

Compliance Monitoring Plan

Phillips 66 Renton Terminal
2423 Lind Ave. Southwest
Renton, Washington 98057

Agreed Order No. DE 11313
Agency No. 2070

Phillips 66 Company

20818 44th Ave. West, Suite 190 Lynnwood Washington 98036
070496 | Report No 46 | October 19 2016

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1. Introduction

GHD Services Inc. (GHD) appreciates the opportunity to submit this Compliance Monitoring Plan (CMP) in behalf of Phillips 66 Company (P66) and Atlantic Richfield Company (BP). This CMP is a deliverable requirement in accordance with the agreed order (No. DE 11313) between the Washington State Department of Ecology (Ecology), P66, and BP/ExxonMobil for the P66 Renton Terminal located at 2423 Lind Avenue Southwest, Renton, Washington (Site, Figure 1). The agreed order sets forth the requirements for the Cleanup Action Plan (CAP) (CRA, 2014) at the Site. This CMP also fulfills the requirements of WAC 173-340-410 regarding compliance monitoring.

1.1 Site Description and Background

The Property is an active bulk petroleum distribution terminal (Figure 2). The Property occupies approximately 7 acres and is situated at the northwest corner of the intersection of Lind Avenue Southwest and Southwest 27th Street in Renton, WA.

The Property is located in King County in the northwest quarter of section 30; township 23 North; Range 5 East. The eastern portion of the parcel is occupied by the terminal facility and the western portion of the parcel is a wetland (King County Tax Parcel Number 3023059086).

Four separate releases have been documented. The first release was documented in 1986 in the vicinity of the current loading racks on the northern portion of the Site. Additional suspected releases were documented in 1990 and 1991 in the vicinity of the loading racks but were never confirmed to be separate from the original release. In 2002, a confirmed release from above ground storage tank (AST) #2 was documented. Additional information regarding the four documented releases is available in the Remedial Investigation and Feasibility Study Work Plan.

Mobil (the predecessor to ExxonMobil) began terminal operations in 1968 and operated the facility until 1988 when the Property was sold to British Petroleum Exploration & Oil (BP). Tosco Corporation (predecessor to ConocoPhillips now Phillips 66) purchased the Property from BP in 1993 and P66 is the current owner/operator.

Following the discovery of the initial release in 1986, ExxonMobil began investigation and cleanup activities under Enforcement Order DE 87-N301 issued by Ecology on October 14, 1987. Cleanup activities consisted of the operation of a groundwater extraction system equipped with two recovery trenches. Following the discovery of the 2002 release, ConocoPhillips began investigation and cleanup activities associated with the 2002 release under Ecology's Voluntary Cleanup Program (VCP). Cleanup activities consisted of product recovery from wells using a vacuum truck and operation of a dual phase extraction system. Additional information regarding the two remediation systems is available in the quarterly remediation progress reports for the Site.

Both the ExxonMobil/BP and P66 systems continued to be operated independently by the two parties. On August 5, 2010, Ecology, ExxonMobil, and ConocoPhillips (now P66) entered into an Agreed Order (DE 7882), effectively combining both contaminated areas into one Site. The purpose of the agreed order was to facilitate completion of a Site-wide remedial investigation and implementation of a final remedial action.

A comprehensive remedial investigation was completed in 2011 and 2012 to delineate contaminants in soil, groundwater, surface water, and sediment. Following completion of the remedial investigation, a feasibility study including an evaluation of cleanup alternatives and pilot tests for air sparge / soil vapor extraction and dual phase extraction was completed in 2012 and 2013. The results of the Remedial Investigation and Feasibility Study (RI/FS) were presented in the *Remedial Investigation and Feasibility Study Report* (CRA, 2013). Following completion of the feasibility study, dual phase extraction was chosen as the appropriate remedial action and a *Draft Corrective Action Plan* (CRA, 2014) was completed. In May 2015, Ecology, ExxonMobil, and Phillips 66 entered into an Agreed Order (DE 11313) to facilitate implementation of the final CAP. Installation of a 57-well dual phase extraction system will be completed in early 2016.

1.2 CAP Summary

The CAP provides a comprehensive plan to meet the remedial objectives defined in the RI/FS report (CRA, 2013) and final CAP (included as part of Agreed Order DE 11313), which includes the following:

- J Development of cleanup standards for the site that are protective of human health and the environment. Cleanup standards were developed for soil, groundwater, and surface water. The site specific contaminants of concern and selected cleanup standards for each media are presented in Table 1.
- J Define the cleanup action areas. The cleanup action areas are those areas for each media where contaminant concentrations exceed the site cleanup standards. The following cleanup action areas were determined for the site:
 - o Soil – The source areas are considered to be near the truck loading racks and AST #2. The cleanup action areas include the source areas and extend to HA-10 to the north, just past HA-1 to the west, LA1x-2 to the south, D-4R to the east (northern portion of the Site) and LA1x-7 to the east (southern portion of the Site).
 - o Groundwater – The cleanup action area for groundwater is based on capture of the dissolved phase plume and free product plume and includes the soil cleanup action area but extends to include MW-10 and MW-15 to the west and HA-14 to the east.
 - o Surface Water – The cleanup action area for surface water is the southwest corner of the retention basin located at the southeast corner of the site.
 - o Soil in the wetlands and retention basin – The cleanup action area for soil in the wetlands and retention basin include the southwest corner of the retention basin.
- J Description of remedial actions chosen to be implemented at the site. For soil and groundwater, Dual Phase Extraction (DPE) was chosen as the remedial action. For surface water and soil in the retention basin, remedial excavation of contaminated soil was chosen as the remedial action.
- J Post-DPE remedial actions. Following active remediation using DPE, any areas that cannot practically be remediated to below cleanup standards, are shown to be stable and shrinking, and are contained to prevent exposure to receptors can be left in place. If necessary, the existing environmental covenant will be modified and conditional points of compliance will be set in place as additional institutional controls. Monitored Natural Attenuation (MNA) in conjunction with long term monitoring will be used to show that contaminants are naturally attenuating, are not migrating, and do not present a hazard to any receptors.

- J Post remedial excavation confirmation sampling. Surface water samples will be collected following soil excavation within the retention pond at the Southeast corner of the Site to confirm surface water impacts have attenuated.

2. Objectives and Scope of the Compliance Monitoring Plan

The objective of this CMP is to provide a description of the compliance monitoring related to the remedial actions identified in Section 1.2. The CMP is composed of the following:

- J **Groundwater Monitoring** – Groundwater monitoring is used to confirm that human health and the environment are adequately protected during the course of the cleanup action. Groundwater monitoring data is also used to evaluate the remediation progress.
- J **Performance Monitoring** – Performance monitoring is used to evaluate the effectiveness and progress of the DPE system and to demonstrate compliance with regulatory discharge permits. Performance monitoring in regards to the remedial investigation consists of the collection of soil samples during excavation to determine if impacted soil has been remediated.
- J **Confirmation Monitoring** – Confirmation monitoring is used to determine whether cleanup standards have been met and to confirm the long term effectiveness of the remedial action. The confirmation monitoring data will be used to determine whether the remedial action is considered complete for either a specific area (well, treatment zone, or contaminated media) and for the site as a whole.

The groundwater monitoring, system performance monitoring, and confirmation monitoring are designed to demonstrate compliance with the conditions of the Agreed Order (No. DE 11313). The CMP specifies the methods, procedures, and protocols to be used to obtain the data used to determine this compliance. These activities will be conducted at the Site until the cleanup actions are complete and post-remediation compliance monitoring is implemented.

3. Groundwater Monitoring

For the duration of the operation of the DPE system, groundwater monitoring will be conducted on a quarterly basis at the Site. Groundwater monitoring consists of sampling 26 wells using low flow sampling techniques. Seven of the twenty-six wells are located in the source areas and will not likely show a significant reduction in contaminant mass for the first few years. These wells will only be sampled on a semi-annual basis (i.e., during seasonal high and seasonal low water table elevations). If any one of these wells begins to show significant reduction in contaminant mass, the sampling frequency may be increased to quarterly. Additionally, after the first four quarterly sampling events, wells that indicate Site constituents of concern (COCs) are stable or show declining trends, will also only be sampled on a semi-annual basis until COC concentrations have declined and final compliance can be demonstrated via eight consecutive quarterly sampling events. The wells to be sampled are presented on Table 2. The locations of the wells are presented on Figure 2.

The purpose of the proposed groundwater monitoring plan is to evaluate groundwater quality in the vicinity, along the perimeter, and down-gradient of the groundwater contaminant plume(s).

Contaminant concentrations will be compared to historic concentrations, where available, for each well to determine if concentration trends are decreasing, increasing, or not changing. Concentration trends will be used to gauge the performance of the existing remediation system (mass removal) and to determine if the system is maintaining adequate control of the plume(s) and preventing further migration to sensitive receptors. Seasonal groundwater variation will also be considered.

All groundwater monitoring and analytical activities will be performed in accordance with the procedures outlined in the Site Sampling and Analysis Plan (Appendix A), Quality Assurance Project Plan (Appendix B), plus the existing Site Health and Safety Plan.

3.1 Determination of Compliance

Compliance for groundwater is considered met when contaminant concentrations meet cleanup standards at the Site. All LNAPL greater than 0.01 feet must also have been removed in order to demonstrate compliance. If analytical data for Site constituents of concern (COCs) in a well have been below cleanup standards for eight consecutive quarters and it can be demonstrated that no further risk to human health or the environment is present in the vicinity of the well, the PLPs may request approval from Ecology to discontinue sampling that well.

If the DPE system has reached its limit of practical contaminant recovery, the next stage of remediation may be Monitored Natural Attenuation (MNA). A major line of evidence for natural attenuation is whether the plume is stable or shrinking in size. As part of the Supplemental Cleanup Plan in Exhibit C of the Agreed Order (also Table 6 of the final Cleanup Action Plan), a separate Compliance Monitoring Plan will be submitted for Ecology approval.

4. System Performance Monitoring

System performance monitoring will be conducted on an ongoing basis for the P66 dual phase extraction system and will consist of the following activities:

-) Hydraulic monitoring (quarterly)
-) Product thickness gauging (quarterly)
-) Monitoring of system operational parameters (weekly)
-) System groundwater and vapor sampling (monthly)
-) Evaluation of individual extraction wells (monthly)

The purpose of the system performance monitoring is to evaluate the performance of the remediation system to determine if:

-) The system is maintaining adequate control of the plume(s) and preventing further migration.
-) The system is removing contaminant mass from the plume(s).
-) The system is meeting the discharge permit requirements.

The results of the performance monitoring will be used to determine if modifications or adjustments can be made to optimize system performance and to report mass removal estimate and permitting compliance.

4.1 Hydraulic Monitoring and Product Thickness Gauging

Hydraulic monitoring and product thickness gauging will be conducted on a quarterly basis at the Site. A total of 56 wells will be gauged for product thickness and water table elevation. During these monitoring events, data will be collected immediately prior to the well sampling task and will occur while the system is operating and has been operating consistently for a period of 1 week. The wells to be monitored are presented on Table 2. The locations of the wells are presented Figure 2.

Hydraulic monitoring and product thickness gauging will be conducted in accordance with the Site Sampling and Analysis Plan and the Site Health and Safety Plan.

The hydraulic monitoring data (water levels) will be used to evaluate hydraulic control (capture) of the contaminant plume. Product thickness data will be used to monitor the occurrence and mobility of free product in the subsurface and progress of the remedial action.

4.2 Monitoring of System Operational Parameters

Monitoring of system operational parameters will be conducted on a weekly basis and will consist of the following:

-) Groundwater extraction flow rates, totals, and run times
-) Soil vapor extraction (SVE) flow rates, vacuum, temperature, and run times
-) SVE volatile organic compound (VOC) influent and effluent concentrations
-) Amount of free product recovered

The system parameter monitoring will be used to measure the progress of the remediation system in terms of mass removal, and to demonstrate compliance with regulatory discharge permits. Data will also be used to evaluate the performance of system to determine if adjustments or modifications should be made to optimize system performance. The performance monitoring will be completed in accordance with the Sampling and Analysis Plan (Appendix A), Quality Assurance Project Plan (Appendix B), and Site Operations and Maintenance Manual (GHD, 2015).

4.3 Effluent Groundwater and Vapor Sampling

Effluent groundwater and vapor samples for laboratory analysis will be collected from the system on a monthly basis. Samples will be collected upstream and downstream of each control point (Oxidizer, carbon vessel, etc.). The data will be used to analyze contaminant reduction across each control point, calculate contaminant mass removal rates, and verify compliance with discharge permits.

Treated water effluent is discharged to the combined sanitary/stormwater system for conveyance to the publicly owned treatment works under King County Discharge Authorization 7910-01. The discharge authorization requires monthly monitoring of discharge volumes and quarterly reporting of the system effluent. Quarterly self-monitoring reports are submitted to King County to demonstrate compliance.

The remediation system was also constructed under the authority of the Puget Sound Clean Air Agency (PSCAA) Authority to Construct No. 10810. Air treated by the oxidizer is discharged to the atmosphere under PSCAA discharge permit NOC 10810. The point of compliance for the air

discharge permit is the sample port on the oxidizer exhaust stack. Initially, vapor samples are collected twice each month to demonstrate compliance with discharge conditions. After 9 months, GHD can request a reduction to monthly sampling. PSCAA does not have specific reporting requirements. Data is maintained onsite in the event that a permit audit should occur. The air and water discharge permits are presented in the Operations and Maintenance Manual (GHD, 2015).

4.4 Evaluation of Individual DPE/Extraction Wells

Individual dual phase extraction wells will be evaluated on a monthly basis. Extraction wells will be monitored for individual soil vapor and groundwater flow rates, vacuum, and VOC concentrations using a PID. Individual groundwater grab samples for lab analysis may be collected from each operating well if necessary. These grab samples will be at the discretion of the system operator and will be used to monitor individual well's contaminant mass contribution (e.g., when to switch operating wells, as only 20 to 25 of the 58 recovery wells will be operational at one time). If LNAPL returns or nearby compliance wells demonstrate an increasing dissolved-phase concentration trend (i.e., rebound effect) in excess of cleanup standards, individual extraction wells will be brought back on-line.

4.5 Criteria for Long-term Shut-Down of DPE/ Extraction Wells

Individual extraction wells will be evaluated as discussed in Section 4.4. As the soil and groundwater contaminant plume decreases in size, the plume may shrink beyond the radius of influence of a given DPE/extraction well or set of wells. As detailed in the CAP, approximately 10 wells may be operated in DPE mode, with an additional 10 to 15 wells operating in groundwater extraction mode. As such, clusters of DPE wells will be operated to remediate local areas (or zones) within the overall plume. During the initial years of system operation, these clusters of wells will be rotated within various remediation system zones (at the operators discretion) in order to maximize contaminant recovery. As remedial activities progress, individual DPE or extraction well data will indicate local treatment area is nearing compliance when LNAPL has been removed and nearby compliance monitoring wells indicate stable or declining concentration trends and/or are below the Site-specific cleanup standards. Prior to long-term shut down, data from the DPE or extraction wells must also show that it has reached its limit on contaminant recovery, such as an asymptotic trend on cumulative recovery curves, very small masses of contaminants are being recovered. When this occurs, individual DPE or extraction wells will be shut off. The DPE/extraction wells are not compliance points, and will not be sampled as such. Groundwater monitoring data for compliance monitoring wells in the vicinity of the DPE or extraction well will be sampled for eight quarters to determine if remediation is complete.

5. Remedial Excavation Performance Sampling

Remedial Excavation of contaminated soil in the southwest corner of the retention basin has been selected as the remedial action for impacted soil and surface water in the retention basin. Details of the remedial action are presented in the CAP.

Performance soil samples will be collected during excavation activities to confirm compliance with the remedial objectives. Excavation will be performed during seasonal low water table elevation (i.e., August thru mid-October) and will be completed to a minimum depth of 1 foot into the underlying soil beneath the surface layer. After the first foot, soil samples will be collected for field

screening. Field screening will include measurement of VOCs with a PID and visual inspection. Excavation will continue until clean soil is encountered, to a maximum depth of 15 feet below ground surface, or until Site infrastructure or City of Renton right-of ways prohibits further excavation. Soil samples will be collected every 2 feet for field screening. Based on seasonal fluctuation in groundwater elevation, it is anticipated that the excavation will likely not exceed 8 to 10 feet below ground surface, which corresponds to the seasonal low water table elevation in this area. The excavation will be sloped appropriately to prevent caving of the side walls. Additionally, the excavation will not extend below the water table or into City or Renton right-of-ways to the south or east. Soil samples will be collected from the final excavation extents and transported to an approved laboratory for analysis of the Site COCs listed on Table 1. Following site restoration, final compliance will be determined via surface water sampling (per Section 6.3 below).

6. Confirmation Monitoring

6.1 Groundwater

Model Toxics Control Act (MTCA) Method A cleanup levels will be used for groundwater since they are considered protective of drinking water. The point of compliance for groundwater is considered throughout the Site from the uppermost level of the saturated zone extending vertically to the maximum extent of contamination. Confirmation monitoring will be done on a per well basis as free-phase light non-aqueous phase liquid (LNAPL), LNAPL trapped in soil pore spaces below the water table (i.e., smear zone) and petroleum hydrocarbons adsorbed to subsurface soil are removed, reducing dissolved phase contaminants in groundwater. As system performance monitoring indicates a certain well or group of wells has been remediated, groundwater analytical data from compliance monitoring wells will be compared to the Site-specific cleanup standards presented in Table 1. Final compliance will be considered met when the Site COCs in a well have been below cleanup standards for eight consecutive quarters. Once compliance has been met, sampling may be discontinued for that well.

6.2 Soil

For contaminated soil at the Site, the primary concern is dissolution of contaminants trapped in soil to groundwater. Groundwater provides a mechanism of contaminant transport to potential receptors. MTCA Method A Soil Cleanup Levels For Industrial Land Use will be used for soil because it is considered protective of groundwater. The point of compliance for soil is considered throughout the Site from ground surface to the maximum extent of soil contamination.

Soil confirmation sampling is proposed to be conducted post remediation. Remediation activities will be considered complete when performance monitoring data and groundwater confirmation sampling indicate contaminants have been removed from all targeted areas to the maximum extent practicable. Soil confirmation samples will be collected from areas of known previous soil contamination. Soil analytical results will be compared to Site-specific cleanup standards and historical soil data. If soil data indicate concentrations below the Site-specific cleanup standards, compliance will be confirmed met and no additional sampling will be required in that area.

6.3 Surface water

For surface water at the Site, MTCA Method A cleanup levels will be used since they are considered protective of drinking water. The point of compliance for surface water is considered throughout the Site at all locations where Site contaminants may be released to surface water.

Once excavation and backfilling is complete, confirmation surface water sampling will be completed to confirm surface water contamination has been remediated. Confirmation sampling may not be conducted for several months after excavation is completed, as the retention basin contains water seasonally. Analytical data from surface water samples will be compared to Site-specific cleanup standards. If surface water analytical data indicate concentrations below the Site-specific cleanup standards, compliance will be confirmed met and no additional surface water sampling will be required.

7. Post-DPE Remedial Actions

The DPE system is estimated to operate for an approximate period of 5 years. Upon reaching the practical limits of the remedial action (which may or may not occur within the 5-year period), it is anticipated that the majority of the Site will meet the cleanup goals. However, since this is an operating industrial site and certain areas of the Site are inaccessible for remediation; it is expected that residual hydrocarbons may still be present and need to be left in place. In order for soil contamination to be left in place the following conditions must be met:

- J All soil and groundwater that is able to be practically remediated, has been remediated to below Site-specific cleanup standards.
- J The remaining contaminant plume must be shown to be stable or shrinking.
- J The remaining soil and groundwater contamination must be contained to the extent that it is protective of human health and ecological receptors.
- J Institutional controls must be set in place to prohibit or limit activities that may cause contaminant exposure to humans or the environment.
- J A Compliance Monitoring Plan (CMP) and 5-year review plan must be set in place to verify that the above conditions are met.

Following active remediation, any areas where cleanup standards are not able to be met using active DPE remediation, the above conditions must be met. Contaminant plumes will be shown as stable or shrinking in these areas before active DPE remediation will be discontinued. At this point, it is anticipated that any remaining soil and groundwater contamination will be contained by either the existing asphalt cap or other site structure such as an above ground storage tank. Additional institutional controls under MTCA will be employed (i.e., Environmental Covenant) and conditional points of compliance will be established at that time with Ecology approval.

Monitored Natural Attenuation (MNA) in conjunction with long term monitoring will be used to show that contaminants are naturally attenuating, are not migrating, and do not present a hazard to human health and the environment. An amended CMP will be set in place at that time detailing the specific sampling requirements associated with MNA and long term monitoring.

8. Reporting

Groundwater and system performance monitoring reports will be provided to Ecology on a quarterly basis. Each report will include of the following:

-) Description of activities completed during the reporting period
-) Groundwater monitoring results
-) Hydraulic monitoring results
-) Isoconcentration contours
-) Contaminant time series for individual wells
-) Product thickness mapping
-) Potentiometric contours with system on
-) Results of the weekly system monitoring and O&M activities
-) Results of the system groundwater and vapor sampling
-) Mass removal data tables
-) Results of individual extraction well analyses
-) Evaluation of system performance
-) Description of modifications or adjustments made to improve performance
-) Description of any system downtime
-) Description of any maintenance activities
-) Determination of compliance for individual wells or areas

The field activities and reporting described in this CMP may change as additional data are collected or if significant modifications or adjustments are made to the existing remediation system. Ecology will be notified of such changes as they occur. If you have any questions or comments regarding this CMP please contact Ed Turner at (425) 563-6519.

9. References

Model Toxics Control Act (MTCA). 2013. Washington State Department of Ecology. November 2013.

Agreed Order DE-11313, May 2015, Washington State Department of Ecology

WDOE 2015. *Corrective Action Plan, Phillips 66 Renton Terminal*. September 2015.

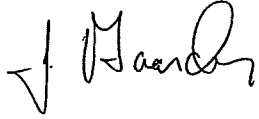
Agreed Order DE-7882, August 2010, Washington State Department of Ecology

CRA, 2013. *Remedial Investigation and Feasibility Study, Phillips 66 Renton Terminal*. September 2013

CRA, 2015. *Operations and Maintenance Manual Dual Phase Extraction System*. September 2015

All of Which is Respectfully Submitted,

GHD



Jeff Gaarder

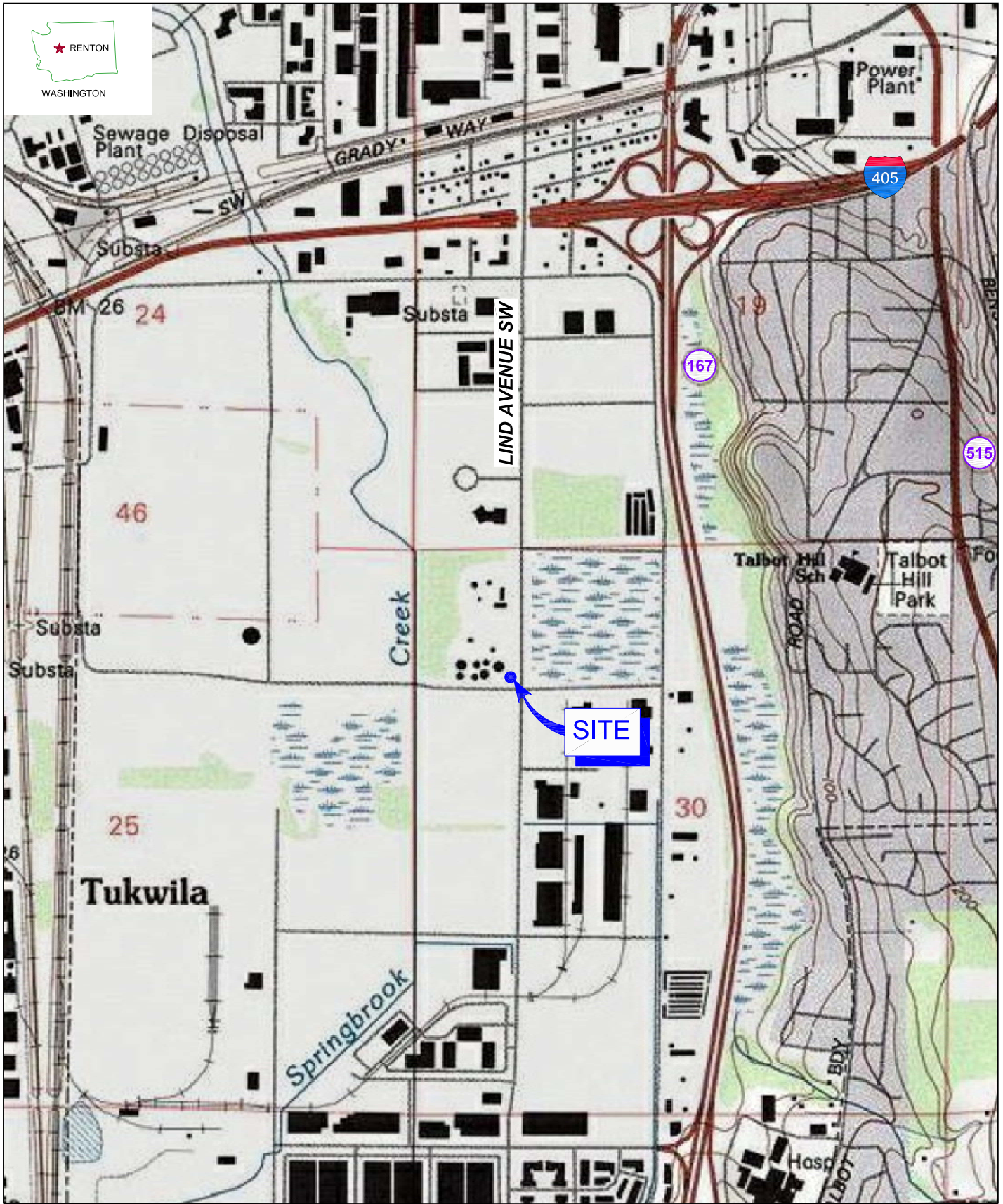


Matthew Davis

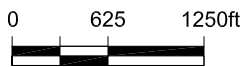


MATTHEW DAVIS

Figures



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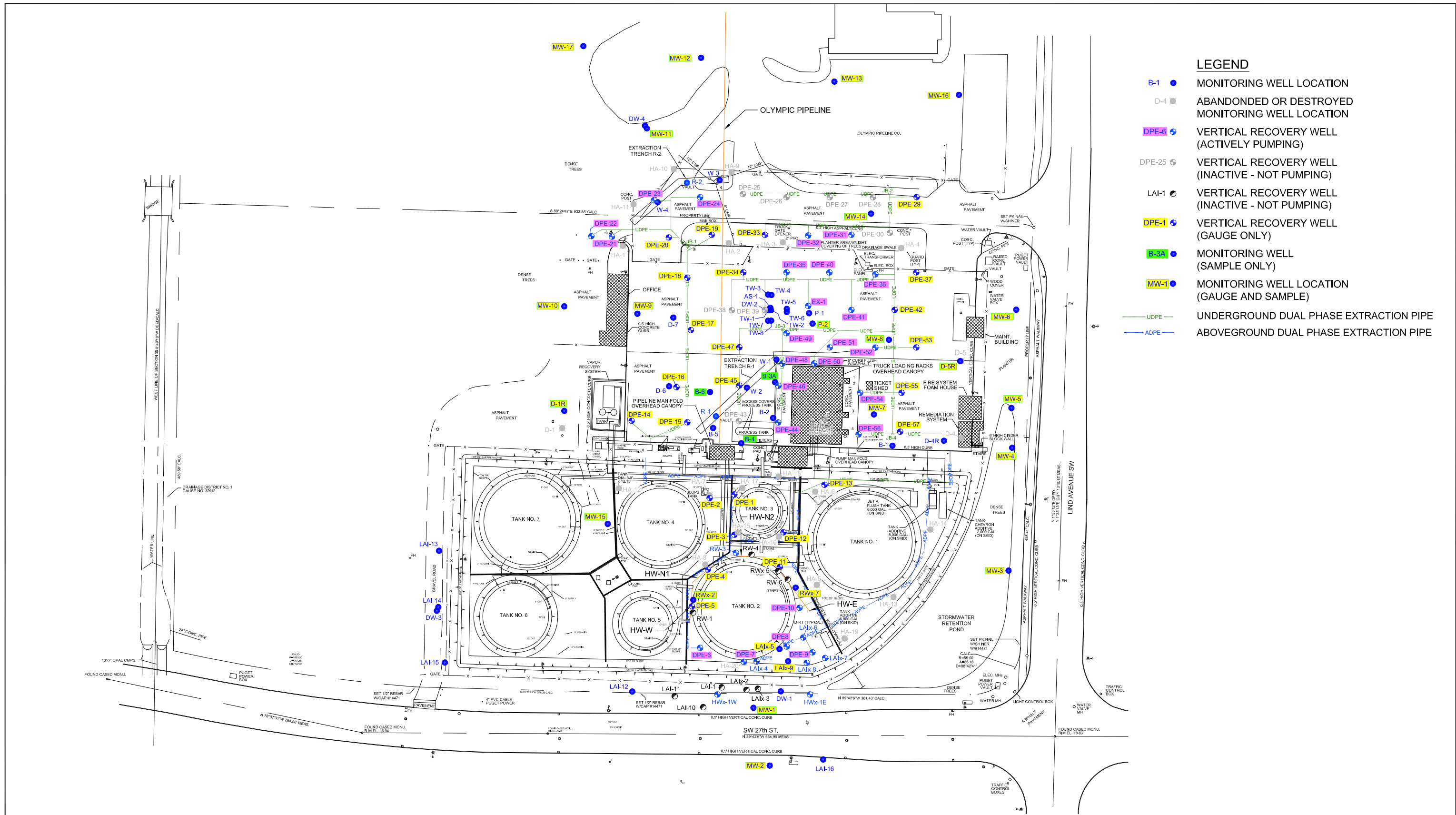
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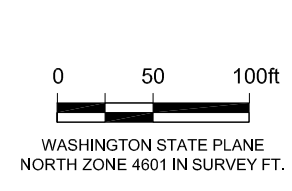
VICINITY MAP

FIGURE 1



- LEGEND**
- B-1 ● MONITORING WELL LOCATION
 - D-4 ■ ABANDONED OR DESTROYED MONITORING WELL LOCATION
 - DPE-6 ⊕ VERTICAL RECOVERY WELL (ACTIVELY PUMPING)
 - DPE-25 ⊕ VERTICAL RECOVERY WELL (INACTIVE - NOT PUMPING)
 - LAI-1 ● VERTICAL RECOVERY WELL (INACTIVE - NOT PUMPING)
 - DPE-1 ⊕ VERTICAL RECOVERY WELL (GAUGE ONLY)
 - B-3A ● MONITORING WELL (SAMPLE ONLY)
 - MW-1 ● MONITORING WELL LOCATION (GAUGE AND SAMPLE)
 - UDPE — UNDERGROUND DUAL PHASE EXTRACTION PIPE
 - ADPE — ABOVEGROUND DUAL PHASE EXTRACTION PIPE

SOURCE: STATEWIDE LAND SURVEYING INC., DATED 01/26/2012.



PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SOUTHWEST
RENTON, WASHINGTON

SITE PLAN WITH MONITORING LOCATIONS

070496-5RM00
Dec 17, 2015

FIGURE 2

Tables

**Site-Specific Cleanup Standards
Phillips 66 Renton Terminal
Renton, Washington**

Soil¹		Groundwater / Surfacewater²	
Chemical	Concentration (mg/kg)	Chemical	Concentration (µg/L)
Benzene	0.03	Benzene	5
Toluene	7	Toluene	1,000
Ethylbenzene	6	Ethylbenzene	700
Total Xylenes	9	Total Xylenes	1,000
cPAHs ³	2	MTBE	20
Naphthalenes ⁴	5	Lead	15
TPHg	30	cPAHs ³	0.1
TPHd	2,000	Naphthalenes ⁴	160
TPHo	2,000	Methylene Chloride	5
Arsenic	20	Vinyl Chloride	0.2
		Arsenic	5
		EDC	5
		TPHg	800
		TPHd	500
		TPHo	500

Notes:

- 1 Soil cleanup levels based on MTCA Method A cleanup levels for industrial properties
- 2 Groundwater/Surfacewater cleanup levels based on MTCA Method A cleanup levels
- 3 cPAHs equal the sum of each cPAH analyte multiplied by the MTCA toxicity factor
- 4 Napthalenes equal the sum of 1-Methylnaphthalene, 2-Methylnaphthalene, and Naphthalene

Table 2

Compliance Monitoring Wells
Phillips 66 Renton Terminal
Renton, Washington

Well	Hydraulic Monitoring and Product Thickness Gauging	Groundwater Monitoring
MW-1	X	X
MW-2	X	X
MW-3	X	X
MW-4	X	X
MW-5	X	X
MW-6	X	X
MW-7 ¹	X	X
MW-8 ¹	X	X
MW-9	X	X
MW-10	X	X
MW-11	X	X
MW-12	X	X
MW-13	X	X
MW-14 ¹	X	X
MW-15	X	X
MW-16	X	X
MW-17	X	X
B-3A ¹		X
B-4 ¹		X
B-6 ¹		X
RWx-2	X	X
RWx-7	X	X
LAIx-5	X	
LAIx-6	X	
LAIx-9	X	
D-1R	X	X
D-4R	X	X
D-5R	X	X
P-1	X	
P-2 ¹	X	X
DPE-1*	X	
DPE-2*	X	
DPE-3*	X	
DPE-4*	X	
DPE-5*	X	
DPE-11*	X	
DPE-12*	X	
DPE-13*	X	
DPE-14*	X	
DPE-15*	X	

Table 2

Compliance Monitoring Wells
Phillips 66 Renton Terminal
Renton, Washington

Well	Hydraulic Monitoring and Product Thickness Gauging	Groundwater Monitoring
DPE-16*	X	
DPE-17*	X	
DPE-18*	X	
DPE-19*	X	
DPE-20*	X	
DPE-29*	X	
DPE-30*	X	
DPE-33*	X	
DPE-34*	X	
DPE-37*	X	
DPE-38*	X	
DPE-39*	X	
DPE-42*	X	
DPE-43*	X	
DPE-45*	X	
DPE-47*	X	
DPE-53*	X	
DPE-55*	X	
DPE-57*	X	

Notes:

- * Dual phase extraction well. Well is only gauged if it is not being used for extraction
- 1 To be sampled semi-annually

Appendices

Appendix A

Sampling and Analysis Plan



Sampling and Analysis Plan

Phillips 66 Renton Terminal
2423 Lind Ave. Southwest
Renton, Washington 98057

Agreed Order No. DE 11313
Agency No. 2070

Phillips 66 Company

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1. Introduction

This sampling and analysis plan (SAP) describes the field procedures and sampling methods to be applied in the performance of the quarterly groundwater monitoring at the Phillips 66 Renton Terminal located at 2423 Lind Avenue Southwest, Renton, Washington. The field procedures presented in this plan follow the United States Environmental Protection Agency's (EPA) procedures for low-flow groundwater sampling (Puls and Barcelona, 1996) and are consistent with sampling procedures used previously at the Site. The objectives of the SAP are to provide field procedures that will result in data of sufficient quality to evaluate the performance of remedial actions at the Site. All activities will be conducted in accordance with the Quality Assurance Project Plan (QAPP) and Site Specific Health and Safety Plan (HASp).

2. Hydraulic Monitoring

Hydraulic Monitoring will be conducted on 56 wells at the Site. The purpose of the hydraulic monitoring is to determine groundwater flow direction(s) and gradients at the Site to assess the migration of contaminants in groundwater beneath the site and assess the performance of the current remediation system. The wells used in the hydraulic monitoring are presented on in Table 1.

2.1 Hydraulic Monitoring Procedures

Each well has a permanent, surveyed, vertical reference point on the casing (the north rim) from which water levels are measured. The vertical reference points for each well are presented in Table 1. Vertical reference points for the new extraction wells will be added to the table at a later date once surveying is complete. An electric oil-water interface probe capable of collecting measurements to 0.01 foot shall be used to determine the depth to free product, if present, and to groundwater. In order to provide reliable data, water levels must be collected over as short a period of time as possible. The hydraulic monitoring program is designed to monitor system performance; therefore, the DPE system must be operational during monitoring activities.

The following procedures will be used to collect free product thicknesses and groundwater elevations:

1. Prior to hydraulic monitoring, remove the sealed j-plugs from all of the wells and allow the wells to stabilize for 3 minutes prior to hydraulic monitoring.
2. Once stabilized, measurements may be collected from each well by slowly lowering the interface probe into the well until a discontinuous beeping is heard. This represents the top of the free product in the well. The depth to free product is the point on the measuring tape at the reference point on the well casing. Record this value on the water level data collection sheet. Double check your measurement before continuing. If free product is not encountered, continue to step 3
3. Lower the probe slowly until a continuous beeping is heard. This represents the bottom of the free product in the well, if present, and the top of the groundwater in the well. Record the depth from the measuring tape on the water level data collection sheet. Double check your measurement before continuing.

4. Remove the probe from the well. If free product was encountered, slowly lower a clear disposable bailer into the well until the bottom of the bailer enters the groundwater. Slowly remove the bailer and record the thickness of the product in the bailer and any other observations. Transfer the contents of the bailer to a bucket for later disposal. Install the j-plug on the well when finished.
5. To determine the product thickness, if present, subtract the free product depth from the groundwater depth. To determine the groundwater elevation; subtract the groundwater depth from the reference elevation on the well casing.
6. Decontaminate the interface probe following the procedures in Section 2.2 before continuing to the next well.

2.2 Decontamination Procedures

Prior to being placed in a well, all equipment will be cleaned according to the following procedures:

- Disassemble the equipment if necessary
- Non-phosphate detergent wash
- Tap water rinse
- Distilled or Deionized water rinse

Disposable PPE, such as nitrile gloves, will be changed between each sampling point and disposed of properly.

3. Groundwater Sampling

Groundwater samples will be collected from 26 Site wells. The wells to be sampled are presented in Table 2. Seven of the twenty-six wells are located in the source area and will be sampled semi-annually until concentrations reduce significantly. If free product is encountered in any of the wells to be sampled, those wells will not be sampled. The purpose of the groundwater sampling is to assess groundwater quality, the offsite migration of contaminants, and mass removal of contaminant mass. The contaminants of concern at the Site are presented in Table 3.

3.1 Groundwater Sampling Procedures

The following presents equipment requirements and procedures for sampling of monitoring wells using low flow purging.

Equipment

The following equipment will be used to conduct low flow purging and sampling:

- Pumps - Peristaltic pumps with well dedicated flexible silicon tubing
- Tubing - Well dedicated polyethylene down-hole tubing
- Field Parameter Monitoring Instruments - Field parameters will be monitored with the use of a flow through cell with sensors to measure pH, specific conductance, temperature, dissolved oxygen, oxidation reduction potential, salinity, and total dissolved solids

- Flow Measurement Equipment - Flow rates will be measured with a graduated container and a stopwatch
- Water Level Indicator - An electric water level indicator or oil-water interface probe will be used to manually measure water levels in the wells
- Bailer - Disposable PVC bailer and disposable rope

Low Flow Purging and Sampling Procedure

The following procedures will be used to purge and sample monitoring wells:

- Identify the well using a current Site map and inspect the well for damage. The condition of the surface protection, manhole or cover, and the well cap will be noted.
- Obtain water level and well depth measurements in order to determine if the well has accumulated sediments.
- When installing tubing, lower slowly into the well to a depth such that the intake end of the tubing is located in the middle of the screened interval or just below the top of the water level if below the top of screen.
- With the pump controller set to its lowest setting, begin pumping.
- Slowly increase the pumping rate until discharge occurs.
- Once discharge occurs, record the visual observation of water quality, check the water level in the well, and adjust the pumping rate such that the pumping rate does not exceed 0.2 liter per minute (LPM);
- Measure and record the water level and pumping rate every 3 minutes during purging. Record any pumping rate changes.
- Measure and record field indicator parameters (pH, specific conductance, temperature, dissolved oxygen, oxidation reduction potential, salinity, total dissolved solids) and visual water quality every 3 minutes. Purging will be considered complete when all of the indicator parameters pH, temperature, dissolved oxygen, specific conductance, and oxidation reduction potential have stabilized. Stabilization will be considered achieved after three consecutive readings are within the following limits:

pH	(±0.1 unit)
Temperature	(3 percent)
Dissolved Oxygen	(10 percent)
Specific Conductance	(3 percent)
Oxidation Reduction Potential	(10 percent)
Water Level	(0.2 feet)
- Disconnect the pump tubing from the flow through cell and fill the sample containers from the pump tubing.
- If parameters will not stabilize or if there is insufficient volume in the well to maintain minimal drawdown, three wells volumes may be purged from the well using a disposable bailer and then sampled. If the well goes dry during bailing, allow the well to recharge and then collect the sample.

- Record the conditions at the time of sampling in the field log book, including a description of the sample, the date and time of sampling, the sample identification number, the sample location, and the weather conditions.
- Sample containers will be labeled, wrapped in packing material, and immediately placed in a cooler with ice.
- Samples will be shipped or transported to the analytical laboratory within one day of the day of collection.

3.2 Decontamination Procedures

Prior to being placed in a well, all equipment will be cleaned according to the following procedures:

- Disassemble the equipment if necessary
- Non-phosphate detergent wash
- Tap water rinse
- Distilled or Deionized water rinse

Disposable PPE, such as nitrile gloves, will be changed between each sampling point and disposed of properly.

3.3 Investigation Derived Waste

All investigation derived waste including decontamination and purge water will be placed in the sump at the Phillips 66 dual phase extraction system to be processed and discharged. Disposable equipment and PPE will be rinsed and disposed of in the trash.

3.4 Laboratory Analysis

All groundwater samples will be analyzed for the following:

- Total petroleum hydrocarbons – gasoline range (TPH-G) per Method NWTPH-Gx
- Total petroleum hydrocarbons – diesel range (TPH-D) and oil range (TPH-O) per Method NWTPH-Dx with silica gel cleanup
- Benzene, Toluene, Ethylbenzene, and total Xylenes (BTEX) per EPA Method 8260

Once the above analytical data for a well have decreased to below cleanup standards, the following will be analyzed in addition to the above parameters for four consecutive quarters as confirmation sampling:

- Full list of volatile organic compounds (VOCs) per EPA Method 8260
- Polycyclic aromatic hydrocarbons (PAHs) and Naphthalenes per EPA Method 8270
- Total lead and arsenic per EPA Method 6020

The analytical parameters, methods, number of samples, and quality control sampling requirements are presented in Table 4. The sample container requirements and holding times for each analysis are presented in Table 5. All sampling activities will be conducted in accordance with the “Quality Assurance Project Plan” (QAPP) included as Appendix B.

4. Remedial Excavation Soil and Surface Water Sampling

Soil and surface water samples will be collected from the remedial excavation (soil) and retention basin (surface water). The sample locations and quantity will be based on field screening conducted during the excavation activities. The purpose of the soil and surface water sampling is to confirm that the extents of the excavation are below clean up levels and that surface water is no longer impacted by contaminated soil. The contaminants of concern at the Site are presented in Table 3.

4.1 Soil Sampling Procedures

The following presents equipment requirements and procedures for soil sampling during excavation activities.

Equipment

The following equipment will be used to collect soil samples:

- Hand Auger - Hand auger with extension
- PID - Photoionization detector with minimum 10.6 eV bulb
- Sealable Plastic Bag – Plastic bags for measuring headspace and sealing samples for later analysis if necessary
- Measuring Tape - Engineering scale measuring tape to determine depth and location of sample point

Soil Sampling Procedure

The following procedures will be used to collect soil samples:

- Identify the location of the desired soil sample and mark it on a site plan with appropriate sample ID.
- If the location is safely accessible, use a hand auger to collect an undisturbed sample from excavation extents. If the location is not safely accessible, have the sample retrieved with the excavator bucket.
- Place a portion of the soil sample into a sealable plastic bag and monitor the headspace of the sample with a PID. Label the plastic bag and place the bag on ice in a cooler.
- Record the field observations, United Soil Classification System (USCS) lithology description, and PID reading in the field book, the date and time of sampling, the sample identification number, the sample location, and the weather conditions.
- Sample containers will be labeled, wrapped in packing material, and immediately placed in a cooler with ice.
- Samples will be shipped or transported to the analytical laboratory within one day of the day of collection.

- Decontaminate sampling equipment following the procedures outlined in Section 3.2 following each sample.

4.2 Surface Water Sampling Procedures

The following presents equipment requirements and procedures for surface water sampling following excavation activities.

Equipment

The following equipment will be used to collect soil samples:

- Pumps - Peristaltic pumps with well dedicated flexible silicon tubing
- Tubing - Well dedicated polyethylene down-hole tubing
- Field Parameter Monitoring Instruments - Field parameters will be monitored with the use of a flow through cell with sensors to measure pH, specific conductance, temperature, dissolved oxygen, oxidation reduction potential, salinity, and total dissolved solids

Surface Water Sampling Procedure

The following procedures will be used to collect surface water samples:

- Identify the desired sample location and mark it with on a site map.
- Obtain water level measurements from the permanent surface water gauge.
- When placing the tubing, lower into the surface water to a depth such that the intake end of the tubing is located in the middle of the water column.
- With the pump controller set to its lowest setting, begin pumping.
- Slowly increase the pumping rate until discharge occurs.
- Once discharge occurs, record the visual observation of water quality and adjust the pumping rate such that the pumping rate does not exceed 0.2 liter per minute (LPM).
- Measure and record field indicator parameters (pH, specific conductance, temperature, dissolved oxygen, oxidation reduction potential, salinity, total dissolved solids) and visual water quality.
- Disconnect the pump tubing from the flow through cell and fill the sample containers from the pump tubing.
- Record the conditions at the time of sampling in the field log book, including a description of the sample, the date and time of sampling, the sample identification number, the sample location, and the weather conditions.
- Sample containers will be labeled, wrapped in packing material, and immediately placed in a cooler with ice.
- Samples will be shipped or transported to the analytical laboratory within 1 day of the day of collection.
- Decontaminate sampling equipment following the procedures outlined in Section 3.2 following each sample.

4.3 Laboratory Analysis

All soil samples will be analyzed for the following:

- Total petroleum hydrocarbons – gasoline range (TPH-G) per Method NWTPH-Gx
- Total petroleum hydrocarbons – diesel range (TPH-D) and oil range (TPH-O) per Method NWTPH-Dx with silica gel cleanup
- Benzene, Toluene, Ethylbenzene, and total Xylenes (BTEX) per EPA Method 8260;
- Polynuclear Aromatic Hydrocarbons (PAHs) using EPA Method 8270SIM;

All sampling activities will be conducted in accordance with the “Quality Assurance Project Plan” (QAPP) included as Appendix B.

All surface water samples will be analyzed for the following:

- Total petroleum hydrocarbons – gasoline range (TPH-G) per Method NWTPH-Gx;
- Total petroleum hydrocarbons – diesel range (TPH-D) and oil range (TPH-O) per Method NWTPH-Dx with silica gel cleanup;
- Benzene, Toluene, Ethylbenzene, and total Xylenes (BTEX) per EPA Method 8260;
- Polynuclear Aromatic Hydrocarbons (PAHs) using EPA Method 8270SIM;

All sampling activities will be conducted in accordance with the “Quality Assurance Project Plan” (QAPP) included as Appendix B.

5. Sample Handling Procedures

Effluent groundwater and vapor samples for laboratory analysis will be collected from the system on a monthly basis. Samples will be collected upstream and downstream of each control point (Oxidizer, carbon vessel, etc.). The data will be used to analyze contaminant reduction across each control point, calculate contaminant mass removal rates, and verify compliance with discharge permits.

5.1 Labeling and Packaging

A unique sample numbering system will be used to identify each collected sample. This system will provide a tracking number to allow retrieval and cross-referencing of sample information. The sample numbering system to be used is described as follows:

Example: GW-081009 – AA – LLL - XXX
Where: GW - Designates sample type
(GW=Groundwater) (S=Soil) (SE=Sediment)
081007: Date of collection (mm/dd/yy)
AA: Sampler initials
LLL: Location ID
XXX: Unique sample number

QC samples will also be numbered with a unique sample number, with the exception of matrix spikes and matrix spike duplicates.

Sample containers will be wrapped and placed on ice or cooler packs in laboratory-supplied coolers immediately after labeling. Samples will be delivered to the laboratory by courier or in person under approved chain of custody procedures as described below.

5.2 Chain of Custody Procedures

Chain of Custody forms will be completed for all samples collected during the program. The Chain of Custody form will document the transfer of sample containers. Custody seals will be placed on each cooler. The cooler will then be sealed with packing tape. Sample container labels will include sample number, place of collection and date and time of collection. All samples will be refrigerated using wet ice at 4 degrees Celsius ($\pm 2^{\circ}\text{C}$) and delivered to the analytical laboratory within 24 to 48 hours of collection. All samples will be delivered to the laboratory by commercial courier or Contractor personnel. All samples will be stored at 4°C ($\pm 2^{\circ}\text{C}$) at the laboratory.

The Chain of Custody record, completed at the time of sampling, will contain, but not be limited to, the sample number, date and time of sampling, and the name of the sampler. The Chain of Custody document will be signed, timed, and dated by the sampler when transferring the samples.

Each sample cooler being shipped to the laboratory will contain a Chain of Custody form. The Chain of Custody form will consist of four copies which will be distributed as follows: The shipper will maintain a copy while the other three copies will be enclosed in a waterproof envelop within the cooler with the samples. The cooler will then be sealed properly for shipment. The laboratory, upon receiving the samples, will complete the three remaining copies. The laboratory will maintain one copy for their records. One copy will be returned to the QA/QC Officer Sampling and Analytical Activities upon receipt of the samples by the laboratory. One copy will be returned with the data deliverables package.

Upon receipt of the cooler at the laboratory, the shipping cooler and the custody seal will be inspected by the Sample Custodian. The condition of the cooler and the custody seal will be noted on the Chain of Custody record sheet by the Sample Custodian. The Sample Custodian will record the temperature of one sample (or temperature blank) from each cooler and the temperature will be noted on the Chain of Custody. If the shipping cooler seal is intact, the sample containers will be accepted for analyses. The Sample Custodian will document the date and time of receipt of the container, and sign the form.

If damage or discrepancies are noticed (including sample temperature exceedances), they will be recorded in the remarks column of the record sheet, dated, and signed. Any damage or discrepancies will be reported to the Laboratory Project Manager and Laboratory QA/QC Officer before sample's are processed.

Tables

**Hydraulic Monitoring Wells
Phillips 66 Renton Terminal
Renton, Washington**

Well	Top of Casing Elevation (feet)	Well	Top of Casing Elevation (feet)
MW-1	20.51	DPE-1	NA
MW-2	20.29	DPE-2	NA
MW-3	21.21	DPE-3	NA
MW-4	20.44	DPE-4	NA
MW-5	21.32	DPE-5	NA
MW-6	22.30	DPE-11	NA
MW-7	22.10	DPE-12	NA
MW-8	21.54	DPE-13	NA
MW-9	20.82	DPE-14	NA
MW-10	21.12	DPE-15	NA
MW-11	16.80	DPE-16	NA
MW-12	19.59	DPE-17	NA
MW-13	21.24	DPE-18	NA
MW-14	21.54	DPE-19	NA
MW-15	20.52	DPE-20	NA
MW-16	21.24	DPE-29	NA
MW-17	13.34	DPE-30	NA
B-3A	21.85	DPE-33	NA
B-4	21.28	DPE-34	NA
B-6	21.00	DPE-37	NA
RWx-2	26.20	DPE-38	NA
RWx-7	24.71	DPE-39	NA
LAIx-5	25.63	DPE-42	NA
LAIx-6	25.25	DPE-43	NA
LAIx-9	25.55	DPE-45	NA
D-1R	20.13	DPE-47	NA
D-4R	21.27	DPE-53	NA
D-5R	21.45	DPE-55	NA
P-1	21.47	DPE-57	NA
P-2	21.60		

NA Not available

**Groundwater Monitoring Wells
Phillips 66 Renton Terminal
Renton, Washington**

Well

- MW-1
- MW-2
- MW-3
- MW-4
- MW-5
- MW-6
- MW-7*
- MW-8*
- MW-9
- MW-10
- MW-11
- MW-12
- MW-13
- MW-14*
- MW-15
- MW-16
- MW-17
- B-3A*
- B-4*
- B-6*
- RWx-2
- RWx-7
- LAIx-5
- LAIx-6
- D-1R
- D-4R
- D-5R
- P-2*

* To be sampled Semi-annually

**Groundwater Constituents of Concern
Phillips 66 Renton Terminal
Renton, Washington**

Parameter	Cleanup Level ⁽¹⁾ (µg/L)
Benzene	5
Toluene	1,000
Ethylbenzene	700
Total Xylenes	1,000
MTBE	20
Lead	15
cPAHs ⁽³⁾	0.1
Naphthalenes ⁽⁴⁾	160
Methylene Chloride	5
Vinyl Chloride	0.2
Arsenic	5
EDC	5
TPHg ⁽²⁾	800
TPHd	500
TPHo	500

Notes:

- (1) Groundwater Cleanup Levels based on MTCA Method A.
- (2) Gasoline range hydrocarbons cleanup level is 800 µg/L if benzene is present in the sample and 1,000 µg/L if benzene is not present in the sample.
- (3) cPAHs equal the sum of each cPAH analyte multiplied by the MTCA toxicity factor
- (4) Naphthalenes equal the sum of 1-Methylnaphthalene, 2-Methylnaphthalene, and Naphthalene
- µg/L Micrograms per Liter

Table 4
Sampling and Analysis Summary
Phillips 66 Renton Terminal
Renton, Washington

Sample Matrix	Analytical Parameters	Analytical Method	Estimated Number of Samples	Field Duplicates	Trip Blanks	MS/MSD/Dup	Total Number of Samples
Groundwater	Gasoline Range Organics	NWTPH-Gx ¹	26	2	2	2/2/0	34
	Diesel and Oil Range Organics ³	NWTPH-Dx ¹	26	2	-	2/2/0	32
	BTEX	SW-846 8260 ²	26	2	2	2/2/0	34
	VOCs w/ BTEX	SW-846 8260 ²	NA	NA	NA	NA	NA
	Lead + Arsenic	6020	NA	NA	NA	NA	NA
	SVOCs	8270sim	NA	NA	NA	NA	NA

Notes:

¹ Referenced from "Analytical Methods for Petroleum Hydrocarbons, Publication No ECY 97-602, June 1997"

² "Test Methods for Solid Waste Physical/Chemical Methods", SW-846, 3rd Edition, September 1986
(with all subsequent revisions).

³ Including silica gel cleanup.

BTEX Benzene, Toluene, Ethylbenzene, Total Xylenes

Dup Laboratory Duplicate.

EPH Extractable Petroleum Hydrocarbons

MS Matrix Spike.

MSD Matrix Spike Duplicate.

Table 5
Sample Container, Preservation, and Holding Time Periods
Phillips 66 Renton Terminal
Renton, Washington

Analyses	Sample Containers	Preservation	Maximum Holding Time	Notes
Groundwater				
Gasoline Range Organics	Two 40 mL glass vials Teflon-lined septum	pH <2, HCl Cool 4°C	14 days from collection to analysis	Fill completely with no head space
Diesel and Oil Range Organics	Two 1L amber glass	pH <2, HCl Cool 4°C	14 days from collection to extraction, 40 days from extraction to analysis.	Fill completely
BTEX/VOCs	Two 40 mL glass vials Teflon-lined septum	pH <2, HCl Cool 4°C	14 days from collection to analysis	Fill completely with no head space
Semi-Volatiles	Two 1L amber glass	pH <2, HCl Cool 4°C	14 days from collection to extraction, 40 days from extraction to analysis.	Fill completely
Metals	One 500mL Poly	pH <2, HNO ₃ Cool 4°C	6 months	Fill completely

Notes:

BTEX Benzene, Toluene, Ethylbenzene, Total Xylenes
 MTBE Methyl Tertiary-Butyl Ether
 HCL Hydrochloric Acid
 HNO₃ Nitric Acid

Appendix B

Quality Assurance Project Plan



Quality Assurance Project Plan

Phillips 66 Renton Terminal
2423 Lind Ave. Southwest
Renton, Washington 98057

Agreed Order No. DE 11313
Agency No. 2070

Phillips 66 Company

20818 44th Avenue West, Suite 190, Lynwood, WA 98036
070496 | 5RM00 | *** | Report No 46 Appendix B | August 2015

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1. Project Organization

A brief description of the duties of the key project personnel is presented below.

Project Manager – Ed Turner

- Provides day-to-day project management
- Provides managerial guidance to the Quality Assurance/Quality Control (QA/QC) Officer - Sampling and Analytical Activities
- Prepares and reviews reports
- Conducts preliminary chemical data interpretation and assessment
- Responsible for overall project completion in accordance with the approved design

QA/QC Officer - Sampling and Analytical Activities – Jeffrey Cloud

- Oversees and reviews laboratory activities
- Determines laboratory data corrective action
- Performs analytical data validation and assessment
- Reviews laboratory QA/QC
- Assists in preparation and review of final report
- Provides technical representation for analytical activities
- Provides managerial and technical guidance to the Field Sampling Supervisor

Field Sampling Supervisor – Matthew Davis

- Provides immediate supervision of all on-Site activities
- Provides field management of sample collection and field QA/QC
- Provides technical representation for field activities
- Responsible for maintenance of the field equipment

Laboratory - Project Manager, Analytical Contractor

- Ensures resources of laboratory are available on an as-required basis
- Coordinates laboratory analyses
- Supervises laboratory's in-house Chain of Custody
- Schedules analyses of samples
- Oversees review of data
- Oversees preparation of analytical reports
- Approves final analytical reports

Laboratory - Quality Assurance/Quality Control Officer, Analytical Contractor

- Overviews laboratory QA/QC
- Overviews QA/QC documentation
- Conducts detailed data review
- Decides laboratory corrective actions, if required
- Provides technical representation for laboratory QA/QC procedures

Laboratory - Sample Custodian - Analytical Contractor

- Receives and inspects the sample containers
- Records the condition of the sample containers
- Signs appropriate documents
- Verifies Chain of Custody and their correctness
- Notifies laboratory Project Manager and laboratory QA/QC Officer of sample receipt and inspection
- Assigns a unique laboratory identification number correlated to the field sample identification number, and enters each into the sample receiving log
- Initiates transfer of samples to the appropriate lab sections with assistance from the laboratory project manager
- Controls and monitors access to and storage of samples and extracts

The analytical laboratory selected to perform the environmental analyses will be a full-service chemical analytical laboratory accredited under the State of Washington Department of Ecology (WDOE) Environmental Laboratory Accreditation Program (ELAP).

2. Background and Objectives

Section 1 of the Compliance Monitoring Plan describes the historical basis for the project and the objectives of the investigation.

3. Project Description

This Quality Assurance Project Plan (QAPP) presents the policies, organization, objectives, functional activities, and QA/QC activities designed to achieve the specific data quality goals to conduct groundwater sampling for the Renton Terminal (site) located at 2423 Lind Avenue Southwest, Renton, Washington. The objectives of this QAPP are to provide sufficiently thorough and concise descriptions of the measures to be applied during the investigations such that the data generated will be of a known and acceptable level of precision and accuracy. This QAPP provides comprehensive information regarding the project personnel responsibilities, and sets forth specific procedures to be used during sampling or relevant environmental matrices and analyses of data.

4. Data Quality Objectives

4.1 Quality Assurance Objectives for Measurement Data

The overall Quality Assurance (QA) objective is to develop and implement procedures for sample collection and analyses which will provide data with an acceptable level of accuracy and precision.

QA measures for this project will begin with sample containers. Sample containers will be purchased from a certified manufacturer and will be pre-cleaned (I-Chem Series 200 or equivalent).

4.2 Laboratory Quality Assurance

The following subsections define the QA goals required to meet the Data Quality Objectives (DQOs) of the project.

4.2.1 Accuracy, Precision, and Sensitivity of Analyses

The fundamental QA objective with respect to the accuracy, precision, and sensitivity of analytical data is to meet the QC acceptance criteria of each analytical protocol. Analytical methods for groundwater analyses were chosen to achieve targeted quantitation limits that are below the MTCA Method A Cleanup Levels for Groundwater (WAC Table 720-1; Ecology, 2007). A summary of the targeted quantitation limits and cleanup levels are presented in Table 4.1. It should be noted that these limits are targeted quantitation limits only; limits are highly matrix dependent and may not always be achieved.

The method accuracy (percent recovery) for investigative samples will be determined by spiking selected samples (matrix spikes) with the method recommended spiking compounds. Accuracy will be reported as the percent recovery of the spiking compound(s) and will compare with the criteria given in the appropriate methods, as identified in Section 7.0.

The method(s) precision (reproducibility between duplicate analyses) will be determined based on the duplicate analysis of matrix spike (MS) samples for organic parameters. Precision will be reported as Relative Percent Differences (RPDs) between duplicate analyses; acceptance criteria will be as specified in the appropriate methods identified in Section 7.0.

4.2.2 Completeness, Representativeness and Comparability

A completeness requirement of 90 percent (%) will be targeted for the program (see Section 12.1.3 for definition of completeness).

The quantity of samples to be collected has been estimated in an effort to effectively represent the population being studied. A summary of the sampling and analysis program is presented in Table 4.2.

Analytical methods selected for this study are consistent with those used for previous studies (if applicable) to assure comparability of the data. All standards used by the laboratory will be traceable to reliable sources and will be checked with an independent standard.

Table 4.1

**Analytical Parameters - Groundwater
Groundwater Sampling
Phillips 66 Renton Terminal
Renton, Washington**

Method	Parameter	Targeted Quantitation	Cleanup Level ¹
		Limit (ug/L)	(ug/L)
NWTPH-Gx	TPH-Gasoline Range	160	800
NWTPH-Dx	TPH-Diesel Range	100	500
	TPH-Heavy Oil Range	100	500
SW-846 8260	Benzene	1	5
	Toluene	200	1000
	Ethylbenzene	140	700
	Xylenes (total)	200	1000
	Methyl tert-butyl ether	4	20

Notes:

¹ MTCA Method A Cleanup Levels for Groundwater (WAC Table 720-1; Ecology, 2007).
TPH Total Petroleum Hydrocarbons

Table 4.2
Sampling and Analysis Summary
Groundwater Sampling
Phillips 66 Renton Terminal
Renton, Washington

Sample Matrix	Analytical Parameters	Analytical Method	Estimated Number of Samples	Field Duplicates	Trip Blanks	MS/MSD/Dup	Total Number of Samples	Unit Price	Unit Subtotal
Groundwater	Gasoline Range Organics	NWTPH-Gx ¹	33	2	5	2/2/0	44	\$ 25.00	\$1,100.00
	Diesel and Oil Range Organics ³	NWTPH-Dx ¹	33	2	-	2/2/0	39	\$ 45.00	\$1,755.00
	BTEX, MTBE	SW-846 8260 ²	33	2	5	2/2/0	44	\$ 45.00	\$1,980.00
								Total:	\$4,835.00

Notes:

¹ Referenced from "Analytical Methods for Petroleum Hydrocarbons, Publication No ECY 97-602, June 1997"

² "Test Methods for Solid Waste Physical/Chemical Methods", SW-846, 3rd Edition, September 1986 (with all subsequent revisions).

³ Including silica gel cleanup.

Dup Laboratory Duplicate.

MS Matrix Spike.

MSD Matrix Spike Duplicate.

4.3 Field Measurement Quality Assurance

Measurement data will be generated during field activities. These activities include, but are not limited to, the following:

- pH measurement (± 0.1 unit)
- Specific conductivity measurement ($\pm 3\%$)
- Temperature measurement ($\pm 3\%$)
- Water level (± 0.2 foot)
- Dissolved oxygen measurement ($\pm 10\%$)
- Oxidation-reduction potential (redox) ($\pm 10\%$)
- Documenting time and weather conditions
- Observation of sample appearance and other conditions

The general QA objective for measurement data is to obtain reproducible and comparable measurements to a degree of accuracy consistent with the use of standardized procedures.

5. Sampling Design

The sampling design is described in the Sampling and Analysis Plan.

6. Field Procedures

The field procedures are presented in Section 3.0 of the Sampling and Analysis Plan.

The sample container, preservation, shipping, and packaging requirements are identified in Table 6.1 and in Section 6.1.3.

The following subsections define sample custody and document control.

6.1 Sample Custody and Document Control

The following documentation procedures will be used during sampling and analysis to provide Chain of Custody control during transfer of samples from collection through storage.

Recordkeeping documentation will include use of the following:

- Field logbooks (bound with numbered pages) to document sampling activities in the field
- Labels to identify individual samples
- Chain of Custody record sheet to document analyses to be performed
- Laboratory sample custody logbook

6.1.1 Field Logbook

In the field, the sampler will record the following information in the field logbook (bound) for each sample collected:

- Project number
- Sample matrix
- Name of sampler
- Sample source
- Time and date
- Pertinent data (e.g., depth)
- Analysis to be conducted
- Sampling method
- Appearance of each sample (i.e., color, evidence of soil staining)
- Preservation added, if any
- Number of sample bottles collected
- Pertinent weather data

Each field logbook page will be signed by the sampler.

6.1.2 Sample Numbering

A unique sample numbering system will be used to identify each collected sample. This system will provide a tracking number to allow retrieval and cross-referencing of sample information. The sample numbering system to be used is described as follows:

Example:	GW-081009 – AA – LLL - XXX
Where:	GW - Designates sample type (GW=Groundwater) (S=Soil) (SE=Sediment)
081007:	Date of collection (mm/dd/yy)
AA:	Sampler initials
LLL:	Location ID
XXX:	Unique sample number

QC samples will also be numbered with a unique sample number, with the exception of matrix spikes and matrix spike duplicates.

6.1.3 Chain of Custody Records

Chain of Custody forms will be completed for all samples collected during the program.

The Chain of Custody form will document the transfer of sample containers. Custody seals will be placed on each cooler. The cooler will then be sealed with packing tape. Sample container labels will include sample number, place of collection and date and time of collection. All samples will be refrigerated using wet ice at 4 degrees Celsius ($\pm 2^{\circ}\text{C}$) and delivered to the analytical laboratory

within 24 to 48 hours of collection. All samples will be delivered to the laboratory by commercial courier or Contractor personnel. All samples will be stored at 4°C ($\pm 2^\circ\text{C}$) at the laboratory.

The Chain of Custody record, completed at the time of sampling, will contain, but not be limited to, the sample number, date and time of sampling, and the name of the sampler. The Chain of Custody document will be signed, timed, and dated by the sampler when transferring the samples.

Each sample cooler being shipped to the laboratory will contain a Chain of Custody form. The Chain of Custody form will consist of four copies which will be distributed as follows: The shipper will maintain a copy while the other three copies will be enclosed in a waterproof envelop within the cooler with the samples. The cooler will then be sealed properly for shipment. The laboratory, upon receiving the samples, will complete the three remaining copies. The laboratory will maintain one copy for their records. One copy will be returned to the QA/QC Officer-Sampling and Analytical Activities upon receipt of the samples by the laboratory. One copy will be returned with the data deliverables package.

Upon receipt of the cooler at the laboratory, the shipping cooler and the custody seal will be inspected by the Sample Custodian. The condition of the cooler and the custody seal will be noted on the Chain of Custody record sheet by the Sample Custodian. The Sample Custodian will record the temperature of one sample (or temperature blank) from each cooler and the temperature will be noted on the Chain of Custody. If the shipping cooler seal is intact, the sample containers will be accepted for analyses. The Sample Custodian will document the date and time of receipt of the container, and sign the form.

If damage or discrepancies are noticed (including sample temperature exceedances), they will be recorded in the remarks column of the record sheet, dated, and signed. Any damage or discrepancies will be reported to the Laboratory Project Manager and Laboratory QA/QC Officer before samples are processed.

6.1.4 Sample Documentation in the Laboratory

Each sample or group of samples shipped to the laboratory for analysis will be given a unique identification number. The Sample Custodian will record the client name, number of samples and date of receipt of samples in the Sample Control Logbook. Samples removed from storage for analyses will be documented in the Sample Control Logbook.

The laboratory will be responsible for maintaining analytical logbooks and laboratory data as well as a sample (on hand) inventory for submittal to the QA/QC Officer - Sampling and Analytical Activities on an "as required" basis. Raw laboratory data produced from the analysis of samples submitted for this program will be inventoried and maintained by the laboratory for a period of 5 years at which time the QA/QC Officer - Sampling and Analytical Activities will advise the laboratory regarding the need for additional storage.

6.1.5 Storage of Samples

After the Sample Custodian has completed the Chain of Custody forms and the incoming sample log, the Chain of Custody will be checked to ensure that all samples are stored in the appropriate locations. All samples will be stored within an access controlled custody room and will be maintained at 4°C ($\pm 2^\circ\text{C}$) until all analytical work is complete.

Table 6.1

**Sample Container, Preservation, and Holding Time Periods
Groundwater Sampling
Phillips 66 Renton Terminal
Renton, Washington**

Analyses	Sample Containers	Preservation	Maximum Holding Time	Notes
Groundwater				
Gasoline Range Organics	Two 40 mL glass vials Teflon-lined septum	pH <2, HCl Cool 4°C	14 days from collection to analysis	Fill completely with no head space
Diesel and Oil Range Organics	Two 1L amber glass	pH <2, HCl Cool 4°C	14 days from collection to extraction, 40 days from extraction to analysis.	Fill completely
BTEX, MTBE	Two 40 mL glass vials Teflon-lined septum	pH <2, HCl Cool 4°C	14 days from collection to analysis	Fill completely with no head space

6.1.6 Sample Documentation

Evidentiary files for the entire project shall be inventoried and maintained by the QA/QC Officer - Sampling and Analytical Activities and shall consist of the following:

- Project related plans
- Project logbooks
- Field data records
- Sample identification documents
- Chain of Custody records
- Report notes, calculations, etc.
- Lab data, etc.
- References, copies of pertinent literature
- Miscellaneous - photos, maps, drawings, etc.
- A copy of all final reports pertaining to the project

The evidentiary file materials shall be the responsibility of the Project Manager with respect to maintenance and document removal.

6.1.7 Field Instrumentation

Calibration and maintenance of field instruments will be performed by the supplier or manufacturer prior to use. Confirmation of properly functioning equipment will be made by the Field Coordinator upon receipt of equipment at the Site. During the field activities, it will be the responsibility of the Field Coordinator to ensure proper field calibration and maintenance. Prior to use, field personnel will have documented training in the use of the field instruments they will be using. All equipment calibration and maintenance will be performed in accordance with manufacturer's guidelines. Manuals for all equipment will be available on-Site during the period(s) the equipment is in use. Field maintenance and calibration records will be maintained in a field logbook or on maintenance and calibration sheets.

Water quality instrumentation used during this investigation will be calibrated prior to the day's surveys in accordance with the manufacturer's instructions. Intermediate checks of calibration will be performed, and the data recorded in a field logbook, periodically throughout the usage period and at the end of the day. If necessary, instruments will be recalibrated.

7. Laboratory Procedures

7.1 Analytical Methods

Investigative samples will be analyzed for the parameters listed in Table 4.1 using the methods cited in Table 4.2. These methods have been selected to meet the DQOs for each sampling activity.

Data deliverables for this program will include final results for the investigative samples and corresponding QC parameters as specified in Section 9.2.

7.2 Calibration Procedures and Frequency

7.2.1 Instrument Calibration and Tuning

Calibration of instrumentation is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established reporting limits. Each instrument is calibrated with standard solutions appropriate to the type of instrument and the linear range established for the analytical method. The frequency of calibration and the concentration of calibration standards are determined by the manufacturer guidelines, the analytical method, or the requirements of special contracts.

A bound notebook will be kept with each instrument requiring calibration in which will be recorded activities associated with the QA monitoring and repairs program. These records will be checked during periodic equipment review and internal and external QA/QC audits.

7.2.2 Gas Chromatography/Mass Spectrometry (GC/MS)

It is necessary to establish that a given GC/MS meets the standard mass spectral abundance criteria prior to initiating any ongoing data collection. This is accomplished through the analyses of tuning compounds as specified in the analytical methods.

Calibration of the GC/MS system will be performed daily at the beginning of the day or with each 12 hours of instrument operating time.

All method-specified calibration criteria must be met prior to sample analyses. All calibrations must be performed using either average response factors or first-order linear regression (with a correlation coefficient requirement of 0.995). Higher order fits will not be allowed.

Quantification of samples that are analyzed by GC/MS will be performed by internal standard calibration. For quantitation, the nearest internal standard free of interferences must be used.

7.2.3 Gas Chromatography

Quantification of samples that are analyzed by GC/MS with element selective detectors shall be performed by external standard calibration. Standards containing the compounds of interest will be analyzed at a minimum of five concentrations to establish the linear range of the detector. Single point calibration will be performed at the beginning of each day and at every tenth injection. The response factors from the single point calibration will be checked against the average response factors from multi-level calibration. If deviations in response factors are greater than those allowed by the analytical method protocols, then system recalibration will be performed. Alternatively, fresh calibration standards will be prepared and analyzed to verify instrument calibration.

All method-specified calibration criteria must be met prior to sample analyses. All calibrations must be performed using either average response factors or first-order linear regression (with a correlation coefficient requirement of ≥ 0.995). Higher order fits will not be allowed.

7.2.4 Field Instrumentation

Field equipment used during this investigation will be calibrated both prior to and following the day's surveys in accordance with the manufacturer's instructions. The equipment will also be operated in

accordance with the manufacturer's instructions. Records of calibrations of field equipment will be recorded in a bound field notebook.

If a Horiba meter is used, calibration should be performed as follows:

- The meter will be calibrated using the one-point calibration standard.
- The pH meter will be checked against a second standard before and after each day's use.

7.3 Compound Identification

Compounds, which will be analyzed by GC/MS, will be identified by comparison of the sample mass spectrum with the mass spectrum of a standard of the suspected compound (standard reference spectrum). Mass spectra for standard references should be obtained on the user's GC/MS within the same 12 hours as the sample analysis. These standard reference spectra may be obtained through analysis of the calibration standards. The following criteria must be satisfied to verify identification:

- Elution of the sample component at the same GC relative retention time (RRT) as the standard component
- Correspondence of the sample component and the standard component mass spectrum

For GC determinations of specific analytes, the RRT of the unknown will be compared with that of an authentic standard. Since a true identification by GC is not possible, an analytical run for compound confirmation will be followed according to the specifications in the methods. Peaks must elute within daily retention time windows established for each indicator parameter to be declared a tentative or confirmed identification. Retention time windows are determined using standard protocols defined in each method.

7.4 Quantitation

The procedures for quantitation of analytes are discussed in the appropriate analytical methods. Sample results are generally calculated using external standards with the exception of the samples analyzed by GC/MS; these methods employ the use of internal standards for analyte quantitation.

7.5 Quantitation Limit Requirements

Targeted quantitation limits will be consistent with those presented in Table 4.1. When matrix interferences are noted during sample analysis, actions will be taken by the laboratory to achieve the specified quantitation limits. Samples will not be diluted by more than a factor of five to reduce matrix effects. The laboratory will re-extract and/or use any of the cleanup techniques presented in the analytical methods to eliminate matrix interferences. Sample results less than the quantitation limits but greater than the method or instrument detection limits will be reported and qualified as estimated.

Samples may be diluted to a greater extent if the concentrations of analytes of concern exceed the calibration range of the instrument. In such cases, the laboratory QA/QC Officer will assure that the laboratory demonstrates good analytical practices and that such practices are documented in order to achieve the specified detection limits.

8. Quality Control

8.1 QC for Laboratory Analysis

Specific procedures related to internal laboratory QC samples are described in the following subsections.

8.1.1 Reagent Blanks

A reagent blank will be analyzed by the laboratory at a frequency of one blank per analytical batch. The reagent blank, an aliquot of analyte-free water or solvent, will be carried through the entire analytical procedure.

8.1.2 Matrix Spike/Matrix Spike Duplicate (MS/MSD)/Duplicate Analyses

An MS/MSD sample will be analyzed for organic parameters and a duplicate and matrix spike will be analyzed for inorganic parameters at a minimum frequency of one per analytical batch. Acceptable criteria and analytes that will be used for matrix spikes are identified in the methods. Where method specified limits were not available, general control limits will be used. Percent spike recoveries will be used to evaluate analytical accuracy while percent relative standard deviation or the RPD between duplicate analyses will be used to assess analytical precision.

8.1.3 Surrogate Analyses

Surrogates are organic compounds which are similar to the analytes of interest, but which are not normally found in environmental samples. Surrogates are added to samples to monitor the effect of the matrix on the accuracy of the analysis. Every blank, standard and environmental sample analyzed by GC or GC/MS, including MS/MSD samples, will be spiked with surrogate compounds prior to sample preparation.

The compounds that will be used as surrogates and the levels of recommended spiking are specified in the methods. Surrogate spike recoveries must fall within the control limits specified in the methods. If surrogate recoveries are excessively low (<10 percent), the laboratory will contact the QA/QC Officer - Sampling and Analytical Activities for further instructions. Dilution of samples to bring the analyte concentration into the linear range of calibration may dilute the surrogates out of the quantification limit. Reanalysis of these samples is not required. Assessment of analytical quality in these cases will be based on the MS/MSD sample analysis results.

8.2 QC for Field Sampling

To assess the quality of data resulting from the field sampling program, field duplicate and trip blank samples will be collected and submitted to the analytical laboratory as samples.

8.2.1 Trip Blanks

Trip blanks will be used during the groundwater sampling program to detect contamination introduced through sample transport, sample container preparation, sample storage, and/or the analytical process.

8.2.2 Field Duplicate Samples

Field duplicate samples will be collected and used to assess the aggregate precision of sampling techniques and laboratory analysis. For every 20 investigative samples, a field duplicate sample will be collected using standard sampling procedures. This duplicate will be packed and shipped to the laboratory for analysis.

9. Data Management Procedures

9.1 General

The contract laboratory will perform analytical data reduction and validation in-house under the direction of the Laboratory QA/QC Officer. The Laboratory QA/QC Officer will be responsible for assessing data quality and advising of any data which were rated "preliminary" or "unacceptable" or other qualifications based on the QC criteria outlined in the relevant methods, which would caution the data user of possible unreliability. Data reduction, validation and reporting by the laboratory will be conducted as detailed in the following:

- Raw data produced and checked by the responsible analysts is turned over for independent review by another analyst.
- The area supervisor reviews the data for attainment of quality control criteria presented in the referenced analytical methods.
- Upon completion of all reviews and acceptance of the raw data by the laboratory operations manager, a computerized report will be generated and sent to the Laboratory QA/QC Officer.
- The Laboratory QA/QC Officer will complete a thorough inspection of all reports.
- The Laboratory QA/QC Officer and area supervisor will decide whether any sample reanalysis is required.
- Upon acceptance of the preliminary reports by the Laboratory QA/QC Officer, final reports will be generated and signed by the Laboratory Project Manager.

9.2 Laboratory Reporting, Data, Presentation and Final Report

Reporting and deliverables shall include, but are not be limited to, all items listed in Table 9.1.

All sample data and corresponding QA/QC data as specified in the analytical methods, shall be maintained accessible either in hard copy or computer data files.

The laboratory will submit one copy of the final analytical report within 10 business days of receipt of the final sample included in the sample delivery group (SDG). An electronic copy of the results and QC in eQuis format will also be required with the hard copy.

9.3 Document Control System

A document control system ensures that all documents are accounted for when the project is complete.

Table 9.1
Laboratory Reporting Deliverables - Level II Data Packages
Groundwater Sampling
Phillips 66 Renton Terminal
Renton, Washington

A detailed report narrative should accompany each submission, summarizing the contents and results.

- A. Chain of Custody Documentation and Detailed Narrative ⁽¹⁾
- B. Sample Information
 - 1. date collected
 - 2. date extracted or digested
 - 3. date analyzed
 - 4. analytical method and reference
- C. Data
 - 1. samples
 - 2. laboratory duplicates ⁽²⁾
 - 3. method blanks
 - 4. spikes, spike duplicates ^{(2) (3)}
 - 5. surrogate recoveries ⁽²⁾
- D. Miscellaneous
 - 1. method detection limits and/or instrument detection limits
 - 2. percent solids (where applicable)
 - 3. metals run logs
 - 4. standard preparation logs
 - 5. sample preparation logs

All sample data and its corresponding quality assurance/quality control (QA/QC) data shall be maintained accessible to CRA either in hard copy or on magnetic tape or disc (computer data files). All solid sample results must be reported on a dry-weight basis.

Notes:

- (1) Any QC outliers must be addressed and corrective action taken must be specified.
- (2) Laboratory must specify applicable control limits for all QC sample results.
- (3) A blank spike must be prepared and analyzed with each sample batch.

A project number will be assigned to the project. This number will appear on sample identification tags, logbooks, data sheets, control charts, project memos, and analytical reports, document control logs, corrective action forms and logs, QA plans, and other project analytical records.

9.4 QC Check Points and Data Flow

The following specific QC check points will be common to all metals, GC, and GC/MS analyses. They are presented with the decision points:

Chemist - bench level checks

- Systems check: sensitivity, linearity, and reproducibility within specified limits
- Duplicate analyses within control limits
- Matrix spike results within control limits
- Surrogate spike results within control limits (organics only)
- Calculation/data reduction checks: calculations cross-checked, any discrepancies between forms and results evident, results tabulated sequentially on the correct forms.

Laboratory Project Manager

- Systems operating within limits
- Data transcription correct
- Data complete
- Data acceptable

Sample Control

- Samples returned to sample control following analysis.

Laboratory QA/QC Officer

- QA objectives met
- QC checks are completed
- Final data and report package is complete

10. Audits

For the purpose of external evaluation, performance evaluation check samples are analyzed periodically by the laboratory. Internally, the evaluation of data from these samples is done on a continuing basis over the duration of a given project.

The QA/QC Officer - Sampling and Analytical Activities may carry out performance and/or systems audits to insure that data of known and defensible quality are consistently produced during this program.

Systems audits are qualitative evaluations of all components of field and laboratory quality control measurement systems. They determine if the measurement systems are being used appropriately. The audits may be carried out before all systems are operational, during the program, or after

completion of the program. Such audits typically involve a comparison of the activities given in the QA/QC plan described herein, with activities actually scheduled or performed. A special type of systems audit is the data management audit. This audit addresses only data collection and management activities.

The performance audit is a quantitative evaluation of the measurement systems used for a monitoring program. It requires testing the measurement systems with samples of known composition or behavior to quantitatively evaluate precision and accuracy. A performance audit may be carried out by or under the auspices of the QA/QC Officer - Sampling and Analytical Activities without the knowledge of the analyst during each sampling event for this program.

It should be noted, however, that any additional external QA audits will only be performed if deemed necessary.

11. Data Review, Verification, and Validation

11.1 General

Validation of the analytical data will be performed by the QA/QC Officer - Sampling and Analytical Activities. The data validation will be performed in accordance with the documents: "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review," United States Environmental Protection Agency USEPA 540/R-99-008, October 1999.

Assessment of analytical and in-house data will include checks on data consistency by looking for comparability of duplicate analyses, comparability to previous data from the same sampling location (if available), adherence to accuracy and precision control criteria detailed in this QAPP and anomalously high or low parameter values. The results of these data validations will be reported to the Project Manager and the contract laboratory, noting any discrepancies and their effect upon acceptability of the data.

Raw data from field measurements and sample collection activities that are used in project reports will be appropriately identified and appended to the report. Where data have been reduced or summarized, the method of reduction will be documented in the report. Field data will be audited for anomalously high or low values that may appear to be inconsistent with other data.

12. Data Quality Assessment

Final reports will contain a discussion on QA/QC summarizing the quality of the data collected and/or used as appropriate for each phase of the project. The Project Manager who has responsibility for these summaries, will rely on written reports/memoranda documenting the data assessment activities, performance and systems audits and footnotes identifying qualifications to the data, if any.

QA reports will be prepared by the QA/QC Officer - Sampling and Analytical Activities following receipt of all analytical data. These reports will include discussions of the following and their effects on the quality of the data reported:

- Sample holding times
- Laboratory/reagent blank data
- Surrogate spike, matrix spike and matrix spike duplicate data
- Field QA/QC data
- Pertinent instrument performance per method protocols
- Audit results (if performed)

In addition, the QA reports will summarize all QA problems, and give a general assessment of QA results versus control criteria for such parameters as accuracy, precision, etc. The QA reports will be forwarded to the Project Manager.

12.1 Specific Routine Procedures Used to Assess Data Precision, Accuracy and Completeness

12.1.1 Precision

Precision will be assessed by comparing the analytical results between duplicate spike analyses. Precision as percent relative difference will be calculated as follows for values significantly greater than the associated detection limit:

$$\text{Precision} = \left| \frac{(D_2 - D_1)}{(D_1 + D_2)/2} \right| \times 100$$

D_1 = matrix spike recovery

D_2 = matrix spike duplicate spike recovery

For results near the associated detection limits, precision will be assessed based on the following criteria:

$$\text{Precision} = \left| \text{Original result} - \text{duplicate result} \right| < \text{CRDL}^1$$

12.1.2 Accuracy

Accuracy will be assessed by comparing a set of analytical results to the accepted or "true" values that would be expected. In general, MS/MSD and check sample recoveries will be used to assess accuracy. Accuracy as percent recovery will be calculated as follows:

$$\text{Accuracy} = \frac{A - B}{C} \times 100$$

A = The analyte determined experimentally from the spike sample

B = The background level determined by a separate analysis of the unspiked sample

C = The amount of spike added

In some cases, MS and/or MSD recoveries may not be available due to elevated levels of the spiked analyte in the investigative sample. In such cases, accuracy will be assessed based on surrogate spike recoveries and/or laboratory control samples.

¹ CRDL - Contract Required Detection Limit.

12.1.3 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under normal conditions.

To be considered complete, the data set must contain all QC check analyses verifying precision and accuracy for the analytical protocol. In addition, all data are reviewed in terms of stated goals in order to determine if the database is sufficient.

When possible, the percent of completeness for each set of samples will be calculated as follows:

$$\text{Completeness} = \frac{\text{usable data obtained}}{\text{total data planned}} \times 100 \text{ percent}$$

12.1.4 Outliers

Procedures discussed previously will be followed for documenting deviations. In the event that a result deviates significantly from method established control limits, this deviation will be noted and its effect on the quality of the remaining data assessed and documented.

13. Preventative Maintenance

This section applies to both field and laboratory equipment. Specific preventive maintenance procedures for field equipment will be consistent with the manufacturer's guidelines. Specific preventive maintenance protocols for laboratory equipment will be consistent with the contract laboratory's standard operating procedures.

All analytical instruments to be used in this project will be serviced by laboratory personnel at regularly scheduled intervals in accordance with the manufacturers' recommendations. Instruments may also be serviced at other times due to failure. Requisite servicing beyond the abilities of laboratory personnel will be performed by the equipment manufacturer or their designated representative.

Routine maintenance of the instruments will be performed as per manufacturers' recommendations. The Laboratory Project Manager is responsible for the preventive maintenance of the instruments.

14. Corrective Action

The need for corrective action may be identified by system or performance audits or by standard QC procedures. The essential steps in the corrective action system will be:

- Checking the predetermined limits for data acceptability beyond which corrective action is required
- Identifying and defining problems
- Assigning responsibility for investigating the problem
- Investigating and determining the cause of the problem
- Determination of a corrective action to eliminate the problem (this may include reanalysis or resampling and analyses)

- Assigning and accepting responsibility for implementing the corrective action
- Implementing the corrective action and evaluating the effectiveness
- Verifying that the corrective action has eliminated the problem
- Documenting the corrective action taken

For each measurement system, the laboratory QA/QC Officer will be responsible for initiating the corrective action and the Laboratory Project Manager will be responsible for implementing the corrective action.