RECEIVED

MAR 05 2012

DEPT OF ECOLOGY
TCP - NWRO

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

In the Matter of Remedial Action by: Fred Meyer Stores, Inc. 1900 SE Sedgewick Road Port Orchard, WA 98366	AGREED ORDER For FINAL CLEANUP ACTION AND COMPLIANCE MONITORING No. DE 9040

TO: **Robert Currey-Wilson**
Vice President
Fred Meyer Stores, Inc.
3800 SE 22nd Ave.
Portland, Oregon 97202

TABLE OF CONTENTS

I. INTRODUCTION

The mutual objective of the State of Washington, Department of Ecology (Ecology) and Fred Meyer Stores, Inc. (Fred Meyer) under this Agreed Order (Order) is to provide for remedial action, and eventually site closure, at a facility where there has been a release or threatened release of hazardous substances. This Order requires Fred Meyer to implement the selected remedy described in the Cleanup Action Plan (CAP) for the Site, which includes ground water quality monitoring and AS/SVE treatment system performance monitoring until cleanup standards have been achieved, and implement a contingency plan in the event the selected cleanup action in the CAP is shown to be ineffective. Ecology believes the actions required by this Order are in the public interest and are necessary to protect human health and the environment.

II. JURISDICTION

This Agreed Order is issued pursuant to the Model Toxics Control Act (MTCA), RCW 70.105D.050(1).

III. PARTIES BOUND

This Agreed Order shall apply to and be binding upon the Parties to this Order, their successors and assigns. The undersigned representative of each party hereby certifies that he or she is fully authorized to enter into this Order and to execute and legally bind such party to comply with this Order. Fred Meyer agrees to undertake all actions required by the terms and conditions of this Order. No change in ownership or corporate status shall alter Fred Meyer's responsibility under this Order. Fred Meyer shall provide a copy of this Order to all agents, contractors, and subcontractors retained to perform work required by this Order, and shall ensure that all work undertaken by such agents, contractors, and subcontractors complies with this Order.

IV. DEFINITIONS

Unless otherwise specified herein, the definitions set forth in Chapter 70.105D RCW and Chapter 173-340 WAC shall control the meanings of the terms in this Order.

A. Site: The Site is referred to as Fred Meyer Property Port Orchard (aka Bethel Texaco, Facility Site ID No. 2614) and is generally located at 1900 SE Sedgewick Road in Port Orchard, Washington 98366. The Site is defined by the extent of contamination caused by the historic release of hazardous substances at the Site. The Site is more particularly described in the Site Diagram (Exhibit A). The Site constitutes a Facility under RCW 70.105D.020(5).

B. Property: Refers to the real property located at 1900 SE Sedgewick Road Port Orchard, Washington. A legal description of the Property is attached as Exhibit B.

C. Parties: Refers to the State of Washington, Department of Ecology and Fred Meyer Stores, Inc.

D. Potentially Liable Person (PLP): Refers to Fred Meyer Stores, Inc.

E. Agreed Order or Order: Refers to this Order and each of the exhibits to this Order. All exhibits are integral and enforceable parts of this Order. The terms "Agreed Order" or "Order" shall include all exhibits to this Order.

V. FINDINGS OF FACT

Ecology makes the following findings of fact, without any express or implied admissions of such facts by Fred Meyer:

A. The Site is located at 1900 SE Sedgewick Road in Port Orchard, Washington. The Property is bounded to the south by the northwest entrance driveway to the Fred Meyer store, to the west by the Bethel Road SE ROW, to the north by the SE Sedgewick Road ROW, and to the east by the Fred Meyer store parking lot. The Site extends from the current Fred Meyer Property to the southwest across Bethel road and includes residential and commercial properties, open fields and wooded areas. Exhibit A depicts the extent of the Site (Exhibit-A).

B. Currently Fred Meyer Stores, Inc. owns the Property and it is a Fred Meyer-branded fueling station facility.

C. In 1990, Ecology determined that the likely source of petroleum hydrocarbon (gasoline) impacts to groundwater and soil at the Site were attributed to an underground storage tank (UST) system release associated with the former Texaco service station located on the

Property. Gasoline-related compounds were detected in private domestic wells located up to approximately 480 feet down-gradient from the Property.

D. In 1992, Ecology entered into a Consent Decree with the then-owner of the Property, B. and C.B. Enterprises, Inc. (Kitsap County Superior Court Cause No. 92-2-015040) ("Consent Decree"). The purpose of the Consent Decree was to remediate the release of hazardous substances at the Bethel former Texaco Site. Remediation work at the Site was to be performed under Ecology's direction. However, Ecology's obligation to implement remedial action at the Site was contingent upon the availability of sufficient funds.

E. The Consent Decree required B. and C.B. Enterprises to provide notice to Ecology prior to transfer of any interest in its Property, and required that any transfer provide for continued performance of B. and C.B. Enterprises' obligations under the Consent Decree.

F. In 1999, after providing prior notice to Ecology of its intent to continue remediation of the Site under a proposed work plan, and after receiving Ecology's determination that the proposed work plan satisfied the Consent Decree's transfer provisions, Fred Meyer purchased the Property. The proposed work plan provided for the completion of the remediation in order to achieve regulatory closure.

G. In April 2011 Ecology notified B. and C.B. Enterprises that, due to the sale of its property at the Site, neither B. and C.B. Enterprises nor Ecology had any further obligations under the Decree. At Ecology's request, B. and C.B. Enterprises provided Ecology with its written agreement and consent to dismissal of the Consent Decree on April 6, 2011. On September 15, 2011, the Kitsap County Superior Court granted Ecology's motion to dismiss the Consent Decree.

H. Interim remedial actions at the Site, prior to the purchase by Fred Meyer, included a light non-aqueous phase liquid (LNAPL) recovery system, an air-sparge/soil-vapor-extraction (AS/SVE) remediation system, an effluent soil vapor treatment unit, and a mechanism to inject hydrogen peroxide into shallow groundwater, all of which were installed and operated by Ecology from July 1995 through April 1998. Active remediation efforts were ceased in 1998.

I. Between 1999 and 2001, the Property was redeveloped as a new Fred Meyer branded fueling station. In 2000, Fred Meyer retained AMEC Earth and Environmental, Inc. (AMEC) to conduct additional Site work. AMEC expanded the AS/SVE network in March 2000. The system was operated between March 2000 and June 2001. Additional monitoring wells were installed during this time to replace damaged or destroyed monitoring wells. The SVE system operated in a limited capacity after June 2001. This was due to damage incurred during expansion of the Bethel Road SE and SE Sedgewick Road Right-Of-Ways adjacent to the Property. The AS groundwater treatment system was inactivated in August 2002 as a result of damages incurred during construction of the Fred Meyer fueling station. In June 2006, further damage to the SVE systems above ground components resulted in the SVE being inactivated. By February 2009, the dual AS/SVE *in-situ* treatment systems had been rebuilt and reactivated by Fred Meyer. Approximately 1,119 lbs of petroleum hydrocarbons are estimated to have been removed from soil and groundwater beneath the Site since March 2000.

J. Numerous groundwater monitoring wells were installed on the Site; six of these wells still remain. Ground water sampling has been conducted on an irregular basis at the Site since June 1990. The ground water samples have been analyzed for total petroleum hydrocarbons-gasoline (TPH-G), TPH-diesel (TPH-D), TPH-Oil (TPH-O), benzene, ethylbenzene, toluene, xylenes (BETX) and dissolved lead. Overall, a decrease in concentrations of TPH-G and BTEX compounds has been observed in groundwater beneath the Site since the activation of the replacement AS/SVE system during March 2000 and subsequent efforts to restore and reactivate the system in 2008/2009. Recent groundwater monitoring results suggest the residual concentrations of TPH-G and BTEX compounds within the plume are generally less than MTCA Method A cleanup levels. However, concentrations of TPH-G and BTEX compounds in excess of the MTCA Method A cleanup levels appear to be present in localized areas within the remaining plume and periodically are detected as evidenced by the recent detections of TPH-G at a concentration of 4,060 μg/l in monitoring well MW-103 (December 2010) and benzene at a concentration of 22.4 μg/l in monitoring well MW-109 (June 2011).

These concentrations exceed the MTCA Method-A cleanup levels of 800 μg/l (TPH-G) and 5 μg/l (benzene). Continued operation of the AS/SVE system is expected to further reduce the residual concentrations of TPH-G and benzene present in groundwater and soil to below MTCA Method A levels.

K. In February 2010, AMEC conducted an investigation for Fred Meyer to evaluate the then-current conditions at the Site. The evaluation included a summary of site investigations, previous remediation efforts, data gaps and additional investigations for the Site. In May 2010 AMEC prepared and submitted a draft Remedial Investigation Report (RI), and a draft Feasibility Study and Cleanup Action Plan (FS/CAP) to Ecology for review and approval. The final approved RI and FS/CAP are attached as Exhibits C and D, respectively.

VI. ECOLOGY DETERMINATIONS

A. Fred Meyer is an "owner or operator" as defined in RCW 70.105D.020(17) of a "facility" as defined in RCW 70.105D.020(5) because it is the current owner of the Site.

B. Based upon all factors known to Ecology, a "release" or "threatened release" of "hazardous substance(s)" as defined in RCW 70.105D.020(25) and RCW 70.105D.020(10), respectively, has occurred at the Site.

C. Based on credible evidence, Ecology determined that Fred Meyer is a PLP based on its current ownership of a facility from which there has been a historic release or threatened release of hazardous substances. By executing this Order, and for the purposes of this Order, Fred Meyer accepts its status as a PLP and voluntarily waives the opportunity for notice and comment as provided in WAC 173-340-500(5) and accepts Ecology's determination that Fred Meyer is a PLP under RCW 70.105D.040.

D. Pursuant to RCW 70.105D.030(1) and -.050(1), Ecology may require PLPs to investigate or conduct other remedial actions with respect to any release or threatened release of hazardous substances, whenever it believes such action to be in the public interest. Based on the foregoing facts, Ecology believes that implementing the CAP, including the potential development of a contingency cleanup action plan, as required by this Order, are in the public interest.

VII. WORK TO BE PERFORMED

Based on the Findings of Fact and Ecology Determinations, it is hereby ordered that Fred Meyer take the following remedial actions at the Site and that these actions be conducted in accordance with Chapter 173-340 WAC unless otherwise specifically provided for herein:

A. Fred Meyer will implement the CAP (Exhibit D), which includes, without limitation, the following:

1. Quarterly ground water quality sampling and analysis of the Site's six compliance monitoring wells (MW-103, MW-105, MW-108A, MW-109, MW-110 and MW-111). The ground water quality sampling and analysis will be submitted to Ecology in Quarterly Reports, which shall be submitted in accordance with Section VIII.H (Progress Reports).
2. Operation of the AS/SVE system on an intermittent or continuous basis until a minimum of four consecutive quarters of TPH-G and BTEX concentrations below MTCA Method A cleanup levels are achieved in all six Site monitoring wells (including source area wells MW-103, MW-109 and MW-110).
3. The subsurface remediation systems will be monitored quarterly for performance to demonstrate that mass removal is occurring at the site and cleanup objectives are being achieved through mass removal.

B. If performance monitoring indicates that the AS/SVE system is no longer effective and current ground water sampling indicates that no further progress toward achieving cleanup standards is being made, or if groundwater cleanup standards have not been achieved within three (3) years from the effective date of this Order, then within ninety (90) days Fred Meyer will prepare, for review and approval by Ecology, an assessment of whether additional *in-situ* treatment wells and/or approaches are required to achieve MTCA Method A cleanup standards in source area soil and groundwater within a reasonable restoration timeframe.

C. If, based on the assessment described in Section VII.B, Ecology concludes that additional remedial action is required, then Fred Meyer will develop a contingency plan within ninety (90) days of Ecology's determination. The contingency plan will identify alternative cleanup actions that can be implemented to achieve MTCA Method A cleanup standards in source area soil and groundwater. If required, the contingency plan will include an evaluation of each alternative to meet cleanup standards within a reasonable restoration time frame.

D. Within ninety (90) days of achieving the confirmation monitoring objectives identified in Section 6.2.3 of the CAP (Exhibit D), Fred Meyer will document all observations, conditions and results related to its implementation of the CAP in a final report with at least four copies, one for Fred Meyer and three for Ecology.

VIII. TERMS AND CONDITIONS OF ORDER

A. Public Notice

RCW 70.105D.030(2)(a) requires that, at a minimum, this Order be subject to concurrent public notice. Ecology shall be responsible for providing such public notice and reserves the right to modify or withdraw any provisions of this Order should public comment disclose facts or considerations which indicate to Ecology that this Order is inadequate or improper in any respect.

B. Remedial Action Costs

Fred Meyer shall pay to Ecology costs incurred by Ecology pursuant to this Order and consistent with WAC 173-340-550(2). These costs shall include work performed by Ecology or its contractors for, or on, the Site under Chapter 70.105D RCW, including remedial actions and Order preparation, negotiation, oversight, and administration. These costs shall include work performed both prior to and subsequent to the issuance of this Order. Ecology's costs shall include costs of direct activities and support costs of direct activities as defined in WAC 173-340-550(2). Ecology has accumulated $2,028.26 in remedial action costs related to this Site as of December 31, 2011, an itemized statement of which has been provided to Fred Meyer. Payment for this amount shall be submitted within thirty (30) days of the effective date of this

Order. For all costs incurred subsequent to December 31, 2011, Fred Meyer shall pay the required amount within ninety (90) days of receiving from Ecology an itemized statement of costs that includes a summary of costs incurred, an identification of involved staff, and the amount of time spent by involved staff members on the project. A general statement of work performed will be provided upon request. Itemized statements shall be prepared quarterly. Pursuant to WAC 173-340-550(4), failure to pay Ecology's costs within ninety (90) days of receipt of the itemized statement of costs will result in interest charges at the rate of twelve percent (12%) per annum, compounded monthly.

In addition to other available relief, pursuant to RCW 19.16.500, Ecology may utilize a collection agency and/or, pursuant to RCW 70.105D.055, file a lien against real property subject to the remedial actions to recover unreimbursed remedial action costs.

C. Implementation of Remedial Action

If Ecology determines that Fred Meyer has failed without good cause to implement the remedial action as provided in the CAP, in whole or in part, Ecology may, after notice to Fred Meyer, and reasonable opportunity to cure, perform any or all portions of the remedial action that remain incomplete. If Ecology performs all or portions of the remedial action because of Fred Meyer's failure to comply with its obligations under this Order, Fred Meyer shall reimburse Ecology for the costs of doing such work in accordance with Section VIII.B (Remedial Action Costs), provided that Fred Meyer is not obligated under this Section to reimburse Ecology for costs incurred for work inconsistent with or beyond the scope of this Order.

Except where necessary to abate an emergency situation, Fred Meyer shall not perform any remedial actions at the Site outside those remedial actions required by this Order, unless Ecology concurs, in writing, with such additional remedial actions.

D. Designated Project Coordinators

The project coordinator for Ecology is:

Russ Olsen
Toxics Cleanup Program
3190 160th Ave SE
Bellevue, WA 98008
(425) 649-7038

E-mail: rols461@ecy.wa.gov

The project coordinator for Fred Meyer is:
Kurt Harrington
AMEC Earth & Environmental, Inc.
7376 SW Durham Rd
Portland OR 97224
(503) 639-3400
E-Mail: kurt.harrington@amec.com

Each project coordinator shall be responsible for overseeing the implementation of this Order. Ecology's project coordinator will be Ecology's designated representative for the Site. To the maximum extent possible, communications between Ecology and Fred Meyer, and all documents, including reports, approvals, and other correspondence concerning the activities performed pursuant to the terms and conditions of this Order shall be directed through the project coordinators. The project coordinators may designate, in writing, working level staff contacts for all or portions of the implementation of the work to be performed under this Order.

Any party may change its respective project coordinator. Written notification shall be given to the other party at least ten (10) calendar days prior to the change.

E. Performance

All geologic and hydrogeologic work performed pursuant to this Order shall be under the supervision and direction of a geologist licensed in the State of Washington or under the direct supervision of an engineer registered in the State of Washington, except as otherwise provided for by Chapters 18.220 and 18.43 RCW.

All engineering work performed pursuant to this Order shall be under the direct supervision of a professional engineer registered in the State of Washington, except as otherwise provided for by RCW 18.43.130.

All construction work performed pursuant to this Order shall be under the direct supervision of a professional engineer or a qualified technician under the direct supervision of a professional engineer. The professional engineer must be registered in the State of Washington, except as otherwise provided for by RCW 18.43.130.

Any documents submitted containing geologic, hydrologic or engineering work shall be under the seal of an appropriately licensed professional as required by Chapter 18.220 RCW or RCW 18.43.130.

Fred Meyer shall notify Ecology in writing of the identity of any supervising engineer(s) and geologist(s), contractor(s) and subcontractor(s), and others to be used in carrying out the terms of this Order, in advance of their involvement at the Site.

F. Access

Ecology or any Ecology authorized representative shall have the full authority to enter and freely move about all property at the Site that Fred Meyer either owns, controls, or has access rights to at all reasonable times for the purposes of, *inter alia*: inspecting records, operation logs, and contracts related to the work being performed pursuant to this Order; reviewing Fred Meyer's progress in carrying out the terms of this Order; conducting such tests or collecting such samples as Ecology may deem necessary; using a camera, sound recording, or other documentary type equipment to record work done pursuant to this Order; and verifying the data submitted to Ecology by Fred Meyer. Fred Meyer shall make all reasonable efforts to secure access rights for those properties within the Site not owned or controlled by Fred Meyer where remedial activities or investigations will be performed pursuant to this Order. Ecology or any Ecology authorized representative shall give at least 48 hours' notice before entering any Site property owned or controlled by Fred Meyer unless an emergency prevents such notice, and shall allow a Fred Meyer representative to accompany Ecology or its authorized representatives while on the Property. All persons who access the Site pursuant to this Section shall comply with any applicable Health and Safety Plan(s). Ecology employees and their representatives shall not be required to sign any liability release or waiver as a condition of Site property access.

G. Sampling, Data Submittal, and Availability

With respect to the implementation of this Order, Fred Meyer shall make the results of all sampling, laboratory reports, and/or test results generated by it or on its behalf available to Ecology. Pursuant to WAC 173-340-840(5), all sampling data shall be submitted to Ecology in both printed and electronic formats in accordance with Section VII (Work to be Performed), Ecology's Toxics Cleanup Program Policy 840 (Data Submittal Requirements), and/or any subsequent procedures specified by Ecology for data submittal.

If requested by Ecology, Fred Meyer shall allow Ecology and/or its authorized representative to take split or duplicate samples of any samples collected by Fred Meyer pursuant to implementation of this Order. Fred Meyer shall notify Ecology seven (7) days in advance of any sample collection or work activity at the Site. Ecology shall, upon request, allow Fred Meyer and/or its authorized representative to take split or duplicate samples of any samples collected by Ecology pursuant to the implementation of this Order, provided that doing so does not interfere with Ecology's sampling. Without limitation on Ecology's rights under Section VIII.F (Access), Ecology shall notify Fred Meyer seven (7) days in advance of any sample collection activity unless an emergency prevents such notice.

In accordance with WAC 173-340-830(2)(a), all hazardous substance analyses shall be conducted by a laboratory accredited under Chapter 173-50 WAC for the specific analyses to be conducted, unless otherwise approved by Ecology.

H. Progress Reports

Fred Meyer shall submit to Ecology written Progress Reports describing the actions taken during the previous reporting period to implement the requirements of this Order on a quarterly basis, as specified in Section VII.A.1 and the CAP (Exhibit D). The Progress Reports shall include the following:

1. A list of on-site activities that have taken place during the reporting period;
2. Detailed description of any deviations from required tasks not otherwise documented in project plans or amendment requests;
3. Description of all deviations from the CAP (Exhibit D) during the current reporting period and any planned deviations in the upcoming reporting period;
4. For any deviations in schedule, a plan for recovering lost time and maintaining compliance with the schedule;
5. All raw data (including laboratory analyses) received by Fred Meyer during the past reporting period will be entered into Ecology's EIM data system with required identification of the source of the sample; and

6. A list of deliverables for the upcoming reporting period if different from the schedule.

All Progress Reports shall be submitted no later than forty-five (45) days after quarterly laboratory results are finalized. Unless otherwise specified, Progress Reports and any other documents submitted pursuant to this Decree shall send two hard copies by US mail and one electronic copy to Ecology's project coordinator.

I. Public Participation

A Public Participation Plan is required for this Site. Ecology shall review any existing Public Participation Plan to determine its continued appropriateness and whether it requires amendment, or if no plan exists, Ecology shall develop a Public Participation Plan alone or in conjunction with Fred Meyer.

Ecology shall maintain the responsibility for public participation at the Site. However, Fred Meyer shall cooperate with Ecology, and shall:

1. If agreed to by Ecology, develop appropriate mailing list, prepare drafts of public notices and fact sheets at important stages of the remedial action, such as the submission of work plans, remedial investigation/feasibility study reports, cleanup action plans, and engineering design reports. As appropriate, Ecology will edit, finalize, and distribute such fact sheets and prepare and distribute public notices of Ecology's presentations and meetings.

2. Notify Ecology's project coordinator prior to the preparation of all press releases and fact sheets, and before major meetings with the interested public and local governments. Likewise, Ecology shall notify Fred Meyer prior to the issuance of all press releases and fact sheets, and before major meetings with the interested public and local governments. For all press releases, fact sheets, meetings, and other outreach efforts by Fred Meyer that do not receive prior Ecology approval, Fred Meyer shall clearly indicate to its audience that the press release, fact sheet, meeting, or other outreach effort was not sponsored or endorsed by Ecology.

3. When requested by Ecology, participate in public presentations on the progress of the remedial action at the Site. Participation may be through attendance at public meetings to assist in answering questions or as a presenter.

4. When requested by Ecology, arrange and/or continue information repositories to be located at the following locations:

a. Kitsap Regional Library
Port Orchard Library Branch
87 Sidney Ave
Port Orchard, WA 98366

b. Washington Department of Ecology
Northwest Regional Office
Toxics Cleanup Program
3190 160th Ave SE
Bellevue, WA 98008

At a minimum, copies of all public notices, fact sheets, and documents relating to public comment periods shall be promptly placed in these repositories. A copy of all documents related to this site shall be maintained in the repository at Ecology's Northwest Regional Office in Bellevue, Washington.

J. Retention of Records

During the pendency of this Order, and for ten (10) years from the date of completion of work performed pursuant to this Order, Fred Meyer shall preserve all records, reports, documents, and underlying data in its possession relevant to the implementation of this Order and shall insert a similar record retention requirement into all contracts with project contractors and subcontractors. Upon request of Ecology, Fred Meyer shall make all records available to Ecology and allow access for review within a reasonable time.

K. Resolution of Disputes

1. In the event a dispute arises as to an approval, disapproval, proposed change, or other decision or action by Ecology's project coordinator, or an itemized billing statement under Section VIII.B (Remedial Action Costs), the Parties shall utilize the dispute resolution procedure set forth below.

a. Upon receipt of Ecology's project coordinator's written decision or the itemized billing statement, Fred Meyer has fourteen (14) days within which to notify Ecology's project coordinator in writing of its objection to the decision or itemized statement.

b. The Parties' project coordinators shall then confer in an effort to resolve the dispute. If the project coordinators cannot resolve the dispute within fourteen (14) days, Ecology's project coordinator shall issue a written decision.

c. Fred Meyer may then request regional management review of the decision. This request shall be submitted in writing to the Northwest Region Toxics Cleanup Section Manager within seven (7) days of receipt of Ecology's project coordinator's written decision.

d. The Section Manager shall conduct a review of the dispute and shall endeavor to issue a written decision regarding the dispute within thirty (30) days of Fred Meyer's request for review. The Section Manager's decision shall be Ecology's final decision on the disputed matter.

2. The Parties agree to only utilize the dispute resolution process in good faith and agree to expedite, to the extent possible, the dispute resolution process whenever it is used.

3. Implementation of these dispute resolution procedures shall not provide a basis for delay of any activities required in this Order, unless Ecology agrees in writing to a schedule extension.

L. Extension of Schedule

1. An extension of schedule shall be granted only when a request for an extension is submitted in a timely fashion, generally at least thirty (30) days prior to expiration of the deadline for which the extension is requested, and good cause exists for granting the extension. All extensions shall be requested in writing. The request shall specify:

a. The deadline that is sought to be extended;

b. The length of the extension sought;

c. The reason(s) for the extension; and

d. Any related deadline or schedule that would be affected if the extension were granted.

2. The burden shall be on Fred Meyer to demonstrate to the satisfaction of Ecology that the request for such extension has been submitted in a timely fashion and that good cause exists for granting the extension. Good cause may include, but may not be limited to:

a. Circumstances beyond the reasonable control and despite the due diligence of Fred Meyer including delays caused by unrelated third parties or Ecology, such as (but not limited to) delays by Ecology in reviewing, approving, or modifying documents submitted by Fred Meyer;

b. Acts of God, including fire, flood, blizzard, extreme temperatures, storm, or other unavoidable casualty; or

c. Endangerment as described in Section VIII.N (Endangerment).

However, neither increased costs of performance of the terms of this Order nor changed economic circumstances shall be considered circumstances beyond the reasonable control of Fred Meyer.

3. Ecology shall act upon any written request for extension in a timely fashion. Ecology shall give Fred Meyer written notification of any extensions granted pursuant to this Order. A requested extension shall not be effective until approved by Ecology. Unless the extension is a substantial change, it shall not be necessary to amend this Order pursuant to Section VIII.M (Amendment of Order) when a schedule extension is granted.

4. An extension shall only be granted for such period of time as Ecology determines is reasonable under the circumstances. Ecology may grant schedule extensions exceeding ninety (90) days only as a result of:

a. Delays in the issuance of a necessary permit which was applied for in a timely manner;

b. Other circumstances deemed exceptional or extraordinary by Ecology; or

c. Endangerment as described in Section VIII.N (Endangerment).

M. Amendment of Order

The project coordinators may verbally agree to minor changes to the work to be performed without formally amending this Order. Minor changes will be documented in writing by Ecology within seven (7) days of verbal agreement.

Except as provided in Section VIII.O (Reservation of Rights), substantial changes to the work to be performed shall require formal amendment of this Order. This Order may only be formally amended by the written consent of both Ecology and Fred Meyer. Fred Meyer shall submit a written request for amendment to Ecology for approval. Ecology shall indicate its approval or disapproval in writing and in a timely manner after the written request for amendment is received. If the amendment to this Order represents a substantial change, Ecology will provide public notice and opportunity to comment. Reasons for the disapproval of a proposed amendment to this Order shall be stated in writing. If Ecology does not agree to a proposed amendment, the disagreement may be addressed through the dispute resolution procedures described in Section VIII.K (Resolution of Disputes).

N. Endangerment

In the event Ecology determines that any activity being performed at the Site is creating or has the potential to create a danger to human health or the environment on or surrounding the Site, Ecology may direct Fred Meyer to cease such activities for such period of time as it deems necessary to abate the danger. Fred Meyer shall immediately comply with such direction.

In the event Fred Meyer determines that any activity being performed at the Site is creating or has the potential to create a danger to human health or the environment, Fred Meyer may cease such activities. Fred Meyer shall notify Ecology's project coordinator as soon as possible, but no later than twenty-four (24) hours after making such determination or ceasing such activities. Upon Ecology's direction Fred Meyer shall provide Ecology with documentation of the basis for the determination or cessation of such activities. If Ecology disagrees with Fred Meyer's cessation of activities, it may direct Fred Meyer to resume such activities.

If Ecology concurs with or orders a work stoppage pursuant to Section VIII.N (Endangerment), Fred Meyer's obligations with respect to the ceased activities shall be suspended until Ecology determines the danger is abated, and the time for performance of such activities, as well as the time for any other work dependent upon such activities, shall be extended in accordance with Section VIII.L (Extension of Schedule) for such period of time as Ecology determines is reasonable under the circumstances.

Nothing in this Order shall limit the authority of Ecology, its employees, agents, or contractors to take or require appropriate action in the event of an emergency.

O. Reservation of Rights

This Order is not a settlement under Chapter 70.105D RCW. Ecology's signature on this Order in no way constitutes a covenant not to sue or a compromise of any of Ecology's rights or authority. Ecology will not, however, bring an action against Fred Meyer to recover remedial action costs paid to and received by Ecology under this Order. In addition, Ecology will not take additional enforcement actions against Fred Meyer regarding remedial actions required by this Order, provided Fred Meyer complies with this Order.

Ecology nevertheless reserves its rights under Chapter 70.105D RCW, including the right to require additional or different remedial actions at the Site should it deem such actions necessary to protect human health and the environment, and to issue orders requiring such remedial actions. Ecology also reserves all rights regarding the injury to, destruction of, or loss of natural resources resulting from the release or threatened release of hazardous substances at the Site.

P. Transfer of Interest in Property

No voluntary conveyance or relinquishment of title, easement, leasehold, or other interest in any portion of the Property shall be consummated by Fred Meyer without provision for continued implementation of all requirements of this Order and implementation of any remedial actions found to be necessary as a result of this Order.

Prior to Fred Meyer's transfer of any interest in all or any portion of the Property, and during the effective period of this Order, Fred Meyer shall provide a copy of this Order to any prospective purchaser, lessee, transferee, assignee, or other successor in said interest; and, at least thirty (30) days prior to any transfer, Fred Meyer shall notify Ecology of said transfer. Upon transfer of any interest, Fred Meyer shall restrict uses and activities to those consistent with this Order and notify all transferees of the restrictions on the use of the Property.

Q. Compliance with Applicable Laws

1. All actions carried out by Fred Meyer pursuant to this Order shall be done in accordance with all applicable federal, state, and local requirements, including requirements to obtain necessary permits, except as provided in RCW 70.105D.090. The permits or specific federal, state or local requirements that the agency has determined are applicable and that are known at the time of entry of this Order have been identified in Section 3.6 of the CAP, attached as Exhibit D.

2. Pursuant to RCW 70.105D.090(1), Fred Meyer is exempt from the procedural requirements of Chapters 70.94, 70.95, 70.105, 77.55, 90.48, and 90.58 RCW and of any laws requiring or authorizing local government permits or approvals. However, Fred Meyer shall comply with the substantive requirements of such permits or approvals. The exempt permits or approvals and the applicable substantive requirements of those permits or approvals, as they are known at the time of entry of this Order, have been identified in Section 3.6 of the CAP, attached as Exhibit D.

Fred Meyer has a continuing obligation to determine whether additional permits or approvals addressed in RCW 70.105D.090(1) would otherwise be required for the remedial action under this Order. In the event either Ecology or Fred Meyer determines that additional permits or approvals addressed in RCW 70.105D.090(1) would otherwise be required for the remedial action under this Order, it shall promptly notify the other party of its determination. Ecology shall determine whether Ecology or Fred Meyer shall be responsible to contact the appropriate state and/or local agencies. If Ecology so requires, Fred Meyer shall promptly consult with the appropriate state and/or local agencies and provide Ecology with written documentation from those agencies of the substantive requirements those agencies believe are applicable to the remedial action. Ecology shall make the final determination on the additional substantive requirements that must be met by Fred Meyer and on how Fred Meyer must meet those requirements. Ecology shall inform Fred Meyer in writing of these requirements. Once established by Ecology, the additional requirements shall be enforceable requirements of this Order. Fred Meyer shall not begin or continue the remedial action potentially subject to the additional requirements until Ecology makes its final determination.

3. Pursuant to RCW 70.105D.090(2), in the event Ecology determines that the exemption from complying with the procedural requirements of the laws referenced in RCW 70.105D.090(1) would result in the loss of approval from a federal agency that is necessary for the State to administer any federal law, the exemption shall not apply and Fred Meyer shall comply with both the procedural and substantive requirements of the laws referenced in RCW 70.105D.090(1), including any requirements to obtain permits.

R. Indemnification

Fred Meyer agrees to indemnify and save and hold the State of Washington, its employees, and agents harmless from any and all claims or causes of action for death or injuries to persons or for loss or damage to property to the extent arising from or on account of acts or omissions of Fred Meyer, its officers, employees, agents, or contractors in entering into and implementing this Order. However, Fred Meyer shall not indemnify the State of Washington nor save nor hold its employees and agents harmless from any claims or causes of action to the extent arising out of the negligent acts or omissions of the State of Washington, or the employees or agents of the State, in entering into or implementing this Order.

IX. SATISFACTION OF ORDER

The provisions of this Order shall be deemed satisfied upon Fred Meyer's receipt of written notification from Ecology that Fred Meyer has completed the remedial activity required by this Order, as amended by any modifications, and that Fred Meyer has complied with all other provisions of this Agreed Order.

X. ENFORCEMENT

Pursuant to RCW 70.105D.050, this Order may be enforced as follows:

A. The Attorney General may bring an action to enforce this Order in a state or federal court.

B. The Attorney General may seek, by filing an action, if necessary, to recover amounts spent by Ecology for investigative and remedial actions and orders related to the Site.

C. In the event Fred Meyer refuses, without sufficient cause, to comply with any term of this Order, Fred Meyer will be liable for:

1. Up to three (3) times the amount of any costs incurred by the State of Washington as a result of its refusal to comply; and

2. Civil penalties of up to twenty-five thousand dollars ($25,000) per day for each day it refuses to comply.

D. This Order is not appealable to the Washington Pollution Control Hearings Board. This Order may be reviewed only as provided under RCW 70.105D.060.

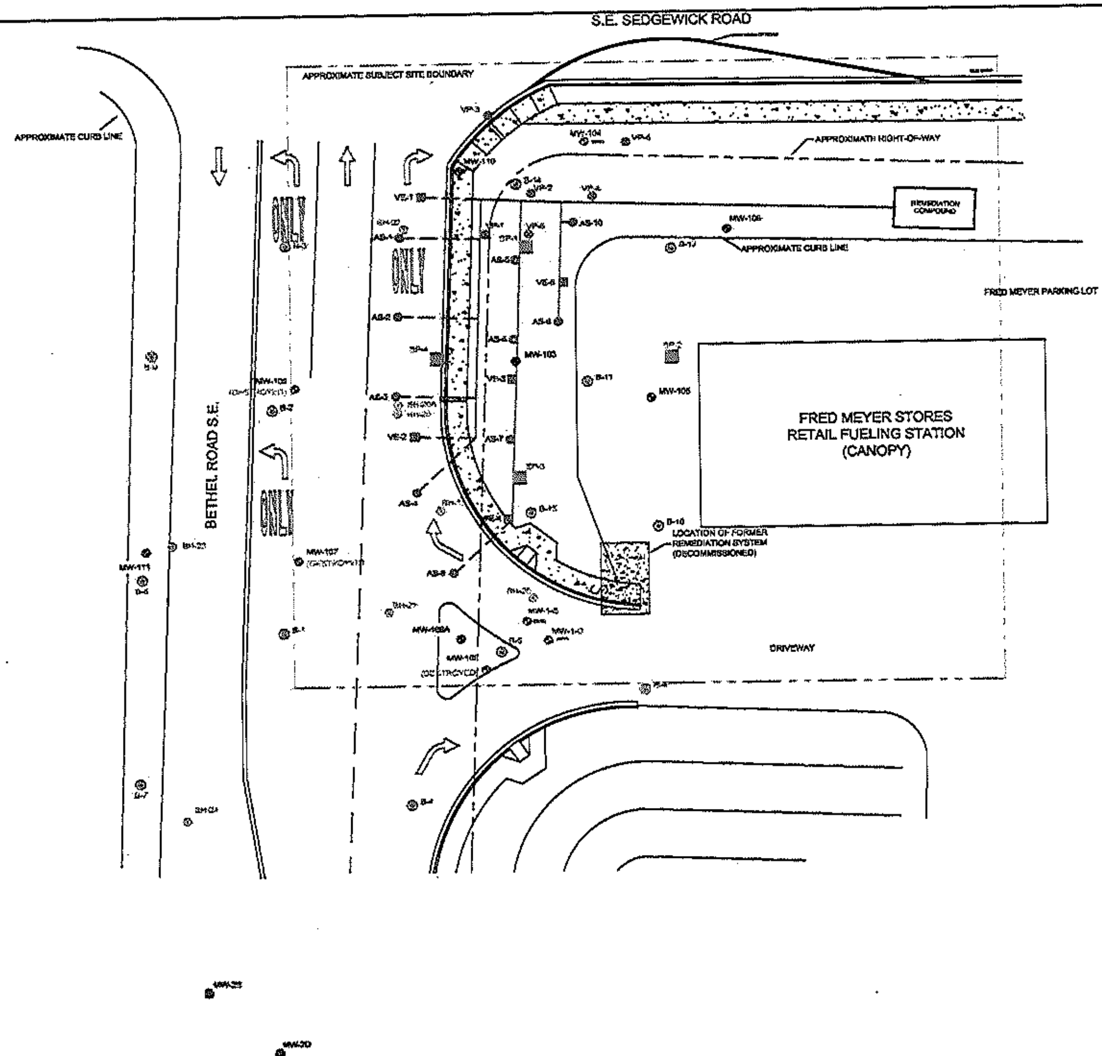
Effective date of this Order: 5/10/12

Fred Meyer Stores, Inc.

Robert Currey-Wilson
Vice President
Portland, Oregon

STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY

Robert W. Warren, P.Hg, MBA
Section Manager
Toxics Cleanup Program
Northwest Regional Office



LEGEND

AS-10	AIR SPARGING WELL NUMBER AND APPROXIMATE LOCATION
VE-6	VAPOR EXTRACTION WELL NUMBER AND APPROXIMATE LOCATION
MW-103	4" PVC MONITORING WELL NUMBER AND LOCATION. MW-103 AND MW-104 BY ECOLOGY, 1991, ALL OTHERS BY AGRA, NOVEMBER, 1999. MW-104, MW-1-S AND MW-1-D DESTROYED IN 1999/200. MW-106, MW-107, AND MW-108 DESTROYED IN 2001.
MW-110	MONITORING WELL INSTALLED 2008
MW-108A	REPLACEMENT MONITORING WELL
(DEC)	WELL DECOMMISSIONED
B-12	AUGUST 2008 GEOPROBE BORING
BH-20	STRATO PROBE BORING NUMBER AND LOCATION OF TEMPORARY 3/4" VAPOR TEST WELL VP BORINGS BY AGRA JULY 28, 1999 (APPROXIMATE LOCATION)
VP-6	STRATO PROBE BORING NUMBER AND LOCATION. BH-15 IS BY GN NORTHERN ON JANUARY 22, 1999. ALL OTHER BORINGS BY AGRA ON JULY 27, 28 AND 29, 1999. (APPROXIMATE LOCATION)
SP-7	SPARGING WELL, 1995 (APPROXIMATE LOCATION)
MW-20	MONITORING WELL, 1991 (APPROXIMATE LOCATION)
———	REMEDIATION SYSTEM TRENCH
— — —	ANGLED WELL LOCATION
— - - —	APPROXIMATE SITE BOUNDARY

0' 12.5' 25' 37.5'
1" = 25'

SOURCE: AHBL CIVIL AND STRUCTURAL ENGINEERS,
FILE NAME: 98169-B.dwg.
HISTORIC WELL LOCATIONS ARE APPROXIMATE AND ARE FOR ILLUSTRATIVE PURPOSES ONLY.

CLIENT: FRED MEYER STORES, INC.

AMEC Earth & Environmental
7376 S.W. Durham Road
Portland, OR. U.S.A. 97224

DWN BY: DD/LR
CHK'D BY: DS/DMF
DATUM: -
PROJECTION: -
SCALE: 1"=25'

PROJECT: PORT ORCHARD

TITLE: SITE PLAN AND SITE FEATURES

DATE: APRIL 2010
PROJECT NO: 9-61M-10282-0
REV. NO.: -
FIGURE No. FIGURE 2

K:\10000\10200\10282\CAP\DWGs\Fig 2 – Site_Plan_and_Site_Features.dwg – – – Apr. 28, 2010 2:53pm – brian.johnson

Exhibit B

Legal Description of Property

Tax Account No.
122301-2-091-2000

RESULTANT PARCEL E OF BOUNDARY LINE ADJUSTMENT RECORDED UNDER AUDITORS FILE NO. 3200204 DESCRIBED AS THAT PORTION OF THE NORTHWEST QUARTER OF THE NORTHWEST QUARTER OF SECTION 12, TOWNSHIP 23 NORTH, RANGE 1 EAST, WILLAMETTE MERIDIAN, IN KITSAP COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS: BEGINNING AT A POINT ON THE EAST LINE OF THE WEST 220.00 FEET OF SAID NORTHWEST QUARTER, 55.00 FEET DISTANT SOUTHERLY FROM THE NORTH LINE OF SAID NORTHWEST QUARTER; THENCE ALONG SAID EAST LINE SOUTH 02°18'00 WEST, 143.00 FEET TO THE SOUTH LINE OF THE NORTH 198.00 FEET OF SAID NORTHWEST QUARTER; THENCE ALONG SAID SOUTH LINE, NORTH 88°04'42 WEST, 175.00 FEET TO THE EAST LINE OF THE WEST 45.00 FEET OF SAID NORTHWEST QUARTER; THENCE ALONG SAID EAST LINE NORTH 02°18'00 EAST, 118.16 FEET TO THE BEGINNING OF A CURVE TO THE RIGHT, HAVING A RADIUS OF 25.00 FEET; THENCE ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 89°37'18 , AN ARC LENGTH OF 39.10 FEET TO THE SOUTH LINE OF THE NORTH 55.00 FEET OF SAID NORTHWEST QUARTER; THENCE ALONG SAID SOUTH LINE SOUTH 88°04'42 EAST, 150.16 FEET TO THE POINT OF BEGINNING. >> SUBJECT TO EASEMENTS, RESTRICTIONS. RESERVATIONS, AND COVENANTS OF RECORD.

EXHIBIT C. Remedial Investigation Report (Ecology, 2011)
Bethel Texaco, 1900 SE Sedgwick Road
Port Orchard, Washington
FSID 2614

DEPARTMENT OF
ECOLOGY
State of Washington

REMEDIAL INVESTIGATION REPORT

Bethel Texaco
1900 SE Sedgwick Road
Port Orchard, Washington
FSID 2614

May 2011

Publication and Contact Information

For more information contact:

Russ Olsen
Toxics Cleanup Program
3190 160th Ave SE
Bellevue, WA 98008
(425) 649-7038
E-mail: rols461@ecy.wa.gov

REMEDIAL INVESTIGATION REPORT

Bethel Texaco
1900 SE Sedgwick Road
Port Orchard, Washington
FSID 2614

Toxics Cleanup Program
Washington State Department of Ecology
3190 160th Ave SE
Bellevue, WA 98008

Table of Contents

List of Tables

List of Figures

List of Appendices

1.0 INTRODUCTION

This Remedial Investigation (RI) Report summarizes work performed by Fred Meyer Stores, Inc. (Fred Meyer) and others at the Fred Meyer Property Port Orchard service station located at 1900 SE Sedgwick Road in Port Orchard, Washington (Site), shown in Figure 1.

1.1 Site Background

Site investigation and remediation efforts have been conducted since June 1990 to address gasoline-impacted soil and groundwater present at the site. Efforts were prompted by a discovery in 1990 revealing gasoline-range petroleum hydrocarbon impacts in downgradient domestic drinking water wells located west and southwest of the property across Bethel Road S.E. Impacts are attributed to a leaking underground storage tank (UST) operated by Texaco, who previously owned the property (AMEC, 2009b). Benzene, toluene, ethylbenzene, and xylene (BTEX) and gasoline-range organics (GRO) concentrations in soil and groundwater samples collected from the site historically have exceeded Ecology's Model Toxics Control Act (MTCA) Method A cleanup levels (AMEC, 2005a).

An onsite remediation system including a light non-aqueous phase liquid (LNAPL) recovery system, an air-sparge/soil-vapor-extraction (AS/SVE) remediation system, an effluent soil vapor treatment unit, and a mechanism to inject hydrogen peroxide into shallow groundwater were installed and operated by Ecology from July 1995 through April 1998. Active remediation efforts were ceased once recoverable LNAPL was removed and the lateral extent of gasoline-impacted groundwater was limited to within the property boundaries (AMEC, 2009b).

Fred Meyer purchased the property in 1999 following Phase I and Phase II Environmental Site Assessments (ESAs) performed by GN Northern, Inc. of Kirkland, WA (GN, 1998; GN, 1999). Between 1999 and 2001, the property was redeveloped with a new Fred Meyer branded fueling station (referred to on construction documents as Pad C). Fred Meyer retained AMEC in 2000 to conduct additional site characterization, indicating gasoline-impacted groundwater was still present beneath the western margins of the property and extended off property within the adjacent Bethel Road SE right-of-way (ROW). AMEC expanded the AS/SVE network in March 2000. The system was operated nearly continuously between March 2000 and June 2001. Additional monitoring wells were installed during this time to replace damaged or destroyed monitoring wells. The AS groundwater treatment system was inactivated in August 2002 as a result of damages incurred during construction of the Fred Meyer fueling station. The SVE system was operated at limited capacity after damage around June 2001 during expansion of the Bethel Road SE and SE Sedgwick Road ROWs adjacent to the property. During June 2006, further damage to the SVE system's above ground components resulted in the SVE being inactivated. By February 2009, the dual AS/SVE *in-situ* treatment systems had been rebuilt and reactivated. Quarterly groundwater monitoring has been conducted at site wells since 2001 (AMEC, 2009b).

Fourth Quarter 2009 groundwater monitoring results indicated GRO detections of 1,320 micrograms per liter (µg/L) in monitoring well MW-103, exceeding the MTCA Method A cleanup level of 800 µg/L. Constituents including ethylbenzene, total xylenes, isopropylbenzene, n-propylbenzene, 1,2,4-trimethylbenzene, 1,35-trimethylbenzene, 4-isopropyltoluene, and n-butylbenzene were detected in groundwater samples collected from site wells (AMEC, 2010b).

1.2 Remedial Investigation Objectives

Previous site investigations conducted to date were intended to:

- Delineate the horizontal and vertical extent of hydrocarbon impacts to soil and groundwater beneath the site;
- Characterize the extent of petroleum impacts to groundwater located to the west of the property and underlying Bethel Road SE;
- Recover free product from site monitoring wells, and
- Evaluate hydrocarbon constituents continuing to exceed MTCA Method A cleanup levels in soil and groundwater at the site. Method A levels were selected since the site was subject to relatively routine cleanup actions based upon relatively few hazardous substances.

This RI is intended to comply with Washington Administrative Code (WAC) 173-340-350 in fulfilling the following objectives:

- Summarize previous investigations conducted by Fred Meyer and others at the site to date, and
- Provide adequate site characterization based on previous investigation results to support cleanup action alternative development and evaluation under WAC 173-340-360 through 173-340-390.

For the purposes of this report, remedial investigation efforts were conducted at the site between 1999 and 2009. Interim remediation efforts previously were conducted by Ecology at the site between 1991 and 1999; and by Fred Meyer between 2001 and

2006. In February 2009, AMEC on behalf of Fred Meyer, restored and reactivated the current *in-situ* remediation system.

1.3 General Site Information

Project title: Remedial Investigation: Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Ecology Site ID #96424236

Project coordinator: Name: Mr. Russ Olsen, MPA; State of Washington Department of Ecology; Voluntary Cleanup Program Unit Supervisor

Address: Northwest Regional Office
3190 160th Avenue SE
Bellevue, WA 98008

Phone number: (425) 649-7038

Facility location: The property is located at 1900 SE Sedgwick Road at the southeast corner of the intersection of Sedgwick Road S.E. and Bethel Road S.E. in Port Orchard, Kitsap County, Washington 98366. The legal description for the property is: a portion of the Northwest Quarter of the Northwest Quarter of Section 12, Township 23 North, Range 1 East, Willamette Meridian. Figure 1 shows the approximate property location relative to surrounding properties and vicinity physical features.

The property is bounded to the south by the northwest entrance driveway to Fred Meyer, to the west by the Bethel Road SE ROW, to the north by the SE Sedgwick Road ROW, and to the east by the Fred Meyer store parking lot (Figure 2).

The Site extends from the current Fred Meyer property to the southwest across Bethel road and includes portions of the Warrington, Peterson, Tripp, Beatty, and Beckwell properties. Figure 4 depicts the extent of the Site.

The site vicinity is characterized by residential and commercial properties, open fields, and wooded areas. A BP-branded gasoline service station is located to the north across S.E. Sedgwick Road and an operating Chevron-branded service station is located to the northwest across the intersection of S.E. Sedgwick Road and Bethel Road S.E.

Facility dimensions: The current property consists of an area approximately ½ acre in extent. The Fred Meyer-branded fueling station facility (Pad C) is located in the northwest corner of a larger Fred Meyer Store property.

Present owner and operator: The property is currently owned and operated by Fred Meyer.

Chronological listing of past owners and operators and operational history: Section 3 of this report presents a discussion of previous property owners and operators in addition to the operational history.

1.4 Report Organization

This report is organized by section:

- Section 1 - Introduction
- Section 2 - Study Area Conditions
- Section 3 - Site Area Conditions
- Section 4 - Risk Assessment
- Section 5 - Conclusions and Recommendations

2.0 STUDY AREA CONDITIONS

This section describes physical conditions within the site vicinity, including a discussion of the regional geology and physiography, hydrogeology, air conditions, natural resources and ecology, hazardous substance sources, and regulatory classifications.

2.1 Regional Physiography and Geology

Port Orchard is located in Kitsap County on the Sinclair Inlet of the Puget Sound and within the Kitsap Peninsula. Physiographic conditions throughout the county are described as being relatively consistent and attributed to glacial remnants (described below). The vicinity is characterized by hills and ridges . The site slopes to the southwest with approximate ground surface elevations above mean sea level ranging between 320 and 300 feet (Figure 1). The average annual precipitation for Port Orchard is approximately 54 inches (City Information, 2010).

Geologic deposits encountered regionally throughout Kitsap County represent the Tertiary through the Quaternary Periods. Bedrock deposits comprised of basalt and andesite were deposited during the Tertiary, typically in a northwest-southeast trend. These deposits also are found interbedded with marine sedimentary deposits due to sea level fluctuations and lava flows. Marine sediments also were deposited on top of volcanic rocks during the Oligocene and Miocene. Northwest-southeast trending folds that formed during the late Miocene were subsequently eroded during the early to middle Pliocene. The present Puget Trough formed during the late Tertiary (late Pliocene) during uplift of the present Cascade and Olympic ranges. Sedimentary deposits accumulated in the lowland Trough during the late Pliocene and throughout most of the Pleistocene (Quaternary Period) due to erosion and depositional events and several advances of glacial deposition. Materials consist of fine-grained silt and clay and coarser grained sands and gravels (Garling, M.E., Molenaar, D., and others, 1965).

The Kitsap Peninsula, in the center of the Puget Lowland, has been glaciated repeatedly during the last 2 million years. Geologic maps of the region indicate the surface geology in the site vicinity generally is comprised of Quaternary Vashon age glacial deposits. Observed thickness ranges from a few feet to over 100 feet in upland regions. Subsurface conditions encountered at the site during advancement of boreholes and monitoring wells and described in Section 3 below are consistent with the regional geology.

2.2 Hydrogeology

2.2.1 Regional Hydrogeology

Over 80 percent of domestic water supply in Kitsap County is provided by groundwater resources according to the Kitsap Public Utility District (GeoEngineers, 2006). . Recharge to shallow groundwater is primarily from precipitation and shallow groundwater levels typically rise and fall with seasonal changes in rainfall. Rainfall is generally greatest between October and March. Groundwater levels in the Western Washington area tend to rise from October through March and to fall from April through September. Near-surface soils in this vicinity generally consist of Vashon-age deposits. The hydrogeologic units typically consist of the shallow aquifer, the Vashon till confining unit, and the Vashon aquifer. These units are commonly heterogeneous and locally discontinuous; Kahle (1998) provides the following descriptions and ranges of unit thickness typically found in areas of Kitsap County:

• Shallow aquifer (Qvr) – This discontinuous unconfined aquifer consists of sand, gravel, and silt and generally ranges from about 10 to 40 ft in thickness (with an average of 25 ft), where encountered. It is composed mostly of recessional outwash, but may include younger stream, beach, or landslide deposits.

• Vashon till confining unit (Qvt) – This low-permeability unit consists of compacted and poorly sorted silt, sand and gravel, although it may contain local water-bearing lenses of sand and gravel. This unit generally ranges from about 10 to 100 ft in thickness, with an average encountered thickness of 45 ft.

• Vashon aquifer (Qva) – This aquifer consists of well-sorted sand or sand and gravel, with lenses of silt and clay. Most of the unit is unconfined; however, it is confined locally where it is fully saturated and overlain by till. The unit typically ranges from about 20 to 200 ft in thickness, with an average encountered thickness of about 100 ft. Most of the wells in the area tap this aquifer.

A groundwater divide separates flow toward the north into Blackjack Creek from the south toward Burley Creek (Garling, M.E., Molenaar, D., and others, 1965). Regionally, groundwater flow within the site vicinity would be expected to discharge to the north, toward Sinclair Inlet.

2.2.2 Local Hydrogeology

Locally, shallow groundwater near the site appears to flow toward the west or southwest based upon review of available groundwater elevation data. This flow direction is consistent with topographic conditions near the site and the observed historical plume direction from the site. The hydraulic gradient observed between site monitoring wells MW-109 and MW-111 is typically 0.10 vertical feet per lateral foot (ft/ft) based upon data collected in January 2010 (AMEC, 2010b), as shown in Figure 3. Groundwater is observed within the sand deposits across the site at depths typically between 15 and 25 feet below ground surface (bgs) (AMEC, 2000a). Groundwater levels observed at the site appear to vary with seasonal precipitation events.

2.3 Surface Water and Sediment

A small creek was identified near the site "flowing southward along the east side of Bethel Road" during an initial investigation (Ecology, 1991). The closest mapped creek appears to be Blackjack Creek, located approximately one-half mile downgradient from the site (Figure 1). The majority of streams within the vicinity, including Blackjack Creek, ultimately drain into Sinclair Inlet, located to the north of the site. No surface water features or stream sediment appear to be present onsite. AMEC's literature search performed in March 2010 did not reveal any documented impacts to nearby surface water features or sediment as a result of contaminated groundwater migration or transport from the site.

2.4 Air

Hazardous substance release into the air is not anticipated at the site since all of the impacted soil is now paved.

2.5 Natural Resources and Ecology

All of Kitsap County in addition to portions of Mason and Pierce Counties and Vashon Island in King County are included within the Water Resource Inventory Area (WRIA) 15. WRIA focus is on managing watershed resources. The site is located within the Blackjack Creek watershed (Kitsap County, 2007a).

In March, 2010, AMEC searched available online Kitsap County Department of Community Development databases for natural resource and ecology designations within the site vicinity. Information reviewed included surface water and wetland features and critical aquifer zones with the following results:

- The site appears to be in an area designated as having wetland potential based upon the presence of hydric soils (Kitsap County, 2007b). GN Northern, Inc. collected three surface water samples (SW-1, SW-2, and SW-3) from standing water during Phase II ESA efforts conducted in 1998 to the southeast of the immediate site vicinity (GN Northern, Inc., 1999).
- The site also appears to be located within a Category One designation for aquifer protection, meaning the potential is high for "certain land use activities to adversely affect groundwater". The site appears to be surrounded by a Category Two aquifer, indicating this area may provide recharge to aquifers that either currently serve or are planned for potable water supply and susceptible to contamination based upon the type of land use activity (Kitsap County, 2007c).

2.6 Hazardous Substance Sources

Ecology identified potential human health risks associated with exposure to site groundwater and soil media containing elevated levels of benzene, xylene, and total volatile petroleum hydrocarbons. These risks included:

- Ingestion of groundwater from the site in nearby drinking water wells; and Ground water at this Site is classified as potable and a potential drinking water source. Consequently the cleanup levels must be protective of drinking water uses.
- Dermal exposure to and/or inhalation of contaminated soil during excavation activities by site workers (Ecology, 1991). The property and adjacent properties that comprise the Site do not meet the MTCA definition of an industrial property.

Consequently unrestricted land uses with direct contact and residential exposure must be considered. In addition, a TEE is needed to determine if soil cleanup levels protective of terrestrial species are needed.

Since Ecology's initial investigation and subsequent site cleanup efforts, the occurrence of these constituents has been reduced to on property locations in the vicinity of monitoring well MW-103. Although no longer a risk to downgradient domestic well users, remediation of these on-property areas of residual petroleum impact is necessary to achieve MTCA Method A cleanup standards.

A description of the extent of hazardous constituents (concentrations and lateral and vertical extent) present in soil and groundwater beneath the site is provided in Section 3 below.

3.0 SITE AREA CONDITIONS

Remedial investigations to collect data necessary to adequately characterize the site for purposes of developing and implementing an appropriate cleanup action alternative have been conducted since a May 31, 1990, when a complaint was received by the Kitsap County Health Department concerning possible petroleum contamination in a domestic drinking water well west of the property at the Tripp residence (4940 Bethel Road SE, Port Orchard, Washington) (Figure 4). Visual analysis of water sampled from the well on June 1, 1990 confirmed the presence of a light sheen floating on the water surface and an odor typical of petroleum hydrocarbons. A subsequent investigation led by Ecology identified the source of the groundwater contamination plume as a historical release from an UST system associated with a former Texaco service station which operated to the east of the affected residences. Since discovery of petroleum hydrocarbons in the Tripp residence well, a six-phased investigation of site conditions has been conducted, including the installation and operation of two separate remediation systems to recover free product and reduce contaminant concentrations in soil and groundwater. Periodic monitoring of groundwater conditions was initiated during 1991 and has been conducted on a quarterly basis since 2000. The investigations and interim remedial actions conducted at the site include:

- An initial assessment of soil and ground water conditions conducted by the Washington Department of Ecology (Ecology) between June 1990 and March 1991 (Ecology, 1991).
- Operation of on-site remediation systems involving free product recovery and air sparging/soil vapor extraction (AS/SVE) by Ecology between July 1995 and April 1998 (Ecology, 1998).

- A Phase I Environmental Site Assessment (ESA) of the property and adjacent parcels proposed for development into a Fred Meyer store by GN Northern during October 1998 (GN Northern, 1998).
- A follow-up limited Phase II ESA Site Assessment conducted by GN Northern during January 1999 which included additional soil and groundwater characterization in the vicinity at the property (GN Northern, 1999).
- Additional investigations by AMEC Earth & Environmental, Inc. (AMEC) to further assess the magnitude and extent of soil and groundwater contamination and installation of a new AS/SVE remediation system between June 1999 and May 2000 (AMEC, 2000a).
- Activities conducted by AMEC to replace groundwater monitoring wells lost during construction of the Fred Meyer store and restoration of the remediation system during August 2008 and February 2009 (AMEC, 2009).
- Periodic monitoring of groundwater conditions by Ecology between 1991 and 1998, followed by regular quarterly monitoring of groundwater conditions from 2000 to the present time by AMEC.

Historical well construction details and cumulative soil and groundwater analytical results are summarized in Tables 1, 2, and 3, respectively. The locations of various borings and monitoring wells completed to characterize the nature and extent of gasoline-related compounds in soil and groundwater are shown in Figures 4 through 10. Borehole logs and well completion details are provided in Appendix A. Each phase of investigation is further summarized below.

3.1 Groundwater Contamination Assessment, Washington Department of Ecology (Ecology, 1991)

Domestic Water Supply Well Investigation

Between June 1990 and March 1991, drinking water samples were collected from the Tripp residence well, along with six additional and nearby domestic water supply wells (the Sommers, Beatty, Warrington, Peterson, Beck and Evans residences), and analyzed for the presence of BTEX compounds. The last samples collected from the Tripp and Peterson residence wells were also evaluated for total petroleum hydrocarbons (TPH) (alternatively referred to as GRO).

Benzene, total xylenes, and GRO were detected in the samples collected from the Tripp well at maximum concentrations of 320 µg/L, 270 µg/L, and 130 µg/L, respectively. Benzene, total xylenes, and GRO were also detected in the Peterson residence well, which is located north of the Tripp residence, at maximum concentrations of 38 µg/L, 16 µg/L and 93 µg/L, respectively. The Tripp and Peterson residences were subsequently supplied with bottled water, and during late August 1990, both residences were equipped with filtration systems to remove petroleum hydrocarbons from well water.

Initial Monitoring Well Network

An eight-well network of groundwater monitoring wells (MW-1-D, MW-1-S, MW-2-D, MW-2-S, MW-101, MW-102, MW-103, and MW-104) was installed by Ecology to characterize subsurface soil and groundwater conditions. During October 1990, deep and shallow paired monitoring wells were installed to approximate depths of 40 and 80 feet bgs, respectively, at the southwest corner of the former Texaco service station (MW-1-D and MW-1-S) and near the southeast corner of the Tripp residence (MW-2-D and MW-2-S). During May 1991, monitoring wells MW-101, MW-102, MW-103, and MW-104 were installed. Monitoring wells MW-101 and MW-102 were installed to approximately 80 feet bgs on the Beck and Tripp properties, respectively. Monitoring wells MW-103 and MW-104 were installed to depths of 30 and 40 feet bgs, respectively, at the former Texaco-branded service station. More specifically, monitoring well MW-103 was installed near the western boundary of the property, and monitoring well MW-104 was installed near the northwest corner of the property close to the intersection of SE Sedgwick Road and SE Bethel Road. Soil samples collected at various depths from the monitoring well borings were analyzed for the presence of GRO and BTEX compounds. Groundwater samples collected from the completed monitoring wells were also evaluated for the presence of GRO and BTEX compounds.

Assessment results indicated GRO and BTEX compounds were present in soil and groundwater at concentrations greater than MTCA Method A cleanup levels. The maximum concentration GRO in soil (3,700 milligrams per kilogram [mg/kg]) was detected in soil sampled from boring MW-103 at 17.5 feet bgs (Figure 5). BTEX compounds were also detected in soil from boring MW-103 (at 17.5 feet bgs) at concentrations of 0.210 mg/kg, 19 mg/kg, 33 mg/kg, and 200 mg/kg, respectively. The MTCA Method A cleanup levels for GRO and BTEX compounds in soil are 30 mg/kg, 0.03 mg/kg, 7 mg/kg, 6 mg/kg, and 9 mg/kg, respectively. In groundwater, the highest concentrations of GRO and BTEX compounds were detected in samples collected from monitoring wells MW-1-D and MW-103 (Figure 4). In these wells, concentrations of GRO and BTEX compounds in groundwater ranged from 2,400 to 22,000 µg/L, 280-2,200 µg/L, 4.9-3,900 µg/L, 5-11 µg/L, and 200-6,800 µg/L, respectively. The MTCA Method A cleanup levels for GRO and BTEX compounds are 800 µg/L, 5 µg/L, 700 µg/L, 1,000 µg/L, and 1,000 µg/L, respectively. No evidence of LNAPL at the site was reported by Ecology during the initial groundwater assessment.

Based on results of the groundwater contamination assessment, Ecology identified the likely source of the groundwater contamination plume which had affected the domestic water wells as a historical release from a UST system associated with the former Texaco service station that was operated at the property. The approximate extent and concentrations of GRO and BTEX compounds in the groundwater contaminant plume during the early 1990s are described in Figure 4. The Texaco service station reportedly closed during September 1988, and the tanks were removed during December 1988. Ecology further concluded that results of tank tightness tests and leak detection monitoring well samples at the BP Mini-Mart (located across S.E. Sedgwick Road from the site) indicated that a release had not occurred at the BP Mini-Mart and that the BP Mini-Mart was not the source of the contaminated groundwater observed at the Tripp and Peterson water wells.

3.2 Remediation - Progress Report Summary, Washington State Department of Ecology (Ecology, 1998)

Product Recovery and Initial AS/SVE Remediation System

Ecology operated an on-site remediation system from July 1995 through April 1998. The remediation system consisted of a LNAPL recovery system to address free product detected during 1993 in monitoring well MW-103, a network of air sparging (AS) wells to add oxygen to and flush contaminated groundwater, a soil vapor extraction (SVE) well system to recover petroleum hydrocarbons from affected soil, a catalytic oxidizer to treat AS/SVE system off gas, and a mechanism to inject hydrogen peroxide into groundwater. The product recovery system consisted of a four-inch diameter extraction well (i.e., monitoring well MW-103) which was equipped with a floating skimmer pump connected to a 300-gallon aboveground storage tank. Monitoring well MW-103 also was designed to act as the main vapor extraction well. The AS system consisted of four sparging wells (SP-1, SP-2, SP-3 and SP-4) installed around the extraction well to flush and clean contaminated groundwater. Available details concerning the Ecology AS/SVE system are described in Figure 2.

In a progress report summary, Ecology reported the on-site remediation system recovered a total of approximately 19 gallons of LNAPL and approximately 4,600 pounds of petroleum hydrocarbons before being deactivated during April 1998. Ecology reported all LNAPL was removed from the site prior to the system's deactivation. Performance data for the AS/SVE system indicated most of the contamination in soil was removed with only residual soil contamination remaining in place. Still need compliance sampling to support this supposition. Also need a graph of the recovery rate and concentrations over time. Results of groundwater monitoring conducted by Ecology from May 1991 through February 1998 showed a steady decline in contaminant concentrations in peripheral wells with the groundwater plume restricted to the site in the area around the extraction well (i.e., monitoring well MW-103) where LNAPL was once present. For example, the GRO and benzene present in groundwater samples collected from the Tripp residence well decreased from 450 to 120 µg/L and 140 to 2.1 µg/L, respectively, between January 1992 and February 1998. Residual concentrations of GRO (120 µg/L) were detected samples collected during 1998 from the Tripp well and monitoring well MW-2-S.

3.3 Phase I and Limited Phase II Environmental Site Assessments, GN Northern (GN Northern, 1998, 1999)

Borings BH-15 and BH-15A

During October 1998, GN Northern conducted a Phase I Environmental Site Assessment (ESA) on behalf of Fred Meyer for the property (i.e., Parcel 023-2003) and 17 other parcels proposed for redevelopment as a Fred Meyer store. Based on results of the Phase I ESA, GN Northern recommended a limited Phase II ESA be conducted to further evaluate soil and groundwater conditions in the vicinity of the former Texaco service station as well as off-property areas where heating oil USTs, septic drain fields, potential asbestos and lead containing buildings, and other garbage and debris were identified as being of potential concern.

A total of 19 borings (borings BH-1 through BH-19) were completed by GN Northern during January 1999. Two of the borings, BH-15 and BH-15A, were advanced to depths of 15 and 22 feet bgs, respectively, in the vicinity of monitoring well MW-103 to evaluate the effectiveness of Ecology's previous cleanup activities at the site (Figures 6 and 7). Assessment results for borings BH-15 and BH-15A indicated gasoline related compounds remained in soil and groundwater in the vicinity of monitoring well MW-103 at concentrations exceeding MTCA Method A cleanup levels. Specifically, GN Northern found BTEX compounds and GRO in groundwater collected from 22 feet bgs in boring BH-15A at concentrations of 130 µg/L, 120 µg/L, 530 µg/L, 5,000 µg/L, and 41,000 µg/L, respectively. Concentrations of GRO and BTEX compounds detected in soil collected from 21 feet bgs in boring BH-15 were 17,000 mg/kg, 12 mg/kg, 39 mg/kg, 69 mg/kg and 280 mg/kg, respectively. Neither BTEX compounds nor GRO were detected in soil sampled from 15 feet bgs in boring BH-15 at concentrations exceeding the method detection limits.

3.4 Subsurface Exploration and Remediation System Installation Report, AMEC Earth & Environmental, Inc. (AMEC, 2000a)

AMEC conducted additional investigations at the site between June 1999 and May 2000 to further assess the magnitude and extent of remaining gasoline-impacted soil and groundwater beneath the site. The investigations involved soil and groundwater sampling in direct-push borings to identify areas where residual concentrations of gasoline related compounds required remediation and testing a network of vapor test wells to evaluate the effectiveness of SVE technology at the site. Based on results of the sampling conducted in the direct-push borings and SVE testing, AMEC installed a new AS/SVE system to replace the previous system installed and operated by Ecology (Figure 2).

Direct-Push Borings BH-20 through BH-25 and Vapor Test Wells VP-1 through VP-6

During July 1999, direct-push borings BH-20/20A through BH-25 and vapor test wells VP-1 through VP-6 (Figure 7) were advanced to depths ranging between 18 and 36 feet bgs beneath the site. Selected soil samples were screened for the presence of VOCs in the field using a photo ionization detector (PID). Maximum VOC readings were observed in borings VP-1 and VP-2 at depths ranging between 10 and 14 feet bgs. Gasoline odors were also noted in soil cuttings from borings VP-1 (at 13 to 23 feet bgs) and VP-2 (14 to 22 feet bgs). Groundwater samples were collected from all the borings using a 4-foot stainless steel screen and peristaltic pump after sufficient groundwater was purged from the borings. Soil and groundwater samples collected during the July 1999 subsurface investigation were analyzed for the presence of GRO and BTEX compounds. More specifically, soil samples collected from near the soil/water interface in borings BH-20 through BH-25, VP-1 through VP-3, and VP-6 were analyzed. Groundwater samples collected from these borings, as well as from borings BH-20A and VP4, were analyzed as well.

Concentrations of GRO exceeding the MTCA Method A cleanup level (30 mg/kg) were detected in soil collected at 6 feet bgs in boring BH-20 (6,500 mg/kg) and 4 feet bgs in borings VP-1 (2,100 mg/kg) and VP-2 (2,200 mg/kg). Detectable levels of benzene were not found in any of the July 1999 soil samples. Toluene, ethylbenzene and total xylenes were detected at concentrations of 65 mg/kg, 65, mg/kg and 390 mg/kg, respectively, in soil sample from 6 feet bgs in boring BH-20. These concentrations exceed the respective MTCA Method A cleanup levels for soil (7 mg/kg, 6 mg/kg, and 9 mg/kg). The gasoline additives EDB, EDC, and MTBE were not detected at concentrations exceeding the method reporting limits As noted elsewhere the MRL for

EDB is insufficient to demonstrate compliance with the cleanup level. GRO and BTEX compound concentrations in soil during 1999 are described in Figure 7.

In groundwater, concentrations of GRO exceeding the MTCA Method A cleanup level (800 μg/L) were detected in samples from borings BH-20A (78,000 μg/L), BH-22 (1,410 μg/L), VP-1 (47,000 μg/L) and VP-2 (8,200). Benzene was also detected in groundwater sampled from BH-20 (15 μg/L) and BH-20A (200 μg/L) at concentrations exceeding the MTCA Method A cleanup level (5 μg/L). The concentrations of toluene (8,700 μg/L), ethylbenzene (2,400 μg/L) and total xylenes (14,000 μg/L) detected in groundwater from boring BH-20A also exceeded MTCA Method A cleanup levels established for these compounds (1,000 μg/L, 700 μg/L, and 1,000 μg/L respectively). Ethylbenzene and total xylenes were also detected at concentrations exceeding the MTCA Method A cleanup levels in groundwater sampled from borings VP-1 and VP-2.

Additional Monitoring Well Installation - MW-105, MW-106, MW-107, and MW-108

During November 1999, monitoring wells MW-105, MW-106, MW-107 and MW-108 (Figure 6) were installed to expand the coverage provided by the initial network of monitoring wells installed at the site by Ecology during 1990 (i.e., MW-1-D, MW-1-S, MW-103, and MW-104). Monitoring well MW-105 was installed approximately 30 feet to the east and cross gradient from monitoring well MW-103. Monitoring wells MW-106, MW-107, and MW-108 were installed downgradient from monitoring well MW-103 along the southwest corner of the former Texaco service station boundaries. Groundwater samples were collected from the newly installed monitoring wells as well as from existing monitoring well MW-103 during March 2000. The samples were evaluated for the presence of GRO, BTEX compounds, and gasoline additives ethylene dibromide (EDB), ethylene dichloride (EDC) and methyl tert-butyl ether (MTBE).

GRO were detected in groundwater sampled from monitoring well MW-103 at a concentration (47,000 μg/L) which exceeds the MTCA Method A cleanup level (800 μg/L) for groundwater. Benzene was not detected in any of the groundwater samples evaluated from the March 2000 sampling event. Concentrations of toluene (450 μg/L), ethylbenzene (1,200 μg/L), and total xylenes (7,900 μg/L), however, were detected in the groundwater sample collected from monitoring well MW-103. The gasoline additives EDB, EDC, and MTBE were not detected at concentrations exceeding the method reporting limits in any of the groundwater samples evaluated during the March 2000 sampling event.

Replacement AS/SVE Remediation System

During July 1999, AMEC conducted a SVE feasibility test to determine if SVE was an appropriate remediation technology to implement at the site. The feasibility test involved installing six temporary SVE test wells (VP-1 through VP-6) near the northwest corner of the site. A blower was connected to induce a subsurface vacuum on a single extraction well while the effects were monitored in the vapor test wells. Results of the testing indicated SVE would be an appropriate and effective remediation technology to apply at the site. An effective radius of influence of a single vertical SVE extraction well was estimated to range between 35 and 45 feet. This information was used to design a replacement remediation system for the site which included SVE as a remediation component.

A remediation system consisting of 10 in-situ AS wells (AS-1 through AS-10) and five new in-situ SVE wells (VE-1 through VE-5) was installed at the site. Construction of the system began during November 1999, and the system was activated during March 2000. The AS wells were located throughout the site in areas of suspected and detected residual groundwater contamination. Five of the AS wells were installed vertically to a depth of approximately 35 feet bgs and screened between 30 and 35 feet bgs. The remaining five AS wells were installed at an angle of approximately 45 degrees off from vertical to depths of 30 to 35 feet, with the bottom most 7.5 feet being screened. Three of the SVE wells were installed vertically to a depth of 15 feet bgs, with the bottom 7.5 feet screened. The two remaining SVE wells were installed at an angle of approximately 45 degrees off vertical to a total depth of 15 feet bgs. The bottom 10 feet of the angled SVE wells was screened. A remediation compound was constructed near the northeastern corner of the facility in which system components related to the AS/SVE system and related emissions controls were located. Available details concerning the replacement AS/SVE system are described in Figure 2.

A follow-up groundwater sample was collected from monitoring well MW-103 to evaluate whether the system was effectively sparging groundwater and recovering significant concentrations of gasoline-related compounds during May 2000. The groundwater sample was analyzed for the presence of GRO, BTEX compounds, EDB, EDC, and MTBE. GRO were detected in the follow-up groundwater sample at a concentration of 3,900 µg/L. Benzene was not detected at a concentration greater than the method reporting limit. Toluene, ethylbenzene, and total xylenes were detected at concentrations of 18.3 µg/L, 33.2 µg/L, and 594 µg/L, respectively. The detected concentration of GRO exceeds the MTCA Method A cleanup level; however the detected GRO concentration was substantially less that observed prior to activation of the new remediation system.

Conclusions

Based on results of the investigations and remedial actions conducted at the site between November 1999 and May 2000, AMEC concluded the extent of the groundwater contaminant plume had diminished substantially relative to that of the early 1990s, with the remaining contamination generally confined to on property and in the immediate vicinity of Pad C (i.e., the portion of the new Fred Meyer store located in the vicinity of the former Texaco service station). The approximate extent and concentrations of GRO and BTEX compounds observed in groundwater at the conclusion of AMEC's additional investigations at the site during 1999 and 2000 are described in Figure 6. GRO and benzene were not detected by AMEC in borings located west of or downgradient of boring BH-21 which is located along the western boundary of the property.

The results of the follow-up May 2000 groundwater sampling also indicated the replacement AS/SVE system installed by AMEC was effective in removing gasoline-related compounds from groundwater beneath the site. The concentrations of GRO in groundwater sampled from monitoring well MW-103 during May 2000 decreased by more than 90% relative to results of the March 2000 sampling event (i.e., from 47,000 µg/L to 3,900 µg/L). Substantial decreases were also observed for BTEX compounds between the March and May 2000 sampling events. As observed in a previous sampling event, the gasoline additives EDB, EDC, and MTBE were not detected at concentrations exceeding the method reporting limits.

3.5 Restoration of Groundwater Monitoring Well Network and Remediation System, and Fourth Quarter 2008 Monitoring Results, AMEC Earth & Environmental, Inc. (AMEC, 2009)

Four phases of investigation and maintenance work were completed by AMEC between August 2008 and February 2009 to restore the network of groundwater monitoring wells and AS/SVE remediation system at the site. Several monitoring wells (MW-104, MW-106, MW-107, and MW-108) were inadvertently destroyed and the AS/SVE system damaged during 1999/2000 redevelopment activities at the site. The first phase of work was conducted during August 2008 and involved soil and groundwater sampling in additional direct-push soil borings to assess residual hydrocarbons remaining in place and to locate new groundwater monitoring wells to take the place of those that were destroyed. Four replacement groundwater monitoring wells (monitoring wells MW-108A, MW-109, MW-110, and MW-111) were subsequently installed as part of a second phase of work conducted during October 2008. Groundwater from the newly and previously installed wells was then sampled and analyzed as part of a third phase of work conducted at the site during January 2009. Lastly, a fourth phase of work was completed during February 2009 and included replacement of miscellaneous components of the AS equipment (compressors, pressure tank, and condensate trap) and reactivation of the dual AS/SVE treatment system.

Direct-Push Soil Borings - B1 through B12, B14, and B15

The first phase of work was conducted during August 2008 and involved fourteen direct-push soil borings (B1 through B12, B14, and B15) advanced to 22 to 36 feet bgs at various locations around the site (Figure 8). Soil and groundwater samples were collected from the borings to evaluate residual hydrocarbon impacts to soil and the magnitude and extent of the identified groundwater plume beneath the site as well as to the west under Bethel Road SE. Borings B-11, B-12, and B-14 were conducted within the central portion of the groundwater plume to evaluate conditions in the source area. Borings B-1, B-2, B-3, B-4, B-7, B-8, and B-9 were advanced within Bethel Road SE ROW. These seven borings were placed to evaluate the nature and extent of impacted groundwater in the cross and down-gradient directions to the west and southwest. Lastly, borings B-5, B-6, B-10, and B-15 were advanced within the site boundaries to the south of the plume to evaluate the nature and extent of impacted groundwater in the cross-gradient direction to the south. Boring B13 was not completed because of conflicts with underground utilities.

Three soil samples collected from borings B1, B2, and B7 at depths ranging between 20 and 26 feet bgs were analyzed for the presence of GRO, diesel-range organics (DRO), and VOCs including BTEX compounds, EDB, EDC, MTBE, and naphthalene. None of the evaluated analytes were detected at concentrations exceeding the method reporting limits. Groundwater samples collected from borings B3 through B7, B10 through B12, B14, and B15 were also evaluated for the presence of GRO, DRO, and/or VOCs including BTEX compounds, EDB, EDC, MTBE, and naphthalene. GRO were detected groundwater sampled from borings B-12 and B-14 at concentrations of 2,000 µg/L and 1,100 µg/L, respectively. DRO were detected in groundwater sampled from borings B-3, B-6, Duplicate (B-6) and B-14 at concentrations of 140 µg/L, 100 µg/L, 64 µg/L and 710 µg/L, respectively. The concentrations of GRO detected in the B-12 and B-14 groundwater samples and DRO detected in the B-14 sample exceed the MTCA Method A cleanup levels for GRO (800 µg/L) and DRO (500 µg/L) in groundwater.

One or more VOCs were detected in groundwater sampled from borings B-12 and B-14. Benzene was detected at a concentration of 980 µg/L in the groundwater sample from boring B-12. Ethylbenzene was detected at a concentration of 4.2 µg/L in groundwater sampled from boring B-14. Total xylenes were detected in groundwater sampled from borings B-12 and B-14 at concentrations of 9.0 µg/L and 2.2 µg/L, respectively. The benzene concentration detected in groundwater from boring B-12 exceeds the MTCA Method A cleanup level for benzene (5 µg/L) in groundwater. EDB, EDC, MTBE, and naphthalene were not detected.

Replacement Groundwater Monitoring Wells - MW-108A, MW-109, MW-110, and MW-111

Based on results of the direct-push assessment, new groundwater monitoring wells MW-108A, MW-109, MW-110 and MW-111 (Figure 8) were installed during October 2008 to replace wells (MW-104, MW-106, MW-107, and MW-108) that were inadvertently damaged during 1999 and 2000 site redevelopment activities (i.e., installation of the Fred Meyer branded service station and expansion of adjacent roadways). Specifically, monitoring well MW-108A was installed approximately 6 feet to the north of former well MW-108 and was placed to monitor potential movement of contaminants downgradient and to the south. Monitoring well MW-109 was installed approximately 60 feet to the southeast of former well MW-104 and was placed as an upgradient well to confirm the interpreted eastward extent of the plume boundary. Monitoring well MW-110 was installed approximately 70 feet to the northeast of former well MW-106 and was placed to evaluate plume conditions in the northwestern portion of the site. Lastly, monitoring well MW-111 was installed approximately 38 feet to the west of former well MW-107 and was placed to monitor potential movement of contaminants in the downgradient direction (to the southwest). Depths of the replacement monitoring wells ranged between 30 and 40 feet bgs, with groundwater encountered at depths ranging between 20 and 33 feet bgs.

Four soil samples collected from the newly installed monitoring well borings were analyzed for petroleum hydrocarbon identification by NWTPH-HCID, with a follow-up analysis for GRO and BTEX compounds on the soil sample collected from boring MW-110 at a depth of 20 to 25 feet bgs. GRO were detected in the soil sample at a concentration (300 mg/kg) exceeding the MTCA Method A cleanup level (Figure 9). Benzene was not detected at a concentration exceeding the method detection limit. Toluene (0.85 mg/kg), ethylbenzene (2.0 mg/kg) and total xylenes (5.3 mg/kg) were detected at concentrations less than the respective MTCA Method A cleanup levels.

Groundwater Quality Monitoring - Existing Network and New Monitoring Wells

During January 2009, a third phase of work involved collection of groundwater samples from the four new monitoring (monitoring wells MW-108A, MW-109, MW-110 and MW-111) and two of the pre-existing wells (monitoring wells MW-103 and MW-105). The groundwater samples were analyzed for the presence of GRO and VOCs including BTEX compounds, EDC, EDB, MTBE, and naphthalene. GRO and BTEX groundwater results are summarized in Figure 10. GRO were detected in groundwater sampled from monitoring well MW-103 and MW-110 at concentrations of 202 µg/L and 10,900 µg/L, respectively. The GRO concentration detected in groundwater sampled from MW-110 exceeds the MTCA Method A cleanup level. BTEX compounds were detected at concentrations less than MTCA Method A Cleanup Levels in groundwater sampled from monitoring wells MW-103 (ethylbenzene at 0.620 µg/L, total xylenes at 4.36), MW-109 (benzene at 1.51 µg/L), and MW-110 (ethylbenzene at 251µg/L, total xylenes at 938 µg/L). EDB, EDC, MTBE, and naphthalene were not detected in any of the samples at concentrations exceeding the method reporting limits.

Replacement AS/SVE Remediation System Upgrades

Beginning in August 2002, the AS component of the groundwater treatment system became inoperative as a result of damages incurred during construction of the Fred Meyer branded fuel station. The SVE system was operated at a limited capacity during this period. In June 2006, the SVE system became completely inoperative following further damage to its aboveground components.

An assessment of the combined AS/SVE system was conducted during June 2008. Following the assessment, two new SVE blowers, a condensate trap, and two rebuilt AS compressor heads were installed. The AS/SVE systems were reactivated during February 2009. Shortly following system startup, AMEC measured and/or recorded vacuum pressure, air velocity and vapor level (using a PID) in each SVE conveyance line, as well as flow rate in each AS conveyance line. Based on the measured vapor levels and volumetric flow rates, the AS/SVE system was removing volatile petroleum constituents from the subsurface at an average calculated rate of approximately 0.9 pounds per day (lbs/day).

Conclusions

Soil samples from only one boring (monitoring well MW-110) contained GRO at concentrations exceeding the MTCA Method A cleanup level. Monitoring well MW-110 is located at the northwestern corner of the site near the intersection of Bethel Road and Sedgwick Road. The results of soil field screening and chemical testing indicate that a relatively localized area of gasoline-impacted soil remains at an approximate depth of 20 feet bgs within the immediate vicinity of monitoring well boring MW-110 (Figure 9). The analytical results also suggest the edge of the GRO and benzene groundwater plume has been defined with the extent limited to western edge of the site and under what is now Bethel Road SE. The approximate extent and concentrations of GRO and BTEX compounds observed in groundwater during AMEC's 2008/2009 investigations at the site are described in Figure 8. The decreases observed in concentrations of GRO and BTEX compounds in groundwater from 1999/2000 (Figure 6) to 2008/2009 (Figure 8) indicate operation of the AS/SVE, even at a reduced capacity as a result of damages incurred during construction, resulted in continued reductions of GRO and BTEX concentrations in groundwater beneath the site.

3.6 Additional Groundwater Sampling and Analysis

Additional groundwater sampling and analysis, beyond that associated with the initial assessment and subsequent remedial investigations, have been conducted by Ecology and AMEC in the existing and expanded network of groundwater monitoring wells since the early 1990s. After sampling the initial network of monitoring wells during 1991, Ecology conducted periodic groundwater sampling and analysis in selected wells of the initial monitoring well network during 1993, 1997, and 1998 (Ecology 1998). Beginning in 2000, AMEC initiated regular quarterly groundwater sampling and analysis, with groundwater conditions being monitored in the expanded network and replacement monitoring wells through the fourth quarter 2009 (AMEC, 2000b - 2009).

Overall, a decrease in concentrations of GRO and BTEX compounds has been observed in groundwater beneath the site since the activation of the replacement AS/SVE system during March 2000 and subsequent efforts to restore and reactivate the system 2008/2009. The concentrations of GRO detected in groundwater sampled from monitoring well MW-103 decreased from 47,000 µg/L in March 2000 to levels less than the MTCA Method A cleanup level during four out of the last five quarterly sampling events. Concentrations of GRO, benzene and toluene have also historically been detected at concentrations exceeding the respective MTCA Method A cleanup levels in groundwater sampled from monitoring well MW-105, which is located approximately 30 feet east-southeast of monitoring well MW-103. The detected concentrations of these compounds in monitoring well MW-105, however, have all decreased to levels less than the respective MTCA Method A cleanup levels over the last eight quarterly sampling events. Likewise, the elevated concentrations of GRO and benzene detected in newly installed monitoring wells MW-110 and MW-109, respectively, have also decreased to levels less than the MTCA Method A cleanup levels during recent monitoring events, likely in response to reactivation of the AS/SVE system during February 2009. Naphthalene was last detected at concentrations exceeding the MTCA Method A cleanup level in groundwater sampled from monitoring well MW-103 during 2001 and 2002. The MTCA Method A level for naphthalene is 160 µg/L.

Based on the results of the quarterly groundwater monitoring conducted on site since 2000, the residual impacts to groundwater appear to be limited to a relatively small area in the vicinity of monitoring wells MW-103 and MW-110. GRO and BTEX compounds have generally not historically been detected in groundwater sampled from downgradient or cross gradient monitoring wells MW-106, MW-107, MW-108, MW-108A, or MW-111. The most recent results of groundwater monitoring conducted during 2009 and 2010, which show the recent downward trend in GRO and BTEX compound concentrations and further restriction of the groundwater plume, are described in Figure 10.

3.7 Summary of Nature and Extent of Contamination

A former Texaco-branded service station operated at the site until September 1988. A release from a UST system associated with the former service station was identified by Ecology during 1990 as the source of petroleum hydrocarbons detected in domestic drinking water supply wells located west of the site. Initial investigations in the vicinity of the source area, near where the UST system was buried showed up to 3 feet of NAPL present on top of groundwater in monitoring well MW-103. Concentrations of GRO and BTEX compounds were detected in soil and groundwater at concentrations exceeding the MTCA Method A cleanup levels (Figures 4 and 5).

In the vicinity of the source area, GRO were detected in soil at concentrations exceeding the MTCA Method A cleanup level and ranging up to 3,700 mg/kg in soil sampled between 7.5 and 17.5 feet bgs in monitoring well borings MW-103 and MW-104. Concentrations of toluene, ethylbenzene, and total xylenes were detected in soil at concentrations ranging up to 19 mg/kg, 33 mg/kg, and 200 mg/kg, respectively. Early concentrations of GRO and benzene detected in groundwater sampled from monitoring well MW-103 ranged up to 22,000 µg/L and 860 µg/L, respectively. Elevated concentrations of GRO (up to 17,000 µg/L) and benzene (up to 2,300 µg/L) were also detected in groundwater sampled from monitoring well MW-1-D, which is located approximately 90 feet south of monitoring well MW-103.

When discovered, the contaminated groundwater plume extended downgradient approximately 500 feet to the southwest. Concentrations of GRO and benzene exceeding the MTCA Method A cleanup levels were detected in groundwater at maximum concentrations of 450 µg/L and 320 µg/L, respectively, in the Tripp residence well, which is located approximately 480 feet from the source area. GRO and benzene were not detected in groundwater sampled from monitoring well MW-101 which is located approximately 100 feet beyond the Tripp residence well. The lateral extent of contamination of the groundwater plume is estimated to range between 300 to 350 feet based on the low detected concentration of GRO (93 µg/L) and absence of BTEX compounds in groundwater sampled form Peterson residence well, along with the absence of both GRO and BTEX compounds in groundwater sampled from monitoring wells MW-2-S and MW-2-D. The downgradient and lateral extents GRO and benzene in the groundwater plume soon after discovery are depicted in Figure 4.

Interim remedial actions conducted at the site since 1995 included the operation of a free product recovery system and two separate AS/SVE systems. The systems were successful in removing a significant amount of petroleum hydrocarbon mass adsorbed to subsurface soil beneath the site and resulted in substantial reductions in both the extent of the groundwater contaminant plume and the associated concentrations of GRO and BTEX compounds present within the plume (Figures 4, 6, and 8). Measurable free product has not been observed in any borings or monitoring wells at the site since November 1999 when 3 feet of product was measured near the source area in monitoring well MW-103. An absorbent sock was subsequently installed in monitoring well MW-103 to recover any residual free product, although none has since been detected. The detected concentration of GRO in groundwater sampled from monitoring well MW-103 has been reduced by greater than 99% from a maximum observed concentration of 47,000 µg/L during March 2000 to concentrations ranging from 202 µg/L to less that the method reporting limit (80 to 100 µg/L) during four out of the five most recent groundwater monitoring events. GRO and BTEX compounds have not recently been detected in monitoring wells or exploratory borings completed along the western and at locations further downgradient from the source area.

The extent of the groundwater plume has been reduced to an area limited to the northwest corner of the property and bounded by monitoring well MW-110 and boring B-14 to the northwest, monitoring well MW-109 and boring B-12 to the east, and monitoring well MW-103 to the south (Figure 10). Recent groundwater monitoring results suggest the residual concentrations of GRO and BTEX compounds within the plume are generally less than MTCA Method A cleanup levels. However; concentrations of GRO and BTEX compounds in excess of the MTCA Method A cleanup levels may be present in localized areas within the remaining plume and periodically detected as evidenced by the recent detections of GRO at a concentration of 1,320 µg/L in monitoring well MW-103 (January 2010) or benzene at a concentration of 27.40 µg/L in monitoring well MW-109 (June 2009). The periodic detections of GRO and benzene at concentrations exceeding the MTCA Method A cleanup levels may be attributed to fluctuations in the water table and the resulting remobilization of residual contamination trapped in soil at or near the soil/groundwater interface (smear zone). Continued operation of the AS/SVE system is expected to further reduce the residual concentrations of GRO and benzene present in groundwater over time. Based on PID measurements and air flow readings in the SVE exhaust stack, the vapor extraction system is currently removing less than 0.1 pounds per day of VOCs from the site vadose zone. It appears that the SVE system has removed over 1,000 pounds of the more mobile fraction petroleum contamination since startup in 2000. The remaining contamination is less volatile and more strongly adsorbed to semi-saturated soil located between 18 and 20 feet below ground surface. Therefore, biodegradation has become the dominant factor in treating residual contamination in the smear zone. Dissolved oxygen (DO) levels in groundwater have increased from less than 1 mg/L to approximately 6-8 mg/L in most of the site's monitoring wells since reactivation of the AS system in February 2009. Increased DO levels in groundwater are expected to increase the rate of biodegradation of residual petroleum contamination beneath the site.

3.8 Quality Assurance

Copies of available laboratory analytical reports from remedial investigations and groundwater monitoring reports are presented in Appendix B for soil analytical results and Appendix C for groundwater analytical results. For earlier studies where laboratory analytical reports are not available, such as the initial assessment of soil and groundwater conditions or follow-up groundwater monitoring conducted by Ecology between 1990 and 1998 (Ecology, 1991), available summary tables from the reports were substituted instead. In some instances system details [i.e. air sparge (AS-1 through AS-10) and vapor extraction (VE-1 through VE-5)], were not available for RI report inclusion. Available analytical reports were reviewed by AMEC as part of the remedial investigation or quarterly groundwater monitoring to assess overall data quality. Based on these reviews, the analytical data are of acceptable quality for their intended use.

4.0 POTENTIAL RISKS TO HUMAN HEALTH, NATURAL RESOURCES, AND ECOLOGICAL RECEPTORS

MTCA requires that site conditions be protective of human health, natural resources, and ecological receptors. The data collected during the remedial investigation and interim actions previously summarized provide the information necessary to adequately characterize the nature and extent of contamination currently present at the site and the associated potential exposure to human health and the environment.

4.1 Conceptual Site Model

A conceptual site model (CSM) based on the results of the remedial investigations and interim actions conducted to date is presented in which the physical and chemical data collected for the site are summarized to describe the known sources of contamination, the pathways by which the contaminants are likely to move, and receptors potentially affected by the contaminants present at the site today and as they are reasonably likely in the future. The conceptual site model will serve as a useful tool used during development of cleanup alternatives which are the subject of the cleanup action plan to be submitted in conjunction with the Feasibility Study.

4.1.1 Hazardous Substances

GRO and related BTEX compounds are the primary COPCs at the site. Low levels of DRO were detected in groundwater sampled from several borings, but these detections are believed to be overlap of weathered GRO into the diesel range. The gasoline additives EDB, EDC, and MTBE were not detected in groundwater collected from the source area or at locations down gradient and cross gradient from the source area, however the laboratory detection limits were not sufficient to determine if EDB is present or not at the Site. EDB will have to be monitored during compliance monitoring to make a final determination. Naphthalene has not been detected in groundwater at concentrations exceeding the MTCA Method A cleanup level since 2002.

4.1.2 Contaminant Sources

There are no continuing sources of hazardous substance releases. All existing contamination appears to be derived from the historical Texaco UST system. The Texaco service station reportedly closed during September 1988, and its UST system removed from the site in December 1988. Results of tank tightness tests and leak detection monitoring well samples collected at the BP Mini-Mart, located across S.E. Sedgwick Road, and generally upgradient from the site, indicated the BP Mini-Mart was not a source of the identified contaminated groundwater plume. Other potential off-site sources (i.e., heating oil USTs, septic drain fields, potential asbestos and lead containing buildings, and other garbage and debris) identified during Phase II ESA activities for parcels eventually redeveloped into the existing Fred Meyer store do not extend on to the site and are not considered sources of the identified groundwater contamination plume.

4.1.3 Contaminated Media

Contaminated media at the site include soil and groundwater. The interim actions undertaken at the site were successful in removing LNAPL from the site and substantial reductions of concentrations of GRO and BTEX compounds in soil and groundwater. The extent of the groundwater plume has been reduced to an area limited to the northwest corner of the property where concentrations of GRO, DRO and BTEX in groundwater are generally less than MTCA Method A cleanup levels. The periodic detections of GRO, DRO and BTEX compounds (particularly benzene) at concentrations exceeding the MTCA Method A cleanup levels are attributed to fluctuations in the water table and subsequent remobilization of residual contamination trapped in soil at depths at or near the soil/groundwater interface. See cleanup standards below, especially the point of compliance for soils via the leaching pathway.

4.1.4 Actual and Potential Exposure Pathways and Receptors

The Conceptual Site Model (CSM) consists of potentially complete exposure routes for current receptors including the incidental ingestion of, dermal contact with, and/or inhalation of volatiles in affected soil or groundwater by construction/excavation workers identified as current or future potential receptors.

Soil

Cleanup Levels:

Groundwater at this Site has been impacted by the identified releases; therefore soil cleanup levels based on leaching (protection of groundwater) are appropriate. To establish soil concentrations protective of groundwater MTCA Method A cleanup levels were selected.

The Site does not meet the MTCA definition of an industrial property; therefore soil cleanup levels suitable for unrestricted land use will also need to be considered. For unrestricted land use, the soil cleanup level is based on the direct contact pathway and residential use. Again MTCA Method A levels were selected for this Site.

Points of Compliance:

The point of compliance based on the protection of groundwater is Site wide throughout the soil profile and may extend below the water table. For soil cleanup levels based on direct contact, the point of compliance is defined as throughout the Site from the ground surface to fifteen feet below the ground surface.

Groundwater

Cleanup Levels:

The groundwater at the Site is classified as potable to protect drinking water beneficial uses. Method A cleanup levels for potable groundwater were selected for this Site. Note: Method A groundwater cleanup levels will be protective of any other exposure pathway.

Point of Compliance:

The standard point of compliance for groundwater is throughout the Site from the uppermost level of the saturated zone extending vertically to the lowest depth which could potentially be affected.

Additional consideration to off-Site receptors was evaluated in November 1999 when utility cutoff collars were installed down gradient of the subject property, as described in the Environmental Activities during Sewer Line Construction report (AGRA 1999). Stormwater is collected through catch basins and piped into the municipal storm sewer located beneath SE Sedgwick and Bethel Road. Stormwater drainage on the roadway and sidewalk portions of the subject property is conveyed through pipes and/or ditch before entering a storm detention pond located south of the Site.

No known areas of particular environmental value, such as wetlands or critical habitat, are present at the Site. The simplified terrestrial ecological evaluation concluded for the Site indicated that no adverse affects are realized to the off-Site habitat quality or other urban wildlife species.

4.2 Natural Resources and Ecological Receptors

The property is currently occupied by a Fred Meyer-branded service station, portions of Bethel Road and SE Sedgwick Road, and associated sidewalks and landscaping. The service station primarily consists of several lanes for fueling automobiles, an overhead canopy, and a relatively small building used by the fueling attendants. With the exception of narrow strips of landscaping along the roadways, the entire site is paved. Land surrounding the property is developed and utilized for a combination of commercial/industrial and residential purposes.

Stormwater is collected through catch basins and piped into the municipal storm sewer located beneath SE Sedgwick and Bethel Road. Stormwater drainage on the roadway and sidewalk portions of the site is likely to municipal collection points. Not true visit during a storm.

No know areas of particular environmental value, such as wetlands or critical habitat, are present at the site. A formal terrestrial ecological evaluation has not been conducted at the site; however, based on the existing site conditions, the habitat quality at the site is assumed to be low, and the site is unlikely to attract wildlife other than birds flying overhead or other urban wildlife species.

5.0 CONCLUSIONS AND RECOMMENDATIONS

A former Texaco-branded service station operated at the site until 1988. A release of petroleum hydrocarbons (gasoline) from a UST system associated with the former

Texaco service station is the source of a groundwater contaminant plume that, at the time of discovery during 1990, extended from the property to neighboring residential properties and domestic water supply wells as far as 480 feet to the southwest. Since discovery of petroleum hydrocarbons in the residential wells, sufficient remedial investigations have been conducted to adequately characterize the nature and extent of the release. Interim remedial actions conducted at the site since 1995, including the operation of a free product recovery system and two separate AS/SVE systems, have been successful in removing free product from the site and substantially reducing the extent of groundwater contaminant plume and the magnitude of gasoline-related contaminants present within the plume and in soil near in the vicinity of the source area.

Results of quarterly groundwater monitoring confirm the extent of the groundwater plume has been reduced to a relatively small area limited to the northwest corner of the site. COPCs (GRO, DRO and BTEX compounds) in groundwater have generally been reduced to concentrations less than MTCA Method A cleanup levels in recent monitoring events. However, COPC concentrations in excess of the MTCA Method A cleanup levels may still be present in localized areas within the remaining plume as evidenced by the recent detections of GRO, DRO and benzene in groundwater sampled from monitoring wells near the source area. The periodic detection of COPCs at concentrations exceeding the MTCA Method A cleanup levels during recent monitoring events is attributed to remobilization of residual COPCs trapped in deep soil (15 to 25 feet bgs) within a smear zone created by fluctuation of the groundwater elevation.

Current and reasonably likely future land use at the property is commercial/industrial, although it is possible that future use could involve redevelopment of the property as a residential property. Current and future receptors likely include on-property occupational workers and construction/excavation workers involved with landscaping, maintenance, construction, or excavation activities. Off-site receptors are not likely to be affected since the extent of contaminated soil and groundwater is limited to on-property. Potentially complete exposure routes for current receptors include incidental ingestion of, dermal contact with, and/or inhalation of volatiles in affected soil or groundwater by construction/excavation workers. For future receptors, potentially complete exposure routes includes these routes, as well as inhalation of volatiles in indoor air by future residential and occupational receptors should the site undergo redevelopment. There are no known significant natural resources present at the site. Based on the existing site conditions, the habitat quality at the site is characterized as being low and unlikely to attract and sustain wildlife other than typical urban wildlife species.Continued operation of the AS/SVE system is recommended until concentrations of COPCs remaining in the groundwater plume beneath the site are reduced to levels less than the MTCA Method A cleanup levels. Operation of the AS/SVE system, and the associated reductions in residual COPC concentrations in soil and groundwater, will also reduce potential risks to current and future receptors that may come into contact with site soil and groundwater. Cleanup to the MTCA Method A cleanup levels will allow for unrestricted site use in the future and no further actions necessary to ensure protection of human health and the environment.

REFERENCES

AMEC Earth & Environmental, Inc., 2000a, Subsurface Exploration and Remediation System Installation Report, Fred Meyer Property Port Orchard, Washington, October 2000.

AMEC Earth & Environmental, Inc. 2000b, Quarterly Site Report Third Quarter 2000, Fred Meyer Property, Port Orchard, Washington, Prepared for Fred Meyer Stores, Inc., October 2000.

AMEC Earth & Environmental, Inc. 2001a, Quarterly Site Report Fourth Quarter 2000, Fred Meyer Property, Port Orchard, Washington, Prepared for Fred Meyer Stores, Inc., March 2001.

AMEC Earth & Environmental, Inc. 2001b, Quarterly Site Report First Quarter 2001, Fred Meyer Property, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., June 2001.

AMEC Earth & Environmental, Inc. 2001c, Quarterly Site Report Second Quarter 2001, Fred Meyer Property, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., September 2001.

AMEC Earth & Environmental, Inc. 2001d, Quarterly Site Report Third Quarter 2001, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., October 2001.

AMEC Earth & Environmental, Inc. 2002a, Quarterly Site Report Fourth Quarter 2001, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., October 2001.

AMEC Earth & Environmental, Inc. 2002b, Quarterly Site Report First Quarter 2002, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., October 2002.

AMEC Earth & Environmental, Inc. 2002c, Quarterly Site Report Second Quarter 2002, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., November 2002.

AMEC Earth & Environmental, Inc. 2003a, Quarterly Site Report Third Quarter 2002, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., January 2003.

AMEC Earth & Environmental, Inc. 2003b, Quarterly Site Report Third Quarter 2003, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., January 2003.

AMEC Earth & Environmental, Inc. 2003c, Quarterly Site Report Fourth Quarter 2002, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., April 2003.

AMEC Earth & Environmental, Inc. 2004a, Quarterly Site Report First Quarter 2003, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., February 2004.

AMEC Earth & Environmental, Inc. 2004b, Quarterly Site Report Second Quarter 2003, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., February 2004.

AMEC Earth & Environmental, Inc. 2004c, Quarterly Site Report Fourth Quarter 2003, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., August 2004.

AMEC Earth & Environmental, Inc. 2004d, Quarterly Site Report First Quarter 2004, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., August 2004.

AMEC Earth & Environmental, Inc. 2004e, Quarterly Site Report Second Quarter 2004, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., September 2004.

AMEC Earth & Environmental, Inc. 2005a, Quarterly Site Report Third Quarter 2004, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., January 2005.

AMEC Earth & Environmental, Inc. 2005b, Quarterly Site Report Fourth Quarter 2004, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., May 2005.

AMEC Earth & Environmental, Inc. 2005c, Quarterly Site Report First Quarter 2005, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., May 2005.

AMEC Earth & Environmental, Inc. 2006a, Quarterly Site Report Second Quarter 2005, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., January 2006.

AMEC Earth & Environmental, Inc. 2006b, Quarterly Site Report Third Quarter 2005, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., February 2006.

AMEC Earth & Environmental, Inc. 2006c, Quarterly Site Report Fourth Quarter 2005, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., February 2006.

AMEC Earth & Environmental, Inc. 2006d, Quarterly Site Report First Quarter 2006, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., May 2006.

AMEC Earth & Environmental, Inc. 2006e, Quarterly Site Report Second Quarter 2006, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., October 2006.

AMEC Earth & Environmental, Inc. 2007a, Quarterly Site Report Third Quarter 2006, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., January 2007.

AMEC Earth & Environmental, Inc. 2007b, Quarterly Site Report Fourth Quarter 2006, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., February 2007.

AMEC Earth & Environmental, Inc. 2007c, Quarterly Site Report First Quarter 2007, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., August 2007.

AMEC Earth & Environmental, Inc. 2007d, Quarterly Site Report Second Quarter 2007, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., August 2007.

AMEC Earth & Environmental, Inc. 2007e, Quarterly Site Report Third Quarter 2007, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., October 2007.

AMEC Earth & Environmental, Inc. 2008a, Quarterly Site Report Fourth Quarter 2007, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., February 2008.

AMEC Earth & Environmental, Inc. 2008b, Quarterly Site Report First Quarter 2008, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., May 2008.

AMEC Earth & Environmental, Inc. 2008c, Quarterly Site Report Second Quarter 2008, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., August 2008.

AMEC Earth & Environmental, Inc. 2008d, Quarterly Site Report Third Quarter 2008, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., October 2008.

AMEC Earth & Environmental, Inc. 2009a, Quarterly Site Report Fourth Quarter 2008, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., March 2009.

AMEC Earth & Environmental, Inc. 2009b, Restoration of Groundwater Monitoring Well Network and Remediation System, and Fourth Quarter 2008 Monitoring Results, Fred Meyer- Port Orchard Site, Ecology Site ID #96424236, Prepared for Fred Meyer Stores, Inc., Submitted to Washington State Department of Ecology. July 2009.

AMEC Earth & Environmental, Inc. 2009c, Quarterly Site Report First Quarter 2009, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., July 2009.

AMEC Earth & Environmental, Inc. 2009d, Quarterly Site Report Second Quarter 2009, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., July 2009.

AMEC Earth & Environmental, Inc. 2010a, Quarterly Site Report Third Quarter 2009, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., February 2010.

AMEC Earth & Environmental, Inc., 2010b, Quarterly Site Report, Fourth Quarter 2009, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Ecology Site ID #2555; Submitted to Fred Meyer Stores, Inc., February 2010.

City Information, 2010, website: http://www.citytowninfo.com/places/washington/port-orchard

Garling, M.E., Molenaar, D., and others, 1965, Water Resources and Geology of the Kitsap Peninsula and Certain Adjacent Islands: Water Supply Bulletin No. 18.

GeoEngineers, Inc., 2006, State of the Drinking Water Supply of Kitsap County: Summary of Kitsap Public Utility District's Monitoring Network Data, Prepared for Public Utility District No. 1 of Kitsap County, October 23, 2006.

GN Northern, Inc., 1998. Report of Phase I Environmental Site Assessment: Proposed Fred Meyer Site Southeast of Bethel Road and SE Sedgwick Road, Port Orchard, Washington. October 1998.

GN Northern, Inc., 1999. Phase II Environmental Site Assessment of 24.32 Acre Fred Meyer Development Site Bethel Road S.E. and Sedgwick Road S.E., Port Orchard, Washington. February 5, 1999.

Kitsap County, 2007a, Website:
http://www.kitsapgov.com/dcd/gis/maps/Standard_Maps/Environmental/Watersheds_FEB2007.pdf

Kitsap County, 2007b, Website:
http://www.kitsapgov.com/dcd/gis/maps/Standard_Maps/Environmental/SURFACE_WATERS_DEM_DEC2007.pdf

Kitsap County, 2007c, Website:
http://www.kitsapgov.com/dcd/gis/maps/Standard_Maps/Environmental/Critical_Aquifer_Recharge_Areas_June2007.pdf

Kitsap Public Utility District, 1997, Kitsap County Initial Basin Assessment Open File Technical Report No. 97-04, prepared in cooperation with Washington State Department of Ecology, October 1997.

Molenaar, Dee, 1962. Geologic Map and Diagrammatic Sections of the Kitsap Peninsula and Certain Adjacent Islands. State of Washington Department of Conservation, Division of Water Resources, 1962.

Washington State Department of Ecology, 1991. Groundwater Contamination Assessment, Bethel Wells, Port Orchard, Washington J5E03. August 1991.

Washington State Department of Ecology, 1999, Letter to David R. Walden, Prudential Northwest Real Estate. Bethel Former Texaco- 4831 Bethel Road SE, Port Orchard, Washington. February 19, 1999.

EXHIBIT D. Feasibility Study and Cleanup Action Plan (Ecology, 2011)
Bethel Texaco, 1900 SE Sedgwick Road
Port Orchard, Washington
FSID 2614

DEPARTMENT OF
ECOLOGY
State of Washington

Feasibility Study and Cleanup Action Plan

Bethel Texaco
1900 SE Sedgwick Road
Port Orchard, Washington
FSID 2614

May 2011

Publication and Contact Information

For more information contact:

Russ Olsen
Toxics Cleanup Program
3190 160th Ave SE
Bellevue, WA 98008
(425) 649-7038
E-mail: rols461@ecy.wa.gov

Feasibility Study and Cleanup Action Plan

Bethel Texaco
1900 SE Sedgwick Road
Port Orchard, Washington
FSID 2614

Toxics Cleanup Program
Washington State Department of Ecology
3190 160th Ave SE
Bellevue, WA 98008

Table of Contents

List of Tables

List of Figures

Appendices

1.0 INTRODUCTION

This Cleanup Action Plan (CAP) has been prepared for the former Bethel Texaco, now known as the Fred Meyer Property Port Orchard fueling station located at the southeastern corner of the intersection of SE Sedgwick Road and Bethel Road SE in Port Orchard, Washington (Figure 1). A leak from an underground storage tank (UST) system at the former Texaco-branded service station which operated at the subject property until 1988 is responsible for petroleum hydrocarbon impacts to soil and groundwater at the property and adjacent parcels located to the southwest, and are collectively referred to as the Site.

1.1 Purpose

The purpose of this CAP is to present the approach for the remediation of petroleum contaminated soil and groundwater. Remedial measures for the impacted media were evaluated for the most feasible remedy. Following a brief evaluation of suitable remedies, the recommended remedial action is described in detail. Work activities described in this CAP were designed to reduce human health and ecological risks associated with the petroleum contaminated soil and groundwater to within acceptable levels and allow for future uses of the Site without further environmental concerns.

1.2 Report Organization

This document presents a brief background of the Site, findings of the remedial investigation (RI), remedial alternatives considered, remedial action objectives (RAOs) and performance criteria, implementation of the selected alternative, and monitoring. Individual sections of the report are as follows:

- Section 1 - Introduction
- Section 2 - Summary of Site Conditions
- Section 3 - Cleanup Requirements
- Section 4 - Remedial Alternatives Considered
- Section 5 - Selected Site Cleanup Alternatives
- Section 6 - Cleanup Action Implementation and Performance Monitoring
- Section 7 - Implementation Schedule

2.0 SUMMARY OF SITE CONDITIONS

This section presents a summary of the Site conditions as described in the RI Report, (AMEC, 2009a).

2.1 Subject Property and Site Description

The Fred Meyer property is located at the southeast corner of the intersection of Sedgwick Road S.E. and Bethel Road S.E. in Port Orchard, Washington (Figure 1). The Leaking Underground Storage Tank (LUST) number assigned by the Washington Department of Ecology (Ecology) for the Site is #200122.

For the purposes of this report, the property consists of an approximately 0.58-acre portion (designated "Pad C" by Fred Meyer) of a larger Fred Meyer Store. The property is bounded by the northwest entrance driveway to the Fred Meyer Store to the south, the Bethel Road SE and SE Sedgwick Road right-of-ways (ROWs) to the west and north, respectively and by the Fred Meyer Store parking lot to the east (Figure 2). The subject property is located in the N.W. 1/4 of the N.W. 1/4 of Section 12, Township 23 North, Range 1 East, Willamette Meridian.

The subject property and full lateral extent of historical petroleum hydrocarbon impacts to soil and groundwater encountered at the property and adjacent parcels located to the southwest are collectively referred to as the Site. The Site is characterized by residential and commercial properties, open fields and wooded areas. A BP branded gasoline service station is located across SE Sedgwick Road to the north of the subject property and a Chevron branded service station is located to the northwest across the intersection of SE Sedgwick Road and Bethel Road SE.

2.2 Site Background

The Site has been under investigation and remediation for soil and groundwater contamination since June 1990, at which time Ecology detected elevated levels of gasoline constituents in domestic drinking water wells located down gradient of the subject property. The soil and groundwater contamination was attributed to a historic release from an underground storage tank (UST) system associated with a Texaco service station formerly located on the subject property. In August 1991, Ecology conducted a groundwater contamination assessment at the subject property and adjacent properties to the south. The assessment included the sampling of domestic drinking water wells in the Site and the installation of eight monitoring wells (MW-1D, MW-1S, MW-2D, MW-2S, MW-101, MW-102, MW-103, and MW-104) to collect soil and groundwater samples. Assessment results indicated benzene, toluene, ethylbenzene, and total xylenes (BTEX) and gasoline-range organics (GRO) in soil and groundwater at concentrations above Ecology's Model Toxics Control Act (MTCA) Method A cleanup levels. Benzene and total xylenes were also detected at elevated concentrations in two nearby domestic drinking water wells. Ecology reported the presence of light non-aqueous phase liquid (LNAPL) in on-Site monitoring wells. The likely source of the groundwater contamination plume was identified as a historical release from a UST system associated with a Texaco branded service station formerly located on the subject property.

An on-Site remediation system installed by Ecology operated from July 1995 through April 1998 (Ecology, 1998). The remediation system consisted of a LNAPL recovery system, a soil vapor extraction (SVE) system, an air-sparging (AS) unit, an off-gas vapor treatment unit, and a mechanism to inject hydrogen peroxide into groundwater. Ecology reported its remediation system recovered a total of approximately 19 gallons of LNAPL and approximately 4,600 pounds of petroleum hydrocarbon vapors from the Site's subsurface between 1995 and 1998. All LNAPL reportedly had been removed prior to system(s) deactivation in April 1998. Ecology stated that the groundwater plume was restricted to the subject property in the vicinity of monitoring well MW-103 and that gasoline in groundwater at the domestic drinking water wells had decreased steadily since initiation of the remediation system.

GN Northern conducted a Phase I Environmental Site Assessment (ESA) of the subject and surrounding properties in October 1998. Based on its results, GN Northern conducted a limited Phase II ESA in January 1999, to assess the potential for subsurface contamination in the vicinity of suspected heating oil UST locations at the subject property. Phase II ESA assessment results indicated that gasoline remained in soils and groundwater in the vicinity of the former Texaco service station at concentrations exceeding MTCA Method A cleanup levels. A soil and groundwater assessment was conducted southeast from the subject property, in the vicinity of the suspected heating oil UST locations, revealed evidence of minor soil and groundwater contamination, none of which appeared to extend on to the Site. At the request of Fred Meyer, AMEC conducted a subsurface assessment at the subject property in the vicinity of the former Texaco service station in June 1999, during the initial stages of the construction of a new Fred Meyer store. The assessment involved the completion of six direct-push soil borings (BH-20 through BH-25), six vapor test wells (VP-1 through VP-6), and four groundwater monitoring wells (MW-105 through MW-108). Following feasibility testing, AMEC designed and assisted in the installation of a new AS/SVE system, which was activated in March 2000 (AMEC, 2000a). During a Site visit in June 1999, approximately 1 liter of LNAPL as GRO was removed from monitoring well MW-103 by hand bailing. Measurable LNAPL was encountered in monitoring well MW-103 in August and November 1999, at thicknesses of 0.02 and

0.03 feet, respectively. An absorbent sock was installed in this well to remove remaining LNAPL.

From August 1999 through March 2000, three Ecology monitoring wells (MW-1-S, MW-1-D, and MW-104) were destroyed during construction activities on the subject property. In addition, AMEC decommissioned Ecology's remediation system in September 1999, and four Ecology AS wells (SP-1 through SP-4) in November 1999. From March through June 2001, three more monitoring wells (MW-106, MW-107, and MW-108) were destroyed during construction of the Fred Meyer retail fueling center and adjacent Bethel Road paving work. From June 2001 through September 2008, only monitoring wells MW-103 and MW-105 remained and were monitored as compliance points on a quarterly basis. In October 2008, four replacement groundwater monitoring wells (monitoring wells MW-108A, MW-109, MW-110, and MW-111) were installed to complete the Site's compliance monitoring point network (Figure 2).

The current *in-situ* AS/SVE remediation system at the subject property was installed from November 1, 1999 through January 26, 2000, and was activated on March 1, 2000. The system consists of 10 AS wells (AS-1 through AS-10), 5 new SVE wells (VES-1 through VES-5), and an aboveground compound. The in-place components of the system were installed throughout the area of expected soil and groundwater impact (the western portion of Pad C and the eastern edge of Bethel Road S.E.). Five of the AS wells and three of the SVE wells were installed vertically, with the remaining AS and SVE wells installed at an angle of approximately 45° from vertical (Figure 2). The aboveground compound controls and monitors all of the AS and SVE wells, the SVE air stream, and the SVE filter system. The SVE exhaust stream flows through a primary and secondary granular activated carbon (GAC) filter array prior to discharging into the atmosphere.

The near-surface soils in this vicinity generally consist of Vashon-age deposits. The hydrogeologic units typically consist of the shallow aquifer (Qvr), the Vashon till (Qvt) confining unit, and the Vashon aquifer (Qva). These units are commonly heterogeneous and locally discontinuous; Kahle (1998) provides the following descriptions and ranges of unit thickness typically found in areas of Kitsap County:

- Shallow aquifer (Qvr) – This discontinuous unconfined aquifer consists of sand, gravel, and silt and generally ranges from about 10 to 40 ft in thickness (with an average of 25 ft), where encountered. It is composed mostly of recessional outwash, but may include younger stream, beach, or landslide deposits.
- Vashon till confining unit (Qvt) – This low-permeability unit consists of compacted and poorly sorted silt, sand and gravel, although it may contain local water-bearing

lenses of sand and gravel. This unit generally ranges from about 10 to 100 ft in thickness, with an average encountered thickness of 45 ft.

- Vashon aquifer (Qva) – This aquifer consists of well-sorted sand or sand and gravel, with lenses of silt and clay. Most of the unit is unconfined; however, it is confined locally where it is fully saturated and overlain by till. The unit typically ranges from about 20 to 200 ft in thickness, with an average encountered thickness of about 100 ft. Most of the wells in the area tap this aquifer.

Shallow groundwater in the vicinity of the Site generally is encountered at depths of less than 30 feet below ground surface (bgs). Measurements conducted by AMEC at the Site from July 1999 through January 2010, indicate shallow groundwater fluctuates between 15 and 25 feet bgs. Groundwater flow at the Site is expected to be directed towards the southwest, towards an unnamed tributary of Blackjack Creek.

The hydraulic gradient observed between Site monitoring wells MW-109 and MW-111 is typically 0.10 vertical feet per lateral foot (ft/ft) based upon data collected in January 2010 (AMEC, 2010). The average hydraulic conductivity in the shallow fill varies between 0.04 and 100 ft/day (Thomas et. al. 1997).

2.3 Conceptual Site Model

The Conceptual Site Model (CSM) consists of potentially complete exposure routes for current receptors including the incidental ingestion of, dermal contact with, and/or inhalation of volatiles in affected soil or groundwater by construction/excavation workers identified as current or future potential receptors.

<u>Soil</u>

Cleanup Levels:

Groundwater at this Site has been impacted by the identified releases; therefore soil cleanup levels based on leaching (protection of groundwater) are appropriate. To establish soil concentrations protective of groundwater MTCA Method A cleanup levels were selected.

The Site does not meet the MTCA definition of an industrial property; therefore soil cleanup levels suitable for unrestricted land use will also need to be considered. For unrestricted land use, the soil cleanup level is based on the direct contact pathway and residential use. Again MTCA Method A levels were selected for this Site.

Points of Compliance:

The point of compliance based on the protection of groundwater is Site wide throughout the soil profile and may extend below the water table. For soil cleanup levels based on direct contact, the point of compliance is defined as throughout the Site from the ground surface to fifteen feet below the ground surface.

Groundwater

Cleanup Levels:

The groundwater at the Site is classified as potable to protect drinking water beneficial uses. Method A cleanup levels for potable groundwater were selected for this Site. Note: Method A groundwater cleanup levels will be protective of any other exposure pathway.

Point of Compliance:

The standard point of compliance for groundwater is throughout the Site from the uppermost level of the saturated zone extending vertically to the lowest depth which could potentially be affected.

Additional consideration to off-Site receptors was evaluated in November 1999 when utility cutoff collars were installed down gradient of the subject property, as described in the Environmental Activities during Sewer Line Construction report (AGRA 1999). Stormwater is collected through catch basins and piped into the municipal storm sewer located beneath SE Sedgwick and Bethel Road. Stormwater drainage on the roadway and sidewalk portions of the subject property is conveyed through pipes and/or ditch before entering a storm detention pond located south of the Site.

No known areas of particular environmental value, such as wetlands or critical habitat, are present at the Site. The simplified terrestrial ecological evaluation concluded for the Site indicated that no adverse affects are realized to the off-Site habitat quality or other urban wildlife species.

A description of the CSM and receptors potentially affected by residual contamination is provided in the RI Report.

3.0 CLEANUP REQUIREMENTS

This section presents a summary of the Site conditions as described in the RI Report, (AMEC 2010). The MTCA cleanup regulations provide that a cleanup action must comply with cleanup levels for identified COPCs, points of compliance, and applicable or regulatory requirements, based on federal and state laws (WAC 173-340-710).

Method A criteria was selected since the Site was subject to relatively routine cleanup actions based upon relatively few hazardous substances. The Site cleanup levels, points of compliance, and the applicable regulatory requirements for the selected cleanup remedy are briefly summarized in the following sections.

3.1 Human Health and Environmental Concerns

The COPCs at the Site may present a hazard to utility or construction workers who may come into contact with the petroleum-impacted soil and/or groundwater during any deep earth-disturbing activity. Potential exposure concerns also include direct contact with soil during use of the Site for residential uses and use of the groundwater for drinking water. Although there aren't any future development activities anticipated at the subject property, these activities could expose people to unsafe levels of the Site contaminants. Cleanup actions that meet MTCA Method A cleanup standards will address these potential exposure scenarios.

3.2 Indicator Hazardous Substances

Under MTCA, "indicator hazardous substances" means the subset of hazardous substances present at a Site for monitoring and analysis during any phase of remedial action for the purpose of characterizing the Site or establishing cleanup requirements for that Site. Ecology may eliminate consideration of those hazardous substances that contribute a small percentage of the overall threat to human health and the environment at a Site that is contaminated with a relatively large number of COPCs (WAC 173-340-703). The remaining COPCs can then serve as indicator hazardous substances for purposes of defining Site cleanup requirements.

GRO and related BTEX compounds are the primary COPCs at the Site. Low levels of DRO were detected in groundwater sampled from several borings, but these detections appear to be overlap of weathered GRO into the diesel range. The gasoline additives EDB, EDC, and MTBE were not detected in groundwater collected from the source area or at locations down gradient and cross gradient from the source area, however the laboratory detection limits were not sufficient to determine if EDB is present or not at the Site. EDB will have to be monitored during compliance monitoring to make a final determination. Naphthalene has not been detected in groundwater at concentrations exceeding the MTCA Method A cleanup level since 2002. In general, GRO and BTEX have been used as the indicator hazardous substances in subsurface soil and groundwater beneath the Site. Additional compliance monitoring may be required for DRO and other constituents, consistent with the monitoring requirements listed in MTCA Table 830-1.

3.3 Cleanup Levels

Cleanup standards consist of 1) cleanup levels that are protective of human health and the environment; and 2) the point of compliance at which the cleanup levels must be met. To eliminate receptor exposure to COPCs during Site development activities and to protect the soil and groundwater, the cleanup levels under MTCA Method A for unrestricted use were selected for the Site COPCs.

The primary COPCs identified at the Site include GRO and BTEX. While these contaminants may not represent the total hazard from this Site, treatment to MTCA Method A cleanup standards will include the removal of the other petroleum-related compounds. Historical and current chemical analytical test results for soil and groundwater are summarized in the RI Report (AMEC, 2010). Table 1 presents the list of COPCs and the associated MTCA Method A cleanup levels.

3.4 Points of Compliance

Under MTCA, the point of compliance is the point or location on a Site where the cleanup levels must be attained. In accordance with WAC 173-340-740(6)(d) and WAC 173-340-7490(4)(b), the standard point of compliance for the soil and groundwater cleanup levels is shown in Table 1. As indicated above for soil, the point of compliance based on the protection of groundwater (leaching) is Site-wide throughout the soil profile and may extend below the water table. For soil cleanup levels based on direct contact (both human and ecologic species), the point of compliance is defined as throughout the Site from the ground surface to 15 feet below the ground surface. The most stringent level is used. In this case the Method A level would be throughout the soil profile.

For groundwater the standard point of compliance is throughout the Site from the uppermost level of the saturated zone extending vertically to the lowest depth which could potentially be affected. The extent of the groundwater plume has been reduced to an area limited to the northwest corner of the property where concentrations or GRO and BTEX in groundwater are generally less than MTCA Method A cleanup levels. The periodic detections of GRO and BTEX compounds (particularly benzene) at concentrations exceeding the MTCA Method A cleanup levels are attributed to fluctuations in the water table and subsequent remobilization of residual contamination trapped in soil at depths at or near the vadose zone/groundwater interface. Down gradient monitoring wells MW-108A and MW-111, located within the Bethel Road SE ROW, serve as off-property monitoring points.

3.5 Remedial Action Objectives

The overall remedial action objective (RAO) is to protect human health and the environment. RAOs form the basis for developing and evaluating remedial actions because the selected remedy must meet Site-specific RAOs.

The purpose of the following abbreviated FS portion of the CAP is to evaluate cleanup alternatives and technologies according to MTCA rules contained in WAC 173-340-360. Included in MTCA are minimum criteria for cleanup alternatives, preference for permanent cleanup alternative, and the process for making these decisions.

The RAOs consist of:

- Protect current and future residential exposure to soil contaminants.
- Protect current and future beneficial use of groundwater, by attaining groundwater cleanup levels.
- Attain cleanup levels and within a reasonable time frame.
- Continue to operate to implement the interim remedial action measure to meet the cleanup levels indicated or until IRAM is no longer effectively achieving progress towards cleanup and final selected remedial action is approved and implemented.
- Attain TPH cleanup levels in soil and groundwater at the Site.

The remedial objectives can be achieved by eliminating or mitigating exposure pathways to humans and by eliminating or reducing petroleum hydrocarbon concentrations in Site soil and groundwater.

3.6 Applicable Regulatory Requirements

In addition to the cleanup standards developed through the MTCA process, other regulatory requirements must be considered in the selection and implementation of the cleanup action. MTCA requires the cleanup standards to be "at least as stringent as all applicable state and federal laws" [WAC 173-340-700(6)(a)]. Besides establishing minimum requirements for cleanup standards, applicable federal, state, and local laws and ordinances may also impose certain technical and procedural requirements for performing cleanup actions. These requirements are described in WAC 173-340-710.

The following regulations apply to the soil and groundwater media at the Site, the health and safety of workers conducting cleanup actions at the Site, and the wastes generated by the cleanup action:

- The final disposition of the petroleum-impacted soil originating from the Site will be evaluated using Ecology's Guidance for Remediation of Petroleum Contaminated Soils under WAC 173-340 and -360 (1995).
- The Department of Labor has published final rules (29 CFR Part 1910.120, March 6, 1990) that amend the existing Occupational Safety and Health Administration (OSHA) standards for hazardous waste operations and emergency response. Within the State of Washington, these requirements are addressed in WAC 296-843, Hazardous Waste Operations. These regulations apply to the activities to be performed at this Site as remediation, or cleanup, under the Federal Resource Conservation and Recovery Act of 1976 and/or the MTCA. The protocols described in a health and safety plan are designed to ensure compliance with state and federal regulations governing worker safety on hazardous waste sites, and the protection monitoring requirements of the MTCA found at WAC Chapter 173-340-410.
- The Port Orchard Municipal Code Title 16, "Land Use Regulatory Code" is required for any development and building permitting at the Site.
- Water Quality - The federal Water Pollution Control Act (a.k.a., the Clean Water Act [CWA]) created programs for permitting wastewater discharges to surface water or to publicly owned treatment works (POTWs). Related Washington regulations are found in WAC 173-220. Discharge of wastewater, such as condensate from a SVE system, to a POTW is considered an off-Site activity. Remedial responses including discharges to a POTW must comply with National Pretreatment Program regulations as well as local POTW requirements. Recovered groundwater is not currently discharged to the local POTW, but it is considered later in this report as a potential remedial technology component of remedial action alternatives. Through the Underground Injection Control (UIC) program, Safe Drinking Water regulations also control the discharge of water, such as treatment solutions, into aquifers. Washington UIC regulations are found in WAC 173-218.
- Air Quality - Applicable for Site excavation work that could generate dust. Controls would need to be in place during construction (e.g., wetting or covering exposed soils and stockpiles), as necessary, to meet the substantive restrictions on off-Site transport of airborne particulates by the local agency. In addition, regardless of whether any VOCs are emitted during treatment, air quality must be considered in accordance with the 1990 Amendments to the Federal Clean Air Act 40 CFR part 70 and Washington Clean Air Act contained in WAC Chapter 173-401.
- General Environment - SEPA applies to cleanup actions that may affect the environment. MTCA cleanup actions are not exempt from SEPA procedures and

Ecology is required to use a SEPA checklist to determine if a proposed cleanup action will or will not have a significant adverse impact on the environment. If Ecology determines that there is no impact, Ecology issues a Determination of Nonsignificance (DNS) or a mitigated DNS with conditions.

- Monitoring Well Network - Ecology enforces rules for the construction, maintenance, and abandonment of monitoring and other types of wells in Washington (WAC 173-160), including injection wells.

4.0 REMEDIAL ALTERNATIVES CONSIDERED

This section summarizes the cleanup technologies and alternatives considered, and the basis for selection of the site-wide remedy. **For the purposes of evaluating the Site-wide remedial strategy, each of the technologies were considered individually, assuming full-scale implementation of the remedial alternative in year 1998; since that was the time period in which the original remediation system was destroyed and the magnitude and extent of impacted soil and groundwater defined.** It should be noted, however, that an IRAM system, consisting of an AS and SVE system has been operating periodically at the Site since year 2000. Figures 3 and 4 depict the extent of the groundwater and soil contamination during the time-frame that remedial action was implemented at the Site, as a basis for comparison between all remedial technologies.

Several remedial alternatives are possible for soil treatment and/or groundwater treatment at the Site. Specific technologies identified for impacted soil include the following:

- Monitored Natural Attenuation (MNA);
- Low-permeability cap;
- Excavation and landfill disposal;
- Excavation and volatilization treatment;
- Excavation and biological treatment;
- Excavation and thermal treatment;
- Excavation and soil washing;
- Excavation and chemical treatment;
- In-situ soil vapor extraction (SVE);
- In-situ biological treatment;

- In-situ recirculating bioremediation wells;
- In-situ soil flushing;
- In-situ thermally enhanced sparging; and
- In-situ chemical treatment.

The technologies identified for initial screening evaluation for groundwater consisted of the following:

- Monitored Natural Attenuation;
- Institutional controls and groundwater monitoring;
- Containment - vertical barriers;
- Groundwater recovery and treatment using horizontal well(s);
- Groundwater recovery and treatment using trench(es);
- Dual phase extraction;
- Biological treatment using ORC® to increase dissolved oxygen (DO);
- In-situ air sparging (AS);
- In-situ steam flushing;
- In-situ passive treatment - reactive walls; and
- In-situ chemical oxidation (ISCO) treatment.

Other secondary technologies and engineering controls, such as utility cut-off collars, were evaluated for the Site to specifically address secondary impacts related to soil and groundwater treatment. Several of the technologies identified for soil, groundwater, and specific engineering controls are not suitable to meet the Site-specific RAO's. Also, limited Site characterization information was available to evaluate all of the above technologies. Therefore, these technologies were not included in the next steps required to identify a cleanup alternative for the Site. The following section describes site-specific data gaps and also describes additional details of technology retention.

4.1 Data Gaps

Data gaps exist which may be a limiting factor in evaluation of remedial technologies. The following are examples of data gaps specific to the Site:

- The contaminant release mechanism from the UST system is unknown (i.e., quantity, time, and duration).
- Density and mobility of free product that was known to be present at the Site in the 1990's.
- Soil parameters that would affect bioremediation or chemical injection, such as soil oxidant demand, presence of petroleum degrading colonies, and mineral content of soil.
- Aquifer parameters that would affect pumping or injection-related technologies, such as hydraulic conductivity.

Consideration of these data gaps were used in the selection and screening of the cleanup action alternatives presented herein. Subsequently, the removal of the contaminant source (i.e., former Texaco UST system and LNAPL) was considered paramount in restoring subsurface conditions to levels protective of human health and the environment. In addition, the frequency and duration of post-cleanup action monitored natural attenuation are based on experience and professional judgment. This effort attempted to strike a balance between reasonably conservative and optimistic assumptions.

4.2 Identification and Development of Cleanup Alternatives

Cleanup technologies identified to address the site-specific RAO identified above are presented in Table 2. Each of the technologies identified in Table 2 were qualitatively assessed for effectiveness, implementability, and reasonableness of cost to identify which of the technologies to retain for further analysis. These preliminary screening factors are described in Appendix A. Based on specific advantages, the following technologies were retained:

General Response Actions

- No Action
- Activity Restrictions
- Utility Cut-off collars

Petroleum Free Product

- Product Skimming
- Excavation

Petroleum Impacted Soil

- Excavation
- Soil Vapor Extraction (SVE)

Petroleum Contaminated Groundwater

- Groundwater Extraction with Ex-Situ Treatment (GWE)
- Air Sparging (AS) with SVE
- Monitored Natural Attenuation (MNA)
- Oxidant Injection with Iron Activated Sodium Persulfate

The retained technologies were assembled into three separate cleanup action alternatives (Alternative No. 2 through No. 4) that include combinations of the retained technologies. Alternative No. 1 (No Action) was included for purposes of comparison and does not constitute a cleanup action to unrestricted MTCA Method A cleanup levels. Cleanup action alternatives were identified by arranging the retained components into sequential treatment approaches designed to achieve cleanup standards. In general, the order of selected alternatives ranks from least likely to meet the site-specific RAO within a reasonable time frame (i.e., Alternative No. 1 - No Action) to most likely and permanent action (i.e., Alternative No. 4 - Physical Destruction of Groundwater COPCs and Removal of All Accessible Petroleum-Impacted Soil). Table 3 provides descriptions of the cleanup action alternatives, and provides additional information regarding design assumptions, additional unknowns that may affect the design assumptions, and advantages and disadvantages associated with each alternative. In accordance with WAC 173-340-350(8)(b)(ii)(A) the cleanup action selection process (i.e., feasibility study) includes at least one permanent cleanup action alternative to serve as a baseline against which other alternatives are evaluated for the purposes of determining whether the cleanup action selected is permanent to the maximum extent practicable. Alternative No. 4 was identified as the "Most Practicable Permanent Cleanup Action".

An unknown associated with each cleanup action alternative is the relative success, duration, and frequency of compliance monitoring, if applicable, following implementation of these baseline cleanup action components. During compliance monitoring, additional reductions of COPC concentrations may occur through natural processes such as biodegradation, diffusion, dispersion, hydrolysis, and sorption. Natural attenuation can be an effective long-term method for mitigating risks. Typical goals for MNA are demonstrated decreases in contaminant mass, toxicity, mobility, volume, or concentrations. Progress toward natural attenuation is typically demonstrated through long-term groundwater quality monitoring. Although a formal MNA monitoring program has not been included as a component to many of the alternatives evaluated, natural attenuation may be occurring throughout the period of compliance monitoring indicated for several of the remedial alternatives. The actual occurrence of natural attenuation required at the Site will have an impact on the costs.

Costs were developed for the Site, based on the design assumptions listed in Table 3. A summary of the cost breakdown for each of the remedial alternatives is presented in Appendix B. The net present value of future costs associated with the various treatment system operation/maintenance and MNA durations was calculated assuming an interest rate of 2% after inflation.

4.2.1 Alternative 1 - No Action

Alternative 1 consists of no action. The assumptions for Alternative one include installation of institutional controls to restrict current/future groundwater use and excavation activities in the Site, as well as to decommission the existing monitoring well network at the Site (Figure 2).

4.2.2 Alternative 2 - SVE and GWE

An SVE system would be installed that includes the installation of up to six, 10-foot deep vertical SVE wells throughout the impacted vadose zone area (Figure 4). Two skimmer pumps would be installed at the Site for free product recovery. The SVE system design is based on air flow rates of approximately 60 cubic feet per minute (cfm) at an applied vacuum pressure of 40 inches of water. For groundwater treatment the alternative considers the installation of four 4-inch diameter GWE wells along the down gradient perimeter of the groundwater plume producing a total maximum extracted flow rate of 16 gallons per minute (gpm). Conveyance piping would be trenched up to 300 feet (in total length) to route the lines to a common treatment compound. Extracted soil vapor and groundwater would be treated through adsorption using GAC vessels (i.e., four-1,000-pound adsorbers for recovered liquids and two 1,000-pound GAC adsorbers for recovered vapors). The treated groundwater would be discharged to the municipal storm system under an approved NPDES discharge permit.

Alternative 2 assumes that GWE would be performed for a 10-year period with quarterly groundwater quality monitoring, followed by another 10 years of semiannual groundwater quality monitoring before groundwater cleanup levels are achieved. Compliance monitoring would be conducted at the Site for an additional 2 years at 6 wells to verify cleanup levels were achieved at the Site and one round of soil confirmation sampling, followed by system decommissioning.

4.2.3 Alternative 3 - AS/SVE

One components of Alternative 3 is the same as Alternative 2, the installation of two skimmer pumps for free product removal. In addition, bentonite utility cut-off walls would be installed at up to four locations adjacent to the subject property to reduce the potential for constituent migration within shallow perched groundwater along the existing utility corridors. The petroleum impacted soil and groundwater would be treated through the installation and operation of an AS and SVE. The AS and SVE system includes installation of up to 17, 25-foot deep AS wells and six 10-foot deep vertical SVE wells throughout the impacted soil (Figure 4) and groundwater (Figure 3) areas. The system would be capable of an injection flow rate of approximately 5 cfm per AS well at up to 10 pounds per square inch of pressure. The SVE system design is based on air flow rates of approximately 60 cfm at an applied vacuum pressure of 40 in. (water). Conveyance piping would be trenched up to 300 feet (in total length) to route the lines to a common treatment compound. SVE vapors would be treated through GAC vessels for the duration of the system operation, anticipated to be up to 10 years to meet the treatment requirements, with two additional years of compliance monitoring. One round of soil confirmation sampling would be performed, followed by system decommissioning.

4.2.4 Alternative 4 - Excavation of Hot Spot Soils and ISCO of Impacted Groundwater

One component of Alternative 4 is the same as Alternative 3; the implementation of bentonite utility cut-off walls at up to four locations adjacent to the subject property to reduce the potential for constituent migration within shallow perched groundwater along the existing utility corridors during remedy implementation. Soil with elevated levels of petroleum hydrocarbons near the former Texaco UST system would be addressed through excavation and off-site disposal. The petroleum-impacted groundwater area shown in Figure 3 would be treated via the direct injection of a strong chemical oxidant through an injection network of up to 24 locations on 16-foot centers to depths ranging from 20 to 25 feet bgs.

Oxidant injection assumes roughly 23,000 pounds of iron activated sodium persulfate during two primary rounds and one polish injection event through permanent wells. Monitoring events would be performed at the Site after 30 and 45 days following the two primary events and after 45 and 60 days following the polish round. Following excavation and treatment, groundwater would be monitored at the Site for two years quarterly. Alternative 4 is based on the assumption that the monitoring well network would be decommissioned after two years of compliance monitoring and a final round of soil confirmation sampling.

4.3 Detailed Evaluation of Cleanup Action Alternatives

This section presents a detailed analysis of selected remedial action alternatives for the Site. Each potential remedial action alternative is evaluated according to the requirements of using permanent solutions to the maximum extent practicable (WAC 173-340-360(5)), providing for a reasonable restoration time frame (WAC 173-340-360(6)), and considering public concerns raised during public comment on the Final Draft cleanup action plan (WAC 173-340-360 (10) through (13)).

4.3.1 Evaluation Criteria

The evaluation criteria consist of MTCA threshold requirements listed in WAC 173-340(2)(a) and (b)), as well as several criteria for disproportionate cost analysis, described in the following sections.

Threshold Requirements

MTCA cleanup alternatives must meet four minimum requirements. A cleanup action must:

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

All of the soil and groundwater alternatives evaluated in this report have been developed to meet these four minimum requirements.

Other MTCA Requirements

After meeting the minimum requirements, MTCA requires that a cleanup action alternative meet three other requirements:

- Use permanent solutions to the maximum extent practicable;
- Provide for a reasonable restoration time frame; and
- Consider public concerns.

MTCA requires permanent cleanup actions to the maximum extent practicable. To determine if a cleanup action uses permanent solutions to the maximum extent practicable alternatives are evaluated using a "disproportionate cost analysis" as specified in WAC 173-340-360(3)(e).

MTCA Disproportionate Cost Analysis

The evaluation of the alternatives was based on MTCA's disproportionate cost analysis (DCA) that identifies which of the alternatives meeting MTCA threshold requirements is permanent to the maximum extent practicable. This analysis compares the relative benefits and costs of cleanup alternatives in selecting the alternative whose incremental cost is not disproportionate to the incremental benefits.

The seven criteria used in the DCA, as specified in WAC 173-340-360(2) and (3), are:

- Protectiveness
- Permanence
- Cost
- Long-term effectiveness
- Short-term risk management
- Implementability
- Consideration of public concerns

Costs are disproportionate to benefits if the incremental costs of a more-permanent alternative is greater than the incremental degree of benefits achieved by that alternative over that of lower cost alternatives (WAC 173-340(3)(e)(i)).

Protectiveness. An alternative's ability to achieve protectiveness is a key factor. Overall protectiveness includes the degree of overall risk reduction, the time required to reduce risk and attain cleanup levels, and the improved overall quality of the environment at a Site.

Permanence. The long-term success of an alternative can be measured by the degree to which an alternative permanently reduces the toxicity, mobility, or volume of hazardous substances, including the originally contaminated material and post-treatment residual materials.

Cost. Cost considerations include design, construction, and installation costs; the net present value (NPV) of long-term costs; and agency oversight costs. Long-term costs include operation and maintenance, monitoring, equipment replacement, and maintaining institutional controls.

Long-term Effectiveness. An alternative's long term effectiveness is based on the reliability of treatment technologies to meet and maintain cleanup levels, and if using engineering or institutional controls, on their reliability to manage residual risks. Long term reliability is also influenced by uncertainties associated with potential long term risk management.

Short-term Risk Management. Short-term risk evaluates the risk posed by the cleanup action during its implementation (including construction and operation), based on potential impacts to the community, workers, and the environment, and the effectiveness and reliability of protective or mitigation measures.

Implementability. An alternative's implementability is evaluated on the basis of whether it is easy or difficult to implement depending on practical, technical, or legal difficulties that may be associated with construction and implementation, including scheduling delays. Implementability also depends upon the ability to measure the remedy's effectiveness and its consistency with MTCA and other regulatory requirements.

Consideration of Public Concerns. Potential public concerns, whether from individuals, community groups, local governments, tribes, and federal and state agencies, about a proposed cleanup alternative are addressed by means of MTCA's public involvement process during Ecology's remedy selection process.

5.0 SELECTED SITE CLEANUP ACTION

Table 4 summarizes the results of the final screening process. Each alternative has been assigned a numerical score relative to the balancing factors. The results of this numerical scoring process and qualitative evaluation indicate that Alternative No. 3 (AS/SVE) is the most protective, permanent, and effective cleanup action for meeting the site-specific RAO (i.e., meet soil and groundwater MTCA Method A cleanup levels) within a reasonable timeframe.

6.0 CLEANUP ACTION IMPLEMENTATION AND PERFORMANCE MONITORING

The following interim remedial action measures have been implemented at the Site to date to achieve cleanup:

- Implementation of Selected Cleanup Action; and
- Compliance monitoring.

The components are described in the following sections.

6.1 Implementation of the Selected Cleanup Action

Several components of the selected cleanup action have been implemented successfully at the Site to achieve Site-wide cleanup. The AS/SVE system and Utility protection activities were implemented as Interim Remedial Action Measures.

Interim Remedial Action Measures

The current *in-situ* AS/SVE remediation system at the subject property was installed from November 1, 1999 through January 26, 2000, and was activated on March 1, 2000. The system consists of 10 AS wells (AS-1 through AS-10), 5 new SVE wells (VES-1 through VES-5), and an aboveground compound. The in-place components of the system were installed throughout the area of expected soil and groundwater impact (the western portion of Pad C and the eastern edge of Bethel Road S.E.). Five of the AS wells and three of the SVE wells were installed vertically, with the remaining AS and SVE wells installed at an angle of approximately 45° from vertical (Figure 2). The aboveground compound controls and monitors all of the AS and SVE wells, the SVE air stream, and the SVE filter system. The SVE exhaust stream flows through a primary and secondary granular activated carbon (GAC) filter array prior to discharging into the atmosphere.

Beginning in August 2002, the AS component of the groundwater treatment system became inoperative as a result of damages incurred during construction of the Fred Meyer branded fuel station. The SVE system was operated at a limited capacity during this period. In June 2006, the SVE system became completely inoperative following further damage to its aboveground components.

An assessment of the combined AS/SVE system was conducted during a Site visit during June 2008. Following evaluation of the new Site assessment activities, two new SVE blowers, a condensate trap, and two rebuilt AS compressor heads were installed, and the dual AS/SVE systems were reactivated in February 2009. Shortly following system startup, AMEC measured and/or recorded vacuum pressure, air velocity and vapor level (using a PID) in each SVE conveyance line, as well as flow rate in each AS conveyance line.

The restoration of the groundwater monitoring well network and AS/SVE remediation system involved a series of four sequential phases of work completed by AMEC from August 2008 through February 2009. The first task or phase of work was conducted in August 2008 and employed direct-push drilling technology to obtain information regarding residual petroleum hydrocarbon impacts to soil and groundwater remaining from the former Texaco UST system. A second phase of work was conducted in October 2008 and included the installation of four replacement groundwater monitoring wells. A third phase of work included the collection of groundwater quality data from the new monitoring well network (a total of six wells) in January 2009. The previously collected subsurface soil data and groundwater quality data were then used to guide decisions regarding which components of the AS/SVE remediation system to repair and reactivate. Lastly, a fourth phase of work was conducted in February 2009 and included replacement of the AS equipment (compressors, pressure tank, and condensate trap) and reactivation of the dual treatment system and two new SVE blowers (Gast SVE blowers (Model R7100A-3).

6.2 Compliance Monitoring

There are three types of compliance monitoring identified for interim or remedial cleanup actions performed under MTCA (WAC 173-340-410): Protection, Performance, and Compliance Monitoring.

The definition of each is presented below (WAC 173-340-410 [1]):

- Protection Monitoring -To confirm that human health and the environment are adequately protected during construction and the operation and maintenance period of an interim action or cleanup action as described in the safety and health plan.
- Performance Monitoring - To confirm that the cleanup action has attained cleanup standards and other performance standards such as construction quality control measurements or monitoring necessary to demonstrate compliance with a permit or, where a permit exemption applies, the substantive requirements of other laws.
- Confirmation Monitoring - To confirm the long-term effectiveness of the cleanup action once cleanup standards and other performance standards have been attained.

This cleanup action involves all three monitoring types. Each type is discussed here.

6.2.1 Protection Monitoring (Completed)

A site-specific health and safety plan (HASP) was been prepared for the Site work conducted under the interim cleanup action implemented at the Site that met the minimum requirements for such a plan identified in federal (Title 29 CFR, Parts 1910.120, and 1926) and state regulations (WAC Title 296).

Protection monitoring completed at the Site included personal and perimeter air sampling for VOCs during performance of routine system operation and maintenance. The frequency of sampling and period of monitoring for personal air sampling was established in the HASP.

6.2.2 Performance Monitoring (Ongoing)

The objectives for performance monitoring are to demonstrate compliance with the MTCA cleanup regulations and to document the Site conditions upon completion of the cleanup action. To demonstrate such compliance, the confirmation performance monitoring activities for soil and groundwater have been conducted to confirm that cleanup levels have been achieved. AMEC continues to complete quarterly groundwater quality monitoring in the Site's six compliance monitoring wells, as well as quarterly operations and maintenance monitoring of the AS/SVE systems. Groundwater compliance monitoring locations were described in the Restoration of Groundwater Monitoring Well Network and Remediation System, and Fourth Quarterly 2008 Monitoring Results Report (AMEC, 2009a).

Soil

During October 2008, the findings of the direct-push assessment were used to select appropriate locations for installing new groundwater monitoring wells MW-108A, MW-109, MW-110 and MW-111 to replace previously existing wells (MW-104, MW-106, MW-107 and MW-108) that were inadvertently damaged during 1999 and 2000 property redevelopment activities. Four soil samples collected from the newly installed monitoring well borings were analyzed for petroleum hydrocarbon identification by NWTPH-HCID, with follow-up analysis for GRO and BTEX compounds on the soil sample collected from boring MW-110 at a depth of 20 to 25 feet bgs. GRO were detected in one on-Site soil sample located near the vadose zone/water interface (smear zone) at a concentration (300 mg/kg) exceeding the MTCA Method A Cleanup Level for GRO in soil in monitoring well MW-110 boring completed near the former Texaco UST system (i.e., source area). Benzene was not detected at a concentration exceeding the method reporting limit in this source area boring indicating that the AS/SVE has been effective in removing most of the volatile contaminant fraction.

Toluene (0.85 mg/kg), ethylbenzene (2.0 mg/kg) and total xylenes (5.3 mg/kg) were detected at concentrations less than the respective MTCA Method A cleanup levels in the MW-110 soil sample. Direct-push borings B-11, B-12, and B-14 were conducted within the central portion of the groundwater plume to evaluate groundwater conditions in the source area. Field screening evidence of minor petroleum impacted soil was observed in borings B-12 and B-14 between depths of 18 and 22 feet bgs (smear zone).

Groundwater

Groundwater performance monitoring has been conducted quarterly at the Site monitoring wells since year 2000. Currently, six compliance monitoring wells are sampled for COPCs on a quarterly basis. In general, the groundwater samples were analyzed for the presence of GRO and VOCs, including BTEX compounds, EDC, EDB, MTBE and naphthalene.

The extent of the groundwater plume has been reduced to an area limited to the northwest corner of the Site and bounded by monitoring well MW-110 and boring B-14 to the northwest, monitoring well MW-109 and boring B-12 to the east, and monitoring well MW-103 to the south (Figure 3). Recent groundwater monitoring results suggest the residual concentrations of GRO and BTEX compounds within the plume are generally less than MTCA Method A cleanup levels. However; concentrations of GRO and BTEX compounds in excess of the MTCA Method A cleanup levels may be present in localized areas within the remaining plume and periodically detected as evidenced by the recent detections of GRO at a concentration of 1,320 µg/L in monitoring well MW-103 (January 2010) or benzene at a concentration of 27.4 µg/L in monitoring well MW-109 (June 2009). The periodic detections of GRO and benzene at concentrations exceeding the MTCA Method A cleanup levels may be attributed to fluctuations in the water table and the resulting remobilization of residual contamination trapped in soil within the smear zone. This response to groundwater changes indicates that soil contamination still exceeds the appropriate cleanup levels. In addition groundwater is also considered contaminated and not meeting cleanup levels. GRO and BTEX concentrations detected in groundwater sampled from monitoring wells MW-103, MW-109 and MW-110, which are located near the former source area, have generally decreased since reactivation of the AS/SVE in February 2009. GRO and VOCs have generally not been detected during recent groundwater monitoring events in monitoring wells located outside and down gradient of the source area (i.e., MW-105, MW-108A, and MW-111).

Neither measurable LNAPL nor a petroleum-related sheen has been detected in the Site's compliance monitoring wells (MW-103, MW-105, MW-108A, MW-109, MW-110 and MW-111) during recent monitoring events.

Subsurface Remediation Systems

The subsurface remediation systems will be monitored routinely for performance to demonstrate that mass removal is occurring at the Site and cleanup objectives are being achieved through mass removal. Additional performance monitoring will be conducted to provide evidence supporting the effectiveness of treating the subsurface via the AS/SVE system.

Continued operation of the AS/SVE system is expected to further reduce the residual concentrations of GRO and benzene present in source area groundwater over time. Based on PID measurements and air flow readings in the SVE exhaust stack, the vapor extraction system is currently removing less than 0.1 pounds per day of VOCs from the Site vadose zone. It appears that the SVE system has removed over 1,000 pounds of the more mobile fraction petroleum contamination since startup in 2000. The remaining contamination is less volatile and more strongly adsorbed to semi-saturated soil located from 18 to 22 feet below ground surface. Therefore, biodegradation has become the dominant factor in treating residual contamination in the smear zone. Dissolved oxygen (DO) levels in groundwater have increased from less than 1 mg/L to approximately 6-8 mg/L in most of the Site's monitoring wells since reactivation of the AS system in February 2009. Increased DO levels in groundwater are expected to increase the rate of biodegradation of residual petroleum contamination beneath the Site.

The AS/SVE system will continue to operate on an intermittent or continuous basis until four consecutive quarters of GRO and BTEX concentrations within MTCA Method A cleanup standards are achieved in all Site monitoring wells (including source area wells MW-103, MW-109 and MW-110). At this time, it is not anticipated having to add additional AS/SVE wells within the source area to meet the identified cleanup standards by approximately 2012. However, the results of continued quarterly groundwater monitoring (i.e., GRO, BTEX and anions/cations) will ultimately dictate whether additional *in-situ* treatment wells and/or approaches are required to achieve MTCA Method cleanup standards in source area soil and groundwater within a reasonable timeframe.

6.2.3 Confirmation (Post-Remediation) Monitoring

Post-remediation confirmation monitoring is anticipated for the Site groundwater following deactivation of the AS/SVE system to assess potential rebound. It is estimated that quarterly confirmation groundwater monitoring will be conducted in the Site's six monitoring wells for GRO and BTEX for a period of two years following deactivation of the AS/SVE system. Site cleanup will be deemed complete when GRO and BTEX concentrations in groundwater samples obtained from the Site's six compliance wells are all below MTCA Method A standards for a minimum of four consecutive quarters. It is assumed that once concentrations of GRO and BTEX in groundwater from all Site monitoring wells remain below MTCA Method A cleanup standards that impacted source area soil (i.e., MW-103, MW-109 and MW-110) located within the smear zone will too have been remediated to MTCA Method A cleanup standards.

One round of soil confirmation sampling will be completed at the Site after groundwater has been shown to meet the Cleanup Levels for the Site. The final confirmation sampling will be completed in accordance with an approved Work Plan.

7.0 IMPLEMENTATION SCHEDULE

On-going operation of the AS and SVE systems will be conducted and quarterly groundwater monitoring will be conducted until COC levels are brought to levels within MTCA level A cleanup levels.

The quarterly reports will describe the results of the remedial activities conducted on-Site to allow Ecology to evaluate whether the cleanup action meets the substantive requirements set forth in WAC Chapter 173-340.

The cleanup action described in this CAP will be completed within a reasonable time.

REFERENCES

AGRA Earth & Environmental, Inc., 2000. Draft Subsurface Exploration and Remediation System Installation Report, Fred Meyer Property, Port Orchard, Washington. July 2000.

AMEC Earth & Environmental, Inc. 2004a, Quarterly Site Report Third Quarter 2003, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., February 2004.

AMEC Earth & Environmental, Inc. 2004b, Quarterly Site Report Fourth Quarter 2003, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., August 2004.

AMEC Earth & Environmental, Inc. 2009a, Restoration of Groundwater Monitoring Well Network and Remediation System, and Fourth Quarterly 2008 Monitoring Results Report, Prepared for Fred Meyer Stores, Inc., July 15, 2009.

AMEC Earth & Environmental, Inc. 2009b, Quarterly Site Report Fourth Quarter 2009, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Lust File #J5E03, Prepared for Fred Meyer Stores, Inc., March 2010.

AMEC Earth & Environmental, Inc., 2010, Quarterly Site Report, Fourth Quarter 2009, Fred Meyer Property, 1900 SE Sedgwick Road, Port Orchard, Washington, Ecology Site ID #2555; Submitted to Fred Meyer Stores, Inc., April 2010.

GN Northern, Inc., 1998. Report of Phase I Environmental Site Assessment: Proposed Fred Meyer Site Southeast of Bethel Road and SE Sedgwick Road, Port Orchard, Washington. October 1998.

GN Northern, Inc., 1999. Phase II Environmental Site Assessment of 24.32 Acre Fred Meyer Development Site Bethel Road S.E. and Sedgwick Road S.E., Port Orchard, Washington. February 5, 1999.

Molenaar, Dee, 1962. Geologic Map and Diagrammatic Sections of the Kitsap Peninsula and Certain Adjacent Islands. State of Washington Department of Conservation, Division of Water Resources, 1962.

Thomas, B.E., J.M. Wilkinson, and S.S. Embrey, 1997. The Ground-Water System and Ground Water Quality in Washington. US Geological Survey Water-Resources Investigations Report 96-4312, Washington State Department of Ecology, 1998. Remediation - Progress Report Summary: Bethel Well - Bethel Road and Sedgwick, Port Orchard, Washington. October 1998.

Washington State Department of Ecology, 1999, Letter to David R. Walden, Prudential Northwest Real Estate. Bethel Former Texaco- 4831 Bethel Road SE, Port Orchard, Washington. February 19, 1999.

Washington State Department of Ecology, 2007. Model Toxics Control Act Statue and Regulation. Publication No. 94-06, November 2007. Compiled by Washington State Department of Ecology Toxics Cleanup Program.

Washington State Department of Ecology, 2009. Clean up Levels and Risk Calculations (CLARC) database. Retrieved online February 2, 2009 at https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx

TABLES

TABLE 1
Cleanup Levels
Fred Meyer Stores -Port Orchard Site
Ecology Site ID #96424236

Contaminants of Potential Concern (COPC) List			**MTCA Method A Table 720-1 (µg/L)**	**MTCA Method A Table 740-1 (mg/kg)**
Medium	CAS No.		Groundwater	Soil
Total Petroleum Hydrocarbon (TPH)				
Diesel Range Hydrocarbons	68334-30-5	--	500	2,000
Gasoline Range Hydrocarbons, with Benzene present	86290-81-5	--	800	30
Gasoline Range Hydrocarbons, without Benzene present	86290-81-5	--	1,000	100
Heavy Oils	8008-20-6	--	500	2,000
Select Volatile Organic Compounds (VOCs)				
Benzene	71-43-2	c	5	0.03
Ethylbenzene	100-41-4	c	700	6
Toluene	108-88-3	nc	1,000	7
Total Xylenes	1330-20-7	nc	1,000	9

Notes:
c = carcinogen
nc = noncarcinogen
µg/L = micrograms per Liter
mg/kg = milligrams per kilogram

TABLE 2
Qualitative Evaluation of Remedial Technologies
Fred Meyer Stores - Port Orchard Site
Ecology Site ID #96424236

General Response Action	Remedial Technology	Effectiveness	Implementability	Reasonableness of Cost	Retained?	Reason for Retaining or Eliminating
No Action	None	Low	High	High	Yes	Does not meet remedial action objectives, but will be used as a baseline to compare other alternatives.
Institutional Controls	Activity Restrictions	Medium	High	High	Yes	No long-term reduction of contaminant concentrations. To be used in conjunction with cleanup actions to break potentially complete exposure pathways (e.g., direct contact by trench worker and groundwater ingestion at water wells) if not cleaning up to MTCA A.
Engineering Controls	Utility Cut-Off Collars	High	High	High	Yes	Removes constituent migration off-site along utility corridors. Not currently applicable, however was implemented at the Site related to impacts discovered downgradient of the Site. May be combined with additional alternatives to remove the potential exposure pathway related to future off-site migration.
Petroleum Free Product						
Ex-situ Treatment Technologies						
Removal	Product Skimming	High	High	High	Yes	Effectively removes small volumes of free product from the subsurface immediately surrounding a well. Above-grade product containment and waste disposal required, causing additional handling requirements. Alternative retained because it was previously implemented at the Site to remove free product and may be combined with alternatives for evaluation considering the infrastructure that was present at the Site.
	Excavation	High	Medium	Medium	Yes	Significant reduction of free product mass in soil can be removed through excavation. Intrusive activities are disruptive to existing commercial business. Should be implemented in conjunction with groundwater remedy to avoid recontamination of the imported backfill.
	Dual Phase Extraction with Ex-Situ Treatment	High	Medium	Low	No	Can be effective in removing free product from subsurface (particularly fine-grained material), depending on the product density and mobility. Dual phase extraction may also influence groundwater impacts, groundwater gradient and flow direction, and provide hydraulic control against downgradient migration. However, there is insufficient contaminant mass (i.e., no free product remaining) to warrant to the cost to implement this technology.
In-situ Treatment Technologies						
Physical	Thermal Treatment (electrical resistive heating)	Medium	Low	Low	No	There is insufficient contaminant mass remaining to justify implementing this technology.
Petroleum Impacted Soil						
Ex-situ Treatment Technologies						
Removal	Excavation	High	Medium	Medium	Yes	Significant reduction of contaminant mass in source areas. Intrusive activities are disruptive to existing commercial business. Residual contaminant mass is located at depths between 18 and 22 feet bgs and would require shoring along adjacent ROWs. The PCS will be moved from the Site to another location where potential receptors may be present. Must be implemented in conjunction with groundwater remedy to avoid recontamination of imported backfill.
Biological	Landfarming	Low	High	High	No	Excavation and placement of contaminated soil in an area of controlled site conditions. A large space is required for an extended period of time for aerobic reduction of site contaminants. This cleanup action is not protective of human health and the environment.
In-situ Treatment Technologies						
Physical	Soil Vapor Extraction	Medium	Low	Low	Yes	Proven to be effective at reducing contaminant concentrations in vadose zone, but its effectiveness is reduced in lower permeability soils. Pilot-scale testing is required to determine actual area of influence. Promotes enhanced biodegradation to speed up remedy.
	Low Temperature Thermal Desorption	Medium	Low	Low	No	Cost prohibitive.
Biological	Bioventing	Low	High	High	No	Relatively long periods of time are required for aerobic reduction of site contaminants. This cleanup action is not protective of human health and the environment in the interim. This cleanup action has not been incorporated with the various remedial alternatives because of the time frame required.

TABLE 2
Qualitative Evaluation of Remedial Technologies
Fred Meyer Stores - Port Orchard Site
Ecology Site ID #96424236

General Response Action	Remedial Technology	Effectiveness	Implementability	Reasonableness of Cost	Retained?	Reason for Retaining or Eliminating
Petroleum Contaminated Groundwater						
Ex-situ Treatment Technologies						
Removal	Groundwater Extraction and Ex-Situ Treatment	High	Medium	Medium	Yes	Significant reduction of contaminant mass in groundwater. Extraction may influence groundwater gradient and flow direction, and provide hydraulic control against the downgradient movement of the contaminant plume. Lowers the water table and may promote natural degradation. Secondary treatment requirements required, with possibilities including air-stripping, granular activated carbon, or discharge to local publicly owned treatment works.
	Dual Phase Extraction with Ex-Situ Treatment	High	Medium	Low	No	Significant reduction of contaminant mass in groundwater and vadose zone. Effectively removes free product from subsurface. Dual phase extraction may influence groundwater gradient and flow direction, and provide hydraulic control against the downgradient mobilization of constituents. There is insufficient contaminant mass remaining to justify the cost to implement this technology.
In-situ Treatment Technologies						
Physical	Air Sparging	Low	Medium	Medium	Yes	Proven to be effective at reducing contaminant concentrations in groundwater, but its effectiveness is reduced in lower permeability soils. Typically is used in conjunction with SVE. Pilot-scale testing is required to determine actual area of influence.
	Soil Vapor Extraction	Low	Medium	Medium	Yes	Proven to be effective at reducing contaminant concentrations in groundwater and vadose zone, but its effectiveness may be reduced in lower permeability soils. Typically is used in conjunction with AS. Pilot-scale testing is required to determine actual area of influence.
	Thermal Treatment (electrical resistive heating)	Medium	Low	Low	No	Cost prohibitive.
Biological	Monitored Natural Attenuation	Low	High	High	Yes	Additional testing is required to determine if subsurface conditions are optimal for aerobic degradation. Relatively long periods of time are required for reduction of site contaminants. This cleanup action must be combined with additional alternatives (e.g., Air Sparging).
	Enhanced Bioremediation	Low	Medium	Low	No	The delivery and effective distribution of electron acceptors (typically oxygen), nutrients, or microbes that are acclimated to the contaminated groundwater is reduced by non-homogeneous soils and low groundwater gradient. Insufficient data to accurately cost this technology, nor is there sufficient contaminant mass to justify its implementation.
Chemical	Oxidant Injection (iron activated sodium persulfate)	Medium	Medium	Low	Yes	Contaminants are treated rather than transferred to a vapor phase. The delivery and effective distribution of oxidant and catalysts are reduced in lowered permeability silt lenses present in the soil at site. High natural organic content of soil may limit the effectiveness of this technology. Insufficient data to accurately cost this technology, nor is there sufficient contaminant mass to justify its implementation.

TABLE 3
Remedial Alternative Descriptions
Fred Meyer Stores - Port Orchard Site
Ecology Site ID #96424236

Alternative Description	Design Assumptions	Unknowns	Preliminary Screening of Remedial Alternatives (Comments): Advantages	Preliminary Screening of Remedial Alternatives (Comments): Disadvantages
Alternative 1 No Action	Implement institutional controls to control current/future groundwater use and excavation activities in the vicinity of the site, and decommission the wells at the Site.	Future distribution of contaminants in soil and groundwater. Risks posed by residual contamination (e.g., vapor intrusion of underground and aboveground facilities, future contact by earthworkers, and migration to potable aquifers). Site conditions (e.g., soil permeability, redox conditions, degree of heterogeneity, preferential pathways) affecting contaminant mobility, plume expansion, and rate of natural attenuation. Potential for third party liability. Cleanup levels and regulatory enforcement action(s).	Lowest cost.	Does not meet the minimum requirements of Washington Administrative Code (WAC) 173-340-360 "Selection of Cleanup Actions." Does not meet remedial action objectives (RAOs) or provide any additional reduction of existing risks at the Site within a reasonable timeframe. Groundwater constituents may migrate off-site or into water-bearing zones with a higher beneficial use. Liable for risks and management costs associated with petroleum-impacted soil and groundwater. Subject to Washington Department of Ecology (WDOE) enforcement actions and third party claims.
Alternative 2 (1) Skimmer for Free Product Removal; (2) SVE for Vadose Zone for 10 Years; (3) Groundwater Extraction with Ex-Situ Treatment through Granular Activated Carbon for 20 years; and (4) Groundwater monitoring for system performance period and compliance monitoring for an additional 2 Years.	Preclude the use of groundwater on site for drinking water until cleanup action is complete. Includes short-term product skimming similar to what was implemented in 1995. Includes the installation of up to six 13-foot deep vertical soil vapor extraction (SVE) wells throughout a 3,600-ft² area of impacted vadose zone. Assumed SVE air flow rates of approximately 60 cfm while applying vacuum pressures between 40 (in. water). Installation of four 4-inch diameter groundwater extraction (GWE) wells along perimeter of groundwater plume. Assumes that a total maximum GWE flow rate of 16 gpm. Includes excavating a GWE/SVE conveyance piping trench line up to 300' (in total length) X 2' (wide) X 12' (deep) routing pipe to a common treatment compound. Replace unimpacted cuttings as backfill within GWE/SVE trench and top with 2-inch minus crush rock. Treat extracted groundwater with four 1,000-pound granular activated carbon (GAC) adsorbers and treat extracted SVE vapors with two 1,000-pound GAC vessels. Discharge treated groundwater to City storm sewer under NPDES permit. Assumes 10 years of SVE O&M and GWE system O&M, with quarterly ground water monitoring (GWM), followed by 10 years of GWE O&M only and semiannual GWM and 2 additional years of GWM at 5 wells. Includes system decommissioning	Heterogeneity of the subsurface environment and its impact on the distribution of air and groundwater flow control. Ability to depress the water table and influence groundwater flow direction in the surrounding formation at 16 gpm or less. Degree of treatment system operations and maintenance (O&M) and duration. Effective radius of influence of SVE outside each well. Frequency and duration of MNA monitoring. Permitting and treatment requirements for GWE/SVE discharges. Effectiveness on weathered petroleum compounds site conditions affecting contaminant persistence/mobility. Frequency and duration of actual GWM.	With hydraulic control in place, don't need to restrict water use on downgradient and off-site properties. Large reduction of contaminant mass in soil and groundwater. Can be a cost-effective groundwater treatment alternative provided residual contamination in soil and groundwater is amenable to natural attenuation/biodegradation.	Unlikely that GWE can depress the water table sufficiently to make contaminant mass in the smear zone amenable to SVE treatment. Long-term hydraulic control may be required to meet RAOs. Biofouling or mineral precipitation in extraction wells or treatment processes can reduce overall GWE performance and increase O&M costs. Long-term GWE O&M is costly.
Alternative 3 (1) Utility cutoff collar; (2) Skimmer for Free Product Removal (3) AS/SVE System for Vadose Zone and Groundwater for 12 years; and (4) Compliance Monitoring during system operation and an additional 2 Years.	Item (2) is the same as Alternative 2. Install bentonite cutoff wall, 5-feet wide by 5-feet deep at up to four locations adjacent to the site to reduce constituent migration within the shallow perched groundwater movement along the existing utility corridors. Install a skimmer at one well location, MW-103 to remove residual free product. Install an air sparge (AS) and SVE system to address groundwater and vadose zone contaminants. Includes the installation of up to seventeen 20-foot deep AS wells throughout a 4,000 ft² area of groundwater impact and six 10-foot deep vertical SVE wells throughout a 3,600-ft² area of impacted vadose zone. Assumed air injection flow rates of approximately 5 cfm per AS well and up to 10 psi. Assumed SVE air flow rates of approximately 60 cfm while applying vacuum pressures between 40 (in. water). Includes excavation of 300' (linear feet) X 2' (wide) X 12' (deep) of AS/SVE trenching to a common treatment compound. Treat extracted SVE vapors with two 1,000-pound GAC adsorbers. Assumes 10 years of system O&M (bi-weekly visits). Assumes 12 years of quarterly GWM at 5 wells. Includes system decommission	Heterogeneity of the subsurface environment and its impact on the distribution of air and groundwater flow control. A Degree of treatment system operations and maintenance (O&M) and duration. Effective radius of influence of AS/SVE outside wells. Effectiveness on weathered petroleum compounds site conditions affecting contaminant persistence/mobility. Occurrence of natural attenuation at the Site.	AS/SVE have been proven effective at reducing most gasoline-related COPCs in soil and groundwater. SVE promotes volatilization of contaminants in the vadose, capillary fringe and dissolved in pore water, as well as stimulates biodegradation. Also, SVE reduces the potential for petroleum vapors to migrate into buildings or dissolve in groundwater. AS promotes biodegradation in saturated and unsaturated soils by increasing subsurface oxygen concentrations. Relatively low capital costs compared with other remediation technologies. AS/SVE operation causes minimal disturbance to site operations.	AS/SVE effectiveness is reduced in tight, low permeability soil outside the backfilled areas. AS can cause groundwater mounding and thereby laterally spread contaminants in groundwater.
Alternative 4 (1) Utility cutoff collar; (2) Soil excavation and disposal of source area PCS; (3) Two rounds of Chemical Oxidant Injection for Groundwater ; (4) Compliance monitoring during remedy implementation and an additional 2 Years.	Item (2) is the same as Alternative 3. Includes the excavation and off-site disposal of 3,500 cubic yards of PCS. Includes the direct injection of a strong chemical oxidant at 24 locations on 16-foot centers to depths ranging between 20 and 25 feet bgs within an approximately 4,500-ft² area of remaining impacted soil and groundwater. Oxidant injection of iron activated sodium persulfate during two primary rounds and one polish injection event through permanent wells. Monitoring events performed after 30 and 45 days following the two primary events. Monitoring events performed after 45 and 60 days following the polish round. Followed by two years of quarterly groundwater quality monitoring. Assumes a natural hydraulic gradient of 0.1 feet per foot and roughly 25,000 pounds of oxidant and 500 pounds of iron activator injected per injection round. Decommission system after NFA.	Duration of PCS removal and loss (utility station revenue compensation requirements. Final total volume of excavated soil and density (i.e., actual soil weight affecting disposal costs). Excavation wall stability and degree of temporary bracing or lay-back shoring required to limit settlement and damage to surrounding structures (i.e., building, roadways and/or subsurface utilities). Dewatering requirements. Type of excavation equipment required. Permitting requirements associated with utility reroute and PCS removal/backfilling/site restoration. Ability to discharge treated water (removal during excavation. Ability to delivery the chemical oxidant in tight, low-permeability soil and low groundwater gradient. Heterogeneity of the subsurface environment. Effectiveness of oxidant for some COPCs under site conditions (e.g., pH, oxidation reduction potential, presence of competing naturally occurring organics). Number of injections required to reduce COPCs to treatment standards. Permitting requirements for oxidation injections. Total treatment time to reach cleanup goals and occurrence of natural attenuation.	Excavation allows for rapid removal of PCS. Groundwater removal during excavation dewatering contributes to mass reduction. In general, oxidant injection is easy to implement with minimal disturbance to site operations. Provides a large COP mass reduction in material not amenable to bioremediation. Contaminants are treated rather than transferred to a vapor phase. Reduces risk of vapor intrusion and future groundwater consumption pathway. Shorter remedy period, if effective.	High cost related to PCS removal and disposal of PCS and dewatered liquids. Temporary closure of fueling operations. Need to re-route utilities. Deep excavation will require geotech study, shoring, permitting and monitoring. Injecting catalyst compounds (e.g., peroxide) under the required high pressures using direct-push drilling methods can be difficult. High material cost associated with chemical oxidant. Multiple injections and large amounts of oxidant may be necessary to reduce COCs to treatment standards. May be low contact between oxidant and contaminant in heterogeneous conditions or in areas with low permeability. High natural organic content of soil may limit effectiveness. Special precautions may be needed to protect worker health and safety during injections. Oxidation reactions may form toxic by-products in the groundwater or in off-gases.

Notes

UST	Underground Storage Tank
MNA	Monitored Natural Attenuation
PCS	Petroleum Contaminated Soil (TPH > MTCA Method A)
cfm	cubic feet per minute
gpm	gallons per minute
bgs	below ground surface
COCs	Contaminants of Concern
RAO	Remedial Action Objectives (MTCA Method A Standards)
NFA	No Further Action Determination from WDOE
' and "	denotes feet and inches, respectively
SVE	Soil Vapor Extraction
AS	Air Sparging
GWE	Groundwater Extraction
GWM	Groundwater Monitoring

General Assumptions

Site groundwater flow is generally to the south.
Treatment standards for the site are protective of MTCA Method A Cleanup Levels.
Worker health and safety will be monitored, and a health and safety plan will be adopted for the site and communicated to site construction workers during construction.
Constituents of concern potentially include BTEX and TPH-Gx in soil, and CPAHs, BTEX, Lead, TPH-Dx and TPH-Gx in groundwater.
The final remedial approach will require the approval or oversight of the Washington Department of Ecology.
No costs included for potential third party liability or natural resource damages.
Utility locations estimated, based on As-Built Plan provided by the Battle Ground Community Development Department.
Cost estimates based on time and materials cost using AMEC current rates and markups.
Cost of due diligence, additional investigations, or remedy, required on the adjacent off-site property have not been included.
Limited details on obstacles within targeted treatment areas and no overhead obstacles.
Dense non-aqueous phase liquid (DNAPL) or light non-aqueous phase liquid (LNAPL) is not present at the Site, and special precautions for DNAPL and LNAPL containment are not necessary.
No additional contaminant sources will be encountered during the implementation of remedial action at the Site.
Soil disposal is permitted at Subtitle D landfill, as non-hazardous waste.
No ecological receptors will be exposed to COCs above applicable screening levels.

TABLE 4
Remedial Alternative Final Screen
Fred Meyer Stores - Port Orchard Site
Ecology Site ID #[illegible]

Evaluation Criteria		Alternative 1 No Action		Alternative 2 (1) Skimmer for Free Product Removal; (2) SVE for Vadose Zone for 10 Years; (3) Groundwater Extraction with Ex-Situ Treatment through Granular Activated Carbon for 20 years; and (4) Groundwater monitoring for system performance period and compliance monitoring for an additional 2 Years.		Alternative 3 (1) Utility cutoff collar; (2) Skimmer for Free Product Removal; (3) AS/SVE System for Vadose Zone and Groundwater for 12 years; and (4) Compliance Monitoring during system operation and an additional 2 Years.		Alternative 4 (1) Utility cutoff collar; (2) Soil excavation and disposal of source area PCS; (3) Two rounds of Chemical Oxidant Injection for Groundwater; (4) Compliance monitoring during remedy implementation and an additional 2 Years.
Protectiveness 5 = high protectiveness	1	No reduction of risks or improvement of overall environmental quality	2	Low/Medium	3	Medium	4	Medium/High
Permanence 5 = high permanence	1	No permanent reduction of contaminant toxicity or mobility	4	Medium/High	4	Medium/High	5	High
Reduction of Toxicity		None		Medium. Source removal and moderate reduction in contaminant mass.		Medium. Proven source removal and moderate reduction in contaminant mass.		High. Proven source removal and moderate potential to reduce accessible contaminant mass.
Reduction of Mobility		None		High. Should influence groundwater flow and reduce contaminant mobility near GWE and SVE will induce a vacuum for vapors within the vadose zone.		Medium/High. Should influence vadose zone vapors. Added treatment within contaminant plume further reduces contaminant mobility.		Medium/High. Should influence groundwater through treatment, though may cause mobility during implementation. Added treatment within contaminant plume further reduces contaminant mobility.
Effectiveness Over The Long Term 5 = high effectiveness	1	Low	2	Low/Medium	3	Medium	4	Medium/High
Nature, Degree, and Certainties or Uncertainties of Alternative to be Successful		No source removal or reduction in contaminant volume or mobility.		Permitting requirements, persistence/mobility of residual contamination, risks/liability posed by residual contaminants, monitoring requirements, treatment time and landfill reliability.		Permitting requirements, radius of influence, persistence/mobility of residual contamination, risks/liability posed by residual contaminants, system O&M and GWM monitoring requirements, treatment time.		Permitting requirements, radius of influence, persistence/mobility of residual contamination, risks/liability posed by residual contaminants, and landfill reliability.
Reliability		None		Medium. Provided GWE influences contaminant mobility and residual contamination in tight soils are amenable to enhanced biodegradation.		Medium. Provided residual contamination is amenable to natural attenuation/biodegradation.		Medium. Provided residual contamination is amenable to natural attenuation/biodegradation.
Magnitude of Residual Risk		Potential direct and indirect exposure to COCs in soil and groundwater at concentrations posing an unacceptable risk to human health and the environment.		Potential direct and indirect exposure to residual COPCs in soil and groundwater at concentrations posing an unacceptable risk to human health and the environment.		Potential direct and indirect exposure to residual COCs in soil and groundwater at concentrations posing an unacceptable risk to human health and the environment.		Potential direct and indirect exposure to residual COCs in soil and groundwater at concentrations posing an unacceptable risk to human health and the environment. Additional Exposure to Chemicals during injection may increase risks.
Effectiveness of Controls Required to Manage Treatment Residues		None		Low/Medium. Reliance on institutional controls.		Medium/High. Further reduction of contaminant mass reduces dependence on institutional controls.		Medium/High. Further reduction of contaminant mass reduces dependence on institutional controls.
Time to Achieve RAOs		Greater Than 30 Years		22 Years		14 Years		2 Years
Management of Short-Term Risks 5 = low implementation risks	1	Low	3	Medium	5	High	2	Low
Implementation Risks		High risk and liability associated with No Action.		Potential damage to surrounding structures, public and construction worker safety, drilling and trenching within ROWs, risks posed by residual contaminants during MNA.		Potential damage to surrounding structures, public and construction worker safety, drilling in ROWs, fugitive vapors from AS, risks posed by residual contaminants during MNA.		Medium/Low. Potential damage to surrounding structures, public and construction worker safety, health hazard from oxidant, and risks posed by residual contaminants during MNA.
Effectiveness of Risk Mitigation Measures		None		Medium. Traffic control, health & safety program, institutional controls.		Medium/Low. Traffic control, health & safety program, SVE in combination with AS, and institutional controls.		Medium/Low. Shoring, health & safety program, and institutional controls.
Implementability 5 = high implementability	5	High	4	Medium/High	4	High	2	Medium/Low
Difficulties and Unknowns Associated with Implementation		Does not constitute a cleanup action.		Actual permitting, SVE/GWE radius of influence, O&M duration and requirements, and treatment duration.		Actual permitting, AS/SVE radius of influence, O&M duration and requirements, and treatment timeframe.		Actual permitting, shoring, excavation, disposal, and long-term treatment O&M and GWM requirements. AS/SVE radius of influence is limited in fine-grained soils.
Ability to Monitor Effectiveness of Remedy		Does not constitute a cleanup action.		High		High		Medium/Low
Consistency with State, Federal, and Local Requirements		None		Medium		Medium/High		Medium
Involvement of Other Agencies or Governmental Bodies		Low		Medium		Medium		Medium/High
Availability of Equipment, Specialists, and Services		Does not constitute a cleanup action.		High		High		Medium/High
Consideration of Public Concerns 5 = high degree of consideration	1	Low	2	Low/Medium	3	Medium	4	Medium/High
Acceptance by WDOE 5 = high likelihood of State acceptance	1	Low	2	Low/Medium	3	Medium	4	Medium/High
Treatment Preference for High Levels of Mobile Contaminants		None		Medium. Capture vapor and dissolved phase petroleum hydrocarbons within SVE/GWE radius of influence.		Medium. Reduce vapor and dissolved phase contaminant mass. Practical attempt to influence contaminant mobility.		Medium/High. Source removal and large reduction in contaminant mass. Practical attempt to treat plume and influence contaminant mobility.
Minimize Long-Term Management		None		Low/Medium. May not meet RAOs within a reasonable time line.		Medium. Low to moderate potential to RAOs within a reasonable time line.		Medium/High. Moderate potential to RAOs within a reasonable time line. Long-term liability at landfill.
Minimize Risk		None		Low/Medium. Residual contaminant concentrations will likely remain in saturated fine-grained soils above MTCA Method A Standards for long time.		Medium. Submerged residual contaminant mass may remain above MTCA Method A Standards for some time. AS should increase MNA rate.		High. Lowering of contaminant concentrations in groundwater reduces threats to downgradient human receptors.
Reasonableness of Cost 5 = low cost	5	Low Cost	1	High	4	Medium	2	Low
Estimate of Cost Net Present Value		$29,403		$1,703,343		$559,500		$2,189,569
Uncertainty of Costs		Low		Cost to obtain necessary permits, material/equipment costs, groundwater pumping rate, O&M duration and cost, time for MNA, and GWM frequency/duration.		Material/equipment costs, time for treatment/MNA, treatment system effectiveness, sparge area of influence and O&M requirements.		Cost to obtain permits, volume and disposal of excavated material, material/equipment costs, shoring/dewatering requirements, time for treatment/MNA, oxidant treatment effectiveness and quantity required.
Total Score	16	Alternative 1	22	Alternative 2	29	Alternative 3	27	Alternative 4

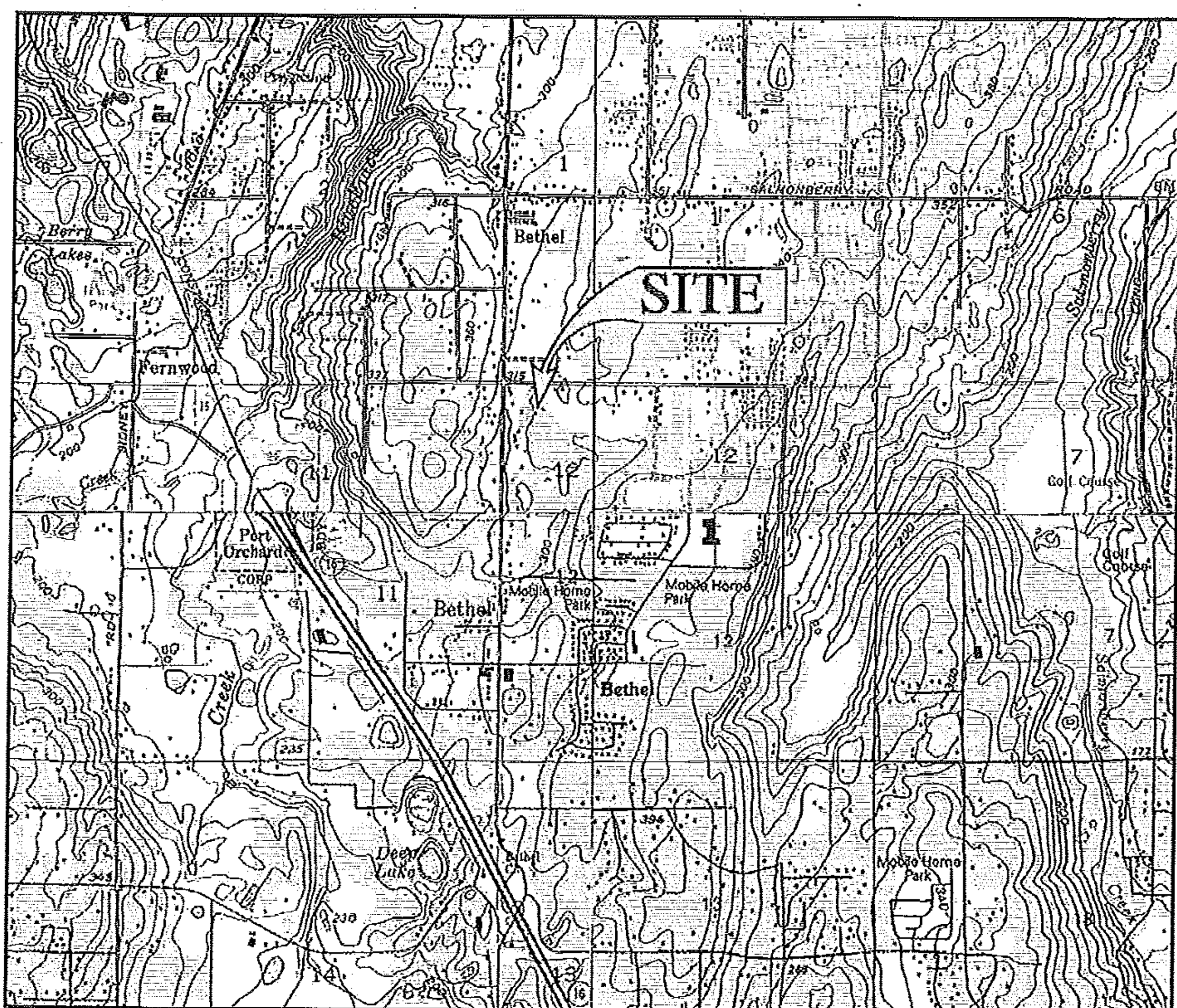
Notes:

GWE = Groundwater Extraction
UST = Underground Storage Tank
PCS = Petroleum Contaminated Soil
MNA = Monitored Natural Attenuation
O&M = Operations and Maintenance
SVE = Soil Vapor Extraction
AS = Air Sparging
COCs = Contaminants of Concern

Example of Criteria Scoring and Relationship Between Numbers and Text: 1 = low, 2 = low/medium, 3 = medium, 4 = medium/high, 5 = high.

amec

FIGURES



Heavy-duty
Medium-duty
Light-duty
Unimproved dirt
U.S. Route
State Route
Interstate Route

BREMERTON WEST, WASH.
47122-E6-TF-024
1953
PHOTOREVISED 1981
DMA 1479 II SERIES V891

BREMERTON EAST, WASH.
N4730-W12230/7.5
1953
PHOTOREVISED 1981
DMA 1479 II SERIES V891

BURLEY, WASH.
47122-D6-TF-024
1953
PHOTOREVISED 1994
DMA 1478 II NW-SERIES V891

OLALLA, WASH.
47122-D5-TF-024
1953
PHOTOREVISED 1981
DMA 1478 I NE SERIES V891

WASHINGTON
QUADRANGLE LOCATION

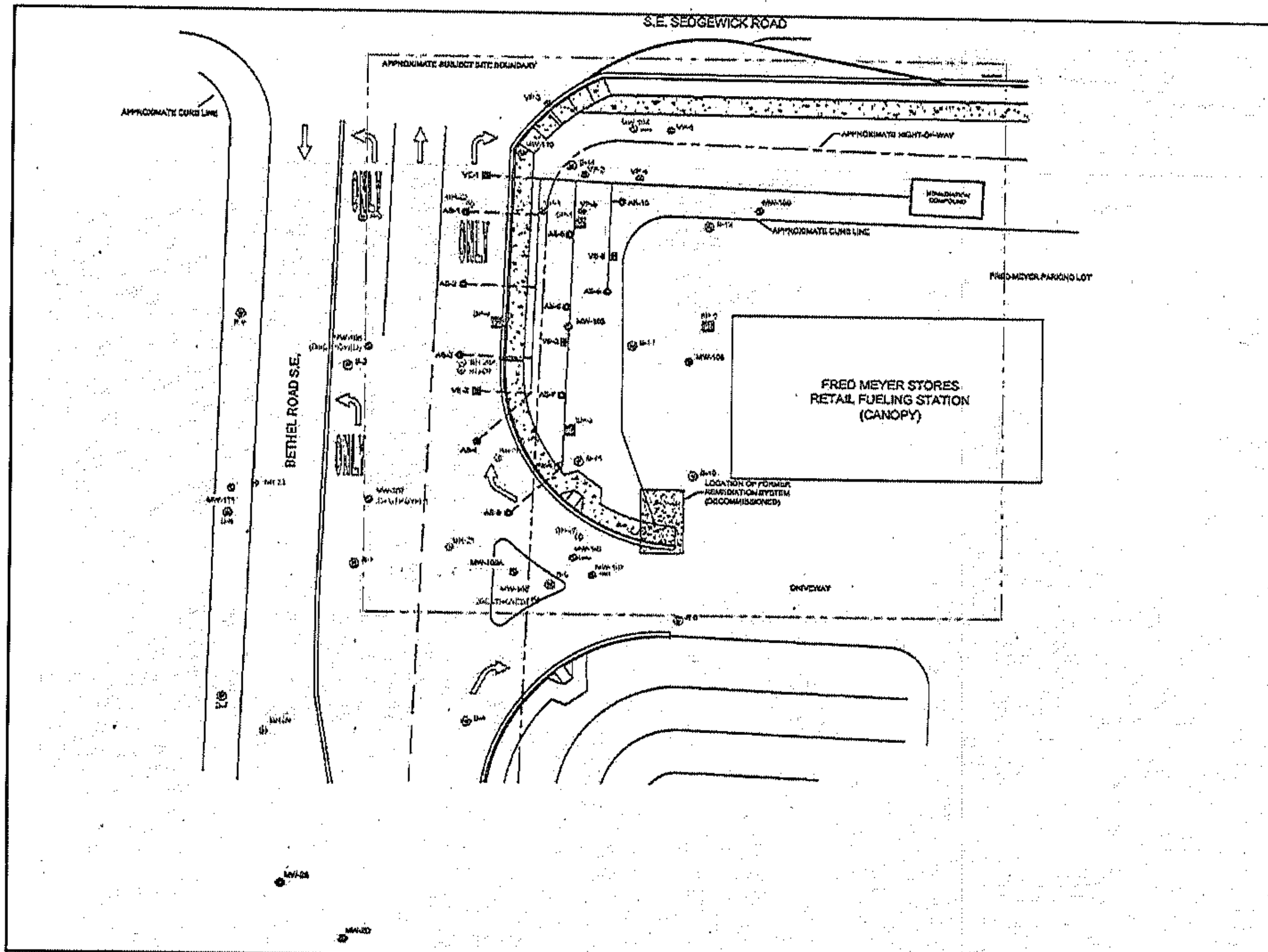
1 — 1/2 — 0 — 1 MILE

1000 — 0 — 1000 — 2000 — 3000 — 4000 — 5000 — 6000 — 7000 FEET

SOURCE: USGS QUAD SHEET: BREMERTON WEST, BREMERTON EAST, BURLEY AND OLALLA, WASH.

AMEC Earth & Environmental 7376 S.W. Durham Road Portland OR. U.S.A. 97224	amec		CLIENT FRED MEYER STORES, INC.	
PROJECT PORT ORCHARD		DWN BY: LR	DATUM: NAD27	DATE: APRIL 2010
TITLE SITE LOCATION MAP		CHKD BY: DMF	REV. NO.: X	PROJECT NO: 9-61M-10282-0
		PROJECTION: UTM ZONE 10N	SCALE: 1:24,000	FIGURE No. FIGURE 1

K:\10000\10200\10282\CAP\DWGs\Fig 1 -- Site Location.dwg -- Apr. 28, 2010 2:50pm -- brian.johnson



LEGEND

- AS-10 AIR SPARGING WELL NUMBER AND APPROXIMATE LOCATION
- VE-6 VAPOR EXTRACTION WELL NUMBER AND APPROXIMATE LOCATION
- MW-103 4" PVC MONITORING WELL NUMBER AND LOCATION. MW-103 AND MW-104 BY ECOLOGY, 1991, ALL OTHERS BY AGRA, NOVEMBER, 1999. MW-104, MW-1-S AND MW-1-D DESTROYED IN 1999/200. MW-106, MW-107, AND MW-108 DESTROYED IN 2001.
- MW-110 MONITORING WELL INSTALLED 2008
- MW-108A REPLACEMENT MONITORING WELL
- WELL DECOMMISSIONED
- B-12 AUGUST 2008 GEOPROBE BORING
- STRATO PROBE BORING NUMBER AND LOCATION OF TEMPORARY 3/4" VAPOR TEST WELL VP BORINGS BY AGRA JULY 28, 1999 (APPROXIMATE LOCATION)
- VP-8 STRATO PROBE BORING NUMBER AND LOCATION. BH-15 IS BY GN NORTHERN ON JANUARY 22, 1999. ALL OTHER BORINGS BY AGRA ON JULY 27, 28 AND 29, 1999. (APPROXIMATE LOCATION)
- SP-2 SPARGING WELL, 1995 (APPROXIMATE LOCATION)
- MW-4D MONITORING WELL, 1991 (APPROXIMATE LOCATION)
- REMEDIATION SYSTEM TRENCH
- ANGLED WELL LOCATION
- APPROXIMATE SITE BOUNDARY

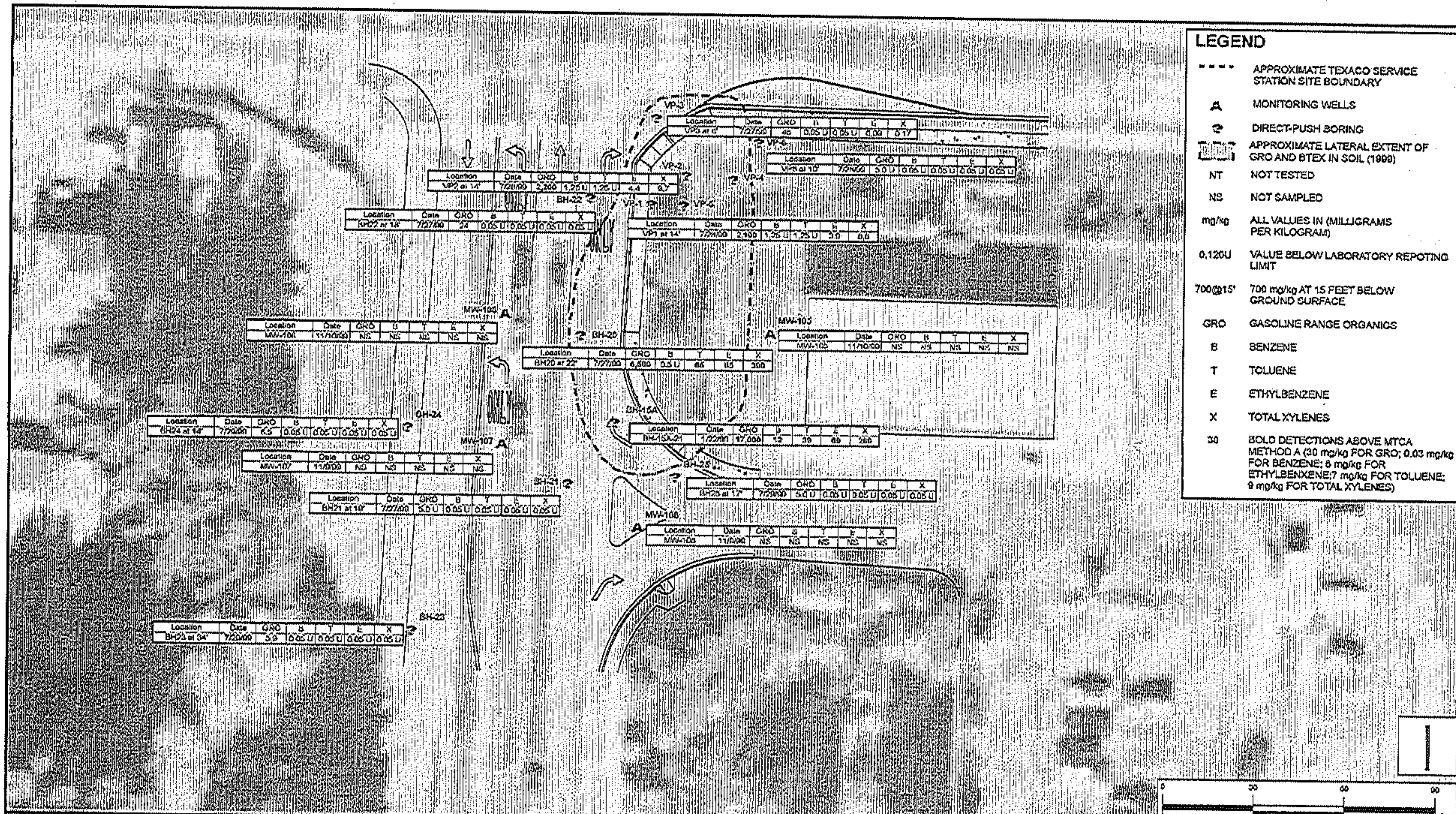
SOURCE: AHBL CIVIL AND STRUCTURAL ENGINEERS, FILE NAME: 98169-B.dwg.
HISTORIC WELL LOCATIONS ARE APPROXIMATE AND ARE FOR ILLUSTRATIVE PURPOSES ONLY.

CLIENT: FRED MEYER STORES, INC.	DWN BY: DD/LR	PROJECT: PORT ORCHARD		DATE: APRIL 2010
	CHKD BY: DS/DMF			PROJECT NO: 9-61M-10282-0
AMEC Earth & Environmental 7376 S.W. Durham Road Portland, OR, U.S.A. 97224	DATUM: -	TITLE: SITE PLAN AND SITE FEATURES		REV. NO.: -
amec	PROJECTION: -			FIGURE No. FIGURE 2
	SCALE: 1"=25'			

K:\10000\10200\10282\CAP\DwGs\Fig 2 -- Site_Plan_and_Site_Features.dwg -- -- -- Apr. 28, 2010 2:53pm -- brian.johnson

CLIENT LOGO	CLIENT: FRED MEYER STORES, INC.	DWN BY: PM	PROJECT: PORT ORCHARD	DATE: APRIL 2010
		CHK'D BY: AC/BC		PROJECT NO.: 0-01M-10202-0
	AMEC Earth & Environmental 7376 SW Durham Road Portland, OR, U.S.A. 97224 amec	DATUM: NAD83	TITLE: APPROXIMATE GROUNDWATER PLUME EXTENT 1998 - 2001 (GRO AND BTEX) SELECT VALUES	REV. NO.: 1
		PROJECTION: WA SP N. FL		FIGURE NO.: FIGURE 3
		SCALE: 1 inch = 80 feet		

K:\10000\10200\10202\CAP\DWG\Fig 3 - Approx GW Plume GRO and BTEX 1998-2001.mxd



CLIENT LOGO

CLIENT: FRED MEYER STORES, INC.

AMEC Earth & Environmental
7376 SW Durham Road
Portland, OR, U.S.A. 97224

amec

DWN BY: PM
CHK'D BY: AC/RC
DATUM: NAD83
PROJECTION: WA SP N FI
SCALE: 1 inch = 30 feet

PROJECT: PORT ORCHARD

TITLE: GRO AND BTEX CONCENTRATIONS IN SOIL 1999

DATE: APRIL 2010
PROJECT NO.: 0-61M-10262-0
REV. NO.: 1
FIGURE NO.: FIGURE 4

K:\10000\10200\10262\CAP\DWGs\Fig 4 - Approx Soil Plume GRO and BTEX 1999.mxd

amec

APPENDIX A

Definitions of Evaluation Criteria

APPENDIX A

WAC 173-340-360 Selection of Cleanup Actions
Definitions of Evaluation Criteria

The following criteria shall be used to evaluate and compare each cleanup action alternative when conducting a disproportionate cost analysis to determine whether a cleanup action is permanent to the maximum extent practicable.

Protectiveness

The ability of each cleanup action alternative to provide overall protectiveness of human health and the environment is a key factor in the screening and selection process. Overall protectiveness includes the degree of overall risk reduction, time required to reduce risk and attain cleanup standards, mitigation of on-site and off-site risks associated with implementation of the cleanup action alternative, and improvement of the overall environmental quality.

Permanence

The degree to which the cleanup action alternative permanently reduces the toxicity, mobility, or volume of hazardous substances provides a measure of long-term success. When evaluating cleanup action technologies in regards to permanence, the ability of the alternative to destroy hazardous substances, and to reduce and eliminate hazardous substances releases and sources are considered in the selection and screening process. The selection process also considers whether the treatment process is reversible or irreversible, and the characteristics and quantity of residuals generated during treatment.

Cost

Consideration of cost during screening of the cleanup action technologies includes construction and installation costs, the net present value of long-term costs, and recoverable costs for agency oversight. Long-term costs include operation and maintenance costs, monitoring costs, equipment replacement costs, and the cost of maintaining institutional controls. Costs associated with the construction and operations of the cleanup action alternative include pretreatment, analytical, labor, and waste management costs. Design life of the alternative and replacement and repair cycles for major components are also considered when estimating alternative costs.

Long-Term Effectiveness

In general, long-term effectiveness provides a measure of certainty in regard to the cleanup action alternative's ability to successfully achieve the established cleanup levels. Assessment of long-term effectiveness includes consideration of the alternative's reliability during the period of time during which hazardous substances are expected to remain on site at concentrations that exceed the cleanup levels, and of the effectiveness of controls required to manage treatment residuals or remaining hazardous substances. When evaluating technologies that include engineering and institutional controls, the evaluation of long-term effectiveness focuses on the control's continued ability to prevent exposure to contaminated media. Technologies that completely and permanently destroy the hazardous substances would have the highest level of long-term effectiveness since it would be impossible for a successfully implemented remedy to fail.

amec

Management of Short-Term Risks

This evaluation criterion addresses risks to human health and the environment associated with construction and implementation of the alternative, and the effectiveness of measures used to manage such risks. Consideration of the management of short-term risks is a qualitative assessment.

Technical and Administrative Implementability

The assessment of implementability is intended to determine whether, or with how much difficulty, the cleanup action alternative can be effectively implemented. Implementability includes considerations such as technical feasibility, availability of off-site facilities, services, and materials, administrative and regulatory requirements, implementation scheduling, alternative size and complexity, monitoring requirements, access for construction, and integration with existing facility operations.

Consideration of Public Concerns

Community concerns regarding the cleanup action alternative should be considered and addressed by the alternative during construction and implementation. Community members may include individuals, community groups, local government, tribes, and federal and state agencies.

amec

APPENDIX B

Table B-1 - Remedial Alternative Cost Summary

APPENDIX B
TABLE B-1
Remedial Alternative Cost Summary
Fred Meyer - Port Orchard

Alternative Description	Design and Installation Cost ($)	Total Quarterly GWM and O&M ($)	Quarterly GWM and O&M Years Incurred	Total Semi-Annual GWM and O&M ($)	Semi-Annual GWM and O&M Years Incurred	Total Estimated System O&M and GWM Costs ($)	NPV of System O&M and GWM ($)	Final Soil Confirmation Sampling and Well Decommissioning Costs ($)	Project Year Incurred	NPV of Soil sampling and Well Decommissioning ($)	Total Estimated Costs ($)
Alternative 1 No Action	$0	$0	NA	$0	NA	$0	None	$30,552	2	$29,400	$29,400
Alternative 2 (1) Skimmer for Free Product Removal; (2) SVE for Vadose Zone for 10 Years; (3) Groundwater Extraction with Ex-Situ Treatment through Granular Activated Carbon for 20 years; and (4) Groundwater monitoring for compliance monitoring for system performance period and an additional 2 Years.	$409,320	$776,947	10	$491,576	12	$1,268,522	$794,900	$40,195	23	$25,500	$1,703,343
Alternative 3 (1) Utility cutoff collar; (2) Skimmer for Free Product Removal; (3) AS/SVE System for Vadose Zone and Groundwater for 10 years; and (4) Compliance Monitoring during system operation and an additional 2 Years.	$351,642	$564,958	14	$0	NA	$564,958	$331,200	$58,227	15	$43,300	$959,900
Alternative 4 (1) Utility cutoff collar; (2) Soil excavation and disposal for free product removal and vadose zone; (3) Two rounds of Chemical Oxidant Injection for Groundwater ; (4)Compliance Monitoring during remedy implementation and an additional 2 Years.	$1,973,192	$72,859	2	$0	NA	$145,717	$42,800	$77,859	5	$70,600	$2,189,509

Notes:

The estimated costs are order of magnitude cost estimates, based on estimated quantities and screening criteria stated in Table 2. Additional specific costs that have not been included in these estimates include public relations, legal fees, taxes, additional site characterization activities, excavation sidewall shoring, UST permitting and compliance monitoring, disposal of wastes other than non-hazardous designated wastes, and regulatory oversight. Net Present Value (NPV) assumes an interest rate of 2% after inflation.

*Well decommissioning cost included in design and installation cost.