SAMPLING AND ANALYSIS PLAN
ExxonMobil / ADC Property, Ecology Site ID 2728
2717/2731 Federal Avenue
Everett, Washington

Submitted to:

ExxonMobil Environmental Services
East Providence Terminal
1001 Wampanoag Trail
Riverside, Rhode Island 02915

and

American Distributing Company
13618 45th Avenue NE
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Submitted by:

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

ADC	American Distributing Company
AMEC	AMEC Earth & Environmental, Inc.
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
COC	chain-of-custodies
CSS	Colorado silica sand
DAHP	Washington State Department of Archaeology and Historic Preservation
DQIs	data quality indicators
DQOs	data quality objectives
Ecology	Washington State Department of Ecology
EDB	ethylene dibromide
EDC	1,2-dichloroethane
EPA	U.S. Environmental Protection Agency
EPH	extractable petroleum hydrocarbons
ExxonMobil	ExxonMobil Oil Corporation
FFS	Focused Feasibility Study
HASP	Health and Safety Plan
HSA	hollow stem auger
IDW	investigation derived waste
mg/kg	milligram per kilograms
mg/L	milligram/liter
MDLs	method detection limits
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolt
NTUs	nephelometric turbidity units
PAHs	polycyclic aromatic hydrocarbons
PID	photoionization detector
PPE	personal protective equipment
ppm	parts per million
PVC	polyvinyl chloride
Property	ExxonMobil/ADC Property
QA	quality assurance
QC	quality control
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SD	standard deviation
TPH-D	total petroleum hydrocarbons–diesel
TPH-O	total petroleum hydrocarbons–oil
TPH-G	total petroleum hydrocarbons–gasoline
VOCs	volatile organic compounds
VPH	volatile petroleum hydrocarbons
WAC	Washington Administrative Code
WP	Work Plan

1.0 INTRODUCTION

AMEC Earth & Environmental, Inc. (AMEC), has prepared this Sampling and Analysis Plan (SAP) as part of the Focused Feasibility Study (FFS) Work Plan (WP) on behalf of ExxonMobil Oil Corporation (ExxonMobil) and the American Distributing Company (ADC) for the ExxonMobil/ADC Property (the Property) located at 2717 and 2731 Federal Avenue in Everett, Washington (Figure 1). This SAP outlines supplemental field investigations that will be conducted at and near the Property to fill remaining data gaps and obtain the information required to complete the FFS for the Exxon Mobil/ADC Site (Washington State Department of Ecology [Ecology] Ecology Facility ID 2728). This SAP addresses the specific field sampling activities, chemical analyses, and quality assurance (QA) procedures that will be conducted during additional investigations at the Property.

2.0 OBJECTIVES

The objective of the soil and groundwater investigation is to collect additional data needed to define the nature and extent of contamination, support decisions regarding future environmental cleanup, and fill existing data gaps to provide the information necessary to complete the FFS. The soil and groundwater investigation will include the following activities.

1. Install five new groundwater monitoring wells (MW-A3 through MW-A7) to the maximum depth of 15 feet bgs to define the western, northwestern, and northeastern limits of the dissolved-phase plume and to identify potential contamination associated with the former ADC Garage and Shop. Soil samples will be collected from each soil boring for laboratory analysis to ensure that additional petroleum hydrocarbon sources are not contributing to the existing plume (Figure 2).

2. Advance seven deep soil borings around the perimeter of the Property (AB-1 through AB-6) and off-Property to the northeast (MW-A7) to a maximum depth of 35 feet below ground surface (bgs) to determine if a silt layer is present beneath the fill and collect samples for geotechnical analysis. Deep boring MW-A7 will be backfilled to a depth of 13 feet bgs and converted to a shallow monitoring well screened from 3 to 13 feet bgs.

3. Four of the six deep soil borings (AB-1, AB-2, AB-5, and AB-6) will be advanced around the perimeter of the Property to assist in evaluating the lateral extent of the secondary source areas 1, 2, and 4 (Section 7.2 in FFS WP). Soil samples from borings AB-1 and AB-5 will be collected continuously from approximately 0.5 to 5 feet bgs. Shallow samples (above water table) with obvious signs of petroleum-hydrocarbon contamination will be analyzed for TPH-D and TPH-O.

4. Advance seven shallow soil borings (AP-1 through AP-7) to a maximum depth of 15 feet bgs. Six soil borings will be drilled east portion of the Property (near former General Petroleum Corporation's spur fuel loading racks) to define the lateral and vertical extent of soil contamination in the vicinity of MW-29. The seventh boring (AP-1) will be drilled in the area of the former ADC Garage and Shop to determine if any hydrocarbons are present in soils beneath the shop floor. A grab groundwater sample will be collected from AP-1.

5. Perform four quarters of groundwater sampling in all new monitoring wells and in five existing wells for natural attenuation parameters. Groundwater sampling for chemistry parameters will be conducted to be representative of separate wet and dry seasons. During two of the four quarterly sampling events, the groundwater sampling program will include general chemistry water quality parameters (i.e., dissolved oxygen, total organic carbon, alkalinity), in addition to the standard suite of laboratory analytical methods in select monitoring wells.

6. Conduct aquifer testing in two monitoring wells to determine the hydraulic conductivity of off-Property aquifer materials. The aquifer testing will consist of slug tests conducted in newly constructed monitoring wells MW-A5 and MW-A6.

7. Undertake a comprehensive tidal influence study incorporating a temporary stilling well in Puget Sound as well as newly installed and existing groundwater monitoring wells.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

AMEC Earth & Environmental, Inc. (AMEC) is the environmental consultant for this project.

The project is organized as follows:

ExxonMobil and ADC are the owners of the Site.

- Gary Dupuy (phone number 206-342-1777) and Meg Strong (phone number 425-368-0966) are the client managers for the project
- Leah Vigoren (phone number 206-838-8470) is the project manager and is responsible for project management. Technical and administrative elements are included in her project management responsibilities.
- Anastasia Speransky (phone number 206-838-1776) is the task manager for the project and quality assurance manager for this project, which includes data quality objectives, and quality assurance/quality control (QA/QC) objectives.
- Heather Vick (phone number 206-838-8463) is the project hydrogeologist. She is responsible for hydrogeological field activities as well as health and safety.
- Test America, Inc., in Tacoma, Washington, is responsible for managing analyses of the samples collected. The laboratory is also responsible for sample preparation and ensuring that the QA/QC results from the laboratory are valid.

4.0 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) is a quality management tool developed by the U.S. Environmental Protection Agency (EPA) that is used to facilitate the planning of data collection activities. The DQO process provides a systematic procedure for defining criteria in the data collection design. The primary reference for the formal DQO process is EPA's guidance document (EPA 1994). The DQO process consists of the following seven key steps.

1. State the problem.
2. Identify the decision.
3. Identify the inputs to the decision.
4. Define the boundaries of the study.
5. Develop a decision rule.
6. Specify tolerable limits on decision errors.
7. Optimize the design for obtaining data.

DQOs are qualitative and quantitative statements, developed using the DQO process, that are intended to clarify study objectives, define an appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.

Table 1 provides the DQOs for the work described in this SAP. Table 2 provides a list of the indicator hazardous substances and their MTCA cleanup criteria.

Data Quality Indicators (DQI) (accuracy, precision, completeness, representativeness, comparability, and method detection limits) refer to quality control criteria established for various aspects of data gathering, sampling, or analysis activity. In defining DQIs specifically for the project, the level of uncertainty associated with each measurement is determined.

Accuracy is the degree of agreement of a measurement with a known or true value. To determine accuracy, a laboratory or field value is compared to a known or true concentration. Accuracy is determined by such quality control (QC) indicators as: matrix spikes (MS), surrogate spikes, laboratory control samples (blind spikes) and performance samples. The frequency of analysis of laboratory control samples will be as follows: Method NWTPH-Gx:1 every 20 samples; Method NWTPH-Dx:1 every 10 samples; Method NWTPH-VPH: 1 every 20 samples; Method NWTPH EPH: 1 every 20 samples; Method 8260B: 1 every 12 hours and Method 8270: 1 every 20 samples.

Precision is the degree of mutual agreement between or among independent measurements of a similar property (usually reported as a standard deviation [SD] or relative percent difference [RPD]). This indicator relates to the analysis of duplicate laboratory or field samples. An RPD of ≤50% for water and ≤50% for soil, depending upon the chemical being analyzed, is generally acceptable. Typically field precision is assessed by field duplicates and laboratory precision is assessed using laboratory duplicates, matrix spike duplicates, or laboratory control sample duplicates).

Completeness is expressed as percent of valid usable data actually obtained compared to the amount that was expected. Due to a variety of circumstances, sometimes either not all samples scheduled to be collected can be collected or else the data from samples cannot be used (for example, samples lost, bottles broken, instrument failures, laboratory errors, etc.). The minimum percent of completed analyses defined in this section depends on how much information is needed for decision making. Generally, completeness percent goals increase when the fewer the number of samples are collected per event or the more critical the data are for decision making. Goals in the 90 to 95% range are typical.

Representativeness is the expression of the degree to which data accurately and precisely represent a characteristic of an environmental condition or a population. It relates both to the area of interest and to the method of taking the individual sample. The idea of representativeness should be incorporated into discussions of sampling design. Representativeness is best assured by a comprehensive statistical sampling design, but it is recognized that this is usually outside the scope of most one-time events. Most one-time event SAP's focus on issues related to judgmental sampling and why certain areas are included or not included and the steps being taken to avoid either false positives or false negatives.

Comparability expresses the confidence with which one data set can be compared to another. The use of methods from EPA or "Standard Methods" or from some other recognized sources allows the data to be compared facilitating evaluation of trends or changes in a site, a river, groundwater, etc. Comparability also refers to the reporting of data in comparable units so direct comparisons are simplified (e.g., this avoids comparison of milligram/liter (mg/L) for nitrate reported as nitrogen to mg/L of nitrate reported as nitrate, or parts per million (ppm) vs. mg/L discussions).

Detection Limit(s) [usually expressed as method detection limits (MDLs) or Quantitation Limit(s)] for all analytes or compounds of interest for all analyses requested is presented on Table 1. These limits should be related to any decisions that will be made as a result of the data collection effort. A critical element to be addressed is how these limits relate to any regulatory or action levels that may apply.

Data Review and Management

Data management will commence during the field investigation. Each soil and groundwater sample collected will be recorded in a bound field book which will include a description of the location, depth, matrix, sample ID, and date and time of collection. Once data has returned from the laboratory, the electronic deliverables will be reviewed to ensure the receipt of all requested analytes and again cross-checked with chain-of-custodies (COCs). Data will be tabulated in electronic spreadsheets and again checked to ensure proper entry before use in reporting.

Assessment Oversight

The project manager will ensure that sample methods and documentation are being practiced. Quality assurance (QA) systems will be emplaced at regular intervals during the data management process as described above. Finally, a peer review process by a senior technical staff will be conducted on the final reporting.

Corrective Actions

Corrective actions, if necessary, shall be completed. If acceptance criteria were not met and a corrective action was not successful or corrective action was not performed, data will be flagged appropriately. Requirements and procedures for documenting the need for corrective actions are described in this section.

Items requiring corrective action in the laboratory shall be documented by the use of a corrective action report. The QA coordinator or any other laboratory member can initiate the corrective action report request in the event QC results exceed acceptability limits, or upon identification of some other laboratory problem. Corrective actions can include reanalysis of the sample or samples affected, resampling and analysis, or a change in procedures, depending upon the severity of the problem.

5.0 PRE- FIELD ACTIVITIES

AMEC will arrange to clear the existing utilities in the project area prior to initiation of field activities. AMEC will contract a private utility locating service in addition to contacting the underground utilities location center (Call Before You Dig). Prior to field activities, AMEC will complete the following activities.

1. Prepare a site-specific Health and Safety Plan (HASP) (Attachment A1).
2. Mark the proposed boring and monitoring well locations.
3. Acquire appropriate permits for drilling and installing monitoring wells.

5.1 Field Health and Safety Procedures

Field personnel will adhere to the health and safety procedures detailed in the *Site-Specific Health and Safety Plan*. Potential hazards that may be encountered include heat stress, slips, trips, falls, and exposure to insects.

The hospital closest to the Site is Providence Hospital. An emergency contact list and a map illustrating the emergency route to Providence Hospital is located in the *Health and Safety Plan*.

It is anticipated that all fieldwork will be performed using Level D modified personal protective equipment (PPE), which includes safety glasses, steel-toed boots, and nitrile and/or leather gloves. At a minimum, each on-Site worker will be required to wear safety footwear (steel-toed boots), hard hat, hearing protection, eye protection, and a high visibility safety vest. PPE will be upgraded whenever there is a potential for direct contact with contaminated soil or groundwater. Changes in the required PPE will be based on changed work conditions and field observations. PPE upgrades may consist of the following:

- Nitrile gloves (surgical-type);
- Tyvek Coveralls – if a splash transfer is considered likely;
- Additional PPE upgrades that may be required, depending on breathing zone levels of petroleum hydrocarbons detected.

Eating, drinking, chewing gum or tobacco, smoking, or any practice that involves hand-to mouth contact increases the probability of contaminant ingestion and is prohibited in any area where the possibility of contamination exists.

Potential physical hazards that may be encountered include heat stress, slips, trips, and falls.

The AMEC field team will have current certifications for first aid, and a cell phone will be available at all times while personnel are in the field. All emergency response services will be reached by calling 911, from a land line if available.

6.0 FIELD PROCEDURES

This section presents the field investigation procedures for the soil and groundwater sampling effort. The field investigation will consist of drilling soil borings, installing monitoring wells, and collecting soil and groundwater samples. The proposed soil boring and monitoring well locations are illustrated on Figure 1. The proposed soil boring locations are listed in Table 3.

6.1 Utility Survey

AMEC will identify all aboveground and overhead power lines. Proposed boring locations that are within 25 feet of an overhead power line will be moved until clearance is achieved. AMEC will also oversee a geophysical survey conducted by a private utility locator to identify subsurface utilities within 25 feet of the proposed soil boring locations. The presence of below-grade utilities will be identified, and their inferred locations will be marked on the ground surface at the site. In addition, subsurface activity locations may be reviewed with the owner or the representative of the owner, if available at the time.

6.2 Calibration of Field Equipment

Field instrument calibration will occur daily at the beginning of field activities. Calibration results and times will be recorded in the field notes. Field equipment requiring calibration includes the photoionization detector (PID) and the Horiba U-22 (or equivalent) water quality meter.

Calibration instructions for the PID and water quality meter are included with the equipment manuals enclosed in the equipment cases. In general, the PID will be used to screen soil for the presence of lighter end petroleum hydrocarbons, such as gasoline and benzene. A Horiba U-22 water quality meter will be used to measure water quality parameters, such as dissolved oxygen, temperature, oxidation-reduction potential, and turbidity. The Horiba U-22 (or equivalent) will be calibrated daily in accordance with the manufacturer's instructions. A record of the daily calibration will be entered in the field log book.

6.3 Soil Borings

Proposed soil borings are listed in Table 3. Seven shallow soil borings (AP-1 through AP-7) will be advanced to a maximum depth of 15 feet bgs using direct-push technology drilling. These borings will be advanced in the vicinity of MW-29 and the former ADC Garage and Shop. Soil samples will be collected continuously from the surface to the total maximum depth of the borings. A soil sample will be collected at the soil/groundwater interface in each soil boring location. An additional sample will be collected based on odor, staining, PID readings, or sheen. If no soil samples exhibit any of these characteristics, the soil sample will be collected from the bottom of the boring to delineate the vertical extent of contamination. A grab groundwater sample will be collected from AP-1 using a temporary screen.

Seven deep soil borings (AB-1 through AB-6 and MW-A7) will be advanced around the western and northern perimeter of the Property to a maximum depth of 35 feet bgs to determine the lithologic conditions underlying that portion of the Site. The borings will be completed at a depth of 35 feet bgs since any proposed slurry wall can be completed as a hanging wall if there is no silt confining layer to key the wall into. The borings will be advanced using a hollow-stem auger (HSA) rig. A soil sample will be collected at the soil/groundwater interface in each soil boring location. An additional sample will be collected based on odor, staining, PID readings, or sheen. If no soil samples exhibit any of these characteristics, the soil sample will be collected from the bottom of the boring to delineate the vertical extent of contamination.

Four soil borings (MW-A3, MW-A4, MW-A5, and MW-A6) will be advanced on the Port of Everett property and will be completed as shallow monitoring wells using a direct-push drill rig equipped with HSA. The wells will be used to determine the western extent of the dissolved plume. A deep soil boring (MW-A7) drilled to a depth of 35 feet will be backfilled to a depth such that MW-A7 will be installed as a shallow monitoring well which straddles the water table (13 feet bgs).

6.4 Soil Sample Collection

Soil samples will be collected from the proposed soil boring and proposed monitoring well locations shown on Figure 1. All soil boring and monitoring well locations are subject to change based on observed conditions in the field (aboveground and belowground utilities, existing equipment, etc.).

Soil samples from the proposed push-probe soil borings/monitoring wells will be collected continuously using a 4-foot stainless steel sampler with a disposable liner.

Soil samples from the five proposed deep soil borings will be collected continuously for lithologic characterization. AMEC will inspect all soil samples and screen the soil samples for volatile organic compounds (VOCs) using a PID.

Each soil sample will be examined and relevant sample information (e.g., depth of sample collection, date and time of sample acquisition, PID measurement, etc.) will be recorded. To prevent cross contamination, any equipment repeatedly in contact with the soil will be decontaminated before and after each individual sampling attempt.

AMEC will select at least two soil samples per soil boring for laboratory analyses. The sample will be selected at the discretion of AMEC on the basis of field observations including a sheen test. A soil sample will be collected for analysis at the soil/groundwater interface in each soil boring location. An additional sample will be collected based on odor, staining, PID readings or sheen. If no soil samples exhibit any of these characteristics, the soil sample will be collected from the bottom of the boring to delineate the vertical extent of contamination.

Samples will be selected from intervals exhibiting petroleum staining and/or elevated PID measurements, the capillary fringe, and/or within an artificial fill unit.

6.5 Sample Containers, Preservation and Storage

Soil and groundwater samples will be collected and placed into precleaned sample containers provided by the analytical laboratory in accordance with Table 4. Upon collection, sample containers will be sealed, labeled, chilled to 4°C in a cooler with ice, and maintained with AMEC's custody until delivery to the project analytical laboratory, Test America, Inc., in Tacoma, Washington.

6.6 Sample Labeling

Each sample container sent to the lab will have a unique sample identification label.

The following information will be included on the sample label:

- Project name and location;
- Project number;
- Sample identification number including sample collection depth;
- Sample depth;
- Date and time of collection;
- Analyses to be performed; and
- Initials of the sampler.

Each soil sample will be assigned a unique alphanumeric code that will be used to identify the source of the sample location. Soil samples will be identified by a label indicating the boring or monitoring well number followed by a dash followed by the depth (feet) below the ground surface that the sample was collected.

6.7 Soil Sample Analyses

Selected soil samples will be submitted to the laboratory for the area-specific chemical analysis. The laboratory analysis will include one or more of the following:

- Total Petroleum Hydrocarbons as Gasoline (TPH-G) by Ecology Method Northwest Total Petroleum Hydrocarbon–Gasoline (NWTPH-G);
- TPH as Diesel and Oil (TPH-D and TPH-O) by Ecology Method NWTPH–Diesel Extended (NWTPH-Dx); TPH-Dx detections with chromatograms that will be run with a silica gel cleanup to remove any biogenic interference (typically from decaying plant matter);
- Benzene, toluene, ethylbenzene, and total xylenes (BTEX) and methyl tertiary butyl ether (MTBE) by U.S. Environmental Protection Agency (EPA) Method 8260B;
- Low-level polycyclic aromatic hydrocarbons (PAHs) by EPA method 8270D SIM;
- 1,2-Dichloroethane (EDC), ethylene dibromide (EDB), and n-hexane in select soil samples that exhibit contamination based on field screening;
- Extractable Petroleum Hydrocarbons (EPH) by Method NW-EPH;
- Volatile Petroleum Hydrocarbons (VPH) by Method NW-VPH.

Soil samples for TPH-G, VOC, and EPH/VPH analyses will be collected using a plastic syringe and placed into laboratory-supplied, preweighed volatile organic analyte vials in accordance with EPA soil sampling method 5035A. Soil samples for all other analyses will be placed in laboratory-supplied glass sample jars and securely fitted with Teflon-lined plastic lids. Particles greater than 2 centimeters in diameter will be removed from the samples and discarded with the drilling cuttings.

EPH and VPH analysis will be requested for soil samples with the highest concentrations of petroleum hydrocarbons and benzene.

Soil sample methods, required sample containers, preservation requirements, and holding times are provided in Table 4.

6.8 Soil Geotechnical Analyses

Two soil samples collected from the saturated zone of the perimeter borings will be analyzed for the following: total organic carbon, soil bulk density, porosity, volumetric water content, and permeability (Shelby tube). Samples of drill cuttings will be retained from each boring for use in slurry wall mix design, if necessary. Two 5-gallon buckets of drill cuttings from the 5- to 15-foot depth interval will be collected from each boring location. Shelby tube samples will be collected from fine-grained materials as undisturbed samples. The Shelby tube sampler will be pushed into undisturbed soil following retrieval of a split-spoon sample that indicates that a fine-grained formation has been encountered. Data from this testing will be used to assist in the development of remedial alternatives. Geotechnical analytical methods are listed in Table 5.

6.9 Monitoring Well Installation and Development

One deep and four shallow monitoring wells (MW-A3, MW-A4, MW-A5, MW-A6, and MW-A7) will be installed using an HSA drill rig and equipment. Soil borings for the monitoring wells will be advanced using 8-inch inside diameter augers. Soil samples to be collected from the monitoring well borings are listed in Table 3. The monitoring wells will be installed in accordance with Washington Administrative Code (WAC) 173-160 Minimum Standards for Construction and Maintenance of Wells.

Each of the monitoring wells will be constructed using 2-inch-diameter, flush-threaded Schedule 40 polyvinyl chloride (PVC) with a 10-foot-long prepack slotted screen with 0.010-inch slots and a 12/20 Colorado silica sand (CSS) pack. A prepack screen is proposed in order to minimize turbidity that has been observed at other monitoring wells in the Site vicinity. The prepack screens also allow rapid construction, since the soil in the area has been observed to heave. The well screens will be installed to straddle the water table. Additional sand (10/20 CSS) will be placed in the annular space surrounding the prepack screens. The sand pack will extend to a height of at least 1 foot above the top of the screen. Placement of the well screen will be determined in the field based on drilling conditions. The wells will be completed with a grout seal to the ground surface. The surface completion will conform to State of Washington standards and will be an 8-inch-diameter, flush-mounted, traffic-rated well monument. Monuments on the Port of Everett property will be constructed of materials that have the same or similar specifications to an eight inch Sherwood monitoring well cover with an 18 inch sonotube concrete surround.

All monitoring wells will be fitted with water-tight locking well caps and locks that are keyed alike.

Following well installation, the monitoring wells will be developed by surging with a surge block, followed by removing water by pumping until the water is clear and free of suspended solids. A minimum of six well volumes will be removed from each newly installed monitoring well. If the well purges dry, well development will resume when the water in the well recharges to 80 percent of the original recorded volume. Well development will cease upon stabilization of temperature, pH, and specific conductivity and turbidity measurements and the removal of six well volumes or two cycles of purging dry, whichever occurs first. AMEC will record the volume of water removed and water quality parameters during well development. An objective of the well development will be to obtain a turbidity value of 5 nephelometric turbidity units (NTU) or as low as is practically possible. The monitoring well development water will be contained in 55-gallon drums and stored at the Property.

6.10 Surveying of Monitoring Wells

The horizontal locations and the elevations of the tops of inner and outer casings of the newly installed monitoring wells will be surveyed by a Washington licensed surveyor. Elevations will be established to the nearest 0.01 foot; locations to the nearest 0.1 foot. The monitoring wells will be surveyed to tie into the existing monitoring well network. Both horizontal and vertical controls used for the new well survey will be consistent with horizontal and vertical controls used previously for surveying monitoring wells

6.11 Groundwater Level Measurements

Groundwater surface elevations will be used to make an initial assessment of the groundwater potentiometric surface, surface gradient, and direction of groundwater flow. During each groundwater sampling event, two groundwater elevation surveys will be conducted. One survey will be conducted during the high tidal stage, and one survey will be conducted during the low tidal stage.

The groundwater elevation will be measured with a decontaminated electronic water level meter or oil/water interface probe with an accuracy of plus or minus 0.01 feet. The groundwater elevation measurement will be made from a reference point on the top of the PVC well casing (to be surveyed and marked by land surveyors).

The water level probe will be decontaminated between each use, and wells with known or suspected contamination will be measured last.

6.12 Groundwater Sample Collection

Groundwater samples will be collected from the newly installed monitoring wells after a minimum of 7 days following development. Existing monitoring wells that do not have a history of containing liquid petroleum hydrocarbons (LPH) will also be sampled. Existing monitoring wells (MW-11, MW 19, MW40R, MW-A1 and MW-A2) and newly installed monitoring wells (MW-A3 through MW-A7) will be sampled using low-flow groundwater sampling techniques (Puls and Barcelona 1996). The groundwater sampling procedure will consist of the following steps.

1. Open well cap and allow well to equilibrate for several minutes.
2. Place an interface probe into the well to determine if LPH is present and measure thickness, if present. The well will not be sampled if LPH is present.
3. Measure depth to water from established top of casing measuring point and record on groundwater sampling field data sheet. Determine the middle depth of the water column that is within the screened interval.
4. Using dedicated (cutter used only for this purpose and kept in a plastic bag) tubing cutter, cut a length of new, low-density polyethylene tubing to extend to the middle depth

of the water column in the well. Connect the end of the tubing to peristaltic pump using dedicated silicone or MasterflexTM tubing.

5. Connect additional tubing to pump discharge line and flow-through cell. Establish flow rate of less than 200 milliliters/minute.
6. Record readings every 3 to 5 minutes with Horiba U-22 or equivalent water quality meter of the following parameters: temperature, pH, specific conductance, dissolved oxygen, oxidation-reduction potential, and turbidity.
7. Also record every 3 to 5 minute measurements of flow rate and depth to water. If drawdown in well exceeds 0.30 feet, reduce flow rate.
8. Stabilization of water quality parameters is assumed when measured parameters are within the following ranges:

   ± 10 percent pH (standard units)

   ± 3 percent electrical conductivity (milli-Siemens per centimeter [mS/cm])

   ± 10 percent oxidation-reduction potential (millivolt [mV])

   ± 10 percent turbidity (Nephelometric Turbidity Units [NTUs])

   ± 10 percent dissolved oxygen (milligram per liter [mg/L])

   ± 10 percent temperature (degrees Centigrade)

9. After stabilization of water quality parameters is achieved, disconnect tubing from flow-through cell and begin sample collection directly from pump discharge tubing.
10. Reduce flow rate to minimal possible flow for collection of volatile organic compound fraction.

6.13 Groundwater Sample Analyses

Increased turbidity in groundwater samples is attributed to soil lithological characteristics, increased organic content and/or improper purging and sampling rates during groundwater sample collection. High concentrations of total metals such as lead occurring in groundwater samples is most likely due to increased organic content in the formation being sampled.

Select groundwater samples will be submitted to the laboratory for the area-specific chemical analysis. The laboratory analysis will include one or more of the following:

- TPH using Ecology methods NWTPH-G and NWTPH-Dx;
- BTEX and MTBE by U.S. EPA Method 8260B;
- EDC, EDB, and n-hexane by U.S. EPA 8260B Selected groundwater samples;

- Low-level PAHs by EPA method 8270D SIM;
- Dissolved lead by EPA Method 6020;
- Natural attenuation parameters (see Table 6).

6.14 Equipment Decontamination

Decontamination of sampling equipment will be performed to maintain data quality, to prevent cross contamination, and to prevent the potential introduction of contaminants into previously unimpacted areas. Reusable sampling equipment, including the drill rig, down-hole drilling equipment, and stainless-steel materials, will be decontaminated prior to each sampling event. General decontamination procedures for nondedicated soil sampling equipment and accessories are as follows.

- Physically remove soils using a nonphosphate detergent solution.
- Rinse with noncontaminated tap water.
- Rinse with deionized water.
- Rinse with Isopropyl alcohol.
- Air dry.

6.15 Investigation Derived Waste Management

Investigation Derived Waste (IDW) generated during the course of the field investigation will be labeled and securely stored on the Property in 55-gallon drums approved by the U.S. Department of Transportation. Drums will be stored at a designated location. The various waste streams will include the following:

- Potentially contaminated liquids, including fluids derived from purging, development of monitoring wells, and equipment decontamination water; and
- Potentially contaminated solids, principally soil cuttings

Each drum will be labeled with standardized IDW drum labels to indicate its contents, date of collection, location from which the IDW originated, and other pertinent information. In addition, all drums will also be labeled with indelible paint sticks or pens. AMEC will maintain an inventory of the drums. On completion of the project, the IDW will be disposed of at an appropriate off-site facility, following a review of the investigation analytical data.

6.16 Aquifer Testing

Aquifer testing will be performed to determine the horizontal hydraulic conductivity of water bearing materials at the Site. The hydraulic conductivity (K) is an important hydraulic parameter for estimating groundwater flow rates and other aquifer characteristics. Slug testing will be performed to estimate K using monitoring wells MW-A5 and MW-A6, which are located west of the site.

A slug test involves the instantaneous injection or withdrawal of a volume or slug of water or solid cylinder of known volume. This is accomplished by displacing a known volume of water from a well and measuring the artificial fluctuation of the groundwater level in the well. Water level changes are usually measured with pressure transducers and recorded by an electronic data logger.

The following equipment will be used to perform the slug test:

- Tape measure (subdivided into tenths of feet)
- Pressure transducer and data logger
- Electronic water level indicator
- Stainless steel or copper slug of known volume
- Dedicated nylon twine for each well to be tested
- Watch or stopwatch with second hand
- Waterproof logbook and pen
- Laptop computer with data logger software preinstalled prior to field event;
- Supplies for decontaminating slug, including alconox soap, scrub brush, deionized water, and tap water

The following procedure will be used for slug testing each monitoring well.

1. Open the monitoring well and allow several minutes for the well to equilibrate to atmospheric pressure.
2. Measure and record static water level in well. Be sure to allow time for equilibration with atmospheric pressure for wells with unvented caps. If a dedicated bailer or other sampling apparatus in place interferes with initial reading, minimize disturbance as much as possible, and allow time for re-equilibration. Wait and repeat measurement to confirm the well is at steady state.
3. Remove any equipment in the well that would interfere with placing the transducer or conducting the slug test.
4. Measure and record the total depth of the well to verify the well depth and verify that the well screen has not been partly silted in. Sediment in the well screen can affect the slug test results.
5. Place pressure transducer in well to appropriate depth (see depth limits for individual transducers, or manufacturers specifications). Use measuring tape to determine point on

cable to set in well. Do not place transducer so that its range will be exceeded, or so that the transducer cable interferes with movement of the slug.

6. Place slug in well, above the transducer. If desired, a falling head test can be run at this point. It is often found in highly permeable materials, however, that the time required for the slug to fall through the water column may be comparable to the recovery time, and these data may therefore not be usable.
7. When the water level has returned to static height, initialize the data logger.
8. Remove the slug. Use auto-start feature if available, or start data logger by hand.
9. Test may be terminated after recovery is complete, or after 10 to 15 minutes for wells with slow recovery. If possible, screen data in the field to ensure data quality prior to demobilization.
10. Plot data using laptop computer to assure slug test is representative. If data are ambiguous or insufficient, repeat test.

The slug test data will be analyzed using the Bouwer and Rice method (Bouwer 1976, 1989a, 1989b) to obtain estimates of K for each monitoring well tested.

6.17 Tidal Study

A tidal influence study will be conducted to determine if groundwater beneath the Site is affected by tides. Permission will be requested from the Port of Everett to install a temporary stilling well on their dock. The stilling well will be in position for the duration of the Tidal Study at the Site.

Pressure transducers and data loggers will be installed in the four new groundwater monitoring wells on the Port of Everett property (MW-A3, MW-A4, MW-A5, MW-A6) and in existing monitoring wells MW-A1, MW-A2, W-3, MW-11, W-17, W-18 MW-19, MW-28, and MW-40R to record groundwater levels in the zone that is potentially tidally influenced. Specifications of the wells are provided in Table 7. The wells were selected to provide upgradient, on-Site/middle of the site, and downgradient information and are also wells that do not have measured concentrations of free product that would clog the transducers. Monitoring well MW-40R may contain LPH and, if so, will not be used in the tidal influence study.

Elevation measurements will be recorded automatically every 6 minutes for a minimum period of 76 hours. Tidal measurements recorded at the stilling well, located approximately 540 yards to the west of the Site, will be compared to the transducer data.

The data collected from the automatic transducers will be stored in the data logger and downloaded to a computer at the end of the tidal study data collection period. An hour after installation of the in-well transducer, a computer will be linked up to check that it is accurately recording data. On completion, the downloaded data will be corrected for actual groundwater depth and correlated with data from the stilling well. Tidal time lag and tidal efficiencies will be calculated for each monitoring well location. In addition, the tidal study data will be analyzed to determine the mean hydraulic gradient at the site using the method described by Serfes (1991).

The data and the results of the study will be presented in a report to the Washington State Department of Ecology, including maps showing the mean hydraulic gradient at low and high tide and data implications with respect to tidal influence.

6.18 Historic or Cultural Resources

Buried cultural artifacts such as chipped or ground stone, historic refuse, buildings foundations, or human bone could be discovered during subsurface activities, although this is highly unlikely. Initial field activities will include the installation of soil borings and monitoring wells which will result in a minimal amount of site disturbance. As such, a professional archaeologist may not be needed on-site during these activities. Cultural Resource review and the need for any on-site archaeologist will be determined by Ecology in communication with the Department of Archaeology and Historic Preservation (DAHP) and the concerned tribal government.

If any excavations (e.g., test pits) are required for the investigation, a separate cultural resources assessment and work plan will be developed in communication with DAHP and the concerned tribal governments pursuant to RCW 27.44 (Indian graves and records) and 27.53 (Archaeological sites and resources) and a professional archaeologist may required to be on-site to oversee the activities.

If any archaeological resources are discovered during field activities, work will be stopped immediately and Ecology, the DAHP, the City of Everett Planning and Community Development Department, and the Tulalip Tribes Cultural Resources Department will be notified by the close of business. A professional archaeologist will arrange an on-site inspection and invite the parties to attend. The professional archaeologist shall document the discovery and provide a professionally documented site form and report to the above listed parties. In the event of an inadvertent discovery of human remains, work will be immediately halted in the discovery area, the remains will be covered and secured against further disturbance, and the Everett Police Department and Snohomish County Medical Examiner will be immediately contacted, along with DAHP and authorized Tribal representatives. A treatment plan by the professional archaeologist shall be developed in consultation with the above listed parties consistent with RCW 27.44 and RCW 27.53 and implemented according to WAC 25-48.

7.0 DOCUMENTATION

The integrity of data obtained from samples collected during the field investigation depends on proper sample management and handling. Proper sample management includes sample labeling, which includes assignment of a specific identification number and affixing proper identification and markings to the collected samples. Proper handling includes proper packing and transport of the sample containers.

7.1 Field Logbook

The field logbook serves as the primary record of field activities. Entries shall be made chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct the applicable events. The field logbook shall be bound with consecutively numbered and water repellent pages.

At a minimum, the following information will be recorded in either the field logbook or a separate sample log sheet during the collection of each sample:

- Sample location and description;
- Sampler's name(s);
- Date and time of sample collection;
- Type of sample (soil, groundwater, or surface water);
- Type of sampling equipment used;
- Field instrument readings and calibration; and
- Field observations and details related to analysis or integrity of samples (e.g., weather conditions, noticeable odors, colors, etc.).

7.2 Labeling

Each sample container sent to the lab will have a unique sample identification label. The following information will be included on the sample label:

- Project name and location;
- Project number;
- Sample identification number;
- Date and time of collection; and
- Initials of the sampler.

Each soil sample will be named by the location and depth of sample collection in feet. For example, a soil sample collected from soil boring AP-1 at a depth of 2 feet will have a sample designation as “AP1-2.” Groundwater samples will be named by the monitoring well location and the date of sample collection. For example, a groundwater sample collected from MW-A2 on March 7, 2010, would be named “XOMADC-02072010-MWA2.”

Duplicate samples will be sent to the laboratory blindly. However, the location of the sample will not be revealed to the laboratory. Instead, duplicate samples will be named sequentially as Dup-1 and Dup-2. The location of the duplicate sample collection will be recorded in the field notebook.

7.3 Sample Chain of Custody

COC forms will be completed at the end of each sampling day. The completed COC form(s) and samples will be kept in the possession of the field team until relinquishing the samples to the laboratory or courier service. One copy of the completed COC form will be kept by the field team, and the original COC form will be stored in a resealable plastic bag and transported in the sample container with the laboratory samples. Custody seals will be placed along the seal of each sample container in order to prevent tampering with the samples. A copy of the COC form is included in Attachment A2.

8.0 DATA VALIDATION

Data validation is the procedure of reviewing data against a known set of criteria to verify data validity prior to its use. Data validation procedures have been developed by the US EPA to standardize the validation process for analytical results for both water-quality and soil-quality investigations and are documented as the *US EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review,* US EPA, Office of Solid Waste and Emergency Response, Washington, D.C., Publication 9240.1-48, US EPA-540/R-08-01 (US EPA 2008). The Functional Guidelines are intended to be used as a guide for evaluation of data generated under statements of work for organic and inorganic analyses associated with the US EPA Contract Laboratory Program (CLP). The Functional Guidelines also provide general data validation guidelines that can be applied to data generated by non-CLP analytical methods.

One hundred percent (100%) of the analytical data for soil and groundwater investigation samples will be validated using EPA Stage 4 data validation level. Stage 4 validation includes an examination of sample and QC raw data and instrument printouts to check for technical, calculation, analyte identification, analyte quantitation, and transcription or reduction errors. At a minimum 10% of reported results on summary forms should be confirmed by recalculation. The data validation staff will review field documents and laboratory data report packages, and if needed, apply data qualifiers to the data. The data reviewer will determine if the project data quality objectives have been met, and will calculate the data completeness for the project.

9.0 QUALITY CONTROL

This SAP has been prepared to provide instructions and guidance to ensure the sample chemical data collected in support of the site soil and groundwater sampling activities are scientifically valid. Indicator hazardous substances at the Site are listed in Table 2. The sections below outline methods and processes to meet these objectives.

9.1 Field Quality Control Samples

To evaluate quality control (QC), two types of QC samples will be collected (trip blank and blind field duplicate). One trip blank will be collected daily and the field duplicate samples will be collected at a frequency of 5 percent of the samples for each matrix (soil and groundwater).

Two trip blank vials provided by the laboratory will be placed into the cooler designated to store samples to be analyzed for VOCs to evaluate the potential for cross-contamination. The trip blanks will be analyzed for TPH using method NWTPH-Gx and for BTEX and MTBE using EPA Method 8260B. Field duplicates are replicate samples collected at the same location during the same sampling session (roughly at the same time). The field duplicate samples will be collected in the same container types and handled and analyzed in the same manner, as all other soil and groundwater samples. The field duplicates will be analyzed for the same analytes as the primary sample.

9.2 Laboratory Quality Control Samples

Laboratory QC samples are analyzed as part of standard laboratory practice. The laboratory monitors the precision and accuracy of the results of its analytical procedures through analysis of QC samples. In part, laboratory QC samples consist of Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples for organic analyses, and MS/MSD for inorganic analyses. The term "matrix" refers to use of the actual media collected in the field (e.g., routine soil and water samples). Laboratory QC samples are an aliquot (subset) of the field sample. They are not separate samples, but a special designation of an existing sample. The laboratory QC samples will be analyzed for the same analytes as the standard samples.

9.3 Field Variances

As conditions in the field may vary, it may become necessary to implement minor modifications to the sampling as presented in this plan. When appropriate, ExxonMobil, ADC, and Ecology will be notified and a verbal (followed by a written verification) approval will be obtained before implementing the changes. Modifications to the approved plan will be documented in the sampling project report.

9.4 Data Management

Data management will commence during the field investigation. Each soil and groundwater sample collected will be recorded on field logs, which will include a description of the location, depth, matrix, sample ID, and date and time of collection. All data submittals will be consistent with Ecology Policy 840 (dated March 31, 2008) Environmental Information Management (EIM) submittal requirement format. Once data have been provided by the laboratory, the electronic deliverables will be reviewed to ensure the receipt of all requested analytes and again cross-checked with COCs.

10.0 REFERENCES

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Washington State Department of Ecology (Ecology) (2001). Model Toxics Control Act Cleanup Regulation, Chapter 173-340 WAC. Publication No. 94-06.

Washington State Department of Ecology (Ecology) (2005). Guidance on Remediation of Petroleum-Contaminated Groundwater by Natural Attenuation. Version 1.0. Publication Number 05-09-091. Toxics Cleanup Program. July.

TABLES

Table 1 Data Quality Objectives

Method	Analyte	MDL	MRL	Units	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
SOIL											
NWTPH-Gx											
NWTPH-Gx	Gasoline Range Hydrocarbons	0.5	5.00	mg/kg dry wt	-	50	10-145	50	80-120	50	8006-61-9
NWTPH-Gx	a,a,a-Trifluorotoluene			Surrogate	50-150	-	-	-	-	-	98-08-8
NWTPH-Dx (w/o Acid/Silica Gel Clean-up)											
NWTPH-Dx	Diesel Range Hydrocarbons	2.00	4.00	mg/kg dry wt	-	48	10-154	48	55-123	48	68476-34-6
NWTPH-Dx	Lube Oil Range Hydrocarbons	2.00	4.00	mg/kg dry wt	-	39	19-146	39	57-128	39	NA
NWTPH-Dx	o-Terphenyl			Surrogate	50-150	-	-	-	-	-	84-15-1
Extractable Petroleum Hydrocarbons											
WA MTCA-EPH	C8-C10 Aliphatics	1.90	5.00	mg/kg dry wt	-	25	50-150	25	50-150	25	NA
WA MTCA-EPH	C10-C12 Aliphatics	1.00	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA
WA MTCA-EPH	C12-C16 Aliphatics	1.40	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA
WA MTCA-EPH	C16-C21 Aliphatics	2.00	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA
WA MTCA-EPH	C21-C34 Aliphatics	3.20	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA
WA MTCA-EPH	C8-C10 Aromatics	2.50	5.00	mg/kg dry wt	-	25	50-150	25	50-150	25	NA
WA MTCA-EPH	C10-C12 Aromatics	0.60	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA
WA MTCA-EPH	C12-C16 Aromatics	1.70	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA
WA MTCA-EPH	C16-C21 Aromatics	3.10	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA
WA MTCA-EPH	C21-C34 Aromatics	4.40	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA
WA MTCA-EPH	C-35			Surrogate	60-140	-	-	-	-	-	94-36-0
WA MTCA-EPH	o-Terphenyl			Surrogate	60-140	-	-	-	-	-	84-15-1
WA MTCA-EPH	2-Fluorobiphenyl			Surrogate	60-140	-	-	-	-	-	321-60-8
WA MTCA-EPH	2-Bromonaphthalene			Surrogate	60-140	-	-	-	-	-	580-13-2
WA MTCA-EPH	1-Chlorooctadecane			Surrogate	60-140	-	-	-	-	-	3386-33-2
Volatile Petroleum Hydrocarbons											
WA MTCA-VPH	C5-C6 Aliphatics	2.00	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA
WA MTCA-VPH	C6-C8 Aliphatics	0.90	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA
WA MTCA-VPH	C8-C10 Aliphatics	2.25	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA
WA MTCA-VPH	C10-C12 Aliphatics	3.65	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA
WA MTCA-VPH	C8-C10 Aromatics	2.40	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA
WA MTCA-VPH	C10-C12 Aromatics	0.30	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA
WA MTCA-VPH	C12-C13 Aromatics	0.50	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA
WA MTCA-VPH	2,5-Dibromotoluene (FID)			Surrogate	70-130	-	-	-	-	-	615-59-8
WA MTCA-VPH	2,5-Dibromotoluene (PID)			Surrogate	70-130	-	-	-	-	-	615-59-8

Table 1 Data Quality Objectives

Method	Analyte	MDL	MRL	Units	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
SOIL (continued)											
Volatile Organic Compounds (Selected List)											
EPA 8260B	Benzene	0.67	2.00	µg/kg dry wt	-	50	42-141	50	78-126	50	71-43-2
EPA 8260B	1,2-Dibromethane (EDB)	0.52	2.00	µg/kg dry wt	-	45	30-155	45	30-155	45	106-93-4
EPA 8260B	1,2-Dichloroethane (EDC)	0.67	2.00	µg/kg dry wt	-	50	32-155	50	70-139	50	107-06-2
EPA 8260B	Ethylbenzene	0.67	2.00	µg/kg dry wt	-	50	21-165	50	79-130	50	100-41-4
EPA 8260B	n-Hexane	0.45	10.000	µg/kg dry wt	-	48	10-180	48	55-136	48	110-54-3
EPA 8260B	Toluene	0.400	2.00	µg/kg dry wt	-	50	45-145	50	76-126	50	108-88-3
EPA 8260B	Total Xylenes	1.30	5.00	µg/kg dry wt	-	50	31-159	50	80-130	50	1330-20-7
Polynuclear Aromatic Hydrocarbons by GC/MS-SIM											
EPA 8270C-SIM	Acenaphthene	0.0003	0.00333	mg/kg dry wt	-	32	42-120	32	44-120	40	83-32-9
EPA 8270C-SIM	Acenaphthylene	0.0004	0.00333	mg/kg dry wt	-	34	39-127	34	46-127	34	208-96-8
EPA 8270C-SIM	Anthracene	0.0007	0.00333	mg/kg dry wt	-	31	39-139	31	49-139	40	120-12-7
EPA 8270C-SIM	Benzo(a)anthracene	0.0003	0.00333	mg/kg dry wt	-	43	31-132	43	53-132	43	56-55-3
EPA 8270C-SIM	Benzo(a)pyrene	0.0004	0.00333	mg/kg dry wt	-	41	22-125	41	57-125	41	50-32-8
EPA 8270C-SIM	Benzo(b)fluoranthene	0.0016	0.00333	mg/kg dry wt	-	50	10-147	50	36-140	50	205-99-2
EPA 8270C-SIM	Benzo(k)fluoranthene	0.0003	0.00333	mg/kg dry wt	-	38	23-140	38	49-140	38	207-08-9
EPA 8270C-SIM	Benzo(ghi)perylene	0.0003	0.00333	mg/kg dry wt	-	50	10-151	50	54-139	50	191-24-2
EPA 8270C-SIM	Chrysene	0.0006	0.00333	mg/kg dry wt	-	40	20-139	40	47-139	40	218-01-9
EPA 8270C-SIM	Dibenz(a,h)anthracene	0.0004	0.00333	mg/kg dry wt	-	50	18-150	50	58-141	50	53-70-3
EPA 8270C-SIM	Fluoranthene	0.0004	0.00333	mg/kg dry wt	-	47	29-135	47	34-135	47	206-44-0
EPA 8270C-SIM	Fluorene	0.0005	0.00333	mg/kg dry wt	-	38	38-129	38	47-129	38	86-73-7
EPA 8270C-SIM	Indeno(1,2,3-cd)pyrene	0.0003	0.00333	mg/kg dry wt	-	46	13-146	46	53-142	46	193-39-5
EPA 8270C-SIM	1-Methylnaphthalene	0.0004	0.00333	mg/kg dry wt	-	35	20-120	35	41-120	35	90-12-0
EPA 8270C-SIM	2-Methylnaphthalene	0.0004	0.00333	mg/kg dry wt	-	38	28-124	38	48-121	38	91-57-6
EPA 8270C-SIM	Naphthalene	0.0007	0.00333	mg/kg dry wt	-	36	10-135	36	42-120	36	91-20-3
EPA 8270C-SIM	Phenanthrene	0.0004	0.00333	mg/kg dry wt	-	46	33-134	46	52-134	46	85-01-8
EPA 8270C-SIM	Pyrene	0.0003	0.00333	mg/kg dry wt	-	50	26-153	50	56-144	50	129-00-0
EPA 8270C-SIM	Nitrobenzene-d5			Surrogate	17-120						4165-60-0
EPA 8270C-SIM	2-Flourobiphenyl			Surrogate	14-120						321-60-8
EPA 8270C-SIM	p-Terphenyl-d14			Surrogate	18-120	-	-	-	-	-	1718-51-0
GROUNDWATER											
NWTPH-Gx											
NWTPH-Gx	Gasoline Range Hydrocarbons	40.0	100.0	µg/L	-	37	58-139	37	65-129	37	8006-61-9
NWTPH-Gx	a,a,a-Trifluorotoluene			Surrogate	50-150	-	-	-	-	-	98-08-8

Table 1 Data Quality Objectives

Method	Analyte	MDL	MRL	Units	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
					GROUNDWATER (continued)						
NWTPH-Dx (w/o Acid/Silica Gel Clean-up)											
NWTPH-Dx	Diesel Range Hydrocarbons	28.0	50.0	mg/L	-	41	10-134	41	50-123	41	68476-34-6
NWTPH-Dx	Lube Oil Range Hydrocarbons	28.0	50.0	mg/L	-	32	18-147	32	49-117	32	NA
NWTPH-Dx	o-Terphenyl			Surrogate	27-150	-	-	-	-	-	84-15-1
Extractable Petroleum Hydrocarbons											
WA MTCA-EPH	C8-C10 Aliphatics	3.0	20.0	µg/L	-	25	50-150	25	50-150	25	NA
WA MTCA-EPH	C10-C12 Aliphatics	2.0	10.0	µg/L	-	25	70-130	25	70-130	25	NA
WA MTCA-EPH	C12-C16 Aliphatics	9.0	30.0	µg/L	-	25	70-130	25	70-130	25	NA
WA MTCA-EPH	C16-C21 Aliphatics	12.0	50.0	µg/L	-	25	70-130	25	70-130	25	NA
WA MTCA-EPH	C21-C34 Aliphatics	19.0	50.0	µg/L	-	25	70-130	25	70-130	25	NA
WA MTCA-EPH	C8-C10 Aromatics	25.0	50.0	µg/L	-	25	50-150	25	50-150	25	NA
WA MTCA-EPH	C10-C12 Aromatics	1.0	10.0	µg/L	-	25	70-130	25	70-130	25	NA
WA MTCA-EPH	C12-C16 Aromatics	3.0	40.0	µg/L	-	25	70-130	25	70-130	25	NA
WA MTCA-EPH	C16-C21 Aromatics	4.0	30.0	µg/L	-	25	70-130	25	70-130	25	NA
WA MTCA-EPH	C21-C34 Aromatics	7.0	50.0	µg/L	-	25	70-130	25	70-130	25	NA
WA MTCA-EPH	C-35			Surrogate	60-140						94-36-0
WA MTCA-EPH	o-Terphenyl			Surrogate	60-140	-	-	-	-	-	84-15-1
WA MTCA-EPH	2-Fluorobiphenyl			Surrogate	60-140						321-60-8
WA MTCA-EPH	2-Bromonaphthalene			Surrogate	60-140						580-13-2
WA MTCA-EPH	1-Chlorooctadecane			Surrogate	60-140	-	-	-	-	-	3386-33-2
Volatile Petroleum Hydrocarbons											
WA MTCA-VPH	C5-C6 Aliphatics	1.0	50.0	µg/L	-	25	70-130	25	70-130	25	NA
WA MTCA-VPH	C6-C8 Aliphatics	1.0	50.0	µg/L	-	25	70-130	25	70-130	25	NA
WA MTCA-VPH	C8-C10 Aliphatics	3.0	50.0	µg/L	-	25	70-130	25	70-130	25	NA
WA MTCA-VPH	C10-C12 Aliphatics	0.90	50.0	µg/L	-	25	70-130	25	70-130	25	NA
WA MTCA-VPH	C8-C10 Aromatics	2.0	50.0	µg/L	-	25	70-130	25	70-130	25	NA
WA MTCA-VPH	C10-C12 Aromatics	0.30	50.0	µg/L	-	25	70-130	25	70-130	25	NA
WA MTCA-VPH	C12-C13 Aromatics	0.30	50.0	µg/L	-	25	70-130	25	70-130	25	NA
WA MTCA-VPH	2,5-Dibromotoluene (FID)			Surrogate	70-130	-	-	-	-	-	615-59-8
WA MTCA-VPH	2,5-Dibromotoluene (PID)			Surrogate	70-130	-	-	-	-	-	615-59-8

Table 1 Data Quality Objectives

Method	Analyte	MDL	MRL	Units	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
GROUNDWATER (continued)											
Volatile Organic Compounds(Selected List)											
EPA 8260B	Benzene	0.410	1.0	µg/L	-	25	70-130	25	70-130	25	71-43-2
EPA 8260B	1,2-Dibromethane (EDB)	0.460	1.0	µg/L	-	10	70-152	10	80-135	10	106-93-4
EPA 8260B	1,2-Dichloroethane (EDC)	0.350	1.0	µg/L	-	25	72-137	25	70-134	25	107-06-2
EPA 8260B	Ethylbenzene	0.350	1.0	µg/L	-	25	70-130	25	70-130	25	100-41-4
EPA 8260B	n-Hexane	0.230	2.0	µg/L	-	13	39-167	13	70-130	13	110-54-3
EPA 8260B	Toluene	0.350	1.0	µg/L	-	25	70-130	25	70-130	25	108-88-3
EPA 8260B	Total Xylenes	0.730	3.0	µg/L	-	25	70-130	25	70-130	25	1330-20-7
Polynuclear Aromatic Compounds by GC/MS with High Volume Injection											
EPA 8270C-HVI	Acenaphthene	0.029	0.100	µg/L	-	35	25-140	35	43-122	35	83-32-9
EPA 8270C-HVI	Acenaphthylene	0.031	0.100	µg/L	-	31	36-135	31	43-129	31	208-96-8
EPA 8270C-HVI	Anthracene	0.076	0.100	µg/L	-	38	20-145	38	50-125	38	120-12-7
EPA 8270C-HVI	Benzo(a)anthracene	0.018	0.100	µg/L	-	50	10-129	50	50-135	50	56-55-3
EPA 8270C-HVI	Benzo(a)pyrene	0.014	0.100	µg/L	-	50	10-136	50	46-136	50	50-32-8
EPA 8270C-HVI	Benzo(b)fluoranthene	0.044	0.100	µg/L	-	50	10-147	50	37-147	50	205-99-2
EPA 8270C-HVI	Benzo(k)fluoranthene	0.027	0.100	µg/L	-	50	10-135	50	47-135	50	207-08-9
EPA 8270C-HVI	Benzo(ghi)perylene	0.018	0.100	µg/L	-	50	10-145	50	30-145	50	191-24-2
EPA 8270C-HVI	Chrysene	0.020	0.100	µg/L	-	50	10-138	50	47-138	50	218-01-9
EPA 8270C-HVI	Dibenz(a,h)anthracene	0.018	0.100	µg/L	-	50	10-144	50	36-144	50	53-70-3
EPA 8270C-HVI	Fluoranthene	0.018	0.100	µg/L	-	40	28-143	40	51-139	40	206-44-0
EPA 8270C-HVI	Fluorene	0.035	0.100	µg/L	-	39	28-144	39	47-128	39	86-73-7
EPA 8270C-HVI	Indeno(1,2,3-cd)pyrene	0.023	0.100	µg/L	-	50	10-142	50	32-142	50	193-39-5
EPA 8270C-HVI	1-Methylnaphthalene	0.030	0.100	µg/L	-	27	37-126	27	37-126	27	90-12-0
EPA 8270C-HVI	2-Methylnaphthalene	0.028	0.100	µg/L	-	29	29-127	29	41-121	29	91-57-6
EPA 8270C-HVI	Naphthalene	0.028	0.100	µg/L	-	32	24-120	32	38-120	32	91-20-3
EPA 8270C-HVI	Pentachlorophenol	0.460	1.00	µg/L	-	32	34-163	32	34-147	32	87-86-5
EPA 8270C-HVI	Phenanthrene	0.051	0.100	µg/L	-	47	31-142	47	45-133	47	85-01-8
EPA 8270C-HVI	Pyrene	0.024	0.100	µg/L	-	37	10-158	37	50-146	37	129-00-0
EPA 8270C-HVI	Nitrobenzene-d5			Surrogate	27-120	-	-	-	-	-	4165-60-0
EPA 8270C-HVI	2-Flourobiphenyl			Surrogate	29-120	-	-	-	-	-	321-60-8
EPA 8270C-HVI	p-Terphenyl-d14			Surrogate	13-120	-	-	-	-	-	1718-51-0

Table 1 Data Quality Objectives

Method	Analyte	MDL	MRL	Units	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
GROUNDWATER (continued)											
Dissolved Metals by EPA 6000/7000 Series Methods											
EPA 6020 - Diss	Lead; dissolved	0.10	2.00	mg/L	-	20	75-125	20	80-120	20	7439-92-1
Natural Attenuation Parameters											
EPA 300.0	Sulfate	0.11	1.00	mg/L	-	20	80-120	20	90-110	20	14808-79-8
EPA 300.0	Nitrate	0.01	0.10	mg/L	-	20	80-120	20	90-110	20	14797-55-8
EPA 6020	Manganese (total; soluble)	0.60	5.00	mg/L	-	20	75-125	20	80-120	20	7439-96-5
RSK-175	Methane	10.0	26.0	µg/L	70-120	33	46-142	33	80-120	33	74-82-8
EPA 310.1	Alkalinity	5.00	10.0	mg/L	-	20	80-120	20	90-110	20	-

Notes:

[1]Titration method; no method detection limit

CAS = chemical Abstracts Service

FID = flame ionization detector

MDL = method detection limit

µg/L = micrograms per liter

µg/kg = microgram per kilograms

mg/kg = milligram per kilograms

mg/L = milligram perliter

MRL = method reporting limit

PID = photoionization detector

%R = percent Recovery

RPD = relative percent difference

VPH = volatile petroleum hydrocarbons

Table 2 Indicator Hazardous Substances

Method	Analyte	MDL	MRL	Unit	MTCA Method A		MTCA Method B	
					Unrestricted	Industrial	Carcinogenic	Noncarcinogenic
Petroleum Hydrocarbons by NWTPH-Gx and NWTPH-Dx in Soil								
NWTPH-Gx	Gasoline Range Hydrocarbons	1.40	5.00	mg/kg dry wt	30/100[1]	30/100[1]	NR	NR
NWTPH-Dx	Diesel Range Hydrocarbons	2.00	10.0	mg/kg dry wt	2,000	2,000	NR	NR
NWTPH-Dx	Lube Oil Range Hydrocarbons	4.00	25.0	mg/kg dry wt	2,000	2,000	NR	NR
Volatile Organic Compounds per EPA Method 8260B in Soil								
EPA 8260B	Benzene	0.0004	0.0015	µg/kg dry wt	0.03	0.03	18	320
EPA 8260B	Toluene	0.0004	0.0015	µg/kg dry wt	7	7	NR	6,400
EPA 8260B	Ethylbenzene	0.0004	0.004	µg/kg dry wt	6	6	NR	800
EPA 8260B	Total Xylenes	0.0015	0.01	µg/kg dry wt				
EPA 8260B	Methyl tert-butyl ether	0.0006	0.001	µg/kg dry wt				
EPA 8260B	1,2-Dichloroethane (EDC)	0.0006	0.00125	µg/kg dry wt	NoD	NoD	11	1,600
EPA 8260B	1,2-Dibromoethane (EDB)	0.0006	0.005	µg/kg dry wt				
EPA 8260B	n-Hexane	0.0008	0.005	µg/kg dry wt				
Polynuclear Aromatic Hydrocarbons by GC/MS-SIM in Soil								
EPA 8270C-SIM	Acenaphthene	0.00170	0.0100	mg/kg dry wt	NoD	NoD	NR	4,800
EPA 8270C-SIM	Acenaphthylene	0.00170	0.0100	mg/kg dry wt				
EPA 8270C-SIM	Anthracene	0.00170	0.0100	mg/kg dry wt	NoD	NoD	NR	24,000
EPA 8270C-SIM	Benzo(a)anthracene	0.00170	0.0100	mg/kg dry wt	2	0.1	NR	NR
EPA 8270C-SIM	Benzo(a)pyrene	0.00170	0.0100	mg/kg dry wt	2	0.1	0.14	NR
EPA 8270C-SIM	Benzo(b)fluoranthene	0.00170	0.0100	mg/kg dry wt	2	0.1	Tef	NR
EPA 8270C-SIM	Benzo(k)fluoranthene	0.00170	0.0100	mg/kg dry wt	2	0.1	Tef	NR
EPA 8270C-SIM	Benzo(b & k)fluoranthene	0.00330	0.0200	mg/kg dry wt				
EPA 8270C-SIM	Benzo(ghi)perylene	0.00170	0.0100	mg/kg dry wt				
EPA 8270C-SIM	Chrysene	0.00170	0.0100	mg/kg dry wt	2	0.1	Tef	NR
EPA 8270C-SIM	Dibenz(a,h)anthracene	0.00170	0.0100	mg/kg dry wt	2	0.1	Tef	NR
EPA 8270C-SIM	Fluoranthene	0.00170	0.0100	mg/kg dry wt	NoD	NoD	NR	3,200
EPA 8270C-SIM	Fluorene	0.00170	0.0100	mg/kg dry wt				
EPA 8270C-SIM	Indeno(1,2,3-cd)pyrene	0.00170	0.0100	mg/kg dry wt	2	0.1	Tef	NR
EPA 8270C-SIM	1-Methylnaphthalene	0.00170	0.0100	mg/kg dry wt				
EPA 8270C-SIM	2-Methylnaphthalene	0.00170	0.0100	mg/kg dry wt				
EPA 8270C-SIM	Naphthalene	0.00170	0.0100	mg/kg dry wt	5	5	NR	1,600
EPA 8270C-SIM	Pentachlorophenol	0.0023	0.01	mg/kg dry wt				
EPA 8270C-SIM	Phenanthrene	0.00170	0.0100	mg/kg dry wt				
EPA 8270C-SIM	Pyrene	0.00170	0.0100	mg/kg dry wt	NoD	NoD	NR	24,000

Table 2 Indicator Hazardous Substances

Method	Analyte	MDL	MRL	Unit	MTCA Method A	MTCA Method B	
					Unrestricted	Carcinogenic	Noncarcinogenic
Petroleum Hydrocarbons by NWTPH-Gx and NWTPH-Dx in Water							
NWTPH-Gx	Gasoline Range Hydrocarbons	38.0	50.0	µg/L	800/1000[1]	NR	NR
NWTPH-Dx	Diesel Range Hydrocarbons	2.00	10.0	µg/L	500	NR	NR
NWTPH-Dx	Lube Oil Range Hydrocarbons	4.00	25.0	µg/L	500	NR	NR
Volatile Organic Compounds by EPA Method 8260B in Water							
EPA 8260B	Benzene	0.0470	0.200	µg/L	5	0.8	32
EPA 8260B	Toluene	0.0210	0.200	µg/L	1,000	NR	640
EPA 8260B	Ethylbenzene	0.0660	0.200	µg/L	700	NR	800
EPA 8260B	Total Xylenes	0.247	0.750	µg/L	1,000	NR	1,600
EPA 8260B	Methyl tert-butyl ether	0.0930	1.00	µg/L	20	24	6,900
EPA 8260B	1,2-Dichloroethane (EDC)	0.0420	0.200	µg/L	5	0.48	160
EPA 8011	1,2-Dibromoethane (EDB)	0.600	5.00	µg/L	0.01	0.00051	NR
EPA 8260B	n-Hexane	0.129	1.00	µg/L	NoD	NR	480
Polynuclear Aromatic Compounds by GC/MS with High Volume Injection in Water							
EPA 8270C-HVI	Acenaphthene	0.00600	0.100	µg/L	NoD	NR	160
EPA 8270C-HVI	Acenaphthylene	0.00700	0.100	µg/L			
EPA 8270C-HVI	Anthracene	0.00900	0.100	µg/L	NoD	NR	4,800
EPA 8270C-HVI	Benzo(a)anthracene	0.00500	0.0100	µg/L	NoD	Tef	NR
EPA 8270C-HVI	Benzo(a)pyrene	0.00600	0.0100	µg/L	0.1	0.012	NR
EPA 8270C-HVI	Benzo(b)fluoranthene	0.00600	0.0100	µg/L	NoD	Tef	NR
EPA 8270C-HVI	Benzo(k)fluoranthene	0.00600	0.0100	µg/L	NoD	Tef	NR
EPA 8270C-HVI	Benzo(ghi)perylene	0.00700	0.100	µg/L			
EPA 8270C-HVI	Chrysene	0.00600	0.0100	µg/L	NoD	Tef	NR
EPA 8270C-HVI	Dibenz(a,h)anthracene	0.00500	0.0100	µg/L	NoD	Tef	NR
EPA 8270C-HVI	Fluoranthene	0.00900	0.100	µg/L	NoD	NR	640
EPA 8270C-HVI	Fluorene	0.00800	0.100	µg/L	NoD	NR	640
EPA 8270C-HVI	Indeno(1,2,3-cd)pyrene	0.00600	0.0100	µg/L	NoD	Tef	NR
EPA 8270C-HVI	1-Methylnaphthalene	0.00600	0.100	µg/L	NR	NR	NR
EPA 8270C-HVI	2-Methylnaphthalene	0.00800	0.100	µg/L	NR	NR	32
EPA 8270C-HVI	Naphthalene	0.00600	0.100	µg/L	160	NR	160
EPA 8270C-SIM	Pentachlorophenol	0.0068	0.01	µg/L	NoD	0.73	480
EPA 8270C-HVI	Phenanthrene	0.00800	0.100	µg/L	NR	NR	NR
EPA 8270C-HVI	Pyrene	0.00700	0.100	µg/L	NoD	NR	480

Table 2 Indicator Hazardous Substances

Method	Analyte	MDL	MRL	Unit	MTCA Method A	MTCA Method B	
					Unrestricted	Carcinogenic	Noncarcinogenic
Dissolved Metals by EPA 6000/7000 Series Methods in Water							
EPA 6020 - Diss	Dissolved Lead	0.000900	0.00100	mg/L	15	NR	NR

Notes:
1. TPH gasoline with benzene present/TPH gasoline without benzene present
MTCA = Model Toxics Control Act
NoD = No data
NR = Not researched
μg/kg = microgram per kilogram
μg/L = microgram per liter
mg/kg = milligram per kilogram
mg/L = milligram per liter
Tef = Toxic equivalency factor

Table 3 Soil and Groundwater Sampling Locations

Sample Location	Soil Sample Label	Drilling Method	Maximum Depth (feet)	No. of Soil Samples	Screen Elevation[1]	No. of Groundwater Samples
Soil Borings						
AP-1	AP-1-(depth in feet)	Direct push	15	2	N/A	0
AP-2	AP-2-(depth in feet)	Direct push	15	2	N/A	0
AP-3	AP-3-(depth in feet)	Direct push	15	2	N/A	0
AP-4	AP-4-(depth in feet)	Direct push	15	2	N/A	0
AP-5	AP-5-(depth in feet)	Direct push	15	2	N/A	0
AP-6	AP-6-(depth in feet)	Direct push	15	2	N/A	0
AP-7	AP-7-(depth in feet)	Direct push	15	2	N/A	0
Duplicate soil sample[2]	DUP-S-1			1		
AB-1	AB-1-(depth in feet)	HSA	35	2	N/A	0
AB-2	AB-2-(depth in feet)	HSA	35	2	N/A	0
AB-3	AB-3-(depth in feet)	HSA	35	2	N/A	0
AB-4	AB-4-(depth in feet)	HSA	35	2	N/A	0
AB-5	AB-5-(depth in feet)	HSA	35	2	N/A	0
AB-6	AB-6-(depth in feet)	HSA	35	2	N/A	0
AB-7	AB-7-(depth in feet)	HSA	35	2	N/A	0
MW-A7	MW-A7-(depth in feet)	HSA	35	2	N/A	0
Duplicate soil sample[2]	DUP-S-2			1		
Monitoring Wells						
MW-A3	MW-A3-(depth in feet)	HSA	15	2	0 to 10	4
MW-A4	MW-A4-(depth in feet)	HSA	15	2	0 to 10	4
MW-A5	MW-A5-(depth in feet)	HSA	15	2	0 to 10	4
MW-A6	MW-A6-(depth in feet)	HSA	15	2	0 to 10	4
MW-A7	(3)	HSA	15	(3)	0 to 10	4
Duplicate groundwater sample[4]	DUP-GW-1					4
Total Samples				40		24

Notes:
1. Approximate elevation in feet above mean sea level.
2. Duplicate samples will be collected from intervals exhibiting evidence of potential contamination, such as staining or odor.
3. Soil samples for this boring are listed under soil borings.
4. A duplicate groundwater sample will be collected each quarter.

HSA = hollow-stem auger
N/A = not applicable

Table 4 Sample Containers, Preservation and Storage

Analysis	Method	Sample Container	Number of Containers	Preservation and Storage	Holding Times
Soil					
Hydrocarbon Identification	NWTPH-HCID	8 oz. CWM jar with PTFE lid	1	4^o C	14 days
Gasoline Range Organics	NWTPH-Gx	VOA vial w/MeOH	1	10 mL MeOH	14 days
Diesel Range Organics[1]	NWTPH-Dx	8 oz. CWM jar[2] with PTFE lid	1	4^o C	14 days
EPH	MTCA-NW EPH	8 oz. CWM jar[2] with PTFE lid	1	HCl pH<2; 4^o C	14 days
VPH	MTCA-NW VPH	8 oz. CWM jar[2] with PTFE lid	1	HCl pH<2; 4^o C	14 days
Volatile Organic Compounds[3,4]	EPA 8260B	VOA vial w/stir bar[5]	2	Freeze within 48 hrs	14 days
Polycyclic Aromatic Hydrocarbons	EPA 8270D	8 oz. CWM jar[2] with PTFE lid	1	4^o C	14 days
Water					
Gasoline Range Organics	NWTPH-Gx	VOA vial w/MeOH	3	HCl pH<2, 4^o C	14 days
Diesel Range Organics	NWTPH-Dx	500-mL amber bottle	2	HCl pH<2, 4^o C	14 days
Volatile Organic Compounds[3,4]	EPA 8260B[6]	VOA vial	3	HCl pH<2, 4^o C	14 days
Polycyclic Aromatic Hydrocarbons	EPA 8270D	1-Liter Amber	2	None	7 days
Dissolved Lead[7]	EPA 6020	500-mL polyethylene	1	None	180 days[8]

Notes:
1. Silica gel cleanup will be performed on samples where the chromatograph indicates a possible biogenic influence.
2. Sample fraction would come from the same 8 oz jar that was collected for NWTPH-HCID.
3. Includes benzene, toluene, ethylbenzene, total xylenes, and methyl tertiary-butyl ether.
4. Includes 1,2-dichloroethane, 1,2-dibromoethane, and n-hexane for selected samples that appear to be contaminated based on field screening.
5. Sample volume = 5 ounces
6. 1,2-Dibromoethane will be analyzed using EPA Method 8011.
7. Sample to be filtered in the lab.
8. Sample must be filtered within 48 hours of collection for this holding time to apply.

CWM jar = Clear, wide-mouth glass jar
EPH = Extractable petroleum hydrocarbons
HCl = Hydrochloric acid
MeOH = Methanol
PTFE = teflon
VOA = volatile organic analysis
VPH = Volatile petroleum hydrocarbons

Table 5 Geotechnical Analyses

Geotechnical Parameter	Analytical Method	Sample Container and Volume	Number of Containers	Preservation and Storage	Holding Time
Fraction organic carbon	Organic content burn	5-gallon bucket	2	None	180 days
Soil bulk density	Unit weight/volume	5-gallon bucket	2	None	180 days
Total soil porosity	(1)	5-gallon bucket	2	None	180 days
Volumetric water content	(2)	5-gallon bucket	2	None	180 days
Permeability		Shelby tube	1	Seal ends and store upright	180 days
Volumetric air content		5-gallon bucket	2	None	180 days

Notes:
1. Calculated w/ bulk density and particle density.
2. Calculated w/ gravimetric water content.

Table 6 Natural Attenuation Parameter Sampling Containers, Preservation, and Storage

Natural Attenuation Parameter Analysis[1]	Method	Sample Container	Number of Containers	Preservation and Storage	Holding Time
Dissolved oxygen (DO)	Field-measured	N/A	N/A	N/A	N/A
Oxidation-reduction potential (ORP)	Field-measured	N/A	N/A	N/A	N/A
pH	Field-measured	N/A	N/A	N/A	N/A
Specific conductance	Field-measured	N/A	N/A	N/A	N/A
Temperature	Field-measured	N/A	N/A	N/A	N/A
Sulfate	EPA 300.0	500 mL unpreserved polyethylene	1	none	28 days
Nitrate	EPA 300.0	500 mL unpreserved polyethylene	1	none	2 days
Ferrous iron (soluble)	Field-measured	N/A	N/A	N/A	N/A
Manganese (soluble)	EPA 6020	500 mL HNO_3 polyethylene	1	HNO_3	180 days
Methane	RSK175	40 mL HCl Vials	3	HCl	14 days
Alkalinity	EPA 310.1	500 mL unpreserved polyethylene	1	none	14 days

Notes

[1]Ecology, 2005

HCl = hydrochloric acid

HNO_3 = nitric acid

NA = not applicable

VOAs = volatile organic analysis

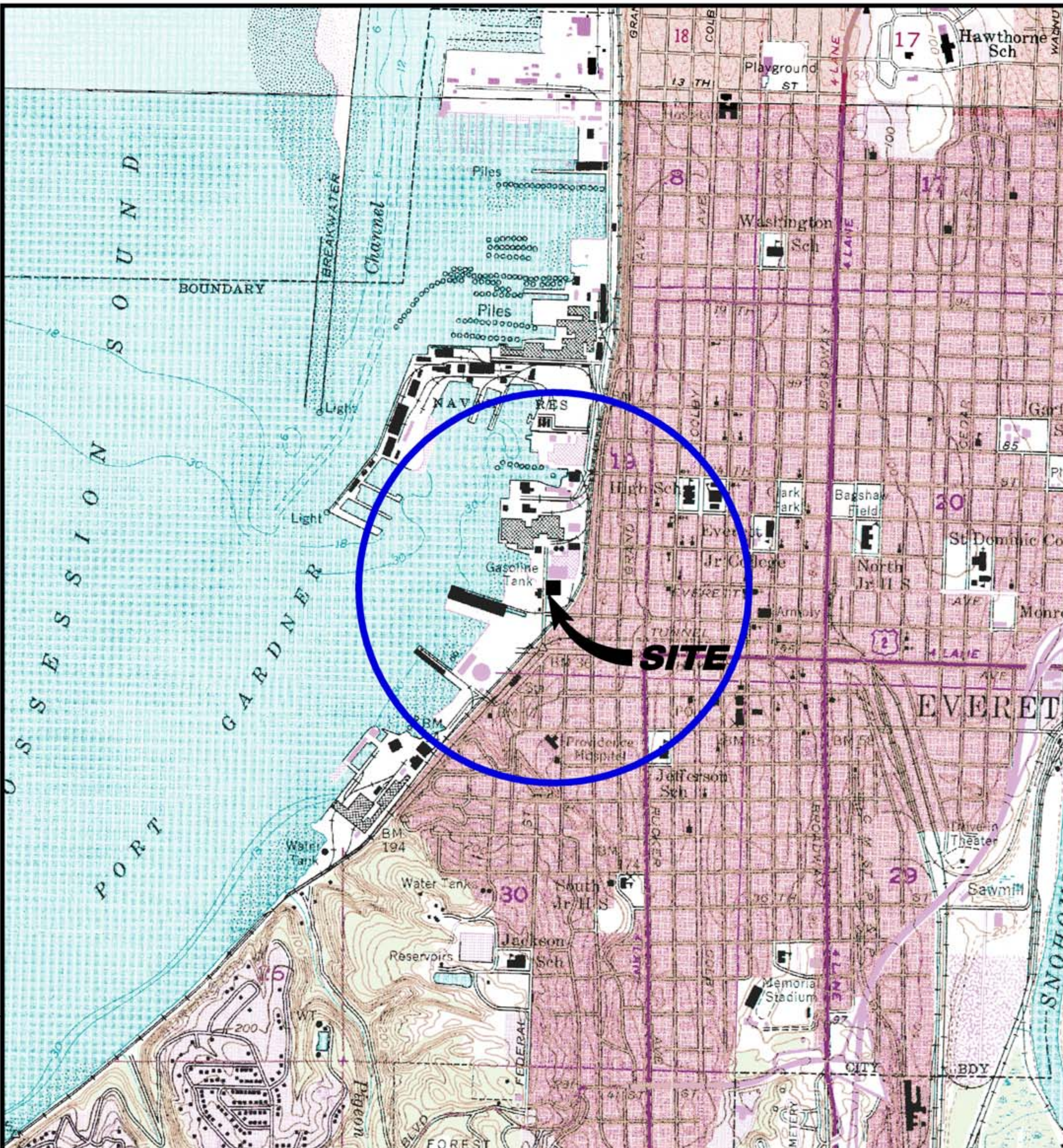
Table 7 Tidal Study Well Specifications

Well No.	Date Installed	Well Depth (feet)	Screened Interval (feet)	TOC Elevation[1]	Depth to Water[2]	Groundwater Elevation[3]	Summary of Lithology
W-3	Feb-90	22.9[4]	3 to 23	13.27	5.88	7.39	sand; H_2S odor
W-6	Feb-90	6.5[4]		14.95	2.83	12.12	sand; organic clay;H_2S odor
MW-11	Mar-88	18.72[4]	NS in log	16.28	2.71	13.57	sand (fill); peat
MW-19	Mar-91	5.26[4]	NS in log	12.79	2.76	10.03	sand
MW-28	June-91	12.18[4]	2.5 to 11.5	13.86	1.25	12.61	silty sand; peat
MW-40R	No log	12.51[4]	No log	15.56	3.35	12.21	No log
MW-A1	Feb-08	15.5	5.5 to 15.5	14.07	7.18[5]	6.89	sand & gravel (fill)
MW-A2	Feb-08	15.5	5.5 to 15.5	12.56	5.82[5]	6.74	sand & silt (fill)
MW-A3	TBI	TBD	25 to 35[6]	TBD	TBD	TBD	TBD
MW-A4	TBI	TBD	25 to 35[6]	TBD	TBD	TBD	TBD
MW-A5	TBI	TBD	25 to 35[6]	TBD	TBD	TBD	TBD
MW-A6	TBI	TBD	25 to 35[6]	TBD	TBD	TBD	TBD
MW-A7	TBI	TBD	25 to 35[6]	TBD	TBD	TBD	TBD

Notes:
1. TOC elevation is in feet above mean sea level.
2. Depth to water in feet below ground surface measured prior to installation of pressure transducer on February 21, 2008.
3. Groundwater elevation is in feet above mean sea level measured prior to installation of pressure transducer on February 21, 2008.
4. Total depth of well measured on February 21, 2008.
5. Depth to water measured on February 24, 2009.
6. Screened interval depth is approximate as wells have not been installed.

H_2S = hydrogen sulfide
NS = Not specified
TBI = To be installed
TBD = To be determined

FIGURES



EXPLANATION

1/2–MILE RADIUS CIRCLE

0 2000 4000 Feet

SCALE: 1:24,000

SOURCE: USGS Quad Topo of Everett and Marysville, Photorevised 1973.

amec

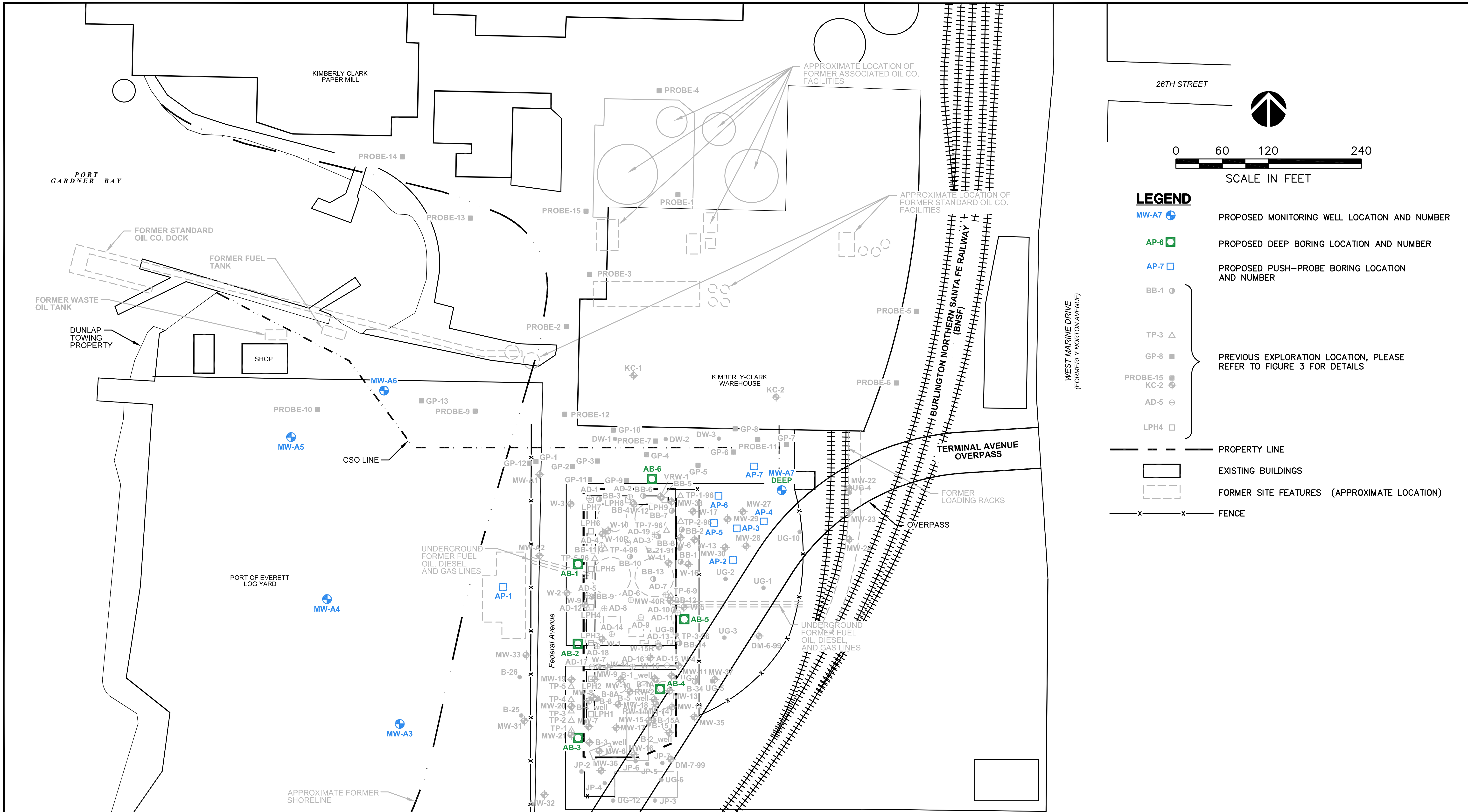
AMEC EARTH & ENVIRONMENTAL, INC.
11810 North Creek Parkway North
Bothell, WA, U.S.A. 98011-8201

SITE LOCATION MAP

EXXONMOBIL/ADC PROPERTY, ECOLOGY SITE ID 2728
2717/2731 FEDERAL AVENUE
EVERETT, WASHINGTON

FIGURE
1

JOB NO.: 9–915–15716–C | DWG DATE: 3–27–2009 10:50am | SCALE: 1"=60' | DESIGN BY: JRS | FILE NAME: 15716–C–01.dwg



SOURCE: Modified from a map provided by City of Everett, ExxonMobil Oil Corporation and Environmental Resolution, Inc.

CLIENT LOGO

CLIENT:
EXXONMOBIL
AMERICAN DISTRIBUTING CO.

AMEC Earth & Environmental
11810 North Creek Parkway N
Bothell, WA, U.S.A. 98011-8201

amec

DWN BY:	JRS
CHK'D BY:	AS/MS
DATUM:	NONE
PROJECTION:	NONE
SCALE:	AS SHOWN

PROJECT
EXXONMOBIL/ADC PROPERTY
ECOLOGY ID 2728

TITLE
PROPOSED DATA GAP INVESTIGATIONS
EXPLORATION PLAN

DATE: FEBRUARY 2010
PROJECT NO: 9-915-15716-C
REV. NO.:
FIGURE No. 2

G:\91\15000\15716-C – Exxon Mobil\15716-C-37.dwg – Exploration (2) – Feb. 23, 2010 3:01pm – jeffrey.sanders

ATTACHMENT A1

Site-Specific Health and Safety Plan

SITE SPECIFIC HEALTH AND SAFETY PLAN

Project Name: ExxonMobil/ADC Property, Ecology Site ID 2728
Project Location: 2717/2731 Federal Avenue, Everett, Washington
Project Number: 9-91-51571-6C

THIS SITE SPECIFIC HEALTH AND SAFETY PLAN APPLIES ONLY TO AMEC PERSONNEL.

All site personnel must have completed the 8-hour ExxonMobil LPS Training prior to undertaking any field work at the site.

A PRE-ENTRY BRIEFING MUST BE HELD PRIOR TO INITIATING ANY SITE ACTIVITY AND AT OTHER TIMES AS NECESSARY TO ENSURE EMPLOYEES ARE APPRISED OF THE SITE HEALTH AND SAFETY PLAN.

SAFETY PERSONNEL:

Health and Safety Coordinators:	Leah Vigoren and Anastasia Speransky
Project Engineers:	Leah Vigoren and Stephen Dailey
Project Managers:	Meg Strong and Gary Dupuy
Site Safety Coordinator (SSC):	Leah Vigoren
Client Contact:	Joe Abel: ExxonMobil Environmental Services (EMES)

EMERGENCY CONTACTS:

Hospital / Emergency Room:	**Providence Medical Center**	**425-258-7555**

Map showing shortest route to Hospital is attached to this document.

Fire:	911
Police:	911
Poison Control Center:	1-800-222-1222
Emergency Water Shut-off: Everett	1-425-257-8821
Electric Utility: Snohomish County PUD	1-877-783-1000
Washington State Patrol:	911

Health and Safety Coordinator: Leah Vigoren (Cell Phone: 206-351-9449)	206-342-1760 (w)
Project Manager: Meg Strong (Cell Phone: 425-864-2096)	425-368-0966 (w)

AMEC Earth & Environmental, Inc.
11810North Creek Parkway
Bothell, Washington
USA 98011
(425) 368-1000 Phone
(425) 368-1001 Facsimile

SITE HISTORY

The approximate 1-acre site was purchased by ExxonMobil's historic predecessors in 1922, and was utilized as a petroleum bulk storage distribution facility between 1922 and 1974. In 1974, the then Mobile Company sold two thirds of the site (northern portion) to A.P. Miller (Miller), for use by the American Distributing Company (ADC). In 1987, Mobile discontinued petroleum storage and dispensing operations on their portion of the site and removed all storage tanks and ancillary equipment. In 1990, petroleum distribution was discontinued on the ADC parcel, and some improvements and tanks were removed from the parcel. Since then, the site has been turned into a parking lot and is leased to the Kimberly Clark facility located to the north of the site. Activities that have occurred on the site since this time have been environmental investigations and remedial activities to address petroleum impacts to soil and groundwater.

In 1985, site characterization activities were initiated to define the nature and extent of petroleum impacts beneath the site. Between 1988 and 1996, a variety of Interim Remedial Action Measures (IRAMs) were implemented to address the free product. In 1998, a Remedial Investigation/Focused Feasibility Study (RI/FFS) was performed in coordination of the Washington State Department of Ecology (Ecology) under the Consent Order. Remedial Action Objectives (RAOs) were developed for the site based on the RI data and baseline human health risk assessment. The remedy selected to achieve RAOs included the following.

1) Construction of an interceptor trench along the down gradient margins of the site (entire western and northern boundaries) to mitigate the off-site migration of the light non-aqueous phase liquid (LNAPL) present on the shallow water table.

2) Placement of low-permeability cap across the entire site surface

3) Ongoing removal and disposal of recovered LNAPL from site monitoring wells and interceptor trench; and

4) Quarterly groundwater monitoring.

ORGANIZATIONAL STRUCTURE

<u>Project Manager(s)</u>:

Gary Dupuy (phone number 206-342-1777) and Meg Strong (phone number 425-368-0966) are the client managers for the project. Responsibilities include remaining in contact with regulatory agencies such as the Department of Ecology, overseeing the Project and ensuring client satisfaction from commencement to closeout.

<u>Site Safety and Health Supervisor</u>:

Leah Vigoren (phone number 206-838-8470) and Anastasia Speransky (phone number 206-838-1776) are the acting Health and Safety Coordinators (HSCs). Primarily the duties of the HSC entail coordination with the Project manager for preparation of site health and safety plans, assessment of chemical hazards and selection of safety / monitoring equipment.

The HSC will also take on the duties of the Site Safety Coordinator. The SSC has the responsibility of implementing the Site Health and Safety Plan while at the Site. The SSC / HSC will be involved with the Project Manager in preparation of the Site Health and Safety Plan. If the plan is not being implemented or if unanticipated situations arise, the SSC / HSC may stop all proceedings and see that all personnel depart the site. The SSC / HSC will have charge of all instruments and see to their proper use and function.

Project Engineer:

Stephen Dailey (phone number 206-342-1775) is the project engineer and is responsible for developing the site conceptual model and providing engineering input to the FFS.

Field Technicians:

Joseph C. Petrick, and Danah Palik are the Field Technicians whose responsibilities include obtaining groundwater samples and other data, as required, from monitoring wells. Keeping field records (I.e. Daily Field Logs) describing field activities, observations and site events. Supplying daily reports and reporting all incidents to the Project Engineer.

Subcontractor

Transport and disposal company (Clear Harbors: AWSL Subcontractor) is responsible for removing all waste from the jobsite and transferring it to a certified facility for disposal.

Drilling company "Cascade Drilling, Inc." is responsible for the advancement of soil borings and the installation of monitoring wells on the site.

ON SITE TASKS

AMEC to remove light non-aqueous phase liquid (LNAPL) monthly and continue the quarterly groundwater monitoring program at the site. Groundwater samples will be collected and analyzed for diesel and heavy oil range organics using Method Northwest Total Petroleum Hydrocarbons Diesel Extended (NWTPH: NWTPH-D, which includes NWTPH-oil (O)) with Silica Gel clean-up), gasoline range organic compounds using Method NWTPH-gasoline Extended (Gx), and benzene, toluene, ethyl benzene, and total xylenes (BTEX) using U.S. Environmental Protection Agency (EPA) Method 8260B.

During monthly O&M events LNAPL is collected by AMEC personnel and stored in two 55-gallon drums within a secured shed on the project site. To mitigate spill hazards, and possible drum failure, these drums are placed on a secondary containment platform which would collect any spilled free liquids. When the drums are full a certified waste transporter and disposal company (ASWL Subcontractor) is contacted to transport the drums for disposal.

AMEC will oversee the advancement of 18 soil borings and the installation of 5 new monitoring wells on the site. Cascade Drilling of Woodinville Washington will conduct the drilling on the site and provide all equipment and personnel necessary. This work will require utility clearances prior to the initiation of drilling. Drilling involves the use of heavy equipment which will require safety precautions during set up and operation. Drilling and sampling at the site brings potentially-contaminated subsurface materials to the surface where Cascade drilling personnel or AMEC personnel overseeing the drilling may be exposed. Soil samples will be collected from each soil boring; a total of 2 samples per boring will be submitted for analyses including NWTPH-Dx, NWTPH-Gx, and BTEX by 8260B. After monitoring well installation, the 5 new wells will be sampled as part of AMEC's ongoing quarterly groundwater monitoring program at the site.

AMEC will be conducting a tidal influence study in which a stilling well will need to be installed on a portion of the Everett pier. The stilling well will need to extend into the water such that the lower portion of it is always submerged. The tidal influence study will consist of programming and installing pressure transducers and data loggers in approximately 12 monitoring wells which will measure water level fluctuations which will be analyzed for the presence and extent of tidal influence.

SAFETY & HEALTH HAZARDS ANALYSIS

a) Physical Hazards

Physical hazards that may be encountered during site activities include noise, manual lifting, powerful moving parts and weather related hazards (cold, heat stress, wind). Hard hats, safety glasses, hearing protection and steel-toed boots will be required for all personnel working in the vicinity of heavy equipment.

Identified hazards may be mitigated by using safe work practices at all times. The SSC has total responsibility for ensuring that all AMEC personnel on-site perform work tasks in a safe and sensible manner. If at any time the SSC determines that safe work practices are not followed, the tasks will be suspended and corrective actions will be taken.

Because of the potential of explosion hazard presented during groundwater monitoring (i.e., W-2) **SMOKING WILL NOT BE ALLOWED WITHIN 50 FEET OF THE WORK ZONE.**

The following are all additional site related hazards:.

1) **Traffic**
   a. Cones will be set out around the work area and safety reflective vests will be worn.

2) **Personnel or property damage from vehicle movement.**
   a. When moving vehicles the following precautions must be taken
   b. Equipment must be stowed and secured
   c. A spotter must be used due to the presence of blind spots in the driver's field of vision.
   d. The spotter must identify any surface obstruction / anomalies
   e. Audible warning signals and hand signals must be used.
   f. Operator must yield to pedestrians.

3) **Personal injury from handling heavy objects.**
   a. Use proper lifting techniques; keeping back straight and lift with arms and legs; keep load near body; avoid reaching.
   b. Do not attempting to lift anything that weighs more than 60 pounds.
   c. Use mechanical equipment such as a cart to carry / lift large, heavy or awkward loads.

4) **Slips, trips and falls.**
   a. Scan area prior to start of work.
   b. Group all equipment and waste in one designated area.
   c. Return tools not in use to storage.

5) **Pinch points on drum and well covers.**
   a. Personnel will wear leather gloves when working with well and drum covers.

6) **Broken Glassware**
   a. Personnel will use bubble wrap and blue ice when transporting samples in glass containers.
   b. Personnel will not overtighten caps on glass bottles.

b) Chemical Hazards

Chemical hazards that could possibly be encountered include Gasoline, BTEX, hydrogen sulfide (H_2S), and methane (CH_4). The Permissible Exposure Limit (PEL) for Gasoline, BTEX, and hydrigen sulfide, and the Threshhold Limit Value (TLV) for methane are listed in the attached table. The nature of this project precludes continuous exposure to any potential contaminant.

Per past anecdotal evidence, monitoring well (MW) 30 occasionlly has contained small amounts of hydrogen sulfide gas. In addition, during installation, well (W) 2 contained methane gas exceeding the lower explosive limit (LEL). AMEC will conduct initial air monitoring using a multi-gas combustible gas indicator (CGI) upon opening wells for sampling. Ensure that the atmosphere is less than 10% LEL, contains between 19.5% and 23.5% oxygen, less than 10 parts per million (ppm) H_2S and less than 10 ppm carbon monozide prior to proceeding with sampling. Each well will be continuously monitored during sampling. The CGI will alarm if atmospheric concentrations exceed the levels required for entry. (Subsequent air monitoring for the year following installation indicates that no hazardous amounts of CH_4 have been detected in or nearby W2 since installation.

1) Personal Injury from chemical contact / exposure / inhalation.
   a. Inspect drums before handling to ensure they are not leaking or bulging, or show any signs of loss of integrity.
   b. AMEC personnel will place themselves upwind when opening monitoring wells.

2) Personal injury from vapor ignition.
   a. AMEC personnel will use metal buckets when collecting and moving product.

c) <u>Biological Hazards</u>

The project site is a flat graded parking lot which eliminates most biological hazards. Current biological hazards are limited to the possibility of insects and / or rodents residing within the monitoring wells. AMEC personnel will take caution when opening the wells and will be wearing leather gloves to mitigate this hazard.

TRAINING

All AMEC personnel will review the site specific Heath and Safety plan before accessing the site. Personnel onsite will also have current 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) Certification.

Certificates of HAZWOPER completion will be maintained at the Kirkland office and will be available to regulatory personnel upon request. All Personnel shall carry current 40-hour HAZWOPER training cards or appropriate paperwork while working onsite. The SSC / HSC shall be first aid and CPR trained.

In addition all site personnel must have completed the **8 hour ExxonMobil LPS Training** prior to undertaking any field work.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

AMEC will wear Level D PPE which consists of steel-toed, chemical resistant rubber boots, inner glove of PVC or latex, outer gloves of Nitrile or equivalent, safety glasses, Tyvek coveralls, and a hard hat. During construction activities, minimal PPE hearing protection will consist of soft foam ear-bud style plugs.

MEDICAL SURVEILLANCE

Evidence of a current physical examination in the form of a letter from an examining physician will be maintained at the Bothell office and will be available to regulatory personnel upon request.

<u>Air Monitoring</u>

AMEC will conduct initial air monitoring using a photoionization detector (PID) upon opening wells for sampling. PID utilizes ultaviolet light to ionize gas molecules and is commonly employed in the detection of volatile organic compounds (VOCs). AMEC will ensure that the concentrations of VOCs are less than 5 parts per million (ppm) in breathing zone prior to proceeding with sampling. Each well will be continuously monitored during sampling. The

PID will alarm if VOC concentrations exceed the levels required for breathing.
AMEC will calibrate the PID both pre and post site visits using Isobutylene calibration gas with compatible regulator.

Air monitoring wil be conducted during drilling and soil sampling activities.

Decontamination

Disposable PPE will be stored in a secured 55-gallon drum onsite. Monthly, a certified waste transporter and disposal company (ASWL Subcontractor) is contacted to transport the drum for disposal.

Water depth meters will be decon'd between depth recordings of individual monitoring wells using a clean metal bucket with distilled water and 1/10 parts cleaning solution.

Site Control

AMEC personnel will be provided with a site map and be required to review the Health and Safety plan prior to entry into the site. A copy of this HASP shall be on hand at all times with emergency contact numbers and directions to the nearest medical facilities easily accessible. When necessary (e.g. quarterly sampling), cones, caution tape or a suitable alternative will be used to deny public access to the work area. Cones will also be used to define an exclusion zone redirecting motorists and pedestrians away from the work area.

In all emergencies AMEC is to document the action taken and notify the HSC, Project Manager and client official of the event and subsequent response.

In the Event of an Injury

If an injury is life-threatening, follow steps 1 though 8 below. If the injury is not life threatening, perform necessary first aid and consider the need for decontamination prior to transport. The SSC shall be first aid and CPR trained.

1) Perform first aid necessary to determine victim(s) medical status
2) Call emergency transport.
3) Give specific directions to location of emergency
4) Give phone from which you are calling;
5) Tell emergency services what happened. Inform that victim(s) may be wearing contaminated clothing.
6) Inform emergency services how many persons need help.
7) Inform emergency services what is being done for the victim(s)
8) Stay on telephone until told to hang up.

Transport to hospital, if possible.

Work Permits

Copies of the permits will be available onsite during drilling activities. Cascade Drilling will obtain start cards required for drilling from the Washington State Department of Ecology.

Security

No unauthorized persons will be allowed in the work zone. Unauthorized persons are those without appropriate training, without proof of medical surveillance, and those with no business on the site.

Confined Space Entry Procedures

AMEC will not be entering confined spaces at the Site.

Spill Containment Program

The site specific accidental spill / release action plan consists of the following:

1) Pick up, isolate, or contain spill;
2) Evacuate area, if necessary;
3) Contact emergency agencies, if necessary.

Incident Reporting Requirements

In all emergencies, document action taken and notify the HSC / SSC, Project Manager and client officials of occurrences.

AMEC will report all incidents and Near Loss Incidents (NLI) to the ExxonMobil contact within 24 hours of the occurrence along with a written report and the launching of an accident investigation.

Attendance/Sign-In (name, date)

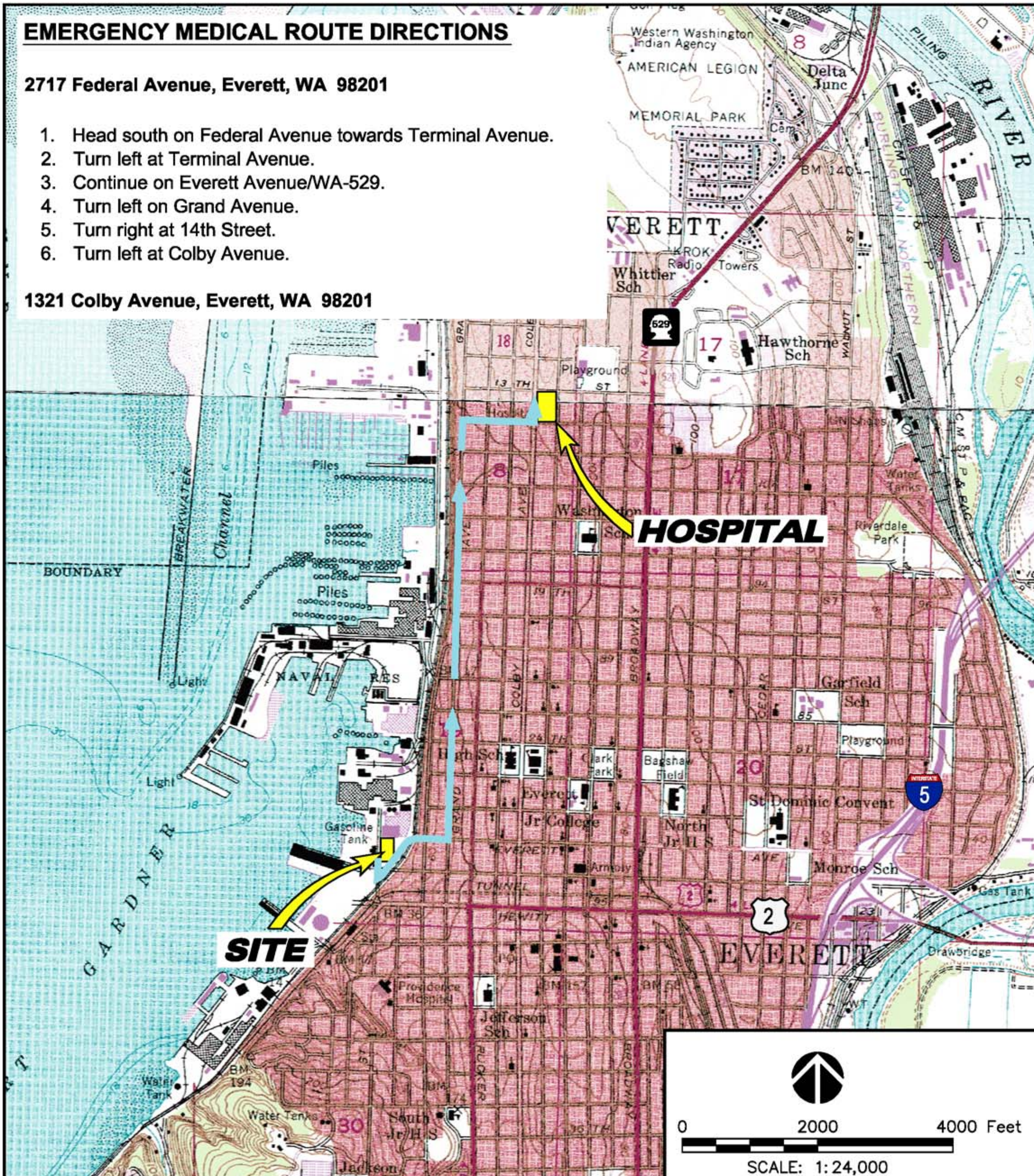
______	______
______	______
______	______
______	______
______	______
______	______
______	______
______	______
______	______

EMERGENCY MEDICAL ROUTE DIRECTIONS

2717 Federal Avenue, Everett, WA 98201

1. Head south on Federal Avenue towards Terminal Avenue.
2. Turn left at Terminal Avenue.
3. Continue on Everett Avenue/WA-529.
4. Turn left on Grand Avenue.
5. Turn right at 14th Street.
6. Turn left at Colby Avenue.

1321 Colby Avenue, Everett, WA 98201



AMEC Earth & Environmental 11335 N.E. 122nd Way, Suite 100 Kirkland, WA, U.S.A. 98034-6918	amec	CLIENT LOGO	CLIENT EXXONMOBIL AND AMERICAN DISTRIBUTING COMPANY	
PROJECT EXXONMOBIL/ADC PROPERTY, ECOLOGY SITE ID 2728		DWN BY: JRS	DATUM: NAD83	DATE: JUNE 2009
TITLE EMERGENCY MEDICAL ROUTE		CHK'D BY: AS	REV. NO.:	PROJECT NO: 9-915-15716-C
		PROJECTION: WA STATE PLANE	SCALE: AS SHOWN	FIGURE No. 1

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ATTACHMENT A2

Field Documentation Forms

AMEC Earth & Environmental, Inc.
11810 North Creek Parkway N Tel (425) 368-1000
Bothell, Washington 98011 Fax (425) 368-1001

DAILY FIELD REPORT

PROJECT NAME Mobil/ADC Everett Facility		PROJECT NO. 9915-15716-0	FIELD REPORT NO.
ADDRESS 2717/2731 Federal Avenue		DATE	PAGE OF
CITY OR COUNTY Everett, WA	PERMIT NO.	ARRIVAL TIME	DEPARTURE TIME
CLIENT ExxonMobil	AMEC PROJECT MANAGER/PHONE NO.		
GENERAL CONTRACTOR	AMEC FIELD REPRESENTATIVE/ MOBILE NO.		
SUBCONTRACTOR	WEATHER		
TYPE OF WORK PERFORMED			
EQUIPMENT USED			

COMMENTS

LOW-FLOW GROUNDWATER SAMPLING LOG

WELL NO: ______ LOCATION: ______ PROJECT NO: ______

DATE: ______ TIME: ______ CLIMATIC CONDITIONS: ______

OVA/PID READING WHEN WELL OPENED: ______ DEPTH TO PRODUCT (TOC): ______

STATIC WATER LEVEL (TOC): ______ TOTAL DEPTH OF WELL (TOC): ______

METHOD OF REMOVAL: ______ PUMPING RATE: ______

WELL PURGE DATA	DTW	Time	Gallons Removed	Temp. (Cº)	pH	Sp. Cond. (mS/cm)	Turbidity (NTU)	DO (mg/L)	REDOX (mv)

SAMPLE WITHDRAWAL METHOD: ______ SAMPLED BY: ______

SAMPLE NUMBER(S) AND TIME: ______

NOTES: ______

LAB ANALYSIS PARAMETERS AND PRESERVATIVES: ______

NUMBER AND TYPES OF SAMPLE CONTAINERS USED: ______

DECON. PROCEDURES: ______

SAMPLES DELIVERED TO: ______ TRANSPORTER: ______

DATE: ______ TIME: ______

CAPACITY OF CASING (GALLONS/LINEAR FOOT)

2" - 0.16 • 4" - 0.65 • 6" - 1.47 • 8" - 2.61 • 10" - 4.08 • 12" - 5.57

SOIL BORING LOG

amec

PROJECT NAME	PROJECT NO		BORING NO
FIELD REPRESENTATIVE	ELEV	DEPTH	PAGE OF
DRILLING CONTRACTOR	DATE BEGUN		DATE COMPLETED
EQUIPMENT USED	WEATHER		

SAMPLE NUMBER G - GRAB S - SPLIT SPOON T - SHELBY TUBE

SAMPLE NUMBER	DEPTH SAMPLED	RECOVERY	GROUNDWATER	DEPTH (FEET)	SOIL DESCRIPTION
				0	
				1	
				2	
				3	
				4	
				5	
				6	
				7	
				8	
				9	
				0	
				1	
				2	
				3	
				4	
				5	
				6	
				7	
				8	
				9	
				0	

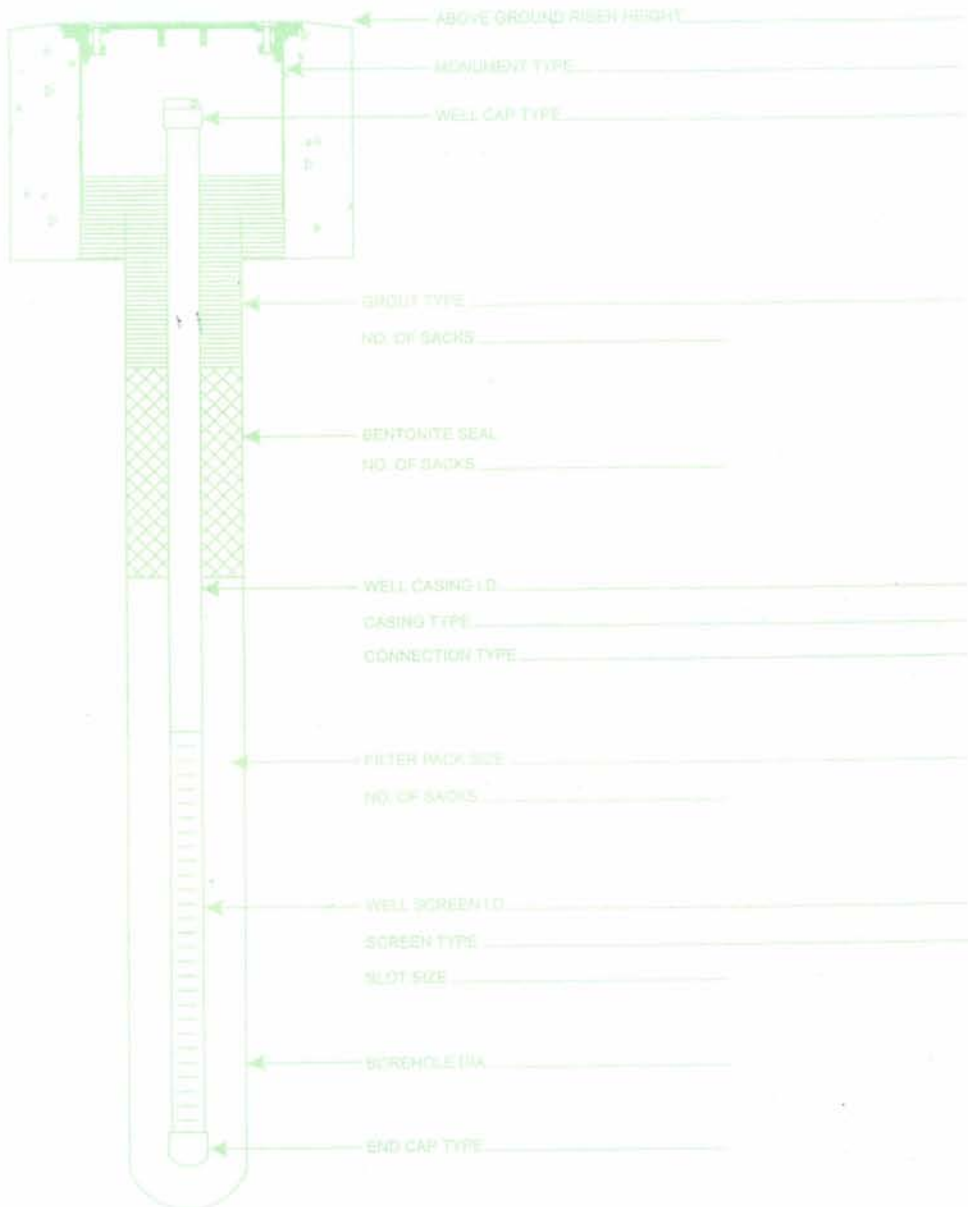
COMMENTS

AS-BUILT WELL LOG

PROJECT NAME	PROJECT NO.	WELL NO.
AEE FIELD REPRESENTATIVE	DATE BEGUN	DATE COMPLETED
DRILLING CONTRACTOR	INSTALLATION TIME	ECOLOGY I.D. NO.

WELL CONSTRUCTION DIAGRAM

SOIL TYPE ELEV.(FEET) DEPTH (FEET)



COMMENTS

Seattle
11720 North Creek Parkway N
Suite 400
Bothell, WA 98011
phone 425.420.9200 fax 425.420.9210

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Leah Vigoren**	**Site Contact: Leah Vigoren**	**Date:**	COC No:
AMEC Earth & Environmental, Inc.	**Tel/Fax: (206) 838-8470**	**Lab Contact:**	**Carrier:**	_____ of _____ COCs
600 University Street Suite 1020	**Analysis Turnaround Time**			Job No.
Seattle, WA 98101	Calendar (C) or Work Days (W) __________			
(206) 342-1760 Phone	TAT if different from Below _________			
(206) 342-1761 FAX	☐ 2 weeks			SDG No.
Project Name: ExxonMobil/ADC	☐ 1 week			
Site: Everett	☐ 2 days			
P O # 9915-15716C	☐ 1 day			

Sample Identification	**Sample Date**	**Sample Time**	**Sample Type**	**Matrix**	**# of Cont.**	**Filtered Sample**																		Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____________

Possible Hazard Identification
☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* *Poison B* ☐ *Unknown* ☐

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ ***Return To Client*** ☐ ***Disposal By Lab*** ☐ ***Archive For __________ Months***

Special Instructions/QC Requirements & Comments: Send electronic data to leah.vigoren@amec.com

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:

WELL DEVELOPMENT LOG

PROJECT		WELL NO.
JOB NO.	DATE	PREPARED BY

METHOD
- OVERPUMPAGE __________
- BAILER __________
- SURGE BLOCK __________
- AIR LIFT __________
- OTHER __________

INITIAL WATER LEVEL __________

FINAL WATER LEVEL __________

REMARKS:

CAPACITY OF CASING
(GALLONS/LINEAR FOOT)

2" = 0.16
4" = 0.65
6" = 1.47

VOLUME BETWEEN CASING AND HOLE
(GALLONS/LINEAR FOOT)
(ASSUMING 40% POROSITY)

2" CASING AND 6" HOLE - 0.52
2" CASING AND 8" HOLE - 0.98
4" CASING AND 10" HOLE = 1.37
4" CASING AND 12" HOLE - 2.09

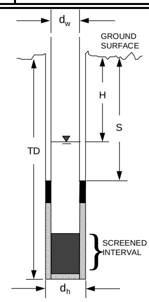
HOLE DIAMETER d_h = _____

WELL CASING INSIDE DIAMETER d_wID = _____

OUTSIDE DIAMETER d_wOD = _____

DEPTH TO:
- **WATER LEVEL** H = _____
- **BASE OF SEAL** S = _____
- **BASE OF WELL** TD = _____

EST. FILTER PACK POROSITY P = _____



WELL VOLUME CALCULATION:

CASING VOLUME = $V_c = \Pi\left(\frac{d_w ID}{2}\right)^2 (TD - H) = 3.14\left(\frac{\_\_\_\_}{2}\right)^2 (\_\_\_\_ - \_\_\_\_) = \_\_\_\_\_\_$

FILTER PACK PORE VOLUME = $V_f = \Pi\left[\left(\frac{d_h}{2}\right)^2 - \left(\frac{d_w OD}{2}\right)^2\right](TD - (S \text{ or } H^*))(P) = \_\_\_\_\_\_$

(*if S > H, use S; if S < H, use H)

$= 3.14\left[\left(\frac{\_\_\_\_}{2}\right)^2 - \left(\frac{\_\_\_\_}{2}\right)^2\right](\_\_\_\_ - \_\_\_\_)(\_\_\_\_) = \_\_\_\_\_\_$

TOTAL WELL VOLUME = VT = Vc + Vf = ____ + ____ = ______ $ft.^3$ x 7.48 = ______ gal.

DEVELOPMENT LOG:					CUMULATIVE WATER REMOVED GALLONS	WATER QUALITY						COMMENTS
DTW	TIME BEGIN/END	METHOD	ELAPSED TIME	FLOW RATE (gpm)		pH	TEMP	CONDUC-TIVITY	D.O.*	REDOX	TURBID-ITY	

* = Dissolved Oxygen