PES Environmental, Inc.
Engineering & Environmental Services

OPERATION AND MAINTENANCE PLAN
TERMINAL 91 TANK FARM CLEANUP

PORT OF SEATTLE
SEATTLE, WASHINGTON

JULY 11, 2013

Prepared for:

Port of Seattle

Port of Seattle
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948.007.04

OPERATION AND MAINTENANCE PLAN
TERMINAL 91 TANK FARM CLEANUP
PORT OF SEATTLE, WASHINGTON

JULY 11, 2013

This Operation and Maintenance Plan has been prepared on behalf of the Port of Seattle for the Washington State Department of Ecology by the following licensed professionals:

By:

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LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

AO	Agreed Order No. DE 8938
AOC	Area of Concern
bgs	Below Ground Surface
BMPs	Best Management Practices
BNSF	Burlington Northern Santa Fe
CAP	Cleanup Action Plan
CMP	Compliance Monitoring Plan
Ecology	Washington State Department of Ecology
EDR	Engineering Design Report
EMIS	Environmental Monitoring Information System
FS	Feasibility Study
Ft	Feet
HASP	Health and Safety Plan
HDPE	High Density Polyethylene
LNAPL	Light Non-Aqueous Phase Liquid
MLLW	Mean Low Low Water
MNA	Monitored Natural Attenuation
MTCA	Model Toxics Control Act
O&M	Operations and Maintenance
OWS	Oil Water Separator
PES	PES Environmental, Inc.
PVC	Polyvinyl Chloride
Port	The Port of Seattle
RCW	Revised Code of Washington
RI	Remedial Investigation
SWMU	Solid Waste Management Unit
SOG	Standard Operating Guideline
SPU	Seattle Public Utilities
TFA	Tank Farm Area
TFAA	Tank Farm Affected Area
TFLP	Tank Farm Lease Parcel
WAC	Washington Administrative Code

1.0 INTRODUCTION

1.1 Purpose

PES Environmental, Inc. (PES) has prepared this Operation and Maintenance (O&M) Plan, a required component of the Engineering Design Report (EDR; PES, 2013), for a cleanup action at the Terminal 91 Tank Farm Affected Area (TFAA), a portion of the Port of Seattle's (Port's) Terminal 91 Complex (T-91) in Seattle, Washington (Figure 1). The EDR was developed pursuant to Agreed Order No. DE-8938 (AO) between the Port and the Washington Department of Ecology (Ecology). This O&M Plan has been prepared in accordance with the Model Toxics Control Act (MTCA) under Chapter 70.105D of the Revised Code of Washington (RCW) and Chapter 173-340 of the Washington Administrative Code (WAC).

The O&M Plan requirements are outlined in Section VII.A.4 of the AO, which stipulates that the EDR shall include an O&M Plan consistent with WAC 173-340-400(4)(c) for long-term care of the remedy components, including the containment wall, asphalt cover, LNAPL recovery system, and other components required to ensure that the remedy remains protective of human health and the environment. The purpose of the O&M Plan is to provide Port personnel with a resource document containing detailed instructions for the O&M of the remedy components.

The selected remedy for the TFAA includes a series of presumptive cleanup and response actions for areas affected by the Tank Farm Lease Parcel (TFLP), and a series of cleanup actions for the former tank farm and adjacent areas. The presumptive actions do not require long term O&M and are not discussed further in this plan. This O&M plan addresses the operations, inspections, and maintenance of the tank farm cleanup actions, including the subsurface cutoff wall around the perimeter of the former tank farm, the enhanced LNAPL recovery system, the asphalt cap, and the stormwater management system. The O&M requirements for these remedy components are expected to be minimal, and periodic inspections will be required to ensure that the components are in proper condition.

Following completion of the construction of the cleanup action, this O&M Plan will be implemented in conjunction with the Compliance Monitoring Plan (CMP; PES, 2013), which specifies the types and frequency of monitoring to be performed to document the performance of the cleanup action. The CMP includes a Monitored Natural Attenuation (MNA) Monitoring Plan. Monitoring procedures to ensure the protection of human health and the environment during construction and operation of the cleanup action will be included in a Construction Health and Safety Plan (HASP) and a project Health and Safety Plan, respectively.

1.2 Report Organization

Section 1 – Introduction: Provides a description of the Site, the purpose of the cleanup action, and the organization of the report.

Section 2 – Background Information: Provides a brief site description and summary of subsurface conditions.

Section 3 – Tank Farm Lease Parcel Remedy Description: Provides a brief description of the individual cleanup action components and their applicable design criteria.

Section 4 – Tank Farm Lease Parcel Operation and Maintenance Plan: Provides a description for operation of the individual cleanup action components, and provides guidelines for monitoring, inspections, and maintenance.

Section 5 – References: Lists the sources of information referenced in this document.

2.0 BACKGROUND INFORMATION

The background and history of the TFAA is described extensively in other documents, including Final Cleanup Action Plan (CAP; Ecology, 2010) and other documents referenced in the CAP. A very brief summary is provided below.

2.1 Site Description and History

T-91 is located at 2001 West Garfield Street, Seattle, Washington and encompasses approximately 216 acres (Figure 1). The TFAA is located in the central portion of T-91 and comprises approximately 17 acres, including the Tank Farm Lease Parcel (TFLP), which is contiguous parcel approximately four acres in size [1]. Figure 2 is a 2002 aerial photograph of the Terminal 91 Site showing the approximate boundaries of T-91, the TFAA, the TFLP, and other portions of T-91, including the Upland Area, Short Fill Area, and Submerged Lands Area.

The TFAA is flat and paved or covered with buildings. The TFAA generally is bounded to the south by Piers 90 and 91 and the Short Fill Area and Lake Jacobs (Short Fill Impoundment) located between the two piers, to the east by the Burlington Northern Santa Fe (BNSF) Rail Yard and the Washington Army National Guard facility, and to the north and west by the T-91 Upland Area.

The TFLP is located at the north end of the TFAA. The primary historical feature of the TFLP is the bulk petroleum tank farm present from the 1920s through 2005. The aboveground portion of the tank farm, including the tanks, containment walls, and other aboveground piping and equipment, was demolished and removed in 2005 as part of an interim remedial action.

2.2 Subsurface Conditions

The following is a brief summary of the geology and hydrostratigraphy at the Site.

2.2.1 Geology

As described in detail in the RI and FS Reports, five mappable lithologic units have been identified beneath the TFLP and adjacent areas. These four units in order of increasing depth include:

- The **Shallow Sand Unit** consists of fill material emplaced over shallow marine and tidal marsh deposits of Smith Cove during the early 1900s. It consists primarily of moderately to poorly sorted, fine- to medium-grained, unconsolidated sand, with laminations of silty sand and gravel lenses occurring locally. The Shallow Sand Unit extends vertically from just below the paved ground surface to between 15 and 20 feet below ground surface (ft bgs).

[1] The AO (Ecology 2012) defines the TFAA as "…*the Tank Farm Lease Parcel and any areas where Hazardous Substances originating from the Tank Farm Lease Parcel have come to be located*.", and the TFLP as, "…*the site of a tank farm, demolished in 2005, which had for a time operated as a Dangerous Waste Facility."*

- The **Silty Sand Unit** is comprised of gray or olive, moderately sorted, fine- to medium-grained, silty sand with traces of coarse sand, shell debris, and wood debris. This unit is interpreted to be native marsh, intertidal, and shallow marine sediments that formed the pre-fill surface in the Smith Cove Waterway and the adjacent tidelands. Beneath the TFLP and adjacent upland areas, the Silty Sand Unit generally occurs at depths of 15 to 20 ft bgs, and varies from 20-ft thick beneath the rail yard, east of the TFLP, to 5-ft thick or less in the southwest corner of the TFLP. A Gravel Layer was found within the Silty Sand Unit in some locations and consists of moderately to poorly sorted, silty sandy gravel.

- The **Deep Sand Unit** directly underlies the Silty Sand Unit and is composed primarily of poorly to moderately sorted, medium- to coarse-grained sand and gravelly sand, with only isolated occurrences of silt. However, beneath the northern portion of the TFLP, the Deep Sand Unit is composed of only 6 to 8 ft of sand, gravelly sand and sandy gravel, with the remaining deeper portions of the unit characterized by interbedded silty sand and sand. The depth to the top of the Deep Sand Unit varies from approximately 25 ft bgs at the center of the TFLP to as much as 45 ft beneath the north end of Pier 90.

- The **Silty Clayey Sand Unit** underlies the Deep Sand Unit and is composed of soft to stiff fine-grained sediments, primarily silty clay and clayey silt, with lesser amounts of silt and silty clayey sand. The top of the Silty Clayey Sand Unit is shallowest beneath the eastern portion of the TFLP, where it occurs as shallow as 42 ft bgs, in boring CP_106B.

The first two of these units have the potential to be encountered during construction of the cleanup action.

2.2.2 Hydrostratigraphy

Shallow Aquifer. The Shallow Aquifer is generally present in the Shallow Sand Unit and is separated from the Deep Confined Aquifer by the Silty Sand Unit, which acts as an upper confining unit. Water level data collected during routine monitoring of monitoring wells show that the dominant unconfined groundwater flow direction is towards the south beneath the TFLP and to the southwest beneath AOC 11. Recorded water elevations in the monitoring wells in and around the former tank farm typically range between 3 and 7 ft bgs and generally correspond to seasonal variations in precipitation rates, with the highest water levels observed during the wetter winter months. The typical horizontal gradient beneath the TFLP is approximately 0.001 ft/ft.

Downward vertical gradients between the Shallow Aquifer and Deep Confined Aquifer have been noted throughout the TFAA. Vertical gradients typically range from approximately 0.018 to 0.040 ft/ft, with vertical gradients decreasing to the south. Despite the presence of downward vertical gradients, significant downward movement of Shallow Aquifer groundwater under most of the TFAA is considered unlikely due to the low measured vertical permeability in the upper confining unit (Silty Sand Unit).

Deep Confined Aquifer. The deep confined aquifer is present in the Deep Sand Unit. Average groundwater flow direction in the Deep Confined Aquifer beneath and shoreward (i.e., south) of the TFLP is towards the south. As in the Shallow Aquifer, water levels in the Deep Confined Aquifer respond to seasonal variations in precipitation rates, with the highest water levels observed during the wetter winter months. The typical Deep Confined Aquifer horizontal gradient is relatively constant at approximately 0.003 ft/ft beneath the Site.

3.0 TANK FARM LEASE PARCEL REMEDY DESCRIPTION

The selected remedy for the TFLP will include long term O&M of a subsurface cutoff wall around the perimeter of the former tank farm, an enhanced LNAPL recovery system, an asphalt final cover, and a stormwater drainage system. The primary objective of these passive systems is to prevent LNAPL migration from the TFLP and adjacent source area systems and to prevent future surface product seeps from occurring.

Details of the cleanup are provided in the following documents:

- Engineering Design Report (PES et al., 2013);
- Construction Drawings – Terminal 91 Tank Farm Cleanup; and
- Technical Specifications – Terminal 91 Tank Farm Cleanup.

3.1 Cutoff Wall

A soil-bentonite (SB) cutoff wall is constructed around the perimeter of the former tank farm area (TFA). The objectives of the cutoff wall are to:

- Prevent migration of LNAPL from the TFLP; and
- Prevent groundwater from flowing through the former tank farm source area.

To meet these requirements, the cutoff wall has a minimum width of 2 feet, a bottom elevation of -0.7 ft Mean Low Low Water (MLLW), a maximum top elevation of 15.2 to 15.6 ft MLLW, and a hydraulic conductivity of 10^{-7} cm/sec or less. The bottom of the cutoff wall is approximately 10 ft below the minimum recorded low water table level (as measured in monitoring wells in and around the former tank farm), and the top of the cutoff wall is at least the 2 ft above the maximum recorded high water table level. The cutoff wall alignment is shown on Figure 3.

3.2 Enhanced LNAPL Recovery System

A series of five LNAPL recovery trenches are constructed in areas most likely to contain recoverable LNAPL (Figure 3). Four of the trenches are installed inside the cutoff wall, and one trench is installed in the former fuel line area directly west of the TFLP. The objective of the LNAPL recovery system is to remove recoverable LNAPL to the extent practicable using passive recovery techniques. To meet these requirements, the LNAPL trenches have a minimum width of 3 feet, are backfilled with coarse granular material that extends from 6.3 ft to 15.7 ft MLLW (i.e., 3 ft below the recorded minimum groundwater elevation and 1.5 feet above the recorded maximum LNAPL elevation), and includes a polyvinyl chloride (PVC) horizontal LNAPL collection pipe, and sumps and vertical risers at each of the collection pipe for removal of accumulated LNAPL.

The top of the vertical LNAPL risers have been surveyed vertically per the Tidelands datum and horizontally per the Washington State Plane NAVD88 datum.

3.3 Final Cover

The objective of the final cover is to minimize infiltration of precipitation, prevent direct contact with residual contaminants, and support vehicle and equipment loads associated with the anticipated use of the Site. The final cover includes the following design assumptions:

- The anticipated use of the Site is similar to those currently being conducted in the TFA (general materials storage and related traffic) and not based on potential future development options. Consistent with the Port's standards for trafficked areas, the 12-inch thick final cover section above the fill consists of a 4-inch thick layer of compacted Class B hot mix asphalt, a 4-inch thick layer of ¾-inch minus crushed rock base, and a 4 -inch thick layer of 1½-inch minus crushed rock subbase.

- The cover grading provides a minimum grade separation of 2 feet between the top of the cutoff wall and final grade to enable the pavement to bridge the slurry wall. This bridging will be enhanced by placing a cement-bentonite, a geogrid, and a geotextile separator across the top of the cutoff wall. The geotextile separator will prevent compacted fill from being pushed into the soil-bentonite, and the cement-bentonite and geogrid will act as a reinforcing layer that will resist vertical deflections. Select fill is required above the geosynthetics to optimize performance.

- The final cover includes 5 drainage basins, and is generally graded at a minimum slope of 2 percent to promote storm water runoff, and a maximum slope of 5 percent, to ensure site usability.

- An asphalt permeability standard is not required since the groundwater surface will be able to fluctuate within the alignment of the "hanging" cutoff wall.

3.4 Stormwater Management

Operation of the stormwater management system is integral to maintaining a functional final cover. The objective of the stormwater management system is to convey stormwater runoff from the final cover and to treat the runoff in accordance with City of Seattle requirements. Stormwater runoff from cover Drainage Basins 2 through 5 is conveyed by gravity to a new stormwater treatment system located near the southeastern corner of the former tank farm. The stormwater treatment systems design flow rate is 248 gallons per minute (gpm) maximum.

The stormwater treatment system also receives stormwater runoff from an adjacent 30,000 square foot area east of the former tank farm that is being used to mitigate a similar volume of runoff that is being discharged from Drainage Basin 1 and from the SWMU 30 excavation area. Runoff from Drainage Basin 1 and SWMU 30 is being managed through the Port's existing stormwater management facilities.

The TFLP stormwater treatment system includes the following components:

- A conveyance system that conveys stormwater runoff from Drainage Basins 2 through 5 to the TFLP stormwater treatment system. The conveyance system gravity drains runoff through a surface swale located on the northeast corner of Drainage Basin 2 and a series of catch basins and underground 8- to 12-inch diameter conveyance piping located on the northern, eastern, and southern perimeter of the former tank farm. As a result of the flat grades on the Site, the pipe grades are between 0.3% and 0.6%. Ductile iron pipe is installed in most areas to support design loading with only 12- to 18-inches of cover. Smooth bore corrugated polyethylene pipe is installed in the remaining areas.

- A conveyance system which conveys stormwater runoff from Drainage Basin 1 to the Port’s existing stormwater management system. The conveyance system gravity drains runoff through a series of catch basins and underground 8-inch ductile iron conveyance piping located along the western perimeter of the former tank farm. The conveyance piping connects to an existing catch basin located near the northwestern corner of Building M28.

- A treatment system consisting of an oil water separator (OWS) vault with coalescing filter and a media filtration vault containing 50 low-head cartridge type filters (StormFilter® or equal). The treatment system is installed in the southeast corner of the former tank farm, and tied into an existing 12-inch diameter conveyance pipe. The treatment system has a treatment capacity of 280 gpm and a hydraulic capacity of over 1,400 gpm. A high flow bypass is included for the treatment facility to prevent the system from being overloaded. Due to the potential for tidal influence, the downstream side of the treatment system includes a backflow prevention device.

4.0 TANK FARM LEASE PARCEL OPERATION AND MAINTENANCE PLAN

After construction of the final cleanup action is complete, O&M activities will be conducted including:

- Cutoff wall inspections;
- LNAPL monitoring and passive recovery from LNAPL trenches and from existing monitoring wells;
- Asphalt paving inspections and maintenance; and
- Stormwater management system inspections and maintenance.

Monitoring, inspections, and maintenance activities will be recorded on field forms, which are provided in Appendix A.

4.1 Cutoff Wall

The cutoff wall will operate passively to prevent migration of LNAPL and to prevent groundwater from flowing through the former tank farm source area. Groundwater elevations in nearby monitoring wells CP_104A, CP_106A, CP_108A, CP_115A, and CP_W210 will be measured quarterly, and compared to the elevation of the cutoff wall to determine if groundwater is overtopping the cutoff wall. Water level monitoring activities, which include monitoring of LNAPL presence/thickness to evaluate potential for LNAPL migration, will be conducted in accordance with the procedures outlined in the CMP (PES, 2013) and the Port's standard operating guidelines (SOGs), which are provided in Appendix B.

4.2 Enhanced LNAPL Recovery System

The LNAPL trenches will operate passively to accumulate LNAPL from areas in and around the former tank farm which are most likely to contain recoverable LNAPL. Periodic inspections, monitoring, and removal of accumulated LNAPL will be performed. Riser pipes and access vaults will be inspected annually to document proper functionality, structural integrity, and evidence of settlement. Cleanout pipe inspections will be performed if conditions indicate that the LNAPL collection pipe is fouled or clogged, and pipe cleaning will be performed as needed.

4.2.1 LNAPL Trench Monitoring

The objective of the LNAPL trench monitoring is to evaluate the accumulation of LNAPL in the five LNAPL recovery trenches, and to remove LNAPL from the trench riser pipes as it accumulates. The work will also include removal of LNAPL accumulations from TFAA monitoring wells that contain recoverable LNAPL.

The five LNAPL trench riser pipes will be monitored on a monthly frequency for the first three months of operation, and on a quarterly frequency thereafter. TFAA monitoring wells will be monitored per the CMP. Trench risers and monitoring wells which contain at least 0.25 feet of

LNAPL will be skimmed to remove the accumulated LNAPL. These trench risers and wells will be monitored and skimmed on a monthly frequency until they contain less than 0.25 feet of LNAPL. Trench risers and wells which contain less than 0.25 feet of LNAPL will remain on the quarterly monitoring frequency and will not be skimmed.

The procedures for LNAPL collection from the recovery trenches will be evaluated based on the amount of LNAPL removed and may be modified to optimize recovery rates. Examples of potential modifications include increasing the frequency of skimming if a trench produces significant volumes of LNAPL, staggering the skimming schedule if recovery rates vary significantly on a seasonal basis, and modifying skimming procedures to increase LNAPL recovery during a specific event.

Equipment

The following equipment will be used for LNAPL monitoring and skimming:

- An electronic oil/water interface probe will be used for detection of LNAPL and water, and includes two types of responses: one for detection of LNAPL, and the other for detection of water. This detector consists of a permanently marked coaxial cable or plastic-coated flat wire with 0.01-foot calibrations, a detection probe, and electronic controls contained in a spool or reel.

- A peristaltic pump with dedicated tubing will be used for LNAPL removal. The pump intake will be placed at a depth equal to the piezometric water level to minimize groundwater removal.

- A reusable graduated container will be used to accumulate and measure the volume of the recovered LNAPL.

Procedures

The Port's SOGs for measuring LNAPL, measuring water levels, and groundwater sampling are included in Appendix B. The SOG for groundwater sampling generally covers the procedures for LNAPL removal using a peristaltic pump.

Accumulated LNAPL will be skimmed or purged from trenches and monitoring wells until a 0.01 to 0.02-ft thickness is achieved. The field procedures include the following steps:

- Measure the initial depths to water and LNAPL;

- Set the pump intake tubing at a depth equal to the piezometric water level, calculated from the following parameters: depth to water, LNAPL thickness, and LNAPL specific gravity (approximately 0.9). For every 0.1 feet of LNAPL thickness, set the tubing intake approximately 0.01 feet below the LNAPL surface;

- Pump the accumulated LNAPL slowly into a graduated container and minimize the volume of water pumped. If water begins to accumulate in the container, stop pumping, re-measure water and LNAPL levels, and adjust the tubing depth as needed.

If the casing is under vacuum or pressure, the casing may need to be sealed to stabilize the LNAPL and water level during skimming;

- Measure the post-skimming depths to water and LNAPL;
- Transfer the accumulated LNAPL into an appropriately labeled waste container; and
- Record the initial and final depths to water and LNAPL, average skimming rate, and volume of LNAPL recovered on field forms.

4.3 Final Cover

Annual inspections of the final cover will be conducted to ensure that the final cover operates as designed for the long term. In addition to the general cover inspection, the portion of the cover above the cutoff wall alignment will be inspected to confirm that settling is not occurring and that the wall is protected from degradation from traffic loading. Inspections will include observing asphalt paving for cracking, holes, other damage, and removing vegetative growth. Cracks, holes, or other damage greater than ⅛ inch should be repaired. Cracks, holes, or other damage less than 1 inch wide should be sealed with an elastic asphalt filler/sealer or similar product. These minor repairs will be addressed within 60 days of the inspection if weather conditions permit. Larger cracks or other damage should be evaluated to determine the appropriate method of repair, up to repaired by full depth re-pavement in accordance with the original design documents, if necessary. If these repairs can be made by Port Maintenance personnel, they will be made within 60 days of the inspection if weather conditions permit. Repairs that require outside contracting will be implemented as soon as practicable.

4.4 Stormwater Management

The Port will inspect and maintain the stormwater system in accordance with the Port's stormwater O&M Manual (Port, 2013). The stormwater O&M Manual is a component of the overall Stormwater Management Plan required by Ecology to meet the conditions of the Port's *Western Washington Phase I Municipal Stormwater Permit* (Permit). The stormwater O&M Manual establishes inspection frequencies, best management practices (BMPs), record keeping requirements, and includes inspection checklists for T-91 and other properties under the Port's functional control. The stormwater O&M Manual meets the requirements of the Permit, and because the Port must also comply with the City of Seattle Municipal Code, the O&M Manual also meets the requirements of the City of Seattle Department of Planning and Development Directors' Rule 17-2009, *Stormwater Manual Volume 3 of 4: Stormwater Flow Control and Water Quality Treatment Technical Requirements Manual,* (SPU, 2009).

Stormwater management system O&M will be performed, tracked, and reported separately from the other components of the T-91 Tank Farm Cleanup. The Port's Marine Maintenance inspectors will conduct routine inspections as prescribed in the stormwater O&M Manual. Inspection checklists will be entered into the Port's maintenance tracking program, Maximo, and the Port Site Facility Manager will assign field crews to perform required maintenance work. Records of the inspections and maintenance will be maintained by the Port and submitted to Ecology on an annual basis per Permit requirements.

4.5 Waste Management

Waste materials associated with maintenance activities will be accumulated in appropriately labeled containers for profiling and disposal by the Port under its waste handing program. Anticipated materials include LNAPL, water, polyethylene tubing, and used sorbent pads or booms.

4.6 Inspections and Maintenance Reporting

Field data will be recorded on field forms, and the data will be submitted to the Port in an appropriate format for inclusion in their Environmental Monitoring Information System (EMIS) database. Inspection and maintenance activities will be recorded on field forms, and summarized in a memorandum. A summary of LNAPL monitoring and skimming results and copies of the inspection and maintenance memoranda, including the stormwater management system O&M records described in Section 4.4 above, will be included with the quarterly progress reports submitted to Ecology.

5.0 REFERENCES

City of Seattle. 2009. *Stormwater Manual Volume 3 of 4: Stormwater Flow Control and Water Quality Treatment Technical Requirements Manual.* November.

PES Environmental, Inc. and Vista Consultants, LLC. 2013. *Engineering Design Report, Terminal 91 Tank Farm Cleanup, Port of Seattle, Seattle, Washington.* July 11.

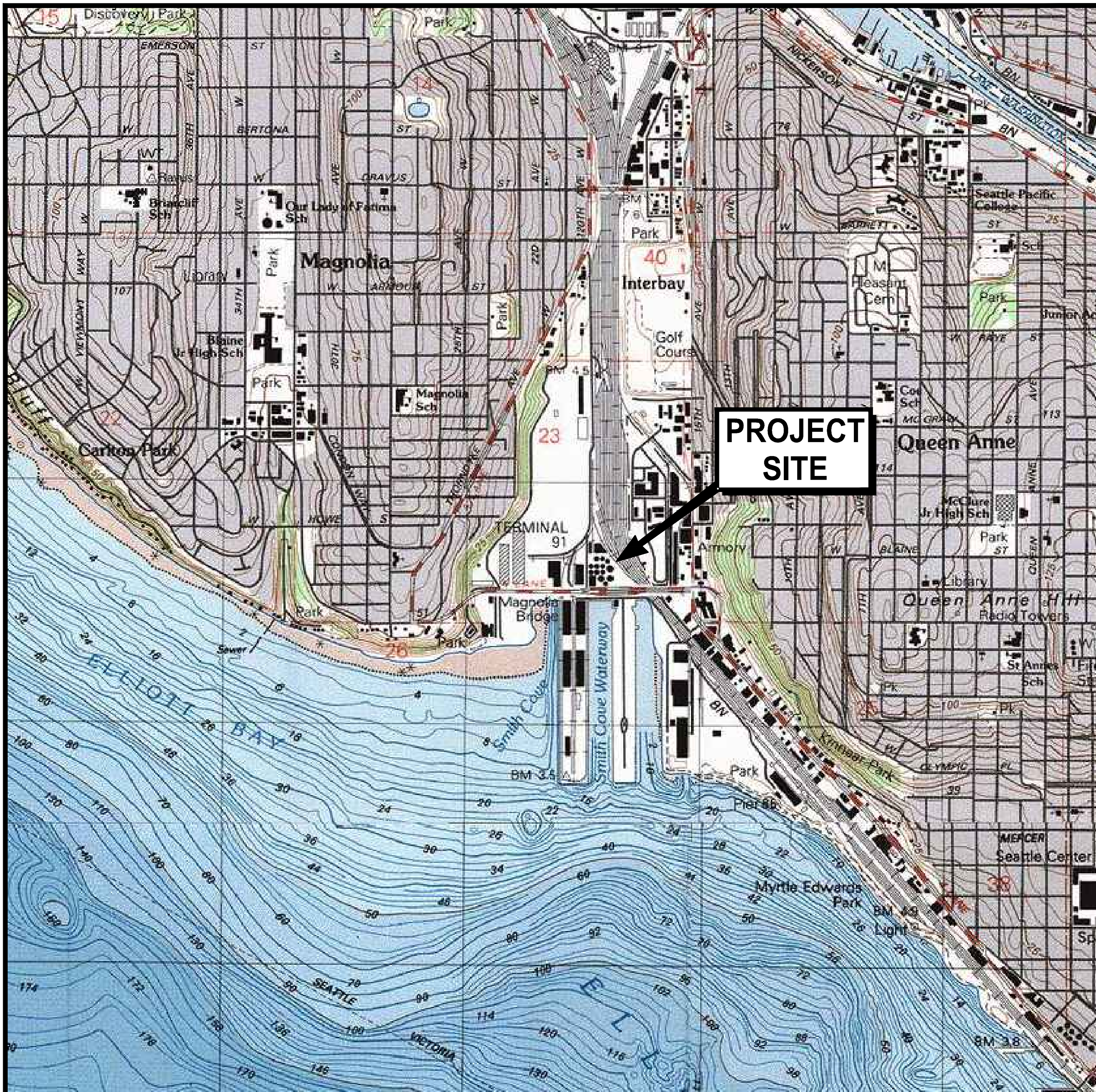
PES Environmental, Inc. and Vista Consultants, LLC. 2013. *Compliance Monitoring Plan, Terminal 91 Tank Farm Cleanup, Port of Seattle, Seattle, Washington.* July 11.

Port of Seattle. 2013. Port of Seattle – Marine Division, Operation and Maintenance Manual.

Washington Department of Ecology. 2010b. *Final Cleanup Action Plan, Port of Seattle Terminal 91 Site, Seattle, Washington.* December 15.

Washington Department of Ecology. 2012. *Agreed Order, N. DE 8938.* April 10.

ILLUSTRATIONS



0 2000 4000
Scale in Feet

N

U.S.G.S. Topo Map - Seattle North W, WA, 7.5-minute quadrangle.1983

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Site Location Map
Port of Seattle Terminal 91
Seattle, Washington

FIGURE
1

948.002.04.005	94800704005_CMP_1		2/13
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE

For areas shown as Tank Farm Affected Area ("TFAA") that are outside the Tank Farm Lease Parcel, the TFAA includes only soil and ground water below the water table. Soil above the water table (and outside the Tank Farm Lease Parcel) is outside the TFAA.

Note:

N

0 700 feet

The locations of all features are approximate.

Explanation

- Port of Seattle Property Limits
- Tank Farm Lease Parcel
- Tank Farm Affected Area
- Submerged Land

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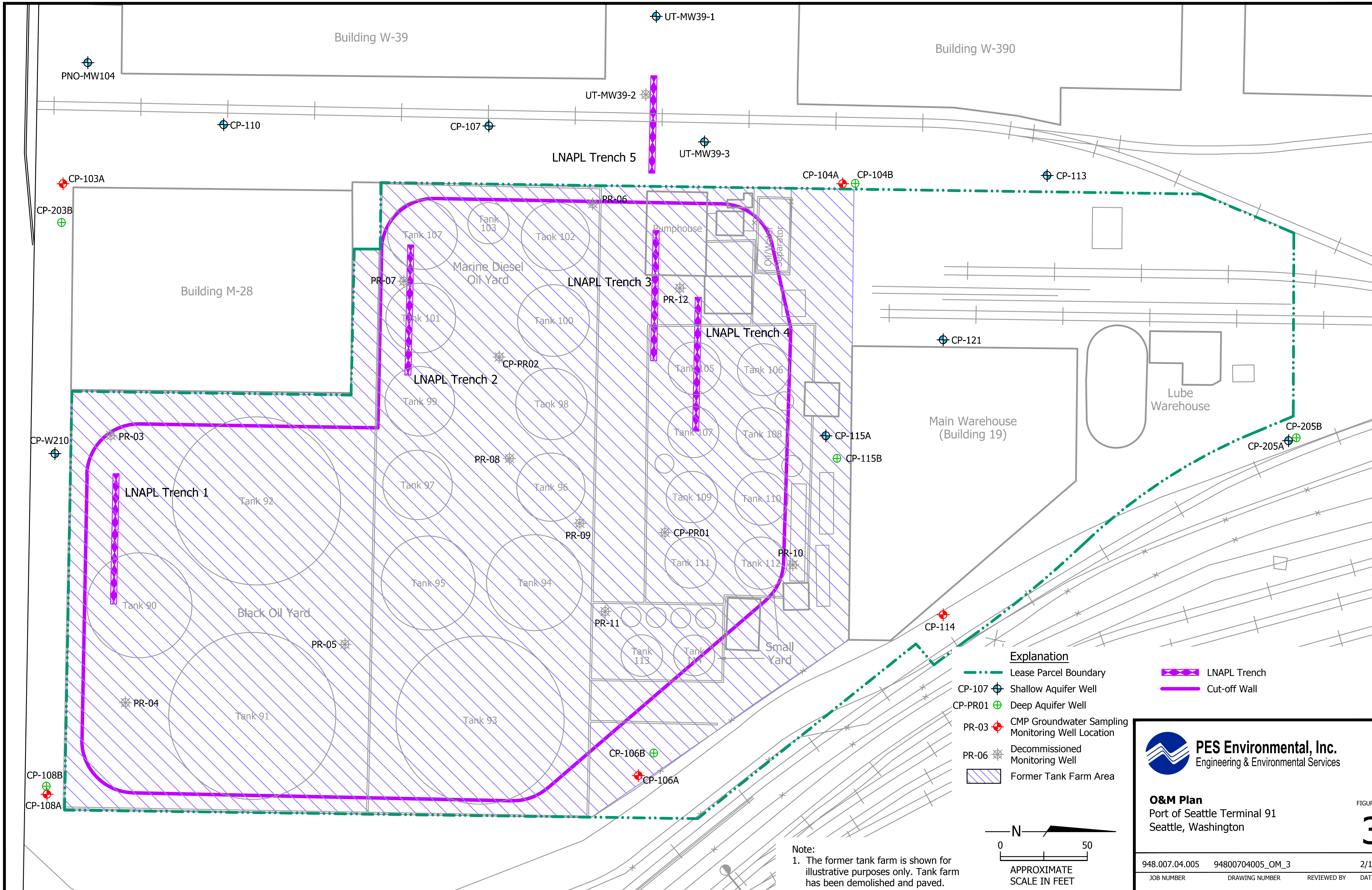
FIGURE 2

Port of Seattle Terminal 91 Facility and Tank Farm Lease Parcel
Port of Seattle Terminal 91
Seattle, Washington

JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE
948.007.04.005	94800704005_CMP_2		2/13



Note:
1. The former tank farm is shown for illustrative purposes only. Tank farm has been demolished and paved.

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O&M Plan
Port of Seattle Terminal 91
Seattle, Washington

FIGURE **3**

JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE
948.007.04.005	94800704005_OM_3		2/13

APPENDIX A

MONITORING AND INSPECTION FORMS

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PAGE	OF
DATE:	

DAILY FIELD REPORT

PROJECT:
JOB No:
PROJECT MANAGER:
RECORDED BY:

TIME	DESCRIPTION, COMMENTS, NOTES, ETC.

ATTACHMENTS: ☐ NO ☐ YES

DESCRIPTION: SIGNATURE

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PAGE OF

DATE:

PROJECT:

JOB No:

FIELD PERSONNEL:

RECORDED BY:

WATER LEVEL DATA FORM

MEASURING INSTRUMENT:

☐ STEEL TAPE ☐ OTHER-TYPE ______

☐ ELECTRONIC SOUNDER SERIAL No.

DATUM: ☐ MEAN SEA LEVEL ☐ OTHER - DESCRIBE

WELL I.D.	TIME	REFERENCE ELEVATION (Feet)	DEPTH TO WATER (Feet)			WATER LEVEL ELEVATION (Feet)	COMMENTS (well condition, odor, presence of product, etc.)
			1st	2nd	3rd		

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FREE PRODUCT FORM

PROJECT:
JOB No:
FIELD PERSONNEL:
RECORDED BY:
DATUM:

MEASURING INSTRUMENT:
☐ STEEL TAPE/BAR WITH PASTE ☐ ELECTRIC INTERFACE PROBE
☐ OTHER-TYPE: ______________________________

PUMP
☐ P-PUMP: ________________________ ☐ OTHER- TYPE: ___________________________

FLOATING PRODUCT THICKNESS MEASUREMENT

			PRE-SKIMMING			POST-SKIMMING				
WELL I.D.	TIME	REFERENCE ELEVATION (Feet)	DEPTH TO PRODUCT (Feet)	DEPTH TO WATER (Feet)	PRODUCT THICKNESS (Feet)	DEPTH TO PRODUCT (Feet)	DEPTH TO WATER (Feet)	PRODUCT THICKNESS (Feet)	SKIMMING RATE (mL/Min)	LNAPL VOLUME (mL)
LNAPL Trenches										
Trench 1										
Trench 2										
Trench 3										
Trench 4										
Trench 5										
Monitoring Wells										

Comments:

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INSPECTION FORM

FACILITY NAME: Terminal 91 Tank Farm Cleanup

LOCATION: Terminal 91 - Port of Seattle, Washington

WEATHER CONDITIONS (during inspection): ____________________

DATE THIS INSPECTION: ____________ DATE OF LAST INSPECTION: ____________

GENERAL FACILITY RATING: ______ Satisfactory ______ Requires Attention

EVALUATION: ____________________
Signature

____
Printed Name & Title

O&M PLAN SECTION #	ITEM	RESPONSE * Y	N	N/A	A
4.1	CUTOFF WALL Not applicable	______	______	______	______
4.2	LNAPL TRENCHES Evidence of settlement in trenches or access vaults, access cover working smoothly, damage or cracks to access vault structure, riser caps secure?	______	______	______	______
4.3	FINAL COVER Observations of pavement cracks, holes, settlement, damage, or nuisance plant growth? Evidence of settlement or damage along wall alignment?	______	______	______	______
4.4	STORMWATER MANAGEMENT Not applicable	______	______	______	______

ADDITIONAL OBSERVATIONS OR CONSIDERATIONS

Section #	Comments

* Response box legend:

Y	=	Yes - provide description in comment section.
N	=	No
N/A	=	Not Applicable
A	=	Requires Attention - comment section shall provide corrective action and due date.

APPENDIX B

STANDARD OPERATING GUIDELINES

Standard Operating Guideline
Measuring Groundwater Levels

Introduction

This Standard Operating Guideline (SOG) describes the field procedure typically followed by site field representatives when measuring groundwater levels. Groundwater levels in wells will be measured prior to commencing developing, purging, sampling, and pumping tests.

Equipment

- Electronic water-level monitoring probe or other measuring device
- Decontamination supplies (e.g., buckets, Alconox, distilled water, squirt bottle)
- Field notebook
- Groundwater purge-and-sample form(s) if in conjunction with groundwater sampling
- Keys for locks (if necessary)
- Tools to open well covers (e.g., socket wrench, spanner wrench)
- Disposable gloves (as a minimum), and other protective clothing (as necessary).

Typical Procedure

1. If more than one well will be measured, begin depth measurement in the order in terms of lowest to highest chemical concentrations in the monitoring wells.

2. Remove well caps from all wells prior to initiation of water level measurement activities. This will allow wells to equilibrate, if necessary.

3. If the potential exists for floating product [light non-aqueous phase liquid (LNAPL)] to be present, use an electric oil-water interface probe or oil-sensitive paper to measure depth of the floating product and the electronic depth probe to measure the depth-to-water. Record both depths in field notebook and note the water depth as the "depth with oil layer present." Unless otherwise instructed, always measure depths to floating product layer and groundwater from the top of the northern side of the well casing.

4. When floating product is not present, measure depth-to-water using a pre-cleaned water-level probe from the top of the northern side of the well casing, unless otherwise instructed.

5. Repeat measurements a minimum of three times or have field partner confirm measurement.

6. Record time of day the measurement was taken using military time (e.g., 16:00).

7. Decontaminate water-level and/or oil-water interface probe and line prior to reuse (refer to the Equipment Decontamination SOG).

Standard Operating Guideline
Groundwater Sampling

Introduction

This Standard Operating Guideline (SOG) provides the procedures typically followed by site field representative's personnel during the collection of groundwater samples from monitoring wells. Groundwater sampling from temporary boreholes (e.g., grab groundwater samples collected from direct-push borings) is not addressed by this SOG. This SOG provides guidance on procedures that are generally consistent with standard practices used in environmental sampling. Federal, state and/or local regulatory agencies may require groundwater sampling procedures that differ from those described in this SOG and/or may require additional procedures. As guidance, this SOG does not constitute a specification of requirements for groundwater sampling. Deviations from, and additions to, the procedures described herein may be appropriate based on project-specific sampling objectives, site-specific conditions, and/or regulatory requirements. The user of this SOG should modify the sampling procedures used, as appropriate, to conform to the project-specific requirements and then document such deviations from this SOG in the project-specific documentation of groundwater sampling activities.

This SOG does not address quality assurance/quality control (QA/QC) procedures for groundwater sampling in detail. While some general QA/QC procedures are addressed, project-specific QA/QC procedures should be developed and presented in a quality assurance project plan (QAPP), field sampling and analysis work plan, or other project- or activity-specific document.

This SOG contains the following sections:

- Field Equipment/Material
- Typical Procedures for Monitoring Well Purging and Groundwater Sampling
- Stabilization Criteria for Adequacy of Monitoring Well Purging
- Typical Procedures for Groundwater Sampling Using Passive Diffusion Bags (PDBs)
- Quality Control Guidance
- Investigation-Derived Waste (IDW) Management
- References.

Field Equipment/Materials

Material/equipment typically required for the collection of groundwater samples from monitoring wells may include:

- Electric water-level monitoring probe
- Multi-phase interface monitoring probe

- Bladder pump, peristaltic pump, pre-cleaned, disposable, 2- or 4-inch bailers with disposable cord, inertial pump, submersible pump, passive diffusion bags, or other suitable apparatus for purging the well and sampling
- Flexible discharge tubing [polyethylene (PE), Teflon™, or similar]
- Purge water collection container
- Multi-parameter water quality meter (temperature, pH, specific conductance, redox potential)
- Turbidity meter
- Flow-through cell
- Nitrocellulose filters (if conducting field filtering)
- Sample containers (laboratory-supplied) with appropriate preservatives
- Additional chemical preservatives (if necessary)
- Watch or stopwatch
- Sample labels, pens, field logbook, or other appropriate field forms (e.g., groundwater purge and sample forms, chain-of-custody forms), and access agreements and third-party sample receipts (if warranted)
- Previous purging and sampling data for monitoring wells to be sampled, including water levels, purging parameters, and laboratory analysis results.
- Monitoring well boring and construction log (including wellhead elevation survey and reference point information)
- Personnel and equipment decontamination supplies
- Sample shipping and packaging supplies
- Personal protective equipment as specified in the Health and Safety Plan (HASP).

Typical Procedures for Monitoring Well Purging and Groundwater Sampling

1. **Pre-Purging Data Collection and Purging Equipment Placement.** Record the data and information collected during this procedure on a groundwater purge and sample form. Perform the following prior to groundwater sampling:

   a. Calibrate the multi-parameter water quality meter, prior to beginning sampling and as necessary based on field conditions, in accordance with the instructions in the manufacturer's operation manual. Note that it may be appropriate to keep a written log of the calibration procedures and instrument maintenance with the instrument.

   b. Examine the monitoring well to be sampled and associated protective surface enclosure for any structural damage, poorly fitting caps, and leaks into the inner casing. If notable conditions exist, they should be recorded on the sampling log for the well so that any necessary follow-up corrective actions can be planned and implemented.

c. Record an initial measurement of the depth to water. Calculate the volume of water in the well casing if wetted-casing-volume-based purging is to be used to remove the so-called "stagnant water" from the well prior to sampling. The volume of water in the wetted well casing should be calculated using the formula: $V = (\pi r^2) \times L$ where r is one half of the inner diameter of the well casing/screen and L is the length of wetted casing/screen (calculated by subtracting the depth to water from the total well depth). Total well depth should not be measured at the start of a sampling event (due to the potential to cause turbidity). Measure the total well depth after sample collection. Note that some regulatory agencies require that the calculated "stagnant water" volume include the water contained in the pores space of the wetted portion of the monitoring well filter pack in addition to the casing/screen. If this is a requirement, it should be defined in the project-specific sampling requirements.

d. If light non-aqueous phase liquid (LNAPL) is potentially present, measure the depth and thickness of the LNAPL and the static water level using a multiphase interface monitoring probe. Use one of the following devices for purging:

   (1) Bladder pump: Adjust the pump intake at a depth approximately equal to the middle or just slightly below the middle of the well screen interval or water column unless another position is justified based on site-specific conditions.

   (2) Peristaltic pump: Place the pump intake at a depth equal to the approximate middle or just slightly above the middle of the well screen interval or water column unless another position is justified based on site-specific conditions. Note: If degassing of water is occurring when sampling with a peristaltic pump, alternative types of sampling equipment should be used for volatile organic compound (VOC) or volatile petroleum hydrocarbon (VPH) sample collection.

   (3) Inertial pump: Place the pump intake at a depth approximate to the middle or just slightly below the middle of the well screen interval or water column unless another position is justified based on site-specific conditions. Note: Some studies suggest that the use of inertial pumps for purging and/or sampling may produce a low bias when collecting samples for VOC and VPH analyses. This should be considered along with regulatory requirements when selecting an inertial pump for purging and/or sampling.

   (4) Submersible pump: place the pump intake at a depth approximate to the middle or just slightly below the middle of the well screen interval unless another position is justified based on site-specific conditions.

   (5) Pre-cleaned or disposable bailers. Note: The use of bailers for low-flow purging/sampling is not appropriate.

   (6) Another suitable purging/sampling device may be selected for use depending upon project requirements.

2. **Monitoring Well Purging and Sampling.** When purging of a monitoring well prior to sampling is appropriate and/or required, purge the well using either (a) wetted-casing-volume-based purging or (b) low-flow purging as described in the following sections. If a well exhibits evidence of slow recharge or produces excessively silty water, etc., the well may need to be redeveloped.

a. Wetted-casing-volume-based purging.

(1) Establish a purging rate to pump or bail approximately three wetted-casing volumes of groundwater without dewatering the well.

(2) If using a pump, set-up the discharge tubing, flow-through cell, water quality meter, and purge water collection container. If turbidity is measured, collect the sample for turbidity measurement after groundwater passes through the flow-through cell in the vial provided with the turbidity meter. If using a bailer, maintain a clean plastic container next to the well for collecting observation samples. Begin purging the well.

(3) At the beginning of purging and periodically thereafter, record the following information and water quality parameters/observations on the groundwater purge and sample form. As guidance, field parameters may be measured after one purge volume is removed and every 1/2 purge volume thereafter.
- Date and time
- Purge volume and/or flow rate
- Water depth
- Temperature
- pH
- Specific conductance
- Dissolved oxygen
- Oxidation-reduction potential (ORP)
- Other observations as appropriate (turbidity, color, presence of odors, sheen, etc).

(4) Continue purging until water quality parameters have stabilized (refer to Stabilization Criteria for Adequacy of Monitoring Well Purging below) and/or a minimum of three wetted-casing volumes of water have been removed from the well. If a well purges dry, let it recover to 80 percent of original water column, then sample. If the well takes a very long time to recover (i.e., longer than 2 hours), try to sample the well at the end of day or first thing the next day.

(5) Collect the sample in pre-cleaned sample containers suitable for the laboratory analyses to be performed.

(6) If sampling using a bailer, use a bottom-emptying device or other technique to avoid sample agitation. If the collected water is very turbid, or a bottom-emptying bailer is not used, properly transfer the water from the bailer into the appropriate sample containers. Be careful to avoid agitating the sample. When sampling for VOCs, turn the bottle upside down after filling the container to identify possible headspace. If bubbles are present, top off the sample container or resample.

b. Low-flow purging and sampling.

(1) Place the pump intake at a depth equal to the approximate middle or just slightly above the middle of the well screen interval or water column or otherwise as dictated by well-specific soil stratigraphy and project-specific requirements. For example, it may be appropriate that the pump intake be set opposite to any preferential flow pathways (i.e., zones of higher permeability).

(2) Place an electronic water-level indicator probe in the well, approximately 0.5 to 3 inches below the piezometric surface. If available, a transducer of sufficient accuracy can also be used to measure depth to water when purging.

(3) Connect the pump discharge tube to a flow-through cell housing a water quality parameter probe.

(4) Activate the pump for purging at a flow rate ranging from approximately 0.1 to 0.5 liters per minute (L/min) or other flow rate as dictated by project-specific and/or site-specific requirements. (Note: Some regulatory agencies may require specific flow rates). Determine the flow rate by timing the rate at which the flow-through cell is filled.

(5) During purging, monitor the water level in the well to evaluate potential drawdown. The goal is to minimize drawdown to less than approximately 4 inches. If drawdown is observed (especially rapid drawdown at the beginning of purging), decrease the pumping rate.

(6) Measure water quality parameters at approximately 3- to 5-minute intervals during purging. Continue purging until water quality parameters have stabilized (refer to Stabilization Criteria for Adequacy of Monitoring Well Purging below).

(7) Immediately after purging, collect the sample in pre-cleaned sampled containers suitable for the laboratory analyses to be performed using the same flow rate that was used during purging unless it is necessary to decrease the rate to minimize aeration or turbulent filling of sample containers. If sampling for VOCs or VPH reduce the flow rate to 0.1 L/min or less.

3. **Sampling with LNAPL Present in a Monitoring Well.** Wells containing LNAPL are typically not sampled for dissolved phase constituents in groundwater due to the potential for entrainment of LNAPL in the aqueous sample matrix. If such sampling is required, and purging is not required, make sure the pump intake is placed in the upper 2 feet of water column and collect the samples without purging in a manner that reduces the potential for mixing of the groundwater sample with air or LNAPL. If groundwater sampling is required from wells containing LNAPL for the purposes of characterizing VOCs, and purging is required, purge the well prior to sampling unless or until LNAPL becomes entrained in the sampling apparatus. If LNAPL will likely become entrained in the groundwater, the sample should be collected without purging. If LNAPL becomes entrained in the sampling apparatus then the sampling effort for VOCs should be aborted.

4. **Field Filtering Groundwater Samples.** Groundwater sample filtering and/or preservation should be performed in accordance with the requirements of the analytical method being specified and any other project-specific requirements. For example, samples collected for dissolved metals are typically filtered using a 0.45 µm filter.

5. **Sample Collection Considerations.** When multiple analyses will be performed, collect the samples in order of decreasing sensitivity to volatilization (i.e., VOC samples first and metals last). When sampling for VOCs, turn the sample container upside down after filling to identify possible headspace. If bubbles are present, top off the sample bottle or resample (do not reuse bottles, especially if they have been pre-preserved by the vendor or laboratory). If possible, the pump should not be moved or turned off between purging and sampling; however, the pump may need to be turned off for a very brief period

(as a practical matter) so field personnel can handle samples and minimize the potential for water to splash on the ground surface. The ground surface should be protected from incidental splashing, especially if water from the well would be considered a hazardous waste for disposal purposes.

6. **Monitoring Wells with Slow Recharge.** If a well purges dry, let it recover to 80 percent of original water column, then sample. If the well takes a very long time to recover (i.e., longer than 2 hours), try to sample the well at the end of day or first thing the next day.
7. **Sample Container Filling and Shipping.** Fill the appropriate containers for the analyses to be requested and ensure that the required label information is completely and accurately filled in. Follow sampling packaging, shipping, and chain-of-custody procedures (see applicable SOG).
8. **Decontamination.** Follow personnel and equipment decontamination procedures (see applicable SOG).

Stabilization Criteria for Adequacy of Monitoring Well Purging

Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EPA 2001) states that "with respect to groundwater chemistry, an adequate purge is achieved when pH, specific conductance, and temperature of groundwater have stabilized and the turbidity has either stabilized or is below 10 nephelometric turbidity units (NTUs). Wells should be considered stable when the criteria listed in the following table have been met for pH, specific conductance, temperature, and turbidity. Attempts should also be made to stabilize ORP and dissolved oxygen.

Field Parameters	Stabilization Criteria for Three or More Consecutive Readings	Notes
pH	Difference between three or more consecutive readings is within ±0.2 units	–
Temperature	Difference between three or more consecutive readings is constant	–
Specific Conductance	Difference between three or more consecutive readings is within ±3%	–
Turbidity	Difference between three or more consecutive readings is within ±10% or three consecutive readings below 10 NTUs	Generally, turbidity is the last parameter to stabilize. Attempts should be made to achieve stabilization; however, this may not be possible. It should be noted that natural turbidity in groundwater may exceed 10 NTUs. If turbidity is greater than 50 NTU, redevelopment of the well may be warranted.
ORP	Difference between three or more consecutive readings is within ±20mV	Very sensitive. Attempts should be made to achieve stabilization; however, due to parameter sensitivity this may not be possible.
Dissolved Oxygen	Difference between three or more consecutive readings is within ±10% or ±0.2 milligrams per liter (mg/L), whichever is greater	Very sensitive. Attempts should be made to achieve stabilization, especially when collecting samples of VOC analysis; however, due to parameter sensitivity this may not be possible.

Attempts should be made to achieve the stabilization criteria. Because of geochemical heterogeneities in the subsurface environment, stabilization of field parameters during purging may not always be achievable. If field parameter measurements do not indicate stabilization, continued conventional purging may be required until a minimum of three wetted-casing volumes have been removed. During low-flow purging of a well containing a large volume of casing water, it may be practical to discontinue low-flow purging and proceed with sampling if field parameters have not stabilized within a reasonable period. This judgment must be made on a site-specific/project-specific basis.

Typical Procedures for Groundwater Sampling Using Passive Diffusion Bags (PDBs)

Groundwater sampling using water-filled passive diffusion bag (PDB) samplers may be suitable for obtaining samples for VOC analysis. The suggested application of the method is for long-term monitoring of VOCs in groundwater wells at well characterized sites. (Note: The use of PDBs may not be suitable for the assessment of tertiary amyl methyl ether, methyl tert-butly ether, methyl-isobutyl ketone, styrene, and acetone). The effectiveness of the use of a single PDB sampler in a well is dependent on the assumption that there is horizontal flow through the well screen and that the quality of the water in the well screen is representative of the groundwater in the aquifer directly adjacent to the screen. If there are vertical components of intrabore-hole flow, multiple intervals of the formation contributing to flow, or varying concentrations of VOCs vertically within the screened or open interval, then a multiple deployment of PDB samplers within a well may be more appropriate for sampling the well.

Typically PDB samplers should not be used in wells having screened or open intervals longer than10 feet. If PDB samplers are to be used in wells with screened intervals of greater than 10 feet, then they are generally used in conjunction with borehole flow meters or other techniques to characterize vertical variability in hydraulic conductivity and contaminant distribution or used strictly for qualitative reconnaissance purposes. In larger well screens or in wells that may have vertical flow, the use of baffles should be considered.

Following are the procedures for deploying a PDB sampler.

1. **Acquire PDBs.** Obtain the pre-filled PDB samplers from the analytical laboratory. (The PDB samplers are prefilled at the laboratory with laboratory-grade deionized water. Unfilled PDB samplers can be obtained and filled in the field, but this is not recommended.)
2. **Deploy PDBs in Monitoring Wells.** To deploy the PDB sampler in the well:
   a. Measure the well depth and compare the measured depth with the reported depth to the bottom of the well screen from well-construction records. This is to check whether sediment has accumulated in the bottom of the well, whether there is a non-screened section of pipe (sediment sump) below the well screen, and the accuracy of well-construction records.

b. Attach the PDB sampler to a weighted line. (Sufficient weight should be added to counterbalance the buoyancy of the PDB sampler.) (Note: Stainless-steel or Teflon™-coated stainless-steel wire is preferable, but rope can be used if it is of sufficient strength, non-buoyant, and subject to minimal stretching. However, the rope should not be reused due to the potential for cross contamination.) Additionally, to prevent cross-contamination, the weighted lines should not be reused in different wells.

c. To prevent cross-contamination, the PDB samplers should not contact non-aqueous phase liquid (NAPL) during deployment or retrieval.

d. Calculate the distance from the bottom of the well, or top of the sediment in the well, up to the point where the PDB sampler is to be placed.

e. Attach the PDB sampler to the weight or weighted line at the target depth.

   1) For the field-fillable type of PDB sampler, the sampler is equipped with a hanger assembly and weight that can be slid over the sampler body until it rests securely near the bottom of the sampler.

   2) If using a coated stainless-steel wire as a weighted line, make loops at appropriate points to attach the upper and lower ends of PDB sampler.

   3) Where the PDB sampler position varies between sampling events, movable clamps with rings can be used.

   4) When using rope as a weighted line, tie knots or attach clasps at the appropriate depths. Nylon cable ties or stainless-steel clips inserted through the knots can be used to attach the PDB samplers.

f. Lower the weight and weighted line down the well until the weight rests on the bottom of the well and the line above the weight is taut. The PDB samplers should now be positioned at the expected depth. (The depth can be checked by placing a knot or mark on the line at the correct distance from the top knot/loop of the PDB sampler to the top of the well casing and checking to make sure that the mark aligns with the lip of the casing after deployment.)

g. Secure the assembly. (A suggested method is to attach the weighted line to a hook on the inside of the well cap.)

h. Reattach the well cap. The well should be sealed in such a way as to prevent surface-water in-flow into the well.

i. Allow the system to remain undisturbed until the PDB sampler equilibrates. Laboratory and field data suggest that a 2-week equilibration time is probably adequate for most applications. Note: In less permeable formations, longer equilibration times may be required.

3. **Recovering the PDBs.** Following the equilibration time, recover the PDB sampler from the monitoring well.

   a. Remove the PDB samplers from the well by using the attached line. The PDB samplers should not be exposed to heat or agitated.

b. Examine the surface of the PDB sampler for evidence of algae, iron, or other coatings and for tears in the membrane. Note the observations in a sampling field book. If there are tears in the membrane, the sample should be rejected. If there is evidence that the PDB sampler exhibits a coating, this should be noted in the report.

c. Detach and remove the PDB sampler from the weighted line. Remove the excess liquid from the exterior of the bag to minimize the potential for cross contamination.

4. **Sample Container Filling and Shipping.** Transfer the water from the PDB sampler to sample container. This is typically accomplished by carefully cutting a small hole in the bag and directing the flow into the sample container. Some commercially available PDB samplers provide a discharge device that can be inserted into the sampler. When transferring the sample to the sample container, minimize agitation. Ensure that the required label information is completely and accurately filled in. Follow sampling packaging, shipping, and chain-of-custody procedures (see applicable SOG).

5. **Decontamination.** Follow personnel and equipment decontamination procedures (see applicable SOG).

Quality Control Guidance

Follow the quality control requirements specified in the Quality Assurance Project Plan (QAPP), project-specific field sampling and analysis work plan, and/or project-specific regulatory requirements, as applicable. The following may be used as guidelines.

1. Approximately one duplicate sample should be obtained for each sampling event or for each batch of samples (a batch is typically defined as 20 samples). Collect duplicate samples immediately after the original samples are collected. Purging is not performed between original sample collection and collection of duplicate samples. Original and duplicate samples are collected sequentially, without appreciable delay between collection cycles. Duplicate samples are to be submitted to the laboratory blind (i.e., not identified as a duplicate sample).

2. Typically, at least one type of field blank sample (rinsate or transfer) should be collected per day of water sampling. All field blank samples are to be collected, preserved, labeled, and treated like any other sample. Field blank samples are to be sent blind to the laboratory (i.e., not identified as a field blank). Record in the field notebook the collection of any blank sample (rinsate, transfer, trip). The types of field blank samples are discussed below.

   a. Rinsate blank samples. If rinsate field blank samples are required, prepare the sample by pouring deionized water over, around, and through the various reusable sampling implements contacting a natural sample. Rinsate blanks need not be collected when dedicated sampling equipment is used for purging and sampling the well. Rinsate blank samples are to be analyzed for the same parameters as the environmental samples.

b. Transfer blank samples. Transfer blank samples are routinely prepared when no rinsate blank samples are collected. (The purpose of a transfer blank sample is to monitor for entrainment of contaminants into the sample from existing atmospheric conditions at the sampling location during the sample collection process.) A transfer blank sample is prepared by filling a sample container(s) with distilled or deionized water at a given sampling location. Transfer blank samples are to be analyzed for the same parameters as the environmental samples.

c. Trip blank samples. Trip blank samples are submitted for VOC analysis to monitor for possible sampling contamination during shipment as volatile organic samples are susceptible to contamination by diffusion of organic contaminants through the Teflon™-faced silicone rubber septum of the sample vial. Trip blank samples are prepared by the laboratory by filling VOA vials from organic-free water and shipped with field sample containers. Trip blank samples accompany the sample bottles through collection and shipment to the laboratory and are stored with the samples. It is suggested that a trip blank sample be included in each cooler of samples submitted for VOC analysis.

Investigation-Derived Waste (IDW) Management

Purge water is to be contained onsite in an appropriate labeled container for disposition by the client unless other project-specific procedures are defined. Other investigation-derived wastes, such as personal protective equipment, are to be properly handled and disposed. Preferably, personal protective equipment (PPE) IDW should also be containerized and left onsite for disposal by the client. As a matter of practice, any waste, or potential waste, generated onsite, should remain onsite. Refer to the IDW SOG.

References

ASTM. 1999. Designation: D 6452 - 99. Standard Guide for Purging Methods for Wells Used for Ground-Water Quality Investigations. Copyright ASTM, West Conshocken, PA.

ASTM International. 2002. Designation D 6771 – 02. Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations. Copyright ASTM International, West Conshocken, PA.

U.S. Environmental Protection Agency. 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM).* Dated November 2001. U.S. EPA Region 4.

Vroblesky, Dan A. 2001. U.S. Geological Survey, User's Guide for Polyethylene Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells. Part 1: Deployment, Recovery, Data Interpretation, and Quality Control and Assurance. Water-Resources Investigations Report 01-4060. Columbia, South Carolina.

Standard Operating Guideline
Equipment Decontamination

Introduction

This Standard Operating Guideline (SOG) describes field procedures typically followed by site field representative's personnel during the decontamination of sampling and monitoring equipment. Proper decontamination procedures minimize the potential for cross-contamination among sampling points on a single site or between separate sites.

Equipment

- Two or three containers (e.g., 5-gallon buckets, or 5- or 10-gallon plastic tubs) for dip rinsing, washing, and collection of rinse water.
- Two or three utility brushes or test tube brushes for removal of visible contamination. A test tube brush (or similar) can be stapled to the end of a dowel and used to clean the inside of a bailer.
- Non-phosphate Alconox, Liquinox, or trisodiumphosphate (TSP) to be mixed with potable or distilled water.
- Rinse solutions, such as methyl alcohol (methanol), dilute nitric acid (0.1 molar), deionized or distilled water, and/or tap water. Deionized water is preferable to distilled water, because the deionization process typically results in greater removal of organic compounds.
- Multi-gallon storage containers filled with potable water to be used for rinsing or washing.
- Spray bottles, squirt bottles, or garden sprayers to apply rinse liquid. A separate bottle should be used for each liquid.
- Solvex or neoprene gloves that extend, as a minimum, halfway up the forearm. In cooler weather, it is advisable to use different resistant chemicals neoprene gloves that provide better insulation against cold temperatures.
- Paper towels to wipe off gross contamination.
- Garbage bags, or other plastic bags, and aluminum foil to wrap clean sampling equipment after decontamination, to store sampling equipment, and/or to dispose of decontamination debris.
- Sample bottles for rinsate blanks. For these blanks, Laboratory Type II (millipore) water should be used. Purified water from the selected analytical laboratory is recommended. This water is often filtered and boiled to remove impurities.
- Department of Transportation (DOT)-approved container (e.g., 55-gallon drum) to store contaminated wash and rinse water. Contained decontamination should be labeled appropriately.

Procedures

In most cases, the following procedures are adequate to remove contamination.

1. Pre-clean sampling equipment. If there is gross contamination on equipment, wipe it off with paper towels and/or rinse it off with water. Additional internal decontamination may be possible by circulation of water or cleaning solutions.
2. Wash all parts of equipment with detergent water and scrub with brushes. Take equipment apart when appropriate to remove visible contamination.
3. Rinse equipment by dipping in rinse solution, spraying, or pouring solution over it. Dip rinsing can introduce contaminants into solution. Spraying might not allow a thorough rinsing of the equipment, but it is a more efficient rinsing method because less rinse solution is used. Appropriate rinsing solutions are specified in the project sampling and analysis plan. Some typical solutions are indicated in the equipment section of this SOG.
   a. Methanol (used to remove organic compounds)
   b. Dilute acids (used to remove metals and other cations)
   c. Tap water
   d. Deionized/distilled water.
4. Rinse the sampler with generous amounts of deionized water. Pouring water over the sampler is best, although spraying or using a squirt bottle to apply rinse water might be adequate if you are trying to minimize waste.
5. Prepare rinsate blanks. To ensure proper decontamination, submit a rinsate blank for analysis. It is best to do this just before sampling. The blank should be analyzed for the same chemicals the samples are being checked for and for the chemical used to decontaminate equipment, if appropriate.

   To prepare a rinsate blank, pour millipore analyte-free water through or into the sampler. Collect the rinsate water in a clean bottle. Pour the collected rinsate water into the appropriate sample container(s). It is advisable to prepare one rinsate blank every day in the field. Use water specifically for blank preparation.
6. Wipe sampling equipment with a paper towel or allow it to air dry.
7. Place samplers in clean plastic bags or sealed containers, or wrap them in aluminum foil for storage in an undisturbed location that is free of contamination.

Investigation-Derived Residuals

For details of handling investigation-derived residuals refer to the project sampling and analysis plan.

Special Notes

- To reduce the potential for cross-contamination, samples should be collected so that the least contaminated stations areas are sampled first. Subsequent sampling should be completed in the order of increasing contamination. Areas that typically have lower levels of contamination include those upgradient of source, background areas, and the periphery of the contaminated area.

- Prepare rinsate blanks. To ensure proper decontamination, submit a rinsate blank for analysis. It is best to do this just before sampling. The blank should be analyzed for the same chemicals the samples are being checked for and for the chemical used to decontaminate equipment, if appropriate.
- To prepare a rinsate blank, pour analyte-free water through or into the sampler. Pour the collected rinsate water into the appropriate sample container(s). It is advisable to prepare one rinsate blank every day in the field. Use water specifically for blank preparation.
- Monitoring instruments that come into contact with sampled materials must be decontaminated, along with sampling devices. They should be washed, or at least rinsed, before monitoring other sampling sites.
- As determined from analysis of rinsate blanks, decontamination using soap and water is adequate in removing detectable quantities of contaminants. This type of decontamination has been compared to laboratory procedures for decontaminating sampling bottles. Using methanol as a rinse does help in cases of contamination with organic compounds.

References

U.S. Environmental Protection Agency. 1987. *Handbook: Groundwater.* U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio.

Washington Department of Ecology. 1982. *Methods for Obtaining Waste Samples.* Ch. 173-303 WAC. Washington State Department of Ecology, Olympia, Washington.

Data Quality Standard Operating Guidelines Environmental Data Collection

Introduction

This Standard Operating Guideline (SOG) describes recommended procedures to be followed by site field representatives when collecting environmental data. The guideline is divided into pre-field procedures and field procedures for ease of use.

Pre-Field Procedures

The following procedures represent the minimal effort appropriate for most environmental data collection projects. Refer to project-specific plans for additional data collection procedures.

1. Review the work plan or sampling plan prior to initiating fieldwork, and discuss any questions with project manager or field leader.
2. Review the Health and Safety Plan.
3. Set up subcontract with analytical laboratory for type and quantity of analyses, documentation and delivery format, both hard copy and electronic data deliverables (EDDs) and turnaround time requirements. Establish contacts at the laboratory, field and home office (Project Manager or person responsible) for all communications.
4. Notify the analytical laboratory of the upcoming fieldwork and advise about the following:
    a. Number of samples per medium
    b. Analyses needed
    c. Dates of sample delivery, coordinate for Saturday pick-up if necessary
    d. Means of delivery (e.g., courier, FedEx)
    e. Turnaround time required
    f. Level of quality control (QC) reporting required
    g. Delivery format, for both hard copy and EDDs. (If EDDs will be uploaded into a database, refer to the Database Use Data Quality SOG.)
5. Order the sample containers from the laboratory. Determine whether field personnel will preserve the samples in the field or if pre-preserved sample containers will be provided. It is preferable to order containers with appropriate preservatives.
6. Arrange for delivery or pickup of sample containers.
7. Request the laboratory fax or email you chain-of-custody forms and laboratory receipt documents immediately after receiving the samples.

8. Check the chain-of-custody form to verify the correct samples were collected and correct analyses were requested. Double check the laboratory receipt documents to verify there are no typographical errors for samples.

   If changes are required, request change in writing, via email; do not request over the phone. Request the laboratory include all change request documentation in the laboratory summary report.

Field Procedures

1. At the beginning of each field day, identify planned work and document field conditions in the field notes.
2. Hold tailgate safety meeting and have all present sign the form.
3. Complete sample identification labels for each sampling container using an indelible pen. Use the sample identification protocol described in the work plan or sampling plan. It is recommended that pre-printed labels be created at the office prior to going to the field site, if possible.
4. Complete the chain-of-custody form, accounting for each sample. Verify that sample identifications, sampling times, and requested analyses on the chain-of-custody form match the sample identifications, sampling times, and requested analyses on the sample labels.
5. Verify that the appropriate QC samples (field duplicate samples, trip blanks samples, etc.) required in the work plan or sampling plan were collected. If applicable, document blind duplicate parents in field notes, and if using a database, supply a summary table of the parent and duplicate samples to your database coordinator.
6. Verify, where applicable, that the appropriate sample volume was collected to enable the analytical laboratory to perform QC analyses (e.g., matrix spike and matrix spike duplicate analysis). (For example, if a water sample is being analyzed for polynuclear aromatic hydrocarbons, 1 liter of sample is required for the analysis, and another 2 liters are required for the matrix spike and matrix spike duplicate analyses.)
7. Collect, preserve, and transport samples to the analytical laboratory in accordance with the work plan or sampling plan.
8. Provide adequate ice in coolers, so the coolers arrive at the laboratory at a temperature of 4 degrees Celsius (C) ± 2 degrees C.
9. Keep in contact with the project manager or other team member to report any problems, unusual observations, etc.
10. Verify samples were received by the analytical laboratory and the laboratory understands the chain-of-custody and requested analyses prior to beginning analyses.
11. If samples are sent by overnight delivery, be sure to include the tracking number and time released to the delivery service on the chain-of-custody form.

Standard Operating Guideline
Sample Packaging and Shipping

Introduction

This Standard Operating Guideline (SOG) presents methods for shipping non-hazardous materials, including most environmental samples via United Parcel Service (UPS), Federal Express, and Greyhound. Many local laboratories offer courier service as well.

Equipment

- Coolers or ice chests
- Sorbent material
- Bubble-wrap
- Strapping tape
- Labels and pens
- Chain-of-Custody forms
- Chain-of-Custody seals
- UPS, Federal Express, or Greyhound manifests.

Samples shipped to each analytical laboratory can be sent by UPS or Federal Express on a next-day basis unless other arrangements are made. Greyhound bus service should only be used if there is direct service (e.g., Sacramento or Bakersfield to San Francisco). Ice chests, used to refrigerate perishable items, can be used to convey non-hazardous samples to the analytical laboratory.

Absorbent pads should be placed in the bottom of the shipping container to absorb liquids in the event of sample container breakage. Transportation regulations require absorbent capacity of the material to equal the amount of liquid being shipped; each pad absorbs approximately 1 quart of liquid. Liquid samples in glass jars or bottles should also be wrapped in plastic bubble wrap. A small amount of air space is desirable in filled plastic containers. This often prevents the cap of the container from coming off should the container undergo compression. Volatile organics analysis (VOA) vials should be packed in sponge holders. Additionally, exposure of filled VOA vials to other types of sample containers, by placement in the same shipping container, is not recommended. Various non-VOA sample containers are solvent-rinsed, which may contaminate the VOA vials before or after sample collection. Therefore, a separate shipping container for VOA vials is recommended. An equal weight of ice substitute should be used to keep the samples below 4 degrees Celsius (C) for the duration of the shipment (up to 48 hours). Care in choosing a method of sample chilling should be observed so that the collected samples are not physically or chemically damaged. Re-usable blue ice blocks, block ice, ice cubes, or dry-ice are suitable for keeping samples chilled. Labels of samples may get wet. Use of waterproof pens and labels is desirable for identification of sample containers. Use of clear tape to cover each affixed sample label is helpful in ensuring sample identification. Strong adhesive tape should be used to band the coolers closed. Additionally, it is recommended that the drain plug be covered with adhesive tape to prevent any liquid from escaping.

Specific requirements for packaging materials may apply if the samples being shipped are known to be hazardous materials as defined in 49 CFR 171.8 (samples are not considered hazardous waste and, therefore, manifest requirements do not apply). UPS holds shippers responsible for damage occurring in the event of accidents when a hazardous material is shipped as a non-hazardous material. Samples that obviously are hazardous materials should, therefore, be shipped as such, and samples that most likely are not hazardous materials should be shipped in coolers. Guidelines for shipping hazardous materials by UPS are provided in the *Guide for Shipping Hazardous Materials* available from UPS. Specific labels for shipping of hazardous materials are available.

Chain-of-custody documentation should accompany shipments of samples to the analytical laboratory. Often, the chain-of-custody document contains an analytical request section that may be completed following sample collection. Chronological listing of collected samples is desirable. A copy of the completed chain-of-custody form should be retained in the event that the original form is lost or destroyed.

It should be noted that samples retained by the analytical laboratory, which are not chosen for analysis, may be assessed a fee for disposal. Often a disposal fee is assigned to a sample, typically soil, that has been retained beyond standard analytical holding periods. Therefore, consultation with project management is recommended to determine which samples may be of interest. Contacting the selected analytical laboratory regarding disposal policies is also recommended. Arrangements may be made with the analytical laboratory for return of the unanalyzed samples for later disposal to the area of origin.

Standard Operating Guideline
Well Construction and Development

Introduction

This Standard Operating Guideline (SOG) describes procedures used by the onsite field Consultants personnel for well construction and development following completion of boring and soil sampling procedures (described in Standard Operating Guideline, Boring, and Subsurface Soil Sampling).

Well Construction Materials

- 2-inch or 4-inch Schedule 40 PVC blank casing
- 2-inch or 4-inch Schedule 40 PVC slotted casing, of appropriate slot size
- 2-inch or 4-inch Schedule 40 PVC threaded and slip caps
- 2-inch or 4-inch Schedule 40 stainless steel blank casing
- 2-inch or 4-inch Schedule 40 stainless steel wire wrapped casing, of appropriate slot size
- 2-inch or 4-inch stainless steel threaded and slip caps
- Stainless steel well centralizers
- 12-inch x 0.25-inch mild steel isolation casing with welded centralizers
- Hasp-locking standpipes
- Ground-level traffic-rated watertight well housing enclosure
- Locking expansion plugs
- Combination or key lock
- Filter pack sand (refer to Standard Operating Guideline, Design of Filter Packs and Selection of Well Screens for Monitoring Wells)
- Type I or II Portland cement
- Concrete
- Bentonite powder
- 0.25-inch bentonite pellets or chips.

Well Development Equipment

- 2-inch or 4-inch-diameter vented surge block
- 1-inch dedicated PVC hose for monitoring well development and purging
- Centrifugal surface pump
- Submersible pump (4-inch-diameter wells or larger)
- 55-gallon DOT-approved drums

- Teflon, stainless steel or PVC bailer
- Teflon-coated bailer retrieval wire
- Airlift pump with foot valve and compressor
- Bladder pump (2-inch diameter wells only)

Typical Procedure

1. Following completion of selected borings, install the monitoring well casing through the center of the hollow stem auger, drive casing, or open boring. The monitoring well consists of a PVC Schedule 40 slotted well casing of appropriate diameter and a blank casing with a threaded bottom cap and a slip or threaded top cap or watertight expansion plug. The casing string must be held in tension during initial installation.
2. Place clean, well graded sand around the slotted section of the monitoring well to serve as the filter pack. The grade of sand is chosen on the basis of aquifer units encountered (refer to Standard Operating Guideline, Design of Filter Packs and Selection of Well Screens for Monitoring Wells). The filter pack is emplaced as the auger or temporary casing is removed from the boring.
3. Ensure that filter pack sand for the well extends to approximately 3 feet above the top of the screened interval.
4. If required in the well construction permit, notify the appropriate inspector prior to placing the well seal.
5. Place a 2- to 3-foot-thick bentonite pellet seal above the sand pack, as the auger and/or casing is removed from the boring. If the seal is placed above the water table, the bentonite pellets must be hydrated with potable water prior to placement of the annular seal.
6. Fill the remainder of the annulus between the well casing and the borehole wall with cement/bentonite grout (with approximately 5 percent bentonite), or a high-solids bentonite slurry (11 to 13 pounds per gallon), to a depth of approximately 1 foot below ground surface. If the water level is higher than the seal, use a tremie pipe to place the grout.
7. Install either a threaded cap or a locking watertight expansion plug on the monitoring well. Place a steel hasp-locking well housing over the top of the well and cement it into the annulus of the boring.
8. Place a traffic-rated precast concrete or steel well enclosure approximately 1 to 2 inches above grade, and cement it into place with concrete. Have a concrete apron constructed around the well housing enclosure to facilitate runoff.
9. For aboveground completion, ensure that the well casing extends approximately 3 feet above ground surface. An 8-inch-diameter hasp-locking steel well housing surrounds the well casing. Traffic bollards can be installed around the well housing as necessary.
10. Repeat Steps 1 through 9 for all monitoring wells at site.
11. Following the curing of the grout (approximately 24 hours), each monitoring well is developed. Prior to development activities, measure the depth in each well to static water level and total casing depth.

12. Also prior to well development, if applicable, check the water interface of each monitoring well for the presence of floating product (NAPL). Use a clear bailer or color indicator paste for the inspection.
13. If a monitoring well has a water level of less than 25 feet, it may be developed by using a centrifugal surface pump with dedicated 1-inch I.D. clear flex suction hose, placed with the hose intake placed temporarily at all levels of the screened interval. If the well is greater than 25 feet deep, a submersible pump or airlift pump with air filter is used for development. In either case, a surge block of appropriate size can be moved up and down inside the screened section of the well casing to create a surging action that hydraulically stresses the filter pack.
14. During development of each well, ensure that field parameters and observations are recorded on a Kennedy/Jenks Consultants purge and sample form (attached). Information to be recorded includes, but is not limited to, the following items:
    a. Depth to water
    b. Development time and volume
    c. Development (flow) rate
    d. pH, temperature, specific conductivity, and turbidity
    e. Other observations, as appropriate (e.g., color, presence of odors, or sheen).
15. Develop each monitoring well until water of relatively low turbidity is removed from the casing.
16. When development of each well is discontinued, record the following field parameters/observations:
    a. Depth to water
    b. Temperature
    c. pH
    d. Specific conductance
    e. Turbidity
    f. Color

Investigation-Derived Wastes

Place groundwater produced by well development in appropriately labeled containers for disposition by the client.

Groundwater Purge and Sample Form Date: ________

PROJECT NAME: ____________________ WELL NUMBER: ____________________

PROJECT NUMBER: ____________________ PERSONNEL: ____________________

STATIC WATER LEVEL (FT): ____________________ MEASURING POINT DESCRIPTION: ____________________

WATER LEVEL MEASUREMENT METHOD: ____________________ PURGE METHOD: ____________________

TIME START PURGE: ____________________ PURGE DEPTH (FT) ____________________

TIME END PURGE: ____________________ ____________________

TIME SAMPLED: ____________________

COMMENTS: ____________________

WELL VOLUME CALCULATION (FILL IN BEFORE PURGING)	TOTAL DEPTH (FT)		DEPTH TO WATER (FT)		WATER COLUMN (FT)		MULTIPLIER FOR CASING DIAMETER (IN)				CASING VOLUME (GAL)
							2	4	6		
		-		=		X	0.16	0.64	1.44	=	

TIME							
VOLUME PURGED (GAL)							
PURGE RATE (GPM)							
TEMPERATURE (°C)							
pH							
SPECIFIC CONDUCTIVITY (micromhos/cm) (uncorrected)							
DISSOLVED OXYGEN (mg/L)							
eH(MV)Pt-AgCl ref.							
TURBIDITY/COLOR							
ODOR							
DEPTH OF PURGE INTAKE (FT)							
DEPTH TO WATER DURING PURGE (FT)							
NUMBER OF CASING VOLUMES REMOVED							
DEWATERED?							

Groundwater Purge and Sample Form

Date: _________

PROJECT NAME: ______________________ WELL NUMBER: ______________________

PROJECT NUMBER: ______________________ PERSONNEL: ______________________

SAMPLE DATA:

TIME SAMPLED: ______________________ COMMENTS: ______________________

DEPTH SAMPLED (FT): ______________________ ______________________

SAMPLING EQUIPMENT: ______________________ ______________________

SAMPLE NO.	NO. OF CONTAIN-ERS	CON-TAINER TYPE	PRESER-VATIVE	FIELD FILTRA-TION	VOLUME FILLED (ml or L)	TURBIDITY	COLOR	SHIPPED UNDER CHAIN-OF-CUS-TODY AT 4°C?	ANALYSIS REQUEST (METHOD)	COMMENTS

PURGE WATER DISPOSAL NOTES:

TOTAL DISCHARGE (GAL): ______________________ COMMENTS: ______________________

DISPOSAL METHOD: ______________________ ______________________

DRUM DESIGNATION(S)/VOLUME PER (GAL): ______________________

WELL HEAD CONDITIONS CHECKLIST (CIRCLE YES OR NO - IF NO, ADD COMMENTS):

WELL SECURITY DEVICES OK (BOLLARDS, CHRISTY LID, CASING LID AND LOCK)?: YES NO

INSIDE OF WELL HEAD AND OUTER CASING DRY?: YES NO

WELL CASING OK?: YES NO

COMMENTS: ______________________

____

GENERAL:

WEATHER CONDITIONS: ______________________

TEMPERATURE (SPECIFY °C OR °F): ______________________

PROBLEMS ENCOUNTERED DURING PURGING OR SAMPLING? ______________________

____

____

cc: Project Manager: ______________________
Job File: ______________________
Other: ______________________

Standard Operating Guideline
Handling and Disposal of Investigation-Derived Waste

Introduction

Environmental site investigations usually result in generation of some regulated waste, particularly if the project involves drilling and construction of monitoring wells. Any potentially hazardous or dangerous material that is generated during a site investigation must be handled and disposed of in accordance with applicable regulations. This guideline provides a procedure to be used for dealing with investigation-derived wastes that have the potential of being classified as hazardous or dangerous, including soil cuttings, well development water, and decontamination water.

Equipment

- DOT-approved packaging (typically DOT 17E or 17H drums)
- Funnel
- Bushing wrench
- 15/16-inch socket wrench
- Shovel
- Appropriate markers (spray paint, paint pen)
- Plastic sheeting
- Drip pans
- Pallets.

Typical Procedures

Preparing Containers

1. Place each container on a pallet if it is to be moved with a fork lift after it is full.
2. Place plastic sheeting under containers for soil and drip pans under containers used to hold water.
3. Ensure that packaging materials are compatible with the wastes to be stored in them. Bung-type drums should be used to contain liquids. If a liquid is corrosive, a plastic or polymer drum should be used.
4. Solids should be placed in open-top drums. Liners are placed in the drums if the solid material is corrosive or contains free liquids. Gaskets are also used on open-top drums.

Storing Wastes

1. As waste materials are generated, place them directly into storage containers.
2. Do not fill storage drums completely. Provide sufficient outage so that the containers will not be overfull if their contents expand.
3. After filling a storage drum, seal it securely, using a bung wrench or socket wrench, for a bung-type or open-top drum, respectively.
4. Label drums or other packages containing hazardous or dangerous materials and mark them for storage or shipment. To comply with marking and labeling requirements, affix a properly filled out yellow hazardous waste marker and a DOT hazard class label to each waste container. Do not mark drums with on-site field representatives name. All waste belongs to the client. Mark accumulation start date.
5. During an ongoing investigation, use a paint marker to mark the contents, station number, date, and quantity of material on each drum or other container. Do not mix investigation-derived wastes with one another or with other materials. Do not place items such as Tyvek, gloves, equipment, or trash into drums containing soils or liquids, and do not mix water and soil. Disposable protective clothing, trash, soil, and water materials should be disposed of in separate containers.
6. Upon completion of field work, or the portion of the project that generates wastes, notify the client as to the location, number, contents, and waste type of waste containers. Remind the client of the obligation to dispose of wastes in a timely manner and in accordance with applicable regulations.

Regulations

49 CFR 100-177, *Federal Transportation of Hazardous Materials Regulations.*

EPA Region X, Technical Assistance Team. 1984. *Manual for Sampling, Packaging, and Shipping Hazardous Materials.* Seattle, WA: EPA.

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OPERATION AND MAINTENANCE PLAN
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