AMENDMENT #2 TO THE RECORD OF DECISION FOR THE

COMMENCEMENT BAY – SOUTH TACOMA CHANNEL SUPERFUND SITE, OPERABLE UNIT 1

WELL 12A

TACOMA, WASHINGTON

PREPARED BY:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
SEATTLE, WA

OCTOBER 2009

DECLARATION FOR THE AMENDMENT TO THE RECORD OF DECISION

SITE NAME AND LOCATION

Commencement Bay - South Tacoma Channel Superfund Site
Well 12A
Tacoma, Washington
EPA ID# WAD980726301

STATEMENT OF BASIS AND PURPOSE OF AMENDMENT

This decision document presents the selected amended remedy for Well 12A, Operable Unit 1 (OU1) of the Commencement Bay/South Tacoma Channel Superfund Site located in Tacoma, Washington. The Well 12A OU1 initial remedy was selected in 1983 and amended in 1985 by the United States Environmental Protection Agency (EPA) in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C §§ 9601 *et seq.* (CERCLA), and the National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R Part 300 (NCP). This amended remedy has also been selected in accordance with CERCLA and the NCP. All selected remedy decisions are based on the Administrative Record for the Well 12A OU1.

The State of Washington, through its Department of Ecology, concurs with the amended remedy.

ASSESSMENT OF THE OPERABLE UNIT

In accordance with Section 104 of CERCLA (42 U.S.C. § 9604), the amended remedy selected in this second amendment (Amendment #2) to the Record of Decision (ROD) is necessary to protect the public health and welfare or the environment from actual or threatened releases of hazardous substances, pollutants, and/or contaminants into the environment from the Well 12A OU1 which may present an imminent and substantial endangerment.

DESCRIPTION OF THE AMENDED REMEDY

This amendment for OU1 addresses releases and sources of volatile organic compounds (VOCs) identified in soil and groundwater at this operable unit. The amended remedy adds excavation and disposal of filter cake and contaminated soils, in situ thermal remediation (ITR), and enhanced anaerobic bioremediation (EAB) as remedial actions to address risks from exposure to residual contamination in soils and groundwater, reduce or eliminate these sources of groundwater contamination, reduce the mass flux, and prevent further migration of contaminant mass and degradation of groundwater quality. The amended remedy will also continue the operation of the groundwater extraction and treatment system (GETS), but has included a contingency for monitored natural attenuation (MNA) following discontinuation of the GETS; wellhead treatment at Well 12A; and Institutional Controls selected in the 1983 ROD and 1985 ROD Amendment. In addition, this amended remedy updates the remedial action objectives and cleanup goals for OU1.

The major components of the amended remedy selected by EPA for OU1 in this Amendment #2 include:

- Excavation and off-site disposal of filter cake and contaminated soils in a Resource Conservation and Recovery Act (RCRA) landfill;
- In situ thermal remediation (ITR) of soil and groundwater;
- In situ enhanced anaerobic bioremediation (EAB) of groundwater;
- Institutional controls to avoid or limit exposure to site contamination and guide the use of the aquifer;
- Continuing operation and maintenance of the groundwater extraction and treatment system (GETS) selected in the ROD to prevent migration of contaminants while their mass is reduced via excavation, ITR and EAB, with a contingency for discontinuation of the groundwater extraction and treatment system and reliance on Monitored Natural Attenuation (MNA) for further remediation once the active measures have achieved interim objectives;
- Monitoring of the plume; and
- Continuing operation and maintenance of the five air stripping units and monitoring groundwater for VOCs at Well 12A.

The amended remedy selected in this Amendment #2 is considered a final remedy for soils and an interim remedy for groundwater that will be protective, achieve the Remedial Action Objectives spelled out in the Decision Summary, and assist in achieving the long-term objective for OU1 of restoring the aquifer to its beneficial use as a drinking water source for the City of Tacoma. A final remedy for groundwater will be selected after these interim actions have been completed, monitored for a reasonable timeframe, and the vapor intrusion pathway has been evaluated following source actions. If the interim remedy does not fully achieve the long-term objective, additional remedial actions will be evaluated, followed by remedy selection and implementation if practicable and necessary.

The residual source area near the Time Oil building contains highly contaminated soils, dense non-aqueous phase liquid (DNAPL), and filter cake material, which are considered to be "principal threat wastes" (PTW) because the chemicals of concern are found at concentrations that pose a significant risk. In addition, this long-term source of contamination to groundwater threatens the municipal water supply of Tacoma, Washington. As such, the amended Remedy selected in this Amendment #2 will take aggressive and timely action to address the PTW in order to accelerate groundwater restoration.

STATUTORY DETERMINATIONS

The amended remedy selected in this Amendment #2 is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and

appropriate to the remedial action, is cost effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. The amended remedy also satisfies the statutory preference for treatment as a principal element of the remedy.

Because the amended remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of the remedial action to ensure that the remedy is or will be protective of human health and the environment.

DATA CERTIFICATION CHECKLIST

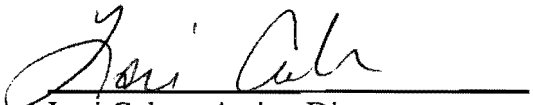
The following information is included in this amendment to the Record of Decision for Well 12A OU1. Additional information can be found in the Administrative Record file for this Site.

- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the Baseline Risk Assessment and ROD (Section 2.3)
- Baseline risk represented by the chemicals of concern (Section 4.2)
- Chemicals of concern and their respective concentrations (Section 4.2)
- Key factor(s) that led to selecting the remedy (i.e,. describe how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (Section 5)
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Section 5.2)
- Clean-up levels established for chemicals of concern and the basis for these levels (Section 7.2)
- How source materials constituting principal threats are addressed (Section 7.5)
- Potential land and groundwater use that will be available at the Site as a result of the selected remedy (Section 7.5)

AUTHORIZING SIGNATURE

This amendment to the Record of Decision documents the final remedy for soils and interim remedy to address the residual source materials and groundwater contamination emanating from the Commencement Bay- South Tacoma Channel Superfund Site Well 12A, Operable Unit 1.

EPA Region 10 approves the selected remedy as described in this ROD Amendment #2.



Lori Cohen, Acting Director
Office of Environmental Cleanup

10/29/09
Date

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47600 • Olympia, WA 98504-7600 • 360-407-6000
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

October 26, 2009

Ms. Lori Cohen
Acting Director of Environmental Cleanup
Environmental Protection Agency
1200 Sixth Avenue
Seattle WA. 98101-3140

Re: Record of Decision Amendment for Well 12-A, State Concurrence.

Dear Ms. Cohen:

The Washington State Department of Ecology (Ecology) has reviewed the Amendment to the Record of Decision for the Commencement Bay-South Tacoma Channel Superfund Site, Operable Unit #1, Well 12-A, Tacoma, Washington, October, 2009. The purpose of the Record of Decision Amendment is to provide active source remediation through excavation, thermal treatment, and enhanced bioremediation of the TCE contamination at the Well 12-A site. This source area treatment is being proposed as well as the ongoing groundwater extraction system currently operated by Ecology and the City of Tacoma.

Ecology concurs with the Environmental Protection Agency's Record of Decision Amendment. We look forward to implementing an effective, long-term solution for this site.

As a side note, I would also like to recognize the fine work that Kira Lynch undertook leading this effort. Her efforts were commendable and appreciated by Ecology staff.

Sincerely,

James J. Pendowski, Manager
Toxics Cleanup Program

cc: Barry Rogowski, Department of Ecology
Kira Lynch, Environmental Protection Agency

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1.0 INTRODUCTION TO THE SITE AND STATEMENT OF PURPOSE

There are three distinct operable units within the 2.5 square mile Commencement Bay - South Tacoma Channel Superfund Site in Tacoma, Washington. The Well 12A Site has been designated as Operable Unit 1 (OU1). The two other distinct operable units are the Tacoma Municipal Landfill and South Tacoma Field. The United States Environmental Protection Agency (EPA) is the lead agency and the Washington State Department of Ecology (Ecology) is the support agency.

OU1 includes volatile organic compound (VOC) contaminated groundwater in the area surrounding the City of Tacoma Water Supply Well 12A and the former Time Oil Company property, which is the apparent source of contamination. OU1 consists primarily of industrial/commercial land, with a small amount of residential land, in southwestern Tacoma, Washington. OU1 is approximately 4 miles southwest of the southernmost tip of Commencement Bay near the junction of Interstate 5 and State Highway 16 (see Figures 1 and 2). The exact area of OU1 is not well defined but is generally considered to be about one square mile.

The original OU1 Record of Decision (ROD) was signed on March 18, 1983 and involved the installation of an air stripping system to treat contaminated groundwater at Well 12A. A ROD Amendment was signed in 1985 to address soil and groundwater contamination in and near the source area. Remedial actions conducted as part of the 1985 Amendment (Amendment #1) included excavation of contaminated soils along the Burlington Northern railroad and installation of the groundwater extraction treatment system (GETS) near the source area at the Time Oil building in 1988, which is still in operation. In addition, approximately 5,000 cubic yards of filter cake were excavated and a soil vapor extraction system (SVE) was built in 1993 near the historical drum storage and disposal operation on the west side of the Time Oil building and operated for approximately four years. This new ROD Amendment (Amendment #2) enhances the remedial action for soil and groundwater at OU1 to address risks from exposure to residual contamination in soils and groundwater, reduce or eliminate these sources of groundwater contamination, reduce the contaminant mass flux and prevent further migration of contaminant mass and degradation of groundwater quality.

The amended remedy selected in this Amendment #2 is considered a final remedy for soils and an interim remedy for groundwater that will be protective, achieve the Remedial Action Objectives spelled out in Section 4.2**,** and assist in achieving the long-term objective for OU1 of restoring the aquifer to its beneficial use as a drinking water source for the City of Tacoma. A final groundwater remedy will be selected after these actions have been completed and monitored for a reasonable timeframe. If the interim remedy does not fully achieve the long-term objective in a reasonable timeframe, additional remedial actions will be evaluated, followed by remedy selection and implementation if practicable and necessary.

Given the conditions at the Site and concentrations of VOCs in soil, vapor intrusion in on-site buildings is also a potential concern. Vapor intrusion will be evaluated by EPA after targeted soil and groundwater contamination is addressed and if necessary, further remedial actions will be evaluated.

The original decision documents and this Amendment #2 present remedial actions selected in accordance with Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, 42 U.S.C. § 9617(a), and Section 300.435(c)(2)(ii) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. §300.435(c)(2)(ii)

This Amendment #2, and all documents that form the basis for this decision, will become part of the Administrative Record file for the Well 12A Operable Unit consistent with Section 300.825(a)(2) of the NCP. The Administrative Record contains the information on which selection of this remedial action is based and is available for review at the following locations:

Citizens for a Healthy Bay
917 Pacific Avenue, Suite 100
Tacoma, Washington 98402
(253) 383-2429

EPA Region 10 Superfund Records Center
1200 Sixth Avenue, Suite 900, ECL-076 (7th Floor)
Seattle, WA 98101
(206) 553-4494

2.0 HISTORY, CONTAMINATION, AND SELECTED REMEDY

2.1 History

In 1981, chlorinated organic solvents were detected in groundwater at Well 12A, a municipal water supply well owned and operated by the City of Tacoma Water Department. EPA conducted a site investigation during the summer of 1981, and concentrations of chlorinated organic solvents detected in groundwater in the well were high enough to remove the well from service. Based on the findings of the investigation, the Commencement Bay South Tacoma Channel Site was proposed for listing on the National Priorities List (NPL) on September 1, 1981. The Site was added to the NPL on September 8, 1983.

The Time Oil property was historically used for various activities including oil recycling and paint and lacquer manufacturing. Oil recycling and solvent processing began as early as 1923 and continued to 1991, with occasional interruptions due to changes in ownership and a large fire in 1976. The Time Oil Company vacated the premises in 1991, and the property has since been used for storage and small-scale manufacturing. The current owner is Western Moving and Storage.

In addition to a number of possible leaks and spills over the years, some of the filter cake generated during oil recycling was land disposed around the Time Oil building and additional filter cake was used as fill material in 1982 for constructing the Burlington North Railroad spur to the north of the Time Oil Property. Subsequent investigations have identified this filter cake as a primary source of 1,1,2,2-tetrachloroethane (PCA), tetrachloroethylene (PCE), trichloroethylene (TCE), and other organic solvents discovered in the groundwater at Well 12A.

2.2 Contamination

Soil samples were collected during several events, the most recent collected during an investigation conducted in 2004/2005. Soil samples at or near the Time Oil property contained the highest concentrations of contaminants. Soil contamination is greatest near the surface on the east side of the Time Oil building where the contamination extends downward to the water table, which suggests a continuing source to groundwater.

Groundwater samples were collected during numerous events over the history of OU1, with the samples analyzed most commonly for VOCs. The primary VOC contaminants of concern, based on risk evaluations, are PCE, trichloroethylene (TCE), 1,2-dichloroethene (cis and trans) (DCE), and vinyl chloride (VC). Groundwater samples were most recently collected in 2008, with chlorinated VOC (CVOC) criteria being exceeded at several locations and the highest concentrations occurring at EW-4, EW-5, CH2M-1, and ICF-2. These wells are located at the south end of the Time Oil property and south of the property. TCE is the most widespread VOC, with a plume extending east and southwest of the Time Oil property, towards Well 12A and the highest concentrations reported south of the Time Oil property. The cis-1,2-DCE plume is much smaller than the TCE plume, with the highest concentrations located on the Time Oil property. Elevated concentrations of 1,1,2,2-PCA were detected in wells on and south of the property. PCE, trans-1,2-DCE, and VC were also detected, but elevated concentrations of these compounds are not as widespread as TCE and they are limited to wells near or at the Time Oil property.

Despite previous remedial efforts, a number of sources of dissolved phase contamination still remain on or near the Time Oil property. Both light and dense non-aqueous phase liquids (LNAPL and DNAPL) have been identified beneath the property and an additional area of filter cake has been identified to the east of the Time Oil building. The LNAPL exists primarily within a smear zone near the water table where it coats soil particles and partially fills voids in the soil. During a sampling event in 2008, 1.41 feet of LNAPL was detected at ICF-4, which is located east of the Time Oil building. The presence of DNAPL is evidenced by high soil concentrations of chlorinated solvents at depths below the historical low groundwater level of 40 feet below ground surface.

2.3 Conceptual Site Model

The updated conceptual site model (which includes the nature and extent of contamination, the location of contamination, and the transport of contaminants and is summarized in Figure 3) was used to identify four zones or areas that need to be addressed by some cleanup action.

1. Filter Cake and Shallow Impacted Soil. This zone needs to be addressed because it is at the surface and it appears to be contributing to subsurface contamination.

2. Deep Vadose Zone Soil and High Concentration Groundwater East of Time Oil Building. The vadose zone, also called the unsaturated zone, extends from the surface to the water table (saturated zone). Since technologies applied in the deep vadose zone would likely be applicable to the upper saturated zone, the two media are combined into this one treatment zone. The extension of vadose zone contamination into the water table suggests that it is a continuing source of contamination. If left untreated, these high concentrations of contamination would continue to impact groundwater.

3. High Concentration Groundwater West and South of Time Oil Building (TCE and cis-1,2-DCE greater than 300 µg/L). This area is predominantly defined by groundwater with TCE and cis-1,2-DCE at concentrations above 300 µg/L . The 300 µg/L concentration was chosen because, beyond this concentration, negligible additional contaminant mass is gained. Also, where contamination drops below 300 µg/L, the aquifer begins to transition from anaerobic conditions (without oxygen) to aerobic conditions (with oxygen). Also included in this zone are the area east of the Time Oil building with elevated concentrations of 1,1,2,2-PCA and the area southwest of the Time Oil building for which limited data are available.

4. Low Concentration Groundwater (TCE and cis-1,2-DCE less than 300 µg/L) This treatment zone includes groundwater with concentrations of TCE/cis-1,2-DCE less than 300 µg/L. Groundwater data from wells in this zone indicate that the degradation of chlorinated volatile organic compounds is probably occurring naturally under current conditions.

As part of the Amendment #2 feasibility study, an evaluation of natural attenuation was conducted in the high concentration (anaerobic) and low concentration (aerobic) groundwater contaminant plumes. For the Well 12A source area and high concentration plume, the natural attenuation evaluation indicated that the Time Oil source area was generally anaerobic, likely a residual impact from the historic presence of petroleum hydrocarbons, but that current conditions are generally carbon-limited, resulting in non-optimal redox conditions of iron- to sulfate-reducing. For chlorinated ethenes, conversion of PCE/TCE to cis-DCE can occur under local redox conditions of sulfate- to iron-reducing, but the anaerobic conversion of VC to ethene occurs under methane-producing redox conditions. The presence of anaerobic degradation by-products, including cis-DCE, VC and ethene, in the source area confirms that anaerobic biological degradation is occurring.

Within the low-concentration dissolved phase plume, conditions are generally aerobic (oxygen is present), which is not conducive to reductive dechlorination of CVOCs. Generally, TCE persists for much longer under aerobic conditions. Cometabolism is the only biodegradation mechanism

described for highly chlorinated CVOCs, such as TCE, under aerobic conditions. Enzymes produced by bacteria that can cometabolically degrade TCE, cis-DCE, trans-DCE, and VC including bacteria that use methane, benzene, humic substances and/or toluene as natural food sources were present and active during the natural attenuation evaluation at Well 12A. This indicates that these mechanisms are occurring at Well12A, although the reactions are likely very slow. Biodegradation rates for TCE in the aerobic plume are estimated between 1.5 to 8 years. This Site data and analysis provide convincing support that aerobic cometabolic degradation is sufficient to attenuate contaminants once established flux goals and RAOs defined in this Amendment #2 have been achieved.

Of note, is that the implementation of EAB within the high concentration source area of the contaminant plume will generate by-products that can stimulate cometabolism of TCE in the aerobic part of the plume. In order for anaerobic degradation of TCE to occur efficiently, methane-producing conditions must be achieved. Methane, however, is not degraded anaerobically and so persists and is transported downgradient of the EAB treatment area. Once methane reaches the aerobic part of the plume, it stimulates aerobic bacteria that use methane as a food source, which also cometabolize TCE. Therefore, EAB not only accelerates anaerobic degradation within the target EAB treatment area, but can also accelerate aerobic biodegradation downgradient of the treatment area and accelerate natural attenuation of contaminants in the low-concentration dissolved phase plume.

2.4 Summary of OU1 Risks

Despite previous actions taken at the Site, concentrations of soil and groundwater contaminants exceed regulatory levels as established by the Washington State Department of Ecology Model Toxics Control Act (MTCA). Concentrations of groundwater contaminants also exceed maximum contaminant levels (MCLs) established under the federal Safe Drinking Water Act. Non-aqueous phase liquids have been identified in the soil and groundwater. Vapor intrusion in onsite buildings is also a concern. The amended remedy is needed to protect public health and the environment from risks posed by OU1 soil and groundwater. Vapor intrusion will be evaluated by EPA after targeted soil and groundwater contamination is addressed.

Direct contact at the source area or through consumption of contaminated drinking water poses risks to human health if no additional remedial action is performed. During 2008, the concentration of TCE in groundwater was as high as 1300 µg/L (MTCA is 2.4 µg/L), PCA was as high as 150 µg/L (MTCA is 0.2 µg/L), PCE was as high as 36 µg/L (MTCA is 0.8 µg/L), cis-1,2-DCE was as high as 2,200 µg/L (MCL is 70 µg/L) , trans-1,2-dichloroethylene was as high as 1400 µg/L (MCL is 100 µg/L), and VC was as high as 330 µg/L (MTCA is 0.3 µg/L). No significant ecological impacts due to the contamination are expected because the area around OU1 is heavily developed and the available data suggest that the contaminant plume does not currently reach local streams or rivers.

2.5 Current and Future Land Use

As in the original decision documents, the current and reasonably anticipated future land use assumptions are industrial/commercial and the current and potential future beneficial use for groundwater is drinking water. Well 12A is currently used by the city of Tacoma for municipal water supply. It is anticipated that future use of Well 12A will increase substantially due to increased demand for the Tacoma municipal water supply. If the actions selected in this amendment, including continued wellhead treatment, are not implemented, contamination levels in Well 12A would likely increase, contamination would likely migrate further and affect other wells, and people could be exposed to contaminated drinking water.

2.6 Selected Remedies and Response Actions to Date

The remedy selected in the 1983 ROD was intended to address groundwater contamination at Well 12A and was the most cost-effective of the systems evaluated. The 1983 remedy involved the installation and operation of an air stripping system that would treat water pumped from Well 12A using five packed towers operating in parallel at a total flow rate of 3,500 gallons per minute (gpm). Treated water would be discharged to Commencement Bay or to the city's water system depending on measured quality and the city's needs. This remedy was meant as an interim measure until the source area could be identified and the contamination mitigated.

Following a remedial investigation and feasibility study, the 1985 OU1 ROD Amendment (Amendment #1) detailed additional measures needed to address soil and groundwater

contamination within the identified source areas. Contaminated filter cake, and soils in and around the Time Oil building were identified as a source of contamination. In addition, the Burlington Northern Railroad right-of-way adjacent to the Time Oil facility was identified as an additional source of contamination to Well 12A in Amendment #1. In June 1986, Burlington Northern excavated approximately 1,200 cubic yards of contaminated soils along the rail spur.

In accordance with Amendment #1, a Groundwater Extraction and Treatment System (GETS) was installed on the Time Oil property in November 1988 to pump and treat contaminated groundwater near the source. In 1995, four additional extraction wells were added to the system.

In 1993, a soil vapor extraction (SVE) system was installed and began operation in the area where drum storage and disposal operations had previously occurred to the west of the Time Oil building. During construction of the SVE system, approximately 5,000 cubic yards of waste sludge (filter cake) from the oil recycling operations were excavated. Operation of the SVE system was discontinued in 1997 after soil contamination was reduced to concentrations that would not impact groundwater quality along the west side of the Time Oil building.

In 2004-2005, the EPA installed additional wells and collected soil samples and groundwater samples. Oily product was identified in some soil samples primarily collected from areas to the east of the Time Oil building. Groundwater contaminant concentrations and distribution had generally decreased compared to previous sampling events, with elevated concentrations of CVOCs still found near the Time Oil property. In September 2008, the third Five-Year Review was completed for Well 12A. The review concluded that the GETS is no longer effectively reducing contaminant concentrations and is not adequately controlling the migration of contamination. Since the report concluded that the remedy was not protective, corrective actions were initiated. EPA conducted a Focused Feasibility Study (FFS) analyzing potential remedial alternatives to address ongoing contamination. The FFS was completed in April 2009.

3.0 BASIS FOR THE DOCUMENT AND SCOPE OF THE REMEDY

Despite prior removal and treatment activities at OU1, soil and groundwater contamination persists at concentrations that exceed regulatory levels for protection of public health. Contamination continues to threaten human health and the environment through either direct

contact at the source area or ingestion of contaminated drinking water. In order to reduce contaminant concentrations and achieve remedial action objectives, aggressive remedial action is required. Source removal and treatment of soil and groundwater are necessary to address risks from exposure to residual contamination in soils and groundwater, reduce or eliminate these sources of groundwater contamination, reduce contaminant mass flux and prevent further migration of contaminant mass and degradation of groundwater quality. Therefore, a fundamental change is being made to the remedies selected in the original ROD and Amendment #1 in order to achieve overall remedy effectiveness and permanence, and have a much higher probability of achieving the ultimate goal of groundwater restoration. The amended remedy selected in this Amendment #2 was chosen because it best satisfies the threshold criteria of protectiveness and compliance with applicable or relevant and appropriate requirements (ARARs), is expected to achieve substantial long-term risk reduction through treatment and source removal, and will do so in a reasonable timeframe at less cost than other alternatives considered.

4.0 DESCRIPTION OF SIGNIFICANT DIFFERENCES

4.1 Description of the Amended Remedy Selected in this Amendment #2

The amended remedy selected in this Amendment #2 addresses releases and sources of volatile organic compounds (VOCs) identified in soil and groundwater at OU1. The amended remedy will continue the groundwater extraction and treatment and wellhead treatment at Well 12A selected in the 1983 ROD and 1985 ROD Amendment #1, and it updates the remedial action objectives and cleanup goals for OU1. The amended remedy adds excavation and disposal of filter cake and contaminated soil located to the eastt of the Time Oil building, in situ thermal remediation (ITR), and enhanced anaerobic bioremediation (EAB), institutional controls, a contingency for MNA, and monitoring of the plume (see Figure 4).

The major components of the amended remedy selected by EPA for OU1 in this Amendment #2 include:

- Excavation and off-site disposal of filter cake and contaminated soils in a Resource Conservation and Recovery Act (RCRA) landfill;

- In situ thermal remediation (ITR) of soil and groundwater;
- In situ enhanced anaerobic bioremediation (EAB) of groundwater;
- Institutional controls to avoid or limit exposure to site contamination and guide the use of the aquifer;
- Continued operation and maintenance of the groundwater extraction system selected in the ROD to prevent migration of contaminants while their mass is reduced (via excavation, ITR and EAB), with a contingency for discontinuation of the groundwater extraction and treatment system and reliance on MNA for further remediation once the active measures have achieved interim objectives;
- Monitoring of the plume; and
- Continued operation and maintenance of the five air stripping units and monitoring groundwater for VOCs at Well 12A.

Contaminated soils and source materials will be excavated to a depth deemed practicable (estimated to be approximately 10 feet), however more or less excavation may be required depending on observations and field screening data. Confirmation sampling will be conducted within the excavated areas to evaluate any contamination left in place, and excavated areas will be backfilled with clean soil and a gravel cover will be placed across the surface. Any contamination left in place following excavation is expected to be addressed by the ITR treatment. The deep vadose zone and upper saturated zone near the former Time Oil building will be treated with ITR. The high concentration groundwater plume will be treated using EAB through reductive dechlorination under anaerobic conditions. EAB will not only accelerate biodegradation of contaminants within the high-concentration treatment area, but will also likely accelerate natural attenuation of contaminants by producing by-products that can induce contaminant-degrading enzymes within the low-concentration aerobic contaminant plume.

The amended remedy includes institutional controls to limit access to and future development, improvement, and use of affected properties to protect human health. ICs would include activity and use restrictions enacted through proprietary (e.g., easements, covenants) and/or governmental (e.g., zoning requirements) controls to prevent uses of the property that would

pose an unacceptable risk to receptors (i.e., for residential use). Informational device ICs (e.g., warning signs, advisories, additional public education) would also be employed to limit access to contaminated soils and groundwater. Tacoma-Pierce County Board of Health Resolution No. 2002-3411, Land Use Regulations, and applicable sections of Washington Administrative Code Titles 173 and 246 are current guidelines that would be considered, or possibly amended, for the location and installation of supply wells.

The preferred remedial alternative in the Proposed Plan included groundwater monitoring and attenuation between the source area and Well 12A. Data suggest that naturally occurring attenuation is contributing to decreasing concentrations of CVOCs in the lower concentration groundwater plume, and the enhanced anaerobic bioremediation being implemented upgradient from this area is expected to accelerate this process in the low concentration plume. While the lines of evidence support the selection of MNA, the amended remedy selected in this Amendment #2 includes monitoring that will allow for a more complete evaluation and a contingency for discontinuing the GETS and relying on MNA to achieve long-term groundwater objectives if monitoring and evaluation shows that MNA can be relied upon to achieve further contaminant reduction in a reasonable timeframe.

The amended remedy also includes groundwater monitoring. Attainment of the remedial action objectives (RAOs) will be measured through the monitoring of contaminant levels in groundwater, and evaluating contaminant mass discharge from the source area. A 30-year monitoring and evaluation program will be implemented to monitor remedial performance.

The estimated cost for implementing the improvements of the amended remedy selected in this Amendment #2 is $16,210,000.

The amended remedy selected in this Amendment #2 is considered a final remedy for soils and an interim remedy for groundwater that will be protective and assist in achieving the long-term objective for OU1 of restoring the aquifer to its beneficial use as a drinking water source for the City of Tacoma. The amended remedy is also expected to enhance site conditions such that MNA will become more effective. After the excavation, disposal, ITR and EAB achieve their

interim objectives, EPA and the Washington State Department of Ecology will evaluate whether further operation of the GETS is necessary to achieve the long-term objectives or if MNA can be relied upon to do so in a reasonable timeframe instead. If, at some point, that is the case, EPA will issue an Explanation of Significant Differences to implement the MNA contingency and discontinue GETS operation. Wellhead treatment and institutional controls will be maintained as long as necessary to prevent exposure. If the interim remedy does not fully achieve the long-term objective in a reasonable timeframe, additional remedial actions will be evaluated, followed by remedy selection and implementation if practicable and necessary.

4.2 Remedial Action Objectives

In order to protect human health and the environment, five Remedial Action Objectives (RAOs) were developed as part of this Amendment #2 to reduce contaminant mass and decrease the size of the contaminated area. The Amendment #2 RAOs replace the RAOs established in the ROD, Amendment #1, and ESD, with the exception of the sixth RAO listed below, which is retained from the earlier decisions. With respect to groundwater, if it is potable, i.e., suitable for drinking in its natural state, MCLs are relevant and appropriate standards that need to be met wherever practicable.

Amendment #1 specified "[t]he objectives of the proposed remedial action are the mitigation and control of contamination in the groundwater and in the soil at the source area." Additional RAOs were developed as part of this Amendment #2 and include:

- Eliminate the risk to human health posed by direct contact with filter cake and contaminated soil at and near the surface still present on the east side of the Time Oil building;
- Prevent or minimize the migration of contamination from the highly contaminated shallow soil and filter cake area into the deeper soils to prevent further degradation of groundwater;
- Remove sufficient contaminant mass within the source area to reduce the transport of contaminants from this highly contaminated source material into downgradient groundwater;

- Reduce contaminant mass discharge by 90% from the source area into the low concentration groundwater treatment zone;
- Reduce contaminant concentrations to meet cleanup levels selected in this amendment to be protective of human health and the environment and to comply with all ARARs at specified points of compliance (ARARs are listed in Section 7.2).
- Eliminate risk to human health from exposure to groundwater containing COCs in excess of protective levels.

Compliance with RAOs has been divided into three tiers to allow for implementation of a multi-component remedy and allow for decision-making such as when to transition from one treatment technology to another and when the operations and maintenance (O & M) of OU1 transfers to the State of Washington. A brief description of each tier is provided below:

- The primary goals for the first tier of compliance are to address residual sources, minimize the risk to receptors due to contaminated surface soils and achieve a contaminant discharge reduction of at least 90% from the high concentration source area near the Time Oil building to the dissolved-phase contaminant plume. Soil removal, ITR and EAB will be considered complete and the Remedy will be considered operational and functional when the tier 1 criteria have been met. Once the tier 1 criteria have been met, the operations and maintenance of OU1 will be turned over to the State of Washington.

- The primary goal of the second tier of compliance and this interim remedy is to achieve the cleanup levels in Table 4-1 at interim performance monitoring points (PMP), CW-1, CW-2, and Well 12A to ensure that groundwater concentrations are below ARAR-specified levels at those locations. The proposed PMPs identified for the second tier of compliance are within the current groundwater contaminant plume. Contaminant reductions to below health-based standards within the high concentration source area would be an additional benefit.

- The primary goal of the third tier of compliance is to determine if cleanup levels can be achieved in a reasonable timeframe throughout the contaminant plume, including the Time Oil source area, by discontinuing GETS operation and continuing to monitor natural attenuation of any remaining contamination. If this can be demonstrated, the

MNA contingency will be implemented and GETs operation will be discontinued through an ESD. If compliance with ARARs throughout the contaminant plume is deemed not feasible, additional remedial alternatives will be evaluated and/or a Technical Impracticability (TI) waiver may be sought for the non-compliant portions of the aquifer.

Based on the Focused Feasibility Study, the estimated time for the reduction of the contaminant mass in the source area by at least 90% is one year. Enhanced anaerobic bioremediation would require a testing program prior to implementation to refine the treatment technology's design. Using the speed of groundwater movement, EPA can estimate how long it will take for impacts from the bioremediation to reach specified points. For example, the distance from the south edge of South Tacoma Way (a proposed location to receive enhanced anaerobic bioremediation) to Well 12A is approximately 1,400 feet. Given that groundwater is moving on average at about 0.42 feet per day, impacts from the bioremediation are estimated to reach Well 12A in 3,333 days, or about 9 years. This estimate is based on current data and conditions; if additional data are collected or conditions change, then the estimate may change. For example, if the velocity is faster (e.g., two times faster) than estimated because the subsurface material differs in some areas then the impacts would be seen two times faster (4.5 years instead of nine years).

4.3 Cleanup Levels

With respect to groundwater, if it is potable, i.e., suitable for drinking in its natural state, Safe Drinking Water Act maximum contaminant levels (MCLs) are relevant and appropriate standards that need to be met wherever practicable. The remediation goals of this Amended Remedy for OU1 include the cleanup levels specified in Table 4-1 and the points of compliance discussed below. The key ARARs for establishment of cleanup levels and points of compliance include MCLs and the Ground Water Cleanup Standards in section 720 of the State of Washington Model Toxics Control Act (MTCA) (WAC 173-340-720). The complete list of ARARs for OU1 and the selected remedial actions are included in Section 7.2 and Table 7.1.

Table 4-1. [Amended] Groundwater Cleanup Levels for COCs at the Time Oil/Well 12A OU1

	MTCA Method B (ingestion + inhalation) ug/L	MCL ug/L	GW Cleanup Level	Basis for Cleanup Level
Dichlorethylene; 1,2-,CIS	70	70	70	MCL
Dichlorethylene; 1,2-,trans	100	100	100	MCL
Tetrachloroethane; 1,1,2,2- (PCA)	0.2	NA	0.2	MTCA B 10^{-6} (no MCL)
Tetrachloroethylene (PCE)	0.8	5	0.8	MTCA B 10^{-5}<MCL
Trichloroethylene (TCE)	2.4	5	2.4	MTCA B non-carcinogenic risk; MTCA B 10^{-5} = 4.9
Vinyl chloride	0.3	2	0.3	MTCA B 10^{-5}<MCL

4.4 Points of Compliance

Points of compliance designate the location in OU1 where the cleanup levels must be met. For soils, contaminated soils and source materials will be excavated to a depth deemed practicable (estimated to be approximately 10 feet), however more or less excavation may be required depending on observations and field screening data. Confirmation sampling will be conducted within the excavated areas to evaluate any contamination left in place, and excavated areas will be backfilled with clean soil and a gravel cover will be placed across the surface. Any contamination left in place following excavation is expected to be addressed by the follow-on ITR treatment. However, wherever confirmation samples show residual contamination above soil cleanup levels for unrestricted use within 15 feet of the ground surface, institutional controls to provide notice and limit exposure to residual contamination will be implemented.

The designated points of compliance for groundwater in OU1 are: Well 12A, proposed well CW-1 (approximately 1250 feet east of the Time Oil building), and proposed well CW-2 (approximately 1250 feet southeast of the Time Oil building). To achieve the long-term objective for OU1, groundwater would have to achieve the selected cleanup levels throughout the plume (unless that is found to be technically impracticable).

5.0 COMPARISON OF SELECTED AMENDED REMEDY AND ALTERNATIVES

Nine criteria are used to evaluate the different remedial alternatives individually and against each other in order to select a remedy. Given the complexity of the site, EPA developed four remedial action alternatives comprised of combinations of the general response actions and technologies identified, screened, and retained in the Focused Feasibility Study. Each of the alternatives described in the Proposed Plan included a combination of individual technologies designed to address the four treatment zones outlined in the Conceptual Site Model.

- ***Alternative 1: No (Additional) Action:*** Alternative 1 would have continued the actions selected in the ROD and Amendment #1 without changes. Based on the evaluation, this alternative is not protective and does not comply with ARARs.
- ***Alternative 2: Institutional Controls and Existing Groundwater Treatment.*** Alternative 2 would have added institutional controls to limit access to and future development, improvement, and use of affected properties to the original remedy as modified by Amendment #1. It was evaluated to be less protective and compliant with ARARs than the selected amended remedy.
- ***Alternative 3 (the Preferred Alternative Selected in this Amendment#2): Excavation; In situ Thermal Remediation; Enhanced Anaerobic Bioremediation (EAB); Groundwater Extraction and Treatment; Wellhead Treatment; Institutional Controls.***
- ***Alternative 4: Excavation; Capping; In situ Thermal Remediation; Enhanced Anaerobic Bioremediation; Air Sparging and Soil Vapor Extraction; Groundwater Extraction and Treatment; Wellhead Treatment; Institutional Controls.*** This alternative would have included all of the actions that are included in the amended remedy selected (Alternative 3) plus the following actions: a) Air Sparging and Soil Vapor Extraction to remove volatile organics from the groundwater, and b) capping the excavated area with concrete. These additional actions would cost more but would not add significantly to the effectiveness or protectiveness of the remedy relative to the selected alternative.

This section compares the relative performance of the original selected remedy as modified by Amendment #1, with the amended remedy selected in this Amendment #2 and the other alternatives that were considered but not selected against the nine criteria, noting how both the original and the new amended remedy compare to the other options under consideration. The more complete Comparative Analysis of all four Alternatives is presented in the Proposed Plan and Focused Feasibility Study, which are part of the Administrative Record.

The nine evaluation criteria are summarized below.

EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES
Threshold Criteria
Overall Protectiveness of Human Health and the Environment requires that an alternative adequately eliminates, reduces, or controls threats to public health, welfare or the environment through all the means it selects, including institutional controls.
Compliance with ARARs requires that an alternative meets all federal and stricter state environmental statutes and regulations, or that such requirements be formally waived.
Primary Balancing Criteria
Long Term Effectiveness and Permanence compares the capacity of alternatives to maintain protection of human health, welfare and the environment over time.
Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment compares the use of treatment to reduce the harmful effects, ability to move in the environment, and quantity of principal contaminants of concern.
Short-term Effectiveness compares the length of time needed to implement alternatives and the risks to workers, residents, and the environment during implementation.
Implementability compares the technical and administrative feasibility of implementing alternatives, including factors such as relative availability of goods and services.
Cost compares estimated capital and annual operation and maintenance (O&M) costs expressed as present-worth costs. Present-worth is the total cost of an alternative over time in terms of current value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
Modifying Criteria
State/Support Agency Acceptance compares state/support agency preferences/views on EPA's remedy selection and analyses as compiled in the Proposed Plan.
Community Acceptance compares affected community preferences/views as reflected in public comments on EPA's remedy selection and analyses as compiled in the Proposed Plan.

The nine criteria are in three categories; threshold, primary balancing, and modifying criteria.

Threshold criteria must be met by an alternative for an alternative to be eligible for selection.

Primary balancing criteria are used to weigh major trade-offs among eligible alternatives.

Modifying criteria by their nature are fully considered after comment on the Proposed Plan.

5.1 Threshold Criteria

1. Overall Protection of Human Health and Environment

Under the 1983 ROD, the initial remedial measure was well head treatment using an air stripping system consisting of five packed towers at Well 12A. The 1985 ROD Amendment #1 provided further protection from contaminated soils and groundwater through soil excavation and flushing, and operation of the GETS within the contaminant source area. As discussed above and documented in the 2008 Five Year Review, prior remedial measures did not prove to be fully protective. The amended remedy selected in this Amendment #2 meets this threshold criterion by adding excavation and disposal of additional soil as well as institutional controls (ICs) such as deed restrictions and limits on digging to reduce exposure to contaminated soils remaining on the Time Oil property. It also includes the application of ITR, EAB, continued operation and maintenance of the GETS, and wellhead treatment at Well 12A. Other alternatives that were considered, but not selected, including capping of contaminated soils and air sparging coupled with SVE, would similarly meet this criterion. However, the selected amended remedy should be less energy intensive and have a smaller carbon footprint to implement, which makes it overall comparatively more protective of human health and the environment.

2. Compliance with ARARs

The amended remedy selected in this Amendment #2 will help achieve ARARs with a higher degree of certainty than the original remedy or the alternatives not chosen. It will do so by adding source removal, ITR and EAB for aggressive treatment of the Time Oil source area, which together are expected to achieve ARARs at the interim points of compliance, and conceivably over time throughout the aquifer. The current remedy has not stopped contaminant migration and cannot achieve regulatory levels at the interim PMPs, much less throughout the plume.

5.2 Balancing Criteria

1. Long-Term Effectiveness and Permanence

The amended remedy selected in this Amendment #2 will provide a higher degree of long-term effectiveness for soil and groundwater than the original remedy and the alternatives not selected.

This will be achieved through removal and treatment of remaining contaminated soils and treatment of soil and groundwater to reduce contaminant concentrations to achieve RAOs.

2. Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment

The original remedy did not include any treatment of the source area, including filter cake or contaminated soils, but focused on air stripping at the Well12A wellhead. The stripping towers remove volatile compounds from the groundwater and emit them to the atmosphere. When the well operates, some control is maintained for contaminants that are in the vicinity of the well. However, data suggest that the pumping action mobilizes contamination near the Time Oil property and contaminants migrate further along the prevailing gradient. Therefore, operation of the well is considered to not reduce the toxicity, mobility, or volume of contaminants.

The toxicity, mobility, and volume of the contaminants of concern (COCs) in soil and groundwater were reduced by treatment alternatives proposed and implemented in the 1985 ROD Amendment #1. Excavation and disposition of contaminated filter cake and soils, and groundwater extraction and treatment reduced the mobility and volume of contaminants, but not the toxicity.

The toxicity, mobility, and volume of the contaminants of concern (COCs) in soil and groundwater will be reduced to a far greater extent by the amended remedy selected in this Amendment #2 than by the original remedy, or any of the other considered alternatives. In addition to existing alternatives (excavation, GETS operation and well-head treatment), the amended selected remedy adds two forms of treatment: ITR and EAB. ITR is expected to reduce the toxicity and volume of contaminated soil and groundwater, as well as mobility through removal of the source. EAB should reduce the toxicity and volume of contamination because CVOCs would be biologically transformed to ethene and ethane.

3. Short-Term Effectiveness

None of the considered alternatives offered significant advantages regarding low to moderate risks to the community or workers during implementation. In each case risks would be minimized by following proper precautions. For construction workers, proper protective equipment, decontamination procedures, and Occupational Safety and Health Administration

safety standards will be employed and/or met. Risks to the community will be reduced by limiting access to construction areas, equipment, treatment facilities if any, along with dust suppression and monitoring. Construction activities would have been shorter for no further action, and would have been the same or longer for the alternatives not selected.

The amended remedy selected in this Amendment #2 estimates that construction of the ITR treatment system will be completed within approximately six months from the completion of the remedial design and the ITR heating phase will last approximately six months. Groundwater monitoring in the zone will continue for 30 years. A fairly significant amount of work will be required for EAB, however, this type of construction is routine, as installation of bioremediation amendment injection systems are relatively common. There will be short-term impacts to the community during construction due to the large number of injection wells that will be installed. Access to private properties will be required for well drilling and nutrient injections. Some traffic control will be required. There will be noise during drilling and nutrient injections. Injection requires a large amount of water that will need to be taken from a hydrant. If feasible, the treated effluent water from the GETS may also be used. Installation of injection wells and the amendment injection system could be completed in approximately six months. The wellhead treatment system and GETS are already installed so there will be no short- term effectiveness issues.

4. Implementability

The amended remedy selected in this Amendment #2 will be more difficult to implement than the original remedy, but is still technically and administratively implementable. The excavation activities will require minimal technical considerations except for the need to ensure structural stability while digging near building foundations. Construction of the ITR treatment system will be completed using conventional construction equipment and services, with contractors that specialize in this innovative technology. The regulatory and permitting requirements associated with installation of thermal and vapor extraction wells, laying piping, constructing the treatment system, and securing approval for air emissions are considered to be moderately administratively intensive.

The ISB/EAB treatment will be constructed and implemented using conventional construction methods and equipment. The processes that govern degradation reactions are well understood, and technical feasibility of enhanced bioremediation has been established at numerous sites. Despite this, bioremediation is still considered an innovative technology. As such, it will require pilot scale testing prior to implementation. In general, no significant technical difficulties are anticipated.

Currently, the treatment zone is underneath private properties and some roadways. Obtaining permission for access to private properties to install the injection wells and amendment system and perform frequent visits to the system may be a challenge. Therefore, the administrative implementation of this alternative will be more difficult due to it being implemented in a city area.

The air stripping treatment system at Well 12A and the GETS were constructed and have been in operation since 1983 and 1988, respectively. Minimal administrative tasks are involved with the long-term groundwater monitoring program and minimal services and materials are required.

5. Costs

The capital, Operation and Maintenance (O&M), and net present value costs for the remedial action set forth in the original ROD, Amendment #1, and for the amended remedy selected in this Amendment #2 are provided in table 5-1. Costs to implement the original ROD and Amendment #1 are as reported in the original and amending documents, and costs to implement the amended remedy selected in this Amendment #2 are from the 2009 Focused Feasibility Study.

Table 5-1. Capital, O&M, and Net Present Value for the 1985 and Amended Selected Remedy

Selected Alternative	Meets RAOs? (Y/N)	Time to Implement	Capital Cost	O&M Present Worth	Present Worth
1985 ROD (Wellhead Treatment – Option D) Amended Selected Remedy	N	Already in place	$620,000	$553,000	$1,173,000
Amended Remedy Selected in this Amendment #2	Y	3 years	$12,527,000	$3,683,000	$16,210,000

Capital costs are incurred prior to achieving the 90% flux reduction goal, which is when the remedy is considered operational and functional. The capital costs include both the direct and indirect capital costs required to implement the remedial actions. Direct costs are comprised of construction costs for equipment, labor, materials, transportation, and disposal. Indirect costs include those associated with permitting and legal, engineering, services during construction, and contingencies. O&M costs include labor and materials associated with operation and maintenance following the remedial action, such as maintaining the air stripping towers at Well 12A, long-term monitoring costs, or five-year site reviews. The three year time to implement is the estimated time from initiation of amended remedy to meeting the 90% flux reduction goal. The present worth in the Focused Feasibility Study has been calculated based on Federal policy which recommends assuming a seven percent discount rate over a 30-year evaluation period; the period was shortened for parts of the alternative that are not anticipated to operate for that long of a period.

5.3 Modifying Criteria

1. State/Support Agency Acceptance

The Washington State Department of Ecology supports the amended remedy selected in this Amendment #2.

2. Community Acceptance

A proposed plan identifying and giving the rationale for the amended remedy selected in this Amendment #2 was published May 4, 2009 for a 30-day Public Comment period lasting from May 4 through June 3, 2009. A public meeting was held on May 19, 2009 at the Tacoma Utilities Administration Building. Community acceptance was evaluated after the public comment period for the Proposed Plan. The input from public meetings and written comments was carefully reviewed and a Responsiveness Summary is presented in Section 9. The amended remedy selected in this Amendment #2 has not changed materially from the Preferred Alternative in the Proposed Plan. The only change made was to clarify that after the excavation, disposal, ITR, and EAB achieve their interim objectives, the Agencies will evaluate whether further operation of the GETS is necessary to achieve the long-term objectives or whether monitored natural attenuation can be relied upon to do so in a reasonable timeframe instead. If at some point that is the case, EPA will issue an Explanation of Significant Differences to implement the MNA contingency and discontinue GETS operation.

6.0 SUPPORT AGENCY COMMENTS

The Washington State Department of Ecology has reviewed this ROD Amendment and supports its conclusions. Comments from Ecology and EPA responses are included in the Responsiveness Summary.

7.0 STATUTORY DETERMINATIONS

Pursuant to Section 121 of CERCLA and the NCP, the lead Agency must select remedies that are protective of human health and the environment, comply with ARARs, are cost effective, and utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. Pursuant to 40 C.F.R.

§ 300.430(f)(5)(ii), the following sections discuss how the amended remedy selected in this Amendment #2 meets these statutory requirements.

7.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The amended remedy selected in this Amendment #2 will adequately protect human health and the environment through treatment, engineering controls, and/or institutional controls. Filter cake and shallow contaminated soils will be removed from OU1 and be taken off-site for disposal in a RCRA Subtitle C or D landfill. Additionally, ITR will be used to reduce mass concentrations in contaminated shallow soil and groundwater. Groundwater will be treated through EAB, continued operation of the GETS, and continued wellhead treatment at Well 12A. A contaminant mass discharge reduction of 90% from the source area is expected which will substantially reduce the mass transport of COCs to the groundwater. All of these measures will reduce the risks to human and ecological receptors to protective levels for the long term. They are not expected to cause unacceptable short-term risks or cross-media impacts. This is an interim remedy for groundwater that will ultimately be followed by a final remedy.

Consistent with the RAOs, opportunities may be sought during the implementation of the remedy to reduce its environmental footprint as defined in U.S. EPA Office of Solid Waste and Emergency Response Principles for Greener Cleanups (http://www.epa.gov/oswer/greencleanups/principles.html).

7.2 COMPLIANCE WITH ARARS

The amended remedy selected in this Amendment #2 will comply with all ARARs. The RAOs are staged and include first minimizing the risk to receptors due to contaminated surface soils by excavation and reducing contaminant discharge in groundwater by at least 90% from the high concentration source area near the Time Oil building to the dissolved-phase contaminant plume. Once this RAO has been achieved, the operations and maintenance of OU1 will be turned over to the State of Washington and the remedy will be considered operational and functional. The amended remedy will also achieve chemical-specific ARARs measured at proposed PMPs and compliance wells (CW-1, CW-2 and Well 12A) to ensure that groundwater concentrations are

below ARAR-specified levels at those locations. Last, the practicability to achieve chemical-specific ARARs throughout the contaminant plume will be evaluated, including natural attenuation, and if deemed not feasible, a Technical Impracticability (TI) waiver may be sought for the non-compliant portions of the contaminated aquifer. The principal ARARs are provided in Table 7-1.

Table 7-1. Well 12A OU1 ARARs

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
"Hazardous Waste Cleanup -- Model Toxics Control Act of 1989," RCW 70.105D	"Model Toxics Control Act of 1989," WAC 173-340 (as amended Nov 2007) Specific subsections: WAC 173-340-720 WAC 173-340-740 WAC 173-340-745(b) WAC 173-340-747 WAC 173-340-440 (1-4,9)	Applicable	Establishes the process and methods used to evaluate risk and develop standards for soil and other environmental media.	The substantive requirements of the specified subsections are relevant and appropriate to developing cleanup standards for the selected remedy. MTCA method B levels as the cleanup levels for TCE, 1,1,2,2,-PCA, PCE, and VC.
Safe Drinking Water Act of 1974, 42 USC 300 et seq.	"National Primary Drinking Water Standards," Subpart G Specific subsections: 40 CFR 141.61 40 CFR 141.62 40 CFR 141.66	Relevant and Appropriate	Establishes maximum contaminant levels for drinking water.	The selected remedy is using the MCLs for 1,2,cis-DCE and 1,2,-tran-DCE.
"Washington Clean Air Act of 1967," RCW 70.94 and RCW 43.21A, "State Government - Executive"	"General Regulation for Air Pollution Sources," WAC 173-400 Specific subsections: WAC 173-400-040	Applicable	Requires all sources of air contaminants to meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions. Requires use of reasonably available control technology.	Applicable to remedial actions at OU1 due to the generation of fugitive dust that will occur during construction activities.

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
"Washington Clean Air Act of 1967," RCW 70.94 and RCW 43.21A, "State Government - Executive"	Specific subsection: WAC 173-400-113	Applicable	Requires controls to minimize the release of air contaminants resulting from new or modified sources of regulated emissions. Emissions are to be minimized through application of best available control technology.	Waste generated for disposal that does not meet Environmental Restoration Disposal Facility waste acceptance criteria, will require the use of a treatment technology (e.g., to treat generated waste to meet disposal facility acceptance requirements) that may emit regulated air emissions. If such treatment is required, this requirement would be applicable.
	"Controls for New Sources of Toxic Air Pollutants," WAC 173-460 Specific subsections: WAC 173-460-030 WAC 173-460-060 WAC 173-460-070	Applicable	Requires specific controls for new regulated air emissions.	Although unlikely, the selected remedy may require use of a treatment technology (e.g., to treat generated waste to meet disposal facility standards) that emits toxic air emission. If such treatment is required, this requirement would be applicable.
"Hazardous Waste Management Act of 1985," RCW 70.105	"Dangerous Waste Regulations," WAC 173-303 Specific subsection: WAC 173-303-016 WAC 173-303-017 WAC 173-303-070(3) WAC 173-303-073 WAC 173-303-077 WAC 173-303-170(3)	Applicable	Specifies how to identify dangerous waste. Establishes the management standards for solid wastes that designate as dangerous wastes.	Applicable to identifying solid and dangerous wastes generated during OU remedial actions. The management standards are applicable to the management and disposal of those wastes identified as dangerous waste.

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
"Hazardous Waste Management Act of 1985," RCW 70.105	"Dangerous Waste Regulations," WAC 173-303 Specific subsection: WAC 173-303-140	Applicable	Identifies dangerous wastes that are restricted from land disposal, describes requirements for state-only-restricted wastes, and prohibits land disposal of restricted wastes unless treatment standards have been met. Incorporates Federal land-disposal restrictions including provisions for treatability variances by reference.	Applicable to the disposal of dangerous waste that will be generated during implementation of the selected remedy.
"Solid Waste Management, Recovery, and Recycling Act of 1969," RCW 70.95	"Nondangerous Nonradioactive Solid Waste Management," WAC 173-304 and 173-351 Specific subsections: WAC 173-304-190 WAC 173-304-200 WAC 173-304-460	Applicable	Establishes requirements for the management of solid waste.	Applicable to the onsite management and disposal of solid waste that will be generated during implementation of the selected remedy.
"Water Well Construction," RCW 18.104	"Minimum Standards for Construction and Maintenance of Water Wells," WAC 173-160 "Rules and Regulations Governing the Licensing of Well Contractors and Operators," WAC 173-162	Applicable	Establishes minimum standards for design, construction, capping, scaling, and decommisioning of wells. Establishes qualifications for well contractors and operators.	Applicable to the installation of wells that will be required for groundwater extraction/injection and monitoring.

7.3 COST EFFECTIVENESS

The amended remedy selected in this Amendment #2 is the most cost-effective alternative considered. The selected amended remedy provides the best overall protection in proportion to cost, and meets all other requirements of CERCLA. Section 300.430(f)(1)(ii)(D) of the NCP requires EPA to evaluate the cost-effectiveness by comparing all of the alternatives which meet the threshold criteria, overall protection of human health and the environment, and compliance with ARARs, against three additional balancing criteria: long-term effectiveness and permanence; reduction of toxicity, mobility or volume through treatment; and short-term effectiveness. Based on this evaluation, the amended remedy selected is the most cost-effective alternative. The estimated present worth cost for the revised remedy presented in this Amendment is $16,210,000.

7.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The amended remedy selected in this Amendment #2 represents the maximum extent to which permanent solutions and treatment technologies can be utilized at OU1, while providing the best balance among other evaluation criteria. Of those alternatives that are protective of human health and the environment and that comply with ARARs, EPA has determined that the amended remedy selected in this Amendment #2 is the most efficient and effective alternative when evaluated using the five balancing criteria, while also considering (1) the statutory preference for treatment as a principal element, (2) the bias against off-site treatment and disposal, and (3) state and community acceptance.

The remedy selected in this Amendment #2 offers superior long-term effectiveness and an acceptable reduction of volume and mobility through excavation and treatment. Application of ITR and EAB, as well as continued operation and maintenance of the GETS, and wellhead treatment at Well 12A, should result in a mass contaminant reduction of 90% as well as reduced contaminant concentrations in soil and groundwater. Ongoing groundwater monitoring will check that RAOs are met. If the soil excavation, ITR, and EAB components of the remedy have a high degree of effectiveness, operation of the current GETs system could be discontinued with transition to MNA. This will be evaluated during the five-year reviews.

7.5 PREFERENCE FOR TREATMENT

The focused efforts of the remedy selected in this Amendment #2 are intended to address, first, the principal threat waste (PTW) comprised of residual source, which contains highly contaminated soils, DNAPL, and filter cake near the Time Oil building. The chemicals of concern are found at concentrations that pose a significant risk in surface soils and may pose an additional threat to indoor air within the Time Oil Building. In addition, this long-term source of contamination to groundwater threatens the municipal water supply of Tacoma, Washington. As such, the amended Remedy will take aggressive and timely action to address this PTW in order to accelerate groundwater restoration. First, filter cake and contaminated soils will be excavated and disposed of in a RCRA landfill to reduce risks due to direct contact with contaminated soils. Next, ITR will be implemented to further reduce the contaminant concentrations in soil and groundwater and EAB will be used to accelerate biological degradation of contaminants in groundwater within the source area and high concentration contaminant plume. These treatments are in addition to the existing GETS and collectively will reduce the mass flux by 90% and contamination levels below ARARs at the specified compliance points. In addition, wellhead treatment at Well 12A will also be continued, and MNA may be evaluated, if necessary, as a follow on to the active treatment. The statutory preference for remedies that employ treatment as a principal element is satisfied by the selected amended remedy as excavation, ITR, EAB, GETS, and wellhead treatment are a significant portion of this remedy. Ultimately, the long-term goal for the remedy is complete groundwater restoration to allow for unrestricted use as a drinking water source for the City of Tacoma.

7.6 FIVE-YEAR REVIEW REQUIREMENT

Because the amended remedy selected in this Amendment #2 will result in hazardous substances, pollutants, or contaminants remaining within OU1 above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of the remedial action to ensure the remedy is and will be protective of human health and the environment. The five-year review process will begin at the time of issuance of this Amendment #2 and will continue to be done as part of the South Tacoma Channel sitewide five year reviews. The first such review will be completed by May 2014.

8.0 PUBLIC PARTICIPATION COMPLIANCE

The Proposed Plan for this ROD Amendment was issued for public comment in accordance with Section 117 of CERCLA, as amended, and Section 300.435(c)(2)(ii) of the NCP. The Proposed Plan was made available on May 4, 2009 in the Administrative Record file at the following locations:

Citizens for a Healthy Bay
917 Pacific Avenue, Suite 100
Tacoma, Washington 98402
(253) 383-2429

EPA Region 10 Superfund Records Center
1200 Sixth Avenue, Suite 900, ECL-076 (7th Floor)
Seattle, WA 98101
(206) 553-4494

A public notice was published in the Tacoma News Tribune announcing the commencement and length of the public comment period and the public meeting.

A public meeting was held to present details related to the Proposed Plan and to solicit public comments. The meeting was held on May 19, 2009 at the Tacoma Utilities Administration Building. A public comment period was held from May 4 through June 3, 2009. The attached Responsiveness Summary addresses comments received on the Proposed Plan during the public comment period.

9.0 RESPONSIVENESS SUMMARY

EPA with concurrence from Ecology identified and proposed the preferred remedial alternative in the Proposed Plan. The preferred remedial alternative did not differ from the amended selected remedy in this ROD Amendment. In accordance with 42 U.S.C. § 117(a) and 40 C.F.R. §300.45(c)(2)(ii)(D), the opportunity for a public meeting was provided during the public comment period. The public meeting was advertised in 125 Proposed Plan fact sheets sent to individuals and other interested parties as well as in the publication noted in Section 8.0. During the public comment period, comments were received from five parties and testimony was heard

from three people at the public meeting held in the Tacoma Utilities Administration Building. These comments and testimony, and EPA's response to the comments and testimony, are included in the following section.

Response to Comments Received During the Public Comment Period

1. It saddens me that EPA is still working on Well 12A cleanup. The real question here is "how clean is clean?" I know that you are probably a lowly bureaucrat that can't effect change back at your headquarters.

   I was the Water Quality Manager at Tacoma Water when this all started. Tacoma Water was contemplating challenging the EPA cleanup rules back then, until EPA offered to fund the cleanup project. Tacoma Water, myself and the Water Superintendent knew we would look bad in Public if we challenged your rules.

   So, "how clean is clean?" We became aware the base cancer rate is about 200 to 250,000 cases per million people. We also learned about half the cases were from food choices and consumption. About 35 percent of cases were from alcohol and cigarettes. So, this leaves about 15 percent of cases to other environmental factors and related reasons. It occurred to us that EPA actually should be hiring public health nurses and educating the public regarding food, alcohol and cigarette risk.

   Your cleanup levels of one extra case per million people never made sense to me. You are probably aware by now that chlorinated drinking water has a risk of about one extra case per 10,000 people. Likewise, peanut butter, strawberries, X rays from your doctor, sunlight, being in a brick/concrete building and other such exposures are at the one extra case per 10,000 people level. The peanut butter problem is aflotoxin, strawberries are mold if not treated and the treatment chemical if treated, X rays are your typical lifetime exposure, etc.

   So, my conclusion is EPA may be wasting my money because the cleanup level is 100 times more than an ordinary prudent person would consider safe if they were aware of the other exposure risks and the base cancer rate. I hope you will work towards changing these illogical

rules and help divert monies to educating the public about lifestyle choices including food, alcohol, cigarettes and regular exercise.

Perhaps, I shouldn't be so critical. At least your illogical rules create jobs for young professionals who fund my social security checks. I will try and get on your website to read your plan. I am sorry I can't get to your public meeting on May 19 due to an existing conflict.

Response: The use of risk-based approaches is the standard for defining federal and/or state environmental regulations and subsequent cleanup levels. As you have alluded to above, there are significant challenges with using risk-based approaches for defining clean up goals. One of the most significant is dealing with the uncertainty associated with the risk assessment and risk management processes, including those associated with sources, pathways, and receptors. Managing this uncertainty is addressed by (1) using conservative cleanup goals, and/or (2) conducting extensive long-term monitoring to reduce uncertainty. Almost all risk-based approaches have traditionally relied on the use of conservative assumptions and cleanup goals to account for uncertainty. While these conservative goals can result in more costly cleanup, there are ways to minimize cost by developing a comprehensive remedial strategy that initiates actions to address areas of greatest risk to receptors and supports realistic interim remedial goals such that remedial alternatives can be selected that are both protective of human health and the environment and cost-effective.

The use of compliance points also allows for flexibility in managing sites with complex mixtures and/or distribution of contaminants, such as the Well 12A Site, to design more cost effective remedies. The chlorinated solvent contaminant plume including the source area at the Time Oil facility extends to the east and south towards Well 12A. The shape of the contaminant plume has been impacted by complex hydrogeology, including seasonal variability in the hydraulic gradient and hydrologic impacts of pumping from the groundwater extraction and treatment system (GETS) and periodic pumping from Well 12A. Given that Well 12A is a municipal groundwater supply well, maximum contaminant levels (MCLs) defined by the Safe Drinking Water Act have been identified as relevant and appropriate for this Site. The current feasibility study defines the compliance points as Well 12A, and two new wells to the east and southeast of the Time Oil source area. For the Well 12A Site, we have developed a comprehensive remedial strategy that addresses the areas of greatest risk (i.e., source area at the Time Oil building) with the most aggressive, and cost effective, actions such that a reduction in contaminant mass transport (or

flux) can be achieved resulting in MCLs at the compliance points. Using this approach, the interim goal for the active (and expensive) treatment components are not to achieve MCLs, although this is a goal for the overall remedy, within every portion of the contaminant plume, but to reduce contaminant concentrations enough in soil and groundwater within high concentration areas to ultimately minimize contaminant transport (and hence the risk) to the receptor at Well 12A. During active treatment, one interim goal is to reduce contaminant mass discharge from the Time Oil source area to the groundwater system such that remaining contaminants can be attenuated within the plume before reaching receptors. This will provide a more cost-effective long-term solution than the current indefinite operation of the GETS. In addition, targeted active treatment will also facilitate a substantial reduction in the timeframe for achieving the ultimate remedial goal, which is complete groundwater restoration throughout the contaminant plume.

2. The TPCHD does have a comment about the locations selected for the interim monitoring points and the compliance monitoring wells. As expressed previously, we are concerned about the contaminant plume moving eastward through the South Tacoma Channel along with the normal groundwater flow. Wells IM2 and CW2 appear to be placed to intercept movement towards the east but not in optimal locations to intercept eastward moving contamination. Groundwater movement in the subject area generally flows eastward through the South Tacoma Channel, an area comprised of recessional outwash deposits. In the subject area, this outwash channel is generally bounded by Center Street on the north and South Tacoma Way on the south. Both wells IM2 and CW2 are depicted along the south edge, or shoulder, of the outwash channel. We expect the lowest point within the outwash channel to be towards the center, and the worst of the chlorinated hydrocarbon contamination to accumulate along that deepest part of the channel.

   Geological cross sections of the channel in the general vicinity of IM2 and CW2 may exist within the historical file for Well 12A/Time Oil. Cross sections would greatly assist in selecting the proper placement of the interim and compliance monitoring wells to ensure that the greatest concentration of contaminants are intercepted.

   Response: We agree that it is important to determine the extent of contaminants moving eastward through the South Tacoma Channel, and that there is significant uncertainty in contaminant distribution both vertically and horizontally to the east and southeast of the Time Oil source area. As such, four additional wells, IM-1 and IM-2 and CW-1 and CW-2 are proposed as interim performance monitoring and compliance wells. As you mentioned, IM-2 and CW-2 are along

the southern shoulder of the outwash Channel. These locations were selected, in part based on the location of the Channel, but also to account for the prevailing groundwater gradient near the Time Oil source area, which appears to be east/ southeast, and to evaluate contaminant transport towards Well 12A to the south. In addition, IM-1 and CW-1 are proposed to be located to the east of the Time Oil source area near the center of the Channel. Distribution of dissolved contaminants in groundwater appears to be consistent with transport in an east/southeast direction from Time Oil as evidence by elevated contaminant concentrations at CH2M-2. In addition, groundwater contaminant data at MW-A located near the northern edge of the Channel, are below MCLs for contaminants of concern. It is recognized, however, that there is little information available on distribution of contaminants between MW-A and CH2M2, including an apparent lack of information in the deeper areas of the upper Aquifer. The intent of IM-1 and CW-1 is to provide additional information on contaminant transport to the east of the Time Oil source area within the center of the South Tacoma Channel. The final placement of these wells will be decided during the remedial design. In addition, an optimal depth to screen the wells will also be determined in order to capture conservative contaminant concentrations migrating from the Time Oil source area. These locations will be illustrated in a plan view map relative to their locations within the South Tacoma Channel in addition to the Time Oil source area and contaminant plume in any future design documents.

Although IM-1 and CW-1 have been selected as the compliance points, additional wells within the South Tacoma Channel to the east of the Time Oil source area are planned to be monitored as part of the performance assessment for the proposed remedial actions at the site. These include aforementioned MW-A, new monitoring well to replace CH2M-4, and CH2M-3. During construction activities, well CH2M-4 was compromised and so the Washington State Department of Transportation decommissioned the well in 2009. This well will be replaced in a new location, likely south of Center St. We would consider placing this new well in a location that would help delineate contaminant extent vertically along the South Tacoma Channel (i.e., next to MW-A, but screened across a deeper interval of the upper aquifer).

3a. In Situ Thermal Remediation is not justified by the small increases of the vapor pressures of the contaminates, (see attached spreadsheet and plots).

Response: The Excel spreadsheet that was provided calculates the Henry's Law constant, which in and of itself is not a very good indicator for potential thermal treatment. There are several laws

that govern thermal remediation. Dalton's law governs the boiling point of a relatively insoluble contaminant, such as a chlorinated solvent DNAPL. Raoult's law governs the boiling point of mutually soluble co-contaminants and Henry's law governs the ratio of the contaminant in the vapor phase to the contaminant in the liquid phase. A brief description of each is provided below:

a. Dalton's Law: For mutually insoluble compounds, Dalton's Law states that the partial pressure of a non aqueous phase liquid (NAPL) is equal to its vapor pressure, and that the NAPL in contact with water will boil when the vapor pressure of water plus the vapor pressure of the VOC is equal to ambient pressure. The net effect of this is that mixtures of contaminants, such as TCE and water, have lower boiling temperatures than either constituent alone (i.e. TCE and water boils at 73C) and forms bubbles that are a ratio of their partial pressures (i.e. 2/3 TCE vapor and 1/3 water).

b. Raoult's Law: For mutually soluble compounds, Raoult's Law states that the partial pressure of a compound is equal to its vapor pressure times its mole fraction. This means that mutually soluble contaminants (such as mixtures of TCE and fuel hydrocarbons) will volatilize slower than if there was only one compound present.

c. Henry's Law: Henry's law describes the tendency of a compound to join air in the vapor phase or dissolve in water. At a constant temperature, the amount of a given gas dissolved in a given type and volume of liquid is directly proportional to the partial pressure of that gas in equilibrium with that liquid. Henry's Law would apply at the water table where groundwater is in direct contact with soil gas. In this case, the calculation indicates that the transfer of VOCs at the water table would increase by about 300 percent.

By understanding the combined effects of heat on vapor pressure for the contaminants of interest (and ultimately boiling), thermal remediation can be effectively designed and implemented for source treatment. For instance, by applying Dalton's Law, the temperature where water/DNAPL will boil and rise through the groundwater can be calculated, which is lower than the boiling point of water. As the DNAPL is removed, the partial pressure of the VOC is reduced and the boiling point shifts towards the boiling point of water. Thermal remediation has been extensively applied and demonstrated to be effective at removing concentrated contaminants, such as DNAPLs, from the subsurface. The substantial amount of information demonstrating its effectiveness, not only

for contaminants of concern at Well12A, but also in similar geology (i.e., thermal remediation has been successfully applied to remove chlorinated DNAPLs at the Ft. Lewis East Gate Disposal Yard near Tacoma, WA), led to its consideration and ultimate selection as part of the preferred alternative.

3b. What will be the targeted increase in the temperature of the soil and groundwater, and what are the installation and operational costs?

Response: The target increase in temperature will likely be the boiling temperature of the water (approximately 90-110 C), although exact temperatures will be developed during the remedial design. A summary of the estimated costs for the in situ thermal remediation is provided in Appendix F of the Well 12A feasibility study (FS) (http://yosemite.epa.gov/r10/cleanup.nsf/4c5259381f6b967d88256b5800611592/d3c814fe6394c2ba882565220048abb2!OpenDocument). Total cost for thermal remediation is estimated at $2.24 million (M) with approximately $1.32M for installation and $0.92M for operations and reporting.

3c. Heating the ground and facilitating bacterial growth are incompatible.

Response: The preferred alternative for Well 12A is a multi-component remedy that includes In Situ Thermal Remediation in a relatively small area to the east of the former Time Oil building and enhanced anaerobic bioremediation (EAB) for the high concentration groundwater contaminant plume. While high temperatures, such as those achieved during operation of the thermal treatment system, can be detrimental to bacteria, the planned EAB will be implemented following thermal treatment (Figure 5-1 of the Well 12A FFS illustrates a hypothetical schedule of activities for the preferred alternative). In addition, injection wells for the EAB will be upgradient of the thermal treatment area. Therefore, injection can not only facilitate distribution of nutrients throughout the thermal treatment area, but can also recruit bacteria from areas outside the thermal treatment area to re-populate the thermal treatment area. In essence, EAB will be used to "polish" any remaining contaminants present within the thermal treatment area, and to treat a much larger area of the dissolved contaminant plume outside of the thermal treatment area not impacted by heating.

3d. Is there any evidence that the proper microorganisms are present in the soil? (chlorinated solvents have only been released into the environment since WII)

Response: The biological degradation of chlorinated ethenes, such as TCE, occurs anaerobically in a stepwise process, termed anaerobic reductive dechlorination, resulting in the sequential generation of daughter products cis- dichloroethene (DCE), vinyl chloride (VC) and ultimately ethene, the desired innocuous end product. While biological degradation of TCE to cis-DCE has been widely documented for a number of different types of bacteria, only one genus of bacteria, Dehalococcoides, has been demonstrated to degrade cis- DCE to VC to ethene. A natural attenuation evaluation was conducted for the Time Oil site to determine if environmental conditions were suitable for biological degradation of chlorinated ethenes. Wells within the Time Oil source area tended to be anaerobic, with a full range of TCE degradation products (cis- and trans- 1,2-DCE, VC, and ethene measured). Therefore, the presence of VC and ethene, in particular, provides strong evidence that Dehalococcoides species is present at the Well 12A Site, and that this native population is capable of complete biodegradation of the chlorinated solvents to innocuous end products.

3f. What about other conditions needed for bacterial metabolism of chlorinated solvents ? (see attached Adventus Reprint)

Response: In order for biological degradation of chlorinated solvents to be successful, appropriate geochemical conditions conducive to the growth and activity of contaminant-degrading populations is required. TCE can act as an electron acceptor for some bacteria under strictly anaerobic conditions (i.e., it serves the same function as oxygen does for people). This type of bioremediation is dependent upon the redox conditions within the aquifer, and the depletion of other competing electron acceptors, such as oxygen, nitrate and/or sulfate. Conversion of TCE to cis-DCE can occur under local redox conditions of sulfate- to iron-reducing, but the anaerobic conversion of VC to ethene can only occur under methane-producing redox conditions. In addition, other parameters, such as pH, must be conducive to microbial activity (pH of 6.5-8.0 for Dehalococcoides). For the Well 12A Site, the natural attenuation evaluation indicated that the Time Oil source area was generally anaerobic, likely a residual impact from the historic presence of petroleum hydrocarbons, but that current conditions are generally carbon-limited, resulting in non-optimal redox conditions of iron- to sulfate-reducing. The presence of anaerobic degradation by-products, including cis-DCE, VC and ethene, in the source area confirms that biological degradation is occurring, although not as efficiently as possible under more favorable conditions. Therefore, the EAB design will be to inject nutrients throughout the Time Oil source area and high concentration dissolved phase plume to create

conditions that are more favorable and will stimulate more efficient biodegradation of contaminants to non-hazardous end products.

Within the low-concentration dissolved phase plume, conditions are generally aerobic (oxygen is present), which is not conducive to reductive dechlorination of TCE. Generally, TCE persists for much longer under aerobic conditions because it is highly oxidized and cannot act as a food-source for microorganisms. There is one aerobic biodegradation mechanism that has been described for TCE. Cometabolism describes a process where certain bacteria produce enzymes that are targeting other substances (such as a food source), but that can also bind and fortuitously react with TCE resulting in degradation. Reaction with TCE, however, does not provide any benefit to the microorganisms and so the substances that those enzymes are trying to react with (i.e. food source) must also be present. A variety of bacteria can cometabolically degrade TCE, cis-DCE, trans-DCE, and VC including bacteria that use ammonia, methane, benzene, propane, humic substances and/or toluene as natural food sources. During the natural attenuation evaluation at Well 12A, molecular analysis was conducted to look for these enzymes in groundwater within the aerobic plume. Enzymes that target aromatic compounds and methane, that also cometabolize TCE, were present and active. This indicates that these mechanisms are occurring at Well12A, although the reactions are likely very slow.

Of note, is that the implementation of EAB within the high concentration source area of the contaminant plume will generate by-products that can stimulate cometabolism of TCE in the aerobic part of the plume. In order for anaerobic degradation of TCE to occur efficiently, methane-producing conditions must be achieved. Methane, however, is not degraded anaerobically and so persists and is transported downgradient of the EAB treatment area. Once methane reaches the aerobic part of the plume, it stimulates aerobic bacteria that use methane as a food source, which also cometabolize TCE. Therefore, EAB not only accelerates anaerobic degradation within the target EAB treatment area, but can also accelerate aerobic biodegradation downgradient of the treatment area and accelerate natural attenuation of contaminants in the low-concentration dissolved phase plume.

3g. Has the addition of an amendment (carbon food source) been demonstrated to “jump start” biological activity at this site?

Response: In essence, yes, although direct injection of carbon as part of remedial strategy has not been done. Historic presence of petroleum hydrocarbons, however, provided a carbon source that stimulated biological activity and resulted in the generation of an anaerobic zone within the source area. Within this anaerobic zone, degradation of TCE is occurring as evidenced by the presence of cis-DCE, VC and ethene. During the natural attenuation evaluation, it was determined that while the area is still anaerobic, it is carbon-limited. Therefore, the EAB will be designed to address this limitation in order to accelerate biodegradation that is already occurring at the site.

3h. Besides pumping and treating the groundwater to maintain the plume boundaries, have other methods of hydraulic control been investigated?

Response: The Well 12A plume is hydraulically complex and there are significant uncertainties in hydraulic properties of the system that make consideration of hydraulic control of the plume a difficult, and unlikely, proposition. Over 20 years of operating the GETS system has not yet achieved hydraulic control of the Time Oil source area. In addition, treatment technologies that focus on hydraulic control, rather than direct treatment of contaminant mass, cannot treat or even contain DNAPLs in sites containing chlorinated solvent source areas within reasonable timeframes, and in addition, are amongst the highest cost treatment options over their operational lifetime. Therefore, hydraulic control was not considered a feasible treatment option for the Well 12A plume. With that being said, for the proposed EAB treatment, different injection strategies will be considered that may include some component of hydraulic control, such as groundwater extraction and recirculation, to help distribute amendments throughout the target treatment area. These options would be evaluated in detail during the remedial design.

3i. Has any pilot testing of the proposed remedies been conducted?

Response: No pilot studies of the proposed technologies have been conducted to date. All of the technologies, however, are well established for the proposed applications for sites similar to Well 12A. In addition, the development of the full-scale application of the treatment technologies is proposed in phases such that iterative optimization can occur.

4. I've already sent Kira kind of a lengthy rambling letter, but one thing I would like to really stress both to Ecology and EPA is that you guys both know that indoor air monitoring and vapor

intrusion is a huge growing problem. To me, to my mind, frankly, it's criminal that you have not tested the air that these people have been working in for eight hours a day for all these years.

Response: The health risk at the Well 12A Site due to vapor intrusion was evaluated using the Johnson and Ettinger model (EPA 2004) since volatile organic compounds (VOCs) may migrate from contaminated soils and groundwater through the subsurface and a building overlying elevated groundwater concentrations. Results of the modeling indicate that unacceptable risk to onsite workers within the building is feasible and that further evaluation is warranted. This risk is anticipated to be addressed when high concentration and NAPL-phase contaminants are reduced during the proposed alternative. EPA will continue to evaluate the risk to verify that it is properly addressed.

5. I'm a civil engineer professional registered with the State of Washington. I read this thing that came in the mail a week ago and what concerned me was this: On page three, second paragraph, "The site consists of a primary source area, which is property formerly owned by the Time Oil Corporation, and a groundwater contamination plume that extends from the source area approximately 2,000 feet to the east and approximately 2,000 feet to the southwest to Well 12A." We bought Time Oil property on the east side of the -- on the Prospect side, which we knew was a Superfund site, and we know that there's a Consent Decree between the three parties, the contaminated, and the EPA, so we know we're safe there, but we have corporate headquarters within about 800 feet of the property, and we have -- that's going west. Going east we have some other property right next door, and we also have some property where there's buses on Sprague and South Tacoma Way, which is about 1,000 feet away. So how are we going to be protected from pollution since there's already a plume that's 1,000 feet past us going both directions? Are we going to become a Superfund site because EPA is here right now? I mean, because the Department of Ecology is here, they could rate us and every other property within 2,000 feet both ways. Is anything from a one to a five a contamination source? So how are we going to be protected is the question.

Response: The boundaries of a Superfund site are defined and fixed in a “record of decision” (ROD) after the remedial investigation/ feasibility study (RI/FS) is completed. They are defined by the "areal extent of contamination." The Well 12A OU encompasses the source of contamination at the property of the former Time Oil Company, and the City of Tacoma's production Well 12A. Therefore, the entire contaminant plume, as defined in the current final FS

is already part of the Well 12A OU and is being addressed in the proposed remedial actions. The EPA is planning to use government funding to construct the proposed alternative.

6. We represent about 2,000 active members in our organization of the Commencement Bay Superfund problem area, and additionally work to provide community input in the oversight into Superfund cleanup activities within Commencement Bay. I appreciate -- or CHB appreciates the fact that Ecology and EPA are taking a look at this again and doing something more. This has been an active problem for 26 years, and what was really concerning was that in terms of Well 12A that it could be another nine years. Tacoma is current -- those are current projections, but Tacoma is currently undergoing a whole comprehensive plan update to bring about greater density to accommodate growth that is predicted to be substantial within the next ten to fifteen years, so it's safe to assume that the pumping rates that are being looked at now, there may be greater demand in the future. You know, in terms of municipal services, it would be very hard to find anything as valuable as the domestic water supply, and we do need this one in the summer and probably will continue to need it more. We will be submitting more written comments on the different aspects of the plan, but we do appreciate the fact that EPA and Ecology are looking to take action on this one, and we urge you to do aggressive action. Thank you.

Response: The re-evaluation of the Well 12A Remedy was prompted by the realization that current remedial actions were not going to achieve the cleanup goals for the site. Therefore, the proposed remedial actions focuses on aggressive removal of the contaminant source at the Time Oil building using excavation and thermal heating in order to have a substantial impact on the longevity of the contaminant plume. In addition, the proposed EAB treatment will polish any residual contaminants following thermal treatment, remove contaminants from the high concentration dissolved phase plume, and help to accelerate the attenuation of contaminants in the low concentration dissolved phase plume. This comprehensive strategy will dramatically reduce the longevity of the plume, reduce risk, and will likely be more cost effective over the life cycle of the plume. Collectively, this will help to make Well 12A a more viable option as a source of domestic water for Tacoma. These remedial actions will be implemented as part of the current preferred alternative in this Well 12A ROD Amendment.

7. This letter presents comments from Citizens for a Healthy Bay (CHB) to the feasibility study and proposed remedial action plan for the Time Oil/Well 12A Superfund problem area. Remedial actions taken to date have not been sufficient to protect human health and municipal groundwater

resources. CHB urges EPA to expedite response actions outlined in Preferred Alternative 3. CHB is a community-based, non-profit environmental organization representing the greater Commencement Bay community. Our mission is to engage citizens to clean up, restore and protect the Commencement Bay environs. As such, we have acted to provide community oversight and public participation into the Commencement Bay area for the past 20 years. Thank you for your consideration of our remarks.

Response: The EPA appreciates the urgency with which you encourage timely remedial action for the Well 12A site. These remedial actions will be implemented as part of the current preferred alternative in this Well 12A ROD Amendment.

8. This letter provides Tacoma Water's comments on the Proposed Plan for the South Tacoma Channel Well 12A Superfund Site (Site) in Tacoma. We believe contamination problems that remain at the Site currently pose a significant potential threat to human health and the environment, and we urge EPA to move forward with additional cleanup plans.

The groundwater contamination from the Site threatens some of Tacoma Water's key drinking water wells. While Green River surface water is the primary source of supply for Tacoma Water, we rely on our groundwater supplies as a critical resource. The wells are invaluable to help meet peak demands and provide a stable supply when adequate capacity from the unfiltered Green River supply is not available. In recent years, groundwater has provided up to 12 percent of Tacoma Water's drinking water supply on an annual basis. The wells also figure prominently in our plans to meet future needs. Currently, Tacoma Water supplies drinking water on a direct service basis to a population of over 310,000 people. Our Green River supply provides a significant regional supply to other cities and wholesale water customers, and as regional demand for our surface water supply increases over the next five to twenty years, we plan to meet demands within our direct service area by more heavily using groundwater supplies. Although the exact timing is uncertain, groundwater pumping rates are expected to significantly increase in the long term.

Tacoma Water has thirteen wells in the South Tacoma Aquifer, which provide the majority of our groundwater supply. These wells have water rights totaling 78 million gallons per day (MGD) with a current total installed pumping capacity of approximately 48 MGD. Well 12A is already known to have contamination from the Site, and air stripping towers for treatment of volatile

organic compounds (VOCs) are present at the wellhead. Several other wells are also at risk from the contamination. The number of people receiving drinking water from these wells depends upon operational conditions. It is estimated that drinking water from the South Tacoma Aquifer could be supplied to tens of thousands of people, or more.

Tacoma Water's objective is to be able to operate all groundwater wells to their full water right capacity without impairment from the Site and without required treatment for VOCs. We also require operational flexibility of the South Tacoma wells. Tacoma Water currently follows informal pumping restrictions for two of our most productive wells, 6B and 11A, so that they are not impaired by the contaminant plume from the Site. While this institutional control has been manageable to date, it will prove more challenging to operate in this manner in the future.

Alternative water supply options are limited. The availability of local water supplies, like the South Tacoma wells, is vital to meet both our current peak and emergency demands, as well as our future growth-driven demands. Other local groundwater options are continuously explored, but water rights availability, aquifer production rates, location constraints, or water quality issues tend to minimize prospective options.

The South Tacoma Aquifer is a critical drinking water supply resource for Tacoma Water and must be preserved and protected. If no additional action is taken to control the source contamination, the increased pumping of our drinking water wells in the future will likely pull the plume closer toward them, further endangering the safety of our public water supply. We strongly support EPA's recent efforts at the Site and appreciate EPA's inclusion of Tacoma Water in the planning process. We encourage EPA to move forward with implementing the preferred alternative for the Site so that the South Tacoma groundwater supply will be appropriately protected and fully available for providing safe and reliable drinking water to our customers.

If you require additional information or have any questions, please contact Craig Downs at 253-396-3063.

Response: The EPA appreciates Tacoma Water's position on the Well 12A cleanup. These remedial actions will be implemented as part of the current preferred alternative in this Well 12A ROD Amendment.

List of Acronyms

ARARs	Applicable or Relevant and Appropriate Requirements
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
COC	Contaminant of Concern
CVOCs	Chlorinated Volatile Organic Compounds
DCE	1,2-Dichloroethene
DNAPL	Dense, Non-Aqueous Phase Liquid
EAB	Enhanced Anaerobic Bioremediation
EPA	Environmental Protection Agency
GETS	Groundwater Extraction and Treatment System
gpm	gallons per minute
ICs	Institutional Controls
ITR	In situ Thermal Remediation
ISB	In situ Bioremediation
LNAPL	Light, Non-Aqueous Phase Liquid
MCL	Maximum Contaminant Level
MTCA	Model Toxics Control Act
MNA	Monitored Natural Attenuation
µg/L	micrograms per liter
mg/L	milligrams per liter
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
ORNL	Oak Ridge National Laboratory
OU	Operable Unit
PCA	1,1,2,2-tetrachloroethane
PCE	Tetrachloroethylene
RAO	Remedial Action Objective
RCRA	Resource Recovery and Conservation Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SVE	Soil Vapor Extraction
TCE	Trichloroethylene
VC	Vinyl Chloride
VOCs	Volatile Organic Compounds

FIGURES

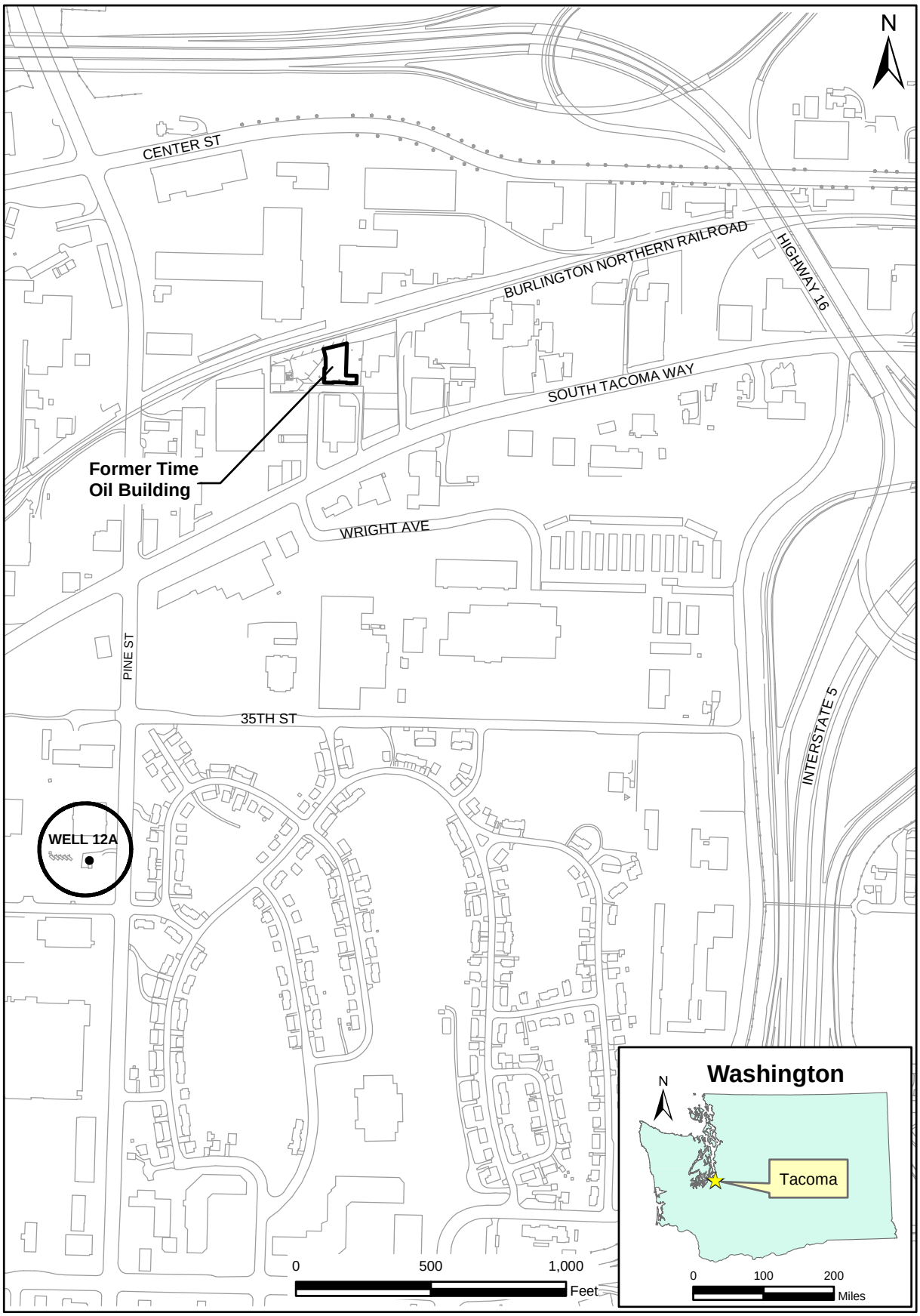

Figure 1
Site Location Map

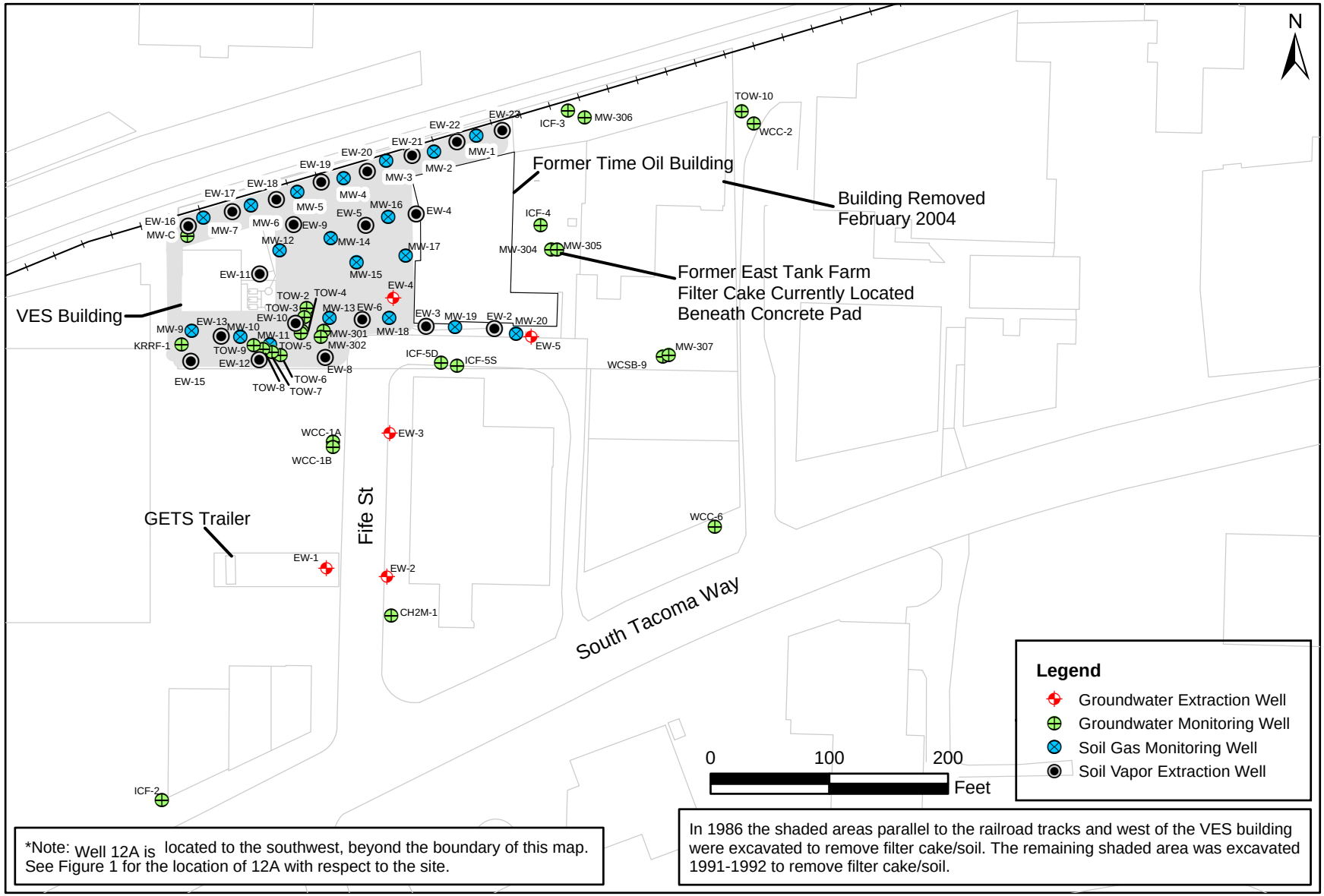

Figure 2
Site Map and Well Locations

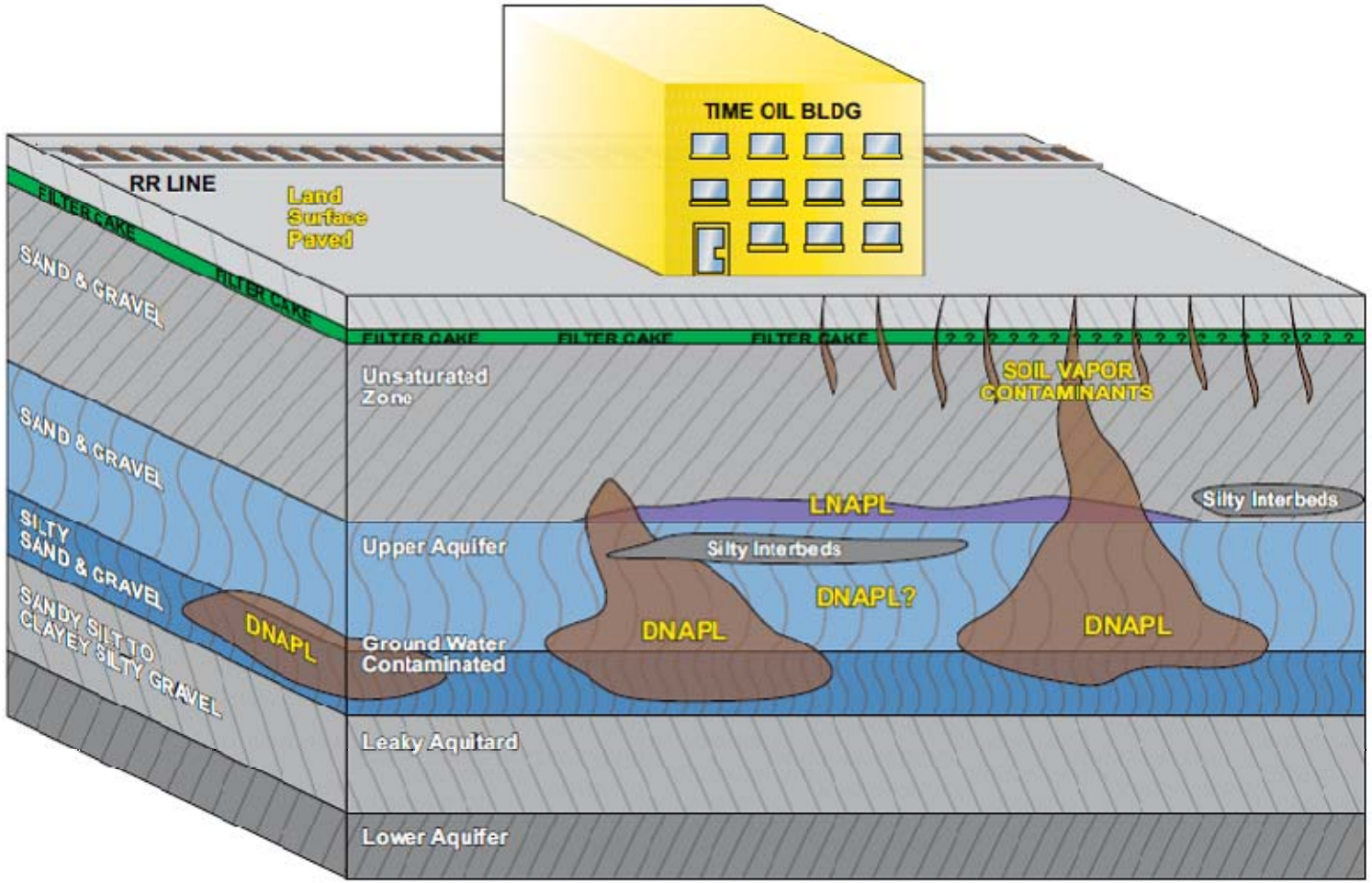

Figure 3
Conceptual Site Model

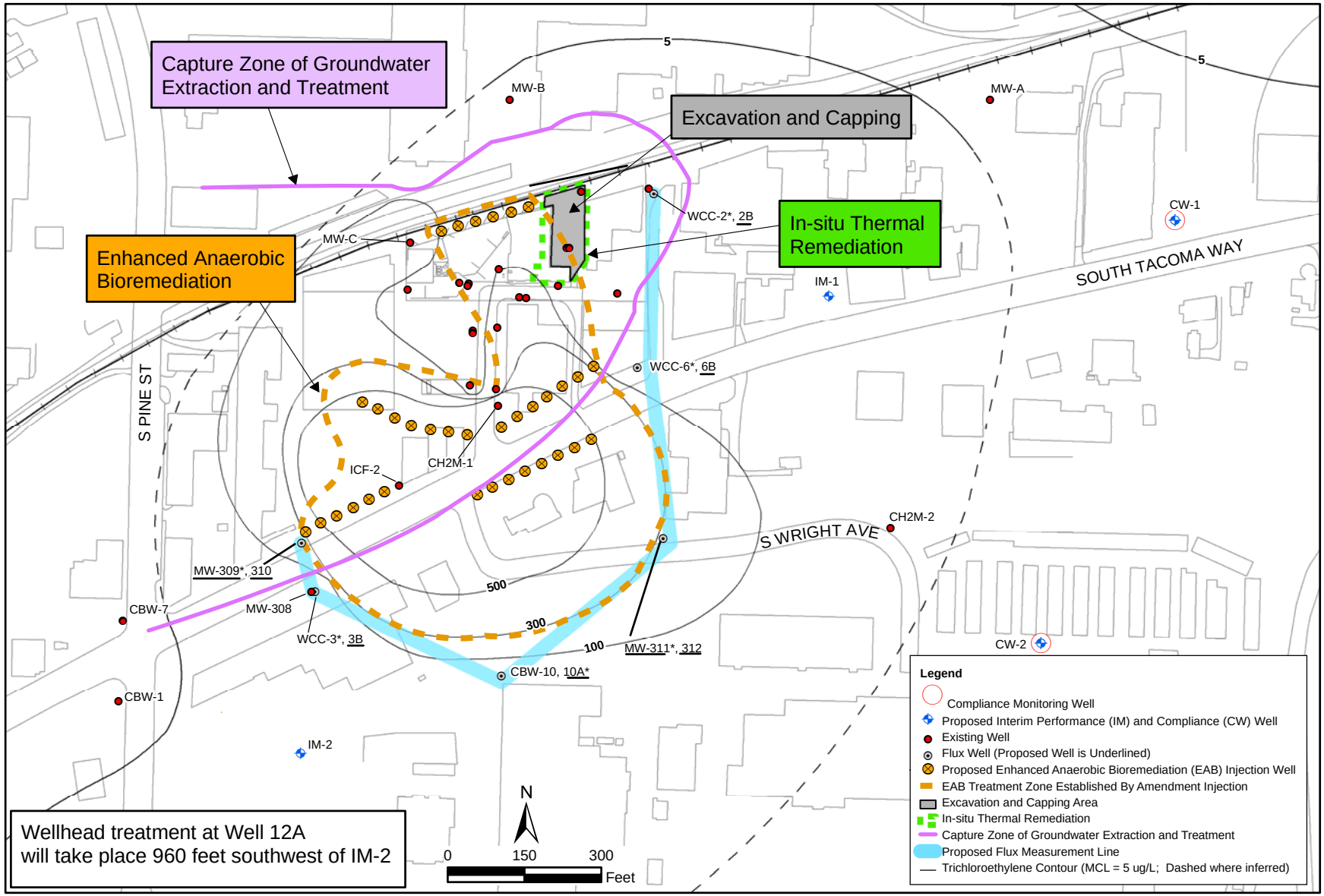

Figure 4
Preferred Alternative