SITE CHARACTERIZATION REPORT / REMEDIAL ACTION COMPLETION REPORT FOR ABOVEGROUND STORAGE TANKS GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UNDERGROUND STORAGE TANK T-355

STORAGE TANK PRIMARY FACILITY IDENTIFICATION NUMBER 51-11557 (SUNOCO/PES) AREA OF INTEREST 5

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February 17, 2017
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1.0 INTRODUCTION

This Site Characterization Report/Remedial Action Completion Report (SCR/RACR) has been prepared to document closure and/or corrective action activities that have been completed for regulated aboveground storage tanks (ASTs) GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, and Underground Storage Tank (UST) T-355 located within Area of Interest 5 (AOI 5) in the Philadelphia Energy Solutions Refining and Marketing LLC (PES) Refining Complex (Complex).

The remediation liability for the Complex was transferred to Philadelphia Refinery Operations, a series of Evergreen Resources Group, LLC (Evergreen) on December 30, 2013. The remediation program is currently being performed under a Buyer Seller Agreement signed by Sunoco, PES and the Pennsylvania Department of Environmental Protection (PADEP) in September 2012. Site remediation at the Complex is ongoing as part of previously-established programs and the 2012 Buyer Seller Agreement as described below. The Complex has operated, and is planned to continue operating, as an oil refinery, marketing terminal and petrochemical complex.

This SCR/RACR is being submitted under separate cover from the Remedial Investigation Report for AOI 5 (AOI 5 RIR), dated January 16, 2017, that was submitted to PADEP and the United States Environmental Protection Agency (EPA) in accordance with PA One Cleanup Program by Evergreen. The purpose of this SCR/RACR is to:

- Document the status of each regulated storage tank referenced above;
- Summarize the previous and more-recent closure and/or corrective action work; and
- Provide necessary information to support closure for specified tanks and incidents.

All of the regulated tank work has been completed pursuant to the requirements of 25 Pa Code Chapter 245. Where applicable, the more-recent investigation work considered other investigation work completed at the Complex under the PA One Cleanup Program.

Numerous ASTs, not discussed in this SCR/RACR, were removed from AOI 5 prior to August 5, 1989. Conditions in tank areas where tanks were removed prior to August 5, 1989 are being characterized under the PA One Cleanup Program investigation and are discussed in the AOI 5 RIR.

Five tanks in AOI 5, GP-1208, GP-1209, GP-1210, GP-1212, and T-355 have been closed-in-place since August 5, 1989. Closure documentation was previously prepared by others for

these tanks, except for UST T-355. Five ASTs in AOI 5, GP-1214, 207, 223, 225, and 226, had reportable open release incidents since August 5, 1989 and these release cases are still open. Three ASTs in AOI 5, 207, 223, and 226 have been removed. AST GP-1208 had a reportable release in 2007 that is managed through the closure documentation referenced previously. PA Title 25, Chapter 245 release reporting letters and/or Notification of Reportable Release Forms were submitted to the PADEP for the above-described open release incidents. Refer to Appendix A of this SCR/RACR for previously-submitted investigations or correspondence with the PADEP regarding these tanks.

1.1 Objective

The objective of this SCR/RACR is to document the status of each tank listed below and to summarize the previous and more-recent closure and/or corrective action work.

Since August 5, 1989, four regulated ASTs and a UST in AOI 5 have been closed-in-place (one with a documented release) and two existing ASTs had open release incidents which are still open. Also, three removed ASTs had reportable open release incidents which are still open. The status of the ASTs and UST is summarized below:

- AST GP-1208 – Closed-in-place with documented benzene release;
- AST GP-1209 – Closed-in-place with no documented release;
- AST GP-1210 – Closed-in-place with no documented release;
- AST GP-1212 – Closed-in-place with no documented release;
- AST GP-1214 – Documented benzene release;
- AST 207 – Removed with documented unleaded gasoline release;
- AST 223 – Removed with documented number 6 fuel oil release;
- AST 225 – Documented number 6 fuel oil release;
- AST 226 – Removed with documented number 6 fuel oil release; and
- UST T-355 – Closed-in-place (removed from within surrounding concrete vault) with no documented release.

The open release incidents addressed in this SCR/RACR are summarized in the table below:

Release/ Incident Date	PADEP Incident ID	Sunoco/PES Tank Number or Release Location	Former PADEP Tank Number	Quantity Released (gallons)	Product Description
6/8/2007	38131	GP-1208	025A	Unknown	Benzene
2/12/1995	45696	GP-1214	128A	42	Benzene
11/24/1992	45690	207	006A	8,400	Unleaded Gasoline
10/26/1994	45695	223	017A	84	Number 6 Fuel Oil
9/7/2002	29484	225	007A	50	Number 6 Fuel Oil
5/29/91	45688	226	020A	125	Number 6 Fuel Oil

1.2 Scope of Work Summary

Additional site characterization activities were completed as part of the larger and more-recent AOI 5 site characterization effort (refer to the AOI 5 RIR for more details). Select site characterization activities were completed in the vicinity of the tanks listed in Section 1.1 to supplement previously-existing site characterization work performed by others, or to further characterize tank areas with open release incidents. These activities are described in this report relative to the tank areas, and in the AOI 5 RIR. Soil and groundwater samples were analyzed for the site constituents of concern (COCs) listed in Table 1. The COCs for the investigation activities include the current constituents from the Corrective Action Process (CAP) Regulation Amendments effective December 1, 2001 (as amended).

2.0 SITE LOCATION AND DESCRIPTION

The Complex is located in southwest Philadelphia. The area known as Girard Point Refinery (encompassing AOI 5 through AOI 7) was purchased by Sunoco, Inc. from Chevron USA, Inc. (Chevron) who acquired the facility from the Gulf Oil Company merger. The facility was purchased by Sunoco in 1994 and transferred to PES in 2012. AOI 5 is located in the southern-most portion of the Complex and is known as the Girard Point South Tank Field Area (Figure 1 and Figure 2). AOI 5 is bordered to the north and northwest by Penrose Avenue and the George Platt (formerly Penrose Avenue) Bridge, an industrial facility to the east, and the Schuylkill River to the south and southwest. AOI 5 encompasses approximately 114 acres. A sheet pile bulkhead, which is keyed into the Alluvium clay and silt layers, extends along the entire western boundary of the AOI, between the AOI and the Schuylkill River. The extent of the wall and the locations of tanks GP-1208, GP-1209, GP-1210, GP-1212, T-355, GP-1214, 207, 223, 225, and 226 are shown in Figure 2.

Approximately half of AOI 5 is covered by impervious surfaces. The existing monitoring well network in AOI 5, which is used to investigate groundwater conditions, includes a total of 96 monitoring wells, eight temporary well points, two piezometers, and three inactive recovery wells. The wells in AOI 5 are shown in Figure 3.

2.1 Complex and AOI 5 Operational History

The Complex has a long history of petroleum transportation, storage, and processing. The oldest portion of the Complex started petroleum-related activities in the 1860s when the Atlantic Refining Company established an oil distribution center. In the 1900s, crude oil processing began followed by full-scale gasoline production during World War II. In addition to refining crude oil, various chemicals, such as acids and ammonia, were also produced at the Complex for a time.

The primary historic operations at AOI 5 consisted of product storage in numerous ASTs containing fuel oil, waste oil, and lube oil. AOI 5 also housed packaging facilities. Other historic operations include transfer facilities for rail and trucking and marine unloading/loading areas. AOI 5 is the oldest operating portion of the Girard Point Refinery, dating back to the 1920s (Dames & Moore, 1987).

2.2 AOI 5 Current Use

Currently, AOI 5 consists primarily of light and intermediate product tankage, warehouses, a benzene rail unloading area, and docks that consist of three barge-loading areas. A loading rack and scale house are currently operating in the southeastern portion of AOI 5, as well as two pump houses. A stormwater separator and hazardous waste storage area are located in the southwestern portion of the AOI 5. Much of the area is open space due to the removal of several large ASTs. Two ship ballast tanks remain in use. In 2014, PES redeveloped a portion of AOI 5 and constructed a butane rail loading/unloading area with an associated iso-butane storage vessel. A PECO substation is located in the northern most part of AOI 5. A sheet pile bulkhead, keyed into the Alluvium clay layer, extends along the entire southern boundary of AOI 5 along the Schuylkill River. The extent of the sheet pile wall/bulkhead is shown in Figure 2.

Groundwater gauging and sampling of select monitoring wells in AOI 5 occurs on an annual basis. This monitoring is completed by Stantec Consulting Corporation (Stantec) on behalf of Evergreen. Annual gauging activities and groundwater results are reported to the PADEP

and EPA in semiannual Groundwater Remediation Status Reports. The reports also include the results of Evergreen's annual perimeter monitoring well sampling program.

2.3 Topography and Physiography

The overall Complex and AOI 5 lies within the Atlantic Coastal Plain Physiographic Province which is generally low-lying and relatively flat. Land surface topography at the Complex is relatively flat, with the land surface elevation being generally less than 30 feet above mean sea level. The flatness of the topography is representative of the Coastal Plain where alluvial sediments have been deposited by meandering streams and rivers with deposition ultimately controlled by the proximity to sea level. There are no significant areas of topographic relief within the Complex.

Northwest of the Complex, bedrock outcrops along the Fall Line (the line between the area where bedrock outcrops to the west and the Coastal Plain sediments lay to the east); near the Complex, bedrock is overlain with thick, unconsolidated deposits of layered sand and gravel, silts, and clays. These deposits are somewhat thin along the western portion of the Coastal Plain where bedrock is at shallower depths, and gradually thicken in a southeast direction to the coast where these deposits are several thousand feet thick. Within the Complex, at the northwestern end of the Coastal Plain, existing boring information indicates the unconsolidated deposits overlying bedrock are generally less than 100 feet in thickness.

3.0 GEOLOGY AND HYDROGEOLOGY

3.1 Geology

The Complex occurs within the up-dip limits of the Atlantic Coastal Plain, generally within two miles of the "Fall Line" where crystalline bedrock of the Appalachian foothills intersects the ground surface (outcrops). The Atlantic Coastal Plain is a physiographic province that is defined as having relatively flat topography and as being underlain by a characteristic wedge of unconsolidated sediments that thicken in a southeasterly direction, away from sediment source areas in the Appalachian Mountains. These sediments were deposited atop a sloping bedrock surface in complex fluvial, estuarine, and marginal marine environments along the passive Atlantic margin. Overall, subsidence of the Piedmont land surface in conjunction with cyclical sea-level fluctuations have been the primary controlling mechanisms driving periods of deposition, non-deposition and erosion in the Atlantic Coastal Plain (Trapp and Meisler, 1992). In general, the resulting sedimentary record in the

vicinity of the Philadelphia Refinery is complex, largely incomplete, and under-represented by only Cretaceous and Quaternary deposits, separated by a regional disconformity. A summary of those deposits within AOI 5 is presented below.

Since 2007, 27 unconfined aquifer monitoring wells ranging between 5 to 18 feet below ground surface (bgs) and 291 soil borings were completed to further characterize geology in AOI 5. Each monitoring well and soil boring location was continually logged by a field geologist.

Subsurface lithology from the numerous borings and monitoring wells completed in AOI 5 was used to characterize geologic conditions beneath AOI 5. A 3-dimensional (3D) geologic model of AOI 5 was generated with C Tech Development Corporation's Earth Volumetric Studio (EVS) software using historic and recently-completed borings and monitoring well logs. One cross-section trending north to south and one trending east to west were created from the 3D geologic model. The plan view key for the cross sections is provided as Figure 3, and the geologic cross sections are provided as Figures 4a and 4b.

The following paragraphs describe the primary geologic units beneath AOI 5 beginning with the deepest units to the shallowest units.

BEDROCK

Wissahickon Formation – Bedrock beneath the Complex and AOI 5 is identified as the Wissahickon Schist. This formation is a metamorphosed greenish-gray micaceous schist and quartzite. The competent bedrock of the Wissahickon Formation is overlain by weathered bedrock consisting of micaceous clay, which becomes increasingly sandy as the degree of weathering lessens and competent bedrock is encountered. The weathered zone of the Wissahickon Schist was encountered approximately 87 feet bgs at monitoring well A-21D on the western side of AOI 5, as shown in the geologic cross section presented as Figures 4a and 4b. Two additional Lower Sand monitoring wells (A-13D and A-19D) did not encounter bedrock at their respective total depths of 69 feet and 60 feet bgs. However, based on geologic interpretation by the USGS, weathered bedrock in the central and northern portions of AOI 5 is at approximately 90 feet bgs.

CRETACEOUS DEPOSITS

The Cretaceous deposits are configured in a southeasterly-thickening wedge, overlain by the much younger Quaternary deposits, and underlain by the Wissahickon Formation. The

wedge is made up of a series of vertically alternating aquifers and confining units called the Potomac-Raritan-Magothy (PRM) aquifer system. Each of the geological units of the PRM progressively pinches out to the northwest. The PRM aquifer system consists of six units:

- Upper Clay unit;
- Upper Sand unit;
- Middle Clay unit;
- Middle Sand unit;
- Lower Clay unit, and
- Lower Sand unit.

Lower Sand Unit of the PRM – Throughout the majority of the Complex, the Wissahickon Formation is overlain by the Lower Sand, which is the lowest member of the PRM aquifer system. As shown in Figures 4a and 4b, the Lower Sand overlies bedrock throughout AOI 5.

Boring logs for the three lower aquifer groundwater monitoring wells, A-13D, A-19D, and A21D, indicate the Lower Sand beneath AOI 5 consists of fine gravel and course sand that grades upward into medium-to-fine sands and may contain layers of silts and clay. The Lower Sand is located approximately 51 to 75 feet bgs in AOI 5. Based on available lithologic data, the Lower Sand is approximately 12 feet thick in the southwestern portion of AOI 5 and increases in thickness towards the eastern-northeastern portion of AOI 5 to approximately 40 feet (see Figures 4a and 4b). The interpreted extent of the Lower Sand beneath AOI 5 is consistent with the extent illustrated by USGS (Greenman et. al., 1961) and also with the generalized cross section prepared in 1992 by Dames and More presented in the CCR.

Lower/Middle Clay – The Lower Sand is overlain by the Lower/Middle Clay unit in AOI 5. The Lower/Middle Clay is characterized by very low permeability reddish-brown, brown or gray clays, sandy clays, with trace amounts of organic matter.

As shown in Figures 4a and 4b, the Lower/Middle Clay ranges in thickness from 0 feet 23 feet throughout AOI 5. The Lower/Middle Clay appears to be fairly extensive throughout the western half of AOI 5 due to the significant thicknesses of 10 and 25 feet observed in A-19D and A-21D well logs, respectively. Based on the absence of the Lower/Middley Clay in the A-13D well log, the clay layer is believed to pinch out to the southeast in the direction

of the confluence of the Schuylkill and Delaware Rivers. Where present the Lower/Middle Clay functions as a confining bed to the lower sand aquifer.

QUATERNARY DEPOSITS

Trenton Gravel – Throughout most of the Complex, the Trenton Gravel typically overlies the Lower/Middle Clay and Lower Sand with thicknesses up to 30 feet. The Trenton Gravel is of Pleistocene Age (Ice Age; less than 2 million years) and is a very heterogeneous unit comprised of a predominant brown to gray sand, gravel and minor amounts of clay (Owens and Minard, 1979).

Along the Schuylkill River, however, most of the Pleistocene formations have been eroded away (Greenman et al., 1961). Based on available soil boring logs for AOI 5, the Trenton Gravel is not present beneath AOI 5.

Recent (Holocene) Alluvium – Recent deposits of richly organic, dark gray mud, silt, and fine sand underlie the channels and tidal flats of the Delaware and Schuylkill Rivers. These sediments are most abundant in south Philadelphia near the confluence of the Delaware and Schuylkill Rivers, and can be up to 78 feet thick (Greenman et al., 1961). The Holocene Alluvium ranges in thickness from approximately 20 feet (A-19D) in the northern portion of AOI 5 to up to 47 feet (A-13D abandoned in March of 2014) near the Schuylkill River. Based on the available lithologic data, the Holocene Alluvium deposits in AOI 5 generally consist of two distinct stratigraphic layers:

- Silt layer: a soft, medium brown to dark gray silt, with organics and pieces of wood, trace to some clay, and interbedded thin sand and gravel lenses; overlain by
- Clay layer: a soft, dark gray clay, with trace to some silt, trace fine sand, and trace organics.

The Holocene silt and clay layers range in thickness from approximately 20 to 36 feet and 0 to 12 feet, respectively, across AOI 5 (see Figures 4a and 4b). The Holocene Alluvium sediments are less permeable than the Lower Sand unit and function as a leaky confining bed to the lower aquifer. Hydraulic conductivity estimates from aquifer tests of monitoring wells within AOI 5 which are screened across the Anthropogenic Fill and Holocene clay layer (A-22, A-24, A-140, A-147, A-151, and A-154) ranged from 0.35 to 56 feet per day (ft/d) (Dames & Moore, 1987, Langan, 2007). It is reasonable to assume the higher estimates are more representative of the fill material, and the lower range is a more appropriate value for

the Holocene clay layer. Estimates from all aquifer tests in the unconfined aquifer in AOI 5 are significantly less than the published hydraulic conductivity estimates from the Lower Sand, which range between 123 to 153 ft/d (Paulachok, 1991).

The thick, low permeability, Holocene Alluvium deposits within AOI 5 tends to limit the free interchange of water between the Schuylkill River and the unconfined aquifer. The Holocene silt layer appears to thicken to the southeast in the direction of the confluence of the Schuylkill and Delaware Rivers. The Holocene clay layer is believed to be fairly extensive across AOI 5 and eventually pinches out to the north (absent in A-19D well log), and may thin in the vicinity of historic tributaries to the Schuylkill River. The southern and western boundary of AOI 5 is bound by a sheet pile wall which is keyed into the Holocene clay layer as shown in Figure 5.

Anthropogenic Fill

Anthropogenic fill lies above the recent alluvium clay layer throughout AOI 5 and includes variable compositions of sands and gravels, brick, wood fragments and cinder ash up to 21 feet thick. Fill thickness tends to increase to the north as shown in Figures 4a and 4b.

3.2 Hydrogeology

The hydrogeologic frame work is defined by grouping geologic units that are laterally extensive and have similar hydrogeologic properties. The generalized hydrostratigraphy of the Complex consists of seven layers (Schreffler, 2001; Sloto, 1988). The typical hydrostratigrapghy at the Complex consists of the following:

- Layer 1: Combined Anthropogenic Fill, Holocene Alluvium and Trenton Gravel (Trenton Gravel does not appear to be present in AOI 5);
- Layer 2: Upper Clay unit of the PRM (not present in AOI 5);
- Layer 3: Upper Sand unit of the PRM (not present in AOI5);
- Layer 4: Middle Clay unit of the PRM ;
- Layer 5: Middle Sand unit of the PRM (not present in AOI5);
- Layer 6: Lower Clay unit of the PRM; and
- Layer 7: Lower Sand unit of the PRM.

Within AOI 5, the hydrogeologic framework consists of the combined anthropogenic fill and Holocene Alluvium (which is referred to as the unconfined aquifer makes up the water table aquifer. No Trenton Gravel is present in AOI 5. At depth and where less permeable, the

Holocene Alluvium also acts as a leaky confining unit. Beneath the Holocene Alluvium is the Lower/Middle Clay confining unit (referred to as the clay aquitard). Beneath the clay aquitard is the Lower Sand which is a semi-confined to confined aquifer. The Lower Sand lies above the Wissahickon Schist bedrock.

3.2.1 Porosity

In July 2014, two Shelby Tube soil samples in the shallow soils of AOI 5 were collected to determine soil properties. Soil sample A-170 8.5'-10.5' and A-186 8.5'-10.5' were both collected from a depth of 8.5 to 10.5 feet bgs. The soil sample from A-170, described as dark gray elastic silt with sand, trace roots, and organics, had a total porosity of 0.541 and an effective porosity of 0.182. The soil sample from A-186, described as dark gray elastic silt, with some organics, had a total porosity of 0.609 and an effective porosity of 0.205.

3.2.2 Unconfined Aquifer Groundwater Occurrence and Flow

As defined above, the unconfined aquifer is the combined fill/alluvium which make up the water table aquifer. Groundwater gauging data collected by Aquaterra Technologies, Inc. (Aquaterra) in July and October of 2014 were used to generate groundwater flow figures for the unconfined aquifer (Figure 5 Figure 6). Monitoring well construction details and all available logs for these monitoring wells are provided in the AOI 5 RIR. Based on the groundwater elevations and interpretation of groundwater flow as shown in Figure 5 and Figure 6, the following observations can be made:

- Groundwater flow is generally to the south towards the Schuylkill River under a typical hydraulic gradient of 0.005 feet/feet (ft/ft).
- Unconfined groundwater flow appears to be influenced by historic tributaries of the Schuylkill River as indicated by the northeast-southwest trending valley-like gradient patterns near the river.
- Unconfined groundwater flow in AOI 5 is also influenced by the presence of the sheet pile bulkhead which extends along the AOI's boundary with the Schuylkill River and is keyed into the Holocene clay. Limited groundwater mounding behind the sheet pile wall is observed.

3.2.2 Lower Aquifer Groundwater Occurrence and Flow

As defined above, within AOI 5 the lower aquifer is the Lower Sand unit of the PRM and is a semi-confined to confined aquifer. This lower aquifer is separated from the unconfined aquifer by subsequent confining, leaky confining, and confining units of the Holocene clay layer, Holocene silt layer, and the Lower/Middle Clay unit. Head potentials observed during the May 2011 gauging event in unconfined and lower aquifer monitoring well pairs confirm the two aquifers are hydraulically separated. The head differences measured in May 2011 between A-13 and A-13D, and A-21 and A-21D, were 4.59 and 11.3 feet, respectively. The observed head differences correspond to downward vertical hydraulic gradients of 0.082 and 0.16 ft/ft at the A-13 and A-21 monitoring well pairs, respectively.

As reference above, published hydraulic conductivity estimates for the Lower Sand range between 123 to 152 ft/d with a mean of 135 feet/day (Paulachok, 1991). Based on limited lower aquifer monitoring wells within AOI 5, groundwater in the lower aquifer is assumed to flow southwest towards the Schuylkill River, under hydraulic gradient of 0.004 ft/ft. This assessment of lower aquifer groundwater conditions, generally corresponds with the groundwater flow direction and gradients collected during the March 2013 site-wide gauging of the lower aquifer

4.0 SELECTION AND SCREENING OF REMEDIATION STANDARDS

The rationale for selection and attainment of soil remediation standards at the Complex is described below. All standards are for non-residential, total dissolved solids less than or equal to 2,500 milligrams per liter (mg/l) scenario,

Surface Soil (0-2 feet bgs)

For all COCs with the exception of lead, surface soil sample results were screened against the PADEP non-residential soil to groundwater medium specific concentrations (MSCs) and the non-residential direct contact MSCs. If the results are below the PADEP non-residential soil to groundwater MSCs, then attainment of the statewide health standards (SHSs) has been demonstrated. If the results are above the PADEP non-residential soil to groundwater MSCs,

but below the direct contact MSCs, then attainment of the SHSs has not been demonstrated and attainment of the site-specific standard will be pursued through evaluation of the groundwater pathway. If the sample results exceed the direct contact MSCs, then the area was delineated and will be addressed in the Complex-wide Cleanup Plan.

For lead, the surface soil sample results were screened against the Complex-specific site specific standard (SSS) for lead. This SSS for lead (2,240 mg/kg) was submitted in the Human Health Risk Assessment (HHRA) by Langan in 2015 and was approved by the PADEP on May 6, 2015. Sample results that are below the SSS for lead have attained the SSS for lead. Sample results that exceed SSS for lead were delineated and will be addressed it the Complex-wide Cleanup Plan.

Subsurface Soil (2-15 ft bgs or the water table)

For all COCs, the subsurface soil sample results were screened against the PADEP non-residential soil to groundwater MSCs and the direct contact MSCs. If the results are below the PADEP non-residential soil to groundwater MSCs, then attainment of the SHS has been demonstrated. If the samples exceed the PADEP non-residential soil to groundwater MSCs or the direct contact MSCs, then attainment of the site-specific remediation standard will be demonstrated (either by pathway elimination due to PES's procedures governing excavations or through evaluation of the groundwater pathway).

Note, the groundwater and potential vapor intrusion into indoor air pathways are being addressed in the AOI 5 RIR as part of the One Cleanup Program.

5.0 SUMMARY OF PREVIOUS INVESTIGATIONS AND REMEDIATION EFFORTS

Previously-completed interim remedial measures or site assessment/characterization activities for the AOI 5 ASTs and UST GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, and T-355 are summarized in the following sections.

5.1 AST GP-1208

Sunoco informed the PADEP of their intent to formally close-in-place AST GP-1208 with a Closure Notification Form submitted to the PADEP Division of Storage Tanks by Sunoco on May 25, 2006. On behalf of Sunoco, Secor International, Inc. (SECOR) conducted investigation activities in support of a tank closure letter for AST GP-1208 that was dated

September 12, 2007. AST GP-1208 is a 462,000-gallon tank that measures 45 feet in diameter. The AST was historically used to store benzene and there was a reported release associated with the tank in June 2007. The PADEP was verbally informed of this release on June 28, 2007, and informed in writing on July 6, 2007.

In response to the release, SECOR collected five perimeter soil samples and one subsurface tank soil sample using a hand auger. The perimeter soil samples were collected from approximately three feet bgs, and the subsurface tank soil sample was collected from approximately 5 feet bgs. In addition, SECOR also collected seven soil samples from beneath aboveground pipelines associated with AST GP-1208 at a depth of approximately 0 to 0.5 feet bgs. Due to an inconsistency in the original report, it is unknown if the GP-1208-LINE samples are surface or subsurface soil samples. The GP-1208-LINE samples were categorized as subsurface samples for this report and are reflected as such on all tables and figures.

Eleven of the soil samples (GP-1208-PER-1 through GP-1208-PER-5, GP-1208-SUB-1, GP-1208-LINE-1 through GP-1208-LINE-4, and GP-1208-LINE-7) exhibited exceedances of the PADEP non-residential soil to groundwater MSC of 0.5 milligrams per kilogram (mg/kg) for benzene. None of the soil samples exhibited exceedances of the PADEP non-residential subsurface soil direct contact MSCs.

SECOR summarized its findings in a report prepared in 2007; this report is included in Appendix A. Historical soil sample analytical results from SECOR's 2007 report are provided in Table 2 and Table 3 and displayed in Figure 7. Refer to Appendix A for additional information regarding the SECOR's 2007 report.

5.2 AST GP-1209

PES notified the PADEP of its intent to formally close-in-place AST GP-1209 by correspondence dated November 16, 2012. This correspondence included a Closure Notification Form. AST GP-1209 has been temporarily out of service since 2006 and Sunoco previously submitted Closure Notification Forms to the PADEP on October 24, 2011, a copy of which was included with the November 16, 2012 correspondence from PES to the PADEP.

Stantec conducted investigation activities in support of a tank closure letter for ASTs GP-1209, GP-1210 and GP-1212 that was dated April 18, 2012. AST GP-1209 is a 462,000-

gallon tank that measured 45 feet in diameter. The AST was historically used to store benzene and there were no reported releases associated with the tank.

Stantec completed four soil borings around the perimeter of AST GP-1209 and one soil boring adjacent to the aboveground delivery piping associated with the tank. The perimeter soil samples were collected from approximately 2.5 to 3.5 feet bgs at the soil to groundwater interface. The delivery piping perimeter sample (GP-1209-PP) and one other perimeter sample for AST GP-1209 (GP-1209-1210) were considered shared characterization samples for AST GP-1210 (see Section 5.3 below). The soil boring adjacent to the delivery piping was collected as a surface soil sample (0 to 0.5 feet bgs).

The surface soil sample (GP-1209-PP), which is shared with AST GP-1210, exhibited an exceedance of the PADEP non-residential soil to groundwater MSC of 0.5 mg/kg for benzene. The surface soil sample did not exhibit exceedances of the PADEP non-residential surface soil direct contact MSCs or the SSS for lead.

Four of the subsurface soil samples (GP-1209-1210, GP-1209-E, GP-1209-NW, and GP-1209-SW) exhibited exceedances of the PADEP non-residential soil to groundwater MSCs of 0.5 mg/kg for benzene and 450 mg/kg for lead. None of these four subsurface soil samples exhibited exceedances of the PADEP non-residential subsurface soil direct contact MSCs for benzene or lead. The subsurface soil sample results indicate that GP-1209-SW exceeded the PADEP non-residential subsurface soil direct contact MSC for cumene of 10,000 mg/kg at 13,000 mg/kg.

Stantec summarized its findings in a report prepared in 2012. This report is included in Appendix A. Historical soil sample analytical results from Stantec's 2012 report are provided in Table 2 and Table 3 and displayed in Figure 7.

Refer to Appendix A for additional information regarding the Stantec's 2012 report. Historical groundwater sample analytical results from Stantec's 2012 report are provided in Appendix A and additional groundwater analytical results are provided in the AOI 5 RIR.

5.3 AST GP-1210

PES notified the PADEP of their intent to formally close-in-place AST GP-1210 by correspondence dated November 16, 2012. This correspondence included a Closure Notification Form. AST GP-1210 has been temporarily out of service since 2006 and

Sunoco previously submitted Closure Notification Forms to the PADEP on October 24, 2011, a copy of which was included with the November 16, 2012 correspondence from PES to the PADEP.

Stantec conducted investigation activities in support of a tank closure letter for ASTs GP-1209, GP-1210 and GP-1212 dated April 18, 2012. AST GP-1210 is a 462,000 gallon tank that measures 45 feet in diameter. The AST was historically used to store cumene and there were no reported releases associated with the tank.

Stantec completed four soil borings around the perimeter of AST GP-1210 and one soil boring adjacent to the aboveground delivery piping associated with the tank. The perimeter soil samples were collected from approximately 2.5 to 3.5 feet bgs at the soil to groundwater interface. The delivery piping perimeter sample (GP-1209-PP) and one other perimeter sample (GP-1209-1210) for AST GP-1210 were considered shared locations with AST GP-1209. The shared soil samples are discussed in Section 4.2.

The surface soil sample (GP-1209-PP), which is shared with AST GP-1209, exhibited an exceedance of the PADEP non-residential soil to groundwater MSC of 0.5 mg/kg for benzene. The surface soil sample did not exhibit exceedances of the PADEP non-residential surface soil direct contact MSCs or the SSS for lead.

Four of the subsurface soil samples (GP-1209-1210, GP-1210-NE, GP-1210-NW, and GP-1210-SW) exhibited exceedances of the PADEP non-residential soil to groundwater MSC of 450 mg/kg for lead but did not exceed the non-residential subsurface soil direct contact MSC for lead. Two subsurface soil samples (GP-1209-1210 and GP-1210-NW) exhibited exceedances of the PADEP non-residential soil to groundwater MSC of 0.5 mg/kg for benzene. Two subsurface soil samples (GP-1210-NE and GP-1210-SW) exhibited exceedances of the non-residential subsurface soil direct contact MSC for benzene of 330 mg/kg at 1,500 mg/kg and 910 mg/kg, respectively. The subsurface soil sample results for GP-1210-SW also exhibited an exceedance of the PADEP non-residential subsurface soil direct contact MSC for cumene of 10,000 mg/kg at 33,000 mg/kg. Refer to Appendix A for additional information regarding the Stantec's 2012 report.

Stantec summarized its findings in a report prepared in 2012. This report is included in Appendix A. Historical soil sample analytical results from Stantec's 2012 report are provided in Table 2 and Table 3 and displayed in Figure 7.

5.4 AST GP-1212

PES notified the PADEP of their intent to formally close-in-place AST GP-1212 by correspondence on November 16, 2012. This correspondence included a Closure Notification Form. AST GP-1212 has been temporarily out of service since 2006 and Sunoco previously submitted Closure Notification Forms to the PADEP on October 24, 2011, a copy of which was included with the November 16, 2012, correspondence from PES to the PADEP. Stantec conducted investigation activities in support of a tank closure letter for ASTs GP-1209, GP-1210 and GP-1212 dated April 18, 2012. AST GP-1212 is a 462,000-gallon tank that measures 45 feet in diameter. The AST was historically used to store cumene and there were no reported releases associate with the tank.

Stantec completed four soil borings around the perimeter of AST GP-1212 and one soil boring adjacent to the aboveground delivery piping associated with the tank. The perimeter soil samples were collected from approximately 2.5 to 3.5 feet bgs at the soil to groundwater interface. The delivery piping perimeter sample was collected as a surface soil sample (0 to 0.5 feet bgs).

The surface soil sample did not exhibit exceedances of the PADEP non-residential soil to groundwater MSCs, PADEP non-residential surface soil direct contact MSCs or the SSS for lead.

All four of the subsurface soil samples (GP-1212-NE, GP-1212-NW, GP-1212-SE, and GP-1212-SW) exhibited exceedances of the PADEP non-residential soil to groundwater MSC of 450 mg/kg for lead but did not exceed the non-residential subsurface soil direct contact MSC for lead.

One of the four subsurface soil samples (GP-1212-NE) exhibited an exceedance of the PADEP non-residential soil to groundwater MSC of 0.5 mg/kg for benzene, however, none of the subsurface soil samples exhibited exceedances of the non-residential subsurface soil direct contact MSC for benzene of 330 mg/kg.

The soil sample results for GP-1212-NE and GP-1212-SE exhibited exceedances of the PADEP non-residential subsurface soil direct contact MSC for cumene of 10,000 mg/kg at 28,000 mg/kg and 30,000 mg/kg, respectively. Refer to Appendix A for additional information regarding the Stantec's 2012 report.

Stantec summarized its findings in a report prepared in 2012. This report is included in Appendix A. Historical soil sample analytical results from Stantec's 2012 report are provided in Table 2 and Table 3 and displayed in Figure 7.

5.5 AST GP-1214

The PADEP was verbally informed by Sunoco on February 12, 1995, and by means of a letter dated February 24, 1995, of a release incident for GP-1214. The letter stated that a faulty seal on Pump P-2 caused a release of approximately 42 gallons of benzene within the tank berm. The ground surface was frozen and covered with snow and ice at the time of the release. The pump was immediately shut down upon discovery of the release and approximately 2 inches of surface soil along with the recoverable benzene were removed for disposal by an environmental contractor. The pump seal was repaired and no further actions were taken. Refer to Appendix A for additional information regarding the release incident including soil disposal documentation.

5.6 AST 207

A previous owner, Chevron informed the PADEP of a release from AST 207 by letter dated December 2, 1992. The release occurred on November 24, 1992, and due to operator error during the tank filling process, approximately 8,400 gallons of unleaded gasoline was released to the ground surface. Interim remedial activities included product recovery using a vacuum truck and the recovered products were processed through the Complex units. A faulty tank gauge was also repaired and may have contributed to the release. The letter states that soil samples were obtained but no results were provided and no further actions were taken.

5.7 AST 223

The PADEP was verbally informed on October 27, 1994 by Sunoco and through a letter, dated November 4, 1994, of a release incident for AST 223. The letter stated that a leak from the mixer seal on AST 223 caused a release of approximately 84 gallons of number 6 fuel oil within the tank berm. The product was recovered using a vacuum truck and the impacted soil was removed and disposed of accordingly. The tank was emptied and the seal was repaired prior to placing the tank back into operation. No other actions were taken. Refer to Appendix A for additional information regarding the release incident including soil disposal documentation.

5.8 AST 225

The PADEP was informed by Sunoco through a letter dated September 18, 2002 of a release incident for AST 225. The letter stated that a leak from the mixer seal on AST 225 caused a release of approximately 50 gallons of number 6 fuel oil within the tank berm. The product was recovered using a vacuum truck and the impacted soil was removed and disposed of accordingly. The tank was emptied and the seal was repaired prior to placing the tank back into operating service. No other actions were taken. Refer to Appendix A for additional information regarding the release incident including soil disposal documentation.

5.9 AST 226

The PADEP was informed by Sunoco through a Storage System Report Form dated May 29, 1991, of a release incident for AST 226. The Form stated that a leak had occurred from AST 226 of approximately 3 barrels (126 gallons) of number 6 fuel oil within the tank berm. The product was recovered and pumped to a barge. No other actions were reported. Refer to Appendix A for additional information regarding the release incident including soil disposal documentation.

5.10 UST T-355

The PADEP was informed by Sunoco on May 8, 1998 through a reportable release notification that UST T-355 was planned to be closed-in-place and removed from service. The tank had been used in a process to separate number 6 fuel oil from water. In accordance with closure plan requirements, soil sampling was performed. Three samples were collected in January 1998.

Soil analytical results exhibited elevated total petroleum hydrocarbon (TPH) values that exceeded action levels in the January samples. The notification informed the PADEP that a site assessment of the area would be completed in the future. Handex completed the site assessment and 10 additional samples were collected in September 1998. The results were discussed in 1999 report. Handex concluded that petroleum contamination could have been from historic usage.

Refer to Section 8.0 below for groundwater sampling details. Refer to Appendix A for additional information regarding Handex's 1999 report.

6.0 SOIL SAMPLING ACTIVITIES

The following sections summarize the additional site characterization activities completed by Langan Engineering & Environmental Services, Inc. (Langan), Stantec, and Aquaterra in AOI 5 to supplement previously-completed work in the tank areas. All soil samples were analyzed for the site COCs listed in Table 1. Evergreen team standard operating procedures (SOPs) were used for the work and the Evergreen Quality Assurance/Quality Control (QA/QC) Plan and Field Procedures Manual is provided in Appendix B. Site characterization boring logs are provided in Appendix C. For additional detail of the AOI 5 site characterization activities completed, refer to the AOI 5 RIR, the AOI 5 SCR/RIR/CUP submitted to the PADEP and EPA on December 13, 2011 and the AOI 5 SCR submitted to PADEP and EPA on August 24, 2007.

6.1 AST GP-1208

The additional soil characterization activities for AST GP-1208 included collecting one surface soil sample in 2013 and collecting four surface soil samples for laboratory analysis in 2014. Surface soil boring BH-13-36 was advanced in 2013. Borings BH-14-26, BH-14-27, and BH-14-29 were advanced in 2014 to horizontally delineate previous exceedances of benzene reported in previously-advanced boring soil samples. Surface and subsurface soil samples were obtained from BH-14-28 in 2014. Soil boring BH-14-28 was considered a shared soil boring location with the investigation of AST GP-1214 release incident. The soil sample locations are shown on Figure 7.

6.2 AST GP-1209

The additional soil characterization activities for AST GP-1209 included the advancement of five soil borings in the former tank area and collection of surface and subsurface soil samples for laboratory analysis. These borings were installed to delineate previous exceedances of lead, benzene, and cumene reported in previously-advanced boring soil samples. The borings BH-13-34 and BH-13-35 were advanced in 2013 and surface and subsurface soil samples were obtained. Borings BH-13-145, BH-13-146, and BH-13-147 were also advanced in 2013 and surface soil samples were collected. The soil sample locations are displayed on Figure 7.

6.3 AST GP-1210

The additional soil characterization activities for AST GP-1210 included advancement of ten soil borings in the former tank area and collection of a surface soil sample for laboratory

analysis. These borings were installed to delineate previous exceedances of lead, benzene, and cumene. In March 2013, two soil borings (BH-13-31 and BH-13-32) were advanced and one surface soil sample was collected to delineate the exceedance observed at GP1210-NE. Soil sample BH-13-32 was further delineated by five soil borings where five surface soil samples were collected in October 2013 (BH-13-142, BH-13-143, BH-13-144, BH-13-148, and BH-13-149). In March 2014, three additional soil borings (BH-14-03, BH-14-04, and BH-14-11) were advanced and three surface soil samples were collected. The soil sample locations are displayed on Figure 7.

6.4 AST GP-1212

The additional soil characterization activities for AST GP-1212 consisted of the advancement of fifteen soil borings. Two borings were advanced and samples were collected (BH-13-29 and BH-13-44) in 2013. Additional horizontal delineation soil borings for soil exceedances of the PADEP non-residential surface soil direct contact MSC for cumene and the non-residential surface soil direct contact MSC for lead were advanced as follows:

- In October 2013:
    - Three soil borings (BH-13-130, BH-13-131, and BH-13-132) were advanced to delineate historic exceedances observed in GP1212-NW. Surface soil samples were collected from all three borings.
    - Three soil borings (BH-13-133, BH-13-134, and BH-13-135) were advanced to delineate exceedances observed in GP1212-NE. Surface soil samples were collected from all three borings.
    - Three soil borings (BH-13-136, BH-13-137, and BH-13-138) were advanced to delineate exceedances observed in GP1212-SE. Surface soil samples were collected from all three borings.
    - Three soil borings (BH-13-139, BH-13-140, and BH-13-141) were advanced to delineate historic exceedances observed in GP1212-SW. Surface soil samples were collected from all three borings.
- In March 2014, one soil boring (BH-14-13) was advanced to delineate exceedances observed in BH-13-29. One surface soil sample was collected.

The soil sample locations are displayed on Figure 7.

6.5 AST GP-1214

The additional soil characterization activities for AST GP-1214 consisted of the advancement of three soil borings in the former tank area and collection of surface and subsurface soil samples for laboratory analysis. Borings BH-14-28, BH-14-30, and BH-14-31 were advanced in 2014 to horizontally and vertically delineate a previous open release incident of benzene associated with AST GP-1214. The 2014 borings were focused around Pump #2 of the tank and BH-14-28 was considered a shared soil boring for the soil characterization for AST GP-1208. Surface and subsurface soil samples were obtained from the 2014 soil borings. The soil sample locations are displayed on Figure 7.

6.6 AST 207

The additional soil characterization activities for AST 207 consisted of the advancement of four soil borings (BH-14-14, BH-14-15, BH-14-17, and BH-14-18) in June of 2014 in the tank area and the collection of surface and subsurface soil samples for laboratory analysis. These borings were installed to horizontally and vertically delineate a previous open release incident of unleaded gasoline associated with AST 207. One groundwater monitoring well was also installed near AST 207. The soil sample locations are displayed on Figure 7.

6.7 AST 223

The additional soil characterization activities for AST 223 consisted of the advancement of four soil borings (BH-14-21, BH-14-22, BH-14-24, and BH-14-25) in June of 2014 in the former tank area and the collection of surface and subsurface soil samples for laboratory analysis. These borings were installed to horizontally and vertically delineate a previous open release incident of number 6 fuel oil associated with AST 223. The soil sample locations are displayed on Figure 7.

6.8 AST 225

The additional soil characterization activities for AST 225 consisted of the advancement of four soil borings (BH-14-19, BH-14-20, BH-14-36 and BH-14-37) in June of 2014 in the tank area and the collection of surface and subsurface soil samples for laboratory analysis. These borings were installed to horizontally and vertically delineate a previous open release incident of number 6 fuel oil associated with AST 225. The soil sample locations are displayed on Figure 7.

6.9 AST 226

The additional soil characterization activities for AST 226 are related to the Solid Waste Management Unit (SWMU) Number 93 and the PES Butane Rail Line Development within AOI 5. Refer to the AOI 5 RIR for additional information regarding the SWMUs and rail line development in AOI 5.

The SWMU sampling by Langan consisted of the advancement of one soil boring (BH-04-07) within the tank dike area of AST 226. The soil sample was analyzed for lead only. The soil sample location is displayed on Figure 7.

Stantec collected subsurface soil samples within the tank dike area of AST 226 prior to its removal. In March 2014, Stantec advanced 120 borings where thirty subsurface composite samples and 30 discrete subsurface soil samples were collected from these 120 borings and submitted for laboratory analysis. The composite samples were analyzed for metals and semi-volatile organic compounds (SVOCs), and the discrete samples were analyzed for volatile organic compounds (VOCs) only. Three subsurface composite soil samples (GPBT_03102014_7_4, GPBT_03102014_7_8, and GPBT_03102014_7_12) were collected in the tank dike area of AST 226. The soil sample locations are displayed on Figure 7.

6.10 UST T-355

The additional soil characterization activities for UST 355 consisted of the advancement of four soil borings (BH-14-32, BH-14-33, BH-14-34 and BH-14-35) in June of 2014 in the tank area and the collection of surface and subsurface soil samples for laboratory analysis. An additional soil boring (BH-16-1) was advanced to delineate a benzo(a)pyrene exceedance in BH-14-33. These borings were installed to horizontally and vertically delineate soils around the tank in support of the closure of UST T-355. The soil sample locations are displayed on Figure 7.

7.0 SOIL SAMPLING RESULTS

All laboratory analytical reports for the supplemental characterization samples are provided in Appendix D. The soil sample results were screened against the corresponding PADEP non-residential soil to groundwater MSCs, direct contact MSCs, and the SSS for lead in Table 2 and Table 3. Only the direct contact MSC and SSS for lead exceedances are illustrated in Figure 7.

The supplemental sample results are summarized in the following sections.

7.1 AST GP-1208

The soil characterization sample results for AST GP-1208 included surface soil samples BH-13-36, BH-14-26, BH-14-27, and BH-14-29 and subsurface soil sample BH-14-28.

- Surface soil samples BH-13-36 and BH-14-28 and subsurface soil sample BH-14-28 exhibited exceedances of the PADEP non-residential soil to groundwater MSC for benzene of 0.5 mg/kg.
- Surface soil sample BH-14-29 exhibited an exceedance of the PADEP non-residential soil to groundwater MSC for lead of 450 mg/kg.
- No other exceedances were reported in these soil samples of the PADEP non-residential soil to groundwater MSCs, PADEP soil direct contact MSCs or the SSS for lead.

7.2 AST GP-1209

The soil characterization sample results for AST GP-1209 included surface and/or subsurface soil samples BH-13-34, BH-13-35, BH-13-145, BH-13-146, and BH-13-147.

- Surface and subsurface soil samples BH-13-34 displayed exceedances of the PADEP non-residential soil to groundwater MSCs for benzene of 0.5 mg/kg and for lead of 450 mg/kg.
- Surface soil sample BH-13-35 displayed an exceedance of the PADEP non-residential soil to groundwater MSC for benzene of 0.5 mg/kg.
- Subsurface soil sample BH-13-34 exhibited an exceedance of the PADEP subsurface soil direct contact MSCs for cumene of 10,000 mg/kg at 23,200 mg/kg.
- No other exceedances were reported in the soil samples of the PADEP non-residential soil to groundwater MSCs, PADEP soil direct contact MSCs or the SSS for lead.

7.3 AST GP-1210

The soil characterization sample results for AST GP-1210 included surface soil samples BH-13-31, BH-13-32, BH-13-142, BH-13-143, BH-13-144, BH-13-148, BH-13-149, BH-14-03, BH-14-04, and BH-14-11.

- Soil sample BH-13-32 displayed an exceedance of the PADEP surface soil direct contact MSCs for benzene of 290 mg/kg at 1,070 mg/kg. The soil sample also displayed exceedances of the PADEP non-residential soil to groundwater MSC for cumene of 2,500 mg/kg and the PADEP non-residential soil to groundwater MSC for lead of 450 mg/kg.
- Soil sample BH-13-144 displayed an exceedance of the SSS for lead at 4,060 mg/kg.
- Soil sample BH-14-03 displayed an exceedance of the PADEP surface soil direct contact MSCs for cumene of 10,000 mg/kg at 21,000 mg/kg.
- Soil sample BH-14-04 displayed an exceedance of the PADEP non-residential soil to groundwater MSC for benzene of 0.5 mg/kg.
- No other exceedances were reported in the soil samples of the PADEP non-residential soil to groundwater MSCs, PADEP surface soil direct contact MSCs or the SSS for lead.

7.4 AST GP-1212

The soil characterization sample results for AST GP-1212 included surface soil samples BH-13-29, BH-13-44, BH-13-130 through BH-13-141, and BH-14-13.

- Soil sample BH-13-44 exhibited an exceedance of the PADEP non-residential soil to groundwater MSC for lead of 450 mg/kg.
- Soil sample BH-13-29 displayed an exceedance of the PADEP surface soil direct contact MSCs for cumene of 10,000 mg/kg at 15,500 mg/kg.
- No other exceedances were reported in these soil samples of the PADEP non-residential soil to groundwater MSCs, PADEP surface soil direct contact MSCs or the SSS for lead.

7.5 AST GP-1214

The soil characterization sample results for AST GP-1214 included surface and subsurface soil samples BH-14-28, BH-14-30, and BH-14-31.

- Surface and subsurface soil samples BH-14-28 and BH-14-30 displayed exceedances of the PADEP non-residential soil to groundwater MSC for benzene of 0.5 mg/kg.

- Surface and subsurface soil samples BH-14-31 displayed an exceedance of the PADEP non-residential soil to groundwater MSC for lead of 450 mg/kg.
- No other exceedances were reported in this soil sample of the PADEP non-residential soil to groundwater MSC, PADEP surface soil direct contact MSCs or the SSS for lead.

7.6 AST 207

The soil characterization sample results for AST 207 included surface and subsurface soil samples BH-14-14, BH-14-15, BH-14-17, and BH-14-18.

- Subsurface soil samples BH-14-15 and BH-14-17 exhibited exceedances of the PADEP non-residential soil to groundwater MSC for benzene of 0.5 mg/kg.
- No other exceedances were reported in these soil samples of the PADEP non-residential soil to groundwater MSCs, PADEP soil direct contact MSCs or the SSS for lead.

7.7 AST 223

The soil characterization sample results for AST 223 included surface and subsurface soil samples BH-14-21, BH-14-22, BH-14-24, and BH-14-25.

- Surface soil samples BH-14-24 and BH-14-25 exhibited exceedances of the PADEP non-residential soil to groundwater MSC for lead of 450 mg/kg.
- Subsurface soil sample BH-14-21 exhibited an exceedance of the PADEP non-residential soil to groundwater MSC for lead of 450 mg/kg.
- No other exceedances were reported in these soil samples of the PADEP non-residential soil to groundwater MSCs, PADEP surface soil direct contact MSCs or the SSS for lead.

7.8 AST 225

The soil characterization sample results for AST 225 included surface and subsurface soil samples BH-14-19, BH-14-20, BH-14-36 and BH-14-37. There were no reported exceedances of PADEP non-residential soil to groundwater MSCs, PADEP non-residential soil direct contact MSCs or the SSS for lead within the soil characterization samples.

7.9 AST 226

The soil characterization sample results for AST 226 included surface and subsurface soil samples BH-04-07, GPBT_03102014_7_4, GPBT_03102014_7_8, and GPBT_03102014_7_12. There were no reported exceedances of PADEP non-residential soil to groundwater MSCs, PADEP non-residential soil direct contact MSCs or the SSS for lead within the soil characterization samples.

7.10 UST T-355

The soil characterization sample results for UST T-355 included soil samples BH-14-32, BH-14-33, BH-14-34 and BH-14-35. An additional soil sample, BH-16-1, was collected to delineate the benzo(a)pyrene exceedance at BH-14-33.

- Surface soil sample BH-14-32 exhibited an exceedance of the PADEP non-residential soil to groundwater MSC for benzene of 0.5 mg/kg.
- Surface soil sample BH-14-33 exhibited an exceedance of the PADEP soil direct contact MSC for benzo(a)pyrene of 12 mg/kg but did not exceed the PADEP non-residential soil to groundwater MSC. This soil sample also displayed an exceedance of the PADEP non-residential soil to groundwater MSC for lead of 450 mg/kg.
- There were no reported exceedances of PADEP non-residential soil to groundwater MSCs, PADEP non-residential soil direct contact MSCs or the SSS for lead within the soil characterization samples.
- Surface soil exceedances of the PADEP surface soil direct contact MSC for benzo(a)pyrene have been delineated.

8.0 ATTAINMENT OF REMEDIATION STANDARDS

The attainment of remediation standards will be demonstrated separately for each tank closure or open release incident as outlined in this section. The groundwater and potential vapor intrusion into indoor air pathways relating to each tank closure or open release incident are being addressed in the AOI 5 RIR.

8.1 AST GP-1208

For this tank closure and open release incident, there were exceedances of the SHS driven

by the soil-to-groundwater MSCs. Concentrations exceeding the PADEP non-residential soil to groundwater MSC of 0.5 mg/kg for benzene were detected in 14 soil samples. A concentration exceeding the PADEP non-residential soil to groundwater MSC of 450 mg/kg for lead was detected in one soil sample.

Concentrations of site COCs did not exceed the applicable PADEP non-residential direct contact MSCs or the SSS for lead in soil; therefore, the direct contact exposure pathway for soil is considered incomplete. The selected remediation standard for soil has been attained; therefore, no further characterization or remedial action is required for soil at AST GP-1208.

8.2 AST GP-1209

There were soil exceedances of the PADEP non-residential soil to groundwater MSC for benzene and lead related to this tank closure driven by the soil-to-groundwater MSCs. Concentrations exceeding the PADEP non-residential soil to groundwater MSC of 0.5 mg/kg for benzene were detected in six soil samples. Concentrations exceeding the PADEP non-residential soil to groundwater MSC of 450 mg/kg for lead were detected in six soil samples. Two subsurface soil samples exhibited concentrations exceeding the PADEP non-residential direct contact MSC of 10,000 mg/kg for cumene.

Concentrations of site COCs, except for cumene in subsurface soil, did not exceed the applicable PADEP non-residential direct contact MSCs or the SSS for lead in soil. Due to PES's on-site permit and personal protective equipment (PPE) procedures governing excavations, the direct contact exposure pathway for subsurface soil is considered incomplete. The selected remediation standard for soil has been attained; therefore, no further characterization or remedial action for soil is required at AST GP-1209.

8.3 AST GP-1210

For this tank closure, there were exceedances of the PADEP non-residential soil to groundwater MSCs for benzene, cumene and lead. Concentrations exceeding the PADEP non-residential soil to groundwater MSC of 0.5 mg/kg for benzene were detected in four soil samples. Concentrations exceeding the PADEP non-residential soil to groundwater MSC of 2,500 mg/kg for cumene were detected in one soil sample and concentrations exceeding the PADEP non-residential soil to groundwater MSC of 450 mg/kg for lead were detected in five soil samples.

Three distinct soil samples exhibited concentrations exceeding the PADEP non-residential

direct contact MSC for benzene (290 mg/kg) and cumene (10,000 mg/kg) and the SSS for lead (2,240 mg/kg). Also, two subsurface soil samples exhibited concentrations exceeding the PADEP non-residential direct contact MSC of 330 mg/kg for benzene and one soil sample exhibited a concentration exceeding the PADEP non-residential direct contact MSC of 10,000 mg/kg for cumene.

Based on the soil characterization results, concentrations of benzene, cumene and lead exceeded their applicable PADEP non-residential direct contact MSCs or the SSS for lead in surface soil. Concentrations of COCs above the non-residential direct contact MSCs were also detected in subsurface soil; however, due to PES's on-site permit and PPE procedures governing excavations, the direct contact exposure pathway for subsurface soil is considered incomplete.

Due to the surface soil sample exceedances of the non-residential direct contact MSCs and the SSS for lead, the potential direct contact exposure pathway is complete, and remedial action is required to address the exceedances.

8.4 AST GP-1212

There were exceedances of the PADEP non-residential soil to groundwater MSCs for benzene and lead related to this tank closure driven by the soil-to-groundwater MSCs. Concentrations exceeding the PADEP non-residential soil to groundwater MSC of 0.5 mg/kg for benzene were detected in two soil samples. Also, concentrations exceeding the PADEP non-residential soil to groundwater MSC of 450 mg/kg for lead were detected in five soil samples. Two soil samples exhibited concentrations exceeding the PADEP non-residential direct contact MSC of 10,000 mg/kg for cumene.

Concentrations of site COCs, except for cumene, did not exceed the applicable PADEP non-residential direct contact MSCs or the SSS for lead in soil. Cumene exceeded its non-residential direct contact MSC in surface and subsurface soil. Due to PES's on-site permit and PPE procedures governing excavations, the direct contact exposure pathway for subsurface soil is considered incomplete; however the potential direct contact exposure pathway is complete, and remedial action is required to address the exceedance.

8.5 AST GP-1214

For this open release incident, there were exceedances detected of the PADEP non-

residential soil to groundwater MSC of 0.5 mg/kg for benzene in two soil samples. Concentrations exceeding the PADEP non-residential soil to groundwater MSC of 450 mg/kg for lead were detected in two soil samples. No soil sample concentrations exceeded the applicable PADEP non-residential direct contact MSCs or the SSS for lead in soil.

Concentrations of site COCs did not exceed the applicable PADEP non-residential direct contact MSCs or the SSS for lead in soil; therefore, the direct contact exposure pathway for soil is considered incomplete. The selected remediation standard for soil has been attained; therefore, the remedial action for soils at AST GP-1214 is complete.

8.6 AST 207

For this tank removal and open release incident, there were exceedances detected of the PADEP non-residential soil to groundwater MSC of 0.5 mg/kg for benzene in two soil samples. No soil sample concentrations exceeded the applicable PADEP non-residential direct contact MSCs or the SSS for lead in soil.

Concentrations of site COCs did not exceed the applicable PADEP non-residential direct contact MSCs or the SSS for lead in soil; therefore, the direct contact exposure pathway is considered incomplete. The selected remediation standard for soil has been attained; therefore, the remedial action for soils at AST 207 is complete.

8.7 AST 223

There were exceedances detected of the PADEP non-residential soil to groundwater MSC of 450 mg/kg for lead in three soil samples related to this tank removal and open release incident. No soil sample concentrations exceeded the applicable PADEP non-residential direct contact MSCs or the SSS for lead in soil.

Concentrations of site COCs did not exceed the applicable PADEP non-residential direct contact MSCs or the SSS for lead in soil; therefore, the direct contact exposure pathway for soil is considered incomplete. The selected remediation standard for soil has been attained; therefore, the remedial action for soils at AST 223 is complete.

8.8 AST 225

For this open release incident, there were no exceedances detected of the PADEP non-residential soil to groundwater MSCs. No soil sample concentrations exceeded the applicable PADEP non-residential direct contact MSCs or the SSS for lead in soil.

No exceedances of PADEP non-residential soil to groundwater MSCs were detected for site COCs so the soil-to-groundwater pathway is incomplete. Concentrations of site COCs did not exceed the applicable PADEP non-residential direct contact MSCs or the SSS for lead in soil; therefore, the direct contact exposure pathway for soil is considered incomplete. The selected remediation standard for soil has been attained; therefore, the remedial action for soils at AST 225 is complete.

8.9 AST 226

For this tank removal and open release incident, there were no exceedances detected of the PADEP non-residential soil to groundwater MSCs. Although the soil samples were not analyzed for all site COCs, concentrations of the analyzed constituents did not exceed the applicable PADEP non-residential soil to groundwater MSCs, PADEP non-residential direct contact MSCs or the SSS for lead in soil. As part of the Butane Rail Line Development, the surface soil to a depth of two feet below grade in the tank dike area of AST 226 was sampled and removed in accordance with the Onsite Soil Reuse Plan approved by the PADEP on July 5, 2013.

No exceedances of PADEP non-residential soil to groundwater MSCs were detected for site COCs so the soil-to-groundwater pathway is incomplete. Concentrations of site COCs did not exceed the applicable PADEP non-residential direct contact MSCs or the SSS for lead in soil; therefore, the direct contact exposure pathway for soil is considered incomplete. The selected remediation standard for soil has been attained; therefore, the remedial action for soils at AST 226 is complete.

8.10 UST T-355

There were exceedances of the SHSs for benzene and lead related to this tank closure driven by the soil-to-groundwater MSCs. A concentration exceeding the PADEP non-residential soil to groundwater MSCs of 0.5 mg/kg for benzene and 450 mg/kg for lead were detected in two distinct soil samples. One soil sample exhibited a concentration exceeding the PADEP non-residential direct contact MSC of 12 mg/kg for benzo(a)pyrene. This exceedance of benzo(a)pyrene has been delineated.

Concentrations of site COCs, except for benzo(a)pyrene, did not exceed the applicable PADEP non-residential direct contact MSCs or the SSS for lead in soil. The direct contact

exposure pathway for COC exceedances of PADEP non-residential direct contact MSCs is considered complete. The selected remediation standard for soil has not been attained; however, the surface soil exceedance has been delineated but remedial action for soils at UST T-355 is not complete.

9.0 LNAPL CHARACTERIZATION

Previous site characterization activities and reports have included light non-aqueous phase liquid (LNAPL) investigations and results that have allowed for the identification of separate LNAPL plumes within the subsurface of AOI 5. The results have assisted with the calculations of LNAPL specific volume and mobility. More detailed information for the LNAPL investigations, results, and conclusions have been presented in the 2017 AOI 5 RIR, the 2011 AOI 5 SCR/RIR/Cleanup Plan (CUP), and the 2007 AOI 5 SCR. Below is a summary of major conclusions regarding the results of the LNAPL characterization and modeling from the previous reports:

- There are two different types or mixtures of LNAPL identified in AOI 5; these consist primarily of middle distillate and heavy distillate; LNAPL that has not been analyzed for type is identified as "Unknown."
- Based on API modeling results and historic distribution, LNAPL in AOI 5 is contained within the boundary of the Complex and does not appear to have to the potential to migrate off-site due to its low mobility.

LNAPL characterization activities/findings from previous investigations/characterization efforts and current soil characterization activities do not show a correlation between ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226 and UST T-355 and the occurrence of LNAPL. No LNAPL was identified during installation of any AST/UST characterization borings.

10.0 GROUNDWATER INVESTIGATION

The groundwater monitoring well network in AOI 5 includes 96 monitoring wells, eight temporary well points, two piezometers, and three inactive recovery wells. Groundwater gauging of select monitoring wells in AOI 5 occurs on an annual basis. Annual gauging

activities and results are reported to the PADEP and EPA in semiannual Groundwater Remediation Status Reports. Refer to the AOI 5 RIR for more detail regarding AOI 5 groundwater monitoring wells, gauging, aquifer testing, groundwater sampling and groundwater analytical results.

The groundwater conditions, as measured during both the July and October 2014 events, are illustrated in Figure 5 and Figure 6. Refer to the AOI 5 RIR for groundwater conditions in the vicinity of ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226 and UST T-355.

11.0 FATE AND TRANSPORT ANALYSIS

The results of previous characterization work completed in response to soil and groundwater site COC exceedances were used in the qualitative fate and transport analysis for the AOI 5 RIR. Please refer to the AOI 5 RIR for information about the qualitative fate and transport analysis.

12.0 EXPOSURE ASSESSMENT

12.1 Human Health

A human health risk assessment has been completed for lead in site soils, as summarized in the AOI 5 RIR. Remedial measures to be taken for soil results that exceed the SSS for lead, or the non-residential direct contact MSC for the other COCs, will be addressed in the Complex-wide Cleanup Plan. Groundwater results that exceed the PADEP non-residential MSC at the point of compliance will also be addressed in the Complex-wide Cleanup Plan.

12.2 Ecological

The majority of AOI 5 is covered with impervious surfaces. Some areas are covered by soil and gravel; however, they are not likely to serve as a breeding area, migratory stopover, or primary habitat for wildlife. In July 2013, a request was submitted to the Pennsylvania Natural Diversity Inventory (PNDI) database to identify potential endangered, threatened and special concern wildlife near the project area. The PNDI search from July 2013 identified one potential impact to the Eastern Red-bellied Turtle under the jurisdiction of PA Fish & Boat Commission (PAFBC). Coordination with PAFBC resulted in a "no impact"

determination as long as no wetlands, open water areas, streams or ponds are to be disturbed. Within AOI 5, wetlands, open water areas, streams or ponds do not exist and therefore the project will not result in impacts to the Eastern Red-bellied Turtle. PAFBC's July 2013 response was valid for two years and was extended in April 2015, making it valid through April 2017. The agency notification and response letters are included in Appendix E.

A new PNDI search was conducted on May 7, 2015 in response to a public notice issued by U.S. Army Corps of Engineers on May 4, 2015, which requires updates to all PNDI receipts dated prior to May 4, 2015 due to listing of the northern long-eared bat as a threatened species under the Endangered Species Act. The May 7, 2015 PNDI search did not result in any additional potential impacts to threatened or endangered species. The updated PNDI search is included in Appendix E.

No surface water features are located in AOI 5. The nearest surface water body to AOI 5 is the Schuylkill River, which borders the western boundary. A sheet pile wall is present between AOI 5 and the Schuylkill River as illustrated in Figure 2. Groundwater interaction with surface water/sediment is limited by the sheet pile wall.

13.0 POST REMEDIAL MEASURES

Due to the exceedances of the non-residential direct contact soil and/or the SSS for lead in surface soil at AST GP-1210 and UST T-355, additional remedial measures are required to obtain attainment of the selected soil remediation standard associated with these tanks. These remedial measures will be presented in the Complex-wide Cleanup Plan. No additional remedial measures are required to maintain attainment of the selected soil remediation standards associated with ASTs GP-1208, GP-1209, GP-1212, GP-1214, 207, 223, 225, and 226 areas.

Additional remedial groundwater measures are required to maintain attainment of the selected soil to groundwater remediation standards associated with ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, and UST T-355 areas. The groundwater pathway is addressed in the RIR and groundwater use restrictions currently exist the in the area of the Complex and within the City of Philadelphia.

Currently, the vapor intrusion pathway is incomplete because of the lack of receptors (occupied buildings) in the ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, and UST T-355 areas. A vapor intrusion assessment will be conducted in a future submittal. If necessary, an institutional/engineering control will be established for any future occupied buildings planned in these tank areas in order to assure that this pathway remains incomplete.

14.0 CONCLUSIONS

Groundwater attainment and LNAPL will be addressed by Evergreen through Act 2 and the One Cleanup Program with site-specific standards and pathway elimination. The conclusions for each tank closure and/or open release incident pursuant to the requirements of the Corrective Action Program are outlined below. Summary tables regarding attainment conclusions are presented at the end of this section.

14.1 AST GP-1208

Attainment of the PADEP soil to groundwater MSCs has not been demonstrated for all COCs; however, attainment of the PADEP non-residential direct contact MSCs and the SSS for lead in soil have been demonstrated and the direct contact exposure pathway is incomplete.

Based on the soil results of characterization work completed in the vicinity of AST GP-1208, no further characterization or remedial activities are required for soil at AST GP-1208.

14.2 AST GP-1209

Attainment of the PADEP soil to groundwater MSCs has not been demonstrated for all COCs. Attainment of the PADEP non-residential surface soil direct contact MSCs and the SSS for lead in soil have been demonstrated. There was one exceedance of the PADEP non-residential subsurface soil direct contact MSCs. However, due to PES's on-site permit and personal PPE procedures governing excavations, the direct contact exposure pathway for subsurface soil is considered incomplete.

Therefore, the selected remediation standards for soil have been attained and no further characterization or remedial action for soil is required at AST GP-1209.

14.3 AST GP-1210

Based on the soil results of characterization work completed, the site characterization activities for AST GP-1210 are complete. Attainment of the PADEP soil to groundwater MSCs for AST GP-1210 has not been demonstrated for all COCs. Attainment of the PADEP non-residential direct contact MSCs and the SSS for lead in soil has not been demonstrated, with the exception of subsurface soil. However, the direct contact exposure pathway to subsurface soil is incomplete due to PES's on-site permit and PPE procedures.

The soil remedies will be addressed as part of the Act 2 Complex-wide Cleanup Plan and not under the Storage Tank Corrective Action Program.

14.4 AST GP-1212

Based on the soil results of characterization work completed, the site characterization activities for AST GP-1212 are complete. Attainment of the PADEP soil to groundwater MSCs has not been demonstrated for all COCs. Attainment of the PADEP non-residential direct contact MSCs and the SSS for lead have been demonstrated; except for exceedances of cumene in surface and subsurface soil samples.

Due to PES's on-site permit and PPE procedures governing excavations, the direct contact exposure pathway for subsurface soil is considered incomplete; however, the potential direct contact exposure pathway to surface soil is complete, and remedial action is required to address the cumene exceedance. The soil remedies will be addressed as part of the Act 2 Complex-wide Cleanup Plan and not under the Storage Tank Corrective Action Program.

14.5 AST GP-1214

Attainment of the PADEP soil to groundwater MSCs has not been demonstrated for all COCs for the open release incident at AST GP-1214. Attainment of the PADEP non-residential direct contact MSCs and the SSS for lead in soil have been demonstrated and the direct contact exposure pathway is incomplete.

Based on the soil results of previous and recent characterization work completed, the site characterization activities for AST GP-1214 are complete.

14.6 AST 207

Attainment of the PADEP soil to groundwater MSCs has not been demonstrated for all COCs for the open release incident at AST 207. Attainment of the PADEP non-residential

direct contact MSCs and the SSS for lead in soil have been demonstrated and the direct contact exposure pathway is incomplete.

Based on the soil results of previous and recent characterization work completed, the site characterization activities for AST 207 are complete.

14.7 AST 223

Attainment of the PADEP soil to groundwater MSCs, for the open release incident at AST 223, has not been demonstrated for all COCs. Attainment of the PADEP non-residential direct contact MSCs and the SSS for lead in soil have been demonstrated and the direct contact exposure pathway is incomplete.

Based on the soil results of previous and recent characterization work completed in the area of AST 223, the site characterization activities are complete.

14.8 AST 225

Attainment of the PADEP soil to groundwater MSCs, for the open release incident at AST 225, has been demonstrated for all COCs. Attainment of the PADEP non-residential direct contact MSCs and the SSS for lead in soil have been demonstrated and the direct contact exposure pathway is incomplete.

Based on the soil results of previous and recent characterization work completed in the area of AST 225, the site characterization activities are complete. Therefore, no further corrective action is required and Evergreen requests the open release incidents corresponding to AST 225 be "administratively closed."

14.9 AST 226

Attainment of the PADEP soil to groundwater MSCs has been demonstrated for all COCs for the open release incident at AST 226. Attainment of the PADEP non-residential direct contact MSCs and the SSS for lead in soil have been demonstrated and the direct contact exposure pathway is incomplete.

Based on the soil results of previous and recent characterization work completed in the area of AST 226, the site characterization activities are complete. Therefore, no further corrective action is required and Evergreen requests the open release incidents corresponding to AST 226 be "administratively closed."

14.10 UST T-355

Attainment of the PADEP soil to groundwater MSCs for UST T-355 has not been demonstrated for all COCs. Attainment of the PADEP non-residential direct contact MSCs and the SSS for lead in soil has not been demonstrated; except the direct contact exposure pathway is incomplete due to PES's on-site permit and PPE procedures.

Based on the soil results of previous and recent characterization work completed, the site characterization activities for UST T-355 are complete. However, due to exceedances of PADEP non-residential direct contact MSCs in surface soil, the remedial action for soils at UST T-355 is incomplete. The soil remedies will be addressed as part of the Act 2 Complex-wide Cleanup Plan and not under the Corrective Action Program.

14.11 VAPOR INTRUSION

The potential vapor intrusion into indoor air pathway is incomplete because of the lack of occupied buildings in the former and active tank dike areas for ASTs GP-1208, GP-1209, GP-1212, GP-1214, 207, 223, and UST T-355.

14.12 SUMMARY

Summary tables regarding attainment conclusions are presented below. The tables include a tank listing for attainment and a listing for soil attainment for site COCs.

Closed in Place or PADEP Release Incident ID	Sunoco/PES Tank Number or Release Location	Attainment of SHS Soil-To-Groundwater	Attainment of Direct Contact MSCs and SSS for Lead	Site Characterization for Soil
CIP and 38131	GP-1208	No	Yes	Complete
CIP	GP-1209	No	Yes	Complete
CIP	GP-1210	No	No	Complete
CIP	GP-1212	No	No	Complete
45696	GP-1214	No	Yes	Complete
Removed and 45690	207	No	Yes	Complete
Removed and 45695	223	No	Yes	Complete
29484	225	Yes	Yes	Complete
Removed and 45688	226	Yes	Yes	Complete
CIP	T-355	No	No	Complete

Statewide Health Standard for Soil (nonresidential)	Site Specific Standard for Soil (nonresidential)
Toluene	Benzene
Ethylbenzene	Cumene
Xylenes	Benzo(a)pyrene
Cumene	Lead
1,2,4-Trimethylbenzene	
1,3,5-Trimethylbenzene	
Methyl-Tert-Butyl-Ether	
1,2-Dibromoethane	
1,2-Dichloroethane	
Anthracene	
Benzo(a)anthracene	
Benzo(a)pyrene	
Benzo(b)fluoranthene	
Benzo(g,h,i)perylene	
Chrysene	
Fluorene	
Naphthalene	
Phenanthrene	
Pyrene	
Lead	

15.0 REFERENCES

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TABLES

Table 1
Constituents of Concern
AOI 5 Site Characterization Report/Remedial Action Completion Report
Philadelphia Energy Solutions Refining Complex
Philadelphia, Pennsylvania

METALS	CAS No.
Lead (Total)	7439-92-1

VOCs	CAS No.
1,2-Dichloroethane	107-06-2
1,2,4-Trimethylbenzene	95-63-6
1,3,5-Trimethylbenzene	108-67-8
Benzene	71-43-2
Cumene	98-82-8
Ethylbenzene	100-41-4
Ethylene Dibromide (EDB)	106-93-4
Methyl Tertiary Butyl Ether	1634-04-4
Toluene	108-88-3
Xylene (Total)	1330-20-7

SVOCs/ PAHs	CAS No.
Anthracene	120-12-7
Benzo(a)anthracene	56-55-3
Benzo(a)pyrene	50-32-8
Benzo(b)fluoranthene	205-99-2
Benzo(g,h,i)perylene	191-24-2
Chrysene	218-01-9
Fluorene	86-73-7
Naphthalene	91-20-3
Phenanthrene	85-01-8
Pyrene	129-00-0

Notes:

1. Constituents are from Pennsylvania Corrective Action Process (CAP) Regulation Amendments effective December 1, 2001; provided in Chapter VI, Section E (pgs. 29-30) of PADEP Document, Closure Requirements for Underground Storage Tank Systems, effective April 1, 1998 and the March 18, 2008 revised PADEP Petroleum Short List. In May 2009, two additional COCs, 1,2,4-trimethylbenze (1,2,4-TMB) and 1,3,5-trimethylbenzene (1,3,5-TMB), were added to the list of COCs by Evergreen based on the PADEP's revisions to the petroleum short list of compounds and at the request of the PADEP. The COC listing for groundwater was also revised in 2012 to follow the soil COC listing.

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	A-140				A-141				AOI5_BH-13-127				AOI5_BH-13-128			
				Sample ID	A-140				A-141				AOI-5_BH-13-127-0-1_103013				AOI-5_BH-13-128-0-1_103013			
				Sample Date	4/6/09				4/6/09				10/30/13				10/30/13			
				Sample Interval	0.5 - 2				0.5 - 2				0 - 1				0 - 1			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	316		1.14	10	**660**		2.4	20	62.9		0.88	1	115		0.9	1
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	NA				NA				ND	U	0.0066	1	ND	U	0.0059	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	0.24	42.81	ND	U	0.28	46.82	ND	U	0.0028	1	ND	U	0.0027	1
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	0.24	42.81	ND	U	0.28	46.82	ND	U	0.0013	1	ND	U	0.0012	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	NA				NA				ND	U	0.0066	1	ND	U	0.0059	1
Benzene	71-43-2	290	0.5	mg/kg	ND	U	0.24	42.81	ND	U	0.28	46.82	ND	U	0.0013	1	ND	U	0.0012	1
Ethylbenzene	100-41-4	890	70	mg/kg	ND	U	0.24	42.81	ND	U	0.28	46.82	ND	U	0.0013	1	ND	U	0.0012	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	ND	U	0.24	42.81	ND	U	0.28	46.82	ND	U	0.0066	1	ND	U	0.0059	1
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	0.24	42.81	ND	U	0.28	46.82	ND	U	0.0013	1	ND	U	0.0012	1
Toluene	108-88-3	10,000	100	mg/kg	ND	U	0.24	42.81	ND	U	0.28	46.82	ND	U	0.0013	1	ND	U	0.0012	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	ND	U	0.24	42.81	ND	U	0.28	46.82	ND	U	0.0013	1	ND	U	0.0012	1
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	0.87		0.19	1	0.38		0.2	1	0.0566		0.033	1	0.178		0.072	2
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	2.3		0.19	1	1		0.2	1	0.159		0.033	1	0.489		0.072	2
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	1.9		0.19	1	0.95		0.2	1	0.169		0.033	1	0.453		0.072	2
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	2.6		0.19	1	1.2		0.2	1	0.214		0.033	1	0.656		0.072	2
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	1.1		0.19	1	0.66		0.2	1	0.122		0.033	1	0.328		0.072	2
Chrysene	218-01-9	760	230	mg/kg	2.2		0.19	1	1.1		0.2	1	0.2		0.033	1	0.575		0.072	2
Fluorene	86-73-7	130,000	3,800	mg/kg	0.42		0.19	1	ND	U	0.2	1	ND	U	0.033	1	0.0609	J	0.072	2
Naphthalene**	91-20-3	760	25	mg/kg	ND	U	0.19	1	ND	U	0.2	1	ND	U	0.033	1	ND	U	0.072	2
Phenanthrene	85-01-8	190,000	10,000	mg/kg	3.8		0.19	1	1.5		0.2	1	0.158		0.033	1	0.672		0.072	2
Pyrene	129-00-0	96,000	2,200	mg/kg	3.9		0.19	1	1.8		0.2	1	0.294		0.033	1	0.791		0.072	2

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	AOI5_BH-13-129				AOI5_BH-13-130				AOI5_BH-13-131				AOI5_BH-13-132			
				Sample ID	AOI-5_BH-13-129-0-1_103013				AOI-5_BH-13-130_0-1_103013				AOI-5_BH-13-131_0-1_103013				AOI-5_BH-13-132_0-1_103013			
				Sample Date	10/30/13				10/30/13				10/30/13				10/30/13			
				Sample Interval	0 - 1				0 - 1				0 - 1				0 - 1			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	171		0.88	1	52.8		0.89	1	48.5		0.87	1	47.6		0.86	1
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	ND	U	0.0054	1	ND	U	0.0076	1	ND	U	0.0075	1	ND	U	0.0061	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	0.0026	1	ND	U	0.0027	1	ND	U	0.0027	1	ND	U	0.0026	1
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	0.0011	1	ND	U	0.0015	1	ND	U	0.0015	1	ND	U	0.0012	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.0054	1	ND	U	0.0076	1	ND	U	0.0075	1	ND	U	0.0061	1
Benzene	71-43-2	290	0.5	mg/kg	ND	U	0.0011	1	ND	U	0.0015	1	ND	U	0.0015	1	ND	U	0.0012	1
Ethylbenzene	100-41-4	890	70	mg/kg	ND	U	0.0011	1	ND	U	0.0015	1	ND	U	0.0015	1	ND	U	0.0012	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	ND	U	0.0054	1	ND	U	0.0076	1	ND	U	0.0075	1	ND	U	0.0061	1
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	0.0011	1	ND	U	0.0015	1	ND	U	0.0015	1	ND	U	0.0012	1
Toluene	108-88-3	10,000	100	mg/kg	ND	U	0.0011	1	ND	U	0.0015	1	ND	U	0.0015	1	ND	U	0.0012	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	ND	U	0.0011	1	ND	U	0.0015	1	ND	U	0.0015	1	ND	U	0.0012	1
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	0.273		0.035	1	0.0788	J	0.16	5	0.0989		0.066	2	ND	U	0.16	5
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	0.746		0.035	1	0.165		0.16	5	0.355		0.066	2	0.154	J	0.16	5
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	0.7		0.035	1	0.182		0.16	5	0.345		0.066	2	0.176		0.16	5
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	0.875		0.035	1	0.26		0.16	5	0.41		0.066	2	0.239		0.16	5
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.467		0.035	1	0.173		0.16	5	0.208		0.066	2	0.167		0.16	5
Chrysene	218-01-9	760	230	mg/kg	0.822		0.035	1	0.189		0.16	5	0.377		0.066	2	0.178		0.16	5
Fluorene	86-73-7	130,000	3,800	mg/kg	0.0734		0.035	1	ND	U	0.16	5	ND	U	0.066	2	ND	U	0.16	5
Naphthalene**	91-20-3	760	25	mg/kg	0.0414		0.035	1	ND	U	0.16	5	ND	U	0.066	2	ND	U	0.16	5
Phenanthrene	85-01-8	190,000	10,000	mg/kg	1.11		0.035	1	0.108	J	0.16	5	0.191		0.066	2	0.0959	J	0.16	5
Pyrene	129-00-0	96,000	2,200	mg/kg	1.22		0.035	1	0.223		0.16	5	0.409		0.066	2	0.197		0.16	5

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	AOI5_BH-13-133				AOI5_BH-13-134				AOI5_BH-13-135				AOI5_BH-13-136			
				Sample ID	AOI-5_BH-13-133_0-1_103013				AOI-5_BH-13-134_0-1_103013				AOI-5_BH-13-135-0-1_103013				AOI5-BH-13-136_103013_0-1			
				Sample Date	10/30/13				10/30/13				10/30/13				10/30/13			
				Sample Interval	0 - 1				0 - 1				0 - 1				0 - 1			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	74.8		0.84	1	55.2		0.9	1	60.9		0.83	1	53.4		0.9	1
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	ND	U	0.0055	1	ND	U	0.0062	1	ND	U	0.0061	1	ND	U	0.006	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	0.0026	1	ND	U	0.0026	1	ND	U	0.0026	1	ND	U	0.0026	1
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	0.0011	1	ND	U	0.0012	1	ND	U	0.0012	1	ND	U	0.0012	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.0055	1	ND	U	0.0062	1	ND	U	0.0061	1	ND	U	0.006	1
Benzene	71-43-2	290	0.5	mg/kg	ND	U	0.0011	1	ND	U	0.0012	1	ND	U	0.0012	1	ND	U	0.0012	1
Ethylbenzene	100-41-4	890	70	mg/kg	ND	U	0.0011	1	ND	U	0.0012	1	ND	U	0.0012	1	ND	U	0.0012	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	ND	U	0.0055	1	ND	U	0.0062	1	ND	U	0.0061	1	ND	U	0.006	1
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	0.0011	1	ND	U	0.0012	1	ND	U	0.0012	1	ND	U	0.0012	1
Toluene	108-88-3	10,000	100	mg/kg	ND	U	0.0011	1	ND	U	0.0012	1	ND	U	0.0012	1	ND	U	0.0012	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	ND	U	0.0011	1	ND	U	0.0012	1	ND	U	0.0012	1	ND	U	0.0012	1
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	0.0786		0.034	1	0.15		0.068	2	0.0862		0.034	1	0.0696	J	0.16	1
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	0.176		0.034	1	0.301		0.068	2	0.198		0.034	1	0.206		0.16	1
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	0.22		0.034	1	0.313		0.068	2	0.266		0.034	1	0.303		0.16	1
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	0.28		0.034	1	0.397		0.068	2	0.333		0.034	1	0.28		0.16	1
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.189		0.034	1	0.221		0.068	2	0.222		0.034	1	0.259		0.16	1
Chrysene	218-01-9	760	230	mg/kg	0.241		0.034	1	0.363		0.068	2	0.262		0.034	1	0.25		0.16	1
Fluorene	86-73-7	130,000	3,800	mg/kg	ND	U	0.034	1	ND	U	0.068	2	ND	U	0.034	1	ND	U	0.16	1
Naphthalene**	91-20-3	760	25	mg/kg	ND	U	0.034	1	0.0642	J	0.068	2	ND	U	0.034	1	ND	U	0.16	1
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.129		0.034	1	0.508		0.068	2	0.242		0.034	1	0.101	J	0.16	1
Pyrene	129-00-0	96,000	2,200	mg/kg	0.273		0.034	1	0.49		0.068	2	0.343		0.034	1	0.401		0.16	1

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	AOI5_BH-13-137				AOI5_BH-13-138				AOI5_BH-13-139				AOI5_BH-13-140			
				Sample ID	AOI5-BH-13-137_103013_0-1				AOI5-BH-13-138_103013_0-1				AOI5-BH-13-139_103013_0-1				AOI5-BH-13-140_103013_0-1			
				Sample Date	10/30/13				10/30/13				10/30/13				10/30/13			
				Sample Interval	0 - 1				0 - 1				0 - 1				0 - 1			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	39.1		0.91	1	35.1		0.97	1	69.2		0.86	1	57.2		0.92	1
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	ND	U	0.0057	1	ND	U	0.0071	1	ND	U	0.0061	1	ND	U	0.0067	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	0.0027	1	ND	U	0.0029	1	ND	U	0.0027	1	ND	U	0.0027	1
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	0.0011	1	ND	U	0.0014	1	ND	U	0.0012	1	ND	U	0.0013	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.0057	1	ND	U	0.0071	1	ND	U	0.0061	1	ND	U	0.0067	1
Benzene	71-43-2	290	0.5	mg/kg	ND	U	0.0011	1	ND	U	0.0014	1	ND	U	0.0012	1	ND	U	0.0013	1
Ethylbenzene	100-41-4	890	70	mg/kg	ND	U	0.0011	1	ND	U	0.0014	1	ND	U	0.0012	1	ND	U	0.0013	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	ND	U	0.0057	1	ND	U	0.0071	1	ND	U	0.0061	1	ND	U	0.0067	1
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	0.0011	1	ND	U	0.0014	1	ND	U	0.0012	1	ND	U	0.0013	1
Toluene	108-88-3	10,000	100	mg/kg	ND	U	0.0011	1	ND	U	0.0014	1	ND	U	0.0012	1	ND	U	0.0013	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	ND	U	0.0011	1	ND	U	0.0014	1	ND	U	0.0012	1	ND	U	0.0013	1
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	0.113	J	0.16	1	0.0873	J	0.19	1	0.214		0.16	1	ND	U	0.17	1
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	0.271		0.16	1	0.206		0.19	1	0.455		0.16	1	0.205		0.17	1
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	0.29		0.16	1	0.22		0.19	1	0.462		0.16	1	0.25		0.17	1
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	0.456		0.16	1	0.341		0.19	1	0.523		0.16	1	0.296		0.17	1
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.314		0.16	1	0.301		0.19	1	0.397		0.16	1	0.212		0.17	1
Chrysene	218-01-9	760	230	mg/kg	0.278		0.16	1	0.243		0.19	1	0.476		0.16	1	0.25		0.17	1
Fluorene	86-73-7	130,000	3,800	mg/kg	ND	U	0.16	1	ND	U	0.19	1	0.145	J	0.16	1	ND	U	0.17	1
Naphthalene**	91-20-3	760	25	mg/kg	ND	U	0.16	1	ND	U	0.19	1	ND	U	0.16	1	ND	U	0.17	1
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.244		0.16	1	0.106	J	0.19	1	0.623		0.16	1	0.105	J	0.17	1
Pyrene	129-00-0	96,000	2,200	mg/kg	0.516		0.16	1	0.403		0.19	1	0.874		0.16	1	0.295		0.17	1

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	AOI5_BH-13-141				AOI5_BH-13-142				AOI5_BH-13-143				AOI5_BH-13-144			
				Sample ID	AOI5-BH-13-141_103013_0-1				AOI5-BH-13-142_103013_0-1				AOI5-BH-13-143_103013_0-1				AOI5-BH-13-144_103013_0-1			
				Sample Date	10/30/13				10/30/13				10/30/13				10/30/13			
				Sample Interval	0 - 1				0 - 1				0 - 1				0 - 1			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	76.8		0.9	1	37.9		0.93	1	40.1		0.88	1	**4060**		8.9	10
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	ND	U	0.0061	1	ND	U	0.0074	1	ND	U	0.006	1	ND	U	0.0056	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	0.0026	1	ND	U	0.0028	1	ND	U	0.0027	1	ND	U	0.0027	1
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	0.0012	1	ND	U	0.0015	1	ND	U	0.0012	1	ND	U	0.0011	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.0061	1	ND	U	0.0074	1	ND	U	0.006	1	ND	U	0.0056	1
Benzene	71-43-2	290	0.5	mg/kg	ND	U	0.0012	1	ND	U	0.0015	1	ND	U	0.0012	1	ND	U	0.0011	1
Ethylbenzene	100-41-4	890	70	mg/kg	ND	U	0.0012	1	ND	U	0.0015	1	ND	U	0.0012	1	ND	U	0.0011	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	ND	U	0.0061	1	ND	U	0.0074	1	ND	U	0.006	1	ND	U	0.0056	1
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	0.0012	1	ND	U	0.0015	1	ND	U	0.0012	1	ND	U	0.0011	1
Toluene	108-88-3	10,000	100	mg/kg	ND	U	0.0012	1	ND	U	0.0015	1	ND	U	0.0012	1	ND	U	0.0011	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	ND	U	0.0012	1	ND	U	0.0015	1	ND	U	0.0012	1	ND	U	0.0011	1
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	0.121	J	0.17	1	0.0841	J	0.18	1	0.109	J	0.17	1	0.071		0.035	1
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	0.227		0.17	1	0.271		0.18	1	0.269		0.17	1	0.209		0.035	1
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	0.302		0.17	1	0.414		0.18	1	0.347		0.17	1	0.256		0.035	1
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	0.381		0.17	1	0.348		0.18	1	0.439		0.17	1	0.324		0.035	1
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.257		0.17	1	0.337		0.18	1	0.269		0.17	1	0.293		0.035	1
Chrysene	218-01-9	760	230	mg/kg	0.263		0.17	1	0.264		0.18	1	0.31		0.17	1	0.252		0.035	1
Fluorene	86-73-7	130,000	3,800	mg/kg	0.111	J	0.17	1	ND	U	0.18	1	ND	U	0.17	1	ND	U	0.035	1
Naphthalene**	91-20-3	760	25	mg/kg	ND	U	0.17	1	0.0822	J	0.18	1	ND	U	0.17	1	0.0481		0.035	1
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.127	J	0.17	1	0.161	J	0.18	1	0.342		0.17	1	0.185		0.035	1
Pyrene	129-00-0	96,000	2,200	mg/kg	0.393		0.17	1	0.44		0.18	1	0.532		0.17	1	0.425		0.035	1

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	AOI5_BH-13-145				AOI5_BH-13-146				AOI5_BH-13-147				AOI5_BH-13-148			
				Sample ID	AOI5-BH-13-145_103013_0-1				AOI5-BH-13-146_103013_0-1				AOI5-BH-13-147_103013_0-1				AOI5-BH-13-148_103013_0-1			
				Sample Date	10/30/13				10/30/13				10/30/13				10/30/13			
				Sample Interval	0 - 1				0 - 1				0 - 1				0 - 1			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	80.4		0.92	1	49.4		0.84	1	43.5		0.89	1	44.9		0.89	1
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	ND	U	0.0059	1	ND	U	0.0074	1	ND	U	0.0057	1	ND	U	0.0061	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	0.0027	1	ND	U	0.0026	1	ND	U	0.0027	1	ND	U	0.0027	1
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	0.0012	1	ND	U	0.0015	1	ND	U	0.0011	1	ND	U	0.0012	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.0059	1	ND	U	0.0074	1	ND	U	0.0057	1	ND	U	0.0061	1
Benzene	71-43-2	290	0.5	mg/kg	ND	U	0.0012	1	ND	U	0.0015	1	ND	U	0.0011	1	ND	U	0.0012	1
Ethylbenzene	100-41-4	890	70	mg/kg	ND	U	0.0012	1	ND	U	0.0015	1	ND	U	0.0011	1	ND	U	0.0012	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	ND	U	0.0059	1	ND	U	0.0074	1	ND	U	0.0057	1	ND	U	0.0061	1
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	0.0012	1	ND	U	0.0015	1	ND	U	0.0011	1	ND	U	0.0012	1
Toluene	108-88-3	10,000	100	mg/kg	ND	U	0.0012	1	ND	U	0.0015	1	ND	U	0.0011	1	ND	U	0.0012	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	ND	U	0.0012	1	ND	U	0.0015	1	ND	U	0.0011	1	ND	U	0.0012	1
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	0.133	J	0.18	1	0.256		0.17	1	0.112	J	0.17	1	0.0753	J	0.17	1
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	0.317		0.18	1	0.585		0.17	1	0.25		0.17	1	0.203		0.17	1
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	0.402		0.18	1	0.725		0.17	1	0.323		0.17	1	0.288		0.17	1
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	0.509		0.18	1	0.765		0.17	1	0.376		0.17	1	0.313		0.17	1
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.405		0.18	1	0.607		0.17	1	0.232		0.17	1	0.233		0.17	1
Chrysene	218-01-9	760	230	mg/kg	0.417		0.18	1	0.719		0.17	1	0.302		0.17	1	0.231		0.17	1
Fluorene	86-73-7	130,000	3,800	mg/kg	ND	U	0.18	1	ND	U	0.17	1	ND	U	0.17	1	ND	U	0.17	1
Naphthalene**	91-20-3	760	25	mg/kg	ND	U	0.18	1	ND	U	0.17	1	ND	U	0.17	1	ND	U	0.17	1
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.296		0.18	1	0.539		0.17	1	0.151	J	0.17	1	0.137	J	0.17	1
Pyrene	129-00-0	96,000	2,200	mg/kg	0.642		0.18	1	1.29		0.17	1	0.444		0.17	1	0.372		0.17	1

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	AOI5_BH-13-149				AOI5_BH-13-149				AOI5_BH-13-26				AOI5_BH-13-28			
				Sample ID	AOI5-BH-13-149_103013_0-1				AOI5-BH-13-DUP-103013_0-1				AOI5_BH-13-26_1.5-2_030813				AOI5_BH-13-28_1.5-2_30713			
				Sample Date	10/30/13				10/30/13				3/8/13				3/7/13			
				Sample Interval	0 - 1				0 - 1				1.5 - 2				1.5 - 2			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	42.5		0.88	1	39.4		0.9	1	**1190**		2.7	1	**1590**		2	1
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	ND	U	0.0063	1	ND	U	0.0056	1	ND	U	0.0048	1	ND	U	0.006	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	0.0027	1	ND	U	0.0027	1	ND	U	0.00097	1	ND	U	0.0012	1
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	0.0013	1	ND	U	0.0011	1	ND	U	0.00097	1	ND	U	0.0012	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.0063	1	ND	U	0.0056	1	ND	U	0.0048	1	ND	U	0.006	1
Benzene	71-43-2	290	0.5	mg/kg	ND	U	0.0013	1	ND	U	0.0011	1	ND	U	0.00097	1	0.0012		0.0012	1
Ethylbenzene	100-41-4	890	70	mg/kg	ND	U	0.0013	1	ND	U	0.0011	1	ND	U	0.00097	1	ND	U	0.0012	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	ND	U	0.0063	1	ND	U	0.0056	1	ND	U	0.0048	1	ND	U	0.006	1
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	0.0013	1	ND	U	0.0011	1	ND	U	0.00097	1	ND	U	0.0012	1
Toluene	108-88-3	10,000	100	mg/kg	ND	U	0.0013	1	ND	U	0.0011	1	ND	U	0.00097	1	ND	U	0.0012	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	ND	U	0.0013	1	ND	U	0.0011	1	ND	U	0.00097	1	ND	U	0.0012	1
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	0.0401		0.034	1	0.041		0.035	1	1.13		0.042	1	12.6	E	0.041	1
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	0.117		0.034	1	0.122		0.035	1	3.2		0.042	1	21.9	E	0.041	1
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	0.144		0.034	1	0.147		0.035	1	3.05		0.042	1	19.4	E	0.041	1
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	0.168		0.034	1	0.169		0.035	1	3.85		0.042	1	26.9	E	0.041	1
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.13		0.034	1	0.151		0.035	1	2.02		0.042	1	12.7	E	0.041	1
Chrysene	218-01-9	760	230	mg/kg	0.147		0.034	1	0.159		0.035	1	3.31		0.042	1	20.6	E	0.041	1
Fluorene	86-73-7	130,000	3,800	mg/kg	ND	U	0.034	1	ND	U	0.035	1	0.48		0.042	1	6.4	E	0.041	1
Naphthalene**	91-20-3	760	25	mg/kg	ND	U	0.034	1	ND	U	0.035	1	0.426		0.042	1	0.96		0.041	1
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.104		0.034	1	0.0864		0.035	1	6.5		0.084	2	53.7	E	0.041	1
Pyrene	129-00-0	96,000	2,200	mg/kg	0.267		0.034	1	0.246		0.035	1	6.5		0.084	2	35.5	E	0.041	1

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	AOI5_BH-13-29				AOI5_BH-13-30				AOI5_BH-13-31				AOI5_BH-13-32			
				Sample ID	AOI5_BH-13-29_1-1.5_30613				AOI5_BH-13-30_1.5-2_30713				AOI5_BH-13-31_1.5-2_30613				AOI5_BH-13-32_1.5-2_30613			
				Sample Date	3/6/13				3/7/13				3/6/13				3/6/13			
				Sample Interval	1 - 1.5				1.5 - 2				1.5 - 2				1.5 - 2			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	195		2	1	446		1.8	1	365		1.9	1	**2020**		6	3
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	ND	U	46	1	0.0107		0.0045	1	ND	U	0.005	1	ND	U	110	2.5
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	***9.3***	1	ND	U	0.0009	1	ND	U	0.001	1	ND	U	***21***	2.5
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	9.3	1	ND	U	0.0009	1	ND	U	0.001	1	ND	U	21	2.5
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	46	1	0.006		0.0045	1	ND	U	0.005	1	ND	U	110	2.5
Benzene	71-43-2	290	0.5	mg/kg	ND	U	9.3	1	ND	U	0.0009	1	0.0161		0.001	1	**1070**		21	2.5
Ethylbenzene	100-41-4	890	70	mg/kg	ND	U	9.3	1	ND	U	0.0009	1	ND	U	0.001	1	ND	U	21	2.5
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	**15500**		460	5	ND	U	0.0045	1	0.0093		0.005	1	**9330**		1100	25
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	9.3	1	ND	U	0.0009	1	ND	U	0.001	1	ND	U	21	2.5
Toluene	108-88-3	10,000	100	mg/kg	ND	U	9.3	1	ND	U	0.0009	1	ND	U	0.001	1	ND	U	21	2.5
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	ND	U	9.3	1	0.0073		0.0009	1	ND	U	0.001	1	ND	U	21	2.5
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	0.199		0.052	1	0.403		0.074	2	0.0522		0.043	1	0.653		0.044	1
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	0.538		0.052	1	0.772		0.074	2	0.137		0.043	1	1.99		0.044	1
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	0.426		0.052	1	0.708		0.074	2	0.127		0.043	1	1.88		0.044	1
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	0.597		0.052	1	0.563		0.074	2	0.16		0.043	1	2.45		0.044	1
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.293		0.052	1	0.622		0.074	2	0.129		0.043	1	1.29		0.044	1
Chrysene	218-01-9	760	230	mg/kg	0.548		0.052	1	0.776		0.074	2	0.159		0.043	1	2.13		0.044	1
Fluorene	86-73-7	130,000	3,800	mg/kg	0.168		0.052	1	0.235		0.074	2	ND	U	0.043	1	0.451		0.044	1
Naphthalene**	91-20-3	760	25	mg/kg	ND	U	0.052	1	0.329		0.074	2	ND	U	0.043	1	1.64		0.044	1
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.998		0.052	1	1.39		0.074	2	0.145		0.043	1	3.33		0.044	1
Pyrene	129-00-0	96,000	2,200	mg/kg	0.989		0.052	1	1.21		0.074	2	0.221		0.043	1	3		0.044	1

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	AOI5_BH-13-33				AOI5_BH-13-34				AOI5_BH-13-35				AOI5_BH-13-36			
				Sample ID	AOI5_BH-13-33_1.5-2_30713				AOI5_BH-13-34_1.5-2_30613				AOI5_BH-13-35_1.5-2_30613				AOI5_BH-13-36_1.5-2_30613			
				Sample Date	3/7/13				3/6/13				3/6/13				3/6/13			
				Sample Interval	1.5 - 2				1.5 - 2				1.5 - 2				1.5 - 2			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	**1090**		2	1	**851**		2.1	1	**1500**		2	1	201		2	1
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	ND	U	0.37	1	ND	U	0.68	1	ND	U	0.006	1	ND	U	0.51	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	0.073	1	ND	U	0.14	1	ND	U	0.0012	1	ND	U	0.1	1
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	0.073	1	ND	U	0.14	1	ND	U	0.0012	1	ND	U	0.1	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.37	1	ND	U	0.68	1	ND	U	0.006	1	ND	U	0.51	1
Benzene	71-43-2	290	0.5	mg/kg	ND	U	0.073	1	**13.6**		0.14	1	0.0512		0.0012	1	**2.62**		0.1	1
Ethylbenzene	100-41-4	890	70	mg/kg	ND	U	0.073	1	0.701		0.14	1	ND	U	0.0012	1	ND	U	0.1	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	ND	U	0.37	1	1650		170	2.5	ND	U	0.006	1	881		25	1
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	0.073	1	ND	U	0.14	1	ND	U	0.0012	1	ND	U	0.1	1
Toluene	108-88-3	10,000	100	mg/kg	ND	U	0.073	1	ND	U	0.14	1	ND	U	0.0012	1	ND	U	0.1	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	0.0879		0.073	1	ND	U	0.14	1	ND	U	0.0012	1	ND	U	0.1	1
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	0.281		0.039	1	0.309		0.04	1	0.358		0.039	1	0.161		0.076	2
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	0.858		0.039	1	1.24		0.04	1	0.851		0.039	1	0.468		0.076	2
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	0.876		0.039	1	1.4		0.04	1	0.198		0.039	1	0.438		0.076	2
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	0.993		0.039	1	1.33		0.04	1	0.823		0.039	1	0.484		0.076	2
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.783		0.039	1	0.933		0.04	1	0.287		0.039	1	0.327		0.076	2
Chrysene	218-01-9	760	230	mg/kg	0.925		0.039	1	1.32		0.04	1	1.17		0.039	1	0.526		0.076	2
Fluorene	86-73-7	130,000	3,800	mg/kg	0.526		0.039	1	0.209		0.04	1	0.504		0.039	1	0.0949		0.076	2
Naphthalene**	91-20-3	760	25	mg/kg	0.14		0.039	1	0.186		0.04	1	0.212		0.039	1	ND	U	0.076	2
Phenanthrene	85-01-8	190,000	10,000	mg/kg	1.43		0.039	1	1.37		0.04	1	6.19		0.19	5	0.691		0.076	2
Pyrene	129-00-0	96,000	2,200	mg/kg	1.45		0.039	1	1.53		0.04	1	2.32		0.039	1	0.772		0.076	2

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	AOI5_BH-13-37				AOI5_BH-13-44				AOI5_BH-14-03				AOI5_BH-14-04			
				Sample ID	AOI5_BH-13-37_1.5-2_030513				AOI5_BH-13-44_1.5-2_030813				AOI5_BH-14-03				AOI5_BH-14-04			
				Sample Date	3/5/13				3/8/13				3/17/14				3/17/14			
				Sample Interval	1.5 - 2				1.5 - 2				0 - 2				0 - 2			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	284		2.4	1	**950**		2.1	1	47.1		2.3	1	40.6		2	1
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	ND	U	0.0041	1	ND	U	0.0044	1	ND	U	35	1	ND	U	0.46	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	0.00081	1	ND	U	0.00087	1	ND	U	0.0029	1	ND	U	0.0034	1
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	0.00081	1	ND	U	0.00087	1	ND	U	7	1	ND	U	0.092	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.0041	1	ND	U	0.0044	1	ND	U	35	1	ND	U	0.46	1
Benzene	71-43-2	290	0.5	mg/kg	0.0021		0.00081	1	ND	U	0.00087	1	ND	U	7	1	**56.7**		0.92	1
Ethylbenzene	100-41-4	890	70	mg/kg	ND	U	0.00081	1	ND	U	0.00087	1	44.2		7	1	ND	U	0.092	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	ND	U	0.0041	1	0.0044		0.0044	1	**21100**		3500	100	15.1		0.46	1
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	0.00081	1	ND	U	0.00087	1	ND	U	7	1	ND	U	0.092	1
Toluene	108-88-3	10,000	100	mg/kg	ND	U	0.00081	1	ND	U	0.00087	1	ND	U	7	1	0.0199	J	0.092	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	ND	U	0.00081	1	ND	U	0.00087	1	ND	U	7	1	ND	U	0.092	1
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	0.0396		0.035	1	0.155		0.033	1	0.0301	J	0.035	1	0.0475		0.042	1
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	0.182		0.035	1	0.592		0.033	1	0.13		0.035	1	0.166		0.042	1
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	0.192		0.035	1	0.696		0.033	1	0.136		0.035	1	0.163		0.042	1
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	0.205		0.035	1	0.937		0.033	1	0.168		0.035	1	0.21		0.042	1
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.12		0.035	1	0.66		0.033	1	0.103		0.035	1	0.122		0.042	1
Chrysene	218-01-9	760	230	mg/kg	0.194		0.035	1	0.599		0.033	1	0.153		0.035	1	0.206		0.042	1
Fluorene	86-73-7	130,000	3,800	mg/kg	0.0158	J	0.035	1	0.0341		0.033	1	ND	U	0.035	1	0.0168	J	0.042	1
Naphthalene**	91-20-3	760	25	mg/kg	0.0191	J	0.035	1	0.0669		0.033	1	ND	U	0.035	1	0.0414	J	0.042	1
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.158		0.035	1	0.304		0.033	1	0.0849		0.035	1	0.155		0.042	1
Pyrene	129-00-0	96,000	2,200	mg/kg	0.27		0.035	1	0.687		0.033	1	ND	U	0.035	1	ND	U	0.042	1

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	AOI5_BH-14-05				AOI5_BH-14-09				AOI5_BH-14-10				AOI5_BH-14-11			
				Sample ID	AOI5_BH-14-05				AOI5_BH-14-09				AOI5_BH-14-10				AOI5_BH-14-11			
				Sample Date	3/18/14				3/18/14				3/18/14				3/18/14			
				Sample Interval	0 - 2				0 - 2				0 - 2				0 - 2			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	45.7		2.2	1	37.9		2.3	1	27.5		2.2	1	38.3		2.4	1
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	ND	U	0.0057	1	ND	U	0.0058	1	ND	U	0.0068	1	ND	U	0.0064	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	0.0028	1	ND	U	0.0028	1	ND	U	0.0028	1	ND	U	0.0029	1
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	0.0011	1	ND	U	0.0012	1	ND	U	0.0014	1	ND	U	0.0013	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.0057	1	ND	U	0.0058	1	ND	U	0.0068	1	ND	U	0.0064	1
Benzene	71-43-2	290	0.5	mg/kg	ND	U	0.0011	1	ND	U	0.0012	1	ND	U	0.0014	1	0.00038	J	0.0013	1
Ethylbenzene	100-41-4	890	70	mg/kg	ND	U	0.0011	1	ND	U	0.0012	1	ND	U	0.0014	1	ND	U	0.0013	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	ND	U	0.0057	1	ND	U	0.0058	1	ND	U	0.0068	1	ND	U	0.0064	1
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	0.0011	1	ND	U	0.0012	1	ND	U	0.0014	1	ND	U	0.0013	1
Toluene	108-88-3	10,000	100	mg/kg	ND	U	0.0011	1	ND	U	0.0012	1	ND	U	0.0014	1	ND	U	0.0013	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	ND	U	0.0011	1	ND	U	0.0012	1	ND	U	0.0014	1	ND	U	0.0013	1
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	0.0575		0.033	1	0.0479	J	0.066	2	0.079		0.035	1	0.105		0.07	2
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	0.214		0.033	1	0.18		0.066	2	0.264		0.035	1	0.323		0.07	2
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	0.227		0.033	1	0.217		0.066	2	0.29		0.035	1	0.316		0.07	2
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	0.289		0.033	1	0.267		0.066	2	0.388		0.035	1	0.376		0.07	2
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.2		0.033	1	0.203		0.066	2	0.23		0.035	1	0.227		0.07	2
Chrysene	218-01-9	760	230	mg/kg	0.271		0.033	1	0.212		0.066	2	0.356		0.035	1	0.396		0.07	2
Fluorene	86-73-7	130,000	3,800	mg/kg	ND	U	0.033	1	ND	U	0.066	2	0.0231	J	0.035	1	0.0316	J	0.07	2
Naphthalene**	91-20-3	760	25	mg/kg	ND	U	0.033	1	ND	U	0.066	2	0.0162	J	0.035	1	ND	U	0.07	2
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.151		0.033	1	0.1		0.066	2	0.283		0.035	1	0.444		0.07	2
Pyrene	129-00-0	96,000	2,200	mg/kg	0.426		0.033	1	0.327		0.066	2	0.538		0.035	1	0.712		0.07	2

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	AOI5_BH-14-13				AOI5-BH-13-27				AOI5-BH-14-14				AOI5-BH-14-15			
				Sample ID	AOI5_BH-14-13				AOI5_BH-13-27_1.5-2_30713				AOI-5_14-14_0-2'				AOI-5_14-15_0-2'			
				Sample Date	3/18/14				3/7/13				6/16/14				6/16/14			
				Sample Interval	0 - 2				1.5 - 2				0 - 2				0 - 2			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	29.5		2.3	1	**2730**		4	2	120		2.1	1	336		2	1
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	ND	U	0.0053	1	ND	U	0.8	1	0.0019	J	0.002	1	0.0007	J	0.002	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	0.0028	1	ND	U	0.16	1	ND		0.0027	1	ND		0.003	1
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	0.0011	1	ND	U	0.16	1	ND		0.001	1	ND		0.001	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.0053	1	ND	U	0.8	1	0.0014	JJ	0.002	1	0.00035	J	0.002	1
Benzene	71-43-2	290	0.5	mg/kg	ND	U	0.0011	1	**12.4**		0.16	1	0.00043	J	0.00051	1	0.00043	J	0.0005	1
Ethylbenzene	100-41-4	890	70	mg/kg	ND	U	0.0011	1	ND	U	0.16	1	ND		0.001	1	0.00033	J	0.001	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	ND	U	0.0053	1	62.4		4	1	0.00023	J	0.0051	1	0.00059	J	0.005	1
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	0.0011	1	ND	U	0.16	1	ND		0.001	1	0.00041	J	0.001	1
Toluene	108-88-3	10,000	100	mg/kg	ND	U	0.0011	1	ND	U	0.16	1	0.0006	J	0.001	1	0.0006	JJ	0.001	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	ND	U	0.0011	1	ND	U	0.16	1	0.0012		0.001	1	0.0022		0.001	1
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	0.0466		0.035	1	0.318		0.045	1	0.387		0.035	1	0.0659		0.038	1
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	0.158		0.035	1	1.4		0.045	1	1.08		0.035	1	0.182		0.038	1
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	0.154		0.035	1	1.48		0.045	1	1.17		0.035	1	0.244		0.038	1
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	0.202		0.035	1	1.29		0.045	1	1.38		0.035	1	0.319		0.038	1
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.141		0.035	1	1.53		0.045	1	0.865		0.035	1	0.2		0.038	1
Chrysene	218-01-9	760	230	mg/kg	0.204		0.035	1	1.54		0.045	1	1.22		0.035	1	0.212		0.038	1
Fluorene	86-73-7	130,000	3,800	mg/kg	ND	U	0.035	1	0.107		0.045	1	0.106		0.035	1	0.0233	JJ	0.038	1
Naphthalene**	91-20-3	760	25	mg/kg	ND	U	0.035	1	0.125		0.045	1	0.0909		0.035	1	0.0422		0.038	1
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.102		0.035	1	1.12		0.045	1	1.19		0.035	1	0.137		0.038	1
Pyrene	129-00-0	96,000	2,200	mg/kg	0.327		0.035	1	2.15		0.045	1	1.98		0.035	1	0.244		0.038	1

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
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DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
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[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	AOI5-BH-14-17				AOI5-BH-14-18				BH_14-19				BH_14-20			
				Sample ID	AOI-5_14-17_0-2'				AOI-5_14-18_0-2'				AOI-5_BH_14-19_0-2'				AOI-5_BH_14-20			
				Sample Date	6/16/14				6/16/14				6/18/14				6/20/14			
				Sample Interval	0 - 2				0 - 2				0 - 2				0 - 2			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	87.7		2	1	31		2	1	70		1.9	1	168		2.1	1
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	0.0003	J	0.0027	1	ND		0.0028	1	0.0011	J	0.0019	1	ND	U	0.0021	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND		0.0029	1	ND		0.0029	1	ND	U	0.0051	1	ND	U	0.003	1
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND		0.0013	1	ND		0.0014	1	ND	U	0.00093	1	ND	U	0.0011	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	0.00034	J	0.0027	1	ND		0.0028	1	0.00075	J	0.0019	1	ND	U	0.0021	1
Benzene	71-43-2	290	0.5	mg/kg	ND		0.00067	1	ND		0.0007	1	0.0044		0.00047	1	ND	U	0.00054	1
Ethylbenzene	100-41-4	890	70	mg/kg	ND		0.0013	1	ND		0.0014	1	0.00054	J	0.00093	1	ND	U	0.0011	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	ND		0.0067	1	ND		0.007	1	ND	U	0.0047	1	ND	U	0.0054	1
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	NDJ		0.0013	1	ND		0.0014	1	ND	U	0.00093	1	ND	U	0.0011	1
Toluene	108-88-3	10,000	100	mg/kg	ND		0.0013	1	ND		0.0014	1	0.00053	J	0.00093	1	ND	U	0.0011	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	0.00037	J	0.0013	1	ND		0.0014	1	0.0082		0.00093	1	ND	U	0.0011	1
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	0.26		0.034	1	0.0393		0.037	1	0.0334		0.033	1	0.142		0.039	1
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	0.783		0.034	1	0.148		0.037	1	0.0933		0.033	1	0.422		0.039	1
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	0.951		0.034	1	0.176		0.037	1	0.102		0.033	1	0.578		0.039	1
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	1.04		0.034	1	0.207		0.037	1	0.0952		0.033	1	0.644		0.039	1
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.673		0.034	1	0.135		0.037	1	0.096		0.033	1	0.449		0.039	1
Chrysene	218-01-9	760	230	mg/kg	0.803		0.034	1	0.159		0.037	1	0.118		0.033	1	0.438		0.039	1
Fluorene	86-73-7	130,000	3,800	mg/kg	0.0849		0.034	1	ND		0.037	1	ND	U	0.033	1	0.023	J	0.039	1
Naphthalene**	91-20-3	760	25	mg/kg	0.0673		0.034	1	ND		0.037	1	0.0208	J	0.033	1	0.161		0.039	1
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.774		0.034	1	0.146		0.037	1	0.0492		0.033	1	0.187		0.039	1
Pyrene	129-00-0	96,000	2,200	mg/kg	1.29		0.034	1	0.239		0.037	1	0.11		0.033	1	0.443		0.039	1

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	BH_14-21				BH_14-22				BH_14-24				BH_14-25			
				Sample ID	AOI-5_BH_14-21_0-2'				AOI-5_BH_14-22_0-2'				AOI-5_BH_14-24_0-2'				AOI-5_BH_14-25_0-2'			
				Sample Date	6/18/14				6/18/14				6/20/14				6/18/14			
				Sample Interval	0 - 2				0 - 2				0 - 2				0 - 2			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	394		1.9	1	441		1.9	1	**641**		4	2	**1200**		4.1	2
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	ND	U	0.0022	1	ND	U	0.0018	1	ND	U	0.003	1	0.0036		0.0034	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	0.0031	1	ND	U	0.003	1	ND	U	0.0032	1	ND	U	0.0042	1
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	0.0011	1	ND	U	0.0009	1	ND	U	0.0015	1	ND	U	0.0017	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.0022	1	ND	U	0.0018	1	ND	U	0.003	1	0.00069	J	0.0034	1
Benzene	71-43-2	290	0.5	mg/kg	0.0034		0.00055	1	0.00061		0.00045	1	0.00062	J	0.00075	1	0.006		0.00084	1
Ethylbenzene	100-41-4	890	70	mg/kg	ND	U	0.0011	1	ND	U	0.0009	1	ND	U	0.0015	1	ND	U	0.0017	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	ND	U	0.0055	1	ND	U	0.0045	1	ND	U	0.0075	1	0.00058	J	0.0084	1
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	0.0011	1	ND	U	0.0009	1	ND	U	0.0015	1	ND	U	0.0017	1
Toluene	108-88-3	10,000	100	mg/kg	ND	U	0.0011	1	ND	U	0.0009	1	ND	U	0.0015	1	ND	U	0.0017	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	ND	U	0.0011	1	0.00023	J	0.0009	1	ND	U	0.0015	1	ND	U	0.0017	1
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	0.671		0.039	1	0.163		0.037	1	0.0179	J	0.043	1	0.659		0.053	1
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	0.914		0.039	1	0.352		0.037	1	0.0983		0.043	1	1.47		0.053	1
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	0.932		0.039	1	0.303		0.037	1	0.122		0.043	1	1.29		0.053	1
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	1		0.039	1	0.301		0.037	1	0.167		0.043	1	1.28		0.053	1
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.513		0.039	1	0.272		0.037	1	0.113		0.043	1	0.983		0.053	1
Chrysene	218-01-9	760	230	mg/kg	1.98		0.039	1	0.449		0.037	1	0.106		0.043	1	2.16		0.053	1
Fluorene	86-73-7	130,000	3,800	mg/kg	0.903		0.039	1	0.0904		0.037	1	ND	U	0.043	1	0.519		0.053	1
Naphthalene**	91-20-3	760	25	mg/kg	0.145		0.039	1	0.0347	J	0.037	1	ND	U	0.043	1	0.149		0.053	1
Phenanthrene	85-01-8	190,000	10,000	mg/kg	2.34		0.039	1	0.319		0.037	1	0.0447		0.043	1	3.67		0.053	1
Pyrene	129-00-0	96,000	2,200	mg/kg	2.65		0.039	1	0.527		0.037	1	0.0956		0.043	1	3.02		0.053	1

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	BH_14-26				BH_14-27				BH_14-28				BH_14-29			
				Sample ID	AOI-5_BH_14-26_0-2'				AOI-5_BH_14-27_0-2'				AOI-5_BH_14-28_0-2'				AOI-5_BH_14-29_0-2'			
				Sample Date	6/19/14				6/19/14				6/19/14				6/19/14			
				Sample Interval	0 - 2				0 - 2				0 - 2				0 - 2			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	51.2		1.9	1	60.7		1.9	1	153		1.9	1	**1330**		2.4	1
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	ND	U	0.0031	1	ND	U	0.0023	1	ND	U	0.0017	1	ND	U	0.0031	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	0.0027	1	ND	U	0.0027	1	ND	U	0.0027	1	ND	U	0.003	1
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	0.0015	1	ND	U	0.0012	1	ND	U	0.00086	1	ND	U	0.0015	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.0031	1	ND	U	0.0023	1	ND	U	0.0017	1	ND	U	0.0031	1
Benzene	71-43-2	290	0.5	mg/kg	ND	U	0.00077	1	ND	U	0.00059	1	**1.76**		0.057	1	0.0337		0.00077	1
Ethylbenzene	100-41-4	890	70	mg/kg	ND	U	0.0015	1	ND	U	0.0012	1	ND	U	0.00086	1	ND	U	0.0015	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	ND	U	0.0077	1	ND	U	0.0059	1	ND	U	0.0043	1	0.0008	J	0.0077	1
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	0.0015	1	ND	U	0.0012	1	ND	U	0.00086	1	ND	U	0.0015	1
Toluene	108-88-3	10,000	100	mg/kg	ND	U	0.0015	1	ND	U	0.0012	1	ND	U	0.00086	1	ND	U	0.0015	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	ND	U	0.0015	1	ND	U	0.0012	1	ND	U	0.00086	1	ND	U	0.0015	1
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	0.0562	J	0.071	2	0.0481	J	0.073	2	0.0565		0.036	1	0.424		0.04	1
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	0.176		0.071	2	0.145		0.073	2	0.227		0.036	1	1.54		0.04	1
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	0.207		0.071	2	0.173		0.073	2	0.241		0.036	1	1.71		0.04	1
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	0.268		0.071	2	0.229		0.073	2	0.319		0.036	1	2.13		0.04	1
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.176		0.071	2	0.151		0.073	2	0.183		0.036	1	1.34		0.04	1
Chrysene	218-01-9	760	230	mg/kg	0.205		0.071	2	0.207		0.073	2	0.275		0.036	1	1.71		0.04	1
Fluorene	86-73-7	130,000	3,800	mg/kg	ND	U	0.071	2	ND	U	0.073	2	ND	U	0.036	1	0.117		0.04	1
Naphthalene**	91-20-3	760	25	mg/kg	ND	U	0.071	2	ND	U	0.073	2	ND	U	0.036	1	0.0902		0.04	1
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.109		0.071	2	0.121		0.073	2	0.178		0.036	1	1.72		0.04	1
Pyrene	129-00-0	96,000	2,200	mg/kg	0.289		0.071	2	0.236		0.073	2	0.388		0.036	1	2.54		0.04	1

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	BH_14-30				BH_14-31				BH_14-32				BH_14-33			
				Sample ID	AOI-5_BH_14-30_0-2'				AOI-5_BH_14-31_0-2'				AOI-5-BH_14-32_0-2'				AOI-5-BH_14-33_0-2'			
				Sample Date	6/19/14				6/19/14				6/17/14				6/17/14			
				Sample Interval	0 - 2				0 - 2				0 - 2				0 - 2			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	350		2	1	**1980**		1.9	1	344		1.9	1	**1520**		2.1	1
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	ND	U	0.0021	1	ND	U	0.003	1	ND	U	0.0028	1	0.133	J	0.32	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	0.0029	1	ND	U	0.007	1	ND	U	0.0029	1	ND	U	0.003	1
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	0.001	1	ND	U	0.0015	1	ND	U	0.0014	1	ND	U	0.16	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.0021	1	ND	U	0.003	1	ND	U	0.0028	1	0.0497	J	0.32	1
Benzene	71-43-2	290	0.5	mg/kg	**3.13**		0.068	1	0.125		0.00076	1	ND	U	0.00071	1	0.127		0.08	1
Ethylbenzene	100-41-4	890	70	mg/kg	ND	U	0.001	1	ND	U	0.0015	1	ND	U	0.0014	1	0.0978	J	0.16	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	0.00027	J	0.0052	1	ND	U	0.0076	1	ND	U	0.0071	1	59.5		4	1
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	0.001	1	ND	U	0.0015	1	ND	U	0.0014	1	ND	U	0.16	1
Toluene	108-88-3	10,000	100	mg/kg	0.0019		0.001	1	ND	U	0.0015	1	ND	U	0.0014	1	0.128	J	0.16	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	ND	U	0.001	1	ND	U	0.0015	1	ND	U	0.0014	1	0.389		0.16	1
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	0.1		0.076	2	0.483		0.047	1	0.104		0.038	1	3.04		0.037	1
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	0.294		0.076	2	2.24		0.047	1	0.343		0.038	1	13.3		0.37	10
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	0.281		0.076	2	2.38		0.047	1	0.481		0.038	1	12.5		0.37	10
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	0.373		0.076	2	2.95		0.047	1	0.544		0.038	1	16.2		0.37	10
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.227		0.076	2	1.62		0.047	1	0.317		0.038	1	3.57		0.037	1
Chrysene	218-01-9	760	230	mg/kg	0.374		0.076	2	2.23		0.047	1	0.362		0.038	1	14.5		0.37	10
Fluorene	86-73-7	130,000	3,800	mg/kg	0.0403	J	0.076	2	0.145		0.047	1	0.0359	J	0.038	1	2.67		0.037	1
Naphthalene**	91-20-3	760	25	mg/kg	0.06	J	0.076	2	0.0775		0.047	1	0.0849		0.038	1	0.555		0.037	1
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.337		0.076	2	2.1		0.047	1	0.489		0.038	1	31		0.37	10
Pyrene	129-00-0	96,000	2,200	mg/kg	0.597		0.076	2	3.31		0.047	1	0.453		0.038	1	25.6		0.37	10

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
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DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
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[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	BH_14-34				BH_14-35				BH_14-36				BH_14-37			
				Sample ID	AOI-5-BH_14-34_0-2'				AOI-5-BH_14-35_0-2'				AOI-5_BH_14-36_0-2'				AOI-5_BH_14-37_0-2'			
				Sample Date	6/17/14				6/17/14				6/18/14				6/19/14			
				Sample Interval	0 - 2				0 - 2				0 - 2				0 - 2			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	**1140**		4.1	2	376		2.1	1	37.9		1.9	1	181		2.3	1
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	0.262		0.2	1	ND	U	0.0029	1	ND	U	0.0018	1	ND	U	0.0021	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	0.003	1	ND	U	0.003	1	ND	U	0.0054	1	ND	U	0.0029	1
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	0.1	1	ND	U	0.0014	1	ND	U	0.00088	1	ND	U	0.001	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	0.0746	J	0.2	1	ND	U	0.0029	1	ND	U	0.0018	1	ND	U	0.0021	1
Benzene	71-43-2	290	0.5	mg/kg	0.348		0.05	1	ND	U	0.00071	1	0.0032		0.00044	1	0.0727		0.00052	1
Ethylbenzene	100-41-4	890	70	mg/kg	0.267		0.1	1	ND	U	0.0014	1	ND	U	0.00088	1	ND	U	0.001	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	39.2		2.5	1	ND	U	0.0071	1	ND	U	0.0044	1	ND	U	0.0052	1
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	0.1	1	ND	U	0.0014	1	ND	U	0.00088	1	ND	U	0.001	1
Toluene	108-88-3	10,000	100	mg/kg	0.396		0.1	1	0.00053	J	0.0014	1	ND	U	0.00088	1	ND	U	0.001	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	0.837		0.1	1	ND	U	0.0014	1	ND	U	0.00088	1	ND	U	0.001	1
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	4.6		0.39	1	0.592		0.037	1	0.227		0.032	1	0.503		0.038	1
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	8.32		0.39	1	0.945		0.037	1	1.24		0.032	1	1.99		0.038	1
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	7.66		0.39	1	1.31		0.037	1	1.13		0.032	1	2.94		0.038	1
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	9.66		0.39	1	1.58		0.037	1	1.25		0.032	1	3.11		0.038	1
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	3.83		0.39	1	0.854		0.037	1	0.591		0.032	1	1.7		0.038	1
Chrysene	218-01-9	760	230	mg/kg	8.93		0.39	1	1.14		0.037	1	1.02		0.032	1	2.21		0.038	1
Fluorene	86-73-7	130,000	3,800	mg/kg	5.09		0.39	1	0.429		0.037	1	0.0171	J	0.032	1	0.129		0.038	1
Naphthalene**	91-20-3	760	25	mg/kg	2.18		0.39	1	1.2		0.037	1	0.0765		0.032	1	0.461		0.038	1
Phenanthrene	85-01-8	190,000	10,000	mg/kg	28.3		0.39	1	1.52		0.037	1	0.19		0.032	1	0.84		0.038	1
Pyrene	129-00-0	96,000	2,200	mg/kg	17.3		0.39	1	1.64		0.037	1	1.43		0.032	1	2.8		0.038	1

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	BH-13-09				BH-14-09				BH-15-09				BH-16-09			
				Sample ID	BH-13-09				BH-14-09				BH-15-09				BH-16-09			
				Sample Date	4/6/09				4/6/09				4/6/09				4/6/09			
				Sample Interval	1 - 2				1 - 2				0.5 - 2				0 - 2			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	298		1.11	10	285		1.2	10	323		1.13	10	**2030**		6.13	50
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	NA				NA				NA				NA			
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	NA				NA				NA				NA			
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	NA				NA				NA				NA			
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	NA				NA				NA				NA			
Benzene	71-43-2	290	0.5	mg/kg	NA				NA				NA				NA			
Ethylbenzene	100-41-4	890	70	mg/kg	NA				NA				NA				NA			
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	NA				NA				NA				NA			
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	NA				NA				NA				NA			
Toluene	108-88-3	10,000	100	mg/kg	NA				NA				NA				NA			
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	NA				NA				NA				NA			
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	NA				NA				NA				NA			
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	NA				NA				NA				NA			
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	NA				NA				NA				NA			
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	NA				NA				NA				NA			
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	NA				NA				NA				NA			
Chrysene	218-01-9	760	230	mg/kg	NA				NA				NA				NA			
Fluorene	86-73-7	130,000	3,800	mg/kg	NA				NA				NA				NA			
Naphthalene**	91-20-3	760	25	mg/kg	NA				NA				NA				NA			
Phenanthrene	85-01-8	190,000	10,000	mg/kg	NA				NA				NA				NA			
Pyrene	129-00-0	96,000	2,200	mg/kg	NA				NA				NA				NA			

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	BH-41-09				BH-42-09				BH-04-07				GP1209-PP			
				Sample ID	BH-41-09				BH-42-09				BH-04-07_1-2				GP1209-PP-0.5			
				Sample Date	7/9/09				7/9/09				7/13/07				1/23/12			
				Sample Interval	0 - 2				0 - 2				1.0-2.0				0.5 - 1			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF	Result	Q	DL	DF
Metals																				
Lead *	7439-92-1	2240	450	mg/kg	387		1.08	10	183		1.1	10	203		0.58		22.2		0.29	1
Volatile Organic Compounds																				
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	NA				NA				NA				ND	U	0.073	55.03
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	NA				NA				NA				ND	U	0.073	55.03
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	NA				NA				NA				ND	U	0.073	55.03
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	NA				NA				NA				ND	U	0.073	55.03
Benzene	71-43-2	290	0.5	mg/kg	NA				NA				NA				**2.2**		0.036	55.03
Ethylbenzene	100-41-4	890	70	mg/kg	NA				NA				NA				ND	U	0.073	55.03
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	NA				NA				NA				4.1		0.073	55.03
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	NA				NA				NA				ND	U	0.036	55.03
Toluene	108-88-3	10,000	100	mg/kg	NA				NA				NA				ND	U	0.073	55.03
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	NA				NA				NA				ND	U	0.073	55.03
Semi-Volatile Organic Compounds																				
Anthracene	120-12-7	190,000	350	mg/kg	NA				NA				NA				ND	U	0.0088	10
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	NA				NA				NA				0.016	J	0.0044	10
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	NA				NA				NA				0.02		0.0044	10
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	NA				NA				NA				0.017		0.0035	10
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	NA				NA				NA				0.033	J	0.026	10
Chrysene	218-01-9	760	230	mg/kg	NA				NA				NA				ND	U	0.04	10
Fluorene	86-73-7	130,000	3,800	mg/kg	NA				NA				NA				ND	U	0.044	10
Naphthalene**	91-20-3	760	25	mg/kg	NA				NA				NA				NA			
Phenanthrene	85-01-8	190,000	10,000	mg/kg	NA				NA				NA				0.028	J	0.026	10
Pyrene	129-00-0	96,000	2,200	mg/kg	NA				NA				NA				0.049	J	0.044	10

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 2
Summary of Surface Soil Sample Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226, AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Surface Soil Direct Contact MSC [1]	PADEP Non-Residential Soil to Groundwater SHS [2]	Location ID	GP1212-PP				AOI5-16-1-0-2-021016			
				Sample ID	GP1212-PP-0.5				AOI5-16-1-0-2-021016			
				Sample Date	1/23/12				2/10/2016			
				Sample Interval	0.5 - 1				0-2			
				Unit	Result	Q	DL	DF	Result	Q	DL	DF
Metals												
Lead *	7439-92-1	2240	450	mg/kg	110		0.267	1	121		0.31	1
Volatile Organic Compounds												
1,2,4-Trimethylbenzene	95-63-6	560	35	mg/kg	ND	U	0.002	1.62	NA			
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	3.7	0.005	mg/kg	ND	U	0.002	1.62	NA			
1,2-Dichloroethane	107-06-2	86	0.5	mg/kg	ND	U	0.002	1.62	NA			
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.002	1.62	NA			
Benzene	71-43-2	290	0.5	mg/kg	0.034		0.001	1.62	NA			
Ethylbenzene	100-41-4	890	70	mg/kg	ND	U	0.002	1.62	NA			
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	0.033		0.002	1.62	NA			
Methyl Tert-Butyl Ether	1634-04-4	8,600	2	mg/kg	ND	U	0.001	1.62	NA			
Toluene	108-88-3	10,000	100	mg/kg	ND	U	0.002	1.62	NA			
Xylenes, Total (Dimethylbenzene)	1330-20-7	8,000	1,000	mg/kg	ND	U	0.002	1.62	NA			
Semi-Volatile Organic Compounds												
Anthracene	120-12-7	190,000	350	mg/kg	0.042		0.0084	10	NA			
Benzo(A)Anthracene	56-55-3	130	430	mg/kg	0.16		0.0042	10	0.3		0.0073	1
Benzo(A)Pyrene	50-32-8	12	46	mg/kg	0.17		0.0042	10	NA			
Benzo(B)Fluoranthene	205-99-2	76	170	mg/kg	0.14		0.0034	10	NA			
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.24		0.025	10	NA			
Chrysene	218-01-9	760	230	mg/kg	0.23		0.038	10	NA			
Fluorene	86-73-7	130,000	3,800	mg/kg	ND	U	0.042	10	NA			
Naphthalene**	91-20-3	760	25	mg/kg	NA				NA			
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.16		0.025	10	NA			
Pyrene	129-00-0	96,000	2,200	mg/kg	0.26		0.042	10	NA			

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA - Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
[1] PADEP Non-Residential Direct Contact MSC for surface soils (0-2 feet below ground surface) (last updated August 27, 2016).
[2] PADEP Non-Residential Soil to Groundwater MSC for unsaturated soils in a used aquifer with total dissolved solids less than 2500 mg/l (last updated August 27, 2016).
* Site Specific Standard for lead is 2,240 mg/kg

**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Surface Soil MSC and Surface Soil Direct Contact MSC or site specific standard for lead.
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Surface Soil Direct Contact MSC

Table 3
Summary of Subsurface Soil Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226 AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Subsurface Soil Direct Contact MSC[1]	PADEP Non-Residential Soil to Groundwater SHS[2]	Location ID	AOI5_BH-13-34				AOI5-BH-13-27				AOI5-BH-14-14				AOI5-BH-14-15				AOI5-BH-14-17			
				Sample ID	AOI5_BH-13-34_2.5-3_30613				AO15-BH-13-27-2.5-330713				AOI-5_14-14_8-9'				AOI-5_14-15_8.0'				AOI-5_14-17_8.0'			
				Sample Matrix	Soil				Soil				Soil				Soil				Soil			
				Sample Date	3/6/13				3/7/13				6/16/14				6/16/14				6/16/14			
				Sample Interval	2.5 - 3				2.5 - 3				8 - 9				8 - 8.5				8 - 8.7			
				Unit	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Metals																								
Lead*	7439-92-1	190,000	450	mg/kg	**677**		2	1	**2120**		2.8	1	144		2	1	203		2	1	336		1.9	1
Volatile Organic Compounds (VOCs)																								
1,2,4-Trimethylbenzene	95-63-6	640	35	mg/kg	ND	U	170	2.5	ND	U	0.0056	1	ND□		0.0026	1	0.305	J□	0.41	1	0.499		0.37	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	4.3	0.005	mg/kg	ND	U	***34***	2.5	ND	U	0.0011	1	ND□		0.0034	1	ND□		0.0042	1	ND□		0.0079	1
1,2-Dichloroethane	107-06-2	98	0.5	mg/kg	ND	U	34	2.5	ND	U	0.0011	1	ND□		0.0013	1	ND□		0.21	1	ND□		0.19	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	170	2.5	ND	U	0.0056	1	ND□		0.0026	1	0.112	J□	0.41	1	0.279	J□	0.37	1
Benzene	71-43-2	330	0.5	mg/kg	**35.3**		34	2.5	0.0336		0.0011	1	ND□		0.00065	1	**3.21**		0.1	1	**0.537**		0.093	1
Ethylbenzene	100-41-4	1,000	70	mg/kg	ND	U	34	2.5	ND	U	0.0011	1	ND□		0.0013	1	0.628		0.21	1	0.275		0.19	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	**23200**		1700	25	0.0445		0.0056	1	ND□		0.0065	1	3.11		1	1	1.67		0.93	1
Methyl Tert-Butyl Ether	1634-04-4	9,900	2	mg/kg	ND	U	34	2.5	ND	U	0.0011	1	0.0026		0.0013	1	ND□		0.21	1	ND		0.19	1
Toluene	108-88-3	10,000	100	mg/kg	ND	U	34	2.5	ND	U	0.0011	1	ND□		0.0013	1	0.892		0.21	1	1.49		0.19	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	9,100	1,000	mg/kg	ND	U	34	2.5	ND	U	0.0011	1	0.00071	J□	0.0013	1	1.63		0.21	1	0.516		0.19	1
Semi-volatile Organic Compounds (SVOCs)																								
Anthracene	120-12-7	190,000	350	mg/kg	0.218		0.046	1	ND	U	0.042	1	1.38		0.045	1	1.21		0.054	1	NA			
Benzo(A)Anthracene	56-55-3	190,000	430	mg/kg	0.712		0.046	1	ND	U	0.042	1	8.65		0.45	10	1.3		0.054	1	NA			
Benzo(A)Pyrene	50-32-8	190,000	46	mg/kg	0.642		0.046	1	0.0689		0.042	1	10.6		0.45	10	1.1		0.054	1	NA			
Benzo(B)Fluoranthene	205-99-2	190,000	170	mg/kg	0.841		0.046	1	0.0688		0.042	1	11.5		0.45	10	1.13		0.054	1	NA			
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.48		0.046	1	0.0535		0.042	1	5.72		0.45	10	0.563		0.054	1	NA			
Chrysene	218-01-9	190,000	230	mg/kg	0.769		0.046	1	0.107		0.042	1	7.82		0.45	10	1.41		0.054	1	NA			
Fluorene	86-73-7	190,000	3,800	mg/kg	0.127		0.046	1	ND	U	0.042	1	0.417		0.045	1	1.08		0.054	1	NA			
Naphthalene**	91-20-3	190,000	25	mg/kg	0.272		0.046	1	ND	U	0.042	1	0.891		0.045	1	0.335		0.054	1	NA			
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.979		0.046	1	0.123		0.042	1	2.15		0.045	1	4.13		0.054	1	NA			
Pyrene	129-00-0	190,000	2,200	mg/kg	1.1		0.046	1	0.0941		0.042	1	8.85		0.45	10	2.91		0.054	1	NA			

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA- Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.
[1] PADEP Act 2 Non-Residental Subsurface Soil Direct Contact MSCs (last updated August 27, 2016).
[2] PADEP nonresidential Statewide Health Standard for soil, used aquifer, total dissolved solids less than or equal to 2,500 milligrams per liter (last updated August 27, 2016).

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits
D - Indicates a dilution

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC

Table 3
Summary of Subsurface Soil Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226 AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Subsurface Soil Direct Contact MSC[1]	PADEP Non-Residential Soil to Groundwater SHS[2]	Location ID	AOI5-BH-14-18				BH_14-19				BH_14-20				BH_14-21				BH_14-22			
				Sample ID	AOI-5_14-18_7.0'				AOI-5_BH_14-19_6-8'				A0I-5_BH_14_20_6-8'				AOI-5_BH_14-21_4-6'				AOI-5_BH_14-22_4-6'			
				Sample Matrix	Soil				Soil				Soil				Soil				Soil			
				Sample Date	6/16/14				6/18/14				6/24/14				6/18/14				6/18/14			
				Sample Interval	7 - 7.5				6 - 8				6 - 8				4 - 6				4 - 6			
				Unit	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Metals																								
Lead*	7439-92-1	190,000	450	mg/kg	14.5		1.9	1	20.7		2	1	17.1		3.1	1	**473**		2	1	87.6		1.9	1
Volatile Organic Compounds (VOCs)																								
1,2,4-Trimethylbenzene	95-63-6	640	35	mg/kg	0.156	J	0.39	1	ND	U	0.0032	1	ND	U	0.0033	1	ND	U	0.0031	1	0.00047	J	0.0029	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	4.3	0.005	mg/kg	ND		0.004	1	ND	U	0.0061	1	ND	U	0.0081	1	ND	U	0.0079	1	ND	U	0.0036	1
1,2-Dichloroethane	107-06-2	98	0.5	mg/kg	ND		0.19	1	ND	U	0.0016	1	ND	U	0.0016	1	ND	U	0.0016	1	ND	U	0.0015	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	0.0673	J	0.39	1	ND	U	0.0032	1	ND	U	0.0033	1	ND	U	0.0031	1	ND	U	0.0029	1
Benzene	71-43-2	330	0.5	mg/kg	0.395		0.096	1	0.0031		0.0008	1	ND	U	0.00081	1	0.0021		0.00079	1	ND	U	0.00073	1
Ethylbenzene	100-41-4	1,000	70	mg/kg	0.144	J	0.19	1	ND	U	0.0016	1	ND	U	0.0016	1	ND	U	0.0016	1	ND	U	0.0015	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	0.878	J	0.96	1	ND	U	0.008	1	ND	U	0.0081	1	ND	U	0.0079	1	ND	U	0.0073	1
Methyl Tert-Butyl Ether	1634-04-4	9,900	2	mg/kg	0.049	J	0.19	1	ND	U	0.0016	1	0.00041	J	0.0016	1	0.0011	J	0.0016	1	0.00076	J	0.0015	1
Toluene	108-88-3	10,000	100	mg/kg	0.636		0.19	1	ND	U	0.0016	1	ND	U	0.0016	1	ND	U	0.0016	1	ND	U	0.0015	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	9,100	1,000	mg/kg	0.282		0.19	1	ND	U	0.0016	1	ND	U	0.0016	1	ND	U	0.0016	1	0.00073	J	0.0015	1
Semi-volatile Organic Compounds (SVOCs)																								
Anthracene	120-12-7	190,000	350	mg/kg	ND		0.051	1	0.0545		0.049	1	ND	U	0.054	1	7.23		0.51	10	0.587		0.048	1
Benzo(A)Anthracene	56-55-3	190,000	430	mg/kg	0.0385	J	0.051	1	0.147		0.049	1	ND	U	0.054	1	15		0.51	10	2.27		0.048	1
Benzo(A)Pyrene	50-32-8	190,000	46	mg/kg	0.0376	J	0.051	1	0.147		0.049	1	ND	U	0.054	1	14.3		0.51	10	2.57		0.048	1
Benzo(B)Fluoranthene	205-99-2	190,000	170	mg/kg	0.0329	J	0.051	1	0.146		0.049	1	ND	U	0.054	1	15.6		0.51	10	2.45		0.048	1
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.0229	J	0.051	1	0.0825		0.049	1	ND	U	0.054	1	9.57		0.51	10	1.4		0.048	1
Chrysene	218-01-9	190,000	230	mg/kg	0.0351	J	0.051	1	0.148		0.049	1	ND	U	0.054	1	15.9		0.51	10	2.2		0.048	1
Fluorene	86-73-7	190,000	3,800	mg/kg	0.0205	J	0.051	1	ND	U	0.049	1	ND	U	0.054	1	3.32		0.051	1	0.363		0.048	1
Naphthalene**	91-20-3	190,000	25	mg/kg	ND		0.051	1	0.0401	J	0.049	1	ND	U	0.054	1	1.3		0.051	1	0.513		0.048	1
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.0356	J	0.051	1	0.101		0.049	1	ND	U	0.054	1	32.2		0.51	10	1.87		0.048	1
Pyrene	129-00-0	190,000	2,200	mg/kg	0.0718		0.051	1	0.291		0.049	1	0.0302	J	0.054	1	34		0.51	10	3.1		0.048	1

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA- Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.
[1] PADEP Act 2 Non-Residental Subsurface Soil Direct Contact MSCs (last updated August 27, 2016).
[2] PADEP nonresidential Statewide Health Standard for soil, used aquifer, total dissolved solids less than or equal to 2,500 milligrams per liter (last updated August 27, 2016).

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits
D - Indicates a dilution

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC

Table 3
Summary of Subsurface Soil Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226 AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Subsurface Soil Direct Contact MSC[1]	PADEP Non-Residential Soil to Groundwater SHS[2]	Location ID	BH_14-24				BH_14-25				BH_14-28				BH_14-30				BH_14-31			
				Sample ID	A0I-5_BH_14_24_4-6'				AOI-5_BH_14-25_6-8'				AOI-5_BH_14-28_4-6'				AOI-5_BH_14-30_4-6'				AOI-5_BH_14-31_4-6'			
				Sample Matrix	Soil				Soil				Soil				Soil				Soil			
				Sample Date	6/24/14				6/18/14				6/19/14				6/19/14				6/19/14			
				Sample Interval	4 - 6				6 - 8				4 - 6				4 - 6				4 - 6			
				Unit	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Metals																								
Lead*	7439-92-1	190,000	450	mg/kg	134		2.4	1	13.7		2	1	196		2	1	320		2.1	1	**843**		4	2
Volatile Organic Compounds (VOCs)																								
1,2,4-Trimethylbenzene	95-63-6	640	35	mg/kg	0.198		0.18	1	ND	U	0.0026	1	ND	U	0.003	1	ND	U	0.0028	1	ND	U	0.0035	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	4.3	0.005	mg/kg	ND	U	0.0035	1	ND	U	0.0036	1	ND	U	0.0064	1	ND	U	0.0036	1	ND	U	0.004	1
1,2-Dichloroethane	107-06-2	98	0.5	mg/kg	ND	U	0.09	1	ND	U	0.0013	1	ND	U	0.0015	1	ND	U	0.0014	1	ND	U	0.0018	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	0.0527	J	0.18	1	ND	U	0.0026	1	ND	U	0.003	1	ND	U	0.0028	1	ND	U	0.0035	1
Benzene	71-43-2	330	0.5	mg/kg	ND	U	0.045	1	0.0052		0.00064	1	**664**		4.1	1	**984**		8.2	1	0.0712		0.00088	1
Ethylbenzene	100-41-4	1,000	70	mg/kg	0.107		0.09	1	ND	U	0.0013	1	0.00039	J	0.0015	1	0.00046	J	0.0014	1	ND	U	0.0018	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	0.0425	J	0.45	1	ND	U	0.0064	1	0.0015	J	0.0075	1	0.0034	J	0.007	1	ND	U	0.0088	1
Methyl Tert-Butyl Ether	1634-04-4	9,900	2	mg/kg	ND	U	0.09	1	ND	U	0.0013	1	ND	U	0.0015	1	ND	U	0.0014	1	ND	U	0.0018	1
Toluene	108-88-3	10,000	100	mg/kg	0.1		0.09	1	ND	U	0.0013	1	0.003		0.0015	1	0.0111		0.0014	1	ND	U	0.0018	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	9,100	1,000	mg/kg	0.492		0.09	1	ND	U	0.0013	1	0.00093	J	0.0015	1	0.00044	J	0.0014	1	ND	U	0.0018	1
Semi-volatile Organic Compounds (SVOCs)																								
Anthracene	120-12-7	190,000	350	mg/kg	0.0946		0.042	1	0.0399	J	0.042	1	0.184		0.042	1	0.282		0.048	1	0.16		0.046	1
Benzo(A)Anthracene	56-55-3	190,000	430	mg/kg	0.381		0.042	1	0.0902		0.042	1	0.478		0.042	1	0.585		0.048	1	0.966		0.046	1
Benzo(A)Pyrene	50-32-8	190,000	46	mg/kg	0.309		0.042	1	0.0909		0.042	1	0.443		0.042	1	0.622		0.048	1	1.12		0.046	1
Benzo(B)Fluoranthene	205-99-2	190,000	170	mg/kg	0.373		0.042	1	0.0725		0.042	1	0.632		0.042	1	0.971		0.048	1	1.46		0.046	1
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.226		0.042	1	0.0506		0.042	1	0.332		0.042	1	0.722		0.048	1	0.905		0.046	1
Chrysene	218-01-9	190,000	230	mg/kg	0.381		0.042	1	0.0885		0.042	1	0.582		0.042	1	0.731		0.048	1	0.997		0.046	1
Fluorene	86-73-7	190,000	3,800	mg/kg	ND	U	0.042	1	0.0289	J	0.042	1	0.155		0.042	1	0.221		0.048	1	0.0633		0.046	1
Naphthalene**	91-20-3	190,000	25	mg/kg	ND	U	0.042	1	0.0182	J	0.042	1	0.323		0.042	1	0.889		0.048	1	0.037	J	0.046	1
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.332		0.042	1	0.126		0.042	1	1.01		0.042	1	1.3		0.048	1	0.607		0.046	1
Pyrene	129-00-0	190,000	2,200	mg/kg	0.745		0.042	1	0.186		0.042	1	0.93		0.042	1	1.16		0.048	1	1.28		0.046	1

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA- Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.
[1] PADEP Act 2 Non-Residental Subsurface Soil Direct Contact MSCs (last updated August 27, 2016).
[2] PADEP nonresidential Statewide Health Standard for soil, used aquifer, total dissolved solids less than or equal to 2,500 milligrams per liter (last updated August 27, 2016).

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits
D - Indicates a dilution

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC

Table 3
Summary of Subsurface Soil Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226 AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Subsurface Soil Direct Contact MSC[1]	PADEP Non-Residential Soil to Groundwater SHS[2]	Location ID	BH_14-32				BH_14-33				BH_14-34				BH_14-35				BH_14-36			
				Sample ID	AOI-5-BH_14-32_4-5'				AOI-5-BH_14-33_5-6'				AOI-5-BH_14-34_5-6'				AOI-5-BH_14-35_5-6'				AOI-5_BH_14-36_4-6'			
				Sample Matrix	Soil				Soil				Soil				Soil				Soil			
				Sample Date	6/17/14				6/17/14				6/17/14				6/17/14				6/18/14			
				Sample Interval	4 - 5				5 - 6				5 - 6				5 - 6				4 - 6			
				Unit	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Metals																								
Lead*	7439-92-1	190,000	450	mg/kg	215		2	1	204		1.9	1	135		2	1	3.1		1.9	1	45		2.1	1
Volatile Organic Compounds (VOCs)																								
1,2,4-Trimethylbenzene	95-63-6	640	35	mg/kg	1.15		0.3	1	0.384		0.28	1	0.207	J	0.47	1	0.0449	J	0.26	1	ND	U	0.0023	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	4.3	0.005	mg/kg	ND	U	0.0031	1	ND	U	0.0032	1	ND	U	0.0033	1	ND	U	0.0032	1	ND	U	0.0034	1
1,2-Dichloroethane	107-06-2	98	0.5	mg/kg	ND	U	0.15	1	ND	U	0.14	1	ND	U	0.23	1	ND	U	0.13	1	ND	U	0.0012	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	0.247	J	0.3	1	0.11	J	0.28	1	ND	U	0.47	1	ND	U	0.26	1	ND	U	0.0023	1
Benzene	71-43-2	330	0.5	mg/kg	**0.638**		0.076	1	0.265		0.071	1	0.177		0.12	1	ND	U	0.066	1	0.0014		0.00058	1
Ethylbenzene	100-41-4	1,000	70	mg/kg	1.71		0.15	1	0.697		0.14	1	0.407		0.23	1	0.0685	J	0.13	1	ND	U	0.0012	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	28.6		0.76	1	45.1		7.1	1	71.2		5.8	1	33.1		6.6	1	ND	U	0.0058	1
Methyl Tert-Butyl Ether	1634-04-4	9,900	2	mg/kg	ND	U	0.15	1	ND	U	0.14	1	ND	U	0.23	1	ND	U	0.13	1	ND	U	0.0012	1
Toluene	108-88-3	10,000	100	mg/kg	1.12		0.15	1	0.344		0.14	1	0.238		0.23	1	ND	U	0.13	1	0.00061	J	0.0012	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	9,100	1,000	mg/kg	3.47		0.15	1	1.21		0.14	1	0.735		0.23	1	ND	U	0.13	1	ND	U	0.0012	1
Semi-volatile Organic Compounds (SVOCs)																								
Anthracene	120-12-7	190,000	350	mg/kg	1		0.04	1	0.575		0.042	1	1.54		0.043	1	0.0238	J	0.041	1	0.163		0.045	1
Benzo(A)Anthracene	56-55-3	190,000	430	mg/kg	0.655		0.04	1	0.922		0.042	1	1.29		0.043	1	0.0762		0.041	1	0.527		0.045	1
Benzo(A)Pyrene	50-32-8	190,000	46	mg/kg	0.547		0.04	1	0.916		0.042	1	1.09		0.043	1	0.0563		0.041	1	0.472		0.045	1
Benzo(B)Fluoranthene	205-99-2	190,000	170	mg/kg	0.634		0.04	1	1.08		0.042	1	1.27		0.043	1	0.061		0.041	1	0.444		0.045	1
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.284		0.04	1	0.521		0.042	1	0.562		0.043	1	0.0315	J	0.041	1	0.228		0.045	1
Chrysene	218-01-9	190,000	230	mg/kg	0.726		0.04	1	1.05		0.042	1	1.56		0.043	1	0.0827		0.041	1	0.463		0.045	1
Fluorene	86-73-7	190,000	3,800	mg/kg	2.77		0.04	1	0.859		0.042	1	3.23		0.043	1	0.0341	J	0.041	1	0.264		0.045	1
Naphthalene**	91-20-3	190,000	25	mg/kg	ND	U	0.04	1	ND	U	0.042	1	ND	U	0.043	1	0.0193	J	0.041	1	0.0754		0.045	1
Phenanthrene	85-01-8	190,000	10,000	mg/kg	6.14		0.2	5	3.01		0.042	1	10.4		0.21	5	0.115		0.041	1	0.419		0.045	1
Pyrene	129-00-0	190,000	2,200	mg/kg	1.43		0.04	1	1.88		0.042	1	2.8		0.043	1	0.134		0.041	1	0.955		0.045	1

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA- Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.
[1] PADEP Act 2 Non-Residental Subsurface Soil Direct Contact MSCs (last updated August 27, 2016).
[2] PADEP nonresidential Statewide Health Standard for soil, used aquifer, total dissolved solids less than or equal to 2,500 milligrams per liter (last updated August 27, 2016).

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits
D - Indicates a dilution

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC

Table 3
Summary of Subsurface Soil Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226 AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Subsurface Soil Direct Contact MSC[1]	PADEP Non-Residential Soil to Groundwater SHS[2]	Location ID	BH_14-37				BH_14-37				GP-1208-PER-1				GP-1208-PER-2				GP-1208-PER-3			
				Sample ID	AOI-5_BH_14-37_6-8'				AOI5-BH-16-001				GP-1208-PER-1				GP-1208-PER-2				GP-1208-PER-3			
				Sample Matrix	Soil				Soil				Soil				Soil				Soil			
				Sample Date	6/19/14				2/10/16				5/30/07				5/30/07				5/30/07			
				Sample Interval	6 - 8				0 - 2				3 - 3.5				3 - 3.5				3 - 3.5			
				Unit	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Metals																								
Lead*	7439-92-1	190,000	450	mg/kg	103		2	1	NA				NA				NA				NA			
Volatile Organic Compounds (VOCs)																								
1,2,4-Trimethylbenzene	95-63-6	640	35	mg/kg	ND	U	0.0033	1	NA				NA				NA				NA			
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	4.3	0.005	mg/kg	ND	U	0.0047	1	NA				NA				NA				NA			
1,2-Dichloroethane	107-06-2	98	0.5	mg/kg	ND	U	0.0017	1	NA				NA				NA				NA			
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.0033	1	NA				NA				NA				NA			
Benzene	71-43-2	330	0.5	mg/kg	0.166		0.00083	1	NA				**1**	D	0.28	50	**4.8**	D	0.21	50	**16**	D	0.3	50
Ethylbenzene	100-41-4	1,000	70	mg/kg	ND	U	0.0017	1	NA				NA				NA				NA			
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	ND	U	0.0083	1	NA				NA				NA				NA			
Methyl Tert-Butyl Ether	1634-04-4	9,900	2	mg/kg	ND	U	0.0017	1	NA				NA				NA				NA			
Toluene	108-88-3	10,000	100	mg/kg	0.00052	J	0.0017	1	NA				NA				NA				NA			
Xylenes, Total (Dimethylbenzene)	1330-20-7	9,100	1,000	mg/kg	ND	U	0.0017	1	NA				NA				NA				NA			
Semi-volatile Organic Compounds (SVOCs)																								
Anthracene	120-12-7	190,000	350	mg/kg	0.0684		0.061	1	NA				NA				NA				NA			
Benzo(A)Anthracene	56-55-3	190,000	430	mg/kg	0.176		0.061	1	NA				NA				NA				NA			
Benzo(A)Pyrene	50-32-8	190,000	46	mg/kg	0.2		0.061	1	0.3		0.0073	1	NA				NA				NA			
Benzo(B)Fluoranthene	205-99-2	190,000	170	mg/kg	0.221		0.061	1	NA				NA				NA				NA			
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.129		0.061	1	NA				NA				NA				NA			
Chrysene	218-01-9	190,000	230	mg/kg	0.181		0.061	1	NA				NA				NA				NA			
Fluorene	86-73-7	190,000	3,800	mg/kg	ND	U	0.061	1	NA				NA				NA				NA			
Naphthalene**	91-20-3	190,000	25	mg/kg	0.0652		0.061	1	NA				NA				NA				NA			
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.135		0.061	1	NA				NA				NA				NA			
Pyrene	129-00-0	190,000	2,200	mg/kg	0.228		0.061	1	NA				NA				NA				NA			

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA- Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.
[1] PADEP Act 2 Non-Residental Subsurface Soil Direct Contact MSCs (last updated August 27, 2016).
[2] PADEP nonresidential Statewide Health Standard for soil, used aquifer, total dissolved solids less than or equal to 2,500 milligrams per liter (last updated August 27, 2016).

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits
D - Indicates a dilution

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC

Table 3
Summary of Subsurface Soil Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226 AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Subsurface Soil Direct Contact MSC[1]	PADEP Non-Residential Soil to Groundwater SHS[2]	Location ID	GP-1208-PER-4				GP-1208-PER-5				GP-1208-SUB-1				GP1209-1210				GP1209-E			
				Sample ID	GP-1208-PER-4				GP-1208-PER-5				GP-1208-SUB-1				GP1209-1210-2.6-3.1				GP1209-E-2.8-3.3			
				Sample Matrix	Soil				Soil				Soil				Soil				Soil			
				Sample Date	5/30/07				5/30/07				5/30/07				1/23/12				1/23/12			
				Sample Interval	3 - 3.5				3 - 3.5				5 - 5.5				2.6 - 3.1				2.8 - 3.3			
				Unit	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Metals																								
Lead*	7439-92-1	190,000	450	mg/kg	NA				NA				NA				**2800**		1.5	5	**1540**		0.3	1
Volatile Organic Compounds (VOCs)																								
1,2,4-Trimethylbenzene	95-63-6	640	35	mg/kg	NA				NA				NA				ND	U	3.6	2606.16	ND	U	0.092	65.92
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	4.3	0.005	mg/kg	NA				NA				NA				ND	U	3.6	2606.16	ND	U	0.092	65.92
1,2-Dichloroethane	107-06-2	98	0.5	mg/kg	NA				NA				NA				ND	U	3.6	2606.16	ND	U	0.092	65.92
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	NA				NA				NA				ND	U	3.6	2606.16	ND	U	0.092	65.92
Benzene	71-43-2	330	0.5	mg/kg	**5.4**	D	0.28	50	**8**	D	0.19	50	**0.76**	D	0.29	50	**230**		1.8	2606.16	**13**		0.046	65.92
Ethylbenzene	100-41-4	1,000	70	mg/kg	NA				NA				NA				ND	U	3.6	2606.16	ND	U	0.092	65.92
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	NA				NA				NA				510		3.6	2606.16	0.23	J	0.092	65.92
Methyl Tert-Butyl Ether	1634-04-4	9,900	2	mg/kg	NA				NA				NA				ND	U	1.8	2606.16	ND	U	0.046	65.92
Toluene	108-88-3	10,000	100	mg/kg	NA				NA				NA				ND	U	3.6	2606.16	ND	U	0.092	65.92
Xylenes, Total (Dimethylbenzene)	1330-20-7	9,100	1,000	mg/kg	NA				NA				NA				ND	U	3.6	2606.16	ND	U	0.092	65.92
Semi-volatile Organic Compounds (SVOCs)																								
Anthracene	120-12-7	190,000	350	mg/kg	NA				NA				NA				1.2		0.018	20	ND	U	0.038	10
Benzo(A)Anthracene	56-55-3	190,000	430	mg/kg	NA				NA				NA				2		0.0092	20	0.24		0.0046	10
Benzo(A)Pyrene	50-32-8	190,000	46	mg/kg	NA				NA				NA				1.8		0.0092	20	0.18		0.0046	10
Benzo(B)Fluoranthene	205-99-2	190,000	170	mg/kg	NA				NA				NA				1.6		0.0074	20	0.36		0.0037	10
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	NA				NA				NA				2.5		0.055	20	0.64		0.028	10
Chrysene	218-01-9	190,000	230	mg/kg	NA				NA				NA				2.7		0.083	20	0.36		0.042	10
Fluorene	86-73-7	190,000	3,800	mg/kg	NA				NA				NA				0.79		0.092	20	ND	U	0.046	10
Naphthalene**	91-20-3	190,000	25	mg/kg	NA				NA				NA				NA				NA			
Phenanthrene	85-01-8	190,000	10,000	mg/kg	NA				NA				NA				5.2		0.055	20	0.64		0.028	10
Pyrene	129-00-0	190,000	2,200	mg/kg	NA				NA				NA				5.1		0.092	20	0.33		0.046	10

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA- Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.
[1] PADEP Act 2 Non-Residental Subsurface Soil Direct Contact MSCs (last updated August 27, 2016).
[2] PADEP nonresidential Statewide Health Standard for soil, used aquifer, total dissolved solids less than or equal to 2,500 milligrams per liter (last updated August 27, 2016).

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits
D - Indicates a dilution

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC

Table 3
Summary of Subsurface Soil Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226 AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Subsurface Soil Direct Contact MSC[1]	PADEP Non-Residential Soil to Groundwater SHS[2]	Location ID	GP1209-NW				GP1209-SW				GP1210-NE				GP1210-NW				GP1210-SW			
				Sample ID	GP1209-NW-2.8-3.3				GP1209-SW-3.0-3.5				GP1210-NE-2.8-3.3				GP1210-NW-2.9-3.4				GP1210-SW-3.3-3.8			
				Sample Matrix	Soil				Soil				Soil				Soil				Soil			
				Sample Date	1/23/12				1/23/12				1/23/12				1/23/12				1/23/12			
				Sample Interval	2.8 - 3.3				3 - 3.5				2.8 - 3.3				2.9 - 3.4				3.3 - 3.8			
				Unit	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Metals																								
Lead*	7439-92-1	190,000	450	mg/kg	**2490**		1.59	5	**1460**		1.07	1	**2680**		1.44	5	**645**		0.314	1	**1370**		0.309	1
Volatile Organic Compounds (VOCs)																								
1,2,4-Trimethylbenzene	95-63-6	640	35	mg/kg	ND	U	0.096	65.24	ND	U	56	11488	ND	U	4	3003.5	ND	U	0.1	70.15	ND	U	9.3	6462.38
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	4.3	0.005	mg/kg	ND	U	0.096	65.24	ND	U	***56***	11488	ND	U	4	3003.5	ND	U	0.1	70.15	ND	U	***9.3***	6462.38
1,2-Dichloroethane	107-06-2	98	0.5	mg/kg	ND	U	0.096	65.24	ND	U	56	11488	ND	U	4	3003.5	ND	U	0.1	70.15	ND	U	9.3	6462.38
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.096	65.24	ND	U	56	11488	ND	U	4	3003.5	ND	U	0.1	70.15	ND	U	9.3	6462.38
Benzene	71-43-2	330	0.5	mg/kg	**4**		0.048	65.24	**49**	J	28	11488	**1500**		5	7508.75	**1.4**		0.051	70.15	**910**		4.6	6462.38
Ethylbenzene	100-41-4	1,000	70	mg/kg	ND	U	0.096	65.24	ND	U	56	11488	ND	U	4	3003.5	ND	U	0.1	70.15	10	J	9.3	6462.38
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	26		0.096	65.24	**13000**		56	11488	2000		10	7508.75	1.5		0.1	70.15	**33000**		370	258495
Methyl Tert-Butyl Ether	1634-04-4	9,900	2	mg/kg	ND	U	0.048	65.24	ND	U	28	11488	ND	U	2	3003.5	ND	U	0.051	70.15	ND	U	4.6	6462.38
Toluene	108-88-3	10,000	100	mg/kg	ND	U	0.096	65.24	ND	U	56	11488	6.5	J	4	3003.5	ND	U	0.1	70.15	ND	U	9.3	6462.38
Xylenes, Total (Dimethylbenzene)	1330-20-7	9,100	1,000	mg/kg	ND	U	0.096	65.24	ND	U	56	11488	ND	U	4	3003.5	ND	U	0.1	70.15	ND	U	9.3	6462.38
Semi-volatile Organic Compounds (SVOCs)																								
Anthracene	120-12-7	190,000	350	mg/kg	0.044		0.0098	10	0.77		0.033	10	0.53		0.018	20	0.023	J	0.0097	10	0.51		0.019	20
Benzo(A)Anthracene	56-55-3	190,000	430	mg/kg	0.28		0.0049	10	1.6		0.016	10	2.2		0.0089	20	0.16		0.0049	10	1.3		0.0096	20
Benzo(A)Pyrene	50-32-8	190,000	46	mg/kg	0.27		0.0049	10	1.4		0.016	10	2.5		0.0089	20	0.13		0.0049	10	1.2		0.0096	20
Benzo(B)Fluoranthene	205-99-2	190,000	170	mg/kg	0.46		0.0039	10	1.2		0.013	10	2.1		0.0071	20	0.15		0.0039	10	1.2		0.0076	20
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	0.75		0.029	10	1.8		0.098	10	3.6		0.053	20	ND	U	0.29	10	2.2		0.057	20
Chrysene	218-01-9	190,000	230	mg/kg	0.53		0.044	10	2.2		0.15	10	3.2		0.08	20	0.24		0.044	10	1.7		0.086	20
Fluorene	86-73-7	190,000	3,800	mg/kg	ND	U	0.049	10	0.59	J	0.16	10	0.42		0.089	20	ND	U	0.049	10	0.47		0.096	20
Naphthalene**	91-20-3	190,000	25	mg/kg	NA				NA				NA				NA				NA			
Phenanthrene	85-01-8	190,000	10,000	mg/kg	0.34		0.029	10	4.3		0.098	10	2.7		0.053	20	0.13		0.029	10	3.4		0.057	20
Pyrene	129-00-0	190,000	2,200	mg/kg	0.54		0.049	10	4.1		0.16	10	3.6		0.089	20	0.27		0.049	10	3		0.096	20

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA- Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.
[1] PADEP Act 2 Non-Residental Subsurface Soil Direct Contact MSCs (last updated August 27, 2016).
[2] PADEP nonresidential Statewide Health Standard for soil, used aquifer, total dissolved solids less than or equal to 2,500 milligrams per liter (last updated August 27, 2016).

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits
D - Indicates a dilution

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC

Table 3
Summary of Subsurface Soil Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226 AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Subsurface Soil Direct Contact MSC[1]	PADEP Non-Residential Soil to Groundwater SHS[2]	Location ID	GP1212-NE				GP1212-NW				GP1212-SE				GP1212-SW				GPBT_03102014_7_12			
				Sample ID	GP1212-NE-2.9-3.4				GP1212-NW-2.7-3.2				GP1212-SE-2.9-3.4				GP1212-SW-2.7-3.2				GPBT_018G_03-10-2014(STF7-12)			
				Sample Matrix	Soil				Soil				Soil				Soil				Soil			
				Sample Date	1/23/12				1/23/12				1/23/12				1/23/12				3/10/14			
				Sample Interval	2.9 - 3.4				2.7 - 3.2				2.9 - 3.4				2.7 - 3.2				2 - 3			
				Unit	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Metals																								
Lead*	7439-92-1	190,000	450	mg/kg	**2550**		1.58	5	**4440**		1.61	5	**2890**		1.56	5	**1850**		0.309	1	NA			
Volatile Organic Compounds (VOCs)																								
1,2,4-Trimethylbenzene	95-63-6	640	35	mg/kg	ND	U	9.1	6282.61	ND	U	0.11	73.07	ND	U	10	7285.88	ND	U	0.002	1.13	0.00027	J	0.0057	1
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	4.3	0.005	mg/kg	ND	U	***9.1***	6282.61	ND	U	0.11	73.07	ND	U	***10***	7285.88	ND	U	0.002	1.13	ND	U	0.0032	1
1,2-Dichloroethane	107-06-2	98	0.5	mg/kg	ND	U	9.1	6282.61	ND	U	0.11	73.07	ND	U	10	7285.88	ND	U	0.002	1.13	ND	U	0.0011	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	9.1	6282.61	ND	U	0.11	73.07	ND	U	10	7285.88	ND	U	0.002	1.13	ND	U	0.0057	1
Benzene	71-43-2	330	0.5	mg/kg	**6.6**	J	4.6	6282.61	0.18	J	0.054	73.07	ND	U	5.2	7285.88	0.003	J	0.0008	1.13	ND	U	0.0011	1
Ethylbenzene	100-41-4	1,000	70	mg/kg	ND	U	9.1	6282.61	ND	U	0.11	73.07	ND	U	10	7285.88	ND	U	0.002	1.13	0.00027	J	0.0011	1
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	**28000**		360	251304	14		0.11	73.07	**30000**		420	291435	0.011		0.002	1.13	ND	U	0.0057	1
Methyl Tert-Butyl Ether	1634-04-4	9,900	2	mg/kg	ND	U	4.6	6282.61	ND	U	0.054	73.07	ND	U	5.2	7285.88	ND	U	0.0008	1.13	ND	U	0.0011	1
Toluene	108-88-3	10,000	100	mg/kg	ND	U	9.1	6282.61	ND	U	0.11	73.07	ND	U	10	7285.88	0.002	J	0.002	1.13	ND	U	0.0011	1
Xylenes, Total (Dimethylbenzene)	1330-20-7	9,100	1,000	mg/kg	17	J	9.1	6282.61	0.16	J	0.11	73.07	ND	U	10	7285.88	0.003	J	0.002	1.13	0.00078	J	0.0011	1
Semi-volatile Organic Compounds (SVOCs)																								
Anthracene	120-12-7	190,000	350	mg/kg	1.5		0.19	10	0.13		0.02	20	1.5		0.048	50	0.56		0.019	20	NA			
Benzo(A)Anthracene	56-55-3	190,000	430	mg/kg	3.9		0.097	10	0.98		0.0098	20	3.3		0.024	50	1.6		0.0095	20	NA			
Benzo(A)Pyrene	50-32-8	190,000	46	mg/kg	4.3		0.097	10	1.3		0.0098	20	3.6		0.024	50	1.7		0.0095	20	NA			
Benzo(B)Fluoranthene	205-99-2	190,000	170	mg/kg	3.8		0.077	10	1.1		0.0079	20	3.1		0.019	50	1.5		0.0076	20	NA			
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	6.7		0.58	10	2.9		0.059	20	5.2		0.14	50	2.3		0.057	20	NA			
Chrysene	218-01-9	190,000	230	mg/kg	6.3		0.87	10	2.1		0.089	20	4.9		0.21	50	2.2		0.085	20	NA			
Fluorene	86-73-7	190,000	3,800	mg/kg	1.5	J	0.97	10	ND	U	0.098	20	1.3		0.24	50	0.36	J	0.095	20	NA			
Naphthalene**	91-20-3	190,000	25	mg/kg	NA				NA				NA				NA				NA			
Phenanthrene	85-01-8	190,000	10,000	mg/kg	6.8		0.58	10	0.68		0.059	20	6.8		0.14	50	2.4		0.057	20	NA			
Pyrene	129-00-0	190,000	2,200	mg/kg	8.6		0.97	10	1.9		0.098	20	7.9		0.24	50	2.4		0.095	20	NA			

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA- Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.
[1] PADEP Act 2 Non-Residental Subsurface Soil Direct Contact MSCs (last updated August 27, 2016).
[2] PADEP nonresidential Statewide Health Standard for soil, used aquifer, total dissolved solids less than or equal to 2,500 milligrams per liter (last updated August 27, 2016).

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits
D - Indicates a dilution

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC

Table 3
Summary of Subsurface Soil Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226 AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Subsurface Soil Direct Contact MSC[1]	PADEP Non-Residential Soil to Groundwater SHS[2]	Location ID	GPBT_03102014_7_4				GPBT_03102014_7_8				GP-1208-LINE-1				GP-1208-LINE-2				GP-1208-LINE-3				GP-1208-LINE-4			
				Sample ID	GPBT_016G_03-10-2014(STF7-4)				GPBT_017G_03-10-2014(STF7-8)				GP-1208-LINE-1				GP-1208-LINE-2				GP-1208-LINE-3				GP-1208-LINE-4			
				Sample Matrix	Soil				Soil				Soil				Soil				Soil				Soil			
				Sample Date	3/10/14				3/10/14				5/30/07				5/30/07				5/30/07				5/30/07			
				Sample Interval	2 - 3				2 - 3				6 - 6.5				6 - 6.5				6 - 6.5				6 - 6.5			
				Unit	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Metals																												
Lead*	7439-92-1	190,000	450	mg/kg	NA				NA				NA				NA				NA				NA			
Volatile Organic Compounds (VOCs)																												
1,2,4-Trimethylbenzene	95-63-6	640	35	mg/kg	ND	U	0.004	1	ND	U	0.0056	1	NA				NA				NA				NA			
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	4.3	0.005	mg/kg	ND	U	0.0028	1	ND	U	0.003	1	NA				NA				NA				NA			
1,2-Dichloroethane	107-06-2	98	0.5	mg/kg	ND	U	0.0008	1	ND	U	0.0011	1	NA				NA				NA				NA			
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	ND	U	0.004	1	ND	U	0.0056	1	NA				NA				NA				NA			
Benzene	71-43-2	330	0.5	mg/kg	0.00018	J	0.0008	1	0.00074	J	0.0011	1	**2.4**	D	0.21	50	**1**	D	0.19	50	**0.75**	D	0.17	50	**0.93**	D	0.23	50
Ethylbenzene	100-41-4	1,000	70	mg/kg	ND	U	0.0008	1	ND	U	0.0011	1	NA				NA				NA				NA			
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	ND	U	0.004	1	ND	U	0.0056	1	NA				NA				NA				NA			
Methyl Tert-Butyl Ether	1634-04-4	9,900	2	mg/kg	ND	U	0.0008	1	ND	U	0.0011	1	NA				NA				NA				NA			
Toluene	108-88-3	10,000	100	mg/kg	0.00023	J	0.0008	1	ND	U	0.0011	1	NA				NA				NA				NA			
Xylenes, Total (Dimethylbenzene)	1330-20-7	9,100	1,000	mg/kg	0.00016	J	0.0008	1	ND	U	0.0011	1	NA				NA				NA				NA			
Semi-volatile Organic Compounds (SVOCs)																												
Anthracene	120-12-7	190,000	350	mg/kg	NA				NA				NA				NA				NA				NA			
Benzo(A)Anthracene	56-55-3	190,000	430	mg/kg	NA				NA				NA				NA				NA				NA			
Benzo(A)Pyrene	50-32-8	190,000	46	mg/kg	NA				NA				NA				NA				NA				NA			
Benzo(B)Fluoranthene	205-99-2	190,000	170	mg/kg	NA				NA				NA				NA				NA				NA			
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	NA				NA				NA				NA				NA				NA			
Chrysene	218-01-9	190,000	230	mg/kg	NA				NA				NA				NA				NA				NA			
Fluorene	86-73-7	190,000	3,800	mg/kg	NA				NA				NA				NA				NA				NA			
Naphthalene**	91-20-3	190,000	25	mg/kg	NA				NA				NA				NA				NA				NA			
Phenanthrene	85-01-8	190,000	10,000	mg/kg	NA				NA				NA				NA				NA				NA			
Pyrene	129-00-0	190,000	2,200	mg/kg	NA				NA				NA				NA				NA				NA			

Notes:
mg/kg - milligram per kilogram
Q - Qualifier
DL - May be reporting limit or method detection limit
ND - Not Detected
NA- Not Analyzed
DF - Dilution Factor
PADEP - Pennsylvania Department of Environmental Protection Agency
SHS - Statewide Health Standard
MSC - Medium Specific Concentration
CAS No - Chemical Abstract Number
**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.
[1] PADEP Act 2 Non-Residental Subsurface Soil Direct Contact MSCs (last updated August 27, 2016).
[2] PADEP nonresidential Statewide Health Standard for soil, used aquifer, total dissolved solids less than or equal to 2,500 milligrams per liter (last updated August 27, 2016).

Qualifiers:
U - The analyte was analyzed but not detected
J - Estimated value. Result between method detection and reporting limits
D - Indicates a dilution

Exceedance Summary:
10 Result exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC

Table 3
Summary of Subsurface Soil Analytical Results
SCR/RACR
ASTs GP-1208, GP-1209, GP-1210, GP-1212, GP-1214, 207, 223, 225, 226 AND UST T-355
AOI 5
PES Refining Complex
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Subsurface Soil Direct Contact MSC[1]	PADEP Non-Residential Soil to Groundwater SHS[2]	Location ID	GP-1208-LINE-5				GP-1208-LINE-6				GP-1208-LINE-7			
				Sample ID	GP-1208-LINE-5				GP-1208-LINE-6				GP-1208-LINE-7			
				Sample Matrix	Soil				Soil				Soil			
				Sample Date	5/30/07				5/30/07				5/30/07			
				Sample Interval	6 - 6.5				6 - 6.5				6 - 6.5			
				Unit	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Metals																
Lead*	7439-92-1	190,000	450	mg/kg	NA				NA				NA			
Volatile Organic Compounds (VOCs)																
1,2,4-Trimethylbenzene	95-63-6	640	35	mg/kg	NA				NA				NA			
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	4.3	0.005	mg/kg	NA				NA				NA			
1,2-Dichloroethane	107-06-2	98	0.5	mg/kg	NA				NA				NA			
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	10,000	210	mg/kg	NA				NA				NA			
Benzene	71-43-2	330	0.5	mg/kg	ND	U,D	0.26	50	0.2	J,D	0.22	50	**1.9**	D	0.25	50
Ethylbenzene	100-41-4	1,000	70	mg/kg	NA				NA				NA			
Isopropylbenzene (Cumene)	98-82-8	10,000	2,500	mg/kg	NA				NA				NA			
Methyl Tert-Butyl Ether	1634-04-4	9,900	2	mg/kg	NA				NA				NA			
Toluene	108-88-3	10,000	100	mg/kg	NA				NA				NA			
Xylenes, Total (Dimethylbenzene)	1330-20-7	9,100	1,000	mg/kg	NA				NA				NA			
Semi-volatile Organic Compounds (SVOCs)																
Anthracene	120-12-7	190,000	350	mg/kg	NA				NA				NA			
Benzo(A)Anthracene	56-55-3	190,000	430	mg/kg	NA				NA				NA			
Benzo(A)Pyrene	50-32-8	190,000	46	mg/kg	NA				NA				NA			
Benzo(B)Fluoranthene	205-99-2	190,000	170	mg/kg	NA				NA				NA			
Benzo(G,H,I)Perylene	191-24-2	190,000	180	mg/kg	NA				NA				NA			
Chrysene	218-01-9	190,000	230	mg/kg	NA				NA				NA			
Fluorene	86-73-7	190,000	3,800	mg/kg	NA				NA				NA			
Naphthalene**	91-20-3	190,000	25	mg/kg	NA				NA				NA			
Phenanthrene	85-01-8	190,000	10,000	mg/kg	NA				NA				NA			
Pyrene	129-00-0	190,000	2,200	mg/kg	NA				NA				NA			

Notes:
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**: Naphthalene was analyzed either as a semi volatile organic compound (analytical method SW8270C SIM) or volatile organic compound (analytical method SW8260B or SW8021B). Naphthalene results are presented on this table as semi-volatile organic compounds.
[1] PADEP Act 2 Non-Residental Subsurface Soil Direct Contact MSCs (last updated August 27, 2016).
[2] PADEP nonresidential Statewide Health Standard for soil, used aquifer, total dissolved solids less than or equal to 2,500 milligrams per liter (last updated August 27, 2016).

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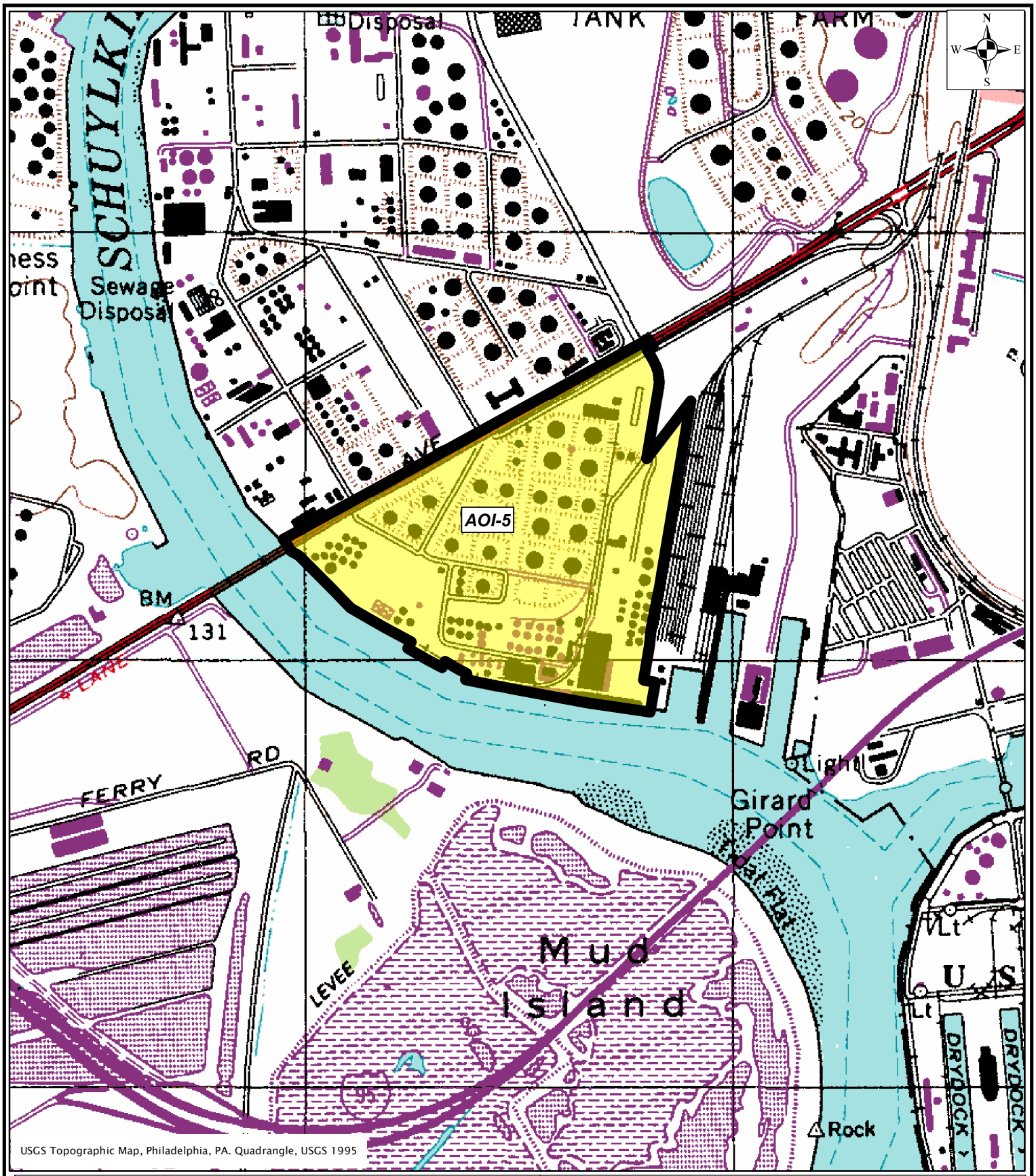
10 Result exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC
10 Result exceeds PADEP Sitewide Health Standard non-residential soil to groundwater standard
10 Reporting limit or method detection limit exceeds the PADEP Non-Residential Subsurface Soil Direct Contact MSC

FIGURES



EVERGREEN

Philadelphia Refinery Operations
A Series of Evergreen Resources Group, LLC.
2 Righter Parkway, Suite 200
Wilmington, DE 19803

Figure 1: Site Location Plan
AOI-5 Site Characterization Report/
Remedial Action Completion Report
PES Philadelphia Refining Complex
Philadelphia Pennsylvania

Job Number	Scale: 1" = 1,000'	Date
2574602	0 500 1,000 Feet	January 4, 2017

Path: \\langan.com\data\DYL\data6\2574601\ArcGIS\MapDocuments\AOI 5 Tank SCR 2016\Figure 1 - Site Location Map_010417.mxd

Legend

- Penrose Avenue Sewer
- Sheet Pile Wall
- AOI Boundary
- Closed in Place
- Closed in Place Tank With Open Incident
- Active Tank With Open Incident
- Removed Tank With Open Incident
- Tank Currently Out of Service
- Tank In Service
- Removed Tank

Notes:
1. Aerial imagery provided by Nearmap.com as is dated 07/29/15.
2. Area of Interest boundaries referenced from 2011 ALTA/ACSM Land Title Survey, prepared for Sunoco Inc. (R&S).

Figure 2: Site Plan
AOI-5 Site Characterization Report/
Remedial Action Completion Report
PES Philadelphia Refining Complex
Philadelphia, Pennsylvania

Philadelphia Refinery Operations
A Series of Evergreen Resources Group, LLC.
2 Righter Parkway, Suite 200
Wilmington, DE 19803

0 150 300 Feet

SCALE: 1" = 150'
DATE: June 9, 2016
DRN. BY: MH
CKD. BY: PT
JOB#: 2574602

\\langan.com\data\DYL\data6\257460\1\ArcGIS\MapDocuments\AOI 5 Tank SCR 2016\Figure 2 - Site Plan_010417.mxd

AOI-6

AOI-5

B-167 S-3 B-94 B A-19 A-153 A-19D B-166 WPM-4 WPM-7 WPM-1 WPM-6 WPM-11 WPM-3 WPM-2 WPM-10 WPM-8 RWM-9 A-25 WP16-2 WP16-1 WP16-3 WP16-4 A-16 A-186 A-174 A-118 A-18 A-119 A-17 A-148 A-147 U-4 U-3 U-5 U-2 U-1 A-26 B-133D URS-2 B-39 WP9-4 RW-9 WP9-7 WP9-8 A-154 A-168 A-27 A-146 A-91 A-23 A-149 A-15 A-138 A-145 A-157 A-155 A-187 A-158 A-152 A-156 A-164 A-163 A-169 A-161 A-162 A-166 A-135 A-170 A-151 A-120 A-139 A-122 A-121 A-3 A-144 A-140 A-49 A-150 A-160 A-43 A-14 A-143 A-44 A-141 A-10 A-183 A-184 A-180 A-179 A-7 A-1 A-40 A-137 A-176 A-177 A-178 A-173 A-45 A-175 A-181 A-182 R-5 WP-7 WP-8 WP-2a WP-4a WP-3a WP-5a A-41 A-39 A-4 A-142 A' A B' B-132D URS-1 PZ-132A A-22 A-169 A-134 A-133 SWR-1 WP-C WP-B SW-5 A-21D A-21S WP-A SW-4 A-171 A-136 A-185 SW-3 SW-2 SW-1 A-172 SWR-2 SWR-3 A-11 A-12 A-20 WP-10 WP-2 WP-3 WP-3-1 WP-5 WP-14 WP-1 RWBH-2 RWBH-1 WP5-1 A-48 A-48 A-46 A-47 A-47 A-5 A-5 WP-9 A-8 A-9 PZ-1 PZ-2 PZ-3 WP-D WP-E A-24 RW-6S A-13 A-13D A-159

N W E S

Legend

- Monitoring Wells in A-A' Cross Section
- Monitoring Wells in B-B' Cross Section
- Lower Aquifer Monitoring Well
- Unconfined Aquifer Monitoring Well
- Unconfined Aquifer Piezometer
- Unconfined Aquifer Recovery Well
- Monitoring Well Abandoned/Damaged/ Unable to Locate
- A — A' AOI-5 Cross Section Location
- B — B' AOI-5 Cross Section Location
- Sheet Pile Wall
- AOI Boundary

Notes:
1. Aerial basemap is provided through Langan's Esri ArcGIS software licensing and ArcGIS online. Source of aerial imagery is Microsoft, 3/19/2011 (Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community)
2. Area of Interest boundaries referenced from 2011 ALTA/ACSM Land Title Survey, prepared for Sunoco Inc. (R&S).

Figure 3: Cross Section Location Plan
AOI-5 Site Characterization Report/
Remedial Action Completion Report
PES Philadelphia Refining Complex
Philadelphia, Pennsylvania

Philadelphia Refinery Operations
A Series of Evergreen Resources Group, LLC.
2 Righter Parkway, Suite 200
Wilmington, DE 19803

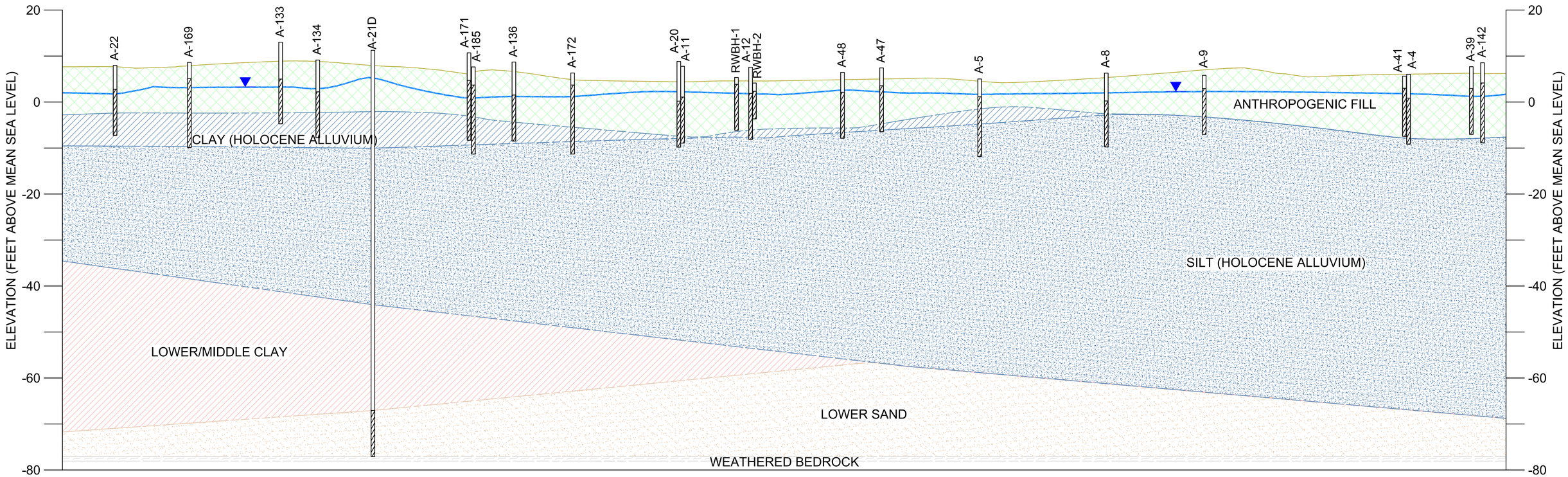
0 150 300 Feet

SCALE: 1" = 150'
DATE: 12/6/2016
DRN. BY: AJC
CKD. BY: KM
JOB#: 2574602

Path: \\langan.com\data\DYL\data\62574601\ArcGIS\MapDocuments\AOI 5 Tank SCR 2016\Figure 3 - Cross Section Location Plan_010417.mxd

LEGEND:

- ANTHROPOGENIC FILL
- LOWER/MIDDLE CLAY
- CLAY (HOLOCENE ALLUVIUM)
- SILT (HOLOCENE ALLUVIUM)
- LOWER SAND
- WEATHERED BEDROCK
- WATER TABLE
- B-129 LOCATION ID
- WELL CASING
- WELL SCREEN



NOTES:

1. GEOLOGIC CROSS SECTION WAS CREATED FROM THE 3D GEOLOGIC MODEL OF AOI 5, WHICH WAS GENERATED IN EARTH VOLUMETRIC STUDIO (EVS) SOFTWARE.
2. THE WATER TABLE SURFACE WAS INTERPOLATED IN EVS USING THE GROUNDWATER ELEVATION DATA COLLECTED DURING THE OCTOBER 2014 GAUGING EVENT BY AQUATERRA TECHNOLOGIES, INC.

5 0 1 2 5
VERTICAL SCALE IN FEET

100 0 50 100
HORIZONTAL SCALE IN FEET

Philadelphia Refinery Operations
A Series of Evergreen Resources Group, LLC.
2 Righter Parkway, Suite 200
Wilmington, DE 19803

Project
AOI-5 SITE CHARACTERIZATION REPORT/REMEDIAL ACTION COMPLETION REPORT
PES PHILADELPHIA REFINING COMPLEX
PHILADELPHIA COUNTY PENNSYLVANIA

Drawing Title
GEOLOGIC CROSS SECTION A-A'

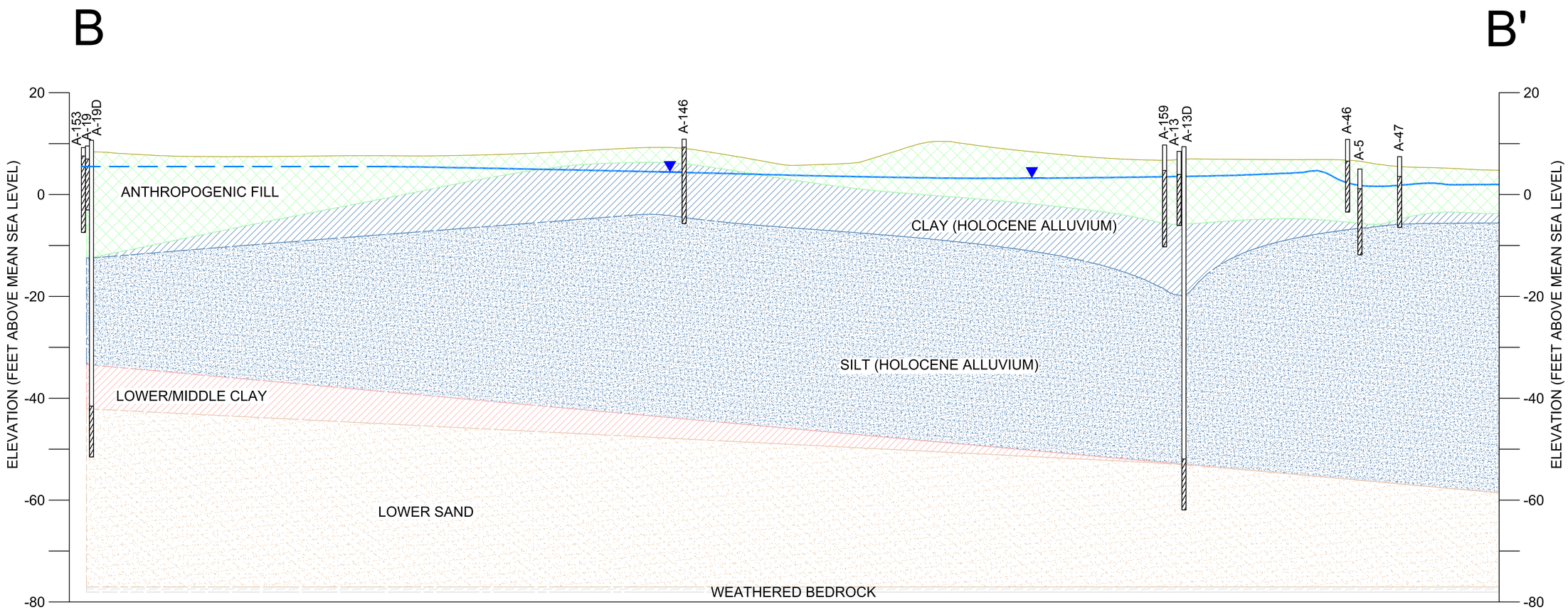
Project No.	2574602
Date	1 DECEMBER 2016
Scale	1"=100' HOR. 1"=5' VER.
Drn. By	MMK
Last Revised	2 DECEMBER 2016

Drawing No.
4A

Filename: \\langan.com\data\DYL\data6\2574601\Cadd Data – 2574601\Dwg\AOI 5 RIR 2016\SCR Geologic Cross-Sections_010417.dwg Date: 2/17/2017 Time: 15:01 User: MMking Style Table: Langan.stb Layout: A-A'

LEGEND:

- ANTHROPOGENIC FILL
- LOWER/MIDDLE CLAY
- CLAY (HOLOCENE ALLUVIUM)
- WATER TABLE
- B-129 LOCATION ID
- WELL CASING
- WELL SCREEN
- SILT (HOLOCENE ALLUVIUM)
- LOWER SAND
- WEATHERED BEDROCK
- INFERRED WATER TABLE



NOTES:

1. GEOLOGIC CROSS SECTION WAS CREATED FROM THE 3D GEOLOGIC MODEL OF AOI 5, WHICH WAS GENERATED IN EARTH VOLUMETRIC STUDIO (EVS) SOFTWARE.
2. THE WATER TABLE SURFACE WAS INTERPOLATED IN EVS USING THE GROUNDWATER ELEVATION DATA COLLECTED DURING THE OCTOBER 2014 GAUGING EVENT BY AQUATERRA TECHNOLOGIES, INC.
3. MONITORING WELL A-19 HAS BEEN DESTROYED, AND MONITORING WELL A-153 WAS UNABLE TO BE LOCATED DURING THE OCTOBER 2014 GAUGING EVENT. THEREFORE, THE WATER TABLE SURFACE IS INFERRED AT THESE WELLS.

5 0 1 2 5
VERTICAL SCALE IN FEET

100 0 50 100
HORIZONTAL SCALE IN FEET

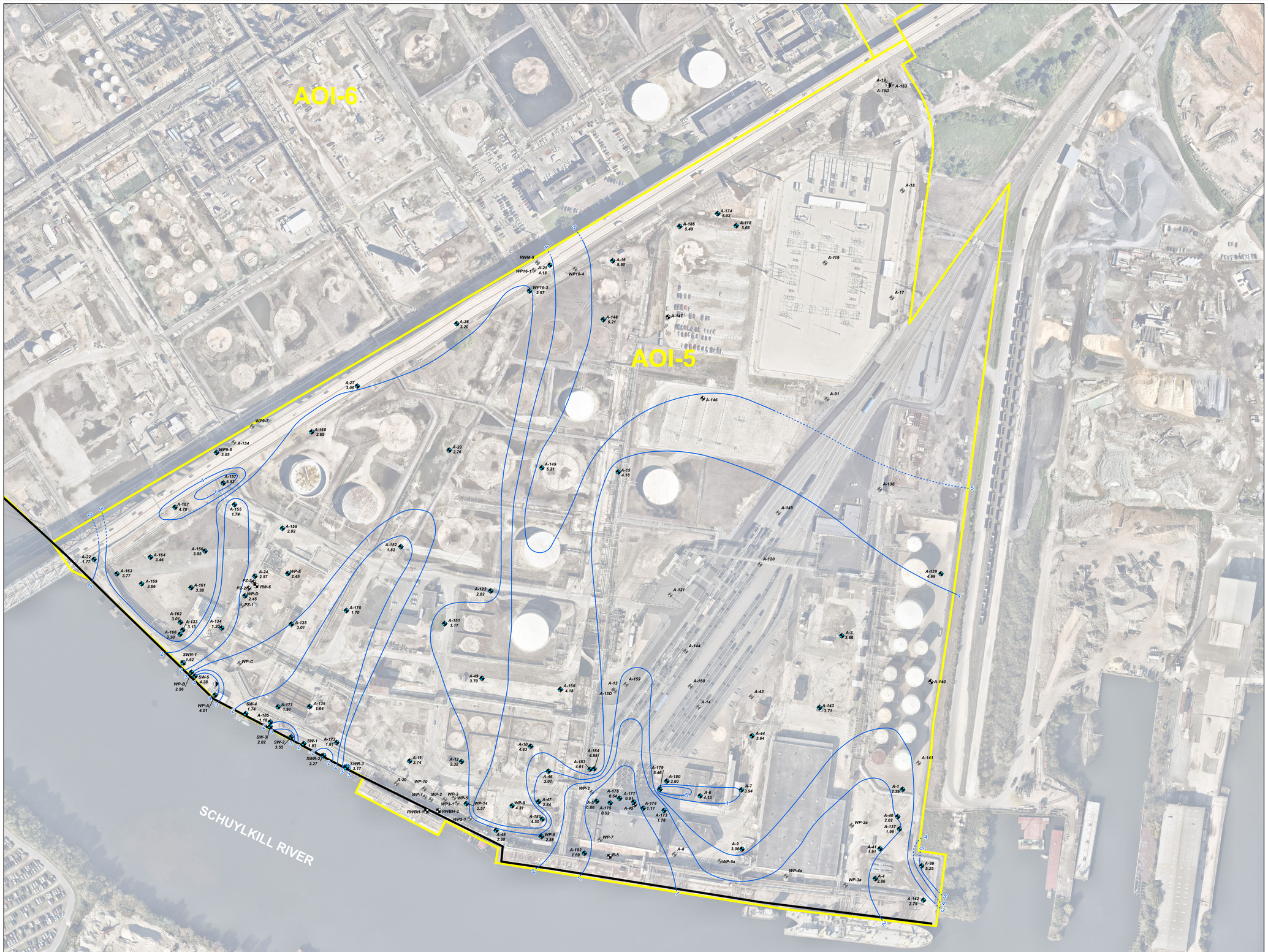
Philadelphia Refinery Operations
A Series of Evergreen Resources Group, LLC.
2 Righter Parkway, Suite 200
Wilmington, DE 19803

Project
AOI-5 SITE CHARACTERIZATION REPORT/REMEDIAL ACTION COMPLETION REPORT
PES PHILADELPHIA REFINING COMPLEX
PHILADELPHIA COUNTY PENNSYLVANIA

Drawing Title
GEOLOGIC CROSS SECTION B-B'

Project No. 2574602	Drawing No. 4B
Date 1 DECEMBER 2016	
Scale 1"=100' HOR. 1"=5' VER.	
Drn. By MMK	
Last Revised 2 DECEMBER 2016	

Filename: \\langan.com\data\DYL\data6\2574601\Cadd Data – 2574601\Dwg\AOI 5 RIR 2016\SCR Geologic Cross-Sections_010417.dwg Date: 2/17/2017 Time: 15:02 User: MMking Style Table: Langan.stb Layout: B-B'



Legend

- A-151 — Unconfined Aquifer Monitoring Well and Groundwater Elevation (ft.)
- SWR-1 — Unconfined Aquifer Recovery Well and Groundwater Elevation (ft.)
- Lower Aquifer Monitoring Well
- Unconfined Aquifer Monitoring Well
- Unconfined Aquifer Piezometer
- Unconfined Aquifer Recovery Well
- Monitoring Well Abandoned/Damaged/ Unable to Locate
- Groundwater Contour (ft - amsl)
- Inferred Groundwater Contour (ft - amsl)
- Sheet Pile Wall
- AOI Boundary
- ft - amsl — Feet above mean sea level

Notes:
1. Aerial imagery provided by Nearmap.com as is dated 07/29/15.
2. Area of Interest boundaries referenced from 2011 ALTA/ACSM Land Title Survey, prepared for Sunoco Inc. (R&S).
3. Groundwater gauging completed in July 2014 by Aquaterra.

Figure 5: Unconfined Groundwater Elevation Contour Plan (July 2014)
AOI-5 Site Characterization Report/
Remedial Action Completion Report
PES Philadelphia Refining Complex
Philadelphia, Pennsylvania

Philadelphia Refinery Operations
A Series of Evergreen Resources Group, LLC.
2 Righter Parkway, Suite 200
Wilmington, DE 19803

0 150 300 Feet

SCALE: 1" = 150'
DATE: 11/23/2016
DRN. BY: AJC
CKD. BY: KM
JOB#: 2574602

Path: \\aquaterra.com\data\DYL\data\62574601\ArcGIS\MapDocuments\AOI 5 Tank SCR 2016\Figure 5 - Shallow GW Elevation Contour Plan (July 2014)_010417.mxd

AOI-6

AOI-5

SCHUYLKILL RIVER

N

W E

S

Legend

- A-151 2.39 — Unconfined Aquifer Monitoring Well and Groundwater Elevation (ft.)
- SWR-1 2.83 — Unconfined Aquifer Recovery Well and Groundwater Elevation (ft.)
- Lower Aquifer Monitoring Well
- Unconfined Aquifer Monitoring Well
- Unconfined Aquifer Piezometer
- Unconfined Aquifer Recovery Well
- Monitoring Well Abandoned/Damaged/ Unable to Locate
- 1 — Groundwater Contour (ft - amsl)
- Inferred Groundwater Contour (ft - amsl)
- Sheet Pile Wall
- AOI Boundary
- ft - amsl — Feet above mean sea level

Notes:
1. Aerial imagery provided by Nearmap.com as is dated 07/29/15.
2. Area of Interest boundaries referenced from 2011 ALTA/ACSM Land Title Survey, prepared for Sunoco Inc. (R&S).
3. Groundwater gauging completed in October 2014 by Aquaterra.

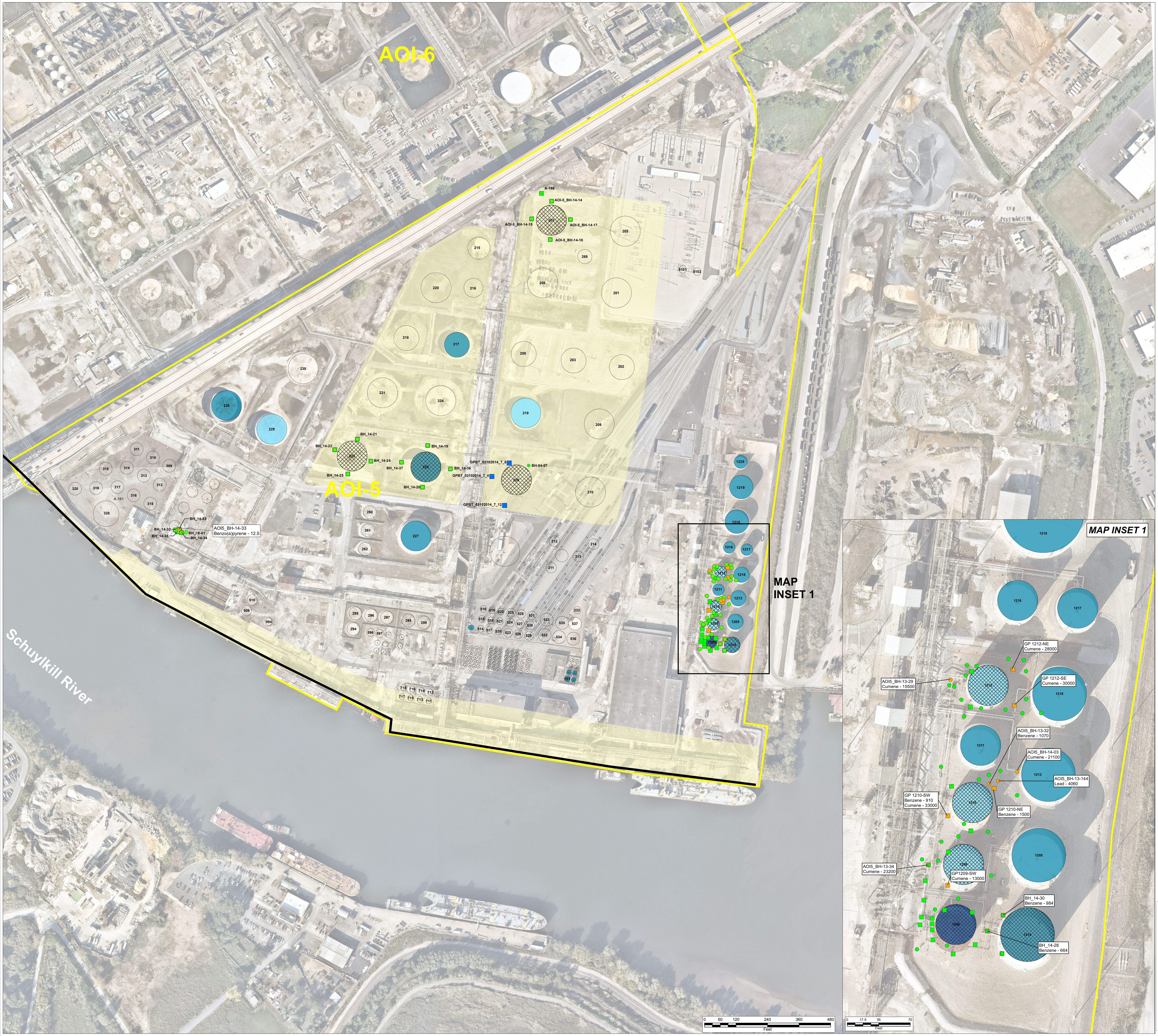
Figure 6: Unconfined Groundwater Elevation Contour Plan (October 2014)
AOI-5 Site Characterization Report/
Remedial Action Completion Report
PES Philadelphia Refining Complex
Philadelphia, Pennsylvania

Philadelphia Refinery Operations
A Series of Evergreen Resources Group, LLC.
2 Righter Parkway, Suite 200
Wilmington, DE 19803

0 150 300 Feet

SCALE: 1" = 150'
DATE: 11/23/2016
DRN. BY: AJC
CKD. BY: KM
JOB# 2574602

Path: \\langan.com\data\DYL\data6\2574601\ArcGIS\MapDocuments\AOI 5 Tank SCR 2016\Figure 6 - Shallow GW Elevation Contour Plan (October 2014)_010417.mxd



N
W E
S

Legend

- Surface Soil Boring Location with No Exceedance of Direct Contact MSCs or SSS For Lead
- Surface Soil Boring Location with Exceedance of Direct Contact MSCs or SSS For Lead
- Subsurface Soil Boring Location with No Exceedance of Direct Contact MSCs
- Subsurface Soil Boring Location with Exceedance of Direct Contact MSCs
- BH-01-07 Soil Boring
- Sheet Pile Wall
- 1212 Closed in Place
- 1208 Closed in Place Tank With Open Incident
- 1214 Active Tank With Open Incident
- 207 Removed Tank With Open Incident
- 219 Tank Currently Out of Service
- 1215 Tank In Service
- 218 Removed Tank
- Solid Waste Management Unit (SWMU)
- AOI Boundary

Site-Specific Standard (SSS)

Lead - 2,240 mg/kg

Notes:
1. Boundary of SWMUs and sheet pile wall referenced from RCRA Facility Investigation Chevron Refinery Vol 1, Dames and Moore, 11-24-93.
2. Aerial imagery provided by Nearmap.com as is dated 07/29/15.
3. Historic soil sample locations referenced in the Aboveground Storage Tank Closure Assessment Report for GP 1209, 1210, and 1212 (Stantec, April 18, 2012), and the Aboveground Storage Tank GP-1208 Closure in Place Sampling Activities Report (Secor, Sept. 12, 2007).
4. Area of Interest boundaries referenced from 2011 ALTA/ACSM Land Title Survey, prepared for Sunoco Inc. (R&S).
5. All results are displayed in milligrams per kilogram (mg/kg)

Figure 7: Summary of AST and UST Soil Sample and Exceedances
AOI-5 Supplemental Tank
Site Characterization Report
PES Philadelphia Refining Complex
Philadelphia, Pennsylvania

Philadelphia Refinery Operations
A Series of Evergreen Resources Group, LLC.
2 Righter Parkway, Suite 200
Wilmington, DE 19803

SCALE: See Map
DATE: June 9, 2016
DRN. BY: MH
CKD. BY: KM
JOB#: 2574602

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APPENDIX A

PADEP CORRESPONDENCE AND PREVIOUS TANK INVESTIGATIONS/REMEDIATION EFFORTS

(on CD)

APPENDIX B

EVERGREEN QA/QC PLAN AND FIELD PROCEDURES MANUAL

LANGAN

Quality Assurance/ Quality Control Plan and Field Procedures Manual

Sunoco Partners Marcus Hook Industrial Complex and Philadelphia Energy Solutions (PES) Philadelphia Refinery Complex

Evergreen Resources Management Operations
May 20, 2016

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Appendix

1.0 INTRODUCTION

This Quality Assurance/Quality Control Plan and Field Procedures Manual (QA/QC Plan) outlines the procedures developed to ensure the collection and analysis of quality data for investigations completed under the United States Environmental Protection Agency (USEPA) Resource Conservation and Recovery Act (RCRA), Pennsylvania Department of Environmental Protection (PADEP) Act 2, and Pennsylvania and Delaware's Tank programs at the Sunoco Partners Marketing and Terminals, LP (Sunoco Partners) Marcus Hook Industrial Complex (MHIC) and the Philadelphia Energy Solutions Refining and Marketing, LLC (PES) Philadelphia Refinery Complex (PRC) on behalf of Evergreen Resources Management Operations (Evergreen). This document shall be used in conjunction with the site-specific work plans developed for each site and Standard Operating Procedures (SOPs) for field work as incorporated as Appendix A of this QA/QC Plan.

The QA/QC Plan is a planning document that provides a "blueprint" for obtaining the type and quality of data needed to support environmental decision making. The QA/QC Plan integrates relevant technical and quality aspects of a project and documents quality assurance and quality control.

The selection criteria and evaluation specified in this document will be used for validating the data in accordance with the USEPA Guidance on Environmental Data Verification and Data Validation (USEPA 240-R-02-004), dated November 2002 (EPA QA/G-8), USEPA Contract Laboratory Program National Functional Guidelines (NFGs) for Superfund Organic Methods Data Review (USEPA 540-R-08-01), dated June 2008 (SOM02.2) and USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review (USEPA 540-R-10-011), dated January 2010 (ISM02.2). Qualifiers assigned to the data will be consistent with the data qualifiers specified in the NFGs and the USEPA Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (USEPA 540-R-08-01), collectively referred to herein as validation guidance.

2.0 QUALITY CONTROL REQUIREMENTS

The field and laboratory QC requirements for the characterization and remediation activities are discussed in the following subsections. Specific QC checks and acceptance criteria are provided in the referenced analytical methods.

2.1 Field Sampling Quality Control

The field QC requirements include analyzing reference standards for field instrument calibration and for routine calibration verifications. All initial and continuing calibration procedures will be implemented by trained personnel following the manufacturer's instructions to ensure the equipment is functioning within the specified tolerances. The calibration and maintenance history of the project-specific field instrumentation will be maintained in an active field logbook.

Field QC samples for this project include field duplicate samples to assess the overall precision of the sampling and analysis event, equipment rinse blanks to ensure proper cleaning of non-dedicated equipment is conducted between samples to avoid potential cross contamination (also generally referred to as field blanks), and trip blank samples to monitor cross contamination of water samples by volatile organic compounds (VOCs) during sample transport.

The frequency of collection of equipment rinse blanks will be one per sampling event. Field duplicate samples will only be prepared for groundwater samples, not for soil sampling events, at a collection frequency of 1 in 20 samples. One trip blank will be included for every shipment of samples to an analytical laboratory, at a minimum frequency of one trip blank per sample shipment which contains samples for VOCs analyses.

2.2 Analytical Quality Control

The laboratory QC requirements for the analyses may include evaluating chemical/thermal preservation, holding times, handling requirements, method blanks, instrument performance checks, initial calibration standards, calibration verification standards, internal standards, surrogate compound spikes, interference check samples, serial dilution samples, matrix spike/matrix spike duplicate (MS/MSD) samples, and laboratory control samples (LCS). The

acceptance criteria for the above identified requirements will be generated by the laboratory and included in the laboratory reports, along with the other laboratory QC requirements.

3.0 DATA VERIFICATION, VALIDATION, AND USABILITY

All field and laboratory data will be reviewed, verified, and/or validated. These terms are defined as follows:

- Data review is the in-house examination to ensure that the data have been recorded, transmitted, and processed correctly.
- Data verification is the process for evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, and/or contractual requirements.
- Data validation is an analyte-specific and sample-specific process that extends the evaluation of data beyond method, procedure, or contractual compliance (i.e., data verification) to determine the quality of a specific data set relative to the end use.

Field data and logbooks will be reviewed to ensure that the requirements of the sampling program, including the number of samples and locations, sampling, and sample handling procedures, were fulfilled.

Data verification, validation, and usability assessments performed on a percentage of lab packages to ensure that the data are scientifically defensible, properly documented, of known quality, and meet the project objectives, are described in the following sections. Data determined to be unusable may require corrective action be taken. Data use limitations will be identified in the data validation and usability assessment (VUA) report, which will be generated as required for characterization or final reporting to the agencies.

3.1 Data Review, Verification, and Validation Requirements

Data review, verification, and validation of the analytical data will be performed by each consultant completing the field activities. The exception to this scenario will be Aquaterra Technologies, Inc. (Aquaterra), in which case Aquaterra will review/verify the data and the consultant company working with Aquaterra will subsequently validate the samples.

Field information will be reviewed to ensure that all field measurements were conducted in accordance with the requirements of the site-specific work plan and this QA/QC Plan including applicable SOPs. Field measurements obtained using procedures inconsistent with the

requirements of these documents will be evaluated and may require that additional samples are collected or the use of the data be restricted.

Stage 1 Verification and Validation Checks

One hundred percent of the sample results will go through a Stage 1 verification and validation. As part of the data management process, each consultant will complete verification and validation based on the validation guidance. Data verification and validation will consist of the following items based on the guidance stated.

Stage 1 verification and validation of the laboratory analytical data package consists of checks for the compliance of sample receipt conditions, sample characteristics (e.g., percent moisture), and analytical results (with associated information). It is recommended that the following minimum baseline checks (as relevant) be performed on the laboratory analytical data package received for a Stage 1 validation label:

1. Documentation identifies the laboratory receiving and conducting analyses, and includes documentation for all samples submitted by the project or requester for analyses.
2. Requested analytical methods were performed and the analysis dates are present.
3. Requested target analyte results are reported along with the original laboratory data qualifiers and data qualifier definitions for each reported result.
4. Requested target analyte result units are reported.
5. Requested reporting limits for all samples are present and results at and below the requested (required) reporting limits are clearly identified (including sample detection limits if required).
6. Sampling dates (including times if needed), date and time of laboratory receipt of samples, and sample conditions upon receipt at the laboratory (including preservation, pH and temperature) are documented.
7. Sample results are evaluated by comparing sample conditions upon receipt at the laboratory (e.g., preservation checks) and sample characteristics (e.g., percent moisture) to the validation guidance.

Stage 2 Verification and Validation Checks

A minimum of 10 percent of the samples will be flagged for VUA. When a laboratory work order is selected, the entire work order will undergo Stage 2 validation. Laboratory work orders or sample delivery groups (SDGs) that are selected for VUA will undergo validation based on the NFGs.

The selection of samples that will undergo VUA process is designed to meet the needs of the site investigation, characterization, remediation, and closure programs, such as tank closures. Sampling that falls outside these programs will not undergo the VUA process. This includes samples that are collected for permit compliance, such as RCRA and effluent wastewater, as well as product samples, onsite soil reuse samples, and waste characterization samples.

Ten percent of samples will be selected based on the following additional conditions:

1. Sample package selected will contain a field duplicate sample.
2. Sample package selected will contain an equipment rinse blank.
3. Sample package selected will be representative of the contracted analytical laboratories, sample media, parameters, time, and project goals.

QC samples that are collected in the field will provide the best information for completing the VUA reports. The conditions for selection of samples are designed to provide the most useful information regarding sample analysis. Therefore, field duplicate samples have been identified as a priority condition. However, field duplicate samples will only be prepared for groundwater samples, not for soil sampling events. This is due to the known, inherent heterogeneity of soil at the sites. For program efficiency, entire SDGs will be selected for submission in the VUA process. Individual samples should not be selected and processed unless there is an overriding reason to do so, such as a point of compliance sample result that when compared to the historic data set appears to be anomalous.

Stage 2 data validation includes a review of the following QC data deliverables:

1. Technical holding times
2. Method blanks
3. Surrogate spikes
4. MS/MSD results
5. LCS results
6. Field duplicates

7. Trip and equipment rinse blank samples

Stage 2B Verification and Validation Checks

Stage 2B verification and validation will be completed on inorganic analytical data and will contain the following (in addition to Stage 1 verification):

1. Requested methods (handling, preparation, cleanup, and analytical) are performed.
2. Method dates (including dates, times and duration of analysis for radiation counting measurements and other methods, if needed) for handling (e.g., Toxicity Characteristic Leaching Procedure), preparation, cleanup and analysis are present, as appropriate.
3. Sample-related QC data and QC acceptance criteria (e.g., method blanks, surrogate recoveries, deuterated monitoring compounds (DMC) recoveries, laboratory control sample (LCS) recoveries, duplicate analyses, matrix spike and matrix spike duplicate recoveries, serial dilutions, post digestion spikes, standard reference materials) are provided and linked to the reported field samples (including the field quality control samples such as trip and equipment blanks).
4. Requested spike analytes or compounds (e.g., surrogate, DMCs, LCS spikes, post digestion spikes) have been added, as appropriate.
5. Sample holding times (from sampling date to preparation and preparation to analysis) are evaluated.
6. Frequency of QC samples is checked for appropriateness (e.g., one LCS per twenty samples in a preparation batch).
7. Sample results are evaluated by comparing holding times and sample-related QC data to the requirements in the data validation guidance.
8. Initial calibration data (e.g., initial calibration standards, initial calibration verification [ICV] standards, initial calibration blanks [ICBs]) are provided for all requested analytes and linked to field samples reported. For each initial calibration, the calibration type used is present along with the initial calibration equation used including any weighting factor(s) applied and the associated correlation coefficients, as appropriate. Recalculations of the standard concentrations using the initial calibration curve are present, along with their associated percent recoveries, as appropriate (e.g., if required by the project, method, or contract). For the ICV standard, the associated percent recovery (or percent difference, as appropriate) is present.
9. Appropriate number and concentration of initial calibration standards are present.

10. Continuing calibration data (e.g., continuing calibration verification [CCV] standards and continuing calibration blanks [CCBs]) are provided for all requested analytes and linked to field samples reported, as appropriate. For the CCV standard(s), the associated percent recoveries (or percent differences, as appropriate) are present.
11. Reported samples are bracketed by CCV standards and CCBs standards as appropriate.
12. Method specific instrument performance checks are present as appropriate (e.g., tunes for mass spectrometry methods, DDT/Endrin breakdown checks for pesticides and aroclors, instrument blanks and interference checks for ICP methods).
13. Frequency of instrument QC samples is checked for appropriateness (e.g., gas chromatography-mass spectroscopy [GC-MS] tunes have been run every 12 hours).
14. Sample results are evaluated by comparing instrument-related QC data to the requirements in the data validation guidance.

Stage 3 Verification and Validation Checks

Stage 3 verification and validation will be completed on organic analytical data and will contain the following (in addition to Stage 2B):

1. Instrument response data (e.g., GC peak areas, ICP corrected intensities) are reported for requested analytes, surrogates, internal standards, and DMCs for all requested field samples, matrix spikes, matrix spike duplicates, LCS, and method blanks as well as calibration data and instrument QC checks (e.g., tunes, DDT/Endrin breakdowns, interelement correction factors, and Florisil cartridge checks).
2. Reported target analyte instrument responses are associated with appropriate internal standard analyte(s) for each (or selected) analyte(s) (for methods using internal standard for calibration).
3. Fit and appropriateness of the initial calibration curve used or required (e.g., mean calibration factor, regression analysis [linear or non-linear, with or without weighting factors, with or without forcing]) is checked with recalculation of the initial calibration curve for each (or selected) analyte(s) from the instrument response.
4. Comparison of instrument response to the minimum response requirements for each (or selected) analyte(s).
5. Recalculation of each (or selected) opening and closing CCV (and CCB) response from the peak data reported for each (or selected) analyte(s) from the instrument response, as appropriate.

6. Compliance check of recalculated opening and/or closing CCV (and CCB) response to recalculated initial calibration response for each (or selected) analyte(s).
7. Recalculation of percent ratios for each (or selected) tune from the instrument response, as appropriate.
8. Compliance check of recalculated percent ratio for each (or selected) tune from the instrument response.
9. Recalculation of each (or selected) instrument performance check (e.g., DDT/Endrin breakdown for pesticide analysis, instrument blanks, interference checks) from the instrument response.
10. Recalculation and compliance check of retention time windows (for chromatographic methods) for each (or selected) analyte(s) from the laboratory reported retention times.
11. Recalculation of reported results for each reported (or selected) target analyte(s) from the instrument response.
12. Recalculation of each (or selected) reported spike recovery (surrogate recoveries, DMC recoveries, LCS recoveries, duplicate analyses, matrix spike and matrix spike duplicate recoveries, serial dilutions, post digestion spikes, standard reference materials etc.) from the instrument response.
13. Each (or selected) sample result(s) and spike recovery(ies) are evaluated by comparing the recalculated numbers to the laboratory reported numbers according to the requirements in the data validation guidance.

Stage 4 Verification and Validation Checks

Additional data validation may be completed for selected sites and/or sampling events, up to EPA Level 4 data review, which will require a laboratory data package inclusive of raw data. Stage 4 verification and validation includes all of the elements of the previous stages of validation and the following:

1. Evaluation of instrument performance checks (GC/MS)
2. Initial and continuing calibration checks (organic and inorganic analyses)
3. Review of internal standards (GC/MS)
4. Instrument blanks (inorganics)
5. Interference check samples (metals)
6. Recalculations of sample results and reporting limits

3.2 Validation Codes

Consultant specific validation codes will be added to the database. This will allow quick identification of the consultant that has performed the verification and/or VUA. Stantec may append additional codes for data management purposes to the codes provided in dt_result table approval_code field. Valid codes are as follows:

Langan:

- LAN1 – Historical data collected by Langan Level 1 Validation (Verification)
- LAN-VER – Langan performed verification
- LAN-USB – Langan performed usability

GHD:

- GHD-VER – GHD performed verification
- GHD-USB – GHD performed usability

Stantec:

- STN-VER – Stantec performed verification
- STN-USB – Stantec performed usability

This methodology creates a means for consultants to perform verification and usability on data collected by another consultant.

3.3 Data Updates in the Electronic Data Deliverables

All consultants will request EQuIS 4 file format Electronic Data Deliverables (EDDs) for data management from the analytical laboratories. In order to facilitate the data updates in the database, the following methodology will be used.

1. The consultant chemist / chemist team will open the .RES file for the EDD that has been selected to be validated for usability. The file can be opened using Excel, Access, Notepad, or similar tool. Although, it is a best practice to open the file in a way to preserve the textual nature of the EDD, it is not necessary.
2. The chemist will use the result_comment field in the .RES file to enter the qualifiers associated with the record and add a semicolon as a delimiter (;) followed by the reason code for the qualification.

3. The .RES file is to be saved with a .USB extension at the end of the file. This file is to be separate from the original .RES file provided and should not be used to over write the original .RES file that was sent with the EDD. This will result in the laboratory work order undergoing VUA having five files instead of four for the EDD. For example:
    - 1234.SMP
    - 1234.TST
    - 1234.BCH
    - 1234.RES
    - 1234.RES.USB
4. Stantec will use the fifth file to update the database with the appropriate qualifiers and codes in validator_qualifiers and approval_a through approval_d fields in dt_result table in the database.
5. Stantec will also change the validated y/n field in dt_result table in the database for the particular EDD.

3.4 Validation Qualifiers

The following qualifiers should be used during the validation/usability process. These are based on the NFGs, validation guidance, and commonly used qualifiers.

Data Qualifiers and Definitions

U The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

J The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

J+ The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample, potentially biased high.

J- The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample, potentially biased low.

UJ The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

NJ The analyte has been "tentatively identified" or "presumptively identified" as present and the associated numerical value is the estimated concentration in the sample.

R The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.

B The analyte was detected in the method, field, and/or trip blank. This qualifier is not pursuant to the NFGs.

If additional qualifiers are required, please forward the suggestions to the Stantec Data Management Team and they will be added to the list of approved codes.

Submitting Data and Validation Codes for Inclusion in the Database

EDDs will be submitted to the database using the SharePoint portal intake forms. The appropriate qualifiers and codes that have been added to the result_comment field in the .RES.USB file will be included in the submission.

Reason Codes

Following is a list of reason codes available for validation. If additional codes are required, please forward the suggestions to the Stantec Data Management Team and they will be added to the list of approved codes.

Reason Code	Reason Description
General Use	
EC	Result exceeds the calibration range.
HT	Holding time requirement was not met
MB	Method blank or preparation blank contamination
LCS	Laboratory control sample evaluation criteria not met
FB	Field blank contamination
RB	Rinsate blank contamination
SQL	The analysis meets all qualitative identification criteria, but the measured concentration is less than the reporting limit.
FD	Field duplicate evaluation criteria not met
TvP	Total to Partial criteria not met
RL	Reporting limit exceeds decision criteria (for non-detects)
Inorganic Methods	
ICV	Initial calibration verification evaluation criteria not met
CCV	Continuing calibration verification evaluation criteria not met
CCB	Continuing calibration blank contamination
PB	Preparation Blank
ICS	Interference check sample evaluation criteria not met
D	Laboratory duplicate or spike duplicate precision evaluation criteria not met
MS	Matrix spike recovery outside acceptance range
PDS	Post-digestion spike recovery outside acceptance range
MSA	Method of standard additions correction coefficient _0.995
DL	Serial dilution results did not meet evaluation criteria
Organic Methods	
TUNE	Instrument performance (tuning) criteria not met
ICAL	Initial calibration evaluation criteria not met
CCAL	Continuing calibration evaluation criteria not met
SUR	Surrogate recovery outside acceptance range
MS/SD	Matrix spike/matrix spike duplicate precision criteria not met
MS	Matrix spike recovery outside acceptance range
IS	Internal standard evaluation criteria not met
LM	The PFK lock mass SICPs indicate that ion suppression evident
ID	Target compound identification criteria not met
Results Reported for Analytes Analyzed Multiple Times	
NSR	Not selected for reporting because the result was qualified as unusable
NSDL	Not selected for reporting because diluted resulted was selected for reporting
NSQ	Not selected for reporting because result was lesser quality based on data validation
NSO	Not selected for reporting because of other reason
Bias Codes	
H	Bias in sample result likely to be high
L	Bias in sample result likely to be low
I	Bias in sample result is indeterminate

3.4 Verification and Validation Summary

Verification of sample collection procedures will consist of reviewing sample collection documentation for compliance with the requirements of the site-specific work plan and this QA/QC Plan. If alternate sampling procedures were used, the acceptability of the procedure will be evaluated to determine the effect on the usability of the data. Data usability will not be affected if the procedure used is determined to be an acceptable alternative that fulfills the measurement performance criteria in this QA/QC Plan.

The results of the data verification and validation procedure will identify data that do not meet the measurement performance criteria of this QA/QC Plan. Data verification and validation will determine whether the data are acceptable, of limited usability (qualified as estimated), or rejected. Data qualified as estimated will be reviewed and a discussion of the usability of estimated data will be included in the VUA report.

Data determined to be unusable may require corrective action to be taken. Potential types of corrective action may include resampling by the field team or reanalysis of samples by the laboratory. The corrective actions taken are dependent upon the ability to mobilize the field team and whether or not the data are critical for project data quality objectives to be achieved. Data use limitations will be identified in VUA report, which will be generated as required for characterization or final reporting to the agencies. Each consultant will be responsible for their own VUA reports.

Revision History

Revision	Description	Prepared By	Date
1.0	Initial creation of document as SOP for VUA	Stantec (Gus Sukkurwala/Jennifer Menges/Andrew Bradley)	5/31/2015
2.0	Incorporation into QA/QC Plan	GHD (Colleen Costello)	3/21/2016
3.0	Inclusion of Field Procedures. Edits from Langan (Emily Strake & Kevin McKeever)	Stantec (Jennifer Menges)	5/13/2016

APPENDIX A
EVERGREEN FIELD PROCEDURES MANUAL

Evergreen
Field Procedures Manual

Sunoco Partners Marcus Hook Industrial Complex and Philadelphia Energy Solutions (PES) Philadelphia Refinery Complex

Evergreen Resources Management Operations

May 20, 2016

Table of Contents

1.0 INTRODUCTION

This Field Procedures Manual outlines the standard operating procedures developed to ensure the collection and analysis of quality data for investigations completed under the United States Environmental Protection Agency (USEPA) Resource Conservation and Recovery Act (RCRA) program, Pennsylvania Department of Environmental Protection (PADEP) Act 2 program and Pennsylvania and Delaware's Tank programs at the Sunoco Partners Marketing and Terminals, LP (Sunoco Partners) Marcus Hook Industrial Complex (MHIC) and the Philadelphia Energy Solutions Refining and Marketing, LLC (PES) Philadelphia Refinery Complex (PRC) on behalf of Evergreen Resources Management Operations (Evergreen). The MHIC and PRC are herein referred to as facility or site.

Evergreen's consultants collect data in pursuit of site characterization and remediation that will meet the expectations of the appropriate regulatory agencies. This document shall be used in conjunction with the site-specific work plans developed for each site and the QA/QC Plan of which this manual was incorporated as Appendix A.

1.1 Training Qualifications

All field personnel involved in field work at MHIC and the PRC shall have completed and where applicable, be current with OSHA 40-hour HAZWOPER training, annual OSHA 8-hour HAZWOPER refresher, Process Safety Management (PSM) training, site-specific safety module training for current facility badges (including fire watch and hole watch, if required), TWIC Card, annual drug screening, and annual respirator fit testing. All field personnel new to the facility should be provided with onsite health and safety (H&S) orientation by an experienced member of the project team. The onsite orientation should include review of the facility's emergency action plan and training on Evergreen and site-specific H&S requirements. Appropriately qualified personnel should perform field work, based on the work scope and experience level required by the task to be executed.

1.2 Health and Safety Requirements

All consultants performing work at the referenced sites on behalf of Evergreen shall comply with the *Evergreen Resources Management Operations Health and Safety Requirements* dated June 1, 2014. This includes contractors, sub-contractors, and third party companies performing

work for Evergreen at MHIC and the PES PRC. Each consultant must also have their own site-specific health and safety plan (HASP) submitted to and approved by Evergreen prior to performing any work. A site-specific HASP must be reviewed and signed by all field personnel prior to commencement of field activities.

1.3 PPE Requirements

The minimum standard PPE at the facilities includes fire resistant clothing (FRC; coveralls may be Nomex or other FRC, 6 ounce minimum, orange in color) with the name of the company displayed on the back of the garment, hard hat, sturdy safety-toe boots, safety glasses, long-gauntlet leather gloves, and personal H_2S monitors. Nitrile gloves for chemical protection and hearing protection may also be required depending on the location and type of work. Workers are to be trained on these PPE requirements before being permitted onsite. An appropriate respirator may be required if site-specific air monitoring action levels are met, in accordance with the site-specific HASP. If a worker has a particular sensitivity or concern, a respirator may be worn regardless of OSHA action levels. During winter weather conditions, slip prevention footwear such as crampons or overshoes should be worn for traction. Task-specific PPE will be further identified in following sections.

1.4 Site Controls

Safety cones and/or caution tape should be used in high traffic areas. The "Buddy System" may also be employed in high traffic areas, in areas where other contractors are working, and in remote areas. Additional task-specific site controls will be detailed in following sections.

1.5 Equipment and Decontamination

Numerous practices are employed throughout the processes of site investigation and sampling to assure the integrity of the resulting data. The risk in use of non-dedicated equipment at multiple sampling locations lies in the potential for cross-contamination. While the threat of cross-contamination is always present, it can be minimized through the implementation of a consistent decontamination program during sensitive site measurement and data collection activities.

All site equipment to be used in multiple locations (non-dedicated) for sampling of soil, sediment, and/or groundwater will be decontaminated immediately prior to initial use and between uses at each location according to the following steps:

- Remove particulates with a sorbent pad or towel and/or initial rinse with clean potable tap water;
- Wash equipment with clean sponge, soft cloth, or scrub brush as necessary in a solution of tap water/laboratory grade detergent (Alconox®, Liquinox®, or equivalent);
- Rinse with tap water;
- Rinse with deionized or distilled water; and
- Air dry for as long as possible.

Rinse water generated during decontamination procedures will be treated onsite by passing the water through a bucket or tube filled with activated carbon prior to discharge to the ground surface. Additional decontamination procedures may be appropriate depending on the task, and will be identified in the following sections, as applicable.

1.6 Documentation

All site activities and conditions for characterization activities should be recorded by field personnel in a field computer (e.g., YUMA) using the EQuIS Data Gathering Engine (EDGE) application, or if necessary, a field book may be used. The entry shall include at a minimum, the date, time, weather conditions, location, personnel present onsite, field readings, sampling methodology, as well as additional comments or observations. Task specific observations which should also be recorded will be identified in the following applicable sections.

2.0 LIQUID LEVEL ACQUISITION (WELL GAUGING) PROCEDURES

2.1 Potential Hazards

Traffic, pinch points, chemical (airborne and physical contact), and biological are all likely hazards to be encountered as well as slip/trip/fall potential during onsite well gauging activities. Additional hazards may be mentioned in the site-specific HASP and/or the daily job safety analysis (JSA).

2.2 Materials and Equipment Necessary for Task Completion

Optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy, decontamination supplies (laboratory-grade detergent, deionized or distilled water, appropriate containers, scrub brush, and sorbent pads or paper towels), socket set, flathead screwdriver (or pry bar or manhole cover lifter), clear bailers with string for confirmation of light non-aqueous phase liquids (LNAPL), if necessary, and air monitoring instruments (optional, based on previous site visits).

2.3 Methodology

This task involves the deployment of an optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy into a well (in most cases), recording the measurement, and decontaminating the probe. The recorded field measurements may then be utilized for one of several applications including: well sampling, water table gradient mapping, LNAPL occurrence, LNAPL thickness, and/or gradient mapping, and various testing procedures. Wells should be gauged in order of least to most contaminated, based on existing sampling data or LNAPL occurrence, to minimize the potential for cross-contamination between wells. If LNAPL is detected in a well that does not typically have LNAPL, it should be confirmed with a clear bailer.

The proper procedure for liquid level acquisition is as follows:

1) Decontaminate the optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy prior to initial deployment, and again after each well measurement to prevent cross-contamination between wells.

2) If warranted, mark off a work area surrounding the well(s) to be gauged with safety cones and/or caution tape in order to protect personnel from auto traffic; the "Buddy System" may also be employed.

3) Where applicable, lift the manhole cover off of the well head (a screwdriver, pry bar, or manhole cover lifter may be used to lift the cover depending on the size of the manhole) or open protective well casing (stickup) and remove the well plug, if present.

4) Most wells should contain a mark or notch in the top edge of the casing from which normalized readings are to be measured (reference point elevation). Slowly lower the optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy into the well until the instrument signals contact with liquid. Note whether or not the instrument's tone is indicative of the presence of free-phase LNAPL (commonly a solid tone), or water (commonly an oscillating or beeping tone). If LNAPL is present, record the depth at which LNAPL was first indicated to the nearest hundredth of a foot, as measured from the top of well casing mark/notch. Slowly lower the probe through the LNAPL until the instrument's tone changes to indicate the presence of water. Record the depth at which water was first indicated to the nearest hundredth of a foot. A clear bailer may be used to verify the existence or approximate amount and appearance of LNAPL. If no LNAPL is apparent, record the depth to water.

5) Retract the probe from the well and secure the well appropriately.

6) Note the date and time of measurement for gauging and record all measurements and observations in the field computer or, if necessary, in a field book for subsequent electronic data entry.

7) Decontaminate the probe in accordance with the decontamination procedure outlined in Section 1.5.

8) Clean up the work area, remove gauging equipment, and remove any traffic control devices.

3.0 GROUNDWATER MONITORING PROCEDURES

3.1 Potential Hazards

Traffic, pinch points, chemical (airborne and physical contact), and biological are all likely hazards to be encountered as well as slip/trip/fall potential during onsite well gauging activities. Additional hazards may be mentioned in the site-specific HASP and/or the daily JSA.

3.2 Materials and Equipment Necessary for Task Completion

A list of equipment required to access, gauge, purge, and sample site monitoring wells is presented below. Also listed are materials necessary to store, label, preserve, and transport groundwater samples.

- Current site map detailing well locations;
- Field book and/or field computer for recording site data;
- Graduated, optical oil/water interface probe;
- Keys and tools to provide well access;
- Appropriate, laboratory prepared sample containers and labels;
- Appropriate well purging apparatus as determined by volume of groundwater to be purged and compounds to be analyzed;
- Water quality meter for monitoring indicator field parameters (DO, pH, specific conductance, redox potential, and turbidity if available);
- Dedicated polyethylene bottom-loading bailer or well pump and disposable tubing for groundwater sample collection;
- Clean nylon or polypropylene bailer cord;
- Disposable nitrile sampling gloves;
- Decontamination supplies;
- Calibrated five-gallon bucket and watch or stopwatch to determine discharge rate during purging;
- Blank chain-of-custody forms; and

- Cooler(s) and ice for sample preservation.

3.3 Methodology for Three Well Volume Sampling

Prior to site visitation for the groundwater sampling event, the following data will be reviewed to ensure proper preparation for field activities:

- Most recent liquid level data from all wells;
- Most recent analytical data from all wells to determine gauging and sampling sequence; and
- Well construction characteristics.

Each monitoring well to be sampled will be gauged to obtain liquid level data immediately prior to initiation of the sampling process (refer to well gauging procedures above). Liquid level data should be recorded in a field computer or if necessary, a field book. Should free-phase LNAPL be detected by the gauging process, routine groundwater sampling will not be conducted at that location. If groundwater sampling under LNAPL is warranted, refer to the sub-LNAPL sampling section and methodology in Section 3.6.

Groundwater sampling will be initiated by purging from the well a minimum of three well volumes, except in cases where the well is pumped dry, as referenced below. Well purging is performed to remove stagnant water and to draw representative water from the aquifer into the well for subsequent sampling and analysis. In extreme cases where a well is pumped dry and/or shows little recharge capacity, the well should be evacuated once prior to sampling. Wellbore storage volume should be estimated using as-built information stored in the field computer or as indicated on the well log, and the depth to water measurement obtained immediately prior to sampling.

Water quality should be monitored and readings recorded in the field computer or field book while purging, typically through use of a multi-parameter water quality meter with a flow through cell or cord for down-well measurements. Water quality readings should be recorded a minimum of three times (pre-purge, during purge, and post-purge/sample collection) or four times (pre-purge and following each well volume). The parameters to be monitored and recorded are

dissolved oxygen, pH, specific conductance, redox potential, temperature, and turbidity if available.

Well purging can be performed with various equipment including: a dedicated bailer for hand bailing low volumes of water; a surface mounted electric centrifugal pump with dedicated polyethylene tubing; and/or submersible pump (particularly when the depth to water is greater than 20 feet) with dedicated polyethylene tubing. During pumping, the intake will be placed directly below the static water surface and slowly lowered during the purging process. This procedure may not be necessary in low-yielding wells but is important in high-yielding, permeable strata where an intake initially placed deep in a well may draw laterally and have little influence in exchanging water from shallower depths within the well bore.

Flow rate during well purging will be approximated by the bucket and stop watch method. The duration of pumping required to remove three well volumes will be calculated directly from this flow rate. All fluids removed during purging will be treated onsite with activated carbon or in accordance with an approved work plan.

The sequence of obtaining groundwater samples will be based upon available historical site data for existing wells and photoionization detector (PID) readings for newly installed wells. Monitoring wells will be sampled in order of those having the lowest to highest concentration of constituents of concern (or PID readings for new wells), based upon the most recent available set of laboratory analyses, to reduce the potential for cross-contamination. For general monitoring events, groundwater samples will not be obtained for analysis from any well containing measurable free product. If groundwater sampling under LNAPL is warranted, refer to the sub-LNAPL sampling section and methodology in Section 3.6.

The following sequence of procedures will be implemented for the collection of groundwater samples from monitoring wells.

1) Establish a clean work area where sampling equipment will not come in contact with the ground or any potentially contaminated surfaces.
2) Use a dedicated polyethylene sampling bailer for each well.
3) Use a clean pair of nitrile gloves.

4) Attach an appropriate length of unused, clean nylon or polypropylene cord to the designated sampling bailer.

5) Select appropriate laboratory-provided sample containers.

6) Slowly lower sampling bailer into well until water surface is encountered; continue to lower the sampling bailer into the standing water column to one foot below the water surface.

7) Retrieve bailer at a steady rate to avoid excess agitation.

8) Visually inspect bailed sample to ensure that no free product or organic detritus has been collected.

9) Uncap first designated sample vial and fill from bailer as rapidly as possible but minimizing agitation; secure septum and lid.

10) Inspect sealed sample for entrapped air; if air is present, remove the lid and gently top off sample in vial, seal and inspect. Repeat until no air is apparent.

11) Repeat Steps 9 and 10 for the remaining sample vials based on the laboratory and/or regulatory protocol.

12) Complete and attach labels to sample containers noting sample collector, date, time, and location of sample; record same data in field computer or field book.

13) Place samples in ice-filled cooler in such a manner as to avoid breakage. Samples will be maintained at a temperature of approximately 4°C.

14) Dispose of gloves, bailer, and bailer cord as solid waste and move to next sample location.

3.4 Methodology for Low-Flow Purging and Sampling

For wells that will be purged and sampled via low-flow methodology, the USEPA Region III Bulletin QAD023: *Procedure for Low-Flow Purging and Sampling of Groundwater Monitoring Wells* will be followed. The following data will be reviewed for each well in order to set the pump intake for the low-flow sampling:

- Soil boring lithologic log;
- Well construction log showing the screened interval;
- Identification of the most permeable zone screened by the well;
- Approximate depth to static water;

- Proposed pump intake setting; and
- Technical rationale for the pump intake setting, preferably across from the most impacted/contaminated subsurface interval.

Adjustable rate, submersible, bladder pumps in conjunction with polyethylene tubing for purging and sampling will be used. An alternate set up could include a stainless steel submersible pump, such as a Hurricane® pump or a Monsoon® pump with dedicated polyethylene tubing. The tubing diameter will be between 3/16-inch and ½-inch inner diameter and the length of the tubing extended outside of the well should be minimized. Flow-through cells will be used to monitor groundwater quality parameters during sampling. Monitoring well information, equipment specifications, water level measurements, parameter readings, and other pertinent information will be recorded during well purging and sampling.

The following sequence of procedures will be implemented for the collection of groundwater samples from monitoring wells by the low-flow methodology.

1) PID Screening of Well: A PID measurement may be collected at the rim of the well immediately after the well cap is removed and recorded in the field computer or field book, if historic data is not available.
2) Depth to Water Measurement: A depth to water measurement will be collected and recorded. To avoid disturbing accumulated sediment and to prevent the inadvertent mixing of stagnant water, measuring the total depth of the well should be done at the completion of sampling.
3) Low Stress Purging Startup: Water pumping will commence at a rate of 100 to 400 milliliters per minute (mL/min). This pumping should cause very little drawdown in the well (less than 0.2-0.3 feet) and the water level should stabilize. Water level measurements are made frequently, and flow rate will be recorded in mL/min on the sampling form or field computer.
4) Low Stress Purging and Sampling: The water level and pumping rate will be monitored and recorded every five minutes during purging, and any pumping rate adjustments will be recorded. During the early phase of purging, emphasis will be placed on minimizing and stabilizing pumping stress, and recording any necessary adjustments. Adjustments, when necessary, will be made in the first 15 minutes of purging. If necessary, pumping rates will

be reduced to the minimum capabilities of the pump to avoid well dewatering. If the minimal drawdown exceeds 0.3 feet, but the water level stabilizes above the pump intake setting, purging will continue until indicator field parameters stabilize, as detailed in Step 5 below. If the water level drops below the pump intake setting at the absolute minimum purge rate, the pump will remain in place and the water level will be allowed to recover repeatedly until there will be sufficient water volume in the well to permit the collection of samples.

5) Indicator Field Parameter Monitoring: During well purging, indicator field parameters (DO, pH, specific conductance, redox potential, and turbidity if available) will be monitored every five minutes (or less frequently, if appropriate). Purging will be considered complete and sampling can commence when all the indicator field parameters have stabilized. Stabilization will be achieved when three consecutive readings, taken at five minute intervals (or less frequently, if appropriate), are within the following limits:
    - DO (±10 percent);
    - turbidity (±10 percent);
    - specific conductance (±3 percent);
    - pH (± 0.1 unit); and
    - redox potential ([Eh] ±10 mv).

    Temperature and depth to water will be also monitored during purging. Should any of the parameter-specific components of the water quality meter fail during monitoring, the sampling team will attempt to locate a replacement multi-meter or individual criteria meter. If none are available, the sampling team will continue recording the parameters that are operational, and proceed with the sampling. Any other field observations relating to sample quality, such as odor, foaming, effervescence, and sheens, will also be recorded in the field computer or on the sampling form.
6) Collection of Ground Water Samples: Water samples for laboratory analyses will be collected prior to the flow-through cell by either using a bypass assembly or by temporarily disconnecting the flow-through cell. All sample containers will be filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence. During purging and sampling, the tubing should remain filled with water in order to minimize possible changes in water chemistry upon contact with the atmosphere. Methods employed to ensure that the outlet tubing will be filled include adjusting the tubing angle upward to

completely fill the tubing and restricting the diameter of the tubing near the outlet of the tubing.

The order in which samples will be collected is as follows:

- Volatile organics;
- Gas sensitive (e.g., Fe^{+2}, CH_4, H_2S/HS);
- Base neutrals or PAHs;
- Total petroleum hydrocarbons;
- Total metals;
- Dissolved metals;
- Cyanide;
- Sulfate and chloride;
- Nitrate and ammonia;
- Preserved inorganic;
- Non-preserved inorganic; and
- Bacteria.

After the appropriate laboratory-provided glassware is filled and labeled, the samples shall be placed in an ice-filled cooler and maintained at approximate 4°C for submittal to the laboratory. Upon completion of sampling at the well, decontaminate non-dedicated equipment in accordance with the decontamination procedure outlined in Section 1.5, and dispose of all dedicated equipment (gloves, tubing, etc.) as solid waste before moving to the next location.

3.5 Methodology for Passive (No-Purge) Sampling for Groundwater Collection

There are many passive groundwater sampling devices that allow for accurate sample collection without purging. Each device has specific uses and conditions for which they are more applicable. This methodology presents details for the use of HydraSleeve samplers.

The HydraSleeve is a disposable, single use device for the collection of representative groundwater samples for laboratory analysis of physical and chemical parameters.

HydraSleeves are placed within the screened interval (or other defined interval) of the well and activated after an equilibrium period. When used according to the manufacturer's instruction, the HydraSleeve will collect a groundwater sample without purging, thus causing no drawdown, agitation, or water column mixing. The HydraSleeve collects a sample from the screened interval only, and excludes water (or other fluids) from other parts of the well by use of check valve that seals when the sampler is full. The HydraSleeve takes advantage of the continuous natural movement of groundwater, which produces an equilibrium condition between the water in a well screen and the adjacent formation. HydraSleeves produce reliable data from low yield wells where other sample methods cannot due to well screen dewatering and associated alteration in water chemistry.

The HydraSleeve consists of the following components:

1) A long (usually 3 to 5 feet), flexible, lay-flat polyethylene sample sleeve, which is sealed at the bottom, and is equipped with a reed valve at the top allowing water to enter the HydraSleeve only during active sample retrieval.
2) A reusable, stainless steel weight attached with a clip to the bottom of the sleeve. The weight is used to carry the sample sleeve down the well to the specified depth (usually the bottom of the well screen). An optional top weight is also available to compress the sleeve in wells with short well screens.
3) A tether line attached to a spring clip at the top of the sample sleeve to deploy the device within the well and later retrieve it for sample collection.
4) A discharge tube is supplied with the device, which is used to puncture the wall of the sleeve after it is recovered to allow direct filling of sample bottles.

Deployment

Upon retrieval, the HydraSleeve is designed to effectively collect a "core" of water from within the well screen, which is equivalent in length and diameter to the sample sleeve. The upward motion opens the valve at the top, which then allows the device to fill with water. The Hydrasleeve should be installed with the top of the sample sleeve as close to the desired sample interval as possible. This will allow the sampler to fill and the check valve to close before the top of the device is pulled past the top of the sample interval.

To assemble and deploy the HydraSleeve:

1) Remove the Hydrasleeve from its package and hold it by the top, pinching the top at the holes.
2) Attach the spring clip and tether in the holes.
3) Slide the clip and bottom weight assembly into the holes at the bottom of the sleeve.
4) Lower the Hydrasleeve by the tether to the bottom or to the specified depth and secure the tether at the wellhead (Note: do not pull the HydraSleeve upward at any time during deployment, as this could cause the check valve to open and water to fill the sleeve inadvertently).

Sample Collection

Although the HydraSleeve only displaces approximately 100 milliliters (ml) of water during deployment, the well should be allowed to stabilize prior to sample collection so that natural flow conditions and contaminant distribution can return to equilibrium conditions. In certain jurisdictions, regulatory directives may prescribe a minimum equilibration period. When used for periodic monitoring programs, such as quarterly or semi-annual sampling, the HydraSleeve can be installed and remain in the well until the next sampling event, thus providing ample time for the well to equilibrate.

To collect a sample:

1) Be sure the tether is secured to the top of the well.
2) In one smooth motion, pull the tether upward at a rate of approximately 1 foot per second. The weight of the sampler will be felt when the valve closes. Continue pulling upward until the HydraSleeve is clear of the well.
3) Discard the water trapped at the top of the HydraSleeve above the reed valve.
4) Hold the HydraSleeve at the reed valve, and puncture the sleeve with the discharge tube just below the reed valve.
5) Decant the water into sample containers.
6) Discard the HydraSleeve as solid waste and process the excess water through activated carbon prior to discharge to the ground surface.

The weight and clips should be decontaminated prior to deploying a replacement HydraSleeve in the well. Tethers can be dedicated to individual wells or decontaminated and reused.

3.6 Methodology for Sub-LNAPL Sampling

The following section describes the methodology used for obtaining groundwater samples from the water column beneath LNAPL. Wells for sub-LNAPL sampling are not purged of three well volumes prior to sampling. This will prevent the potential of drawing LNAPL into the sample and to be representative of steady-state groundwater conditions beneath the LNAPL.

The following data will be reviewed for each well in order determine the appropriate equipment necessary:

- Well construction log showing diameter and total depth of the well;
- Approximate depth to LNAPL; and
- Approximate depth to static water.

A list of equipment for sub-LNAPL sampling is presented below:

- Field book or field computer for recording site data;
- Optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy;
- Keys and tools to provide well access;
- Peristaltic pump;
- Polyethylene tubing specifications of 0.25-inch outer diameter x 0.17-inch inner diameter is preferable as this small diameter assists in achieving lower flow rates;
- Silicone tubing of appropriate diameter to operate peristaltic pump;
- Polyvinyl chloride (PVC) drop tube (1.5-inch or other appropriate diameter);
- PVC rod (0.5-inch or other appropriate diameter);
- PVC end cap for drop tube;
- Tether for end cap;
- Clamps for securing drop tube to well casing;
- Appropriate sample containers and labels;

- Decontamination supplies;
- Blank chain-of-custody forms; and
- Cooler and ice for sample preservation.

The following sequence of procedures will be implemented for the collection of sub-LNAPL groundwater samples.

1) Determine LNAPL Thickness: Use an optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy to collect depth to LNAPL and depth to water measurements.
2) Installing Sampling Equipment: Deploy a 1.5-inch (or other appropriate diameter) PVC pipe (drop tube), with an attached end cap, through the LNAPL layer in the well. The end cap should be tethered to the drop tube so it is not lost in the well when removed and in a way that allows the drop tube to be sealed during installation. Lower the drop tube until the bottom of the tube is approximately two feet into the water column below the bottom of the LNAPL. Secure the drop tube to the well, and allow the system to equilibrate, approximately one half hour. The end cap is then removed by inserting a 0.5-inch (or other appropriate diameter) PVC rod into the drop tube and pushing on the cap until the lid is removed. The cap will be removed along with the tube upon completion of sampling.
3) Collection of Groundwater Samples: Lower polyethylene tubing through the 1.5-inch drop tube into the water column. Connect the polyethylene tubing to silicon tubing and engage the peristaltic pump for groundwater retrieval. Set the flow rate to the lowest pumping rate that can be sustained so that the LNAPL is not drawn into the tubing. Begin collecting groundwater in the sample container and continue until enough volume is obtained for all bottleware required by the laboratory for the requested analyses.

3.7 Decontamination Requirements

Of particular significance to the procedures of groundwater measurement and sampling is the limitation, whenever possible, of materials inserted into a well bore and, even more importantly, of materials transferred from well to well.

Many items can be discarded between well sampling and/or gauging locations without significantly impacting project costs. Dedicated sampling equipment which can be discarded

between well sampling locations, will be used whenever possible to preclude decontamination requirements. Sampling equipment included in this category are polyethylene bailers, bailer cord, nitrile gloves, and sampling tubing. However, other monitoring and sampling equipment, such as oil/water interface probes and submersible sampling pumps, must be reused from well to well.

All site equipment to be used in multiple locations (non-dedicated) for gauging and/or sampling of groundwater will be decontaminated immediately prior to initial use and between uses at each location according to the following steps:

- Remove particulates with a sorbent pad or towel and/or initial rinse with clean potable tap water;
- Wash equipment with clean sponge, soft cloth, or scrub brush as necessary in a solution of tap water/laboratory grade detergent (Alconox®, Liquinox®, or equivalent);
- Rinse with tap water;
- Rinse with deionized or distilled water; and
- Air dry for as long as possible.

Rinse water generated during decontamination procedures will be treated onsite by passing the water through a bucket filled with activated carbon prior to disposal.

3.8 Documentation

All site activities and conditions at the time of purging and groundwater sampling should be recorded by field personnel in a field computer via the EDGE application or, if necessary, a field book may be used. The entry shall include the date, time, weather conditions, location (well name), personnel present onsite, PID readings, sampling methodology, purge rate, purge volume, and the aforementioned groundwater indicator parameters. A field qualifier “SL” shall be applied to each sub-LNAPL sample entry to denote sample collection as sub-LNAPL. Additional comments or observations (e.g., well damage, nearby pumping, LNAPL sheen) should also be recorded.

4.0 SOIL SAMPLING & WELL INSTALLATION PROCEDURES

4.1 Site Controls

Prior to hand augering, hydroexcavation, utilizing a backhoe, or deploying any drilling apparatus to the site, an underground utility line protection request must be made (i.e., Pennsylvania One Call) for mark-out of known subsurface utilities and associated laterals proximal to the drilling location. Site plans, if available, should be reviewed to document and avoid the location of onsite utilities.

After review of all known mapped and marked utilities, a site reconnaissance will be performed to document the location of utility meters and storm sewer drains. In addition, the location of overhead utilities must be documented. After completing the subsurface and overhead utility review, the area to drill may be considered clear of utilities, or the location may be adjusted to a nearby location, which must also be cleared.

Lastly, any drilling activities must be preceeded by clearing of the borehole, prior to advancement of augers or split spoons. To ensure the safety of workers, the borehole will be cleared by hand, hydroexcavator, or backhoe to a depth of approximately 8 feet below ground surface.

4.2 Potential Hazards

Traffic, pinch points, chemical (airborne and physical contact), and biological are all likely hazards to be encountered during soil sampling and well installation, as well as slip/trip/fall potential. Drilling is considered a high risk activity which requires facility approval prior to implementation. Additional hazards are identified in the site-specific HASP and/or the daily JSA.

4.3 Materials and Equipment Necessary for Task Completion

A list of equipment required to oversee test boring advancement and, where applicable, sample soil is presented below. Also listed are materials necessary to store, label, preserve, and transport soil samples.

- Current site map detailing well locations;
- Field computer and/or field book for recording site data;

- Appropriate, laboratory prepared sample containers and labels;
- PID;
- Single-use, disposable plastic scoops or stainless steel scoop for collecting soil samples;
- Single-use, disposable, laboratory-supplied syringes for soil sample collection (if applicable);
- Scale for weighing samples (e.g., methanol kits, if necessary);
- Disposable nitrile sampling gloves;
- Measuring tape (for measuring core recovery);
- Munsell soil color chart/book (recommended);
- Decontamination equipment (if applicable);
- Blank chain-of-custody forms; and
- Cooler(s) and ice for sample preservation.

4.4 Decontamination Requirements

All down-hole drilling equipment must be steam cleaned prior to drilling at each soil boring or well location. All soil sampling equipment must be cleaned with detergent and rinsed with deionized or distilled water prior to deployment into the borehole. All well construction materials (i.e. PVC well casing, PVC well screen, sand pack, bentonite) should be clean and dedicated to each borehole.

4.5 Methodology for Soil Boring Installation

4.5.1. Borehole Advancement

During test drilling activities, a borehole is advanced into the subsurface via a rotary or direct-push drilling technique. Various types of drilling methods could be deployed at these facilities to advance the borehole and gain access to the subsurface for characterization and sampling. A description of the most commonly utilized drilling methods is included below:

4.5.1.1 Hollow Stem Auger

A hollow, steel pipe (available diameters vary) with welded, exterior steel "flights" is used to convey subsurface material to the surface when rotated clockwise. A bit at the bottom of the lead auger cuts into the subsurface material, and the rotation conveys the loosened material (cuttings) up the flights, allowing the hole to be advanced (cuttings may not always return to the surface, such as when drilling in soft, saturated materials). The hollow center of the auger allows the driller to access the subsurface for soil sample collection and, where applicable, well installation during borehole advancement. During borehole advancement, a center stem of steel rods connected to an auger plug prevent soil cuttings from entering the drill column. Once a desired drilling depth is reached, the center plug and rods can be pulled out, leaving the auger stem in place to prevent borehole collapse. A split-spoon sampler can be threaded onto the rods in place of the plug and driven via a hammer to obtain a sample (Standard Penetration Test), or if terminal depth has been reached a monitoring well could be installed through the augers.

4.5.1.2 Air and Mud Rotary

Rotary drilling methods are similar to hollow stem auger drilling, however specialized drilling bits at the bottom of rods are used to cut into the subsurface material using compressed air, vibration, and/or pressurized drilling mud. Compressed air or mud is forced through the drilling rods via an air compressor or pump, and escapes through small holes in the drill bit. The circulation of drilling mud, or air combined with introduced water or formation water, conveys the soil cuttings to the surface (while also cooling the drilling bit and preventing borehole collapse).

4.5.1.3 Geoprobe®

A direct-push drilling method, Geoprobe® sampling utilizes a hydraulic hammer to drive steel rods into the subsurface for soil sampling. This method advances a core barrel lined with a plastic Macro-Core® sleeve into the soil column for continuous soil core collection.

4.5.1.4 Hand Auger

A stainless steel or aluminum hand auger is physically advanced to a desired soil sampling depth through rotation of the auger and head.

4.5.2 Soil Sampling

Soil samples will be obtained for lithologic logging and where appropriate, for laboratory analysis with one of three different sampling devices: Split barrel spoon sampler, hand auger, or Geoprobe® soil sampler. For either method, the sampling devices are lowered through the hollow-stem augers or open borehole to allow sampling of undisturbed sediments below the bit or drive shoe. Soil samples will be collected at regular intervals for subsurface characterization and selection of appropriate well screen interval(s). Soils which appear to be visually impacted or from intervals which exhibit the highest deflections on the screening device (PID or similar) will be sampled for laboratory analysis in accordance with an approved sampling plan.

4.5.2.1. Split barrel spoon sampler (split spoon)

The split spoon sampler will be driven into the soil column in accordance with ASTM Standard Method D1586 (Reference A6, Appendix E). Soil sampling by split spoon is characterized by drilling a borehole with a hollow-stem auger to the desired sampling depth (the standard calls for one sample per five foot depth interval). The split spoon sampler is attached to the drilling rods after removal of the auger plug. The drill operator will drive the sampler into the undisturbed soil by repeatedly striking the drilling rods with a 140 pound safety hammer over a 30 inch drop. Field personnel will record the number of blows required to drive the split spoon sampler for each successive six-inch interval. After the sampler has been filled, the driller will remove the rods and sampler from the borehole and should provide the intact sampler to field personnel for opening (the drive shoe and head can be loosened). Field personnel should split the spoon, scan with PID, measure sample recovery, thoroughly describe the soil lithology, note visual observations and odors, note degree of saturation, and where applicable collect soil sample(s) utilizing a stainless steel or disposable scoop. An approved, retractable knife may be used to trim the top and edges of the sample, and once prepared the sample should be containerized in appropriate sample containers.

4.5.2.2. Geoprobe®

The Geoprobe® operator will advance the drilling rods into the subsurface using a truck or track-mounted drill with a hydraulic hammer. A dedicated Geoprobe® Macro-Core® liner is

inserted into the core barrel to collect continuous core samples, usually one per 4 foot interval. The Geoprobe® operator will remove the soil filled liner from the core barrel, cut the liner, and provide field personnel with the intact cores. After retrieval of the sample, the liner may be removed by field personnel and the soil core should be scanned with a PID and logged, including documentation of core recovery, soil lithology, visual observations and odors, and degree of saturation. Where applicable, field staff should remove the soil sample utilizing a stainless steel or disposable scoop and containerize in an appropriate sample container.

4.5.2.3. Hand Auger

The self-powered hand auger allows for soil from the desired interval to be collected directly through removal of the soil sample that is collected in the auger head for every six inches of advancement.

4.6 Methodology for Leaded Tank Bottoms Soil Sampling

Leaded tank bottom material is described as containing materials distinguished by distinctive rust/red to black, metallic, mostly oxidized scale materials, sometimes in a matrix of petroleum wax sludge. The approach for identifying leaded tank bottom materials is summarized below:

- If materials are encountered within the previously designated leaded tank bottom areas, matching the physical description given above for leaded tank bottoms, then samples should be collected for lead analysis.
- If total lead results are above the site-specific standard (SSS) for lead of 2,240 milligrams per kilogram (mg/kg) then samples should be analyzed for lead via Toxicity Characteristic Leaching Procedure (TCLP), EPA Test Method 1311.
- Delineated areas that exhibit soils that physically resemble leaded tank bottoms, exhibit lead concentrations greater than 2,240 mg/kg, and exceed 5 milligrams per liter (mg/l) for lead in the TCLP leachate (which is characteristically hazardous for lead) will retain the leaded tank bottom designation. If no soils are encountered that meet all three of these criteria, then the area will no longer be classified as a leaded tank bottom area.

4.7 Methodology for Monitoring Well or Recovery Well Installation

4.7.1 Well Construction

After drilling to a desired terminal depth via any of the drilling methods referenced above, permanent monitoring wells can be installed to allow access to groundwater for future monitoring and groundwater sampling. In general, monitoring wells are constructed of pipe with a slotted interval(s) (screen) through which groundwater can flow into the well from a desired water-bearing stratum. In most cases, PVC materials are utilized for monitoring well construction.

- For applications where LNAPL thickness measurement is necessary, the screened interval should extend above the presumed highest groundwater level.
- For applications where the shallowest groundwater interval is to be monitored (e.g., water-table aquifer), a single well casing is installed.
- For applications where multiple water bearing strata will be penetrated and where deep groundwater conditions are selected for monitoring, a double-cased well may be installed to prevent the vertical migration of contaminants to the deeper water bearing zone from shallower zone(s).

Each well construction type and considerations for field staff regarding how many casings are needed have been provided below.

4.7.1.1 Single Casing Construction

The most commonly installed monitoring well at the facilities have single casings and are constructed of PVC. To determine the length of screen used, seasonal groundwater table or tidal fluctuations should be considered to allow the water table to intercept the well screen throughout the year. Field personnel should advise the driller on the required well diameter, total well depth, screen interval, screen length, and slot size based on available subsurface information prior to drilling. Once the borehole is completed and the drilling crew has been advised on the desired construction, the drilling crew will thread the well screen onto an end cap at the wellhead and will lower the well into the borehole, adding lengths of casing until the terminal depth is reached.

While the well is held near the center of the borehole, the annular space between the well screen and formation is carefully backfilled with a sand filter pack, which consists of clean,

sorted quartz sand sized to the formation grain size (typically #1 or #2 sand). The sand pack establishes continuity with the formation and acts as a filter to prevent soil from entering the well (the well screen slot size should be sized according to the formation median grain size to mitigate sediment intrusion, however is most commonly available from suppliers as 0.01 or 0.02-inch diameter slot size).

The sand pack should extend one to two feet above the top of well screen, and care must be taken by the driller to not bridge the sand or overshoot the top of sand target depth (particularly when installing wells through the auger stem). Above the sand pack, a seal (grout) is installed in the annular space between the well casing and the soil. The seal is comprised of hydrated bentonite, sometimes amended with pellets or a grout consisting of hydrated Portland cement, bentonite powder, or a blend of the two. A conventional grout blend is 95% Portland cement and 5% bentonite powder. The purpose of the seal is to prevent surface water from infiltrating the well screen. It is installed from the top of the sand to one to two feet below ground surface.

In circumstances where the top of well sand terminates below the water table (e.g., deeper groundwater or submerged screen), grout should be mixed into a slurry at the ground surface and pumped via tremmie pipe or hose to prevent bridging. Above the well seal, the annular space can be backfilled with granular bentonite or concrete. A cement cap or well pad is placed at the surface to further mitigate potential infiltration of surface water. A locking, steel protective casing (stand pipe) or a locking, flush-mounted curb box should be installed to protect the well.

4.7.1.2 Double Casing Construction

Construction of a double cased well is similar to that of a single case well; however, to prevent groundwater infiltration from shallower water bearing zones, a second casing is installed through a surface casing. This type of construction requires drilling two different diameter boreholes.

During drilling through the shallower groundwater bearing zone(s), a larger diameter borehole is drilled and should be sized according to the desired well and/or outer casing diameter. This may require reaming of the borehole depending on the conditions and

drilling equipment. An outer (surface) casing is installed and the annulus is grouted. After the outer casing is installed and the grout has set, the borehole is advanced through the surface casing with a smaller diameter drill stem and bit. When the desired terminal depth is reached, a monitoring well is installed through the inner casing using the above-referenced single casing construction procedure (the annular space between the outer and inner casings above the well filter sand should be pressure grouted).

4.7.2 Handling of Soil Cuttings

Soil cuttings generated during drilling will be containerized or stockpiled on plastic until sampling and analytical data can be obtained. Soil cutting final placement (onsite soil reuse or offsite disposal) will be performed in accordance with Pennsylvania Department of Environmental Protection (PADEP) approved onsite soil reuse plans for each facility.

4.7.3 Well Development

After installation, monitoring wells will be developed to remove residual soil from within the well and filter media and to establish communication between the well and formation. Pump and surge methodology, either through use of a ditch pump or air compressor connected to black polyethylene pipe and surge block, should be utilized to successively agitate relatively clear groundwater from the well. Surging should begin from the bottom of the screened interval and continue iteratively to the top of the well screen in approximately 2 to 4-foot intervals (i.e., pump and surge each 2 to 4 foot interval of well screen several times until relatively clear discharge water is maintained, then move up to the next screen interval until all of the screen has been developed).

Alternately, a submersible pump may be used to pump water from the screened interval of shallow wells, with the screen of the well surged to evacuate silt that remains in the sand pack. The well should be alternately surged and purged until groundwater flowing from the well appears relatively free of sediments. A vacuum truck may be used for development for wells that contains product. Well development water should be managed/treated in accordance with the site-specific work plan.

4.8 Documentation

All site activities and conditions at the time of soil sampling, well installation, and well development should be recorded by field personnel in a field computer via the EDGE application or, if necessary, a field book may be used. The entry shall include the date, time, weather conditions, location (well or boring name), personnel present onsite, and the aforementioned lithologic data and well construction information. The entry shall include detailed data required to create representative soil boring lithologic logs and well as-built logs (if a well is constructed). This data should include but not be limited to soil type, soil texture (e.g., USCS), soil color, relative moisture content, depth of apparent water table, PID readings, blow counts (if split spoon samples are collected), sample recovery, total depth of borehole, length of well screen, length of well casing, sand pack interval, filter sand size, grout materials used, well seal interval, and all well construction materials. Notes should also include well development pumping rate, duration, and observations. Additional comments or observations should also be recorded, as appropriate.

5.0 LIGHT NON-AQUEOUS PHASE LIQUID (LNAPL) SAMPLING PROCEDURES

5.1 Potential Hazards

Traffic, pinch points, chemical (airborne and physical contact), and biological are all likely hazards to be encountered during LNAPL sampling, as well as slip/trip/fall potential. Additional hazards may be mentioned in the site-specific HASP and/or the daily JSA. If significant amounts of LNAPL are being handled, a Tyvek suit should also be worn.

5.2 Materials and Equipment Necessary for Task Completion

A list of equipment required to sample LNAPL from a monitoring well is presented below:

- Current site map detailing well locations;
- Field book or field computer for recording site data;
- Optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy;
- Keys and tools to provide well access;
- Appropriate sample containers and labels. LNAPL samples will be collected in laboratory provided glassware with appropriate preservative, if applicable. A minimum of 10 ml is required for most laboratory analyses. In the case that sufficient volume is not obtained, a swabbing technique (described below) could be used;
- Sorbent pads (required for swabbing technique);
- Stainless steel or clear bottom-loading or top-loading bailer, depending on product thickness;
- Clean nylon or polypropylene bailer cord;
- Decontamination supplies;
- Blank chain-of-custody forms; and
- Cooler and ice for sample preservation.

5.3 Decontamination Requirements

During LNAPL sampling activities, dedicated sampling equipment (i.e., clear bailers, nitrile gloves, and bailer cord) may be utilized; thereby, minimizing decontamination requirements. However, a stainless steel bailer may be used and decontaminated between LNAPL sampling locations. The optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy used to record the presence or absence and approximate thickness of LNAPL prior to sampling also requires decontamination between sampling locations. Decontamination procedures are detailed in Section 1.5.

5.4 Sampling Procedure

Immediately prior to sampling, each monitoring well should be gauged to obtain liquid levels (i.e., depth to LNAPL and depth to water) for estimation of current LNAPL thickness. Refer to Section 3.0 for appropriate well gauging procedures. Liquid level data should be recorded in a field book or field computer through the EDGE application or, if necessary, a field book.

LNAPL sampling may be performed via two different methods, based upon the LNAPL thickness/availability at the time of sampling: direct sample or swabbing. As indicated above, a minimum LNAPL volume of 10 mL is typically required by the analytical laboratory for most LNAPL characterization.

The following sequence of procedures will be implemented for the collection of LNAPL samples from monitoring wells:

1) A clean work area will be established so that sampling equipment will not come in contact with the ground surface or any other potentially contaminated surfaces near the wellhead.
2) A pre-cleaned stainless steel bailer or dedicated disposable bailer will be used for each well.
3) A new pair of nitrile gloves will be worn during sampling and replaced for each well.
4) Based on the gauged depth to LNAPL, an appropriate length of dedicated nylon or polypropylene cord will be tied to the sampling bailer.
5) An appropriately sized (i.e., 40 ml glass vial with plastic cap fitted with Teflon® lined septum) laboratory-provided sample container will be used to containerize the LNAPL sample.

6) The sampling bailer will be slowly lowered into the well until the liquid level is encountered. Once encountered, the sampling bailer should be lowered into the standing liquid column to a depth of approximately 1 foot, or other appropriate depth based on product thickness.

7) The bailer should be retrieved at a steady rate to avoid excess agitation.

8) The bailed sample should be visually evaluated for the presence or absence of LNAPL. If sufficient LNAPL volume is present (>10 ml), a direct sample of the LNAPL will be collected into the laboratory vial. If less than 10 ml of LNAPL is apparent, a sorbent pad may be used to absorb the LNAPL from the surface of the groundwater sample and the swab placed in the laboratory vial. The site-specific work plan should dictate whether a swab sample should be analyzed, or if the well should be monitored at a later date for re-sampling.

9) Labels will be completed and attached to the sample vials, indicating the sample collector's name, date, time, and location of sample; record same data in field computer or field notebook.

10) Store samples in a secure location until possession is transferred to the laboratory.

11) Nitrile gloves, bailer, bailer cord, and any other trash will be disposed of as solid waste.

5.5 Documentation

All site activities and conditions at the time of sampling should be recorded by field personnel in a field computer via the EDGE application or, if necessary, a field book may be used. The entry shall include the date, time, weather conditions, location (well name), personnel present onsite, and the aforementioned well gauging parameters. Additional comments or observations (e.g., color or apparent viscosity of LNAPL) should be recorded.

6.0 INDOOR AND AMBIENT AIR SAMPLING PROCEDURES

In preparation for indoor and/or ambient air sampling, appropriate facility personnel should be notified of intended sampling prior to mobilization. The purpose of this would be to confirm that there are not any non-routine activities occurring in the building, such as painting of indoor walls, which would cause incidental contamination of the samples.

6.1 Materials and Equipment Necessary for Task Completion

A list of equipment required to collect indoor and/or ambient air samples is presented below:

- Field data book or field computer for recording site data;
- Laboratory certified Summa canisters (standard size is 6 liters);
- Flow controllers (standard duration is 8-hours) with integrated vacuum gauge;
- Equipment for elevating sample intake height (examples: extended sampling inlets, zip ties to attach units to fencing, tables, etc);
- Camera; and
- Blank chain-of-custody forms.

6.2 Precautions to Avoid Incidental Contamination

EPA Method TO-15 is the most common method used for analysis of air samples at these sites. This method is highly sensitive to trace concentrations of volatile organic compounds (VOCs). To avoid incidental contamination:

- Do not wear cologne or fragrance on day of sampling;
- Do not use hand sanitizers or lotions;
- Do not store canisters near containers of gasoline, or any fuel; and
- Make sure there are no sources of VOCs in the vehicle used to transport the canisters.

6.3 Sampling Procedure

1) Set Up Summa Canister. Inlets of the flow controllers are to be placed in the breathing zone, approximately 4 to 6 feet above the ground surface. Elevate Summa canisters using appropriate materials available onsite or use laboratory-provided extended inlets (approximately 3 ft long sampling canes). Indoor air samples should be representative of air

in the buildings and should be placed away from obvious ventilation to outdoor air or sources of VOCs. Securely attach flow controller and extended sampling inlet if applicable.

2) Start Air Sample Collection. Open the valve. Document the initial vacuum (should be between approximately -30 inHg and -26 inHg) and the start time of the test. If the vacuum is significantly outside of the range or has a high rate of change, consider using an alternate canister or flow controller as there may be leakage.
3) Monitoring Summa Condition During Sampling Period. Several times during the sampling period, verify that the Summa is in good condition and that the vacuum is decreasing at an appropriate rate several times during the sampling period. An example of a reasonable frequency would be every two hours during an 8-hour event. During these checks, record the time, remaining vacuum, and canister condition. If necessary, obtain a permit to operate a camera, and take a least one photo of each sampling location.
4) Completing Air Sample Collection. Near the end of the sampling period, monitor the gauge more frequently. The sample collection should be stopped when the gauge reads approximately -5 inHg. At this point, close the canister valve. Record the sample end time and sample end vacuum. Ensure that the canister is labeled with the sample ID. Remove all of the attached equipment from the canister. Pack the canisters, flow controller wrapped in bubble wrap, chain of custody (additional information in the following section), and any other laboratory provided equipment back into the original packaging.

6.4 Documentation

All site activities and conditions at the time of air sampling should be recorded by field personnel. The entry shall include the date, time, weather conditions (including wind direction and start/end barometric pressure), sample locations and IDs, and personnel present onsite. Any observation that could influence the level of VOCs in the samples should be noted.

7.0 SURFACE WATER SAMPLING PROCEDURES

7.1 Field Procedures for Surface Water Sampling

7.1.1 General

Surface water sampling is performed to obtain samples for surface water bodies that are representative of existing surface water conditions. Surface water sampling (or gauging) within 3 feet of a bulkhead at certain facilities will require field personnel to wear a life vest.

Surface water sampling locations for surface water quality and groundwater interaction studies are selected based on the following:

1) Study objectives
2) Location of point surface discharges
3) Non-point source discharges and tributaries
4) Presence of structures (e.g., bridge, dam)
5) Accessibility

During surface water sampling it is important to obtain samples that are not impacted by the re-suspension of sediment produced because of improper or poor surface water sampling techniques.

7.1.2 Surface Water Sample Location Selection

Prior to conducting surface water sampling activities, the first requirement is the consideration and development of surface water sampling locations. It is important that all surface water sampling locations be selected in accordance with the work plan.

Wading for surface water samples increases the chances of disturbance of sediments from the floor of the surface water body. When wading for surface water samples be aware of potential safety and health risks. A life vest and safety line must be worn at all times where footing is unstable or when sampling in fast moving or more than 3 feet (0.9 m) deep. A two-person team is required for most surface water sampling activities. If the site conditions require the use of the life vest and safety line, the two people involved in the sampling must be competent swimmers.

Surface water samples must be collected with no suspended sediments. Surface water samples are collected commencing with the furthest downstream location to avoid sediment interference with upstream locations.

7.1.2.1 Rivers, Streams, and Creeks

Surface water samples are generally collected in areas of surface water bodies that are representative of the surface water body conditions. Representative surface water samples will usually be collected in sections of surface water bodies that have a uniform cross section and flow rate. Mixing is influenced by turbulence and water velocity, therefore the selection of surface water sampling locations immediately downstream of a riffle area (i.e., fast flow zone) will ensure good vertical mixing. These locations are also likely areas for deposition of sediment since this occurs in areas of decreased flow velocity.

Surface water sampling locations should not be established in areas near point source discharges. Surface water sampling of these source discharge points can be performed to assess the impact of these source areas on overall surface water quality. Sample tributaries as close to the mouth as possible. It is important to select surface water sample locations considering the impact downstream, including tributary flow and sediment.

In all instances, properly document all surface water sampling locations. Documentation may include photographs and tie-ins to known structures.

7.1.2.2. Sampling Equipment and Techniques

When collecting surface water samples, direct dipping of the sample container into the stream or water is acceptable unless the sample container contains preservatives. If preserved, a pre-cleaned unpreserved sample container should be used to collect the surface water sample. The surface water sample is then transferred to the appropriate preserved sample container. When collecting surface water samples, submerse the inverted bottle to the desired sample depth and tilt the opening of the sample container upstream to fill. During surface water sample collection, wading or movement may cause sediment deposits to be re-suspended and can result in biased samples. Wading is acceptable if the stream has a noticeable current and the samples are collected directly in

the sample container when faced upstream. If the stream is too deep to wade in or if addition samples must be collected at various depths, additional sampling equipment will be required. Surface water samples should be collected about 6 inches (15 cm) below the surface, with the sample bottles being completely submerged. Taking the surface water sample at this depth eliminates the collection of floating debris in the sample container.

Surface water sample collection where the flow depth is less than 1 inch (<2.5 cm) requires the use of special equipment to eliminate sediment disturbance. Surface water sampling may be conducted with a container then transferred to the appropriate sample container, or collection may be performed using a peristaltic pump. A small excavation in the stream bed to create a sump for sample collection can also be considered but should be prepared in advance to allow all the sediment to settle prior to surface water sampling activities.

Teflon™ bailers can be used for surface water sampling if it is not necessary to collect surface water samples at specific depths. A bottom loading bailer with a check ball is sufficient. When the bailer is lowered through the water, the water is continually displaced through the bailer until the desired depth is reached. The bailer is retrieved and the check ball prohibits the release of the collected surface water sample. Bailers are not suitable in surface water bodies with strong currents, or where depth-specific sampling is required. For discrete and specified depth surface water sampling, and the parameters to be monitored do not require a Teflon™ coated sampling device, a standard Kemmerer or Van Dorn sampler can be used. The Kemmerer sampler is a brass cylinder with rubber stoppers that leave the sampler ends open while the sampler is being lowered. The sampler is lowered in a vertical position to allow water to pass through. The Van Dorn sampler is plastic and is lowered in a horizontal position. For both samplers, a messenger is sent down a rope when the sampler has reached the required depth. The messenger causes the stopper on the sampler to close. The sampler is then retrieved and the surface water sample can be collected through a valve. DO sample bottles can be filled by allowing overflow using a rubber tube attached to the valve. During depth-specific surface water sampling, take care not to disturb bottom sediments.

Glass beakers or stainless steel cups may also be used to collect surface water samples if

parameter interference does not occur. The beaker or cup must be rinsed at least three times with the surface water sample prior to sample collection.

All equipment must be thoroughly decontaminated.

7.1.2.3 Field Notes for Surface Water Sampling

Record daily surface sampling activities, describe surface water sampling locations, sampling techniques, and, if applicable, provide a description of photographs taken. Visual observations are important and provide valuable information when interpreting surface water quality results. Observations include:

1) Weather conditions
2) Stream flow directions
3) Stream physical conditions (width, depth, etc.)
4) Tributaries
5) Effluent discharges
6) Impoundments
7) Bridges
8) Railway trestles
9) Oil sheens
10) Odors
11) Buried debris
12) Vegetation
13) Algae
14) Fish and other aquatic life
15) Surrounding industrial areas

The following factors should be considered for surface water sampling:

1) Predominant Surrounding Land Use: Observe the prevalent land use type in the vicinity and note any other land uses in the area which, although not dominant, may potentially affect surface water quality.

2) Local Watershed Erosion: Note the existing or potential erosion of soil in the local watershed and its movement into the stream. Erosion can be rated through visual observation of watershed stream characteristics including increases or decreases in turbidity.

3) Local Watershed Non-Point Source Pollution: This refers to problems or potential problems other than erosion and sedimentation. Nonpoint source pollution can be diffuse agricultural and urban runoff. Other factors may include feed lots, wetlands, septic systems, dams, impoundments, and mine seepage.

4) Estimated Stream Width: The estimated distance from shore at a transect representative of the stream width in the area.

5) Estimated Stream Depth: Riffle (rocky area), run (steady flow area), and pool (still area). Estimate the vertical distance from the water surface to the bottom of the surface water body at a representative depth at three locations.

6) High Water Mark: Estimate the vertical distance from the bank of the surface water body to the peak overflow level, as indicated by debris hanging in bank or flood plain vegetation, and deposition of silt. In instances where bank flow is rare, high water marks may not be evident.

7) Velocity: Record or measure the stream velocity in a representative run area.

8) Dam Present: Indicate the presence or absence of a dam upstream or downstream of the surface water sampling location. If a dam is present, include specific information detailing the alteration of the surface water flow.

9) Channelized: Indicate if the area surrounding the surface water sampling location is channelized.

10) Canopy Cover: Note the general proportion of open to shaded areas which best describes the amount of cover at the surface water sampling location.

7.2 References

For additional information pertaining to surface water sampling, the user of this manual may reference the following:

ASTM D5358 Practice for Sampling with a Dipper or Pond Sampler

ASTM D4489 Practices for Sampling of Waterborne Oils

ASTM D3325 Practice for the Preservation of Waterborne Oil Samples

ASTM D4841 Practice for Estimation of Holding Time for Water Samples Containing Organic and Inorganic Constituents

ASTM D4411 Guide for Sampling Fluvial Sediment in Motion

ASTM D4823 Guide for Core-Sampling Submerged, Unconsolidated Sediments

ASTM D3213 Practice for Handling, Storing, and Preparing Soft Undisturbed Marine Soil

ASTM D3976 Practice for Preparation of Sediment Samples for Chemical Analysis

ASTM E1391 Guide for Collection, Storage, Characterization, and Manipulation of Sediments for Toxicological Testing

ASTM D4581 Guide for Measurement of Morphologic Characteristics of Surface Water Bodies

ASTM D5906 Guide for Measuring Horizontal Positioning During Measurements of Surface Water Depths

ASTM D5073 Practice for Depth Measurement of surface water

8.0 SEDIMENT SAMPLING PROCEDURES

8.1. Introduction

Sediment sampling is conducted to obtain samples that are representative of existing chemical and/or physical conditions of sediment.

8.2 Equipment Decontamination

On environmental sites, sediment sampling equipment (e.g., split spoons, trowel, spoons, shovels, bowls, dredges, corers, scoops) are typically cleaned as follows:

1) Wash with clean potable water and laboratory detergent, using a brush as necessary to remove particulates.
2) Rinse with tap water.
3) Rinse with deionized water.
4) Air dry for as long as possible.

Additional or different decontamination procedures may be necessary if sampling for some parameters, including VOCs and metals.

8.3 Sample Site Selection

Before any sampling is conducted, the first requirement is to consider suitable sampling locations. Sampling locations should be selected in accordance with the work plan. Wading for sediment samples in lagoons, lakes, ponds, and slow-moving rivers and streams must be done with caution since bottom deposits are easily disturbed. Sampling must only be attempted where safe conditions exist and samples must be collected from undisturbed sediments. All sediment samples are to be collected commencing with the most downstream sample to avoid sediment interference with other downstream samples. A life vest and safety line should be worn in all cases where footing is unstable or where water is fast moving or over 3 feet (0.85 m) in depth. A second person may also be required for most of the sampling scenarios.

8.3.1. Rivers, Streams, and Creeks

Sediment samples may be collected along a cross-section of a river or stream in order to adequately characterize the bed material, or from specific sediment deposits as described in the work plan. A common procedure is to sample at quarter points along the cross-section of the sampling site selected. Samples may be composited as described in the work plan. Samples of dissimilar composition (e.g., grain size, organic content) should not be combined. Representative samples can usually be collected in portions of the surface water body that have a uniform cross-section and flow rate. Since mixing is influenced by turbulence and water velocity, the selection of a site immediately downstream of a riffle area (e.g., fast flow zone) are likely areas for deposition of sediment since the greatest deposition occurs where stream velocity slows.

A site that is clear of immediate point sources (e.g., tributaries and industrial and municipal effluents) is preferred for the collection of sediment samples unless the sampling is being performed to assess these sources.

8.4 Sampling Equipment and Techniques

8.4.1. General

Any equipment or sampling technique(s) [e.g., stainless steel, polyvinyl chloride (PVC)] used to collect a sample is acceptable so long as it provides a sample which is representative of the area being sampled and is consistent with the work plan.

8.4.2. Sediment Sampling Equipment and Techniques

A variety of methods may be used to collect sediment samples from a stream, river, or lake bed. Dredging (Peterson, Ponar, Van Veen), coring and scooping are acceptable sediment sample collection techniques. Precautions shall be taken to ensure that a representative sample of the targeted sediment is collected. Caution should be exercised when wading in shallow water so as not to disturb the area to be sampled. Samplers should be selected based on the interval to be sampled, type of sediment/sludge (silt, sand, gravel), and required sample volume. More than one sampler is often required to implement a sampling program at a site. The following

describes some of these methods. Manufacturer's information should be consulted to determine the limitations of each type of sampling equipment.

8.4.3 Dredging

The Peterson dredge is best used for rocky bottoms, in very deep water, or when the stream velocity is rapid. The dredge should be lowered slowly as it approaches the bottom, so as to not disturb the lighter sediments.

The Ponar dredge is similar to the Peterson dredge in size and weight. The Ponar dredge is a "clam-shell" type unit that closes on contact with the river/lake bottom. Depending on the size of the unit, a winch is required for larger units, whereas smaller units are available for lowering by a hand line. Once retrieved, the unit is opened and the sample extracted using a sample scoop or spoon. The unit has been modified by the addition of side plates and a screen on top of the sample compartment. This permits water to pass through the sampler as it descends.

The Ponar grab sampler functions by the use of a spring-latch-messenger arrangement. The sampler is lowered to the bottom of the water body by means of a rope, then the messenger is sent down to trip the latch causing the sampler to close on the sediments. The sampler is then raised slowly to minimize the disturbance of the lighter sediments. Sediment is then placed into a stainless steel bowl, homogenized, and placed into the appropriate sample container (if collecting for VOC parameters, fill the VOC jars before homogenization).

8.4.4. Corers

Core samplers are used to obtain vertical columns of sediment. Many types of coring devices are available, depending on the depth of water from which the sample is to be collected, the type of bottom material, and the length of core to be obtained. They vary from hand-push tubes to weight or gravity-driven devices to vibrating penetration devices.

Coring devices are useful in contaminant monitoring due to the minimal disturbance created during descent. The sample is withdrawn intact, allowing the removal of only those layers of interest. Core liners consisting of plastic or Teflon may also be added, thereby reducing the potential for sample contamination and maintaining a stratified sample. The samples may be shipped to the lab in the tubes in which they were collected. The disadvantage of coring devices

is that only a small sampling surface area and sample size is obtained, often necessitating repetitive sampling in order to collect the required amount of sediment for analysis. It is also often difficult to extract the sediment sample back out through the water column without losing the sample.

The core tube is pushed/driven into the sediment until only 4 inches (10 cm) or less of tube is above the sediment-water interface. When sampling hard or coarse sediments, a slight rotation of the tube while it is pushed will create greater penetration and reduce compaction. Cap the tube with a Teflon plug or a sheet of Teflon. The tube is then slowly withdrawn, keeping the sample in the tube. Before pulling the bottom part of the core above the water surface, it must be capped.

8.4.5 Scooping

The easiest way to collect a sediment sample is to scoop the sediment using a stainless steel spoon or scoop. This may be done by wading into the stream or pond and, while facing upstream (into the current), scooping the sample from along the bottom in an upstream direction. This method is only practical in very shallow water.

8.4.6 Mixing

Sediment samples collected for chemical analysis should be thoroughly mixed (except for VOCs) in a stainless steel bowl prior to placement in the appropriate sample container. Standard procedures exist for preparation of sediment samples (ASTM D3976). These should be followed or the laboratory informed of applicable procedures.

8.4.7 Air Monitoring

Prior to sediment/sludge sampling, measure the breathing space above the sample location with a PID, should the potential for volatiles be present, and use a hydrogen sulfide meter should hydrogen sulfide be present. Repeat these measurements during sampling. If either of these measurements exceed any of the air quality criteria established in the HASP, air purifying respirators (APRs) or supplied air systems will be required.

8.4.8 Sample Location Tie-In/Surveying

The recording of the sample locations and depth on the site plan is extremely important. This may be accomplished by manual measurement (i.e., swing ties), global positioning system (GPS) survey, or stadia methods. Manual measurements for each sample location should be tied into three permanent features (e.g., buildings, utility poles, hydrants). Diagrams with measurements should be included in the field book.

8.5 Field Notes

A bound field book is used to record daily activities, describe sampling locations and techniques, and describe photographs (if taken). Visual observations are important, as they may prove invaluable in interpreting water or sediment quality results. Observations shall include (as applicable) weather, stream flow conditions, stream physical conditions (width, depth, etc.), tributaries, effluent discharges, impoundments, bridges, railroad trestles, oil sheens, odors, buried debris, vegetation, algae, fish or other aquatic life, and surrounding industrial areas. The following observations should be considered:

- Predominant Surrounding Land Use: Observe the prevalent land use type in the vicinity (noting any other land uses in the area which, although not predominant, may potentially affect water quality).
- Local Watershed Erosion: The existing or potential erosion of soil within the local watershed (the portion of the watershed that drains directly into the stream) and its movement into a stream is noted. Erosion can be rated through visual observation of watershed and stream characteristics. (Note any turbidity observed during water quality assessment.)
- Local Watershed Non-point Source Pollution: This item refers to problems and potential problems other than siltation. Non-point source pollution is defined as diffuse agricultural and urban runoff (e.g., stormwater runoff). Other compromising factors in a watershed that may affect water quality are feedlots, wetlands, septic systems, dams and impoundments, and/or mine seepage.
- Estimated Stream Width: Estimate the distance from shore at a transect representative of the stream width in the area.

- Estimated Stream Depth: Riffle (rocky area), run (steady flow area), and pool (still area). Estimate the vertical distance from water surface to stream bottom at a representative depth at each of the three locations.
- High Water Mark: Estimate the vertical distance from the stream bank to the peak overflow level, as indicated by debris hanging in bank or floodplain vegetation, and deposition of silt or soil. In instances where bank overflow is rare, a high water mark may not be evident.
- Velocity: Record an estimate of stream velocity in a representative run area (see Section 12.0).
- Dam Present: Indicate the presence or absence of a dam upstream or downstream of the sampling station. If a dam is present, include specific information relating to alteration of flow.
- Channelized: Indicate whether the area around the sampling station is channelized.
- Canopy Cover: Note the general proportion of open to shaded area which best describes the amount of cover at the sampling station.
- Sediment Odors: Disturb sediment and note any odors described (or include any other odors not listed) which are associated with sediment in the area of the sampling station.
- Sediment Oils: Note the term which best describes the relative amount of any sediment oils observed in the sampling area.
- Sediment Characteristics: Note the grain size, color, consistency, layering, presence of biological organisms, man-made debris, etc. in accordance with standard ASTM soil description protocols.
- Sediment Deposits: Note those deposits described (or include any other deposits not listed) which are present in the sampling area. Also indicate whether the undersides of rocks not deeply embedded are black (which generally indicates low dissolved oxygen or anaerobic conditions).

8.6 References

For additional information pertaining to this topic, the user of this manual may reference the following:

ASTM D5358 Practice for Sampling with a Dipper or Pond Sampler

ASTM D4489 Practices for Sampling of Waterborne Oils

ASTM D3325 Practice for the Preservation of Waterborne Oil Samples

ASTM D4841 Practice for Estimation of Holding Time for Water Samples Containing Organic and Inorganic Constituents

ASTM D4416 Guide for Sampling Fluvial Sediment in Motion

ASTM D4823 Guide for Core-Sampling Submerged, Unconsolidated Sediments

ASTM D3213 Practice for Handling, Storing, and Preparing Soft Undisturbed Marine Soil

ASTM D3976 Practice for Preparation of Sediment Samples for Chemical Analysis

ASTM E1391 Guide for Collection, Storage, Characterization, and Manipulation of Sediments for Toxicological Testing

ASTM D4581 Guide for Measurement of Morphologic Characteristics of Surface Water Bodies

ASTM D5906 Guide for Measuring Horizontal Positioning During Measurements of Surface Water Depths

ASTM D5073 Practice for Depth Measurement of Surface Water

ASTM D5413 Test Methods for Measurement of Water Levels in Open-Water Bodies

9.0 SLUG TEST PROCEDURES

9.1 Materials and Equipment Necessary for Task Completion

Water level (data) logger capable of recording pressure and/or depth at sub-second time intervals (preferably a vented logger capable of advanced logging modes); vented, direct-read cable of sufficient length (with dessicant); interface tape/probe or water level meter; solid (mechanical) slug, pneumatic slug, or packer system [the introduction or removal of water is not recommended (e.g., bailer or bucket)]; 5 gallon bucket, traffic cones and/or barricades, deionized or distilled water and Alconox®; decontamination bucket and brush; and laptop computer or rugged reader.

9.2 Decontamination Requirements

Equipment utilized during slug testing must be thoroughly decontaminated with Alconox® and deionized/distilled water prior to and between uses at each test well to prevent cross contamination between wells. Any groundwater removed from the well during testing must be containerized and either treated and discharged to ground surface, or disposed of in an approved manner, preferably in a properly installed, onsite holding tank. If LNAPL is encountered/recovered, it should be containerized and properly disposed onsite. However, the preferred test initiation methods (solid and/or pneumatic slug) do not generate any groundwater.

9.3 Methodology for Slug Testing

Slug tests are utilized to provide in-situ estimations of hydraulic conductivity (k) in saturated media, most often in geologic formations that exhibit aquifer properties (low k media can also be tested with special consideration). Slug tests involve rapidly displacing the static water level in a well, and analyzing the well's rate and pattern of recovery back to near-static conditions. Falling head or slug-in tests involve analysis of displacement due to the addition of volume, and rising head or slug-out tests involve the analysis of displacement due to the removal of volume. Displacement is initiated using either a solid or pneumatic slug. Water level response is monitored immediately following the initial displacement and for the ensuing time period until the water level has returned to near-static level (generally within 5% of static). Water level response should be recorded using a water level (data) logger capable of recording pressure and/or depth at sub-second time intervals (preferably a vented logger). Logarithmic logging modes are preferred to shorten the data file while still providing high resolution data just after test initiation.

9.4 Field Procedures

1) Test Well Construction and Configuration - Well construction details are needed to perform slug test calculations and are important considerations when selecting appropriate wells for testing. Important as-built details include: total well depth, well screened interval(s), depth to (static) water, casing diameter, screen diameter, filter pack diameter, filter pack size, and filter pack interval. While these details should be documented on the well log, static water level and total well depth should be field-confirmed before the test. Of particular importance to the testing procedure is the relationship between static water level and well screened interval, and the degree of well development. Test results for poorly or insufficiently-developed wells may be strongly affected by drilling debris/disturbance in the formation that can create skin effects, lowering the apparent formation k. Analysis of testing data for wells screened across the water-table should consider drainage of the filter pack media. In addition, a pneumatic slug assembly should not be utilized unless the test well is screened below the water table and the water level remains above the screen throughout the test.

2) Test Setup and Initiation - Upon arrival, the test well should be gauged for static depth to water and total well depth so that the total water column length can be estimated. Well gauging data should be recorded in a rugged reader using an EDGE file, if available, or field form or book.

   a. Solid Slug

      The displacement volume of the slug is needed. It is suggested that the slug be prefabricated and calibrated for displacement volume prior to site use. Calculate the expected initial well displacement, using the slug volume and well casing radius, and deploy the data logger/cable to a depth just below that level while considering the slug length (to avoid conflict and tangling of the slug and transducer). Also consider the submergence depth limit of the data logger (usually indicated on the logger body). Generally, placing the data logger a foot or two below the bottom of the slug is good practice. Once submerged, allow the

data logger temperature to equilibrate with groundwater prior to initiating the test (up to 30 minutes).

While the data logger temperature equilibrates, secure the slug to an adequate length of disposable string or rope and hang in the well to a depth just above the water surface. Mark the string/rope to accommodate the slug length and tie off. Using the rugged reader or field computer, set up a new test (logarithmic mode or sub-second recording interval) in the data logger supplied software and start the test. Indicate in the file name the type of test and test number (e.g., rising or falling head; test 1 or 2). Once logging is initiated, quickly and smoothly lower the slug (slug-in or falling head test) to the submerged depth and tie off the string/rope (displacement should be instantaneous). Monitor the data logger data until the water level has returned to near-static level. Stop the falling head test.

Without moving the slug or data logger, set up a new test in the data logger supplied software with the same settings and indicate in the file name the type of test being performed (rising head or slug out). Start the test and once the data logger is running, instantaneously lift the slug and tie off the string/rope to its pre-test position (just above static). Monitor the data being recorded by the data logger and stop the test when the water level has returned to near-static.

b. Pneumatic Slug

If a high formation k is anticipated, solid slug removal is found to be too slow to capture well recovery, or to minimize equipment decontamination for wells with submerged screens, a pneumatic slug assembly should be utilized.

Open air release valve, secure pneumatic slug assembly to well casing and tighten coupling to provide an air tight seal. Insert the data logger/cable and deploy to the target submergence depth [it is generally best to keep the data logger shallow (~1-2 feet below static water level) and use small initial displacements to avoid dynamic recovery effects in high k formations]. Close the air release valve and attach the air pump or compressor. Pressurize the well and

use the pressure gauge to set initial displacement. Check for air leaks using a soapy water mixture and sprayer (assembly must be air tight). Allow the water level to return to static and remove the air pump. Using the rugged reader or field computer, set up a new test (logarithmic mode or sub-second recording interval) in the data logger supplied software and start the test. Indicate in the file name the type of test and test number (e.g., rising head; test number). Once logging is initiated, open the air release valve and monitor the test data. Stop the test when the water level has returned to near-static.

3) Test Monitoring and Guidelines - The following are general guidelines for slug testing performance as published by Midwest Geosciences Group in "Field Guide for Slug Testing and Data Analysis:"

- Conduct at least three or more tests per well and if possible conduct both rising and falling head test data.
- Use two or more initial displacement values (2 slug sizes or air pressures applied) that vary by an order of magnitude or more.
- Final slug test initial displacement should be nearly equivalent to the first test's displacement.
- Allow tests to run until near-static conditions are achieved (+/- 5% of static)
- Digital slug test data files collected with the data loggers and/or EDGE files should be backed up to either a thumb drive, corporate email server, and/or corporate file server immediately after collection.

4) Test Data Reduction and Processing - Prior to slug test analyses, digital data logger files should be normalized so that multiple tests conducted on the same test well can be compared for the assessment of test validity and well conditions. Reducing the data as follows:

- From each raw data file, estimate the time of test initiation and the head (depth or pressure) under static conditions.

- In each slug test data file, subtract the time of test initiation from the elapsed time and save to a new field (normalized time or test time; start of test should be time zero).
- In each slug test data file, subtract the static pressure head from the test period pressure head values and save to a new field (deviation from static).
- To normalize the deviation from static values, divide that field by the displacement expected based upon the slug volume or air pressure head applied.
- Create a graphical plot of the normalized head data versus test time for each test performed on the test well. Review the data plots and confirm that the testing data for each repeat test roughly concur. Also confirm that the actual and expected initial displacements are nearly equal.
- If repeat testing data and/or expected versus actual initial displacements vary widely, review well completion details and testing methods prior to performing further analysis (step 5 below) as the results may not be valid (e.g., the well screen interval may be poorly developed or fouled, the data logger may have moved or placed too deep in the well, slug was removed too slowly). The well may need to be retested.

5) Test Data Analysis - For the purposes of this standard operating procedural document, it is assumed that slug test analysis software will be used to apply standard solution methods to the testing data. Various computer programs are available, such as AQTESOLV Professional. Choose an appropriate test solution method by considering the following well configurations (in AQTESOLV, use the Solution Expert):

a. Submerged Screen and/or Confined Aquifer Well - If the well screen fully penetrates the intersecting aquifer, utilize the Cooper et al. Model or Hvorslev Model and analyze the curve match and/or best fit. If well is partially penetrating a confined formation, utilize the KGS Model or Hvorslev Model. If well screen is submerged in an unconfined formation, utilize the KGS Model or Bouwer and Rice Model.

b. Water-Table Intersects Well Screen - If the well screen is intersected by the water table, utilize the Bouwer and Rice Model (double straight line effect) or KGS Model.

c. Rapid Well Recovery in High k Formations - If well response to displacement is extremely rapid and normalized head plots display an oscillatory or concave-downward form, utilize the Butler and Zhan Model (most comprehensive solution available) or High-k Hvorslev Model for confined wells, or the High-k Bouwer and Rice Model.

9.5 Limitations

In general, results of slug test data analyses provide an initial estimate of formation k and have a small scale of relevance (particularly in high k settings). Slug tests can be strongly affected by the degree of well development and can be used diagnostically to assess the degree of well development. In most cases, slug testing should be performed on several wells in an area of interest to develop an understanding of the formation characteristics (e.g., heterogeneous or homogeneous formations).

10.0 PUMP TEST PROCEDURES

10.1 Materials and Equipment Necessary for Task Completion

Water-level (data) loggers (transducers) capable of recording pressure and/or depth at sub-second time intervals (preferably a vented logger capable of advanced logging modes for at least the pumping well); vented, direct-read cables of sufficient length (with dessicant packs); interface tape/probe or water-level meter; well pump (preferably a submersible pump), drop pipe and layflat or comparable discharge line of sufficient length, totalizing flow meter (recommended) and 5 gallon bucket, stop watch, rain gauge or nearby weather station; materials needed to monitor surface water bodies near the test site (e.g., staff gauge, weir, stakes, data logger, camera with permission from refinery personnel); traffic cones and/or barricades, deionized or distilled water and Alconox®; decontamination bucket and brush; laptop computer or rugged reader; portable generator or other power supply appropriate for the submersible pump; and containment (e.g., frac tank) or activated carbon filtration for the temporary staging or filtering of discharge water.

10.2 Decontamination Requirements

Equipment utilized during pumping tests must be thoroughly decontaminated with Alconox® and deionized/distilled water prior to and between uses at each test well to prevent cross contamination between wells. Any groundwater removed from the tested well must be containerized and either treated (filtered as appropriate) and discharged to ground surface, or disposed of in an approved manner, preferably in a properly installed, onsite holding tank. If LNAPL is encountered/recovered, it should be containerized and properly disposed of on or off-site.

10.3 Methodology for Pump Testing

10.3.1 Pre-test Considerations

In general, pumping tests are performed to estimate large-scale in-situ hydraulic properties of water-bearing strata in the subsurface (i.e., transmissivity and storativity) and average out local-scale heterogeneity that can limit the applicability of smaller-scale testing methods, such as slug tests. The geographical area influenced by a pumping test will be determined by the hydraulic properties of the strata being tested (including hydraulic properties of other strata supplying recharge to the pumped formation), boundary conditions, and on the duration of the test.

Pumping tests are also commonly performed to generate drawdown data from which hydraulic boundary conditions, hydraulic flow regime (e.g., anisotropy), and aquifer type (i.e., unconfined or confined, leaky confined) may be estimated. Smaller-scale pumping tests may also be utilized to address pumping efficiency and/or signal to noise ratio (pumping rate) at the pumping well, or to assist in remedial system design. However at this scale, the assumptions of some data analysis methods may not be applicable and should be considered prior to testing.

Appropriate design of a pumping test should include review of site-specific information regarding the geology and hydrogeology of the test area. Pumping test design should also consider the goal(s) of the test (i.e., scale of application of derived aquifer properties, identification of boundary influences, sources of recharge, well efficiency). This should include review of available lithologic well logs or test boring logs, geologic maps, cross sections, structure contour maps, isopach maps, and any other available information so that a conceptual model relating geologic units to hydrostratigraphic units or water-bearing strata can be developed. Additional pre-test considerations should include identification of any potential positive or negative hydraulic barriers, tidal effects, and/or influence from other wells that may be pumping in the test area. Without sufficient knowledge of factors influencing water-levels and hydrology of the test area, test results could be misinterpreted.

Often times, budget considerations and/or time limitations will necessitate the use of an existing monitoring well as the pumping well and/or existing wells as observation points. While this is generally acceptable, the wells must be screened appropriately with respect to the goals of the test and knowledge of well construction is critical to applying test solutions. Wells should also be redeveloped prior to testing if they are relatively old or if records of sufficient well development at the time of installation are not readily available.

Pumping tests can be divided into two general classifications: step-drawdown tests and constant rate tests. Step tests typically involve pumping a well at progressively higher rates or “steps” at intervals of one or two hours per step (typically up to 3 steps). They are often used to estimate the yield a well will sustain during a constant rate pumping test and to evaluate well efficiency (frictional head losses between the screen/gravel pack and the formation). Constant rate pumping tests are used primarily to evaluate hydraulic properties of water-bearing strata for design of groundwater treatment systems and/or water supply purposes (e.g., groundwater

allocation). Where budgets permit, the best pumping test approach is to first perform a step-drawdown test on the pumping well to evaluate well efficiency and sustainable yield (and to gauge whether or not the pumping well needs additional development), allow recovery to near-static conditions, and then initiate a constant rate test.

The test duration is subject to goals of the test and to budget considerations. Optimally, a constant rate test should be run until all drawdowns have stabilized or boundary conditions are identified, and gravity drainage effects are curtailed; however, this is seldom practical due to time limitations. In most instances, an 8 hour constant rate test will be adequate, and a 24 hour test will be sufficient for higher sensitivity sites. Occasionally a 72 hour pumping test is warranted, though this is usually reserved for large scale water supply work. If there are any unexplained water level anomalies observed toward the scheduled end of a test, the test should be continued if at all possible.

The approximate test flow rate needs to be determined in advance for proper pump and discharge design selection, and sizing of discharge containment. If it is not appropriate to perform a step test, sustainable yield can be estimated from slug test data or a brief (<30 minutes) pumping episode the day before the actual test. Generally, it is best to pump the test well at a rate that maximizes the signal to noise ratio (a higher pumping rate does not influence test scale and should not be used as a means to shorten the test duration).

If testing must be performed in an area where contamination is known to be present, careful consideration of the impacts of the test scale should be considered prior to testing so that the spread of subsurface contamination is not increased. If floating product (LNAPL) is present at or near the pumping well, drawdown should be limited so as to not impact uncontaminated soils below the static water table (i.e., create a “smear” zone or allow for the significant migration of free-phase product). Discharge water must be either 1) treated prior to discharge or 2) containerized for on or off-site disposal. If it is to be discharged directly on-site and allowed to infiltrate, it must be routed sufficiently far enough from the test area as to avoid any artificial recharge effects. All appropriate withdrawal and discharge permits must be obtained and complied with. If discharge water is to be treated on-site, proper contaminant loading calculations for the test flow rate, approximate contaminant loading and test duration must be performed in advance to insure treatment is sufficient. Any on-site treatment should also

include at least one discharge effluent sample analysis by an approved laboratory to document treatment effectiveness.

10.3.2 Pre-Test Water Level Monitoring

Water-level conditions in the test area should be monitored for at least one week prior to initiation of testing to identify background trends and factors influencing groundwater levels in the test area. Data loggers should be deployed in all wells to be utilized in the pumping test and set to record depth or pressure at a resolution that is high enough to identify any potential trends (generally a 15 minute recording interval is sufficient for background monitoring). A manual water level should be measured with a water-level meter or interface probe and referenced to the top of casing mark to calibrate the data logger data at the time of deployment and at sufficient intervals throughout the recording period to validate the data and provide backup data in the event that a data logger was to fail.

Ideally, groundwater levels should be static prior to starting a pumping test so that pumping influences alone can be readily evaluated. Any significant precipitation events within the previous several days (documented through use of a site rain gauge or nearby weather station) will usually result in noticeable water level changes. If there are any major water level changes observed that cannot be explained prior to testing, additional investigation into possible area influences (e.g., local well pumping or construction de-watering) should be conducted.

10.3.3 Pumping Test Set Up

Prior to starting the test, all well measuring points (i.e. top of casing) should be clearly marked and preferably surveyed to the nearest 0.01 feet in elevation. The horizontal distance between all wells utilized should be measured and illustrated on a base map. If there are any surface water bodies in the vicinity, a staff gauge (or similar measuring device) should be set up and surveyed to evaluate possible test influences on water levels or stream flow.

The preferred pump to be used for a pumping test is a submersible centrifugal pump powered by either existing site power or a portable generator. These pumps are not explosion proof, so a conductivity probe must be tied into the pump controls to alleviate any possibility of product coming into contact with the pump (if product is anticipated). If the test pump is designed to pump total fluids (e.g. air operated double diaphragm pump, jack pump, etc.) discharge must

either be containerized, or treatment must include an oil/water separator to handle any floating product. The submersible pump should be set deep enough to maintain flow during the test period or at a maximum of just above the screened interval, using a handling line to support the pump's weight [**NOTE:** extreme care must be taken that the power cord is neither bearing any of the pumps weight, nor damaged during installation due to the potential for severe electric shock]. A check valve (or two check valves) should be installed above the pump in the discharge line to prevent backflow into the well after testing.

Discharge piping from the pump should include a flow meter (preferably with totalizer), followed by a flow adjustment valve. The flow meter should be installed in a straight section of hard piping of sufficient length to avoid meter distortion caused by turbulence (typically about 10 pipe diameters on either side of the meter). In low-flow pumping tests, flow rate can be calculated by measuring the exact time required to fill a known-sized container (bucket and stop watch) several times throughout the testing period. The bucket and stop watch method of estimating flow should also be used to back up and check the flow meter data.

Precise and frequent water-level measurements (to the nearest 0.01 feet) and time denotations before, during, and after pumping tests are critical to achieving accurate test results. In terms of prioritization, data loggers should be utilized in at least the pumping well and observation wells closest to the pumping well. Wells further from the pumping well may be manually monitored, due to the reduced likelihood that early-time drawdown will be critical at distal locations. Back-up manual measurements should be collected at least hourly during the first 8 hours of the test, and then at least every 3 hours, to verify data logger measurements. Readings from the transducers are not completely reliable until they have been submerged for at least 30 minutes (sensor equilibration period). All field personnel should have watches with a second hand, and they should all be calibrated to the same time. Liquid level measurements should be obtained using an optical oil/water interface probe with a graduated measuring tape to 0.01 foot accuracy for those wells with floating product. For wells without product, a water-level meter may be sufficient. All non-dedicated probes must be properly decontaminated after each level reading to prevent any possibility of cross- contamination between wells.

Data loggers should be deployed in each selected well to a depth that will maintain submergence through the test period. Data loggers selected should be capable of being

submerged to that anticipated depth (typically noted on the instrument body). The transducer cable should be secured at the wellhead (manufacturer supplied hangers, well caps, or electrical tape/cable ties) to minimize any movement of the sensor. Care must be taken that the transducer cable is not damaged from rough edges at the well head, and that no vehicles run over the cable. The data logger installed in the pumping well will need to be installed at a depth that will maintain submergence through the test, but also remain clear of the submersible pump (and pump noise if possible). In addition, wells with floating product may require an inner PVC stilling well surrounding the data logger cable to prevent damage from contact with the product. A stilling well may also eliminate the need for any water-level corrections for product thickness.

10.3.4 Running the Test

Once the data loggers have been deployed and secured, tests should be set up in each device and each device either started or “future” started to begin logging when the pump is turned on. The data logger in the pumping well should be set to logarithmic logging mode to capture sub-second data during the early portion of the test. If possible, the pump discharge control valve should be have been pre-set (based on the step test or mini pump test) to the desired flow rate prior to turning on the pump. However, depending on the test pumps performance curves, minor flow rate adjustments are generally needed during the first hour or two of the test to correct for the additional lift required by the pump due to increasing drawdown. In addition, movement of the discharge hose after the test has been started should be avoided, since any change in the elevation of the discharge will affect the pumping rate. All changes in flow rate should be recorded and time stamped.

A minimum of two field personnel are needed to run a pumping test, with additional personnel required for tests with multiple observations wells or additional complexity. One person should be designated to turn on the pump, monitor and adjust flow rate, maintain discharge and treatment, maintain the generator, etc. The second person should be responsible for data logger management and manual water-level measurements. As a rule of thumb regarding the frequency of manual well gauging, one measurement every half minute during the first 5 to 10 minutes, followed by one measurement every 3 to 5 minutes during the first hour, one measurement every 10 to 20 minutes for the second hour, and one hourly measurement thereafter is acceptable.

Throughout the test, data loggers should be downloaded in real time through use of direct-read, vented cables (or non-vented with a barometric logger for compensation) to monitor water-level conditions. It is essential that some data reduction be accomplished in the field, so that major water level trends are recognized during the test. At a minimum, drawdown trends from the pumping well and two of the nearest monitoring wells need to be semi-log plotted against time so that deviations indicative of boundary conditions can be discerned before pumping is ceased. This will allow decisions to be made about whether the test should run longer than planned.

Generally, water quality samples are collected during a pumping test for laboratory analysis of constituents of concern. These are generally collected after the first hour of pumping and just prior to pump shutdown. If the test is of more than 24 hours duration, it is advisable to collect additional samples during the testing period. All groundwater samples should be collected following Evergreen Field Procedures.

10.3.5 Post-test Recovery

At the conclusion of the test, water level recovery data should be collected until near-static conditions are re-established. This requires the installation of a check valve in the discharge line above the submersible pump to prevent backflow. The recovery data has the advantage in that there are no variations in the curve produced due to variations in pumping rate and is independent of test length. In water-table aquifers, however, the effects of formation de-watering can cause the recovery trends to be substantially different from drawdown trends. Consequently, recovery (residual drawdown) data should be used in conjunction with drawdown data where possible.

10.3.6 Data Analysis

The data collected during pumping tests are analyzed to estimate aquifer hydraulic properties, such as transmissivity, conductivity, and storage. Data collected by transducers must be downloaded and transformed (dimensionless drawdown or displacement from static) prior to analysis. Analysis typically involves curve matching of site data to type curves established in literature for particular flow regimes. Curve matching is commonly performed utilizing computer software, such as HydroSOLV's AQTESOLV program, along with diagnostic methods and derivative analysis to best estimate aquifer properties through identification of flow regimes and conditions.

It is noted that the mathematical solutions used in pumping test analysis include many assumptions that must be considered in the context of each test area (e.g., the formation is of uniform thickness and of infinite areal extent). In addition, some of the values incorporated into typical pumping test solutions are not actually measured, but are educated estimates (e.g., porosity based on lithology, etc.). Many problems associated with pumping test data evaluation are due to not recognizing, and/or correcting for, deviations from the theoretical solution employed. Some of the more common analytical errors occur due to: partial well penetration effects, formation de-watering effects, casing storage effects, poor pumping well efficiency and/or the application of incorrect equations or units. Consequently, a thorough understanding of the underlying assumptions inherent to the solution employed is required before the validity of the results can be trusted.

APPENDIX C

SOIL BORING LOGS

MONITORING WELL LOG: A-140

PROJECT:	Sunoco Refinery	DRILLING CO.:	Total Quality Drilling
SITE LOCATION:	Philadelphia	DRILLING METHOD:	Hollow Stem Auger
JOB NO.:	AOI-5	SAMPLING METHOD:	Cuttings
LOGGED BY:	Brandee Blasi	SCREEN/RISER DIAMETER:	4-inch
DATES DRILLED:	6 March 2007	WELLBORE DIAMETER:	8.25"
TOTAL DEPTH:	17'	ELEVATION:	NA

Depth (feet)	OVM (ppm)	USCS	LITHOLOGY	COMMENTS	WELL CONSTRUCTION	WELL DIAGRAM
0			Brown silt and gravel		Completed as a stickup with locking cap	
			Brown silt/sand and gravel, moist	Utility clearance to 10'		
			No lithology available, hydro-vacuum extraction	Sample A-140_071207_1.5-2	Bentonite (0'-0.5')	
-5					Sand pack (0.5'-17')	
-10			Stained silty clay, highly plastic, saturated, odor	water encountered	Screen interval (2'-17')	
			sheen present			
-15				Borehole completed to 17'		

MONITORING WELL LOG: A-141

PROJECT:	Sunoco Refinery	DRILLING CO.:	Total Quality Drilling
SITE LOCATION:	Philadelphia	DRILLING METHOD:	Hollow Stem Auger
JOB NO.:	AOI-5	SAMPLING METHOD:	Cuttings
LOGGED BY:	Brandee Blasi	SCREEN/RISER DIAMETER:	4-inch
DATES DRILLED:	6 March 2007	WELLBORE DIAMETER:	8.25"
TOTAL DEPTH:	17'	ELEVATION:	NA

Depth (feet)	OVM (ppm)	USCS	LITHOLOGY	COMMENTS	WELL CONSTRUCTION	WELL DIAGRAM
0			Large stone gravel surface		Completed as a stickup with locking cap	
			No lithology available, hydro-vacuum extraction	Utility clearance to 6'	Bentonite (0'-0.5')	
-5						
					Sand pack (0.5'-17')	
-10			Green-black silty clay, saturated, odor	water encountered	Screen interval (2'-17')	
				Borehole completed to 17'		
-15						

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Log of Boring **BH-13-26** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan Engineering	Date Started: 3/8/13 / Date Finished: 3/8/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 2 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1, Undisturbed 0, Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ NE, Completion ▼, 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Eric Dieck
Sampler: NA	Inspecting Engineer: Eric Dieck
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		FILL	0		HA	6			
			1		HA	6			
					HA	6			
			2	1	HA	6			Collected sample AOI5_BH-13-26_1.5-2_030813 at 10:00.
									Ended boring at 2 ft bgs.
			3						
			4						
			5						

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Log of Boring **BH-13-27** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan Engineering	Date Started: 3/7/13 / Date Finished: 3/7/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 3 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 2, Undisturbed 0, Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ 3, Completion ▼, 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Eric Dieck
Sampler: NA	Inspecting Engineer: Eric Dieck
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Gravel FILL	0		HA	6			
					HA	6		0	
		Yellow brown clay FILL	1		HA	6		0	
				1	HA	6		0	Collected sample AOI5_BH-13-27_1.5-2_030713 at 13:15.
		Black brown silt, gravel, glass, and brick FILL	2		HA	6		3.7	
				2	HA	6		0	Collected sample AOI5_BH-13-27_2.5-3_030713 at 13:30.
		▽	3					0.3	Ended boring at 3 ft bgs due to groundwater.
			4						
			5						

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Log of Boring **BH-13-28** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan Engineering	Date Started: 3/7/13 / Date Finished: 3/7/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 2 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1, Undisturbed 0, Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ NE, Completion ▼, 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Eric Dieck
Sampler: NA	Inspecting Engineer: Eric Dieck
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Gravel FILL	0		HA	6			
		Yellow brown clay FILL	1		HA	6			
					HA	6			
		Brown black silt and gravel FILL		1	HA	6			Collcected sample AOI5_BH-13-28_1.5-2_030713 at 12:40.
			2						Ended boring at 2 ft bgs.
			3						
			4						
			5						

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Log of Boring **BH-13-29** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan Engineering	Date Started: 3/6/13 / Date Finished: 3/6/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 1.5 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1, Undisturbed 0, Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ 1.5, Completion ▼, 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Eric Dieck
Sampler: NA	Inspecting Engineer: Eric Dieck
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Gravel and silt FILL	0		HA	6			
		Yellowish brown clay FILL			HA	6			
			1	1	HA	6			Collected sample AOI5_BH-13-29_1-1.5_030613 at 14:00.
		▽							Ended boring at 1.5 ft bgs due to groundwater.
			2						
			3						
			4						
			5						

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Log of Boring **BH-13-30** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan Engineering	Date Started: 3/7/13 / Date Finished: 3/7/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 2 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1, Undisturbed 0, Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ NE, Completion ▼, 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Eric Dieck
Sampler: NA	Inspecting Engineer: Eric Dieck
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Gravel FILL with marble cobbles,	0		HA	6		0	
					HA	6		0	
		Brown silt and gravel FILL	1		HA	6		0	
				1	HA	6		0	Collected sample AOI5_BH-13-30_1.5-2_030713 at 11:30.
			2					0	Ended boring at 2 ft bgs.
			3						
			4						
			5						

LANGAN

Log of Boring **BH-13-31** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan Engineering	Date Started: 3/6/13 / Date Finished: 3/6/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 2 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1, Undisturbed 0, Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ 2, Completion ▼, 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Eric Dieck
Sampler: NA	Inspecting Engineer: Eric Dieck
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Gravel FILL with some silt	0		HA	6			
		Yellowish brown clay FILL	1		HA	6			
					HA	6			
		Red brown clay with gravel and slag, FILL		1	HA	6			Collected sample AOI5_BH-13-31_1.5-2_030613 at 13:15.
		▽	2						Ended boring at 2 ft bgs due to groundwater.
			3						
			4						
			5						

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Log of Boring **BH-13-32** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan Engineering	Date Started: 3/6/13 / Date Finished: 3/6/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 2 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1, Undisturbed 0, Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ 2, Completion ▼, 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Eric Dieck
Sampler: NA	Inspecting Engineer: Eric Dieck
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Gravel FILL with some silt	0		HA	6			
		Yellowish brown clay FILL	1		HA	6			
					HA	6			
		Red brown clay with some gravel and slag, FILL		1	HA	6			Collected sample AOI5_BH-13-32_1.5-2_030613 at 12:00.
		▽	2						Ended boring at 2 ft bgs due to groundwater.
			3						
			4						
			5						

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Log of Boring **BH-13-33** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan Engineering	Date Started: 3/7/13 / Date Finished: 3/7/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 2 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1, Undisturbed 0, Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ NE, Completion ▼, 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Eric Dieck
Sampler: NA	Inspecting Engineer: Eric Dieck
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Gravel FILL	0		HA	6			
		Yellow brown clay FILL			HA	6			
		Grey gravel FILL	1		HA	6			
		Black gravel and silt FILL		1	HA	6			Collected sample AOI5_BH-13-33_1.5-2_030713 at 10:00.
			2					8.0	End boring at 2 ft bgs due to obstruction.
			3						
			4						
			5						

LANGAN

Log of Boring **BH-13-34** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan Engineering	Date Started: 3/6/13 / Date Finished: 3/6/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 3 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 2, Undisturbed 0, Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ 3, Completion ▼, 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Eric Dieck
Sampler: NA	Inspecting Engineer: Eric Dieck
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Gravel FILL with some silt	0		HA	6			
		Yellowish brown clay FILL	1		HA	6			
					HA	6			
		Red brown clay, some gravel, slag, and brick, FILL	2	1	HA	6			Collected sample AOI5_BH-13-34_1.5-2_030613 at 10:00.
					HA	6			
		▽	3	2	HA	6			Collected sample AOI5_BH-13-34_2.5-3_030613 at 10:40.
									Ended boring at 3 ft bgs due to groundwater.
			4						
			5						

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Log of Boring **BH-13-35** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan Engineering	Date Started: 3/6/13 / Date Finished: 3/6/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 2 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1, Undisturbed 0, Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ NE, Completion ▼, 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Eric Dieck
Sampler: NA	Inspecting Engineer: Eric Dieck
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Gravel FILL with some silt	0		HA	6			
		Yellowish brown clay FILL	1		HA	6			
					HA	6			
		Red brown clay, some gravel, brick, and slag, FILL		1	HA	6			Collected sample AOI5_BH-13-35_1.5-2_030613 at 9:40.
			2						Ended boring at 2 ft bgs.
			3						
			4						
			5						

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Log of Boring **BH-13-36** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan Engineering	Date Started: 3/6/13 / Date Finished: 3/6/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 2 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1, Undisturbed 0, Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ 2, Completion ▼, 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Eric Dieck
Sampler: NA	Inspecting Engineer: Eric Dieck
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Gravel and silt FILL	0		HA	6			
		Yellowish brown clay FILL	1		HA	6			
					HA	6			
		Red brown clay with gravel and slag, FILL		1	HA	6			Collected sample AOI5_BH-13-36_1.5-2_030613 at 9:00.
		▽	2					282	Ended boring at 2 ft bgs due to groundwater.
			3						
			4						
			5						

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Log of Boring **BH-13-37** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan Engineering	Date Started: 3/5/13 / Date Finished: 3/5/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 3 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 2, Undisturbed 0, Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ NE, Completion ▼, 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Eric Dieck
Sampler: NA	Inspecting Engineer: Eric Dieck
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Gravel FILL	0		HA	6			
					HA	6			
		Silt with gravel and slag, FILL	1		HA	6			
		Silty clay with gravel, FILL		1	HA	6			Collected sample AOI5_BH-13-37_1.5-2_030513 at 13:00.
		Silt with gravel and slag, FILL	2		HA	6			
				2	HA	6			Collected sample AOI5_BH-13-37_2.5-3_030513 at 13:00.
			3						Ended boring at 3 ft bgs.
			4						
			5						

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Log of Boring **BH-13-44** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan Engineering	Date Started: 3/8/13 / Date Finished: 3/8/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 2 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1, Undisturbed 0, Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ NE, Completion ▼, 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Eric Dieck
Sampler: NA	Inspecting Engineer: Eric Dieck
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		FILL	0		HA	6			
			1		HA	6			
					HA	6			
			2	1	HA	6			Collected sample AOI5_BH-13-44_1.5-2_030813 at 10:30.
									Ended boring at 2 ft bgs.
			3						
			4						
			5						

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Log of Boring **AOI5_BH-13-127** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan	Date Started: 10/30/13 / Date Finished: 10/30/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 1 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1 / Undisturbed 0 / Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ NE / Completion ▼ / 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Patrick Troy
Sampler: Hand Auger	Inspecting Engineer: Patrick Troy
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		FILL	0	1	HA	12			Collected sample BH-13-127_0-1_103013 at 8:10.
			1						Ended boring at 1 ft bgs.
			2						No PID readings due to malfunctioning PID.
			3						
			4						
			5						

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Log of Boring **AOI5_BH-13-128** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan	Date Started: 10/30/13 / Date Finished: 10/30/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 1 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1, Undisturbed 0, Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First NE, Completion, 24 HR.
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Patrick Troy
Sampler: Hand Auger	Inspecting Engineer: Patrick Troy
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		FILL	0	1	HA	12			Collected sample BH-13-128_0-1_103013 at 8:00.
			1						Ended boring at 1 ft bgs.
			2						No PID readings due to malfunctioning PID.
			3						
			4						
			5						

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Log of Boring **AOI5_BH-13-129** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan	Date Started: 10/30/13 / Date Finished: 10/30/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 1 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1, Undisturbed 0, Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First NE, Completion, 24 HR.
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Patrick Troy
Sampler: Hand Auger	Inspecting Engineer: Patrick Troy
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		FILL	0	1	HA	12			Collected sample BH-13-129_0-1_103013 at 7:50.
			1						Ended boring at 1 ft bgs.
			2						No PID readings due to malfunctioning PID.
			3						
			4						
			5						

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Log of Boring **AOI5_BH-13-130** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan	Date Started: 10/30/13 / Date Finished: 10/30/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 1 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1 / Undisturbed 0 / Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ NE / Completion ▼ / 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Patrick Troy
Sampler: Hand Auger	Inspecting Engineer: Patrick Troy
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

MATERIAL SYMBOL	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		FILL	0	1	HA	12			Collected sample BH-13-130_0-1_103013 at 10:20.
			1						Ended boring at 1 ft bgs.
			2						No PID readings due to malfunctioning PID.
			3						
			4						
			5						

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Log of Boring **AOI5_BH-13-131** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan	Date Started: 10/30/13 / Date Finished: 10/30/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 1 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1 / Undisturbed 0 / Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First NE / Completion / 24 HR.
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Patrick Troy
Sampler: Hand Auger	Inspecting Engineer: Patrick Troy
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		FILL	0	1	HA	12			Collected sample BH-13-131_0-1_103013 at 10:10.
			1						Ended boring at 1 ft bgs.
			2						No PID readings due to malfunctioning PID.
			3						
			4						
			5						

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Log of Boring **AOI5_BH-13-132** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan	Date Started: 10/30/13 / Date Finished: 10/30/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 1 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1, Undisturbed 0, Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First NE, Completion, 24 HR.
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Patrick Troy
Sampler: Hand Auger	Inspecting Engineer: Patrick Troy
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		FILL	0	1	HA	12			Collected sample BH-13-132_0-1_103013 at 10:00.
			1						Ended boring at 1 ft bgs.
			2						No PID readings due to malfunctioning PID.
			3						
			4						
			5						

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Log of Boring **AOI5_BH-13-133** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan	Date Started: 10/30/13 / Date Finished: 10/30/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 1 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1 / Undisturbed 0 / Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ NE / Completion ▼ / 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Patrick Troy
Sampler: Hand Auger	Inspecting Engineer: Patrick Troy
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		FILL	0	1	HA	12			Collected sample BH-13-133_0-1_103013 at 9:50.
			1						Ended boring at 1 ft bgs.
			2						No PID readings due to malfunctioning PID.
			3						
			4						
			5						

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LANGAN

Log of Boring **AOI5_BH-13-134** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan	Date Started: 10/30/13 / Date Finished: 10/30/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 1 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1 / Undisturbed 0 / Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First ▽ NE / Completion ▼ / 24 HR. ▼
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Patrick Troy
Sampler: Hand Auger	Inspecting Engineer: Patrick Troy
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		FILL	0	1	HA	12			Collected sample BH-13-134_0-1_103013 at 9:40.
			1						Ended boring at 1 ft bgs.
			2						No PID readings due to malfunctioning PID.
			3						
			4						
			5						

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LANGAN

Log of Boring **AOI5_BH-13-135** Sheet 1 of 1

Project: Sunoco PES Facility	Project No.: 25746012
Location: Philadelphia, Pa	Elevation and Datum: --
Drilling Company: Langan	Date Started: 10/30/13 / Date Finished: 10/30/13
Drilling Equipment: Stainless Steel Hand Auger	Completion Depth: 1 ft / Rock Depth: NE
Size and Type of Bit: 2"	Number of Samples: Disturbed 1 / Undisturbed 0 / Core 0
Casing Diameter (in): NA / Casing Depth (ft): NA	Water Level (ft.): First NE / Completion / 24 HR.
Casing Hammer: NA / Weight (lbs): NA / Drop (in): NA	Drilling Foreman: Patrick Troy
Sampler: Hand Auger	Inspecting Engineer: Patrick Troy
Sampler Hammer: NA / Weight (lbs): NA / Drop (in): NA	

Material Symbol	Elev. (ft)	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	PID Reading (ppm)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		FILL	0	1	HA	12			Collected sample BH-13-135_0-1_103013 at 9:30.
			1						Ended boring at 1 ft bgs.
			2						No PID readings due to malfunctioning PID.
			3						
			4						
			5						

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PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BORE HOLE NO: **BH_14-14** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/15/14** COMPLETED: **6/15/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **8.00** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **9.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID Method	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			SANDY SILT WITH GRAVEL ; gray and orange; Boring installed via Hand Auger.		BH_14-14_0-2 1530			0.5	
			GRAVELLY CLAY ; dark grayish black		BH_14-14@ 2-4'			18.9	
5			**CLAY WITH GRAVEL** ; black and orange		BH_14-14@ 4-6'			21.3	5
			CLAY ; grayish black and dark red		BH_14-14@ 6-8'			25.1	
			CLAY ; grayish black; wet; Metallic in color.		BH_14-14_8-9 1600			30.7	▽
			Borehole terminated at 9 feet.						
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-15** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/15/14** COMPLETED: **6/15/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **6.00** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **8.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			SANDY SILT WITH GRAVEL ; whiteish gray; Boring installed via Hand Auger.		1000 BH_14-15_0-2			0.1	
			CLAY ; black with orange		BH_14-15@ 2-4'			2.2	
5			**GRAVELLY CLAY** ; black and gray		BH_14-15@ 4-6'			3.1	5
			CLAY ; black; wet; Strong petroleum-like odor. Sheen present.		1200 BH_14-15_6-8			8.2	
			Borehole terminated at 8 feet.						
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BORE HOLE NO:
BH_14-17 PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/15/14** COMPLETED: **6/15/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **Not Encountered** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **8.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
		SM	**SILTY SAND WITH GRAVEL** ; SM; white and orange; Boring installed via Hand Auger.		1400 BH_14-17_0-2			2.7	
			GRAVELLY CLAY ; orange and brown; Fill (bricks)		BH_14-17@ 2-4'			7.1	
5		CL	**CLAY** ; CL; black		BH_14-17@ 4-6'			8.8	5
		CL	**CLAY** ; CL; blackish gray and dark red		1500 BH_14-17_6-8			10.4	
			Borehole terminated at 8 feet.						
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BORE HOLE NO: **BH_14-18** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/15/14** COMPLETED: **6/15/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **7.00** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **8.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
		SM	**SILTY SAND WITH GRAVEL** ; SM; orange and brown; Boring installed via Hand Auger.		1200 BH_14-18_0-2			0.2	
			GRAVELLY CLAY ; dark grayish black		BH_14-18@ 2-4'			0.2	
			GRAVELLY CLAY ; brown and black		BH_14-18@ 4-6'			0.1	
			CLAY ; dark blackish gray and dark red; Metallic color. Wet at 7'bgs.		1330 BH_14-18_6-8			0.3	▽
			Borehole terminated at 8 feet.						

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-19** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/18/04** COMPLETED: **6/18/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **6** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **8.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			SILTY CLAY AND GRAVEL ; orange; Boring installed via Hand Auger.		1400 BH_14-10_0-2			0.0	
			CLAY ; black		BH_14-19@ 2-4'			0.3	
5			**CLAY** ; gray		BH_14-19@ 4-6'			0.0	5
			CLAY ; gray and black; wet; Cohesive.		1445 BH_14-19_6-8			0.0	▽
			Borehole terminated at 8 feet.						
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BORE HOLE NO:
BH_14-20 PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/20/14** COMPLETED: **6/20/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **Not Encountered** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **8.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			SILTY CLAY WITH SAND ; black and brown; Boring installed via Hand Auger.		0800 BH_14-20_0-2			0.3	
			SANDY SILT WITH GRAVEL ; black		BH_14-20@ 2-4'			42.3	
5			**CLAY** ; black and gray		BH_14-20@ 4-6'				5
			CLAY ; gray		1400 BH_14-20_6-8			50.8	
			Borehole terminated at 8 feet.						
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-21** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/18/14** COMPLETED: **6/18/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **5.5** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **6.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			GRAVELLY CLAY ; black; Boring installed via Hand Auger.		1030 BH_14-21_0-2			7.3	
			SILTY CLAY WITH SAND ; black and tan		BH_14-21@ 2-4'			111.3	
			CLAY ; red and gray; Wet at 5.5'bgs.						
5					1130 BH_14-21_4-6				5
			Borehole terminated at 6 feet.						
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-22** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/18/14** COMPLETED: **6/18/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **6.00** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **6.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			SILTY SAND ; brown and tan; Boring installed via Hand Auger. Fill (concrete)		1145 BH_14-22_0-2			3.4	
			SILTY CLAY ; black and brown		BH_14-22@ 2-4'			2.0	
5			**CLAY** ; gray and black; Wet at 6'bgs.		1215 BH_14-22_4-6			8.7	5
			Borehole terminated at 6 feet.						
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-24** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/20/14** COMPLETED: **6/20/12**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **4.00** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **8.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			SILTY CLAY WITH SAND ; dark orangeish brown; Boring installed via Hand Auger.		0900 BH_14-24_0-2			0.0	
			SANDY SILT ; black; Wet at 4'bgs. Perch water suspected due to soil being dry at 5-6'bgs. SPH noted.		1300 BH_14-24_4-6			348.8	5
			CLAY ; dark grayish black; dry		12.2 BH_14-24@ 6-8'			12.2	
			Borehole terminated at 8 feet.						
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-25** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/18/14** COMPLETED: **6/18/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **8.00** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **8.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			CLAY ; black and red; Boring installed via Hand Auger.		1230 BH_14-25_0-2			2.7	
			SANDY CLAY WITH SILT ; brown		BH_14-25@ 2-4'			2.8	
5			**CLAY** ; gray and black		BH_14-25@ 4-6'			2.1	5
			CLAY ; black; Wet at 8'bgs. SPH present.		1245 BH_14-25_6-8			2.9	
			Borehole terminated at 8 feet.						▽
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-26** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/19/14** COMPLETED: **6/19/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **Not Encountered** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **2.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			SANDY SILT WITH GRAVEL ; dark brown; Boring installed via Hand Auger.		1430 BH_14-26_0-2			4.5	
			Borehole terminated at 2 feet.						
5									5
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-27** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/19/14** COMPLETED: **6/19/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **Not Encountered** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **2.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			SANDY SILT WITH CLAY ; dark brown with orange; Boring installed via Hand Auger.		1500 BH_14-27_0-2			3.7	
			Borehole terminated at 2 feet.						
5									5
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-28** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/18/14** COMPLETED: **6/18/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **6.00** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **6.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			SANDY SILT WITH GRAVEL ; gray and black; Boring installed via Hand Auger.		0900 BH_14-28_0-2			5.4	
			CLAY ; orange		BH_14-28@ 2-4'			38.7	
5			**SILTY CLAY** ; black and brown; Wet at 6'bgs.		0830 BH_14-28_4-6			53.9	5
			Borehole terminated at 6 feet.						
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-29** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/19/14** COMPLETED: **6/19/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **Not Encountered** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **2.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			SANDY SILT WITH CLAY ; black with orange; Boring installed via Hand Auger.		1400 BH_14-29_0-2			5.2	
			Borehole terminated at 2 feet.						
5									5
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-30** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/18/14** COMPLETED: **6/18/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **5.50** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **6.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			SANDY CLAY WITH SILT ; brown and gray; Boring installed via Hand Auger.		1000 BH_14-30_0-2			8.3	
			CLAY ; orange		BH_14-30@ 2-4'			38.7	
			CLAY WITH GRAVEL ; white and greenish gray; Wet at 5.5'bgs.		1030 BH_14-30_4-6			60.4	
5			Borehole terminated at 6 feet.						5
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-31** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/18/14** COMPLETED: **6/18/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **5.5** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **6.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			SANDY SILT WITH CLAY ; gray and tan; Boring installed vis Hand Auger.		1100 BH_14-31_0-2			26.4	
			SANDY CLAY ; white and gray		BH_14-31@ 2-4'			10.3	
			SANDY CLAY WITH SILT ; black and greenish gray; Wet at 5.5'bgs.		1130 BH_14-31_4-6			23.7	
5			Borehole terminated at 6 feet.						5
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-32** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/17/14** COMPLETED: **6/17/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **4.50** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **5.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			GRAVELLY SAND ; orangeish brown; Boring installed via Hand Auger. Fill (debris)		1330 BH_14-32_0-2			596.3	
			CLAY ; dark brown and grayish tan		BH_14-32@ 2-4'			1468	
			SANDY GRAVEL WITH SILT ; black; Wet at 4.5'bgs. Srong petroleum-like odor.		1400 BH_14-32_4-5			4399 ▽	
5			Borehole terminated at 5 feet.						5
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-33** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/17/14** COMPLETED: **6/17/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **5.50** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **6.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			GRAVELLY SILT ; dark brown; Boring installed via Hand Auger. Fill (debris).		1100 BH_14-33_0-2			599.1	
			CLAY ; brown and gray		BH_14-33@ 2-4'			700.2	
			CLAY ; black; Wet at 5.5'bgs. Saturated with product.		1200 BH_14-33_4-6			1866	
5									5
			Borehole terminated at 6 feet.						
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-34** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/17/14** COMPLETED: **6/17/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **5.50** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **6.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			GRAVELLY SILT ; black and brown; Boring installed via Hand Auger. Fill (debris)		1100 BH_14-34_0-2			769	
			CLAY ; brown and gray		BH_14-34@ 2-4'			884	
5			**CLAY WITH SILT AND SAND** ; black and gray; Wet at 5.5'bgs. Saturated with product.		1230 BH_14-34_4-6			2105	5
			Borehole terminated at 6 feet.						
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-35** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/17/14** COMPLETED: **6/17/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **5.50** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **6.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			Boring installed via Hand Auger. Fill (slag)						
			SILTY GRAVEL ; dark brown		1430 BH_14-35_0-2			18.9	
			CLAY ; black		BH_14-35@ 2-4'			438	
			CLAY ; black		BH_14-35@ 4-5'			613	
5			**SAND** ; black and gray; fine-grained; Wet at 5.5'bgs.		1500 BH_14-35_5-6			887 ▽	5
			Borehole terminated at 6 feet.						
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-36** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/18/14** COMPLETED: **6/18/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **6.00** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **6.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			GRAVEL WITH CLAY ; white with reddish orange; Boring installed via Hand Auger.		1300 BH_14-36_0-2			0.2	
			SILTY CLAY WITH SAND ; black and brown		BH_14-36@ 2-4'			0.8	
			CLAY AND SILT WITH SAND ; dark brown; Wet at 6'bgs.		1330 BH_14-36_4-6			3.1	
5			Borehole terminated at 6 feet.						5
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO: **BH_14-37** PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **6/18/14** COMPLETED: **6/18/14**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT:
DRILLING METHOD:
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft): EASTING (ft):
LAT: LONG:
GROUND ELEV (ft): TOC ELEV (ft):
INITIAL DTW (ft): **8.00** WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered** BOREHOLE DEPTH (ft): **8.0**
WELL CASING DIA. (in): **---** BOREHOLE DIA. (in): **2**
LOGGED BY: **LM** CHECKED BY:

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			CLAY WITH GRAVEL ; black; Boring installed via Hand Auger.		0800 BH_14-37_0-2			3.2	
			CLAY ; green and gray		BH_14-37@ 2-4'			4.1	
5			**CLAY** ; gray and black		BH_14-37@ 4-6'			4.7	5
			CLAY ; black; Wet at 8'bgs.		0830 BH_14-37_6-8			8.1	
			Borehole terminated at 8 feet.						▽
10									10
15									15

GEO FORM 304 PHILLY REFINERY AOI-5.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 9/15/14

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-13-09**

Page 1 of 1

Aquaterra Technologies, Inc.

PROJECT:	**Sunoco Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-5**	DRILLING METHOD	**Hollow Stem Auger**
JOB NO.:		SAMPLING METHOD	**Split Spoon**
LOGGED BY:	**Tiffani Doerr**	TOTAL DEPTH:	**2'**
DATES DRILLED:	**6 April 2009**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	LITH-OLOGY	COMMENTS
0	0'-2'		Brown clayey sand, fill with gravel, brick and glass		Sample 0'-2' collected for lead anaylsis

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-14-09**

Page 1 of 1

Aquaterra Technologies, Inc.

PROJECT:	**Sunoco Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-5**	DRILLING METHOD	**Hollow Stem Auger**
JOB NO.:		SAMPLING METHOD	**Split Spoon**
LOGGED BY:	**Tiffani Doerr**	TOTAL DEPTH:	**2'**
DATES DRILLED:	**6 April 2009**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	LITH-OLOGY	COMMENTS
0	0'-2'		Brown clayey sand, fill with gravel, brick and glass		Sample 0'-2' collected for lead anaylsis

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-15-09**

Page 1 of 1

Aquaterra Technologies, Inc.

PROJECT:	**Sunoco Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-5**	DRILLING METHOD	**Hollow Stem Auger**
JOB NO.:		SAMPLING METHOD	**Split Spoon**
LOGGED BY:	**Tiffani Doerr**	TOTAL DEPTH:	**2'**
DATES DRILLED:	**6 April 2009**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	LITH-OLOGY	COMMENTS
0	0'-2'		Brown clayey sand, fill with gravel, brick and glass		Sample 0'-2' collected for lead anaylsis

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-16-09**

Page 1 of 1

Aquaterra Technologies, Inc.

PROJECT:	**Sunoco Refinery**	DRILLING CO.:	**Aquaterra**
SITE LOCATION:	**AOI-5**	DRILLING METHOD	**Hollow Stem Auger**
JOB NO.:		SAMPLING METHOD	**Split Spoon**
LOGGED BY:	**Tiffani Doerr**	TOTAL DEPTH:	**2'**
DATES DRILLED:	**6 April 2009**		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	LITH-OLOGY	COMMENTS
0			Brown clayey sand, fill with gravel, brick and glass		Sample 0'-2' collected for lead anaylsis

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO:
BH-41-09 PAGE 1 OF 1

Aquaterra Technologies, Inc.

DRILLING / INSTALLATION:
STARTED **7/9/09** COMPLETED: **7/9/09**
DRILLING COMPANY: **Total Quality Drilling**
DRILLING EQUIPMENT: **Hand Auger**
DRILLING METHOD: **Hand Auger**
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft):
EASTING (ft):
LAT:
LONG:
GROUND ELEV (ft):
TOC ELEV (ft):
INITIAL DTW (ft): **Not Encountered**
WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered**
BOREHOLE DEPTH (ft): **2.0**
WELL CASING DIA. (in): **---**
BOREHOLE DIA. (in): **4**
LOGGED BY: **TD**
CHECKED BY: **TD**

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			Fill, dirt		BH-41-09@ 0-2'				

Borehole terminated at 2 feet.

GEO FORM 304 2009_PHL_AOI5_SOIL BORINGS.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 5/31/16

PROJECT: **Philadelphia Refinery**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO:
BH-42-09 PAGE 1 OF 1

Aquaterra Technologies, Inc.

DRILLING / INSTALLATION:
STARTED **7/9/09** COMPLETED: **7/9/09**
DRILLING COMPANY: **Total Quality Drilling**
DRILLING EQUIPMENT: **Hand Auger**
DRILLING METHOD: **Hand Auger**
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft):
EASTING (ft):
LAT:
LONG:
GROUND ELEV (ft):
TOC ELEV (ft):
INITIAL DTW (ft): **Not Encountered**
WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered**
BOREHOLE DEPTH (ft): **2.0**
WELL CASING DIA. (in): **---**
BOREHOLE DIA. (in): **4**
LOGGED BY: **TD**
CHECKED BY: **TD**

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			GRAVEL ; 8 inches of gravel						
			Fill		BH-42-09@ 0-2'				

Borehole terminated at 2 feet.

GEO FORM 304 2009_PHL_AOI5_SOIL BORINGS.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 5/31/16

SUBSURFACE BORING LOG

BOREHOLE NO. **BH-04-07**

PROJECT:	Sunoco Refinery	DRILLING CO.:	Aquaterra
SITE LOCATION:	AOI-5	DRILLING METHOD	Hand Auger
JOB NO.:		SAMPLING METHOD	Cuttings
LOGGED BY:	Brandee Blasi	TOTAL DEPTH:	2'
DATES DRILLED:	13 July 2007		

DEPTH (feet)	SAMPLE INTERVAL	PID (ppm)	LITHOLOGY DESCRIPTION	LITH-OLOGY	COMMENTS
0	0-1'		Brown sandy silt and gravel		
-1	1'-2'		Black sandy silt, stained, metallic-like appearance		Sample 1'-2' collected for lead analysis
-2					

PROJECT: **Philadelphia Energy Solutions**
LOCATION: **AOI-5**
PROJECT NUMBER:

WELL / PROBEHOLE / BOREHOLE NO:
BH-16-1 PAGE 1 OF 1

DRILLING / INSTALLATION:
STARTED **2/10/16** COMPLETED: **2/10/16**
DRILLING COMPANY: **Aquaterra**
DRILLING EQUIPMENT: **Hand Auger**
DRILLING METHOD: **Hand Auger**
SAMPLING EQUIPMENT: **Hand Auger**

NORTHING (ft):
EASTING (ft):
LAT:
LONG:
GROUND ELEV (ft):
TOC ELEV (ft):
INITIAL DTW (ft): **Not Encountered**
WELL DEPTH (ft): **---**
STATIC DTW (ft): **Not Encountered**
BOREHOLE DEPTH (ft): **2.0**
WELL CASING DIA. (in): **---**
BOREHOLE DIA. (in): **2**
LOGGED BY: **LM**
CHECKED BY: **TD**

Time & Depth (feet)	Graphic Log	USCS	Description	Sample	Time Sample ID	Measured Recov. (feet)	Blow Count	Headspace PID (units)	Depth (feet)
			SANDY SILT WITH CLAY ; red and orangeish brown; Fill (bricks, slag, comcrete, rubble)		1300 BH-16-1 _0-2			0.0	
			Borehole terminated at 2 feet.						

GEO FORM 304 2016-02_PHL_AOI5_SOIL BORING.GPJ STANTEC ENVIRO TEMPLATE 010509.GDT 2/19/16

APPENDIX D

SOIL ANALYTICAL REPORTS

(On CD)

APPENDIX E

PNDI DOCUMENTATION

1. PROJECT INFORMATION

Project Name: **Evergreen/PES AOI 5**
Date of review: **5/7/2015 12:35:18 PM**
Project Category: **Hazardous Waste Clean-up, Site Remediation, and Reclamation,Other**
Project Area: **100.2** acres
County: **Philadelphia** Township/Municipality: **Philadelphia**
Quadrangle Name: **PHILADELPHIA** ~ ZIP Code: **19145**
Decimal Degrees: **39.898574 N, -75.205556 W**
Degrees Minutes Seconds: **39° 53' 54.9" N, -75° 12' 20" W**

2. SEARCH RESULTS

Agency	Results	Response
PA Game Commission	No Known Impact	No Further Review Required
PA Department of Conservation and Natural Resources	No Known Impact	No Further Review Required
PA Fish and Boat Commission	**Potential Impact**	**FURTHER REVIEW IS REQUIRED, See Agency Response**
U.S. Fish and Wildlife Service	No Known Impact	No Further Review Required

As summarized above, Pennsylvania Natural Diversity Inventory (PNDI) records indicate there may be potential impacts to threatened and endangered and/or special concern species and resources within the project area. If the response above indicates "No Further Review Required" no additional communication with the respective agency is required. If the response is "Further Review Required" or "See Agency Response," refer to the appropriate agency comments below. Please see the DEP Information Section of this receipt if a PA Department of Environmental Protection Permit is required.

3. AGENCY COMMENTS

Regardless of whether a DEP permit is necessary for this proposed project, any potential impacts to threatened and endangered species and/or special concern species and resources must be resolved with the appropriate jurisdictional agency. In some cases, a permit or authorization from the jurisdictional agency may be needed if adverse impacts to these species and habitats cannot be avoided.

These agency determinations and responses are **valid for two years** (from the date of the review), and are based on the project information that was provided, including the exact project location; the project type, description, and features; and any responses to questions that were generated during this search. If any of the following change: 1) project location, 2) project size or configuration, 3) project type, or 4) responses to the questions that were asked during the online review, the results of this review are not valid, and the review must be searched again via the PNDI Environmental Review Tool and resubmitted to the jurisdictional agencies. The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer impacts than what is listed on this PNDI receipt. The jursidictional agencies **strongly advise against** conducting surveys for the species listed on the receipt prior to consultation with the agencies.

PA Game Commission

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Department of Conservation and Natural Resources

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Fish and Boat Commission

RESPONSE: Further review of this project is necessary to resolve the potential impacts(s). Please send project information to this agency for review (see WHAT TO SEND).

PFBC Species: (Note: The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer species than what is listed below.)
Scientific Name: Sensitive Species**
Common Name:
Current Status: Threatened

Scientific Name: Sensitive Species**
Common Name:
Current Status: Endangered

U.S. Fish and Wildlife Service

RESPONSE: No impacts to **federally** listed or proposed species are anticipated. Therefore, no further consultation/coordination under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.* is required. Because no take of federally listed species is anticipated, none is authorized. This response does not reflect potential Fish and Wildlife Service concerns under the Fish and Wildlife Coordination Act or other

authorities.

* Special Concern Species or Resource - Plant or animal species classified as rare, tentatively undetermined or candidate as well as other taxa of conservation concern, significant natural communities, special concern populations (plants or animals) and unique geologic features.
** Sensitive Species - Species identified by the jurisdictinal agency as collectible, having economic value, or being susceptible to decline as a result of visitation.

WHAT TO SEND TO JURISDICTIONAL AGENCIES

If project information was requested by one or more of the agencies above, send the following information to the agency(s) seeking this information (see AGENCY CONTACT INFORMATION).

Check-list of *Minimum* Materials to be submitted:

____**SIGNED** copy of this Project Environmental Review Receipt
____Project narrative with a description of the overall project, the work to be performed, current physical characteristics of the site and acreage to be impacted.
____Project location information (name of USGS Quadrangle, Township/Municipality, and County)
____USGS 7.5-minute Quadrangle with project boundary clearly indicated, and quad name on the map

The inclusion of the following information may expedite the review process.
____A basic site plan(particularly showing the relationship of the project to the physical features such as wetlands, streams, ponds, rock outcrops, etc.)
____Color photos keyed to the basic site plan (i.e. showing on the site plan where and in what direction each photo was taken and the date of the photos)
____Information about the presence and location of wetlands in the project area, and how this was determined (e.g., by a qualified wetlands biologist), if wetlands are present in the project area, provide project plans showing the location of all project features, as well as wetlands and streams

4. DEP INFORMATION

The Pa Department of Environmental Protection (DEP) requires that a signed copy of this receipt, along with any required documentation from jurisdictional agencies concerning resolution of potential impacts, be submitted with applications for permits requiring PNDI review. For cases where a "Potential Impact" to threatened and endangered species has been identified before the application has been submitted to DEP, the application should not be submitted until the impact has been resolved. For cases where "Potential Impact" to special concern species and resources has been identified before the application has been submitted, the application should be submitted to DEP along with the PNDI receipt. The PNDI Receipt should also be submitted to the appropriate agency according to directions on the PNDI Receipt. DEP and the jurisdictional agency will work together to resolve the potential impact(s). See the DEP PNDI policy at http://www.naturalheritage.state.pa.us.

5. ADDITIONAL INFORMATION

The PNDI environmental review website is a **preliminary** screening tool. There are often delays in updating species status classifications. Because the proposed status represents the best available information regarding the conservation status of the species, state jurisdictional agency staff give the proposed statuses at least the same consideration as the current legal status. If surveys or further information reveal that a threatened and endangered and/or special concern species and resources exist in your project area, contact the appropriate jurisdictional agency/agencies immediately to identify and resolve any impacts.

For a list of species known to occur in the county where your project is located, please see the species lists by county found on the PA Natural Heritage Program (PNHP) home page (www.naturalheritage.state.pa.us). Also note that the PNDI Environmental Review Tool only contains information about species occurrences that have actually been reported to the PNHP.

6. AGENCY CONTACT INFORMATION

PA Department of Conservation and Natural Resources

Bureau of Forestry, Ecological Services Section
400 Market Street, PO Box 8552, Harrisburg, PA. 17105-8552
Fax:(717) 772-0271

U.S. Fish and Wildlife Service

Pennsylvania Field Office
110 Radnor Rd; Suite 101, State College, PA 16801
NO Faxes Please.

PA Fish and Boat Commission

Division of Environmental Services
450 Robinson Lane, Bellefonte, PA. 16823-7437
NO Faxes Please

PA Game Commission

Bureau of Wildlife Habitat Management
Division of Environmental Planning and Habitat Protection
2001 Elmerton Avenue, Harrisburg, PA. 17110-9797
Fax:(717) 787-6957

7. PROJECT CONTACT INFORMATION

Name:_____
Company/Business Name:_____
Address:_____
City, State, Zip:_____
Phone:(_____)_____Fax:(_____)_____
Email:_____

8. CERTIFICATION

I certify that ALL of the project information contained in this receipt (including project location, project size/configuration, project type, answers to questions) is true, accurate and complete. In addition, if the project type, location, size or configuration changes, or if the answers to any questions that were asked during this online review change, I agree to re-do the online environmental review.

_____ _____
applicant/project proponent signature date

Pennsylvania Fish & Boat Commission
established 1866

Division of Environmental Services
Natural Diversity Section
450 Robinson Lane
Bellefonte, PA 16823
814-359-5237

April 2, 2015

IN REPLY REFER TO
SIR# 44011

Langan Engineering & Environmental Services, Inc.
Jason Gilmore
2700 Kelly Road
Warrington, Pennsylvania 18976

RE: Species Impact Review (SIR) – Rare, Candidate, Threatened and Endangered Species
PNDI Search No. 20150312489658
Evergreen/PES AOI 5
PHILADELPHIA County: Philadelphia City

Dear Jason Gilmore:

This responds to your inquiry about a Pennsylvania Natural Diversity Inventory (PNDI) Internet Database search "potential conflict" or a threatened and endangered species impact review. These projects are screened for potential conflicts with rare, candidate, threatened or endangered species under Pennsylvania Fish & Boat Commission jurisdiction (fish, reptiles, amphibians, aquatic invertebrates only) using the Pennsylvania Natural Diversity Inventory (PNDI) database and our own files. These species of special concern are listed under the Endangered Species Act of 1973, the Wild Resource Conservation Act, and the Pennsylvania Fish & Boat Code (Chapter 75), or the Wildlife Code.

According to this submission and our records there have been no changes in the project or on-site biological information; therefore, the Commission's comments regarding potential impacts to rare, candidate, threatened, or endangered species under our jurisdiction, as detailed in our letter of July 15, 2013 for SIR# 41012, remain unchanged.

This response represents the most up-to-date summary of the PNDI data and our files and is valid for two (2) years from the date of this letter. An absence of recorded species information does not necessarily imply species absence. Our data files and the PNDI system are continuously being updated with species occurrence information. Should project plans change or additional information on listed or proposed species become available, this determination may be reconsidered, and consultation shall be re-initiated.

If you have any questions regarding this review, please contact Kathy Gipe at 814-359-5186 and refer to the SIR # 44011. Thank you for your cooperation and attention to this important matter of species conservation and habitat protection.

Sincerely,

Christopher A. Urban, Chief
Natural Diversity Section

CAU/KDG/dn

LANGAN

Technical Excellence
Practical Experience
Client Responsiveness

March 12, 2015

PA Fish and Boat Commission
Division of Environmental Services
450 Robinson Lane
Bellefonte, PA 16823-7437

Re: *UPDATE* SIR # 41012
PNDI Search ID: 20150312489658
Philadelphia Energy Solutions Refining and Marketing LLC
Philadelphia Refinery, AOI-5
City of Philadelphia, Philadelphia County, Pennsylvania
Langan Project No.: 002574601

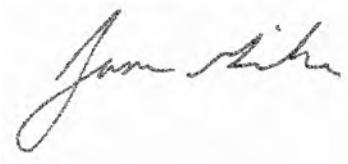
Dear Sir/Madam:

As environmental and regulatory compliance agent for Evergreen Resources Management Operations (applicant), Langan Engineering & Environmental Services (Langan) submits this request for potential conflicts associated with a search of the Pennsylvania Natural Diversity Inventory (PNDI) database. According to the PNDI search (PNDI 201503212489658), potential impacts may exist within the project site under the jurisdiction of the Pennsylvania Fish and Boat Commission. A SIR is enclosed for your reference.

AOI 5 is located in the southern most portion of the Philadelphia Energy Solutions (PES) Refining and Marketing, LLC Philadelphia Refinery in Philadelphia, Pennsylvania and is known as the Girard Point South Tank Field Area (Figure 1). AOI 5 is bordered to the North and Northwest by Penrose Avenue and the George Platt (formerly Penrose Avenue) Bridge, an industrial facility to the East, and the Schuylkill River to the South and Southwest. AOI 5 encompasses approximately 100 acres. No surface water features are located in AOI 5. The nearest surface water body to AOI 5 is the Schuylkill River which comprises the southern boundary of AOI 5. A sheet pile bulkhead, keyed into the Middle Clay Unit, extends along the entire southern boundary of the AOI 5 along the Schuylkill River. The extent of the sheet pile wall/bulkhead is shown in Figure 2. Groundwater interaction with surface water/sediment is limited by the sheet pile wall.

The project is currently in the Act 2 reporting process and information related to threatened/endangered species or their habitats is required. A previous response was obtained from your office in July 2013 (enclosed). We request updated information as to whether the project is determined to affect species of special concern under your jurisdiction, specifically addressing Act 2 reporting. If you have any questions on the enclosed materials or require any additional materials to make your determination, please feel free to contact me at (215) 491-6553.

Sincerely,
Langan Engineering and Environmental Services, Inc.



Jason Gilmore, PWS
Project Scientist

Enclosure(s): As discussed

\\langan.com\data\DT\data6\2574601\Engineering Data\Natural Resources\2015 PNDIs\AOI 5\2015-3-12 PFBC Update Letter.docx

PFBC-NESU-1 (5/2/03)

COMMONWEALTH OF PENNSYLVANIA
FISH AND BOAT COMMISSION
NATURAL DIVERSITY SECTION

SPECIES IMPACT REVIEW (SIR) REQUEST FORM

A. This form provides the site information necessary to perform a computer database search for species of special concern listed under the Endangered Species Act of 1973, the Wild Resource Conservation Act, the Pennsylvania Fish and Boat Code or the Wildlife Code.

B. Use only ***one form*** for each proposed project or location. Complete the information below and **mail** form to:

Natural Diversity Section
PA Fish and Boat Commission
450 Robinson Lane
Bellefonte, PA 16823
Fax: (814) 359-5153

C. This form, a cover letter including a project narrative, and accompanying maps should be sent to the above address for environmental reviews that ***only*** concern ***reptiles, amphibians, fishes and aquatic invertebrates***. Reviews for other natural resources must be submitted to other appropriate agencies.

D. The absence of recorded information from our databases and files does not necessarily imply actual conditions on site. Future field investigations could alter this determination. The information contained in our files is routinely updated. A review is valid for one year.

E. ***Please send us only one (1) copy of your request*** – either by fax or by mail – not both. Mail is preferred to improve legibility of maps. Facsimile submission will not improve our response turn-around time.

F. ***Allow 30 days for completion of the review from the date of PFBC-NESU receipt.*** Large projects and workload may extend this review timeframe.

G. ***In any future correspondence with us following your receipt of the SIR response, please refer to the assigned SIR number at the top left of our cover letter.***

H. **FORMS THAT ARE NOT COMPLETED IN FULL WILL NOT BE REVIEWED.**

PLEASE PRINT OR TYPE: If available, provide the potential conflict **PNDI Search Number**: 20150312489658

PFBC response should be sent to:

Company/Agency: Langan Form Preparer: Jason Gilmore

Address: 2700 Kelly Rd, Suite 200, Doylestown, PA 18976

Phone: (8:00 AM – 4:00 PM): 215-491-6553

Project Description: The project consists of approximately 100 acres. The project is currently in the Act 2 reporting process and information related to threatened/endangered species or their habitats is required.

Indicate if the project is: Transportation ☐ or Non-transportation ☒ (check one)

Will the proposed project encroach directly or indirectly (e.g., runoff) upon wetlands or waterways? Circle one for each:

Wetlands: Yes **No** Unknown Waterways: **Yes** No Unknown

County: Philadelphia Township/Municipality: City of Philadelphia

Name of the United States Geological Survey (U.S.G.S.) 7.5 Minute Quadrangle Map where project is located:

Philadelphia, PA Project size (in acres): 100

Attach an 8.5" by 11" photocopy (**DO NOT REDUCE**) of the section of the U.S.G.S. Quadrangle Map which identifies the project location. On this map, indicate the location of the project center (if linear, depict both ends) and outline the appropriate boundaries of the project area.

Specify latitude/longitude of the project center. **Latitude**: 39° / 53' / 53.6" **N**

Indicate latitude/longitude in degrees-minutes-seconds format only. **Longitude**: 75° / 12' / 11.4" **W**

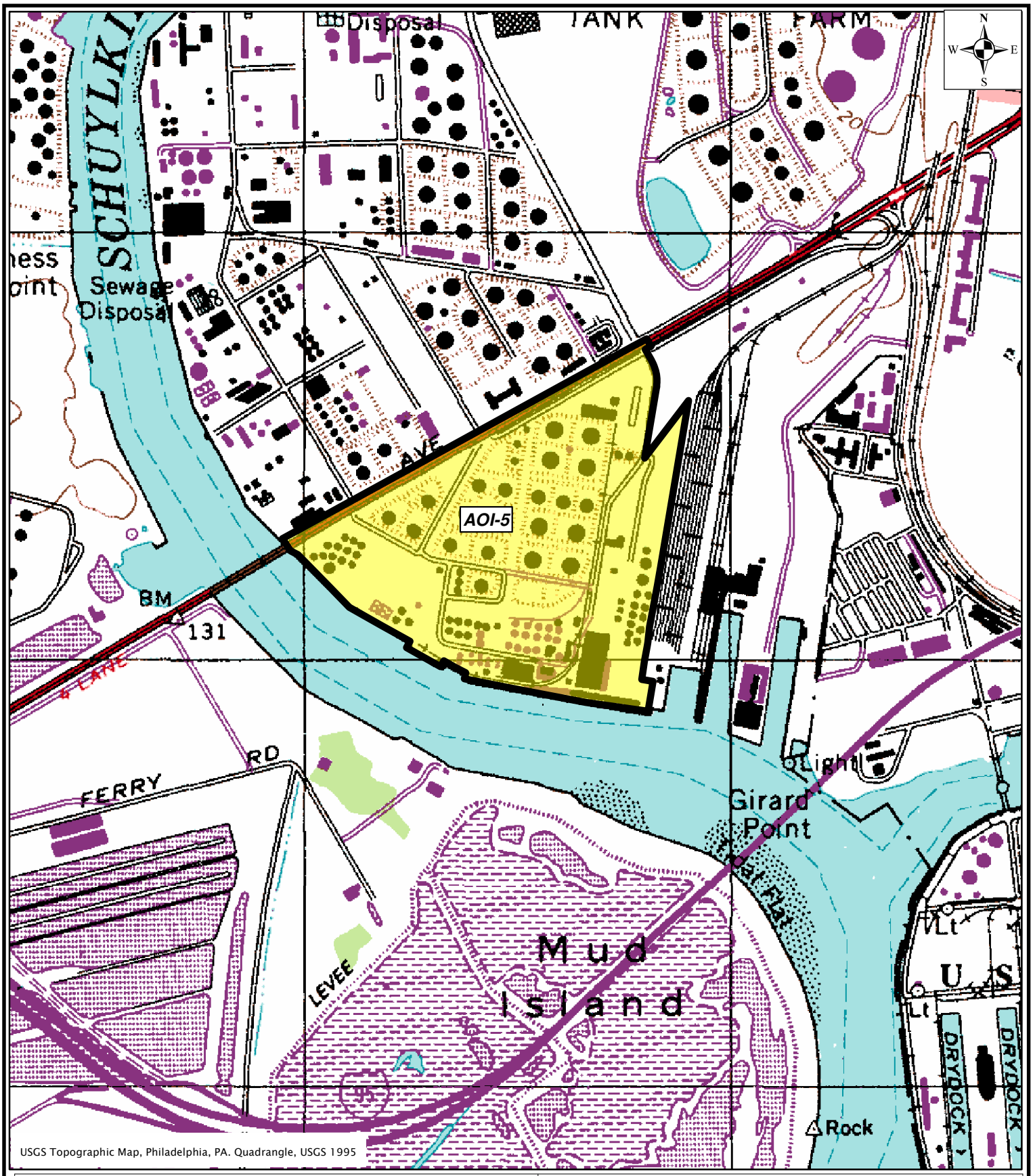
Three steps are needed to convert from decimal to degrees-minutes-seconds: (1) Degrees will be the whole number. (2) To get minutes, multiply the decimal degree portion by 60. (3) Multiply the decimal minute portion by 60 to get seconds.

Example: (Latitude) 40.93748 = **40**° ; 0.93748 x 60 = 56.2488' = **56**' ; 0.2488 x 60 = 14.928 = **15**" = **40°56'15"N**

(Longitude) 75.94740 = **75**° ; 0.94740 x 60 = 56.844' = **56**' ; 0.844 x 60 = 50.64 = **51**' = **75°56'51"W**

FOR PFBC USE ONLY

SIR#	Quad Name	Data Source	Search Results-Potential Species Conflict	Action



Evergreen Resources Management Operations

2 Righter Parkway, Suite 200
Wilmington, DE 19803

Figure 1: Site Location Map
AOI-5 Remedial Investigation Report
PES Philadelphia Refinery

Philadelphia Pennsylvania

Job Number	Scale: 1" = 1,000'	Date
2574601	0 500 1,000 Feet	March 12, 2015

Path: \\langan.com\data\DT\data6\2574601\ArcGIS\MapDocuments\Natural Resources\AOI5\Figure 1- Site Location Map_3-12-15.mxd

N
W E
S

Legend

- Sheet Pile Wall
- AOIs

Notes:
1. Aerial basemap is provided through Langan's Esri ArcGIS software licensing and ArcGIS online. Source of aerial imagery is Microsoft, 3/19/2011.

Figure 2: Site Plan
AOI-5 Remedial Investigation Report
PES Philadelphia Refinery

Evergreen Resources Management Operations
2 Righter Parkway, Suite 200
Wilmington, DE 19803

0 150 300 Feet

SCALE: 1" = 150'
DATE: March 12, 2015
DRN. BY: MH
CKD. BY: KM
JOB#: 2574601

Q:\Data\2574601\ArcGIS\MapDocuments\AOI 6 Site Characterization\Figure 8 Summary of Non SWMUs Soil Sample Exceedances.mxd

1. PROJECT INFORMATION

Project Name: **Evergreen/PES AOI 5**
Date of review: **3/12/2015 11:22:09 AM**
Project Category: **Hazardous Waste Clean-up, Site Remediation, and Reclamation,Other**
Project Area: **101.6** acres
County: **Philadelphia** Township/Municipality: **Philadelphia**
Quadrangle Name: **PHILADELPHIA** ~ ZIP Code: **19145**
Decimal Degrees: **39.897916 N, -75.205106 W**
Degrees Minutes Seconds: **39° 53' 52.5" N, -75° 12' 18.4" W**

2. SEARCH RESULTS

Agency	Results	Response
PA Game Commission	No Known Impact	No Further Review Required
PA Department of Conservation and Natural Resources	No Known Impact	No Further Review Required
PA Fish and Boat Commission	**Potential Impact**	**FURTHER REVIEW IS REQUIRED, See Agency Response**
U.S. Fish and Wildlife Service	No Known Impact	No Further Review Required

As summarized above, Pennsylvania Natural Diversity Inventory (PNDI) records indicate there may be potential impacts to threatened and endangered and/or special concern species and resources within the project area. If the response above indicates "No Further Review Required" no additional communication with the respective agency is required. If the response is "Further Review Required" or "See Agency Response," refer to the appropriate agency comments below. Please see the DEP Information Section of this receipt if a PA Department of Environmental Protection Permit is required.

3. AGENCY COMMENTS

Regardless of whether a DEP permit is necessary for this proposed project, any potential impacts to threatened and endangered species and/or special concern species and resources must be resolved with the appropriate jurisdictional agency. In some cases, a permit or authorization from the jurisdictional agency may be needed if adverse impacts to these species and habitats cannot be avoided.

These agency determinations and responses are **valid for two years** (from the date of the review), and are based on the project information that was provided, including the exact project location; the project type, description, and features; and any responses to questions that were generated during this search. If any of the following change: 1) project location, 2) project size or configuration, 3) project type, or 4) responses to the questions that were asked during the online review, the results of this review are not valid, and the review must be searched again via the PNDI Environmental Review Tool and resubmitted to the jurisdictional agencies. The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer impacts than what is listed on this PNDI receipt. The jursidictional agencies **strongly advise against** conducting surveys for the species listed on the receipt prior to consultation with the agencies.

PA Game Commission

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Department of Conservation and Natural Resources

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Fish and Boat Commission

RESPONSE: Further review of this project is necessary to resolve the potential impacts(s). Please send project information to this agency for review (see WHAT TO SEND).

PFBC Species: (Note: The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer species than what is listed below.)
Scientific Name: Sensitive Species**
Common Name:
Current Status: Threatened

Scientific Name: Sensitive Species**
Common Name:
Current Status: Endangered

U.S. Fish and Wildlife Service

RESPONSE: No impacts to **federally** listed or proposed species are anticipated. Therefore, no further consultation/coordination under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.* is required. Because no take of federally listed species is anticipated, none is authorized. This response does not reflect potential Fish and Wildlife Service concerns under the Fish and Wildlife Coordination Act or other

authorities.

* Special Concern Species or Resource - Plant or animal species classified as rare, tentatively undetermined or candidate as well as other taxa of conservation concern, significant natural communities, special concern populations (plants or animals) and unique geologic features.
** Sensitive Species - Species identified by the jurisdictinal agency as collectible, having economic value, or being susceptible to decline as a result of visitation.

WHAT TO SEND TO JURISDICTIONAL AGENCIES

If project information was requested by one or more of the agencies above, send the following information to the agency(s) seeking this information (see AGENCY CONTACT INFORMATION).

Check-list of *Minimum* Materials to be submitted:

____**SIGNED** copy of this Project Environmental Review Receipt
____Project narrative with a description of the overall project, the work to be performed, current physical characteristics of the site and acreage to be impacted.
____Project location information (name of USGS Quadrangle, Township/Municipality, and County)
____USGS 7.5-minute Quadrangle with project boundary clearly indicated, and quad name on the map

The inclusion of the following information may expedite the review process.
____A basic site plan(particularly showing the relationship of the project to the physical features such as wetlands, streams, ponds, rock outcrops, etc.)
____Color photos keyed to the basic site plan (i.e. showing on the site plan where and in what direction each photo was taken and the date of the photos)
____Information about the presence and location of wetlands in the project area, and how this was determined (e.g., by a qualified wetlands biologist), if wetlands are present in the project area, provide project plans showing the location of all project features, as well as wetlands and streams

4. DEP INFORMATION

The Pa Department of Environmental Protection (DEP) requires that a signed copy of this receipt, along with any required documentation from jurisdictional agencies concerning resolution of potential impacts, be submitted with applications for permits requiring PNDI review. For cases where a "Potential Impact" to threatened and endangered species has been identified before the application has been submitted to DEP, the application should not be submitted until the impact has been resolved. For cases where "Potential Impact" to special concern species and resources has been identified before the application has been submitted, the application should be submitted to DEP along with the PNDI receipt. The PNDI Receipt should also be submitted to the appropriate agency according to directions on the PNDI Receipt. DEP and the jurisdictional agency will work together to resolve the potential impact(s). See the DEP PNDI policy at http://www.naturalheritage.state.pa.us.

5. ADDITIONAL INFORMATION

The PNDI environmental review website is a **preliminary** screening tool. There are often delays in updating species status classifications. Because the proposed status represents the best available information regarding the conservation status of the species, state jurisdictional agency staff give the proposed statuses at least the same consideration as the current legal status. If surveys or further information reveal that a threatened and endangered and/or special concern species and resources exist in your project area, contact the appropriate jurisdictional agency/agencies immediately to identify and resolve any impacts.

For a list of species known to occur in the county where your project is located, please see the species lists by county found on the PA Natural Heritage Program (PNHP) home page (www.naturalheritage.state.pa.us). Also note that the PNDI Environmental Review Tool only contains information about species occurrences that have actually been reported to the PNHP.

6. AGENCY CONTACT INFORMATION

PA Department of Conservation and Natural Resources
Bureau of Forestry, Ecological Services Section
400 Market Street, PO Box 8552, Harrisburg, PA. 17105-8552
Fax:(717) 772-0271

U.S. Fish and Wildlife Service
Pennsylvania Field Office
110 Radnor Rd; Suite 101, State College, PA 16801
NO Faxes Please.

PA Fish and Boat Commission
Division of Environmental Services
450 Robinson Lane, Bellefonte, PA. 16823-7437
NO Faxes Please

PA Game Commission
Bureau of Wildlife Habitat Management
Division of Environmental Planning and Habitat Protection
2001 Elmerton Avenue, Harrisburg, PA. 17110-9797
Fax:(717) 787-6957

7. PROJECT CONTACT INFORMATION

Name: Jason Gilmore, PWS
Company/Business Name: Langan
Address: 2700 Kelly Road, Suite 200
City, State, Zip: Warrington, PA 18976
Phone:(215)491-6553 Fax:( )
Email: jgilmore@langan.com

8. CERTIFICATION

I certify that ALL of the project information contained in this receipt (including project location, project size/configuration, project type, answers to questions) is true, accurate and complete. In addition, if the project type, location, size or configuration changes, or if the answers to any questions that were asked during this online review change, I agree to re-do the online environmental review.

applicant/project proponent signature

3/12/2015
date

Pennsylvania Fish & Boat Commission

established 1866

Division of Environmental Services
Natural Diversity Section
450 Robinson Lane
Bellefonte, PA 16823-9620
(814) 359-5237 Fax: (814) 359-5175

July 15, 2013

IN REPLY REFER TO
SIR# 41012

LINDA KENNEY
LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES
PO BOX 1569
DOYLESTOWN, PA 18901-0219

RE: Species Impact Review (SIR) – Rare, Candidate, Threatened and Endangered Species
PNDI Search No. 20130115386609
PHILADELPHIA AO1-5
UPDATE TO SIR #37591
PHILADELPHIA Township, PHILADELPHIA County, Pennsylvania

Dear Ms. KENNEY:

I have examined the map accompanying your recent correspondence which shows the location for the above referenced project. Based on records maintained in the Pennsylvania Natural Diversity Inventory (PNDI) database and our own files, the state threatened eastern redbelly turtle (*Pseudemys rubriventris*) is known from the vicinity of the project site.

The eastern redbelly turtle is one of Pennsylvania's largest native aquatic turtles. This turtle species is known to inhabit relatively large, deep streams, rivers, ponds, lakes and marshes with permanent water and ample basking sites. Redbelly turtles are restricted to the southcentral and southeastern regions of the Commonwealth. The existence of this turtle species is threatened by habitat destruction, poor water quality, and competition with aggressive non-native turtle species that share its range and habitat (e.g., red-eared slider, *Trachemys scripta elegans*).

Redbelly turtles are known from near the project area. It is possible that they could also occur in any wetlands and water bodies on-site. **Therefore, if wetlands with open water areas, streams, or ponds are to be disturbed from the project activity**, we will need to conduct a more thorough evaluation of the potential adverse impacts to the redbelly turtle. Items **such as:** basic project plans, project narrative, general habitat descriptions, and color photographs keyed to a site map or diagram of the project area, wetlands identification and delineation, stream characterization (flow velocity, width, depth, substrate type, pools and riffles, identification of basking areas, logs, woody debris, presence of aquatic vegetation) would expedite our review process. Pending the review of information, a survey for targeting the presence of the species of concern may be warranted.

However, if wetlands or water bodies are not to be disturbed in any way by the proposed activity, and provided that best management practices are employed and strict erosion and sedimentation measures are maintained, I do not foresee any adverse impacts to eastern redbelly turtle or any other rare or protected species under Pennsylvania Fish and Boat Commission jurisdiction.

Note that this office performed no field inspection of the project area. Consequently, comments in this letter are not meant to address other issues or concerns that might arise concerning matters under Pennsylvania Fish and Boat Commission jurisdiction or that of other authorities. If you have any questions regarding this response, please contact Kathy Gipe at 814-359-5186 **and refer to the SIR number at the top of this letter**. Thank you for your cooperation and attention to this matter of endangered species conservation and habitat protection.

Sincerely,

Christopher A. Urban, Chief
Natural Diversity Section

CAU/KDG/kn