SITE CHARACTERIZATION/REMEDIAL INVESTIGATION REPORT AOI 11

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September 12, 2011
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1.0 INTRODUCTION

Sunoco Inc. (R&M) (Sunoco) and the Pennsylvania Department of Environmental Protection (PADEP) entered into a Consent Order & Agreement (CO&A) in December 2003 with respect to Sunoco's Philadelphia Refinery (refinery). Sunoco's Phase I Remedial Plan (Phase I Plan), dated November 2003, was included as an attachment to the CO&A. In accordance with the CO&A and Phase I Plan, a Current Conditions Report and Comprehensive Remedial Plan (CCR) was prepared by Sunoco in June 2004. The Phase I Plan and the CCR divided the facility into 11 Areas of Interest (AOIs), and presented a prioritization of the AOIs based on specific risk factors. The AOIs are shown in Figures 1 and 2 of this report. The CCR also presented the Phase II remedial approach and schedule to characterize each of the 11 AOIs, and to conduct Phase I and II corrective action activities in accordance with the 2003 CO&A and the Phase I Plan. Since 2003, Sunoco has completed site characterization activities at ten AOIs (AOIs 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10). For each AOI that has been characterized, Sunoco prepared and submitted a corresponding Site Characterization Report (SCR) in accordance with the Revised Phase II Corrective Action Activities schedule that was included in the CCR.

This Site Characterization Report/Remedial Investigation Report (SCR/RIR) has been prepared for AOI 11 in accordance with the 2003 CO&A. AOI 11 consists of the deep groundwater (groundwater in the Farrington Sand) aquifer which is a geologic unit that underlies the majority of the refinery. This SCR/RIR documents the activities completed to characterize conditions in the deep groundwater beneath the refinery and the results of these activities. As presented in the CCR, deep groundwater in each AOI was characterized during the individual AOI investigations between 2005 and 2011. In addition to the individual AOI investigations, additional deep groundwater characterization activities were completed in April 2011 and June/July 2011 in support of this SCR/RIR.

In accordance with the provisions of Act 2, Langan, on behalf of Sunoco, prepared the required public and municipal notices as part of this SCR/RIR submittal. The notices and their proof of receipt/publication are included in Appendix A of this SCR/RIR.

1.1 Site History and Background

The refinery is located in southwest Philadelphia and has a long history of petroleum transportation, storage, and processing. The oldest portion of the refinery started

petroleum-related activities in the 1860s when the Atlantic Refining Company established an oil distribution center. In the 1900s, crude oil processing began and full-scale gasoline production was initiated during World War II. In addition to refining crude oil, various chemicals such as acids and ammonia were also produced at the refinery for a time. Current operations at the refinery are limited to the production of fuels and basic petrochemicals for the chemical industry. The current and future intended use of the refinery is non-residential.

1.2 Selection of Constituents of Concern and Applicable Standards

Constituents and Media of Concern

The groundwater constituents of concern (COCs) for AOI 11 are listed in Table 1 of this report. The COCs for the completed activities include all current constituents from the Pennsylvania Corrective Action Process (CAP) Regulation Amendments effective December 1, 2001; provided in Chapter VI, Section E of PADEP's Closure Requirements for Underground Storage Tank Systems, with the exception of the waste oil parameters since waste oil is only stored in small tanks within the facility maintenance garages. These COCs are the same as those listed for groundwater in the CCR. In May 2009, two additional COCs, 1,2,4-trimethylbenze and 1,3,5-trimethylbenzene, were added to the list of COCs by Sunoco based on the PADEP's revisions to the petroleum short list of compounds and at the request of the PADEP. For AOI 11, four additional metals (arsenic, cobalt, iron and manganese) and wet chemistry parameters including ammonia, chloride, fluoride, nitrate, nitrite, sulfate, alkalinity, total organic carbon (TOC), and total dissolved solids (TDS) were added to the COC list to further characterize deep groundwater at the site in accordance with the CO&A.

The media of concern for AOI 11 is groundwater. The potential indoor air quality and off-site vapor migration exposure pathways from deep groundwater beneath the refinery are not applicable since there is shallow groundwater throughout the refinery that was evaluated for potential vapor intrusion issues. As presented in the CCR, the potential receptors in AOI 11 are the Delaware River and Schuylkill River from groundwater discharge and the Potomac, Raritan and Magothy (PRM) aquifer system through groundwater recharge.

Act 2 Remediation Standards

The approach for attaining Act 2 remediation standards for the media of concern is described below by media.

Groundwater

Groundwater sample results were screened against the PADEP non-residential, used-aquifer (TDS<2,500) statewide health groundwater medium-specific concentrations (MSCs). As summarized in the CCR, where constituent concentrations are above these statewide health MSCs, Sunoco evaluated application of the site-specific remediation standard using either the pathway elimination or calculated risk-based standard options.

Vapor Intrusion into Indoor Air

The potential vapor intrusion into indoor air from deep groundwater pathway is considered incomplete for AOI 11 because a shallow water table aquifer exists throughout the refinery within recent alluvium deposits and the Trenton Gravels, and the Middle/Lower clay exists between the shallow water table aquifer and above deep groundwater in most places of the refinery. Where present, the Middle/Lower Clay serves is an aquitard that would prevent the upward migration of vapor from deep groundwater.

Vapor intrusion assessments were completed for the shallow water table aquifer throughout the refinery as part of the individual AOI investigations. These assessments were completed following the current PADEP guidance for evaluating the potential vapor intrusion into indoor air pathway.

1.3 Overview of Investigative Framework and Remedial Approach for AOI 11

The current remediation program for the refinery is performed under the 2003 CO&A between PADEP and Sunoco. In April 2004, the PADEP and EPA signed an agreement entitled "One Cleanup Program Memorandum of Agreement (MOA or PA One-Cleanup Program)," which clarifies how sites remediated under Pennsylvania's Act 2 program may satisfy RCRA corrective action requirements through characterization and attainment of Act 2 remediation standards pursuant to Pennsylvania's Act 2. On November 22, 2005, Sunoco and its representatives met with officials of the PADEP and EPA to discuss the applicability of the Sunoco Philadelphia Refinery to the PA One Cleanup Program. During the November 22, 2005 meeting, all parties agreed that the

One Cleanup Program would benefit the project by merging the remediation obligations under the various programs into one streamlined approach which would be conducted under the existing 2003 CO&A.

As a follow up to the November 22, 2005 meeting, Sunoco submitted a letter dated December 2, 2005 to EPA and PADEP documenting the discussions at the meeting. Sunoco submitted a notice of intent to remediate (NIR) for the refinery, excluding the Belmont Terminal, to the PADEP on October 12, 2006 and held a public involvement meeting in South Philadelphia on September 19, 2007. A copy of this NIR and the Act 2 report notifications for this SCR/RIR are included in Appendix A.

On March 5, 2009, Sunoco and its representatives met again with EPA to discuss Sunoco Philadelphia Refinery's remediation progress and path forward under the One Clean-Up Program. As a follow up to the meeting, Sunoco submitted a letter dated March 11, 2009 to EPA and PADEP documenting the discussions at the meeting. The major points of this letter are as follows:

- EPA will provide a formal letter that acknowledges that there is a One Clean Up Program Agreement with Sunoco and it's currently operating under one EPA ID Number (PAD049791098) for Point Breeze, Girard Point and Schuylkill River Tank Farm;
- EPA will add in a Corrective Action Module to the Sunoco-submitted Draft Part B RCRA Permit. The module will reference the One Clean-Up Program agreement and the current remediation work being completed under the existing Consent Order and Agreement between PADEP and Sunoco, Inc.; and
- EPA will issue a letter to Sunoco for each characterized SWMU that lists a non-leaded tank bottom designation for which no further action is required.

Sunoco is also developing a report entitled, *Work Plan for* S*itewide Approach Under the One Cleanup Program* (Work Plan for Sitewide Approach), to document the Sitewide remedial approach extending beyond the requirements of the 2003 CO&A. DEP and EPA have reviewed and provided input to this report and the final report is expected to be submitted to DEP and EPA in September 2011.

2.0 ENVIRONMENTAL SETTING

The refinery is located on approximately 1,300 acres in southwest Philadelphia and has a long history of petroleum transportation, storage, and processing.

Groundwater quality and quantity in the Philadelphia area has been documented in detail in a number of USGS reports, as summarized in the reference section. As indicated in these reports, widespread industrial land use and urbanization in the region of the refinery has had an effect on both groundwater quality and flow.

2.1 Physiography and Topography

The refinery lies within the Atlantic Coastal Plain Physiographic Province which is generally low-lying and relatively flat. Land surface topography at the refinery is relatively flat, with the land surface elevation being generally below 30 feet above mean sea level (ft amsl). 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 refinery. Northwest of the refinery, 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). The refinery is underlain by a portion of the PRM aquifer system. The PRM system is a wedge-shaped mass of sediments of Cretaceous age is composed of alternating layers of clay, silt, sand, and gravel that are thinnest near the Fall Line and gradually thicken in a southeast direction to the coast, where these deposits are several thousand feet thick. These deposits range in thickness from a featheredge along the Fall Line to more than 4,100 feet beneath Cape May County, New Jersey. The aquifer system is confined except in outcrop areas by the underlying crystalline rocks and the overlying Merchantville-Woodbury confining unit. In the northern part of the Coastal Plain, the PRM aquifer system is divided into two aquifers. They are the Farrington aquifer (mainly Raritan age) and the Old Bridge aquifer (Magothy age). The deep groundwater at the refinery occurs in the Farrington Sand unit of the Farrington aquifer.

2.2 Regional and Site-Specific Geology

Regional Geology – PRM

The PRM system begins at the Fall Line east of the Delaware River and thickens as it moves eastward into New Jersey and towards the Atlantic Ocean. Not all units of the PRM system are present near the Fall Line but develop as the formation moves eastward. This system consists of unconsolidated sediments that are comprised of highly permeable sands and gravels separated by less-permeable layers of silts and clays (USGS, 2001). The Middle Clay and Farrington Sand units are part of the PRM system and exist in some areas beneath the refinery.

The Middle Clay member of the Raritan Formation is the most extensive clay layer in the Philadelphia area. The Middle Clay is fairly uniform, being less variable in lithology than the other clay members of the Raritan Formation, and is a tough, red and white massive clay with a characteristic basal layer of lignite. The Middle Clay has been eroded away beneath parts of the refinery, particularly under the West Yard. Regionally, the thickness of the Middle Clay ranges from 0 to 60 feet, with thicknesses commonly greater than 20 feet. The Middle Clay is characterized by a very low permeability and forms an effective barrier to vertical groundwater flow.

The Farrington Sand is the basal member of the lowermost part of the PRM consisting of pre-Cretaceous channels carved into underlying crystalline rocks (USGS, 1961). The Farrington Sand generally consists of coarse sand and fine gravel which grade upward into medium to fine-grained sand with a few beds/layers of clay. The color of the sand often varies from yellowish-brown to yellowish-gray. The coarse sand and fine gravels are fairly well sorted. Thickness of the Farrington Sand various throughout southeastern Pennsylvania and is summarized in USGS Plates 9 and 10 in Appendix B. Typical thickness is approximately 60 feet throughout the region, but ranges upwards to 90 feet. Throughout most of the region, the Farrington Sand is overlain by the Middle/Lower Clay (USGS, 1961). In locations of troughs (as observed in western portion of AOI 8, portions of AOI 9, and in AOI 10) the clay has been removed by erosion.

Site-Specific Geology

The geology of the refinery is composed of several different geologic units which generally include the following units from deep to shallow: Wissahickon Formation

(bedrock), Farrington Sand unit of PRM, Middle/Lower Clay, Trenton Gravel, and recent fill/alluvium. Detailed descriptions for Farrington Sand and the Middle/Lower Clay are presented below.

The groundwater monitoring wells screened within or below the Middle/Lower Clay and in the Farrington Sand are referred to as deep monitoring wells. A total of 45 deep monitoring wells currently exist throughout AOI 11. The locations of the deep monitoring wells are shown in Figure 3. Site-specific boring logs and monitoring well summaries that describe the occurrence and thickness of the Middle Clay and Farrington Sand units are presented in Appendix C and site wide geologic cross sections are presented in Appendix D. Detailed site-specific and regional geologic cross sections that depict the occurrence and thickness of the Middle Clay and Farrington Sand units are presented in Appendices B and D, respectively. A complete list of deep monitoring wells located throughout the refinery by AOI is provided in Table 2. Below is a general geologic description of the Farrington Sand beneath the refinery.

- Farrington Sand beneath the refinery generally consists of green, brown, orange and/or red, fine gravel and course sand that grades upward into medium-to-fine sands and contains thin layers of silts and clays.
- The Farrington Sand is present beneath the limits of the refinery, with the exception of AOI 10 and the northwestern and western portions of AOI 8 where the sand has been eroded and replaced with alluvium.
- The extent of the Farrington Sand beneath the refinery is generally consistent with the extent illustrated by USGS, 1961 Plate 7 (Appendix B).

Below is a detailed summary of the occurrence and thickness of the Middle/Lower Clay and Farrington Sand for each AOI within the refinery.

- Throughout AOI 1, the Farrington Sand is overlain by the Middle/Lower Clay based USGS interpretation and recent geologic cross section O-O'. The Middle/Lower Clay ranges in thickness from 15 to 25 feet thick and the Farrington Sand ranges in thickness from 30 to 40 feet.
- The Middle/Lower Clay overlays the Farrington Sand throughout AOI 2 based on geologic cross sections X-X' and Y-Y'. The Middle/Lower Clay ranges in

thickness between 5 to 35 feet beneath AOI 2 and the Farrington Sand ranges in thickness from 15 to 35 feet.

- The Middle/Lower Clay overlies the Farrington Sand throughout most of AOI 3 based on recent geologic cross sections X-X', Z-Z', AA-AA', and BB-BB'. In the northern portion and southern portions of AOI 3, the Lower/Middle ranges in thickness from 15 to 30 feet. In the central portion of AOI 3, the Middle/Lower Clay is shallower in depth and inter-fingers with the Middle/Lower Sand. The extent of clay beneath AOI 3 is generally consistent with the extent illustrated by USGS (USGS, 1961) Plates 7, 9, 15, and 18. The Farrington Sand ranges in thickness throughout AOI 3 between 20 to 35 feet.
- Throughout AOI 4, the Farrington Sand is overlain by the Middle/ Clay based on USGS interpretations and recent geologic cross section P-P'. The Middle/Lower Clay ranges in thickness from 15 to 20 feet and the Farrington Sand in the northern and western portions of AOI 4 is 15 to 20 feet thick and in the southern and eastern portions of AOI 4 is 30 to 40 feet thick.
- Throughout the central and western portions of AOI 5, based on recent geologic cross section R-R' and USGS publications the Farrington Sand is overlain by the Middle/Lower Clay throughout AOI 5. The Middle/Lower Clay ranges in thickness from 25 to 65 feet and the Farrington Sand in the western portion of AOI 5 is 10 to 15 feet thick and in the eastern portion of AOI 5 is 30 to 40 feet thick.
- Throughout AOI 6 the Farrington Sand is overlain by the Middle/Lower Clay, based on recent geologic cross section Q-Q' and USGS publications. The Middle/Lower Clay ranges in thickness from 20 to 50 feet and the Farrington Sand is approximately 15 feet thick in the western portion of AOI 6 and 50 feet thick in the eastern portion of AOI 6.
- Throughout AOI 7 the Farrington Sand is overlain by the Middle/Lower Clay based on recent geologic cross sections Z-Z', AA-AA', and CC-CC'. The Middle/Lower Clay ranges in thickness from 15 to 55 feet and the Farrington Sand ranges in thickness between 20 and 70 feet, and generally is thinner closer to the Schuylkill River.
- Based on USGS publication and geologic cross sections S-S', T-T' and U-T' the Farrington Sand overlies bedrock in the eastern and central portions of AOI 8

ranging in thickness from 0 to 65 feet, but is absent in the northwestern and western portions where it has been eroded and replaced with alluvium. The Middle/Lower Clay overlies the Farrington Sand in the central and eastern portions of AOI 8 ranging in thickness from 10 to 25 feet. In the western and northwestern portions of AOI 8, the Farrington Sand is overlain by either alluvium or Trenton Gravel and the Middle/Lower Clay is absent.

- Based on USGS publications and geologic cross sections V-V' and W-W' the Farrington Sand overlies bedrock throughout AOI 9. The Farrington Sand in AOI 9 ranges in thickness between 50 to 70 feet. The Lower/Middle Clay overlies the Farrington Sand in the northern, eastern and southern portions of AOI 9. In the north-central and western portions of AOI 9, the Lower/Middle Clay appears to have been removed possibly due to erosion. The USGS (USGS, 1961) interpreted that a depositional trough is located near AOI 9 and notes that, near the heads of these troughs of deposition, the clay members have been removed. The extent of the clay beneath AOI 9 is generally consistent with the extent illustrated by USGS, 1961 Plate 20. Where present, the clay ranges in thickness from 5 feet to 25 feet.
- Based on geologic data collected in AOI 10, the Farrington Sand does not exist beneath AOI 10. This geologic interpretation is consistent with the extent of the Farrington Sand illustrated by USGS Plates 7, 9, 15, and 18 as presented in Appendix B. Alluvium is present beneath AOI 10 and thickens in a wedge shape towards the Schuylkill River.

2.3 Regional and Site-Specific Hydrogeology

Regional Hydrogeology

The Cape May Formation (commonly referred to as the Trenton Gravel) consists of sand, gravel and minor amounts of clay (Owens and Minard, 1979). In some of the western portions of the PRM, the Trenton Gravel overlies bedrock and can serve as an important shallow aquifer in the portions where the Trenton Gravel is thick. Where present between the Trenton Gravel and Farrington Sand, the Middle/Lower Clay acts to confine deep groundwater beneath the clay.

Regional development and industrial uses of the deep groundwater has manipulated groundwater flow and quality in Farrington Sand in the PRM. Excessive concentrations

of iron and manganese have been reported in regional deep groundwater (USGS, 2001). Included in Appendix B are several figures from the USGS illustrating the change in groundwater flow, direction, and quality in the Farrington Sand over the past century.

When examining the groundwater quality and chemistry of the Farrington Sand in the PRM, it is evident that historically there has been a high presence of dissolved metals (USGS, 2001 and Sloto, 2003). Releases of contaminants from industrial brines, sewage, and inorganic and organic wastes from industrial and residential sources have led to regional degraded groundwater conditions. The PRM aquifer system no longer is used as a source of water supply in Philadelphia because of highly elevated concentrations of iron (as high as 429,000 ug/L), manganese (as high as 4,000 ug/L), and sulfate (as high as 1,720,000 ug/L) that have contaminated the aquifer in south Philadelphia and have made the ground water unusable for most purposes (Sloto, 2003). Many wells in Philadelphia were abandoned primarily due to the contaminants within the aquifer.

Site Specific Hydrogeology

The refinery is located in the portion of the PRM system that originates at the fall line to the west of the Schuylkill River and extends eastward to the Delaware River. Deep groundwater elevation contours generated from June/July 2011 data collected by Aquaterra Technologies, Inc. (Aquaterra) are shown on Figure 4. Historic (2001 to 2010) deep groundwater contours are included in Appendix E.

Below is a summary of the hydrologic conditions of the Farrington Sand beneath the refinery based on lithologic data from deep boring logs and historic and current (2010/2011) groundwater elevation data.

- In the northern-most part of the refinery (AOI 8), the Farrington Sand is hydraulically disconnected to the Schuylkill River by the wedge-shaped alluvium deposit that fills the erosional trough down to the surface of bedrock (see the geologic cross section in Appendix D corresponding to AOI 8).
- At the AOI 2 boundary with the Schuylkill River, the top of the Farrington Sand is possibly in hydraulic connection with the bottom of the Schuylkill River (see the geologic cross section in Appendix D corresponding to AOI 2).

- South of the AOI 2 area boundary with the river, the Farrington Sand is present at depths greater than the bottom of the Schuylkill River, and more importantly, is hydraulically separated from the River by the presence of the Lower Clay (see the geologic cross sections in Appendix D corresponding to AOIs 3, 7, 6, 5 and 9).
- Depth to deep groundwater throughout the refinery occurs at depths ranging between 8 and 37 feet below the ground surface to the piezometric surface.
- Downward vertical gradients exist between the shallow/intermediate and deep monitoring wells throughout the refinery, with the exception of AOI 9 where deep groundwater flows vertically upward at the edges of the semi-confining clay.
- Based on the 2010 and 2011 deep groundwater elevation data, the deep groundwater gradients are relatively flat with an average gradient of 0.001 ft/ft.
- All deep groundwater flow generally is towards the Schuylkill River or the Delaware River (Figure 4). The current and historic deep groundwater flow patterns are generally consistent. Based on the 2011 deep groundwater elevation contours illustrated in Figure 4, the following points can be made:
    - In AOI 8, a groundwater flow divide, trending northwest to southeast, exists. This divide generally corresponds with the eastern extent of the alluvium materials deposited following the erosion and removal of the Pleistocene age deposits. Groundwater on the east side of the divide flows to the east-southeast and groundwater on the west side of the divide flows to the southwest. The divide is likely caused by the presence of the alluvium wedge located along the border between AOI 8 and the Schuylkill River.
    - South of AOI 8, the deep groundwater flow direction is towards the south under a very low hydraulic gradient. This flow pattern and gradient is generally consistent across AOIs 1, 2, 3 and 4.
    - At AOIs 5, 6, and 7, deep groundwater flow is generally towards the southwest and the hydraulic gradient steepens along refinery boundary with the Schuylkill River.

- The deep groundwater flow direction in AOI 9, across the Schuylkill River, is towards the southwest and occurs at an elevation that is consistent with the deep groundwater elevations across the river (AOIs 5, 6, and 7). The groundwater flow direction in AOI 9 also matches the groundwater flow direction in AOIs 5, 6, and 7. The similarity in depth and flow direction indicates the Farrington Sand is present beneath the river between these areas and is hydraulically separated from the river by overlying Middle Clay. This lithology can be inferred from geologic cross sections in Appendix D that correspond to the geology at the river boundaries of AOIs 9 and AOIs 5, 6, and 7.
- In AOI 9, where the Middle/Lower Clay potentially is absent, a water table aquifer exists that corresponds to the water level of the combined fill/alluvium/Trenton Gravel and the Farrington Sand. Shallow groundwater elevations in this area are generally consistent with elevations in the Farrington Sand unit beneath the clay. Water in the Farrington Sand may flow vertically upward at the boundaries of the clay, affecting the flow of groundwater in the water table aquifer where the clay is absent. This may explain the variable flow directions observed in groundwater that is in connection with the Farrington Sand materials and is consistent with the USGS interpretations. Groundwater flow in the water table aquifer above the clay is generally radial and towards the area where the clay is absent. In the southern portion of AOI 9, a groundwater divide exists and groundwater flow in the southern portion is towards the south. In the south portion of AOI 9, the southern groundwater flow direction observed in both aquifer regimes is likely attributable to the influence of the water elevation in the adjacent Mingo Creek Flood Control Basin.

- Based on recent geologic data collected in AOI 10 in 2011 and summarized in the AOI 10 SCR/RIR submitted to agencies in June 2011, the Farrington Sand does not exist beneath AOI 10. This geologic interpretation is consistent with the extent of the Farrington Sand illustrated by USGS as presented in Appendix B.

Site-Specific Groundwater Quality

Previous studies of the deeper aquifer at the facility have been conducted by ENSR (*Investigation of Shallow and Deep Groundwater Quality, Philadelphia Refinery, Philadelphia, PA, May 1994.*). This study indicated that groundwater, both surficial and deeper, is in a reduced state and has inorganic compounds at concentrations consistent with a low oxygen, high electron potential (high eH) environment. However, the concentrations of these compounds are generally consistent with regional groundwater quality data collected by the USGS (Paulachok, 1991). The ENSR report did find high ammonia concentrations in deep monitoring well (N-38D) located in AOI 8 in the upgradient area suggesting off-site sources not related to refinery operations, and did not observe a spatial trend of increasing concentrations with downgradient locations. ENSR also reported that organic petroleum compounds (BTEX) were detected in two deep monitoring wells (S-42D and S-38D) in the South Yard although they questioned whether the sampled intervals were actually above the deep aquifer. S-38D was reclassified as an intermediate monitoring well during AOI 1 site characterization activities and only benzene was detected in S-42D during latest June 2011 AOI 11 groundwater sampling event.

When examining the chemistry of deep groundwater beneath the refinery, the groundwater conditions are very similar to the surrounding regional deep groundwater conditions. The groundwater table within the refinery has been strongly influenced by historic pumping and other industrial uses of the deep groundwater in the region (USGS, 2001 and Sloto, 2003). The 1994 ENSR investigation of the shallow and deep groundwater quality of the refinery noted that there were elevated levels of iron and manganese in the Farrington Sand Aquifer and that the results were consistent with those found by the USGS's regional report released in 1991. Groundwater quality in the deep aquifer beneath the refinery is discussed in further detail in subsequent sections of this report.

2.4 Groundwater Usage and Use Restrictions

Langan, as part of the AOI 11 characterization, completed a well search for water wells within a 1.0 mile radius of the refinery using the Pennsylvania Groundwater Information System (PaGWIS) software and database. The results of the search indicated there are no residential or agricultural water supply wells within the search radius. This finding is consistent with a well search completed by URS for the refinery in 2002. In addition, a list of potable wells obtained from the PADEP on September 8, 2011 were compared to the well search radius map and confirmed that there are no potable wells within a 1.0

mile radius of the refinery. A copy of the well search radius figure is provided as Appendix F.

2.5 Surface Water

The Delaware River is the major surface water body within the vicinity of the refinery. A tributary of the Delaware River, the Schuylkill River, is present within the refinery, and bisects the refinery in a generally north to south direction (Figures 1 and 2). Both rivers are tidally-influenced in the vicinity of the refinery. The Schuylkill River defines the western borders of AOIs 2, 3, 5, 6, 7, and 8 and the eastern borders of AOIs 9 and 10. Lands Creek, a small tidal tributary to the Schuylkill River, traverses the southern portion of AOI 10. The confluence of Lands Creek and the Schuylkill River is in the southeast corner of AOI 10. The Mingo Creek Flood Control Basin is located adjacent south of AOI 9. As reported by Dames & Moore (Dames & Moore, 1991), water levels in the Mingo Creek Flood Control Basin are maintained below the surface level of the Schuylkill River at all times by large-capacity pumps used for flood control.

3.0 SITE CHARACTERIZATION ACTIVITIES

The following sections summarize the site characterization activities that were completed in AOI 11 in support of this SCR/RIR. Site characterization activities were performed between 2005 and 2011, by Aquaterra, Stantec, and Langan in coordination with Sunoco. All site characterization activities are discussed in the following sections. Field procedures followed during the site characterization activities are included in Appendix G of this report.

3.1 Installation of Groundwater Monitoring Wells

Deep groundwater monitoring wells existed at the refinery prior to 2005, however, additional deep groundwater monitoring wells were installed between 2005 and 2011 as part of the individual AOI investigations. Deep monitoring well installation activities were performed by several drilling companies between 2005 and 2011 under direct supervision of Aquaterra, Langan, and Stantec in coordination with Sunoco. All monitoring wells were installed and constructed in accordance with the AOIs 1 through 10 Work Plans. The locations of all deep monitoring wells at the refinery are shown on Figure 3. Monitoring well construction details are provided in Table 2 and soil

boring/monitoring well construction logs are provided in Appendix C. Geologic information obtained from the deep soil borings were used to prepare geologic cross sections provided in Appendix D. A summary of the deep monitoring wells installed in each AOI is described below.

AOI 1

- Three deep monitoring wells (S-264, S-46D, and S-80D) were installed between 2005 and 2007. The deep monitoring wells were installed using a combination of hollow stem augers and mud rotary drilling techniques with split spoon samplers to record lithology.

AOI 2

- One deep monitoring well (S-72D) existed in AOI 2 prior to the AOI 2 site characterization activities. As part of the 2010 site characterization, a total of three (S-294D, S-302D and S-305D) deep monitoring wells were installed in AOI. The deep monitoring wells were installed using hollow stem augers, mud rotary, and split spoon samplers to record lithology.

AOI 3

- Six deep monitoring wells existed in AOI 3 prior to AOI 3 site characterization activities. Two deep monitoring wells (S-280D and S-284D) were installed in AOI 3 during the 2010 site characterization activities. The deep monitoring wells were installed using hollow stem augers, mud rotary, and split spoon samplers to record lithology.

AOI 4

- Two deep monitoring wells (S-38D and S-38D2) existed prior to AOI 4 site characterization activities. Two deep monitoring wells (S-58D and S-119D) were installed in 2005 as part of the site characterization activities. The deep monitoring wells were installed using hollow stem augers, mud rotary, and split spoon samplers to record lithology.

AOI 5

- Three deep monitoring wells (A-13D, A-19D, and A-21D) existed in AOI 5 prior to the AOI 5 site characterization activities. No additional deep groundwater

monitoring wells were installed since adequate characterization data existed from the three existing deep monitoring wells.

AOI 6

- Four deep monitoring wells (B-48D, B-132D, B-133D, and B-134D) existed in AOI 6 prior to the AOI 6 site characterization activities. No additional deep monitoring wells were installed in AOI 6 as adequate characterization data existed from the four existing deep monitoring wells.

AOI 7

- Two deep monitoring wells (C-50D and C-65D) existed in AOI 7 prior to the AOI 7 site characterization activities. Three deep monitoring wells (C-129D, C-134D and C-144D) were installed in 2010 as part of the AOI 7 site characterization activities. The deep monitoring wells were installed using hollow stem augers, mud rotary, and split spoon samplers to record lithology.

AOI 8

- Eleven deep monitoring wells (N-4, N-9, N-13, N-19, N-21, N-27, N-30, N-38D, N-44D, N-46D, and 50D) existed in AOI 8 prior to the AOI 8 site characterization activities. No additional deep monitoring wells were installed in AOI 8; however, four deep soil borings were advanced to bedrock to further characterize geologic conditions beneath AOI 8. Soil borings were advanced using hollow stem augers and split spoon samplers to record lithology.

AOI 9

- Three deep monitoring wells (S-74D1SRTF, S-76DSRTF, and S-106DSRTF) existed in AOI 9 prior to the AOI 9 site characterization activities. Two deep monitoring wells (S-74D2SRTF and S-120DSRTF) were installed in AOI 9 as part of the 2009 site characterization activities. Deep monitoring wells were advanced using hollow stem augers and split spoon samplers to record lithology.

AOI 10

- The Farrington Sand does not exist beneath AOI 10. Geologic information obtained from deeper soil borings and monitoring wells installed in AOI 10 as part of the site characterization activities confirmed that the Farrington Sand

does not exist beneath AOI 10. This interpretation is consistent with the USGS publications and maps as presented in Appendix B.

3.2 Surveying Activities

All deep monitoring wells at the refinery were surveyed by Langan to establish the location and elevation of the inner and outer casing and ground surface at each point. All monitoring well elevations were determined to the nearest 0.01 foot relative to mean sea level. All survey activities were performed by a Pennsylvania-licensed surveyor and tied to the NAVD 88 datum. The survey data for the monitoring wells is presented in Table 2.

3.3 Groundwater Monitoring

On an annual basis, all accessible groundwater monitoring wells, including deep groundwater monitoring wells, are gauged for depth-to-water and depth-to-product as part of the refinery's routine monitoring program. The deep monitoring well gauging readings from the 2010 and 2011 gauging events are summarized in Table 3. The groundwater monitoring data from Table 3 was used to generate deep groundwater elevation contour plans provided as Figure 4 and in Appendix E. Historic annual deep groundwater elevation contours from 2001 to 2010 are presented in Appendix E.

As part of the recent AOI 11 site characterization activities, Aquaterra completed two rounds of groundwater monitoring of the deep monitoring wells in April and June/July of 2011. The groundwater elevation measurements from these two monitoring events are summarized in Table 3. For the 2010 groundwater gauging data, the following wells were not incorporated into the groundwater contour figure due to groundwater elevation anomalies: C-129D, N-50D, S-8, and S-38D. These wells were used in the 2011 groundwater contouring. Deep monitoring well S-74D1 was omitted from the 2010 and 2011 groundwater contouring and data analysis due to its unknown well construction and high water elevations recorded.

Historic deep groundwater flow patterns were compared to patterns from the recent gauging events performed in 2011. Based on the comparison, historic and current deep groundwater flow patterns are consistent.

3.4 Groundwater Sampling

Between 2005 and 2010, Aquaterra, Langan, and Stantec performed deep groundwater sampling activities for AOIs 1 through 9 (the Farrington Sand is absent in AOI 10). A summary of the analytical data collected for the deep monitoring wells during the 2005 to 2010 sampling activities are provided in Table 4.

As part of the recent AOI 11 site characterization activities, two rounds of groundwater sampling from all accessible deep monitoring wells at the refinery were completed in April and June/July of 2011. A summary of the April and June/July 2011 monitoring well sampling analytical data are provided in Tables 5 and 6. Groundwater sampling activities were completed using three well volume purging techniques and a Horiba U-22 water quality meter was used to record temperature, pH, conductivity, dissolved oxygen, and EH parameters in the field at each monitoring well locations in accordance with the field sampling procedures (Appendix G). The monitoring well sampling summary data sheets from the 2011 groundwater sampling events are provided as Appendix H.

In April 2011, groundwater samples were collected from 41 deep monitoring wells, and in June/July 2011, a total of 44 groundwater samples were collected from deep monitoring wells by Aquaterra. Three additional deep monitoring wells were able to be sampled during the June/July 2011 event as they were repaired by Sunoco. All deep groundwater samples collected were submitted to Lancaster Laboratories Inc. (LLI) for analysis of site COCs as listed in Table 1. For groundwater samples analyzed for metals, the samples were filtered to analyze for total and dissolved concentration. The groundwater analytical results were screened against the PADEP non-residential groundwater MSCs and are presented in Tables 5 and 6. The laboratory analytical reports and laboratory quality assurance/quality control data are included as Appendix I.

3.5 Fate and Transport Evaluation

Fate and transport simulations were completed for select deep groundwater monitoring wells in AOI 11 to evaluate potential migration pathways/impacts to: 1) the Schuylkill River and 2) off-site areas. Modeling to evaluate the potential impact to the Schuylkill River was performed as a conservative measure because, based on the geologic cross sections provided in Appendix D, groundwater in the Farrington Sand unit only appears to have the potential to discharge to the Schuylkill River in the area of AOI 2. North of

AOI 2 (AOI 8 area), the Farrington Sand is not present along the river's edge. Along this portion of the refinery boundary with the river, the Farrington Sand has been eroded and replaced with a thick wedge of alluvium that continues to bedrock. South of the AOI 2 area boundary with the river, the Farrington Sand is present at depths greater than the bottom of the Schuylkill River, and more importantly, is hydraulically separated from the River by the presence of the Lower Clay. Based on deep groundwater flow as illustrated in Figure 4 of the SCR/RIR, deep groundwater south of the AOI 2 boundary generally flows towards the southwest and beneath the Schuylkill River.

Modeling was performed to evaluate potential off-site impacts only in the select few areas where the deep groundwater monitoring wells are located in close proximity the refinery boundary.

Several deep groundwater monitoring wells at the refinery exhibited concentrations of COCs above the MSC.

The approach to fate-and-transport modeling for deep groundwater is summarized below:

1. Wells with COC concentrations above the MSC were evaluated to determine whether wells with results below the MSC exist. Wells that are not delineated by downgradient wells were modeled using QD.
2. For wells that were modeled using QD, the higher COC concentration detected in each well between the April and June/July 2011 groundwater sampling events was used as the source concentration in the QD models. The COCs modeled include: benzene, MTBE, chrysene, arsenic and manganese.
3. QD simulations were then run to predict the migration distance to which the concentration falls below the MSC. Wells that were not predicted to exceed the MSC at the boundary were not carried forward with fate and transport analysis.
4. Based on the results from Step 3 above, none of the wells with the potential for off-site migration exhibited concentrations at the off-site boundary above the MSC; therefore, no further fate-and-transport analysis was completed for these wells.

5. For those wells that have the potential to exceed the MSC at the boundary with the Schuylkill River, the COC concentration at the boundary with the river (edge criterion) was determined.
6. The edge criterion was then input into the PADEP SWLOAD model to calculate the mass loading of the COC and to determine if surface water mixing calculations were required.
7. Where required, surface water allocations were calculated using the equation for determining the allowable groundwater concentration in a plume discharging to surface water found in the Act 2 TGM Section IV page 20.
8. The calculated wasteload calculations were then compared to the COC concentration at the boundary with the river.

A detailed overview of the fate-and-transport modeling performed is presented in Appendix J and the results of the modeling are discussed in Section 6.0 and Appendix J.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

The following sections outline the field and laboratory quality assurance/quality control measures that were incorporated into the site characterization activities. All groundwater gauging and sampling activities were completed in accordance with the field sampling procedures included as Appendix G of this report. The complete laboratory analytical data packages for the site wide deep groundwater sampling events are included in Appendix I.

4.1 Equipment Decontamination

All sampling equipment was decontaminated in accordance with the field sampling procedures to prevent cross-contamination. Prior to sampling, the equipment was decontaminated with successive rinses of detergent and potable water and distilled deionized water. All down-hole equipment used in monitoring well purging, such as submersible pumps, was cleaned with an external non-phosphate detergent wash and tap water rinse. This cleaning process was followed by a flush of potable water.

4.2 Equipment Calibration

Prior to each use, the Horiba instrument was calibrated by measuring the parameters using manufacturer-provided buffer solutions, deionized water and zero oxygen solution.

4.3 Sample Preservation

Samples were preserved, where necessary, with the addition of chemical preservatives, and by cooling the samples at 4°C before and during shipment to the laboratory. Chemical additives necessary for sample preservation were added to the sample containers by the analytical laboratory prior to releasing them to sampling personnel.

4.4 Laboratory Quality Assurance/Quality Control

The laboratory performed quality assurance and quality control (QA/QC) analyses, including laboratory control spikes and laboratory control spike duplicates, matrix spikes and matrix spike duplicates, surrogate spikes, method blanks and QA/QC checks such as GC/MS instrument tuning and mass calibration, as appropriate. Laboratory QA/QC summaries were completed by the laboratory and provided in each data package, attached. The analytical data, data qualifiers, and QC results provided in these reports were evaluated to determine the confidence with which this groundwater data could be used in the decision-making process. For the purposes of this investigation, sample results were summarized in sixteen sample delivery groups, provided by LLI, and were evaluated for usability. Copies of the usability assessment and laboratory reports are provided in Appendix I.

Data quality indicators (DQIs) are qualitative and quantitative measures of data quality "attributes," which are descriptors used to express various properties of analytical data. Thus, DQIs are the various measures of the individual data characteristics that collectively comprise the general, all-encompassing term "data quality." Quality attributes used to assess the data usability include:

- Method selectivity/specificity
- Accuracy (bias)
- Precision
- Representativeness
- Comparability
- Completeness

Based on the evaluation of these indicators in Appendix I, the groundwater data collected during this investigation is considered usable. As further detailed in Appendix I, few concentrations should be considered as biased because MS/MSD and surrogate recoveries were beyond acceptable control limits. The analytes most affected were the wet chemistry analytes: these analytes aren't pervasive and aren't considered compounds of concern at the Site. The data for these biased samples are considered usable but should be considered slightly higher or lower in concentration than groundwater representative of the site and time collected.

4.5 Documentation

Chain-of-custody forms were maintained throughout the sampling program to document sample acquisition, possession and analysis. Chain-of-custody documentation accompanied all samples from the field to the laboratory. Each sample was assigned a unique number that was recorded on permanent field sheet.

5.0 SITE CHARACTERIZATION ANALYTICAL RESULTS

The following sections discuss the results of the site characterization results for AOI 11.

5.1 Groundwater Results

The results of the groundwater samples collected from deep monitoring wells (from 2005 through 2011) are provided in Tables 4, 5, and 6, respectively. The results were screened against the PADEP non-residential used aquifer (TDS<2,500) groundwater MSCs. Locations with concentrations above the groundwater MSCs from the deep groundwater sampling events are illustrated in Figures 5 and 6. The complete laboratory data packages for the April and June/July 2011 deep groundwater sampling events are included as Appendix I. Laboratory data packages for the 2005 through 2010 groundwater sampling events were provided in the previously submitted site characterization reports for AOIs 1 through 9.

As a conservative measure, fate and transport modeling was performed for several monitoring well locations where detections of COCs were above their respective non-

residential groundwater MSCs. The results of this modeling are presented in Section 6.0 below. COCs at concentrations above their respective non-residential groundwater MSCs included: benzene, chrysene, methyl tertiary butyl ether (MTBE), naphthalene, arsenic, cobalt, and manganese. A summary of these COC concentrations observed in the deep monitoring wells along with an evaluation of these COCs in relation to trends, spatial distribution, and groundwater flow are presented below:

- There were no volatile or semi-volatile COCs that were detected above their respective non-residential groundwater MSCs in AOIs 1, 6, and 7.
- In AOI 8, deep monitoring well S-294D had a slight detection of naphthalene above the non-residential groundwater MSC during the July 2010 sampling event, however naphthalene was not detected in the April and June/July 2011 sampling events. There were no other naphthalene exceedances in AOI 11 during the 2005 though 2011 sampling events.
- Four deep monitoring wells (N-21, N-44D, N-4, and N-9) located in AOI 8 had benzene detections that were above the non-residential groundwater MSC. N-4 and N-9 exhibited decreasing trends to non-detects and down gradient deep monitoring wells exhibited non-detects. Deep monitoring well N-50D had a detection of chrysene slightly above its respective non-residential groundwater MSC. This well was modeled using Quick Domenico (QD) model and the results of the modeling are presented in Section 6.0 below. N-21 and N-44D benzene values were below the Chapter 93 surface water criteria and therefore were not modeled using QD.
- One deep monitoring well (S-38D2) in the southern portion of AOI 4 had a benzene concentration above the non-residential groundwater MSC. Downgradient deep monitoring wells exhibited non-detects for benzene.
- There were three deep monitoring wells (S-22, S-8, and BF-108) in AOI 3 and one deep monitoring well (A-19D) in AOI 5 which had MTBE concentrations above the non-residential groundwater MSC. Downgradient deep monitoring wells from S-22 and S-8 exhibited non-detects for MTBE. MTBE concentrations in A-19D and BF-108 exhibited a decreasing trend and down gradient wells exhibited non-detects for MTBE.
- There were two deep monitoring wells (S-120DSRTF and S-106DSRTF) located in AOI 9 which had exceedances for MTBE.

- A total of 33 deep monitoring wells exhibited concentrations of groundwater COCs above their respective MSCs for manganese. The highest manganese detections were observed along the central and eastern portions of AOI 1.
- Four deep monitoring wells had detections of arsenic above its respective MSC and one deep monitoring well had a detection of cobalt during one sampling event above its respective MSC. Groundwater concentrations of cobalt and arsenic that were above their respective non-residential groundwater MSC are separated from the Schuylkill River and the refinery boundaries by deep monitoring wells which exhibited non-detects for these two compounds. Arsenic detected in deep monitoring well N-44D had no downgradient deep wells with non-detects for arsenic therefore QD modeling was performed and the results of the modeling are presented in Section 6.0 below.
- All other COCs analyzed in Tables 4, 5, and 6 were below their respective non-residential groundwater MSCs.
- LNAPL was not observed in any of the deep monitoring wells monitored.

A brief comparison summary of the regional and site specific groundwater quality results for iron, manganese, sulfate, total dissolved solids (TDS), ammonia, nitrate/nitrite, alkalinity, chloride, fluoride, sulfide, and total organic carbon (TOC) are displayed in the table below:

Compound	Iron (dissolved)	Manganese (dissolved)	Sulfate	TDS	Ammonia	Nitrate/ Nitrite	Alkalinity	Chloride	Fluoride	Sulfide	TOC
Units	**ug/l**	**ug/l**	**ug/l**	**ug/l**	**ug/l**	**ug/l**	**ug/l**	**ug/l**	**ug/l**	**ug/l**	**ug/l**
USGS Average (1991)	17,000	1,700	161,000	778,000	2,100	NA	NA	NA	NA	NA	NA
ENSR Average (1994)	33,150	2,100	NA	908,000	2,100	3,200	NA	NA	NA	NA	NA
Langan Average (2011)	29,962	2,539	585,837	585,837	12,757	775	87,951,845	67,418	717	813	10,615
USGS Range (1991)	0 - 220,000	0 - 31,000	0.9 - 2,200,000	90 - 4,480,000	NA	NA	NA	NA	NA	NA	NA
ENSR Range (1994)	NA	NA	ND - 2,910,000	176,000 - 4,550,000	100 - 99,200	500 - 9,800	71,000 - 1,025,000	18,000 - 118,000	100 - 530	ND - 5,610	3,000 - 37,000
Langan Range (2011)	ND - 78,700	ND - 20,500	ND - 5,400,000	ND - 7,000,000	ND - 88,200	ND - 920	ND - 100,000,000	ND - 212,000	ND - 1,200	ND - 2,000	ND - 53,500

A brief summary of the occurrence of inorganic COCs is presented below and a trend plot figures are presented in Appendix K of each compound for both April and June/July 2011 groundwater sampling events.

- Values for TDS ranged from ND to 7,000,000 ug/L with an average detection of 585,837 ug/L. Slightly higher TDS values observed in AOIs 1, 2 and 8 correlating with the high levels of sulfates and manganese detections in these areas.
- Total alkalinity values ranged from ND to 100,000,000 ug/L, with an average detection of 87,951,845 ug/L. No significant trends observed for alkalinity. In general the total alkalinity values in AOI 3 and 8 were slightly higher.
- Ammonia values ranged from ND to 88,200 ug/L, with an average detection of 12,757 ug/L. In general ammonia values located along the Schuylkill River in AOIs 5, 6, 7 and 9 were slightly higher.
- Chloride values ranged from ND to 212,000 ug/L, with an average detection of 67,418 ug/L. No significant trend is observed for chloride.
- Fluoride values ranged from ND to 1,200 ug/L, with an average detection of 717 ug/L. No distinct trend for fluoride was observed. There is a slight increase in fluoride observed in AOI 3 and AOI 8.
- Nitrate/nitrite values ranged from ND to 920 ug/L, with an average detection of 775 ug/L. No significant trends were observed.
- Sulfate values ranged from ND to 5,400,000 ug/L, with an average detection of 585,837 ug/L. In general, sulfate values are higher in AOIs 1, 2, and 8 indicative of reducing groundwater conditions in these areas.
- Sulfide values ranged from ND to 2,000 ug/L, with an average detection of 813 ug/L. No distinct trends for sulfide, however there is a slight increase in values in AOI 7 and in the southern portion of AOI 8.
- Total organic carbon (TOC) values ranged from ND to 53,500 ug/L, with an average detection of 10,615 ug/L. There were no overall distinct trends for TOC throughout the refinery. However there were slightly higher values detected in AOI 3 and 8.

6.0 FATE AND TRANSPORT ANALYSIS

The following sections describe fate and transport modeling activities performed as part of AOI 11 site characterization.

6.1 Groundwater

The details of the fate and transport analysis are presented in Appendix J. By evaluating groundwater flow and the distribution of COC groundwater impacts across the refinery, the COCs that were identified for further screening through fate and transport analysis were chrysene, benzene, methyl tertiary butyl ether, and manganese. To screen and predict the potential for fate and transport in groundwater the Quick Domenico model was used. Ten monitoring wells containing one or two of these compounds, located throughout the refinery, were used as the starting point for Quick Domenico groundwater fate and transport simulations. The results of the Quick Domenico simulations indicate that, due to attenuation in groundwater, chrysene, benzene and MTBE do not have the potential to migrate far enough to impact the Schuylkill River. However, Quick Domenico simulations did indicate that manganese concentration at three locations (A-21D, C-144D and S-302D) might have the potential to impact the Schuylkill River.

To further address manganese fate and transport at A-21D, C-144D and S-302D, the SWLOAD model was used to calculate groundwater flux to surface water which was then used to derive a site-specific wasteload allocation. The wasteload allocation was then used to screen the predicted manganese groundwater concentration at the edge of the Schuylkill River for the potential groundwater impact at each location. The predicted concentrations for manganese did not exceed any of the site specific wasteload allocations.

6.2 Vapor Intrusion into Indoor Air

The potential vapor intrusion into indoor air pathway is considered incomplete for AOI 11 because a water table aquifer exists throughout the refinery within recent alluvium deposits and the Trenton Gravels, and the Middle/Lower clay exists beneath the water table aquifer in most places of the refinery. Where present, the Middle/Lower Clay serves as an aquitard that would prevent the upward migration of

vapor from deep groundwater. Vapor intrusion assessments were completed for the water table aquifer throughout the refinery as part of the individual AOI investigations.

7.0 SITE CONCEPTUAL MODEL

A site conceptual model (SCM) was developed for AOI 11 based on earlier USGS studies, the 1994 deep groundwater study performed by ENSR, and the data collected during site characterization activities completed between 2005 and 2011. The SCM for AOI 11 is described in the following sections:

7.1 Description and Use

The Farrington Sand is present beneath the entire refinery property with the exception of AOI 10 and the northwestern and western portions of AOI 8 where it has been eroded and replaced with alluvium. The extent of the Farrington Sand beneath the refinery is generally consistent with the extent illustrated by USGS. There are no active remediation systems currently operating in AOI 11 and no deep groundwater supply wells exist at the refinery.

7.2 Geology and Hydrogeology

The following summarizes relevant information concerning geology and hydrogeology in AOI 11:

<u>Geology</u>

- The PRM system begins at the fall line just north of AOI 8 and thickens to the east into New Jersey and towards the Atlantic Ocean. The Middle Clay and Farrington Sand units of the PRM system exist in most areas beneath the refinery.
- In most areas of the refinery, the lithology is comprised of several the following units from deep to shallow: Wissahickon Formation (bedrock), Farrington Sand Unit of PRM, Middle/Lower Clay, Trenton Gravel, and recent fill/alluvium.

- Farrington Sand beneath the refinery generally consists of green, brown, orange and/or red, fine gravel and course sand that grades upward into medium-to-fine sands and contains thin layers of silts and clays.
- The Farrington Sand is not present beneath AOI 10 and along the western portion of AOI 8.
- The Middle Clay is present in most places beneath the refinery with the exception of AOI 10, the western portion of AOI 8 and the western portion of AOI 9. A hole in the clay may exist in the northern portion of AOI 3 and along the eastern portion of AOIs 1 and 4. Where the clay is present beneath the refinery, the clay overlies the Farrington Sand as an aquitard.
- The extent of the Farrington Sand and Middle/Lower clay beneath the refinery is generally consistent with the extent illustrated by USGS, 1961 Plate 7 (Appendix B).

Hydrogeology

- In the northern-most part of the refinery (AOI 8), the Farrington Sand is hydraulically disconnected to the Schuylkill River by the wedge-shaped alluvium deposit that fills the erosional trough down to the surface of bedrock (see the geologic cross section in Appendix D corresponding to AOI 8).
- At the AOI 2 boundary with the Schuylkill River, the top of the Farrington Sand is possibly in hydraulic connection with the bottom of the Schuylkill River (see the geologic cross section in Appendix D corresponding to AOI 2).
- South of the AOI 2 area boundary with the river, the Farrington Sand is present at depths greater than the bottom of the Schuylkill River, and more importantly, is hydraulically separated from the River by the presence of the Lower Clay (see the geologic cross sections in Appendix D corresponding to AOIs 3, 7, 6, 5 and 9).
- Downward vertical gradients exist between the shallow/intermediate and deep monitoring wells throughout the refinery with the exception of AOI 9 where deep groundwater flows vertically upward at the edges of the semi-confining clay.

- Deep groundwater flow beneath the refinery is generally towards the south and southwest (Figure 4). Along the western refinery boundary (where it meets the river), deep groundwater passes beneath the river flowing southwest and is hydraulically disconnected from the river by the presence of overlying Middle Clay.
- In AOI 9, where the Middle Clay pinches out, the Farrington Sand is hydraulically connected to the overlying water table aquifer. Deep groundwater flow in AOI 9 is towards the southwest, and is affected by the pinching out of the clay.

7.3 Constituents of Concern

The following summarizes relevant information concerning COCs in AOI 11:

Between 2005 and 2010, Aquaterra, Langan, and Stantec performed deep groundwater sampling activities for AOIs 1 through 9. As part of the recent AOI 11 site characterization activities, groundwater sampling was completed in April and June/July of 2011. Based on these sampling events, COCs in deep groundwater at concentrations above their respective non-residential groundwater MSCs include: benzene, chrysene, MTBE, naphthalene, arsenic, cobalt, and manganese. All other COCs analyzed in Tables 4, 5, and 6 were below their respective non-residential groundwater MSCs.

7.4 Groundwater Quality Conditions

As discussed previously in the report, deep groundwater quality throughout the region has been degraded by historic industrial operations and groundwater pumping. To evaluate deep groundwater quality conditions beneath the refinery relative to the site specific geology and hydrogeology, a figure was developed to visualize subsurface conditions. This figure, Figure 7, illustrates the following conditions:

- Deep groundwater flow;
- Manganese concentrations in deep groundwater; and
- Presence/absence of the Middle/Lower Clay.

In addition, figures in Appendix K were prepared to illustrate the results of other indicative groundwater quality parameters.

The groundwater quality data collected as part of the AOI 11 site characterization activities are generally consistent with the degraded groundwater quality in the Farrington Sand throughout the Philadelphia region. Recent and historic data has also concluded that water quality has been regionally degraded over time due to urbanization. Average values of dissolved iron and manganese detected beneath the refinery is generally consistent with regional conditions. These findings are also consistent with those found by the USGS in their regional report released in 1991 and the report released in 2003. Included in Appendix B are several figures from the USGS and other supporting regional publications illustrating the drastic change in groundwater flow, direction, and quality in the Farrington Sand over the past century.

7.5 Potential Migration Pathways and Site Receptors

The following summarizes potential migration pathways and site receptors for AOI 11.

- Deep groundwater beneath AOI 2 may be hydraulically connected to the Schuylkill River in the area of AOI 2; therefore, the Schuylkill River is considered a potential surface water receptor.
- Based on the results of fate and transport modeling completed, concentrations of COCs in the deep groundwater beneath the refinery are not predicted to trigger violations of in-stream criteria in the Schuylkill River. Based on the proximity of the Schuylkill River relative to the Delaware River, the COCs in the deep groundwater beneath the facility are not predicted to trigger violations of in-stream criteria in the Delaware River.
- Deep groundwater beneath the refinery is not pumped or otherwise brought to the surface. Based on the depth to deep groundwater beneath the facility and the absence of pumping, there are no migration pathways for deep groundwater to human health receptors at the refinery. In addition, the potential direct contact pathway to groundwater is deemed incomplete based on Sunoco's existing permitting procedures which prevent exposure to groundwater that may be encountered in excavations.
- Deep groundwater could be pumped offsite; however, 2011 investigations and well searches verified that no water supply wells for residential or agricultural use exist within a 1.0 mile radius of the refinery.

- Groundwater withdrawal in the city of Philadelphia is not allowed without the prior approval from the Philadelphia Health Department.
- The potential vapor intrusion into indoor air pathway is considered incomplete for AOI 11 due to the presence of the Middle Clay and the upper aquifers.

8.0 HUMAN HEALTH EXPOSURE ASSESSMENT/RISK ASSESSMENT

Based on the current and future intended non-residential site use for AOI 11, an exposure assessment was conducted for all constituents that were above the non-residential statewide health standards in AOI 11. Potential human health exposures for the refinery are for an industrial worker scenario. The media evaluated included groundwater. Further evaluation of the vapor intrusion pathway into indoor air pathway is considered incomplete for AOI 11 because a water table aquifer exists throughout the refinery within recent alluvium deposits and the Trenton Gravels, and the Middle/Lower clay exists beneath the water table aquifer in most places of the refinery. Where present, the Middle/Lower Clay serves is an aquitard that would prevent the upward migration of vapor from deep groundwater. Vapor intrusion assessments were completed for the water table aquifer throughout the refinery as part of the individual AOI investigations.

The following table serves as a summary of potential human health exposure pathways that can be reasonably expected under the current and intended future non-residential use for AOI 11. The table lists potentially contaminated media, potential receptors for these media, and a summary of whether any potentially-complete exposure pathways exist at AOI 11 from the media to these receptors.

Exposure Pathway Evaluation Summary

Contaminated Media	Residents	Workers	Day Care	Construction	Trespassers	Recreation	Food
Groundwater	NA	No(1)	NA	No(2)	No	NA	NA
Air (indoor)	NA	No(3)	NA	No(3)	No	NA	NA
Surface Water	NA	No(4)	NA	No(4)	NA	NA	NA
Sediment	No	No(4)	NA	No(4)	NA	NA	NA
LNAPL	NA	No(1)	NA	No(2)	NA	NA	NA

Notes:

(1) No complete groundwater or LNAPL pathways exist for workers that are not addressed through on-site permitting procedures and PPE.
(2) No complete groundwater or LNAPL pathway exists for construction workers that are not addressed through on-site permitting procedures and PPE.
(3) No complete pathway to indoor air exists based on the AOI 11 vapor evaluation.
(4) No complete pathway exists for surface water or sediment that is not addressed through on-site permitting procedures and PPE.

Na - Not applicable
No - No potential complete exposure pathway
Yes – Potential complete exposure pathway

A more detailed evaluation of each of these potential human health exposure pathways is presented in the following section by media.

8.1 Groundwater

Results of the groundwater sampling indicated COCs at concentrations above their respective non-residential groundwater MSCs, including benzene, chrysene, MTBE, and naphthalene. Concentrations of these COCs are not predicted to migrate beyond the boundaries of the refinery or trigger a condition in surface water that would exceed an in-stream water quality standard. Manganese, cobalt, and arsenic were also detected in deep monitoring wells above their non-residential groundwater MSCs. Based on non-detects within downgradient wells, decreasing trends, and QD modeling, these compounds do not have the potential to impact the Schuylkill River. Based on regional and site specific data evaluation provided in Section 2.3 and 7.5 above, and regional publications provided in Appendix B, the presence of these metals are on a regional basis and is attributed to urbanization of the deep groundwater.

Excavations within the refinery are governed by Sunoco's permitting procedures which protect against potential exposures to groundwater that could be encountered in an excavation. 2011 well searches verified that no residential or agricultural water supply wells exist within 1.0 mile of the refinery.

8.2 LNAPL

There is no LNAPL present in any of the 45 deep monitoring wells.

8.3 Vapor

The potential vapor intrusion into indoor air pathway is considered incomplete for AOI 11 because a water table aquifer exists throughout the refinery within recent alluvium deposits and the Trenton Gravels, and the Middle/Lower clay exists beneath the water table aquifer in most places of the refinery. Where present, the Middle/Lower Clay serves as an aquitard that would prevent the upward migration of vapor from deep groundwater. Vapor intrusion assessments were completed for the water table aquifer throughout the refinery as part of the individual AOI investigations.

9.0 ECOLOGICAL ASSESSMENT

Because the potential deep groundwater to surface water pathway was evaluated using modeling, and the results indicated that no violations of the in-stream criteria would be triggered, no further ecological evaluation for surface water was performed. Deep groundwater beneath the refinery does not discharge anywhere on the refinery.

10.0 COMMUNITY RELATION ACTIVITIES

A Community Relation Plan (CRP) that includes public involvement with local residents to inform them of the anticipated investigations and remediation activities was completed as part of the NIR submittal in 2006. The purpose of this CRP is to provide a mechanism for the community, government officials, and other interested or affected citizens to be informed of on-site activities related to the investigation activities at the Site. This plan incorporates aspects of public involvement under both PADEP's Act 2 program and EPA's RCRA Corrective Action program. This report and future Act 2 reports will include the appropriate municipal and public notices in accordance with the provisions of Act 2. Notices will be published in the Pennsylvania Bulletin and a summary of the notice will appear in local newspapers. As part of the CRP, Sunoco intends to hold annual public meetings in the city of Philadelphia to give status updates of the project.

EPA will complete its own public involvement through notices under the Corrective Action Program and by updating its online Fact Sheet for the refinery. A copy of the NIR and the Act 2 report notifications for this SCR/RIR are included in Appendix A.

11.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the completed activities, the following conclusions and recommendations have been developed for AOI 11.

GROUNDWATER

- The inorganic groundwater quality data collected as part of the AOI 11 site characterization activities are generally consistent with the degraded groundwater quality in the Farrington Sand throughout the Philadelphia region.
- LNAPL was not observed in any of the deep monitoring wells monitored.
- COCs at concentrations above their respective non-residential groundwater MSCs included: benzene, chrysene, MTBE, naphthalene, arsenic, cobalt, and manganese. However, other indicator parameters of degraded conditions were not observed at these locations.
- Based on the results of fate and transport modeling completed, concentrations of COCs in the deep groundwater beneath the refinery are not predicted to trigger violations of in-stream criteria in the Schuylkill River. Based on the proximity of the Schuylkill River relative to the Delaware River, the COCs in the deep groundwater beneath the facility are not predicted to trigger violations of in-stream criteria in the Delaware River.
- Deep groundwater beneath the refinery is not pumped or otherwise brought to the surface. Based on the depth to deep groundwater beneath the facility, and the absence of pumping, there are no migration pathways for deep groundwater to human health receptors at the refinery. In addition, the potential direct contact pathway to groundwater is deemed incomplete based on Sunoco's existing permitting procedures which prevent exposure to groundwater that may be encountered in excavations.
- Deep groundwater could be pumped offsite; however, 2011 investigations and well searches verified that no water supply wells for residential or agricultural use exist within a 1.0 mile radius of the refinery.

- Groundwater withdrawal in the city of Philadelphia is not allowed without the prior approval from the Philadelphia Health Department.
- The potential vapor intrusion into indoor air pathway is considered incomplete for AOI 11 due to the presence of the Middle Clay and the upper aquifers.

Recommendations

- Sunoco will perform four additional rounds of low-flow groundwater sampling from select deep monitoring wells to update/confirm the fate and transport modeling to demonstrate attainment of Act 2 standards. The results of the additional sampling and analysis will be prepared in a combined RIR/Final Report for AOI 11.

12.0 SCHEDULE

The proposed schedule for future Site activities is:

- Submittal of a combined RIR/Final Report within 3 months following the completion of the fourth consecutive quarter of groundwater sampling.

13.0 SIGNATURES

The following parties are participating in the remediation at this time and are seeking relief from liability under Act 2 of 1995:

James Oppenheim
Sunoco Inc. (R&M)

This Act 2 RIR has been prepared in accordance with the final provisions of Act 2 and the June 8, 2002 Land Recycling Program Technical Guidance Manual.

14.0 REFERENCES

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Simulation of Ground-Water Flow in the Potomac-Raritan-Magothy Aquifer System Near the Defense Supply Center Philadelphia, and the Point Breeze Refinery, Southern Philadelphia Pennsylvania, U.S. Geological Survey, Water-Resources Investigations Report 01-4218, Sloto, R. A., 2003.

Current Conditions Report and Comprehensive Remedial Plan, Sunoco Inc., Philadelphia, PA, prepared by Langan Engineering and Environmental Services June 30, 2004.

TABLES

Table 1
Constituents of Concern for Groundwater
AOI 11 Site Characterization/Remedial Investigaion Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

VOLATILE ORGANIC COMPOUNDS	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	106-93-4
Methyl Tertiary Butyl Ether (MTBE)	1634-04-4
Toluene	108-88-3
Xylenes (total)	1330-20-7

SEMI-VOLATILE ORGANIC COMPOUNDS	CAS No.
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.

Table 1 con't
Constituents of Concern for Groundwater
AOI 11 Site Characterization/Remedial Investigation Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Metals	CAS No.
Arsenic (Total & Dissolved)	7440-38-2
Cobalt (Total & Dissolved)	7440-48-4
Iron (Total & Dissolved)	7439-89-6
Lead (Total & Dissolved)	7439-92-1
Manganese (Total & Dissolved)	7439-96-5

Misc Parameters	CAS No.
Ammonia	7664-41-7
Chloride	16887-00-6
Fluoride	7782-41-4
Nitrate	84145-82-4
Nitrite	1594-56-5
Sulfate	18785-72-3
Sulfide	-
Total Alkalinity	-
Bicarbonate	71-52-3
Total Organic Carbon	7440-44-0
Total Dissolved Solids	CASID10052

Field Parameters to be Collected with Downhole Water Quality Meter (pre-purge, post-purge, & post sampling)
pH
Specific Conductance
Dissolved Oxygen
Oxidation-Reduction Potential
Temperature

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.
2. Additional site COCs obtained from ENSR 1994 Investigation of Shallow and Deep Ground Water Report and from USGS regional studies performed on deep groundwater.

Table 2
Existing Deep Well Summary
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Well ID	Northing	Easting	Well Type	Well Classification[2]	Soil Boring Log Available (Y/N)	Construction Detail Available (Y/N)	Date of Well Completion	Well Construction Details[3]							
								Well Completion Depth (ft. bgs)	Well Diameter (in)	Top of Inner Casing Elevation[4] (ft. msl) (NAVD88)	Ground Surface Elevation (ft.) (NAVD88)	Top of Screen Elevation (ft) (NAVD88)	Bottom of Screen Elevation (ft) (NAVD88)	Depth to Screen (ft. bgs)	Screen Length (ft.)
AOI 1															
S-264	221289.016	2685761.821	Monitoring Well	Deep	Y	Y	12/20/07	81	4	26.63	25.19	-45.81	-55.81	71	10
S-46D	222025.700	2685274.000	Monitoring Well	Deep	Y	Y	3/18/05	69	2	15.71	13.63	-40.37	-55.37	54	15
S-80D	223710.420	2685511.730	Monitoring Well	Deep	Y	Y	3/31/05	80	2	31.74	--	--	--	64	15
AOI 2															
S-72D	223838.100	2683833.766	Monitoring Well	Deep	N	N	3/7/94	100	2	34.51	32.08	-56.93	-66.93	89	10
S-294D	224164.508	2684682.460	Monitoring Well	Deep	Y	Y	6/10/10	99	4	34.68	35.07	-48.93	-63.93	84	15
S-302D	222606.828	2683247.675	Monitoring Well	Deep	Y	Y	5/10/10	92	4	24.60	22.05	-54.95	-69.95	77	15
S-305D	221989.608	2684881.879	Monitoring Well	Deep	Y	Y	6/1/10	82	4	20.48	17.90	-49.10	-64.10	67	15
AOI 3															
BF-108	219700.730	2683185.260	Monitoring Well	Deep	--	--	--	--	--	10.98	9.46	--	--	--	--
S-13	218891.500	2683521.790	Monitoring Well	Deep	Y	Y	2/26/92	85	2	6.48	6.27	-58.73	-68.73	65	10
S-22	218842.350	2684080.790	Monitoring Well	Deep	Y	Y	3/19/92	85	2	18.66	17.41	-52.59	-62.59	70	10
S-69D	219970.516	2682398.764	Monitoring Well	Deep	N	N	3/2/94	64	2	13.64	11.70	-42.30	-52.30	54	10
S-8	218427.640	2683688.160	Monitoring Well	Deep	Y	Y	2/19/92	91	2	6.05	6.33	-53.67	-63.17	60	9.5
S-280D	220955.220	2682595.586	Monitoring Well	Deep	Y	Y	5/17/10	61	4	25.88	23.42	-27.58	-37.58	51	10
S-284D	220356.118	2683136.483	Monitoring Well	Deep	Y	Y	5/25/10	78	4	12.12	9.71	-53.29	-68.29	63	15
S-6	--	--	Monitoring Well	Deep	Y	Y	3/2/92	72	4	--	8.37	-53.63	-63.63	62	10
BF-90D	218957.152	2683040.367	Monitoring Well	Intermediate/Deep	--	--	--	--	--	9.77	7.35	--	--	--	--
AOI 4															
S-119D	220820.250	2685497.800	Monitoring Well	Deep	Y	Y	4/4/05	72	2	25.10	23.36	--	--	57	15
S-38D	219173.760	2685231.040	Monitoring Well	Deep	N	N	3/14/94	130	2	17.70	15.88	-104.12	-114.12	120	10
S-38D2	219162.590	2685229.490	Monitoring Well	Deep	N	N	3/17/94	80	2	18.19	15.84	-54.16	-64.16	70	10
S-59D	221368.050	2683842.990	Monitoring Well	Deep	Y	Y	4/13/05	56	2	--	--	--	--	41	15
AOI 5															
A-13D	215608.118	2682677.259	Monitoring Well	Deep	Y	Y	11/13/86	69	4	9.39	7.07	-51.93	-61.93	59	10
A-19D	217562.844	2683562.754	Monitoring Well	Deep	Y	Y	10/30/86	60	4	10.64	--	--	--	50	10
A-21D	215629.744	2681388.358	Monitoring Well	Deep	Y	Y	10/28/86	85	4	11.25	7.94	-67.06	-77.06	75	10
AOI 6															
B-132D	216098.267	2680856.844	Monitoring Well	Deep	Y	Y	3/7/01	85	2	10.31	--	--	--	75	10
B-133D	216723.250	2681722.458	Monitoring Well	Deep	Y	Y	3/5/01	65	2	8.60	6.10	-48.90	-58.90	55	10
B-134D	216764.146	2681037.349	Monitoring Well	Deep	Y	Y	3/5/01	79	2	8.12	5.45	5.45	-4.55	69	10
B-48D	217521.709	2682250.701	Monitoring Well	Deep	Y	Y	11/6/86	55	4	9.42	8.77	-36.23	-46.23	45	10
AOI 7															
C-50D	219609.420	2682342.490	Monitoring Well	Deep	Y	Y	11/4/86	26	4	11.49	9.11	-6.89	-16.89	16	10
C-129D	220492.006	2681929.233	Monitoring Well	Deep	Y	Y	6/25/10	66	4	9.19	6.85	-44.15	-59.15	51	15
C-144D	220107.413	2680336.744	Monitoring Well	Deep	Y	Y	7/9/10	78	4	8.67	6.14	-56.86	-71.86	63	15
C-65D	220116.050	2680259.790	Monitoring Well	Deep	Y	Y	11/11/86	75	4	9.62	7.60	-57.40	-67.40	65	10
AOI 8															
N-13	227095.475	2683398.971	Monitoring Well	Deep	Y	N	12/13/84	50	--	26.77	24.35	--	--	--	--
N-19	226736.819	2684650.605	Monitoring Well	Deep	Y	N	12/14/84	60	--	32.78	30.46	--	--	--	--
N-21	226627.765	2683879.135	Monitoring Well	Deep	Y	N	11/30/84	51.5	--	28.01	25.04	--	--	--	--
N-27	226112.946	2684408.569	Monitoring Well	Deep	Y	N	11/29/84	60.5	--	23.26	20.73	--	--	--	--
N-30	225824.605	2685036.828	Monitoring Well	Deep	Y	N	12/6/84	60	--	40.15	37.39	--	--	--	--
N-38D	226897.427	2680792.262	Monitoring Well	Deep	Y	Y	2/25/94	85	2	10.43	8.77	-66.23	-76.23	75	10
N-4	227944.638	2683123.405	Monitoring Well	Deep	Y	N	12/12/84	44.5	--	26.36	23.91	--	--	--	--
N-44D	225587.984	2682498.213	Monitoring Well	Deep	N	N	--	58	--	30.70	27.17	--	--	--	--
N-50D	225249.929	2682949.287	Monitoring Well	Deep	N	N	12/7/84	60	--	32.31	30.53	--	--	--	--
N-9	227374.619	2684097.082	Monitoring Well	Deep	Y	N	11/28/84	78	--	38.21	36.00	--	--	--	--
N-46D6	225495.445	2683945.399	Monitoring Well	Deep	N	N	12/5/84	55	--	32.80	29.70	--	--	--	--
AOI 9															
S-74D2 SRTF	216095.384	2679122.082	Monitoring Well	Deep	Y	Y	7/14/09	42	4	13.28	10.67	-21.33	-31.33	32	10
S-74D1 SRTF	216087.004	2679175.318	Monitoring Well	Deep	--	--	--	--	4	12.58	10.85	--	--	--	--
S-76D SRTF	216806.470	2678240.930	Monitoring Well	Deep	--	--	--	--	2	8.63	6.51	--	--	--	--
S-106D SRTF	214778.370	2677609.520	Monitoring Well	Deep	--	--	--	--	--	9.46	7.37				
S-120D SRTF	215267.387	2677542.246	Monitoring Well	Deep	Y	Y	6/12/09	35	4	12.37	9.35	-15.65	-25.65	25	10

NOTES:

-- Data could not be located or determined based on available reports

Abandoned/damaged/destroyed wells

AOI - Area of Interest
ft. - feet
bgs - below ground surface
in. - inches
msl - elevation relative to mean sea level
g/cc - grams per cubic centimeter
NA - Data not available

1. Former well IDs were derived from handwritten notes on the logs themselves or the referenced report.
2. Well classification based on the formation in which the well was screened in. Wells screened within the Middle Clay or the Farrington Sand were classified as deep wells.
   Well classification for wells screened above the Lower/Middle Clay were based on the following: screened in Fill/Alluvium - Shallow, screened in Trenton Gravel - Intermediate, screened in Fill/Alluvium & Trenton Gravel - Shallow/Intermediate
3. Well construction details were taken directly from well boring logs provided by Handex, Stantec, Aquaterra or collected from available historic reports.

Table 3 - 2010 to 2011 Groundwater Elevations
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Monitoring Point ID	Northing	Easting	Well Type	Well Classification	Static or Pumping	Well Completion Depth (ft bgs)	Depth to Product (ft btic)	Depth to GW (ft btic) Aug. 2010	Depth to GW (ft btic) April 2011	Depth to GW (ft btic) Jun/July 2011	Apparent LNAPL Thickness (ft)	LNAPL Elevation (ft am sl)	GW Elevation (ft am sl) Aug 2010	GW Elevation (ft am sl) April 2011	GW Elevation (ft am sl) Jun/July 2011	Corrected GW Elevation (ft am sl)	TIC Elevation (ft am sl)	Notes
AOI 1																		
S-46D	222025.7	2685274	Monitoring Well	Deep	Static	69	---	14.40	15.15	14.65	---	---	1.31	0.56	1.06	1.31	15.71	
S-80D	223710.42	2685511.73	Monitoring Well	Deep	Static	80	---	29.37	30.63	29.92	---	---	2.37	1.11	1.82	2.37	31.74	
S-264	221289.016	2685761.821	Monitoring Well	Deep	Static	81	---	26.10	26.40	26.10	---	---	---	0.23	0.53	---	26.63	
AOI 2																		
S-72D	223838.1	2683833.766	Monitoring Well	Deep	Static	100	---	33.31	32.97	32.13	---	---	1.20	1.54	2.38	1.20	34.51	
S-294D	224164.508	2684682.46	Monitoring Well	Deep	Static	99	---	32.33	33.23	32.27	---	---	2.35	1.45	2.41	2.35	34.68	
S-302D	222606.828	2683247.675	Monitoring Well	Deep	Static	92	---	24.60	24.94	22.90	---	---	0.002	-0.34	1.70	0.00	24.60	
S-305D	221989.608	2684881.879	Monitoring Well	Deep	Static	82	---	19.66	20.21	20.01	---	---	0.82	0.27	0.47	0.82	20.48	
AOI 3																		
BF-90D	218957.152	2683040.367	Monitoring Well	Intermediate/Deep	Static	--	NM	NM	3.89	9.76	NM	NM	NM	5.43	-0.44	NM	9.32	Well damaged in 2010
BF-108	219700.73	2683185.26	Monitoring Well	Deep	Static	--	---	10.85	11.21	NR	---	---	0.13	-0.23	---	0.13	10.98	
S-6	---	---	Monitoring Well	Deep	Static	72	---	---			---	---	---	---	---	---	---	Well destroyed
S-8	218427.64	2683688.16	Monitoring Well	Deep	Static	91	---	0.00		7.77	---	---	6.05	---	-1.72	6.05	6.05	Well damaged in 2010 and April 2011,
S-13	218891.5	2683521.79	Monitoring Well	Deep	Static	85	---	7.24			---	---	-0.76	---	---	-0.76	6.48	Well damaged
S-22	218842.35	2684080.79	Monitoring Well	Deep	Static	85	---	19.20	19.56	19.39	---	---	-0.54	-0.90	-0.73	-0.54	18.66	
S-69D	219970.516	2682398.764	Monitoring Well	Deep	Static	64	---	13.87	14.01	13.79	---	---	-0.23	-0.37	-0.15	-0.23	13.64	
S-280D	220955.22	2682595.586	Monitoring Well	Deep	Static	61	---	25.91	25.57	25.37	---	---	-0.03	0.31	0.51	-0.03	25.88	
S-284D	220356.118	2683136.483	Monitoring Well	Deep	Static	78	---	11.64	12.10	11.75	---	---	0.48	0.02	0.37	0.48	12.12	
AOI 4																		
S-38D	219173.76	2685231.04	Monitoring Well	Deep	Static	130	---	18.91	18.41	18.22	---	---	-1.21	-0.71	-0.52	-1.21	17.70	Not used in 2010 GW contouring due to GW elevation anomaly
S-38D2	219162.59	2685229.49	Monitoring Well	Deep	Static	80	---	18.44	19.02	18.89	---	---	-0.25	-0.83	-0.70	-0.25	18.19	former S-38I
S-59D	221368.050	2683842.990	Monitoring Well	Intermediate/Deep	Static	56	---	16.23	16.83	16.23	---	---	---	---	---	---	---	
S-119D	220820.25	2685497.8	Monitoring Well	Deep	Static	72	---	24.44	25.01	24.69	---	---	0.66	0.09	0.41	0.66	25.10	
AOI 5																		
A-13D	215608.118	2682677.259	Monitoring Well	Deep	Static	69	---	11.50	11.13	11.54	---	---	-2.11	-1.74	-2.15	-2.11	9.39	
A-19D	217562.844	2683562.754	Monitoring Well	Deep	Static	60	---	12.37	12.22	12.53	---	---	-1.73	-1.58	-1.89	-1.73	10.64	
A-21D	215629.744	2681388.358	Monitoring Well	Deep	Static	85	---	15.66	15.95	16.56	---	---	-4.41	-4.70	-5.31	-4.41	11.25	
AOI 6																		
B-48D	217521.709	2682250.701	Monitoring Well	Deep	Static	55	---	10.70	10.88	11.06	---	---	-1.28	-1.46	-1.64	-1.28	9.42	
B-132D	216098.267	2680856.844	Monitoring Well	Deep	Static	85	---	14.83	14.61	15.27	---	---	-4.52	-4.30	-4.96	-4.52	10.31	
B-133D	216723.25	2681722.458	Monitoring Well	Deep	Static	65	---	10.02	10.32	10.19	---	---	-1.42	-1.72	-1.59	-1.42	8.60	
C-134D	218306.504	2681164.764	Monitoring Well	Deep	Static	70	---	10.50	10.96	10.83	---	---	-1.10	-1.56	-1.43	-1.10	9.40	
B-134D	216764.146	2681037.349	Monitoring Well	Deep	Static	79	---	10.88	11.08	11.03	---	---	-2.76	-2.96	-2.91	-2.76	8.12	
AOI 7																		
C-50D	219609.42	2682342.49	Monitoring Well	Deep	Static	26	---	11.52	11.54	11.65	---	---	-0.03	-0.05	-0.16	-0.03	11.49	
C-65D	220116.05	2680259.79	Monitoring Well	Deep	Static	75	---	2.24	Destroyed	Destroyed	---	---	7.38	---	---	7.38	9.62	
C-129D	220492.006	2681929.233	Monitoring Well	Deep	Static	66	---	5.25	9.77	9.06	---	---	3.94	-0.58	0.13	3.94	9.19	Not used in 2010 GW contouring due to GW elevation anomaly
C-144D	220107.413	2680336.744	Monitoring Well	Deep	Static	78	---	12.39		12.83	---	---	-3.72	---	-4.16	-3.72	8.67	Well damaged in 2010
AOI 8																		
N-4	227944.638	2683123.405	Monitoring Well	Deep	Static	45	---	18.34	19.26	19.21	---	---	8.02	7.10	7.15	8.02	26.36	
N-9	227374.619	2684097.082	Monitoring Well	Deep	Static	78	---	32.03	34.88	32.53	---	---	6.18	3.33	5.68	6.18	38.21	
N-13	227095.475	2683398.971	Monitoring Well	Deep	Static	50	---	21.60	22.34	21.89	---	---	5.17	4.43	4.88	5.17	26.77	
N-19	226736.819	2684650.605	Monitoring Well	Deep	Static	60	---	29.17	29.82	29.60	---	---	3.61	2.96	3.18	3.61	32.78	
N-21	226627.765	2683879.135	Monitoring Well	Deep	Static	52	---	22.25	22.50	24.29	---	---	5.76	5.51	3.72	5.76	28.01	
N-27	226112.946	2684408.569	Monitoring Well	Deep	Static	61	---	20.22	20.76	20.75	---	---	3.04	2.50	2.51	3.04	23.26	
N-30	225824.605	2685036.828	Monitoring Well	Deep	Static	60	---	36.33	37.09	36.38	---	---	3.82	3.06	3.77	3.82	40.15	
N-38D	226897.427	2680792.262	Monitoring Well	Deep	Static	85	---	9.50	10.46	9.58	---	---	0.93	-0.03	0.85	0.93	10.43	
N-44D	225587.984	2682498.213	Monitoring Well	Deep	Static	58	---	25.97	26.15	26.55	---	---	4.73	4.55	4.15	4.73	30.70	
N-46D	225495.445	2683945.399	Monitoring Well	Deep	Static	55	---	---	Destroyed	Destroyed	---	---	---	---	---	---	32.80	
N-50D	225249.929	2682949.287	Monitoring Well	Deep	Static	60	---	26.00	26.12	28.06	---	---	6.31	6.19	4.25	6.31	32.31	Not used in 2010 GW contouring due to GW elevation anomaly
AOI 9																		
S-74D1 SRTF	216087.004	2679175.318	Monitoring Well	Deep	Static	--	---	18.92	18.95	19.18	---	---	-6.34	-6.37	-6.60	-6.34	12.58	Not used in 2010 or 2011 GW contouring due to GW elevation anomaly
S-74D2 SRTF	216095.384	2679122.082	Monitoring Well	Deep	Static	42	---	17.76	17.85	18.31	---	---	-4.48	-4.57	-5.03	-4.48	13.28	
S-76D SRTF	216806.47	2678240.93	Monitoring Well	Deep	Static	--	---	14.71	14.77	15.03	---	---	-6.08	-6.14	-6.40	-6.08	8.63	
S-106D SRTF	214778.37	2677609.52	Monitoring Well	Deep	Static	--	---	15.26	16.28	16.63	---	---	-5.80	-6.82	-7.17	-5.80	9.46	
S-120D SRTF	215267.387	2677542.246	Monitoring Well	Deep	Static	35	---	18.98	19.06	19.37	---	---	-6.61	-6.69	-7.00	-6.61	12.37	

Notes:
1. Depth to water provided by Stantek August 2010 and Aquaterra in April and June/July 2011.
g/cc = grams per cubic centimeter
ft amsl = Feet Above Mean Sea Level
GW = Groundwater
NA = Not Applicable
NM = Not Measured
NP = No Product
ft btic = Feet Below Top of Inner Casing

Table 4
2005-2010 Summary of Deep Groundwater Analytical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	1			1			2			2			2			2			3			3			3			3		
			Sample ID	S80D-041505			S46D-041805			S-294D_072310			S-302D_072610			S-305D_072610			S-72D_072310			BF-108_072210			BF-90D_072110			S-22_071610			S-280D_072310		
			Sample Date	4/15/2005			4/18/2005			7/23/2010			7/26/2010			7/26/2010			7/23/2010			7/22/2010			7/21/2010			7/16/2010			7/23/2010		
			Sample Matrix	Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater		
			Unit	ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l		
Volatile Organic Compounds			Unit	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.028	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	NA	-	-	NA	-	-	15	-	2	ND	U	2	ND	U	2	ND	U	2	ND	U	2	ND	U	2	ND	U	2	ND	U	2
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	**5**	ND	U	**5**	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	NA	-	-	NA	-	-	6	-	2	ND	U	2	ND	U	2	ND	U	2	ND	U	2	ND	U	2	2	-	2	ND	U	2
Benzene	71-43-2	5	ug/l	ND	U	**5**	ND	U	**5**	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	**6**	-	1	ND	U	1
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	5	ND	U	5	19	-	1	ND	U	1	ND	U	1	1	-	1	ND	U	1	1	-	1	17	-	1	ND	U	1
Ethylbenzene	100-41-4	700	ug/l	ND	U	5	ND	U	5	17	-	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1
Cumene	98-82-8	2300	ug/l	ND	U	5	ND	U	5	3	-	2	ND	U	2	5	-	2	ND	U	2	ND	U	2	ND	U	2	ND	U	2	ND	U	2
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	ND	U	5	ND	U	5	ND	U	1	ND	U	1	ND	U	1	1	-	1	**120**	-	1	ND	U	1	**48**	-	1	2	-	1
Toluene	108-88-3	1000	ug/l	ND	U	5	ND	U	5	1	-	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	7	-	1	ND	U	1
Semi-Volatile Organic Compounds																																
Chrysene	218-01-9	1.9	ug/l	ND	U	**11**	ND	U	**10**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**
Fluorene	86-73-7	1900	ug/l	ND	U	11	ND	U	10	6	-	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Naphthalene	91-20-3	100	ug/l	ND	U	11	ND	U	10	**140**	-	24	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Phenanthrene	85-01-8	1100	ug/l	ND	U	11	ND	U	10	8	-	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Pyrene	129-00-0	130	ug/l	ND	U	11	ND	U	10	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Metals																																
Lead (Total)	7439-92-1	5	ug/L	ND	U	1	ND	U	1	ND	U	1	ND	U	0.001	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1

Notes:
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MSC - PADEP's Medium Specific Concentration for Groundwater
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
Groundwater samples were collected between 2005 and 2009 as part of site characterization activities for AOI's 1-9.

Qualifiers:
Q - Lab Qualifier
U - The analyte was analyzed but not detected
E - The analyte exceeded the calibration range of the instrument

Exceedance Summary:
10 - Compound is above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10 - Reporting Limit is above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

Table 4
2005-2010 Summary of Deep Groundwater Analytical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	3			3			3			4			4			4			4			5			5			6			6		
			S-284D_072310			S-69D_072210			S-8_072110			S119D-050305			S38I-050305			S38D-050305			S59D-050605			A-13D_050307			A-21D_050707			B48D-060806			B132D-060606		
			7/23/2010			7/22/2010			7/21/2010			5/3/2005			5/3/2005			5/3/2005			5/6/2005			5/3/2007			5/7/2007			6/8/2006			6/6/2006		
			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater		
			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l		
Volatile Organic Compounds			**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**
Ethylene dibromide (EDB)	106-93-4	0.05	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.028	ND	U	**0.05**	ND	U	**0.05**	ND	U	0.029	ND	U	0.029
1,2,4-Trimethylbenzene	95-63-6	53	ND	U	2	ND	U	2	ND	U	2	NA	-	-	NA	-	-	NA	-	-	NA	-	-	NA	-	-	NA	-	-	NA	-	-	NA	-	-
1,2-Dichloroethane	107-06-2	5	ND	U	1	ND	U	1	ND	U	1	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**
1,3,5-Trimethylbenzene	108-67-8	35	ND	U	2	ND	U	2	ND	U	2	NA	-	-	NA	-	-	NA	-	-	NA	-	-	NA	-	-	NA	-	-	NA	-	-	NA	-	-
Benzene	71-43-2	5	ND	U	1	ND	U	1	ND	U	1	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**
Xylene (Total)	1330-20-7	10000	ND	U	1	ND	U	1	ND	U	1	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Ethylbenzene	100-41-4	700	ND	U	1	ND	U	1	ND	U	1	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Cumene	98-82-8	2300	ND	U	2	ND	U	2	ND	U	2	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Methyl Tertiary Butyl Ether	1634-04-4	20	ND	U	1	2	-	1	1	-	1	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	0.57	J	5	ND	U	5	ND	U	5
Toluene	108-88-3	1000	ND	U	1	ND	U	1	ND	U	1	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Semi-Volatile Organic Compounds																																			
Chrysene	218-01-9	1.9	ND	U	**5**	ND	U	**5**	ND	U	**47**	ND	U	**10**	ND	U	**10**	ND	U	**10**	ND	U	**10**	ND	U	1	ND	U	1	ND	U	**5**	ND	U	**5**
Fluorene	86-73-7	1900	ND	U	5	ND	U	5	ND	U	47	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	1	ND	U	1	ND	U	5	ND	U	5
Naphthalene	91-20-3	100	ND	U	5	ND	U	5	ND	U	47	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	1	ND	U	1	ND	U	5	ND	U	5
Phenanthrene	85-01-8	1100	ND	U	5	ND	U	5	ND	U	47	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	1	ND	U	1	ND	U	5	ND	U	5
Pyrene	129-00-0	130	ND	U	5	ND	U	5	ND	U	47	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	1	ND	U	1	ND	U	5	ND	U	5
Metals																																			
Lead (Total)	7439-92-1	5	ND	U	1	ND	U	1	1.1	-	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	0.8	ND	U	1	ND	U	1

Notes:
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Groundwater samples were collected between 2005 and 2009 as part of site characterization activities for AOI's 1-9.

Qualifiers:
Q - Lab Qualifier
U - The analyte was analyzed but not detected
E - The analyte exceeded the calibration range of the instrument

Exceedance Summary:
10 - Compound is above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS
10 - Reporting Limit is above the PADEP Non-Residential Used Aquifer MSC for Groundwate

Table 4
2005-2010 Summary of Deep Groundwater Analytical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	6			6			7			7			7			7			8			8			8			8		
			B133D-060606			B134D-060606			C-129D_071210			C-134D_072010			C-144D_071910			C-50D_071310			N-4			N-9			N-13			N-19		
			6/6/2006			6/6/2006			7/12/2010			7/20/2010			7/19/2010			7/13/2010			7/15/2008			7/16/2008			7/23/2008			7/16/2008		
			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater		
			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l		
Volatile Organic Compounds			**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**
Ethylene dibromide (EDB)	106-93-4	0.05	ND	U	0.028	ND	U	0.028	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029
1,2,4-Trimethylbenzene	95-63-6	53	NA	-	-	NA	-	-	ND	U	2	ND	U	2	ND	U	2	ND	U	2	NA	-	-	NA	-	-	NA	-	-	NA	-	-
1,2-Dichloroethane	107-06-2	5	ND	U	**5**	ND	U	**5**	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1
1,3,5-Trimethylbenzene	108-67-8	35	NA	-	-	NA	-	-	ND	U	2	ND	U	2	ND	U	2	ND	U	2	NA	-	-	NA	-	-	NA	-	-	NA	-	-
Benzene	71-43-2	5	ND	U	**5**	ND	U	**5**	ND	U	1	ND	U	1	ND	U	1	ND	U	1	**5**	-	1	**8**	-	1	ND	U	1	ND	U	1
Xylene (Total)	1330-20-7	10000	ND	U	5	ND	U	5	ND	U	1	ND	U	1	ND	U	1	ND	U	1	2	-	1	6	-	1	ND	U	1	ND	U	1
Ethylbenzene	100-41-4	700	ND	U	5	ND	U	5	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	2	-	1	ND	U	1	ND	U	1
Cumene	98-82-8	2300	ND	U	5	ND	U	5	ND	U	2	ND	U	2	ND	U	2	ND	U	2	3	-	2	ND	U	2	ND	U	2	ND	U	2
Methyl Tertiary Butyl Ether	1634-04-4	20	ND	U	5	ND	U	5	ND	U	1	1	-	1	ND	U	1	ND	U	1	2	-	1	ND	U	1	2	-	1	ND	U	1
Toluene	108-88-3	1000	ND	U	5	ND	U	5	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1
Semi-Volatile Organic Compounds																																
Chrysene	218-01-9	1.9	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**
Fluorene	86-73-7	1900	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Naphthalene	91-20-3	100	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Phenanthrene	85-01-8	1100	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Pyrene	129-00-0	130	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Metals																																
Lead (Total)	7439-92-1	5	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1

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10 - Compound is above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS
10 - Reporting Limit is above the PADEP Non-Residential Used Aquifer MSC for Groundwater

Table 4
2005-2010 Summary of Deep Groundwater Analytical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	8			8			8			8			8			8			9			9			9			9			9		
			N-21			N-27			N-30			N-38D			N-44D			N-50D			S-74D1 SRTF			S-74D2 SRTF			S-76D SRTF			S-106D SRTF			S-120D SRTF		
			7/23/2008			7/17/2008			7/22/2008			7/24/2008			7/25/2008			7/23/2008			8/12/2009			8/12/2009			8/12/2009			8/12/2009			8/12/2009		
			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater		
			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l			ug/l		
Volatile Organic Compounds			**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**
Ethylene dibromide (EDB)	106-93-4	0.05	ND	U	0.029	ND	U	0.03	ND	U	0.03	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.03	ND	U	0.029	ND	U	0.029
1,2,4-Trimethylbenzene	95-63-6	53	NA	-	-	NA	-	-	NA	-	-	NA	-	-	NA	-	-	NA	-	-	ND	U	2	ND	U	2	ND	U	2	ND	U	2	ND	U	2
1,2-Dichloroethane	107-06-2	5	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1
1,3,5-Trimethylbenzene	108-67-8	35	NA	-	-	NA	-	-	NA	-	-	NA	-	-	NA	-	-	NA	-	-	ND	U	2	ND	U	2	ND	U	2	ND	U	2	ND	U	2
Benzene	71-43-2	5	**16**	-	1	ND	U	1	ND	U	1	ND	U	1	**6**	-	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1
Xylene (Total)	1330-20-7	10000	ND	U	1	ND	U	1	ND	U	1	ND	U	1	4	-	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	2	-	1
Ethylbenzene	100-41-4	700	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1
Cumene	98-82-8	2300	190	-	2	ND	U	2	ND	U	2	ND	U	2	5	-	2	ND	U	2	ND	U	2	ND	U	2	ND	U	2	ND	U	2	4	-	2
Methyl Tertiary Butyl Ether	1634-04-4	20	ND	U	1	4	-	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	1	-	1	ND	U	1	**98**	-	1	**21**	-	1
Toluene	108-88-3	1000	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1
Semi-Volatile Organic Compounds																																			
Chrysene	218-01-9	1.9	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**5**	ND	U	**50**
Fluorene	86-73-7	1900	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	50
Naphthalene	91-20-3	100	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	50
Phenanthrene	85-01-8	1100	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	50
Pyrene	129-00-0	130	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	5	ND	U	50
Metals																																			
Lead (Total)	7439-92-1	5	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	1.4	-	1	ND	U	1

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - microgram per liter
mg/l - milligram per liter
MSC - PADEP's Medium Specific Concentration for Groundwater
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
Groundwater samples were collected between 2005 and 2009 as part of site characterization activities for AOI's 1-9.

Qualifiers:
Q - Lab Qualifier
U - The analyte was analyzed but not detected
E - The analyte exceeded the calibration range of the instrument

Exceedance Summary:
10 - Compound is above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS
10 - Reporting Limit is above the PADEP Non-Residential Used Aquifer MSC for Groundwate

Table 5
April 2011 Summary of Deep Groundwater Analytical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	1				1				1				1				1				1				2				2				2			
			Well Name	S-46D				S-46D				S-80D				S-80D				S-264				S-264				S-72D				S-72D				S-294D			
			Sample ID	S-46D_04062011				S-46D_04062011 FILTERED				S-80D_04062011				S-80D_04062011 FILTERED				S-264_04062011				S-264_04062011 FILTERED				S-72D_04072011				S-72D_04072011 FILTERED				S-294D_04062011			
			Sample Date	4/6/2011				4/6/2011				4/6/2011				4/6/2011				4/6/2011				4/6/2011				4/7/2011				4/7/2011				4/6/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.0096	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-	ND	U	0.0098	1	-	-	-	-	ND	U	0.0098	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	1	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Benzene	71-43-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	0.7	J	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	0.8	J	0.5	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	1	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	5	-	0.5	1	-	-	-	-	1	-	0.5	1	-	-	-	-	0.8	J	0.5	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Semi-Volatile Organic Compounds																																										
Chrysene	218-01-9	1.9	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	1	J	1	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Metals																																										
Cobalt	7440-48-4	31	ug/l	26.7	-	2.3	1	19.7	-	5	1	ND	U	2.3	1	ND	U	5	1	**44.4**	-	2.3	1	29	-	5	1	ND	U	2.3	1	ND	U	5	1	4.3	J	2.3	1	ND	U	5	1
Iron	7439-89-6	NS	ug/l	57500	-	52.2	1	33300	-	200	1	44500	-	52.2	1	44000	-	200	1	46700	-	52.2	1	6940	-	200	1	62200	-	52.2	1	48600	-	200	1	68100	-	52.2	1	60500	-	200	1
Manganese	7439-96-5	300	ug/l	**17600**	-	4.2	5	**16400**	-	25	5	**11800**	-	4.2	5	**11800**	-	25	5	**7840**	-	0.84	1	**7420**	-	5	1	**3950**	-	0.84	1	**4020**	-	5	1	**8120**	-	0.84	1	**8210**	-	5	1
Arsenic	7440-38-2	10	ug/l	**128**	-	0.95	1	**34.6**	-	2	1	ND	U	0.95	1	ND	U	2	1	8.6	-	0.95	1	ND	U	2	1	ND	U	0.95	1	ND	U	2	1	4.3	-	0.95	1	ND	U	2	1
Lead	7439-92-1	5	ug/l	**9.8**	-	0.052	1	ND	U	1	1	ND	U	0.052	1	ND	U	1	1	**6.2**	-	0.052	1	ND	U	1	1	ND	U	0.052	1	ND	U	1	1	0.3	J	0.052	1	ND	U	1	1
General Chemistry																																										
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mgl as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	751000	-	19400	1	-	-	-	-	945000	-	19400	1	-	-	-	-	645000	-	19400	1	-	-	-	-	662000	-	19400	1	-	-	-	-	862000	-	19400	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	5400	-	200	1	-	-	-	-	ND	U	200	1	-	-	-	-	2200	-	200	1	-	-	-	-	5800	-	200	1	-	-	-	-	ND	U	200	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	**270**	5	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	**220**	-	**54**	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	78600	-	4000	20	-	-	-	-	78000	-	10000	50	-	-	-	-	89300	-	4000	20	-	-	-	-	87900	-	4000	20	-	-	-	-	88100	-	10000	50	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	231000	-	6000	20	-	-	-	-	461000	-	15000	50	-	-	-	-	105000	-	6000	20	-	-	-	-	247000	-	6000	20	-	-	-	-	331000	-	15000	50	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	10300	-	500	1	-	-	-	-	5300	-	500	1	-	-	-	-	12000	-	500	1	-	-	-	-	3200	-	500	1	-	-	-	-	3500	-	500	1	-	-	-	-

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - microgram per liter
mg/l - milligram per liter
MSC - PADEP's Medium Specific Concentration for Groundwater
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
Alkalinity is reported in mg/l rather than ug/l

Qualifiers:
Q - Lab Qualifier
U - The analyte was analyzed but not detected
E - The analyte exceeded the calibration range of the instrument
J - Compound detected but below the reporting limit (the value given is an estimate).

Exceedance Summary:
10 - Compound above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10 - Reporting Limit above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

Table 5
April 2011 Summary of Deep Groundwater Analytical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	2				2				2				2				3				3				3				3				3			
			Well Name	S-302D				S-302D				S-305D				S-305D				S-8				S-8				S-22				S-22				S-69D				S-69D			
			Sample ID	S-302D_04072011				S-302D_04072011 FILTERED				S-305D_04062011				S-305D_04062011 FILTERED				S-8_04072011				S-8_04072011 FILTERED				S-22_04072011				S-22_04072011 FILTERED				S-69D_04072011				S-69D_04072011 FILTERED			
			Sample Date	4/7/2011				4/7/2011				4/6/2011				4/6/2011				4/7/2011				4/7/2011				4/7/2011				4/7/2011				4/7/2011				4/7/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.01	1	-	-	-	-	ND	U	0.0098	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-	ND	U	0.0098	1	-	-	-	-	ND	U	0.0098	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	2	J	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	9	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Benzene	71-43-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	0.5	J	0.5	1	-	-	-	-	**20**	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	0.6	J	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	110	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	5	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	ND	U	0.5	1	-	-	-	-	0.8	J	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	10	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	0.6	J	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	**30**	-	0.5	1	-	-	-	-	**75**	-	0.5	1	-	-	-	-	5	-	0.5	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	8	-	0.5	1	-	-	-	-	43	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Semi-Volatile Organic Compounds																																											
Chrysene	218-01-9	1.9	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	**100**	10	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	100	10	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	**100**	10	-	-	-	-	3	J	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	100	10	-	-	-	-	1	J	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	100	10	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Metals																																											
Cobalt	7440-48-4	31	ug/l	ND	U	2.3	1	ND	U	5	1	17	-	2.3	1	16.6	-	5	1	**71.9**	-	2.3	1	ND	U	5	1	6.9	-	2.3	1	ND	U	5	1	4	J	2.3	1	ND	U	5	1
Iron	7439-89-6	NS	ug/l	77400	-	52.2	1	67200	-	200	1	103000	-	52.2	1	67500	-	200	1	155000	-	52.2	1	ND	U	200	1	36300	-	52.2	1	2940	-	200	1	70.6	J	52.2	1	ND	U	200	1
Manganese	7439-96-5	300	ug/l	**4040**	-	0.84	1	**4140**	-	5	1	**1870**	-	0.84	1	**1840**	-	5	1	**7410**	-	0.84	1	**1140**	-	5	1	**371**	-	0.84	1	293	-	5	1	**3000**	-	0.84	1	**2940**	-	5	1
Arsenic	7440-38-2	10	ug/l	ND	U	0.95	1	ND	U	2	1	**322**	-	0.95	1	**39.6**	-	2	1	**45.3**	-	0.95	1	ND	U	2	1	2.9	-	0.95	1	ND	U	2	1	ND	U	0.95	1	ND	U	2	1
Lead	7439-92-1	5	ug/l	ND	U	0.052	1	ND	U	1	1	ND	U	0.052	1	ND	U	1	1	**2590**	-	0.52	10	1	-	1	1	3.9	-	0.052	1	ND	U	1	1	ND	U	0.052	1	ND	U	1	1
General Chemistry																																											
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mgl as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	944000	-	19400	1	-	-	-	-	1140000	-	38800	1	-	-	-	-	333000	-	9700	1	-	-	-	-	300000	-	9700	1	-	-	-	-	493000	-	9700	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	11600	-	200	1	-	-	-	-	2300	-	200	1	-	-	-	-	20400	-	600	3	-	-	-	-	1800	-	200	1	-	-	-	-	2600	-	200	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	-	-	-	-	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	82900	-	10000	50	-	-	-	-	70100	-	10000	50	-	-	-	-	98300	-	4000	20	-	-	-	-	41300	-	2000	10	-	-	-	-	94000	-	4000	20	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	500	-	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	410000	-	15000	50	-	-	-	-	484000	-	15000	50	-	-	-	-	3900	J	1500	5	-	-	-	-	1500	J	1500	5	-	-	-	-	21400	-	1500	5	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	8500	-	500	1	-	-	-	-	14800	-	500	1	-	-	-	-	13000	-	500	1	-	-	-	-	13400	-	500	1	-	-	-	-	4200	-	500	1	-	-	-	-

Notes:
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ug/l - microgram per liter
mg/l - milligram per liter
MSC - PADEP's Medium Specific Concentration for Groundwater
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
Alkalinity is reported in mg/l rather than ug/l

Qualifiers:
Q - Lab Qualifier
U - The analyte was analyzed but not detected
E - The analyte exceeded the calibration range of the instrument
J - Compound detected but below the reporting limit (the value given is an estimate).

Exceedance Summary:
10 - Compound above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10 - Reporting Limit above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

Table 5
April 2011 Summary of Deep Groundwater Analytical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	3				3				3				3				3				3				3				4				4			
			Well Name	BF-108				BF-108				BF-90D				BF-90D				S-280D				S-280D				S-284D				S-284D				S-38D			
			Sample ID	BF-108_04072011				BF-108_04072011 FILTERED				BF-90D_04072011				BF-90D_04072011 FILTERED				S-280D_04072011				S-280D_04072011 FILTERED				S-284D_04072011				S-284D_04072011 FILTERED				S-38D_04062011			
			Sample Date	4/7/2011				4/7/2011				4/7/2011				4/7/2011				4/7/2011				4/7/2011				4/7/2011				4/7/2011				4/6/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.0097	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-	ND	U	0.0099	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Benzene	71-43-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	0.5	J	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	**55**	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	1	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	4	-	0.5	1	-	-	-	-
Semi-Volatile Organic Compounds																																											
Chrysene	218-01-9	1.9	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Metals																																											
Cobalt	7440-48-4	31	ug/l	2.5	J	2.3	1	ND	U	5	1	3.2	J	2.3	1	ND	U	5	1	3	J	2.3	1	ND	U	5	1	ND	U	2.3	1	ND	U	5	1	ND	U	2.3	1	ND	U	5	1
Iron	7439-89-6	NS	ug/l	90.5	J	52.2	1	ND	U	200	1	1460	-	52.2	1	ND	U	200	1	23500	-	52.2	1	9420	-	200	1	2580	-	52.2	1	1220	-	200	1	2790	-	52.2	1	ND	U	200	1
Manganese	7439-96-5	300	ug/l	**1060**	-	0.84	1	**1070**	-	5	1	190	-	0.84	1	167	-	5	1	**709**	-	0.84	1	**694**	-	5	1	**972**	-	0.84	1	**979**	-	5	1	291	-	0.84	1	ND	U	5	1
Arsenic	7440-38-2	10	ug/l	ND	U	0.95	1	ND	U	2	1	1.6	J	0.95	1	ND	U	2	1	**15.3**	-	0.95	1	2.5	-	2	1	ND	U	0.95	1	ND	U	2	1	ND	U	0.95	1	ND	U	2	1
Lead	7439-92-1	5	ug/l	ND	U	0.052	1	ND	U	1	1	2.5	-	0.052	1	ND	U	1	1	0.16	J	0.052	1	ND	U	1	1	0.14	J	0.052	1	ND	U	1	1	2.4	-	0.052	1	ND	U	1	1
General Chemistry																																											
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mgl as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	335000	-	9700	1	-	-	-	-	339000	-	9700	1	-	-	-	-	249000	-	9700	1	-	-	-	-	531000	-	19400	1	-	-	-	-	150000	-	9700	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	750	-	200	1	-	-	-	-	840	-	200	1	-	-	-	-	14700	-	200	1	-	-	-	-	22300	-	200	1	-	-	-	-	ND	U	200	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	37500	-	2000	10	-	-	-	-	25800	-	1000	5	-	-	-	-	45400	-	2000	10	-	-	-	-	59300	-	4000	20	-	-	-	-	4100	-	1000	5	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	16300	-	1500	5	-	-	-	-	14300	-	1500	5	-	-	-	-	4200	J	1500	5	-	-	-	-	157000	-	6000	20	-	-	-	-	ND	U	1500	5	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	3800	-	500	1	-	-	-	-	13500	-	500	1	-	-	-	-	4500	-	500	1	-	-	-	-	4900	-	500	1	-	-	-	-	ND	U	500	1	-	-	-	-

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10 - Compound above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
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April 2011 Summary of Deep Groundwater Analytical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	4				4				4				4				4				4				5				5				5				5			
			Well Name	S-38D2				S-38D2				S-59D				S-59D				S-119D				S-119D				A-13D				A-13D				A-19D				A-19D			
			Sample ID	S-38D2_04072011				S-38D2_04072011 FILTERED				S-59D_04072011				S-59D_04072011 FILTERED				S-119D_04062011				S-119D_04062011 FILTERED				A-13D_04112011				A-13D_04112011 FILTERED				A-19D_04112011				A-19D_04112011 FILTERED			
			Sample Date	4/7/2011				4/7/2011				4/7/2011				4/7/2011				4/6/2011				4/6/2011				4/11/2011				4/11/2011				4/11/2011				4/11/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.0099	1	-	-	-	-	ND	U	0.0098	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-	ND	U	0.0095	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	2	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Benzene	71-43-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	0.5	1	-	-	-	-	2	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	ND	U	0.5	1	-	-	-	-	2	-	0.5	1	-	-	-	-	0.5	J	0.5	1	-	-	-	-	4	-	0.5	1	-	-	-	-	**43**	-	0.5	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	0.8	J	0.5	1	-	-	-	-	0.5	J	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Semi-Volatile Organic Compounds																																											
Chrysene	218-01-9	1.9	ug/l	ND	U	0.9	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	ND	U	0.9	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	0.9	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	ND	U	0.9	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	ND	U	0.9	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Metals																																											
Cobalt	7440-48-4	31	ug/l	ND	U	2.3	1	ND	U	5	1	12.7	-	2.3	1	11.9	-	5	1	7.9	-	2.3	1	7.4	-	5	1	3	J	2.3	1	ND	U	5	1	5	-	2.3	1	ND	U	5	1
Iron	7439-89-6	NS	ug/l	3060	-	52.2	1	1650	-	200	1	15600	-	52.2	1	2430	-	200	1	31100	-	52.2	1	29400	-	200	1	54900	-	52.2	1	32500	-	200	1	48800	-	52.2	1	35300	-	200	1
Manganese	7439-96-5	300	ug/l	**6670**	-	0.84	1	**6730**	-	5	1	**3010**	-	0.84	1	**2910**	-	5	1	287	-	0.84	1	282	-	5	1	**746**	-	0.84	1	**709**	-	5	1	**3520**	-	0.84	1	**3480**	-	5	1
Arsenic	7440-38-2	10	ug/l	ND	U	0.95	1	ND	U	2	1	**55.1**	-	0.95	1	**13.3**	-	2	1	5.1	-	0.95	1	4.6	-	2	1	7.2	-	0.95	1	ND	U	2	1	**29.1**	-	0.95	1	**11.4**	-	2	1
Lead	7439-92-1	5	ug/l	0.072	J	0.052	1	ND	U	1	1	1.5	-	0.052	1	ND	U	1	1	1.2	-	0.052	1	ND	U	1	1	2.6	-	0.052	1	ND	U	1	1	0.059	J	0.052	1	ND	U	1	1
General Chemistry																																											
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mgl as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	337000	-	9700	1	-	-	-	-	676000	-	19400	1	-	-	-	-	458000	-	9700	1	-	-	-	-	454000	-	9700	1	-	-	-	-	340000	-	9700	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	ND	U	200	1	-	-	-	-	3200	-	200	1	-	-	-	-	ND	U	200	1	-	-	-	-	11800	-	200	1	-	-	-	-	1700	-	200	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	**97**	J	**54**	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	38200	-	2000	10	-	-	-	-	179000	-	10000	50	-	-	-	-	140000	-	10000	50	-	-	-	-	90800	-	4000	20	-	-	-	-	52200	-	4000	20	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	12800	-	1500	5	-	-	-	-	8700	-	1500	5	-	-	-	-	145000	-	15000	50	-	-	-	-	2100	J	1500	5	-	-	-	-	16100	-	1500	5	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	2600	-	500	1	-	-	-	-	7300	-	500	1	-	-	-	-	1400	-	500	1	-	-	-	-	6900	-	500	1	-	-	-	-	8100	-	500	1	-	-	-	-

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - microgram per liter
mg/l - milligram per liter
MSC - PADEP's Medium Specific Concentration for Groundwater
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
Alkalinity is reported in mg/l rather than ug/l

Qualifiers:
Q - Lab Qualifier
U - The analyte was analyzed but not detected
E - The analyte exceeded the calibration range of the instrument
J - Compound detected but below the reporting limit (the value given is an estimate).

Exceedance Summary:
10 - Compound above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10 - Reporting Limit above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

Table 5
April 2011 Summary of Deep Groundwater Analytical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	5				5				6				6				6				6				6				6				6			
			Well Name	A-21D				A-21D				B-132D				B-132D				B-133D				B-133D				B-134D				B-134D				B-48D			
			Sample ID	A-21D_04112011				A-21D_04112011 FILTERED				B-132D_04112011				B-132D_04112011 FILTERED				B-133D_04082011				B-133D_04082011 FILTERED				B-134D_04082011				B-134D_04082011 FILTERED				B-48D_04082011				B-48D_04082011 FILTERED			
			Sample Date	4/11/2011				4/11/2011				4/11/2011				4/11/2011				4/8/2011				4/8/2011				4/8/2011				4/8/2011				4/8/2011				4/8/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.0096	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-	ND	U	0.029	1	-	-	-	-	ND	U	0.029	1	-	-	-	-	ND	U	0.028	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	2	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	2	1	-	-	-	-
Benzene	71-43-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	2	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	2	-	0.5	1	-	-	-	-	1	-	0.5	1	-	-	-	-	2	-	1	1	-	-	-	-	2	-	1	1	-	-	-	-	4	-	1	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Semi-Volatile Organic Compounds																																											
Chrysene	218-01-9	1.9	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	**5**	1	-	-	-	-	ND	U	**5**	1	-	-	-	-	ND	U	**5**	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	5	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	5	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	5	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	5	1	-	-	-	-
Metals																																											
Cobalt	7440-48-4	31	ug/l	ND	U	2.3	1	ND	U	5	1	ND	U	2.3	1	ND	U	5	1	ND	U	0.005	1	ND	U	0.005	1	ND	U	0.005	1	ND	U	0.005	1	ND	U	0.005	1	ND	U	0.005	1
Iron	7439-89-6	NS	ug/l	50500	-	52.2	1	34200	-	200	1	37200	-	52.2	1	27000	-	200	1	35300	-	0.2	1	11100	-	0.2	1	36600	-	0.2	1	7170	-	0.2	1	35100	-	0.2	1	9310	-	0.2	1
Manganese	7439-96-5	300	ug/l	**724**	-	0.84	1	**708**	-	5	1	261	-	0.84	1	268	-	5	1	220	-	0.005	1	197	-	0.005	1	245	-	0.005	1	229	-	0.005	1	**2110**	-	0.005	1	**2050**	-	0.005	1
Arsenic	7440-38-2	10	ug/l	4.6	-	0.95	1	2.1	-	2	1	3.6	-	0.95	1	ND	U	2	1	9.5	-	0.002	1	ND	U	0.002	1	3.9	-	0.002	1	ND	U	0.002	1	ND	U	0.002	1	ND	U	0.002	1
Lead	7439-92-1	5	ug/l	ND	U	0.052	1	ND	U	1	1	ND	U	0.052	1	ND	U	1	1	ND	U	0.001	1	ND	U	0.001	1	ND	U	0.001	1	ND	U	0.001	1	ND	U	0.001	1	ND	U	0.001	1
General Chemistry																																											
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	0.296	-	0.002	1	-	-	-	-	0.301	-	0.002	1	-	-	-	-	0.272	-	0.002	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.002	1	-	-	-	-	ND	U	0.002	1	-	-	-	-	ND	U	0.002	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mgl as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	0.296	-	0.002	1	-	-	-	-	0.301	-	0.002	1	-	-	-	-	0.272	-	0.002	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	376000	-	9700	1	-	-	-	-	340000	-	9700	1	-	-	-	-	328000	-	30	1	-	-	-	-	297000	-	30	1	-	-	-	-	429000	-	30	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	25200	-	200	1	-	-	-	-	25400	-	200	1	-	-	-	-	28000	-	0.6	1	-	-	-	-	30500	-	0.6	1	-	-	-	-	6700	-	0.6	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	0.16	1	-	-	-	-	ND	U	0.16	1	-	-	-	-	ND	U	0.16	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	54700	-	4000	20	-	-	-	-	65700	-	4000	20	-	-	-	-	67300	-	8	20	-	-	-	-	52600	-	4	10	-	-	-	-	72300	-	8	20	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	0.5	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	0.5	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	0.5	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	ND	U	1500	5	-	-	-	-	ND	U	1500	5	-	-	-	-	ND	U	5	5	-	-	-	-	ND	U	5	5	-	-	-	-	ND	U	5	5	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	8400	-	500	1	-	-	-	-	6600	-	500	1	-	-	-	-	7200	-	1	1	-	-	-	-	7700	-	1	1	-	-	-	-	5500	-	1	1	-	-	-	-

Notes:
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mg/l - milligram per liter
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Exceedance Summary:
10 - Compound above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10 - Reporting Limit above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

Table 5
April 2011 Summary of Deep Groundwater Analytical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	7				7				7				7				7				7				8				8				8				8			
			Well Name	C-129D				C-129D				C-134D				C-134D				C-50D				C-50D				N-13				N-13				N-19				N-19			
			Sample ID	C-129D_04082011				C-129D_04082011 FILTERED				C-134D_04082011				C-134D_04082011 FILTERED				C-50D_04082011				C-50D_04082011 FILTERED				N-13_04062011				N-13_04062011 FILTERED				N-19_4-5-11				N-19_4-5-11 FILTERED			
			Sample Date	4/8/2011				4/8/2011				4/8/2011				4/8/2011				4/8/2011				4/8/2011				4/6/2011				4/6/2011				4/5/2011				4/5/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.028	1	-	-	-	-	ND	U	0.029	1	-	-	-	-	ND	U	0.029	1	-	-	-	-	ND	U	0.0098	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	2	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	2	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Benzene	71-43-2	5	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	0.5	J	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	ND	U	2	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	2	1	-	-	-	-	3	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	2	-	1	1	-	-	-	-	1	-	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	1	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	1	J	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Semi-Volatile Organic Compounds																																											
Chrysene	218-01-9	1.9	ug/l	ND	U	**5**	1	-	-	-	-	ND	U	**5**	1	-	-	-	-	ND	U	**5**	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	ND	U	5	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	5	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	ND	U	5	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	ND	U	5	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Metals																																											
Cobalt	7440-48-4	31	ug/l	ND	U	0.005	1	ND	U	0.005	1	ND	U	0.005	1	ND	U	0.005	1	ND	U	0.005	1	ND	U	0.005	1	7.6	-	2.3	1	ND	U	5	1	4.3	J	2.3	1	ND	U	5	1
Iron	7439-89-6	NS	ug/l	19900	-	0.2	1	ND	U	0.2	1	8100	-	0.2	1	ND	U	0.2	1	52700	-	0.2	1	8210	-	0.2	1	26100	-	52.2	1	8880	-	200	1	30100	-	52.2	1	29600	-	200	1
Manganese	7439-96-5	300	ug/l	140	-	0.005	1	115	-	0.005	1	**374**	-	0.005	1	ND	U	0.005	1	**3050**	-	0.005	1	**2890**	-	0.005	1	**1450**	-	0.84	1	**1370**	-	5	1	**489**	-	0.84	1	**484**	-	5	1
Arsenic	7440-38-2	10	ug/l	**11**	-	0.002	1	ND	U	0.002	1	**10.7**	-	0.002	1	6.4	-	0.002	1	**44.5**	-	0.002	1	2.8	-	0.002	1	**12.3**	-	0.95	1	2.4	-	2	1	1	J	0.95	1	ND	U	2	1
Lead	7439-92-1	5	ug/l	ND	U	0.001	1	ND	U	0.001	1	1.1	-	0.001	1	ND	U	0.001	1	ND	U	0.001	1	ND	U	0.001	1	**11.8**	-	0.052	1	ND	U	1	1	2.3	-	0.052	1	ND	U	1	1
General Chemistry																																											
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	0.398	-	0.002	1	-	-	-	-	0.239	-	0.002	1	-	-	-	-	0.397	-	0.002	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.002	1	-	-	-	-	0.0452	-	0.002	1	-	-	-	-	ND	U	0.002	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mgl as CaCO3	0.398	-	0.002	1	-	-	-	-	ND	-	0.002	1	-	-	-	-	0.397	-	0.002	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	350000	-	30	1	-	-	-	-	312000	-	30	1	-	-	-	-	666000	-	60	1	-	-	-	-	390000	-	9700	1	-	-	-	-	369000	-	9700	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	44900	-	0.6	1	-	-	-	-	26400	-	0.6	1	-	-	-	-	16400	-	0.6	1	-	-	-	-	3100	-	200	1	-	-	-	-	250	J	200	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	0.16	1	-	-	-	-	**560**	-	0.16	1	-	-	-	-	ND	U	0.16	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	47800	-	4	10	-	-	-	-	79200	-	8	20	-	-	-	-	199000	-	20	50	-	-	-	-	68000	-	4000	20	-	-	-	-	87200	-	4000	20	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	0.5	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	0.5	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	0.5	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	6000	-	5	5	-	-	-	-	7200	-	5	5	-	-	-	-	ND	U	5	5	-	-	-	-	6900	-	1500	5	-	-	-	-	36300	-	1500	5	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	8300	-	1	1	-	-	-	-	23400	-	1	1	-	-	-	-	17500	-	1	1	-	-	-	-	10400	-	500	1	-	-	-	-	3400	-	500	1	-	-	-	-

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - microgram per liter
mg/l - milligram per liter
MSC - PADEP's Medium Specific Concentration for Groundwater
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
Alkalinity is reported in mg/l rather than ug/l

Qualifiers:
Q - Lab Qualifier
U - The analyte was analyzed but not detected
E - The analyte exceeded the calibration range of the instrument
J - Compound detected but below the reporting limit (the value given is an estimate).

Exceedance Summary:
10 - Compound above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10 - Reporting Limit above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

Table 5
April 2011 Summary of Deep Groundwater Analytical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	8				8				8				8				8				8				8				8			
			Well Name	N-21				N-21				N-27				N-27				N-30				N-30				N-38D				N-38D				N-4				N-4			
			Sample ID	N-21_04062011				N-21_04062011 FILTERED				N-27_4-5-11				N-27_4-5-11 FILTERED				N-30_4-5-11				N-30_4-5-11 FILTERED				N-38D_04062011				N-38D_04062011 FILTERED				N-4_04062011				N-4_04062011 FILTERED			
			Sample Date	4/6/2011				4/6/2011				4/5/2011				4/5/2011				4/5/2011				4/5/2011				4/6/2011				4/6/2011				4/6/2011				4/6/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.0098	1	-	-	-	-	ND	U	0.0098	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Benzene	71-43-2	5	ug/l	**20**	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	2	-	0.5	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	2	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	120	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	3	-	0.5	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	0.6	J	0.5	1	-	-	-	-	3	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	2	-	0.5	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	0.7	J	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	2	-	0.5	1	-	-	-	-	4	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Semi-Volatile Organic Compounds																																												
Chrysene	218-01-9	1.9	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	1	J	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-
Metals																																												
Cobalt	7440-48-4	31	ug/l	**39.1**	-	2.3	1	**36.1**	-	5	1	10.6	-	2.3	1	10.4	-	5	1	7	-	2.3	1	ND	U	5	1	3.7	J	2.3	1	ND	U	5	1	2.4	J	2.3	1	ND	U	5	1
Iron	7439-89-6	NS	ug/l	62400	-	52.2	1	54300	-	200	1	1530	-	52.2	1	867	-	200	1	36500	-	52.2	1	22900	-	200	1	37000	-	52.2	1	ND	U	200	1	11700	-	52.2	1	ND	U	200	1
Manganese	7439-96-5	300	ug/l	**650**	-	0.84	1	**606**	-	5	1	**6070**	-	0.84	1	**5930**	-	5	1	288	-	0.84	1	243	-	5	1	**861**	-	0.84	1	**356**	-	5	1	**3080**	-	0.84	1	**2850**	-	5	1
Arsenic	7440-38-2	10	ug/l	5.7	-	0.95	1	4.3	-	2	1	ND	U	0.95	1	ND	U	2	1	3	-	0.95	1	ND	U	2	1	**13.5**	-	0.95	1	2.3	-	2	1	ND	U	0.95	1	ND	U	2	1
Lead	7439-92-1	5	ug/l	1.7	-	0.052	1	ND	U	1	1	0.23	J	0.052	1	ND	U	1	1	**23.9**	-	0.052	1	ND	U	1	1	**32.7**	-	0.052	1	ND	U	1	1	1.9	-	0.052	1	ND	U	1	1
General Chemistry																																												
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	ND	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mgl as CaCO3	ND	U	0.46	1	-	-	-	-	ND	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	1040000	-	19400	1	-	-	-	-	629000	-	19400	1	-	-	-	-	503000	-	9700	1	-	-	-	-	818000	-	38800	1	-	-	-	-	756000	-	19400	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	1700	-	200	1	-	-	-	-	710	-	200	1	-	-	-	-	ND	U	200	1	-	-	-	-	85100	-	200	1	-	-	-	-	1100	-	200	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**220**	4	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	47600	-	2000	10	-	-	-	-	108000	-	4000	20	-	-	-	-	136000	-	10000	50	-	-	-	-	8700	-	1000	5	-	-	-	-	56000	-	4000	20	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	630	-	250	5	-	-	-	-	ND	U	250	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	703000	-	30000	100	-	-	-	-	176000	-	6000	20	-	-	-	-	132000	-	15000	50	-	-	-	-	ND	U	1500	5	-	-	-	-	53800	-	3000	10	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	13200	-	500	1	-	-	-	-	2600	-	500	1	-	-	-	-	3900	-	500	1	-	-	-	-	40600	-	500	1	-	-	-	-	6600	-	500	1	-	-	-	-

Notes:
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MSC - PADEP's Medium Specific Concentration for Groundwater
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Qualifiers:
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U - The analyte was analyzed but not detected
E - The analyte exceeded the calibration range of the instrument
J - Compound detected but below the reporting limit (the value given is an estimate).

Exceedance Summary:
10 - Compound above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10 - Reporting Limit above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

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April 2011 Summary of Deep Groundwater Analytical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	8				8				8				8				8				8				9				9				9				9			
			Well Name	N-44D				N-44D				N-50D				N-50D				N-9				N-9				S-106DSRTF				S-106DSRTF				S-120DSRTF				S-120DSRTF			
			Sample ID	N-44D_4-5-11				N-44D_4-5-11 FILTERED				N-50D_4-5-11				N-50D_4-5-11 FILTERED				N-9_4-5-11				N-9_4-5-11 FILTERED				S-106DSRTF_04082011				S-106DSRTF_04082011 FILT				S-120DSRTF_04082011				S-120DSRTF_04082011 FILT			
			Sample Date	4/5/2011				4/5/2011				4/5/2011				4/5/2011				4/5/2011				4/5/2011				4/8/2011				4/8/2011				4/8/2011				4/8/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.029	1	-	-	-	-	ND	U	0.0098	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	0.9	J	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	5	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Benzene	71-43-2	5	ug/l	**10**	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	0.7	J	0.5	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	6	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	1	-	0.5	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	2	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	14	-	0.5	1	-	-	-	-	5	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	6	-	0.5	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	**300**	-	0.5	1	-	-	-	-	**37**	-	0.5	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	1	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	0.5	J	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	2	-	0.5	1	-	-	-	-
Semi-Volatile Organic Compounds																																											
Chrysene	218-01-9	1.9	ug/l	ND	U	1	1	-	-	-	-	**2**	J	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	1	J	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	2	J	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	ND	U	1	1	-	-	-	-	3	J	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Metals																																											
Cobalt	7440-48-4	31	ug/l	ND	U	2.3	1	ND	U	5	1	ND	U	2.3	1	ND	U	5	1	8.3	-	2.3	1	ND	U	5	1	11.5	-	2.3	1	11.2	-	5	1	3.2	J	2.3	1	ND	U	5	1
Iron	7439-89-6	NS	ug/l	27400	-	52.2	1	17200	-	200	1	25100	-	52.2	1	9620	-	200	1	3960	-	52.2	1	ND	U	200	1	31800	-	52.2	1	787	-	200	1	39100	-	52.2	1	ND	U	200	1
Manganese	7439-96-5	300	ug/l	**560**	-	0.84	1	**486**	-	5	1	**1070**	-	0.84	1	**1000**	-	5	1	**1430**	-	0.84	1	155	-	5	1	**1060**	-	0.84	1	**1030**	-	5	1	**1880**	-	0.84	1	**1720**	-	5	1
Arsenic	7440-38-2	10	ug/l	**114**	-	0.95	1	**55.1**	-	2	1	4.1	-	0.95	1	ND	U	2	1	1.9	J	0.95	1	ND	U	2	1	5.1	-	0.95	1	ND	U	2	1	**11.3**	-	0.95	1	ND	U	2	1
Lead	7439-92-1	5	ug/l	1.7	-	0.052	1	ND	U	1	1	**37.7**	-	0.052	1	ND	U	1	1	2.6	-	0.052	1	ND	U	1	1	0.2	J	0.052	1	ND	U	1	1	4.5	-	0.052	1	ND	U	1	1
General Chemistry																																											
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mgl as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	275000	-	9700	1	-	-	-	-	653000	-	9700	1	-	-	-	-	431000	-	9700	1	-	-	-	-	494000	-	9700	1	-	-	-	-	400000	-	9700	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	980	-	200	1	-	-	-	-	2500	-	200	1	-	-	-	-	590	J	200	1	-	-	-	-	14700	-	200	1	-	-	-	-	9200	-	200	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	**2000**	-	**110**	2	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	28400	-	1000	5	-	-	-	-	18700	-	1000	5	-	-	-	-	54900	-	4000	20	-	-	-	-	48900	-	2000	10	-	-	-	-	25500	-	1000	5	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	15700	-	1500	5	-	-	-	-	ND	U	1500	5	-	-	-	-	89000	-	6000	20	-	-	-	-	36800	-	1500	5	-	-	-	-	ND	U	1500	5	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	49400	-	500	1	-	-	-	-	20500	-	500	1	-	-	-	-	2500	-	500	1	-	-	-	-	9700	-	500	1	-	-	-	-	11000	-	500	1	-	-	-	-

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - microgram per liter
mg/l - milligram per liter
MSC - PADEP's Medium Specific Concentration for Groundwater
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
Alkalinity is reported in mg/l rather than ug/l

Qualifiers:
Q - Lab Qualifier
U - The analyte was analyzed but not detected
E - The analyte exceeded the calibration range of the instrument
J - Compound detected but below the reporting limit (the value given is an estimate).

Exceedance Summary:
10 - Compound above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10 - Reporting Limit above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

Table 5
April 2011 Summary of Deep Groundwater Analytical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	9				9				9				9				9				9			
			Well Name	S-74D1SRTF				S-74D1SRTF				S-74D2SRTF				S-74D2SRTF				S-76DSRTF				S-76DSRTF			
			Sample ID	S-74D1SRTF_04082011				S-74D1SRTF_04082011 FILT				S-74D2SRTF_04082011				S-74D2SRTF_04082011 FILT				S-76DSRTF_04082011				S-76DSRTF_04082011 FILT			
			Sample Date	4/8/2011				4/8/2011				4/8/2011				4/8/2011				4/8/2011				4/8/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.0097	1	-	-	-	-	ND	U	0.0099	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Benzene	71-43-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	2	-	0.5	1	-	-	-	-	0.6	J	0.5	1	-	-	-	-	2	-	0.5	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Semi-Volatile Organic Compounds																											
Chrysene	218-01-9	1.9	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Metals																											
Cobalt	7440-48-4	31	ug/l	27.9	-	2.3	1	25.5	-	5	1	ND	U	2.3	1	ND	U	5	1	2.9	J	2.3	1	ND	U	5	1
Iron	7439-89-6	NS	ug/l	44000	-	52.2	1	7180	-	200	1	26400	-	52.2	1	239	-	200	1	1910	-	52.2	1	1620	-	200	1
Manganese	7439-96-5	300	ug/l	214	-	0.84	1	200	-	5	1	278	-	0.84	1	257	-	5	1	**3830**	-	0.84	1	**3900**	-	5	1
Arsenic	7440-38-2	10	ug/l	**18.9**	-	0.95	1	ND	U	2	1	4	-	0.95	1	ND	U	2	1	ND	U	0.95	1	ND	U	2	1
Lead	7439-92-1	5	ug/l	0.066	J	0.052	1	ND	U	1	1	1.3	-	0.052	1	ND	U	1	1	0.077	J	0.052	1	ND	U	1	1
General Chemistry																											
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	-	-	-	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	-	-	-	1	-	-	-	-	ND	U	0.46	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mgl as CaCO3	100000	-	0.46	1	-	-	-	-	-	-	-	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	303000	-	9700	1	-	-	-	-	606000	-	19400	1	-	-	-	-	267000	-	9700	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	24100	-	200	1	-	-	-	-	13100	-	200	1	-	-	-	-	2300	-	200	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	44500	-	4000	20	-	-	-	-	35500	-	2000	10	-	-	-	-	32400	-	2000	10	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	ND	U	1500	5	-	-	-	-	ND	U	1500	5	-	-	-	-	3000	J	1500	5	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	6900	-	500	1	-	-	-	-	6600	-	500	1	-	-	-	-	1700	-	500	1	-	-	-	-

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - microgram per liter
mg/l - milligram per liter
MSC - PADEP's Medium Specific Concentration for Groundwater
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
Alkalinity is reported in mg/l rather than ug/l

Qualifiers:
Q - Lab Qualifier
U - The analyte was analyzed but not detected
E - The analyte exceeded the calibration range of the instrument
J - Compound detected but below the reporting limit (the value given is an estimate).

Exceedance Summary:
10 - Compound above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10 - Reporting Limit above the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

Table 6
June-July 2011 Summary of Deep Groundwater Analyical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	1				1				1				1				1				1				2				2				2			
			Well Name	S-46D				S-46D				S-80D				S-80D				S-264				S-264				S-72D				S-72D				S-294D			
			Sample ID	S-46D_06282011				S-46D_06282011 FILTERED				S-80D_06282011				S-80D_06282011 FILTERED				S-264_06282011				S-264_06282011 FILTERED				S-72D_06282011				S-72D_06282011 FILTERED				S-294D_06282011			
			Sample Date	6/28/2011				6/28/2011				6/28/2011				6/28/2011				6/28/2011				6/28/2011				6/28/2011				6/28/2011				6/28/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.0098	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-	ND	U	0.0098	1	-	-	-	-	ND	U	0.0098	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	2	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Benzene	71-43-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	2	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	6	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	0.8	J	0.5	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Semi-Volatile Organic Compounds																																										
Chrysene	218-01-9	1.9	ug/l	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Metals																																										
Cobalt	7440-48-4	31	ug/l	17.8	-	0.62	1	18.2	-	5	1	ND	U	0.62	1	ND	U	5	1	**35.5**	-	0.62	1	**35.7**	-	5	1	ND	U	0.62	1	ND	U	5	1	4.3	J	0.62	1	ND	U	5	1
Iron	7439-89-6	NS	ug/l	10400	-	14.1	1	7400	-	200	1	43700	-	14.1	1	42900	-	200	1	14000	-	14.1	1	9920	-	200	1	62200	-	14.1	1	58100	-	200	1	69100	-	14.1	1	65000	-	200	1
Manganese	7439-96-5	300	ug/l	**21200**	-	2.2	5	**20500**	-	25	5	**12000**	-	2.2	5	**11900**	-	25	5	**8570**	-	0.44	1	**8580**	-	5	1	**3690**	-	0.44	1	**3770**	-	5	1	**8400**	-	0.44	1	**8390**	-	5	1
Arsenic	7440-38-2	10	ug/l	**20.7**	-	0.95	1	**11.1**	-	2	1	ND	U	0.95	1	ND	U	2	1	2.7	-	0.95	1	ND	U	2	1	ND	U	0.95	1	ND	U	2	1	4.5	-	0.95	1	3.2	-	2	1
Lead	7439-92-1	5	ug/l	2.1	-	0.08	1	ND	U	1	1	ND	U	0.08	1	ND	U	1	1	0.25	J	0.08	1	ND	U	1	1	ND	U	0.08	1	ND	U	1	1	0.14	J	0.08	1	ND	U	1	1
General Chemistry																																										
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	676000	-	19400	1	-	-	-	-	969000	-	19400	1	-	-	-	-	695000	-	19400	1	-	-	-	-	688000	-	19400	1	-	-	-	-	883000	-	19400	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	4300	-	200	1	-	-	-	-	420	J	200	1	-	-	-	-	2000	-	200	1	-	-	-	-	4000	-	200	1	-	-	-	-	1500	-	200	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	80500	-	4000	20	-	-	-	-	73600	-	10000	50	-	-	-	-	91100	-	4000	20	-	-	-	-	77700	-	4000	20	-	-	-	-	93600	-	10000	50	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	166000	-	6000	20	-	-	-	-	462000	-	15000	50	-	-	-	-	130000	-	6000	20	-	-	-	-	216000	-	6000	20	-	-	-	-	350000	-	15000	50	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	12000	-	500	1	-	-	-	-	6400	-	500	1	-	-	-	-	13800	-	500	1	-	-	-	-	4300	-	500	1	-	-	-	-	4600	-	500	1	-	-	-	-

Notes:
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mg/l - milligram per liter
MSC - PADEP's Medium Specific Concentration for Groundwater
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
Alkalanity is reported in mg/l rather than ug/l

Qualifiers:
Q - Lab Qualifier
U - The analyte was analyzed but not detected
E - The analyte exceeded the calibration range of the instrument
J - Compound detected but below the reporting limit (the value given is an estimate).

Exceedance Summary:
10 - Compound exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10 - Reporting Limit exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

Table 6
June-July 2011 Summary of Deep Groundwater Analyical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	2				2				2				2				3				3				3				3			
			Well Name	S-302D				S-302D				S-305D				S-305D				S-8				S-8				S-22				S-22				S-69D				S-69D			
			Sample ID	S-302D_06282011				S-302D_06282011 FILTERED				S-305D_06292011				S-305D_06292011 FILTERED				S-8_06292011				S-8_06292011 FILTERED				S-22_06292011				S-22_06292011 FILTERED				S-69D_06292011				S-69D_06292011 FILTERED			
			Sample Date	6/28/2011				6/28/2011				6/29/2011				6/29/2011				6/29/2011				6/29/2011				6/29/2011				6/29/2011				6/29/2011				6/29/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.0098	1	-	-	-	-	ND	U	0.0095	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-	ND	U	0.029	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	3	5	-	-	-	-	ND	U	2	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	3	5	-	-	-	-	ND	U	1	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	10	J	3	5	-	-	-	-	ND	U	2	1	-	-	-	-
Benzene	71-43-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	**28**	-	3	5	-	-	-	-	ND	U	1	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	140	-	3	5	-	-	-	-	ND	U	1	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	7	-	3	5	-	-	-	-	ND	U	1	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	10	J	3	5	-	-	-	-	ND	U	2	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	0.5	J	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	8	-	0.5	1	-	-	-	-	**49**	-	3	5	-	-	-	-	4	-	1	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	0.8	J	0.5	1	-	-	-	-	53	-	3	5	-	-	-	-	ND	U	1	1	-	-	-	-
Semi-Volatile Organic Compounds																																											
Chrysene	218-01-9	1.9	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	**5**	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	5	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	1	J	0.9	1	-	-	-	-	ND	U	5	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	5	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	1	J	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	5	1	-	-	-	-
Metals																																											
Cobalt	7440-48-4	31	ug/l	1.8	J	0.62	1	ND	U	5	1	23.6	-	0.62	1	24	-	5	1	**46.8**	-	0.62	1	ND	U	5	1	7.1	-	0.62	1	ND	U	5	1	ND	U	0.005	1	ND	U	0.005	1
Iron	7439-89-6	NS	ug/l	76300	-	14.1	1	66900	-	200	1	114000	-	14.1	1	78700	-	200	1	54500	-	14.1	1	ND	U	200	1	28500	-	14.1	1	1750	-	200	1	ND	U	0.2	1	ND	U	0.2	1
Manganese	7439-96-5	300	ug/l	**4000**	-	0.44	1	**3930**	-	5	1	**2170**	-	0.44	1	**2160**	-	5	1	**1460**	-	0.44	1	**368**	-	5	1	272	-	0.44	1	239	-	5	1	**2770**	-	0.005	1	**2730**	-	0.005	1
Arsenic	7440-38-2	10	ug/l	ND	U	0.95	1	ND	U	2	1	**367**	-	0.95	1	**51.9**	-	2	1	**13.7**	-	0.95	1	ND	U	2	1	2.6	-	0.95	1	ND	U	2	1	ND	U	0.002	1	ND	U	0.002	1
Lead	7439-92-1	5	ug/l	ND	U	0.08	1	ND	U	1	1	ND	U	0.08	1	ND	U	1	1	**239**	-	0.08	1	ND	U	1	1	0.46	J	0.08	1	ND	U	1	1	ND	U	0.001	1	ND	U	0.001	1
General Chemistry																																											
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	0.324	-	0.002	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.002	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	0.324	-	0.002	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	950000	-	19400	1	-	-	-	-	1160000	-	19400	1	-	-	-	-	154000	-	9700	1	-	-	-	-	320000	-	9700	1	-	-	-	-	492000	-	30	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	13200	-	200	1	-	-	-	-	10200	-	200	1	-	-	-	-	3000	-	200	1	-	-	-	-	1600	-	200	1	-	-	-	-	3300	-	0.6	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**1100**	20	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	0.16	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	75000	-	10000	50	-	-	-	-	76600	-	10000	50	-	-	-	-	27300	-	1000	5	-	-	-	-	35700	-	2000	10	-	-	-	-	91600	-	8	20	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	910	-	400	5	-	-	-	-	ND	U	0.5	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	0.5	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	0.5	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	400000	-	15000	50	-	-	-	-	508000	-	15000	50	-	-	-	-	5800	-	1500	5	-	-	-	-	ND	U	1500	5	-	-	-	-	19600	-	5	5	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	10000	-	500	1	-	-	-	-	14800	-	500	1	-	-	-	-	5500	-	500	1	-	-	-	-	12700	-	500	1	-	-	-	-	3900	-	1	1	-	-	-	-

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June-July 2011 Summary of Deep Groundwater Analyical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	3				3				3				3				3				3				4				4			
			Well Name	BF-108				BF-108				BF-90D				BF-90D				S-280D				S-280D				S-284D				S-284D				S-38D				S-38D			
			Sample ID	BF-108_07052011				BF-108_07052011 FILTERED				BF-90D_07052011				BF-90D_07052011 FILTERED				S-280D_06282011				S-280D_06282011 FILTERED				S-284D_06292011				S-284D_06292011 FILTERED				S-38D_06292011				S-38D_06292011 FILTERED			
			Sample Date	7/5/2011				7/5/2011				7/5/2011				7/5/2011				6/28/2011				6/28/2011				6/29/2011				6/29/2011				6/29/2011				6/29/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.0096	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-	ND	U	0.0098	1	-	-	-	-	ND	U	0.029	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Benzene	71-43-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	0.5	J	0.5	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	1	-	0.5	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	2	1	-	-	-	-	3	-	0.5	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	1	-	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	0.7	J	0.5	1	-	-	-	-
Semi-Volatile Organic Compounds																																												
Chrysene	218-01-9	1.9	ug/l	ND	U	1	1	-	-	-	-	1	J	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	**5**	1	-	-	-	-	ND	U	1	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	1	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	1	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	1	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	ND	U	1	1	-	-	-	-	2	J	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	1	1	-	-	-	-
Metals																																												
Cobalt	7440-48-4	31	ug/l	**94.8**	-	0.62	1	ND	U	5	1	**32.6**	-	0.62	1	ND	U	5	1	2.8	J	0.62	1	ND	U	5	1	ND	U	0.005	1	ND	U	0.005	1	ND	U	0.62	1	ND	U	5	1
Iron	7439-89-6	NS	ug/l	294000	-	70.5	5	ND	U	200	1	92900	-	14.1	1	ND	U	200	1	23300	-	14.1	1	9270	-	200	1	2710	-	0.2	1	821	-	0.2	1	5710	-	14.1	1	ND	U	200	1
Manganese	7439-96-5	300	ug/l	**2840**	-	0.44	1	262	-	5	1	**1090**	-	0.44	1	**351**	-	5	1	**672**	-	0.44	1	**661**	-	5	1	**905**	-	0.005	1	**922**	-	0.005	1	**309**	-	0.44	1	**430**	-	5	1
Arsenic	7440-38-2	10	ug/l	**85.6**	-	0.95	1	ND	U	2	1	**33.1**	-	0.95	1	2.1	-	2	1	**14.5**	-	0.95	1	2.4	-	2	1	ND	U	0.002	1	ND	U	0.002	1	ND	U	0.95	1	ND	U	2	1
Lead	7439-92-1	5	ug/l	**1110**	-	0.4	5	ND	U	1	1	**356**	-	0.08	1	ND	U	1	1	0.28	J	0.08	1	ND	U	1	1	ND	U	0.001	1	ND	U	0.001	1	1.7	-	0.08	1	ND	U	1	1
General Chemistry																																												
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	0.315	-	0.002	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.002	1	-	-	-	-	ND	U	0.46	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	0.315	-	0.002	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	408000	-	9700	1	-	-	-	-	388000	-	9700	1	-	-	-	-	258000	-	9700	1	-	-	-	-	550000	-	30	1	-	-	-	-	174000	-	9700	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	ND	U	200	1	-	-	-	-	ND	U	200	1	-	-	-	-	17200	-	200	1	-	-	-	-	23500	-	0.6	1	-	-	-	-	ND	U	200	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	**54**	1	-	-	-	-	-	-	-	-	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	0.16	1	-	-	-	-	ND	U	**54**	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	10200	-	1000	5	-	-	-	-	11800	-	1000	5	-	-	-	-	43400	-	2000	10	-	-	-	-	66300	-	8	20	-	-	-	-	3200	-	1000	5	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	580	-	400	5	-	-	-	-	620	-	400	5	-	-	-	-	580	-	400	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	630	-	400	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	250	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	400	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	23100	-	1500	5	-	-	-	-	33200	-	1500	5	-	-	-	-	6500	-	1500	5	-	-	-	-	166000	-	20	20	-	-	-	-	ND	U	1500	5	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	12300	-	500	1	-	-	-	-	12700	-	500	1	-	-	-	-	5900	-	500	1	-	-	-	-	5000	-	1	1	-	-	-	-	1200	-	500	1	-	-	-	-

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - microgram per liter
mg/l - milligram per liter
MSC - PADEP's Medium Specific Concentration for Groundwater
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
Alkalanity is reported in mg/l rather than ug/l

Qualifiers:
Q - Lab Qualifier
U - The analyte was analyzed but not detected
E - The analyte exceeded the calibration range of the instrument
J - Compound detected but below the reporting limit (the value given is an estimate).

Exceedance Summary:

10	- Compound exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10	- Reporting Limit exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

Table 6
June-July 2011 Summary of Deep Groundwater Analyical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	4				4				4				4				4				4				5				5				5			
			Well Name	S-38D2				S-38D2				S-59D				S-59D				S-119D				S-119D				A-13D				A-13D				A-19D			
			Sample ID	S-38D2_06292011				S-38D2_06292011 FILTERED				S-59D_06292011				S-59D_06292011 FILTERED				S-119D_06282011				S-119D_06282011 FILTERED				A-13D_07012011				A-13D_07012011 FILTERED				A-19D_07012011				A-19D_07012011 FILTERED			
			Sample Date	6/29/2011				6/29/2011				6/29/2011				6/29/2011				6/28/2011				6/28/2011				7/1/2011				7/1/2011				7/1/2011				7/1/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.0095	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-	ND	U	0.0098	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	1	2	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	1	J	1	2	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	1	2	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Benzene	71-43-2	5	ug/l	**110**	-	1	2	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	20	-	1	2	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	12	-	1	2	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	2	J	1	2	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	ND	U	1	2	-	-	-	-	2	-	0.5	1	-	-	-	-	0.6	J	0.5	1	-	-	-	-	4	-	0.5	1	-	-	-	-	**40**	-	0.5	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	14	-	1	2	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Semi-Volatile Organic Compounds																																										
Chrysene	218-01-9	1.9	ug/l	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Metals																																										
Cobalt	7440-48-4	31	ug/l	5	-	0.62	1	ND	U	5	1	11.2	-	0.62	1	10.8	-	5	1	7.5	-	0.62	1	6.6	-	5	1	3.1	J	0.62	1	ND	U	5	1	4.8	J	0.62	1	ND	U	5	1
Iron	7439-89-6	NS	ug/l	8740	-	14.1	1	1120	-	200	1	11500	-	14.1	1	1620	-	200	1	31300	-	14.1	1	29300	-	200	1	44400	-	14.1	1	20400	-	200	1	44100	-	14.1	1	24300	-	200	1
Manganese	7439-96-5	300	ug/l	**7270**	-	0.44	1	**6410**	-	5	1	**2460**	-	0.44	1	**2440**	-	5	1	286	-	0.44	1	277	-	5	1	**647**	-	0.44	1	**621**	-	5	1	**3320**	-	0.44	1	**3130**	-	5	1
Arsenic	7440-38-2	10	ug/l	1.7	J	0.95	1	ND	U	2	1	**49.3**	-	0.95	1	**13.2**	-	2	1	5	-	0.95	1	4.6	-	2	1	4.4	-	0.95	1	ND	U	2	1	**27**	-	0.95	1	5.2	-	2	1
Lead	7439-92-1	5	ug/l	4.2	-	0.08	1	ND	U	1	1	0.16	J	0.08	1	ND	U	1	1	1	-	0.08	1	ND	U	1	1	0.33	J	0.08	1	ND	U	1	1	ND	U	0.08	1	ND	U	1	1
General Chemistry																																										
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	384000	-	9700	1	-	-	-	-	688000	-	19400	1	-	-	-	-	487000	-	9700	1	-	-	-	-	456000	-	9700	1	-	-	-	-	313000	-	9700	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	ND	U	200	1	-	-	-	-	2300	-	200	1	-	-	-	-	530	J	200	1	-	-	-	-	14400	-	200	1	-	-	-	-	1600	-	200	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	44900	-	2000	10	-	-	-	-	171000	-	10000	50	-	-	-	-	136000	-	20000	100	-	-	-	-	90200	-	4000	20	-	-	-	-	58400	-	4000	20	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	11400	-	1500	5	-	-	-	-	9500	-	1500	5	-	-	-	-	85300	-	3000	10	-	-	-	-	2500	J	1500	5	-	-	-	-	14800	-	1500	5	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	2700	-	500	1	-	-	-	-	7600	-	500	1	-	-	-	-	2300	-	500	1	-	-	-	-	9300	-	500	1	-	-	-	-	9600	-	500	1	-	-	-	-

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MSC - PADEP's Medium Specific Concentration for Groundwater
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Q - Lab Qualifier
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Exceedance Summary:
10 - Compound exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10 - Reporting Limit exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

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June-July 2011 Summary of Deep Groundwater Analyical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	5				5				6				6				6				6				6				6				6			
			Well Name	A-21D				A-21D				B-132D				B-132D				B-133D				B-133D				B-134D				B-134D				B-48D			
			Sample ID	A-21D_07012011				A-21D_07012011 FILTERED				B-132D_07012011				B-132D_07012011 FILTERED				B-133D_07012011				B-133D_07012011 FILTERED				B-134D_07012011				B-134D_07012011 FILTERED				B-48D_07012011				B-48D_07012011 FILTERED			
			Sample Date	7/1/2011				7/1/2011				7/1/2011				7/1/2011				7/1/2011				7/1/2011				7/1/2011				7/1/2011				7/1/2011				7/1/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.0096	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Benzene	71-43-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	2	-	0.5	1	-	-	-	-	1	-	0.5	1	-	-	-	-	2	-	0.5	1	-	-	-	-	1	-	0.5	1	-	-	-	-	4	-	0.5	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Semi-Volatile Organic Compounds																																											
Chrysene	218-01-9	1.9	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	1	J	0.9	1	-	-	-	-
Metals																																											
Cobalt	7440-48-4	31	ug/l	ND	U	0.62	1	ND	U	5	1	ND	U	0.62	1	ND	U	5	1	2.4	J	0.62	1	ND	U	5	1	0.73	J	0.62	1	ND	U	5	1	ND	U	0.62	1	ND	U	5	1
Iron	7439-89-6	NS	ug/l	45400	-	14.1	1	27000	-	200	1	37100	-	14.1	1	18100	-	200	1	33200	-	14.1	1	14300	-	200	1	35200	-	14.1	1	15300	-	200	1	39200	-	14.1	1	12500	-	200	1
Manganese	7439-96-5	300	ug/l	**638**	-	0.44	1	**611**	-	5	1	247	-	0.44	1	246	-	5	1	210	-	0.44	1	199	-	5	1	247	-	0.44	1	235	-	5	1	**2030**	-	0.44	1	**1890**	-	5	1
Arsenic	7440-38-2	10	ug/l	4.6	-	0.95	1	ND	U	2	1	4.3	-	0.95	1	ND	U	2	1	**10.9**	-	0.95	1	2.7	-	2	1	4.3	-	0.95	1	ND	U	2	1	2.2	-	0.95	1	ND	U	2	1
Lead	7439-92-1	5	ug/l	0.16	J	0.08	1	ND	U	1	1	ND	U	0.08	1	ND	U	1	1	0.12	J	0.08	1	ND	U	1	1	ND	U	0.08	1	ND	U	1	1	0.96	J	0.08	1	ND	U	1	1
General Chemistry																																											
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	352000	-	9700	1	-	-	-	-	343000	-	9700	1	-	-	-	-	344000	-	9700	1	-	-	-	-	320000	-	9700	1	-	-	-	-	313000	-	9700	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	25500	-	200	1	-	-	-	-	26400	-	200	1	-	-	-	-	25200	-	200	1	-	-	-	-	28900	-	200	1	-	-	-	-	8400	-	200	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	62300	-	4000	20	-	-	-	-	68800	-	4000	20	-	-	-	-	66200	-	4000	20	-	-	-	-	51200	-	2000	10	-	-	-	-	74100	-	4000	20	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	2100	J	1500	5	-	-	-	-	2300	J	1500	5	-	-	-	-	2300	J	1500	5	-	-	-	-	ND	U	1500	5	-	-	-	-	3700	J	1500	5	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	9600	-	500	1	-	-	-	-	8000	-	500	1	-	-	-	-	8700	-	500	1	-	-	-	-	9500	-	500	1	-	-	-	-	7100	-	500	1	-	-	-	-

Notes:
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mg/l - milligram per liter
MSC - PADEP's Medium Specific Concentration for Groundwater
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
Alkalanity is reported in mg/l rather than ug/l

Qualifiers:
Q - Lab Qualifier
U - The analyte was analyzed but not detected
E - The analyte exceeded the calibration range of the instrument
J - Compound detected but below the reporting limit (the value given is an estimate).

Exceedance Summary:

10	- Compound exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10	- Reporting Limit exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

Table 6
June-July 2011 Summary of Deep Groundwater Analyical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	7				7				7				7				7				7				7				8				8			
			Well Name	C-129D				C-129D				C-134D				C-134D				C-144D				C-144D				C-50D				C-50D				N-13			
			Sample ID	C-129D_06292011				C-129D_06292011 FILTERED				C-134D_07012011				C-134D_07012011 FILTERED				C-144D_07052011				C-144D_07052011 FILTERED				C-50D_07052011				C-50D_07052011 FILTERED				N-13_06272011			
			Sample Date	6/29/2011				6/29/2011				7/1/2011				7/1/2011				7/5/2011				7/5/2011				7/5/2011				7/5/2011				6/27/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.029	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	2	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	2	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Benzene	71-43-2	5	ug/l	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	ND	U	2	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	2	-	1	1	-	-	-	-	0.7	J	0.5	1	-	-	-	-	0.9	J	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	0.9	J	0.5	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Semi-Volatile Organic Compounds																																										
Chrysene	218-01-9	1.9	ug/l	ND	U	**5**	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	ND	U	5	1	-	-	-	-	2	J	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	5	1	-	-	-	-	1	J	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	ND	U	5	1	-	-	-	-	2	J	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	ND	U	5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Metals																																										
Cobalt	7440-48-4	31	ug/l	ND	U	0.005	1	ND	U	0.005	1	0.76	J	0.62	1	ND	U	5	1	1.1	J	0.62	1	ND	U	5	1	ND	U	0.62	1	ND	U	5	1	5.1	-	0.62	1	ND	U	5	1
Iron	7439-89-6	NS	ug/l	20800	-	0.2	1	ND	U	0.2	1	649	-	14.1	1	ND	U	200	1	74900	-	14.1	1	55700	-	200	1	56000	-	14.1	1	25500	-	200	1	22800	-	14.1	1	10100	-	200	1
Manganese	7439-96-5	300	ug/l	114	-	0.005	1	104	-	0.005	1	43	-	0.44	1	ND	U	5	1	**1540**	-	0.44	1	**1490**	-	5	1	**3140**	-	0.44	1	**2970**	-	5	1	**1440**	-	0.44	1	**1370**	-	5	1
Arsenic	7440-38-2	10	ug/l	9.6	-	0.002	1	ND	U	0.002	1	5.8	-	0.95	1	2.3	-	2	1	2.5	-	0.95	1	ND	U	2	1	**45**	-	0.95	1	5.4	-	2	1	9.8	-	0.95	1	3.9	-	2	1
Lead	7439-92-1	5	ug/l	ND	U	0.001	1	ND	U	0.001	1	0.16	J	0.08	1	ND	U	1	1	0.84	J	0.08	1	ND	U	1	1	ND	U	0.08	1	ND	U	1	1	**6.3**	-	0.08	1	ND	U	1	1
General Chemistry																																										
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	0.386	-	0.002	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.002	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mg/l as CaCO3	0.386	-	0.002	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	343000	-	30	1	-	-	-	-	402000	-	9700	1	-	-	-	-	461000	-	9700	1	-	-	-	-	693000	-	19400	1	-	-	-	-	414000	-	9700	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	36900	-	0.6	1	-	-	-	-	18600	-	200	1	-	-	-	-	22300	-	200	1	-	-	-	-	12400	-	200	1	-	-	-	-	760	-	200	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	0.16	1	-	-	-	-	**1100**	-	**54**	1	-	-	-	-	**120**	J	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	47100	-	4	10	-	-	-	-	82900	-	4000	20	-	-	-	-	36300	-	2000	10	-	-	-	-	212000	-	10000	50	-	-	-	-	67700	-	4000	20	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	0.5	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	0.5	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	0.5	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	ND	U	5	5	-	-	-	-	18600	-	1500	5	-	-	-	-	4300	J	1500	5	-	-	-	-	2100	J	1500	5	-	-	-	-	8200	-	1500	5	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	8000	-	1	1	-	-	-	-	37000	-	500	1	-	-	-	-	11000	-	500	1	-	-	-	-	17500	-	500	1	-	-	-	-	11900	-	500	1	-	-	-	-

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AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	8				8				8				8				8				8				8				8			
			Well Name	N-19				N-19				N-21				N-21				N-27				N-27				N-30				N-30				N-38D				N-38D			
			Sample ID	N-19_06272011				N-19_06272011 FILTERED				N-21_06292011				N-21_06292011 FILTERED				N-27_06282011				N-27_06282011 FILTERED				N-30_06282011				N-30_06282011 FILTERED				N-38D_06282011				N-38D_06282011 FILTERED			
			Sample Date	6/27/2011				6/27/2011				6/29/2011				6/29/2011				6/28/2011				6/28/2011				6/28/2011				6/28/2011				6/28/2011				6/28/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.0096	1	-	-	-	-	ND	U	0.029	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-	ND	U	0.0096	1	-	-	-	-	ND	U	0.0098	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Benzene	71-43-2	5	ug/l	ND	U	0.5	1	-	-	-	-	**110**	-	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	ND	U	0.5	1	-	-	-	-	64	-	2	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	2	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Semi-Volatile Organic Compounds																																												
Chrysene	218-01-9	1.9	ug/l	ND	U	1	1	-	-	-	-	ND	U	**5**	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	ND	U	1	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	1	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	ND	U	1	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	ND	U	1	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.9	1	-	-	-	-	ND	U	1	1	-	-	-	-
Metals																																												
Cobalt	7440-48-4	31	ug/l	3.5	J	0.62	1	ND	U	5	1	**228**	-	0.005	1	**228**	-	0.005	1	9.5	-	0.62	1	9.8	-	5	1	22.3	-	0.62	1	ND	U	5	1	3	J	0.62	1	ND	U	5	1
Iron	7439-89-6	NS	ug/l	27600	-	14.1	1	23500	-	200	1	526000	-	1	5	535000	-	1	5	1650	-	14.1	1	ND	U	200	1	56400	-	14.1	1	21900	-	200	1	28200	-	14.1	1	ND	U	200	1
Manganese	7439-96-5	300	ug/l	276	-	0.44	1	251	-	5	1	**4810**	-	0.005	1	**4830**	-	0.005	1	**5850**	-	0.44	1	**5850**	-	5	1	**380**	-	0.44	1	237	-	5	1	**445**	-	0.44	1	**340**	-	5	1
Arsenic	7440-38-2	10	ug/l	1	J	0.95	1	ND	U	2	1	**55.7**	-	0.002	1	**54**	-	0.002	1	ND	U	0.95	1	ND	U	2	1	5.3	-	0.95	1	ND	U	2	1	**12.5**	-	0.95	1	ND	U	2	1
Lead	7439-92-1	5	ug/l	2.8	-	0.08	1	ND	U	1	1	1.2	-	0.001	1	ND	U	0.001	1	0.32	J	0.08	1	ND	U	1	1	**42.4**	-	0.08	1	ND	U	1	1	**5.4**	-	0.08	1	ND	U	1	1
General Chemistry																																												
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	ND	U	0.002	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	ND	U	0.002	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	ND	U	0.002	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	386000	-	9700	1	-	-	-	-	7000000	-	240	1	-	-	-	-	635000	-	9700	1	-	-	-	-	468000	-	9700	1	-	-	-	-	860000	-	38800	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	ND	U	200	1	-	-	-	-	12900	-	0.6	1	-	-	-	-	740	-	200	1	-	-	-	-	420	J	200	1	-	-	-	-	88200	-	200	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	**54**	1	-	-	-	-	ND	U	0.16	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	87800	-	4000	20	-	-	-	-	83600	-	8	20	-	-	-	-	108000	-	4000	20	-	-	-	-	136000	-	10000	50	-	-	-	-	15600	-	1000	5	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	400	5	-	-	-	-	1200	-	0.5	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	250	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	920	-	250	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	400	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	23800	-	1500	5	-	-	-	-	5400000	-	500	500	-	-	-	-	192000	-	6000	20	-	-	-	-	148000	-	15000	50	-	-	-	-	7100	-	1500	5	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	4100	-	500	1	-	-	-	-	31700	-	1	1	-	-	-	-	3300	-	500	1	-	-	-	-	6000	-	500	1	-	-	-	-	40900	-	500	1	-	-	-	-

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - microgram per liter
mg/l - milligram per liter
MSC - PADEP's Medium Specific Concentration for Groundwater
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
Alkalanity is reported in mg/l rather than ug/l

Qualifiers:
Q - Lab Qualifier
U - The analyte was analyzed but not detected
E - The analyte exceeded the calibration range of the instrument
J - Compound detected but below the reporting limit (the value given is an estimate).

Exceedance Summary:

10	- Compound exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10	- Reporting Limit exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

Table 6
June-July 2011 Summary of Deep Groundwater Analyical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	8				8				8				8				8				8				8				9				9			
			Well Name	N-4				N-4				N-44D				N-44D				N-50D				N-50D				N-9				N-9				S-106DSRTF				S-106DSRTF			
			Sample ID	N-4_06272011				N-4_06272011 FILTERED				N-44D_06282011				N-44D_06282011 FILTERED				N-50D_06292011				N-50D_06292011 FILTERED				N-9_06272011				N-9_06272011 FILTERED				S-106DSRTF_06302011				S-106DSRTF_06302011 FILT.			
			Sample Date	6/27/2011				6/27/2011				6/28/2011				6/28/2011				6/29/2011				6/29/2011				6/27/2011				6/27/2011				6/30/2011				6/30/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.0096	1	-	-	-	-	ND	U	0.0098	1	-	-	-	-	ND	U	0.029	1	-	-	-	-	ND	U	0.0097	1	-	-	-	-	ND	U	0.0095	1	-	-	-	-
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	2	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Benzene	71-43-2	5	ug/l	ND	U	0.5	1	-	-	-	-	**7**	-	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	0.5	1	-	-	-	-	3	-	0.5	1	-	-	-	-	2	-	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Ethylbenzene	100-41-4	700	ug/l	ND	U	0.5	1	-	-	-	-	1	-	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Cumene	98-82-8	2300	ug/l	ND	U	0.5	1	-	-	-	-	9	-	0.5	1	-	-	-	-	14	-	2	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	2	-	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	**260**	-	0.5	1	-	-	-	-
Toluene	108-88-3	1000	ug/l	ND	U	0.5	1	-	-	-	-	0.6	J	0.5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1	-	-	-	-
Semi-Volatile Organic Compounds																																												
Chrysene	218-01-9	1.9	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	**5**	-	**5**	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Fluorene	86-73-7	1900	ug/l	ND	U	1	1	-	-	-	-	2	J	1	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Naphthalene	91-20-3	100	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Phenanthrene	85-01-8	1100	ug/l	ND	U	1	1	-	-	-	-	2	J	1	1	-	-	-	-	ND	U	5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Pyrene	129-00-0	130	ug/l	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-	8	-	5	1	-	-	-	-	ND	U	1	1	-	-	-	-	ND	U	1	1	-	-	-	-
Metals																																												
Cobalt	7440-48-4	31	ug/l	4.3	J	0.62	1	ND	U	5	1	ND	U	0.62	1	ND	U	5	1	13	-	0.005	1	ND	U	0.005	1	8.3	-	0.62	1	ND	U	5	1	9.4	-	0.62	1	10.2	-	5	1
Iron	7439-89-6	NS	ug/l	9310	-	14.1	1	361	-	200	1	36600	-	14.1	1	31100	-	200	1	71500	-	0.2	1	ND	U	0.2	1	11900	-	14.1	1	4170	-	200	1	29900	-	14.1	1	1710	-	200	1
Manganese	7439-96-5	300	ug/l	**2890**	-	0.44	1	**2750**	-	5	1	**598**	-	0.44	1	**605**	-	5	1	**1230**	-	0.005	1	**588**	-	0.005	1	**1900**	-	0.44	1	**1810**	-	5	1	**969**	-	0.44	1	**913**	-	5	1
Arsenic	7440-38-2	10	ug/l	ND	U	0.95	1	ND	U	2	1	**132**	-	0.95	1	**62.2**	-	2	1	**29.6**	-	0.002	1	ND	U	0.002	1	2.2	-	0.95	1	ND	U	2	1	5.1	-	0.95	1	ND	U	2	1
Lead	7439-92-1	5	ug/l	1.3	-	0.08	1	ND	U	1	1	0.75	J	0.08	1	ND	U	1	1	**576**	-	0.005	5	ND	U	0.001	1	**7.7**	-	0.08	1	ND	U	1	1	ND	U	0.08	1	ND	U	1	1
General Chemistry																																												
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	0.304	-	0.002	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.002	1	-	-	-	-	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	0.304	-	0.002	1	-	-	-	-	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	801000	-	19400	1	-	-	-	-	342000	-	9700	1	-	-	-	-	430000	-	30	1	-	-	-	-	639000	-	9700	1	-	-	-	-	511000	-	9700	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	ND	U	200	1	-	-	-	-	1100	-	200	1	-	-	-	-	2400	-	0.6	1	-	-	-	-	1500	-	200	1	-	-	-	-	16200	-	200	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	**54**	1	-	-	-	-	**1600**	-	**54**	1	-	-	-	-	ND	U	0.16	1	-	-	-	-	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	62600	-	4000	20	-	-	-	-	30000	-	2000	10	-	-	-	-	17200	-	2	5	-	-	-	-	67800	-	4000	20	-	-	-	-	48800	-	2000	10	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	0.5	5	-	-	-	-	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	85300	-	1500	5	-	-	-	-	17200	-	1500	5	-	-	-	-	8800	-	5	5	-	-	-	-	99400	-	6000	20	-	-	-	-	33000	-	1500	5	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	7800	-	500	1	-	-	-	-	53500	-	500	1	-	-	-	-	18400	-	1	1	-	-	-	-	3000	-	500	1	-	-	-	-	11200	-	500	1	-	-	-	-

Notes:
PADEP - Pennsylvania Department of Environmental Protection
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MSC - PADEP's Medium Specific Concentration for Groundwater
RL - Reporting Limit
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NA - Not Analyzed
Alkalanity is reported in mg/l rather than ug/l

Qualifiers:
Q - Lab Qualifier
U - The analyte was analyzed but not detected
E - The analyte exceeded the calibration range of the instrument
J - Compound detected but below the reporting limit (the value given is an estimate).

Exceedance Summary:

10	- Compound exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10	- Reporting Limit exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

Table 6
June-July 2011 Summary of Deep Groundwater Analyical Results
AOI 11
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Name	Cas No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	AOI	9				9				9				9				9				9				9			
			Well Name	S-120DSRTF				S-120DSRTF				S-74D1SRTF				S-74D1SRTF				S-74D2SRTF				S-74D2SRTF				S-76DSRTF			
			Sample ID	S-120DSRTF_06302011				S-120DSRTF_06302011 FILT.				S-74D1SRTF_063020 FILT.				S-74D1SRTF_06302011				S-74D2SRTF_06302011				S-74D2SRTF_06302011 FILT.				S-76DSRTF_06302011			
			Sample Date	6/30/2011				6/30/2011				6/30/2011				6/30/2011				6/30/2011				6/30/2011				6/30/2011			
			Sample Matrix	Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater				Groundwater			
			Unit	ug/l				ug/l				ug/l				ug/l				ug/l				ug/l				ug/l			
Volatile Organic Compounds				Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF	Result	Q	RL	DF
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.0095	1	-	-	-	-	-	-	-	-	ND	U	0.0095	1	ND	U	0.0095	1	-	-	-	-	ND	U	0.0094	1
1,2,4-Trimethylbenzene	95-63-6	53	ug/l	ND	U	0.5	1	-	-	-	-	-	-	-	-	ND	U	0.5	1	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	0.5	1	-	-	-	-	-	-	-	-	ND	U	0.5	1	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1
1,3,5-Trimethylbenzene	108-67-8	35	ug/l	ND	U	0.5	1	-	-	-	-	-	-	-	-	ND	U	0.5	1	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1
Benzene	71-43-2	5	ug/l	0.6	J	0.5	1	-	-	-	-	-	-	-	-	ND	U	0.5	1	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1
Xylene (Total)	1330-20-7	10000	ug/l	0.6	J	0.5	1	-	-	-	-	-	-	-	-	ND	U	0.5	1	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1
Ethylbenzene	100-41-4	700	ug/l	ND	U	0.5	1	-	-	-	-	-	-	-	-	ND	U	0.5	1	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1
Cumene	98-82-8	2300	ug/l	4	-	0.5	1	-	-	-	-	-	-	-	-	ND	U	0.5	1	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	**30**	-	0.5	1	-	-	-	-	-	-	-	-	2	-	0.5	1	0.6	J	0.5	1	-	-	-	-	3	-	0.5	1
Toluene	108-88-3	1000	ug/l	0.7	J	0.5	1	-	-	-	-	-	-	-	-	ND	U	0.5	1	ND	U	0.5	1	-	-	-	-	ND	U	0.5	1
Semi-Volatile Organic Compounds																															
Chrysene	218-01-9	1.9	ug/l	ND	U	1	1	-	-	-	-	-	-	-	-	ND	U	1	1	ND	U	0.9	1	-	-	-	-	ND	U	0.9	1
Fluorene	86-73-7	1900	ug/l	ND	U	1	1	-	-	-	-	-	-	-	-	ND	U	1	1	ND	U	0.9	1	-	-	-	-	ND	U	0.9	1
Naphthalene	91-20-3	100	ug/l	ND	U	1	1	-	-	-	-	-	-	-	-	ND	U	1	1	ND	U	0.9	1	-	-	-	-	ND	U	0.9	1
Phenanthrene	85-01-8	1100	ug/l	ND	U	1	1	-	-	-	-	-	-	-	-	ND	U	1	1	ND	U	0.9	1	-	-	-	-	ND	U	0.9	1
Pyrene	129-00-0	130	ug/l	ND	U	1	1	-	-	-	-	-	-	-	-	ND	U	1	1	ND	U	0.9	1	-	-	-	-	ND	U	0.9	1
Metals																															
Cobalt	7440-48-4	31	ug/l	4.8	J	0.62	1	ND	U	5	1	24.3	-	5	1	24.4	-	0.62	1	ND	U	0.62	1	ND	U	5	1	2.5	J	0.62	1	ND	U	5	1
Iron	7439-89-6	NS	ug/l	37800	-	14.1	1	ND	U	200	1	6360	-	200	1	39200	-	14.1	1	25700	-	14.1	1	529	-	200	1	1840	-	14.1	1	949	-	200	1
Manganese	7439-96-5	300	ug/l	**1890**	-	0.44	1	**1710**	-	5	1	177	-	5	1	171	-	0.44	1	268	-	0.44	1	253	-	5	1	**3470**	-	0.44	1	**3540**	-	5	1
Arsenic	7440-38-2	10	ug/l	9.2	-	0.95	1	ND	U	2	1	ND	U	2	1	**18.8**	-	0.95	1	4.1	-	0.95	1	ND	U	2	1	ND	U	0.95	1	ND	U	2	1
Lead	7439-92-1	5	ug/l	**14**	-	0.08	1	ND	U	1	1	ND	U	1	1	ND	U	0.08	1	0.82	J	0.08	1	ND	U	1	1	0.49	J	0.08	1	ND	U	1	1
General Chemistry																															
Alkalinity to pH 4.5	ALK4.5	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	-	-	-	-	100000	-	460	1	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Alkalinity to pH 8.3	ALK8.3	NS	mg/l as CaCO3	ND	U	0.46	1	-	-	-	-	-	-	-	-	ND	U	460	1	ND	U	0.46	1	-	-	-	-	ND	U	0.46	1	-	-	-	-
Bicarbonate Alkalinity	ALKB	NS	mg/l as CaCO3	100000	-	0.46	1	-	-	-	-	-	-	-	-	100000	-	460	1	100000	-	0.46	1	-	-	-	-	100000	-	0.46	1	-	-	-	-
Total Dissolved Solids	TDS	NS	ug/l	394000	-	9700	1	-	-	-	-	-	-	-	-	313000	-	9700	1	594000	-	19400	1	-	-	-	-	268000	-	9700	1	-	-	-	-
Ammonia Nitrogen	7664-41-7	NS	ug/l	20300	-	200	1	-	-	-	-	-	-	-	-	26200	-	200	1	16800	-	200	1	-	-	-	-	4800	-	200	1	-	-	-	-
Sulfide	18496-25-8	5	ug/l	ND	U	**54**	1	-	-	-	-	-	-	-	-	ND	U	**54**	1	ND	U	**54**	1	-	-	-	-	ND	U	**54**	1	-	-	-	-
Chloride	16887-00-6	NS	ug/l	24300	-	2000	10	-	-	-	-	-	-	-	-	45600	-	2000	10	36500	-	2000	10	-	-	-	-	33400	-	2000	10	-	-	-	-
Fluoride	16984-48-8	4000	ug/l	ND	U	400	5	-	-	-	-	-	-	-	-	ND	U	400	5	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Nitrate Nitrogen	14797-55-8	10000	ug/l	ND	U	250	5	-	-	-	-	-	-	-	-	ND	U	250	5	ND	U	250	5	-	-	-	-	ND	U	250	5	-	-	-	-
Nitirite Nitrogen	14797-65-0	1000	ug/l	ND	U	400	5	-	-	-	-	-	-	-	-	ND	U	400	5	ND	U	400	5	-	-	-	-	ND	U	400	5	-	-	-	-
Sulfate	14808-79-8	NS	ug/l	1800	J	1500	5	-	-	-	-	-	-	-	-	ND	U	1500	5	1800	J	1500	5	-	-	-	-	4600	J	1500	5	-	-	-	-
Total Organic Carbon	TOC	NS	ug/l	12900	-	500	1	-	-	-	-	-	-	-	-	8200	-	500	1	7400	-	500	1	-	-	-	-	2400	-	500	1	-	-	-	-

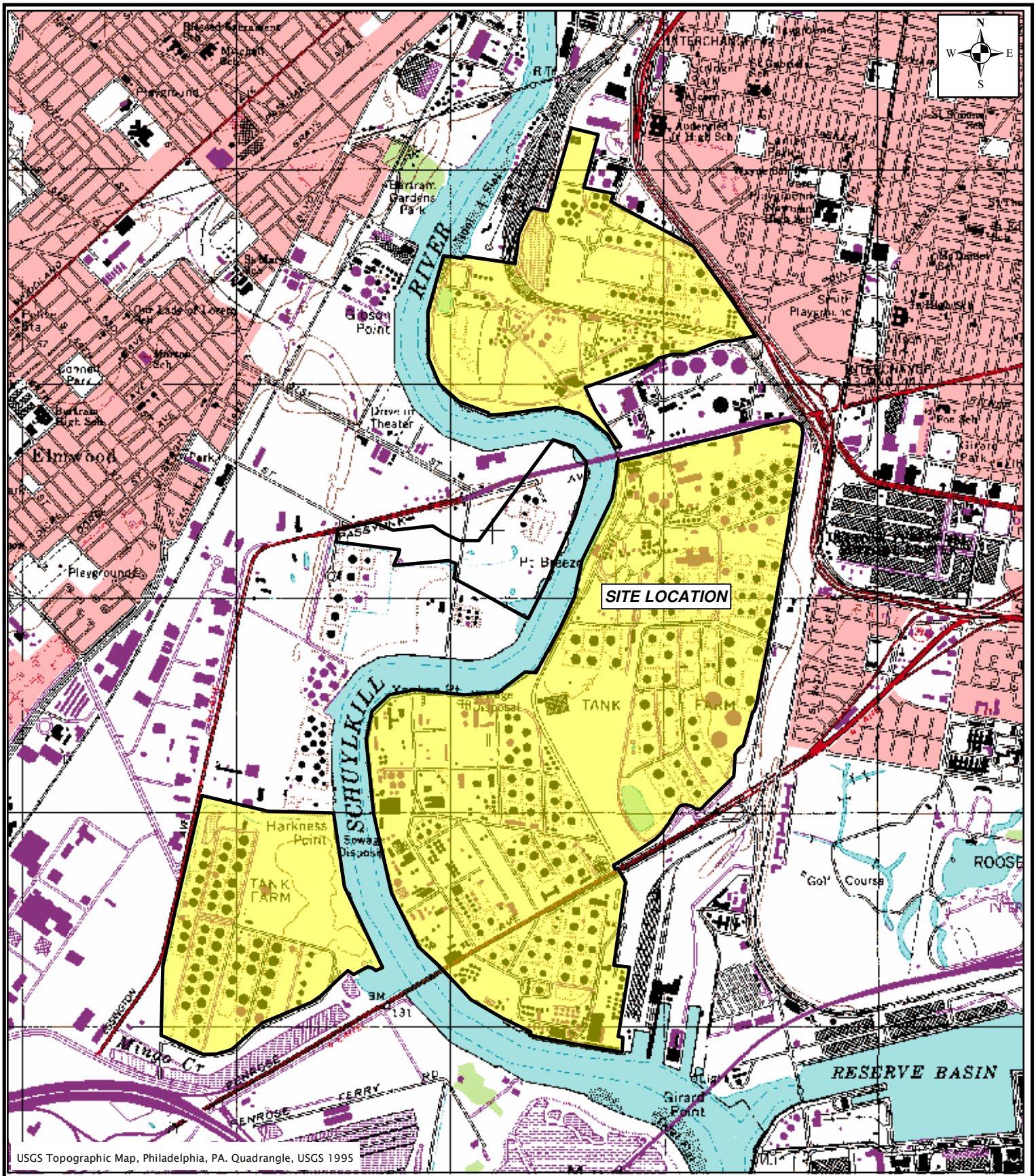
Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - microgram per liter
mg/l - milligram per liter
MSC - PADEP's Medium Specific Concentration for Groundwater
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
Alkalanity is reported in mg/l rather than ug/l

Qualifiers:
Q - Lab Qualifier
U - The analyte was analyzed but not detected
E - The analyte exceeded the calibration range of the instrument
J - Compound detected but below the reporting limit (the value given is an estimate).

Exceedance Summary:

10	- Compound exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10	- Reporting Limit exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

FIGURES



USGS Topographic Map, Philadelphia, PA. Quadrangle, USGS 1995

Sunoco, Inc. (R&M)

Philadelphia Refinery

3144 Passyunk Avenue
Philadelphia, PA. 19145

Figure 1: Site Location Map
AOI-11 Deep Aquifer
Sunoco Philadelphia Refinery

Philadelphia Pennsylvania

Job Number	Scale: 1" = 2000'	Date
2574601	0 1,000 2,000 Feet	August 22, 2011

Path: \\langan.com\data\DT\data6\2574601\ArcGIS\MapDocuments\AOI 11 SCR\Figure 1 - Site Location Map.mxd

AOI-8
AOI -10
AOI-2
AOI-1
AOI-11
AOI-3
AOI-4
AOI-7
AOI-6
AOI-9
AOI-5
LANDS CREEK
SCHUYLKILL RIVER
MINGO CREEK
FLOOD CONTROL BASIN

Notes:
1. Bings Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.

Legend

- AOI -11: Deep (Lower Sand) Aquifer
- AOI-1: Belmont Terminal/No.1 Tank Farm/No.2 Tank Farm
- AOI-2: Point Breeze Processing Area
- AOI-3: Impoundment Area
- AOI-4: No. 4 Tank Farm Area
- AOI-5: Girard Point South Tank Field Area
- AOI-6: Girard Point Chemical Processing Area
- AOI-7: Girard Point Fuels Processing Area
- AOI-8: Point Breeze Process Area North Yard
- AOI-9: Schuylkill River Tank Farm
- AOI -10: Point Breeze Processing Area West Yard

N W E S

Figure 2: Area of Interest Site Plan
AOI-11 Site Characterization/
Remedial Investigation Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Sunoco, Inc. (R&M)
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA.
19145

0 250 500 1,000 Feet

SCALE: 1" = 500'
DATE: November 23, 2010
DRN. BY: MH
CKD. BY: DW
JOB#: 2574601

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N-4
N-9
N-13
N-38D
N-19
N-21
N-27
N-30
N-44D
N-46D
N-50D
AOI-8
AOI -10
SCHUYLKILL RIVER
S-294D
S-72D
S-80D
AOI-2
AOI-1
S-302D
S-305D
S-46D
S-59D
S-264
S-280D
S-119D
AOI-4
C-129D
S-284D
C-65D
C-144D
S-69D
AOI-3
BF-108
C-50D
AOI-7
S-38D
S-38D2
BF-90D
S-13
S-22
S-8
S-6
C-134D
AOI-6
B-48D
A-19D
S-76DSRTF
B-134D
B-133D
AOI-9
S-74D2SRTF
S-74D1SRTF
B-132D
AOI-5
A-21D
A-13D
S-120DSRTF
S-106DSRTF

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.

PENNSYLVANIA

Approximate Site Location

Legend

BF-108 — Deep Groundwater Monitoring Well

S-6 — Abandoned or Damaged Monitoring Well

Area of Interest (AOI)

Figure 3: Deep Monitoring Well Location Plan
AOI-11 Site Characterization/
Remedial Investigation Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Sunoco, Inc. (R&M)
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA.
19145

0 250 500 1,000 Feet

SCALE: 1" = 500'
DATE: August 22, 2011
DRN. BY: MH
CKD. BY: DW
JOB#: 2574601

Path: \\langan.com\data\DT\data6\2574601\ArcGIS\MapDocuments\AOI 11 SCR\Figure 3 - Sitewide Deep Wells.mxd

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AOI-8
AOI -10
AOI-2
AOI-1
AOI-4
AOI-3
AOI-7
AOI-6
AOI-5
AOI-9

SCHUYLKILL RIVER

N-4 7.15
N-9 5.68
N-13 4.88
N-38D 0.85
N-21 3.72
N-19 3.18
N-27 2.51
N-30 3.77
N-44D 4.15
N-46D
N-50D 4.25
S-294D 2.41
S-72D 2.38
S-80D 1.82
S-302D 1.7
S-305D 0.47
S-46D 1.06
S-59D
S-264 0.53
S-280D 0.51
S-119D 0.41
C-129D 0.13
S-284D 0.37
C-65D
C-144D -4.16
S-69D -0.15
BF-108
C-50D -0.16
S-38D -0.52
S-38D2 -0.7
BF-90D -0.44
S-13
S-22 -0.73
S-8 -1.72
S-6
C-134D -1.43
B-48D -1.64
A-19D -1.89
S-76DSRTF -6.4
B-134D -2.91
B-133D -1.59
S-74D2SRTF -5.03
S-74D1SRTF -6.6
B-132D -4.96
A-21D -5.31
A-13D -2.15
S-120DSRTF -7
S-106DSRTF -7.17

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1
1
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-7
-7

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.
2. Deep groundwater elevations provided by Aquaterra, June/July 2011.

PENNSYLVANIA

Approximate Site Location

Legend

S-119D 0.41 — Deep Groundwater Monitoring Well and Groundwater Elevation

N-46D — Damaged/Abandoned/Unable to Locate

Deep Groundwater Contour

Area of Interest (AOI)

N-30 3.77 — Wells omitted from contouring

Figure 4 - Deep Groundwater Elevation Contour Plan - June/July 2011
AOI-11 Site Characterizaton/ Remedial Investigation Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Sunoco, Inc. (R&M)
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA.
19145

0 250 500 1,000 Feet

SCALE: 1" = 500'
DATE: November 24, 2010
DRN. BY: MH
CKD. BY: DW
JOB#: 2574601

Path: \\langan.com\data\DT\data6\2574601\ArcGIS\MapDocuments\AOI 11\Workplan\Figure 4 - July 2011 Deep GW Contours_9-8-11.mxd

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N-21				
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	7/23/2008 Result (ug/L)	4/6/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Volatile Organic Compounds (VOCs)				
Benzene	5	**16**	**20**	**110**

N-4				
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	7/15/2008 Result (ug/L)	4/6/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Volatile Organic Compounds (VOCs)				
Benzene	5	**5**	ND	ND

N-9				
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	7/16/2008 Result (ug/L)	4/6/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Volatile Organic Compounds (VOCs)				
Benzene	5	**8**	ND	ND

N-44D				
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	7/25/2008 Result (ug/L)	4/5/2011 Result (ug/L)	6/28/2011 Result (ug/L)
Volatile Organic Compounds (VOCs)				
Benzene	5	**6**	**10**	**7**

N-50D				
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	7/23/2008 Result (ug/L)	4/5/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Volatile Organic Compounds (VOCs)				
Chrysene	1.9	ND	**2**	**5**

S-294D				
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	7/23/2010 Result (ug/L)	4/6/2011 Result (ug/L)	6/28/2011 Result (ug/L)
Semi-Volatile Organic Compounds (SVOCs)				
Naphthalene	100	**140**	ND	ND

BF-108				
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	7/22/2010 Result (ug/L)	4/7/2011 Result (ug/L)	7/5/2011 Result (ug/L)
Volatile Organic Compounds (VOCs)				
Methyl Tertiary Butyl Ether	20	**120**	**55**	ND

S-38D2				
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	5/3/2010 Result (ug/L)	4/7/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Volatile Organic Compounds (VOCs)				
Benzene	5	ND	ND	**110**

S-22				
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	7/16/2010 Result (ug/L)	4/7/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Volatile Organic Compounds (VOCs)				
Benzene	5	**6**	**20**	**28**
Methyl Tertiary Butyl Ether	20	**48**	**75**	**49**

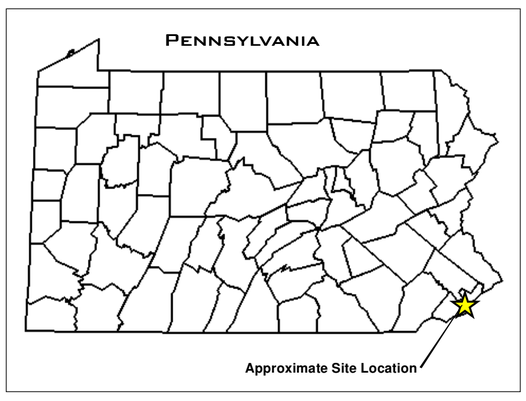
S-8				
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	7/21/2010 Result (ug/L)	4/7/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Volatile Organic Compounds (VOCs)				
Methyl Tertiary Butyl Ether	20	1	**30**	8

A-19D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/11/2011 Result (ug/L)	7/1/2011 Result (ug/L)
Volatile Organic Compounds (VOCs)			
Methyl Tertiary Butyl Ether	20	**43**	**40**

S-120DSRTF				
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	8/12/2009 Result (ug/L)	4/8/2011 Result (ug/L)	6/30/2011 Result (ug/L)
Volatile Organic Compounds (VOCs)				
Methyl Tertiary Butyl Ether	20	**21**	**37**	**30**

S-106DSRTF				
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	8/12/2009 Result (ug/L)	4/8/2011 Result (ug/L)	6/30/2011 Result (ug/L)
Volatile Organic Compounds (VOCs)				
Methyl Tertiary Butyl Ether	20	**98**	**300**	**260**

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.



Legend

- BF-108 — Deep Groundwater Monitoring Well with no exceedances of PADEP Non-Res groundwater MSC's
- S-294D — Deep Groundwater Monitoring Well with exceedances of PADEP Non-Res groundwater MSC's
- S-6 — Abandoned or Damaged Monitoring Well
- Deep Groundwater Contours (June/July 2011)
- Area of Interest (AOI)

Figure 5: Summary Volatile and Semi-Volatile Exceedances in Deep Groundwater - 2005-2010, April/June-July 2011
AOI-11 Site Characterization
Remedial Investigation Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Sunoco, Inc. (R&M)
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA.
19145

0 275 550 1,100 Feet

SCALE: 1" = 550'
DATE: August 22, 2011
DRN. BY: MH
CKD. BY: DW
JOB#: 2574601

Path: \\langan.com\data\DT\data6\2574601\ArcGIS\MapDocuments\AOI 11 SCR\Figure 5 - GW VOC SVOC Exceedances with 2011 Contours.mxd

N

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N-4			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/6/2011 Result (ug/L)	6/27/2011 Result (ug/L)
Metals			
Manganese	300	**2850**	**2750**

N-13			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/6/2011 Result (ug/L)	6/27/2011 Result (ug/L)
Metals			
Manganese	300	**1370**	**1370**

N-9			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/5/2011 Result (ug/L)	6/27/2011 Result (ug/L)
Metals			
Manganese	300	155	**1810**

N-38D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/6/2011 Result (ug/L)	6/28/2011 Result (ug/L)
Metals			
Manganese	300	**356**	**340**

N-19			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/5/2011 Result (ug/L)	6/27/2011 Result (ug/L)
Metals			
Manganese	300	**484**	251

N-21			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/6/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Metals			
Cobalt	31	**36.1**	**228**
Manganese	300	**606**	**4830**
Arsenic	10	4.3	**54**

N-44D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/5/2011 Result (ug/L)	6/28/2011 Result (ug/L)
Metals			
Manganese	300	**486**	**605**
Arsenic	10	**55.1**	**62.2**

N-27			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/5/2011 Result (ug/L)	6/28/2011 Result (ug/L)
Metals			
Manganese	300	**5930**	**5850**

N-50D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/5/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Metals			
Manganese	300	**1000**	**588**

S-294D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/6/2011 Result (ug/L)	6/28/2011 Result (ug/L)
Metals			
Manganese	300	**8210**	**8390**

S-72D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/7/2011 Result (ug/L)	6/28/2011 Result (ug/L)
Metals			
Manganese	300	**4020**	**3770**

S-80D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/6/2011 Result (ug/L)	6/28/2011 Result (ug/L)
Metals			
Manganese	300	**11800**	**11900**

S-302D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/7/2011 Result (ug/L)	6/28/2011 Result (ug/L)
Metals			
Manganese	300	**4140**	**3930**

S-46D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/6/2011 Result (ug/L)	6/28/2011 Result (ug/L)
Metals			
Manganese	300	**16400**	**20500**
Arsenic	10	**34.6**	**11.1**

S-264			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/6/2011 Result (ug/L)	6/28/2011 Result (ug/L)
Metals			
Cobalt	31	29	**35.7**
Manganese	300	**7420**	**8580**

S-305D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/6/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Metals			
Manganese	300	**1840**	**2160**
Arsenic	10	**39.6**	**51.9**

S-59D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/7/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Metals			
Manganese	300	**2910**	**2440**
Arsenic	10	**13.3**	**13.2**

S-280D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/7/2011 Result (ug/L)	6/28/2011 Result (ug/L)
Metals			
Manganese	300	**694**	**661**

C-144D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/8/2011 Result (ug/L)	7/5/2011 Result (ug/L)
Metals			
Manganese	300	**2890**	**1490**

S-284D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/7/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Metals			
Manganese	300	**979**	**922**

C-50D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/8/2011 Result (ug/L)	7/5/2011 Result (ug/L)
Metals			
Manganese	300	**2890**	**2970**

S-69D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/7/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Metals			
Manganese	300	**2940**	**2730**

B-48D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/8/2011 Result (ug/L)	7/1/2011 Result (ug/L)
Metals			
Manganese	300	**2050**	**1890**

BF-108			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/7/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Metals			
Manganese	300	**1070**	262

S-38D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/7/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Metals			
Manganese	300	ND	**430**

S-38D2			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/7/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Metals			
Manganese	300	**6730**	**6410**

S-8			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/7/2011 Result (ug/L)	6/29/2011 Result (ug/L)
Metals			
Manganese	300	**1140**	**368**

BF-90D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/7/2011 Result (ug/L)	7/5/2011 Result (ug/L)
Metals			
Manganese	300	167	**351**

A-13D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/11/2011 Result (ug/L)	7/1/2011 Result (ug/L)
Metals			
Manganese	300	**709**	**621**

S-76DSRTF			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/8/2011 Result (ug/L)	6/30/2011 Result (ug/L)
Metals			
Manganese	300	**3900**	**3540**

A-21D			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/11/2011 Result (ug/L)	7/1/2011 Result (ug/L)
Metals			
Manganese	300	**708**	**611**

S-120DSRTF			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/8/2011 Result (ug/L)	6/30/2011 Result (ug/L)
Metals			
Manganese	300	**1720**	**1710**

S-106DSRTF			
Chemical Name	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	4/8/2011 Result (ug/L)	6/30/2011 Result (ug/L)
Metals			
Manganese	300	**1030**	**913**

AOI-8
AOI -10
AOI-2
AOI-1
AOI-4
AOI-3
AOI-7
AOI-6
AOI-9
AOI-5

SCHUYLKILL RIVER

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.
2. Results based on dissolved metal values.

PENNSYLVANIA

Approximate Site Location

Legend

- BF-108 — Deep Groundwater Monitoring Well with no exceedances of PADEP Non-Res groundwater MSC's
- BF-108 — Deep Groundwater Monitoring Well with exceedances of PADEP Non-Res groundwater MSC's
- S-6 — Abandoned or Damaged Monitoring Well
- Deep Groundwater Contours (June/July 2011)
- Area of Interest (AOI)

Figure 6: Summary Metal Exceedances in Deep Groundwater - April/June-July 2011
AOI-11 Site Characterization/ Remedial Investigation Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Sunoco, Inc. (R&M)
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA.
19145

0 285 570 1,140 Feet

SCALE: 1" = 570'
DATE: August 22, 2011
DRN. BY: MH
CKD. BY: DW
JOB#: 2574601

N
W
E
S

N-4
N-9
N-13
N-38D
N-19
N-21
N-27
N-30
N-44D
N-46D
N-50D
S-294D
S-72D
S-80D
S-302D
S-305D
S-46D
S-59D
S-264
S-280D
S-119D
S-284D
S-69D
BF-108
C-50D
C-129D
C-65D
C-144D
S-38D
S-38D2
BF-90D
S-13
S-22
S-8
S-6
C-134D
B-48D
A-19D
S-76DSRTF
S-74D2SRTF
S-74D1SRTF
S-120DSRTF
S-106DSRTF
B-134D
B-133D
B-132D
A-21D
A-13D

Absent
Absent
Clay
Alluvium
Alluvium
Alluvium
Clay
Clay
Absent/ Interfingering
Clay
Clay
Deep Well Data Gap
Clay
Deep Well Data Gap
Deep Well Data Gap

AOI-3
AOI -10
AOI-2
AOI-1
AOI-4
AOI-7
AOI-6
AOI-9
AOI-5

SCHUYLKILL RIVER

1,000 ug/L
300 ug/L
10,000 ug/L
1,000 ug/L
300 ug/L
300 ug/L
1,000 ug/L
300 ug/L
300 ug/L

1 2 3 4 4 3
1 2 3 4 5 6 7
7 6 5 4
2 1
2 1
0 -1 -2 -3 -4
0 -1
-7 -6 -5 -5 -6 -7
-5 -5 -4 -3 -2

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.

PENNSYLVANIA
Approximate Site Location

BF-108 Deep Groundwater Monitoring Well with no exceedances of PADEP Non-Res groundwater MSC's
S-294D Deep Groundwater Monitoring Well with exceedances of PADEP Non-Res groundwater MSC's
S-6 Abandoned or Damaged Monitoring Well
Deep Groundwater Contours (June/July 2011)
Sheetpile/Bulkhead
Area of Interest (AOI)

Legend

Alluvium Present to Depth No Clay Present
Clay
AOIs

Manganese Isoconcentrations (ug/L)
300
1,000
10,000

Figure 7: AOI-11 Conceptual Model Drawing
AOI-11 Site Characterization/
Remedial Investigation Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Sunoco, Inc. (R&M)
Philadelphia Refinery
3144 Passyunk Avenue
Philadelphia, PA.
19145

0 250 500 1,000 Feet

SCALE: 1" = 500'
DATE: August 22, 2011
DRN. BY: MH
CKD. BY: DW
JOB#: 2574601

Path: \\langan.com\data\DT\data6\2574601\ArcGIS\MapDocuments\AOI 11 SCR\Figure 7 - Conceptual Model Drawing_rev9-8-11.mxd