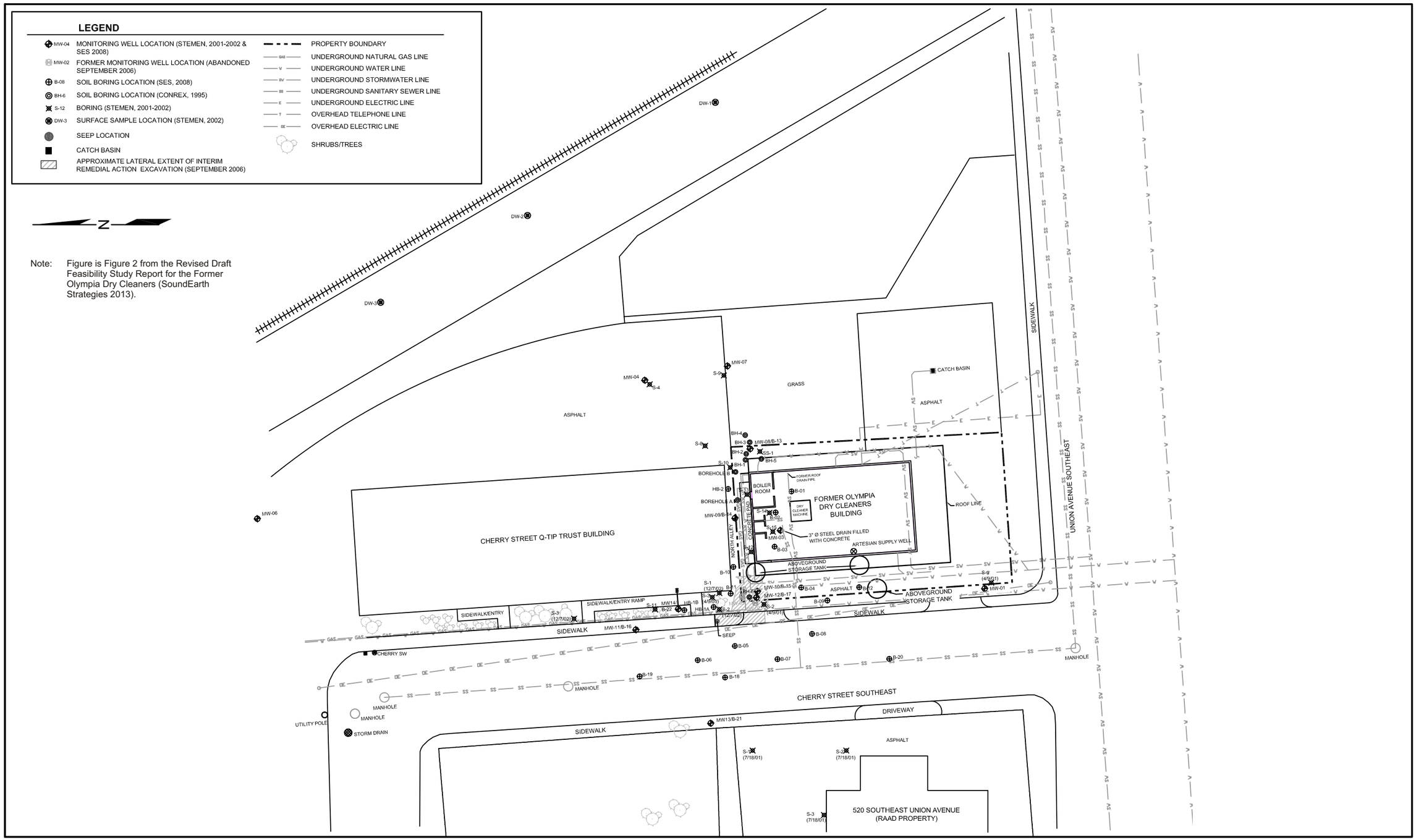
Figures

FLOYD | SNIDER
strategy ▪ science ▪ engineering

GTH-Olympia Dry Cleaners
Cleanup Action Plan

Figure 1
Site Vicinity Map

I:\GIS\Projects\GTH-Olympia_Dry_Cleaners\MXD\Figure 1 (Vicinity Map).mxd
4/7/2014



Note: Figure is Figure 2 from the Revised Draft Feasibility Study Report for the Former Olympia Dry Cleaners (SoundEarth Strategies 2013).

FLOYD | SNIDER
strategy ▪ science ▪ engineering

Cleanup Action Plan
Former Olympia Dry Cleaners Site
Olympia, Washington

Figure 2
Site Features Map

G:Project\Clients\Floyd Snider\GTH Olympia/Cleanup Action Plan Figure 2

LEGEND

06-C19@10FT — SOIL SAMPLE LOCATION

STORM SEWER CATCH BASIN (REPLACED)

AREA OF INTERIM REMEDIAL ACTION EXCAVATION

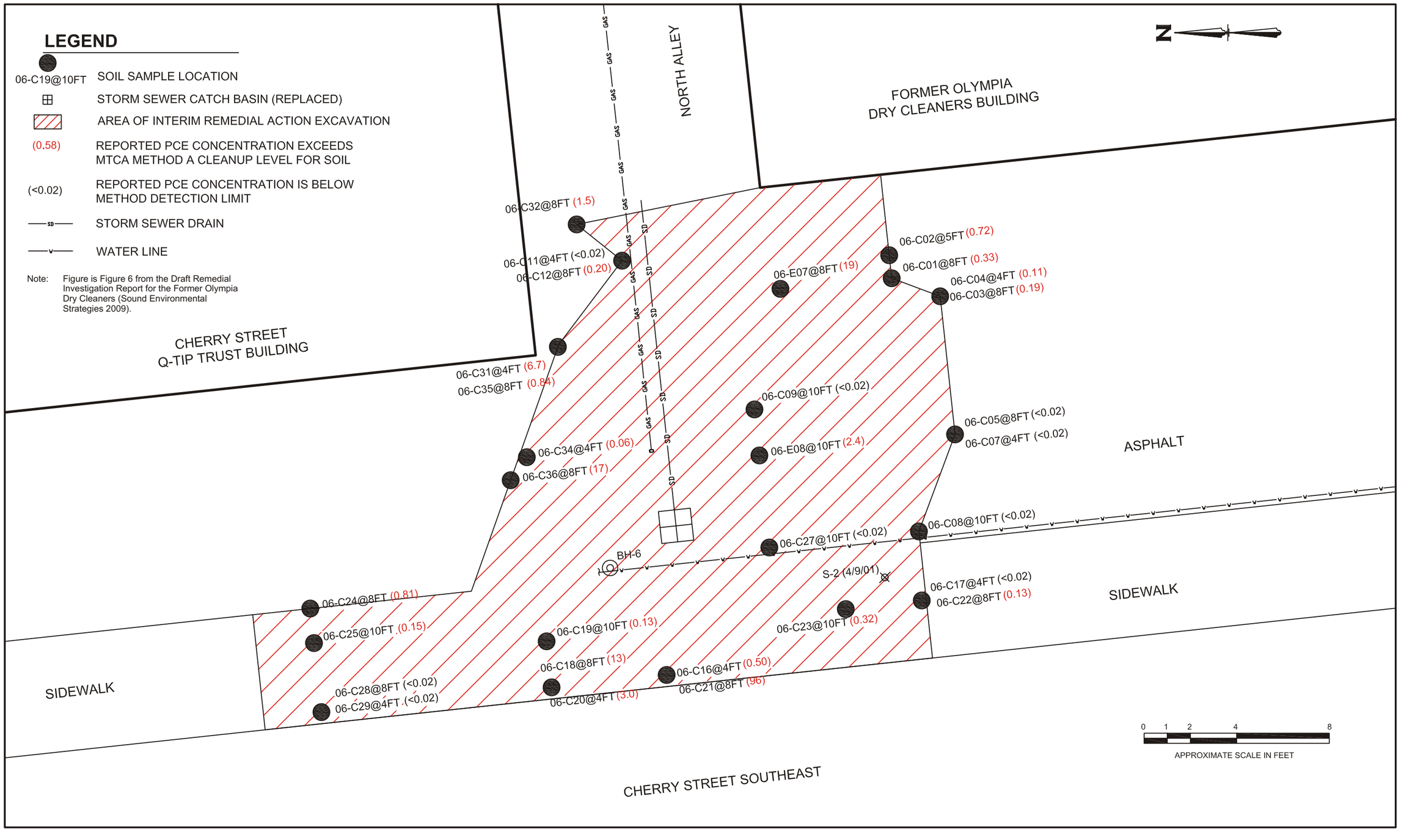
(0.58) — REPORTED PCE CONCENTRATION EXCEEDS MTCA METHOD A CLEANUP LEVEL FOR SOIL

(<0.02) — REPORTED PCE CONCENTRATION IS BELOW METHOD DETECTION LIMIT

SD — STORM SEWER DRAIN

W — WATER LINE

Note: Figure is Figure 6 from the Draft Remedial Investigation Report for the Former Olympia Dry Cleaners (Sound Environmental Strategies 2009).

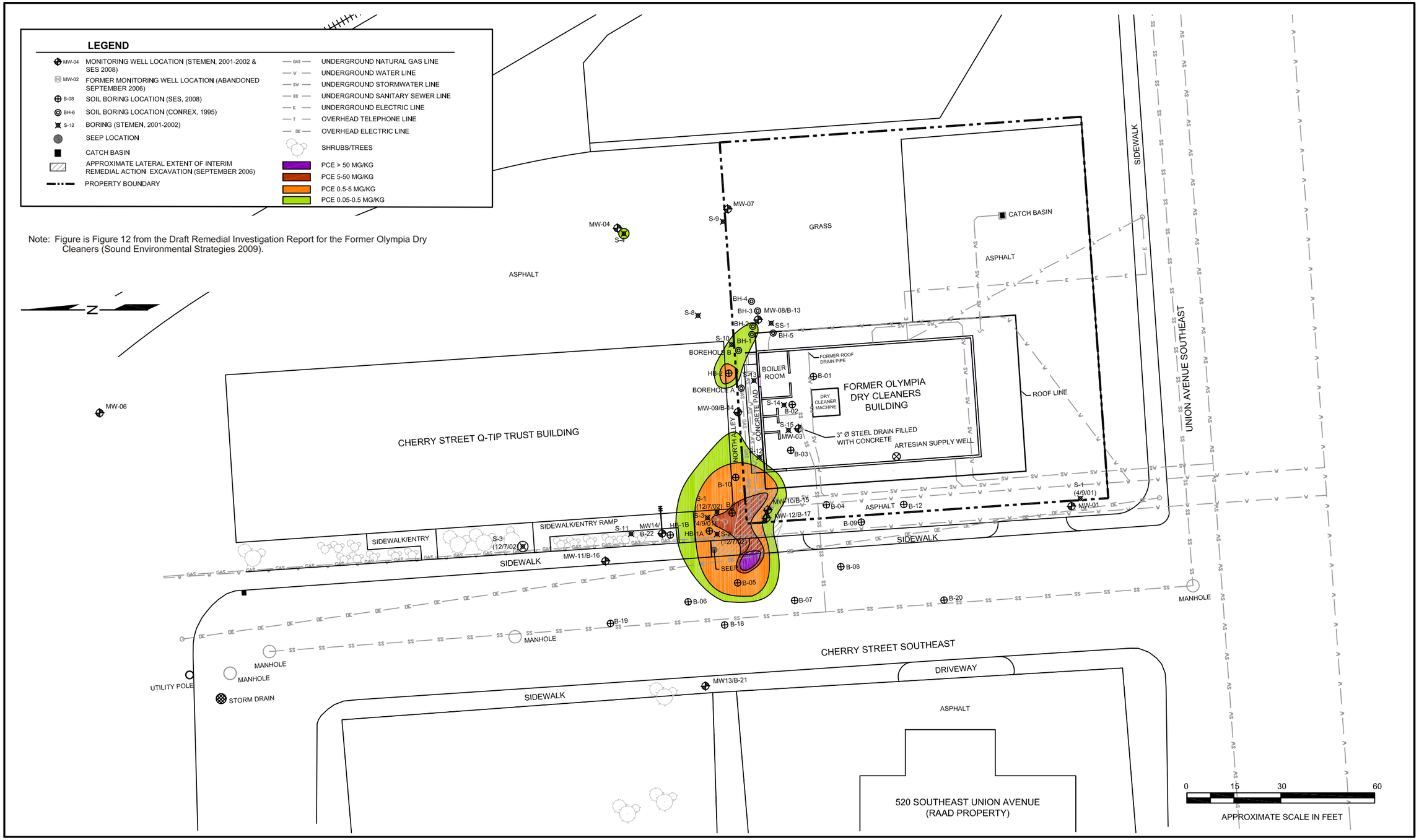


FLOYD | SNIDER
strategy ▪ science ▪ engineering

Cleanup Action Plan
Former Olympia Dry Cleaners Site
Olympia, Washington

Figure 3
Interim Action Excavation Area

G:Project\Clients\Floyd Snider\GTH Olympia/Cleanup Action Plan Figure 3



FLOYD | SNIDER
strategy ▪ science ▪ engineering

Cleanup Action Plan
Former Olympia Dry Cleaners Site
Olympia, Washington

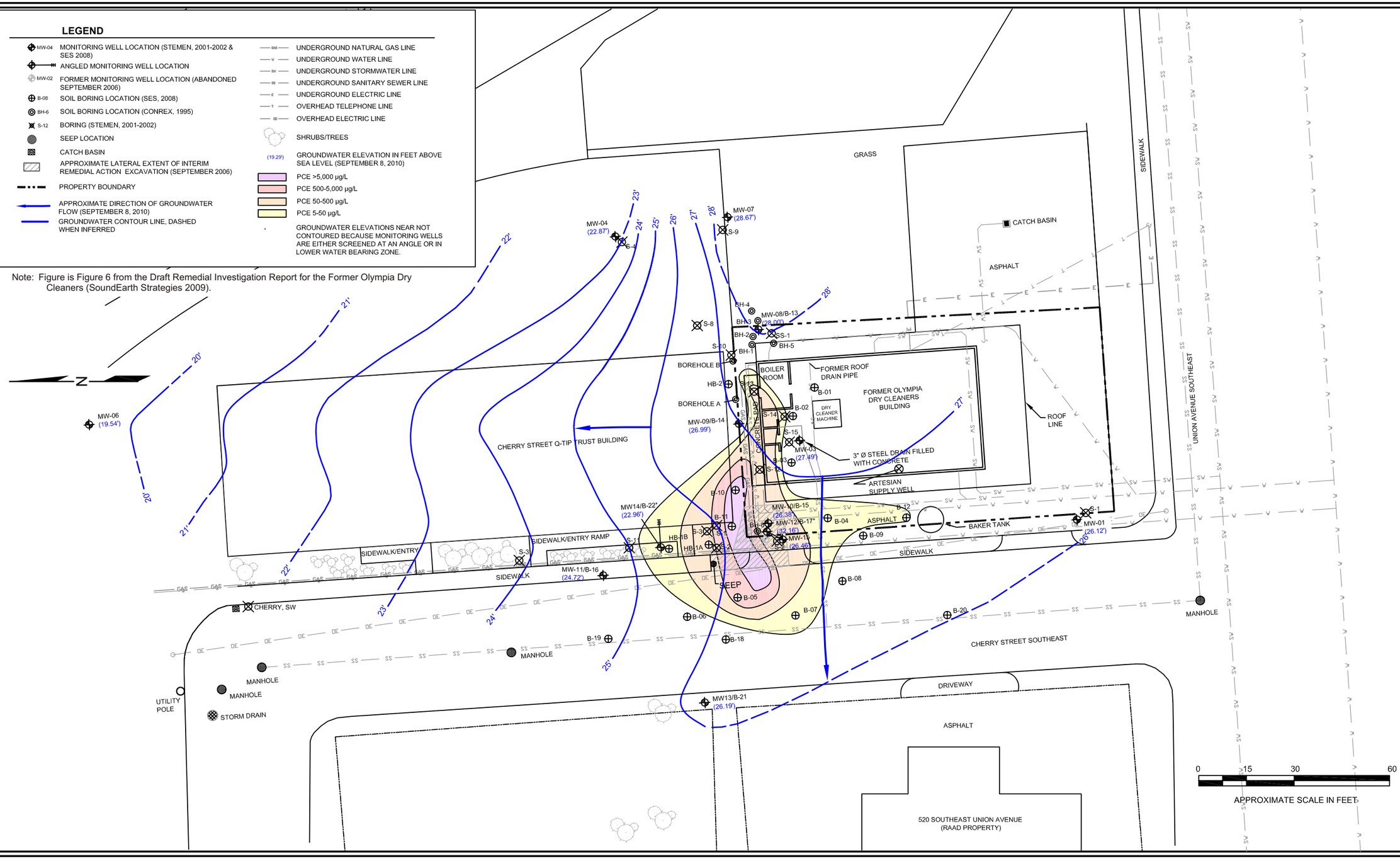
Figure 4
PCE Concentrations in Soil

G:Project\Clients\Floyd Snider\GTH Olympia/Cleanup Action Plan Figure 4

LEGEND

- MW-04 — MONITORING WELL LOCATION (STEMEN, 2001-2002 & SES 2008)
- ANGLED MONITORING WELL LOCATION
- MW-02 — FORMER MONITORING WELL LOCATION (ABANDONED SEPTEMBER 2006)
- B-08 — SOIL BORING LOCATION (SES, 2008)
- BH-6 — SOIL BORING LOCATION (CONREX, 1995)
- S-12 — BORING (STEMEN, 2001-2002)
- SEEP LOCATION
- CATCH BASIN
- APPROXIMATE LATERAL EXTENT OF INTERIM REMEDIAL ACTION EXCAVATION (SEPTEMBER 2006)
- PROPERTY BOUNDARY
- APPROXIMATE DIRECTION OF GROUNDWATER FLOW (SEPTEMBER 8, 2010)
- GROUNDWATER CONTOUR LINE, DASHED WHEN INFERRED
- UNDERGROUND NATURAL GAS LINE
- UNDERGROUND WATER LINE
- UNDERGROUND STORMWATER LINE
- UNDERGROUND SANITARY SEWER LINE
- UNDERGROUND ELECTRIC LINE
- OVERHEAD TELEPHONE LINE
- OVERHEAD ELECTRIC LINE
- SHRUBS/TREES
- (19.29') — GROUNDWATER ELEVATION IN FEET ABOVE SEA LEVEL (SEPTEMBER 8, 2010)
- PCE >5,000 µg/L
- PCE 500-5,000 µg/L
- PCE 50-500 µg/L
- PCE 5-50 µg/L
- GROUNDWATER ELEVATIONS NEAR NOT CONTOURED BECAUSE MONITORING WELLS ARE EITHER SCREENED AT AN ANGLE OR IN LOWER WATER BEARING ZONE.

Note: Figure is Figure 6 from the Draft Remedial Investigation Report for the Former Olympia Dry Cleaners (SoundEarth Strategies 2009).

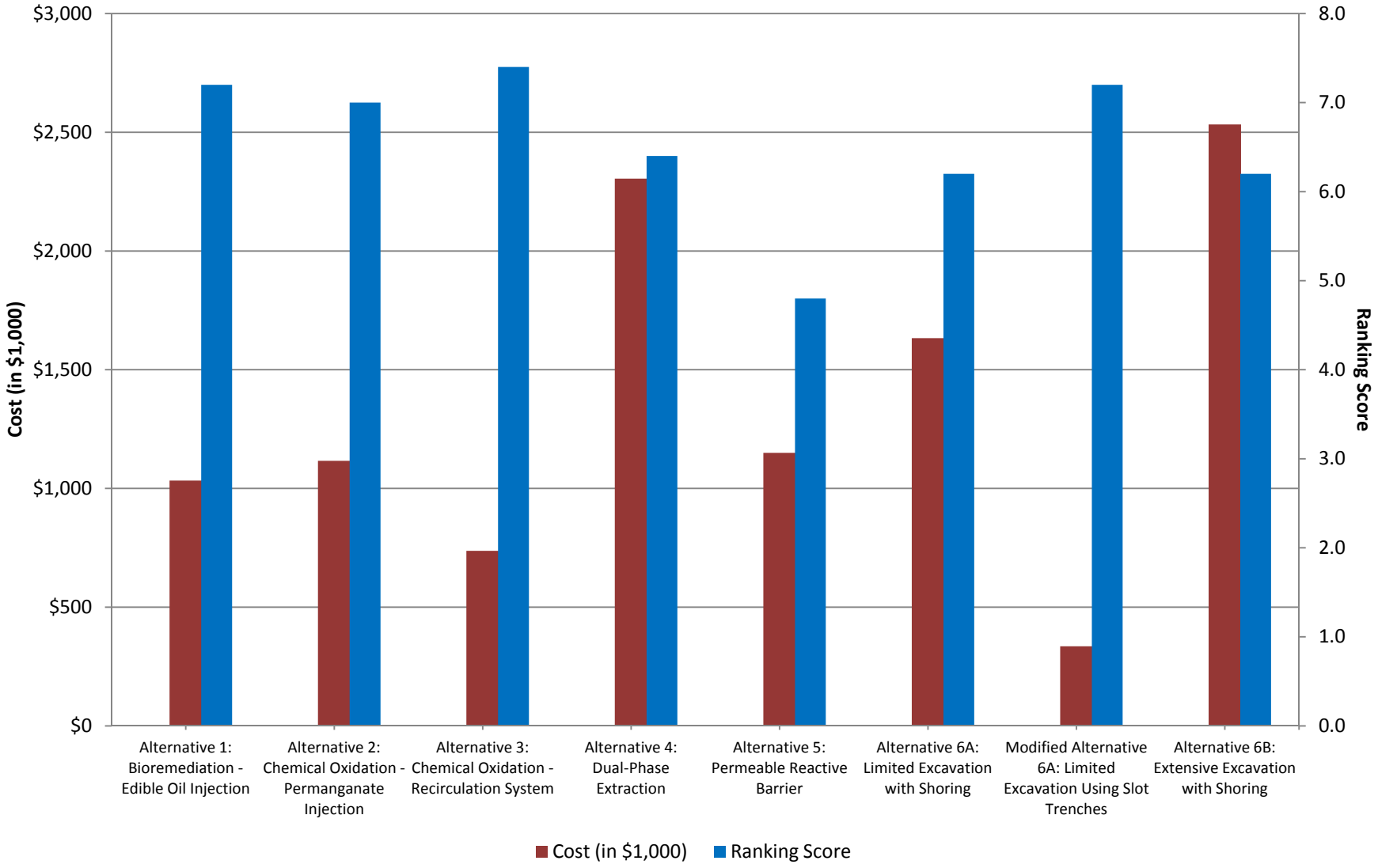


FLOYD | SNIDER
strategy ▪ science ▪ engineering

Cleanup Action Plan
Former Olympia Dry Cleaners Site
Olympia, Washington

Figure 5
PCE Isoconcentrations in Groundwater

G:Project\Clients\Floyd Snider\GTH Olympia/Cleanup Action Plan Figure 5



FLOYD | SNIDER
strategy • science • engineering

Cleanup Action Plan
Former Olympia Dry Cleaners Site
Olympia, Washington

Figure 6
Cost and Relative Ranking of Cleanup Action Alternatives

LEGEND

- MW-04 — MONITORING WELL LOCATION (STEMEN, 2001-2002 & SES 2008)
- MW-02 — FORMER MONITORING WELL LOCATION (ABANDONED SEPTEMBER 2006)
- B-08 — SOIL BORING LOCATION (SES, 2008)
- BH-6 — SOIL BORING LOCATION (CONREX, 1995)
- S-12 — BORING (STEMEN, 2001-2002)
- SEEP LOCATION
- CATCH BASIN
- APPROXIMATE LATERAL EXTENT OF INTERIM REMEDIAL ACTION EXCAVATION (SEPTEMBER 2006)
- PROPERTY BOUNDARY
- GAS — UNDERGROUND NATURAL GAS LINE
- W — UNDERGROUND WATER LINE
- SW — UNDERGROUND STORMWATER LINE
- SS — UNDERGROUND SANITARY SEWER LINE
- E — UNDERGROUND ELECTRIC LINE
- T — OVERHEAD TELEPHONE LINE
- OE — OVERHEAD ELECTRIC LINE
- SHRUBS/TREES
- A — A' CROSS-SECTION LOCATION
- MW-06 — PROPOSED COMPLIANCE MONITORING WELL
- APPROXIMATE LIMITS OF EXCAVATION FOR THE SELECTED CLEANUP ACTION

Notes:
1. Base figure is Figure 7 from the Draft Remedial Investigation Report for the Former Olympia Dry Cleaners (Sound Environmental Strategies 2009).
2. Approximate limits of excavation and other supporting information for the Selected Cleanup Action have been added to this figure by Floyd|Snider.

MW-06

CHERRY STREET Q-TIP TRUST BUILDING

See Inset (below left)

ASPHALT

MW-04

S-4

A'

MW-07

S-9

GRASS

CATCH BASIN

ASPHALT

SIDEWALK

UNION AVENUE SOUTHEAST

BH-4

BH-3

MW-08/B-13

S-8

BH-2

SS-1

BH-5

S-10

BH-1

BOREHOLE B

HB-2

BOREHOLE A

MW-09/B-14

BOILER ROOM

FORMER ROOF DRAIN PIPE

B-01

B'

FORMER OLYMPIA DRY CLEANERS BUILDING

DRY CLEANER MACHINE

ROOF LINE

S-14

B-02

S-15

MW-03

B-03

3" Ø STEEL DRAIN FILLED WITH CONCRETE

ARTESIAN SUPPLY WELL

NORTH ALLEY

CONCRETE PAD

B-10

MW14/ B-22

S-1 (12/7/02)

B-11

S-3 (12/9/01)

HB-1B

HB-1A

S-2 (12/7/02)

MW-10/B-15

MW-12/B-17

B-04

ASPHALT

B-12

S-1 (4/9/01)

MW-01

SIDEWALK/ENTRY RAMP

S-11

SEEP

SIDEWALK

MW-11/B-16

B-08

B-05

B-06

B-07

B-20

MANHOLE

B-19

B-18

MANHOLE

CHERRY STREET SOUTHEAST

DRIVEWAY

MW-13/B-21

SIDEWALK

ASPHALT

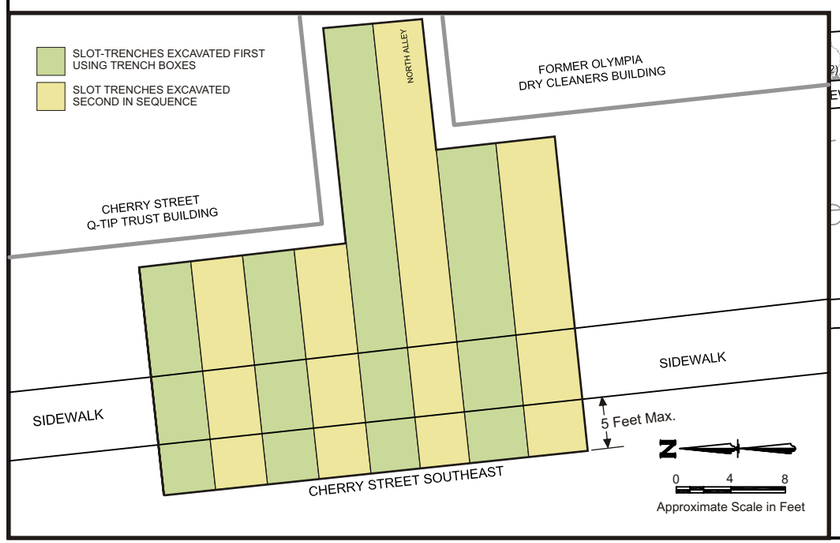
S-1 (7/18/01)

S-2 (7/18/01)

S-3 (7/18/01)

520 SOUTHEAST UNION AVENUE (RAAD PROPERTY)

Conceptual Placement of Slot Trenches and Removal Sequence

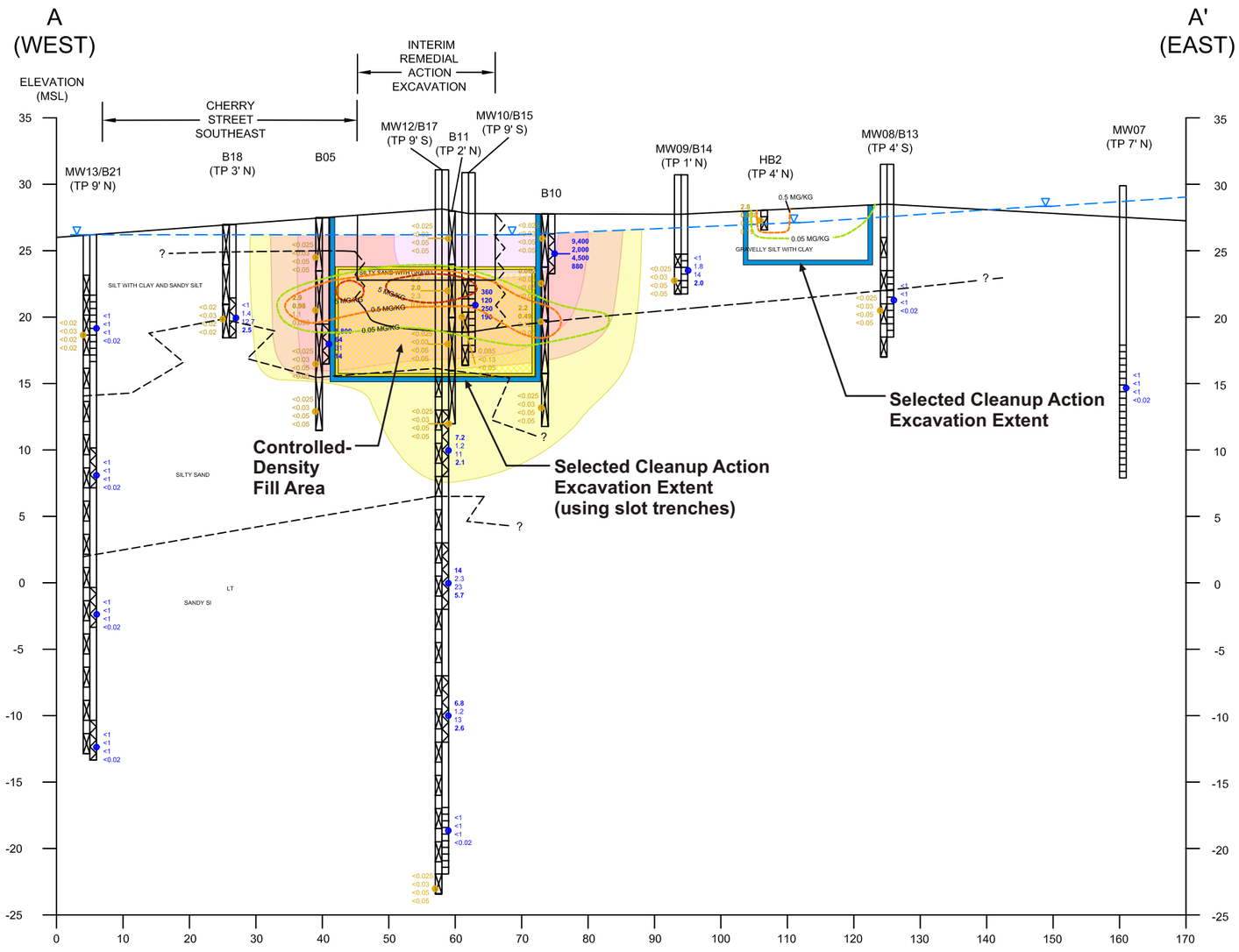


FLOYD SNIDER
strategy science engineering

Cleanup Action Plan
Former Olympia Dry Cleaners Site
Olympia, Washington

Figure 7
Conceptual Site Plan
for the Selected Cleanup Action

G:Project\Clients\Floyd Snider\GTH Olympia/Cleanup Action Plan Figure 7



Notes:
1. Cross section is Figure 8 from the Draft Remedial Investigation Report for the Former Olympia Dry Cleaners (Sound Environmental Strategies 2009)
2. Approximate limits of excavation and the controlled-density fill area for the Selected Cleanup Action have been added to this cross section by Floyd|Snider.

LEGEND:

MW08/B13 (TP 4' S) — MONITORING WELL/BORING LOCATION TRANSPOSED (TP) IN FEET, NORTH (N), SOUTH (S), EAST (E), OR WEST (W), OF CROSS SECTION LINE

- BLANK CASING
- SOIL SAMPLE INTERVAL
- GROUNDWATER LEVEL (1/14/2009)
- TEMPORARY WELL SCREEN INTERVAL
- WELL SCREEN INTERVAL

PCE = TETRACHLOROETHENE

TCE = TRICHLOROETHENE

< = NON DETECT AT THE LABORATORY PRACTICAL QUANTITATION LIMIT

NA = EITHER NO GROUNDWATER ENCOUNTERED OR NO ANALYTICAL DATA AVAILABLE

MG/KG = MILLIGRAMS PER KILOGRAM

µg/L = MICROGRAMS PER LITER

MSL = FEET BELOW MEAN SEA LEVEL

SOIL CONCENTRATION IN MILLIGRAMS PER KILOGRAM (MG/KG)

6.0	PCE
2.0	TCE
2.3	CIS - 1,2 - DICHLOROETHENE
<0.05	VINYL CHLORIDE

GROUNDWATER CONCENTRATION IN MICROGRAMS PER LITER (µg/L)

<1	PCE
1.8	TCE
14	CIS - 1,2 - DICHLOROETHENE
2.0	VINYL CHLORIDE

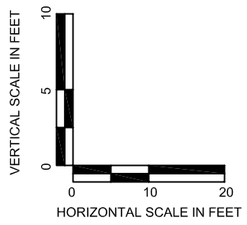
14 — BOLD INDICATES CONCENTRATION EXCEEDING MTCA CLEANUP LEVEL

PCE CONCENTRATION IN GROUNDWATER

- >5,000 µg/L
- 500-5,000 µg/L
- 50-500 µg/L
- 5-50 µg/L

PCE CONCENTRATION IN SOIL

- 5 MG/KG
- 0.5 MG/KG
- 0.05 MG/KG



FLOYD | SNIDER
strategy ▪ science ▪ engineering

Cleanup Action Plan
Former Olympia Dry Cleaners Site
Olympia, Washington

Figure 8
Cross Section A-A'

G:Project\Clients\Floyd Snider\GTH Olympia/Cleanup Action Plan Figure 8

Former Olympia Dry Cleaners Site

Cleanup Action Plan

Appendix A
MTCA Method B Modified Indoor Air Cleanup Level Calculations

INDOOR AIR CLEANUP LEVELS

PCE Air Cleanup Levels from Cancer Risk

Equation 750-2 Cancer **Air Cleanup Level (ug/m^3) = (RISK x ABW x AT x UCF) / (CPF x BR x ABS x ED x EF)**

RISK = Acceptable excess individual lifetime cancer risk level (unitless)
ABW = Average body weight (kg) over the exposure duration
AT = Averaging time (years)
UCF = 1,000 mg/kg
CPF = Carcinogenic potency factor as specified in WAC 173-340-708(8), PCE is 0.00091 mg/kg/day
BR = Breathing rate (m^3/day)
ABS = Inhalation absorption fraction (unitless)
ED = Exposure duration (years)
EF = Exposure frequency (unitless fraction of full-time exposure, see below)

									Assumptions for Unitless EF Term			
Exposure Scenarios	**RISK** (unitless)	**ABW** (kg)	**AT** (years)	**CPF** (kg-day/mg)	**BR** (m^3/day)	**ABS** (unitless)	**ED** (years)	**EF** (unitless)	**hours/day** (unitless)	**days/week** (unitless)	**weeks/year** (unitless)	**RESULT** ug/m^3
DEFAULT MTCA Method B	1.00E-06	70	75	0.00091	20	1	30	1	24	7	52	**9.6**
MODIFIED MTCA Method B	1.00E-06	70	75	0.00091	20	1	30	0.30	10	5	52	**32**
DEFAULT MTCA Method C	1.00E-05	70	75	0.00091	20	1	30	1	24	7	52	**96**

PCE Air Cleanup Levels from Non-Cancer Risk

Equation 750-1 Non-Cancer **Air Cleanup Level = (RfD x ABW x UCF1 x HQ xAT) / (BR x ABS x ED x EF)**

RfD = Reference dose as specified in WAC 173-340-708(7), PCE is 0.0114 mg/kg-day
ABW = Average body weight (kg) over the exposure duration
UCF1 = 1,000 µg/mg
BR = Breathing rate (m^3/day)
ABS = Inhalation absorption fraction (unitless)
HQ = Hazard quotient (unitless)
AT = Averaging time (years)
ED = Exposure duration (years)
EF = Exposure frequency (unitless fraction of full-time exposure, see below)

									Assumptions for Unitless EF Term			
Exposure Scenarios	**RfD** (mg/kg-day)	**HQ** (unitless)	**ABW** (kg)	**AT** (years)	**BR** (m^3/day)	**ABS** (unitless)	**ED** (years)	**EF** (unitless)	**hours/day** (unitless)	**days/week** (unitless)	**weeks/year** (unitless)	**RESULT** ug/m^3
DEFAULT MTCA Method B	0.0114	1.00E+00	16	6	10	1	6	1	24	7	52	**18**
MODIFIED MTCA Method B	0.0114	1.00E+00	70	30	20	1	30	0.30	10	5	52	**134**
DEFAULT MTCA Method C	0.0114	1.00E+00	70	30	20	1	30	1	24	7	52	**40**

Notes:

Ecology MTCA Method B exposure was modified from full time residential exposure (365 days/year x 24 hours/day) to an adjusted industrial worker exposure (10 hours/day x 5 days/week x 52 weeks/year).

INDOOR AIR CLEANUP LEVELS

TCE Air Cleanup Levels from Cancer Risk

Equation 750-2 Cancer **Air Cleanup Level = $\frac{\text{(RISK x ABW x AT x UCF)}}{\text{(CPF x BR x ABS x ED x EF}}$** **($ug/m^3$)**

RISK = Acceptable excess individual lifetime cancer risk level (unitless)
ABW = Average body weight (kg) over the exposure duration
AT = Averaging time (years)
UCF = 1,000 mg/kg
CPF = Carcinogenic potency factor as specified in WAC 173-340-708(8), TCE is 0.014 mg/kg/day
BR = Breathing rate (m^3/day)
ABS = Inhalation absorption fraction (unitless)
ED = Exposure duration (years)
EF = Exposure frequency (unitless fraction of full-time exposure, see below)

									Assumptions for Unitless EF Term			
Exposure Scenarios	**RISK** (unitless)	**ABW** (kg)	**AT** (years)	**CPF** (kg-day/mg)	**BR** (m^3/day)	**ABS** (unitless)	**ED** (years)	**EF** (unitless)	**hours/day** (unitless)	**days/week** (unitless)	**weeks/year** (unitless)	**RESULT** ug/m^3
DEFAULT MTCA Method B	1.00E-06	70	75	see note	20	1	30	1	24	7	52	**0.37**
MODIFIED MTCA Method B	1.00E-06	70	75	0.014	20	1	30	0.30	10	5	52	**2.1**
DEFAULT MTCA Method C	1.00E-05	70	75	0.014	20	1	30	1	24	7	52	**6.3**

Notes:

Method B has been modified to assume worker exposure only. It is therefore calculated using equation 750-2 and a CPFi = 1.4E-02 (mg/kg-day)-1. (sum of 3 CPFi's with no ELE adjustment)--similar to the default MTCA Method C calculation.

Calculation of MTCA Method B for TCE is complicated by the fact than an early-life adjustment is required for cancer risk. Because of this, I have not included the slope factors here or completed calculations, but they can be viewed at https://fortress.wa.gov/ecy/clarc/focussheets/tce%20pce%20oct%202004%20final.pdf

TCE Air Cleanup Levels from Non-Cancer Risk

Equation 750-1 Non-Cancer **Air Cleanup Level = $\frac{\text{(RfD x ABW x UCF1 x HQ xAT)}}{\text{(BR x ABS x ED x EF)}}$**

RfD = Reference dose as specified in WAC 173-340-708(7), TCE is 0.00057 mg/kg-day
ABW = Average body weight (kg) over the exposure duration
UCF1 = 1,000 µg/mg
BR = Breathing rate (m^3/day)
ABS = Inhalation absorption fraction (unitless)
HQ = Hazard quotient (unitless)
AT = Averaging time (years)
ED = Exposure duration (years)
EF = Exposure frequency (unitless fraction of full-time exposure, see below)

										Assumptions for Unitless EF Term		
Exposure Scenarios	**RfD** (mg/kg-day)	**HQ** (unitless)	**ABW** (kg)	**AT** (years)	**BR** (m^3/day)	**ABS** (unitless)	**ED** (years)	**EF** (unitless)	**hours/day** (unitless)	**days/week** (unitless)	**weeks/year** (unitless)	**RESULT** ug/m^3
DEFAULT MTCA Method B	0.00057	1.00E+00	16	6	10	1	6	1	24	7	52	**0.9**
MODIFIED MTCA Method B	0.00057	1.00E+00	70	30	20	1	30	0.30	10	5	52	**6.7**
DEFAULT MTCA Method C	0.00057	1.00E+00	70	30	20	1	30	1	24	7	52	**2.0**

Notes:

Ecology MTCA Method B exposure was modified from full time residential exposure (365 days/year x 24 hours/day) to an adjusted industrial worker exposure (10 hours/day x 5 days/week x 52 weeks/year).

INDOOR AIR CLEANUP LEVELS

VC Air Cleanup Levels from Cancer Risk

Equation 750-2 Cancer **Air Cleanup Level = (ug/m^3)** $\frac{\text{(RISK x ABW x AT x UCF)}}{\text{(CPF x BR x ABS x ED x EF)}}$

RISK = Acceptable excess individual lifetime cancer risk level (unitless)
ABW = Average body weight (kg) over the exposure duration
AT = Averaging time (years)
UCF = 1,000 mg/kg
CPF = Carcinogenic potency factor as specified in WAC 173-340-708(8), VC is 0.031 mg/kg/day
BR = Breathing rate (m^3/day)
ABS = Inhalation absorption fraction (unitless)
ED = Exposure duration (years)
EF = Exposure frequency (unitless fraction of full-time exposure, see below)

Exposure Scenarios	RISK (unitless)	ABW (kg)	AT (years)	CPF (kg-day/mg)	BR (m^3/day)	ABS (unitless)	ED (years)	EF (unitless)	Assumptions for Unitless EF Term: hours/day (unitless)	days/week (unitless)	weeks/year (unitless)	RESULT ug/m^3
DEFAULT MTCA Method B	1.00E-06	70	75	0.031	20	1	30	1	24	7	52	**0.28**
MODIFIED MTCA Method B	1.00E-06	70	75	0.031	20	1	30	0.30	10	5	52	**0.9**
DEFAULT MTCA Method C	1.00E-05	70	75	0.031	20	1	30	1	24	7	52	**2.8**

VC Air Cleanup Levels from Non-Cancer Risk

Equation 750-1 Non-Cancer **Air Cleanup Level =** $\frac{\text{(RfD x ABW x UCF1 x HQ xAT)}}{\text{(BR x ABS x ED x EF)}}$

RfD = Reference dose as specified in WAC 173-340-708(7), VC is 0.029 mg/kg-day
ABW = Average body weight (kg) over the exposure duration
UCF1 = 1,000 µg/mg
BR = Breathing rate (m^3/day)
ABS = Inhalation absorption fraction (unitless)
HQ = Hazard quotient (unitless)
AT = Averaging time (years)
ED = Exposure duration (years)
EF = Exposure frequency (unitless fraction of full-time exposure, see below)

Exposure Scenarios	RfD (mg/kg-day)	HQ (unitless)	ABW (kg)	AT (years)	BR (m^3/day)	ABS (unitless)	ED (years)	EF (unitless)	Assumptions for Unitless EF Term: hours/day (unitless)	days/week (unitless)	weeks/year (unitless)	RESULT ug/m^3
DEFAULT MTCA Method B	2.90E-02	1.00E+00	16	6	10	1	6	1	24	7	52	**46**
MODIFIED MTCA Method B	0.029	1.00E+00	70	30	20	1	30	0.30	10	5	52	**341**
DEFAULT MTCA Method C	0.029	1.00E+00	70	30	20	1	30	1	24	7	52	**102**

Notes:

Ecology MTCA Method B exposure was modified from full time residential exposure (365 days/year x 24 hours/day) to an adjusted industrial worker exposure (10 hours/day x 5 days/week x 52 weeks/year).

INDOOR AIR CLEANUP LEVELS

trans-1,2-DCE Air Cleanup Levels from Non-Cancer Risk

Equation 750-1 **Air Cleanup Level =** $\frac{\text{(RfD x ABW x UCF1 x HQ xAT)}}{\text{(BR x ABS x ED x EF)}}$

Non-Cancer

RfD = Reference dose as specified in WAC 173-340-708(7), trans-1,2-DCE is 0.017 mg/kg-day
ABW = Average body weight (kg) over the exposure duration
UCF1 = 1,000 µg/mg
BR = Breathing rate (m^3/day)
ABS = Inhalation absorption fraction (unitless)
HQ = Hazard quotient (unitless)
AT = Averaging time (years)
ED = Exposure duration (years)
EF = Exposure frequency (unitless fraction of full-time exposure, see below)

										Assumptions for Unitless EF Term		
Exposure Scenarios	**RfD** (mg/kg-day)	**HQ** (unitless)	**ABW** (kg)	**AT** (years)	**BR** (m^3/day)	**ABS** (unitless)	**ED** (years)	**EF** (unitless)	**hours/day** (unitless)	**days/week** (unitless)	**weeks/year** (unitless)	**RESULT** ug/m^3
DEFAULT MTCA Method B	1.70E-02	1.00E+00	16	6	10	1	6	1	24	7	52	**27**
MODIFIED MTCA Method B	0.017	1.00E+00	70	30	20	1	30	0.30	10	5	52	**200**
DEFAULT MTCA Method C	0.017	1.00E+00	70	30	20	1	30	1	24	7	52	**60**

Notes:

Ecology MTCA Method B exposure was modified from full time residential exposure (365 days/year x 24 hours/day) to an adjusted industrial worker exposure (10 hours/day x 5 days/week x 52 weeks/year).

INDOOR AIR CLEANUP LEVELS

1,1--DCE Air Cleanup Levels from Non-Cancer Risk

Equation 750-1 **Air Cleanup Level =** $\frac{\text{(RfD x ABW x UCF1 x HQ xAT)}}{\text{(BR x ABS x ED x EF)}}$

Non-Cancer

RfD = Reference dose as specified in WAC 173-340-708(7), 1,1-DCE is 0.057 mg/kg-day
ABW = Average body weight (kg) over the exposure duration
UCF1 = 1,000 µg/mg
BR = Breathing rate (m^3/day)
ABS = Inhalation absorption fraction (unitless)
HQ = Hazard quotient (unitless)
AT = Averaging time (years)
ED = Exposure duration (years)
EF = Exposure frequency (unitless fraction of full-time exposure, see below)

										Assumptions for Unitless EF Term		
Exposure Scenarios	**RfD** (mg/kg-day)	**HQ** (unitless)	**ABW** (kg)	**AT** (years)	**BR** (m^3/day)	**ABS** (unitless)	**ED** (years)	**EF** (unitless)	**hours/day** (unitless)	**days/week** (unitless)	**weeks/year** (unitless)	**RESULT** ug/m^3
DEFAULT MTCA Method B	0.057	1.00E+00	16	6	10	1	6	1	24	7	52	**91**
MODIFIED MTCA Method B	0.057	1.00E+00	70	30	20	1	30	0.30	10	5	52	**670**
DEFAULT MTCA Method C	0.057	1.00E+00	70	30	20	1	30	1	24	7	52	**200**

Notes:

Ecology MTCA Method B exposure was modified from full time residential exposure (365 days/year x 24 hours/day) to an adjusted industrial worker exposure (10 hours/day x 5 days/week x 52 weeks/year).