# SITE CHARACTERIZATION/REMEDIAL INVESTIGATION REPORT AOI 8

## SUNOCO, INC. (R&M)
## PHILADELPHIA REFINERY
## PHILADELPHIA, PENNSYLVANIA


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**January 31, 2012**
**2574601**

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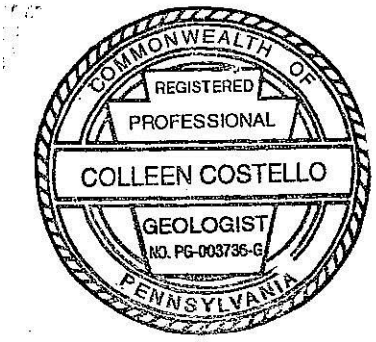


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## 1.0 INTRODUCTION

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 eleven AOIs (AOIs 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11). For each AOI that has been characterized, Sunoco has 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.

Sunoco submitted a Site Characterization Work Plan (Work Plan) for AOI 8 on May 16, 2008 to the PADEP and United States Environmental Protection Agency (EPA). This Work Plan summarized proposed activities to be completed to characterize AOI 8 in accordance with the objectives of the CCR. The Work Plan also included proposed activities to characterize the Resource, Conservation and Recovery Act (RCRA) Solid Waste Management Unit (SWMU) in AOI 8. The Work Plan was implemented between May and August 2008 and the results were summarized in a SCR submitted to PADEP and EPA on September 30, 2008. A PADEP technical response comment letter, dated November 14, 2008, was received by Sunoco in response to the SCR. In 2009, additional site characterization work was performed to address PADEP comments in the November 14, 2008 comment letter.

This report is a combined Site Characterization/Remedial Investigation Report (SCR/RIR) which summarizes the site characterization work completed in 2008 and 2009. This SCR/RIR is being submitted to the PADEP and EPA in accordance with the provisions of Pennsylvania's Land Recycling and Environmental Remediation Standards Act (Act 2).

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

### 1.1 Site Description

The Sunoco Philadelphia Refinery is located in southwest Philadelphia. AOI 8 is the northern most area of the refinery and is known as the Point Breeze Process Area North Yard. AOI 8 is bound by the Philadelphia Gas Works (PGW) property to the south, the Schuylkill River to the west, industrial properties to the north, and urban streets to the east (Figures 1 and 2), and encompasses approximately 250 acres.

### 1.2 Site History

The facility has a long history of petroleum transportation, storage, and processing. The oldest portion of the facility started petroleum related activities in the 1860's, when the Atlantic Refining Company was established as an oil distribution center. In the 1900's, 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 site 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 historic uses of AOI 8 are described on figures provided in Appendix B.

AOI 8 was an active refinery process area since the early twentieth century with process areas and above ground storage tanks (ASTs). The area also included the former lube, asphalt, soap, and wax plants. The majority of AOI 8 structures were demolished between 1975 and 1980. Subsequent to decommissioning of the process areas, a Land Treatment Unit ("LTU") was operated from 1986 through 2000. Currently, the only remaining active facilities in AOI 8 are the asphalt dock, the boiler house, a storm water separator, fuel oil storage, butane and propane storage area, and loading and unloading facilities. Much of AOI 8 is unimproved and many of the ASTs have been demolished. The majority of the land surface in AOI 8 is not covered by impervious surfaces.

### 1.3 Selection of Compounds of Concern and Applicable Standards

The COCs for soil and groundwater are listed in Table 1 of this report. The COCs for the ongoing and proposed investigation activities include the 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. These COCs are the same as those listed in the CCR. In May 2009, Sunoco included two additional COCs 1,2,4-trimethylbenze and 1,3,5-trimethylbenzene. These two compounds were added to the list of COCs by Sunoco based on the PADEP's revisions to the petroleum short list of compounds at the request of the PADEP, but are not part of the COC lists for soil and groundwater in AOI 8 because the site characterization work in AOI 8 was performed prior to these chemicals being added to the list.

Media of Concern

The media of concern for AOI 8 include groundwater and soil. The potential indoor air quality and off-site vapor migration exposure pathways were evaluated through the PADEP's vapor intrusion guidance. Surface water was evaluated as a receptor in relation to facility activities.

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.

Shallow Soil – 0 to 2 Feet Interval

Shallow (0-2 feet) soil samples were collected at each soil boring/monitoring well location that represents a potential complete direct contact exposure pathway to site workers (e.g., unpaved areas). These shallow soil results were screened against the PADEP non-residential soil MSCs. Where constituent concentrations are above the PADEP non-residential soil MSCs, Sunoco evaluated application of the site-specific remediation standard using either the pathway elimination or calculated risk-based standard options.

Soil – 2 to 15 Feet Interval

A site-specific remediation standard using the pathway elimination option was applied for soil between 2 and 15 feet beneath the ground surface within the boundaries of AOI 8 based on Sunoco's existing permit program governing excavations. This permit program serves as an institutional control that prevents potential exposure to impacted soils greater than two feet beneath the ground surface. Soil at this depth is evaluated through the groundwater data.

Vapor Intrusion into Indoor Air

For the current occupied buildings in AOI 8 as depicted on Figure 2, groundwater is less than five feet below the ground surface; therefore, the PA DEP USEPA-PA Default Non-Residential Permissible Exposure Limit (PEL) for Volatilization to Indoor Air for soil and groundwater screening criteria in the PADEP's guidance could not be used. As part of the Cleanup Plan for AOI 8, further evaluation (i.e., soil gas samples) will be necessary to assess the impact to indoor air. Because the site specific standard is being used for the Facility, groundwater within some portions of AOI 8 is shallower than five feet, underground utilities exist and sampling was not completed below areas with impervious covers, Sunoco will place a restriction in the Uniform Environmental Covenants Act (UECA covenant) for AOI 8 that will require further vapor site characterization activities and/or installation of a vapor mitigation systems for any new occupied buildings that will be constructed within AOI 8.

## 1.4 Overview of Investigative Framework and Remedial Approach for AOI 8

The current remediation program for the refinery is performed under the 2003 CO&A between PADEP and Sunoco. Below is a general summary of the regulatory frame work for the refinery:

- In April 2004, the PADEP and EPA signed an agreement entitled "One Cleanup Program Memorandum of Agreement (MOA or 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.
- In 2005, PADEP, EPA, and Sunoco 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.

- In October 2006, Sunoco submitted a notice of intent to remediate (NIR) to the PADEP for the refinery entering the refinery into the Act 2 program, excluding the Belmont Terminal. A copy of this NIR and the Act 2 report notifications for this SCR/RIR/Cleanup Plan are included in Appendix A.
- In September 2007, Sunoco held a public involvement meeting in South Philadelphia, Pennsylvania.
- On November 8, 2011, the EPA provided an acknowledgment letter to Sunoco formerly accepting the Sunoco Philadelphia Refinery into the One Clean Up Program. EPA acknowledges that Sunoco is currently operating under the one EPA ID Number (PAD049791098) for Point Breeze, Girard Point and Schuylkill River Tank Farm. 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.
- On November 30, 2011, Sunoco submitted a revised *Work Plan for Sitewide 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. With this work plan Sunoco submitted a letter of commitment stating Sunoco will remediate the Philadelphia refinery site according to the Work Plan for Sitewide Approach.

### *1.4.1 Overview of the Land Farm Treatment Unit (LTU) in AOI 8*

The LTU is located in the northwestern portion of AOI 8 and encompasses approximately 20 acres. RCRA closure of the LTU was completed in 2005 and the unit is currently undergoing RCRA Closure and Post-Closure monitoring activities in accordance with a separate 1996 CO&A. Therefore, no characterization work was undertaken at the LTU as part of this site characterization. A description of the LTU is included in the Amended Post-Closure Plan (original dated November 1988 and amended May 2004).

## 2.0 ENVIRONMENTAL SETTING

AOI 8 is located in the northern most portion of the refinery and is also known as the North Yard. AOI 8 is bound by the PGW property to the south, the Schuylkill River to the west, industrial properties to the north and urban streets to the east (Figures 1 and 2). AOI 8 encompasses approximately 250 acres.

### 2.1 Historic and Current Use

AOI 8 was an active refinery process area since the early twentieth century with significant process areas and ASTs. The area also included the former lube, asphalt, soap, and wax plants. The majority of AOI 8 structures were demolished between 1975 and 1980. Subsequent to decommissioning of the process areas, the LTU was operated from 1986 through 2000.

Currently, the only remaining active facilities in AOI 8 are the asphalt dock, the boiler house, a storm water separator, fuel oil storage, butane and propane storage area, and loading and unloading facilities. Much of AOI 8 is unimproved and many of the ASTs have been removed. The majority of the land surface in AOI 8 is not covered by impervious surfaces.

Sheet pile and wooden bulkheads exist along the Schuylkill River as shown in Figure 2. The bulkheads extend along the Schuylkill River from the storm water separator south towards and including the active asphalt loading dock in the southwestern portion of AOI 8. The wooden portion of the bulkhead was constructed in the early 1930s and starts just south of the AOI 8 storm water separator and extends approximately 2,460 feet downstream. The southern 940 feet of the bulkhead is of newer steel sheet piling construction.

The 1991 RFI identified one SWMU in AOI 8 that required further characterization. This SWMU was identified as SWMU 2 containing leaded tank bottoms sludge and is located in the southwestern portion of AOI 8. This SWMU area was characterized during the site characterization activities and is described in further detail in Section 3.0 below.

The existing monitoring well network in AOI 8 includes a total of 174 monitoring points as listed in Table 2. This network includes those monitoring wells that were installed as part of the 2008 site characterization effort. The monitoring wells in AOI 8 are summarized in Table 2 and the remedial systems in AOI 8 are discussed in detail in Section 5.0. Sunoco samples select monitoring wells in AOI 8 for site COCs established in the CCR on an annual basis. Groundwater gauging of select monitoring wells in AOI 8 also occurs on an annual basis during the fourth quarter of each year. Annual gauging activities and groundwater results are reported to the PADEP and EPA in Quarterly Reports prepared by Sunoco.

Institutional controls (i.e. permits governing excavation, Occupation Safety and Health Administration (OSHA) restrictions, etc.) apply to AOI 8. These institutional controls limit exposure to hazardous site compounds of concern (COCs) as listed in Table 1. Prior to any work being completed within AOI 8, appropriate work permits, safety and security measures, etc. must be approved by refinery personnel. Operating areas of AOI 8 are located within a secured area to prevent unauthorized access. Direct contact to site soils (soils greater than two feet beneath the ground surface) is governed by Sunoco's on-site procedures and personal protective equipment (PPE).

## 2.2 Geology

To further characterize geology at AOI 8, Sunoco advanced 39 shallow and intermediate monitoring wells. Four deep soil borings were advanced to the top of bedrock. Each shallow, intermediate and deep boring was continually logged by a field geologist. To illustrate the geology at AOI 8, three geologic cross sections were prepared and are provided as Figures 5a, 5b and 5c in this report. The geologic cross section location lines are shown in Figure 4.

The following paragraphs describe the primary geologic units beneath AOI 8 beginning with the deepest units to the shallowest units.

***Wissahickon Formation*** – Bedrock beneath the refinery and AOI 8 is identified as the Wissahickon Schist. This formation is a metamorphosed greenish-gray micaceous schist and quartzite. The competent bedrock of the Wissahickon Formation is overlain by weathered bedrock consisting of micaceous clay, which becomes increasingly sandy as the degree of weathering lessens and competent bedrock is encountered. Based on

deep monitoring well and soil borings completed in AOI 8, the Wissahickon Schist ranges between approximately 40 feet beneath the ground surface in the northern portion of AOI 8 to approximately 70 feet beneath the ground surface in the southern portion. This range in bedrock depth is illustrated in Figure 5c.

***Lower Sand Unit of the PRM*** – Throughout the majority of the refinery, the Wissahickon Formation is overlain by the Lower Sand, which is the lowest member of the Potomac-Raritan Magothy (PRM) Aquifer System. As shown in Figures 5a through 5c, the Lower Sand overlies bedrock in the eastern and central portions of AOI 8, but is absent in the northwestern and western portions where it has been eroded and replaced with alluvium.

The Lower Sand beneath AOI 8 is a green, brown, orange and/or red, fine gravel and course sand that grades upward into medium-to-fine sands and contains layers of silts and clay. The Lower/Middle Clay overlies the Lower Sand in the central and eastern portions of AOI 8 as shown in Figures 5a and 5b. As shown in Figures 5a through 5c, in the western and northwestern portions AOI 8, the Lower Sand is overlain by either alluvium or Trenton Gravel and the Lower/Middle Clay is absent. Where present at AOI 8, the Lower Sand ranges in thickness between 7 to 63 feet.

Fourteen deep (Lower Sand) groundwater monitoring wells existed in AOI 8 when the AOI 8 Work Plan was prepared. These monitoring wells included N-13, N-19, N-21, N-27, N-30, N-38D, N-4, N-43, N-46D, N-50D, N-69, N-79, N-83, and N-9. Using the geologic information gathered in AOI 8 as part of the characterization activities, the classification of the 14 monitoring wells were re-evaluated considering known geology and monitoring well construction. Based on this evaluation, three of these monitoring wells (N-69, N-79 and N-83) are not screened in the Lower Sand and therefore have been re-classified as intermediate monitoring wells.

***Middle/Lower Clay –*** The Middle/Lower Clay, where present in beneath the refinery is characterized by very low permeability reddish-brown, brown or gray clays and sandy clays. Based on recent geologic data collected in AOI 8, the Middle/Lower Clay is present beneath AOI 8 as a wedge which thickens towards the west and the Schuylkill River. As shown in Figure 5a, the clay ranges in thickness from approximately 10 feet on the east side of AOI 8 to approximately 38 feet in the central portion of AOI 8.

***Trenton Gravel*** – Throughout most of the refinery, the Trenton Gravel typically overlies the Middle/Lower Clay and Lower Sand with thicknesses up to 80 feet and a typical thickness of 40 feet. The Trenton Gravel is of Pleistocene Age (Ice Age; less than 2 million years) and is a very heterogeneous unit comprised of a predominant brown to gray sand, gravel and minor amounts of clay (Owens and Minard, 1979). As shown in Figures 5a through 5c, Trenton Gravel is present in the northern, central and eastern portions of AOI 8 and is absent in the western portion of AOI 8 where it has been eroded and replaced with alluvium.

***Recent Fill/Alluvium*** - The alluvium deposits in AOI 8 generally consist of dark gray organic clayey mud or silt and fine sand. As shown in Figures 5a through 5c, alluvium deposits exist in the western and central portions of AOI 8 and to a lesser extent in the northern portion. No alluvium materials are located in the eastern portion of AOI 8. As shown in Figures 5a and 5c, the alluvium thickens in the western portion of AOI 8 where the Pleistocene age deposits have been eroded and replaced. As shown in Figures 5a through 5c, the alluvium deposits range in thickness between 2 and 60 feet in AOI 8.

Fill type varies across AOI 8 and includes various sands and gravels, brick and wood fragments, and cinder ash. Fill overlies native geologic deposits throughout AOI 8 and ranges between 2 and 15 feet in thickness.

In addition to the above descriptions, the following general observations can be made concerning the geology in AOI 8:

- Fill materials are present throughout AOI 8 generally ranging from 5 to 20 feet in thickness.
- In the western portion of AOI 8, the Pleistocene age formations have been eroded and replaced with alluvium. The alluvium extends to the central and northern portions of AOI 8, but is absent in the eastern portion. Where present the alluvium generally ranges in thickness from 5 to 60 feet.
- Trenton Gravel is present in the northern, central and eastern portions of AOI 8 but is absent in the western portion where it has been eroded and replaced with

alluvium. Where present the Trenton Gravel ranges in thickness from 5 to 30 feet.

- The Middle/Lower Clay is present beneath AOI 8 as a wedge that thickens towards the west and the Schuylkill River. The clay is absent between the central and western portions of AOI 8. Where present the clay ranges in thickness from 10 to 20 feet.
- The Lower Sand overlies bedrock in the eastern and central portions of AOI 8, but is absent in the northwestern and western portions of AOI 8. Where present the Lower Sand ranges in thickness from 2 to 60 feet.
- In the western and northern portions of AOI 8, the middle clay is absent, and the alluvium is in direct contact with Trenton Gravel, Lower/Middle Clay, Lower Sand and/or bedrock.
- The depth to bedrock beneath AOI 8 increases towards the south. Depth to bedrock in the northern portion of AOI 8 is generally encountered at 40 ft bgs and along the southern portion of AOI 8 is located at 75 ft bgs.

## 2.3 Hydrogeology

### *2.3.1 Shallow/Intermediate Groundwater Occurrence and Flow*

Shallow groundwater at the refinery refers to unconfined groundwater that occurs in either the fill or alluvium (or both). Intermediate groundwater at the refinery refers to unconfined groundwater that occurs in Trenton Gravel. Groundwater gauging data collected by Stantec in May 2011 was used to generate a groundwater flow figure for the shallow/intermediate zone in AOI 8 (Figure 6). The groundwater elevation data from this gauging event is provided in Table 3. Monitoring well construction details for these monitoring wells are provided in Table 2 and boring/well construction logs for the newly installed monitoring wells are provided in Appendix C of this report. Historic boring/well logs for monitoring wells installed prior to the site characterization activities are provided in Appendix D of the CCR. Based on the groundwater elevations as shown in Figure 6, the following observations can be made.

- Groundwater in the shallow/intermediate zone of AOI 8 occurs at depths between 1 and 37 feet below the ground surface under unconfined conditions.

- A groundwater flow divide, trending northwest to southeast, is present in the central portion of AOI 8. This divide generally corresponds with the eastern extent of the alluvium materials deposited following the erosion and removal of the Pleistocene age deposits. Where the Pleistocene age deposits have been eroded, the alluvium is in direct contact with the Trenton Gravel, Lower/Middle Clay, and/or the Lower Sand. Groundwater on the east side of the divide flows to the northeast. Groundwater on the west side of the divide flows to the southwest.
- The hydraulic gradient in the western portion of AOI 8 is relatively flat with some depressions and mounds at isolated locations.
- Along the western boundary of AOI 8, flow is more pronounced towards the bulkheads and Schuylkill River.
- The hydraulic gradient in the eastern and southern portions of AOI 8 is relatively flat with some depressions and mounds at isolated locations.

### *2.3.2 Deep Groundwater Occurrence and Flow*

Eleven deep (Lower Sand) monitoring wells are located in AOI 8 which include N-4, N-9, N-13, N-19, N-21, N-27, N-30, N-38D, N-44D, N-46D and N-50D. Well construction details for these monitoring wells are provided in Table 2 and the available logs for these monitoring wells are provided in the CCR.

Groundwater gauging data collected by Stantec in May 2011 was used to generate groundwater flow figures for the deep groundwater zone in AOI 8 (Figure 7). The groundwater elevation data from this gauging event are provided in Table 3. Based on the groundwater elevations as shown in Figure 7, the following observations can be made:

- A groundwater flow divide, trending northwest to southeast, is present in the central portion of AOI 8. This divide generally corresponds with the eastern extent of the alluvium materials deposited following the erosion and removal of the Pleistocene age deposits. Where the Pleistocene age deposits have been eroded, the alluvium is in direct contact with the Trenton Gravel, Lower/Middle Clay, and/or the Lower Sand. Groundwater on the east side of the divide flows to the east and

southeast. Groundwater on the west side of the divide flows to the southwest.

- A downward vertical flow gradient exists between the shallow/intermediate and deep zone as indicated by the groundwater elevations in the following monitoring well pairs: N-3/N-4, N-12/N-13, N-8/N-9, N-18/N-19, N-20/N-21, N-29/N-30, N-38/N-38D, N-43/N-44D, N-47/N-46D and N-51/N-50D. This is consistent with vertical gradients elsewhere in the refinery.

No aquifer testing was performed in AOI 8 as part of the 2008 site characterization activities since sufficient data was available from former aquifer tests (pumping and slug tests) performed in AOI 8 by others (GES in 1993 and 1994). Aquifer testing, consisting of 40 and 48-hour constant rate pump tests were performed on two monitoring wells (N-76 and N-80) in AOI 8 by GES in December 1993. Slug tests were completed in August 1994 on monitoring wells N-29, N-32, N-81 and N-82. Based on these tests and other site specific data obtained from the CCR, for the fate and transport modeling a hydraulic conductivity of 24 ft/day was used for monitoring wells screened in the Trenton Gravel and a hydraulic conductivity of 4.64 ft/day was used for monitoring wells screened in the alluvium. A hydraulic conductivity of 135 ft/day was used for monitoring wells screened in the Lower Sand which was obtained from the USGS Water-Supply Paper 2346.

## 2.4 Surface Water

No surface water features are located in AOI 8. The nearest surface water body to AOI 8 is the Schuylkill River which borders the western boundary. Sheet pile and wooden bulkheads exist along the Schuylkill River as shown in Figure 2. The bulkhead extend along the Schuylkill River from the storm water separator south towards, and including, the active asphalt loading dock in the southwestern portion of AOI 8. The wooden portion of the bulkhead was constructed in the early 1930s and begins south of the AOI 8 storm water separator and extends approximately 2,460 feet downstream. In 1957, upgrades were completed to approximately 100 linear feet of the timber bulkhead that included steel sheet piles and partial replacement of timber spur piles with steel pipe piles. More recently, tie rods have also been installed in this area. The southern

940 feet of the bulkhead is of newer, steel sheet piling construction. Shallow/intermediate groundwater interaction with surface water is limited by the bulk head and sheet pile wall.

## 2.5 Jackson Street Sewer

To address question No. 2 of the PADEPs technical response letter (Appendix D), the following response was prepared to provide additional information on the Jackson Street Sewer. The Jackson Street sewer is a combined storm and sanitary sewer traversing the North Yard in an east-west direction. The sewer was constructed of brick between 1903 and 1917 and is 6.5 feet in diameter where it enters the refinery, on the eastern border near 29th Street and the Schuylkill Expressway. The sewer continues west across Sunoco property for 4,180 ft. at a grade of approximately 0.0028 ft. per ft. and increases in diameter to 7.5 ft. at its terminus, the Jackson Street Sewer Outfall on the Schuylkill River (GES 1993). Section 5.0 and 6.0 below provides an evaluation of the sewer as a transport mechanism for contaminants.

In response to questions No. 5 and 6 of the PADEPs technical response letter (Appendix D), a further evaluation of the sewer as a preferential migration pathway for light non-aqueous phase liquid (LNAPL) and vapor, was performed by Sunoco in 2009. As part of this evaluation, a review of historic investigations (1993 through 2009) was completed. A summary of the historic sewer investigations is presented below:

- In 1993 and 1995, investigations performed by GES and Sunoco determined the following:
    - Lithology surrounding the sewer consisted of poorly graded sand and gravel with lenses of silts and clays;
    - Construction of the sewer is brick;
    - The entire length of sewer intercepts alluvial groundwater;
    - Hydraulic conductivity values of the fill and alluvium ranged from 9.37x10-5 cm/sec to 1.51x10-4 cm/sec;
    - Transmissivity values of 1.49 cm2/sec suggested alluvial groundwater flow is semi-restricted;
    - Storativity value of 2.8x10-3 suggested limited water available for pumping; and

  - The highly variable grain size and finer grained; clay and silt lenses may limit the transmissivity and storativity of the unconfined aquifer.

- In 2002 and 2003, investigations performed by Aquaterra and Sunoco determined the following:
  - LNAPL existed in the subsurface proximal to the Jackson Street Sewer;
  - A groundwater remediation system controls the separate phase hydrocarbons plumes proximal to the Jackson Street Sewer;
  - Oil was present in the North Yard facility sewer system;
  - Sunoco improved operating procedures with regards to sewer system and completed sewer cleaning projects decreasing the presence of oil in the sewer; and
  - Improved operation of the Klondike separator and a higher degree of vigilance in the North Yard mitigated the discharge of oil to the Jackson Street Sewer Outfall.
- From December 2002 through September 2004, PADEP performed inspections in residential neighborhoods to the east of the site boundary. Petroleum odors were reported and PID readings ranged from 0.0 to 239 ppm.
- In February of 2003, PADEP and Philadelphia Water Department (PWD) inspected the interior of the sewer and determined the overall structural condition of the sewer was good. The PADEP and PWD observed evidence of hydrocarbons in the sewer using ultraviolet (UV) light. Increased amounts of hydrocarbons were observed towards the western portion of the sewer closer to the outfall structure.
- In March of 2003, Sunoco and Aquaterra mapped the inside of the sewer and mapped locations of hydrocarbon seep areas by use of ultra violet (UV) light and visual observations. Sunoco and Aquaterra also identified locations of other pipes tying into the sewer.
- In June and September of 2003, Sunoco performed outfall modifications, including the construction of an underflow weir, rerouting the discharge pipe from Klondike separator, automated the skimmer, and installed the water curtain.

- In September 2005, PADEP inspections reported no odors or PID readings present in nearby residential neighborhoods to the east of the site boundary.
- In 2005, Sunoco blanked off a pipe located at the western end of the sewer reducing amount of oil observed at outfall.
- In December of 2008, Sunoco and Stantec investigations reported no PID readings east of the water curtain.

In June 2009, Sunoco and Aquaterra collected 24-hour TO-15 summa air gas samples east and west of the water curtain alongside and inside of sewer (Figure 3). The air gas sampling was performed to evaluate possible vapor migration off-site in the residential neighborhood. The air gas sample results were screened against the PADEP residential indoor air screening criteria. The analytical results of the air gas samples indicated there were no benzene detections east of the water curtain or off-site in the sewer near residential neighborhoods. Chloroform was above its screening criteria west of water curtain (Manhole No. 1) and off-site in sewer (Manhole No. 6). Concentrations of COCs were below criteria in the background ambient air sample. Methane was detected in Manhole No. 3 west of the water curtain and in Manhole No.6 located in the residential neighborhood.

## 3.0 SITE CHARACTERIZATION ACTIVITIES

The following sections summarize the site characterization activities that were completed in AOI 8 in support of this report. Site characterization activities were performed between May and August 2008, by Aquaterra Technologies, Inc. (Aquaterra) and Langan in coordination with Sunoco. These activities were executed in accordance with the AOI 8 Work Plan for Site Characterization which is included as Appendix L of this report. Additional site characterization activities were performed in 2009 to address PADEP's comments in the technical response letter for AOI 8 dated November 14, 2008 (Appendix D).

### 3.1 Shallow Soil Borings and Sampling at Non-RCRA SWMU Areas

A total of 66 soil samples were collected for analysis of site COCs from areas within AOI 8 that are outside SWMU 2. The locations of all soil and monitoring well borings are shown on Figures 3 and 8 and the boring logs are provided in Appendix C. Soil samples were collected utilizing split-spoon sampling techniques. Soil borings were

advanced to a maximum depth of two feet below grade at each unpaved location in accordance with the AOI 8 Work Plan.

Soil samples from the soil borings were submitted to Lancaster Laboratories, Inc. (LLI) of Lancaster, Pennsylvania for analysis of site COCs. A summary of the soil analytical results screened against the PADEP non-residential soil MSCs is provided as Table 4 and the results are discussed in Section 4.1. The laboratory analytical reports are provided as Appendix E.

### 3.2 Shallow Soil Borings and Sampling at SWMU 2

The 1991 RFI identified one SWMU in AOI 8 that required further characterization. This SWMU was identified as SWMU 2 (Storage Leaded Tank Bottoms Sludge Weathering Pad). SWMU 2 was characterized during the 2008 site characterization efforts following the investigative approach outlined in Section 1.2.2 of the AOI 8 Work Plan and summarized below:

- If materials were encountered within the leaded tank bottom areas matching the physical description of the leaded tank bottoms, then Sunoco collected samples for lead.
- If the lead results were above 450 parts per million (ppm) (PADEP's non-residential soil MSC for lead) then samples were analyzed for lead via Toxicity Characteristic Leaching Procedure (TCLP), EPA Test Method 1311.
- Delineated areas that had soils that physically resemble leaded tank bottoms, had lead concentrations greater than 450 ppm and failed the TCLP test for lead would retain the leaded tank bottom designation. If no soils were encountered that meet all three of the above mentioned criteria, then the area would no longer be classified as a leaded tank bottom area.

A detailed description of SWMU 2 and a summary of previous investigation work completed at SWMU 2 are provided in Section 1.2.1 of the AOI 8 Work Plan. To supplement data previously collected during the RCRA RFI, a total of six borings (BH-08-05, BH-08-06, BH-08-19, BH-08-20, BH-08-36, and BH-08-37) were completed in SWMU 2. The locations of these borings are shown on Figures 3 and 9 and the boring logs are provided in Appendix C. Soil samples were collected utilizing split-spoon sampling techniques. Soil borings were advanced to a maximum depth of eight feet

below grade at each location in accordance with the AOI 8 Work Plan. At boring locations BH-08-36 and BH-08-37, the existing sub grade concrete slab was mechanically broken up with a backhoe to advance the soil borings. Locations BH-08-19 and BH-08-20 were located on asphalt which was also removed with a backhoe. No concrete slab was encountered at these two locations. The soils were evaluated to determine if leaded tank bottom materials were present.

Soil samples requiring analysis were submitted to LLI for analysis of lead concentrations. A summary of the soil analytical results is provided as Table 5 and the results are discussed in Section 4.2 below. The laboratory analytical reports are provided as Appendix E.

## 3.3 Installation of Groundwater Monitoring Wells

Monitoring well installation activities were performed between June and July 2008 by Parrat Wolff, Inc. (PWI) of East Syracuse, New York under direct supervision of Aquaterra and Langan, and in coordination with Sunoco. There were no new wells installed during the additional 2009 site characterization activities. The locations of all monitoring wells installed in 2008 are shown on Figure 3. Monitoring wells were installed to monitor the water table aquifers beneath AOI 8. No deep monitoring wells were installed since adequate characterization data exists from the three existing deep monitoring wells in AOI 8. The monitoring well installation activities are discussed in the following sections.

### *3.3.1 Fill/Alluvium (Shallow) and Trenton Gravel (Intermediate) Groundwater Monitoring Wells*

PWI installed 39 shallow and intermediate monitoring wells which included N-100, N-101, N-102, N-103, N-104, N-105, N-106, N-107, N-108, N-109, N-110, N-111, N-112, N-113, N-114, N-115, N-116, N-117, N-118, N-119, N-120, N-121, N-122, N-123, N-124, N-125, N-126, N-127, N-128, N-129, N-130, N-131, N-132, N-133, N-134, N-135, N-136, N-98, N-99. Monitoring wells were installed and constructed under the direct supervision of Aquaterra and Langan in accordance with the AOI 8 Work Plan. Locations of these monitoring wells are shown on Figure 3. Monitoring well borings were advanced utilizing hollow stem augers and split spoon samplers to record lithology. Locations of these monitoring wells are shown on Figures 3. Boring logs and monitoring well construction

details and lithology are provided in Appendix C. Monitoring wells were constructed with a flush mount manhole cover or with a stickup steel casing for protection. Following construction, the monitoring wells were developed in accordance with the AOI 8 Work Plan. Well construction details are provided in Table 2.

### *3.3.2 Lower Sand (Deep) Groundwater Monitoring Wells*

Eleven deep (Lower Sand) groundwater monitoring wells exist in AOI 8; these monitoring wells included: N-4, N-9, N-13, N-19, N-21, N-27, N-30, N-38D, N-44D, N-46D, and 50D. No additional deep groundwater monitoring wells were installed in AOI 8 as part of the site characterization activities. Four deep soil borings were completed to a maximum depth of 103 feet for further geological characterization of AOI 8. The locations of the deep monitoring wells and deep soil borings are shown on Figure 3. Monitoring well construction details are provided in Table 2 and soil boring/well construction logs are provided in Appendix C. Geologic information obtained from the deep soil borings completed in AOI 8 was used to prepare geologic cross sections provided as Figures 5a through 5c.

## 3.4 Groundwater Monitoring

In May 2011, Stantec performed monitoring well gauging activities from all accessible monitoring points in AOI 8. Monitoring points were gauged for depth-to-water, and if applicable, depth-to-product in accordance with the AOI 8 Work Plan. The monitoring point gauging readings are summarized in Table 3.

The groundwater monitoring data from Table 3 was used to generate a shallow/intermediate groundwater elevation contours provided as Figure 6. Groundwater gauging data from the deep (Lower Sand) monitoring wells in Table 3 was used to generate a groundwater contour figure for the deep (Lower Sand) zone in AOI 8 (Figure 7).

## 3.5 Groundwater Sampling

Aquaterra performed a round of groundwater sampling from accessible monitoring wells in AOI 8 in July 2008. A total of 111 groundwater samples were collected during this

groundwater sampling event. Groundwater sampling activities were completed in accordance with the AOI 8 Work Plan. The monitoring well sampling summary data sheets are provided as Appendix F.

Following monitoring well purging activities, groundwater samples were collected by lowering a disposable bailer slowly into the monitoring well to minimize excess agitation. The bailer was filled with water from the top of the water table and retrieved. Samples were then collected in laboratory-prepared bottleware and immediately placed on ice. Samples were submitted to LLI for analysis of site COCs. Once the sample was collected, the bailer, bailer cord, and nitrile gloves used to obtain the sample were discarded. Sample date, time, number, and site name were recorded on the chain-of-custody and in field books. For groundwater samples analyzed for lead, LLI filtered the samples to analyze for dissolved concentrations.

The groundwater analytical results for shallow monitoring wells were screened against the PADEP non-residential groundwater MSCs and are presented in Table 6. The groundwater analytical results for the deep monitoring wells are presented in Table 7. The laboratory analytical reports are included as Appendix E.

### 3.6 LNAPL Sampling

LNAPL samples for select monitoring wells in AOI 8 were previously characterized as described in the CCR. As part of the 2008 site characterization activities, Aquaterra collected LNAPL samples from a total of eleven existing monitoring wells (N-42, N-47, N-51, N-75, N-76, N-82, N-91, N-503, RW-202, RW-300 and RW-305) in AOI 8 to further characterize LNAPL in AOI 8. Eight LNAPL samples were collected from newly installed monitoring wells (N-107, N-113, N-116, N-125, N-127, N-129, N-130, and N-135). LNAPL samples were collected using a direct sampling method in accordance with the AOI 8 Work Plan. LNAPL samples were packaged in certified hazardous material shipping boxes and shipped to Torkelson Laboratories (Torkelson) of Tulsa, Oklahoma for LNAPL characterization. LNAPL characterization data included product types, density, proportions of product, degree of weathering, and similarities to other LNAPL samples collected at the refinery.

Appendix G summarizes the LNAPL characterization results for samples collected in AOI 8 as well as previous results from the CCR.

## 3.7 Surveying Activities

Following completion of monitoring well installation and soil boring activities, the newly installed monitoring wells and soil boring locations were surveyed by Langan to establish the location and elevation of the inner and outer casing and ground surface at each point. Well elevations were determined to the nearest 0.01 foot relative to mean sea level. Survey activities were performed by a Pennsylvania-licensed surveyor and tied to the NAVD 88 datum. The new survey data for the monitoring wells is presented in Table 2. This new survey data was used to update the Geographic Information System (GIS) and site wide database for the refinery.

## 3.8 Vapor Intrusion Assessment Activities

Philadelphia Firehouse Building

Based on the presence of LNAPL in monitoring well MW-7 which is located approximately 150 feet southeast of the Philadelphia Fire Department building, and since there are no monitoring points between MW-7 and the fire department building, further evaluation of the potential vapor intrusion into indoor air pathway for this building was completed in 2009. A total of four soil gas monitoring points (SG-1 through SG-4) were installed around the perimeter of the fire department building in April 2009 by Aquaterra. These soil gas monitoring points were installed adjacent to the northeast and southeast exterior walls of the building. The soil gas monitoring points were left as permanent monitoring points for use in future sampling events. The soil gas monitoring points were sampled on April 23, 2009 by Aquaterra. In addition to the soil gas point samples, on June 5, 2009, two indoor air gas samples (Firehouse Ambient and Firehouse Indoor Air) were collected by Aquaterra. The soil gas sample locations are shown on Figure 3 and the field notes and analytical summary tables are presented in Appendix H. The soil gas sampling activities were completed in accordance with the procedures provided in the AOI 8 Work Plan. The soil gas and indoor air samples were analyzed via EPA Method TO-15 by LCI.

Jackson Street Sewer Vapor Assessment

In response to question No. 5 of the PADEPs technical response letter (Appendix D), a total of four air samples were collected around and in the Jackson Street Sewer on June 5, 2009. Sunoco and Aquaterra collected 24-hour TO-15 summa air samples east

and west of the water curtain alongside and inside of sewer. The locations of these samples are shown in Figure 3. The air samples were analyzed via EPA Method TO-15 by LCI. The following is description of each air sample location:

- One ambient background air sample (Jackson Ambient) was collected east of the water curtain;
- Manhole No.1 collected on the east side of the water curtain;
- Manhole No.2 collected on the west side of the water curtain; and
- Manhole No. 6 collected offsite on the east side of Route 76 in the vicinity of South 29th Street in a residential neighborhood.

The result of this sampling is summarized in Section 5.5.

## 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 presented in the AOI 8 Work Plan. The complete laboratory analytical data packages for the soil and groundwater sampling events are included in Appendix E.

### 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

For the purposes of this investigation, sample results were summarized in thirty one sample delivery groups, provided by LLI, and are evaluated in the sections above for usability. Copies of the laboratory reports are provided in Appendix E for your reference.

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, soil and air data could be used in the decision-making process.

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 evaluation of these indicators the groundwater, soil and air data collected during this investigation are considered usable for characterizing the site, identifying compounds of concern, and delineating potential impacts, with the exceptions described below.

For compounds analyzed in soil (with exception of ethylene dibromide) greater than 95% percent of the data is considered usable. The remaining 5% is considered unusable because, due to matrix interference, the samples were diluted to the point that the laboratory reporting limits were elevated above the corresponding soil screening criteria (PADEP Soil MSCs) and no concentration was detected. Specifically, MTBE in samples N-109_1.0-2.0 and N-126_1.0-2.0; benzene in samples N-109_1.0-2.0, N-122_1.0-2.0, and N-126_1.0-2.0; and 1,2-dichloroethane in samples N-109_1.0-2.0, N-122_1.0-2.0, and N-126_1.0-2.0 are not considered usable for the purposes of characterization and delineation. Similarly, due to matrix interference, ethylene dibromide is also considered unusable in any sample because the laboratory reporting limits were elevated above the PADEP Soil MSC.

For compounds analyzed in groundwater (with exception of chrysene) greater than 92% percent of the data is considered usable. The remaining 8% is considered unusable because, due to matrix interference, the samples were diluted to the point that the laboratory reporting limits were elevated above the corresponding groundwater screening criteria (PADEP GW MSCs) and no concentration was detected. Specifically, 1,2-dichloroethane in samples N-23, N-34, N-35, N-58, N-61, N-119, N-133 and PZ-506; benzene in samples N-23, N-34, N-35, N-58, N-61 and PZ-506; and naphthalene in sample N-36. Similarly, due to matrix interference, chrysene is also considered unusable in any sample because the laboratory reporting limits were elevated above the PADEP groundwater MSC.

One hundred percent of the air data is considered usable, with select concentrations considered biased and therefore estimated.

Due to the number of samples collected and the high percentage of useable data, the data collected is sufficient for the completed Remedial Investigation activities. In addition, as detailed in Appendix E, few concentrations should be considered as biased because LCS/LCSD, MS/MSD and surrogate recoveries were beyond acceptable control

limits. Reviews of the biased concentrations show that it is unlikely that any of the concentrations would have exceeded the standard had the bias not occurred.

### 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 analytical results of the site characterization activities performed in AOI 8.

### 5.1 Soil Analytical Results at Non-SWMU Areas

A total of 66 soil samples were collected for analysis of site COCs from areas within AOI 8 that are outside SWMU 2. The results of the soil samples collected outside of SWMU 2 are provided in Table 4 and are summarized below. Soil samples were collected between the ground surface and two feet below the ground surface and no saturated soils were observed at these depths. The soil sample results were screened against the PADEP non-residential soil MSCs. Soil sample locations with results above their respective soil MSCs are shown in Figure 8. COCs detected in soil, above their respective non-residential soil MSCs included: benzene, naphthalene, benzo(a)pyrene and lead.

### 5.2 Soil Results at SWMU 2

The following approved procedures were followed in relation to potential leaded tank bottoms. Soil samples were collected for lead if materials were encountered within the leaded tank bottom sludge weathering pad area during site characterization activities matching the physical description of the leaded tank bottom materials. If the lead results exceeded 450 ppm (the PADEP non-residential MSC for lead), then the samples were analyzed for lead via TCLP, EPA Test Method 1311.

A total of six soil borings/samples (BH-08-05, BH-08-06, BH-08-19, BH-08-20, BH-08-36, and BH-08-37) were completed at SWMU 2. One sample location (BH-08-05) exhibited trace amounts of material with characteristics resembling the physical description of leaded tank bottoms and was submitted for lead analysis. The sample collected from boring BH-08-05 exhibited a lead concentration below the PADEP non-residential MSC (450 ppm) and was therefore not submitted for TCLP analysis. No evidence of leaded tank bottom materials was observed in the remaining five soil borings. The results of the sample analyses are summarized in Table 5, illustrated in Figure 9, and the logs for these borings are provided in Appendix C.

## 5.3 Groundwater Results

Shallow/Intermediate and Deep (Lower Sand) Monitoring Wells

The results of the groundwater samples collected from monitoring wells in the shallow/intermediate and deep groundwater zones are provided in Tables 6 and 7. The results were screened against the PADEP non-residential used aquifer (TDS<2,500) groundwater MSCs. Locations with concentrations above the groundwater MSCs are illustrated in Figure 10. A summary of the COC concentrations that were above their respective PADEP non-residential groundwater MSCs are presented below.

Shallow/Intermediate Monitoring Wells

- COCs detected in shallow/intermediate monitoring wells at concentrations above their respective non-residential groundwater MSCs included: benzene, pyrene, chrysene, phenanthrene, and naphthalene.
- Cumene, toluene, ethylbenzene, ethylene dibromide, xylenes, fluorene, MTBE, 1,2-dichoroethane and lead were not detected in AOI 8 groundwater at concentrations above their respective non-residential groundwater MSCs.

Deep (Lower Sand) Monitoring Wells

- Benzene was detected in three deep (Lower Sand) monitoring wells (N-9, N-21, N-44D) at concentrations slightly above its respective non-residential PADEP groundwater MSC.
- Toluene, MTBE, 1,2-dichoroethane, xylenes (total), cumene, ethylbenzene, ethylene dibromide, pyrene, phenanthrene, fluorene, naphthalene, and lead were

not detected in deep groundwater in AOI 8 at concentrations above their respective PADEP non-residential groundwater MSCs.

### 5.4 LNAPL Characterization Results

As a part of the site characterization activities for AOI 8, LNAPL samples were collected from 18 monitoring wells (N-42, N-47, N-51, N-75, N-76, N-82, N-91, N-503, RW-205, RW-300, RW-305, N-107, N-113, N-116, N-125, N-127, N-129, N-130, and N-135). This appendix also includes previous LNAPL characterization data for AOI 8 which was obtained as part of the CCR. As part of the CCR, LNAPL samples were collected from 11 monitoring wells (N-14, N-25, N-31, N-35, N-48, N-52, N-68, N-78, N-79, PZ-204, and PZ-502). The LNAPL samples collected from AOI 8 were submitted to Torkelson Geochemistry, Inc. (Torkelson) of Tulsa, Oklahoma for characterization. The extent of LNAPL, the LNAPL type, as well as the apparent thickness of LNAPL measured during the May 2011 gauging event is illustrated in Figure 11. The LNAPL product typing and characterization results are presented in Appendix G.

As part of the AOI 8 SCR/RIR, LNAPL modeling was performed using the American Petroleum Institute (API) Model. LNAPL modeling procedures, input parameters, and results are included as Appendix G. LNAPL was identified in 43 wells (N-14, N-23, N-25, N-31, N-42, N-45, N-47, N-48, N-49, N-503, N-504, N-51, N-52, N-54, N-68, N-75, N-76, N-79, N-81, N-82, N-91, PZ-204, PZ-502, RW-201, RW-203, RW-204, RW-205, RW-206, RW-300, RW-306, RW-502, N-107, N-112, N-113, N-115, N-116, N-125, N-127, N-128, N-129, N-130, N-135, and P-30) during the May 2011 groundwater gauging activities. LNAPL thicknesses ranged from sheen (0.01 feet) to 3.20 feet.

Based on the LNAPL characterization performed by Torkelson, the LNAPL types present in AOI 8 consist of four different types or mixtures of LNAPL including residual oil, lube oil, lube oil/middle distillate mixture, and middle distillate. All four LNAPL types have a high degree of weathering. The physical properties of these LNAPL types (drawn from literature sources), soil types (AOI 8 boring logs) and recent LNAPL thickness measurements (May 2011) were entered into the API Model to estimate LNAPL specific volume and seepage velocity. The input and output parameters of the updated API Model and seepage velocity calculations is presented in Appendix G.

The distribution of LNAPL, specific volume and seepage velocities derived from the May 2011 data are similar to what was reported in the CCR. Figures depicting the results of the LNAPL modeling are included in Appendix G. Based on the LNAPL types, LNAPL modeling results and recent groundwater gauging activities, LNAPL in these wells is stable and generally immobile.

## 5.5 Vapor Intrusion Assessment Results

The Philadelphia Fire Department building soil gas and Jackson Street Sewer air sample locations are presented on Figure 3. The vapor intrusion assessment field notes and analytical summary tables are provided in Appendix H. The analytical laboratory reports are presented in Appendix E. Sampling techniques were completed in accordance with the procedures of the AOI 8 Work Plan. Samples were collected via EPA Method TO-15 and analyzed by LCI.

The results of the sampling are summarized below:

Philadelphia Fire Department Building

- Benzene was detected above its respective PADEP indoor air screening criteria in three of the four soil gas sample locations.
- Benzene was not detected above the PADEP indoor air screening criteria in the two indoor air samples collected from inside the fire department building.
- 1,4-dichlorobenzene was detected above the PADEP indoor air screening criteria in one of the samples collected inside the building; however, the presence of this compound in indoor air is likely attributable to background conditions at the time the sampling was completed because concentrations of this compound were not detected in the soil gas samples.

Jackson Street Sewer

In June of 2009, Sunoco and Aquaterra collected 24-hour TO-15 summa air samples east and west of the water curtain as background samples and one sample inside of the sewer. Below is a summary of those results:

- Benzene was detected above the PADEP indoor air screening criteria on-site at Manhole No. 3 sample location.

- Benzene was not detected at concentrations above the PADEP indoor air screening criteria east of water curtain or off-site.
- Chloroform was detected above the PADEP indoor air screening criteria west of the water curtain (Manhole No. 1) and off-site in the sewer (Manhole No. 6). This compound is not attributed to site COCs.
- No exceedances of indoor air screening criteria in background ambient air sample.

With the exception of the above-mentioned compounds, all other TO-15 compounds were below their respective PADEP residential indoor air screening criteria. Methane was present in two of the samples collected inside the sewer (Manhole No. 3 and Manhole No. 6); however, there are no screening criteria for this COC. The analytical results indicated that indoor air exceedances were detected west of the water curtain, but not to the east, indicating that the water curtain is effectively controlling vapor migration from the sewer. Although methane was detected east of the water curtain, it is associated with a background source.

## 6.0 REMEDIAL SYSTEM EVALUATION AND UPDATE

### 6.1 PGW Border Total Fluids Recovery System

The PGW Total Fluids Recovery System is composed of recovery wells numbered RW-200 through RW-205 and an interceptor trench with a recovery sump (RW-206). The system was installed to help prevent off-site migration of LNAPL. The system recovery network consists of total fluids recovery utilizing electric submersible pumps equipped with individual timers to control the on and off cycle of each pump. Total fluids are extracted from recovery wells RW-201, RW-202, and RW-203. Total fluids produced by the 200 series pumps are routed to the North Yard 10,000-gallon holding tank where a flow meter measures incoming fluids produced by the three recovery wells. Groundwater is passed through the tank and routed to the Point Breeze Processing Area Wastewater Treatment Plant. Accumulated LNAPL is pumped out of the 10,000-gallon holding tank as needed by a vacuum truck. The recovered LNAPL is quantified while being vacuumed from the holding tank.

The PGW Total Fluids Recovery System was taken off-line during in March 2008 due to electrical issues associated with the system and maintenance on the 10,000-gallon holding tank and has remained off-line. Although the system shut down was initiated due to maintenance issues, this shutdown allowed time to evaluate the AOI 8 recovery systems. Based on an evaluation of this system and the dissolved phase concentration in the vicinity of the PGW border, re-initiation of this system is recommended and will be further described in the Clean Up Plan.

### 6.2 Jackson Street Sewer Total Fluids Recovery System

This section describes activities performed, and information gathered, to address Question No. 3 of the PADEPs technical response letter (Appendix D).

According to the 1995 Brown & Root, Inc. Ground Water Remediation Project Data Book Volumes 1 and 2, the original recovery network was to include a total of nine recovery wells. The original purpose of this system was to control the LNAPL plume in the center of the North Yard and prevent LNAPL migration to the Jackson Street Sewer and Schuylkill River. Installation occurred sometime prior to March 1995 and is reflected in the system "As Builts."

The recovery network originally included a total of nine recovery wells: RW-300 through 308. Total fluids produced from the recovery wells were routed to the North Yard 10,000-gallon holding tank where a flow meter recorded the combined total fluids produced from the recovery well network. Groundwater is passed through the tank and routed to the Point Breeze Processing Area Wastewater Treatment Plant. Accumulated LNAPL is pumped out of the 10,000-gallon holding tank by a vacuum truck quarterly. Since all three AOI-8 recovery systems are routed to the 10,000-gallon holding tank the actual volume of LNAPL recovered from each individual system was not able to be determined.

The Jackson Street Sewer Total Fluids Recovery System was taken offline during the first week in March 2008 due to maintenance issues and has remained offline. Although the system was shut down due to maintenance issues, this allowed time to evaluate the system's performance.

The Jackson Street combined sewer overflow ("CSO") outfall is checked once per shift at low tide and findings are recorded twice daily by Sunoco personnel to determine if a sheen or LNAPL are present. Flow through the sewer during a severe rain storm in August 2005 damaged the outfall structure beyond repair. The outfall structure has since been removed and the installation of a slide boom structure at the outfall was completed in May 2006. An absorbent boom was placed behind the slide boom in response to a slight sheen at the outfall in April 2007. Currently, there is no evidence of oil in the Jackson Street sewer and it outfalls to the river with no controls.

Recovery wells are gauged as part of the quarterly recovery system maintenance and monitoring program to ensure the system is operating as designed. Recovery wells RW-304 and RW-308 were taken off-line in August 1999. Recovery wells RW-303 and RW-305 through RW-308 were taken off-line in August 2004 due to the absence of measurable LNAPL (>0.01 feet). These recovery wells are monitored semi-annually and will be brought back on-line if measurable LNAPL returns.

To evaluate the historical performance of the total fluids recovery system, Langan had compiled data from quarterly reports and other historical documents from 1992 through December 2010. Recovery wells (RW-301 through RW-308) were included as part of the analysis, as well as eight surrounding monitoring wells (N-20, 22, 23, 24, 25, 26, 79, and 87). Trend charts were prepared to compare the corrected groundwater elevation and apparent LNAPL thickness over time. These trend charts are presented as Appendix I. Depicted on the graphs are the dates when the pumps were shut down. If the product thickness is shown to be zero on the graphs, this indicates that either a sheen was observed or there was no measurable LNAPL. If no data point is present on the graphs, then there was no sheen or measurable LNAPL observed. Included in Appendix I, are figures presented in chorological order (by date) that depict apparent LNAPL locations, thickness, and plumes over time. The data analysis, attached graphs and figures indicate a general decreasing trend in apparent LNAPL thickness in the recovery and nearby monitoring wells over time.

Due to lack of LNAPL in the vicinity of the system (Figures 3 and 11), Sunoco intends to keep the system offline. The Jackson Street Sewer outfall will continue to be monitored to confirm lack of LNAPL presence.

### 6.3 Jackson Street Sewer Water Curtain

Installation of a water curtain in the Jackson Street sewer was completed during the 4th quarter of 2003. The water curtain is designed to reduce hydrocarbon odors potentially migrating from the Jackson Street sewer to the surrounding areas. The water curtain apparatus is located in the first manhole west of the interceptor chamber along 26th Street and consists of a single centrally located nozzle that emits a radial spray pattern. Water is supplied to the water curtain apparatus from the North Yard fire water system. Heat trace equipment was installed along the water feed line allowing winter operation of the water curtain.

The current water curtain system monitoring includes vapor readings from the interceptor chamber and at the manhole of the water curtain. Historically, flowrate/totalizer readings were recorded but the totalizer has been removed due to continuous fouling. Although the clogged totalizer did not restrict flow, the fouling frequently caused inaccurate or no measurements and the totalizer was removed during the 4th Quarter of 2009.

Langan and Sunoco performed field sampling activities to evaluate the effectiveness of the water curtain system with respect to preventing off-site migration of vapors. The results of this evaluation are presented in Section 6.5 of this report.

### 6.4 North Yard Bulkhead/No. 3 Tank Farm Separator Total Fluids Recovery System

This section describes activities performed, and information gathered, to address Question No. 4 of the PADEPs technical response letter (Appendix D).

The North Yard Bulkhead Total Fluids Recovery System currently consists of a 3,400-feet long interceptor trench with two recovery sumps (RW-500 and RW-501). The No. 3 Tank Farm Separator Total Fluids Recovery System consists of one recovery system RW-502 located in the center of the capped closed separator. These systems addressed potential migration of LNAPL into the Schuylkill River. RW-500, RW-501 and RW-502 utilize electric submersible pumps and are controlled by a timer to recover total fluids. The total fluids from the three recovery wells were pumped to the North Yard 10,000-gallon holding tank where a flow meter measured incoming fluids pumped from the recovery

wells. Groundwater passed through the tank and was routed to the Point Breeze Processing Area Wastewater Treatment Plant. Accumulated LNAPL is pumped out of the 10,000-gallon holding tank as needed by a vacuum truck.

Regarding the systems operation and success, Langan compiled system monitoring data from the quarterly reports and other historical documents from 1992 through December 31, 2010. Recovery wells (RW-500 through RW-502) were included along with eight surrounding monitoring wells (N-55, 57, 58, 59, 61, 64, 72, and 73D). Trend charts were prepared to compare the corrected groundwater elevation and apparent LNAPL thickness over time. These charts are provided in Appendix I. If the product thickness is shown to be zero on the graphs, this indicates that either a sheen was observed or there was no measurable LNAPL. If no data point is present on the graphs, then there was no sheen or measurable LNAPL observed. Included in Appendix I are figures presented in chorological order that depict apparent LNAPL locations, thickness, and plumes over time.

The remedial system evaluation indicated a general decreasing trend in apparent LNAPL thickness in the recovery and nearby monitoring wells overtime. In the 3rd quarter of 2010, the North Yard Bulkhead and No. 3 Tank Farm Separator Total Fluids Recovery Systems were taken offline due to lack of LNAPL in the vicinity of the system. Due to lack of LNAPL in the vicinity of the system, Sunoco intends to keep the system offline.

## 7.0 FATE AND TRANSPORT ANALYSIS

The following sections describe fate and transport modeling activities performed as part of AOI 8 site characterization.

### 7.1 Soil

No fate and transport modeling was completed for the soil analytical results since the soil-to-groundwater pathway is evaluated through groundwater data. Potential exposure pathways for AOI 8 are discussed in more detail in Sections 9.0 and 10.0 below.

## 7.2 Groundwater

Fate and transport calculations were completed for groundwater in AOI 8 to evaluate potential migration pathways/potential impacts to receptors.

Five COCs were detected in groundwater during the July 2008 groundwater sampling event at concentrations above their respective MSCs. These COCs are benzene, pyrene, chrysene, phenanthrene and naphthalene. Groundwater samples from 53 monitoring wells in AOI 8 exhibited COC detections above their respective used-aquifer, non-residential groundwater medium specific concentrations (MSCs) for one or more of the above mentioned COCs.

To address the potential future migration of these COCs, a fate and transport analysis was performed using three models developed by PADEP. The Quick Domenico Version 2 (QD) model and the SWLOAD model were used for fate and transport in groundwater. PENTOXSD was used when assessing potential impacts of groundwater on surface water from organic COCs. Site-specific data was used to complete the fate and transport calculations, when available. A detailed summary of the procedures and calculations of the modeling procedures are presented in Appendix J. The approach and results of the modeling are discussed below.

Screening and Approach to Fate and Transport Analysis

Based on groundwater flow directions derived from May 2011 groundwater elevations (Figures 6 and 7) and the locations of potential off-site receptors AOI 8 was divided into three drainage areas for fate and transport analysis. Locations of each of these drainage areas are show on Figure J.1 of Appendix J.

- Drainage Area 1 is located in the eastern portion of AOI 8. The western boundary of Drainage Area 1 was defined as the groundwater divide where groundwater flow is generally east towards the AOI 8 property line. QD modeling was used to address potential off-site impacts along the AOI 8 northeast boundary.
- Drainage Area 2 consists of the central and western portions of AOI 8 where groundwater flow is generally towards the Schuylkill River. To address potential off-site impacts along the Schuylkill River the QD model was used first; then the SWLOAD model; then, as need, PENTOXSD.

- Drainage Area 3 was not defined hydraulically like Drainage Areas 1 and 2 but was used to delineate where active remediation will be conducted. Drainage Area 3 is located along the southern AOI 8 property boundary.

Groundwater concentrations at AOI 8 are assumed to be at or near steady-state for this analysis. A detailed description of the fate and transport modeling is presented below based on the three drainage areas and the July 2008 groundwater analytical results.

*Drainage Area 1 Wells*

1. Wells with exceedences of benzene, chrysene, pyrene and phenanthrene that are located hydraulically up-gradient of wells with non-exceedences of COCs and had stable groundwater trends did not undergo analysis by QD. The Drainage Area 1 wells that fall into this category include: N-11, N-106, N-12, N-102, N-103, N-104, N-20, N-21, and N-97. These wells are located up gradient of northeast property boundary wells N-3, N-4, N-8, N-16, N-17, N-19, N-84, N-85, N-28 and N-134 which do not contain COC concentrations above their respective MSCs.
2. N-9, N-12 and N-101, have exceedences of one or more COCs (benzene, pyrene, chrysene and phenanthrene) and are located up gradient of the northeast property boundary where no down gradient monitoring wells exist. To assess potential migration beyond the northeast property boundary for N-12 and N-101, a QD model was constructed. Fate and transport for benzene at deep well N-9 (screened in Lower Sand) was addressed in the AOI 11 report, where it was noted that benzene concentrations at N-9 exhibited decreasing trends to non-detect. Deep monitoring wells down gradient of N-9 also exhibited non-detects and was therefore not modeled.
3. As a check on the results of Drainage Area 1 fate and transport evaluation, a QD simulation was created for N-106 which had the highest benzene concentration in Drainage Area 1 (410 ug/l). Benzene is the most mobile of the COCs present therefore its ability to attenuate before it reaches N-98, near the northeast property line and where benzene was not detected, was further evaluated and the modeled results supported the observed groundwater concentrations.
4. At all sampled monitoring well locations in Drainage Area 1, laboratory RLs for chrysene were higher than the groundwater MSC of 1.9 ug/l. To ensure that the

potential for chrysene to impact off-site groundwater was evaluated, an additional QD simulation was constructed using site conditions found at N-8 (located about 25 feet from the property boundary) using the most elevated, site-wide chrysene RL of 120 ug/l as the starting concentration.

*Drainage Area 2 Wells*

1. Benzene detections above the groundwater MSC in Drainage Area 2 wells could be found in two general areas. The first area was at the center of AOI 8 (which includes RW-301, RW-303, RW-304, RW-305, RW-307, RW-308, N-108, N-121, N-118, N-119, N-123, N-44D and PZ-300) and second area was near the Schuylkill River on the west side of Drainage Area 2 (which includes N-59, N-61, N-136, N-133, PZ-503, PZ-504, PZ-505 and RW-500). Fate and transport of benzene groundwater impacts originating in the center of AOI 8 were not modeled because benzene impacts were not detected hydraulically downgradient of this area. Four monitoring well locations (N-23, N-34, N-35 and N-36) at the center of AOI 8 had benzene RLs above the benzene groundwater MSC and were reported not detected. Well locations down-gradient of these four monitoring wells had no benzene detections above the groundwater MCS and therefore were not further evaluated.

   Benzene groundwater impacts in wells located along the Schuylkill River were further evaluated with QD. Based on the July 2008 groundwater data, eight wells along the wooden bulkhead had detected benzene concentrations ranging from 13 ug/l to 10,000 ug/l. These eight wells are located along a 1,500 feet stretch of the Schuylkill River within approximately 250 feet from the bulkhead. A benzene isoconcentration map was constructed using the July 2008 data as shown in Figure J.3. The highest benzene concentration detected along the bulkhead was found near monitoring wells N-133 (10,000 ug/L) and N-61 (8,700 ug/L). Benzene concentrations decreased to the north and south of N-133 and N-61. To assess the entire 1,500 feet stretch of benzene impacts, the impacted area was broken into four zones to better define the variation in benzene concentration within the plume. For each zone a QD and SWLOAD model was constructed. If the SWLOAD results still exceeded the benzene surface water quality criteria (SWQC), PENTOXSD was used to derive a site-specific benzene wasteload allocation to re-screen the SWLOAD results.

N-58 and PZ-506 located along the Schuylkill River had elevated benzene RLs but was listed as not detected. QD and SWLOAD simulations for benzene at N-58 and PZ-506 were constructed using the benzene RLs as the starting concentration.

2. Naphthalene concentrations were detected above the groundwater MSC at three Drainage Area 2 wells (N-23, N119, and N-123) and evaluated using QD. The naphthalene RL at N-36 was greater than its MSC but listed as a not detect. No modeling was performed for naphthalene at this location because it was located in the center of AOI 8 and naphthalene impacts were not detected down-gradient of this monitoring well.

3. Phenanthrene concentrations were detected above the groundwater MSC at two monitoring wells (N-112 and N-128) in Drainage Area 2. Wells located down gradient of N-112 and N-128 were not impacted by phenanthrene, therefore, no fate and transport modeling was performed.

4. Chrysene detections above the groundwater MSC are ubiquitous in AOI 8. Due to the low affinity for transport (strong tendency to sorb to aquifer materials) and stable groundwater trends in interior wells potential impacts of chrysene on surface water were assessed at locations along the Schuylkill River only. The wells included in this evaluation included N-111, N-60, PZ-503, PZ-505, PZ-506, PZ-507 and RW-200.

   Chrysene impacts in Drainage Area 2 wells located along the Schuylkill River were first screened against the chrysene SWQC found in the PA Code Chapter 93.8c. Neither chronic nor acute SWQC for chrysene have been derived for the PA Code. Therefore additional screening was done with US EPA Lowest Observable Effect Level (LOELs) for acute exposure to chrysene in the marine environment of 300 ug/l. Screening results indicate that chrysene at present concentrations does not exceed the LOEL value along the bulkhead. Groundwater is impacted by chrysene near the Schuylkill River when compared to the human health SWQC of 0.0038 ug/l. Chrysene was assessed using QD and SWLOAD. If the SWLOAD results still exceeded the groundwater quality criteria, PENTOXSD was used to derive a site-specific wasteload allocation to re-screen the SWLOAD results.

Chrysene RLs at all sampled monitoring wells in Drainage Area 2 were higher than the chrysene groundwater MSC of 1.9 ug/l. To ensure chrysene will not impact off-site surface water, a simulation was constructed using site conditions found at PZ-504 (26 feet from the bulkhead) and the site-wide maximum chrysene RL of a 120 ug/l was used as the starting concentration. The result of this simulation was used to evaluate chrysene in Drainage Area 2 near the Schuylkill River.

5. Pyrene has a strong affinity to sorb to aquifer materials and a low affinity for transport. Therefore the assessment of pyrene for potential fate and transport was focused along the Schuylkill River.

   Based on the July 2008 groundwater data, pyrene was detected above its groundwater MSC of a 130 ug/l at two monitoring well locations (N-111 and RW-200) along the Schuylkill River. Chronic and acute SWQC for pyrene were not developed in Pennsylvania. The PA Code human health SWQC for pyrene is 830 ug/l. Pyrene concentrations at RW-200 (300 ug/l) and N-111 (160 ug/l) do not exceed the human health SWQC. A screening concentration for chronic exposure to pyrene in fresh water of 0.025 ug/l was derived by Environment Canada which is below the detected pyrene concentration at N-111 and RW-200. Therefore, fate and transport modeling for pyrene was performed.

6. 1,2-dichloroethane RLs were elevated above its groundwater MSC of 5 ug/l at four monitoring well locations (N-58, N-61, N-133 and PZ-506) along the bulkhead, and one location (N-119) in the interior of Drainage Area 2. Wells located down gradient of N-119 did not contain 1,2-dichloroethane above its groundwater MSC and was therefore not modeled. To address the potential for 1,2-dichloroethane to impact surface water QD, SWLOAD and PENTOXSD models were constructed for the four locations along the bulkhead using each RL as the starting concentration.

   *Drainage Area 3 Wells*

   Drainage Area 3 wells will be addressed through active remediation and therefore were not modeled.

**QD and SWLOAD Modeling Results**

Drainage Area 1

*N-12*

The QD modeling result for benzene, pyrene, chrysene and phenanthrene at N-12 indicates potential transport distances ranging from two to eight feet. N-12 is located 575 feet from the property line. These results indicate that there is little potential for these COCs to migrate beyond the property boundary. Individual QD and SWLOAD modeling spreadsheets can be found in Tables J.2 through J.5.

*N-101*

QD modeling results for chrysene at N-101 indicates potential transport distances of 4 feet. N-101 is located about 350 feet from the northeast property boundary, therefore groundwater at N-101 impacted with chrysene is not likely to migrate to the AOI 8 northeast property boundary.

*N-8*

This simulation was constructed to address chrysene RL data quality issues. RLs for chrysene were not met in all AOI 8 groundwater analyzed from the July 2008 groundwater sampling event. RLs for chrysene ranged from 5 ug/l to 120 ug/l while the chrysene groundwater MSC is 1.9 ug/l. To address the potential impact of chrysene at concentrations between the groundwater MSC and the maximum RL, a QD model was constructed for N-8 because of its close proximity (25 feet) to the property boundary with a starting concentration of 120 ug/l (maximum RL for chrysene in July 2008 groundwater results). QD modeling results indicate that chrysene would attenuate to a concentration below its MSC within 11 feet from the source. Based on the distances of other site wells from the property boundary chrysene is not predicted to migrate beyond the property boundary above its respective MSC.

Drainage Area 2

*Chrysene*

Chrysene starting concentrations used in the QD and SWLOAD modeling ranged from 8 ug/l to 120 ug/l for wells N-60, N-111, PZ-503, PZ-505, PZ-506, PZ-507 and RW-200 (Table J.1). Individual QD and SWLOAD modeling spreadsheets can be found in Tables J.6 through J.40. QD modeling results predicted chrysene transport under current aquifer conditions range from less than one to eleven feet before attenuating to

its groundwater MSC of 1.9 ug/l. This suggests that chrysene at these locations will not impact the Schuylkill River.

To address RL issues with chrysene, the closest well to the Schuylkill River, PZ-504, was modeled with at starting concentration of 120 ug/l. QD modeling predicts that chrysene will attenuate below its groundwater MSC of 1.9 ug/l within eight feet of PZ-504. This suggests that chrysene in groundwater where the RLs were above the groundwater MSC will not impact the Schuylkill River.

*Benzene*

As discussed, the benzene concentrations in Drainage Area 2 were divided up into four "zones" based on the benzene isoconcentrations. Starting concentration for benzene in Zones 1 through 4 are, respectively, 300 ug/l (RW-500); 8,700 ug/l (N-61); 2,400 ug/l (PZ-504); and 160 ug/l (PZ-505). QD results for benzene in Zones 1 through 4 indicate that groundwater concentrations will attenuate below its groundwater MSC in 23 feet for Zone 1; 90 feet for Zone 2; 134 feet for Zone 3; and 59 feet for Zone 4. The distances to the Schuylkill River from the most down gradient impacted wells in each zone ranges between 26 to 29 feet. These results suggest that benzene in Zones 2 through 4 have the potential to migrate and reach the Schuylkill River at concentrations greater than the groundwater MSC. Benzene in Zone 1 does not have the potential to discharge to the Schuylkill River above its MSC. SWLOAD was then used to predict groundwater benzene concentration at the Schuylkill River for Zones 1 through 4.

SWLOAD modeling results for Zone 1 predicted a benzene concentration of 2.07 ug/l in groundwater at the Schuylkill River. This concentration does not exceed the groundwater MSC, therefore a PENTOXSD model was not needed for Zone 1.

The SWLOAD model predicted groundwater concentration for benzene in Zone 2 is 947.2 ug/l which exceeds the benzene groundwater MSC. This predicted concentration also exceeds the acute fish, chronic fish and human health SWQC. Therefore the groundwater discharge volume calculated by SWLOAD for Zone 2 was used to create a PENTOXSD model to derive acute fish, chronic fish and human health wasteload allocation for Zone 2.

The SWLOAD model predicted groundwater concentration for benzene in Zone 3 is 676.4 ug/l, which is above the benzene groundwater MSC. This value also exceeds the acute fish, chronic fish and human health SWQC. Therefore the groundwater discharge volume calculated by SWLOAD for Zone 3 was used to create a PENTOXSD model to derive acute fish, chronic fish and human health wasteload allocations for Zone 3.

The SWLOAD model predicted groundwater concentration for benzene in Zone 4 is 29.03 ug/l, which is above the benzene groundwater MSC. It does not exceed the acute or chronic fish SWQC, but does exceed the human health SWQC. Therefore the groundwater discharge volume calculated by SWLOAD for Zone 4 was used to create a PENTOXSD model to derive a human health wasteload allocation for Zone 4.

QD and SWLOAD results for benzene RL problems at N-58 and PZ-506 which used the maximum benzene RL of 10 ug/l, indicates that benzene will attenuate below its MSC (Tables J.1) within 41 feet of N-58 and 11 feet of PZ-506. N-58 is about 55 feet from the Schuylkill River and PZ-506 is 130 feet from the river; therefore, potential benzene impacts at N-58 and PZ-506 are not predicted to reach the river. SWLOAD predicted a benzene concentration in groundwater of 3.96 ug/l at N-58 and <0.001 at PZ-506 at the Schuylkill River.

*1,2-Dichloroethane*

Elevated RLs for 1,2-dichloroethane in Drainage Area 2 were found at N-58, N-61, N-133 and PZ-506. Because these wells are located close to the Schuylkill River, there is a possibility that groundwater could be impacted with a 1,2-dichloroethane concentration below the RL but above the MSC. This possibility was addressed by constructing QD and SWLOAD models with starting 1,2-dichloroethane concentrations equal to the RL for all four locations (10 ug/l). The groundwater MSC for 1,2-dichloroethane is 5 ug/l. QD and SWLOAD results for N-61, N-133 and PZ-506 indicate that 1,2-dichloroethane in groundwater attenuates to a concentration below the MSC before it reaches the Schuylkill River. 1,2-dichloroethane at N-58 required 75 feet to attenuate below the MSC while the distance to the Schuylkill River is 55 feet. SWLOAD calculated the 1,2-dichloroethane concentration in groundwater adjacent to the Schuylkill River at 5.97 ug/l. Therefore a PENTOXSD simulation was constructed using the SWLOAD calculated groundwater discharge rate for 1,2-dichloroethane at N-58.

*Pyrene*

Pyrene starting concentrations used in the QD and SWLOAD modeling was 160 ug/l at N-111 and 300 ug/l at RW-200. QD modeling results predicted pyrene transport distance under current aquifer conditions would attenuate to its MSC of 130 ug/l at N-111 in <1 foot and nine feet for RW-200 (Table J.1). This suggests that chrysene at these locations will not impact the Schuylkill River.

**Potential Impacts to Surface Water (PENTOXSD) Results**

Three PENTOXSD simulations were constructed to address benzene groundwater impacts along the Schuylkill River on the west side of AOI 8. PENTOXSD models were constructed for Zone 2 (N-61, PZ-503), Zone 3 (N-133, PZ-504) and Zone 4 (PZ-505) (Figure J.4). Input parameters for PENTOXSD are summarized in Table J.41. As directed by PADEP the Schuylkill River $Q_{7\text{-}10}$ flow was entered into PENTOXSD as 10% of the actual $Q_{7\text{-}10}$ flow of 101 cubic feet per second (CFS); the harmonic mean flow for the Schuylkill River was entered in PENTOXSD as 10% of the actual harmonic mean flow of 807 CFS. The resulting wasteload allocations for benzene range from a minimum of 417,325 ug/l for human health cancer risk in Zone 3 to a maximum of 11,360,000 ug/l for chronic fish criterion in Zone 2. These results indicate that benzene groundwater concentrations near the bulkhead will not impact the Schuylkill River.

A fifth PENTOXSD model was created to address the elevated RL for 1,2-dichloroethane at N-58 for the July 2008. Flow in the Schuylkill River was identical to the previous PENTOXSD simulations. Input parameters for PENTOXSD are summarized in Table J.41. Wasteload allocations for 1,2-dichloroethane ranged from 165,191.1 ug/l (human health cancer risk level) to 1.04e8 ug/l (chronic fish criterion). PENTOXSD modeling results can be found in Tables J.41 through J.45.

**Fate and Transport Modeling Conclusions**

*Drainage Area 1*

Fate and Transport simulations indicate that groundwater concentrations of benzene, chrysene, pyrene and phenanthrene do not pose an unacceptable risk to off-site receptors.

*Drainage Area 2*

Fate and transport analysis of benzene, chrysene and 1,2-dichloroethane do not pose an unacceptable risk to off-site receptors.

## 7.3 LNAPL

As described in Appendix G, Sunoco evaluated LNAPL mobility across the site using the API LNAPL model, as a guide for assessing LNAPL volume, mobility, and recoverability across the refinery. Based on the LNAPL types (extremely weathered middle distillates, residual and lubrication oils), updated API Model output results, and recent groundwater gauging activities (May 2011) LNAPL in AOI 8 is stable and immobile.

## 7.4 Vapor Intrusion into Indoor Air

Occupied areas of AOI 8 include the Boiler House located in the central portion of AOI 8 and the Philadelphia Fire Department building located west of the PGW border. These buildings are shown on Figure B-1 in Appendix B. The Boiler House is operated by Sunoco and regulated by OSHA and there are no known preferential pathways that exist in the immediate area (less than 100 feet) of this occupied building.

Boiler House

The Boiler House building is greater than 100 feet from above mentioned groundwater and soil sample locations which had detections above their respective soil and groundwater MSCs. There are no known preferential pathways connecting these locations to the Boiler House. There is no known LNAPL within 100 feet of the Boiler House. The Boiler House is operated by Sunoco and is included in the indoor air monitoring program and is regulated by OSHA. Indoor air monitoring was performed by Sunoco on September 25, 2008 at the Boiler House for benzene and total VOCs using an Ultra Rae PID. The Ultra Rae is calibrated for benzene and total VOC's using 5 ppm benzene calibration gas and 100 ppm isobutylene calibration gas respectively. The Ultra Rae has a detection limit of 100 parts per billion (ppb) or 0.1 ppm for both benzene and total VOCs. Benzene and total VOCs were not detected in any location during the monitoring event.

Since the site specific standard is being applied, groundwater within some portions of AOI 8 is shallower than 5 feet, underground utilities exist and sampling was not

completed below all areas with impervious covers, Sunoco will place a restriction in the UECA covenant for AOI 8 that will require the evaluation of the need for vapor mitigation systems to be installed for any new occupied buildings that will be constructed within AOI 8 as well as any used buildings.

Philadelphia Fire Department Building

The soil gas and indoor air samples collected at the Fire Department building were screened against the applicable indoor air screening criteria in Appendix H of this report. Based on the results, the vapor intrusion into indoor air pathway is incomplete at the Fire Department building.

Jackson Street Sewer

In response to questions No. 5 and 6 of the PADEPs technical response letter (Appendix D), a further evaluation of the sewer as a preferential migration pathway for LNAPL and vapor, was performed by Sunoco in 2009.

In June 2009 Sunoco and Aquaterra collected 24-hour TO-15 summa air gas samples east and west of the water curtain alongside and inside of sewer (Figure 3). The air gas sampling was performed to evaluate possible vapor migration off-site in the residential neighborhood. The air gas sample results were screened against the PADEP residential indoor air screening criteria. The analytical results of the air gas samples indicated that were no benzene detections east of water curtain or off-site in the sewer near residential neighborhoods. Chloroform was above its screening criteria west of water curtain (Manhole No. 1) and off-site in sewer (Manhole No. 6). Concentrations of COCs were below criteria in the background ambient air sample. Methane was detected in Manhole No. 3 west of the water curtain and in Manhole No.6 located in the residential neighborhood.

Sunoco will place a restriction in the UECA covenant for AOI 8 that will require further vapor site characterization activities and/or installation of a vapor mitigation systems for any new/existing occupied buildings within AOI 8.

## 8.0 SITE CONCEPTUAL MODEL

A preliminary site conceptual model (SCM) for the refinery, including AOI 8, was presented in the CCR. Data collected from the recent site characterization activities performed in AOI 8 were used to refine the SCM for this area. The revised SCM for AOI 8 is described in the following sections:

### 8.1 Description and Site Use

AOI 8 is the northern-most area of the refinery and is bound by the PGW plant to the south, the Schuylkill River to the west, industrial properties to the north, and urban streets to the east (Figure 1), and encompasses approximately 250 acres.

AOI 8 was an active refinery process area since the early twentieth century with process areas and ASTs. The area also included the former lube, asphalt, soap, and wax plants. The majority of AOI 8 structures were demolished between 1975 and 1980. Subsequent to decommissioning of most of the process areas, a LTU was operated from 1986 through 2000. Currently, the only remaining active facilities in AOI 8 are the asphalt dock, the boiler house, a storm water separator, fuel oil storage, butane and propane storage areas, and loading and unloading facilities. Much of AOI 8 is unimproved and many of the ASTs have been removed. There is one RCRA SWMU located in AOI 8 that was addressed in various stages of previous RCRA investigations as part of the EPA Corrective Action Process. The current, historic uses/investigations and approximate limits of impervious surfaces are depicted on Figure B-1 provided in Appendix B.

AOI 8 is located within a fenced and secured area to prevent unauthorized access. Prior to any work being completed within AOI 8, appropriate work permits, safety and security measures must be approved by Sunoco Refinery personnel. AOI 8 is under the control of Sunoco's health and safety administrative procedures and is regulated by OSHA. Direct contact to site soils (soils greater than two feet beneath the ground surface) is controlled by Sunoco's on-site permit and personal protective equipment (PPE) procedures. The current and future intended use of AOI 8 is non-residential.

## 8.2 Geology and Hydrogeology

The following summarizes relevant information concerning geology and hydrogeology in AOI 8:

Geology

- Fill materials are present throughout AOI 8.
- In the western portion of AOI 8, the Pleistocene age formations have been eroded and replaced with alluvium. The alluvium is deposited atop bedrock and extends to the central and northern portions of AOI 8, but is absent in the eastern portion. Along the eroded edge (central portion of AOI 8), the alluvium is in direct contact with Trenton Gravel, Lower/Middle Clay, Lower Sand and/or bedrock.
- Trenton Gravel is present in the northern, central and eastern portions of AOI 8 but is absent in the western portion where it has been eroded and replaced with alluvium. The Lower/Middle Clay is present beneath AOI 8 as a wedge that thickens towards the west and the Schuylkill River but is absent between the central and western portions of AOI 8 where it has been eroded and replaced with alluvium. The Lower Sand overlies bedrock in the eastern and central portions of AOI 8, but is absent in the northwestern and western portions where it has been eroded and replaced with alluvium.
- The depth to bedrock beneath AOI 8 increases towards the south.

Hydrogeology

- A groundwater flow divide, trending northwest to southeast, is present in the central portion of AOI 8 in both the shallow and deep groundwater zones. This divide generally corresponds with the eastern extent of the alluvium materials deposited following the erosion and removal of the Pleistocene age deposits. In shallow and intermediate groundwater zones, groundwater on the east side of the divide flows to the northeast and groundwater on the west side of the divide flows to the southwest. In the deep zone, groundwater on the east side of the divide flows to the east and southeast and groundwater on the west side of the divide flows to the southwest.

- The shallow groundwater gradient in the western portion of AOI 8 is relatively flat with some depressions and mounds at isolated locations. Along the western AOI 8 boundary, shallow groundwater flow is more pronounced towards the bulkheads and River.
- The shallow groundwater gradient in the eastern and southern portions of AOI 8 is relatively flat with some depressions and mounds at isolated locations.
- A downward vertical flow gradient exists between the shallow and deep zone as indicated by the groundwater elevations in the following monitoring well pairs: N-3/N-4, N-12/N-13, N-8/N-9, N-18/N-19, N-20/N-21, N-29/N-30, N-38/N-38D, N-43/N-44D, N-47/N-46D and N-51/N-50D. This is consistent with vertical gradients elsewhere in the refinery.

## 8.3 Compounds of Concern

The following summarizes relevant information concerning COCs in AOI 8:

Shallow Soil

- COCs detected in shallow soil at concentrations above their respective non-residential soil MSCs included: benzene, naphthalene, benzo(a)pyrene and lead.
- Toluene, ethylbenzene, ethylene dibromide, 1,2-dichloroethane, total xylenes, MTBE, cumene, anthracene, pyrene, benzo(g,h,i)perylene, benzo(b)fluoranthene, chrysene, benzo(a)anthracene, phenanthrene and flourene were not detected in shallow soil samples at concentrations above their respective PADEP non-residential soil MSCs.

SWMU 2

- Materials resembling leaded tank bottoms were observed in one boring location (BH-08-05) at SWMU 2. Soil from this boring exhibited a lead concentration below the PADEP non-residential MSC (450 ppm) and was therefore not submitted for TCLP analysis. No other evidence of leaded tank bottom materials were observed in all other soil borings advanced in the area of SWMU 2.

Groundwater

Groundwater samples were collected from monitoring wells that did not contain LNAPL and that were accessible. This included monitoring wells that screened both the shallow/intermediate and lower sand units. The results of the groundwater samples are summarized below by corresponding hydrogeologic zone.

Shallow/Intermediate

- COCs detected in shallow groundwater at concentrations above their respective non-residential groundwater MSCs included: benzene, pyrene, chrysene, phenanthrene, and naphthalene.
- Cumene, toluene, ethylbenzene, ethylene dibromide, xylenes (total), fluorene, MTBE, 1,2-dichoroethane and lead were not detected in shallow groundwater at concentrations above their respective PADEP non-residential MSCs.

Deep (Lower Sand)

- Benzene was detected in three deep (Lower Sand) monitoring wells (N-9, N-21, N-44D) at concentrations slightly above its respective non-residential PADEP MSC.
- Toluene, MTBE, 1,2-dichoroethane, xylenes (total), cumene, ethylbenzene, ethylene dibromide, pyrene, chrysene, phenanthrene, fluorine, naphthalene, and lead were not detected in deep groundwater at concentrations above their respective PADEP non-residential MSCs.

The exposure assessment completed for the COCs above the MSCs is discussed in Section 8.0 of this report.

## 8.4 LNAPL Distribution and LNAPL Mobility

The following summarizes relevant information concerning LNAPL distribution in AOI 8:

- There are four different types or mixtures of LNAPL were identified in AOI 8 which includes residual oil, lube oil, lube oil/middle distillate mixture, and middle distillate.
- Based on LNAPL modeling, the LNAPL type, degree of weathering, groundwater flow/gradients, presence of a sheet pile/bulk head walls, the absence of LNAPL

in the surrounding monitoring wells, and the occurrence of LNAPL in these monitoring wells over time, LNAPL is considered to be stable and immobile.

## 8.5 Fate and Transport of COCs

No fate and transport modeling was completed for the soil analytical results since the only potential exposure pathway to soil is by direct contact. The soil-to-groundwater pathway is evaluated through groundwater data.

*Drainage Area 1*

Fate and Transport simulations indicate that groundwater concentrations of benzene, chrysene, pyrene and phenanthrene do not pose an unacceptable risk to off-site receptors.

*Drainage Area 2*

Fate and transport analysis of benzene, chrysene and 1,2-dichloroethane do not pose an unacceptable risk to off-site receptors.

*Drainage Area 3*

Drainage Area 3 wells will be addressed through active remediation. The groundwater and surface water modeling is described in detail in Appendix J.

## 8.6 Potential Migration Pathways and Site Receptors

The following summarizes potential migration pathways and site receptors for AOI 8.

- AOI 8 is situated within a fenced, secured area to prevent unauthorized access.
- The potential direct contact pathway to soil greater than two feet is deemed incomplete based on Sunoco's existing permitting procedures which protect against exposure to soil encountered in excavations. This pathway may be further evaluated based on site redevelopment.
- 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.

- The need for further vapor site characterization activities and/or the installation of vapor mitigation systems for future occupied buildings will be evaluated on a case by case basis.
- The water curtain in the Jackson Street sewer effectively reduces hydrocarbon odors and vapors potentially migrating from the Jackson Street sewer to the surrounding areas.

## 9.0 HUMAN HEALTH EXPOSURE ASSESSMENT/RISK ASSESSMENT

Based on the current and future intended non-residential site use for AOI 8, an exposure assessment was conducted for compounds that were above the non-residential statewide health standards in AOI 8. Potential human health exposures for the refinery are for an industrial worker scenario. The media evaluated included groundwater, shallow soil, and subsurface soil (greater than two feet below grade).

The potential direct contact pathway for soil (greater than two feet), groundwater and LNAPL under the industrial scenario is eliminated through Sunoco's established excavation procedures, PPE requirements and soil handling procedures described in the CCR. However, because direct contact to shallow soils could occur outside of excavation activities, shallow soil samples were collected in non-paved areas of AOI 8 to assess this potential exposure pathway.

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 8. The table lists potentially contaminated media, potential receptors for these media, and a summary of whether any potentially complete exposure pathways exist at AOI 8 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 |
| Soil <2 feet bgs. | NA | Yes | NA | Yes | No | NA | NA |
| Soil >2 feet bgs. | NA | No(4) | NA | No(4) | No | NA | NA |
| Surface Water | NA | No(5) | NA | No(5) | Na | NA | NA |
| Sediment | NA | NA | NA | NA | 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 current complete pathway to indoor air exists based on the evaluation described in Section 6.5.
(4) No complete pathway exists for site soil >2 feet deep that are not addressed through on-site permitting procedures and PPE.
(5) 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 sections by media.

### 9.1 Surface Water

There are no surface water features located within AOI 8. The nearest surface water body to AOI 8 is the Schuylkill River which borders the western site boundary (Figure 2). A sheet pile wall and bulkhead are located along the western boundary of the site. Shallow/intermediate groundwater interaction with surface water is limited by the above referenced sheet pile wall and bulkhead.

Based on the location of the sheet pile wall and bulkhead, groundwater flow, and the results of the groundwater modeling for monitoring wells where groundwater samples were above the groundwater MSCs, none of the constituents detected in groundwater will cause an in-stream violation of surface water quality criteria for the Schuylkill River.

### 9.2 Shallow Soils (0-2 Feet Below Grade)

The soil-to-groundwater pathway is being addressed through the groundwater pathway discussed in Section 9.3.

Direct Contact Exposure

Shallow soil samples collected and analyzed as part of the AOI 8 characterization activities exhibited concentrations of benzene, benzo(a)pyrene, naphthalene and lead above their respective non-residential direct contact MSCs. In accordance with Section IV of the PADEP's Technical Guidance Manual, site-specific standards for lead and benzene were calculated using PADEP default intake parameters for an onsite worker and a risk level of $10^{-4}$. For calculating a site-specific standard for on-site workers exposed to lead, Sunoco used the Society of Environmental Geochemistry and Health (SEGH) model used by PADEP to develop the non-residential soil MSCs.

The site-specific standards for the organic compounds (calculated in Appendix K, Tables F-1 through F-4) are as follows:

| **Compound** | **Calculated Site-Specific Standard (mg/kg)** |
|---|---|
| Benzene | 2,160 |
| Naphthalene | 56,780 |
| Benzo(a)pyrene | 109 |
| Lead | 1,708 |

The site-specific screening level for benzene was calculated for inhalation based on the calculation specified in 25 Pa. Code § 250.307(b), and for naphthalene and benzo(a)pyrene for ingestion based on the calculations specified in 25 Pa. Code § 250.306(b). These calculations used the PADEP's default parameters and an updated target risk level of 1E-4, in consideration of the site-specific conditions (PADEP's default target risk level is 1E-5).

As presented in Table F-1 through F-4, based on the revised target risk level, the derived site-specific standards for benzene, naphthalene and benzo(a)pyrene are calculated for an onsite worker and are consistent with the values used in the previous AOI SCRs prepared for the refinery. Concentrations of benzene, naphthalene and benzo(a)pyrene detected in the shallow soil samples collected in AOI 8 are below the site-specific standards and, therefore, risk to an on-site worker due to exposure is considered to be within the acceptable Act 2 range.

The site-specific standard for lead based on the SEGH model presented in Appendix K was calculated to be 1,708 mg/kg for a worker. The site-specific screening level for lead was calculated for ingestion. As presented in 25 Pa. Code § 250.306(e), Appendix A, Table 7, the non-residential soil screening value for lead is based on the method presented in the report 'The Society for Environmental Geochemistry and Health (SEGH) Task Force Approach to the Assessment of Lead in Soil' (Wixson, 1991). The model used by the PADEP and developed by SEGH was also used to calculate the site specific criterion for the refinery. Based on the SEGH model and PADEP's default parameters, PADEP's non-residential direct contact MSC default value for lead in shallow soil is 1,000 mg/kg. To develop a site-specific criterion for lead, some of the parameters used by the PADEP were updated in consideration of site-specific conditions and updated lead data collected from recent studies.

As presented in Table F-4 of Appendix K, based on the revised parameters, the derived site-specific standard for lead in soil is 1,708 mg/kg for a refinery worker. Concentrations of lead detected in the shallow soil samples collected in AOI 8 are below the site-specific standard and, therefore, risk to an on-site worker due to exposure to lead is considered to be within the acceptable Act 2 range.

In addition to calculating the site-specific standards for benzene, naphthalene, benzo(a)pyrene, and lead, the cumulative risk of exposure was also calculated. Lead exposure is dependent on the blood/lead concentration and not risk based; therefore, lead could not be incorporated into the cumulative risk calculation.

The cumulative hazard index is the combined index for exposure to non-carcinogenic compounds (naphthalene) and should not exceed 1. As presented in Table F-5 of Appendix K, the cumulative hazard index for exposure to the non-carcinogenic compounds is less than the PADEP's requirement of 1.0 and therefore no remedies are required for AOI 8 to address exposure to non-carcinogenic compounds.

The total cumulative risk is the combined risk of exposure to the concentrations of carcinogenic compounds (benzene and benzo(a)pyrene) and, in accordance with the TGM, the total cumulative risk should not exceed $10^{-4}$. As presented in Table F-5, the total cumulative risk of exposure to the carcinogenic compounds in AOI 8 is $1.69^{E-4}$, and exceeds the acceptable risk limit. Potential exposure to carcinogenic compounds in the

areas of N-99 and N-134 (which have the highest concentrations of benzo(a)pyrene), will be addressed by Sunoco through implementation of a remedy which will either remediate or eliminate the potential pathway to onsite workers. Once these areas are addressed as will be proposed in the Cleanup Plan, the total cumulative risk will be below $10^{-4}$.

### 9.3 Groundwater

Results of the groundwater sampling indicated COCs at concentrations above their respective non-residential groundwater MSCs, included benzene, pyrene, chrysene, phenanthrene, and naphthalene. Concentrations of these COCs to impact off-site receptors are limited due to the direction of groundwater flow. In addition, pyrene, chrysene, phenanthrene and naphthalene groundwater impacts do not migrate very far (tens of feet) from their respective sources; this is due primarily to a strong tendency for these compounds to partition to soils during transport. Based on the QD, SWLOAD and PENTOXSD fate and transport analysis, concentrations of the above mentioned COCs are not expected to exceed the groundwater MSCs at the site boundary or have an unacceptable impact on site receptors (Schuylkill River to the west and/or residential areas to the east).

Excavations in AOI 8 are governed by Sunoco's permitting procedures which protect against potential exposures to groundwater that could be encountered in an excavation. Also, there are no complete direct contact exposure pathways for groundwater within AOI 8 because of on-site refinery safety procedures and required PPE. Previous investigations and well searches verified that no wells located within 1.5 miles of the refinery are used for drinking water or agricultural use.

### 9.4 LNAPL

There are no complete direct contact exposure pathways for LNAPL within AOI 8 because of on-site permitting procedures and required PPE.

### 9.5 Vapor

Based on the results of the vapor intrusion assessment completed at the Philadelphia Fire Department Building indicated that concentrations of COCs are below the indoor air screening criteria.

Based on the results of the assessment activities completed at the Jackson Street Sewer, the water curtain is successfully reducing hydrocarbon odors and vapors that potentially could migrate from the Jackson Street sewer to the surrounding areas.

Further evaluation (i.e. soil gas samples) will be completed to assess the impact to indoor air or vapor mitigation systems will be installed in any occupied buildings constructed/used at the refinery dependent upon site redevelopment.

## 10.0 ECOLOGICAL ASSESSMENT

The majority of AOI 8 is covered with soil and gravel. Some areas are covered by impervious surfaces as shown in Appendix B. The soil and gravel-covered portions of AOI 8 are not likely to serve as a breeding area, migratory stopover, or primary habitat for wildlife. In 2011, a survey of endangered, threatened and special concern wildlife was conducted by submitting a request to the Pennsylvania Natural Diversity Inventory (PNDI) data base. No endangered, threatened or special concern wildlife was identified in AOI 8 using these maps or during historical investigations. Based on this information, there are no terrestrial ecological receptors of concern for AOI 8 and no related assessment was necessary.

No surface water features are located in AOI 8. The nearest surface water body to AOI 8 is the Schuylkill River which borders the western boundary. Sheet pile and wooden bulkheads are present between AOI 8 and the Schuylkill River as illustrated in Figure 2. Groundwater interaction with surface water/sediment is limited by the above-referenced walls. Based on QD, SWLOAD and PENTOXSD fate and transport analysis, the presence of impacted groundwater in AOI 8 should not pose a threat to surface water.

## 11.0 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 a local newspaper. As part of the CRP, Sunoco intends to hold an initial public meeting in the city of Philadelphia to present the strategy and give status updates of the project at the CAP meeting on an annual basis.

A copy of the NIR and the Act 2 report notifications for this SCR/RIR are included in Appendix A.

## 12.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the completed activities, the following conclusions and recommendations have been developed for AOI 8:

Soil Outside of SWMU 2

- Concentrations of benzene, naphthalene, benzo(a)pyrene and lead detected in shallow soil samples collected in AOI 8 were above their respective non-residential soil MSCs; however they were below the calculated site-specific standards. The total cumulative risk of exposure to the carcinogenic compounds in AOI 8 is $1.69E^{-4}$, and exceeds the acceptable risk limit. Potential exposure to carcinogenic compounds in the areas of N-99 and N-134 (which have the highest concentrations of benzo(a)pyrene), will be addressed by Sunoco through implementation of a remedy which will either remediate or eliminate the potential pathway to onsite workers. As part of the Cleanup Plan for AOI 8, these areas will be addressed and the total cumulative risk will be below $10^{-4}$. Selected soil samples of ethylene dibromide will also be collected due to the RLs exceeding the MSCs and the results will be reported in the Cleanup Plan.
- With regard to the potential direct-contact pathway to deeper soil (i.e., greater than 2 feet deep) and the soil-to-groundwater pathway, the direct contact pathway to soil greater than 2 feet beneath the ground surface at the refinery is incomplete because of on-site procedures and PPE requirements that protect onsite workers from exposure. This pathway may be further evaluated under redevelopment scenarios. The soil-to-groundwater pathway was evaluated using shallow groundwater data as is discussed below.

Groundwater

- Five COCs (benzene, pyrene, chrysene, phenanthrene, and naphthalene) were detected in groundwater during the July 2008 groundwater sampling event at concentrations above their respective used-aquifer, non-residential groundwater MSCs. Based on QD, SWLOAD, and PENTOXD fate and transport simulations, the presence of the bulkhead/sheet pile wall, groundwater flow direction and the proposed re-start of remedial activities along the PGW border, concentrations of the above mentioned COCs are not expected to exceed the groundwater MSCs at the site boundary and or affect site receptors (Schuylkill River to the west and/or residential areas to the east).
- Chrysene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene will be evaluated in select wells and the results will be documented in the Cleanup Plan due to the RL exceedances of the groundwater MSCs. Based on the conservative fate and transport modeling it is not expected that these results will alter the results of this RIR.

Vapor

The results of the vapor intrusion screening evaluation using the PADEP guidance indicated:

- Results of the soil gas and indoor air sampling completed at the Philadelphia Fire Department Building indicated that concentrations of COCs are below the indoor air screening criteria.
- The Jackson Street Sewer analytical results indicated that indoor air exceedances were detected west of the water curtain, but not to the east, indicating that the water curtain is effectively controlling vapor migration from the sewer. Although methane was detected east of the water curtain, it is associated with a background source.
- The need for further vapor site characterization activities and/or the installation of vapor mitigation systems for future/existing occupied buildings will be performed per the UECA covenant as part of redevelopment activities, as necessary.

LNAPL

- The horizontal extent of the LNAPL plume relative to the site boundaries has been delineated and mobility of the identified LNAPL is low.

- Based on the remedial system evaluations performed on the Jackson Street Sewer and the Bulkhead systems, Sunoco intends to keep the systems offline. The Jackson Street Sewer outfall will continue to be monitored to confirm the lack of LNAPL presence.
- Impacted groundwater and LNAPL (lube oil and residual oil) along the PGW border in Drainage Area 3 will be addressed by the existing PGW Border Total Fluids Recovery System. The effectiveness of the PGW Border Total Fluids Recovery system and the need to expand the system is being further evaluated by Sunoco. Updates and proposed modifications to the existing remediation system will be provided in the quarterly reports or the Cleanup Plan prepared for the refinery.
- There are no complete direct contact exposure pathways for LNAPL within AOI 8 because of on-site permitting procedures and required PPE.

RCRA SWMUs

- No leaded tank bottom materials were identified meeting all of the established criteria in AOI 8. Therefore, Sunoco is requesting a comfort letter for SWMU 2 in AOI 8 from EPA.

## 13.0 SCHEDULE

The proposed schedule for future Site activities is:

- Submittal of a Cleanup Plan following PADEP approval of the SCR/RIR and in concert with redevelopment plans;
- Submittal of a Final Report; and
- Continue quarterly monitoring activities and reports.

## 14.0 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.

## 15.0 REFERENCES

*Groundwater Resources of the Coastal Plain Area of Southeastern Pennsylvania. Greenman, Topographic and Geologic Survey, Bulletin W-13, 375 pp., David W., Rima, Donald R., Lockwood, William N. and Meisler, Harold. 1961.*

*Simulation of Ground-Water Flow in the Lower Sand Unit of the Potomac-Raritan-Magothy Aquifer System*, Philadelphia, Pennsylvania, U.S. Geological Survey, Water-Resources Investigations Report 86-4055, Sloto, R. A., 1988.

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*The Atlantic Lead Weathering Pad Final Closure Report*, Sun Refining and marketing Company, Atlantic Refining and marketing Corporation, Philadelphia Refinery, K.W. Brown & Associates, Inc., March 1991.

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*Remedial Action Plan for the NO.3 Tank Farm Separator*, Sun Company (R&M), Philadelphia Refinery, ENSR Consulting and Engineering, October 1993.

*Remedial Action Plan for the North Yard Bulkhead*, Sun Company (R&M), Philadelphia Refinery, ENSR Consulting and Engineering, October 1993.

*Remedial Action Plan for the North Yard Southern Property Boundary*, Sun Company (R&M), Philadelphia Refinery, ENSR Consulting and Engineering, December 1993.

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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 County, Pennsylvania, Water-Resources Investigations Report 01-4218, 20 pp, Schreffler, C. L., U.S. Department of the Interior, 2001.

*Amended Closure Plan*, Sunoco, Inc. Philadelphia Refinery, Point Breeze Processing Area, Land Treatment Unit, Blazosky Associates, Inc., November 1988 and amended November 2002 and May 2004.

*Consent Order and Agreement by and between the Commonwealth of Pennsylvania*, Department of Environmental Protection, Atlantic Refining & Marketing Corporation and Sunoco Company, Inc. (R&M), August 1996, and amended December 2000 and July 2004.

*Amended Post-Closure Plan*, Sunoco, Inc. Philadelphia Refinery, Point Breeze Processing Area, Land Treatment Unit, Blazosky Associates, Inc., November 1988 and amended June 2003 and May 2004.

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*U.S. Department of the Interior, Geohydrology and Ground-Water Resources of Philadelphia*, Pennsylvania, U.S. Geological Survey, Water-Supply Paper 2346.

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

**Table 1**
**Compounds of Concern for Soil**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| SOIL | |
|---|---|
| **METALS** | **CAS No.** |
| Lead (total) | 7439-92-1 |
| **VOLATILE ORGANIC COMPOUNDS** | **CAS No.** |
| 1,2-dichloroethane | 107-06-2 |
| Benzene | 71-43-2 |
| Cumene | 98-82-8 |
| Ethylbenzene | 100-41-4 |
| Ethylene dibromide | 106-93-4 |
| Methyl tertiary butyl ether | 1634-04-4 |
| Toluene | 108-88-3 |
| Xylenes (total) | 1330-20-7 |
| **SEMI-VOLATILE ORGANIC COMPOUNDS** | **CAS No.** |
| Anthracene | 120-12-7 |
| Benzo(a)anthracene | 56-55-3 |
| Benzo (g,h,i) perylene | 191-24-2 |
| Benzo(a)pyrene | 50-32-8 |
| Benzo(b)fluoranthene | 205-99-2 |
| Chrysene | 218-01-9 |
| Fluorene | 86-73-7 |
| Naphthalene | 91-20-3 |
| Phenanthrene | 85-01-8 |
| Pyrene | 129-00-0 |

Notes:
1. Constituents are from Pennsylvania Corrective Action Process (CAP) Regulation Amendments effective December 1, 2001; provided in Chapter VI, Section E (pgs. 29-30) of PADEP Document, *Closure Requirements for Underground Storage Tank Systems,* effective April 1, 1998 and the March 18, 2008 revised PADEP Short List.

**Table 1 (continued)**
**Compounds of Concern for Groundwater**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| GROUNDWATER | |
|---|---|
| **METALS** | **CAS No.** |
| Lead (dissolved) | 7439-92-1 |
| **VOLATILE ORGANIC COMPOUNDS** | **CAS No.** |
| 1,2-dichloroethane | 107-06-2 |
| Benzene | 71-43-2 |
| Cumene | 98-82-8 |
| Ethylbenzene | 100-41-4 |
| Ethylene dibromide | 106-93-4 |
| Methyl tertiary butyl ether | 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.

**Table 2**
**AOI 8 Existing Well Summary**
**Last Updated January 25, 2012**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| AOI # | Well ID | Former Well ID[3] | Well Status/ Description | Northing | Easting | Well Type | Well Classification (Shallow, Intermediate, Deep)[4] | Soil Boring Log Available (Y/N) | Construction Detail Available (Y/N) | Date of Well Completion | Well Construction Details[2] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Well Completion Depth (ft. bgs) | Well Diameter (in) | Top of Inner Casing Elevation (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.) |
| 8 | River 2 | River Gauge 2 | | 224676.427 | 2682316.050 | Staff Gauge | | | | | | | | 8.17 | | | | |
| 8 | N-1 | B-2, NS-2 | | 228366.226 | 2682437.196 | Monitoring Well | Shallow | Y | N | 7/22/85 | 8 | -- | 24.69 | 22.57 | -- | -- | -- | -- |
| 8 | N-10 | B-65 | | 227333.894 | 2682477.634 | Monitoring Well | Shallow | Y | N | 7/29/85 | 10 | -- | 19.96 | 17.59 | -- | -- | -- | -- |
| 8 | N-100 | -- | | 228209.793 | 2682716.186 | Monitoring Well | Intermediate | Y | Y | 6/13/08 | 20 | 2 | 27.01 | 24.99 | 14.99 | 4.99 | 10 | 10 |
| 8 | N-101 | -- | | 227221.776 | 2683652.840 | Monitoring Well | Intermediate | Y | Y | 6/16/08 | 23 | 2 | 27.15 | 25.43 | 12.43 | 2.43 | 13 | 10 |
| 8 | N-102 | -- | | 227035.480 | 2683869.606 | Monitoring Well | Intermediate | Y | Y | 6/5/08 | 30 | 2 | 33.21 | 31.59 | 11.59 | 1.59 | 20 | 10 |
| 8 | N-103 | -- | | 226781.705 | 2683660.200 | Monitoring Well | Intermediate | Y | Y | 6/6/08 | 27 | 2 | 29.33 | 27.56 | 10.56 | 0.56 | 17 | 10 |
| 8 | N-104 | -- | | 226914.012 | 2683419.549 | Monitoring Well | Intermediate | Y | Y | 6/16/08 | 25 | 2 | 27.64 | 25.96 | 10.96 | 0.96 | 15 | 10 |
| 8 | N-105 | -- | | 226745.373 | 2683442.708 | Monitoring Well | Intermediate | Y | Y | 6/18/08 | 25 | 2 | 28.11 | 26.26 | 11.26 | 1.26 | 15 | 10 |
| 8 | N-106 | -- | | 227044.243 | 2682976.538 | Monitoring Well | Intermediate | Y | Y | 6/5/08 | 19 | 2 | 23.03 | 21.50 | 12.50 | 2.50 | 9 | 10 |
| 8 | N-107 | -- | | 226909.904 | 2683133.246 | Monitoring Well | Intermediate | Y | Y | 6/20/08 | 22 | 2 | 26.37 | 24.38 | 12.38 | 2.38 | 12 | 10 |
| 8 | N-108 | -- | | 226848.509 | 2682983.450 | Monitoring Well | Intermediate | Y | Y | 5/29/08 | 18 | 2 | 22.41 | 22.97 | 15.12 | 5.12 | 8 | 10 |
| 8 | N-109 | -- | | 226649.194 | 2681604.972 | Monitoring Well | Intermediate | Y | Y | 7/3/08 | 20 | 2 | 18.42 | 15.54 | 10.54 | -4.46 | 5 | 15 |
| 8 | N-11 | B-14 | | 227226.306 | 2682914.822 | Monitoring Well | Intermediate | Y | N | 11/13/84 | 25 | -- | 29.74 | 27.33 | -- | -- | -- | -- |
| 8 | N-110 | -- | Destroyed | 226640.022 | 2680765.883 | Monitoring Well | Intermediate | Y | Y | 5/14/08 | 15 | 2 | 12.11 | 9.92 | 4.92 | -5.08 | 5 | 10 |
| 8 | N-111 | -- | | 226514.002 | 2680519.261 | Monitoring Well | Intermediate | Y | Y | 5/14/08 | 15 | 2 | 10.76 | -- | 5.52 | -4.48 | 5 | 10 |
| 8 | N-112 | -- | | 226328.461 | 2681663.567 | Monitoring Well | Intermediate | Y | Y | 5/14/08 | 20 | 2 | 15.72 | 13.85 | 8.86 | -6.14 | 5 | 15 |
| 8 | N-113 | -- | | 226054.267 | 2681733.331 | Monitoring Well | Intermediate | Y | Y | 5/15/08 | 15 | 2 | 14.15 | 12.32 | 7.32 | -2.68 | 5 | 10 |
| 8 | N-114 | -- | | 226224.645 | 2681510.698 | Monitoring Well | Intermediate | Y | Y | 5/13/08 | 25 | 2 | 14.37 | 12.47 | 2.47 | -12.53 | 10 | 15 |
| 8 | N-115 | -- | | 225824.433 | 2682246.434 | Monitoring Well | Intermediate | Y | Y | 5/28/08 | 14 | 2 | 15.33 | 13.43 | 11.33 | -2.67 | 4 | 14 |
| 8 | N-116 | -- | | 225843.598 | 2682616.585 | Monitoring Well | Intermediate | Y | Y | 5/20/08 | 12 | 2 | 11.28 | 8.49 | 6.49 | -3.51 | 2 | 10 |
| 8 | N-117 | -- | Destroyed | 226416.379 | 2682828.260 | Monitoring Well | Intermediate | Y | Y | 6/4/08 | 20 | 2 | 24.24 | 22.16 | 16.24 | -3.76 | 8 | 20 |
| 8 | N-118 | -- | | 226460.505 | 2683077.266 | Monitoring Well | Intermediate | Y | Y | 5/23/08 | 20 | 2 | 23.45 | 21.49 | 11.49 | 1.49 | 10 | 10 |
| 8 | N-119 | -- | | 226406.087 | 2683561.624 | Monitoring Well | Intermediate | Y | Y | 5/29/08 | 18 | 2 | 20.43 | 18.73 | 10.73 | 0.73 | 8 | 10 |
| 8 | N-12 | B-15 | | 227099.363 | 2683393.606 | Monitoring Well | Intermediate | Y | N | 11/14/84 | 20 | -- | 27.19 | 24.36 | -- | -- | -- | -- |
| 8 | N-120 | -- | | 226332.599 | 2683852.895 | Monitoring Well | Intermediate | Y | Y | 5/22/08 | 18 | 2 | 22.33 | 20.18 | 12.18 | 2.18 | 8 | 10 |
| 8 | N-121 | -- | | 226380.688 | 2683357.051 | Monitoring Well | Intermediate | Y | Y | 6/9/08 | 20 | 2 | 20.77 | 18.95 | 8.95 | -1.05 | 10 | 10 |
| 8 | N-122 | -- | | 226074.378 | 2683576.782 | Monitoring Well | Intermediate | Y | Y | 5/21/08 | 18 | 2 | 17.05 | 14.93 | 8.93 | -3.07 | 6 | 12 |
| 8 | N-123 | -- | | 225788.933 | 2684165.075 | Monitoring Well | Intermediate | Y | Y | 5/20/08 | 20 | 2 | 21.24 | 19.42 | 9.42 | -0.58 | 10 | 10 |
| 8 | N-124 | -- | | 225963.423 | 2684525.329 | Monitoring Well | Intermediate | Y | Y | 5/21/08 | 25 | 2 | 25.67 | 26.02 | 16.02 | 1.02 | 10 | 15 |
| 8 | N-125 | -- | | 225653.256 | 2683530.878 | Monitoring Well | Intermediate | Y | Y | 6/17/08 | 25 | 2 | 25.94 | 24.28 | 9.28 | -0.72 | 15 | 10 |
| 8 | N-126 | -- | | 225829.500 | 2683283.039 | Monitoring Well | Shallow | Y | Y | 5/29/08 | 14 | 2 | 10.80 | 8.83 | 4.83 | -5.17 | 4 | 10 |
| 8 | N-127 | -- | | 225192.921 | 2682768.505 | Monitoring Well | Intermediate | Y | Y | 5/28/08 | 34 | 2 | 33.45 | 31.75 | 14.45 | -19.55 | 19 | 34 |
| 8 | N-128 | -- | | 225454.117 | 2682901.765 | Monitoring Well | Intermediate | Y | Y | 5/20/08 | 25 | 2 | 28.14 | 26.50 | 11.50 | 1.50 | 15 | 10 |
| 8 | N-129 | -- | | 225469.919 | 2683240.942 | Monitoring Well | Intermediate | Y | Y | 7/1/08 | 30 | 2 | 28.90 | 27.12 | 13.12 | -2.88 | 14 | 16 |
| 8 | N-13 | B-16 | | 227095.475 | 2683398.971 | Monitoring Well | Deep | Y | N | 12/13/84 | 50 | -- | 26.77 | 24.35 | -- | -- | -- | -- |
| 8 | N-130 | -- | | 225087.603 | 2682501.018 | Monitoring Well | Intermediate | Y | Y | 5/16/08 | 32 | 2 | 31.60 | 30.07 | 13.60 | -16.40 | 18 | 30 |
| 8 | N-131 | -- | Unable to Locate | 225671.489 | 2681085.575 | Monitoring Well | Shallow | Y | Y | 6/10/08 | 15 | 2 | 9.03 | 7.10 | 2.10 | -7.90 | 5 | 10 |
| 8 | N-132 | -- | | 225634.140 | 2681685.292 | Monitoring Well | Shallow | Y | Y | 5/13/08 | 25 | 2 | 11.11 | 9.06 | -5.94 | -15.94 | 15 | 10 |
| 8 | N-133 | -- | | 224966.629 | 2680751.162 | Monitoring Well | Shallow | Y | Y | 5/15/08 | 12 | 2 | 9.36 | 7.19 | 5.19 | -4.81 | 2 | 10 |
| 8 | N-134 | -- | | 226063.245 | 2685261.950 | Monitoring Well | Intermediate | Y | Y | 5/22/08 | 20 | 2 | 27.49 | 25.79 | 15.79 | 5.79 | 10 | 10 |
| 8 | N-135 | -- | | 225141.446 | 2680687.178 | Monitoring Well | Shallow | Y | Y | 5/15/08 | 12 | 2 | 9.92 | 7.76 | 5.76 | -4.24 | 2 | 10 |
| 8 | N-136 | -- | | 225342.984 | 2680714.222 | Monitoring Well | Shallow | Y | Y | 5/15/08 | 12 | 2 | 10.85 | 8.68 | 6.68 | -3.32 | 2 | 10 |
| 8 | N-137 | MW-13 | | 227831.661 | 2683096.088 | Monitoring Well | Intermediate | Y | Y | 9/19/11 | 23 | 2 | 25.59 | 23.87 | 10.87 | 0.87 | 13 | 10 |
| 8 | N-138 | MW-14 | | 227756.893 | 2683256.138 | Monitoring Well | Intermediate | Y | Y | 9/16/11 | 33 | 2 | 35.29 | 33.29 | 10.29 | 0.29 | 23 | 10 |
| 8 | N-139 | MW-15 | | 227732.146 | 2683308.896 | Monitoring Well | Intermediate | Y | Y | 9/15/11 | 33 | 2 | 35.00 | 33.00 | 10.00 | 0.00 | 23 | 10 |
| 8 | N-14 | B-19 | | 227010.933 | 2683665.271 | Monitoring Well | Intermediate | Y | N | 11/15/84 | 25 | -- | 31.99 | 29.64 | -- | -- | -- | -- |
| 8 | N-15 | B-17 | | 226992.660 | 2684060.447 | Monitoring Well | Intermediate | Y | N | 11/15/84 | 24.5 | -- | 29.35 | 29.30 | -- | -- | -- | -- |
| 8 | N-16 | -- | | 226992.615 | 2684408.639 | Monitoring Well | Intermediate | N | N | -- | 26.8 | -- | 32.98 | 31.80 | -- | -- | -- | -- |
| 8 | N-17 | B-18 | | 226992.700 | 2684410.420 | Monitoring Well | Intermediate | Y | N | 11/15/84 | 25.5 | -- | 34.42 | 31.80 | -- | -- | -- | -- |
| 8 | N-18 | B-21 | | 226744.095 | 2684649.893 | Monitoring Well | Intermediate | Y | N | 11/16/84 | 25 | -- | 32.90 | 30.15 | -- | -- | -- | -- |
| 8 | N-19 | B-20 | | 226736.819 | 2684650.605 | Monitoring Well | Deep | Y | N | 12/14/84 | 60 | -- | 32.78 | 30.46 | -- | -- | -- | -- |
| 8 | N-2 | B-4 | | 228025.225 | 2682758.321 | Monitoring Well | Shallow | Y | N | 11/15/84 | 25 | -- | 26.42 | 26.40 | -- | -- | -- | -- |
| 8 | N-20 | B-23 | | 226644.836 | 2683877.900 | Monitoring Well | Shallow | Y | N | 7/22/85 | 6 | -- | 28.39 | 25.12 | -- | -- | -- | -- |
| 8 | N-21 | B-24 | | 226627.765 | 2683879.135 | Monitoring Well | Deep | Y | N | 11/30/84 | 51.5 | -- | 28.01 | 25.04 | -- | -- | -- | -- |
| 8 | N-22 | B-22 | Destroyed | 226765.482 | 2683180.268 | Monitoring Well | Intermediate | Y | N | 11/16/84 | 20 | -- | -- | 28.48 | -- | -- | -- | -- |
| 8 | N-23 | B-64 | | 226791.399 | 2682839.371 | Monitoring Well | Intermediate | Y | N | 7/30/84 | 20 | -- | 20.88 | 20.90 | -- | -- | -- | -- |

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

**NOTES:**

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
*Product type percentage data not available

1. For wells that have not been surveyed by Langan, the pre-existing elevations (in NVGD 29) were converted to NAVD 88 (conversion factor is 1.05 ft).
2. Well construction details were taken directly from well boring logs provided by Handex, Secor, Aquaterra or collected from available historic reports. Where no well boring logs exist, no well construction or lithologic data is listed.
3. Former well IDs were derived from handwritten notes on the logs themselves or the referenced report.
4. 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
5. Product characterization data obtained from Sunoco's 2004 CCR and 2005 through 2010 Site Characterization Reports for AOIs 1 through 9.
6. For wells with no direct LNAPL density measurements, the density value in the nearest well with LNAPL data was used.

**Table 2**
**AOI 8 Existing Well Summary**
**Last Updated January 25, 2012**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| AOI # | Well ID | Former Well ID[3] | Well Status/ Description | Northing | Easting | Well Type | Well Classification (Shallow, Intermediate, Deep)[4] | Soil Boring Log Available (Y/N) | Construction Detail Available (Y/N) | Date of Well Completion | Well Construction Details[2] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Well Completion Depth (ft. bgs) | Well Diameter (in) | Top of Inner Casing Elevation (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.) |
| 8 | N-24 | B-25 | | 226437.463 | 2682553.561 | Monitoring Well | Shallow | Y | N | 11/15/84 | 16 | -- | 20.65 | 18.03 | -- | -- | -- | -- |
| 8 | N-25 | B-26 | | 226322.123 | 2683073.851 | Monitoring Well | Shallow | Y | N | 11/16/84 | 12 | -- | 18.78 | 18.73 | -- | -- | -- | -- |
| 8 | N-26 | B-27 | | 226231.010 | 2683594.774 | Monitoring Well | Shallow | Y | N | 11/16/84 | 10 | -- | 21.03 | 18.07 | -- | -- | -- | -- |
| 8 | N-27 | B-28 | | 226112.946 | 2684408.569 | Monitoring Well | Deep | Y | N | 11/29/84 | 60.5 | -- | 23.26 | 20.73 | -- | -- | -- | -- |
| 8 | N-28 | B-30, NS-30 | | 226330.807 | 2684924.768 | Monitoring Well | Shallow | Y | N | 7/22/85 | 6 | -- | 20.45 | 18.36 | -- | -- | -- | -- |
| 8 | N-29 | B-36, NS-36 | | 225834.838 | 2685039.366 | Monitoring Well | Shallow | Y | N | 11/19/84 | 30 | -- | 40.12 | 36.96 | -- | -- | -- | -- |
| 8 | N-3 | B-5 | | 227951.850 | 2683124.606 | Monitoring Well | Shallow | Y | N | 11/14/84 | 23 | -- | 26.66 | 23.91 | -- | -- | -- | -- |
| 8 | N-30 | B-37, NS-37 | | 225824.369 | 2685036.986 | Monitoring Well | Deep | Y | N | 12/6/84 | 60 | -- | 39.37 | 36.35 | -- | -- | -- | -- |
| 8 | N-31 | B-35 | | 225799.287 | 2684423.595 | Monitoring Well | Shallow | Y | N | 11/19/84 | 20 | -- | 24.52 | 13.97 | -- | -- | -- | -- |
| 8 | N-32 | B-34, NS-34 | | 226035.860 | 2683879.671 | Monitoring Well | Shallow | Y | N | 7/23/85 | 6 | -- | 16.27 | 21.20 | -- | -- | -- | -- |
| 8 | N-33 | PH-83 | Destroyed | 226174.169 | 2682934.348 | Monitoring Well | -- | Y | N | 1946 | 77 | 10 | -- | 14.95 | -45.05 | -62.05 | 60 | 17 |
| 8 | N-34 | B-33 | | 226258.771 | 2682271.688 | Monitoring Well | Intermediate | Y | N | 11/21/84 | 14 | -- | 13.59 | 11.01 | -- | -- | -- | -- |
| 8 | N-35 | B-62 | | 226288.786 | 2681868.397 | Monitoring Well | Shallow | Y | N | 7/30/85 | 20 | -- | 14.08 | 14.00 | -- | -- | -- | -- |
| 8 | N-36 | B-32 | | 226219.904 | 2681731.671 | Monitoring Well | Shallow | Y | N | 11/21/84 | 13 | -- | 15.16 | 12.73 | -- | -- | -- | -- |
| 8 | N-37 | B-31 | | 226827.511 | 2681542.987 | Monitoring Well | Shallow | Y | N | 11/20/84 | 17 | -- | 18.22 | 16.26 | -- | -- | -- | -- |
| 8 | N-38 | N-71 | | 226898.645 | 2680805.008 | Monitoring Well | Shallow | Y | Y | 8/9/88 | 17 | 4 | 10.09 | 8.77 | 9.36 | -5.64 | 2 | 15 |
| 8 | 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 |
| 8 | N-39 | B-38 | | 226133.874 | 2681220.305 | Monitoring Well | Shallow | Y | N | 11/20/84 | -- | -- | 9.54 | 9.52 | -- | -- | -- | -- |
| 8 | N-4 | B-6 | | 227944.638 | 2683123.405 | Monitoring Well | Deep | Y | N | 12/12/84 | 44.5 | -- | 26.36 | 23.91 | -- | -- | -- | -- |
| 8 | N-40 | B-39 | | 226015.397 | 2682005.798 | Monitoring Well | Shallow | Y | N | 11/20/84 | 15 | -- | 12.10 | 10.26 | -- | -- | -- | -- |
| 8 | N-41 | B-40 | | 225981.161 | 2682417.344 | Monitoring Well | Shallow | Y | N | 11/20/84 | 14 | -- | 10.17 | 10.19 | -- | -- | -- | -- |
| 8 | N-42 | B-41 | | 225812.913 | 2682411.559 | Monitoring Well | Shallow | Y | N | 11/20/84 | 15 | -- | 14.90 | 12.09 | -- | -- | -- | -- |
| 8 | N-43 | B-42, NS-42 | | 225594.747 | 2682491.345 | Monitoring Well | Shallow | Y | N | 10/12/84 | 21 | -- | 30.34 | 27.70 | -- | -- | -- | -- |
| 8 | N-44D | B-43 | | 225587.984 | 2682498.213 | Monitoring Well | Deep | N | N | -- | 58 | -- | 30.70 | 27.17 | -- | -- | -- | -- |
| 8 | N-45 | B-46 | | 225745.621 | 2683509.627 | Monitoring Well | Intermediate | Y | N | 11/19/84 | 20 | -- | 22.75 | 21.20 | -- | -- | -- | -- |
| 8 | N-46D | B-60 | Destroyed | 225495.445 | 2683945.399 | Monitoring Well | Deep | N | N | 12/5/84 | 55 | -- | 32.80 | 29.70 | -- | -- | -- | -- |
| 8 | N-47 | B-59 | | 225489.329 | 2683935.877 | Monitoring Well | Intermediate | Y | N | 11/19/84 | 25 | -- | 31.92 | 29.55 | -- | -- | -- | -- |
| 8 | N-48 | B-58 | | 225311.830 | 2683476.247 | Monitoring Well | Intermediate | Y | N | 11/19/84 | 27 | -- | 31.25 | 28.92 | -- | -- | -- | -- |
| 8 | N-49 | B-63 | | 225174.606 | 2683115.270 | Monitoring Well | Intermediate | Y | N | 7/29/85 | 27 | -- | 33.70 | 30.55 | -- | -- | -- | -- |
| 8 | N-5 | -- | | 227645.565 | 2682201.244 | Monitoring Well | Shallow | Y | N | 11/15/84 | 13 | -- | 25.96 | 23.80 | -- | -- | -- | -- |
| 8 | N-503 | -- | | 226576.298 | 2680565.721 | Monitoring Well | Shallow | Y | Y | -- | -- | -- | 12.40 | 11.46 | -- | -- | -- | -- |
| 8 | N-504 | -- | | 226856.668 | 2680651.601 | Monitoring Well | Intermediate | Y | Y | -- | -- | -- | 12.31 | 11.36 | -- | -- | -- | -- |
| 8 | N-50D | B-57, NS-57 | | 225249.929 | 2682949.287 | Monitoring Well | Deep | N | N | 12/7/84 | 60 | -- | 32.31 | 30.53 | -- | -- | -- | -- |
| 8 | N-51 | B-56, NS-56 | | 225253.104 | 2682956.087 | Monitoring Well | Intermediate | Y | N | 11/21/84 | 28 | -- | 31.85 | 30.92 | -- | -- | -- | -- |
| 8 | N-52 | B-55 | | 225021.374 | 2682624.237 | Monitoring Well | Intermediate | Y | N | 11/20/84 | 25 | -- | 33.50 | 31.10 | -- | -- | -- | -- |
| 8 | N-53 | B-50 | | 225394.959 | 2682283.454 | Monitoring Well | Shallow | Y | N | 11/20/84 | 25 | -- | 29.13 | 12.73 | -- | -- | -- | -- |
| 8 | N-54 | B-52 | Unable to Locate | 225146.026 | 2681898.892 | Monitoring Well | Shallow | Y | N | 11/21/84 | 13 | -- | 10.88 | 8.56 | -- | -- | -- | -- |
| 8 | N-55 | B-51 | | 225122.420 | 2681473.558 | Monitoring Well | Shallow | Y | N | 11/21/84 | 7.6 | -- | 10.26 | 8.19 | -- | -- | -- | -- |
| 8 | N-56 | B-48 | | 225658.872 | 2681265.721 | Monitoring Well | Shallow | Y | N | 11/212/84 | 13 | -- | 13.37 | 10.68 | -- | -- | -- | -- |
| 8 | N-57 | B-61 | | 226031.486 | 2680585.797 | Monitoring Well | Shallow | Y | N | 7/29/85 | 10 | -- | 10.91 | 8.80 | -- | -- | -- | -- |
| 8 | N-58 | N-70 | | 225832.212 | 2680454.872 | Monitoring Well | Shallow | Y | Y | 8/8/88 | 17 | 4 | 9.23 | 7.21 | 4.74 | -10.26 | 2 | 15 |
| 8 | N-59 | N-69 | | 225386.806 | 2680469.612 | Monitoring Well | Shallow | Y | Y | 8/8/88 | 17 | 4 | 6.95 | 6.81 | 6.56 | -8.44 | 2 | 15 |
| 8 | N-6 | -- | | 227533.563 | 2682704.627 | Monitoring Well | Shallow | Y | Y | -- | -- | -- | 31.05 | 31.08 | -- | -- | -- | -- |
| 8 | N-60 | B-47, NS-47 | | 225507.791 | 2680804.085 | Monitoring Well | Shallow | Y | N | 11/21/84 | 6 | -- | 10.85 | 8.56 | -- | -- | -- | -- |
| 8 | N-61 | N-68 | | 225119.242 | 2680588.298 | Monitoring Well | Shallow | Y | Y | 5/8/88 | 17 | 4 | 8.91 | 6.79 | 4.34 | -10.66 | 2 | 15 |
| 8 | N-62 | N-67 | Destroyed | -- | -- | Monitoring Well | -- | Y | Y | 4/8/88 | 17 | 2 | -- | -- | -- | -- | 2 | 15 |
| 8 | N-63 | N-66 | Destroyed | -- | -- | Monitoring Well | -- | Y | Y | 4/8/88 | 17 | 2 | -- | -- | -- | -- | 2 | 15 |
| 8 | N-64 | B-54 | | 224842.035 | 2682308.564 | Monitoring Well | Shallow | Y | N | 11/21/84 | 12 | -- | 11.24 | 8.99 | -- | -- | -- | -- |
| 8 | N-65 | B-29 | | 226363.780 | 2684499.095 | Monitoring Well | Shallow | Y | N | 11/16/84 | 15 | -- | 23.48 | 20.43 | -- | -- | -- | -- |
| 8 | N-66 | B-44 | | 225636.657 | 2682973.281 | Monitoring Well | Shallow | Y | N | 11/20/84 | 15.33 | -- | 17.59 | 15.75 | -- | -- | -- | -- |
| 8 | N-67 | -- | | 226940.291 | 2682697.910 | Monitoring Well | Shallow | -- | -- | -- | 21 | 2 | 18.23 | 17.48 | -- | -- | -- | -- |
| 8 | N-68 | W-3 | | 226910.742 | 2682972.832 | Monitoring Well | Shallow | Y | Y | 9/30/80 | 21 | 4 | 24.22 | 22.14 | -- | -- | -- | -- |
| 8 | N-69 | W-4 | | 227391.604 | 2681821.580 | Monitoring Well | Intermediate | Y | Y | 11/4/81 | 42 | 12 | 23.20 | 20.86 | 10.57 | -9.43 | 12 | 20 |
| 8 | N-7 | B-10 | Destroyed | 227550.215 | 2683520.135 | Monitoring Well | Shallow | Y | N | 11/14/84 | 30 | -- | -- | 39.59 | -- | -- | -- | -- |
| 8 | N-70 | W-5 | | 227135.669 | 2681744.967 | Monitoring Well | Intermediate | Y | Y | 11/4/81 | 38 | 12 | 22.17 | 20.29 | 10.86 | -9.14 | 10 | 20 |
| 8 | N-71 | W-6 | Destroyed | -- | -- | Monitoring Well | -- | Y | -- | 11/5/81 | 35 | -- | -- | -- | -- | -- | 12 | 10 |
| 8 | N-72 | MW-15 | | 226761.053 | 2680685.868 | Monitoring Well | Shallow | N | Y | 5/19/93 | 16.5 | 4 | 12.67 | 9.46 | 5.60 | -4.40 | 3.2 | 10 |

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

**NOTES:**

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
*Product type percentage data not available

1. For wells that have not been surveyed by Langan, the pre-existing elevations (in NVGD 29) were converted to NAVD 88 (conversion factor is 1.05 ft).
2. Well construction details were taken directly from well boring logs provided by Handex, Secor, Aquaterra or collected from available historic reports. Where no well boring logs exist, no well construction or lithologic data is listed.
3. Former well IDs were derived from handwritten notes on the logs themselves or the referenced report.
4. 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
5. Product characterization data obtained from Sunoco's 2004 CCR and 2005 through 2010 Site Characterization Reports for AOIs 1 through 9.
6. For wells with no direct LNAPL density measurements, the density value in the nearest well with LNAPL data was used.

**Table 2**
**AOI 8 Existing Well Summary**
**Last Updated January 25, 2012**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| AOI # | Well ID | Former Well ID[3] | Well Status/ Description | Northing | Easting | Well Type | Well Classification (Shallow, Intermediate, Deep)[4] | Soil Boring Log Available (Y/N) | Construction Detail Available (Y/N) | Date of Well Completion | Well Construction Details[2] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Well Completion Depth (ft. bgs) | Well Diameter (in) | Top of Inner Casing Elevation (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.) |
| 8 | N-73 | MW-2D, LD-B-9 | | 225822.483 | 2680415.328 | Monitoring Well | Intermediate | Y | Y | 5/21/93 | 45.6 | 2 | 8.90 | 6.49 | -26.16 | -36.16 | 32.3 | 10 |
| 8 | N-74 | MW-3, LD-B-4 | | 224909.029 | 2680694.217 | Monitoring Well | Shallow | Y | Y | 5/18/93 | 35.4 | 4 | 7.88 | 6.15 | 3.30 | -6.70 | 2.7 | 10 |
| 8 | N-75 | MW-3D, LD-B-4D | | 224898.050 | 2680701.173 | Monitoring Well | Intermediate | Y | Y | 5/25/93 | 47.5 | 2 | 8.19 | 6.00 | -28.34 | -38.34 | 33.5 | 10 |
| 8 | N-76 | -- | | 225362.174 | 2683610.375 | Recovery Well - Inactive | Intermediate | Y | Y | 7/1/93 | 50 | 8 | 30.47 | 29.25 | 14.40 | -20.60 | 15 | 35 |
| 8 | N-77 | -- | | 226734.344 | 2682467.850 | Monitoring Well | Shallow | Y | Y | 8/11/93 | 30 | 4 | 18.61 | 16.49 | 15.65 | -9.35 | 5 | 25 |
| 8 | N-78 | -- | Unable to Locate | 226634.702 | 2683036.636 | Monitoring Well | Intermediate | Y | Y | 8/10/93 | 30 | 4 | 22.18 | 22.36 | 17.02 | -7.98 | 5 | 25 |
| 8 | N-79 | -- | | 226515.434 | 2683789.228 | Monitoring Well | Intermediate | Y | Y | 8/10/93 | 30 | 4 | 21.87 | 22.02 | 24.64 | -0.36 | 5 | 25 |
| 8 | N-8 | NS-11, B-11 | | 227375.293 | 2684091.768 | Monitoring Well | Shallow | Y | N | 11/14/84 | 35 | -- | 37.61 | 36.03 | -- | -- | -- | -- |
| 8 | N-80 | -- | Destroyed | -- | -- | Monitoring Well | -- | Y | Y | 10/11/93 | 50 | 8 | -- | -- | -- | -- | 15 | 35 |
| 8 | N-81 | -- | | 225644.533 | 2684343.238 | Monitoring Well | Shallow | Y | Y | 6/29/94 | 25 | 4 | 28.88 | 26.65 | 27.39 | 12.39 | 10 | 15 |
| 8 | N-82 | -- | | 225723.348 | 2684633.659 | Monitoring Well | Shallow | Y | Y | 6/30/94 | 30 | 4 | 33.49 | 30.98 | -8.88 | -23.88 | 15 | 15 |
| 8 | N-83 | MW-12, JS-12B | | 226827.806 | 2681760.791 | Monitoring Well | Intermediate | Y | Y | 5/30/02 | 27 | 4 | 21.45 | 19.27 | 12.29 | -6.71 | 8 | 19 |
| 8 | N-84 | MW-17, JS-17 | | 226457.117 | 2684677.455 | Monitoring Well | Shallow | Y | Y | 5/30/02 | 23 | 4 | 25.88 | 23.32 | 5.36 | -4.64 | 13 | 10 |
| 8 | N-85 | MW-18, JS-18 | | 226448.228 | 2684734.375 | Monitoring Well | Shallow | Y | Y | 5/31/02 | 24 | 4 | 25.29 | 22.95 | 19.32 | -0.68 | 4 | 20 |
| 8 | N-86 | MW-23, JS-24 | | 226462.981 | 2684118.579 | Monitoring Well | Intermediate | Y | Y | 6/4/02 | 18 | 4 | 25.84 | 29.30 | 21.30 | 11.30 | 8 | 10 |
| 8 | N-87 | MW-24, JS-29 | | 226550.229 | 2683965.423 | Monitoring Well | Shallow | Y | Y | 6/4/02 | 18 | 4 | 26.26 | 23.89 | 16.13 | 6.13 | 8 | 10 |
| 8 | N-88 | JS-47 | Destroyed | 226693.870 | 2682778.136 | Monitoring Well | Shallow | Y | Y | 8/1/02 | 22 | 4 | -- | 0.00 | -2.00 | -22.00 | 2 | 20 |
| 8 | N-89 | MW-27/ JS-48 | | 226717.413 | 2682823.991 | Monitoring Well | Intermediate | Y | Y | 6/4/2002 - 8/1/02JSC | 22 | -- | 23.41 | 21.87 | -- | -- | -- | -- |
| 8 | N-9 | B-12, NS-12 | | 227374.619 | 2684097.082 | Monitoring Well | Deep | Y | N | 11/28/84 | 78 | -- | 38.21 | 36.00 | -- | -- | -- | -- |
| 8 | N-90 | MW-29, JS-49 | | 226679.051 | 2682992.994 | Monitoring Well | Shallow | Y | Y | 8/2/02 | 18 | 4 | 25.71 | 22.78 | 13.87 | 3.87 | 8 | 10 |
| 8 | N-91 | MW-32, JS-50 | | 226270.997 | 2683624.675 | Monitoring Well | Shallow | Y | Y | 8/2/02 | 17 | 4 | 20.90 | 18.10 | 13.07 | -1.93 | 5 | 15 |
| 8 | N-92 | MW-36, JS-51 | | 226211.450 | 2683566.496 | Monitoring Well | Shallow | Y | Y | 8/2/02 | 17 | 4 | 20.86 | 17.74 | 15.73 | 2.73 | 3 | 13 |
| 8 | N-93 | MW-48, JS-27 | | 226550.366 | 2683794.415 | Monitoring Well | Shallow | Y | Y | 6/4/02 | 18 | 4 | 25.09 | 23.05 | 15.89 | 5.89 | 8 | 10 |
| 8 | N-94 | MW-49, JS-32 | | 226666.529 | 2681861.391 | Monitoring Well | Shallow | Y | Y | 6/5/02 | 16 | 4 | 20.36 | 18.34 | 13.83 | 3.83 | 6 | 10 |
| 8 | N-95 | MW-50, JS-36 | Destroyed | 226756.666 | 2682552.164 | Monitoring Well | Shallow | Y | Y | 6/5/02 | 18 | 4 | 21.92 | 20.65 | 15.80 | 5.80 | 8 | 10 |
| 8 | N-97 | MW-51 | | -- | -- | Monitoring Well | -- | N | N | -- | -- | -- | 22.96 | -- | -- | -- | -- | -- |
| 8 | N-98 | -- | | 227658.440 | 2683478.923 | Monitoring Well | Intermediate | Y | Y | 6/2/08 | 30 | 2 | 34.53 | 32.46 | 12.46 | 2.46 | 20 | 10 |
| 8 | N-99 | -- | | 228875.116 | 2682854.562 | Monitoring Well | Intermediate | Y | Y | 6/19/08 | 28 | 2 | 28.26 | 26.26 | 8.26 | -1.74 | 18 | 10 |
| 8 | P-20 | -- | Destroyed | -- | -- | Monitoring Well | Shallow | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | P-21 | MW-21 | | 224770.782 | 268269.189 | | Shallow | -- | -- | -- | -- | -- | 13.09 | 11.50 | -- | -- | -- | -- |
| 8 | P-28 | -- | Destroyed | -- | -- | Monitoring Well | Shallow | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | P-5 | MW-5 | | 224440.628 | 2683134.395 | Monitoring Well | Shallow | -- | -- | -- | -- | -- | 34.34 | 33.36 | -- | -- | -- | -- |
| 8 | P-6 | -- | Destroyed | -- | -- | Monitoring Well | Shallow | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | P-7 | MW-7 | | 224648.164 | 2682983.478 | Monitoring Well | Shallow | -- | -- | -- | -- | -- | 22.94 | 23.18 | -- | -- | -- | -- |
| 8 | P-8 | MW-8 | | 224237.069 | 2685109.662 | Monitoring Well | Shallow | -- | -- | -- | -- | -- | 30.25 | 30.59 | -- | -- | -- | -- |
| 8 | P-9 | MW-9 | | 224403.524 | 2683168.441 | Monitoring Well | Shallow | -- | -- | -- | -- | -- | 32.44 | -- | -- | -- | -- | -- |
| 8 | PH-73 | -- | Destroyed | -- | -- | Monitoring Well | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | PH-74 | -- | Destroyed | -- | -- | Monitoring Well | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | PH-75 | -- | Destroyed | -- | -- | Monitoring Well | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | PH-76 | -- | Destroyed | -- | -- | Monitoring Well | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | PH-77 | -- | Destroyed | -- | -- | Monitoring Well | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | PH-778 | -- | Destroyed | -- | -- | Monitoring Well | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | PH-779 | -- | Destroyed | -- | -- | Monitoring Well | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | PH-78 | -- | Destroyed | -- | -- | Monitoring Well | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | PH-79 | -- | Destroyed | -- | -- | Monitoring Well | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | PH-82 | -- | Destroyed | -- | -- | Monitoring Well | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | PH-84 | -- | Destroyed | -- | -- | Monitoring Well | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | PZ-201 | -- | | 225409.395 | 2683718.309 | Piezometer | Intermediate | N | N | -- | 23 | -- | 32.28 | 29.40 | -- | -- | -- | -- |
| 8 | PZ-202 | -- | | 225484.370 | 2683876.463 | Piezometer | Intermediate | N | N | -- | 23 | -- | 33.39 | 30.45 | -- | -- | -- | -- |
| 8 | PZ-203 | -- | | 225560.000 | 2684037.463 | Piezometer | Intermediate | N | N | -- | 20.7 | -- | 34.11 | 31.16 | -- | -- | -- | -- |
| 8 | PZ-204 | -- | | 225633.438 | 2684195.803 | Piezometer | Intermediate | N | N | -- | -- | -- | 28.88 | 29.32 | -- | -- | -- | -- |
| 8 | PZ-300 | -- | | 226640.067 | 2683295.022 | Piezometer | Intermediate | N | N | -- | 26.8 | -- | 26.77 | 25.11 | -- | -- | -- | -- |
| 8 | PZ-500 | -- | | 225304.743 | 2680477.774 | Piezometer | Shallow | N | N | -- | 10 | -- | 7.55 | 6.12 | -- | -- | -- | -- |
| 8 | PZ-501 | -- | | 225834.728 | 2680429.243 | Piezometer | Shallow | N | N | -- | 9.5 | -- | 9.00 | 6.47 | -- | -- | -- | -- |
| 8 | PZ-502 | -- | | 225561.581 | 2680433.690 | Piezometer | Intermediate | N | N | -- | -- | -- | 7.92 | 6.14 | -- | -- | -- | -- |
| 8 | PZ-503 | -- | | 225084.552 | 2680589.725 | Piezometer | Shallow | N | N | -- | 9 | -- | 8.69 | 6.34 | -- | -- | -- | -- |
| 8 | PZ-504 | -- | | 224902.998 | 2680729.739 | Piezometer | Shallow | N | N | -- | 6 | -- | 7.63 | 5.16 | -- | -- | -- | -- |

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

**NOTES:**

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
*Product type percentage data not available

1. For wells that have not been surveyed by Langan, the pre-existing elevations (in NVGD 29) were converted to NAVD 88 (conversion factor is 1.05 ft).
2. Well construction details were taken directly from well boring logs provided by Handex, Secor, Aquaterra or collected from available historic reports. Where no well boring logs exist, no well construction or lithologic data is listed.
3. Former well IDs were derived from handwritten notes on the logs themselves or the referenced report.
4. 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
5. Product characterization data obtained from Sunoco's 2004 CCR and 2005 through 2010 Site Characterization Reports for AOIs 1 through 9.
6. For wells with no direct LNAPL density measurements, the density value in the nearest well with LNAPL data was used.

**Table 2**
**AOI 8 Existing Well Summary**
**Last Updated January 25, 2012**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| AOI # | Well ID | Former Well ID[3] | Well Status/ Description | Northing | Easting | Well Type | Well Classification (Shallow, Intermediate, Deep)[4] | Soil Boring Log Available (Y/N) | Construction Detail Available (Y/N) | Date of Well Completion | Well Construction Details[2] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Well Completion Depth (ft. bgs) | Well Diameter (in) | Top of Inner Casing Elevation (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.) |
| 8 | PZ-505 | -- | | 224708.210 | 2681023.814 | Piezometer | Shallow | N | N | -- | 8.5 | -- | 8.46 | 5.85 | -- | -- | -- | -- |
| 8 | PZ-506 | -- | | 224742.224 | 2681823.385 | Piezometer | Shallow | N | N | -- | 10.3 | -- | 11.19 | 8.77 | -- | -- | -- | -- |
| 8 | PZ-507 | -- | | 224811.796 | 2682205.934 | Piezometer | Shallow | N | N | -- | 9.6 | -- | 12.68 | 9.39 | -- | -- | -- | -- |
| 8 | R-1 | -- | Destroyed | -- | -- | Abandoned | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | R-3 | -- | Destroyed | -- | -- | Abandoned | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 8 | RW-200 | PH-2 | | 224924.799 | 2682439.477 | Recovery Well - Inactive | Intermediate | Y | Y | 5/20/94 | 22 | 6 | 12.02 | 11.63 | 21.10 | 11.10 | 10 | 10 |
| 8 | RW-201 | PH-12 | | 225059.936 | 2682703.971 | Recovery Well - Active | Intermediate | Y | Y | 5/17/94 | 37 | 6 | 31.99 | 31.61 | 10.92 | -4.08 | 20 | 15 |
| 8 | RW-202 | PH-19 | | 225065.071 | 2682880.588 | Recovery Well - Active | Intermediate | Y | Y | 5/17/94 | 36 | 6 | 29.51 | 31.04 | 10.32 | -4.68 | 20 | 15 |
| 8 | RW-203 | PH-3 | | 225154.073 | 2683032.076 | Recovery Well - Active | Intermediate | Y | Y | 5/18/94 | 39 | 6 | 31.10 | 31.07 | 8.55 | -6.45 | 22 | 15 |
| 8 | RW-204 | PH-18 | | 225163.199 | 2683189.656 | Recovery Well - Inactive | Intermediate | Y | Y | 6/22/94 | 34 | 6 | 28.57 | 30.34 | -- | -- | 19 | 15 |
| 8 | RW-205 | -- | | 225250.547 | 2683342.699 | Recovery Well - Inactive | Intermediate | Y | Y | 5/12/94 | 31 | 6 | 29.67 | 29.30 | 14.92 | -0.08 | 14 | 15 |
| 8 | RW-206 | -- | | 225332.300 | 2683557.050 | Recovery Well - Inactive | Intermediate | Y | Y | 5/11/94 | 31 | 6 | 30.94 | 30.58 | 13.25 | -1.75 | 16 | 15 |
| 8 | RW-26 | -- | | 224410.491 | 2685473.615 | Recovery Well | -- | N | N | -- | -- | -- | 29.21 | 30.60 | -- | -- | -- | -- |
| 8 | RW-27 | -- | | 224396.009 | 2685423.426 | Recovery Well | -- | N | N | -- | -- | -- | 29.71 | 30.74 | -- | -- | -- | -- |
| 8 | RW-28 | -- | | 224377.764 | 2685357.402 | Recovery Well | -- | N | N | -- | -- | -- | 29.74 | 30.10 | -- | -- | -- | -- |
| 8 | RW-29 | -- | | 224360.164 | 2685285.507 | Recovery Well | -- | N | N | -- | -- | -- | 29.44 | 30.19 | -- | -- | -- | -- |
| 8 | RW-30 | -- | | 224352.411 | 2685256.623 | Recovery Well | -- | N | N | -- | -- | -- | 29.39 | 30.33 | -- | -- | -- | -- |
| 8 | RW-300 | -- | | 226710.145 | 2681809.651 | Recovery Well - Active | Intermediate | N | N | -- | -- | -- | 21.64 | 19.83 | -- | -- | -- | -- |
| 8 | RW-301 | PH-16 | | 226707.352 | 2682907.114 | Recovery Well - Inactive | Intermediate | Y | Y | 5/12/94 | 31 | 6 | 22.41 | 21.95 | 9.92 | -5.08 | 14 | 15 |
| 8 | RW-302 | PH-5 | | 226687.489 | 2683040.088 | Recovery Well - Inactive | Intermediate | Y | Y | 5/11/94 | 31 | 6 | 24.09 | 23.92 | 6.82 | -8.18 | 16 | 15 |
| 8 | RW-303 | -- | | 226663.398 | 2683166.980 | Recovery Well - Active | Intermediate | Y | Y | 5/12/94 | 31 | 6 | 24.98 | 24.76 | -- | -- | -- | -- |
| 8 | RW-304 | PH-17 | | 226635.005 | 2683321.529 | Recovery Well - Inactive | Intermediate | Y | Y | 5/13/94 | 33 | 6 | 25.28 | 24.95 | 9.27 | -5.73 | 16 | 15 |
| 8 | RW-305 | PH-4 | | 226614.941 | 2683458.406 | Recovery Well - Active | Intermediate | Y | Y | 5/11/94 | 33 | 6 | 25.27 | 24.89 | 7.22 | -7.78 | 16 | 15 |
| 8 | RW-306 | PH-15 | | 226581.193 | 2683767.983 | Recovery Well - Active | Intermediate | Y | Y | 5/10/94 | 28 | 6 | 23.58 | 23.22 | 12.05 | -2.95 | 11 | 15 |
| 8 | RW-307 | -- | | 226603.861 | 2683079.555 | Recovery Well - Active | Intermediate | -- | -- | -- | -- | -- | 23.26 | 22.82 | -- | -- | -- | -- |
| 8 | RW-308 | -- | | 226622.581 | 2683240.062 | Recovery Well - Active | Intermediate | -- | -- | -- | -- | -- | 25.61 | 25.27 | -- | -- | -- | -- |
| 8 | RW-309 | -- | | 226602.424 | 2683373.035 | Recovery Well - Inactive | Intermediate | -- | -- | -- | -- | -- | 25.23 | 24.81 | -- | -- | -- | -- |
| 8 | RW-31 | -- | | 224339.191 | 2685206.135 | Recovery Well | -- | -- | -- | -- | -- | -- | 29.38 | 30.31 | -- | -- | -- | -- |
| 8 | RW-32 | -- | | 224324.104 | 2685149.766 | Recovery Well | -- | -- | -- | -- | -- | -- | 29.05 | 30.05 | -- | -- | -- | -- |
| 8 | RW-500 | -- | | 225305.391 | 2680478.176 | Recovery Well - Active | Intermediate | -- | -- | -- | -- | -- | 7.56 | 6.79 | -- | -- | -- | -- |
| 8 | RW-501 | -- | | 224727.458 | 2681487.009 | Recovery Well - Inactive | Intermediate | -- | -- | -- | -- | -- | 9.79 | 7.98 | -- | -- | -- | -- |
| 8 | RW-502 | -- | | 226713.569 | 2680606.719 | Recovery Well - Active | Intermediate | -- | -- | -- | -- | -- | 12.47 | 11.40 | -- | -- | -- | -- |
| 8 | WP-1 | -- | Destroyed | 215265.302 | 2682064.502 | Temporary Well | Shallow | Y | Y | 5/25/93 | 6.95 | 1 | -- | 9.92 | 5.97 | 2.97 | 3.95 | 3 |
| 8 | WP-2 | -- | | 215256.247 | 2682083.943 | Temporary Well | Shallow | Y | Y | 6/2/93 | 6.66 | 1 | -- | 10.83 | 7.17 | 4.17 | 3.66 | 3 |
| 8 | WP-3 | -- | | 215256.450 | 2682128.553 | Temporary Well | Shallow | Y | Y | 6/2/93 | 8 | 1 | -- | 11.72 | 6.72 | 3.72 | 5 | 3 |
| 8 | WP-4 | -- | Destroyed | -- | -- | Temporary Well | Shallow | Y | Y | 6/2/93 | 8.77 | 1 | -- | 10.73 | 4.96 | 1.96 | 5.77 | 3 |
| 8 | WP-5 | -- | | 215244.767 | 2682167.862 | Temporary Well | Shallow | Y | Y | 6/2/93 | 7.88 | 1 | -- | 7.60 | 2.72 | -0.28 | 4.88 | 3 |
| 8 | WP-6 | -- | | -- | -- | Temporary Well | Shallow | Y | Y | 6/2/93 | 6.86 | 1 | -- | -- | -- | -- | 3.86 | 3 |
| 8 | WP-7 | -- | | 215126.582 | 2682631.124 | Temporary Well | Shallow | Y | Y | 6/2/93 | 7.88 | 1 | -- | 8.84 | 3.96 | 0.96 | 4.88 | 3 |

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

**NOTES:**

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
*Product type percentage data not available

1. For wells that have not been surveyed by Langan, the pre-existing elevations (in NVGD 29) were converted to NAVD 88 (conversion factor is 1.05 ft).
2. Well construction details were taken directly from well boring logs provided by Handex, Secor, Aquaterra or collected from available historic reports. Where no well boring logs exist, no well construction or lithologic data is listed.
3. Former well IDs were derived from handwritten notes on the logs themselves or the referenced report.
4. 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
5. Product characterization data obtained from Sunoco's 2004 CCR and 2005 through 2010 Site Characterization Reports for AOIs 1 through 9.
6. For wells with no direct LNAPL density measurements, the density value in the nearest well with LNAPL data was used.

**Table 3**
**Summary of Groundwater and LNAPL Elevations**
**AOI 8**
**May 2011**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Monitoring Point ID | Northing | Easting | Well Type | Well[1] Classification | Specific Gravity (g/cc) Used for Correction | | Depth to Product (ft btic) | Depth to Groundwater[4] (ft btic) | Apparent LNAPL Thickness (ft btic) | LNAPL Elevation (ft amsl) | Groundwater Elevation (ft amsl) | Corrected Groundwater Elevation (ft amsl) | TIC Elevation (ft amsl) | Notes (May 2011 Gauging Event) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | S.G.[2] | Source[3] | | | | | | | | |
| N-1 | 228366.226 | 2682437.196 | Monitoring Well | Shallow | | | NP | 11.46 | | | 13.23 | **13.23** | 24.69 | |
| N-10 | 227333.894 | 2682477.634 | Monitoring Well | Shallow | | | NP | 4.58 | | | 15.38 | **15.38** | 19.96 | |
| N-11 | 227226.306 | 2682914.822 | Monitoring Well | Intermediate | | | NP | 18.29 | | | 11.45 | **11.45** | 29.74 | |
| N-12 | 227099.363 | 2683393.606 | Monitoring Well | Intermediate | | | NP | 15.80 | | | 11.39 | **11.39** | 27.19 | |
| N-13 | 227095.475 | 2683398.971 | Monitoring Well | Deep | | | NP | 21.46 | | | 5.31 | **5.31** | 26.77 | |
| N-14 | 227010.933 | 2683665.271 | Monitoring Well | Intermediate | 0.9299 | N-14 | 20.08 | 20.08 | 0.01 | **11.91** | 11.91 | **11.92** | 31.99 | |
| N-15 | 226992.660 | 2684060.447 | Monitoring Well | Intermediate | | | NP | 21.25 | | | 8.10 | **8.10** | 29.35 | |
| N-16 | 226992.615 | 2684408.639 | Monitoring Well | Intermediate | | | NP | 21.22 | | | 11.76 | **11.76** | 32.98 | |
| N-17 | 226992.700 | 2684410.420 | Monitoring Well | Intermediate | | | NP | 22.71 | | | 11.71 | **11.71** | 34.42 | |
| N-18 | 226744.095 | 2684649.893 | Monitoring Well | Intermediate | | | NP | 21.29 | | | 11.61 | **11.61** | 32.90 | |
| N-19 | 226736.819 | 2684650.605 | Monitoring Well | Deep | | | NP | 29.29 | | | 3.49 | **3.49** | 32.78 | |
| N-20 | 226644.836 | 2683877.900 | Monitoring Well | Shallow | | | NP | 17.15 | | | 11.24 | **11.24** | 28.39 | |
| N-21 | 226627.765 | 2683879.135 | Monitoring Well | Deep | | | NP | 23.77 | | | 4.24 | **4.24** | 28.01 | |
| N-23 | 226791.473 | 2682839.038 | Monitoring Well | Intermediate | 0.9033 | N-107 | 12.30 | 12.55 | 0.25 | **8.84** | 8.59 | **8.82** | 21.14 | |
| N-24 | 226437.463 | 2682553.561 | Monitoring Well | Shallow | | | NP | 12.28 | | | 8.37 | **8.37** | 20.65 | |
| N-25 | 226322.126 | 2683073.859 | Monitoring Well | Shallow | 0.9402 | N-25 | 1.80 | 2.20 | 0.40 | **16.98** | 16.58 | **16.96** | 18.78 | |
| N-26 | 226231.010 | 2683594.774 | Monitoring Well | Shallow | | | NP | 5.40 | | | 15.63 | **15.63** | 21.03 | |
| N-27 | 226112.946 | 2684408.569 | Monitoring Well | Deep | | | NP | 20.15 | | | 3.11 | **3.11** | 23.26 | |
| N-28 | 226330.807 | 2684924.768 | Monitoring Well | Shallow | | | NP | 8.95 | | | 11.50 | **11.50** | 20.45 | |
| N-29 | 225834.838 | 2685039.366 | Monitoring Well | Shallow | | | NP | 29.75 | | | 10.37 | **10.37** | 40.12 | |
| N-3 | 227951.850 | 2683124.606 | Monitoring Well | Shallow | | | NP | 14.93 | | | 11.73 | **11.73** | 26.66 | |
| N-30 | 225824.369 | 2685036.986 | Monitoring Well | Deep | | | NP | 36.65 | | | 2.72 | **2.72** | 39.37 | Damaged-Broken at Ground Surface |
| N-31 | 225799.287 | 2684423.595 | Monitoring Well | Shallow | 0.9132 | N-82 | 12.82 | 13.27 | 0.45 | **11.70** | 11.25 | **11.66** | 24.52 | |
| N-32 | 226035.860 | 2683879.671 | Monitoring Well | Shallow | | | NP | 8.00 | | | 8.27 | **8.27** | 16.27 | |
| N-34 | 226258.771 | 2682271.688 | Monitoring Well | Intermediate | | | NP | 6.51 | | | 7.08 | **7.08** | 13.59 | |
| N-35 | 226288.786 | 2681868.397 | Monitoring Well | Shallow | | | NP | 7.20 | | | 6.88 | **6.88** | 14.08 | Damaged-Broken at Ground Surface |
| N-36 | 226219.904 | 2681731.671 | Monitoring Well | Shallow | | | NP | 8.00 | | | 7.16 | **7.16** | 15.16 | |
| N-37 | 226827.511 | 2681542.987 | Monitoring Well | Shallow | | | NP | 12.07 | | | 6.15 | **6.15** | 18.22 | |
| N-38 | 226898.645 | 2680805.008 | Monitoring Well | Shallow | | | NP | 6.26 | | | 3.83 | **3.83** | 10.09 | |
| N-38D | 226897.427 | 2680792.262 | Monitoring Well | Deep | | | NP | 8.94 | | | 1.49 | **1.49** | 10.43 | |
| N-39 | 226133.874 | 2681220.305 | Abandoned | Shallow | | | NP | 4.00 | | | 5.54 | **5.54** | 9.54 | Damaged-Broken at Ground Surface |
| N-4 | 227944.638 | 2683123.405 | Monitoring Well | Deep | | | NP | 18.76 | | | 7.60 | **7.60** | 26.36 | |
| N-40 | 226015.397 | 2682005.798 | Monitoring Well | Shallow | | | NP | 6.19 | | | 5.91 | **5.91** | 12.10 | |
| N-41 | 225981.161 | 2682417.344 | Monitoring Well | Shallow | | | NP | 4.53 | | | 5.64 | **5.64** | 10.17 | Damaged-Broken at Ground Surface |
| N-42 | 225812.913 | 2682411.559 | Monitoring Well | Shallow | 0.8900 | N-42 | 7.52 | 7.52 | 0.01 | **7.38** | 7.38 | **7.39** | 14.90 | |
| N-43 | 225594.747 | 2682491.345 | Monitoring Well | Shallow | | | NP | 18.01 | | | 12.33 | **12.33** | 30.34 | |
| N-44D | 225587.984 | 2682498.213 | Monitoring Well | Deep | | | NP | 26.17 | | | 4.53 | **4.53** | 30.70 | |
| N-45 | 225745.621 | 2683509.627 | Monitoring Well | Intermediate | 0.8922 | N-125 | 13.57 | 13.61 | 0.22 | **9.18** | 9.14 | **9.34** | 22.75 | |
| N-46D | 225495.445 | 2683945.399 | Monitoring Well | Deep | | | NM | NM | | | NA | **NA** | 32.80 | Damaged- Blocked at 3.9' bgs |
| N-47 | 225489.329 | 2683935.877 | Monitoring Well | Intermediate | 0.8834 | N-47 | 19.40 | 20.01 | 0.61 | **12.52** | 11.91 | **12.45** | 31.92 | |
| N-48 | 225311.830 | 2683476.247 | Monitoring Well | Intermediate | 0.9049 | N-48 | 21.65 | 21.78 | 0.13 | **9.60** | 9.47 | **9.59** | 31.25 | |
| N-49 | 225174.606 | 2683115.270 | Monitoring Well | Intermediate | 0.8995 | N–51 | 24.37 | 25.78 | 1.41 | **9.33** | 7.92 | **9.19** | 33.70 | |

Notes:

1. 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
2. Specific Gravity (S.G.) values were determined from LNAPL samples taken by Aquaterra on February and July 2008 or from samples collected by Stantec in 1999-2000.
3. For wells with no direct S.G. measurements, the S.G. value in the nearest well with a direct S.G was used.
4. Depth to Water and Depth to LNAPL provided by Stantec. All wells gauged in May 2011 unless otherwise noted.

AOI - Area of Interest
LNAPL - Light Non-Aqueous Phase Liquid
GW - Groundwater
ft - Feet
bgs - Below Ground Surface
tic - Top of Inner Casing
in - Inches
msl - Elevation Relative to Mean Sea Level
g/cc - Grams Per cubic centimeter
NA - Data Not Available

**Table 3**
**Summary of Groundwater and LNAPL Elevations**
**AOI 8**
**May 2011**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Monitoring Point ID | Northing | Easting | Well Type | Well[1] Classification | Specific Gravity (g/cc) Used for Correction | | Depth to Product (ft btic) | Depth to Groundwater[4] (ft btic) | Apparent LNAPL Thickness (ft btic) | LNAPL Elevation (ft amsl) | Groundwater Elevation (ft amsl) | Corrected Groundwater Elevation (ft amsl) | TIC Elevation (ft amsl) | Notes (May 2011 Gauging Event) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | S.G.[2] | Source[3] | | | | | | | | |
| N-1 | 228366.226 | 2682437.196 | Monitoring Well | Shallow | | | NP | 11.46 | | | 13.23 | **13.23** | 24.69 | |
| N-5 | 227645.565 | 2682201.244 | Monitoring Well | Shallow | | | NP | 9.49 | | | 16.47 | **16.47** | 25.96 | |
| N-503 | 226576.298 | 2680565.721 | Monitoring Well | Shallow | 0.9065 | N-503 | 8.15 | 8.73 | 0.58 | **4.25** | 3.67 | **4.20** | 12.40 | |
| N-504 | 226856.668 | 2680651.601 | Monitoring Well | Intermediate | 0.9065 | N-503 | 8.55 | 8.55 | 0.01 | **3.76** | 3.76 | **3.77** | 12.31 | |
| N-50D | 225249.929 | 2682949.287 | Monitoring Well | Deep | | | NP | 26.74 | | | 5.57 | **5.57** | 32.31 | |
| N-51 | 225253.104 | 2682956.087 | Monitoring Well | Intermediate | 0.8995 | N-51 | 22.73 | 23.77 | 1.04 | **9.12** | 8.08 | **9.02** | 31.85 | |
| N-52 | 225021.374 | 2682624.237 | Monitoring Well | Intermediate | 0.8613 | N-52 | 24.45 | 24.53 | 0.02 | **9.05** | 8.97 | **8.99** | 33.50 | |
| N-53 | 225394.959 | 2682283.454 | Monitoring Well | Shallow | | | NP | 20.19 | | | 8.94 | **8.94** | 29.13 | |
| N-54 | 225146.026 | 2681898.892 | Monitoring Well | Shallow | 0.7893 | N-130 | 4.05 | 4.15 | 0.10 | **6.83** | 6.73 | **6.81** | 10.88 | |
| N-55 | 225122.420 | 2681473.558 | Monitoring Well | Shallow | | | NP | 2.53 | | | 7.73 | **7.73** | 10.26 | |
| N-56 | 225658.872 | 2681265.721 | Monitoring Well | Shallow | | | NP | 7.28 | | | 6.09 | **6.09** | 13.37 | |
| N-57 | 226031.486 | 2680585.797 | Monitoring Well | Shallow | | | NP | 4.99 | | | 5.92 | **5.92** | 10.91 | |
| N-58 | 225832.212 | 2680454.872 | Monitoring Well | Shallow | | | NP | 3.37 | | | 5.86 | **5.86** | 9.23 | |
| N-59 | 225386.806 | 2680469.612 | Monitoring Well | Shallow | | | 1.6 | 1.62 | | | 5.33 | **5.33** | 6.95 | Too viscous to accurately measure |
| N-60 | 225507.791 | 2680804.085 | Monitoring Well | Shallow | | | NP | 5.86 | | | 4.99 | **4.99** | 10.85 | |
| N-61 | 225119.242 | 2680588.298 | Monitoring Well | Shallow | | | NP | 3.33 | | | 5.58 | **5.58** | 8.91 | |
| N-64 | 224842.035 | 2682308.564 | Monitoring Well | Shallow | | | NP | 6.56 | | | 4.68 | **4.68** | 11.24 | |
| N-65 | 226363.780 | 2684499.095 | Monitoring Well | Shallow | | | NP | 12.41 | | | 11.07 | **11.07** | 23.48 | |
| N-66 | 225636.657 | 2682973.281 | Monitoring Well | Shallow | | | NP | 8.08 | | | 9.51 | **9.51** | 17.59 | |
| N-67 | 226940.291 | 2682697.910 | Monitoring Well | Shallow | | | NP | 5.65 | | | 12.58 | **12.58** | 18.23 | |
| N-68 | 226910.742 | 2682972.832 | Monitoring Well | Shallow | 0.9211 | N-68 | 12.5 | 12.52 | 0.02 | **11.72** | 11.70 | **11.72** | 24.22 | |
| N-69 | 227391.604 | 2681821.580 | Monitoring Well | Intermediate | | | NP | 14.98 | | | 8.22 | **8.22** | 23.20 | |
| N-70 | 227135.669 | 2681744.967 | Monitoring Well | Intermediate | | | NP | 14.50 | | | 7.67 | **7.67** | 22.17 | |
| N-72 | 226761.053 | 2680685.868 | Monitoring Well | Shallow | | | NP | 8.73 | | | 3.94 | **3.94** | 12.67 | |
| N-73 | 225822.483 | 2680415.328 | Monitoring Well | Intermediate | | | NP | 6.65 | | | 2.25 | **2.25** | 8.90 | |
| N-74 | 224909.029 | 2680694.217 | Monitoring Well | Shallow | | | NP | 5.74 | | | 2.14 | **2.14** | 7.88 | |
| N-75 | 224898.050 | 2680701.173 | Monitoring Well | Intermediate | 0.9371 | N-75 | 5.35 | 6.50 | 1.15 | **2.84** | 1.69 | **2.77** | 8.19 | |
| N-76 | 225362.174 | 2683610.375 | Recovery Well - Inactive | Intermediate | 0.8899 | N-76 | 20.97 | 21.21 | 2.08 | **9.50** | 9.26 | **11.11** | 30.47 | |
| N-77 | 226734.344 | 2682467.850 | Monitoring Well | Shallow | | | NP | 7.95 | | | 10.66 | **10.66** | 18.61 | |
| N-78 | 226634.702 | 2683036.636 | Monitoring Well | Intermediate | | | NM | NM | | | NA | **NA** | 22.18 | Well lost in road stone |
| N-79 | 226515.434 | 2683789.228 | Monitoring Well | Intermediate | 0.8169 | N-79 | 11.11 | 11.11 | 0.01 | **10.76** | 10.76 | **10.77** | 21.87 | |
| N-8 | 227375.293 | 2684091.768 | Monitoring Well | Shallow | | | NP | 25.69 | | | 11.92 | **11.92** | 37.61 | |
| N-81 | 225644.533 | 2684343.238 | Monitoring Well | Shallow | 0.9016 | PZ-204 | 17.78 | 17.80 | 0.02 | **11.10** | 11.08 | **11.10** | 28.88 | |
| N-82 | 225723.348 | 2684633.659 | Monitoring Well | Shallow | 0.9132 | N-82 | 22.91 | 23.04 | 0.13 | **10.58** | 10.45 | **10.57** | 33.49 | |
| N-83 | 226827.806 | 2681760.791 | Monitoring Well | Intermediate | | | NP | 15.13 | | | 6.32 | **6.32** | 21.45 | |
| N-84 | 226457.117 | 2684677.455 | Monitoring Well | Shallow | | | NP | 14.44 | | | 11.44 | **11.44** | 25.88 | |
| N-85 | 226448.228 | 2684734.375 | Monitoring Well | Shallow | | | NP | 13.73 | | | 11.56 | **11.56** | 25.29 | |
| N-86 | 226462.981 | 2684118.579 | Monitoring Well | Intermediate | | | NP | 14.82 | | | 11.02 | **11.02** | 25.84 | |
| N-87 | 226550.229 | 2683965.423 | Monitoring Well | Shallow | | | NP | 15.14 | | | 11.12 | **11.12** | 26.26 | |
| N-89 | 226717.413 | 2682823.991 | Monitoring Well | Intermediate | | | NP | 13.96 | | | 9.45 | **9.45** | 23.41 | |
| N-9 | 227374.619 | 2684097.082 | Monitoring Well | Deep | | | NP | 32.20 | | | 6.01 | **6.01** | 38.21 | |
| N-90 | 226679.051 | 2682992.994 | Monitoring Well | Shallow | | | NP | 14.76 | | | 10.95 | **10.95** | 25.71 | |
| N-91 | 226270.997 | 2683624.675 | Monitoring Well | Shallow | 0.9471 | N-91 | 7.72 | 9.80 | 2.08 | **13.18** | 11.10 | **13.07** | 20.90 | |
| N-92 | 226211.450 | 2683566.496 | Monitoring Well | Shallow | | | NP | 7.39 | | | 13.47 | **13.47** | 20.86 | |

Notes:

1. 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
2. Specific Gravity (S.G.) values were determined from LNAPL samples taken by Aquaterra on February and July 2008 or from samples collected by Stantec in 1999-2000.
3. For wells with no direct S.G. measurements, the S.G. value in the nearest well with a direct S.G was used.
4. Depth to Water and Depth to LNAPL provided by Stantec. All wells gauged in May 2011 unless otherwise noted.

AOI - Area of Interest
LNAPL - Light Non-Aqueous Phase Liquid
GW - Groundwater
ft - Feet
bgs - Below Ground Surface
tic - Top of Inner Casing
in - Inches
msl - Elevation Relative to Mean Sea Level
g/cc - Grams Per cubic centimeter
NA - Data Not Available

**Table 3**
**Summary of Groundwater and LNAPL Elevations**
**AOI 8**
**May 2011**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Monitoring Point ID | Northing | Easting | Well Type | Well[1] Classification | Specific Gravity (g/cc) Used for Correction | | Depth to Product (ft btic) | Depth to Groundwater[4] (ft btic) | Apparent LNAPL Thickness (ft btic) | LNAPL Elevation (ft amsl) | Groundwater Elevation (ft amsl) | Corrected Groundwater Elevation (ft amsl) | TIC Elevation (ft amsl) | Notes (May 2011 Gauging Event) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | S.G.[2] | Source[3] | | | | | | | | |
| N-1 | 228366.226 | 2682437.196 | Monitoring Well | Shallow | | | NP | 11.46 | | | 13.23 | **13.23** | 24.69 | |
| N-93 | 226550.366 | 2683794.415 | Monitoring Well | Shallow | | | NP | 14.58 | | | 10.51 | **10.51** | 25.09 | |
| N-94 | 226666.529 | 2681861.391 | Monitoring Well | Shallow | | | NP | 5.40 | | | 14.96 | **14.96** | 20.36 | |
| N-97 | -- | -- | Abandoned | Shallow | | | NP | 13.65 | | | 9.31 | **9.31** | 22.96 | |
| PZ-201 | 225409.395 | 2683718.309 | Piezometer | Intermediate | | | NM | NM | | | NA | **NA** | 32.28 | well was dry at 22.10 ft bgs |
| PZ-202 | 225484.370 | 2683876.463 | Piezometer | Intermediate | | | NM | NM | | | NA | **NA** | 33.39 | well was dry at 21.80 ft bgs |
| PZ-203 | 225560.000 | 2684037.463 | Piezometer | Intermediate | | | NP | 20.23 | | | 13.88 | **13.88** | 34.11 | |
| PZ-204 | 225633.438 | 2684195.803 | Piezometer | Intermediate | 0.9016 | PZ-204 | 20.11 | 21.31 | 1.20 | **8.77** | 7.57 | **8.65** | 28.88 | |
| PZ-300 | 226640.067 | 2683295.022 | Piezometer | Intermediate | | | NP | 16.98 | | | 9.79 | **9.79** | 26.77 | |
| PZ-500 | 225304.743 | 2680477.774 | Piezometer | Shallow | | | NP | 2.07 | | | 5.48 | **5.48** | 7.55 | |
| PZ-501 | 225834.728 | 2680429.243 | Piezometer | Shallow | | | NP | 3.12 | | | 5.88 | **5.88** | 9.00 | |
| PZ-502 | 225561.581 | 2680433.690 | Piezometer | Intermediate | 0.9155 | PZ-502 | 1.95 | 3.49 | 1.54 | **5.97** | 4.43 | **5.84** | 7.92 | |
| PZ-503 | 225084.552 | 2680589.725 | Piezometer | Shallow | | | NP | 2.26 | | | 6.43 | **6.43** | 8.69 | |
| PZ-504 | 224902.998 | 2680729.739 | Piezometer | Shallow | | | NP | 2.32 | | | 5.31 | **5.31** | 7.63 | |
| PZ-505 | 224708.210 | 2681023.814 | Piezometer | Shallow | | | NP | 3.08 | | | 5.38 | **5.38** | 8.46 | |
| PZ-506 | 224742.224 | 2681823.385 | Piezometer | Shallow | | | NP | 5.87 | | | 5.32 | **5.32** | 11.19 | |
| PZ-507 | 224811.796 | 2682205.934 | Piezometer | Shallow | | | NP | 7.75 | | | 4.93 | **4.93** | 12.68 | |
| RW-200 | 224924.799 | 2682439.477 | Recovery Well - Inactive | Intermediate | | | NP | 5.52 | | | 6.50 | **6.50** | 12.02 | |
| RW-201 | 225059.936 | 2682703.971 | Recovery Well - Active | Intermediate | 0.8613 | N-52 | 22.81 | 22.82 | 0.01 | **9.18** | 9.17 | **9.18** | 31.99 | |
| RW-202 | 225065.071 | 2682880.588 | Recovery Well - Active | Intermediate | | | NP | 20.28 | | | 9.23 | **9.23** | 29.51 | |
| RW-203 | 225154.073 | 2683032.076 | Recovery Well - Active | Intermediate | 0.8995 | N-51 | 22.73 | 22.75 | 0.02 | **8.37** | 8.35 | **8.37** | 31.10 | |
| RW-204 | 225163.199 | 2683189.656 | Recovery Well - Inactive | Intermediate | 0.8995 | N-51 | 19.1 | 20.22 | 1.12 | **9.47** | 8.35 | **9.36** | 28.57 | |
| RW-205 | 225250.547 | 2683342.699 | Recovery Well - Inactive | Intermediate | 0.9112 | RW-205 | 18.96 | 21.80 | 2.84 | **10.71** | 7.87 | **10.46** | 29.67 | |
| RW-206 | 225332.300 | 2683557.050 | Recovery Well - Inactive | Intermediate | 0.9112 | RW-205 | 21.3 | 21.31 | 0.01 | **9.64** | 9.63 | **9.64** | 30.94 | |
| RW-300 | 226710.145 | 2681809.651 | Recovery Well - Active | Intermediate | 0.8358 | RW-300 | 14.1 | 14.45 | 0.35 | **7.54** | 7.19 | **7.48** | 21.64 | |
| RW-301 | 226707.352 | 2682907.114 | Recovery Well - Inactive | Intermediate | | | NP | 11.90 | | | 10.51 | **10.51** | 22.41 | |
| RW-302 | 226687.489 | 2683040.088 | Recovery Well - Inactive | Intermediate | | | NP | 13.11 | | | 10.98 | **10.98** | 24.09 | |
| RW-303 | 226663.398 | 2683166.980 | Recovery Well - Active | Intermediate | | | NP | 13.86 | | | 11.12 | **11.12** | 24.98 | |
| RW-304 | 226635.005 | 2683321.529 | Recovery Well - Inactive | Intermediate | | | NP | 14.65 | | | 10.63 | **10.63** | 25.28 | |
| RW-305 | 226614.941 | 2683458.406 | Recovery Well - Active | Intermediate | | | NP | 14.68 | | | 10.59 | **10.59** | 25.27 | |
| RW-306 | 226581.193 | 2683767.983 | Recovery Well - Active | Intermediate | 0.8169 | N-79 | 12.8 | 12.81 | 0.01 | **10.78** | 10.77 | **10.78** | 23.58 | |
| RW-307 | 226603.861 | 2683079.555 | Recovery Well - Active | Intermediate | | | NP | 14.35 | | | 8.91 | **8.91** | 23.26 | |

Notes:
1. 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.
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2. Specific Gravity (S.G.) values were determined from LNAPL samples taken by Aquaterra on February and July 2008 or from samples collected by Stantec in 1999-2000.
3. For wells with no direct S.G. measurements, the S.G. value in the nearest well with a direct S.G was used.
4. Depth to Water and Depth to LNAPL provided by Stantec. All wells gauged in May 2011 unless otherwise noted.

AOI - Area of Interest
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GW - Groundwater
ft - Feet
bgs - Below Ground Surface
tic - Top of Inner Casing
in - Inches
msl - Elevation Relative to Mean Sea Level
g/cc - Grams Per cubic centimeter
NA - Data Not Available

**Table 3**
**Summary of Groundwater and LNAPL Elevations**
**AOI 8**
**May 2011**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Monitoring Point ID | Northing | Easting | Well Type | Well[1] Classification | Specific Gravity (g/cc) Used for Correction | | Depth to Product (ft btic) | Depth to Groundwater[4] (ft btic) | Apparent LNAPL Thickness (ft btic) | LNAPL Elevation (ft amsl) | Groundwater Elevation (ft amsl) | Corrected Groundwater Elevation (ft amsl) | TIC Elevation (ft amsl) | Notes (May 2011 Gauging Event) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | S.G.[2] | Source[3] | | | | | | | | |
| N-1 | 228366.226 | 2682437.196 | Monitoring Well | Shallow | | | NP | 11.46 | | | 13.23 | **13.23** | 24.69 | |
| RW-308 | 226622.581 | 2683240.062 | Recovery Well - Active | Intermediate | | | NP | 16.52 | | | 9.09 | **9.09** | 25.61 | |
| RW-309 | 226602.424 | 2683373.035 | Recovery Well - Inactive | Intermediate | | | NP | 15.40 | | | 9.83 | **9.83** | 25.23 | |
| RW-500 | 225305.391 | 2680478.176 | Recovery Well - Active | Intermediate | | | NP | 2.05 | | | 5.51 | **5.51** | 7.56 | |
| RW-501 | 224727.458 | 2681487.009 | Recovery Well - Inactive | Intermediate | | | NP | 4.39 | | | 5.40 | **5.40** | 9.79 | |
| RW-502 | 226713.569 | 2680606.719 | Recovery Well - Active | Intermediate | 0.9065 | N-503 | 8.38 | 8.43 | 0.05 | **4.09** | 4.04 | **4.09** | 12.47 | |
| N-98 | 227658.440 | 2683478.923 | Monitoring Well | Intermediate | | | NP | 23.28 | | | 11.25 | **11.25** | 34.53 | |
| N-99 | 228875.116 | 2682854.562 | Monitoring Well | Intermediate | | | NP | 19.45 | | | 8.81 | **8.81** | 28.26 | |
| N-100 | 228209.793 | 2682716.186 | Monitoring Well | Intermediate | | | NP | 18.25 | | | 8.76 | **8.76** | 27.01 | |
| N-101 | 227221.776 | 2683652.840 | Monitoring Well | Intermediate | | | NP | 15.75 | | | 11.40 | **11.40** | 27.15 | |
| N-102 | 227035.480 | 2683869.606 | Monitoring Well | Intermediate | | | NP | 20.45 | | | 12.76 | **12.76** | 33.21 | |
| N-103 | 226781.705 | 2683660.200 | Monitoring Well | Intermediate | | | NP | 18.14 | | | 11.19 | **11.19** | 29.33 | |
| N-104 | 226914.012 | 2683419.549 | Monitoring Well | Intermediate | | | NP | 16.38 | | | 11.26 | **11.26** | 27.64 | |
| N-105 | 226745.373 | 2683442.708 | Monitoring Well | Intermediate | | | NP | 17.06 | | | 11.05 | **11.05** | 28.11 | |
| N-106 | 227044.243 | 2682976.538 | Monitoring Well | Intermediate | | | NP | 8.62 | | | 14.41 | **14.41** | 23.03 | |
| N-107 | 226909.904 | 2683133.246 | Monitoring Well | Intermediate | 0.9033 | N-107 | 15.07 | 15.07 | 0.01 | **11.30** | 11.30 | **11.31** | 26.37 | |
| N-108 | 226848.509 | 2682983.450 | Monitoring Well | Intermediate | | | NM | NM | | | NA | **NA** | 22.41 | damaged- crimped over as if hit by vehicle |
| N-109 | 226649.194 | 2681604.972 | Monitoring Well | Intermediate | | | NP | 10.70 | | | 7.72 | **7.72** | 18.42 | |
| N-110 | 226640.022 | 2680765.883 | Monitoring Well | Intermediate | | | NM | NM | | | NA | **NA** | 12.11 | Well destroyed |
| N-111 | 226514.002 | 2680519.261 | Monitoring Well | Intermediate | | | NP | 6.30 | | | 4.46 | **4.46** | 10.76 | |
| N-112 | 226328.461 | 2681663.567 | Monitoring Well | Intermediate | 0.9167 | N-113 | 8.9 | 12.10 | 3.20 | **6.82** | 3.62 | **6.55** | 15.72 | |
| N-113 | 226054.267 | 2681733.331 | Monitoring Well | Intermediate | 0.9167 | N-113 | 8.9 | 9.70 | 0.80 | **5.25** | 4.45 | **5.19** | 14.15 | |
| N-114 | 226224.645 | 2681510.698 | Monitoring Well | Intermediate | | | NP | 8.01 | | | 6.36 | **6.36** | 14.37 | |
| N-115 | 225824.433 | 2682246.434 | Monitoring Well | Intermediate | 0.8985 | N-116 | 7.66 | 7.66 | 0.01 | **7.67** | 7.67 | **7.68** | 15.33 | |
| N-116 | 225843.598 | 2682616.585 | Monitoring Well | Intermediate | 0.8985 | N-116 | 5.31 | 6.52 | 0.73 | **5.97** | 4.76 | **5.41** | 11.28 | |
| N-117 | 226416.379 | 2682828.260 | Monitoring Well | Intermediate | | | NM | NM | | | NA | **NA** | 24.24 | Well destroyed |
| N-118 | 226460.505 | 2683077.266 | Monitoring Well | Intermediate | | | NP | 14.07 | | | 9.38 | **9.38** | 23.45 | |
| N-119 | 226406.087 | 2683561.624 | Monitoring Well | Intermediate | | | NP | 9.12 | | | 11.31 | **11.31** | 20.43 | |
| N-120 | 226332.599 | 2683852.895 | Monitoring Well | Intermediate | | | NP | 10.82 | | | 11.51 | **11.51** | 22.33 | |
| N-121 | 226380.688 | 2683357.051 | Monitoring Well | Intermediate | | | NP | 11.19 | | | 9.58 | **9.58** | 20.77 | |
| N-122 | 226074.378 | 2683576.782 | Monitoring Well | Intermediate | | | NP | 9.74 | | | 7.31 | **7.31** | 17.05 | |
| N-123 | 225788.933 | 2684165.075 | Monitoring Well | Intermediate | | | NP | 11.21 | | | 10.03 | **10.03** | 21.24 | |
| N-124 | 225963.423 | 2684525.329 | Monitoring Well | Intermediate | | | NP | 13.88 | | | 11.79 | **11.79** | 25.67 | |
| N-125 | 225653.256 | 2683530.878 | Monitoring Well | Intermediate | 0.8922 | N-125 | 16.1 | 18.99 | 2.89 | **9.84** | 6.95 | **9.53** | 25.94 | |
| N-126 | 225829.500 | 2683283.039 | Monitoring Well | Shallow | | | NP | 4.80 | | | 6.00 | **6.00** | 10.80 | |
| N-127 | 225192.921 | 2682768.505 | Monitoring Well | Intermediate | 0.8785 | N-127 | 24.23 | 24.72 | 0.49 | **9.22** | 8.73 | **9.16** | 33.45 | |
| N-128 | 225454.117 | 2682901.765 | Monitoring Well | Intermediate | 0.8785 | N-127 | 18.72 | 19.37 | 0.65 | **9.42** | 8.77 | **9.34** | 28.14 | |
| N-129 | 225469.919 | 2683240.942 | Monitoring Well | Intermediate | 0.9017 | N-129 | 19.39 | 20.52 | 1.13 | **9.51** | 8.38 | **9.39** | 28.90 | |
| N-130 | 225087.603 | 2682501.018 | Monitoring Well | Intermediate | 0.7893 | N-130 | 22.75 | 22.96 | 0.21 | **8.85** | 8.64 | **8.80** | 31.60 | |
| N-131 | 225671.489 | 2681085.575 | Monitoring Well | Shallow | | | NP | 3.40 | | | 5.63 | **5.63** | 9.03 | |
| N-132 | 225634.140 | 2681685.292 | Monitoring Well | Shallow | | | NP | 4.78 | | | 6.33 | **6.33** | 11.11 | |
| N-133 | 224966.629 | 2680751.162 | Monitoring Well | Shallow | | | NP | 3.61 | | | 5.75 | **5.75** | 9.36 | |
| N-134 | 226063.245 | 2685261.950 | Monitoring Well | Intermediate | | | NP | 17.20 | | | 10.29 | **10.29** | 27.49 | |
| N-135 | 225141.446 | 2680687.178 | Monitoring Well | Shallow | 0.9148 | N-135 | 4.01 | 5.13 | 1.12 | **5.91** | 4.79 | **5.81** | 9.92 | |
| N-136 | 225342.984 | 2680714.222 | Monitoring Well | Shallow | | | NP | 3.60 | | | 7.25 | **7.25** | 10.85 | |
| **Philadelphia Gas Works Wells** | | | | | | | | | | | | | | |
| P-30 | 225510.928 | 2684088.101 | Monitoring Well | Shallow | 0.9112 | RW-205 | 19.87 | 22.31 | 2.44 | **12.68** | 10.24 | **12.46** | 32.55 | |
| P-42 | 225555.206 | 2684361.371 | Monitoring Well | Shallow | | | NP | 12.79 | | | 20.37 | **20.37** | 33.16 | |
| P-44 | 225647.296 | 2684648.203 | Monitoring Well | Shallow | | | NP | 21.75 | | | 10.45 | **10.45** | 32.20 | |
| P-45 | 225230.820 | 2684147.076 | Monitoring Well | Shallow | | | NP | 23.14 | | | 10.40 | **10.40** | 33.54 | |
| MW-5 | -- | -- | -- | -- | | | NP | 26.80 | | **NA** | NA | **NA** | | |
| MW-7 | -- | -- | -- | -- | Unknown | | 15.07 | 15.58 | 0.51 | **NA** | NA | **NA** | | |
| MW-8 | -- | -- | -- | -- | | | NP | 24.15 | | **NA** | NA | **NA** | | |
| MW-9 | -- | -- | -- | -- | | | NP | 25.29 | | **NA** | NA | **NA** | | |
| MW-21 | 224770.752 | 2682698.189 | Monitoring Well | Shallow | | | NP | 5.16 | | **NA** | NA | **NA** | | |

Notes:
1. 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
2. Specific Gravity (S.G.) values were determined from LNAPL samples taken by Aquaterra on February and July 2008 or from samples collected by Stantec in 1999-2000.
3. For wells with no direct S.G. measurements, the S.G. value in the nearest well with a direct S.G was used.
4. Depth to Water and Depth to LNAPL provided by Stantec. All wells gauged in May 2011 unless otherwise noted.

AOI - Area of Interest
LNAPL - Light Non-Aqueous Phase Liquid
GW - Groundwater
ft - Feet
bgs - Below Ground Surface
tic - Top of Inner Casing
in - Inches
msl - Elevation Relative to Mean Sea Level
g/cc - Grams Per cubic centimeter
NA - Data Not Available

**Table 4**
**Summary of Soil Sample Analytical Results: Non SWMU Area**
**AOI 8 Site Characterization Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer Soil MSCs (TDS<2,500) | Location ID | BH-08-01 | | | | BH-08-02 | | | | BH-08-03 | | | | BH-08-04 | | | | BH-08-07 | | | | BH-08-08 | | | | BH-08-09 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | BH-08-01_1.0-2.0 | | | | BH-08-02_1.0-2.0 | | | | BH-08-03_1.0-2.0 | | | | BH-08-04_1.0-2.0 | | | | BH-08-07_1.0-2.0 | | | | BH-08-08_1.0-2.0 | | | | BH-08-09_1.0-2.0 | | | |
| | | | Sample Matrix | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | |
| | | | Sample Interval | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | |
| | | | Sample Date | 6/17/2008 | | | | 5/7/2008 | | | | 5/7/2008 | | | | 5/8/2008 | | | | 5/8/2008 | | | | 5/7/2008 | | | | 5/7/2008 | | | |
| | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 2.0 | mg/kg | ND | U | 0.24 | 43.78 | ND | U | 0.23 | 39.81 | ND | U | 0.22 | 39.43 | ND | U | 0.27 | 43.71 | ND | U | 0.25 | 41.12 | ND | U | 0.38 | 62.19 | ND | U | 0.4 | 71.63 |
| Benzene | 71-43-2 | 0.5 | mg/kg | ND | U | 0.24 | 43.78 | ND | U | 0.23 | 39.81 | 0.58 | | 0.22 | 39.43 | 3.3 | | 0.27 | 43.71 | 1.4 | | 0.25 | 41.12 | 1.9 | | 0.38 | 62.19 | 3.2 | | 0.4 | 71.63 |
| 1,2-Dichloroethane | 107-06-2 | 0.5 | mg/kg | ND | U | 0.24 | 43.78 | ND | U | 0.23 | 39.81 | ND | U | 0.22 | 39.43 | ND | U | 0.27 | 43.71 | ND | U | 0.25 | 41.12 | ND | U | 0.38 | 62.19 | ND | U | 0.4 | 71.63 |
| Toluene | 108-88-3 | 100 | mg/kg | ND | U | 0.24 | 43.78 | ND | U | 0.23 | 39.81 | 0.23 | | 0.22 | 39.43 | 0.59 | | 0.27 | 43.71 | 0.47 | | 0.25 | 41.12 | ND | U | 0.38 | 62.19 | 0.99 | | 0.4 | 71.63 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.005 | mg/kg | ND | U | 0.24 | 43.78 | ND | U | 0.23 | 39.81 | ND | U | 0.22 | 39.43 | ND | U | 0.27 | 43.71 | ND | U | 0.25 | 41.12 | ND | U | 0.38 | 62.19 | ND | U | 0.4 | 71.63 |
| Ethylbenzene | 100-41-4 | 70 | mg/kg | ND | U | 0.24 | 43.78 | ND | U | 0.23 | 39.81 | ND | U | 0.22 | 39.43 | 8.4 | | 0.27 | 43.71 | 8.4 | | 0.25 | 41.12 | ND | U | 0.38 | 62.19 | ND | U | 0.4 | 71.63 |
| Cumene | 98-82-8 | 2,500 | mg/kg | ND | U | 0.24 | 43.78 | ND | U | 0.23 | 39.81 | 0.44 | | 0.22 | 39.43 | 2.4 | | 0.27 | 43.71 | 3.8 | | 0.25 | 41.12 | ND | U | 0.38 | 62.19 | ND | U | 0.4 | 71.63 |
| Xylene (Total) | 1330-20-7 | 1,000 | mg/kg | ND | U | 0.24 | 43.78 | ND | U | 0.23 | 39.81 | 0.34 | | 0.22 | 39.43 | 32 | | 2.7 | 437.06 | 28 | | 2.5 | 411.18 | 0.62 | | 0.38 | 62.19 | 3.2 | | 0.4 | 71.63 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 2,200 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.95 | 5 | ND | U | 4.7 | 5 | ND | U | 10 | 5 | 5.9 | | 5.1 | 5 | ND | U | 5.1 | 5 | 8.5 | | 4.7 | 5 |
| Naphthalene | 91-20-3 | 25 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.95 | 5 | ND | U | 4.7 | 5 | 12 | | 10 | 5 | 15 | | 5.1 | 5 | ND | U | 5.1 | 5 | 5.9 | | 4.7 | 5 |
| Fluorene | 86-73-7 | 3,800 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.95 | 5 | ND | U | 4.7 | 5 | ND | U | 10 | 5 | 12 | | 5.1 | 5 | ND | U | 5.1 | 5 | ND | U | 4.7 | 5 |
| Phenanthrene | 85-01-8 | 10,000 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.95 | 5 | 6.8 | | 4.7 | 5 | 20 | | 10 | 5 | 34 | | 5.1 | 5 | ND | U | 5.1 | 5 | 8.5 | | 4.7 | 5 |
| Anthracene | 120-12-7 | 350 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.95 | 5 | ND | U | 4.7 | 5 | ND | U | 10 | 5 | ND | U | 5.1 | 5 | ND | U | 5.1 | 5 | ND | U | 4.7 | 5 |
| Benzo(a)anthracene | 56-55-3 | 320 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.95 | 5 | ND | U | 4.7 | 5 | ND | U | 10 | 5 | ND | U | 5.1 | 5 | ND | U | 5.1 | 5 | ND | U | 4.7 | 5 |
| Chrysene | 218-01-9 | 230 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.95 | 5 | ND | U | 4.7 | 5 | ND | U | 10 | 5 | ND | U | 5.1 | 5 | 7.2 | | 5.1 | 5 | 6.9 | | 4.7 | 5 |
| Benzo(b)fluoranthene | 205-99-2 | 170 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.95 | 5 | ND | U | 4.7 | 5 | ND | U | 10 | 5 | ND | U | 5.1 | 5 | ND | U | 5.1 | 5 | 6.3 | | 4.7 | 5 |
| Benzo(a)pyrene | 50-32-8 | 46 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.95 | 5 | ND | U | 4.7 | 5 | ND | U | 10 | 5 | ND | U | 5.1 | 5 | ND | U | 5.1 | 5 | ND | U | 4.7 | 5 |
| Benzo(g,h,i)perylene | 191-24-2 | 180 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.95 | 5 | ND | U | 4.7 | 5 | ND | U | 10 | 5 | ND | U | 5.1 | 5 | ND | U | 5.1 | 5 | ND | U | 4.7 | 5 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 450 | mg/kg | 69.7 | | 1.08 | 10 | 138 | U | 1.11 | 10 | 291 | | 291 | 10 | 829 | | 2.41 | 20 | 519 | | 1.18 | 10 | 637 | | 2.41 | 20 | 262 | | 1.09 | 10 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/kg - microgram per kilogram
mg/kg - milligram per kilogram
MSC - PADEP's Medium Specific Concentration for Soil
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
SWMU - Solid Waste Management Unit

All soil samples collected and analyzed were unsaturated

**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
N - Spike Amount not within control limits

**Exceedance Summary:**
**10** - RL exceeds the PADEP Non-Residential Soil MSC
10 - Concentration exceeds the PADEP Non-Residential Soil MSC

**Table 4**
**Summary of Soil Sample Analytical Results: Non SWMU Area**
**AOI 8 Site Characterization Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer Soil MSCs (TDS<2,500) | Location ID | BH-08-10 | | | | BH-08-11 | | | | BH-08-12 | | | | BH-08-13 | | | | BH-08-14 | | | | BH-08-15 | | | | BH-08-16 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | BH-08-10_1.0-2.0 | | | | BH-08-11_1.0-2.0 | | | | BH-08-12_1.0-2.0 | | | | BH-08-13_1.0-2.0 | | | | BH-08-14_1.0-2.0 | | | | BH-08-15_1.0-2.0 | | | | BH-08-16_1.0-2.0 | | | |
| | | | Sample Matrix | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | |
| | | | Sample Interval | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | |
| | | | Sample Date | 5/7/2008 | | | | 5/7/2008 | | | | 5/6/2008 | | | | 5/6/2008 | | | | 5/6/2008 | | | | 5/6/2008 | | | | 5/7/2008 | | | |
| | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 2.0 | mg/kg | ND | U | 0.2 | 35.92 | ND | U | 0.24 | 40.26 | ND | U | 0.27 | 44.33 | ND | U | 0.19 | 33.2 | ND | U | 0.23 | 41.39 | ND | U | 0.2 | 34.44 | ND | U | 0.26 | 45.45 |
| Benzene | 71-43-2 | 0.5 | mg/kg | ND | U | 0.2 | 35.92 | 0.31 | | 0.24 | 40.26 | 3.1 | | 0.27 | 44.33 | ND | U | 0.19 | 33.2 | ND | U | 0.23 | 41.39 | ND | U | 0.2 | 34.44 | 3.1 | | 0.26 | 45.45 |
| 1,2-Dichloroethane | 107-06-2 | 0.5 | mg/kg | ND | U | 0.2 | 35.92 | ND | U | 0.24 | 40.26 | ND | U | 0.27 | 44.33 | ND | U | 0.19 | 33.2 | ND | U | 0.23 | 41.39 | ND | U | 0.2 | 34.44 | ND | U | 0.26 | 45.45 |
| Toluene | 108-88-3 | 100 | mg/kg | 4.2 | | 0.2 | 35.92 | ND | U | 0.24 | 40.26 | 0.66 | | 0.27 | 44.33 | ND | U | 0.19 | 33.2 | ND | U | 0.23 | 41.39 | ND | U | 0.2 | 34.44 | 4.2 | | 0.26 | 45.45 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.005 | mg/kg | ND | U | 0.2 | 35.92 | ND | U | 0.24 | 40.26 | ND | U | 0.27 | 44.33 | ND | U | 0.19 | 33.2 | ND | U | 0.23 | 41.39 | ND | U | 0.2 | 34.44 | ND | U | 0.26 | 45.45 |
| Ethylbenzene | 100-41-4 | 70 | mg/kg | ND | U | 0.2 | 35.92 | ND | U | 0.24 | 40.26 | 0.74 | | 0.27 | 44.33 | ND | U | 0.19 | 33.2 | ND | U | 0.23 | 41.39 | ND | U | 0.2 | 34.44 | 6.6 | | 0.26 | 45.45 |
| Cumene | 98-82-8 | 2,500 | mg/kg | ND | U | 0.2 | 35.92 | ND | U | 0.24 | 40.26 | 1.5 | | 0.27 | 44.33 | ND | U | 0.19 | 33.2 | ND | U | 0.23 | 41.39 | ND | U | 0.2 | 34.44 | 2100 | | 0.26 | 45.45 |
| Xylene (Total) | 1330-20-7 | 1,000 | mg/kg | 0.36 | | 0.2 | 35.92 | ND | U | 0.24 | 40.26 | 5.8 | | 0.27 | 44.33 | ND | U | 0.19 | 33.2 | ND | U | 0.23 | 41.39 | ND | U | 0.2 | 34.44 | 34 | | 0.26 | 45.45 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 2,200 | mg/kg | 2.1 | | 0.94 | 5 | ND | U | 4.9 | 5 | 2.2 | | 1 | 1 | 2.6 | | 0.98 | 1 | 0.27 | | 0.19 | 1 | ND | U | 0.19 | 1 | 15 | | 9.7 | 5 |
| Naphthalene | 91-20-3 | 25 | mg/kg | ND | U | 0.94 | 5 | ND | U | 4.9 | 5 | 2.7 | | 1 | 1 | ND | U | 0.98 | 1 | ND | U | 0.19 | 1 | ND | U | 0.19 | 1 | 18 | | 9.7 | 5 |
| Fluorene | 86-73-7 | 3,800 | mg/kg | ND | U | 0.94 | 5 | ND | U | 4.9 | 5 | 2.4 | | 1 | 1 | ND | U | 0.98 | 1 | ND | U | 0.19 | 1 | ND | U | 0.19 | 1 | 21 | | 9.7 | 5 |
| Phenanthrene | 85-01-8 | 10,000 | mg/kg | 1.7 | | 0.94 | 5 | ND | U | 4.9 | 5 | 6.6 | | 1 | 1 | ND | U | 0.98 | 1 | 0.33 | | 0.19 | 1 | ND | U | 0.19 | 1 | 58 | | 9.7 | 5 |
| Anthracene | 120-12-7 | 350 | mg/kg | ND | U | 0.94 | 5 | ND | U | 4.9 | 5 | 1.5 | | 1 | 1 | ND | U | 0.98 | 1 | ND | U | 0.19 | 1 | ND | U | 0.19 | 1 | 11 | | 9.7 | 5 |
| Benzo(a)anthracene | 56-55-3 | 320 | mg/kg | 2 | | 0.94 | 5 | ND | U | 4.9 | 5 | ND | U | 1 | 1 | 1.1 | | 0.98 | 1 | ND | U | 0.19 | 1 | ND | U | 0.19 | 1 | ND | U | 9.7 | 5 |
| Chrysene | 218-01-9 | 230 | mg/kg | 1.9 | | 0.94 | 5 | ND | U | 4.9 | 5 | 1.9 | | 1 | 1 | 2.7 | | 0.98 | 1 | 0.25 | | 0.19 | 1 | ND | U | 0.19 | 1 | 13 | | 9.7 | 5 |
| Benzo(b)fluoranthene | 205-99-2 | 170 | mg/kg | 2.5 | | 0.94 | 5 | ND | U | 4.9 | 5 | ND | U | 1 | 1 | 1.1 | | 0.98 | 1 | ND | U | 0.19 | 1 | ND | U | 0.19 | 1 | ND | U | 9.7 | 5 |
| Benzo(a)pyrene | 50-32-8 | 46 | mg/kg | 2.6 | | 0.94 | 5 | ND | U | 4.9 | 5 | ND | U | 1 | 1 | 1.3 | | 0.98 | 1 | ND | U | 0.19 | 1 | ND | U | 0.19 | 1 | ND | U | 9.7 | 5 |
| Benzo(g,h,i)perylene | 191-24-2 | 180 | mg/kg | 1.8 | | 0.94 | 5 | ND | U | 4.9 | 5 | ND | U | 1 | 1 | 1.1 | | 0.98 | 1 | ND | U | 0.19 | 1 | ND | U | 0.19 | 1 | ND | U | 9.7 | 5 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 450 | mg/kg | 428 | | 1.1 | 10 | 131 | | 1.16 | 10 | 1250 | | 11.6 | 100 | 314 | | 1.14 | 10 | 78.8 | | 1.12 | 10 | 22.8 | | 1.13 | 10 | 1380 | | 5.58 | 50 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/kg - microgram per kilogram
mg/kg - milligram per kilogram
MSC - PADEP's Medium Specific Concentration for Soil
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
SWMU - Solid Waste Management Unit

All soil samples collected and analyzed were unsaturated

**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
N - Spike Amount not within control limits

**Exceedance Summary:**
**10** - RL exceeds the PADEP Non-Residential Soil MSC
10 - Concentration exceeds the PADEP Non-Residential Soil MSC

**Table 4**
**Summary of Soil Sample Analytical Results: Non SWMU Area**
**AOI 8 Site Characterization Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer Soil MSCs (TDS<2,500) | Location ID | BH-08-17 | | | | BH-08-18 | | | | BH-08-21 | | | | BH-08-22 | | | | BH-08-23 | | | | BH-08-24 | | | | BH-08-25 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | BH-08-17_1.0-2.0 | | | | BH-08-18_1.0-2.0 | | | | BH-08-21_1.0-2.0 | | | | BH-08-22_1.0-2.0 | | | | BH-08-23_1.0-2.0 | | | | BH-08-24_1.0-2.0 | | | | BH-08-25_1.0-2.0 | | | |
| | | | Sample Matrix | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | |
| | | | Sample Interval | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | |
| | | | Sample Date | 5/7/2008 | | | | 5/7/2008 | | | | 5/7/2008 | | | | 5/7/2008 | | | | 5/7/2008 | | | | 5/7/2008 | | | | 5/7/2008 | | | |
| | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 2.0 | mg/kg | ND | U | 0.24 | 39.68 | ND | U | 0.24 | 42.09 | ND | U | 0.25 | 44.01 | ND | U | 0.26 | 44.88 | ND | U | 0.18 | 30.64 | ND | U | 0.38 | 68.87 | ND | U | 0.46 | 83.06 |
| Benzene | 71-43-2 | 0.5 | mg/kg | ND | U | 0.24 | 39.68 | ND | U | 0.24 | 42.09 | ND | U | 0.25 | 44.01 | ND | U | 0.26 | 44.88 | ND | U | 0.18 | 30.64 | ND | U | 0.38 | 68.87 | ND | U | 0.46 | 83.06 |
| 1,2-Dichloroethane | 107-06-2 | 0.5 | mg/kg | ND | U | 0.24 | 39.68 | ND | U | 0.24 | 42.09 | ND | U | 0.25 | 44.01 | ND | U | 0.26 | 44.88 | ND | U | 0.18 | 30.64 | ND | U | 0.38 | 68.87 | ND | U | 0.46 | 83.06 |
| Toluene | 108-88-3 | 100 | mg/kg | ND | U | 0.24 | 39.68 | ND | U | 0.24 | 42.09 | ND | U | 0.25 | 44.01 | ND | U | 0.26 | 44.88 | ND | U | 0.18 | 30.64 | ND | U | 0.38 | 68.87 | ND | U | 0.46 | 83.06 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.005 | mg/kg | ND | U | 0.24 | 39.68 | ND | U | 0.24 | 42.09 | ND | U | 0.25 | 44.01 | ND | U | 0.26 | 44.88 | ND | U | 0.18 | 30.64 | ND | U | 0.38 | 68.87 | ND | U | 0.46 | 83.06 |
| Ethylbenzene | 100-41-4 | 70 | mg/kg | ND | U | 0.24 | 39.68 | ND | U | 0.24 | 42.09 | ND | U | 0.25 | 44.01 | ND | U | 0.26 | 44.88 | ND | U | 0.18 | 30.64 | ND | U | 0.38 | 68.87 | ND | U | 0.46 | 83.06 |
| Cumene | 98-82-8 | 2,500 | mg/kg | ND | U | 0.24 | 39.68 | ND | U | 0.24 | 42.09 | ND | U | 0.25 | 44.01 | ND | U | 0.26 | 44.88 | ND | U | 0.18 | 30.64 | 1.4 | | 0.38 | 68.87 | ND | U | 0.46 | 83.06 |
| Xylene (Total) | 1330-20-7 | 1,000 | mg/kg | ND | U | 0.24 | 39.68 | ND | U | 0.24 | 42.09 | ND | U | 0.25 | 44.01 | ND | U | 0.26 | 44.88 | 0.2 | | 0.18 | 30.64 | 0.6 | | 0.38 | 68.87 | ND | U | 0.46 | 83.06 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 2,200 | mg/kg | ND | U | 0.99 | 5 | ND | U | 0.94 | 5 | ND | U | 4.8 | 5 | ND | U | 4.8 | 5 | ND | U | 5 | 5 | ND | U | 4.6 | 5 | ND | U | 4.6 | 5 |
| Naphthalene | 91-20-3 | 25 | mg/kg | ND | U | 0.99 | 5 | ND | U | 0.94 | 5 | ND | U | 4.8 | 5 | ND | U | 4.8 | 5 | ND | U | 5 | 5 | ND | U | 4.6 | 5 | ND | U | 4.6 | 5 |
| Fluorene | 86-73-7 | 3,800 | mg/kg | ND | U | 0.99 | 5 | ND | U | 0.94 | 5 | ND | U | 4.8 | 5 | ND | U | 4.8 | 5 | ND | U | 5 | 5 | ND | U | 4.6 | 5 | ND | U | 4.6 | 5 |
| Phenanthrene | 85-01-8 | 10,000 | mg/kg | ND | U | 0.99 | 5 | ND | U | 0.94 | 5 | 9.7 | | 4.8 | 5 | ND | U | 4.8 | 5 | ND | U | 5 | 5 | 5.9 | | 4.6 | 5 | ND | U | 4.6 | 5 |
| Anthracene | 120-12-7 | 350 | mg/kg | ND | U | 0.99 | 5 | ND | U | 0.94 | 5 | ND | U | 4.8 | 5 | ND | U | 4.8 | 5 | ND | U | 5 | 5 | ND | U | 4.6 | 5 | ND | U | 4.6 | 5 |
| Benzo(a)anthracene | 56-55-3 | 320 | mg/kg | ND | U | 0.99 | 5 | ND | U | 0.94 | 5 | ND | U | 4.8 | 5 | ND | U | 4.8 | 5 | ND | U | 5 | 5 | ND | U | 4.6 | 5 | ND | U | 4.6 | 5 |
| Chrysene | 218-01-9 | 230 | mg/kg | ND | U | 0.99 | 5 | ND | U | 0.94 | 5 | ND | U | 4.8 | 5 | ND | U | 4.8 | 5 | ND | U | 5 | 5 | ND | U | 4.6 | 5 | ND | U | 4.6 | 5 |
| Benzo(b)fluoranthene | 205-99-2 | 170 | mg/kg | ND | U | 0.99 | 5 | ND | U | 0.94 | 5 | ND | U | 4.8 | 5 | ND | U | 4.8 | 5 | ND | U | 5 | 5 | ND | U | 4.6 | 5 | ND | U | 4.6 | 5 |
| Benzo(a)pyrene | 50-32-8 | 46 | mg/kg | ND | U | 0.99 | 5 | ND | U | 0.94 | 5 | ND | U | 4.8 | 5 | ND | U | 4.8 | 5 | ND | U | 5 | 5 | ND | U | 4.6 | 5 | ND | U | 4.6 | 5 |
| Benzo(g,h,i)perylene | 191-24-2 | 180 | mg/kg | ND | U | 0.99 | 5 | ND | U | 0.94 | 5 | ND | | 4.8 | 5 | ND | U | 4.8 | 5 | ND | U | 5 | 5 | ND | U | 4.6 | 5 | ND | U | 4.6 | 5 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 450 | mg/kg | 102 | | 1.16 | 10 | 22.2 | | 1.13 | 10 | 540 | | 1.15 | 10 | 213 | | 1.13 | 10 | 374 | | 1.17 | 10 | 172 | | 1.08 | 10 | 223 | | 1.11 | 10 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/kg - microgram per kilogram
mg/kg - milligram per kilogram
MSC - PADEP's Medium Specific Concentration for Soil
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
SWMU - Solid Waste Management Unit

All soil samples collected and analyzed were unsaturated

**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
N - Spike Amount not within control limits

**Exceedance Summary:**
**10** - RL exceeds the PADEP Non-Residential Soil MSC
10 - Concentration exceeds the PADEP Non-Residential Soil MSC

**Table 4**
**Summary of Soil Sample Analytical Results: Non SWMU Area**
**AOI 8 Site Characterization Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer Soil MSCs (TDS<2,500) | Location ID | BH-08-26 | | | | BH-08-27 | | | | BH-08-28 | | | | BH-08-29 | | | | BH-08-31 | | | | BH-08-32 | | | | BH-08-33 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | BH-08-26_1.0-2.0 | | | | BH-08-27_1.0-2.0 | | | | BH-08-28_1.0-2.0 | | | | BH-08-29_1.0-2.0 | | | | BH-08-31_1.0-2.0 | | | | BH-08-32_0.0-2.0 | | | | BH-08-33_1.5-2.0 | | | |
| | | | Sample Matrix | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | |
| | | | Sample Interval | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 0-2.0 | | | | 1.5-2.0 | | | |
| | | | Sample Date | 5/8/2008 | | | | 5/6/2008 | | | | 5/6/2008 | | | | 5/6/2008 | | | | 5/6/2008 | | | | 7/3/2008 | | | | 5/6/2008 | | | |
| | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 2.0 | mg/kg | ND | U | 0.21 | 35.31 | ND | U | 0.18 | 31.57 | ND | U | 0.27 | 44.8 | ND | U | 0.23 | 40.72 | ND | U | 0.24 | 44.09 | ND | U | 0.3 | 57.34 | ND | U | 0.28 | 47.53 |
| Benzene | 71-43-2 | 0.5 | mg/kg | 9 | | 0.21 | 35.31 | ND | U | 0.18 | 31.57 | ND | U | 0.27 | 44.8 | ND | U | 0.23 | 40.72 | ND | U | 0.24 | 44.09 | ND | U | 0.3 | 57.34 | ND | U | 0.28 | 47.53 |
| 1,2-Dichloroethane | 107-06-2 | 0.5 | mg/kg | ND | U | 0.21 | 35.31 | ND | U | 0.18 | 31.57 | ND | U | 0.27 | 44.8 | ND | U | 0.23 | 40.72 | ND | U | 0.24 | 44.09 | ND | U | 0.3 | 57.34 | ND | U | 0.28 | 47.53 |
| Toluene | 108-88-3 | 100 | mg/kg | ND | U | 0.21 | 35.31 | ND | U | 0.18 | 31.57 | ND | U | 0.27 | 44.8 | ND | U | 0.23 | 40.72 | ND | U | 0.24 | 44.09 | ND | U | 0.3 | 57.34 | ND | U | 0.28 | 47.53 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.005 | mg/kg | ND | U | 0.21 | 35.31 | ND | U | 0.18 | 31.57 | ND | U | 0.27 | 44.8 | ND | U | 0.23 | 40.72 | ND | U | 0.24 | 44.09 | ND | U | 0.3 | 57.34 | ND | U | 0.28 | 47.53 |
| Ethylbenzene | 100-41-4 | 70 | mg/kg | ND | U | 0.21 | 35.31 | ND | U | 0.18 | 31.57 | ND | U | 0.27 | 44.8 | ND | U | 0.23 | 40.72 | ND | U | 0.24 | 44.09 | ND | U | 0.3 | 57.34 | ND | U | 0.28 | 47.53 |
| Cumene | 98-82-8 | 2,500 | mg/kg | 0.66 | | 0.21 | 35.31 | ND | U | 0.18 | 31.57 | ND | U | 0.27 | 44.8 | ND | U | 0.23 | 40.72 | ND | U | 0.24 | 44.09 | ND | U | 0.3 | 57.34 | ND | U | 0.28 | 47.53 |
| Xylene (Total) | 1330-20-7 | 1,000 | mg/kg | ND | U | 0.21 | 35.31 | ND | U | 0.18 | 31.57 | 0.67 | | 0.27 | 44.8 | ND | U | 0.23 | 40.72 | ND | U | 0.24 | 44.09 | ND | U | 0.3 | 57.34 | ND | U | 0.28 | 47.53 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 2,200 | mg/kg | ND | U | 4.9 | 5 | 0.58 | | 0.19 | 1 | 1.1 | | 1 | 1 | ND | U | 0.19 | 1 | 25 | | 4.6 | 5 | 1.6 | | 0.17 | 1 | 7.5 | | 0.97 | 5 |
| Naphthalene | 91-20-3 | 25 | mg/kg | ND | U | 4.9 | 5 | ND | U | 0.19 | 1 | ND | U | 1 | 1 | ND | U | 0.19 | 1 | ND | U | 0.92 | 1 | ND | U | 0.17 | 1 | 0.36 | | 0.19 | 1 |
| Fluorene | 86-73-7 | 3,800 | mg/kg | ND | U | 4.9 | 5 | ND | U | 0.19 | 1 | 1.1 | | 1 | 1 | ND | U | 0.19 | 1 | 2000 | | 0.92 | 1 | ND | U | 0.17 | 1 | 0.72 | | 0.19 | 1 |
| Phenanthrene | 85-01-8 | 10,000 | mg/kg | ND | U | 4.9 | 5 | 0.45 | | 0.19 | 1 | 2.9 | | 1 | 1 | ND | U | 0.19 | 1 | 26 | | 4.6 | 5 | 1.4 | | 0.17 | 1 | 7.2 | | 0.97 | 5 |
| Anthracene | 120-12-7 | 350 | mg/kg | ND | U | 4.9 | 5 | ND | U | 0.19 | 1 | ND | U | 1 | 1 | ND | U | 0.19 | 1 | 8.1 | | 0.92 | 1 | 0.35 | | 0.17 | 1 | 1.7 | | 0.19 | 1 |
| Benzo(a)anthracene | 56-55-3 | 320 | mg/kg | ND | U | 4.9 | 5 | 0.37 | | 0.19 | 1 | ND | U | 1 | 1 | ND | U | 0.19 | 1 | 16 | | 0.92 | 1 | 0.92 | | 0.17 | 1 | 4.6 | | 0.97 | 5 |
| Chrysene | 218-01-9 | 230 | mg/kg | ND | U | 4.9 | 5 | 0.44 | | 0.19 | 1 | 1.2 | | 1 | 1 | ND | U | 0.19 | 1 | 13 | | 0.92 | 1 | 0.95 | | 0.17 | 1 | 4.3 | | 0.19 | 1 |
| Benzo(b)fluoranthene | 205-99-2 | 170 | mg/kg | ND | U | 4.9 | 5 | 0.48 | | 0.19 | 1 | ND | U | 1 | 1 | ND | U | 0.19 | 1 | 12 | | 0.92 | 1 | 1.2 | | 0.17 | 1 | 5.4 | | 0.97 | 5 |
| Benzo(a)pyrene | 50-32-8 | 46 | mg/kg | ND | U | 4.9 | 5 | 0.4 | | 0.19 | 1 | ND | U | 1 | 1 | ND | U | 0.19 | 1 | 11 | | 0.92 | 1 | 0.9 | | 0.17 | 1 | 3.6 | | 1.9 | 1 |
| Benzo(g,h,i)perylene | 191-24-2 | 180 | mg/kg | ND | U | 4.9 | 5 | 0.37 | | 0.19 | 1 | ND | U | 1 | 1 | ND | U | 0.19 | 1 | 6.9 | | 0.92 | 1 | 0.73 | | 0.17 | 1 | 2.3 | | 0.19 | 1 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 450 | mg/kg | 261 | | 1.13 | 10 | 89.7 | | 1.09 | 10 | 132 | | 1.15 | 10 | 96.4 | | 1.1 | 10 | 1300 | | 10.9 | 100 | 128 | | 1.01 | 10 | 172 | | 1.15 | 10 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/kg - microgram per kilogram
mg/kg - milligram per kilogram
MSC - PADEP's Medium Specific Concentration for Soil
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
SWMU - Solid Waste Management Unit

All soil samples collected and analyzed were unsaturated

**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
N - Spike Amount not within control limits

**Exceedance Summary:**
**10** - RL exceeds the PADEP Non-Residential Soil MSC
10 - Concentration exceeds the PADEP Non-Residential Soil MSC

**Table 4**
**Summary of Soil Sample Analytical Results: Non SWMU Area**
**AOI 8 Site Characterization Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer Soil MSCs (TDS<2,500) | Location ID | BH-08-34 | | | | BH-08-35 | | | | N-98 | | | | N-99 | | | | N-100 | | | | N-101 | | | | N-102 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | BH-08-34_1.5-2.0 | | | | BH-08-35_1.0-2.0 | | | | N-98_1.0-2.0 | | | | N-99_1.0-2.0 | | | | N-100_0.0-2.0 | | | | N-101_1.0-2.0 | | | | N-102_1.0-2.0 | | | |
| | | | Sample Matrix | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | |
| | | | Sample Interval | 1.5-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 0.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | |
| | | | Sample Date | 5/6/2008 | | | | 5/6/2008 | | | | 6/2/2008 | | | | 6/17/2008 | | | | 6/11/2008 | | | | 6/16/2008 | | | | 6/5/2008 | | | |
| | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 2.0 | mg/kg | ND | U | 0.26 | 45.13 | ND | U | 0.22 | 40.58 | ND | U | 0.21 | 36.23 | ND | U | 0.27 | 45.79 | ND | U | 0.28 | 51.12 | ND | U | 0.21 | 35.87 | ND | U | 0.25 | 42.44 |
| Benzene | 71-43-2 | 0.5 | mg/kg | ND | U | 0.26 | 45.13 | ND | U | 0.22 | 40.58 | ND | U | 0.21 | 36.23 | ND | U | 0.27 | 45.79 | ND | U | 0.28 | 51.12 | ND | U | 0.21 | 35.87 | ND | U | 0.25 | 42.44 |
| 1,2-Dichloroethane | 107-06-2 | 0.5 | mg/kg | ND | U | 0.26 | 45.13 | ND | U | 0.22 | 40.58 | ND | U | 0.21 | 36.23 | ND | U | 0.27 | 45.79 | ND | U | 0.28 | 51.12 | ND | U | 0.21 | 35.87 | ND | U | 0.25 | 42.44 |
| Toluene | 108-88-3 | 100 | mg/kg | ND | U | 0.26 | 45.13 | ND | U | 0.22 | 40.58 | ND | U | 0.21 | 36.23 | ND | U | 0.27 | 45.79 | ND | U | 0.28 | 51.12 | ND | U | 0.21 | 35.87 | ND | U | 0.25 | 42.44 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.005 | mg/kg | ND | U | 0.26 | 45.13 | ND | U | 0.22 | 40.58 | ND | U | 0.21 | 36.23 | ND | U | 0.27 | 45.79 | ND | U | 0.28 | 51.12 | ND | U | 0.21 | 35.87 | ND | U | 0.25 | 42.44 |
| Ethylbenzene | 100-41-4 | 70 | mg/kg | ND | U | 0.26 | 45.13 | ND | U | 0.22 | 40.58 | ND | U | 0.21 | 36.23 | ND | U | 0.27 | 45.79 | ND | U | 0.28 | 51.12 | ND | U | 0.21 | 35.87 | ND | U | 0.25 | 42.44 |
| Cumene | 98-82-8 | 2,500 | mg/kg | ND | U | 0.26 | 45.13 | ND | U | 0.22 | 40.58 | ND | U | 0.21 | 36.23 | ND | U | 0.27 | 45.79 | ND | U | 0.28 | 51.12 | ND | U | 0.21 | 35.87 | ND | U | 0.25 | 42.44 |
| Xylene (Total) | 1330-20-7 | 1,000 | mg/kg | ND | U | 0.26 | 45.13 | ND | U | 0.22 | 40.58 | ND | U | 0.21 | 36.23 | ND | U | 0.27 | 45.79 | ND | U | 0.28 | 51.12 | ND | U | 0.21 | 35.87 | ND | U | 0.25 | 42.44 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 2,200 | mg/kg | 63 | | 9.7 | 50 | ND | U | 0.18 | 1 | 2.4 | | 0.98 | 5 | 140 | | 25 | 125 | 1.9 | | 0.19 | 1 | 0.44 | | 0.2 | 1 | 0.39 | | 0.19 | 1 |
| Naphthalene | 91-20-3 | 25 | mg/kg | ND | U | 1.9 | 10 | ND | U | 0.18 | 1 | 1 | | 0.98 | 5 | 53 | | 5 | 25 | ND | U | 0.19 | 1 | ND | U | 0.2 | 1 | ND | U | 0.19 | 1 |
| Fluorene | 86-73-7 | 3,800 | mg/kg | 8 | | 1.9 | 10 | ND | U | 0.18 | 1 | ND | U | 0.98 | 5 | 78 | | 5 | 25 | ND | U | 0.19 | 1 | 0.28 | | 0.2 | 1 | ND | U | 0.19 | 1 |
| Phenanthrene | 85-01-8 | 10,000 | mg/kg | 18 | | 1.9 | 50 | ND | U | 0.18 | 1 | 4.5 | | 0.98 | 5 | 280 | | 2.5 | 125 | 1.5 | | 0.19 | 1 | 0.53 | | 0.2 | 1 | 0.31 | | 0.19 | 1 |
| Anthracene | 120-12-7 | 350 | mg/kg | 18 | | 1.9 | 10 | ND | U | 0.18 | 1 | ND | U | 0.98 | 5 | 64 | | 5 | 25 | 320 | | 0.19 | 1 | 0.24 | | 0.2 | 1 | ND | U | 0.19 | 1 |
| Benzo(a)anthracene | 56-55-3 | 320 | mg/kg | 37 | | 1.9 | 10 | ND | U | 0.18 | 1 | ND | U | 0.98 | 5 | 82 | | 5 | 25 | 1.1 | | 0.19 | 1 | ND | U | 0.2 | 1 | ND | U | 0.19 | 1 |
| Chrysene | 218-01-9 | 230 | mg/kg | 32 | | 1.9 | 10 | ND | U | 0.18 | 1 | ND | U | 0.98 | 5 | 71 | | 5 | 25 | 1.1 | | 0.19 | 1 | 0.25 | | 0.2 | 1 | 0.27 | | 0.19 | 1 |
| Benzo(b)fluoranthene | 205-99-2 | 170 | mg/kg | 39 | | 1.9 | 10 | ND | U | 0.18 | 1 | ND | U | 0.98 | 5 | 69 | | 5 | 25 | 1.2 | | 0.19 | 1 | ND | U | 0.2 | 1 | 0.32 | | 0.19 | 1 |
| Benzo(a)pyrene | 50-32-8 | 46 | mg/kg | 29 | | 1.9 | 10 | ND | U | 0.18 | 1 | ND | U | 0.98 | 5 | 61 | | 5 | 25 | ND | U | 0.19 | 1 | ND | U | 0.2 | 1 | 0.2 | | 0.19 | 1 |
| Benzo(g,h,i)perylene | 191-24-2 | 180 | mg/kg | 18 | | 1.9 | 10 | ND | U | 0.18 | 1 | ND | U | 0.98 | 5 | 29 | | 5 | 25 | 0.62 | | 0.19 | 1 | ND | U | 0.2 | 1 | ND | U | 0.19 | 1 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 450 | mg/kg | 354 | | 1.12 | 10 | 14.3 | | 1.05 | 10 | 94.5 | | 1.14 | 10 | 146 | | 1.14 | 10 | 135 | | 1.09 | 10 | 78.1 | | 1.15 | 10 | 24.7 | | 0.115 | 1 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/kg - microgram per kilogram
mg/kg - milligram per kilogram
MSC - PADEP's Medium Specific Concentration for Soil
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
SWMU - Solid Waste Management Unit

All soil samples collected and analyzed were unsaturated

**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
N - Spike Amount not within control limits

**Exceedance Summary:**
**10** - RL exceeds the PADEP Non-Residential Soil MSC
10 - Concentration exceeds the PADEP Non-Residential Soil MSC

**Table 4**
**Summary of Soil Sample Analytical Results: Non SWMU Area**
**AOI 8 Site Characterization Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer Soil MSCs (TDS<2,500) | Location ID | N-103 | | | | N-104 | | | | N-105 | | | | N-106 | | | | N-107 | | | | N-108 | | | | N-109 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | N-103_1.0-2.0 | | | | N-104_1.0-2.0 | | | | N-105_1.0-2.0 | | | | N-106_1.0-2.0 | | | | N-107_1.0-2.0 | | | | N-108_1.0-2.0 | | | | N-109_1.0-2.0 | | | |
| | | | Sample Matrix | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | |
| | | | Sample Interval | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | |
| | | | Sample Date | 6/6/2008 | | | | 6/17/2008 | | | | 6/17/2008 | | | | 6/5/2008 | | | | 6/17/2008 | | | | 5/29/2008 | | | | 6/17/2008 | | | |
| | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 2.0 | mg/kg | ND | U | 0.26 | 45.96 | ND | U | 0.23 | 41.19 | ND | U | 0.24 | 43.03 | ND | U | 0.19 | 34.39 | ND | U | 0.22 | 40.19 | ND | U | 0.23 | 39.12 | ND | U | 3.1 | 539.96 |
| Benzene | 71-43-2 | 0.5 | mg/kg | ND | U | 0.26 | 45.96 | ND | U | 0.23 | 41.19 | ND | U | 0.24 | 43.03 | ND | U | 0.19 | 34.39 | 0.74 | | 0.22 | 40.19 | ND | U | 0.23 | 39.12 | ND | U | 3.1 | 539.96 |
| 1,2-Dichloroethane | 107-06-2 | 0.5 | mg/kg | ND | U | 0.26 | 45.96 | ND | U | 0.23 | 41.19 | ND | U | 0.24 | 43.03 | ND | U | 0.19 | 34.39 | ND | U | 0.22 | 40.19 | ND | U | 0.23 | 39.12 | ND | U | 3.1 | 539.96 |
| Toluene | 108-88-3 | 100 | mg/kg | ND | U | 0.26 | 45.96 | ND | U | 0.23 | 41.19 | ND | U | 0.24 | 43.03 | ND | U | 0.19 | 34.39 | 0.42 | | 0.22 | 40.19 | ND | U | 0.23 | 39.12 | ND | U | 3.1 | 539.96 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.005 | mg/kg | ND | U | 0.26 | 45.96 | ND | U | 0.23 | 41.19 | ND | U | 0.24 | 43.03 | ND | U | 0.19 | 34.39 | ND | U | 0.22 | 40.19 | ND | U | 0.23 | 39.12 | ND | U | 3.1 | 539.96 |
| Ethylbenzene | 100-41-4 | 70 | mg/kg | ND | U | 0.26 | 45.96 | ND | U | 0.23 | 41.19 | ND | U | 0.24 | 43.03 | ND | U | 0.19 | 34.39 | 1.6 | | 0.22 | 40.19 | ND | U | 0.23 | 39.12 | ND | U | 3.1 | 539.96 |
| Cumene | 98-82-8 | 2,500 | mg/kg | ND | U | 0.26 | 45.96 | ND | U | 0.23 | 41.19 | ND | U | 0.24 | 43.03 | ND | U | 0.19 | 34.39 | 360 | | 0.22 | 40.19 | ND | U | 0.23 | 39.12 | ND | U | 3.1 | 539.96 |
| Xylene (Total) | 1330-20-7 | 1,000 | mg/kg | ND | U | 0.26 | 45.96 | ND | U | 0.23 | 41.19 | ND | U | 0.24 | 43.03 | ND | U | 0.19 | 34.39 | 2.7 | | 0.22 | 40.19 | ND | U | 0.23 | 39.12 | ND | U | 3.1 | 539.96 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 2,200 | mg/kg | ND | U | 0.95 | 1 | 2.2 | | 0.92 | 5 | ND | U | 0.92 | 5 | 0.27 | | 0.19 | 1 | ND | U | 1.8 | 5 | ND | U | 1.9 | 5 | ND | U | 0.95 | 5 |
| Naphthalene | 91-20-3 | 25 | mg/kg | ND | U | 0.95 | 1 | ND | U | 0.92 | 5 | ND | U | 0.92 | 5 | ND | U | 0.19 | 1 | ND | U | 1.8 | 5 | ND | U | 1.9 | 5 | ND | U | 0.95 | 5 |
| Fluorene | 86-73-7 | 3,800 | mg/kg | ND | U | 0.95 | 1 | ND | U | 0.92 | 5 | ND | U | 0.92 | 5 | ND | U | 0.19 | 1 | ND | U | 1.8 | 5 | ND | U | 1.9 | 5 | ND | U | 0.95 | 5 |
| Phenanthrene | 85-01-8 | 10,000 | mg/kg | ND | U | 0.95 | 1 | 1.5 | | 0.92 | 5 | ND | U | 0.92 | 5 | ND | U | 0.19 | 1 | ND | U | 1.8 | 5 | 2.1 | | 1.9 | 5 | ND | U | 0.95 | 5 |
| Anthracene | 120-12-7 | 350 | mg/kg | ND | U | 0.95 | 1 | ND | U | 0.92 | 5 | ND | U | 0.92 | 5 | ND | U | 0.19 | 1 | ND | U | 1.8 | 5 | ND | U | 1.9 | 5 | ND | U | 0.95 | 5 |
| Benzo(a)anthracene | 56-55-3 | 320 | mg/kg | ND | U | 0.95 | 1 | ND | U | 0.92 | 5 | ND | U | 0.92 | 5 | ND | U | 0.19 | 1 | ND | U | 1.8 | 5 | 2 | | 1.9 | 5 | ND | U | 0.95 | 5 |
| Chrysene | 218-01-9 | 230 | mg/kg | ND | U | 0.95 | 1 | 1.2 | | 0.92 | 5 | ND | U | 0.92 | 5 | 190 | | 0.19 | 1 | ND | U | 1.8 | 5 | 3.8 | | 1.9 | 5 | ND | U | 0.95 | 5 |
| Benzo(b)fluoranthene | 205-99-2 | 170 | mg/kg | ND | U | 0.95 | 1 | ND | U | 0.92 | 5 | ND | U | 0.92 | 5 | 0.3 | | 0.19 | 1 | ND | U | 1.8 | 5 | 3.3 | | 1.9 | 5 | ND | U | 0.95 | 5 |
| Benzo(a)pyrene | 50-32-8 | 46 | mg/kg | ND | U | 0.95 | 1 | ND | U | 0.92 | 5 | ND | U | 0.92 | 5 | 0.19 | | 0.19 | 1 | ND | U | 1.8 | 5 | 5.4 | | 1.9 | 5 | ND | U | 0.95 | 5 |
| Benzo(g,h,i)perylene | 191-24-2 | 180 | mg/kg | 1 | | 0.95 | 1 | ND | U | 0.92 | 5 | ND | U | 0.92 | 5 | 0.22 | | 0.19 | 1 | ND | U | 1.8 | 5 | 20 | | 1.9 | 5 | ND | U | 0.95 | 5 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 450 | mg/kg | 174 | | 0.567 | 5 | 164 | | 1.07 | 10 | 36.4 | | 1.08 | 10 | 76.7 | | 0.546 | 5 | 173 | | 1.07 | 10 | 147 | | 1.16 | 10 | 294 | | 1.13 | 10 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/kg - microgram per kilogram
mg/kg - milligram per kilogram
MSC - PADEP's Medium Specific Concentration for Soil
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
SWMU - Solid Waste Management Unit

All soil samples collected and analyzed were unsaturated

**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
N - Spike Amount not within control limits

**Exceedance Summary:**
**10** - RL exceeds the PADEP Non-Residential Soil MSC
10 - Concentration exceeds the PADEP Non-Residential Soil MSC

**Table 4**
**Summary of Soil Sample Analytical Results: Non SWMU Area**
**AOI 8 Site Characterization Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer Soil MSCs (TDS<2,500) | Location ID | N-110 | | | | N-111 | | | | N-112 | | | | N-113 | | | | N-114 | | | | N-115 | | | | N-116 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | N-110_1.0-2.0 | | | | N-111_1.0-2.0 | | | | N-112_1.0-2.0 | | | | N-113_1.0-2.0 | | | | N-114_1.0-2.0 | | | | N-115_0.0-2.0 | | | | N-116_1.0-2.0 | | | |
| | | | Sample Matrix | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | |
| | | | Sample Interval | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 0.0-2.0 | | | | 1.0-2.0 | | | |
| | | | Sample Date | 5/14/2008 | | | | 5/14/2008 | | | | 5/8/2008 | | | | 5/15/2008 | | | | 5/8/2008 | | | | 5/28/2008 | | | | 5/20/2008 | | | |
| | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 2.0 | mg/kg | ND | U | 0.24 | 43.86 | ND | U | 0.24 | 43.1 | ND | U | 0.44 | 73.96 | ND | U | 0.18 | 34.72 | ND | U | 0.24 | 42.66 | ND | U | 0.38 | 61.12 | ND | U | 0.23 | 39.12 |
| Benzene | 71-43-2 | 0.5 | mg/kg | ND | U | 0.24 | 43.86 | ND | U | 0.24 | 43.1 | ND | U | 0.44 | 73.96 | ND | U | 0.18 | 34.72 | 0.51 | | 0.24 | 42.66 | ND | U | 0.38 | 61.12 | ND | U | 0.23 | 39.12 |
| 1,2-Dichloroethane | 107-06-2 | 0.5 | mg/kg | ND | U | 0.24 | 43.86 | ND | U | 0.24 | 43.1 | ND | U | 0.44 | 73.96 | ND | U | 0.18 | 34.72 | ND | U | 0.24 | 42.66 | ND | U | 0.38 | 61.12 | ND | U | 0.23 | 39.12 |
| Toluene | 108-88-3 | 100 | mg/kg | ND | U | 0.24 | 43.86 | ND | U | 0.24 | 43.1 | ND | U | 0.44 | 73.96 | ND | U | 0.18 | 34.72 | 0.42 | | 0.24 | 42.66 | ND | U | 0.38 | 61.12 | ND | U | 0.23 | 39.12 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.005 | mg/kg | ND | U | 0.24 | 43.86 | ND | U | 0.24 | 43.1 | ND | U | 0.44 | 73.96 | ND | U | 0.18 | 34.72 | ND | U | 0.24 | 42.66 | ND | U | 0.38 | 61.12 | ND | U | 0.23 | 39.12 |
| Ethylbenzene | 100-41-4 | 70 | mg/kg | ND | U | 0.24 | 43.86 | ND | U | 0.24 | 43.1 | ND | U | 0.44 | 73.96 | ND | U | 0.18 | 34.72 | 0.25 | | 0.24 | 42.66 | ND | U | 0.38 | 61.12 | ND | U | 0.23 | 39.12 |
| Cumene | 98-82-8 | 2,500 | mg/kg | ND | U | 0.24 | 43.86 | ND | U | 0.24 | 43.1 | ND | U | 0.44 | 73.96 | 0.32 | | 0.18 | 34.72 | 0.59 | | 0.24 | 42.66 | ND | U | 0.38 | 61.12 | 0.81 | | 0.23 | 39.12 |
| Xylene (Total) | 1330-20-7 | 1,000 | mg/kg | ND | U | 0.24 | 43.86 | ND | U | 0.24 | 43.1 | ND | U | 0.44 | 73.96 | ND | U | 0.18 | 34.72 | 0.69 | | 0.24 | 42.66 | ND | U | 0.38 | 61.12 | ND | U | 0.23 | 39.12 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 2,200 | mg/kg | ND | U | 0.18 | 1 | 1.4 | | 0.91 | 5 | ND | U | 2 | 1 | ND | U | 4.4 | 5 | 13 | | 4.7 | 5 | 32 | | 5.2 | 5 | 1.2 | | 0.97 | 5 |
| Naphthalene | 91-20-3 | 25 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.91 | 5 | ND | U | 2 | 1 | ND | U | 4.4 | 5 | ND | U | 4.7 | 5 | ND | U | 5.2 | 5 | ND | U | 0.97 | 5 |
| Fluorene | 86-73-7 | 3,800 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.91 | 5 | ND | U | 2 | 1 | ND | U | 4.4 | 5 | 10 | | 4.7 | 5 | ND | U | 5.2 | 5 | 2.1 | | 0.97 | 5 |
| Phenanthrene | 85-01-8 | 10,000 | mg/kg | ND | U | 0.18 | 1 | 1.1 | | 0.91 | 5 | ND | U | 2 | 1 | ND | U | 4.4 | 5 | 26 | | 4.7 | 5 | 14 | | 5.2 | 5 | 5.9 | | 0.97 | 5 |
| Anthracene | 120-12-7 | 350 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.91 | 5 | ND | U | 2 | 1 | ND | U | 4.4 | 5 | ND | U | 4.7 | 5 | ND | U | 5.2 | 5 | 1 | | 0.97 | 5 |
| Benzo(a)anthracene | 56-55-3 | 320 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.91 | 5 | ND | U | 2 | 1 | ND | U | 4.4 | 5 | ND | U | 4.7 | 5 | 10 | | 5.2 | 5 | ND | U | 0.97 | 5 |
| Chrysene | 218-01-9 | 230 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.91 | 5 | ND | U | 2 | 1 | ND | U | 4.4 | 5 | 6.9 | | 4.7 | 5 | 15 | | 5.2 | 5 | ND | U | 0.97 | 5 |
| Benzo(b)fluoranthene | 205-99-2 | 170 | mg/kg | ND | U | 0.18 | 1 | 0.96 | | 0.91 | 5 | ND | U | 2 | 1 | ND | U | 4.4 | 5 | ND | U | 4.7 | 5 | ND | U | 5.2 | 5 | ND | U | 0.97 | 5 |
| Benzo(a)pyrene | 50-32-8 | 46 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.91 | 5 | ND | U | 2 | 1 | ND | U | 4.4 | 5 | ND | U | 4.7 | 5 | 6.5 | | 5.2 | 5 | ND | U | 0.97 | 5 |
| Benzo(g,h,i)perylene | 191-24-2 | 180 | mg/kg | ND | U | 0.18 | 1 | ND | U | 0.91 | 5 | ND | U | 2 | 1 | ND | U | 4.4 | 5 | ND | U | 4.7 | 5 | 7.1 | | 5.2 | 5 | ND | U | 0.97 | 5 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 450 | mg/kg | 15 | | 1.06 | 10 | 117 | | 1.06 | 10 | 11.6 | | 1.16 | 10 | 77.9 | | 1.06 | 10 | 139 | | **139** | 10 | 1250 | N | 3 | 25 | 340 | | 1.16 | 10 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/kg - microgram per kilogram
mg/kg - milligram per kilogram
MSC - PADEP's Medium Specific Concentration for Soil
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
SWMU - Solid Waste Management Unit

All soil samples collected and analyzed were unsaturated

**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
N - Spike Amount not within control limits

**Exceedance Summary:**
**10** - RL exceeds the PADEP Non-Residential Soil MSC
10 - Concentration exceeds the PADEP Non-Residential Soil MSC

**Table 4**
**Summary of Soil Sample Analytical Results: Non SWMU Area**
**AOI 8 Site Characterization Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer Soil MSCs (TDS<2,500) | Location ID | N-117 | | | | N-118 | | | | N-119 | | | | N-120 | | | | N-121 | | | | N-122 | | | | N-123 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | N-117_1.0-2.0 | | | | N-118_1.0-2.0 | | | | N-119_1.0-2.0 | | | | N-120_1.0-2.0 | | | | N-121_1.0-2.0 | | | | N-122_1.0-2.0 | | | | N-123_1.0-2.0 | | | |
| | | | Sample Matrix | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | |
| | | | Sample Interval | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | |
| | | | Sample Date | 6/4/2008 | | | | 5/23/2008 | | | | 6/17/2008 | | | | 5/22/2008 | | | | 6/9/2008 | | | | 5/7/2008 | | | | 5/20/2008 | | | |
| | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 2.0 | mg/kg | ND | U | 0.23 | 39.81 | ND | U | 0.22 | 39.31 | ND | U | 0.24 | 40.26 | ND | U | 0.17 | 29.1 | ND | U | 0.23 | 38.94 | ND | U | 2 | 35.06 | ND | U | 0.24 | 37.09 |
| Benzene | 71-43-2 | 0.5 | mg/kg | ND | U | 0.23 | 39.81 | ND | U | 0.22 | 39.31 | ND | U | 0.24 | 40.26 | ND | U | 0.17 | 29.1 | ND | U | 0.23 | 38.94 | ND | U | 2 | 35.06 | ND | U | 0.24 | 37.09 |
| 1,2-Dichloroethane | 107-06-2 | 0.5 | mg/kg | ND | U | 0.23 | 39.81 | ND | U | 0.22 | 39.31 | ND | U | 0.24 | 40.26 | ND | U | 0.17 | 29.1 | ND | U | 0.23 | 38.94 | ND | U | 2 | 35.06 | ND | U | 0.24 | 37.09 |
| Toluene | 108-88-3 | 100 | mg/kg | ND | U | 0.23 | 39.81 | ND | U | 0.22 | 39.31 | ND | U | 0.24 | 40.26 | ND | U | 0.17 | 29.1 | ND | U | 0.23 | 38.94 | ND | U | 2 | 35.06 | ND | U | 0.24 | 37.09 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.005 | mg/kg | ND | U | 0.23 | 39.81 | ND | U | 0.22 | 39.31 | ND | U | 0.24 | 40.26 | ND | U | 0.17 | 29.1 | ND | U | 0.23 | 38.94 | ND | U | 2 | 35.06 | ND | U | 0.24 | 37.09 |
| Ethylbenzene | 100-41-4 | 70 | mg/kg | ND | U | 0.23 | 39.81 | ND | U | 0.22 | 39.31 | ND | U | 0.24 | 40.26 | ND | U | 0.17 | 29.1 | ND | U | 0.23 | 38.94 | ND | U | 2 | 35.06 | ND | U | 0.24 | 37.09 |
| Cumene | 98-82-8 | 2,500 | mg/kg | ND | U | 0.23 | 39.81 | 0.47 | | 0.22 | 39.31 | ND | U | 0.24 | 40.26 | ND | U | 0.17 | 29.1 | ND | U | 0.23 | 38.94 | ND | U | 2 | 35.06 | ND | U | 0.24 | 37.09 |
| Xylene (Total) | 1330-20-7 | 1,000 | mg/kg | ND | U | 0.23 | 39.81 | ND | U | 0.22 | 39.31 | ND | U | 0.24 | 40.26 | ND | U | 0.17 | 29.1 | ND | U | 0.23 | 38.94 | ND | U | 2 | 35.06 | ND | U | 0.24 | 37.09 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 2,200 | mg/kg | 1.1 | | 0.19 | 1 | 1.2 | | 0.94 | 5 | 0.56 | | 2 | 1 | ND | U | 0.98 | 5 | 2.5 | | 0.99 | 1 | 1.2 | | 0.94 | 5 | 25 | | 1.1 | 5 |
| Naphthalene | 91-20-3 | 25 | mg/kg | ND | U | 0.19 | 1 | ND | U | 0.94 | 5 | ND | U | 2 | 1 | ND | U | 0.98 | 5 | ND | U | 0.99 | 1 | ND | U | 0.94 | 5 | ND | U | 1.1 | 5 |
| Fluorene | 86-73-7 | 3,800 | mg/kg | ND | U | 0.19 | 1 | 1.2 | | 0.94 | 5 | ND | U | 2 | 1 | ND | U | 0.98 | 5 | ND | U | 0.99 | 1 | 0.98 | | 0.94 | 5 | ND | U | 1.1 | 5 |
| Phenanthrene | 85-01-8 | 10,000 | mg/kg | 1.4 | | 0.19 | 1 | 3.7 | | 0.94 | 5 | ND | U | 2 | 1 | ND | U | 0.98 | 5 | 2.5 | | 0.99 | 1 | 2.1 | | 0.94 | 5 | 16 | | 1.1 | 5 |
| Anthracene | 120-12-7 | 350 | mg/kg | 0.35 | | 0.19 | 1 | ND | U | 0.94 | 5 | ND | U | 2 | 1 | ND | U | 0.98 | 5 | ND | U | 0.99 | 1 | 2.1 | | 0.94 | 5 | 5 | | 1.1 | 5 |
| Benzo(a)anthracene | 56-55-3 | 320 | mg/kg | 0.74 | | 0.19 | 1 | ND | U | 0.94 | 5 | 0.34 | | 2 | 1 | ND | U | 0.98 | 5 | ND | U | 0.99 | 1 | ND | U | 0.94 | 5 | 17 | | 1.1 | 5 |
| Chrysene | 218-01-9 | 230 | mg/kg | 0.68 | | 0.19 | 1 | ND | U | 0.94 | 5 | 0.65 | | 2 | 1 | ND | U | 0.98 | 5 | 1.5 | | 0.99 | 1 | ND | U | 0.94 | 5 | 16 | | 1.1 | 5 |
| Benzo(b)fluoranthene | 205-99-2 | 170 | mg/kg | 0.94 | | 0.19 | 1 | ND | U | 0.94 | 5 | 0.21 | | 2 | 1 | ND | U | 0.98 | 5 | ND | U | 0.99 | 1 | ND | U | 0.94 | 5 | 18 | | 1.1 | 5 |
| Benzo(a)pyrene | 50-32-8 | 46 | mg/kg | 0.63 | | 0.19 | 1 | ND | U | 0.94 | 5 | 0.43 | | 2 | 1 | ND | U | 0.98 | 5 | ND | U | 0.99 | 1 | ND | U | 0.94 | 5 | 13 | | 1.1 | 5 |
| Benzo(g,h,i)perylene | 191-24-2 | 180 | mg/kg | 0.42 | | 0.19 | 1 | ND | U | 0.94 | 5 | 0.33 | | 2 | 1 | ND | U | 0.98 | 5 | ND | U | 0.99 | 1 | ND | U | 0.94 | 5 | 8 | | 1.1 | 5 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 450 | mg/kg | 219 | | 0.565 | 5 | 200 | | 1.11 | 10 | 101 | | 1.17 | 10 | 181 | | 1.16 | 10 | 64 | | 1.17 | 10 | 207 | | 1.11 | 10 | 254 | | 1.27 | 10 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/kg - microgram per kilogram
mg/kg - milligram per kilogram
MSC - PADEP's Medium Specific Concentration for Soil
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
SWMU - Solid Waste Management Unit

All soil samples collected and analyzed were unsaturated

**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
N - Spike Amount not within control limits

**Exceedance Summary:**
**10** - RL exceeds the PADEP Non-Residential Soil MSC
10 - Concentration exceeds the PADEP Non-Residential Soil MSC

**Table 4**
**Summary of Soil Sample Analytical Results: Non SWMU Area**
**AOI 8 Site Characterization Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer Soil MSCs (TDS<2,500) | Location ID | N-124 | | | | N-125 | | | | N-126 | | | | N-127 | | | | N-128 | | | | N-129 | | | | N-130 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | N-124_1.0-2.0 | | | | N-125_1.0-2.0 | | | | N-126_1.0-2.0 | | | | N-127_1.0-2.0 | | | | N-128_1.0-2.0 | | | | N-129_1.0-2.0 | | | | N-130_0.0-2.0 | | | |
| | | | Sample Matrix | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | |
| | | | Sample Interval | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 0.0-2.0 | | | |
| | | | Sample Date | 5/21/2008 | | | | 6/17/2008 | | | | 6/17/2008 | | | | 5/22/2008 | | | | 5/20/2008 | | | | 6/17/2008 | | | | 5/16/2008 | | | |
| | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 2.0 | mg/kg | ND | U | 0.37 | 63.94 | ND | U | 0.23 | 41.88 | ND | U | 3.1 | 517.6 | ND | U | 0.19 | 33.03 | ND | U | 0.29 | 48.08 | ND | U | 0.23 | 39.31 | ND | U | 0.22 | 38.46 |
| Benzene | 71-43-2 | 0.5 | mg/kg | ND | U | 0.37 | 63.94 | ND | U | 0.23 | 41.88 | ND | U | 3.1 | 517.6 | ND | U | 0.19 | 33.03 | 1.9 | | 0.29 | 48.08 | ND | U | 0.23 | 39.31 | ND | U | 0.22 | 38.46 |
| 1,2-Dichloroethane | 107-06-2 | 0.5 | mg/kg | ND | U | 0.37 | 63.94 | ND | U | 0.23 | 41.88 | ND | U | 3.1 | 517.6 | ND | U | 0.19 | 33.03 | ND | U | 0.29 | 48.08 | ND | U | 0.23 | 39.31 | ND | U | 0.22 | 38.46 |
| Toluene | 108-88-3 | 100 | mg/kg | ND | U | 0.37 | 63.94 | ND | U | 0.23 | 41.88 | ND | U | 3.1 | 517.6 | ND | U | 0.19 | 33.03 | ND | U | 0.29 | 48.08 | ND | U | 0.23 | 39.31 | ND | U | 0.22 | 38.46 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.005 | mg/kg | ND | U | 0.37 | 63.94 | ND | U | 0.23 | 41.88 | ND | U | 3.1 | 517.6 | ND | U | 0.19 | 33.03 | ND | U | 0.29 | 48.08 | ND | U | 0.23 | 39.31 | ND | U | 0.22 | 38.46 |
| Ethylbenzene | 100-41-4 | 70 | mg/kg | ND | U | 0.37 | 63.94 | ND | U | 0.23 | 41.88 | ND | U | 3.1 | 517.6 | ND | U | 0.19 | 33.03 | 0.34 | | 0.29 | 48.08 | ND | U | 0.23 | 39.31 | ND | U | 0.22 | 38.46 |
| Cumene | 98-82-8 | 2,500 | mg/kg | ND | U | 0.37 | 63.94 | ND | U | 0.23 | 41.88 | ND | U | 3.1 | 517.6 | ND | U | 0.19 | 33.03 | ND | U | 0.29 | 48.08 | ND | U | 0.23 | 39.31 | ND | U | 0.22 | 38.46 |
| Xylene (Total) | 1330-20-7 | 1,000 | mg/kg | ND | U | 0.37 | 63.94 | ND | U | 0.23 | 41.88 | ND | U | 3.1 | 517.6 | ND | U | 0.19 | 33.03 | 0.61 | | 0.29 | 48.08 | ND | U | 0.23 | 39.31 | ND | U | 0.22 | 38.46 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 2,200 | mg/kg | ND | U | 0.19 | 1 | 2.5 | | 0.93 | 5 | 2.2 | | 1 | 5 | 1.4 | | 0.94 | 5 | ND | U | 1 | 5 | ND | U | 0.97 | 5 | ND | U | 0.94 | 5 |
| Naphthalene | 91-20-3 | 25 | mg/kg | ND | U | 0.19 | 1 | ND | U | 0.93 | 5 | ND | U | 1 | 5 | ND | U | 0.94 | 5 | 2.2 | | 1 | 5 | ND | U | 0.97 | 5 | ND | U | 0.94 | 5 |
| Fluorene | 86-73-7 | 3,800 | mg/kg | ND | U | 0.19 | 1 | ND | U | 0.93 | 5 | 1.2 | | 1 | 5 | ND | U | 0.94 | 5 | ND | U | 1 | 5 | ND | U | 0.97 | 5 | ND | U | 0.94 | 5 |
| Phenanthrene | 85-01-8 | 10,000 | mg/kg | ND | U | 0.19 | 1 | 1.6 | | 0.93 | 5 | 1.1 | | 1 | 5 | 1.2 | | 0.94 | 5 | 1.9 | | 1 | 5 | ND | U | 0.97 | 5 | ND | U | 0.94 | 5 |
| Anthracene | 120-12-7 | 350 | mg/kg | ND | U | 0.19 | 1 | ND | U | 0.93 | 5 | 1.1 | | 1 | 5 | ND | U | 0.94 | 5 | ND | U | 1 | 5 | ND | U | 0.97 | 5 | ND | U | 0.94 | 5 |
| Benzo(a)anthracene | 56-55-3 | 320 | mg/kg | ND | U | 0.19 | 1 | 2 | | 0.93 | 5 | ND | U | 1 | 5 | ND | U | 0.94 | 5 | 1.7 | | 1 | 5 | ND | U | 0.97 | 5 | ND | U | 0.94 | 5 |
| Chrysene | 218-01-9 | 230 | mg/kg | ND | U | 0.19 | 1 | 2.1 | | 0.93 | 5 | 1.4 | | 1 | 5 | ND | U | 0.94 | 5 | 1.9 | | 1 | 5 | 1 | | 0.97 | 5 | ND | U | 0.94 | 5 |
| Benzo(b)fluoranthene | 205-99-2 | 170 | mg/kg | ND | U | 0.19 | 1 | 1.6 | | 0.93 | 5 | ND | U | 1 | 5 | ND | U | 0.94 | 5 | 3.3 | | 1 | 5 | ND | U | 0.97 | 5 | ND | U | 0.94 | 5 |
| Benzo(a)pyrene | 50-32-8 | 46 | mg/kg | ND | U | 0.19 | 1 | 1.5 | | 0.93 | 5 | ND | U | 1 | 5 | ND | U | 0.94 | 5 | 6 | | 1 | 5 | ND | U | 0.97 | 5 | ND | U | 0.94 | 5 |
| Benzo(g,h,i)perylene | 191-24-2 | 180 | mg/kg | ND | U | 0.19 | 1 | ND | U | 0.93 | 5 | 1 | | 1 | 5 | ND | U | 0.94 | 5 | 20 | | 1 | 5 | 1.7 | | 0.97 | 5 | ND | U | 0.94 | 5 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 450 | mg/kg | 43.9 | | 1.15 | 10 | 150 | | 1.07 | 10 | 912 | | 2.36 | 20 | 191 | | 1.09 | 10 | 61.4 | | 1.18 | 10 | 31.3 | | 1.14 | 10 | 670 | | 2.25 | 20 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/kg - microgram per kilogram
mg/kg - milligram per kilogram
MSC - PADEP's Medium Specific Concentration for Soil
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
SWMU - Solid Waste Management Unit

All soil samples collected and analyzed were unsaturated

**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
N - Spike Amount not within control limits

**Exceedance Summary:**
**10** - RL exceeds the PADEP Non-Residential Soil MSC
10 - Concentration exceeds the PADEP Non-Residential Soil MSC

**Table 4**
**Summary of Soil Sample Analytical Results: Non SWMU Area**
**AOI 8 Site Characterization Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer Soil MSCs (TDS<2,500) | Location ID | N-131 | | | | N-132 | | | | N-133 | | | | N-134 | | | | N-135 | | | | N-136 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | N-131_1.0-2.0 | | | | N-132_1.0-2.0 | | | | N-133_1.0-2.0 | | | | N-134_1.0-2.0 | | | | N-135_1.0-2.0 | | | | N-136_1.0-2.0 | | | |
| | | | Sample Matrix | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | | Soil | | | |
| | | | Sample Interval | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | | 1.0-2.0 | | | |
| | | | Sample Date | 6/17/2008 | | | | 5/13/2008 | | | | 5/15/2008 | | | | 5/22/2008 | | | | 5/15/2008 | | | | 5/15/2008 | | | |
| | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 2.0 | mg/kg | ND | U | 0.38 | 61.12 | ND | U | 0.23 | 41.39 | ND | U | 0.3 | 51.65 | ND | U | 0.32 | 53.42 | ND | U | 0.35 | 57.47 | ND | U | 0.21 | 35.56 |
| Benzene | 71-43-2 | 0.5 | mg/kg | ND | U | 0.38 | 61.12 | ND | U | 0.23 | 41.39 | 3.7 | | 0.3 | 51.65 | ND | U | 0.32 | 53.42 | ND | U | 0.35 | 57.47 | 0.7 | | 0.21 | 35.56 |
| 1,2-Dichloroethane | 107-06-2 | 0.5 | mg/kg | ND | U | 0.38 | 61.12 | ND | U | 0.23 | 41.39 | ND | U | 0.3 | 51.65 | ND | U | 0.32 | 53.42 | ND | U | 0.35 | 57.47 | ND | U | 0.21 | 35.56 |
| Toluene | 108-88-3 | 100 | mg/kg | ND | U | 0.38 | 61.12 | ND | U | 0.23 | 41.39 | ND | U | 0.3 | 51.65 | ND | U | 0.32 | 53.42 | ND | U | 0.35 | 57.47 | ND | U | 0.21 | 35.56 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.005 | mg/kg | ND | U | 0.38 | 61.12 | ND | U | 0.23 | 41.39 | ND | U | 0.3 | 51.65 | ND | U | 0.32 | 53.42 | ND | U | 0.35 | 57.47 | ND | U | 0.21 | 35.56 |
| Ethylbenzene | 100-41-4 | 70 | mg/kg | ND | U | 0.38 | 61.12 | ND | U | 0.23 | 41.39 | ND | U | 0.3 | 51.65 | ND | U | 0.32 | 53.42 | ND | U | 0.35 | 57.47 | ND | U | 0.21 | 35.56 |
| Cumene | 98-82-8 | 2,500 | mg/kg | ND | U | 0.38 | 61.12 | ND | U | 0.23 | 41.39 | ND | U | 0.3 | 51.65 | ND | U | 0.32 | 53.42 | ND | U | 0.35 | 57.47 | ND | U | 0.21 | 35.56 |
| Xylene (Total) | 1330-20-7 | 1,000 | mg/kg | ND | U | 0.38 | 61.12 | ND | U | 0.23 | 41.39 | 0.48 | U | 0.3 | 51.65 | ND | U | 0.32 | 53.42 | ND | U | 0.35 | 57.47 | ND | U | 0.21 | 35.56 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 2,200 | mg/kg | ND | U | 1 | 5 | ND | U | 9.4 | 10 | ND | U | 9.8 | 5 | 50 | | 4.9 | 5 | 4.4 | | 1 | 5 | ND | U | 0.19 | 1 |
| Naphthalene | 91-20-3 | 25 | mg/kg | ND | U | 1 | 5 | ND | U | 9.4 | 10 | ND | U | 9.8 | 5 | 4.7 | | 9.9 | 5 | 2.1 | | 1 | 5 | ND | U | 0.19 | 1 |
| Fluorene | 86-73-7 | 3,800 | mg/kg | ND | U | 1 | 5 | ND | U | 9.4 | 10 | ND | U | 9.8 | 5 | 3300 | | 9.9 | 5 | ND | U | 1 | 5 | ND | U | 0.19 | 1 |
| Phenanthrene | 85-01-8 | 10,000 | mg/kg | ND | U | 1 | 5 | ND | U | 9.4 | 10 | ND | U | 9.8 | 5 | 48 | | 4.9 | 5 | 7.7 | | 1 | 5 | ND | U | 0.19 | 1 |
| Anthracene | 120-12-7 | 350 | mg/kg | ND | U | 1 | 5 | ND | U | 9.4 | 10 | ND | U | 9.8 | 5 | 11 | | 9.9 | 5 | 1.6 | | 1 | 5 | ND | U | 0.19 | 1 |
| Benzo(a)anthracene | 56-55-3 | 320 | mg/kg | ND | U | 1 | 5 | ND | U | 9.4 | 10 | ND | U | 9.8 | 5 | 41 | | 4.9 | 5 | 1.5 | | 1 | 5 | ND | U | 0.19 | 1 |
| Chrysene | 218-01-9 | 230 | mg/kg | ND | U | 1 | 5 | ND | U | 9.4 | 10 | ND | U | 9.8 | 5 | 35 | | 4.9 | 5 | 3 | | 1 | 5 | ND | U | 0.19 | 1 |
| Benzo(b)fluoranthene | 205-99-2 | 170 | mg/kg | ND | U | 1 | 5 | ND | U | 9.4 | 10 | ND | U | 9.8 | 5 | 44 | | 4.9 | 5 | ND | U | 1 | 5 | ND | U | 0.19 | 1 |
| Benzo(a)pyrene | 50-32-8 | 46 | mg/kg | ND | U | 1 | 5 | ND | U | 9.4 | 10 | ND | U | 9.8 | 5 | 37 | | 4.9 | 5 | 1.5 | | 1 | 5 | ND | U | 0.19 | 1 |
| Benzo(g,h,i)perylene | 191-24-2 | 180 | mg/kg | ND | U | 1 | 5 | ND | U | 9.4 | 10 | ND | U | 9.8 | 5 | 21 | | 9.9 | 5 | 2.4 | | 1 | 5 | ND | U | 0.19 | 1 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 450 | mg/kg | 88.8 | | 1.23 | 10 | 94.9 | | 1.11 | 10 | 865 | | 2.36 | 20 | 74.6 | | 1.17 | 10 | 273 | | 1.21 | 10 | 320 | | 1.13 | 10 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/kg - microgram per kilogram
mg/kg - milligram per kilogram
MSC - PADEP's Medium Specific Concentration for Soil
RL - Reporting Limit
ND - Not Detected
NA - Not Analyzed
SWMU - Solid Waste Management Unit

All soil samples collected and analyzed were unsaturated

**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
N - Spike Amount not within control limits

**Exceedance Summary:**
**10** - RL exceeds the PADEP Non-Residential Soil MSC
10 - Concentration exceeds the PADEP Non-Residential Soil MSC

# Table 5
# Summary of Soil Sample Analytical Results: SWMU 2
# AOI 8 Site Characterization/Remedial Investigation Report
# Sunoco Philadelphia Refinery
# Philadelphia, Pennsylvania

| Chemical Name | Analytical Method | CAS No | PADEP Non-Residential Used Aquifer Soil MSCs (TDS<2,500) | Location ID | BH-08-05 | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Sample ID | BH-08-05_6.0-8.0 | | | |
| | | | | Sample Matrix | Soil | | | |
| | | | | Sample Interval | 6.0-8.0 | | | |
| | | | | Sample Date | 5/8/2008 | | | |
| | | | | SWMU Number | 2 | | | |
| | | | | Unit | Result | Q | RL | DF |
| **Metals** | | | | | | | | |
| Lead (Total) | SW846 6010B | 7439-92-1 | 450 | mg/kg | 63.4 | | 1.35 | 10 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
mg/kg - milligrams per kilogram
MSC - PADEP's Medium Specific Concentration for Soil
RL - Reporting Limit
(1) All soil samples collected and analyzed were unsaturated
SWMU - Solid Waste Management Unit

**Qualifiers:**
Q - Qualifier
RL - Reporting Limit
DF - Dilution Factor

**Exceedance Summary:**
**10** - RL exceeds the PADEP Non-Residential Soil MSC
10 - Result exceeds the PADEP Non-Residential Soil MSC

**Table 6**
**Summary of Groundwater Analytical Results**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Fill-Alluvium/Trenton Gravel Wells**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Location ID | N-1 | | | | N-3 | | | | N-5 | | | | N-8 | | | | N-10 | | | | N-11 | | | | N-12 | | | | N-15 | | | | N-16 | | | | N-17 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | N-1 | | | | N-3 | | | | N-5 | | | | N-8 | | | | N-10 | | | | N-11 | | | | N-12 | | | | N-15 | | | | N-16 | | | | N-17 | | | |
| | | | Sample Date | 7/15/2008 | | | | 7/15/2008 | | | | 7/15/2008 | | | | 7/16/2008 | | | | 7/15/2008 | | | | 7/15/2008 | | | | 7/23/2008 | | | | 7/15/2008 | | | | 7/16/2008 | | | | 7/16/2008 | | | |
| | | | Sample Matrix | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | |
| **Volatile Organic Compounds** | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | 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 | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 |
| Ethylbenzene | 100-41-4 | 700 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 | ND | U | 1 | 1 | ND | U | 1 | 1 | 2 | | 1 | 1 | 1 | 1 | 1 | 1 | ND | U | 2 | 2 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 2 | 2 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Toluene | 108-88-3 | 1,000 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 | ND | U | 1 | 1 | ND | U | 1 | 1 | 9 | | 1 | 1 | 10 | | 1 | 1 | 6 | | 2 | 2 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Xylene (Total) | 1330-20-7 | 10,000 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 | ND | U | 1 | 1 | 1 | | 1 | 1 | 13 | | 1 | 1 | 14 | | 1 | 1 | 10 | | 2 | 2 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Methyl Tertiary Butyl Ether (MTBE) | 1634-04-4 | 20 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 2 | 2 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Benzene | 71-43-2 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 | 1 | | 1 | 1 | 1 | | 1 | 1 | 6 | | 1 | 1 | 6 | | 1 | 1 | 3 | | 2 | 2 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Cumene | 98-82-8 | 3,500 | ug/l | ND | U | 2 | 1 | ND | U | 2 | 1 | ND | U | 10 | 5 | ND | U | 2 | 1 | ND | U | 2 | 1 | 38 | 38 | 2 | 1 | 15 | 15 | 2 | 1 | 230 | | 4 | 2 | ND | U | 2 | 1 | ND | U | 2 | 1 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | 870 | | 50 | 1 | ND | U | 99 | 10 | ND | U | 50 | 1 | 130 | | 50 | 1 |
| Chrysene | 218-01-9 | 1.9 | ug/l | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | 470 | | **50** | 1 | ND | U | **99** | 10 | ND | U | **50** | 1 | ND | U | **50** | 1 |
| Phenanthrene | 85-01-8 | 1,100 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | 5500 | | 500 | 10 | 440 | | 99 | 10 | ND | U | 50 | 1 | ND | U | 50 | 1 |
| Fluorene | 86-73-7 | 1,900 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | 1600 | | 500 | 10 | 180 | | 99 | 10 | ND | U | 50 | 1 | ND | U | 50 | 1 |
| Naphthalene | 91-20-3 | 100 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 50 | 1 | ND | U | 99 | 10 | ND | U | 50 | 1 | ND | U | 50 | 1 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 5 | ug/l | ND | U | 0 | 1 | 1.1 | | 1 | 1 | 1.13 | | 1 | 5 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | 1.1 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/l - micrograms per liter
mg/L - milligram per liter
RL - Reporting Limit
ND - Not Detected
DF - Dilution Factor
NA - Not Analyzed

**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
J - The analyte was detected below the RL. The result should be considered an estimate.
D - The sample was diluted.

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

**Table 6**
**Summary of Groundwater Analytical Results**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Fill-Alluvium/Trenton Gravel Wells**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Location ID | N-18 | | | | N-20 | | | | N-23 | | | | N-24 | | | | N-26 | | | | N-28 | | | | N-29 | | | | N-30 | | | | N-32 | | | | N-34 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | N-18 | | | | N-20 | | | | N-23 | | | | N-24 | | | | N-26 | | | | N-28 | | | | N-29 | | | | N-30 | | | | N-32 | | | | N-34 | | | |
| | | | Sample Date | 7/16/2008 | | | | 7/23/2008 | | | | 7/22/2008 | | | | 7/18/2008 | | | | 7/17/2008 | | | | 7/16/2008 | | | | 7/22/2008 | | | | 7/22/2008 | | | | 7/22/2008 | | | | 7/24/2008 | | | |
| | | | Sample Matrix | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | |
| **Volatile Organic Compounds** | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | 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 | 0.03 | 1 | 0.029 | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 |
| Ethylbenzene | 100-41-4 | 700 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 10 | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 10 | 10 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | **10** | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | **10** | 10 |
| Toluene | 108-88-3 | 1,000 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 10 | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 10 | 10 |
| Xylene (Total) | 1330-20-7 | 10,000 | ug/l | 1 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 10 | 10 | 3 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 10 | 10 |
| Methyl Tertiary Butyl Ether (MTBE) | 1634-04-4 | 20 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 10 | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 10 | 10 |
| Benzene | 71-43-2 | 5 | ug/l | 3 | | 1 | 1 | ND | U | 1 | 1 | ND | U | **10** | 10 | 3 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | **10** | 10 |
| Cumene | 98-82-8 | 3,500 | ug/l | 20 | 20 | 2 | 1 | 42 | | 2 | 1 | ND | U | 20 | 10 | 44 | | 2 | 1 | ND | U | 2 | 1 | ND | U | 2 | 1 | ND | U | 2 | 1 | ND | U | 2 | 1 | ND | U | 2 | 1 | ND | U | 20 | 10 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | ND | U | 25 | 1 | 90 | | 50 | 1 | 1900 | | 120 | 1 | ND | U | 47 | 10 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | 610 | | 50 | 1 |
| Chrysene | 218-01-9 | 1.9 | ug/l | ND | U | **25** | 1 | 70 | | **50** | 1 | 620 | | **120** | 1 | ND | U | **47** | 10 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | 290 | | **50** | 1 |
| Phenanthrene | 85-01-8 | 1,100 | ug/l | ND | U | 25 | 1 | ND | U | 50 | 1 | 520 | | 120 | 1 | ND | U | 47 | 10 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | 200 | | 50 | 1 |
| Fluorene | 86-73-7 | 1,900 | ug/l | ND | U | 25 | 1 | 66 | | 50 | 1 | 1100 | | 120 | 1 | ND | U | 47 | 10 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | 200 | | 50 | 1 |
| Naphthalene | 91-20-3 | 100 | ug/l | ND | U | 25 | 1 | ND | U | 50 | 1 | 260 | | **120** | 1 | ND | U | 47 | 10 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 50 | 1 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/l - micrograms per liter
mg/L - milligram per liter
RL - Reporting Limit
ND - Not Detected
DF - Dilution Factor
NA - Not Analyzed

**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
J - The analyte was detected below the RL. The result should be considered an estimate.
D - The sample was diluted.

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

**Table 6**
**Summary of Groundwater Analytical Results**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Fill-Alluvium/Trenton Gravel Wells**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Location ID | N-35 | | | | N-36 | | | | N-37 | | | | N-38 | | | | N-39 | | | | N-40 | | | | N-41 | | | | N-53 | | | | N-55 | | | | N-57 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | N-35 | | | | N-36 | | | | N-37 | | | | N-38 | | | | N-39 | | | | N-40 | | | | N-41 | | | | N-53 | | | | N-55 | | | | N-57 | | | |
| | | | Sample Date | 7/24/2008 | | | | 7/25/2008 | | | | 7/24/2008 | | | | 7/24/2008 | | | | 7/28/2008 | | | | 7/25/2008 | | | | 7/28/2008 | | | | 7/28/2008 | | | | 7/28/2008 | | | | 7/25/2008 | | | |
| | | | Sample Matrix | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | |
| **Volatile Organic Compounds** | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | 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 | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 |
| Ethylbenzene | 100-41-4 | 700 | ug/l | ND | U | 10 | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | ND | U | **10** | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 |
| Toluene | 108-88-3 | 1,000 | ug/l | ND | U | 10 | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | 1 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 |
| Xylene (Total) | 1330-20-7 | 10,000 | ug/l | ND | U | 10 | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | 3 | | 1 | 1 | 1 | | 1 | 1 | ND | U | 1 | 1 | 11 | | 1 | 1 | ND | U | 1 | 1 | 120 | | 5 | 5 |
| Methyl Tertiary Butyl Ether (MTBE) | 1634-04-4 | 20 | ug/l | ND | U | 10 | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 |
| Benzene | 71-43-2 | 5 | ug/l | ND | U | **10** | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 |
| Cumene | 98-82-8 | 3,500 | ug/l | ND | U | 20 | 10 | ND | U | 2 | 1 | ND | U | 2 | 1 | ND | U | 2 | 1 | 24 | | 2 | 1 | 7 | | 2 | 1 | 8 | | 2 | 1 | 17 | | 2 | 1 | ND | U | 2 | 1 | ND | U | 10 | 5 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | 70 | | 47 | 10 | ND | U | 120 | 5 | ND | U | 5 | 1 | ND | U | 5 | 1 | 25 | | 5 | 1 | ND | U | 24 | 5 | 390 | | 50 | 1 | 220 | | 50 | 1 | ND | U | 5 | 1 | ND | U | 24 | 5 |
| Chrysene | 218-01-9 | 1.9 | ug/l | 61 | | **47** | 10 | ND | U | **120** | 5 | ND | U | **5** | 1 | ND | U | **5** | 1 | 41 | | **5** | 1 | ND | U | **24** | 5 | 280 | | **50** | 1 | 180 | | **50** | 1 | ND | U | **5** | 1 | ND | U | **24** | 5 |
| Phenanthrene | 85-01-8 | 1,100 | ug/l | ND | U | 47 | 10 | ND | U | 120 | 5 | ND | U | 5 | 1 | ND | U | 5 | 1 | 7 | | 5 | 1 | ND | U | 24 | 5 | 1100 | | 50 | 1 | 610 | | 50 | 1 | ND | U | 5 | 1 | ND | U | 24 | 5 |
| Fluorene | 86-73-7 | 1,900 | ug/l | ND | U | 47 | 10 | ND | U | 120 | 5 | ND | U | 5 | 1 | ND | U | 5 | 1 | 9 | | 5 | 1 | ND | U | 24 | 5 | 450 | | 50 | 1 | 360 | | 50 | 1 | ND | U | 5 | 1 | ND | U | 24 | 5 |
| Naphthalene | 91-20-3 | 100 | ug/l | ND | U | 47 | 10 | ND | U | **120** | 5 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 24 | 5 | ND | U | 50 | 1 | ND | U | 50 | 1 | ND | U | 5 | 1 | ND | U | 24 | 5 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |

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RL - Reporting Limit
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**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
J - The analyte was detected below the RL. The result should be considered an estimate.
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**10** - Reporting limit exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10 - Result exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

**Table 6**
**Summary of Groundwater Analytical Results**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Fill-Alluvium/Trenton Gravel Wells**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Location ID | N-58 | | | | N-59 | | | | N-60 | | | | N-61 | | | | N-64 | | | | N-65 | | | | N-66 | | | | N-67 | | | | N-69 | | | | N-70 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | N-58 | | | | N-59 | | | | N-60 | | | | N-61 | | | | N-64 | | | | N-65 | | | | N-66 | | | | N-67 | | | | N-69 | | | | N-70 | | | |
| | | | Sample Date | 7/25/2008 | | | | 8/6/2008 | | | | 7/25/2008 | | | | 7/25/2008 | | | | 7/23/2008 | | | | 7/16/2008 | | | | 7/22/2008 | | | | 7/18/2008 | | | | 7/18/2008 | | | | 7/18/2008 | | | |
| | | | Sample Matrix | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | |
| **Volatile Organic Compounds** | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | 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 | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 |
| Ethylbenzene | 100-41-4 | 700 | ug/l | ND | U | 10 | 10 | 3 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 10 | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | 1 | 1 | 1 | 1 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | ND | U | **10** | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | **10** | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Toluene | 108-88-3 | 1,000 | ug/l | ND | U | 10 | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 10 | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Xylene (Total) | 1330-20-7 | 10,000 | ug/l | 100 | | 10 | 10 | 4 | | 1 | 1 | ND | U | 1 | 1 | 23 | 23 | 10 | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | 1 | | 1 | 1 |
| Methyl Tertiary Butyl Ether (MTBE) | 1634-04-4 | 20 | ug/l | ND | U | 10 | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 10 | 10 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Benzene | 71-43-2 | 5 | ug/l | ND | U | **10** | 10 | 98 | | 1 | 1 | ND | U | 1 | 1 | 8700 | | **50** | 50 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Cumene | 98-82-8 | 3,500 | ug/l | ND | U | 20 | 10 | 2 | 2 | 2 | 1 | ND | U | 2 | 1 | ND | U | 20 | 10 | ND | U | 2 | 1 | ND | U | 2 | 1 | 4 | | 2 | 1 | ND | U | 2 | 1 | 2 | | 2 | 1 | 35 | | 2 | 1 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | 12 | | 5 | 1 | ND | U | 24 | 5 | ND | U | 5 | 1 | ND | U | 5 | 1 | 19 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 |
| Chrysene | 218-01-9 | 1.9 | ug/l | ND | U | **5** | 1 | ND | U | **5** | 1 | 14 | | **5** | 1 | ND | U | **24** | 5 | ND | U | **5** | 1 | ND | U | **5** | 1 | 7 | | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 |
| Phenanthrene | 85-01-8 | 1,100 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 5 | ND | U | 24 | 5 | ND | U | 5 | 1 | ND | U | 5 | 1 | 67 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 |
| Fluorene | 86-73-7 | 1,900 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 24 | 5 | ND | U | 5 | 1 | ND | U | 5 | 1 | 31 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 |
| Naphthalene | 91-20-3 | 100 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 24 | 5 | ND | U | 5 | 1 | ND | U | 5 | 1 | 48 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |

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**Qualifiers:**
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10 - Result exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

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**Summary of Groundwater Analytical Results**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Fill-Alluvium/Trenton Gravel Wells**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Location ID | N-73 | | | | N-74 | | | | N-77 | | | | N-84 | | | | N-85 | | | | N-86 | | | | N-87 | | | | N-89 | | | | N-90 | | | | N-92 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | N-73 | | | | N-74 | | | | N-77 | | | | N-84 | | | | N-85 | | | | N-86 | | | | N-87 | | | | N-89 | | | | N-90 | | | | N-92 | | | |
| | | | Sample Date | 7/25/2008 | | | | 7/25/2008 | | | | 7/18/2008 | | | | 7/16/2008 | | | | 7/16/2008 | | | | 7/17/2008 | | | | 7/17/2008 | | | | 7/22/2008 | | | | 7/22/2008 | | | | 7/17/2008 | | | |
| | | | Sample Matrix | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | |
| **Volatile Organic Compounds** | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | 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 | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 |
| Ethylbenzene | 100-41-4 | 700 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Toluene | 108-88-3 | 1,000 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | 2 | | 1 | 1 | 4 | | 1 | 1 | ND | U | 1 | 1 |
| Xylene (Total) | 1330-20-7 | 10,000 | ug/l | 1 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | 5 | | 1 | 1 | 6 | | 1 | 1 | ND | U | 1 | 1 |
| Methyl Tertiary Butyl Ether (MTBE) | 1634-04-4 | 20 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Benzene | 71-43-2 | 5 | ug/l | 4 | | 1 | 1 | 4 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | 1 | | 1 | 1 | 5 | | 1 | 1 | ND | U | 1 | 1 |
| Cumene | 98-82-8 | 3,500 | ug/l | ND | U | 2 | 1 | ND | U | 2 | 1 | 15 | | 2 | 1 | 11 | | 2 | 1 | 2 | | 2 | 1 | 21 | | 2 | 1 | 34 | | 2 | 1 | 23 | 23 | 2 | 1 | 8 | | 2 | 1 | ND | U | 2 | 1 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 50 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | 27 | | 5 | 1 |
| Chrysene | 218-01-9 | 1.9 | ug/l | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **50** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | 11 | | **5** | 1 |
| Phenanthrene | 85-01-8 | 1,100 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 50 | 1 | 13 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 |
| Fluorene | 86-73-7 | 1,900 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | 7 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 50 | 1 | 9 | | 5 | 1 | ND | U | 5 | 1 | 7 | | 5 | 1 | ND | U | 5 | 1 | 17 | | 5 | 1 |
| Naphthalene | 91-20-3 | 100 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 50 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |

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**AOI 8 Site Characterization/Remedial Investigation Report**
**Fill-Alluvium/Trenton Gravel Wells**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Location ID | N-93 | | | | N-94 | | | | N-97 | | | | N-98 | | | | N-99 | | | | N-100 | | | | N-101 | | | | N-102 | | | | N-103 | | | | N-104 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | N-93 | | | | N-94 | | | | N-97 | | | | N-98 | | | | N-99 | | | | N-100 | | | | N-101 | | | | N-102 | | | | N-103 | | | | N-104 | | | |
| | | | Sample Date | 7/17/2008 | | | | 7/18/2008 | | | | 8/6/2008 | | | | 7/14/2008 | | | | 7/23/2008 | | | | 7/14/2008 | | | | 7/15/2008 | | | | 7/15/2008 | | | | 7/23/2008 | | | | 7/23/2008 | | | |
| | | | Sample Matrix | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | |
| **Volatile Organic Compounds** | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | 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 | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 |
| Ethylbenzene | 100-41-4 | 700 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 1 | 8 | | 1 | 1 | ND | U | 5 | 5 | 2 | | 1 | 1 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 | ND | U | 1 | 1 |
| Toluene | 108-88-3 | 1,000 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 1 | 4 | 4 | 1 | 1 | 22 | | 5 | 5 | 13 | | 1 | 1 |
| Xylene (Total) | 1330-20-7 | 10,000 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | 12 | | 5 | 1 | 16 | | 1 | 1 | 47 | | 5 | 5 | 30 | | 1 | 1 |
| Methyl Tertiary Butyl Ether (MTBE) | 1634-04-4 | 20 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 | ND | U | 1 | 1 |
| Benzene | 71-43-2 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | 2 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 1 | 25 | | 1 | 1 | 16 | | 5 | 5 | 7 | | 1 | 1 |
| Cumene | 98-82-8 | 3,500 | ug/l | 17 | | 2 | 1 | ND | U | 2 | 1 | 140 | | 2 | 1 | ND | U | 2 | 1 | ND | U | 2 | 1 | ND | U | 2 | 1 | 26 | | 10 | 1 | 7 | 7 | 2 | 1 | 360 | | 10 | 5 | 44 | | 2 | 1 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | 10 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 50 | 1 | ND | U | 5 | 1 | 9 | | 5 | 1 | 9 | | 5 | 1 | 390 | | 50 | 1 | 150 | | 50 | 1 |
| Chrysene | 218-01-9 | 1.9 | ug/l | ND | U | **5** | 1 | ND | U | **5** | 1 | 6 | | **5** | 1 | ND | U | **5** | 1 | ND | U | **50** | 1 | ND | U | **5** | 1 | 8 | | **5** | 1 | 15 | | **5** | 1 | 360 | | **50** | 1 | 85 | | **50** | 1 |
| Phenanthrene | 85-01-8 | 1,100 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | 45 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 50 | 1 | ND | U | 5 | 1 | 67 | | 5 | 1 | 77 | | 5 | 1 | 2500 | | 250 | 5 | 740 | | 50 | 1 |
| Fluorene | 86-73-7 | 1,900 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | 13 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 50 | 1 | ND | U | 5 | 1 | 28 | | 5 | 1 | 22 | | 5 | 1 | 740 | 740 | 50 | 1 | 310 | | 50 | 1 |
| Naphthalene | 91-20-3 | 100 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | 50 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 50 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | 10 | | 5 | 1 | ND | U | 50 | 1 | ND | U | 50 | 1 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/l - micrograms per liter
mg/L - milligram per liter
RL - Reporting Limit
ND - Not Detected
DF - Dilution Factor
NA - Not Analyzed

**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
J - The analyte was detected below the RL. The result should be considered an estimate.
D - The sample was diluted.

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

**Table 6**
**Summary of Groundwater Analytical Results**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Fill-Alluvium/Trenton Gravel Wells**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Location ID | N-105 | | | | N-106 | | | | N-108 | | | | N-109 | | | | N-110 | | | | N-111 | | | | N-112 | | | | N-114 | | | | N-115 | | | | N-117 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | N-105 | | | | N-106 | | | | N-108 | | | | N-109 | | | | N-110 | | | | N-111 | | | | N-112 | | | | N-114 | | | | N-115 | | | | N-117 | | | |
| | | | Sample Date | 7/23/2008 | | | | 7/14/2008 | | | | 7/22/2008 | | | | 7/24/2008 | | | | 7/24/2008 | | | | 7/24/2008 | | | | 7/24/2008 | | | | 7/24/2008 | | | | 7/28/2008 | | | | 7/17/2008 | | | |
| | | | Sample Matrix | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | |
| **Volatile Organic Compounds** | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | 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 | 0.03 | 1 | ND | U | 0.03 | 2 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 |
| Ethylbenzene | 100-41-4 | 700 | ug/l | ND | U | 1 | 1 | 22 | | 2 | 2 | ND | U | 5 | 5 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 2 | 2 | ND | U | 5 | 5 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Toluene | 108-88-3 | 1,000 | ug/l | 3 | | 1 | 1 | 60 | | 2 | 2 | 11 | | 5 | 5 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Xylene (Total) | 1330-20-7 | 10,000 | ug/l | 7 | | 1 | 1 | 120 | | 2 | 2 | 15 | | 5 | 5 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | 3 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Methyl Tertiary Butyl Ether (MTBE) | 1634-04-4 | 20 | ug/l | ND | U | 1 | 1 | ND | U | 2 | 2 | ND | U | 5 | 5 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Benzene | 71-43-2 | 5 | ug/l | ND | U | 1 | 1 | 410 | | **20** | 20 | 14 | | 5 | 5 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Cumene | 98-82-8 | 3,500 | ug/l | 9 | | 2 | 1 | 57 | | 4 | 2 | 28 | | 10 | 5 | 11 | 11 | 2 | 1 | ND | U | 2 | 1 | 8 | | 2 | 1 | 22 | | 2 | 1 | 24 | | 2 | 1 | 6 | | 2 | 1 | 14 | | 2 | 1 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | ND | U | 50 | 1 | ND | U | 5 | 1 | 13 | | 5 | 1 | 63 | | 50 | 1 | ND | U | 50 | 1 | 160 | | 50 | 1 | 760 | | 50 | 1 | ND | U | 5 | 1 | 8 | | 5 | 1 | 11 | | 5 | 1 |
| Chrysene | 218-01-9 | 1.9 | ug/l | ND | U | **50** | 1 | ND | U | **5** | 1 | 8 | | **5** | 1 | ND | U | **50** | 1 | ND | U | **50** | 1 | 110 | | **50** | 1 | 290 | | **50** | 1 | ND | U | **5** | 1 | 7 | | **5** | 1 | 11 | | **5** | 1 |
| Phenanthrene | 85-01-8 | 1,100 | ug/l | 100 | | 50 | 1 | ND | U | 5 | 1 | 47 | | 5 | 1 | 230 | | 50 | 1 | ND | U | 50 | 1 | 380 | | 50 | 1 | 1400 | | 250 | 5 | 7 | | 5 | 5 | 10 | 10 | 5 | 1 | 71 | | 5 | 1 |
| Fluorene | 86-73-7 | 1,900 | ug/l | 72 | | 50 | 1 | ND | U | 5 | 1 | 19 | | 5 | 1 | 140 | | 50 | 1 | ND | U | 50 | 1 | 170 | | 50 | 1 | 380 | | 50 | 1 | 9 | | 5 | 1 | ND | U | 5 | 1 | 24 | | 5 | 1 |
| Naphthalene | 91-20-3 | 100 | ug/l | ND | U | 50 | 1 | 20 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 50 | 1 | ND | U | 50 | 1 | ND | U | 50 | 1 | ND | U | 50 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |

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RL - Reporting Limit
ND - Not Detected
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**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
J - The analyte was detected below the RL. The result should be considered an estimate.
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**Exceedance Summary:**
**10** - Reporting limit exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500
10 - Result exceeds the PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500

**Table 6**
**Summary of Groundwater Analytical Results**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Fill-Alluvium/Trenton Gravel Wells**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Location ID | N-118 | | | | N-119 | | | | N-120 | | | | N-121 | | | | N-122 | | | | N-123 | | | | N-124 | | | | N-126 | | | | N-128 | | | | N-131 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | N-118 | | | | N-119 | | | | N-120 | | | | N-121 | | | | N-122 | | | | N-123 | | | | N-124 | | | | N-126 | | | | N-128 | | | | N-131 | | | |
| | | | Sample Date | 7/22/2008 | | | | 7/17/2008 | | | | 7/17/2008 | | | | 7/17/2008 | | | | 7/22/2008 | | | | 7/22/2008 | | | | 7/22/2008 | | | | 7/22/2008 | | | | 7/23/2008 | | | | 7/28/2008 | | | |
| | | | Sample Matrix | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | |
| **Volatile Organic Compounds** | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | 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 | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 |
| Ethylbenzene | 100-41-4 | 700 | ug/l | 3 | 3 | 1 | 1 | 210 | | 20 | 20 | ND | U | 1 | 1 | 2 | | 1 | 1 | ND | U | 1 | 1 | 5 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 2 | 2 | ND | U | 2 | 2 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | ND | U | 1 | 1 | ND | U | **20** | 20 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 2 | 2 |
| Toluene | 108-88-3 | 1,000 | ug/l | 7 | | 1 | 1 | 64 | | 20 | 20 | ND | U | 1 | 1 | 11 | 11 | 1 | 1 | ND | U | 1 | 1 | 1 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 2 | 2 |
| Xylene (Total) | 1330-20-7 | 10,000 | ug/l | 18 | | 1 | 1 | 570 | | 20 | 20 | ND | U | 1 | 1 | 36 | | 1 | 1 | 1 | | 1 | 1 | 2 | | 1 | 1 | ND | U | 1 | 1 | 2 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 2 | 2 |
| Methyl Tertiary Butyl Ether (MTBE) | 1634-04-4 | 20 | ug/l | ND | U | 1 | 1 | ND | U | 20 | 20 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 2 | 2 |
| Benzene | 71-43-2 | 5 | ug/l | 9 | | 1 | 1 | 81 | | **20** | 20 | ND | U | 1 | 1 | 27 | | 1 | 1 | ND | U | 1 | 1 | 6 | | 1 | 1 | ND | U | 1 | 1 | 1 | | 1 | 1 | ND | U | 1 | 1 | 3 | | 2 | 2 |
| Cumene | 98-82-8 | 3,500 | ug/l | 97 | | 2 | 1 | 520 | | 40 | 20 | 130 | | 2 | 1 | 34 | | 2 | 1 | 5 | | 2 | 1 | 34 | | 2 | 1 | ND | U | 2 | 1 | 3 | | 2 | 1 | 30 | | 2 | 1 | 370 | | 4 | 2 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | 9 | | 5 | 1 | 6 | | 5 | 1 | 7 | | 5 | 1 | ND | U | 20 | 1 | 16 | | 5 | 1 | 110 | | 5 | 1 | ND | U | 5 | 1 | 20 | | 5 | 1 | 940 | | 100 | 1 | ND | U | 50 | 1 |
| Chrysene | 218-01-9 | 1.9 | ug/l | 9 | | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **20** | 1 | 5 | | **5** | 1 | 66 | | **5** | 1 | ND | U | **5** | 1 | 30 | | **5** | 1 | 470 | | **100** | 1 | 86 | | **50** | 1 |
| Phenanthrene | 85-01-8 | 1,100 | ug/l | 70 | | 5 | 1 | 63 | | 5 | 1 | 21 | | 5 | 1 | ND | U | 20 | 1 | 250 | | 24 | 5 | 170 | | 24 | 1 | ND | U | 5 | 1 | 45 | | 5 | 1 | 4300 | | 500 | 5 | ND | U | 50 | 1 |
| Fluorene | 86-73-7 | 1,900 | ug/l | 34 | | 5 | 1 | 31 | | 5 | 1 | 13 | | 5 | 1 | ND | U | 20 | 1 | 84 | | 5 | 1 | 60 | | 5 | 1 | ND | U | 5 | 1 | 13 | | 5 | 1 | ND | U | 100 | 1 | ND | U | 50 | 1 |
| Naphthalene | 91-20-3 | 100 | ug/l | ND | U | 5 | 1 | 220 | | 48 | 10 | ND | U | 5 | 1 | ND | U | 20 | 1 | ND | U | 5 | 1 | 140 | | 24 | 1 | ND | U | 5 | 1 | 14 | | 5 | 1 | ND | U | 100 | 1 | ND | U | 50 | 1 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |

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**Summary of Groundwater Analytical Results**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Fill-Alluvium/Trenton Gravel Wells**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Location ID | N-132 | | | | N-133 | | | | N-134 | | | | N-136 | | | | PZ-300 | | | | PZ-503 | | | | PZ-504 | | | | PZ-505 | | | | PZ-506 | | | | PZ-507 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | N-132 | | | | N-133 | | | | N-134 | | | | N-136 | | | | PZ-300 | | | | PZ-503 | | | | PZ-504 | | | | PZ-505 | | | | PZ-506 | | | | PZ-507 | | | |
| | | | Sample Date | 7/28/2008 | | | | 7/23/2008 | | | | 7/16/2008 | | | | 7/25/2008 | | | | 7/29/2008 | | | | 7/25/2008 | | | | 7/25/2008 | | | | 7/23/2008 | | | | 7/23/2008 | | | | 7/23/2008 | | | |
| | | | Sample Matrix | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | |
| **Volatile Organic Compounds** | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | 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 | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 |
| Ethylbenzene | 100-41-4 | 700 | ug/l | ND | U | 1 | 1 | 11 | | 10 | 10 | ND | U | 1 | 1 | ND | U | 5 | 5 | 9 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 2 | 2 | ND | U | 1 | 1 | ND | U | 10 | 10 | ND | U | 1 | 1 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | ND | U | 1 | 1 | ND | U | **10** | 10 | ND | U | 1 | 1 | ND | U | 5 | 5 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 2 | 2 | ND | U | 1 | 1 | ND | U | **10** | 10 | ND | U | 1 | 1 |
| Toluene | 108-88-3 | 1,000 | ug/l | ND | U | 1 | 1 | ND | U | 10 | 10 | ND | U | 1 | 1 | ND | U | 5 | 5 | 1 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 2 | 2 | ND | U | 1 | 1 | ND | U | 10 | 10 | ND | U | 1 | 1 |
| Xylene (Total) | 1330-20-7 | 10,000 | ug/l | 4 | | 1 | 1 | 17 | | 10 | 10 | ND | U | 1 | 1 | ND | U | 5 | 5 | 9 | | 1 | 1 | 3 | | 1 | 1 | 6 | | 2 | 2 | 2 | | 1 | 1 | ND | U | 10 | 10 | ND | U | 1 | 1 |
| Methyl Tertiary Butyl Ether (MTBE) | 1634-04-4 | 20 | ug/l | ND | U | 1 | 1 | ND | U | 10 | 10 | ND | U | 1 | 1 | ND | U | 5 | 5 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 2 | 2 | ND | U | 1 | 1 | ND | U | 10 | 10 | ND | U | 1 | 1 |
| Benzene | 71-43-2 | 5 | ug/l | ND | U | 1 | 1 | 10000 | | **100** | 100 | ND | U | 1 | 1 | 110 | | 5 | 5 | 110 | | 1 | 1 | 13 | | 1 | 1 | 2400 | | **20** | 20 | 160 | | 1 | 1 | ND | U | **10** | 10 | ND | U | 1 | 1 |
| Cumene | 98-82-8 | 3,500 | ug/l | ND | U | 2 | 1 | ND | U | 20 | 10 | ND | U | 2 | 1 | ND | U | 10 | 5 | 6 | | 2 | 1 | 6 | 6 | 2 | 1 | ND | U | 4 | 2 | 3 | 3 | 2 | 1 | ND | U | 20 | 10 | ND | U | 2 | 1 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | ND | U | 5 | 1 | 6 | | 5 | 1 | ND | U | 50 | 1 | ND | U | 24 | 5 | 6 | | 5 | 1 | 62 | | 50 | 1 | ND | U | 5 | 1 | 61 | | 10 | 1 | 11 | | 5 | 1 | 120 | | 50 | 1 |
| Chrysene | 218-01-9 | 1.9 | ug/l | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **50** | 1 | ND | U | **24** | 5 | ND | U | **5** | 1 | 51 | | **50** | 1 | ND | U | **5** | 1 | 41 | | **10** | 1 | 8 | | **5** | 1 | 120 | | **50** | 1 |
| Phenanthrene | 85-01-8 | 1,100 | ug/l | ND | U | 5 | 1 | 9 | | 5 | 1 | ND | U | 50 | 1 | ND | U | 24 | 5 | ND | U | 5 | 1 | ND | U | 50 | 1 | ND | U | 5 | 1 | ND | U | 10 | 1 | ND | U | 5 | 1 | ND | U | 50 | 1 |
| Fluorene | 86-73-7 | 1,900 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 50 | 1 | ND | U | 24 | 5 | ND | U | 5 | 1 | ND | U | 50 | 1 | ND | U | 5 | 1 | 11 | 11 | 10 | 1 | ND | U | 5 | 1 | ND | U | 50 | 1 |
| Naphthalene | 91-20-3 | 100 | ug/l | ND | U | 5 | 1 | ND | U | 40 | 1 | ND | U | 50 | 1 | ND | U | 24 | 5 | ND | U | 5 | 1 | ND | U | 50 | 1 | ND | U | 5 | 1 | ND | U | 10 | 1 | ND | U | 5 | 1 | ND | U | 50 | 1 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/l - micrograms per liter
mg/L - milligram per liter
RL - Reporting Limit
ND - Not Detected
DF - Dilution Factor
NA - Not Analyzed

**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
J - The analyte was detected below the RL. The result should be considered an estimate.
D - The sample was diluted.

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

**Table 6**
**Summary of Groundwater Analytical Results**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Fill-Alluvium/Trenton Gravel Wells**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Location ID | RW-200 | | | | RW-202 | | | | RW-301 | | | | RW-302 | | | | RW-303 | | | | RW-304 | | | | RW-305 | | | | RW-307 | | | | RW-308 | | | | RW-500 | | | | RW-501 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | RW-200 | | | | RW-202 | | | | RW-301 | | | | RW-302 | | | | RW-303 | | | | RW-304 | | | | RW-305 | | | | RW-307 | | | | RW-308 | | | | RW-500 | | | | RW-501 | | | |
| | | | Sample Date | 7/23/2008 | | | | 7/29/2008 | | | | 7/22/2008 | | | | 7/23/2008 | | | | 7/25/2008 | | | | 7/22/2008 | | | | 7/22/2008 | | | | 7/23/2008 | | | | 7/25/2008 | | | | 7/25/2008 | | | | 7/23/2008 | | | |
| | | | Sample Matrix | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | |
| **Volatile Organic Compounds** | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | 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 | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.02 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 |
| Ethylbenzene | 100-41-4 | 700 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | 1 | | 1 | 1 | ND | U | 1 | 1 | 1 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | ND | U | 5 | 5 | ND | U | 1 | 1 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 | ND | U | 1 | 1 |
| Toluene | 108-88-3 | 1,000 | ug/l | ND | U | 1 | 1 | 1 | | 1 | 1 | 16 | | 1 | 1 | 2 | | 1 | 1 | 13 | | 1 | 1 | 9 | | 1 | 1 | 4 | | 1 | 1 | 30 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 | ND | U | 1 | 1 |
| Xylene (Total) | 1330-20-7 | 10,000 | ug/l | ND | U | 1 | 1 | 1 | | 1 | 1 | 21 | | 1 | 1 | 4 | | 1 | 1 | 21 | | 1 | 1 | 15 | | 1 | 1 | 10 | | 1 | 1 | 34 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 | ND | U | 1 | 1 |
| Methyl Tertiary Butyl Ether (MTBE) | 1634-04-4 | 20 | ug/l | ND | U | 1 | 1 | 2 | | 1 | 1 | ND | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 5 | 5 | ND | U | 1 | 1 |
| Benzene | 71-43-2 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | 10 | | 1 | 1 | 3 | | 1 | 1 | 14 | | 1 | 1 | 9 | | 1 | 1 | 3 | | 1 | 1 | 52 | | 1 | 1 | 46 | | 1 | 1 | 300 | | 5 | 5 | 3 | | 1 | 1 |
| Cumene | 98-82-8 | 3,500 | ug/l | ND | U | 2 | 1 | 17 | | 2 | 1 | 18 | | 2 | 1 | 17 | | 2 | 1 | 16 | | 2 | 1 | 13 | | 2 | 1 | 18 | 18 | 2 | 1 | 30 | | 2 | 1 | 5 | 5 | 2 | 1 | ND | U | 10 | 5 | ND | U | 2 | 1 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | 300 | | 50 | 1 | 36 | | 5 | 1 | ND | U | 5 | 1 | 5 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | 6 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 |
| Chrysene | 218-01-9 | 1.9 | ug/l | 97 | | **50** | 1 | 17 | | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | 6 | | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 |
| Phenanthrene | 85-01-8 | 1,100 | ug/l | 100 | 100 | 50 | 1 | 33 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | 15 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 |
| Fluorene | 86-73-7 | 1,900 | ug/l | 72 | 72 | 50 | 1 | 19 | | 5 | 1 | ND | U | 5 | 1 | 8 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | 10 | | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 |
| Naphthalene | 91-20-3 | 100 | ug/l | ND | U | 50 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/l - micrograms per liter
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RL - Reporting Limit
ND - Not Detected
DF - Dilution Factor
NA - Not Analyzed

**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
J - The analyte was detected below the RL. The result should be considered an estimate.
D - The sample was diluted.

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

**Table 7**
**Summary of Groundwater Analytical Results:**
**Deep (Lower Sand) Wells**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Chemical Name | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Location ID | N-4 | | | | N-9 | | | | N-13 | | | | N-19 | | | | N-21 | | | | N-27 | | | | N-30 | | | | N-38D | | | | N-44D | | | | N-50D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | N-4 | | | | N-9 | | | | N-13 | | | | N-19 | | | | N-21 | | | | N-27 | | | | N-30 | | | | N-38D | | | | N-44D | | | | N-50D | | | |
| | | | Sample Date | 7/15/2008 | | | | 7/16/2008 | | | | 7/23/2008 | | | | 7/16/2008 | | | | 7/23/2008 | | | | 7/17/2008 | | | | 7/22/2008 | | | | 7/24/2008 | | | | 7/25/2008 | | | | 7/23/2008 | | | |
| | | | Sample Matrix | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | | Groundwater | | | |
| **Volatile Organic Compounds** | | | Unit | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | Result | Q | RL | DF | 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 | 0.029 | 1 | ND | U | 0.029 | 1 | ND | U | 0.029 | 1 | ND | U | 0.029 | 1 | ND | U | 0.03 | 1 | ND | U | 0.03 | 1 | ND | U | 0.029 | 1 | ND | U | 0.029 | 1 | ND | U | 0.029 | 1 |
| Ethylbenzene | 100-41-4 | 700 | ug/l | ND | U | 1 | 1 | 2 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Toluene | 108-88-3 | 1,000 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Xylene (Total) | 1330-20-7 | 10,000 | ug/l | 2 | | 1 | 1 | 6 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | 4 | | 1 | 1 | ND | U | 1 | 1 |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 20 | ug/l | 2 | | 1 | 1 | ND | U | 1 | 1 | 2 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | 4 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |
| Benzene | 71-43-2 | 5 | ug/l | 5 | | 1 | 1 | 8 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | 16 | | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | 6 | | 1 | 1 | ND | U | 1 | 1 |
| Cumene | 98-82-8 | 3,500 | ug/l | 3 | | 2 | 1 | ND | U | 2 | 1 | ND | U | 2 | 1 | ND | U | 2 | 1 | 190 | | 2 | 1 | ND | U | 2 | 1 | ND | U | 2 | 1 | ND | U | 2 | 1 | 5 | | 2 | 1 | ND | U | 2 | 1 |
| **Semi Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 |
| Chrysene | 218-01-9 | 1.9 | ug/l | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 | ND | U | **5** | 1 |
| Phenanthrene | 85-01-8 | 1,100 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 |
| Fluorene | 86-73-7 | 1,900 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 |
| Naphthalene | 91-20-3 | 100 | ug/l | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 | ND | U | 5 | 1 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 5 | ug/l | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 | ND | U | 1 | 1 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/l - micrograms per liter
mg/L - milligram per liter
RL - Reporting Limit
ND - Not Detected
DF - Dilution Factor
NA - Not Analyzed

**Qualifiers:**
Q - Qualifier
U - The analyte was analyzed but not detected
J - The analyte was detected below the RL. The result should be considered an estimate.
D - The sample was diluted.

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

**Sunoco Inc.**
3144 Passyunk Avenue
Philadelphia PA 19145-5299
215 339 2000

October 12, 2006

Mr. Robert Day-Lewis
Pennsylvania DEP
2 East Main Street
Norristown, PA 19401

Mr. Steve O'Neil
Pennsylvania DEP
2 East Main Street
Norristown, PA 19401

Re: Sunoco Inc. (R&M) Philadelphia Refinery
Philadelphia, Philadelphia County

Dear Mr. Day-Lewis and Mr. O'Neil:

In accordance with the Land Recycling and Environmental Remediation Standards Act (Act 2), enclosed are two copies of a Notice of Intent to Remediate (NIR) for the Sunoco Inc. (R&M) Philadelphia Refinery. This NIR covers remediation being done as part of the 2003 Consent Order and Agreement (CO&A) at Point Breeze, Girard Point and Schuylkill River Tank Farm. Remediation at Belmont Terminal, which is part of the CO&A, is not part of this NIR since this site is not subject to RCRA Corrective Action. Sunoco is considering submitting a separate NIR for this area under the Act 2 program only.

This NIR is being submitted with the intent to enter the Sunoco Philadelphia Refinery into the One Cleanup Program with PaDEP and the USEPA. All remediation work at the Philadelphia refinery will be completed under the 2003 Consent Order & Agreement (CO&A), however, RCRA Corrective Action measures will be addressed concurrently with work performed under the CO&A and within the Act 2 program.

Please call me at 610-859-1881 or email me at jroppenheim@sunocoinc.com with any questions or comments.

Best Regards,

James Oppenheim, PE
Sr. Environmental Consultant

Cc: Sunoco Legal Dept.
Philadelphia Refinery Environmental Central File
David Burke, PADEP
Walter Payne, PADEP
Hon Lee, USEPA Region III
Colleen Costello, Langan

**Will remediation be to a site-specific standard ☒ or as a special industrial area ☐? If so, the municipality or municipalities must be provided 30-day comment period.**
**Remediator/Property Owner/Consultant. For each of these recipients of the approval of the final report, complete form below.**

| |
|---|
| **Remediator** |
| Contact Person: James R. Oppenheim |
| Relationship to site (e.g. owner, remediator, participating in cleanup, consultant): Remediation Project Manager |
| Phone Number: (610) 859-1881 |
| Company Name: Sunoco, Inc. (R&M) |
| Address (street, city, state, zip): 100 Green St., Marcus Hook, PA 19061 |
| Email Address: jroppenheim@sunocoinc.com |
| **Property Owner** |
| Contact Person: Scott Baker |
| Relationship to site (e.g. owner, remediator, participating in cleanup, consultant): Environmental Manager |
| Phone Number: (215) 339-2074 |
| Company Name: Sunoco, Inc. (R&M) |
| Address (street, city, state, zip): 3144 Passyunk Ave. Philadelphia, PA 19145 |
| Email Address: sabaker@sunocoinc.com |
| **Consultant** |
| Contact Person: Colleen Costello |
| Relationship to site (e.g. owner, remediator, participating in cleanup, consultant): Consultant |
| Phone Number: (215) 864-0640 |
| Company Name: Langan Engineering and Environmental Services |
| Address (street, city, state, zip): 30 South 17th St., Suite 1500, Philadelphia, PA 19103 |
| Email Address: ccostello@langan.com |

**Preparer of Notice of Intent to Remediate:**

Name: James Oppenheim

Title: Project Manager

Address: 100 Green Street
Marcus Hook, PA 19061

Telephone: (610) 859-1881

Email Address: jroppenheim@sunocoinc.com

**Email Image File of Site Map showing property lines and general area of site(s) to be remediated to:** (landrecycling@state.pa.us)

**Sunoco Inc.**
3144 Passyunk Avenue
Philadelphia PA 19145-5299
215 339 2000

October 12, 2006

Manager
Philadelphia Department of Public Health
Environmental Health Services
321 University Avenue
Philadelphia, PA 19104

Re: Sunoco, Inc. (R&M) Philadelphia Refinery
Philadelphia, Philadelphia County

Dear Sir/Madam:

The Land Recycling and Environmental Remediation Standards Act (Act 2) requires that a Notice of Intent to Remediate (NIR) be provided to the municipality in which the site is located when a site is being remediated to a site-specific Standard. The municipality is afforded a 30-day comment period. In accordance with this provision of the Act, Sunoco, Inc. (R&M) is formally notifying you of its intent to remediate the subject site under Act 2. A copy of the NIR, which will be sent to the Pennsylvania Department of Environmental Protection (PaDEP), is enclosed. This notice will also be published in the Pennsylvania Bulletin, and a summary of the notice appeared in the Philadelphia Daily News on October 16, 2006.

Publication of this notice in the Philadelphia Daily News initiates the 30-day public and municipal comment period. During the next thirty days, your municipality may request to become involved in the development of the remediation plans for the site. If the municipality wishes to become involved in this project, please send your comments to Sunoco to my attention.

Please call me at (610) 859-1881 if you have any questions concerning the proposed remediation.

Best Regards,

James R. Oppenheim, P.E.
Senior Environmental Consultant

Cc: Sunoco Legal Dept.
Philadelphia Refinery Environmental Central File
Steve O'Neil, PaDEP
Colleen Costello, Langan

**Will remediation be to a site-specific standard ☒ or as a special industrial area ☐? If so, the municipality or municipalities must be provided 30-day comment period.**
**Remediator/Property Owner/Consultant. For each of these recipients of the approval of the final report, complete form below.**

| **Remediator** |
|---|
| Contact Person: James R. Oppenheim |
| Relationship to site (e.g. owner, remediator, participating in cleanup, consultant): Remediation Project Manager |
| Phone Number: (610) 859-1881 |
| Company Name: Sunoco, Inc. (R&M) |
| Address (street, city, state, zip): 100 Green St., Marcus Hook, PA 19061 |
| Email Address: jroppenheim@sunocoinc.com |
| **Property Owner** |
| Contact Person: Scott Baker |
| Relationship to site (e.g. owner, remediator, participating in cleanup, consultant): Environmental Manager |
| Phone Number: (215) 339-2074 |
| Company Name: Sunoco, Inc. (R&M) |
| Address (street, city, state, zip): 3144 Passyunk Ave. Philadelphia, PA 19145 |
| Email Address: sabaker@sunocoinc.com |
| **Consultant** |
| Contact Person: Colleen Costello |
| Relationship to site (e.g. owner, remediator, participating in cleanup, consultant): Consultant |
| Phone Number: (215) 864-0640 |
| Company Name: Langan Engineering and Environmental Services |
| Address (street, city, state, zip): 30 South 17th St., Suite 1500, Philadelphia, PA 19103 |
| Email Address: ccostello@langan.com |

**Preparer of Notice of Intent to Remediate:**

Name: James Oppenheim
Title: Project Manager
Address: 100 Green Street
Marcus Hook, PA 19061
Telephone: (610) 859-1881
Email Address: jroppenheim@sunocoinc.com

**Email Image File of Site Map showing property lines and general area of site(s) to be remediated to:** (landrecycling@state.pa.us)

**Proof of Publication in The Philadelphia Daily News**
**Under Act. No 587, Approved May 16, 1929**

*STATE OF PENNSYLVANIA*
*COUNTY OF PHILADELPHIA*

Anna Dickerson being duly sworn, deposes and says that **The Philadelphia Daily News** is a newspaper published daily, except Sunday, at Philadelphia, Pennsylvania, and was established in said city in 1925, since which date said newspaper has been regularly issued in said County, and that a copy of the printed notice of publication is attached hereto exactly as the same was printed and published in the regular editions and issues of the said newspaper on the following dates:

October 16, 2006

Affiant further deposes and says that he is an employee of the publisher of said newspaper and has been authorized to verify the foregoing statement and that he is not interested in the subject matter of the aforesaid notice of publication, and that all allegations in the foregoing statement as to time, place and character of publication are true.

Anna Dickerson

Sworn to and subscribed before me this 16th day of October, 2006

Mary Anne Logan
*Notary Public*

My Commission Expires:

NOTARIAL SEAL
Mary Anne Logan, Notary Public
City of Philadelphia, Phila. County
My Commission Expires March 30, 2009

**Copy of Notice of Publication**

**Newspaper Notice of Intent to Remediate to an Environmental Standard. (Sections 302(e)(1)(ii), 303(h)(1)(ii), 304(n)(1)(i), and 305(c)(1))**

Pursuant to the Land Recycling and Environmental Remediation Standards Act (Act), the act of May 19, 1995, P.L. 4, No. 1995-2, notice is hereby given that Sunoco Inc.(R&M) has submitted to the Pennsylvania Department of Environmental Protection a Notice of Intent to Remediate a site located at 3144 Passyunk Ave., Philadelphia, Philadelphia County, Pennsylvania. This Notice of Intent to Remediate states that the site is a petroleum refinery. It has been determined that petroleum compounds have impacted soil and groundwater at the site. Sunoco, Inc. (R&M) has indicated that proposed remediation measures will include source reduction and engineered boundary controls. The proposed future use of the property is industrial for continued operation as a petroleum refinery.

Sunoco Inc. (R&M) plans to use the site-specific remediation standard at the site. The Act provides for a 30-day public comment period for site-specific standard remediation. The 30-day comment period is initiated with the publication of this notice. Until November 16, 2006, the City of Philadelphia may submit a request to Sunoco Inc. (R&M) to be involved in the development of the remediation and reuse plans for the site. The City of Philadelphia may also submit a request to Sunoco Inc. (R&M) during this 30-day comment period to develop and implement a public involvement plan. Copies of these requests and of any comments should also be submitted to the Department of Environmental Protection at 2 East Main Street, Norristown, PA 19401 to the attention of Mr. Walter Payne. All correspondence with Sunoco Inc. (R&M) should be addressed to the Public Relations Dept., Sunoco Inc. (R&M) at 3144 Passyunk Ave, Philadelphia, PA, 19145.

**LEGAL NOTICES**

Newspaper Notice of Intent to Remediate
to an Environmental Standard.
(Sections 302(e)(1)(ii), 303(h)(1)(ii),
304(n)(1)(i), and 305(c)(1))

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Appeared in: ***Philadelphia Inquirer & Philadelphia Daily News*** on Monday, 10/16/2006

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ENGINEERING & ENVIRONMENTAL SERVICES

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George P. Kelley, P.E.
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May 04, 2011

***CERTIFIED MAIL***
***RETURN RECEIPT REQUESTED***

Manager
Philadelphia Department of Public Health
Environmental Health Services
321 University Avenue
Philadelphia, Pennsylvania 19104

**RE: Notice of Submittal of Site Characterization/ Remedial Investigation Report**
**Area of Interest (AOI) 8**
**Sunoco, Inc. (R&M) Philadelphia Refinery**
**Philadelphia, Philadelphia County, Pennsylvania**
**Langan Project No.: 2574601**

Dear Sir/Madam:

Notice is hereby given that Sunoco, Inc. (R&M) (Sunoco) is in the process of submitting a Site Characterization/Remedial Investigation Report to the Pennsylvania Department of Environmental Protection for AOI 8 located at the Sunoco Philadelphia Refinery, Philadelphia, Philadelphia County, Pennsylvania. The report indicates that the remediation planned will attain compliance with a combination of site-specific and the statewide health cleanup standards.

This notice is made under the provision of the Land Recycling and Environmental Standards Act, the Act of May 19, 1995, P.L. #4, No. 2.

Sincerely,
**Langan Engineering and Environmental Services, Inc.**

Colleen Costello

Colleen Costello, P.G.
Senior Principal

cc: Jim Oppenheim, Sunoco
Kevin Dunleavy, Sunoco

\\langan.com\data\DT\data6\2574601\Office Data\Reports\Repackaged SCR_RIR\AOI 8\Appendices\Appendix A - NIR and Public Notices\RIR Municipal Notice_042511.DOC

**Proof of Publication in The Philadelphia Daily News**
**Under Act. No 587, Approved May 16, 1929**

*STATE OF PENNSYLVANIA*
*COUNTY OF PHILADELPHIA*

Anna Dickerson being duly sworn, deposes and says that **The Philadelphia Daily News** is a newspaper published daily, except Sunday, at Philadelphia, Pennsylvania, and was established in said city in 1925, since which date said newspaper has been regularly issued in said County, and that a copy of the printed notice of publication is attached hereto exactly as the same was printed and published in the regular editions and issues of the said newspaper on the following dates:

May 23, 2011

Affiant further deposes and says that she is an employee of the publisher of said newspaper and has been authorized to verify the foregoing statement and that she is not interested in the subject matter of the aforesaid notice of publication, and that all allegations in the foregoing statement as to time, place and character of publication are true.

Anna Dickerson

Sworn to and subscribed before me this 23rd day of May, 2011.

Mary Anne Logan
Notary Public

My Commission Expires:

NOTARIAL SEAL
Mary Anne Logan, Notary Public
City of Philadelphia, Phila. County
My Commission Expires March 30, 2013

**Copy of Notice of Publication**

**Notification of Receipt of Site Characterization / Remedial Investigation Report**
Notice is hereby given that Sunoco Inc. (R&M) (Sunoco) is in the process of submitting a Site Characterization / Remedial Investigation Report to the Pennsylvania Department of Environmental Protection (PADEP), Southeast Regional Office for Area of Interest (AOI 8) located at the Sunoco Philadelphia Refinery, Philadelphia, Pennsylvania. Sunoco has indicated in the report that site characterization activities have been completed at AOI 8 in accordance with the Land Recycling and Environmental Remediation Standards Act and the 2004 Memorandum of Agreement between the PADEP and U.S. Environmental Protection Agency (EPA) (a.k.a., the PA One Cleanup Program). This notice is made under the provision of the Land Recycling and Environmental Remediation Standards Act, the Act of May 19, 1995, P.L. #4, No. 2.

**SENDER: *COMPLETE THIS SECTION***

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Manager
Philadelphia Dept. of Public Health
Environmental Health Services
321 University Avenue
Philadelphia, Pennsylvania 19104

***COMPLETE THIS SECTION ON DELIVERY***

A. Signature
X Dawn Galloway ☑ Agent ☐ Addressee

B. Received by *(Printed Name)*

C. Date of Delivery 5/6/11

D. Is delivery address different from Item 1? ☐ Yes
If YES, enter delivery address below: ☑ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☑ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? *(Extra Fee)* ☐ Yes

2. Article Number *(Transfer from service label)* 7010 1870 0001 9784 1237

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

7010 1870 0001 9784 1237

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Street, Apt. No., or PO Box No. Environmental Health Services
321 University Avenue
City, State, ZIP+4 Philadelphia, Pennsylvania 19104

PS Form 3800, August 2006 See Reverse for Instructions


N
W E
S

## Legend

- Steel Bulkhead
- Wooden Bulkhead
- Current Uses
- Occupied Buildings
- AOI Boundary

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.
2. Bulkhead referenced from Remedial Action Plan for the North Yard Bulkhead, ENSR Consulting and Engineering, October 1993.

Figure B-1: Current Use
AOI 8 Site Characterization Report/
Remedial Investigation Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 250 500 Feet

SCALE: 1" = 250'
DATE: August 26, 2008
DRN. BY: MPH
CKD. BY: JSC
JOB#: 2574601

Q:\Data\2574601\ArcGIS\MapDocuments\AOI 8 SCR\Final Figures\Figure A-1 - AOI 8 SCR Current Use - rev9-29-08.mxd


N
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S

## Legend

- Steel Bulkhead
- Wooden Bulkhead
- Historic Uses
- AOI Boundary

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.
2. Bulkhead referenced from Remedial Action Plan for the North Yard Bulkhead, ENSR Consulting and Engineering, October 1993.

Figure B-2: Historic Use
AOI 8 Site Characterization Report/
Remedial Investigation Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 250 500 Feet

SCALE: 1" = 250'
DATE: April 13, 2011
DRN. BY: MPH
CKD. BY: DN
JOB#: 2574601

Q:\Data\25746011\ArcGIS\MapDocuments\AOI 8 SCR\Final Figures\Figure A-2 - AOI 8 SCR Historic Use - rev8-29-08.mxd

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-01**



PROJECT: **Sunoco Philadelphia Refinery**
SITE LOCATION: **AOI-8**
JOB NO.: -
LOGGED BY: **Shaun Sykes**
DATES DRILLED: **6/17/08**

DRILLING CO.: **Parrat Wolff Inc.**
DRILLING METHOD **Direct Push**
SAMPLING METHOD **Split Spoon**
TOTAL DEPTH: **2'**

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - dry gravel and fine sand | | |
| | | 0.0 | Same | | |
| | | 0.1 | Dry brown sandy silt and gravel | | |
| | Sample taken from 1-2' for laboratory analysis | 0.2 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-02**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/7/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - gravel, tan silt | | |
| | | 0.0 | Same | | |
| | | 0.0 | Fill, stiff brown/gray sandy silt, gravel | | |
| | Sample taken from 1-2' for laboratory analysis | 0.0 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-03**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/7/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 5.6 | Fill - stiff med. brown andy silt, gravel, brick | | |
| | | 83 | Fill - black/brown silty sand and gravel, dry | | |
| | | 265 | Same | | |
| | Sample taken from 1-2' for laboratory analysis | 142 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-04**



PROJECT: **Sunoco Philadelphia Refinery**
SITE LOCATION: **AOI-8**
JOB NO.: -
LOGGED BY: **Shaun Sykes**
DATES DRILLED: **5/8/08**

DRILLING CO.: **Parrat Wolff Inc.**
DRILLING METHOD **Direct Push**
SAMPLING METHOD **Split Spoon**
TOTAL DEPTH: **2'**

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - brown sandy silt and gravel, dry | | |
| | | 7.9 | Same, stiff | | |
| | | 122 | Fill - black sandy silt and gravel | | |
| | Sample taken from 1-2' for laboratory analysis | 179 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-05**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **8'** |
| DATES DRILLED: | **5/8/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - gravel, some tan sandy silt, dry | | |
| | | 0.0 | Same | | |
| | | 1,7 | Fill - black/brown sandy silt, brick | | |
| | | 5.5 | Same | | |
| | | 13.8 | Same | | |
| | | 25.4 | Same | | |
| | | 16.7 | Same | | |
| | | 7.9 | Same | | |
| | | 12.3 | Fill - gravel | | |
| | | 14.7 | Fill - black sand and gravel | | |
| -5 | | 16.9 | Same | | |
| | | 8.4 | Same | | Water at 4.5-5' |
| | | 4.4 | Fill - brown/black gravel, wet, some metallic objects | | |
| | | 7.8 | Same | | |
| | Sample taken 6-8' for laboratory analysis | 59.3 | Same | | |
| | | 26.7 | Same, increased sand content | | Boring complete @ 8' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-06**



PROJECT: **Sunoco Philadelphia Refinery**
SITE LOCATION: **AOI-8**
JOB NO.: -
LOGGED BY: **Shaun Sykes**
DATES DRILLED: **5/8/2008**

DRILLING CO.: **Parrat Wolff Inc.**
DRILLING METHOD **Direct Push**
SAMPLING METHOD **Split Spoon**
TOTAL DEPTH: **8'**

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - tan brown sandy silt, gravel, dry | | |
| | | 0.0 | Same | | |
| | | 0.0 | Same | | |
| | | 0.0 | Gravel | | |
| | | 48.8 | Black/brown sandy silt and gravel | | |
| | | 14.4 | Same | | |
| | | 20.7 | Same | | |
| | | | Same | | |
| | No sample taken (no tank bottom material observed) | 43.7 | Same | | |
| | | 56.8 | Same | | |
| -5 | | 103 | Fill - brick, black sandy silt | | |
| | | 76.5 | Same | | Water at 5.5-6' |
| | | 56.4 | Same | | |
| | | 65.5 | Fill - black sandy clay, brick | | |
| | | 43.4 | Same | | |
| | | 36.5 | Same | | Boring complete @ 8' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-07**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/8/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill, gravel, tan sandy silt, dry | | |
| | | 35.6 | Fill, stiff, brown sandy silt and gravel | | |
| | | 163 | Fill, black sandy silt and gravel | | |
| | Sample taken from 1-2' for laboratory analysis | 287 | Fill, black sandy clay and gravel | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-08**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/7/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - gravel, tan sandy silt, dry | | |
| | | 0.0 | Same | | |
| | | 0.0 | Fill - black/brown sandy silt & gravel | | |
| | Sample taken from 1-2' for laboratory analysis | 0.0 | Same, brick | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-09**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/7/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - gravel, tan sandy silt, dry | | |
| | | 2.8 | Fill - black/brown sandy silt & gravel | | |
| | | 7.9 | Same | | |
| | Sample taken from 1-2' for laboratory analysis | 8.0 | Same, wood | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-10**



PROJECT: **Sunoco Philadelphia Refinery**
SITE LOCATION: **AOI-8**
JOB NO.: -
LOGGED BY: **Shaun Sykes**
DATES DRILLED: **5/7/08**

DRILLING CO.: **Parrat Wolff Inc.**
DRILLING METHOD **Direct Push**
SAMPLING METHOD **Split Spoon**
TOTAL DEPTH: **2'**

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill, dark brown silt, gravel, dry | | |
| | | 0.0 | Same, brick | | |
| | | 0.0 | Same | | |
| | Sample taken from 1-2' for laboratory analysis | 0.0 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-11**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/7/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - gravel, cement | | |
| | | 0.0 | Same | | |
| | | 6.4 | Fill - black/brown sandy silt, fill, gravel | | |
| | Sample taken from 1-2' for laboratory analysis | 19.1 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-12**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/6/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - brown sandy silt, gravel | | |
| | | 13.3 | Same | | |
| | | 55.8 | Fill - compact brown/black silty clay, gravel | | |
| | Sample taken from 1-2' for laboratory analysis | 95.6 | Fill - black silty clay, gravel | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-13**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/6/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - gravel, light brown silt, dry | | |
| | | 0.0 | Same | | |
| | | 17.2 | Fill - brown/black silty clay, gravel | | |
| | Sample taken from 1-2' for laboratory analysis | 20.7 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-14**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/6/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - very stiff orange brown sandy clay, rock frags, dry | | |
| | | 10.4 | Black layer, clay | | |
| | | 0.0 | Fill - dark brown/black clay with sand and gravel, cinders | | |
| | Sample taken from 1-2' for laboratory analysis | 0.0 | Fill - brick, dry | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-15**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/6/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - gravel, brown sandy silt, dry | | |
| | | 0.0 | Same | | |
| | | 0.0 | Same | | |
| | Sample taken from 1-2' for laboratory analysis | 0.0 | Fill - brown silty clay | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-16**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/7/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - gravel, brown sandy silt, dry | | |
| | | 193 | Same | | |
| | | 215 | Black silty clay, gravel, stiff | | |
| | Sample taken from 1-2' for laboratory analysis | 286 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-17**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/7/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - brown sandy silt, dry | | |
| | | 0.0 | Same, gravel | | |
| | | 0.0 | Fill - brown/black sandy silt, gravel | | |
| | Sample taken from 1-2' for laboratory analysis | 0.9 | Same, some clay | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-18**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/7/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - brown sandy silt, gravel, dry | | |
| | | 0.0 | Same | | |
| | | 0.0 | Same | | |
| | Sample taken from 1-2' for laboratory analysis | 0.0 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-19**



PROJECT: **Sunoco Philadelphia Refinery**
SITE LOCATION: **AOI-8**
JOB NO.: -
LOGGED BY: **Shaun Sykes**
DATES DRILLED: **6/19/2008**

DRILLING CO.: **Parrat Wolff Inc.**
DRILLING METHOD **Direct Push**
SAMPLING METHOD **Split Spoon**
TOTAL DEPTH: **8'**

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | | Fill, concrete, gravel | | |
| | | 105 | Black sand, wood, brick, moist | | |
| | | 216 | Same | | |
| | | 173 | Black sand and gravel, very moist | | |
| | No sample taken (no tank bottom material observed) | 356 | Same | | |
| -5 | | 211 | Same | | |
| | | 256 | Coarse sand and gravel, black, wet | | Water at 6-6.5' |
| | | 108 | Same | | |
| | | | | | Boring complete @ 8' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-21**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/7/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - brown/orange sandy silt, gravel, dry | | |
| | | 3.6 | Same | | |
| | | 10.4 | Same, dark brown/black | | |
| | Sample taken from 1-2' for laboratory analysis | 0.1 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-22**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/7/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - tan sitly sand, gravel, dry | | |
| | | 3.5 | Fill - stiff brown/black sandy silt, gravel, brick dry | | |
| | | 40.0 | Same | | |
| | Sample taken from 1-2' for laboratory analysis | 115 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-23**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/7/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill, tan sandy silt, gravel, dry | | |
| | | 75.6 | Fill - stiff brown/black sandy silt, gravel, dry | | |
| | | 89.8 | Same | | |
| | Sample taken from 1-2' for laboratory analysis | 38.6 | Same, dark brown | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-24**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/7/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 3.6 | Fill, brown sandy silt, gravel, dry | | |
| | | 282 | Same | | |
| | | 598 | Fill, black/brown silty sand, gravel, dry | | |
| | Sample taken from 1-2' for laboratory analysis | 968 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-25**



PROJECT: **Sunoco Philadelphia Refinery**
SITE LOCATION: **AOI-8**
JOB NO.: -
LOGGED BY: **Shaun Sykes**
DATES DRILLED: **5/7/08**

DRILLING CO.: **Parrat Wolff Inc.**
DRILLING METHOD **Direct Push**
SAMPLING METHOD **Split Spoon**
TOTAL DEPTH: **2'**

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 72.4 | Fill - brown/black sandy silt, gravel, brick, dry | | |
| | | 103 | Same | | |
| | | 276 | Same | | |
| | Sample taken from 1-2' for laboratory analysis | 137 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-26**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/8/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill, tan/brown sandy silt and gravel, dry | | |
| | | 0.0 | Same | | |
| | | 1.2 | Fill, brown/black silty sand and gravel, some clay | | |
| | Sample taken from 1-2' for laboratory analysis | 2.1 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-27**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/6/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - gravel, brown silt, dry | | |
| | | 0.0 | Fill - gravel, brown sandy silt, brick, compact | | |
| | | 0.0 | Same | | |
| | Sample taken from 1-2' for laboratory analysis | 0.0 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-28**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/6/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - gravel, brown sandy silt, dry | | |
| | | 13.3 | Fill, brown/black sandy silt, gravel | | |
| | | 55.8 | Same | | |
| | Sample taken from 1-2' for laboratory analysis | 95.6 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-29**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/6/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 15.1 | Fill - gravel, dry | | |
| | | 10.0 | Fill - gravel, black | | |
| | | 43.1 | Fill - brick, sandy clay, brown/black | | |
| | Sample taken from 1-2' for laboratory analysis | 56.3 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-31**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/6/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Grass, fill - dark brown silt, gravel, brick, dry | | |
| | | 0.0 | Fill - silt, gravel, brick, dry | | |
| | | 0.0 | Same | | |
| | Sample taken from 1-2' for laboratory analysis | 0.0 | Same | | Boring complete @ 2' |

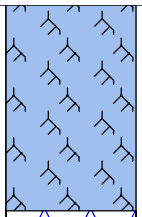
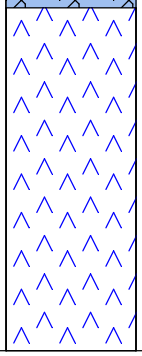
# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-32**



PROJECT: **Sunoco Philadelphia Refinery**
SITE LOCATION: **AOI-8**
JOB NO.: **-**
LOGGED BY: **Tiffani Doerr**
DATES DRILLED: **7/3/08**

DRILLING CO.: **NA**
DRILLING METHOD **Hand Auger**
SAMPLING METHOD **Hand Auger**
TOTAL DEPTH: **2'**

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Grass and topsoil top 8" |  | |
| | | 0.0 | Dry, medium brown sandy clay with few gravels |  | |
| | | 0.0 | | | |
| | Sample taken from 1-2' for laboratory analysis | 0.0 | | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-33**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/6/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - gravel, brick, sandy silt, dry | | |
| | | 0.0 | Same | | |
| | | 0.0 | Same | | |
| | Sample taken from 1-2' for laboratory analysis | 0.0 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-34**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/6/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - gravel, brick, sandy silt, dry | | |
| | | 0.0 | Same | | |
| | | 0.0 | Same | | |
| | Sample taken from 1-2' for laboratory analysis | 0.0 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-35**



| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **2'** |
| DATES DRILLED: | **5/6/08** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | 0.0 | Fill - gravel, light brown silt & sand, dry | | |
| | | 0.0 | Fill - dark brown sandy silt, gravel, brick | | |
| | | 0.0 | Fill - gravel, light brown sandy silt | | |
| | Sample taken from 1-2' for laboratory analysis | 0.0 | Same | | Boring complete @ 2' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-36**



Aquaterra Technologies, Inc.

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **8'** |
| DATES DRILLED: | **6/19/2008** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | | Fill, gravel, concrete | | |
| | | 177 | Black sandy silt, slightly moist | | |
| | | 242 | Black sandy clay and gravel, very moist to wet | | |
| | | 218 | Same | | Water at 3-3.5' |
| | No sample taken (no tank bottom material observed) | 81.8 | Same, wet | | |
| -5 | | 101 | Same, wet | | |
| | | 212 | Black sand and gravel, wet | | |
| | | 243 | Same | | |
| | | | | | Boring complete @ 8' |

# SUBSURFACE BORING LOG

BOREHOLE NO. **BH-08-37**



Aquaterra Technologies, Inc.

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD | **Direct Push** |
| JOB NO.: | - | SAMPLING METHOD | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | TOTAL DEPTH: | **8'** |
| DATES DRILLED: | **6/19/2008** | | |

| DEPTH (feet) | SAMPLE INTERVAL | PID (ppm) | LITHOLOGY DESCRIPTION | LITH-OLOGY | COMMENTS |
|---|---|---|---|---|---|
| 0 | | | Fill, gravel, concrete | | |
| | | 136 | Black sandy silt, slightly moist | | |
| | | 252 | Same | | |
| | No sample taken (no tank bottom material observed) | 341 | Black sandy clay and gravel, wet | | Water at 4-4.5' |
| -5 | | 262 | Same | | |
| | | 115 | Same | | |
| | | 102 | Same | | |
| | | | | | Boring complete @ 8' |

# MONITORING WELL LOG: N-98

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **6/2/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **30'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.3 | | Fill - asphalt, black/brown sandy silt and gravel, dry | | | |
| | 0.3 | | | | | |
| | 2.2 | | | Sample taken 1-2' for laboratory analysis | | |
| | 0.6 | | | | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | | |
| -10 | 0.0 | | Brown/tan fine sand, slightly moist | | 20' riser | |
| | 0.0 | | | | | |
| | 0.0 | | | | | |
| | 0.0 | | | | | |
| | 0.3 | | Medium sand and gravel, slightly moist | | | |
| -15 | 0.2 | | | | | |
| | 0.0 | | | | | |
| | 0.0 | | | | | |
| | 1.1 | | Medium sand and gravel, moist | | | |
| | 0.3 | | | | | |
| -20 | 0.1 | | Medium to fine sand and gravel, trace tan clay, very moist to wet | | | |
| | 0.0 | | Sand and gravel, trace clay, wet | | | |
| | 0.0 | | Tan/brown sandy clay and gravel, trace clay, wet | | | |
| | 0.0 | | Tan/brown sand and gravel, trace clay | | | |
| | 0.0 | | Gray sand and clay, wet | | | |
| -25 | 0.0 | | Fine gray sand, trace clay, wet | | 10' screen | |
| | 0.0 | | | | | |
| | 0.0 | | Brown/gray medium sand and gravel, wet | | | |
| | 0.0 | | | | | |
| | 0.0 | | | Auger/boring complete to 30' | | |
| -30 | | | | | | |

# MONITORING WELL LOG: N-99

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **6/19/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **28'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - brown fine sand, dry | | | |
| | 0.0 | | | | | |
| | 0.0 | | | Sample taken 1-2' for laboratory analysis | | |
| | 0.0 | | | | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 18' riser | |
| -10 | 0.8 | | Coarse sand and gravel, trace gray clay | | | |
| | 2.5 | | | | | |
| | 4.8 | | Same, no clay | | | |
| | 1.2 | | Fine sand, slightly moist | | | |
| | 0.9 | | Fine sand and gravel, slightly moist | | | |
| -15 | 0.3 | | Same, very moist | | | |
| | 0.0 | | Coarse sand and gravel, very moist to wet | | | |
| | 3.4 | | | | | |
| | 0.5 | | | | | |
| | 0.0 | | | | | |
| -20 | 0.0 | | Gray fine sand, wet, trace clay | | 10' screen | |
| | 0.0 | | | | | |
| | 0.0 | | | | | |
| | 0.0 | | Coarse tan/brown sand and gravel, wet | | | |
| | 0.0 | | | | | |
| -25 | 0.0 | | | | | |
| | 0.0 | | | | | |
| | 0.0 | | Fine sand, trace gray/orange clay | Auger complete to 28' | | |

# SUBSURFACE LOG: N-100
# AND WELL CONSTRUCTION : N-100

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco-Philadelphia Refinery** | DRILLING CO.: | **Parratt-Wolffe** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **Hollow Stem Auger & Mud Rotary** |
| LOGGED BY: | **Tiffani Doerr/Shaun Sykes** | SAMPLING METHOD: | **Split Spoon** |
| DATES DRILLED: | **6/11-6/13/08** | SCREEN/RISER DIAMETER: | **2-inch** |
| TOTAL BORING DEPTH: | **63** | WELLBORE DIAMETER: | **8-inch** |
| BORING ELEVATION | | TOC (inner) ELEVATION: | |

NOTE: Well N-100 was drilled within 5 feet of boring N-100. Screen=0.010 slot; "0" sand; 2' stickup finish. Screen (10'-20'); Riser (2' stickup - 10'); Sand (8'-20'); Bentonite (4'-8'); Grout (surface to 4')

| Depth (feet) | Blow Counts | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| | | 0.0 | | | | |
| | 8-4 | | | Fill - dry mixture of brick, gravel, glass, brown sandy clay | Boring location pre-cleared by Mobile Dredge to 10' | |
| | | 0.0 | | | | |
| | 7-4 | | | | Sample 1'-2' submitted for laboratory analysis | |
| -5 | | | | | | |
| -10 | 16-14 | | | Tan clayey sand, large sandstone cobble in bottom | | |
| | 14-14 | | | | | |
| | 14-8 | 0.0 | | Tan medium sand, trace fine gravel, moist, wet at bottom | | |
| | 8-10 | 0.0 | | | | |
| | | | | Bottom 4" mottled gray/lt.brown and yellow plastic sand w/ trace gravel | | |
| | 13-12 | 1.3 | | Same as above to 15' (mottled plastic sand), Remainder gray gravelly med-coarse sand | | |
| -15 | 10-10 | 3.1 | | | | |

Aquaterra Technologies, Inc.

# SUBSURFACE LOG: N-100
# AND WELL CONSTRUCTION: N-100

| Depth (feet) | Blow Counts | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| | 5-8 | 9.6 | | Saturated at 17', same sand and gravel to 17' | | |
| | 12-9 | 2.4 | | 17-17.5' Gray coarse sand 17.5-18' Mixed sand and gravel | | |
| | 9-8 | | | Coarse gray sand with few fine gravels (coarser and more frequent gravels @ 19.5'). Fining upward sequence. | | |
| | 9-12 | | | 19.5'-20' thin fine sandy clay lense and 3" fine sand, last 3" same coarse sand w/ few small gravels | | |
| -20 | 13-12 | 4.2 | | Tan/gray med-coarse sand w/ few gravels (fine to 1") sm. clay plug @ 21.5' | Switch from auger to mud rotary | |
| | 12-14 | 3.6 | | | | |
| | 13-14 | 13.6 | | Same as above | | |
| | 7-14 | 4.6 | | Yellow/gray mottled clay w/ some fine sand to 23.8', | | |
| | 9-6 | 20.3 | | Moist red-brown clay w/ some fine sand and few fine gravels<br>Brown clayey fine sand w/ few round gravels to 25.5' (granite, red sandstone) | | |
| -25 | 14-28 | 152 | | | | |
| | 45-46 | 615 | | Dark gray coarse sand and gravel, strong petroleum odors<br>Med-coarse dense gravel w/ sand matrix (red and gray sandstone, white qtz & qtzite). Heterogeneous, up to 2+" gravels. | | |
| | 50-50/0' | | | | | |
| | 34-29 | 1286 | | Same, large gravel in sand matrix | | |
| | 29-34 | | | | | |
| -30 | 13-30 | 356 | | 6" Recovery - red/brown/gray sand and gravel (gray sand is gray qtz, fine sand is completely weathered sandstone; gravels are granite, qtzite, sandstone). | | |
| | 33-39 | | | | | |
| | 47-30 | 1020 | | Same, gravels w/ sand | | |
| | 30-24 | | | | | |
| | 49-35 | 660 | | Same as above - formation very tight (does not seem saturated) | | |
| -35 | 17-12 | 21.7 | | | | |

Aquaterra Technologies, Inc.

# SUBSURFACE LOG: N-100
# AND WELL CONSTRUCTION: N-100

| Depth (feet) | Blow Counts | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| | 20-22 | | | Same as above | | |
| | 18-17 | | | | | |
| | 20-20 | 0.8 | | Same but smaller gravels and more sand now with few fines (clay and silt ~5%), saturated | | |
| | 25-25 | | | | | |
| -40 | 20-25 | | | No recovery (cobble in bottom - little recovery likely due to pushing larger gravels) | | |
| | 19-20 | | | | | |
| | 14-14 | 7.2 | | Brown med-coarse sand w/ few coarse gravels (extremely weathered gray & lt. gray fine sandstones) and few fine-med gravels (white and gray qtz and qtzite) | | |
| | 17-23 | 0.8 | | | | |
| | 22-10 | 32.2 | | Lt. brown/gray coarse sand w/ few fine gravels, grades into orange-brown fine sand, last 2" gray clay w/ trace sand | | |
| -45 | 12-6 | 1.1 | | | | |
| | 12-13 | 46.8 | | Top 8" coarse gray sand w/ few gravels grade to orange fine sand, 4" lt. gray fat clay, 4" layers of gray/yellow and orange fine -med sand w/ coarse sand and fine gravel at bottom of spoon | | |
| | 13-18 | 0.8 | | | | |
| | 10-14 | | | No recovery - rock lodged in tip | | |
| | 20-32 | | | | | |
| -50 | 12-11 | 0.1 | | Top 1' - laminated gray/orange silty clay and very fine sand, Bottom 1' - homogeneous coarse orange sand w/ trace fine gravel | | |
| | 17-18 | 0.1 | | | | |
| | 10-14 | 5.8 | | Same as above to 53.5, orange brown clayey silt and fine sand w/ black laminations | | |
| | 18-25 | 0.3 | | | | |
| | | 0.5 | | Gray clayey silt and fine sand | | |
| -55 | | 0.5 | | Red/brown fine sand | | |
| | | 1.9 | | Orange-brown fine sand, saturated | | |

Aquaterra Technologies, Inc.

# SUBSURFACE LOG: N-100
# AND WELL CONSTRUCTION: N-100

| Depth (feet) | Blow Counts | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| | | 0.7 | | Same as above | | |
| | 15 | 4.3 | | Red/brown fine sand and clayey silt | | |
| | 22 | 0.9 | | Orange-brown fine sand and weathered rock | | |
| -60 | 50 | 5.3 | | Orange-brown sand and weathered rock, micaceous | Borehole complete to 63' | |
| | 22 | 7.3 | | | | |
| | | 15.3 | | 6" recovery, mica SCHIST in spoon | | |
| -65 | | | | | | |
| -70 | | | | | | |

# MONITORING WELL LOG: N-101

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **6/16/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **23'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | | | Fill - gravel, brown silt and sand, dry | | | |
| | | | Fill - dark brown clayey silt, dry | Sample taken 1-2' for laboratory analysis | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 13' riser | |
| -10 | | | Brown silty sand and gravel, dry | | | |
| | | | Brown silty coarse and and gravel, moist | | | |
| | | | Same, wet at 14' | | | |
| | | | Coarse sand and gravel, wet, sheen on spoon | | | |
| -15 | | | | | 10' screen | |
| -20 | | | Gray fine sand, trace clay, very mosit | | | |
| | | | | Auger complete to 23' | | |

# MONITORING WELL LOG: N-102

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **6/5/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **30'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - gravel, silty sand, dry | | | |
| | 1.2 | | | | | |
| | 2.6 | | | | | |
| | 10.3 | | Fill - brown/orange sandy clay, gravel | Sample taken 1-2' for laboratory analysis | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | | |
| -10 | 869 | | Black fine sand, trace clay, very moist | | 20' riser | |
| | 1112 | | | | | |
| | 1442 | | Black sand and gravel, very moist | | | |
| | 1283 | | | | | |
| | 1515 | | Same, fine sand | | | |
| -15 | 1414 | | | | | |
| | 1312 | | | | | |
| | 1474 | | | | | |
| | 1374 | | Same, trace clay | | | |
| | 1054 | | Tan/light brown fine sand and gravel | | | |
| -20 | 871 | | Black/gray fine sand and gravel, very moist | | | |
| | 603 | | Same, wet | | | |
| | 561 | | Black/gray coarse sand and gravel, wet | | | |
| | 230 | | Same, brown clay at 24' | | | |
| | 11.8 | | Brown sandy clay, compact, very moist | | | |
| -25 | 7.2 | | Gray/green fine sand and gravel, trace layers of clay | | 10' screen | |
| | 11.7 | | Same, some clay layers | | | |
| | 6.0 | | Brown/red fine sand, slightly moist | | | |
| | 5.6 | | | | | |
| | 7.5 | | | Auger/boring complete to 30' | | |
| -30 | | | | | | |

# MONITORING WELL LOG: N-103

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **6/6/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **27'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill -gravel, silty sand, dry with some brick | | | |
| | 0.0 | | | | | |
| | 0.2 | | Black/brown silty sand and gravel, dry | Sample taken 1-2' for laboratory analysis | | |
| | 10.6 | | | | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | | |
| -10 | 6.6 | | Brown fine sand and some gravel, moist | | 17' riser | |
| | 8.8 | | | | | |
| | 28.8 | | | | | |
| | 32.1 | | Coarse sand and gravel, moist | | | |
| | 252 | | | | | |
| -15 | 269 | | | | | |
| | 1120 | | Same, wet | | | |
| | 1432 | | Same, wet | | | |
| | 1226 | | Same, black, wet | | | |
| | 1134 | | Same, black, wet | | | |
| -20 | 1652 | | Coarse sand and gravel, wet | | 10' screen | |
| | 1466 | | Same, sheen on spoon | | | |
| | 1720 | | | | | |
| | 321 | | Coarse sand and gravel, trace gray/brown clay, wet | | | |
| | 9.2 | | Fine gray/brown sand, trace clay, moist | | | |
| -25 | 6.6 | | | | | |
| | 13.3 | | Orange/gray fine sand, trace clay, moist | Auger complete to 27' | | |
| | 5.2 | | | Boring complete to 28' | | |

# MONITORING WELL LOG: N-104

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **6/18/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **25'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - gravel, fine sand, dry | | | |
| | 0.0 | | | | | |
| | 0.3 | | Fill - dark brown/black silty sand and gravel, dry | Sample taken 1-2' for laboratory analysis | | |
| | 6.1 | | | | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 15' riser | |
| -10 | | | Sand from clearance | | | |
| | | | Sand from clearance | | | |
| | 780 | | Brown fine sand, slightly moist | | | |
| | 1303 | | | | | |
| | 860 | | Brown/black coarse sand and gravel, wet | | | |
| -15 | 927 | | Same, sheen on spoon | | | |
| | 923 | | Black sand and gravel, wet | | | |
| | 1206 | | | | | |
| | 525 | | | | | |
| | 969 | | | | | |
| -20 | 16,1 | | Brown/orange fine sand, very moist | | 10' screen | |
| | 7.4 | | Brown/orange fine sand, trace clay, moist | | | |
| | 362 | | Brown/orange fine sand, moist | | | |
| | 37.6 | | | | | |
| -25 | | | | Auger complete to 25' | | |

# MONITORING WELL LOG: N-105

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **6/18/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **25'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - gravel, fine sand, dry | | | |
| | 0.0 | | | | | |
| | 0.2 | | Dark brown/black sandy silt and gravel, dry | Sample taken 1-2' for laboratory analysis | | |
| | 3.1 | | | | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 15' riser | |
| -10 | | | Sand from clearance | | | |
| | | | Sand from clearance | | | |
| | 478 | | Brown coarse sand and gravel, very moist | | | |
| | 918 | | | | | |
| | 1109 | | | | | |
| -15 | 738 | | | | | |
| | 341 | | Black coarse sand and gravel, wet | | | |
| | 437 | | Same, sheen on spoon | | | |
| | 1468 | | Same, wet | | | |
| | 37.7 | | Brown/tan sand and gravel, wet | | | |
| -20 | 9.9 | | Brown/orange fine sand, trace clay, moist | | 10' screen | |
| | 3.2 | | Brown/orange sand and clay, moist | | | |
| | 106 | | | | | |
| | 5.9 | | Brown/orange fine sand, slightly moist | | | |
| -25 | | | | Auger complete to 25' | | |

# MONITORING WELL LOG: N-106

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **6/5/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **19'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - gravel, silt | | | |
| | 0.1 | | Concrete | | | |
| | | | Concrete, fill - brown silt and sand | Sample taken 1-2' for laboratory analysis | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 9' riser | |
| -10 | 763 | | Gray sandy clay and gravel, wet | | | |
| | 1793 | | Coarse sand and gravel, trace black/gray clay, wet | | | |
| | 2150 | | | | | |
| | 1768 | | Fine sand and gravel, black/gray, red sand 13.75-14' | | | |
| | 1376 | | Coarse sand and gravel, trace clay, wet | | | |
| -15 | 261 | | Tan/orange clay and sand, slightly moist | | 10' screen | |
| | 119 | | | | | |
| | 49.1 | | Orange/brown sand and clay, compact, slightly moist | | | |
| | 163 | | Same, gravel | Auger complete to 19' | | |
| -20 | 52.1 | | Fine light brown/orange sand, trace clay | Boring complete to 20' | | |

# MONITORING WELL LOG: N-107

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **6/20/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **22'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.1 | | Fill - fine sand and gravel, dry | | | |
| | 5.2 | | Fill - black/brown silty sand and gravel, dry | | | |
| | 20.6 | | | Sample taken 1-2' for laboratory analysis | | |
| | 28.3 | | | | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 12' riser | |
| -10 | | | Medium sand, black, very moist | | | |
| | 478 | | Coarse sand and gravel, black, wet | | | |
| | 918 | | | | | |
| | 1109 | | | | | |
| -15 | 738 | | | | | |
| | 341 | | | | 10' screen | |
| | 437 | | Fine sand and gravel, wet | | | |
| | 1468 | | | | | |
| | 37.7 | | Tan/orange sandy clay, very moist | | | |
| -20 | 9.9 | | Tan fine sand, very moist | | | |
| | 3.2 | | | Auger complete to 22' | | |

# MONITORING WELL LOG: N-108

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/29/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **18'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - gravel, sand, dry | | | |
| | 0.5 | | Fill - brown/black silty sand, gravel, dry | | | |
| | 123 | | | Sample taken 1-2' for laboratory analysis | | |
| | 57.6 | | | | | |
| | | | | | 8' riser | |
| -5 | | | | Previously cleared to 10', backfilled with sand | | |
| -10 | 849 | | Coarse sand and gravel, gray/black, wet | | | |
| | 1248 | | | | | |
| | 756 | | Medium to fine sand and gravel, wet | | 10' screen | |
| | 842 | | | | | |
| | 756 | | | | | |
| -15 | 121 | | Brown sandy clay and gravel, very moist | | | |
| | 42.9 | | Brown/orange sandy clay and gravel, very moist, stiff | | | |
| | 3.7 | | | Auger/boring complete to 18' | | |

# SUBSURFACE LOG: N-109
# AND WELL CONSTRUCTION : N-109

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco-Philadelphia Refinery** | DRILLING CO.: | **Parratt-Wolff** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **Hollow Stem Auger & Mud Rotary** |
| LOGGED BY: | **Tiffani Doerr/Shaun Sykes** | SAMPLING METHOD: | **Split Spoon** |
| DATES DRILLED: | **7/2-7/3/08** | SCREEN/RISER DIAMETER: | **2-inch** |
| TOTAL BORING DEPTH: | **42'6"** | WELLBORE DIAMETER: | **8-inch** |
| BORING ELEVATION | | TOC (inner) ELEVATION: | |

NOTE: Well N-109 was drilled within 5 feet of boring N-109. Screen=0.010 slot; "0" sand; 2' stickup finish. Screen (5'-20'); Riser (2' stickup - 5'); Sand (3'-20'); Bentonite (1'-3'); Grout (surface to 1')

| Depth (feet) | Blow Counts | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | | 0.0 | | | Boring location pre-cleared by Mobile Dredge to 10' | |
| | | 0.0 | | FILL - dry, brown/black silty sand and gravel with brick. | Sample 1'-2' submitted for laboratory analysis | |
| -5 | | | | | | |
| -10 | 4-4 | 156 | | Moist to wet med brown silty fine sandy CLAY, gray mottling from 11-12', Fine-med gravel in bottom 2" | | |
| | 6-10 | 139 | | | | |
| | 15-16 | 51.6 | | Wet med SAND w/ clay plugs to 13.5, last 6" fine-coarse sand w/ some fine to coarse gravels | | |
| | 32-50/0.4 | 18.5 | | | | |
| | 18-20 | 252 | | Saturated med brown fine to med GRAVELS w/ coarse sand to 15' | | |

Aquaterra Technologies, Inc.

# SUBSURFACE LOG: N-109
# AND WELL CONSTRUCTION: N-109

| Depth (feet) | Blow Counts | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| -15 | 21-17 | 176 | | Med-coarse sand w/ gravel (fine-coarse 1") | | |
| | 20-32 | 58.4 | | Grades from lt. brown/gray fine to coarse sand from 16' to 16'10", then grades from coarse sand and fine gravel to heterogenous gravels, fine to 1" with coarse sand (gravels qtz, qtzite, sandstone) | | |
| | 27-27 | 322 | | | | |
| | 50/0.2 | | | Crushed gravel in tip, no return | | |
| | | | | Cobble/boulder from 18'2" to ~19'. Auger through to 20'. | | |
| -20 | 4-7 | 0.0 | | Top 8" grading through orange/gray mix to mostly orange at bottom. 60-70% Mica, rest clay and fine sand. Saprolite - original rock structure present throughout. Overall, fine sandy clay. | Switch to mud rotary | |
| | 8-9 | 0.0 | | | | |
| | 6-6 | 0.0 | | | | |
| | | | | Only 2" recovery - same as above. | | |
| | 9-8 | | | | | |
| | 5-16 | 0.0 | | Same to 25' | | |
| -25 | 15-11 | 0.0 | | 25-25'10" - Larger mica flakes and qtz. grains, few qtz-mica gravels, last 2" white clay w/ gray fine qtz. gravels | | |
| | 24-25 | 0.0 | | 12" Recovery - top 2" same as above, 90% mica (up to 0.5" books) w/few fine sands and white clay (not layered) | | |
| | 27-35 | | | | | |
| | 24-28 | 1.6 | | Same to 29' | | |
| | 29-29 | 0.0 | | Layered/laminated white/gray coarse mica w/ clay and orange/black mica w/ clay | | |
| -30 | 11-9 | 0.0 | | Top 1' - light gray fine - med micaceous clayey sand, next 6" same as above but coarse, last 6" layered alternating lt. gray/orange brown mica w/ little clay | | |
| | 11-19 | 0.0 | | | | |
| | 32-24 | 0.0 | | Same as above, heavy mica saprolite, gray and clayey to 33' | | |
| | 37-47 | 0.0 | | 1" layer of round med-coarse gray qtzite gravel @ 33', last 1' laminated orange white/gray clay | | |
| | 15-12 | 0.0 | | Yellow-gray medium grained qtz-mica sand, 2" white clay w/ very fine qtz gravels | | |

Aquaterra Technologies, Inc.

# SUBSURFACE LOG: N-109
# AND WELL CONSTRUCTION: N-109

| Depth (feet) | Blow Counts | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| -35 | 13-15 | 0.0 | | | | |
| | 16-19 | | | No recovery | | |
| | 26-32 | | | | | |
| | 18-19 | 0.0 | | Slight layering orange-yellow gray muscovite-biotite and fine qtz sand. Some yellow-white clay layers w/ coarse qtz gravels | | |
| | 47-50/0.4 | 0.0 | | | | |
| -40 | 34-45 | 5.3 | | Same as above | | |
| | 50/0.3 | 1.0 | | | | |
| | 78/6" | 8.2 | | Extremely weathered bedrock | Borehole complete to 42'6" | |

# MONITORING WELL LOG: N-110

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/14/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **15'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - gravel, tan sandy silt, dry | | | |
| | 0.1 | | | | | |
| | 0.3 | | | | | |
| | 0.3 | | Brown sandy silt and gravel, dry | Sample taken 1-2' for laboratory analysis | | |
| | | | | | 5' riser | |
| -5 | | | | Previously cleared to 10', backfilled with sand | | |
| -10 | 27.3 | | Brown/black sand with clay, wet | | 10' screen | |
| | 28.9 | | | | | |
| | 52.2 | | Black/brown coarse sand, gravel, wet | | | |
| | 98.9 | | | | | |
| | 97.6 | | Black/brown coarse sand and gravel, wet | Auger to 15' | | |
| -15 | 89.2 | | | | | |
| | 78.5 | | | | | |
| | 22.9 | | Black/brown clay, very moist | Boring complete to 18' | | |

# MONITORING WELL LOG: N-111

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/14/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **15'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - brown sandy silt, dry | | | |
| | 1.3 | | Same with gravel | | | |
| | 1.7 | | Fill - brown/black silty sand and gravel, dry, some brick | Sample taken 1-2' for laboratory analysis | | |
| | 1.2 | | | | | |
| | | | | | 5' riser | |
| -5 | | | | Previously cleared to 10', backfilled with sand | | |
| -10 | 84.6 | | Black/gray sand and gravel, wet, some brick | | 10' screen | |
| | 92.1 | | | | | |
| | 112 | | | | | |
| | 59.9 | | Black sandy clay with gravel, wet | | | |
| | 149 | | Black coarse sand and gravel, wet | Auger to 15' | | |
| -15 | 46.3 | | Black clay, very moist to wet | | | |
| | 56.8 | | Black sandy clay, very moist to wet | | | |
| | 38.5 | | | Boring complete to 18' | | |

# MONITORING WELL LOG: N-112

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/14/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **20'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - gravel, brown sandy silt, dry | | | |
| | 2.8 | | | | | |
| | 6.4 | | Fill - brown/black silty sand and gravel, dry | Sample taken 1-2' for laboratory analysis | | |
| | 8.5 | | | | 5' riser | |
| -5 | | | | Previously cleared to 10', backfilled with sand | | |
| -10 | 89,7 | | Dark brown clayey sand and gravel, wet | | 15' screen | |
| | 143 | | | | | |
| | 178 | | | | | |
| | 128 | | Brown/tan sand and gravel, wet | | | |
| | 193 | | Brown sand and coarse gravel, wet | Visible sheen on spoon at 14' | | |
| -15 | 223 | | | | | |
| | 145 | | | | | |
| | 194 | | | | | |
| | 9.8 | | Sand and gravel, very moist | | | |
| | 8.7 | | Sand and gravel, greenish tint, trace clay, very moist | Auger complete to 20' | | |
| -20 | | | | | | |

# MONITORING WELL LOG: N-113

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/15/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **15'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - tar, brown sandy clay and gravel | | | |
| | 0.9 | | Fill - brown/gray silty clay and gravel | | | |
| | 7.5 | | | Sample taken 1-2' for laboratory analysis | 5' | |
| | 6.6 | | | | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | | |
| -10 | 106 | | Brown sand w/ clay, wet | | 10' screen | |
| | 95.6 | | | | | |
| | 260 | | | | | |
| | 25.8 | | | | | |
| | 5.8 | | Brown/tan stiff sandy clay, very moist | Auger complete to 15' | | |
| -15 | | | | | | |

# MONITORING WELL LOG: N-114

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/13/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **25'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 45.4 | | Fill - gravel, brown sandy silt, dry | | | |
| | 288 | | | | | |
| | 302 | | Fill - brown/black sandy silt and gravel, wood fragments | Sample taken 1-2' for laboratory analysis | | |
| | 292 | | | | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 10' riser | |
| -10 | 349 | | Coarse sand and gravel, very moist | | | |
| | 562 | | Brown sandy clay and gravel, very moist | | | |
| | 342 | | Brown sand and gravel, trace clay, very moist | | | |
| | 284 | | | | | |
| | 181 | | Sand and coarse gravel, trace brown clay, very moist | | | |
| -15 | 240 | | | | | |
| | 249 | | Sand and gravel turning to coarse gravel, very moist | | | |
| | 7.3 | | Sand and coarse gravel, trace orange/brown sandy silt | | | |
| | 293 | | Sand and coarse gravel, moist | | | |
| | 12.4 | | Tan clay and micaceous sand | | | |
| -20 | 69.6 | | | | 15' screen | |
| | 13.2 | | | | | |
| | 8.0 | | Same, trace brown/gray clay | | | |
| | 1.8 | | | | | |
| | 1.5 | | Micaceous sand | Auger complete to 25' | | |
| -25 | | | | | | |

# MONITORING WELL LOG: N-115

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Continuous Split Spoon** |
| LOGGED BY: | **T. Doerr** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/28/08** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **14'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| | 1.2 | | FILL material - dry dark brown to black brick, sandy clay material (few layers), cinders | Sample taken 1-2' for laboratory analysis | ~2' stick up | |
| | 4.6 | | | | 0'-4' riser | |
| -5 | | | | Previously cleared to 10', backfilled with sand | | |
| -10 | 80.5 | | Gray/black coarse SAND and GRAVEL, petroleum soaked | | 4'-14' screen | |
| | 3.6 | | Light brown sl plastic very fine sandy SILT, slightly micaceous, moist | | | |
| | 72.2 | | Gray/black coarse SAND and GRAVEL to 13'4" | | | |
| | 0.9 | | Slightly mottled light brown and gray CLAY with some silt | Auger complete to 14' | | |
| | 2.3 | | 14'-14'4" CLAY | | | |
| | | | Gray fine SAND | Saturated at 15' | | |
| -15 | 1.0 | | Gray clayey SAND | Boring complete to 16' | | |
| | | | Bottom 1" gray/orange mottled CLAY | | | |

# MONITORING WELL LOG: N-116

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/20/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **12'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 4.9 | | Fill - gravel, sand, tan/brown silty sand, dry | | | |
| | 16.8 | | Fill - brown/black sand and gravel, dry | | | |
| | 182 | | | Sample taken 1-2' for laboratory analysis | | |
| | 147 | | Gray sandy clay, moist, stiff | | 2' riser | |
| -5 | | | | Previously cleared to 10', backfilled with sand | | |
| -10 | 98.8 | | Black/gray sandy clay, very moist, sheen | | 10' screen | |
| | 85.6 | | | Auger complete to 12' | | |
| | 46.5 | | | | | |
| | 87.5 | | | Boring complete to 14' | | |

# MONITORING WELL LOG: N-117

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Continuous Split Spoon** |
| LOGGED BY: | **T. Doerr** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **6/4/08** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **20'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 1.3 | | FILL - gravel w/ sand to 1.5' | | ~2' stick up | |
| | 2.4 | | Brown moist clayey sand and gravel | Sample taken 1-2' for laboratory analysis | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 0'-8' riser | |
| -10 | 94.8 | | Very moist dark brown sandy CLAY mottled with black product to 13' | Product present from 10' to 16' | 8'-20' screen | |
| | 66.9 | | | | | |
| | 251 | | | | | |
| | 743 | | Wet brown to black product laden GRAVEL (sub-angular up to 1.5") with coarse sand | | | |
| | 480 | | | | | |
| -15 | 732 | | | | | |
| | 855 | | Saturated (water) at 16' | | | |
| | 282 | | Medium brown to red-brown fine SAND | | | |
| | 56.4 | | Micaceous fine to medium SAND | Auger/boring complete to 20' | | |
| | 30.2 | | Orange and gray mottled very fine sandy SILT grading to clayey silt (19.5'-20') | | | |
| -20 | | | | | | |

# MONITORING WELL LOG: N-118

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/23/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **20'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.1 | | Fill - brown silty sand and gravel, moist | | | |
| | 3.6 | | Fill - black/brown sitly sand and gravel | | | |
| | 142 | | | Sample taken 1-2' for laboratory analysis | | |
| | 156 | | | | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 10' riser | |
| -10 | 86.6 | | Coarse sand and gravel, wet | | | |
| | 225 | | | | | |
| | 971 | | Same, trace brown clay | | | |
| | 1633 | | Same, trace brown clay | | | |
| | 966 | | | | | |
| -15 | 781 | | Coarse sand and gravel. trace clay | | 10' screen | |
| | 93.5 | | Red/brown sandy clay and gravel | | | |
| | 13.7 | | Tan/orange sandy clay | | | |
| | 14.7 | | Tan/orange sand, some clay | | | |
| | 22.1 | | | Auger/boring complete to 20' | | |
| -20 | | | | | | |

# MONITORING WELL LOG: N-119

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/29/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **18'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 5.9 | | Fill - gravel, sand, dry | | | |
| | 6.2 | | Fill - orange/brown sandy silt and gravel, dry | | | |
| | 7.4 | | | Sample taken 1-2' for laboratory analysis | | |
| | 14.1 | | Brown/black silt and clay, dry | | | |
| | | | | | 8' riser | |
| -5 | | | | Previously cleared to 10', backfilled with sand | | |
| -10 | 1341 | | Black coarse sand and gravel, wet | | | |
| | 1678 | | | | | |
| | 186 | | Black/gray medium sand and gravel, trace clay, wet | | 10' screen | |
| | 35.5 | | | | | |
| | 28.7 | | | | | |
| -15 | 14.3 | | | | | |
| | 26.6 | | Coarse sand and gravel, wet | | | |
| | 7.5 | | | Auger complete to 18' | | |

# MONITORING WELL LOG: N-120

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/22/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **18'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - medium brown sandy clay and gravel, dry | | | |
| | 0.0 | | | | | |
| | 0.0 | | | Sample taken 1-2' for laboratory analysis | | |
| | 0.4 | | | | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 8' riser | |
| -10 | 994 | | Black coarse sand and gravel, wet, sheen | | | |
| | 1063 | | | | | |
| | 1074 | | | | 10' screen | |
| | 983 | | | | | |
| | 35.7 | | Tan/orange sandy clay, very moist | | | |
| -15 | 29.3 | | | | | |
| | 43.4 | | Gray sand and clay, some gravel, very moist | | | |
| | 28.6 | | | Auger/boring complete to 18' | | |

# MONITORING WELL LOG: N-121

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **6/9/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **20'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - gravel, brown silty and sand, dry | | | |
| | 5.3 | | | | | |
| | 34.6 | | Dark brown fill, gravel, sandy clay | Sample taken 1-2' for laboratory analysis | | |
| | 40.8 | | | | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 10' riser | |
| -10 | 1446 | | Fine sand and gravel, brown, wet | | | |
| | 1332 | | Coarse sand and gravel, wet | | | |
| | 1177 | | | | | |
| | 36.1 | | Gray/orange fine sand and clay, very moist | | | |
| | 72.6 | | Gray fine sand, trace clay, very moist | | | |
| -15 | 39.6 | | | | 10' screen | |
| | 535 | | Coarse sand and gravel, very moist to wet | | | |
| | 80.1 | | Gray/orange fine sand, very moist | | | |
| | 45.5 | | Tan/orange fine sand, trace clay, very moist | | | |
| -20 | 26.6 | | Same, increased clay content | Auger/boring complete to 20' | | |

# MONITORING WELL LOG: N-122

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/21/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **18'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - gravel, stiff brown silty, dry | | | |
| | 18.8 | | | | | |
| | 78.9 | | Fill - gray/black stiff sandy silt, gravel, dry | Sample taken 1-2' for laboratory analysis | | |
| | 15.7 | | | | | |
| | | | | | 6' riser | |
| -5 | | | | Previously cleared to 10', backfilled with sand | | |
| | | | | Water at 8' | | |
| -10 | 6.6 | | Dark brown/gray sand and clay, some gravel, very moist to wet | | | |
| | 7.2 | | Same, increased clay content | | | |
| | 5.3 | | Brown/gray sand with clay, very moist | | 12' screen | |
| | 3.9 | | Gray sand with clay, very moist | | | |
| | 1.3 | | | | | |
| -15 | 1.1 | | Orange-tan/gray sandy clay, very moist | | | |
| | 4.3 | | Same, some gravel | | | |
| | 2.2 | | Gray/brown sand and clay, moist | Auger/boring complete to 18' | | |

# MONITORING WELL LOG: N-123

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/20/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **20'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - gravel, sand, brick | | | |
| | 0.5 | | | | | |
| | 0.8 | | | Sample taken 1-2' for laboratory analysis | | |
| | 1.2 | | Same, trace silt and clay | | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 10' riser | |
| -10 | 24.5 | | Coarse sand and gravel, black, sheen, very moist | | | |
| | 37.6 | | | | | |
| | 116 | | Same, wet | | | |
| | 254 | | | | | |
| | 236 | | Same, very moist to wet | | | |
| -15 | 117 | | | | 10' screen | |
| | 65.2 | | Same, trace clay | | | |
| | 20.3 | | | | | |
| | 6.5 | | Coarse sand and gravel, trace clay | | | |
| | 7.9 | | | Auger/boring complete to 20' | | |
| -20 | | | | | | |

# MONITORING WELL LOG: N-124

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/21/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **25'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - sand, gravel, brick, dry | | | |
| | 0.0 | | | | | |
| | 0.4 | | | Sample taken 1-2' for laboratory analysis | | |
| | 0.5 | | | | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 10' riser | |
| -10 | 0.0 | | Fill - sand, gravel, brick, trace brown clay | | | |
| | 0.0 | | | | | |
| | 0.2 | | Black coarse sand and gravel, very moist | | | |
| | 0.4 | | | | | |
| | 0.0 | | Brown/gray sandy clay and gravel, very moist to wet | | | |
| -15 | 0.0 | | | | 15' screen | |
| | 0.0 | | Orange/brown sandy clay and gravel, very moist to wet | | | |
| | 0.0 | | | | | |
| | 0.0 | | Same, wet | | | |
| | 0.0 | | | | | |
| -20 | 0.0 | | Light brown sand and clay, some gravel, wet | | | |
| | 0.0 | | | | | |
| | 0.0 | | Same, very moist | | | |
| | 0.0 | | | | | |
| | 0.0 | | | Auger complete to 25' | | |
| -25 | | | | | | |

# MONITORING WELL LOG: N-125

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **6/17/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **25'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - gravel, sand, brick, concrete, dry | | | |
| | 4.2 | | | | | |
| | 3.7 | | | Sample taken 1-2' for laboratory analysis | | |
| | 35.2 | | | | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 15' riser | |
| -10 | 392 | | Clayey sand and gravel, dry | | | |
| | 894 | | | | | |
| | 1065 | | Brown/tan coarse sand and gravel, moist | | | |
| | 1225 | | | | | |
| | 770 | | Brown fine sand, very moist to wet | | | |
| -15 | 756 | | | | | |
| | 467 | | Brown fine sand, very moist (6" recovery) | | | |
| | 401 | | | | | |
| | 302 | | | | | |
| -20 | 483 | | Same, wet | | 10' screen | |
| | 92 | | Coarse sand and gravel, wet | | | |
| | 96.2 | | | | | |
| | 10.2 | | Gray fine clayey sand, very moist | | | |
| -25 | | | | Auger complete to 25' | | |

# MONITORING WELL LOG: N-126

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/29/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **14'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.8 | | Fill - brown sandy silt, gravel, brick, dry | | | |
| | 1.2 | | | | | |
| | 120 | | Fill - brown/black sandy silt, gravel, dry, trace clay | Sample taken 1-2' for laboratory analysis | | |
| | 456 | | | | 4' riser | |
| -5 | | | | Previously cleared to 10', backfilled with sand | | |
| -10 | 348 | | Fill - black gravel, wood, wet | | 10' screen | |
| | 57.4 | | Black coarse sand and gravel, wet | | | |
| | 409 | | | | | |
| | 20.0 | | Black/brown sandy clay, very moist | Auger/boring complete to 14' | | |

# SUBSURFACE LOG: N-129
# AND WELL CONSTRUCTION : N-129

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco-Philadelphia Refinery** | DRILLING CO.: | **Parratt-Wolff** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **Hollow Stem Auger & Mud Rotary** |
| LOGGED BY: | **Tiffani Doerr/Shaun Sykes** | SAMPLING METHOD: | **Split Spoon** |
| DATES DRILLED: | **6/24-6/26/08 & 7/1/08** | SCREEN/RISER DIAMETER: | **2-inch** |
| TOTAL BORING DEPTH: | **103** | WELLBORE DIAMETER: | **8-inch** |
| BORING ELEVATION | | TOC (inner) ELEVATION: | |

NOTE: Well N-129 was drilled within 5 feet of boring N-129. Screen=0.010 slot; "0" sand; 2' stickup finish. Screen (14'-30'); Riser (2' stickup - 14'); Sand (12'-30'); Bentonite (10'-12'); Grout (surface to 10')

| Depth (feet) | Blow Counts | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | | | | FILL - brown sandy silt and gravel, dry. | Boring location pre-cleared by Mobile Dredge to 10'<br>Sample 1'-2' submitted for laboratory analysis | |
| -5 | | | | | | |
| -10 | 1-7 | | | No recovery | | |
| | 13-16 | | | | | |
| | 12-9 | 0.0 | | Moist coarse SAND and fine GRAVEL, light brown | | |
| | 12-12 | 0.1 | | | | |
| | 19-22 | 187 | | Wet, brown, heterogeneous mix of fine sand to coarse gravel (gravels vary in color and comp: sandstone, quartzite: brn, blk, wht). Strong odors. | Boring augered to 14', then switched to mud rotary drilling. | |
| -15 | 15-11 | | | | | |
| | 12-5 | 869 | | Wet, brown medium SAND (no gravel) w/1" plug of fine sandy clay at 17'10". | | |

Aquaterra Technologies, Inc.

# SUBSURFACE LOG: N-129
# AND WELL CONSTRUCTION: N-129

| Depth (feet) | Blow Counts | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| | 7-8 | | | Sand saturated w/ product at 18'. | | |
| | 11-15 | 371 | | | | |
| | 17-14 | | | | | |
| -20 | 18-15 | | | Medium SAND with GRAVELS (brn, blk, red), not prod saturated. No recovery | | |
| | 13-16 | | | | | |
| | 16-12 | 114 | | Brown, medium coarse SAND w/ few fine gravels. Prod saturated | | |
| | 14-15 | | | | | |
| | 5-9 | 102 | | Prod. saturated coarse sand & fine gravel to 26.5'. Only few vugs of product at 26.5'. | | |
| -25 | 11-9 | | | | | |
| | 10-19 | 11.7 | | Yellow and gray fine sandy CLAY | At 26' stong odors, but not petroleum. Pungent, fruity (like additive or solvent). | |
| | 16-25 | 13.3 | | Slightly micaceous, moist tan and gray fine to med. SAND | | |
| | 17-21 | 14.6 | | | | |
| | 18-8 | | | | | |
| -30 | 3-1 | 9.9 | | Moist layered orange/gray SILTY CLAY w/ very fine SAND, color change to dark gray 31.5' | | |
| | 3-4 | 18.4 | | | | |
| | 17-21 | 13.8 | | Same as 31.5'-32', moist dark gray micaceious sl. plastic very fine SANDY SILT | | |
| | 19-15 | 28.8 | | | | |
| | 4-4 | 6.2 | | | | |
| -35 | 5-10 | 5.0 | | | | |
| | 6-9 | 1.6 | | Few sandier layers at 36'. | | |
| | 9-10 | 1.7 | | | | |
| | 8-9 | 0.9 | | | | |
| | 8-9 | 0.7 | | | | |

Aquaterra Technologies, Inc.

# SUBSURFACE LOG: N-129
# AND WELL CONSTRUCTION: N-129

| Depth (feet) | Blow Counts | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| -40 | 5-5 | 0.3 | | Silty CLAY w/ trace fine sand to 41'10" | | |
| | 5-9 | 0.3 | | | | |
| | 9-7 | 0.2 | | Sat. brown medium SAND, trace fine gravel. At 43', brown slightly plastic silty very fine micaceous sand | | |
| | 9-9 | 0.2 | | | | |
| | 2-2 | 0.4 | | Brown slightly micaceous very fine sandy CLAY | | |
| -45 | 2-3 | 0.3 | | | | |
| | 2-4 | 0.5 | | 1" layers of fine sand at 46.5' and 47.5' | | |
| | 5-5 | 0.4 | | | | |
| | 4-5 | | | No recovery | | |
| | 6-8 | | | | | |
| -50 | 12-13 | 0.0 | | Alternating layers of brown clayey fine SAND and med sand (1-3" layers) | | |
| | 15-9 | 0.0 | | | | |
| | 11-9 | 0.4 | | Brown medium sand w/ few coarse grains | | |
| | 18-19 | 0.2 | | Alternating layers of brown fine clayey sand and brown medium sand with coarse grains | | |
| | 10-4 | 0.0 | | Same alternating layers to 57.5'; sand layers only 1" thick and all fine sands, Fine sandy clay layers 6" thick. | | |
| -55 | 6-5 | 0.0 | | | | |
| | 12-16 | 3.3 | | | | |
| | 18-13 | 2.2 | | Medium-coarse sand w/ trace fine gravels, saturated, slight odors | | |
| | 12-18 | 9.1 | | Same as last 1', Sandy clay plug at 59.5', orange-brown in color near bottom | | |
| | 19-24 | 3.1 | | | | |
| -60 | 18-16 | 12.3 | | 18" Recovery - Top 6" - 3" Brown fine sandy clay, 3" - Brown fine sand, Lower 1' - yellow brown coarse sand with few fine gravels | | |
| | 13-15 | 3.6 | | | | |
| | 34-24 | 18.7 | | 12" Recovery - Top 6" - Lt. brown medium sands, Lower 6" - Coarse sand and fine gravel with medium gravel in bottom 1" | | |

Aquaterra Technologies, Inc.

# SUBSURFACE LOG: N-129
# AND WELL CONSTRUCTION: N-129

| Depth (feet) | Blow Counts | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| | 24-17 | | | | | |
| | 23-17 | 2.5 | | 12" Recovery - Red-brown and gray heterogeneous gravel and coarse sand with trace clay | | |
| -65 | 13-15 | | | | | |
| | 18-17 | 13.7 | | Medium gray/brown med-coarse sand and fine gravel at top grades to coarse sand and fine-med gravel at 67' | | |
| | 19-27 | 2.0 | | Mix of coarse sand with fine gravel | | |
| | 27-50/0.4 | 57.2 | | Brown med-coarse gravels w/ sand | | |
| | | 35.4 | | | | |
| -70 | 38-40 | 9.3 | | Brown med-coarse gravels w/ sand | | |
| | 50/0.3 | | | | | |
| | 50/0.6 | | | Same | | |
| | 48-25 | 4.6 | | Same | | |
| -75 | 50/0.4 | | | | | |
| | 45-38 | 3.6 | | 14" Recovery, gravel and sand to 77.5', 2" layer gray fine sand w/ clay, 3" gray coarse sand w/ few fine gravels, 1" gray fine sand | | |
| | 19-26 | | | | | |
| | | 4.0 | | 6" gray fine sand, 1' Orange/yellow coarse sand and gravel, 6" compact dark gray clay, trace sand | | |
| | | 3.2 | | | | |
| -80 | 8-9 | 0.0 | | 10" recovery, compact dark gray clay, trace fine sand | | |
| | 14-20 | 0.0 | | | | |
| | 15-14 | 1.0 | | 6" recovery, top 2" compact dark gray clay, trace sand, bottom 4" gray/brown med. sand and gravel | | |
| | 18-17 | 0.3 | | | | |
| | 7-8 | 0.0 | | Compact dark gray clay, trace fine sand | | |
| -85 | 9-9 | 0.0 | | | | |

Aquaterra Technologies, Inc.

# SUBSURFACE LOG: N-129
# AND WELL CONSTRUCTION: N-129

| Depth (feet) | Blow Counts | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| | 7-6 | 0.0 | | Same, increase in sand content bottom 4" | | |
| | 7-12 | 0.0 | | | | |
| | 11-12 | 0.0 | | 6" recovery, same | | |
| | 7-12 | 0.0 | | | | |
| -90 | 12-13 | 0.0 | | Compact dark gray clay w/ trace fine sand layers | | |
| | 5-7 | 0.0 | | | | |
| | 7-12 | 0.0 | | Compact dark gray clay w/ numerous thin fine sand layers | | |
| | 7-13 | 0.0 | | | | |
| | 18-18 | | | | | |
| -95 | | | | | | |
| | 11-10 | 0.6 | | Moist, stiff dark gray silty clay, few thin layers of fine sand | | |
| | 14-20 | 0.1 | | | | |
| -100 | 17-19 | 3.6 | | Moist, fine to medium gray micaceous sand w/ few fine gravels, clayey sand plugs present | Borehole complete to 103' | |
| | 17-10 | 0.8 | | | | |
| | 76-105 | 1.6 | | Moist, fine to med. gray micaceous sand to 102'10", bottom 2" - gray qtz. gravels w/ black/white SCHIST in bottom of spoon | | |

# MONITORING WELL LOG: N-130

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Continuous Split Spoon** |
| LOGGED BY: | **T. Doerr** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/16/08** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **32'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | | | | |
| | 0.0 | | Med brown moist plastic fine sandy SILT, no gravel | | ~2' stick up | |
| | 0.1 | | | Sample taken 1-2' for laboratory analysis | | |
| | 0.2 | | | | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 0'-18' riser | |
| -10 | 0.4 | | Moist, light brown SAND and GRAVEL. White/yellow coarse sand with 50% round to subround gravel from 1/8" to 1.5" (quartz, sandstone and brn siltstone gravels). Extends to 19.5' | | | |
| | 0.3 | | | | | |
| | 0.1 | | | | | |
| | 0.1 | | | | | |
| | 0.3 | | | | | |

# MONITORING WELL LOG: N-130

Aquaterra Technologies, Inc.

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| -15 | 0.3 | | | | | |
| | 0.4 | | | | | |
| | 0.4 | | | | | |
| | 45.5 | | Slightly more orange at 19' | | | |
| | 120 | | Dark gray coarse SAND with fine GRAVEL with fewer and smaller gravel extends from 19.5' to 25'. Heavy petroleum odors start at 19.5' | | | |
| -20 | 293 | | 2" layer medium SAND at 20' | | | |
| | 398 | | | Saturated at 21' (sheen) | | |
| | 547 | | 2" layer medium SAND at 21'10" | | | |
| | 421 | | | | | |
| | 393 | | | | | |
| -25 | 126 | | From 25' to 26' grades to medium-fine SAND with sandstone cobble in bottom of spoon | | 18'-30' screen | |
| | 13.7 | | Brown coarse SAND and fine GRAVELS (yellow & white quartz) from 26' to 26.5' | | | |
| | 6.7 | | 26.5'-28' - Alternating 3" layers of gray med-coarse sand and gray sand and gravels (<1") of qtz and brn-red siltstone | | | |
| | 22 | | Gray med-coarse sand with few gravels to 32' | | | |
| | 2.9 | | | Auger complete to 30' | | |
| -30 | 99.7 | | | Boring complete to 32' | | |
| | 4.1 | | | | | |

# SUBSURFACE LOG: N-131
# AND WELL CONSTRUCTION : N-131

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco-Philadelphia Refinery** | DRILLING CO.: | **Parratt-Wolffe** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **Hollow Stem Auger & Mud Rotary** |
| LOGGED BY: | **Tiffani Doerr** | SAMPLING METHOD: | **Split Spoon** |
| DATES DRILLED: | **6/3/08 & 6/10/08** | SCREEN/RISER DIAMETER: | **2-inch** |
| TOTAL BORING DEPTH: | **70** | WELLBORE DIAMETER: | **8-inch** |
| BORING ELEVATION | | TOC (inner) ELEVATION: | |

NOTE: Well N-131 was drilled within 5 feet of boring N-131 on 6/17/2008. Screen=0.010 slot; "0" sand; 2' stickup finish. Screen (5'-15'); Riser (2' stickup - 5'); Sand (3'-15'); Bentonite (1'-3'); Grout (surface to 1')

| Depth (feet) | Blow Counts | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | | 0.1 | | | | |
| | | 15.5 | | | Boring location pre-cleared by Mobile Dredge to 10' | |
| | | 46.5 | | | | |
| | | 52.2 | | Brown-black silty sand and gravel. Asphalt layer at 3.5 feet. | Sample 1'-2' submitted for laboratory analysis | |
| -5 | | | | | | |
| -10 | 3-6 | 241 | | Wet, black, medium SAND and GRAVEL. | | |
| | 1/1' | 207 | | | | |
| | 2-1 | 128 | | Dark brown micaceous silty CLAY, with wood and organic matter. | | |
| | 2-1 | 70.1 | | | | |
| | 1-2 | 3.2 | | | | |

Aquaterra Technologies, Inc.

# SUBSURFACE LOG: N-131
# AND WELL CONSTRUCTION: N-131

| Depth (feet) | Blow Counts | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| -15 | 3-1 | 1.9 | | | | |
| | 1-2 | 0.6 | | | | |
| | 2-1 | 0.8 | | | | |
| | 1-1 | 0.9 | | | | |
| | 1-1 | | | | | |
| -20 | 1-2 | 0.0 | | Same, but becomes gray at 20'. | Augers pulled at 20'. Switch to mud rotary for remainder of drilling. | |
| | 3-6 | 0.0 | | | | |
| | 2-1 | 0.0 | | | | |
| | 1-1 | 0.0 | | | | |
| | woh/2' | 0.0 | | | | |
| -25 | woh/2' | 0.0 | | | | |
| | woh/1' | 0.1 | | Becomes silty at 26'. Less organic matter. | | |
| | 4-2 | 0.0 | | | | |
| | woh/1' | 0.0 | | | | |
| | 3-2 | 0.0 | | | | |
| -30 | woh/2' | 0.0 | | Dark gray CLAY with trace fine sand and organics. | | |
| | woh/2' | 0.0 | | | | |
| | woh/2' | 0.0 | | | | |
| | woh/2' | 0.0 | | | | |
| | woh/3' | 0.0 | | | | |

Aquaterra Technologies, Inc.

# SUBSURFACE LOG: N-131
# AND WELL CONSTRUCTION: N-131

| Depth (feet) | Blow Counts | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| -35 | woh/3' | 0.0 | | | | |
| | 2-2 | 0.0 | | | | |
| | 2-2 | 0.0 | | 36.5' to 37' - Fine clayey sand layer. | | |
| | 3-2 | 0.0 | | Fine brown/gray slightly micaceous SAND with layers of clay. | | |
| | 3-2 | 0.0 | | | | |
| -40 | woh/2' | 0.0 | | | | |
| | woh/2' | 0.0 | | Dark gray CLAY with few fine sands and organics. Some silt. | | |
| | 3-2 | 0.0 | | | | |
| | 3-2 | 0.0 | | | | |
| | 3-3 | 0.0 | | Dark gray silty CLAY wtih 1" spaced fine sand laminations. Some woody layers. | | |
| -45 | 3-3 | 0.0 | | | | |
| | 5-6 | 0.0 | | | | |
| | 5-6 | 0.0 | | | | |
| | 4-5 | 0.0 | | Brown/gray fine SAND, trace clay and organic matter. | | |
| | 4-5 | 0.0 | | | | |
| -50 | 4-6 | 0.0 | | | | |
| | 4-6 | 0.6 | | | | |
| | 7-9 | 0.3 | | Sand grains increasing in size. | | |
| | 7-9 | 1.0 | | Brown/gray coarse SAND, slight odor, saturated. | | |
| | 2-4 | 0.0 | | Moist, gray plastic micaceous SILT to SILTY CLAY to 55.5'. 2" layer of coarse sand at 54.5'. | | |

Aquaterra Technologies, Inc.

# SUBSURFACE LOG: N-131
# AND WELL CONSTRUCTION: N-131

| Depth (feet) | Blow Counts | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| -55 | 2-8 | 0.2 | | | | |
| | 3-5 | 0.3 | | Gray/brown medium coarse SAND (mostly qtz with mica flakes) with trace fine gravels to 60.5'. 2" clay/silt lenses at 56.5' and 57.5'. Very weathered petroleum odors. Saturated. | | |
| | 6-11 | 1.2 | | | | |
| | 5-6 | 0.3 | | | | |
| | 0-2 | 0.4 | | | | |
| -60 | 2-2 | 0.0 | | | | |
| | | | | 60.5' to 61' soft clay and sand layer | | |
| | 2-2 | 0.1 | | Gray clayey SILT/silty CLAY with very fine sand laminations at 1 cm intervals. | | |
| | 2-2 | 0.5 | | Very loose/soft, wet clay/sand mixture to 63'4". 63'4" clayey silt with very fine sand (few irregular laminations). Layer of fine gravel near 64'. | | |
| | 2-2 | 0.2 | | | | |
| | 7-8 | 0.0 | | Finely laminated clayey SILTS and very fine SANDS. 1" wood layer at 64.5'. 1" coarse-grained weathered qtz-mica rock at 65.5'. | | |
| -65 | 2-2 | 0.2 | | | | |
| | 4-4 | 1.2 | | Coarse SAND and fine GRAVEL. Homogeneous with exception of band of larger gravel (~1") at 66.5'. Gravel is variable in color and composition: white, yellow, green, brown, orange, black - qtz, sandstone, qtzite, biotite. Few fines give overall gray appearance. | | |
| | 4-8 | 0.2 | | | | |
| | 8-8 | 0.1 | | 6" plastic sitly very fine SAND. Gray and red-brown fine to medium SAND grading to coarse sand at 69'4" and into GRAVEL at 69'8". | | |
| | 4-50 | 0.7 | | 3" of silty CLAY with few gravels. Bottom 1" of last spoon is fine grained black/white qtz-mica SCHIST. | Augered to 70', attempted another spoon 50/0" - schist in tip of spoon. | |
| -70 | | | | | | |

# MONITORING WELL LOG: N-132

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/13/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **25'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.2 | | Fill - gravel, brown/black sandy silt, dry | | | |
| | 1.2 | | | | | |
| | 2.3 | | Fill - gravel, brown/black silty sand, brick, dry | Sample taken 1-2' for laboratory analysis | | |
| | 3.2 | | | | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 15' riser | |
| -10 | 8.7 | | Brown/black silty sand, gravel, wet | | | |
| | 13.5 | | Brown/black silty clay, very moist to wet | | | |
| | 23.4 | | | | | |
| | 30.6 | | Brown/black silty sand, very moist to wet | | | |
| | 29.9 | | Brown/black sandy clay, very moist | | | |
| -15 | 30.4 | | | | | |
| | 30.2 | | Brown/black silty sand, moist | | | |
| | 2.0 | | Brown/black clay with organic matter, moist | | | |
| | 0.9 | | Brown/black sandy clay, moist | | | |
| | 0.8 | | Dark brown clay, trace sand | | | |
| -20 | 1.2 | | Dark brown clay, trace sand, organic matter, moist | | 10' screen | |
| | 0.9 | | | | | |
| | 3.2 | | Brown/black sand, trace clay, wet | | | |
| | 1.4 | | Same, increased clay content | | | |
| -25 | 0.9 | | Brown/black sand and clay, wet | Auger complete to 25' | | |

# MONITORING WELL LOG: N-133

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/15/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **12'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.1 | | Fill - gravel, tan silty sand, dry | | | |
| | 2.9 | | Fill - brown/black silty sand, gravel, brick, dry | | | |
| | 6.7 | | Fill - brown/black silty sand, gravel, wood, dry | | | |
| | 11.9 | | Same, wet at 2' | Sample taken 1-2' for laboratory analysis | 2' riser | |
| -5 | | | | Previously cleared to 10', backfilled with sand | | |
| -10 | 215 | | Black sand and gravel, wet | | 10' screen | |
| | 185 | | | Auger complete to 12' | | |

# MONITORING WELL LOG: N-134

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/22/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **20'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - dark brown silty sand, gravel, brick | | | |
| | 0.0 | | | | | |
| | 0.0 | | | | | |
| | 0.0 | | | Sample taken 1-2' for laboratory analysis | | |
| -5 | | | | Previously cleared to 10', backfilled with sand | 10' riser | |
| -10 | 0.0 | | Tan/orange sandy clay and gravel, very moist to wet | | | |
| | 0.0 | | | | | |
| | 0.0 | | Reb/brown/orange sand and gravel, trace clay, very moist to wet | | | |
| | 0.0 | | | | | |
| | 0.0 | | | | | |
| -15 | 0.0 | | | | 10' screen | |
| | 0.0 | | Brown/red/orange sand and gravel, trace clay | | | |
| | 8.0 | | | | | |
| | 58.4 | | Gray/red sand and gravel, trace clay | | | |
| | 62.2 | | | Auger/boring complete to 20' | | |
| -20 | | | | | | |

# MONITORING WELL LOG: N-135

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/15/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **12'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - black/brown silty sand and gravel, dry | | | |
| | 0.7 | | | | | |
| | 1.2 | | Black sand and gravel, very moist | Sample taken 1-2' for laboratory analysis | | |
| | 2.3 | | Same, wet at 2' | | 2' riser | |
| -5 | | | | Previously cleared to 10', backfilled with sand | | |
| -10 | 57.1 | | Fill - gravel, wood, brick | | 10' screen | |
| | 69.3 | | | Auger complete to 12' | | |
| | 115 | | | | | |
| | 121 | | Black sandy clay, wet | Boring complete to 14' | | |

# MONITORING WELL LOG: N-136

| | | | |
|---|---|---|---|
| PROJECT: | **Sunoco Philadelphia Refinery** | DRILLING CO.: | **Parrat Wolff Inc.** |
| SITE LOCATION: | **AOI-8** | DRILLING METHOD: | **6" Hollow Stem Auger** |
| JOB NO.: | | SAMPLING METHOD: | **Split Spoon** |
| LOGGED BY: | **Shaun Sykes** | SCREEN/RISER DIAMETER: | **2"** |
| DATES DRILLED: | **5/15/2008** | WELLBORE DIAMETER: | **6"** |
| TOTAL DEPTH: | **12'** | ELEVATION: | |

| Depth (feet) | OVM (ppm) | USCS | LITHOLOGY | COMMENTS | WELL CONSTRUCTION | WELL DIAGRAM |
|---|---|---|---|---|---|---|
| 0 | 0.0 | | Fill - gravel, brown sandy silt, slightly moist | | | |
| | 0.5 | | | | | |
| | 0.6 | | | Sample taken 1-2' for laboratory analysis | | |
| | 1.2 | | Brown/black silty sand and gravel, very moist | | 2' riser | |
| -5 | | | | Previously cleared to 10', backfilled with sand | | |
| -10 | 75.6 | | Black/gray sand and gravel, trace clay, wet | | 10' screen | |
| | 124 | | Black/gray sandy clay, wet | Auger complete to 12' | | |
| | 89.2 | | Black/gray sandy clay, very moist | | | |
| | 75.6 | | | Boring complete to 15' | | |
| -15 | 64.2 | | | | | |

Pennsylvania Department of Environmental Protection

**2 East Main Street**
**Norristown, PA 19401**
November 14, 2008

**Southeast Regional Office**

Phone: 484-250-5960
Fax: 484-250-5961

Ms. Dina Toto
Remediation Engineer
Sunoco, Inc.
10 Industrial Highway
Lester, PA 19029

Re: ECP – Special Projects
AOI No. 8 Technical Review Comments
Water Quality Consent Order
IW/Operations Sunoco Point Breeze Refinery
NPDES Permit No. PA0012629
Passyunk Avenue
City of Philadelphia

Dear Ms. Toto:

The Pennsylvania Department of Environmental Protection (Department) has received and reviewed the Site Characterization Report AOI 8 dated September 30, 2008. This document was prepared by Langan Engineering and Environmental Services on behalf of Sunoco Refining and was received in our Norristown office on September 30, 2008.

The Department's comments are as follows:

1. A Site-Specific Standard has been proposed for surface soils in the North Yard. Analytical data collected in the 0.0 to 2.0-foot interval shows contaminants of concern (COCs) to be Benzene, Benzo(a)pyrene, and Naphthalene. Appendix F contains the calculations used to support this Demonstration of Attainment. A closer examination of the data in Table F-5 used to calculate the cumulative risk for Benzo(a)pyrene seems to indicate that the total excess cancer cumulative risks would be 1.67 x 10-4. Unfortunately, this number is outside our Act 2 acceptable risk range. Please revisit this part of the assessment.

2. Section 2.4 should include a description of the Jackson Street Sewer, including its dimensions, purpose, and construction. The incidental role of the sewer as a transport mechanism for contaminants from the refinery must not be ignored. The sewer can transport NAPL or contaminated water from AOI-8 to the Schuylkill River, and it can also transport vapor from AOI-8 either to the west (to the River area) or to the east (to the neighborhoods in the vicinity of 29th Street, between Vare Avenue and McKean Street.)

3. Section 5.2 should include more information about the Jackson Street Sewer Total Fluids Recovery System, including when it was constructed, the original purpose, and some information about its operation and success.

4. Section 5.4 should include more information about the North Yard Bulkhead/No. 3 Tank Farm Separator Total Fluids Recovery System, including when it was constructed, the original purpose, and some information about its operation and success.

5. Section 6.5 includes a discussion of vapor control efforts in the Jackson Street Sewer using the water curtain, but it includes no analysis of vapor migration and no assessment of whether or not the water curtain is actually effective. The Department continues to receive reports from residents in the neighborhood adjacent to this sewer complaining about petroleum odors that emanate from the sewer. Based on this history of mysterious and chronic petroleum odor, the Department remains concerned about the possibility that the refinery property, AOI-8, is a source of this nuisance odor. The AOI-8 Site Characterization cannot be considered complete unless it contains an evaluation of the migration of nuisance odors and/or vapors from the site via the sewer.

6. Section 7.6 is incomplete. It should discuss the Jackson Street Sewer as a pathway for contaminants in groundwater to the Schuylkill River. The observed presence of hydrocarbons in the inside walls of the sewer strongly suggests that some such transport occurs. It also should discuss the role of the sewer as a pathway for vapor migration, particularly into the residential neighborhoods in the vicinity of South 29th Street, between Vare Avenue and McKean Street.

If you have any questions or need further information regarding this matter, please contact Ayman Ghobrial at 484-250-5781.

Sincerely,

Ayman L. Ghobrial

Ayman L. Ghobrial, P.G.
Licensed Professional Geologist
Environmental Cleanup

cc: Mr. O'Neil
Mr. Payne, P.G.
Mr. Burke
Mr. Sneath
Ms. Warren
Ms. Costello, P.G. - Langan Engineering
City of Philadelphia
Mr. Herr, P.G. - RT Environmental Services, Inc.
Mr. Brown, P.E. - RT Environmental Services, Inc.
West Chester Borough
Chester County Courthouse
Chester County Health Department
Chester County Planning Commission
Regional File
30 (AR08ECP)318-5

## Appendix E: Data Usability Assessment

Data usability is the process of evaluating the laboratory data results and determining the confidence with which any data point may be used. Data usability is evaluated to ensure that the opportunity for incorporating unacceptable and unmanageable error into the decision-making process is minimized to the extent possible. Usability is determined by evaluating the data qualifiers applied by the laboratory or data validator and the project data quality objectives. Reported results may be considered to have a high degree of confidence because the method performance criteria were achieved or, alternatively, the results may be considered estimates and flagged by the lab. These flags include "J" qualifiers to indicate a reported result is estimated below the laboratory reporting limit; "UJ" qualifiers to indicate a reported non-detect result may be biased because the associated detection limits are inaccurate; and "B" qualifiers to indicate a reported result may be biased high due to blank contamination.

For the purposes of this investigation, groundwater, soil and indoor air sample results were summarized in thirty-one laboratory reports, provided by Lancaster Laboratories, and are evaluated in the sections below for usability. These samples were collected between 2008 and 2009 by Aquaterra Tech. on behalf of Sunoco Inc. and analyzed for volatile organic compounds (VOC), polyaromatic hydrocarbons (PAH), ethylene dibromide (EDB), lead, methane and wet chemistry parameters. Copies of the laboratory reports are provided in this appendix for your reference. Any 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. The criteria used in the data usability summary are presented in the following sections.

### Data Quality Indicators

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

These indicators, as they relate to the data collected during the site characterization, are described in more detail below.

Method Selectivity/Specificity

Method selectivity/specificity is defined as the compound type or class that can be detected by the instrument or detector. Instruments that are used to detect a compound class (i.e., hydrocarbons) are said to be selective. Instruments that are used to detect a specific element group (e.g., halogens) are said to be specific. Groundwater, soil, and indoor air samples, as well as field QC blanks, were analyzed for the following parameters using the listed selective and specified methods:

- GC/MS Volatiles via EPA Methods SW-846 5030B and SW-846 8260B,
- GC/MS PAHs in water via EPA Method SW-846 8270C,
- Ethylene Dibromide via EPA Method SW-846 8011,
- Lead via EPA Method SW-846 6010B and SW-846 6020,
- Wet Chemistry via EPA Method SM20 2540C and SM20 2540G,
- Volatiles via EPA Method TO-15 and
- Methane via EPA Method 18 modified.

Accuracy (Bias)

Accuracy is defined as the amount of agreement between the laboratory's reported concentration and the true concentration of an analyte in an environmental sample. An evaluation of accuracy provides an estimate of bias. Bias is considered to be high or low, which means that the "actual" concentration is likely lower or higher (respectively) than the laboratory result indicates. While bias direction can be estimated for data quality impacts the degree to which bias impacts the laboratory result cannot be estimated.

Indicators of accuracy include, but are not limited to, surrogate spike recoveries, laboratory control spike recoveries, matrix spike recoveries, and matrix spike duplicate recoveries. The acceptable ranges of accuracy for each of the above listed indicators are method specific and are defined within the published analytical test methods specified in the section above. For the purposes of this assessment, accuracy [or bias] was evaluated by reviewing the following indicators:

- *Sample hold times* to ensure all samples were analyzed within method specific timeframes. If hold times are exceeded, reported concentrations may be negatively biased.

- *Lab and field blank samples* to ensure no analytes were detected: if analytes were detected in blank samples, the concentrations of these analytes in the normal environmental samples may be positively biased.

- *Percent recovery of surrogate spikes* (synthetic compounds injected into each sample) to ensure that these compounds were recovered within the

range deemed acceptable by the analytic method. If surrogates are recovered below this range then concentrations reported for the target analytes may be negatively biased: likewise, if surrogates are recovered above this range then concentrations reported for the target analytes may be positively biased.

- *Percent recovery of each compound analyzed in the lab QC samples [Laboratory Control Spike (LCS) and Laboratory Control Spike Duplicate (LCSD)] and field QC samples [Matrix Spike (MS) and Matrix Spike Duplicate (MSD)]*.

  LCS and LCSD samples are samples of DI water spiked with known concentrations of the target analytes. LCS and LCSD samples are run at a rate of one per sample batch (approximately 20 samples) and are indicators of method performance. If compounds within the LCS or LCSD are recovered above or below the acceptable ranges than concentrations of those compounds may be biased in each of the normal environmental samples within the corresponding batch.

  MS and MSD samples are normal environmental samples collected at the project site and spiked with known concentrations of the target analytes. MS and MSD samples are typically run at the same frequency as LCS and LCSD samples but are indicators of potential bias based on the sampling matrix. If compounds within the MS or MSD are recovered above or below the acceptable ranges than concentrations of those compounds may be biased in each of the normal environmental samples within the corresponding batch.

Each laboratory sample delivery group was evaluated for accuracy based on the components listed above. Below is a summary of findings:

*Sample Delivery Group 1090076:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- With the exceptions noted below, recoveries in MS/MSD samples were between acceptable recovery control limits.
  - Recoveries were less than the lower limit for fluorene and benzo(ghi)perylene in the MS and fluorene in the MSD for batch 08130SLA026 (corresponding to samples 5353907 - 5353917).
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.

- Recoveries of 4-bromofluorobenzene in samples 5353909 and 5353917 were less than the lower control limit.
- Recoveries of toluene in samples 5353916 and 5353917 were less than the lower control limit.
- Recovery of 4-bromofluorobenzene in sample 5353916 was greater than the upper control limit.

*Sample Delivery Group 1090550:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
  - Recoveries of nitrobenzene in samples 5356706, 5356714, 5356716 and 5356718 exceeded the upper control limits.
  - Recoveries of 2-fluorobiphenyl in samples 5356699, 5356702, 5356705-5356707, 5356714 and 5356718 exceeded the upper control limits.
  - Recoveries of toluene in samples 5356699, 5356701-5356703, 5356709-5356711, 5356714, 5356716 and 5356717 were less than the lower control limit.
  - Recoveries of 1,2-dichloroethane in samples 5356710-5356711, 5356714 and 5356716 were less than the lower control limit.
  - Recoveries of 4-bromofluorobenzene in samples 5356702 - 5356703 and 5356709 - 5356711 and 5356714 - 5356717 were less than the lower control limit.
  - Recoveries of dibromofluoromethane in samples 5356711, 5356714 and 5356716 were less than the lower control limit.

*Sample Delivery Group 1091319:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
  - Surrogate recovery for 1,2-dichloroethane, toluene and 4-bromofluorobenzene for sample 5361075 were less than the lower limit.

*Sample Delivery Group 1092714:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
    - Surrogate recovery for dibromofluoromethane in sample 5369568 was less than the lower limit.
    - Surrogate recovery for 1,2-dichloroethane in samples 5369567 and 5369568 were less than the lower limit.
    - Surrogate recovery for toluene in samples 5369566-5369569 were less than the lower limit.
    - Surrogate recovery for 4-bromofluorobenzene in samples 5369567 and 5369568 were less than the lower limit.

*Sample Delivery Group 1092715:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
    - Surrogate recovery of toluene in samples 5369573 and 539672 were less than the lower limit.
    - Surrogate recovery of 1,2-dichloroethane in samples 5369571-5369572 were less than the lower limit.
    - Surrogate recovery of 4-bromofluorobenzene in samples 5369572-5369573 were less than the lower limit.
    - Surrogate recovery of 4-bromofluorobenzene in sample 5369571 was greater than the upper limit.

*Sample Delivery Group 1092716:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.

- Surrogate recoveries were between acceptable recovery control limits.

*Sample Delivery Group 1092862:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.
    - Surrogate recovery of 1,2-dichloroethane in samples 5370416-5370417 was less than the lower limit.
    - Surrogate recovery of toluene in samples 5370416-5370418 was less than the lower limit.
    - Surrogate recovery of 4-bromofluorobenzene in sample 5370417 was less than the lower limit.

*Sample Delivery Group 1093507:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits with the exceptions below.
    - Surrogate recovery of toluene and 4-bromofluorobenzene in sample 5374123 was less than the lower limit.

*Sample Delivery Group 1094202:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
    - Surrogate recovery of toluene in sample 5378096 was less than the lower limit.
    - Surrogate recovery of 4-bromofluorobenzene in samples 5378095-5378096 were less than the lower limit.

*Sample Delivery Group 1094907:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

*Sample Delivery Group 1094908:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

*Sample Delivery Group 1095356:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

*Sample Delivery Group 1095850:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

*Sample Delivery Group 1096046:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.

- Surrogate recoveries were between acceptable recovery control limits.

*Sample Delivery Group 1096740:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

*Sample Delivery Group 1096931:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
    - Surrogate recovery of dibromofluoromethane in samples 5394558-5394560 were less than the lower limit.
    - Surrogate recovery of 1,2-dichloroethane in samples 5394558-5394560 were less than the lower limit.
    - Surrogate recovery of toluene in samples 5394558-5394560 were less than the lower limit.
    - Surrogate recovery of 4-bromofluorobenzene in samples 5394557-5394560 were less than the lower limit.

*Sample Delivery Group 1099596:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- With the exceptions noted below, recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
    - Recoveries were greater than the upper limits for pyrene and phenanthrene in the MSD for batch 08191SLB026 (corresponding to sample 5409889.
- Surrogate recoveries were between acceptable recovery control limits.

*Sample Delivery Group 1100643:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.

- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

*Sample Delivery Group 1100865:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for EDB, lead, VOC and PAH parameters, were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
    - Surrogate recovery of nitrobenzene in sample 5416341 was greater than the upper limit.

*Sample Delivery Group 1101087:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- With the exceptions noted below, recoveries in MS/MSD samples, analyzed for EDB, lead, VOC and PAH parameters, were between acceptable recovery control limits.
    - Recoveries were less than the lower limits for toluene, ethylbenzene and xylene in the MS for batch P082053AA (corresponding to samples 5417526 - 5415727).
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
    - Surrogate recovery of 2-fluorobiphenyl in sample 5417522 was greater than the upper limit.

*Sample Delivery Group 1101339:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- With the exceptions noted below, recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.

  - Recoveries were less than the lower limits for toluene, ethylbenzene and xylene in the MS for batch P082053AA (corresponding to samples 5418823 – 5418832).
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
  - Surrogate recovery of 1,1,2,2-tetrachloroethane in samples 5418824 and 5418828 were greater than the upper limit.

*Sample Delivery Group 1101473:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

*Sample Delivery Group 1102042:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
  - Surrogate recoveries of nitrobenzene and 2-fluorobiphenyl in sample 5422562 were greater than the upper limit.

*Sample Delivery Group 1102389:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- With the exceptions noted below, recoveries in MS/MSD samples, analyzed for EDB, lead, VOC and PAH parameters, were between acceptable recovery control limits.
  - Recoveries were greater than the upper limits for lead in the MSD for batch 082136050003A (corresponding to samples 5424682 - 5424694).
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
  - Surrogate recovery of 1,1,2,2-tetrachloroethane in samples 5424688 and 5424691-5424692 were greater than the upper limit.

- Surrogate recoveries of nitrobenzene, 2-fluorobiphenyl and terphenyl for sample 5424693 are greater than the upper limits.

*Sample Delivery Group 1102390:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for EDB, lead, VOC and PAH parameters, were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
  - Surrogate recovery of nitrobenzene in samples 5424702 and 5424705 were greater than the upper limit.
  - Surrogate recovery of 1,1,2,2-tetrachloroethane in sample 5424713 was greater than the upper limit.

*Sample Delivery Group 1102391:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

*Sample Delivery Group 1103058:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

*Sample Delivery Group 1104407:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- With the exceptions noted below, recoveries in LCS/LCSD samples were between acceptable recovery control limits.
  - Recoveries were greater than the upper limits for phenanthrene in the LCSD for batch 08221WAA026 (corresponding to samples 5435927 - 5435928).

- Recoveries in MS/MSD samples, analyzed for EDB, lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

*Sample Delivery Group 1142359:*

- Samples were analyzed within sample hold times.
- One trip blank and no field blanks were submitted for analysis. Target compounds weren't detected above the LOQ in the trip blank.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- MS/MSD samples were not prepared or analyzed for these air samples.
- Surrogate analyses were not performed on air samples.

*Sample Delivery Group 1148395:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- With the exceptions noted below, recoveries in LCS/LCSD samples were between acceptable recovery control limits.
    - Recoveries were greater than the upper limits for 1,4-dioxane and 2-hexanone in the LCS/LCSD for batch C0916730AA (corresponding to samples 5695000 - 5695001).
    - Recoveries were less than the lower limits for vinyl acetate in the LCS/LCSD for batch C0916730AA (corresponding to samples 5695000 - 5695001).
- MS/MSD samples were not prepared or analyzed for these air samples.
- Surrogate analyses were not performed on air samples.

*Sample Delivery Group 1148396:*

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- With the exceptions noted below, recoveries in LCS/LCSD samples were between acceptable recovery control limits.
    - Recoveries were greater than the upper limits for 1,4-dioxane and 2-hexanone in the LCS/LCSD for batch C0916730AA (corresponding to samples 5695002 - 5695004) and for batch C0916730AB (corresponding to sample 5695005).
    - Recoveries were less than the lower limits for vinyl acetate in the LCS/LCSD for batch C0916730AB (corresponding to samples 5695005).
- MS/MSD samples were not prepared or analyzed for these air samples.
- Surrogate analyses were not performed on air samples.

Precision

Precision is defined as the ability to reproduce analytical results and is the measure of variability between individual sample measurements under prescribed conditions. Precision is assessed by the analysis of duplicate samples and expressed in terms of relative percent difference (RPD). For this project, analytical variability was measured as the relative percent difference (RPD) between 1) analytical laboratory duplicates (LCS and LCSD), and 2) the matrix spike (MS) and matrix spike duplicate (MSD). Field duplicate samples are not required under the sampling guidelines and were not collected.

Each laboratory sample delivery group was evaluated for precision based on the components listed above. Below is a summary of findings:

*Sample Delivery Group 1090076:*

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.
- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method, with the following exceptions:
  - Pyrene, fluorene, phenanthrene, anthracene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene and benzo(g,h,i)perylene in batch 08130SLA026 (corresponding to samples 5353907 – 5353917).
  - Lead in batch 081306150002A (corresponding to samples 5353907 – 5353917).

*Sample Delivery Group 1090550:*

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.
- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method, with the following exceptions:
  - Lead in batch 081356150001A (corresponding to sample 5356718).

*Sample Delivery Group 1091319:*

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.
- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method, with the following exceptions:
  - Lead in batch 081376150002A (corresponding to sample 5361075).

*Sample Delivery Group 1092714:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1092715:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1092716:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1092862:*

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.
- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method, with the exceptions noted below.
    - Fluorene and phenanthrene in batch 08149SLE026 (corresponding to samples 5370416 – 5370418)

*Sample Delivery Group 1093507:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1094202:*

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.
- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method, with the following exceptions:
    - Lead in batch 081566150002A (corresponding to samples 5378093 – 5378096).

*Sample Delivery Group 1094907:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1094908:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1095356:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1095850:*

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.

- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method, with the following exceptions:
    - Lead in batch 081706150003A (corresponding to sample 5388263).

*Sample Delivery Group 1096046:*

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.
- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method with the following exceptions:
    - Lead in batch 081706150003A (corresponding to sample 5389508).

*Sample Delivery Group 1096740:*

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.
- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method, with the following exceptions:
    - Lead in batch 081716150003A (corresponding to sample 5393378).

*Sample Delivery Group 1096931:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1099596:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1100643:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1100865:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1101087:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1101339:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1101473:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1102042:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1102389:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1102309:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1102391:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1103058:*

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.
- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method, with the following exceptions:
  - Lead in batch 082146050002A (corresponding to samples 5428282 – 5428285).

*Sample Delivery Group 1104407:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1142359:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1148395:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

*Sample Delivery Group 1148396:*

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Representativeness

Representativeness is the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter most concerned with the proper design of the sampling program. The representativeness criteria may be satisfied by making certain the sampling locations are selected properly and that a sufficient number of samples are collected to fulfill program objectives.

Groundwater, surface water and indoor air samples were collected from locations biased to potential source areas and/or sensitive receptors (surface water bodies, occupied buildings, residential properties). The compounds analyzed in groundwater and soil samples include the compounds currently identified in 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 exception for the waste oil parameters since waste oil is only stored in small tanks within the facility maintenance garages). These compounds are the same as those listed for groundwater in the Current Conditions Report (Langan, 2004). Air samples were analyzed for volatile compounds using the EPA TO-15 method.

The data collected during this investigation is considered representative of groundwater, soil and air in AOI 8 based on the distribution of the monitoring wells, soil borings and air sampling locations within the sampling program, the frequency of sample collection, and the suite of parameters analyzed.

Comparability

Comparability is the degree to which data from one study can be compared with data from other similar studies, reference values (such as background), reference materials, and screening values. This goal was achieved by using standard techniques to collect and analyze representative samples and reporting analytical results in appropriate units. The sample collection methods used were based on PADEP's guidelines summarized in the Groundwater Monitoring Guidance Manual dated December 1, 2001 and the Groundwater Sampling and Analysis Plan, dated January 17, 2008. The analytical methods used are EPA solid waste methods or Standard Methods.

Based on this data quality analysis the data are considered comparable to other groundwater, soil and air data collected as part of other sampling programs.

Completeness

Completeness is defined as the percentage of usable data in the total data population generated. Completeness was calculated for each compound where data were qualified as estimated or rejected and for compounds that were affected by blank contamination. Completeness is determined as the difference between the total

number of data points and the number of data points qualified divided by the total number of data points.

For compounds analyzed in soil [with exception of ethylene dibromide] greater than 95% percent of the data is considered usable. The remaining 5% is considered unusable because, due to matrix interference, the samples were diluted to the point that the laboratory reporting limits were elevated above the corresponding soil screening criteria (PADEP Soil MSCs) and no concentration was detected. Specifically, MTBE in samples N-109_1.0-2.0 and N-126_1.0-2.0; benzene in samples N-109_1.0-2.0, N-122_1.0-2.0, and N-126_1.0-2.0; and 1,2-dichloroethane in samples N-109_1.0-2.0, N-122_1.0-2.0, and N-126_1.0-2.0 are not considered usable for the purposes of characterization and delineation. Similarly, due to matrix interference, ethylene dibromide is also considered unusable in any sample because the laboratory reporting limits were elevated above the PADEP Soil MSC.

For compounds analyzed in groundwater [with exception of chrysene] greater than 92% percent of the data is considered usable. The remaining 8% is considered unusable because, due to matrix interference, the samples were diluted to the point that the laboratory reporting limits were elevated above the corresponding groundwater screening criteria (PADEP GW MSCs) and no concentration was detected. Specifically, 1,2-dichloroethane in samples N-23, N-34, N-35, N-58, N-61, N-119, N-133 and PZ-506; benzene in samples N-23, N-34, N-35, N-58, N-61 and PZ-506; and naphthalene in sample N-36. Similarly, due to matrix interference, chrysene is also considered unusable in any sample because the laboratory reporting limits were elevated above the PADEP Soil MSC.

One hundred percent of the air data is considered usable, with select concentrations considered biased and, therefore, estimated. The number of samples planned was expected to provide sufficient data to satisfy the objective defined in the Current Conditions Report (Langan, 2004). Had the initial results not met QC requirements the volume of samples collected was sufficient to reanalyze samples as necessary.

**Summary and Conclusions**

For the purposes of this investigation, sample results were summarized in thirty one sample delivery groups, provided by Lancaster Laboratories, and are evaluated in the sections above for usability. Copies of the laboratory reports are provided in this appendix for your reference.

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, soil and air data could be used in the decision-making process.

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 evaluation of these indicators the groundwater, soil and air data collected during this investigation is considered usable with the exception of those described above for characterizing the site, identifying compounds of concern, and delineating potential impacts. As detailed in the sections above, few concentrations should be considered as biased because LCS/LCSD, MS/MSD and surrogate recoveries were beyond acceptable control limits. Reviews of the biased concentrations show that it is unlikely that any of the concentrations would have exceeded the standard had the bias not occurred.

Where the LCS/LCSD and MS/MSD recoveries were less than the lower recovery control limit the reported values should be considered as estimated low. Where the recoveries were greater than the upper recovery control limit the reported values should be considered as estimated high. The corresponding data are considered usable but should be considered slightly higher or lower in concentration than representative of the site and time collected.

Lancaster Laboratories

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1090076. Samples arrived at the laboratory on Wednesday, May 07, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| BH-08-31_1.0-2.0 Grab Soil | 5353907 |
| BH-08-33_1.5-2.0 Grab Soil | 5353908 |
| BH-08-34_1.5-2.0 Grab Soil | 5353909 |
| BH-08-29_1.0-2.0 Grab Soil | 5353910 |
| BH-08-15_1.0-2.0 Grab Soil | 5353911 |
| BH-08-35_1.0-2.0 Grab Soil | 5353912 |
| BH-08-14_1.0-2.0 Grab Soil | 5353913 |
| BH-08-27_1.0-2.0 Grab Soil | 5353914 |
| BH-08-13_1.0-2.0 Grab Soil | 5353915 |
| BH-08-28_1.0-2.0 Grab Soil | 5353916 |
| BH-08-12_1.0-2.0 Grab Soil | 5353917 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |

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Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Michele M. Turner

Michele M. Turner
Director

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353907** **Group No. 1090076**

**BH-08-31_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-31_1.0-2.0**
Collected:05/06/2008 10:30 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH831

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation | Units | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 1,300. | 10.9 | mg/kg | 100 |
| 00111 | Moisture | n.a. | 9.4 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | |
| 01195 | Pyrene | 129-00-0 | 25,000. | 4,600. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 920. | 920. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | 2,000. | 920. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | 26,000. | 4,600. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | 8,100. | 920. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 16,000. | 920. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | 13,000. | 920. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 12,000. | 920. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 11,000. | 920. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 6,900. | 920. | ug/kg | 1 |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 240. | 240. | ug/kg | 44.09 |
| 05460 | Benzene | 71-43-2 | < 240. | 240. | ug/kg | 44.09 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 240. | 240. | ug/kg | 44.09 |
| 05466 | Toluene | 108-88-3 | < 240. | 240. | ug/kg | 44.09 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 240. | 240. | ug/kg | 44.09 |
| 05474 | Ethylbenzene | 100-41-4 | < 240. | 240. | ug/kg | 44.09 |
| 05479 | Isopropylbenzene | 98-82-8 | < 240. | 240. | ug/kg | 44.09 |
| 06301 | Xylene (Total) | 1330-20-7 | < 240. | 240. | ug/kg | 44.09 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353907** **Group No. 1090076**

**BH-08-31_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-31_1.0-2.0**
Collected:05/06/2008 10:30 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH831

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 17:34 | James R Williams II | 100 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/08/2008 16:23 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/13/2008 16:06 | Timothy J Trees | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/14/2008 09:59 | Linda M Hartenstine | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/14/2008 05:29 | Stephanie A Selis | 44.09 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/12/2008 20:55 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/06/2008 10:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/10/2008 20:20 | Patricia L Foreman | 1 |

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353908** **Group No. 1090076**

**BH-08-33_1.5-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-33_1.5-2.0**
Collected:05/06/2008 10:40 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH833

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation | Units | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 172. | 1.15 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 13.9 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | |
| 01195 | Pyrene | 129-00-0 | 7,500. | 970. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | 360. | 190. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | 720. | 190. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | 7,200. | 970. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | 1,700. | 190. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 4,600. | 970. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | 4,300. | 190. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 5,400. | 970. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 3,600. | 190. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 2,300. | 190. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 280. | 280. | ug/kg | 47.53 |
| 05460 | Benzene | 71-43-2 | < 280. | 280. | ug/kg | 47.53 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 280. | 280. | ug/kg | 47.53 |
| 05466 | Toluene | 108-88-3 | < 280. | 280. | ug/kg | 47.53 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 280. | 280. | ug/kg | 47.53 |
| 05474 | Ethylbenzene | 100-41-4 | < 280. | 280. | ug/kg | 47.53 |
| 05479 | Isopropylbenzene | 98-82-8 | < 280. | 280. | ug/kg | 47.53 |
| 06301 | Xylene (Total) | 1330-20-7 | < 280. | 280. | ug/kg | 47.53 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353908 Group No. 1090076**

**BH-08-33_1.5-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-33_1.5-2.0**
Collected:05/06/2008 10:40 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH833

| | | | | | | |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 13:05 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/08/2008 16:23 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/13/2008 19:13 | Timothy J Trees | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/14/2008 10:22 | Linda M Hartenstine | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/14/2008 05:52 | Stephanie A Selis | 47.53 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/12/2008 20:55 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/06/2008 10:40 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/10/2008 20:20 | Patricia L Foreman | 1 |

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353909** **Group No. 1090076**

**BH-08-34_1.5-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-34_1.5-2.0**
Collected:05/06/2008 11:00 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH834

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation | Units | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 354. | 1.12 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 13.7 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | |
| 01195 | Pyrene | 129-00-0 | 63,000. | 9,700. | ug/kg | 50 |
| 03761 | Naphthalene | 91-20-3 | < 1,900. | 1,900. | ug/kg | 10 |
| 03768 | Fluorene | 86-73-7 | 8,000. | 1,900. | ug/kg | 10 |
| 03775 | Phenanthrene | 85-01-8 | 64,000. | 9,700. | ug/kg | 50 |
| 03776 | Anthracene | 120-12-7 | 18,000. | 1,900. | ug/kg | 10 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 37,000. | 1,900. | ug/kg | 10 |
| 03782 | Chrysene | 218-01-9 | 32,000. | 1,900. | ug/kg | 10 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 39,000. | 1,900. | ug/kg | 10 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 29,000. | 1,900. | ug/kg | 10 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 18,000. | 1,900. | ug/kg | 10 |
| 02308 | UST-Leaded Soils by 8260B | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 260. | 260. | ug/kg | 45.13 |
| 05460 | Benzene | 71-43-2 | < 260. | 260. | ug/kg | 45.13 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 260. | 260. | ug/kg | 45.13 |
| 05466 | Toluene | 108-88-3 | < 260. | 260. | ug/kg | 45.13 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 260. | 260. | ug/kg | 45.13 |
| 05474 | Ethylbenzene | 100-41-4 | < 260. | 260. | ug/kg | 45.13 |
| 05479 | Isopropylbenzene | 98-82-8 | < 260. | 260. | ug/kg | 45.13 |
| 06301 | Xylene (Total) | 1330-20-7 | < 260. | 260. | ug/kg | 45.13 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353909 Group No. 1090076**

**BH-08-34_1.5-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-34_1.5-2.0**
Collected:05/06/2008 11:00 by SS Account Number: 10132

Submitted: 05/07/2008 17:25 SUN: Aquaterra Tech.
Reported: 05/19/2008 at 18:53 PO Box 744
Discard: 07/19/2008 West Chester PA 19381

BH834

| | | | | | | |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 13:14 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/08/2008 16:23 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/13/2008 21:57 | Timothy J Trees | 10 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/14/2008 10:46 | Linda M Hartenstine | 50 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/14/2008 06:14 | Stephanie A Selis | 45.13 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/12/2008 20:55 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/06/2008 11:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/10/2008 20:20 | Patricia L Foreman | 1 |

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353910** **Group No. 1090076**

**BH-08-29_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-29_1.0-2.0**
Collected:05/06/2008 11:10 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH829

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation | Units | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 96.4 | 1.10 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 12.4 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | |
| 01195 | Pyrene | 129-00-0 | < 190. | 190. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 190. | 190. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 190. | 190. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | < 190. | 190. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 190. | 190. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 190. | 190. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | < 190. | 190. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 190. | 190. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 190. | 190. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 190. | 190. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 230. | 230. | ug/kg | 40.72 |
| 05460 | Benzene | 71-43-2 | < 230. | 230. | ug/kg | 40.72 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 230. | 230. | ug/kg | 40.72 |
| 05466 | Toluene | 108-88-3 | < 230. | 230. | ug/kg | 40.72 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 230. | 230. | ug/kg | 40.72 |
| 05474 | Ethylbenzene | 100-41-4 | < 230. | 230. | ug/kg | 40.72 |
| 05479 | Isopropylbenzene | 98-82-8 | < 230. | 230. | ug/kg | 40.72 |
| 06301 | Xylene (Total) | 1330-20-7 | < 230. | 230. | ug/kg | 40.72 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353910 Group No. 1090076**

**BH-08-29_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-29_1.0-2.0**
Collected:05/06/2008 11:10 by SS Account Number: 10132

Submitted: 05/07/2008 17:25 SUN: Aquaterra Tech.
Reported: 05/19/2008 at 18:53 PO Box 744
Discard: 07/19/2008 West Chester PA 19381

BH829

| | | | | | | |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 13:17 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/08/2008 16:23 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/13/2008 22:20 | Timothy J Trees | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/14/2008 06:37 | Stephanie A Selis | 40.72 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/12/2008 20:55 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/06/2008 11:10 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/10/2008 20:20 | Patricia L Foreman | 1 |

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353911** **Group No. 1090076**

**BH-08-15_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-15_1.0-2.0**
Collected:05/06/2008 12:25 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH815

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation | Units | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 22.8 | 1.13 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 14.0 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | |
| 01195 | Pyrene | 129-00-0 | < 190. | 190. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 190. | 190. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 190. | 190. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | < 190. | 190. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 190. | 190. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 190. | 190. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | < 190. | 190. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 190. | 190. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 190. | 190. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 190. | 190. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 200. | 200. | ug/kg | 34.44 |
| 05460 | Benzene | 71-43-2 | < 200. | 200. | ug/kg | 34.44 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 200. | 200. | ug/kg | 34.44 |
| 05466 | Toluene | 108-88-3 | < 200. | 200. | ug/kg | 34.44 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 200. | 200. | ug/kg | 34.44 |
| 05474 | Ethylbenzene | 100-41-4 | < 200. | 200. | ug/kg | 34.44 |
| 05479 | Isopropylbenzene | 98-82-8 | < 200. | 200. | ug/kg | 34.44 |
| 06301 | Xylene (Total) | 1330-20-7 | < 200. | 200. | ug/kg | 34.44 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353911 Group No. 1090076**

**BH-08-15_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-15_1.0-2.0**
Collected:05/06/2008 12:25 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH815

| | | | | | | |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 13:20 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/08/2008 16:23 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/13/2008 22:44 | Timothy J Trees | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/15/2008 17:17 | Kerri E Koch | 34.44 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/12/2008 20:55 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/06/2008 12:25 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/10/2008 20:20 | Patricia L Foreman | 1 |

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353912** **Group No. 1090076**

**BH-08-35_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-35_1.0-2.0**
Collected:05/06/2008 12:50 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH835

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation | Units | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 14.3 | 1.05 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 7.3 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | |
| 01195 | Pyrene | 129-00-0 | < 180. | 180. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 180. | 180. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 180. | 180. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | < 180. | 180. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 180. | 180. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 180. | 180. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | < 180. | 180. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 180. | 180. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 180. | 180. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 180. | 180. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 220. | 220. | ug/kg | 40.58 |
| 05460 | Benzene | 71-43-2 | < 220. | 220. | ug/kg | 40.58 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 220. | 220. | ug/kg | 40.58 |
| 05466 | Toluene | 108-88-3 | < 220. | 220. | ug/kg | 40.58 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 220. | 220. | ug/kg | 40.58 |
| 05474 | Ethylbenzene | 100-41-4 | < 220. | 220. | ug/kg | 40.58 |
| 05479 | Isopropylbenzene | 98-82-8 | < 220. | 220. | ug/kg | 40.58 |
| 06301 | Xylene (Total) | 1330-20-7 | < 220. | 220. | ug/kg | 40.58 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353912 Group No. 1090076**

**BH-08-35_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-35_1.0-2.0**
Collected:05/06/2008 12:50 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH835

| | | | | | | |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 13:23 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/08/2008 16:23 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/14/2008 11:09 | Linda M Hartenstine | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/14/2008 07:21 | Stephanie A Selis | 40.58 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/12/2008 20:55 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/06/2008 12:50 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/10/2008 20:20 | Patricia L Foreman | 1 |

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353913** **Group No. 1090076**

**BH-08-14_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-14_1.0-2.0**
Collected:05/06/2008 13:15 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH814

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation | Units | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 78.8 | 1.12 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 11.8 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | |
| 01195 | Pyrene | 129-00-0 | 270. | 190. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 190. | 190. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 190. | 190. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | 330. | 190. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 190. | 190. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 190. | 190. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | 250. | 190. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 190. | 190. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 190. | 190. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 190. | 190. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 230. | 230. | ug/kg | 41.39 |
| 05460 | Benzene | 71-43-2 | < 230. | 230. | ug/kg | 41.39 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 230. | 230. | ug/kg | 41.39 |
| 05466 | Toluene | 108-88-3 | < 230. | 230. | ug/kg | 41.39 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 230. | 230. | ug/kg | 41.39 |
| 05474 | Ethylbenzene | 100-41-4 | < 230. | 230. | ug/kg | 41.39 |
| 05479 | Isopropylbenzene | 98-82-8 | < 230. | 230. | ug/kg | 41.39 |
| 06301 | Xylene (Total) | 1330-20-7 | < 230. | 230. | ug/kg | 41.39 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353913** **Group No. 1090076**

**BH-08-14_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-14_1.0-2.0**
Collected:05/06/2008 13:15 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH814

| | | | | | | |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 13:26 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/08/2008 16:23 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/14/2008 11:32 | Linda M Hartenstine | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/14/2008 07:44 | Stephanie A Selis | 41.39 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/12/2008 20:55 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/06/2008 13:15 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/10/2008 20:20 | Patricia L Foreman | 1 |

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353914** **Group No. 1090076**

**BH-08-27_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-27_1.0-2.0**
Collected:05/06/2008 13:45 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH827

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation | Units | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 89.7 | 1.09 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 10. | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | |
| 01195 | Pyrene | 129-00-0 | 580. | 190. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 190. | 190. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 190. | 190. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | 450. | 190. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 190. | 190. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 370. | 190. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | 440. | 190. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 480. | 190. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 400. | 190. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 370. | 190. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 180. | 180. | ug/kg | 31.57 |
| 05460 | Benzene | 71-43-2 | < 180. | 180. | ug/kg | 31.57 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 180. | 180. | ug/kg | 31.57 |
| 05466 | Toluene | 108-88-3 | < 180. | 180. | ug/kg | 31.57 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 180. | 180. | ug/kg | 31.57 |
| 05474 | Ethylbenzene | 100-41-4 | < 180. | 180. | ug/kg | 31.57 |
| 05479 | Isopropylbenzene | 98-82-8 | < 180. | 180. | ug/kg | 31.57 |
| 06301 | Xylene (Total) | 1330-20-7 | < 180. | 180. | ug/kg | 31.57 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353914 Group No. 1090076**

**BH-08-27_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-27_1.0-2.0**
Collected:05/06/2008 13:45 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH827

| | | | | | | |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 13:29 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/08/2008 16:23 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/14/2008 11:56 | Linda M Hartenstine | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/14/2008 08:07 | Stephanie A Selis | 31.57 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/12/2008 20:55 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/06/2008 13:45 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/10/2008 20:20 | Patricia L Foreman | 1 |

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353915 Group No. 1090076**

**BH-08-13_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-13_1.0-2.0**
Collected:05/06/2008 14:35 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH813

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation | Units | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 314. | 1.14 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 14.8 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | |
| 01195 | Pyrene | 129-00-0 | 2,600. | 980. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 980. | 980. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 980. | 980. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | < 980. | 980. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 980. | 980. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 1,100. | 980. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | 2,700. | 980. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 1,100. | 980. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 1,300. | 980. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 1,100. | 980. | ug/kg | 1 |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 190. | 190. | ug/kg | 33.2 |
| 05460 | Benzene | 71-43-2 | < 190. | 190. | ug/kg | 33.2 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 190. | 190. | ug/kg | 33.2 |
| 05466 | Toluene | 108-88-3 | < 190. | 190. | ug/kg | 33.2 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 190. | 190. | ug/kg | 33.2 |
| 05474 | Ethylbenzene | 100-41-4 | < 190. | 190. | ug/kg | 33.2 |
| 05479 | Isopropylbenzene | 98-82-8 | < 190. | 190. | ug/kg | 33.2 |
| 06301 | Xylene (Total) | 1330-20-7 | < 190. | 190. | ug/kg | 33.2 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353915 Group No. 1090076**

**BH-08-13_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-13_1.0-2.0**
Collected:05/06/2008 14:35 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH813

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 13:32 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/08/2008 16:23 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/15/2008 04:09 | Linda M Hartenstine | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/14/2008 08:29 | Stephanie A Selis | 33.2 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/12/2008 20:55 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/06/2008 14:35 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/10/2008 20:20 | Patricia L Foreman | 1 |

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353916** **Group No. 1090076**

**BH-08-28_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-28_1.0-2.0**
Collected:05/06/2008 14:50 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH828

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation | Units | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 132. | 1.15 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 16.4 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | |
| 01195 | Pyrene | 129-00-0 | 1,100. | 1,000. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 1,000. | 1,000. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | 1,100. | 1,000. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | 2,900. | 1,000. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 1,000. | 1,000. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 1,000. | 1,000. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | 1,200. | 1,000. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 1,000. | 1,000. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 1,000. | 1,000. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 1,000. | 1,000. | ug/kg | 1 |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 270. | 270. | ug/kg | 44.8 |
| 05460 | Benzene | 71-43-2 | < 270. | 270. | ug/kg | 44.8 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 270. | 270. | ug/kg | 44.8 |
| 05466 | Toluene | 108-88-3 | < 270. | 270. | ug/kg | 44.8 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 270. | 270. | ug/kg | 44.8 |
| 05474 | Ethylbenzene | 100-41-4 | < 270. | 270. | ug/kg | 44.8 |
| 05479 | Isopropylbenzene | 98-82-8 | < 270. | 270. | ug/kg | 44.8 |
| 06301 | Xylene (Total) | 1330-20-7 | 670. | 270. | ug/kg | 44.8 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353916** **Group No. 1090076**

**BH-08-28_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-28_1.0-2.0**
Collected:05/06/2008 14:50 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH828

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 13:35 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/08/2008 16:23 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/15/2008 04:33 | Linda M Hartenstine | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/14/2008 09:14 | Stephanie A Selis | 44.8 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/12/2008 20:55 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/06/2008 14:50 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/10/2008 20:20 | Patricia L Foreman | 1 |

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353917 Group No. 1090076**

**BH-08-12_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-12_1.0-2.0**
Collected:05/06/2008 15:10 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH812

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation | Units | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 1,250. | 11.6 | mg/kg | 100 |
| 00111 | Moisture | n.a. | 16.6 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | |
| 01195 | Pyrene | 129-00-0 | 2,200. | 1,000. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | 2,700. | 1,000. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | 2,400. | 1,000. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | 6,600. | 1,000. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | 1,500. | 1,000. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 1,000. | 1,000. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | 1,900. | 1,000. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 1,000. | 1,000. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 1,000. | 1,000. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 1,000. | 1,000. | ug/kg | 1 |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 270. | 270. | ug/kg | 44.33 |
| 05460 | Benzene | 71-43-2 | 3,100. | 270. | ug/kg | 44.33 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 270. | 270. | ug/kg | 44.33 |
| 05466 | Toluene | 108-88-3 | 660. | 270. | ug/kg | 44.33 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 270. | 270. | ug/kg | 44.33 |
| 05474 | Ethylbenzene | 100-41-4 | 740. | 270. | ug/kg | 44.33 |
| 05479 | Isopropylbenzene | 98-82-8 | 1,500. | 270. | ug/kg | 44.33 |
| 06301 | Xylene (Total) | 1330-20-7 | 5,800. | 270. | ug/kg | 44.33 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

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# Analysis Report



**Lancaster Laboratories Sample No. SW5353917** **Group No. 1090076**

**BH-08-12_1.0-2.0 Grab Soil**
**Philadelphia Refinery A01-8**
**BH-08-12_1.0-2.0**
Collected:05/06/2008 15:10 by SS

Account Number: 10132

Submitted: 05/07/2008 17:25
Reported: 05/19/2008 at 18:53
Discard: 07/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH812

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 17:36 | James R Williams II | 100 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/08/2008 16:23 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/15/2008 04:56 | Linda M Hartenstine | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/15/2008 18:02 | Kerri E Koch | 44.33 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/12/2008 20:55 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/06/2008 15:10 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/10/2008 20:20 | Patricia L Foreman | 1 |

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1090076
Reported: 05/19/08 at 06:53 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|
| Batch number: 08129820005B | Sample number(s): 5353907-5353917 | | | | | | | |
| Moisture | | | | 100 | | 99-101 | | |
| Batch number: 081306150002A | Sample number(s): 5353907-5353917 | | | | | | | |
| Lead | < 0.100 | 0.100 | mg/kg | 111 | | 82-118 | | |
| Batch number: 08130SLA026 | Sample number(s): 5353907-5353917 | | | | | | | |
| Pyrene | < 170. | 170. | ug/kg | 92 | | 75-115 | | |
| Naphthalene | < 170. | 170. | ug/kg | 89 | | 73-106 | | |
| Fluorene | < 170. | 170. | ug/kg | 91 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | ug/kg | 98 | | 77-113 | | |
| Anthracene | < 170. | 170. | ug/kg | 93 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | ug/kg | 90 | | 73-112 | | |
| Chrysene | < 170. | 170. | ug/kg | 90 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | ug/kg | 86 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | ug/kg | 89 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | ug/kg | 88 | | 65-122 | | |
| Batch number: Q081351AA | Sample number(s): 5353907-5353910,5353912-5353916 | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | ug/kg | 94 | 94 | 72-117 | 0 | 30 |
| Benzene | < 250. | 250. | ug/kg | 94 | 96 | 84-115 | 2 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | ug/kg | 98 | 98 | 76-135 | 1 | 30 |
| Toluene | < 250. | 250. | ug/kg | 91 | 93 | 81-116 | 2 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | ug/kg | 93 | 91 | 77-114 | 1 | 30 |
| Ethylbenzene | < 250. | 250. | ug/kg | 90 | 91 | 82-115 | 1 | 30 |
| Isopropylbenzene | < 250. | 250. | ug/kg | 88 | 88 | 82-110 | 0 | 30 |
| Xylene (Total) | < 250. | 250. | ug/kg | 90 | 92 | 82-117 | 1 | 30 |
| Batch number: Q081361AA | Sample number(s): 5353911,5353917 | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | ug/kg | 102 | 102 | 72-117 | 0 | 30 |
| Benzene | < 250. | 250. | ug/kg | 104 | 104 | 84-115 | 0 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | ug/kg | 108 | 109 | 76-135 | 1 | 30 |
| Toluene | < 250. | 250. | ug/kg | 96 | 96 | 81-116 | 0 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | ug/kg | 96 | 96 | 77-114 | 0 | 30 |
| Ethylbenzene | < 250. | 250. | ug/kg | 94 | 95 | 82-115 | 2 | 30 |
| Isopropylbenzene | < 250. | 250. | ug/kg | 90 | 92 | 82-110 | 2 | 30 |
| Xylene (Total) | < 250. | 250. | ug/kg | 93 | 95 | 82-117 | 2 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|

*- Outside of specification
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1090076
Reported: 05/19/08 at 06:53 PM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08129820005B | Sample number(s): 5353907-5353917 BKG: P353871 | | | | | | | | |
| Moisture | | | | | | 57.6 | 57.5 | 0 | 15 |
| Batch number: 081306150002A | Sample number(s): 5353907-5353917 UNSPK: P357306 BKG: P357306 | | | | | | | | |
| Lead | -41570 (2) | 29412 (2) | 75-125 | 25* | 20 | 4,370. | 5,800. | 28* | 20 |
| Batch number: 08130SLA026 | Sample number(s): 5353907-5353917 UNSPK: 5353907 | | | | | | | | |
| Pyrene | -226 (2) | -688 (2) | 19-162 | 51* | 30 | | | | |
| Naphthalene | 96 | 94 | 29-140 | 2 | 30 | | | | |
| Fluorene | 69 | 31* | 42-139 | 24 | 30 | | | | |
| Phenanthrene | -218 (2) | -715 (2) | 1-181 | 53* | 30 | | | | |
| Anthracene | -33 (2) | -173 (2) | 34-148 | 42* | 30 | | | | |
| Benzo(a)anthracene | -184 (2) | -427 (2) | 20-156 | 45* | 30 | | | | |
| Chrysene | -90 (2) | -343 (2) | 19-158 | 50* | 30 | | | | |
| Benzo(b)fluoranthene | -39 (2) | -314 (2) | 13-161 | 55* | 30 | | | | |
| Benzo(a)pyrene | -90 (2) | -273 (2) | 24-154 | 42* | 30 | | | | |
| Benzo(g,h,i)perylene | -3* | -114* | 26-154 | 35* | 30 | | | | |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08130SLA026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5353907 | 103 | 112 | 107 |
| 5353908 | 83 | 89 | 85 |
| 5353909 | 80 | 84 | 83 |
| 5353910 | 83 | 88 | 81 |
| 5353911 | 77 | 84 | 78 |
| 5353912 | 85 | 88 | 90 |
| 5353913 | 90 | 92 | 87 |
| 5353914 | 89 | 93 | 87 |
| 5353915 | 102 | 104 | 90 |
| 5353916 | 108 | 97 | 86 |
| 5353917 | 104 | 100 | 84 |
| Blank | 86 | 89 | 84 |
| LCS | 86 | 88 | 86 |
| MS | 94 | 99 | 97 |
| MSD | 98 | 107 | 98 |

*- Outside of specification
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1090076
Reported: 05/19/08 at 06:53 PM

### Surrogate Quality Control

| | | | | |
|---|---|---|---|---|
| Limits: | 49-120 | 55-117 | 43-131 | |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081351AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5353907 | 98 | 97 | 88 | 83 |
| 5353908 | 94 | 92 | 87 | 83 |
| 5353909 | 82 | 79 | 73 | 67* |
| 5353910 | 86 | 84 | 80 | 75 |
| 5353912 | 84 | 81 | 78 | 73 |
| 5353913 | 87 | 85 | 78 | 78 |
| 5353914 | 82 | 79 | 75 | 70 |
| 5353915 | 79 | 77 | 70 | 71 |
| 5353916 | 74 | 72 | 68* | 124* |
| Blank | 92 | 92 | 86 | 82 |
| LCS | 98 | 97 | 94 | 94 |
| LCSD | 100 | 98 | 97 | 94 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081361AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5353911 | 88 | 84 | 75 | 72 |
| 5353917 | 81 | 76 | 58* | 63* |
| Blank | 102 | 102 | 92 | 86 |
| LCS | 99 | 98 | 91 | 91 |
| LCSD | 100 | 95 | 92 | 93 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1090076 Sample # 5353907-17

**COC #** 183722

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: Aquaterra Tech Acct. #:

Project Name/#: Sun Refinery AOI-8 PWSID #:

Project Manager: Tiff Doerr P.O.#:

Sampler: Shaun Sykes Quote #:

Name of state where samples were collected: PA

| (2) Sample Identification | Date Collected | Time Collected | (3) # of containers | Matrix (4) Soil | Water | Other | Total # of Containers | (5) Analyses Requested — Preservation Codes: 8260B PAH6 | Lead | Moisture | PAHs by 6C/MS | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BH-08-31_1.0-2.0 | 5/16/08 | 1030 | X | X | | | 2 | 1 | X | X | X | temp 1.1-1.3°C |
| BH-08-33_1.5-2.0 | 5/16/08 | 1040 | X | X | | | 2 | 1 | X | X | X | * pls copy Kevin Martin & Jason Logan * |
| BH-08-34_1.5-2.0 | 5/16/08 | 1100 | X | X | | | 2 | 1 | X | X | X | |
| BH-08-29_1.0-2.0 | 5/16/08 | 1110 | X | X | | | 2 | 1 | X | X | X | |
| BH-08-15_1.0-2.0 | 5/16/08 | 1225 | X | X | | | 2 | 1 | X | X | X | |
| BH-08-35_1.0-2.0 | 5/16/08 | 1250 | X | X | | | 2 | 1 | X | X | X | * analyses per Table provided |
| BH-08-14_1.0-2.0 | 5/16/08 | 1315 | X | X | | | 2 | 1 | X | X | X | |
| BH-08-27_1.0-2.0 | 5/16/08 | 1345 | X | X | | | 2 | 1 | X | X | X | |
| BH-08-13_1.0-2.0 | 5/16/08 | 1435 | X | X | | | 2 | 1 | X | X | X | * call Tiffani Doerr w questions * |
| BH-08-28_1.0-2.0 | 5/16/08 | 1450 | X | X | | | 2 | 1 | X | X | X | |

**For Lab Use Only**

FSC:

SCR#:

**Preservation Codes**

H=HCl T=Thiosulfate

N=$HNO_3$ B=NaOH

S=$H_2SO_4$ O=Other

(6) Preservation Codes

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush

(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)

Date results are needed:

Rush results requested by (please circle): Phone Fax E-mail

Phone #: Fax #:

E-mail address:

(8) **Data Package Options** (please circle if required)

Type I (validation/NJ Reg)

Type II (Tier II)

Type III (Reduced NJ)

Type IV (CLP SOW)

Type VI (Raw Data Only)

TX TRRP-13

MA MCP CT RCP

SDG Complete? Yes No

Site-specific QC (MS/MSD/Dup)? Yes No

(If yes, indicate QC sample and submit triplicate volume.)

Internal COC Required? Yes / No

| Relinquished by: | Date | Time | Received by: | Date | Time (9) |
|---|---|---|---|---|---|
| [illegible] / AQUATERRA | 5/16/08 | 1730 | AQUATERRA FADGE | 5/16/08 | 1730 |
| AT BRIDGE | 5/17/08 | 1000 | [illegible] | 5/17/08 | 1000 |
| [illegible] | 5/17/08 | 1000 | Marvin McFadden | 5/17/08 | 10:10 |
| Marvin McFadden | 5/17/08 | 17:25 | | | |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| | | | [illegible] | 5/17/08 | 17:2[illegible] |

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1090076 Sample # 5353907-17

**COC #** 183723

Please print. Instructions on reverse side correspond with circled numbers.

**For Lab Use Only**
FSC: _____
SCR#: _____

(1) Client: _____ Acct. #: _____
Project Name/#: _____ PWSID #: _____
Project Manager: _____ P.O.#: _____
Sampler: Shaun Sykes Quote #: _____
Name of state where samples were collected: PA

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(6) Comments, Special Requirements or Regulations

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix | Other | Total # of Containers | (5) Analyses Requested / Preservation Codes: 8260B PAVs | Lead | Moisture | PAHs by 6C/MS | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BH-08-12_1.0-2.0 | 5/6/08 | 1510 | X | | X | | 2 | 1 | X | X | X | |

* pls copy Kevin Martin @ Jason @ Lagan *

* analyses per table provided *

temp 1.1-1.3

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: _____
Rush results requested by (please circle): Phone Fax E-mail
Phone #: _____ Fax #: _____
E-mail address: _____

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg) TX TRRP-13
Type II (Tier II) MA MCP CT RCP
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)

SDG Complete? Yes No

Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No _____

| (9) Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| Shaun Sykes / AQUATERRA | 5/6/08 | 1730 | AQUATERRA FRIDGE | 5/6/08 | 1730 |
| AT FRIDGE | 5/7/08 | 1000 | Aquaterra | 5/7/08 | 1000 |
| Aquaterra | 5/7/08 | 1010 | Maureen McFadden | 5/7/08 | 1010 |
| Maureen McFadden | 5/7/08 | 1725 | | | |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| | | | Jeremy Dolan | 5/7/08 | 1725 |

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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Lancaster Laboratories

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1090550. Samples arrived at the laboratory on Friday, May 09, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| BH-08-16_1.0-2.0 Grab Soil | 5356699 |
| BH-08-18_1.0-2.0 Grab Soil | 5356700 |
| BH-08-17_1.0-2.0 Grab Soil | 5356701 |
| BH-08-21_1.0-2.0 Grab Soil | 5356702 |
| BH-08-11_1.0-2.0 Grab Soil | 5356703 |
| BH-08-25_1.0-2.0 Grab Soil | 5356704 |
| BH-08-03_1.0-2.0 Grab Soil | 5356705 |
| BH-08-22_1.0-2.0 Grab Soil | 5356706 |
| BH-08-24_1.0-2.0 Grab Soil | 5356707 |
| BH-08-23_1.0-2.0 Grab Soil | 5356708 |
| BH-08-10_1.0-2.0 Grab Soil | 5356709 |
| BH-08-09_1.0-2.0 Grab Soil | 5356710 |
| BH-08-08_1.0-2.0 Grab Soil | 5356711 |
| BH-08-02_1.0-2.0 Grab Soil | 5356712 |
| N-122_1.0-2.0 Grab Soil | 5356713 |
| BH-08-04_1.0-2.0 Grab Soil | 5356714 |
| BH-08-26_1.0-2.0 Grab Soil | 5356715 |
| BH-08-07_1.0-2.0 Grab Soil | 5356716 |
| N-112_1.0-2.0 Grab Soil | 5356717 |
| N-114_1.0-2.0 Grab Soil | 5356718 |
| BH-08-05_6.0-8.0 Grab Soil | 5356719 |

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# Analysis Report

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Michele M. Turner

Michele M. Turner
Director

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report



**Lancaster Laboratories Sample No. 5356699 SW  Group No. 1090550**

**BH-08-16_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-16**

Collected:05/07/2008 10:00  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

08-16

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 1,380. | 5.58 | 0.838 | mg/kg | 50 |
| 00111 | Moisture | n.a. | 13.9 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 15,000. | 9,700. | 1,900. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | 18,000. | 9,700. | 1,900. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | 21,000. | 9,700. | 1,900. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 58,000. | 9,700. | 1,900. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | 11,000. | 9,700. | 1,900. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 9,700. | 9,700. | 1,900. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | 13,000. | 9,700. | 1,900. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 9,700. | 9,700. | 1,900. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 9,700. | 9,700. | 1,900. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 9,700. | 9,700. | 1,900. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 260. | 260. | 26. | ug/kg | 45.45 |
| 05460 | Benzene | 71-43-2 | 3,100. | 260. | 26. | ug/kg | 45.45 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 260. | 260. | 53. | ug/kg | 45.45 |
| 05466 | Toluene | 108-88-3 | 4,200. | 260. | 53. | ug/kg | 45.45 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 260. | 260. | 53. | ug/kg | 45.45 |
| 05474 | Ethylbenzene | 100-41-4 | 6,600. | 260. | 53. | ug/kg | 45.45 |
| 05479 | Isopropylbenzene | 98-82-8 | 2,100. | 260. | 53. | ug/kg | 45.45 |
| 06301 | Xylene (Total) | 1330-20-7 | 34,000. | 260. | 53. | ug/kg | 45.45 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5356699 SW  Group No. 1090550**

**BH-08-16_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-16**

Collected:05/07/2008 10:00  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20  SUN: Aquaterra Tech.
Reported: 05/22/2008 at 17:49  PO Box 744
Discard: 07/22/2008  West Chester PA 19381

08-16

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/17/2008 09:42 | David K Beck | 50 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 17:13 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/20/2008 16:09 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 15:44 | Kerri E Koch | 45.45 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/07/2008 10:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5356700 SW  Group No. 1090550**

**BH-08-18_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-18**

Collected:05/07/2008 08:45  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

08-18

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 22.2 | 1.13 | 0.169 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 11.5 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 940. | 940. | 190. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 940. | 940. | 190. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 940. | 940. | 190. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 940. | 940. | 190. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 940. | 940. | 190. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 940. | 940. | 190. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 940. | 940. | 190. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 940. | 940. | 190. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 940. | 940. | 190. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 940. | 940. | 190. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 240. | 240. | 24. | ug/kg | 42.09 |
| 05460 | Benzene | 71-43-2 | < 240. | 240. | 24. | ug/kg | 42.09 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 240. | 240. | 48. | ug/kg | 42.09 |
| 05466 | Toluene | 108-88-3 | < 240. | 240. | 48. | ug/kg | 42.09 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 240. | 240. | 48. | ug/kg | 42.09 |
| 05474 | Ethylbenzene | 100-41-4 | < 240. | 240. | 48. | ug/kg | 42.09 |
| 05479 | Isopropylbenzene | 98-82-8 | < 240. | 240. | 48. | ug/kg | 42.09 |
| 06301 | Xylene (Total) | 1330-20-7 | < 240. | 240. | 48. | ug/kg | 42.09 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5356700 SW  Group No. 1090550**

**BH-08-18_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-18**

Collected:05/07/2008 08:45  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20  SUN: Aquaterra Tech.
Reported: 05/22/2008 at 17:49  PO Box 744
Discard: 07/22/2008  West Chester PA 19381

08-18

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 16:12 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 17:13 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/20/2008 17:21 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 16:28 | Kerri E Koch | 42.09 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/07/2008 08:45 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356701 SW  Group No. 1090550**

**BH-08-17_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-17**

Collected:05/07/2008 09:15  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

08-17

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 102. | 1.16 | 0.174 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 15.6 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 990. | 990. | 200. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 990. | 990. | 200. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 990. | 990. | 200. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 990. | 990. | 200. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 990. | 990. | 200. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 990. | 990. | 200. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 990. | 990. | 200. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 990. | 990. | 200. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 990. | 990. | 200. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 990. | 990. | 200. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 240. | 240. | 24. | ug/kg | 39.68 |
| 05460 | Benzene | 71-43-2 | < 240. | 240. | 24. | ug/kg | 39.68 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 240. | 240. | 47. | ug/kg | 39.68 |
| 05466 | Toluene | 108-88-3 | < 240. | 240. | 47. | ug/kg | 39.68 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 240. | 240. | 47. | ug/kg | 39.68 |
| 05474 | Ethylbenzene | 100-41-4 | < 240. | 240. | 47. | ug/kg | 39.68 |
| 05479 | Isopropylbenzene | 98-82-8 | < 240. | 240. | 47. | ug/kg | 39.68 |
| 06301 | Xylene (Total) | 1330-20-7 | < 240. | 240. | 47. | ug/kg | 39.68 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5356701 SW  Group No. 1090550**

**BH-08-17_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-17**

Collected:05/07/2008 09:15  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20  SUN: Aquaterra Tech.
Reported: 05/22/2008 at 17:49  PO Box 744
Discard: 07/22/2008  West Chester PA 19381

08-17

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 16:40 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 17:13 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/20/2008 17:44 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 16:51 | Kerri E Koch | 39.68 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/07/2008 09:15 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356702 SW  Group No. 1090550**

**BH-08-21_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-21**

Collected:05/07/2008 09:30  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

08-21

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 540. | 1.15 | 0.172 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 13.6 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 9,700. | 4,800. | 960. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 250. | 250. | 25. | ug/kg | 44.01 |
| 05460 | Benzene | 71-43-2 | < 250. | 250. | 25. | ug/kg | 44.01 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 250. | 250. | 51. | ug/kg | 44.01 |
| 05466 | Toluene | 108-88-3 | < 250. | 250. | 51. | ug/kg | 44.01 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 250. | 250. | 51. | ug/kg | 44.01 |
| 05474 | Ethylbenzene | 100-41-4 | < 250. | 250. | 51. | ug/kg | 44.01 |
| 05479 | Isopropylbenzene | 98-82-8 | < 250. | 250. | 51. | ug/kg | 44.01 |
| 06301 | Xylene (Total) | 1330-20-7 | < 250. | 250. | 51. | ug/kg | 44.01 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356702 SW  Group No. 1090550**

**BH-08-21_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-21**

Collected:05/07/2008 09:30  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20  SUN: Aquaterra Tech.
Reported: 05/22/2008 at 17:49  PO Box 744
Discard: 07/22/2008  West Chester PA 19381

08-21

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 16:43 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 17:13 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/20/2008 18:08 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 17:13 | Kerri E Koch | 44.01 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/07/2008 09:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356703 SW  Group No. 1090550**

**BH-08-11_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-11**

Collected:05/07/2008 10:15  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

08-11

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 131. | 1.16 | 0.174 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 15.3 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 240. | 240. | 24. | ug/kg | 40.26 |
| 05460 | Benzene | 71-43-2 | 310. | 240. | 24. | ug/kg | 40.26 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 240. | 240. | 48. | ug/kg | 40.26 |
| 05466 | Toluene | 108-88-3 | < 240. | 240. | 48. | ug/kg | 40.26 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 240. | 240. | 48. | ug/kg | 40.26 |
| 05474 | Ethylbenzene | 100-41-4 | < 240. | 240. | 48. | ug/kg | 40.26 |
| 05479 | Isopropylbenzene | 98-82-8 | < 240. | 240. | 48. | ug/kg | 40.26 |
| 06301 | Xylene (Total) | 1330-20-7 | < 240. | 240. | 48. | ug/kg | 40.26 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5356703 SW  Group No. 1090550**

**BH-08-11_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-11**

Collected:05/07/2008 10:15  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20  SUN: Aquaterra Tech.
Reported: 05/22/2008 at 17:49  PO Box 744
Discard: 07/22/2008  West Chester PA 19381

08-11

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 16:46 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 2 | 05/13/2008 18:00 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/20/2008 18:31 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 17:35 | Kerri E Koch | 40.26 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/07/2008 10:15 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356704 SW  Group No. 1090550**

**BH-08-25_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-25**

Collected:05/07/2008 10:40  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

08-25

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 223. | 1.11 | 0.167 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 10.3 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 4,600. | 4,600. | 930. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 4,600. | 4,600. | 930. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 4,600. | 4,600. | 930. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 4,600. | 4,600. | 930. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 4,600. | 4,600. | 930. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 4,600. | 4,600. | 930. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 4,600. | 4,600. | 930. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 4,600. | 4,600. | 930. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 4,600. | 4,600. | 930. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 4,600. | 4,600. | 930. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 460. | 460. | 46. | ug/kg | 83.06 |
| 05460 | Benzene | 71-43-2 | < 460. | 460. | 46. | ug/kg | 83.06 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 460. | 460. | 93. | ug/kg | 83.06 |
| 05466 | Toluene | 108-88-3 | < 460. | 460. | 93. | ug/kg | 83.06 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 460. | 460. | 93. | ug/kg | 83.06 |
| 05474 | Ethylbenzene | 100-41-4 | < 460. | 460. | 93. | ug/kg | 83.06 |
| 05479 | Isopropylbenzene | 98-82-8 | < 460. | 460. | 93. | ug/kg | 83.06 |
| 06301 | Xylene (Total) | 1330-20-7 | < 460. | 460. | 93. | ug/kg | 83.06 |
| | The reporting limits for the GC/MS volatile compounds were raised due to the level of non-target compounds. | | | | | | |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5356704 SW  Group No. 1090550**

**BH-08-25_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-25**

Collected:05/07/2008 10:40  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20  SUN: Aquaterra Tech.
Reported: 05/22/2008 at 17:49  PO Box 744
Discard: 07/22/2008  West Chester PA 19381

08-25

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

All QC is compliant unless otherwise noted.  Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 16:48 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 17:13 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/20/2008 18:55 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 17:58 | Kerri E Koch | 83.06 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/07/2008 10:40 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356705 SW  Group No. 1090550**

**BH-08-03_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-03**

Collected:05/07/2008 11:00  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

B0803

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 291. | 1.09 | 0.164 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 11.3 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 4,700. | 4,700. | 940. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 4,700. | 4,700. | 940. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 4,700. | 4,700. | 940. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 6,800. | 4,700. | 940. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 4,700. | 4,700. | 940. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 4,700. | 4,700. | 940. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 4,700. | 4,700. | 940. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 4,700. | 4,700. | 940. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 4,700. | 4,700. | 940. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 4,700. | 4,700. | 940. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 220. | 220. | 22. | ug/kg | 39.43 |
| 05460 | Benzene | 71-43-2 | 580. | 220. | 22. | ug/kg | 39.43 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 220. | 220. | 44. | ug/kg | 39.43 |
| 05466 | Toluene | 108-88-3 | 230. | 220. | 44. | ug/kg | 39.43 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 220. | 220. | 44. | ug/kg | 39.43 |
| 05474 | Ethylbenzene | 100-41-4 | < 220. | 220. | 44. | ug/kg | 39.43 |
| 05479 | Isopropylbenzene | 98-82-8 | 440. | 220. | 44. | ug/kg | 39.43 |
| 06301 | Xylene (Total) | 1330-20-7 | 340. | 220. | 44. | ug/kg | 39.43 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356705 SW  Group No. 1090550**

**BH-08-03_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-03**

Collected:05/07/2008 11:00  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

B0803

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 16:51 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 17:13 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/20/2008 19:19 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 18:43 | Kerri E Koch | 39.43 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/07/2008 11:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356706 SW  Group No. 1090550**

**BH-08-22_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-22**

Collected:05/07/2008 11:15  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

08-22

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 213. | 1.13 | 0.169 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 13.2 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 4,800. | 4,800. | 960. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 260. | 260. | 26. | ug/kg | 44.88 |
| 05460 | Benzene | 71-43-2 | < 260. | 260. | 26. | ug/kg | 44.88 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 260. | 260. | 52. | ug/kg | 44.88 |
| 05466 | Toluene | 108-88-3 | < 260. | 260. | 52. | ug/kg | 44.88 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 260. | 260. | 52. | ug/kg | 44.88 |
| 05474 | Ethylbenzene | 100-41-4 | < 260. | 260. | 52. | ug/kg | 44.88 |
| 05479 | Isopropylbenzene | 98-82-8 | < 260. | 260. | 52. | ug/kg | 44.88 |
| 06301 | Xylene (Total) | 1330-20-7 | < 260. | 260. | 52. | ug/kg | 44.88 |

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All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5356706 SW  Group No. 1090550**

**BH-08-22_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-22**

Collected:05/07/2008 11:15  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

08-22

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 16:54 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 17:13 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/20/2008 19:43 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 19:06 | Kerri E Koch | 44.88 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/07/2008 11:15 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356707 SW  Group No. 1090550**

**BH-08-24_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-24**

Collected:05/07/2008 12:20  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

08-24

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 172. | 1.08 | 0.162 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 9.4 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 4,600. | 4,600. | 920. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 4,600. | 4,600. | 920. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 4,600. | 4,600. | 920. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 5,900. | 4,600. | 920. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 4,600. | 4,600. | 920. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 4,600. | 4,600. | 920. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 4,600. | 4,600. | 920. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 4,600. | 4,600. | 920. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 4,600. | 4,600. | 920. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 4,600. | 4,600. | 920. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 380. | 380. | 38. | ug/kg | 68.87 |
| 05460 | Benzene | 71-43-2 | < 380. | 380. | 38. | ug/kg | 68.87 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 380. | 380. | 76. | ug/kg | 68.87 |
| 05466 | Toluene | 108-88-3 | < 380. | 380. | 76. | ug/kg | 68.87 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 380. | 380. | 76. | ug/kg | 68.87 |
| 05474 | Ethylbenzene | 100-41-4 | < 380. | 380. | 76. | ug/kg | 68.87 |
| 05479 | Isopropylbenzene | 98-82-8 | 1,400. | 380. | 76. | ug/kg | 68.87 |
| 06301 | Xylene (Total) | 1330-20-7 | 600. | 380. | 76. | ug/kg | 68.87 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356707 SW  Group No. 1090550**

**BH-08-24_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-24**

Collected:05/07/2008 12:20  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

08-24

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 16:57 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 17:13 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/20/2008 20:06 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 19:28 | Kerri E Koch | 68.87 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/07/2008 12:20 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356708 SW  Group No. 1090550**

**BH-08-23_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-23**

Collected:05/07/2008 12:40  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

08-23

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 374. | 1.17 | 0.175 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 15.9 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 5,000. | 5,000. | 990. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 5,000. | 5,000. | 990. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 5,000. | 5,000. | 990. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 5,000. | 5,000. | 990. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 5,000. | 5,000. | 990. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 5,000. | 5,000. | 990. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 5,000. | 5,000. | 990. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 5,000. | 5,000. | 990. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 5,000. | 5,000. | 990. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 5,000. | 5,000. | 990. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 180. | 180. | 18. | ug/kg | 30.64 |
| 05460 | Benzene | 71-43-2 | < 180. | 180. | 18. | ug/kg | 30.64 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 180. | 180. | 36. | ug/kg | 30.64 |
| 05466 | Toluene | 108-88-3 | < 180. | 180. | 36. | ug/kg | 30.64 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 180. | 180. | 36. | ug/kg | 30.64 |
| 05474 | Ethylbenzene | 100-41-4 | < 180. | 180. | 36. | ug/kg | 30.64 |
| 05479 | Isopropylbenzene | 98-82-8 | < 180. | 180. | 36. | ug/kg | 30.64 |
| 06301 | Xylene (Total) | 1330-20-7 | 200. | 180. | 36. | ug/kg | 30.64 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356708 SW  Group No. 1090550**

**BH-08-23_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-23**

Collected:05/07/2008 12:40  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20  SUN: Aquaterra Tech.
Reported: 05/22/2008 at 17:49  PO Box 744
Discard: 07/22/2008  West Chester PA 19381

08-23

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 17:00 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 17:13 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/20/2008 20:30 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 20:13 | Kerri E Koch | 30.64 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/07/2008 12:40 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356709 SW  Group No. 1090550**

**BH-08-10_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-10**

Collected:05/07/2008 13:15  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

08-10

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 428. | 1.10 | 0.165 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 11.5 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 2,100. | 940. | 190. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 940. | 940. | 190. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 940. | 940. | 190. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 1,700. | 940. | 190. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 940. | 940. | 190. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 2,000. | 940. | 190. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | 1,900. | 940. | 190. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 2,500. | 940. | 190. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 2,600. | 940. | 190. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 1,800. | 940. | 190. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 200. | 200. | 20. | ug/kg | 35.92 |
| 05460 | Benzene | 71-43-2 | < 200. | 200. | 20. | ug/kg | 35.92 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 200. | 200. | 41. | ug/kg | 35.92 |
| 05466 | Toluene | 108-88-3 | 420. | 200. | 41. | ug/kg | 35.92 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 200. | 200. | 41. | ug/kg | 35.92 |
| 05474 | Ethylbenzene | 100-41-4 | < 200. | 200. | 41. | ug/kg | 35.92 |
| 05479 | Isopropylbenzene | 98-82-8 | < 200. | 200. | 41. | ug/kg | 35.92 |
| 06301 | Xylene (Total) | 1330-20-7 | 360. | 200. | 41. | ug/kg | 35.92 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5356709 SW  Group No. 1090550**

**BH-08-10_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-10**

Collected:05/07/2008 13:15  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20  SUN: Aquaterra Tech.
Reported: 05/22/2008 at 17:49  PO Box 744
Discard: 07/22/2008  West Chester PA 19381

08-10

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 17:02 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 17:13 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/20/2008 20:54 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 20:36 | Kerri E Koch | 35.92 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/07/2008 13:15 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356710 SW  Group No. 1090550**

**BH-08-09_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-09**

Collected:05/07/2008 14:00  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

08-09

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 262. | 1.09 | 0.163 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 10.7 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 8,500. | 4,700. | 930. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | 5,900. | 4,700. | 930. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 4,700. | 4,700. | 930. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 8,500. | 4,700. | 930. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 4,700. | 4,700. | 930. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 4,700. | 4,700. | 930. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | 6,900. | 4,700. | 930. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 6,300. | 4,700. | 930. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 4,700. | 4,700. | 930. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 4,700. | 4,700. | 930. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 400. | 400. | 40. | ug/kg | 71.63 |
| 05460 | Benzene | 71-43-2 | 3,200. | 400. | 40. | ug/kg | 71.63 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 400. | 400. | 80. | ug/kg | 71.63 |
| 05466 | Toluene | 108-88-3 | 990. | 400. | 80. | ug/kg | 71.63 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 400. | 400. | 80. | ug/kg | 71.63 |
| 05474 | Ethylbenzene | 100-41-4 | < 400. | 400. | 80. | ug/kg | 71.63 |
| 05479 | Isopropylbenzene | 98-82-8 | < 400. | 400. | 80. | ug/kg | 71.63 |
| 06301 | Xylene (Total) | 1330-20-7 | 3,200. | 400. | 80. | ug/kg | 71.63 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5356710 SW  Group No. 1090550**

**BH-08-09_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-09**

Collected:05/07/2008 14:00  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20  SUN: Aquaterra Tech.
Reported: 05/22/2008 at 17:49  PO Box 744
Discard: 07/22/2008  West Chester PA 19381

08-09

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 17:05 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 17:13 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/21/2008 05:45 | Linda M Hartenstine | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 20:58 | Kerri E Koch | 71.63 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/07/2008 14:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356711 SW  Group No. 1090550**

**BH-08-08_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-08**

Collected:05/07/2008 14:20  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

B0808

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 637. | 2.41 | 0.361 | mg/kg | 20 |
| 00111 | Moisture | n.a. | 17.7 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 5,100. | 5,100. | 1,000. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 5,100. | 5,100. | 1,000. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 5,100. | 5,100. | 1,000. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 5,100. | 5,100. | 1,000. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 5,100. | 5,100. | 1,000. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 5,100. | 5,100. | 1,000. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | 7,200. | 5,100. | 1,000. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 5,100. | 5,100. | 1,000. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 5,100. | 5,100. | 1,000. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 5,100. | 5,100. | 1,000. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised.<br><br>Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 380. | 380. | 38. | ug/kg | 62.19 |
| 05460 | Benzene | 71-43-2 | 1,900. | 380. | 38. | ug/kg | 62.19 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 380. | 380. | 76. | ug/kg | 62.19 |
| 05466 | Toluene | 108-88-3 | < 380. | 380. | 76. | ug/kg | 62.19 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 380. | 380. | 76. | ug/kg | 62.19 |
| 05474 | Ethylbenzene | 100-41-4 | < 380. | 380. | 76. | ug/kg | 62.19 |
| 05479 | Isopropylbenzene | 98-82-8 | < 380. | 380. | 76. | ug/kg | 62.19 |
| 06301 | Xylene (Total) | 1330-20-7 | 620. | 380. | 76. | ug/kg | 62.19 |
| | Surrogate recoveries are outside of QC limits for the GC/MS volatile fraction. The analysis was repeated and the reanalysis surrogate recoveries are also out of specification indicating a matrix effect. An internal standard peak area was also outside the QC limits for the re-analysis. | | | | | | |

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5356711 SW  Group No. 1090550**

**BH-08-08_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-08**

Collected:05/07/2008 14:20  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20  SUN: Aquaterra Tech.
Reported: 05/22/2008 at 17:49  PO Box 744
Discard: 07/22/2008  West Chester PA 19381

B0808

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted.  Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/17/2008 09:45 | David K Beck | 20 |
| 00111 | Moisture | SM20 2540 G | 2 | 05/13/2008 18:00 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/21/2008 06:08 | Linda M Hartenstine | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 14:41 | Nicholas R Rossi | 62.19 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/07/2008 14:20 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356712 SW  Group No. 1090550**

**BH-08-02_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-02**

Collected:05/07/2008 14:50  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

08-02

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 138. | 1.11 | 0.167 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 11.9 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 950. | 950. | 190. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 950. | 950. | 190. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 950. | 950. | 190. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 950. | 950. | 190. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 950. | 950. | 190. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 950. | 950. | 190. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 950. | 950. | 190. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 950. | 950. | 190. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 950. | 950. | 190. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 950. | 950. | 190. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 230. | 230. | 23. | ug/kg | 39.81 |
| 05460 | Benzene | 71-43-2 | < 230. | 230. | 23. | ug/kg | 39.81 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 230. | 230. | 45. | ug/kg | 39.81 |
| 05466 | Toluene | 108-88-3 | < 230. | 230. | 45. | ug/kg | 39.81 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 230. | 230. | 45. | ug/kg | 39.81 |
| 05474 | Ethylbenzene | 100-41-4 | < 230. | 230. | 45. | ug/kg | 39.81 |
| 05479 | Isopropylbenzene | 98-82-8 | < 230. | 230. | 45. | ug/kg | 39.81 |
| 06301 | Xylene (Total) | 1330-20-7 | < 230. | 230. | 45. | ug/kg | 39.81 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5356712 SW  Group No. 1090550**

**BH-08-02_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-02**

Collected:05/07/2008 14:50  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20  SUN: Aquaterra Tech.
Reported: 05/22/2008 at 17:49  PO Box 744
Discard: 07/22/2008  West Chester PA 19381

08-02

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 17:17 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 17:13 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/21/2008 06:32 | Linda M Hartenstine | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 15:04 | Nicholas R Rossi | 39.81 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/07/2008 14:50 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356713 SW  Group No. 1090550**

**N-122_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 N-122**

Collected:05/07/2008 09:05  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-122

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 207. | 1.11 | 0.166 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 11.3 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 1,200. | 940. | 190. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 940. | 940. | 190. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | 980. | 940. | 190. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 2,100. | 940. | 190. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | 2,100. | 940. | 190. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 940. | 940. | 190. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 940. | 940. | 190. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 940. | 940. | 190. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 940. | 940. | 190. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 940. | 940. | 190. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 200. | 200. | 20. | ug/kg | 35.06 |
| 05460 | Benzene | 71-43-2 | < 200. | 200. | 20. | ug/kg | 35.06 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 200. | 200. | 40. | ug/kg | 35.06 |
| 05466 | Toluene | 108-88-3 | < 200. | 200. | 40. | ug/kg | 35.06 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 200. | 200. | 40. | ug/kg | 35.06 |
| 05474 | Ethylbenzene | 100-41-4 | < 200. | 200. | 40. | ug/kg | 35.06 |
| 05479 | Isopropylbenzene | 98-82-8 | < 200. | 200. | 40. | ug/kg | 35.06 |
| 06301 | Xylene (Total) | 1330-20-7 | < 200. | 200. | 40. | ug/kg | 35.06 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5356713 SW  Group No. 1090550**

**N-122_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 N-122**

Collected:05/07/2008 09:05  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-122

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 17:19 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 17:13 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/21/2008 06:56 | Linda M Hartenstine | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 15:26 | Nicholas R Rossi | 35.06 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/07/2008 09:05 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356714 SW  Group No. 1090550**

**BH-08-04_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-04**

Collected:05/08/2008 08:45  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

B0804

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 829. | 2.41 | 0.362 | mg/kg | 20 |
| 00111 | Moisture | n.a. | 17.9 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 10,000. | 10,000. | 2,000. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | 12,000. | 10,000. | 2,000. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 10,000. | 10,000. | 2,000. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 20,000. | 10,000. | 2,000. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 10,000. | 10,000. | 2,000. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 10,000. | 10,000. | 2,000. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 10,000. | 10,000. | 2,000. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 10,000. | 10,000. | 2,000. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 10,000. | 10,000. | 2,000. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 10,000. | 10,000. | 2,000. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 270. | 270. | 27. | ug/kg | 43.71 |
| 05460 | Benzene | 71-43-2 | 3,300. | 270. | 27. | ug/kg | 43.71 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 270. | 270. | 53. | ug/kg | 43.71 |
| 05466 | Toluene | 108-88-3 | 590. | 270. | 53. | ug/kg | 43.71 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 270. | 270. | 53. | ug/kg | 43.71 |
| 05474 | Ethylbenzene | 100-41-4 | 8,400. | 270. | 53. | ug/kg | 43.71 |
| 05479 | Isopropylbenzene | 98-82-8 | 2,400. | 270. | 53. | ug/kg | 43.71 |
| 06301 | Xylene (Total) | 1330-20-7 | 32,000. | 2,700. | 530. | ug/kg | 437.06 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5356714 SW  Group No. 1090550**

**BH-08-04_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-04**

Collected:05/08/2008 08:45  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20  SUN: Aquaterra Tech.
Reported: 05/22/2008 at 17:49  PO Box 744
Discard: 07/22/2008  West Chester PA 19381

B0804

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/17/2008 09:55 | David K Beck | 20 |
| 00111 | Moisture | SM20 2540 G | 2 | 05/13/2008 16:38 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/21/2008 07:20 | Linda M Hartenstine | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 16:56 | Nicholas R Rossi | 43.71 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 17:18 | Nicholas R Rossi | 437.06 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/08/2008 08:45 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356715 SW  Group No. 1090550**

**BH-08-26_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-26**

Collected:05/08/2008 09:00  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

08-26

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 261. | 1.13 | 0.170 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 15.1 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 4,900. | 4,900. | 980. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 210. | 210. | 21. | ug/kg | 35.31 |
| 05460 | Benzene | 71-43-2 | 9,000. | 210. | 21. | ug/kg | 35.31 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 210. | 210. | 42. | ug/kg | 35.31 |
| 05466 | Toluene | 108-88-3 | < 210. | 210. | 42. | ug/kg | 35.31 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 210. | 210. | 42. | ug/kg | 35.31 |
| 05474 | Ethylbenzene | 100-41-4 | < 210. | 210. | 42. | ug/kg | 35.31 |
| 05479 | Isopropylbenzene | 98-82-8 | 660. | 210. | 42. | ug/kg | 35.31 |
| 06301 | Xylene (Total) | 1330-20-7 | < 210. | 210. | 42. | ug/kg | 35.31 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5356715 SW  Group No. 1090550**

**BH-08-26_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-26**

Collected:05/08/2008 09:00  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

08-26

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 17:25 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 17:13 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/21/2008 07:44 | Linda M Hartenstine | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 15:49 | Nicholas R Rossi | 35.31 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/08/2008 09:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356716 SW  Group No. 1090550**

**BH-08-07_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-07**

Collected:05/08/2008 09:15  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

B0807

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 519. | 1.18 | 0.177 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 17.6 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 5,900. | 5,100. | 1,000. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | 15,000. | 5,100. | 1,000. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | 12,000. | 5,100. | 1,000. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 34,000. | 5,100. | 1,000. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 5,100. | 5,100. | 1,000. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 5,100. | 5,100. | 1,000. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 5,100. | 5,100. | 1,000. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 5,100. | 5,100. | 1,000. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 5,100. | 5,100. | 1,000. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 5,100. | 5,100. | 1,000. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 250. | 250. | 25. | ug/kg | 41.12 |
| 05460 | Benzene | 71-43-2 | 1,400. | 250. | 25. | ug/kg | 41.12 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 250. | 250. | 50. | ug/kg | 41.12 |
| 05466 | Toluene | 108-88-3 | 470. | 250. | 50. | ug/kg | 41.12 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 250. | 250. | 50. | ug/kg | 41.12 |
| 05474 | Ethylbenzene | 100-41-4 | 8,400. | 250. | 50. | ug/kg | 41.12 |
| 05479 | Isopropylbenzene | 98-82-8 | 3,800. | 250. | 50. | ug/kg | 41.12 |
| 06301 | Xylene (Total) | 1330-20-7 | 28,000. | 2,500. | 500. | ug/kg | 411.18 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5356716 SW  Group No. 1090550**

**BH-08-07_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-07**

Collected:05/08/2008 09:15  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20  SUN: Aquaterra Tech.
Reported: 05/22/2008 at 17:49  PO Box 744
Discard: 07/22/2008  West Chester PA 19381

B0807

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 17:28 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 17:13 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/21/2008 08:08 | Linda M Hartenstine | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 17:40 | Nicholas R Rossi | 41.12 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 18:03 | Nicholas R Rossi | 411.18 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/08/2008 09:15 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356717 SW  Group No. 1090550**

**N-112_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 N-112**

Collected:05/08/2008 14:20  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-112

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 11.6 | 1.16 | 0.173 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 15.2 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 200. | 200. | 39. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 200. | 200. | 39. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 200. | 200. | 39. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | < 200. | 200. | 39. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 200. | 200. | 39. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 200. | 200. | 39. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | < 200. | 200. | 39. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 200. | 200. | 39. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 200. | 200. | 39. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 200. | 200. | 39. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 440. | 440. | 44. | ug/kg | 73.96 |
| 05460 | Benzene | 71-43-2 | < 440. | 440. | 44. | ug/kg | 73.96 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 440. | 440. | 87. | ug/kg | 73.96 |
| 05466 | Toluene | 108-88-3 | < 440. | 440. | 87. | ug/kg | 73.96 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 440. | 440. | 87. | ug/kg | 73.96 |
| 05474 | Ethylbenzene | 100-41-4 | < 440. | 440. | 87. | ug/kg | 73.96 |
| 05479 | Isopropylbenzene | 98-82-8 | < 440. | 440. | 87. | ug/kg | 73.96 |
| 06301 | Xylene (Total) | 1330-20-7 | < 440. | 440. | 87. | ug/kg | 73.96 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted.  Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5356717 SW  Group No. 1090550**

**N-112_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 N-112**

Collected:05/08/2008 14:20  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-112

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 17:31 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 2 | 05/13/2008 16:38 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/21/2008 08:31 | Linda M Hartenstine | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 16:11 | Nicholas R Rossi | 73.96 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/08/2008 14:20 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5356718 SW  Group No. 1090550**

**N-114_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 N-114**

Collected:05/08/2008 14:50  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-114

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 139. | 1.11 | 0.167 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 11.0 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 13,000. | 4,700. | 940. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 4,700. | 4,700. | 940. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | 10,000. | 4,700. | 940. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 26,000. | 4,700. | 940. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 4,700. | 4,700. | 940. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 4,700. | 4,700. | 940. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | 6,900. | 4,700. | 940. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 4,700. | 4,700. | 940. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 4,700. | 4,700. | 940. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 4,700. | 4,700. | 940. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 240. | 240. | 24. | ug/kg | 42.66 |
| 05460 | Benzene | 71-43-2 | 510. | 240. | 24. | ug/kg | 42.66 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 240. | 240. | 48. | ug/kg | 42.66 |
| 05466 | Toluene | 108-88-3 | 420. | 240. | 48. | ug/kg | 42.66 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 240. | 240. | 48. | ug/kg | 42.66 |
| 05474 | Ethylbenzene | 100-41-4 | 250. | 240. | 48. | ug/kg | 42.66 |
| 05479 | Isopropylbenzene | 98-82-8 | 590. | 240. | 48. | ug/kg | 42.66 |
| 06301 | Xylene (Total) | 1330-20-7 | 690. | 240. | 48. | ug/kg | 42.66 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5356718 SW  Group No. 1090550**

**N-114_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 N-114**

Collected:05/08/2008 14:50  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-114

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/18/2008 14:34 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 17:13 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/21/2008 08:55 | Linda M Hartenstine | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/16/2008 16:33 | Nicholas R Rossi | 42.66 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/14/2008 20:40 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/08/2008 14:50 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/15/2008 02:00 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5356719 SW  Group No. 1090550**

**BH-08-05_6.0-8.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC:  183724 BH-08-05**

Collected:05/08/2008 13:50  by SS  Account Number: 10132

Submitted: 05/09/2008 15:20
Reported: 05/22/2008 at 17:49
Discard: 07/22/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

B0805

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 63.4 | 1.35 | 0.203 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 27.6 | 0.50 | 0.50 | % | 1 |

"Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis.

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted.  Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/15/2008 16:28 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/12/2008 15:01 | Scott W Freisher | 1 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/13/2008 20:10 | Annamaria Stipkovits | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1090550
Reported: 05/22/08 at 05:49 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08133820005A | Sample number(s): 5356719 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08133820006A | Sample number(s): 5356699-5356702,5356704-5356708 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08133820006B | Sample number(s): 5356709-5356710,5356712-5356713,5356715-5356716,5356718 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 081346150002A | Sample number(s): 5356699-5356717,5356719 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 111 | | 82-118 | | |
| Batch number: 08134820002A | Sample number(s): 5356703 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08134820002B | Sample number(s): 5356711 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08134820003A | Sample number(s): 5356714 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08134820003B | Sample number(s): 5356717 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 081356150001A | Sample number(s): 5356718 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 104 | | 82-118 | | |
| Batch number: 08135SLD026 | Sample number(s): 5356699-5356718 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 104 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 89 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 105 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 108 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 102 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 104 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 101 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 115 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 113 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 109 | | 65-122 | | |
| Batch number: Q081371AA | Sample number(s): 5356699-5356710 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 110 | 105 | 72-117 | 4 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 110 | 105 | 84-115 | 4 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 116 | 110 | 76-135 | 5 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 97 | 93 | 81-116 | 4 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 96 | 94 | 77-114 | 2 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 94 | 92 | 82-115 | 3 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 92 | 90 | 82-110 | 3 | 30 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1090550
Reported: 05/22/08 at 05:49 PM

### Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 95 | 92 | 82-117 | 3 | 30 |
| Batch number: R081371AA | Sample number(s): 5356711-5356718 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 89 | 89 | 72-117 | 0 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 95 | 93 | 84-115 | 2 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 93 | 95 | 76-135 | 2 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 100 | 99 | 81-116 | 1 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 99 | 98 | 77-114 | 1 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 99 | 98 | 82-115 | 1 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 100 | 98 | 82-110 | 2 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 99 | 98 | 82-117 | 1 | 30 |

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08133820005A | Sample number(s): 5356719 BKG: P355918 | | | | | | | | |
| Moisture | | | | | | 41.0 | 41.5 | 1 | 15 |
| Batch number: 08133820006A | Sample number(s): 5356699-5356702,5356704-5356708 BKG: 5356701 | | | | | | | | |
| Moisture | | | | | | 15.6 | 15.0 | 4 | 15 |
| Batch number: 08133820006B | Sample number(s): 5356709-5356710,5356712-5356713,5356715-5356716,5356718 BKG: P356714 | | | | | | | | |
| Moisture | | | | | | 14.2 | 17.1 | 19* | 15 |
| Batch number: 081346150002A | Sample number(s): 5356699-5356717,5356719 UNSPK: 5356700 BKG: 5356700 | | | | | | | | |
| Lead | 214 (2) | 154 (2) | 75-125 | 4 | 20 | 19.6 | 20.2 | 3 | 20 |
| Batch number: 08134820002A | Sample number(s): 5356703 BKG: 5356703 | | | | | | | | |
| Moisture | | | | | | 15.3 | 16.8 | 9 | 15 |
| Batch number: 08134820002B | Sample number(s): 5356711 BKG: 5356711 | | | | | | | | |
| Moisture | | | | | | 17.7 | 17.5 | 1 | 15 |
| Batch number: 08134820003A | Sample number(s): 5356714 BKG: 5356714 | | | | | | | | |
| Moisture | | | | | | 17.9 | 18.3 | 2 | 15 |
| Batch number: 08134820003B | Sample number(s): 5356717 BKG: 5356717 | | | | | | | | |
| Moisture | | | | | | 15.2 | 15.9 | 4 | 15 |
| Batch number: 081356150001A | Sample number(s): 5356718 UNSPK: P356481 BKG: P356481 | | | | | | | | |
| Lead | -7815 (2) | -8833 (2) | 75-125 | 52* | 20 | 155. | 31.4 | 132* | 20 |
| Batch number: 08135SLD026 | Sample number(s): 5356699-5356718 UNSPK: 5356699 | | | | | | | | |
| Pyrene | 171 (2) | 210 (2) | 19-162 | 4 | 30 | | | | |
| Naphthalene | 126 (2) | 152 (2) | 29-140 | 2 | 30 | | | | |
| Fluorene | 172 (2) | 207 (2) | 42-139 | 3 | 30 | | | | |
| Phenanthrene | 207 (2) | 316 (2) | 1-181 | 3 | 30 | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1090550
Reported: 05/22/08 at 05:49 PM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Anthracene | 119 (2) | 96 (2) | 34-148 | 4 | 30 | | | | |
| Benzo(a)anthracene | 112 | 150 | 20-156 | 8 | 30 | | | | |
| Chrysene | 171 (2) | 168 (2) | 19-158 | 0 | 30 | | | | |
| Benzo(b)fluoranthene | 131 | 147 | 13-161 | 5 | 30 | | | | |
| Benzo(a)pyrene | 129 | 102 | 24-154 | 8 | 30 | | | | |
| Benzo(g,h,i)perylene | 129 | 110 | 26-154 | 8 | 30 | | | | |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08135SLD026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5356699 | 110 | 119* | 116 |
| 5356700 | 96 | 104 | 91 |
| 5356701 | 95 | 102 | 90 |
| 5356702 | 109 | 120* | 102 |
| 5356703 | 95 | 101 | 92 |
| 5356704 | 114 | 109 | 102 |
| 5356705 | 112 | 124* | 103 |
| 5356706 | 126* | 129* | 115 |
| 5356707 | 109 | 119* | 107 |
| 5356708 | 119 | 113 | 94 |
| 5356709 | 91 | 98 | 85 |
| 5356710 | 55 | 61 | 55 |
| 5356711 | 100 | 108 | 97 |
| 5356712 | 100 | 106 | 96 |
| 5356713 | 100 | 103 | 92 |
| 5356714 | 132* | 126* | 117 |
| 5356715 | 104 | 113 | 111 |
| 5356716 | 139* | 102 | 84 |
| 5356717 | 90 | 93 | 75 |
| 5356718 | 163* | 133* | 111 |
| Blank | 93 | 97 | 88 |
| LCS | 92 | 99 | 90 |
| MS | 112 | 113 | 119 |
| MSD | 108 | 107 | 107 |
| Limits: | 49-120 | 55-117 | 43-131 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081371AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5356699 | 78 | 76 | 61* | 66* |
| 5356700 | 89 | 88 | 72 | 71 |
| 5356701 | 87 | 86 | 69* | 67* |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1090550
Reported: 05/22/08 at 05:49 PM

### Surrogate Quality Control

| | | | | |
|---|---|---|---|---|
| 5356702 | 84 | 81 | 62* | 62* |
| 5356703 | 85 | 84 | 69* | 61* |
| 5356704 | 86 | 86 | 74 | 73 |
| 5356705 | 90 | 87 | 81 | 76 |
| 5356706 | 91 | 88 | 72 | 72 |
| 5356707 | 97 | 93 | 76 | 101 |
| 5356708 | 93 | 90 | 74 | 83 |
| 5356709 | 89 | 79 | 68* | 64* |
| 5356710 | 79 | 67* | 49* | 39* |
| Blank | 106 | 105 | 91 | 87 |
| LCS | 106 | 102 | 92 | 92 |
| LCSD | 101 | 99 | 88 | 89 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: R081371AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5356711 | 61* | 57* | 50* | 39* |
| 5356712 | 77 | 75 | 77 | 77 |
| 5356713 | 73 | 71 | 74 | 76 |
| 5356714 | 56* | 56* | 46* | 50* |
| 5356715 | 72 | 70 | 70 | 68* |
| 5356716 | 59* | 59* | 59* | 66* |
| 5356717 | 74 | 74 | 48* | 21* |
| 5356718 | 71 | 71 | 78 | 106 |
| Blank | 85 | 87 | 88 | 87 |
| LCS | 83 | 82 | 87 | 91 |
| LCSD | 83 | 83 | 86 | 89 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10182 Group# 1090550 Sample # 5356699-719

**COC # 183724**

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: SUN-AQUATERRA Acct. #:

Project Name/#: PHIL REF-AOI-8 PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: S. SYKES Quote #:

Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#:

Preservation Codes
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water | Other | Total # of Containers | (5) Analyses Requested: 8260B PAV6 | Lead | Moisture | PAHs by GCMS 8270 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BH-08-16_1.0-2.0 | 5/7/08 | 1000 | X | | X | | | 2 | 1 | X | X | X | temp 1.9-2.1°C |
| BH-08-18_1.0-2.0 | | 845 | X | | X | | | 2 | 1 | X | X | X | |
| BH-08-17_1.0-2.0 | | 915 | X | | X | | | 2 | 1 | X | X | X | * Pls copy |
| BH-08-21_1.0-2.0 | | 930 | X | | X | | | 2 | 1 | X | X | X | Kevin Martin & |
| BH-08-11_1.0-2.0 | | 1015 | X | | X | | | 2 | 1 | X | X | X | Jason @ Langan |
| BH-08-25_1.0-2.0 | | 1040 | X | | X | | | 2 | 1 | X | X | X | |
| BH-08-03_1.0-2.0 | | 1100 | X | | X | | | 2 | 1 | X | X | X | * Analyses per table |
| BH-08-22_1.0-2.0 | | 1115 | X | | X | | | 2 | 1 | X | X | X | provided |
| BH-08-24_1.0-2.0 | | 1220 | X | | X | | | 2 | 1 | X | X | X | |
| BH-08-23_1.0-2.0 | | 1240 | X | | X | | | 2 | 1 | X | X | X | |

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

(9)

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| AQUATERRA | 5/7/08 | 1730 | AQUATERRA FRIDGE | 5/7/08 | 1730 |
| | 5/9/08 | 0950 | Erma Allman | 5/9/08 | 9:50 |
| Erma Allman | 5/9/08 | 15:20 | | | |
| | | | | | |
| | | | Erma Allman | 5/9/08 | 1520 |

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1090550 Sample # 5356699-719

**COC # 183725**

Please print. Instructions on reverse side correspond with circled numbers.

**For Lab Use Only**
FSC:
SCR#:

(1) Client: SUN-AQUATERRA Acct. #:
Project Name/#: PHILREF-AOI-8 PWSID #:
Project Manager: T. DOERR P.O.#:
Sampler: S. SYKES Quote #:
Name of state where samples were collected: PA

(3) Grab / Composite

(4) Matrix: Soil / Water / Other (Potable / NPDES — Check if Applicable); Total # of Containers

(5) Analyses Requested — Preservation Codes

| (2) Sample Identification | Date Collected | Time Collected | Grab | Composite | Soil | Water | Other | Total # of Containers | 8260B PAH's | Lead | Moisture | PAHs by GC/MS 8270 | | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BH-08-10_1.0-2.0 | 5/7/08 | 1315 | X | | X | | | 2 | X | X | X | X | | | | | | | | temp 1.9-2.1°C |
| BH-08-09_1.0-2.0 | 5/7/08 | 1400 | X | | X | | | 2 | X | X | X | X | | | | | | | | * pls copy Kevin Martin & Jason @ Langan |
| BH-08-08_1.0-2.0 | 5/7/08 | 1420 | X | | X | | | 2 | X | X | X | X | | | | | | | | |
| BH-08-02_1.0-2.0 | 5/7/08 | 1450 | X | | X | | | 2 | X | X | X | X | | | | | | | | * Analyses per table provided |
| N-122_1.0-2.0 | 5/7/08 | 905 | X | | X | | | 2 | X | X | X | X | | | | | | | | |

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(6) Temperature upon receipt

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

(9)

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| [signature] / AQUATERRA | 5/7/08 | 1730 | AQUATERRA FRIDGE | 5/7/08 | 1730 |
| [signature] | 5/8/08 | 0950 | Erma Hellman | 5/8/08 | 9:50 |
| Erma Hellman | 5/9/08 | 1520 | | | |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| Relinquished by: | Date | Time | Received by: [signature] | 5/6/08 | 1520 |

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 190550 Sample # 5356699-719

**COC #** 183726

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: SUN-AQUATERRA Acct. #:

Project Name/#: PHILA REF-AOI-8 PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: S. SYKES Quote #:

Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#:

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(6) Condition of Samples upon receipt (preservation)

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water | Other | Total # of Containers | (5) Analyses Requested: 8260B PAVs | Moisture | Lead | PAHs by 8270 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BH-08-04_1.0-2.0 | 5/8/08 | 845 | X | | X | | | 2 | X | X | X | X | *Pls copy Kevin Martin & Jason Morgan |
| BH-08-26_1.0-2.0 | " | 900 | X | | X | | | 2 | X | X | X | X | |
| BH-08-07_1.0-2.0 | " | 915 | X | | X | | | 2 | X | X | X | X | |
| N-112_1.0-2.0 | " | 1420 | X | | X | | | 2 | X | X | X | X | ^Analyses per table provided |
| N-114_1.0-2.0 | " | 1450 | X | | X | | | 2 | X | X | X | X | |
| BH-08-05_6.0-8.0 | " | 1350 | X | | X | | | 1 | | | X | | *Hold for TCLP Analysis (BH-08-05) |
| | | | | | | | | | | | | | temp 1.9-2.1°C |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

(9)

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| [signature] / AQUATERRA | 5/8/08 | 1700 | AQUATERRA FRIDGE | 5/8/08 | 1700 |
| [signature] | 5/9/08 | 0950 | Erma Hellman | 5/9/08 | 9:50 |
| Erma Hellman | 5/9/08 | 15:10 | | | |
| | | | | | |
| | | | [signature] | 5/9/08 | 1520 |

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Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

**WARRANTY AND LIMITS OF LIABILITY –** In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1091319. Samples arrived at the laboratory on Wednesday, May 14, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-132_1.0-2.0 Grab Soil | 5361075 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |

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Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Michele M. Turner

Michele M. Turner
Director

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5361075 SW  Group No. 1091319**

**N-132_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183729 N-132_1.0-2.0**

Collected:05/13/2008 08:00  by SS  Account Number: 10132

Submitted: 05/14/2008 16:45
Reported: 05/30/2008 at 11:29
Discard: 07/30/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-132

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 94.9 | 1.11 | 0.166 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 11.6 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 9,400. | 9,400. | 1,900. | ug/kg | 10 |
| 03761 | Naphthalene | 91-20-3 | < 9,400. | 9,400. | 1,900. | ug/kg | 10 |
| 03768 | Fluorene | 86-73-7 | < 9,400. | 9,400. | 1,900. | ug/kg | 10 |
| 03775 | Phenanthrene | 85-01-8 | < 9,400. | 9,400. | 1,900. | ug/kg | 10 |
| 03776 | Anthracene | 120-12-7 | < 9,400. | 9,400. | 1,900. | ug/kg | 10 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 9,400. | 9,400. | 1,900. | ug/kg | 10 |
| 03782 | Chrysene | 218-01-9 | < 9,400. | 9,400. | 1,900. | ug/kg | 10 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 9,400. | 9,400. | 1,900. | ug/kg | 10 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 9,400. | 9,400. | 1,900. | ug/kg | 10 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 9,400. | 9,400. | 1,900. | ug/kg | 10 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 230. | 230. | 23. | ug/kg | 41.39 |
| 05460 | Benzene | 71-43-2 | < 230. | 230. | 23. | ug/kg | 41.39 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 230. | 230. | 47. | ug/kg | 41.39 |
| 05466 | Toluene | 108-88-3 | < 230. | 230. | 47. | ug/kg | 41.39 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 230. | 230. | 47. | ug/kg | 41.39 |
| 05474 | Ethylbenzene | 100-41-4 | < 230. | 230. | 47. | ug/kg | 41.39 |
| 05479 | Isopropylbenzene | 98-82-8 | < 230. | 230. | 47. | ug/kg | 41.39 |
| 06301 | Xylene (Total) | 1330-20-7 | < 230. | 230. | 47. | ug/kg | 41.39 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5361075 SW  Group No. 1091319**

**N-132_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183729 N-132_1.0-2.0**

Collected:05/13/2008 08:00  by SS  Account Number: 10132

Submitted: 05/14/2008 16:45
Reported: 05/30/2008 at 11:29
Discard: 07/30/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-132

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 05/20/2008 14:35 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/15/2008 18:50 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/25/2008 19:15 | Gregory J Drahovsky | 10 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/21/2008 18:09 | Lauren C Marzario | 41.39 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/18/2008 20:50 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/13/2008 08:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/18/2008 22:00 | Patricia L Foreman | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1091319
Reported: 05/30/08 at 11:29 AM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08136820006A | Sample number(s): 5361075 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 081376150002A | Sample number(s): 5361075 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 112 | | 82-118 | | |
| Batch number: 08138SLA026 | Sample number(s): 5361075 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 100 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 92 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 110 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 103 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 99 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 98 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 97 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 103 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 103 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 102 | | 65-122 | | |
| Batch number: Q081422AA | Sample number(s): 5361075 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 92 | 94 | 72-117 | 2 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 90 | 92 | 84-115 | 2 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 98 | 99 | 76-135 | 1 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 90 | 91 | 81-116 | 1 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 91 | 92 | 77-114 | 1 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 88 | 90 | 82-115 | 3 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 86 | 88 | 82-110 | 2 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 89 | 91 | 82-117 | 3 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08136820006A | Sample number(s): 5361075 BKG: P361398 | | | | | | | | |
| Moisture | | | | | | 34.2 | 31.3 | 9 | 15 |
| Batch number: 081376150002A | Sample number(s): 5361075 UNSPK: P360657 BKG: P360657 | | | | | | | | |
| Lead | 3039 (2) | 492 (2) | 75-125 | 37* | 20 | 76.2 | 102. | 29* | 20 |
| Batch number: 08138SLA026 | Sample number(s): 5361075 UNSPK: P361321 | | | | | | | | |
| Pyrene | 104 | 108 | 19-162 | 4 | 30 | | | | |
| Naphthalene | 93 | 98 | 29-140 | 6 | 30 | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1091319
Reported: 05/30/08 at 11:29 AM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Fluorene | 110 | 115 | 42-139 | 5 | 30 | | | | |
| Phenanthrene | 103 | 108 | 1-181 | 5 | 30 | | | | |
| Anthracene | 101 | 106 | 34-148 | 5 | 30 | | | | |
| Benzo(a)anthracene | 99 | 104 | 20-156 | 5 | 30 | | | | |
| Chrysene | 99 | 102 | 19-158 | 3 | 30 | | | | |
| Benzo(b)fluoranthene | 103 | 106 | 13-161 | 3 | 30 | | | | |
| Benzo(a)pyrene | 105 | 110 | 24-154 | 5 | 30 | | | | |
| Benzo(g,h,i)perylene | 107 | 113 | 26-154 | 5 | 30 | | | | |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed
unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08138SLA026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5361075 | 95 | 106 | 101 |
| Blank | 87 | 96 | 93 |
| LCS | 88 | 98 | 94 |
| MS | 89 | 101 | 100 |
| MSD | 94 | 106 | 103 |
| Limits: | 49-120 | 55-117 | 43-131 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081422AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5361075 | 73 | 68* | 60* | 58* |
| Blank | 94 | 92 | 87 | 89 |
| LCS | 88 | 86 | 85 | 89 |
| LCSD | 91 | 87 | 89 | 92 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only
Acct. # 10132 Group# 1091319 Sample # 5361075

**COC # 183729**

Please print. Instructions on reverse side correspond with circled numbers. Cooler temp 4.7°C

(1) Client: SUN-AQUATERRA Acct. #:
Project Name/#: PHILA REF AOI-8 PWSID #:
Project Manager: T. DOERR P.O.#:
Sampler: S. SYKES Quote #:
Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#:

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Drinking Water | Groundwater | Wastewater | Other | Total # of Containers | (5) Analyses Requested / Preservation Codes: PAN 8260 B | Moisture | Lead | PAHs 8270 | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-132_1.0-2.0 | 5/13/08 | 800 | X | | X | | | | | 2 | X | X | X | X | | | | | * pls copy Kenmartin and Jason DLangan<br>** See table per analyses |

Preservation Codes
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(6) Preservation Codes (please fill in the preservation codes for all samples submitted)

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| [signature] / AQUATERRA | 5/13/08 | 1640 | AQUATERRA FRIDGE | 5/13/08 | 1640 |
| [signature] | 5/14/08 | 9:10 | Marvin McCallister | 5/14/08 | 9:10 |
| Marvin McCallister | 5/14/08 | 1648 | | | |
| | | | | | |
| | | | Katie Hartline | 5/14/08 | 16:45 |

(9)

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Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

**WARRANTY AND LIMITS OF LIABILITY –** In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1092714. Samples arrived at the laboratory on Thursday, May 22, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-110_1.0-2.0 Grab Soil | 5369564 |
| N-111_1.0-2.0 Grab Soil | 5369565 |
| N-113_1.0-2.0 Grab Soil | 5369566 |
| N-133_1.0-2.0 Grab Soil | 5369567 |
| N-135_1.0-2.0 Grab Soil | 5369568 |
| N-136_1.0-2.0 Grab Soil | 5369569 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Marla S. Lord
Senior Specialist

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5369564 SW  Group No. 1092714**

**N-110_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183728 N-110_1.0-2.0**

Collected:05/14/2008 09:10  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30
Reported: 06/03/2008 at 12:24
Discard: 08/03/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N110-

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 15.0 | 1.06 | 0.159 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 6.7 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 180. | 180. | 36. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 180. | 180. | 36. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 180. | 180. | 36. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | < 180. | 180. | 36. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 180. | 180. | 36. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 180. | 180. | 36. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | < 180. | 180. | 36. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 180. | 180. | 36. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 180. | 180. | 36. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 180. | 180. | 36. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 240. | 240. | 24. | ug/kg | 43.86 |
| 05460 | Benzene | 71-43-2 | < 240. | 240. | 24. | ug/kg | 43.86 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 240. | 240. | 47. | ug/kg | 43.86 |
| 05466 | Toluene | 108-88-3 | < 240. | 240. | 47. | ug/kg | 43.86 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 240. | 240. | 47. | ug/kg | 43.86 |
| 05474 | Ethylbenzene | 100-41-4 | < 240. | 240. | 47. | ug/kg | 43.86 |
| 05479 | Isopropylbenzene | 98-82-8 | < 240. | 240. | 47. | ug/kg | 43.86 |
| 06301 | Xylene (Total) | 1330-20-7 | < 240. | 240. | 47. | ug/kg | 43.86 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5369564 SW  Group No. 1092714**

**N-110_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183728 N-110_1.0-2.0**

Collected:05/14/2008 09:10  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30
Reported: 06/03/2008 at 12:24
Discard: 08/03/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N110-

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/01/2008 06:07 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/23/2008 15:56 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/27/2008 13:27 | Joseph M Gambler | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/28/2008 13:51 | Kerri E Koch | 43.86 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/26/2008 19:25 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/14/2008 09:10 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/23/2008 13:15 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5369565 SW  Group No. 1092714**

**N-111_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183728 N-111_1.0-2.0**

Collected:05/14/2008 11:00  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30
Reported: 06/03/2008 at 12:24
Discard: 08/03/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N111-

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 117. | 1.06 | 0.158 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 8.9 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 1,400. | 910. | 180. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 910. | 910. | 180. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 910. | 910. | 180. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 1,100. | 910. | 180. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 910. | 910. | 180. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 910. | 910. | 180. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 910. | 910. | 180. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 960. | 910. | 180. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 910. | 910. | 180. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 910. | 910. | 180. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 240. | 240. | 24. | ug/kg | 43.1 |
| 05460 | Benzene | 71-43-2 | < 240. | 240. | 24. | ug/kg | 43.1 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 240. | 240. | 47. | ug/kg | 43.1 |
| 05466 | Toluene | 108-88-3 | < 240. | 240. | 47. | ug/kg | 43.1 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 240. | 240. | 47. | ug/kg | 43.1 |
| 05474 | Ethylbenzene | 100-41-4 | < 240. | 240. | 47. | ug/kg | 43.1 |
| 05479 | Isopropylbenzene | 98-82-8 | < 240. | 240. | 47. | ug/kg | 43.1 |
| 06301 | Xylene (Total) | 1330-20-7 | < 240. | 240. | 47. | ug/kg | 43.1 |

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All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5369565 SW  Group No. 1092714**

**N-111_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183728 N-111_1.0-2.0**

Collected:05/14/2008 11:00  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30
Reported: 06/03/2008 at 12:24
Discard: 08/03/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N111-

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/01/2008 06:10 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/23/2008 15:56 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/27/2008 13:51 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/28/2008 14:14 | Kerri E Koch | 43.1 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/26/2008 19:25 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/14/2008 11:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/23/2008 13:15 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5369566 SW  Group No. 1092714**

**N-113_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183728 N-113_1.0-2.0**

Collected:05/15/2008 08:00  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30
Reported: 06/03/2008 at 12:25
Discard: 08/03/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N113-

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 77.9 | 1.06 | 0.158 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 5.3 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 4,400. | 4,400. | 880. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 4,400. | 4,400. | 880. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 4,400. | 4,400. | 880. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 4,400. | 4,400. | 880. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 4,400. | 4,400. | 880. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 4,400. | 4,400. | 880. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 4,400. | 4,400. | 880. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 4,400. | 4,400. | 880. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 4,400. | 4,400. | 880. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 4,400. | 4,400. | 880. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 180. | 180. | 18. | ug/kg | 34.72 |
| 05460 | Benzene | 71-43-2 | < 180. | 180. | 18. | ug/kg | 34.72 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 180. | 180. | 37. | ug/kg | 34.72 |
| 05466 | Toluene | 108-88-3 | < 180. | 180. | 37. | ug/kg | 34.72 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 180. | 180. | 37. | ug/kg | 34.72 |
| 05474 | Ethylbenzene | 100-41-4 | < 180. | 180. | 37. | ug/kg | 34.72 |
| 05479 | Isopropylbenzene | 98-82-8 | 320. | 180. | 37. | ug/kg | 34.72 |
| 06301 | Xylene (Total) | 1330-20-7 | < 180. | 180. | 37. | ug/kg | 34.72 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5369566 SW  Group No. 1092714**

**N-113_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183728 N-113_1.0-2.0**

Collected:05/15/2008 08:00  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30  SUN: Aquaterra Tech.
Reported: 06/03/2008 at 12:25  PO Box 744
Discard: 08/03/2008  West Chester PA 19381

N113-

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/01/2008 06:14 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/23/2008 15:56 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/27/2008 14:15 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/29/2008 18:27 | Kerri E Koch | 34.72 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/26/2008 19:25 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/15/2008 08:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/23/2008 13:15 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5369567 SW  Group No. 1092714**

**N-133_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183728 N-133_1.0-2.0**

Collected:05/15/2008 11:00  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30
Reported: 06/03/2008 at 12:25
Discard: 08/03/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N133-

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 865. | 2.36 | 0.353 | mg/kg | 20 |
| 00111 | Moisture | n.a. | 15.1 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 9,800. | 9,800. | 2,000. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 9,800. | 9,800. | 2,000. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 9,800. | 9,800. | 2,000. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 9,800. | 9,800. | 2,000. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 9,800. | 9,800. | 2,000. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 9,800. | 9,800. | 2,000. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 9,800. | 9,800. | 2,000. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 9,800. | 9,800. | 2,000. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 9,800. | 9,800. | 2,000. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 9,800. | 9,800. | 2,000. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 300. | 300. | 30. | ug/kg | 51.65 |
| 05460 | Benzene | 71-43-2 | 3,700. | 300. | 30. | ug/kg | 51.65 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 300. | 300. | 61. | ug/kg | 51.65 |
| 05466 | Toluene | 108-88-3 | < 300. | 300. | 61. | ug/kg | 51.65 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 300. | 300. | 61. | ug/kg | 51.65 |
| 05474 | Ethylbenzene | 100-41-4 | < 300. | 300. | 61. | ug/kg | 51.65 |
| 05479 | Isopropylbenzene | 98-82-8 | < 300. | 300. | 61. | ug/kg | 51.65 |
| 06301 | Xylene (Total) | 1330-20-7 | 480. | 300. | 61. | ug/kg | 51.65 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5369567 SW  Group No. 1092714**

**N-133_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183728 N-133_1.0-2.0**

Collected:05/15/2008 11:00  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30
Reported: 06/03/2008 at 12:25
Discard: 08/03/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N133-

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/01/2008 09:22 | David K Beck | 20 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/23/2008 15:56 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/27/2008 14:39 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/29/2008 18:50 | Kerri E Koch | 51.65 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/26/2008 19:25 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/15/2008 11:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/23/2008 13:15 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5369568 SW  Group No. 1092714**

**N-135_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183728 N-135_1.0-2.0**

Collected:05/15/2008 14:00  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30
Reported: 06/03/2008 at 12:25
Discard: 08/03/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N135-

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 273. | 1.21 | 0.181 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 18.0 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 4,400. | 1,000. | 200. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | 2,100. | 1,000. | 200. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 1,000. | 1,000. | 200. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 7,700. | 1,000. | 200. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | 1,600. | 1,000. | 200. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 1,500. | 1,000. | 200. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | 3,000. | 1,000. | 200. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 1,000. | 1,000. | 200. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 1,500. | 1,000. | 200. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 2,400. | 1,000. | 200. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 350. | 350. | 35. | ug/kg | 57.47 |
| 05460 | Benzene | 71-43-2 | < 350. | 350. | 35. | ug/kg | 57.47 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 350. | 350. | 70. | ug/kg | 57.47 |
| 05466 | Toluene | 108-88-3 | < 350. | 350. | 70. | ug/kg | 57.47 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 350. | 350. | 70. | ug/kg | 57.47 |
| 05474 | Ethylbenzene | 100-41-4 | < 350. | 350. | 70. | ug/kg | 57.47 |
| 05479 | Isopropylbenzene | 98-82-8 | < 350. | 350. | 70. | ug/kg | 57.47 |
| 06301 | Xylene (Total) | 1330-20-7 | < 350. | 350. | 70. | ug/kg | 57.47 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5369568 SW  Group No. 1092714**

**N-135_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183728 N-135_1.0-2.0**

Collected:05/15/2008 14:00  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30  SUN: Aquaterra Tech.
Reported: 06/03/2008 at 12:25  PO Box 744
Discard: 08/03/2008  West Chester PA 19381

N135-

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/01/2008 06:29 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/23/2008 15:56 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/27/2008 15:03 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/29/2008 19:13 | Kerri E Koch | 57.47 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/26/2008 19:25 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/15/2008 14:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/23/2008 13:15 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5369569 SW  Group No. 1092714**

**N-136_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183728 N-136_1.0-2.0**

Collected:05/15/2008 15:30  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30
Reported: 06/03/2008 at 12:25
Discard: 08/03/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-136

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 320. | 1.13 | 0.170 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 13.6 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 190. | 190. | 39. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 190. | 190. | 39. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 190. | 190. | 39. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | < 190. | 190. | 39. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 190. | 190. | 39. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 190. | 190. | 39. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | < 190. | 190. | 39. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 190. | 190. | 39. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 190. | 190. | 39. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 190. | 190. | 39. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 210. | 210. | 21. | ug/kg | 35.56 |
| 05460 | Benzene | 71-43-2 | 700. | 210. | 21. | ug/kg | 35.56 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 210. | 210. | 41. | ug/kg | 35.56 |
| 05466 | Toluene | 108-88-3 | < 210. | 210. | 41. | ug/kg | 35.56 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 210. | 210. | 41. | ug/kg | 35.56 |
| 05474 | Ethylbenzene | 100-41-4 | < 210. | 210. | 41. | ug/kg | 35.56 |
| 05479 | Isopropylbenzene | 98-82-8 | < 210. | 210. | 41. | ug/kg | 35.56 |
| 06301 | Xylene (Total) | 1330-20-7 | < 210. | 210. | 41. | ug/kg | 35.56 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5369569 SW  Group No. 1092714**

**N-136_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183728 N-136_1.0-2.0**

Collected:05/15/2008 15:30  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30  SUN: Aquaterra Tech.
Reported: 06/03/2008 at 12:25  PO Box 744
Discard: 08/03/2008  West Chester PA 19381

N-136

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/01/2008 06:33 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/23/2008 15:56 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/27/2008 15:27 | Joseph M Gambler | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/29/2008 19:36 | Kerri E Koch | 35.56 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/26/2008 19:25 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/15/2008 15:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/23/2008 13:15 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1092714
Reported: 06/03/08 at 12:25 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 081446150001A | Sample number(s): 5369564-5369569 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 84 | | 82-118 | | |
| Batch number: 08144820005A | Sample number(s): 5369564-5369569 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08144SLA026 | Sample number(s): 5369564-5369569 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 92 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 81 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 87 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 89 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 83 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 84 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 85 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 80 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 81 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 84 | | 65-122 | | |
| Batch number: Q081491AA | Sample number(s): 5369564-5369565 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 106 | | 72-117 | | |
| Benzene | < 250. | 250. | 25. | ug/kg | 106 | | 84-115 | | |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 120 | | 76-135 | | |
| Toluene | < 250. | 250. | 50. | ug/kg | 94 | | 81-116 | | |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 96 | | 77-114 | | |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 94 | | 82-115 | | |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 91 | | 82-110 | | |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 94 | | 82-117 | | |
| Batch number: Q081501AA | Sample number(s): 5369566-5369569 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 112 | 96 | 72-117 | 16 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 104 | 90 | 84-115 | 14 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 120 | 105 | 76-135 | 13 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 90 | 91 | 81-116 | 1 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 90 | 93 | 77-114 | 4 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 89 | 92 | 82-115 | 3 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 86 | 87 | 82-110 | 0 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 90 | 91 | 82-117 | 1 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1092714
Reported: 06/03/08 at 12:25 PM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 081446150001A | Sample number(s): 5369564-5369569 UNSPK: P368322 BKG: P368322 | | | | | | | | |
| Lead | 16 (2) | 49 (2) | 75-125 | 4 | 20 | 12.5 | 12.0 | 4 | 20 |
| Batch number: 08144820005A | Sample number(s): 5369564-5369569 BKG: P368711 | | | | | | | | |
| Moisture | | | | | | 27.1 | 25.7 | 5 | 15 |
| Batch number: 08144SLA026 | Sample number(s): 5369564-5369569 UNSPK: P369443 | | | | | | | | |
| Pyrene | 87 | 81 | 19-162 | 7 | 30 | | | | |
| Naphthalene | 79 | 75 | 29-140 | 6 | 30 | | | | |
| Fluorene | 83 | 79 | 42-139 | 6 | 30 | | | | |
| Phenanthrene | 83 | 79 | 1-181 | 4 | 30 | | | | |
| Anthracene | 84 | 78 | 34-148 | 7 | 30 | | | | |
| Benzo(a)anthracene | 80 | 75 | 20-156 | 6 | 30 | | | | |
| Chrysene | 81 | 77 | 19-158 | 4 | 30 | | | | |
| Benzo(b)fluoranthene | 75 | 71 | 13-161 | 5 | 30 | | | | |
| Benzo(a)pyrene | 79 | 76 | 24-154 | 5 | 30 | | | | |
| Benzo(g,h,i)perylene | 84 | 81 | 26-154 | 4 | 30 | | | | |
| Batch number: Q081491AA | Sample number(s): 5369564-5369565 UNSPK: P363004 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 109 | 99 | 59-119 | 6 | 30 | | | | |
| Benzene | 103 | 96 | 66-112 | 3 | 30 | | | | |
| 1,2-Dichloroethane | 122 | 114 | 62-130 | 3 | 30 | | | | |
| Toluene | 93 | 87 | 58-116 | 3 | 30 | | | | |
| 1,2-Dibromoethane | 97 | 89 | 66-108 | 4 | 30 | | | | |
| Ethylbenzene | 95 | 88 | 54-116 | 4 | 30 | | | | |
| Isopropylbenzene | 98 | 87 | 54-113 | 7 | 30 | | | | |
| Xylene (Total) | 97 | 88 | 52-117 | 6 | 30 | | | | |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08144SLA026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5369564 | 87 | 93 | 101 |
| 5369565 | 76 | 78 | 79 |
| 5369566 | 89 | 83 | 87 |
| 5369567 | 82 | 78 | 80 |
| 5369568 | 73 | 69 | 72 |
| 5369569 | 95 | 99 | 97 |
| Blank | 81 | 87 | 94 |
| LCS | 85 | 90 | 94 |
| MS | 82 | 89 | 94 |
| MSD | 78 | 86 | 90 |
| Limits: | 49-120 | 55-117 | 43-131 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1092714
Reported: 06/03/08 at 12:25 PM

### Surrogate Quality Control

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081491AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5369564 | 93 | 87 | 75 | 74 |
| 5369565 | 95 | 90 | 78 | 74 |
| Blank | 106 | 100 | 88 | 85 |
| LCS | 112 | 106 | 95 | 94 |
| MS | 91 | 88 | 75 | 79 |
| MSD | 95 | 89 | 80 | 81 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081501AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5369566 | 81 | 75 | 68* | 80 |
| 5369567 | 71 | 67* | 56* | 53* |
| 5369568 | 65* | 58* | 50* | 44* |
| 5369569 | 83 | 76 | 69* | 76 |
| Blank | 112 | 107 | 89 | 85 |
| LCS | 112 | 108 | 91 | 94 |
| LCSD | 98 | 93 | 93 | 96 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1092714 Sample # 5369564-69

**COC # 183728**

Please print. Instructions on reverse side correspond with circled numbers.

temp 1.2°C

For Lab Use Only
FSC:
SCR#:

(1) Client: SUN-AQUATERRA Acct. #:
Project Name/#: PHILA REF AOI-8 PWSID #:
Project Manager: T. DOERR P.O.#:
Sampler: S. SYKES Quote #:
Name of state where samples were collected: PA

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water | Other | Container Codes | (5) Analyses Requested / Preservation Codes: PAH 8260B | Moisture | Lead | PAHs by 4ms 8270 | | | | | Remarks | Temperature of samples received (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-110_1.0-2.0 | 5/14/08 | 910 | X | | X | | | 2 | 1 | X | X | X | | | | | * Pls Copy Jo Kathcs Kevin Martin + Jason @ Langan | |
| N-111_1.0-2.0 | 5/14/08 | 1100 | X | | X | | | 2 | 1 | X | X | X | | | | | | |
| N-113_1.0-2.0 | 5/15/08 | 800 | X | | X | | | 2 | 1 | X | X | X | | | | | | |
| N-133_1.0-2.0 | 5/15/08 | 1100 | X | | X | | | 2 | 1 | X | X | X | | | | | | |
| N-135_1.0-2.0 | 5/15/08 | 1400 | X | | X | | | 2 | 1 | X | X | X | | | | | * Analyses per table provided | |
| N-136_1.0-2.0 | 5/15/08 | 1530 | X | | X | | | 2 | 1 | X | X | X | | | | | | |

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(6) Remarks

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| (9) Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| AQUATERRA | 5/15/08 | 1745 | AQUATERRA 'FRIDGE | 5/15/08 | 1745 |
| | 5/22/08 | 0904 | | 5/22/08 | 9:04 |
| | 5/22/08 | 1623 | | | |
| | | | | | |
| | | | | 5/22/08 | 1630 |

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1092715. Samples arrived at the laboratory on Thursday, May 22, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-116_1.0-2.0 Grab Soil | 5369570 |
| N-128_1.0-2.0 Grab Soil | 5369571 |
| N-123_1.0-2.0 Grab Soil | 5369572 |
| N-124_1.0-2.0 Grab Soil | 5369573 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Marla S. Lord
Senior Specialist

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5369570 SW  Group No. 1092715**

**N-116_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183727 N-116_1.0-2.0**

Collected:05/20/2008 08:00  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30
Reported: 06/03/2008 at 12:25
Discard: 08/03/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N116-

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 340. | 1.16 | 0.174 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 14.5 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 1,200. | 970. | 190. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 970. | 970. | 190. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | 2,100. | 970. | 190. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 5,900. | 970. | 190. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | 1,000. | 970. | 190. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 970. | 970. | 190. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 970. | 970. | 190. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 970. | 970. | 190. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 970. | 970. | 190. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 970. | 970. | 190. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 230. | 230. | 23. | ug/kg | 39.12 |
| 05460 | Benzene | 71-43-2 | < 230. | 230. | 23. | ug/kg | 39.12 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 230. | 230. | 46. | ug/kg | 39.12 |
| 05466 | Toluene | 108-88-3 | < 230. | 230. | 46. | ug/kg | 39.12 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 230. | 230. | 46. | ug/kg | 39.12 |
| 05474 | Ethylbenzene | 100-41-4 | < 230. | 230. | 46. | ug/kg | 39.12 |
| 05479 | Isopropylbenzene | 98-82-8 | 810. | 230. | 46. | ug/kg | 39.12 |
| 06301 | Xylene (Total) | 1330-20-7 | < 230. | 230. | 46. | ug/kg | 39.12 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5369570 SW  Group No. 1092715**

**N-116_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183727 N-116_1.0-2.0**

Collected:05/20/2008 08:00  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30  SUN: Aquaterra Tech.
Reported: 06/03/2008 at 12:25  PO Box 744
Discard: 08/03/2008  West Chester PA 19381

N116-

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/01/2008 06:37 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/23/2008 15:56 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/27/2008 15:51 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/30/2008 16:55 | Kerri E Koch | 39.12 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/26/2008 19:25 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/20/2008 08:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/23/2008 13:15 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5369571 SW  Group No. 1092715**

**N-128_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183727 N-128_1.0-2.0**

Collected:05/20/2008 09:30  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30
Reported: 06/03/2008 at 12:25
Discard: 08/03/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N128-

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 61.4 | 1.18 | 0.178 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 17.2 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 1,000. | 1,000. | 200. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | 2,200. | 1,000. | 200. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 1,000. | 1,000. | 200. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 1,900. | 1,000. | 200. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 1,000. | 1,000. | 200. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 1,700. | 1,000. | 200. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | 1,900. | 1,000. | 200. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 3,300. | 1,000. | 200. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 6,000. | 1,000. | 200. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 20,000. | 1,000. | 200. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 290. | 290. | 29. | ug/kg | 48.08 |
| 05460 | Benzene | 71-43-2 | 1,900. | 290. | 29. | ug/kg | 48.08 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 290. | 290. | 58. | ug/kg | 48.08 |
| 05466 | Toluene | 108-88-3 | < 290. | 290. | 58. | ug/kg | 48.08 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 290. | 290. | 58. | ug/kg | 48.08 |
| 05474 | Ethylbenzene | 100-41-4 | 340. | 290. | 58. | ug/kg | 48.08 |
| 05479 | Isopropylbenzene | 98-82-8 | < 290. | 290. | 58. | ug/kg | 48.08 |
| 06301 | Xylene (Total) | 1330-20-7 | 610. | 290. | 58. | ug/kg | 48.08 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5369571 SW  Group No. 1092715**

**N-128_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183727 N-128_1.0-2.0**

Collected:05/20/2008 09:30  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30  SUN: Aquaterra Tech.
Reported: 06/03/2008 at 12:25  PO Box 744
Discard: 08/03/2008  West Chester PA 19381

N128-

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/01/2008 06:40 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/23/2008 15:56 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/27/2008 16:15 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/31/2008 17:00 | Kerri E Koch | 48.08 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/26/2008 19:25 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/20/2008 09:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/23/2008 13:15 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5369572 SW  Group No. 1092715**

**N-123_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183727 N-123_1.0-2.0**

Collected:05/20/2008 14:45  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30
Reported: 06/03/2008 at 12:25
Discard: 08/03/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N123-

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 254. | 1.27 | 0.191 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 22.2 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 25,000. | 1,100. | 210. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 1,100. | 1,100. | 210. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 1,100. | 1,100. | 210. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 16,000. | 1,100. | 210. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | 5,000. | 1,100. | 210. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 17,000. | 1,100. | 210. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | 16,000. | 1,100. | 210. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 18,000. | 1,100. | 210. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 13,000. | 1,100. | 210. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 8,000. | 1,100. | 210. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 240. | 240. | 24. | ug/kg | 37.09 |
| 05460 | Benzene | 71-43-2 | < 240. | 240. | 24. | ug/kg | 37.09 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 240. | 240. | 48. | ug/kg | 37.09 |
| 05466 | Toluene | 108-88-3 | < 240. | 240. | 48. | ug/kg | 37.09 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 240. | 240. | 48. | ug/kg | 37.09 |
| 05474 | Ethylbenzene | 100-41-4 | < 240. | 240. | 48. | ug/kg | 37.09 |
| 05479 | Isopropylbenzene | 98-82-8 | < 240. | 240. | 48. | ug/kg | 37.09 |
| 06301 | Xylene (Total) | 1330-20-7 | < 240. | 240. | 48. | ug/kg | 37.09 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5369572 SW  Group No. 1092715**

**N-123_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183727 N-123_1.0-2.0**

Collected:05/20/2008 14:45  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30  SUN: Aquaterra Tech.
Reported: 06/03/2008 at 12:25  PO Box 744
Discard: 08/03/2008  West Chester PA 19381

N123-

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/01/2008 06:44 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/23/2008 15:56 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/27/2008 16:39 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/31/2008 17:22 | Kerri E Koch | 37.09 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/26/2008 19:25 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/20/2008 14:45 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/23/2008 13:15 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5369573 SW  Group No. 1092715**

**N-124_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183727 N-124_1.0-2.0**

Collected:05/21/2008 11:30  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30
Reported: 06/03/2008 at 12:25
Discard: 08/03/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N124-

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 43.9 | 1.15 | 0.173 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 14.2 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 190. | 190. | 39. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 190. | 190. | 39. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 190. | 190. | 39. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | < 190. | 190. | 39. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 190. | 190. | 39. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 190. | 190. | 39. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | < 190. | 190. | 39. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 190. | 190. | 39. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 190. | 190. | 39. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 190. | 190. | 39. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 370. | 370. | 37. | ug/kg | 63.94 |
| 05460 | Benzene | 71-43-2 | < 370. | 370. | 37. | ug/kg | 63.94 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 370. | 370. | 75. | ug/kg | 63.94 |
| 05466 | Toluene | 108-88-3 | < 370. | 370. | 75. | ug/kg | 63.94 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 370. | 370. | 75. | ug/kg | 63.94 |
| 05474 | Ethylbenzene | 100-41-4 | < 370. | 370. | 75. | ug/kg | 63.94 |
| 05479 | Isopropylbenzene | 98-82-8 | < 370. | 370. | 75. | ug/kg | 63.94 |
| 06301 | Xylene (Total) | 1330-20-7 | < 370. | 370. | 75. | ug/kg | 63.94 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5369573 SW  Group No. 1092715**

**N-124_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 183727 N-124_1.0-2.0**

Collected:05/21/2008 11:30  by SS  Account Number: 10132

Submitted: 05/22/2008 16:30
Reported: 06/03/2008 at 12:25
Discard: 08/03/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N124-

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/01/2008 06:48 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/23/2008 15:56 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/27/2008 17:03 | Joseph M Gambler | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/29/2008 19:59 | Kerri E Koch | 63.94 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/26/2008 19:25 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/21/2008 11:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/23/2008 13:15 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1092715
Reported: 06/03/08 at 12:25 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 081446150001A | Sample number(s): 5369570-5369573 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 84 | | 82-118 | | |
| Batch number: 08144820005A | Sample number(s): 5369570-5369573 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08144SLA026 | Sample number(s): 5369570-5369573 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 92 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 81 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 87 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 89 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 83 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 84 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 85 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 80 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 81 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 84 | | 65-122 | | |
| Batch number: Q081501AA | Sample number(s): 5369573 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 112 | 96 | 72-117 | 16 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 104 | 90 | 84-115 | 14 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 120 | 105 | 76-135 | 13 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 90 | 91 | 81-116 | 1 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 90 | 93 | 77-114 | 4 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 89 | 92 | 82-115 | 3 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 86 | 87 | 82-110 | 0 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 90 | 91 | 82-117 | 1 | 30 |
| Batch number: Q081511AA | Sample number(s): 5369570 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 98 | 100 | 72-117 | 2 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 95 | 93 | 84-115 | 2 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 108 | 107 | 76-135 | 1 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 94 | 93 | 81-116 | 1 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 94 | 91 | 77-114 | 4 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 94 | 91 | 82-115 | 3 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 91 | 90 | 82-110 | 1 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 93 | 92 | 82-117 | 1 | 30 |
| Batch number: Q081521AA | Sample number(s): 5369571-5369572 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 105 | 106 | 72-117 | 1 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 97 | 97 | 84-115 | 0 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 114 | 116 | 76-135 | 2 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 91 | 94 | 81-116 | 3 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 91 | 95 | 77-114 | 4 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 91 | 93 | 82-115 | 2 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 88 | 91 | 82-110 | 3 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 90 | 92 | 82-117 | 3 | 30 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1092715
Reported: 06/03/08 at 12:25 PM

### Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 081446150001A | Sample number(s): 5369570-5369573 UNSPK: P368322 BKG: P368322 | | | | | | | | |
| Lead | 16 (2) | 49 (2) | 75-125 | 4 | 20 | 12.5 | 12.0 | 4 | 20 |
| Batch number: 08144820005A | Sample number(s): 5369570-5369573 BKG: P368711 | | | | | | | | |
| Moisture | | | | | | 27.1 | 25.7 | 5 | 15 |
| Batch number: 08144SLA026 | Sample number(s): 5369570-5369573 UNSPK: P369443 | | | | | | | | |
| Pyrene | 87 | 81 | 19-162 | 7 | 30 | | | | |
| Naphthalene | 79 | 75 | 29-140 | 6 | 30 | | | | |
| Fluorene | 83 | 79 | 42-139 | 6 | 30 | | | | |
| Phenanthrene | 83 | 79 | 1-181 | 4 | 30 | | | | |
| Anthracene | 84 | 78 | 34-148 | 7 | 30 | | | | |
| Benzo(a)anthracene | 80 | 75 | 20-156 | 6 | 30 | | | | |
| Chrysene | 81 | 77 | 19-158 | 4 | 30 | | | | |
| Benzo(b)fluoranthene | 75 | 71 | 13-161 | 5 | 30 | | | | |
| Benzo(a)pyrene | 79 | 76 | 24-154 | 5 | 30 | | | | |
| Benzo(g,h,i)perylene | 84 | 81 | 26-154 | 4 | 30 | | | | |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed
unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08144SLA026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5369570 | 78 | 77 | 83 |
| 5369571 | 72 | 71 | 76 |
| 5369572 | 80 | 77 | 78 |
| 5369573 | 88 | 93 | 87 |
| Blank | 81 | 87 | 94 |
| LCS | 85 | 90 | 94 |
| MS | 82 | 89 | 94 |
| MSD | 78 | 86 | 90 |
| Limits: | 49-120 | 55-117 | 43-131 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081501AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5369573 | 82 | 79 | 61* | 41* |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1092715
Reported: 06/03/08 at 12:25 PM

### Surrogate Quality Control

| | | | | |
|---|---|---|---|---|
| Blank | 112 | 107 | 89 | 85 |
| LCS | 112 | 108 | 91 | 94 |
| LCSD | 98 | 93 | 93 | 96 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081511AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5369570 | 78 | 73 | 74 | 85 |
| Blank | 100 | 97 | 92 | 87 |
| LCS | 100 | 93 | 96 | 97 |
| LCSD | 103 | 97 | 97 | 96 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081521AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5369571 | 76 | 61* | 70 | 117* |
| 5369572 | 71 | 63* | 56* | 60* |
| Blank | 105 | 98 | 90 | 87 |
| LCS | 103 | 96 | 92 | 91 |
| LCSD | 105 | 100 | 94 | 94 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only
Acct. # 10132 Group# 1092715 Sample # 5369520-78

**COC # 183727**

temp 1.2°C

Please print. Instructions on reverse side correspond with circled numbers.

For Lab Use Only
FSC:
SCR#:

(1)
Client: SUN-AQUATERRA Acct. #:
Project Name/#: PHILA REF AOI-8 PWSID #:
Project Manager: T. DOERR P.O.#:
Sampler: S. SYKES Quote #:
Name of state where samples were collected: PA

(4) Matrix

(5) Analyses Requested — Preservation Codes

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | Soil | Water | Oil | Total # Containers | AJW 8260b | Moisture | Lead | PAHs by 64ms 8270 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-116_1.0-2.0 | 5/20/08 | 800 | X | | X | | | 2 | 1 | X | X | X | * Analyses per table provided |
| N-128_1.0-2.0 | 5/20/08 | 930 | X | | X | | | 2 | 1 | X | X | X | |
| N-123_1.0-2.0 | 5/20/08 | 1445 | X | | X | | | 2 | 1 | X | X | X | |
| N-124_1.0-2.0 | 5/21/08 | 1130 | X | | X | | | 2 | 1 | X | X | X | * Pls Copy Jason @ Langan + Kevin Martin @ Aquaterra |

(6) Preservation Codes
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| [signature] / AQUATERRA | 5/21/08 | 1700 | AQUATERRA 'FRIDGE' | 5/21/08 | 1700 |
| [signature] | 5/22/08 | 0904 | [signature] | 5/22/08 | 9:04 |
| [signature] | 5/22/08 | 1630 | | | |
| | | | | | |
| | | | [signature] | 5/22/08 | 1630 |

(9)

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

**WARRANTY AND LIMITS OF LIABILITY –** In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1092716. Samples arrived at the laboratory on Thursday, May 22, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-130_0.0-2.0 Grab Soil | 5369574 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |

Lancaster Laboratories

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Marla S. Lord
Senior Specialist

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report



**Lancaster Laboratories Sample No. 5369574 SW  Group No. 1092716**

**N-130_0.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 0286 N-130_0.0-2.0**

Collected:05/16/2008 08:30  by TD  Account Number: 10132

Submitted: 05/22/2008 16:30
Reported: 06/04/2008 at 13:08
Discard: 08/04/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

NW130

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 670. | 2.25 | 0.338 | mg/kg | 20 |
| 00111 | Moisture | n.a. | 11.2 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 940. | 940. | 190. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 940. | 940. | 190. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 940. | 940. | 190. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 940. | 940. | 190. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 940. | 940. | 190. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 940. | 940. | 190. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 940. | 940. | 190. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 940. | 940. | 190. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 940. | 940. | 190. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 940. | 940. | 190. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 220. | 220. | 22. | ug/kg | 38.46 |
| 05460 | Benzene | 71-43-2 | < 220. | 220. | 22. | ug/kg | 38.46 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 220. | 220. | 43. | ug/kg | 38.46 |
| 05466 | Toluene | 108-88-3 | < 220. | 220. | 43. | ug/kg | 38.46 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 220. | 220. | 43. | ug/kg | 38.46 |
| 05474 | Ethylbenzene | 100-41-4 | < 220. | 220. | 43. | ug/kg | 38.46 |
| 05479 | Isopropylbenzene | 98-82-8 | < 220. | 220. | 43. | ug/kg | 38.46 |
| 06301 | Xylene (Total) | 1330-20-7 | < 220. | 220. | 43. | ug/kg | 38.46 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5369574 SW  Group No. 1092716**

**N-130_0.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 0286 N-130_0.0-2.0**

Collected:05/16/2008 08:30  by TD  Account Number: 10132

Submitted: 05/22/2008 16:30
Reported: 06/04/2008 at 13:08
Discard: 08/04/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

NW130

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/04/2008 08:11 | David K Beck | 20 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/23/2008 15:56 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/27/2008 17:27 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 05/30/2008 18:27 | Kerri E Koch | 38.46 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/29/2008 20:40 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/16/2008 08:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/23/2008 13:15 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1092716
Reported: 06/04/08 at 01:08 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08144820005A | Sample number(s): 5369574 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08144SLA026 | Sample number(s): 5369574 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 92 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 81 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 87 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 89 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 83 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 84 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 85 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 80 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 81 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 84 | | 65-122 | | |
| Batch number: 081506150002A | Sample number(s): 5369574 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 85 | | 82-118 | | |
| Batch number: Q081511AA | Sample number(s): 5369574 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 98 | 100 | 72-117 | 2 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 95 | 93 | 84-115 | 2 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 108 | 107 | 76-135 | 1 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 94 | 93 | 81-116 | 1 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 94 | 91 | 77-114 | 4 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 94 | 91 | 82-115 | 3 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 91 | 90 | 82-110 | 1 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 93 | 92 | 82-117 | 1 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08144820005A | Sample number(s): 5369574 BKG: P368711 | | | | | | | | |
| Moisture | | | | | | 27.1 | 25.7 | 5 | 15 |
| Batch number: 08144SLA026 | Sample number(s): 5369574 UNSPK: P369443 | | | | | | | | |
| Pyrene | 87 | 81 | 19-162 | 7 | 30 | | | | |
| Naphthalene | 79 | 75 | 29-140 | 6 | 30 | | | | |
| Fluorene | 83 | 79 | 42-139 | 6 | 30 | | | | |
| Phenanthrene | 83 | 79 | 1-181 | 4 | 30 | | | | |
| Anthracene | 84 | 78 | 34-148 | 7 | 30 | | | | |
| Benzo(a)anthracene | 80 | 75 | 20-156 | 6 | 30 | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1092716
Reported: 06/04/08 at 01:08 PM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Chrysene | 81 | 77 | 19-158 | 4 | 30 | | | | |
| Benzo(b)fluoranthene | 75 | 71 | 13-161 | 5 | 30 | | | | |
| Benzo(a)pyrene | 79 | 76 | 24-154 | 5 | 30 | | | | |
| Benzo(g,h,i)perylene | 84 | 81 | 26-154 | 4 | 30 | | | | |
| Batch number: 081506150002A | Sample number(s): 5369574 UNSPK: 5369574 BKG: 5369574 | | | | | | | | |
| Lead | -10812 (2) | -9875 (2) | 75-125 | 3 | 20 | 595. | 612. | 3 | 20 |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08144SLA026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5369574 | 76 | 76 | 76 |
| Blank | 81 | 87 | 94 |
| LCS | 85 | 90 | 94 |
| MS | 82 | 89 | 94 |
| MSD | 78 | 86 | 90 |
| Limits: | 49-120 | 55-117 | 43-131 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081511AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5369574 | 86 | 79 | 74 | 71 |
| Blank | 100 | 97 | 92 | 87 |
| LCS | 100 | 93 | 96 | 97 |
| LCSD | 103 | 97 | 97 | 96 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# PA UST Analysis Request/Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. #: 10132 Group #: 1092716 Sample #: 5369574 0286

temp 1.2°C

SCR #:

Consultant/Office #: Sun-Aquaterra

Consultant Prj. Mgr.: T. Doerr

Consultant Phone #: _____ Fax #: _____

Site Name: Philadelphia Refinery AOI-8

Site Address: _____

Sampler: T. Doerr

| Sample Identification | Date Collected | Time Collected | Grab | Composite | Matrix: Soil | Matrix: Water (Potable ☐ NPDES ☐) | Matrix: Oil ☐ Air ☐ | Total Number of Containers | Number of EnCores | PA Unleaded Gasoline | PA Leaded Gasoline | PA Kerosene (No. 1) | PA Diesel Fuel (No. 2) | PA Fuel Oil No. 4, 5, 6 | PA Used Motor Oil | 8260B | 8270C | Lead | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-130_0.0-2.0 | 5/16/08 | 0830 | X | | X | | | 2 | - | | | | | | | X | X | X | | | * Specific list of analytes provided to Lancaster in table form. * Results go to Jason & Joe at Langan, too. |

Analyses Requested — List total number of containers in the box under each analyses.

Turnaround Time: (STD (7-10)) RUSH

Comments:

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| | 5/16/08 | 1240 | Aquaterra Fridge | 5/16/08 | 1240 |
| | 5/22/08 | 0904 | Marvin McCallister | 5/22/08 | 9:04 |
| Marvin McCallister | 5/22/08 | 16:30 | | | |
| | | | | 5/23/08 | 630 |

Lancaster Laboratories, Inc., 2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 (717) 656-2300

Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

4400 Rev. 4/26/05

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

**WARRANTY AND LIMITS OF LIABILITY –** In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1092862. Samples arrived at the laboratory on Friday, May 23, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-127_1.0-2.0 Grab Soil | 5370416 |
| N-134_1.0-2.0 Grab Soil | 5370417 |
| N-120_1.0-2.0 Grab Soil | 5370418 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Christine Dulaney
Senior Specialist

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5370416 SW  Group No. 1092862**

**N-127_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 0153801 N-127_1.0-2.0**

Collected:05/22/2008 08:00  by SS  Account Number: 10132

Submitted: 05/23/2008 15:15
Reported: 06/09/2008 at 00:14
Discard: 08/09/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-127

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 191. | 1.09 | 0.164 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 11.8 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 1,400. | 940. | 190. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 940. | 940. | 190. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 940. | 940. | 190. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 1,200. | 940. | 190. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 940. | 940. | 190. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 940. | 940. | 190. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 940. | 940. | 190. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 940. | 940. | 190. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 940. | 940. | 190. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 940. | 940. | 190. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 190. | 190. | 19. | ug/kg | 33.03 |
| 05460 | Benzene | 71-43-2 | < 190. | 190. | 19. | ug/kg | 33.03 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 190. | 190. | 37. | ug/kg | 33.03 |
| 05466 | Toluene | 108-88-3 | < 190. | 190. | 37. | ug/kg | 33.03 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 190. | 190. | 37. | ug/kg | 33.03 |
| 05474 | Ethylbenzene | 100-41-4 | < 190. | 190. | 37. | ug/kg | 33.03 |
| 05479 | Isopropylbenzene | 98-82-8 | < 190. | 190. | 37. | ug/kg | 33.03 |
| 06301 | Xylene (Total) | 1330-20-7 | < 190. | 190. | 37. | ug/kg | 33.03 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5370416 SW  Group No. 1092862**

**N-127_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 0153801 N-127_1.0-2.0**

Collected:05/22/2008 08:00  by SS  Account Number: 10132

Submitted: 05/23/2008 15:15  SUN: Aquaterra Tech.
Reported: 06/09/2008 at 00:14  PO Box 744
Discard: 08/09/2008  West Chester PA 19381

N-127

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/01/2008 08:53 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/27/2008 14:35 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/31/2008 01:58 | Gregory J Drahovsky | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/05/2008 03:44 | Stephanie A Selis | 33.03 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/29/2008 20:40 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/22/2008 08:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/28/2008 23:15 | Patricia L Foreman | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5370417 SW  Group No. 1092862**

**N-134_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 0153801 N-134_1.0-2.0**

Collected:05/22/2008 10:45  by SS  Account Number: 10132

Submitted: 05/23/2008 15:15
Reported: 06/09/2008 at 00:14
Discard: 08/09/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-134

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 74.6 | 1.17 | 0.176 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 15.6 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 50,000. | 4,900. | 990. | ug/kg | 25 |
| 03761 | Naphthalene | 91-20-3 | 4,700. | 990. | 200. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | 3,300. | 990. | 200. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 48,000. | 4,900. | 990. | ug/kg | 25 |
| 03776 | Anthracene | 120-12-7 | 11,000. | 990. | 200. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 41,000. | 4,900. | 990. | ug/kg | 25 |
| 03782 | Chrysene | 218-01-9 | 35,000. | 4,900. | 990. | ug/kg | 25 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 44,000. | 4,900. | 990. | ug/kg | 25 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 37,000. | 4,900. | 990. | ug/kg | 25 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 21,000. | 990. | 200. | ug/kg | 5 |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 320. | 320. | 32. | ug/kg | 53.42 |
| 05460 | Benzene | 71-43-2 | < 320. | 320. | 32. | ug/kg | 53.42 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 320. | 320. | 63. | ug/kg | 53.42 |
| 05466 | Toluene | 108-88-3 | < 320. | 320. | 63. | ug/kg | 53.42 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 320. | 320. | 63. | ug/kg | 53.42 |
| 05474 | Ethylbenzene | 100-41-4 | < 320. | 320. | 63. | ug/kg | 53.42 |
| 05479 | Isopropylbenzene | 98-82-8 | < 320. | 320. | 63. | ug/kg | 53.42 |
| 06301 | Xylene (Total) | 1330-20-7 | < 320. | 320. | 63. | ug/kg | 53.42 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5370417 SW  Group No. 1092862**

**N-134_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 0153801 N-134_1.0-2.0**

Collected:05/22/2008 10:45  by SS  Account Number: 10132

Submitted: 05/23/2008 15:15
Reported: 06/09/2008 at 00:14
Discard: 08/09/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-134

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/01/2008 08:56 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/27/2008 14:35 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/31/2008 03:10 | Gregory J Drahovsky | 5 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/31/2008 10:49 | Joseph M Gambler | 25 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/04/2008 20:52 | Kerri E Koch | 53.42 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/29/2008 20:40 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/22/2008 10:45 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/28/2008 23:15 | Patricia L Foreman | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5370418 SW  Group No. 1092862**

**N-120_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 0153801 N-120_1.0-2.0**

Collected:05/22/2008 14:30  by SS  Account Number: 10132

Submitted: 05/23/2008 15:15
Reported: 06/09/2008 at 00:14
Discard: 08/09/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-120

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 181. | 1.16 | 0.174 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 14.8 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 980. | 980. | 200. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 980. | 980. | 200. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 980. | 980. | 200. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 980. | 980. | 200. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 980. | 980. | 200. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 980. | 980. | 200. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 980. | 980. | 200. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 980. | 980. | 200. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 980. | 980. | 200. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 980. | 980. | 200. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 170. | 170. | 17. | ug/kg | 29.1 |
| 05460 | Benzene | 71-43-2 | < 170. | 170. | 17. | ug/kg | 29.1 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 170. | 170. | 34. | ug/kg | 29.1 |
| 05466 | Toluene | 108-88-3 | < 170. | 170. | 34. | ug/kg | 29.1 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 170. | 170. | 34. | ug/kg | 29.1 |
| 05474 | Ethylbenzene | 100-41-4 | < 170. | 170. | 34. | ug/kg | 29.1 |
| 05479 | Isopropylbenzene | 98-82-8 | < 170. | 170. | 34. | ug/kg | 29.1 |
| 06301 | Xylene (Total) | 1330-20-7 | < 170. | 170. | 34. | ug/kg | 29.1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5370418 SW  Group No. 1092862**

**N-120_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 0153801 N-120_1.0-2.0**

Collected:05/22/2008 14:30  by SS  Account Number: 10132

Submitted: 05/23/2008 15:15  SUN: Aquaterra Tech.
Reported: 06/09/2008 at 00:14  PO Box 744
Discard: 08/09/2008  West Chester PA 19381

N-120

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/01/2008 09:07 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/27/2008 14:35 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 05/31/2008 03:34 | Gregory J Drahovsky | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/05/2008 04:30 | Stephanie A Selis | 29.1 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 05/29/2008 20:40 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/22/2008 14:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/28/2008 23:15 | Patricia L Foreman | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1092862
Reported: 06/09/08 at 12:14 AM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08148820001A | Sample number(s): 5370416-5370418 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08149SLE026 | Sample number(s): 5370416-5370418 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 97 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 87 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 94 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 94 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 88 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 91 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 89 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 89 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 90 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 84 | | 65-122 | | |
| Batch number: 081506150002A | Sample number(s): 5370416-5370418 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 85 | | 82-118 | | |
| Batch number: Q081561AA | Sample number(s): 5370417 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 103 | 101 | 72-117 | 2 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 93 | 92 | 84-115 | 1 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 109 | 108 | 76-135 | 1 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 93 | 89 | 81-116 | 4 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 96 | 93 | 77-114 | 4 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 93 | 91 | 82-115 | 1 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 91 | 89 | 82-110 | 3 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 92 | 90 | 82-117 | 3 | 30 |
| Batch number: Q081563AA | Sample number(s): 5370416,5370418 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 107 | 109 | 72-117 | 2 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 98 | 100 | 84-115 | 2 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 115 | 113 | 76-135 | 2 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 92 | 92 | 81-116 | 0 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 93 | 96 | 77-114 | 3 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 92 | 93 | 82-115 | 2 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 90 | 91 | 82-110 | 1 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 91 | 92 | 82-117 | 2 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1092862
Reported: 06/09/08 at 12:14 AM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08148820001A | Sample number(s): 5370416-5370418 | | | | | BKG: P368699 | | | |
| Moisture | | | | | | 21.9 | 22.0 | 0 | 15 |
| Batch number: 08149SLE026 | Sample number(s): 5370416-5370418 UNSPK: 5370416 | | | | | | | | |
| Pyrene | 89 | 113 | 19-162 | 13 | 30 | | | | |
| Naphthalene | 64 | 84 | 29-140 | 27 | 30 | | | | |
| Fluorene | 60 | 93 | 42-139 | 31* | 30 | | | | |
| Phenanthrene | 41 | 80 | 1-181 | 32* | 30 | | | | |
| Anthracene | 59 | 85 | 34-148 | 30 | 30 | | | | |
| Benzo(a)anthracene | 74 | 86 | 20-156 | 11 | 30 | | | | |
| Chrysene | 61 | 91 | 19-158 | 25 | 30 | | | | |
| Benzo(b)fluoranthene | 62 | 77 | 13-161 | 14 | 30 | | | | |
| Benzo(a)pyrene | 59 | 88 | 24-154 | 27 | 30 | | | | |
| Benzo(g,h,i)perylene | 55 | 86 | 26-154 | 27 | 30 | | | | |
| Batch number: 081506150002A | Sample number(s): 5370416-5370418 UNSPK: P369574 BKG: P369574 | | | | | | | | |
| Lead | -10812 (2) | -9875 (2) | 75-125 | 3 | 20 | 595. | 612. | 3 | 20 |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed
unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08149SLE026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5370416 | 75 | 81 | 74 |
| 5370417 | 81 | 88 | 100 |
| 5370418 | 75 | 79 | 79 |
| Blank | 82 | 88 | 89 |
| LCS | 79 | 87 | 89 |
| MS | 56 | 61 | 62 |
| MSD | 74 | 83 | 83 |
| Limits: | 49-120 | 55-117 | 43-131 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081561AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5370417 | 72 | 68* | 63* | 63* |
| Blank | 99 | 91 | 91 | 89 |
| LCS | 94 | 88 | 87 | 86 |
| LCSD | 95 | 90 | 88 | 87 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

Analysis Name: UST-Leaded Soils by 8260B

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1092862
Reported: 06/09/08 at 12:14 AM

## Surrogate Quality Control

Batch number: Q081563AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5370416 | 71 | 65* | 61* | 71 |
| 5370418 | 74 | 70 | 64* | 72 |
| Blank | 101 | 95 | 89 | 86 |
| LCS | 97 | 91 | 87 | 85 |
| LCSD | 101 | 95 | 91 | 89 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 109862 Sample # 5370416-18

**COC # 0153801**

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: SUN-AQUATERRA Acct. #:

Project Name/#: PHILA REF AOI-8 PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: S. SYKES Quote #:

Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#:

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(6) Preservation Codes

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water | Other | Total # of Containers | (5) Analyses Requested: PAHs 8260 | Moisture | Lead | PAHs by 8270 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-127_1.0-2.0 | 5/22/08 | 800 | X | | X | | | 2 | 1 | X | X | X | * Analyses per table provided |
| N-134_1.0-2.0 | 5/22/08 | 1045 | X | | X | | | 2 | 1 | X | X | X | |
| N-120_1.0-2.0 | 5/22/08 | 1430 | X | | X | | | 2 | 1 | X | X | X | * Pls copy Kevin Martin + Jason @ Langan |
| | | | | | | | | | | | | | temp 3.0°C |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| Relinquished by: | Date | Time | Received by: | Date | Time (9) |
|---|---|---|---|---|---|
| Aquaterra | 5/22/08 | 1735 | Aquaterra Fridge | 5/22/08 | 1735 |
| | 5/23/08 | 1016 | Emma Allman | 5/23/08 | 1016 |
| Emma Allman | 5/23/08 | 1515 | | | |
| | | | | | |
| | | | | 5/23/08 | 1515 |

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-2766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1093507. Samples arrived at the laboratory on Thursday, May 29, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-118_1.0-2.0 Grab Soil | 5374122 |
| N-115_0.0-2.0 Grab Soil | 5374123 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |
| ELECTRONIC COPY TO | Langan | Attn: Jason Hanna |

Lancaster Laboratories

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Marla S. Lord
Senior Specialist

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report



**Lancaster Laboratories Sample No. 5374122 SW  Group No. 1093507**

**N-118_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 0153802 N-118_1.0-2.0**

Collected:05/23/2008 08:30  by SS  Account Number: 10132

Submitted: 05/29/2008 16:05
Reported: 06/09/2008 at 19:02
Discard: 08/09/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-118

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 200. | 1.11 | 0.166 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 11.3 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 1,200. | 940. | 190. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 940. | 940. | 190. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | 1,200. | 940. | 190. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 3,700. | 940. | 190. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 940. | 940. | 190. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 940. | 940. | 190. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 940. | 940. | 190. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 940. | 940. | 190. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 940. | 940. | 190. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 940. | 940. | 190. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 220. | 220. | 22. | ug/kg | 39.31 |
| 05460 | Benzene | 71-43-2 | < 220. | 220. | 22. | ug/kg | 39.31 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 220. | 220. | 44. | ug/kg | 39.31 |
| 05466 | Toluene | 108-88-3 | < 220. | 220. | 44. | ug/kg | 39.31 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 220. | 220. | 44. | ug/kg | 39.31 |
| 05474 | Ethylbenzene | 100-41-4 | < 220. | 220. | 44. | ug/kg | 39.31 |
| 05479 | Isopropylbenzene | 98-82-8 | 470. | 220. | 44. | ug/kg | 39.31 |
| 06301 | Xylene (Total) | 1330-20-7 | < 220. | 220. | 44. | ug/kg | 39.31 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5374122 SW  Group No. 1093507**

**N-118_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 0153802 N-118_1.0-2.0**

Collected:05/23/2008 08:30  by SS  Account Number: 10132

Submitted: 05/29/2008 16:05  SUN: Aquaterra Tech.
Reported: 06/09/2008 at 19:02  PO Box 744
Discard: 08/09/2008  West Chester PA 19381

N-118

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/04/2008 08:03 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/30/2008 16:18 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/04/2008 09:38 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/05/2008 22:30 | Lauren C Marzario | 39.31 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/02/2008 20:20 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/23/2008 08:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/31/2008 08:25 | Adrienne E Fellenbaum | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5374123 SW  Group No. 1093507**

**N-115_0.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 0153802 N-115_0.0-2.0**

Collected:05/28/2008 13:30  by TD  Account Number: 10132

Submitted: 05/29/2008 16:05
Reported: 06/09/2008 at 19:02
Discard: 08/09/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-115

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 1,250. | 3.00 | 0.451 | mg/kg | 25 |
| 00111 | Moisture | n.a. | 20.0 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 32,000. | 5,200. | 1,000. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 5,200. | 5,200. | 1,000. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 5,200. | 5,200. | 1,000. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 14,000. | 5,200. | 1,000. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 5,200. | 5,200. | 1,000. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 10,000. | 5,200. | 1,000. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | 15,000. | 5,200. | 1,000. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 5,200. | 5,200. | 1,000. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 6,500. | 5,200. | 1,000. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 7,100. | 5,200. | 1,000. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 380. | 380. | 38. | ug/kg | 61.12 |
| 05460 | Benzene | 71-43-2 | < 380. | 380. | 38. | ug/kg | 61.12 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 380. | 380. | 76. | ug/kg | 61.12 |
| 05466 | Toluene | 108-88-3 | < 380. | 380. | 76. | ug/kg | 61.12 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 380. | 380. | 76. | ug/kg | 61.12 |
| 05474 | Ethylbenzene | 100-41-4 | < 380. | 380. | 76. | ug/kg | 61.12 |
| 05479 | Isopropylbenzene | 98-82-8 | < 380. | 380. | 76. | ug/kg | 61.12 |
| 06301 | Xylene (Total) | 1330-20-7 | < 380. | 380. | 76. | ug/kg | 61.12 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5374123 SW  Group No. 1093507**

**N-115_0.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 0153802 N-115_0.0-2.0**

Collected:05/28/2008 13:30 by TD

Account Number: 10132

Submitted: 05/29/2008 16:05
Reported: 06/09/2008 at 19:02
Discard: 08/09/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-115

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/07/2008 07:08 | David K Beck | 25 |
| 00111 | Moisture | SM20 2540 G | 1 | 05/30/2008 16:18 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/04/2008 16:50 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/05/2008 07:59 | Stephanie A Selis | 61.12 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/02/2008 20:20 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/28/2008 13:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 05/31/2008 08:25 | Adrienne E Fellenbaum | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1093507
Reported: 06/09/08 at 07:02 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08151820004A | Sample number(s): 5374122-5374123 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08151SLC026 | Sample number(s): 5374122-5374123 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 98 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 87 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 83 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 86 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 81 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 89 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 84 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 86 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 83 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 80 | | 65-122 | | |
| Batch number: 081546150001A | Sample number(s): 5374122-5374123 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 104 | | 82-118 | | |
| Batch number: Q081563AA | Sample number(s): 5374123 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 107 | 109 | 72-117 | 2 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 98 | 100 | 84-115 | 2 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 115 | 113 | 76-135 | 2 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 92 | 92 | 81-116 | 0 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 93 | 96 | 77-114 | 3 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 92 | 93 | 82-115 | 2 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 90 | 91 | 82-110 | 1 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 91 | 92 | 82-117 | 2 | 30 |
| Batch number: Q081571AA | Sample number(s): 5374122 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 106 | 103 | 72-117 | 3 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 96 | 93 | 84-115 | 3 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 110 | 108 | 76-135 | 2 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 95 | 91 | 81-116 | 5 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 100 | 95 | 77-114 | 5 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 95 | 92 | 82-115 | 4 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 93 | 89 | 82-110 | 5 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 94 | 90 | 82-117 | 4 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1093507
Reported: 06/09/08 at 07:02 PM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08151820004A | Sample number(s): 5374122-5374123 | | | | | BKG: P373845 | | | |
| Moisture | | | | | | 25.8 | 23.6 | 9 | 15 |
| Batch number: 08151SLC026 | Sample number(s): 5374122-5374123 UNSPK: P373847 | | | | | | | | |
| Pyrene | 99 | 98 | 19-162 | 1 | 30 | | | | |
| Naphthalene | 87 | 85 | 29-140 | 2 | 30 | | | | |
| Fluorene | 90 | 89 | 42-139 | 1 | 30 | | | | |
| Phenanthrene | 93 | 94 | 1-181 | 1 | 30 | | | | |
| Anthracene | 89 | 90 | 34-148 | 1 | 30 | | | | |
| Benzo(a)anthracene | 87 | 87 | 20-156 | 0 | 30 | | | | |
| Chrysene | 90 | 89 | 19-158 | 1 | 30 | | | | |
| Benzo(b)fluoranthene | 74 | 80 | 13-161 | 7 | 30 | | | | |
| Benzo(a)pyrene | 84 | 85 | 24-154 | 1 | 30 | | | | |
| Benzo(g,h,i)perylene | 84 | 83 | 26-154 | 1 | 30 | | | | |
| Batch number: 081546150001A | Sample number(s): 5374122-5374123 UNSPK: P374581 BKG: P374581 | | | | | | | | |
| Lead | 95 (2) | 225 (2) | 75-125 | 8 | 20 | 20.9 | 23.0 | 10 | 20 |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed
unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08151SLC026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5374122 | 83 | 84 | 90 |
| 5374123 | 84 | 83 | 92 |
| Blank | 88 | 89 | 86 |
| LCS | 87 | 81 | 88 |
| MS | 85 | 91 | 96 |
| MSD | 84 | 88 | 94 |
| Limits: | 49-120 | 55-117 | 43-131 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081563AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5374123 | 82 | 75 | 58* | 56* |
| Blank | 101 | 95 | 89 | 86 |
| LCS | 97 | 91 | 87 | 85 |
| LCSD | 101 | 95 | 91 | 89 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081571AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1093507
Reported: 06/09/08 at 07:02 PM

## Surrogate Quality Control

| | | | | |
|---|---|---|---|---|
| 5374122 | 84 | 79 | 73 | 71 |
| Blank | 99 | 95 | 92 | 91 |
| LCS | 95 | 90 | 89 | 88 |
| LCSD | 95 | 89 | 88 | 87 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1093507 Sample # 537412-23

**COC # 0153802**

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: SUN-AQUATERRA Acct. #:

Project Name/#: PHILA REF AOI-8 PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: S. SYKES Quote #:

Name of state where samples were collected: PA

**For Lab Use Only**

FSC:

SCR#:

**Preservation Codes**

H=HCl T=Thiosulfate

N=$HNO_3$ B=NaOH

S=$H_2SO_4$ O=Other

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water | Other | Total # of Containers | (5) Analyses Requested: Preservation Codes: PAH's by 6/ms 8270 | Moisture | Lead | PAH's by 6/ms 8270 | Remarks | (6) Turnaround Time Requested (if requested) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-118_1.0-2.0 | 5/23/08 | 830 | X | | X | | | 2 | 1 | X | X | X | ☆ Analyses per table provided | |
| | | | | | | | | | | | | | ☆ Pls copy kevin martin & Jason @ Langan | |
| | | | | | | | | | | | | | temp 4.4°C | |

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush

(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)

Date results are needed:

Rush results requested by (please circle): Phone Fax E-mail

Phone #: Fax #:

E-mail address:

(8) **Data Package Options** (please circle if required)

Type I (validation/NJ Reg)

Type II (Tier II)

Type III (Reduced NJ)

Type IV (CLP SOW)

Type VI (Raw Data Only)

TX TRRP-13

MA MCP CT RCP

SDG Complete? Yes No

Site-specific QC (MS/MSD/Dup)? Yes No

(If yes, indicate QC sample and submit triplicate volume.)

Internal COC Required? Yes / No

(9)

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| AQUATERRA | 5/23/08 | 1430 | AQUATERRA 'FRIDGE | 5/23/08 | 1430 |
| AT FRIDGE | 5/29/08 | 1310 | | | |
| | | | | 5/29/08 | 1310 |
| | 5/29/08 | 1310 | | 5/29/08 | 13:10 |
| | 5/29/08 | 16:05 | | | |
| | | | | 5/29/08 | 16:05 |

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766

Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 198507 Sample # 5874122-23

**COC # 176471**

Please print. Instructions on reverse side correspond with circled numbers.

**For Lab Use Only**
FSC:
SCR#: 53719

(1) Client: Sun - Aquaterra Acct. #:
Project Name/#: Philly Refinery AOI-8 PWSID #:
Project Manager: T. Doerr P.O.#:
Sampler: T. Doerr Quote #:
Name of state where samples were collected: PA

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water | Other | Potable (Check if Applicable) | NPDES (Check if Applicable) | Total # of Containers | (5) Analyses Requested: PA UST 8260B | PA UST 8270C | Lead 6020 | (6) Temperature of Samples (preserved) upon receipt (if requested) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-115_0.0-2.0 | 5/28/08 | 1330 | X | | X | | | | | 2 | ✓ | ✓ | ✓ | |

**Remarks**
Specific Analysis list per previously submitted table.

CC results to Jason Hanna & Joe Patricks @ Langan

temp 4.4°C

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address: tde aquaterra-tech.com

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

(9)

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| Bob Storaci | 1/15/08 | 830 | J. Lefevre | 1/15/08 | 830 |
| J. Lefevre | 1/15/08 | 1100 | | | |
| T. Doerr | 5/28/08 | 1600 | Aquaterra Fridge | 5/28/08 | 1600 |
| AIRBRIDGE | 5/29/08 | 1310 | Lisa Schlegel | 5/29/08 | 1310 |
| Lisa Schlegel | 5/29/08 | 1310 | Erma Uhlman | 5/29/08 | 13:10 |

Erma Uhlman 5/29/08 16:05 Katie Hartlove 5/29/08 16:05

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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Lancaster Laboratories

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1094202. Samples arrived at the laboratory on Tuesday, June 03, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-126_1.0-2.0 Grab Soil | 5378093 |
| N-119_1.0-2.0 Grab Soil | 5378094 |
| N-108_1.0-2.0 Grab Soil | 5378095 |
| N-98_1.0-2.0 Grab Soil | 5378096 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

Lancaster Laboratories

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Christine Dulaney
Senior Specialist

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report



**Lancaster Laboratories Sample No. 5378093 SW  Group No. 1094202**

**N-126_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS# NA COC: 0153799 N-126_1.0-2.0**

Collected:05/29/2008 08:00  by SS  Account Number: 10132

Submitted: 06/03/2008 15:58
Reported: 06/13/2008 at 11:18
Discard: 08/13/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

SA126

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 1,090. | 5.98 | 0.897 | mg/kg | 50 |
| 00111 | Moisture | n.a. | 18.0 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 21,000. | 4,100. | 810. | ug/kg | 10 |
| 03761 | Naphthalene | 91-20-3 | 50,000. | 4,100. | 810. | ug/kg | 10 |
| 03768 | Fluorene | 86-73-7 | 21,000. | 4,100. | 810. | ug/kg | 10 |
| 03775 | Phenanthrene | 85-01-8 | 55,000. | 4,100. | 810. | ug/kg | 10 |
| 03776 | Anthracene | 120-12-7 | 61,000. | 4,100. | 810. | ug/kg | 10 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 8,100. | 4,100. | 810. | ug/kg | 10 |
| 03782 | Chrysene | 218-01-9 | 9,100. | 4,100. | 810. | ug/kg | 10 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 4,100. | 4,100. | 810. | ug/kg | 10 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 4,100. | 4,100. | 810. | ug/kg | 10 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 4,100. | 4,100. | 810. | ug/kg | 10 |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/07/2008 12:11 | David K Beck | 50 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/04/2008 16:53 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/10/2008 10:12 | Joseph M Gambler | 10 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/04/2008 20:15 | Annamaria Stipkovits | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/04/2008 16:55 | Adrienne E Fellenbaum | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5378094 SW  Group No. 1094202**

**N-119_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS# NA COC: 0153799 N-119_1.0-2.0**

Collected:05/29/2008 10:30  by SS  Account Number: 10132

Submitted: 06/03/2008 15:58
Reported: 06/13/2008 at 11:18
Discard: 08/13/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

SA119

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 68.1 | 1.16 | 0.173 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 13.5 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 190. | 190. | 39. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 190. | 190. | 39. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 190. | 190. | 39. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | < 190. | 190. | 39. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 190. | 190. | 39. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 190. | 190. | 39. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | < 190. | 190. | 39. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 190. | 190. | 39. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 190. | 190. | 39. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 190. | 190. | 39. | ug/kg | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/07/2008 11:05 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/04/2008 16:53 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/10/2008 10:36 | Joseph M Gambler | 1 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/04/2008 20:15 | Annamaria Stipkovits | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/04/2008 16:55 | Adrienne E Fellenbaum | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5378095 SW  Group No. 1094202**

**N-108_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS# NA COC: 0153799 N-108_1.0-2.0**

Collected:05/29/2008 14:30  by SS  Account Number: 10132

Submitted: 06/03/2008 15:58
Reported: 06/13/2008 at 11:18
Discard: 08/13/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

SA108

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 147. | 1.16 | 0.174 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 14.5 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 1,900. | 1,900. | 390. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 1,900. | 1,900. | 390. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 1,900. | 1,900. | 390. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 2,100. | 1,900. | 390. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 1,900. | 1,900. | 390. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 2,000. | 1,900. | 390. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | 3,800. | 1,900. | 390. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 3,300. | 1,900. | 390. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 5,400. | 1,900. | 390. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 20,000. | 1,900. | 390. | ug/kg | 5 |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 230. | 230. | 23. | ug/kg | 39.12 |
| 05460 | Benzene | 71-43-2 | < 230. | 230. | 23. | ug/kg | 39.12 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 230. | 230. | 46. | ug/kg | 39.12 |
| 05466 | Toluene | 108-88-3 | < 230. | 230. | 46. | ug/kg | 39.12 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 230. | 230. | 46. | ug/kg | 39.12 |
| 05474 | Ethylbenzene | 100-41-4 | < 230. | 230. | 46. | ug/kg | 39.12 |
| 05479 | Isopropylbenzene | 98-82-8 | < 230. | 230. | 46. | ug/kg | 39.12 |
| 06301 | Xylene (Total) | 1330-20-7 | < 230. | 230. | 46. | ug/kg | 39.12 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5378095 SW  Group No. 1094202**

**N-108_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS# NA COC: 0153799 N-108_1.0-2.0**

Collected:05/29/2008 14:30  by SS  Account Number: 10132

Submitted: 06/03/2008 15:58  SUN: Aquaterra Tech.
Reported: 06/13/2008 at 11:18  PO Box 744
Discard: 08/13/2008  West Chester PA 19381

SA108

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/07/2008 11:09 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/04/2008 16:53 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/10/2008 11:00 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/09/2008 18:16 | Kerri E Koch | 39.12 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/04/2008 20:15 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 05/29/2008 14:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/04/2008 16:55 | Adrienne E Fellenbaum | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5378096 SW  Group No. 1094202**

**N-98_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS# NA COC: 0153799 N-98_1.0-2.0**

Collected:06/02/2008 14:00  by SS  Account Number: 10132

Submitted: 06/03/2008 15:58
Reported: 06/13/2008 at 11:18
Discard: 08/13/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

SA098

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 94.5 | 1.14 | 0.171 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 14.6 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 2,400. | 980. | 200. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | 1,000. | 980. | 200. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 980. | 980. | 200. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 4,500. | 980. | 200. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 980. | 980. | 200. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 980. | 980. | 200. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 980. | 980. | 200. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 980. | 980. | 200. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 980. | 980. | 200. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 980. | 980. | 200. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 210. | 210. | 21. | ug/kg | 36.23 |
| 05460 | Benzene | 71-43-2 | < 210. | 210. | 21. | ug/kg | 36.23 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 210. | 210. | 42. | ug/kg | 36.23 |
| 05466 | Toluene | 108-88-3 | < 210. | 210. | 42. | ug/kg | 36.23 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 210. | 210. | 42. | ug/kg | 36.23 |
| 05474 | Ethylbenzene | 100-41-4 | < 210. | 210. | 42. | ug/kg | 36.23 |
| 05479 | Isopropylbenzene | 98-82-8 | < 210. | 210. | 42. | ug/kg | 36.23 |
| 06301 | Xylene (Total) | 1330-20-7 | < 210. | 210. | 42. | ug/kg | 36.23 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5378096 SW  Group No. 1094202**

**N-98_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS# NA COC: 0153799 N-98_1.0-2.0**

Collected:06/02/2008 14:00  by SS  Account Number: 10132

Submitted: 06/03/2008 15:58
Reported: 06/13/2008 at 11:18
Discard: 08/13/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

SA098

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/07/2008 11:13 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/04/2008 16:53 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/10/2008 11:24 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/09/2008 17:53 | Kerri E Koch | 36.23 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/04/2008 20:15 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 06/02/2008 14:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/04/2008 16:55 | Adrienne E Fellenbaum | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1094202
Reported: 06/13/08 at 11:18 AM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 081566150002A | Sample number(s): 5378093-5378096 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 104 | | 82-118 | | |
| Batch number: 08156820005B | Sample number(s): 5378093-5378096 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08156SLC026 | Sample number(s): 5378093-5378096 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 93 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 83 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 87 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 92 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 87 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 85 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 91 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 75 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 84 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 85 | | 65-122 | | |
| Batch number: Q081611AA | Sample number(s): 5378095-5378096 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 107 | 111 | 72-117 | 4 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 95 | 98 | 84-115 | 4 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 112 | 116 | 76-135 | 3 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 90 | 92 | 81-116 | 2 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 94 | 97 | 77-114 | 3 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 90 | 93 | 82-115 | 4 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 87 | 90 | 82-110 | 4 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 88 | 92 | 82-117 | 5 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 081566150002A | Sample number(s): 5378093-5378096 UNSPK: P377502 BKG: P377502 | | | | | | | | |
| Lead | -1238 (2) | -2757 (2) | 75-125 | 14 | 20 | 197. | 137. | 36* | 20 |
| Batch number: 08156820005B | Sample number(s): 5378093-5378096 BKG: P377706 | | | | | | | | |
| Moisture | | | | | | 7.4 | 6.9 | 8 | 15 |
| Batch number: 08156SLC026 | Sample number(s): 5378093-5378096 UNSPK: P375888 | | | | | | | | |
| Pyrene | 105 | 125 | 19-162 | 17 | 30 | | | | |
| Naphthalene | 87 | 83 | 29-140 | 4 | 30 | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1094202
Reported: 06/13/08 at 11:18 AM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Fluorene | 89 | 87 | 42-139 | 3 | 30 | | | | |
| Phenanthrene | 96 | 114 | 1-181 | 17 | 30 | | | | |
| Anthracene | 88 | 87 | 34-148 | 1 | 30 | | | | |
| Benzo(a)anthracene | 86 | 88 | 20-156 | 2 | 30 | | | | |
| Chrysene | 92 | 100 | 19-158 | 9 | 30 | | | | |
| Benzo(b)fluoranthene | 71 | 80 | 13-161 | 12 | 30 | | | | |
| Benzo(a)pyrene | 75 | 77 | 24-154 | 3 | 30 | | | | |
| Benzo(g,h,i)perylene | 71 | 74 | 26-154 | 4 | 30 | | | | |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08156SLC026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5378093 | 103 | 95 | 87 |
| 5378094 | 91 | 87 | 93 |
| 5378095 | 106 | 86 | 85 |
| 5378096 | 92 | 87 | 78 |
| Blank | 91 | 88 | 97 |
| LCS | 90 | 85 | 94 |
| MS | 90 | 86 | 102 |
| MSD | 87 | 83 | 103 |
| Limits: | 49-120 | 55-117 | 43-131 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081611AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5378095 | 82 | 80 | 71 | 66* |
| 5378096 | 84 | 80 | 69* | 65* |
| Blank | 104 | 100 | 91 | 90 |
| LCS | 95 | 93 | 87 | 85 |
| LCSD | 103 | 100 | 92 | 92 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1094202 Sample #5378093

**COC # 0153799**

Please print. Instructions on reverse side correspond with circled numbers. 4.1 °C

(1)
Client: SUN-AQUATERRA Acct. #:
Project Name/#: PHILA REF AOI-8 PWSID #:
Project Manager: T. DOERR P.O.#:
Sampler: S. SYKES Quote #:
Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#:

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water | Other | Total # of Containers | (5) Analyses Requested / Preservation Codes: PAHs 8260 | Lead | Moisture | PAHs by 8270 | | | | | | | | (6) Number of containers (if required) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-126_1.0-2.0 | 5/29/08 | 800 | X | | X | | | 2 | X | X | X | X | | | | | | | | |
| N-119_1.0-2.0 | 5/29/08 | 1080 | X | | X | | | 2 | X | X | X | X | | | | | | | | |
| N-108_1.0-2.0 | 5/29/08 | 1430 | X | | X | | | 2 | X | X | X | X | | | | | | | | |

Preservation Codes
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

Remarks
* Analyses per table provided
* Please copy Kevin Morter & Jason @ Langan

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| Steve Sen / AQUATERRA | 5/29/08 | 1730 | AQUATERRA / FRIDGE | 5/29/08 | 1730 |
| AT FRIDGE | 6/3/08 | 1000 | Aquaterra | 6/3/08 | 1000 |
| Aquaterra | 6/3/08 | 1000 | P. Lefever | 6/3/08 | 1000 |
| P. Lefever | 6/3/08 | 1558 | | | |
| | | | | 6/3/08 | 1558 |

(9)

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1094202 Sample # 5378093

**COC # 0154360**

Please print. Instructions on reverse side correspond with circled numbers. 4.1 °C

**For Lab Use Only**
FSC:
SCR#:

(1) Client: SUN-AQUATERRA Acct. #:
Project Name/#: PHILA REF AOI-8 PWSID #:
Project Manager: T. DOERR P.O.#:
Sampler: S. SYKES Quote #:
Name of state where samples were collected: PA

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water | Other | Potable Check if Applicable | NPDES | Total # of Containers | (5) Analyses Requested: PAH 8260 | Moisture | Lead | PAHs by 6Hrs 8270 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-98_1.0-2.0 | 6/2/08 | 1400 | X | | X | | | | | 2 | 1 | X | X | X | * Analyses per table provided |
| | | | | | | | | | | | | | | | * Pls copy Kevin Martin & Jason @ Langan |

(6) Temperature of Samples when received (optional)

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg) TX TRRP-13
Type II (Tier II) MA MCP CT RCP
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

(9)

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| Shu Jun / AQUATERRA | 6/2/08 | 1715 | AQUATERRA FRIDGE | 6/2/08 | 1714 |
| ATFRIDGE | 6/3/08 | 1000 | | 6/3/08 | 1000 |
| | 6/3/08 | 1000 | L. Lefever | 6/3/08 | 1000 |
| L. Lefever | 6/3/08 | 1558 | | | |
| | | | | 6/3/08 | 1558 |

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Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

**WARRANTY AND LIMITS OF LIABILITY –** In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 1094907. Samples arrived at the laboratory on Friday, June 06, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-117-1.0-2.0 Grab Soil | 5382600 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |

Lancaster Laboratories

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Dorothy M. Love

Dorothy M. Love
Group Leader

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5382600 SW  Group No. 1094907**

**N-117-1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 0156515 N-117**

Collected:06/04/2008 13:20  by TD  Account Number: 10132

Submitted: 06/06/2008 14:25
Reported: 06/19/2008 at 12:07
Discard: 08/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PN117

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 219. | 0.565 | 0.0848 | mg/kg | 5 |
| 00111 | Moisture | n.a. | 12.4 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 1,100. | 190. | 38. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 190. | 190. | 38. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 190. | 190. | 38. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | 1,400. | 190. | 38. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | 350. | 190. | 38. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 740. | 190. | 38. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | 680. | 190. | 38. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 940. | 190. | 38. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 630. | 190. | 38. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 420. | 190. | 38. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 230. | 230. | 23. | ug/kg | 39.81 |
| 05460 | Benzene | 71-43-2 | < 230. | 230. | 23. | ug/kg | 39.81 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 230. | 230. | 45. | ug/kg | 39.81 |
| 05466 | Toluene | 108-88-3 | < 230. | 230. | 45. | ug/kg | 39.81 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 230. | 230. | 45. | ug/kg | 39.81 |
| 05474 | Ethylbenzene | 100-41-4 | < 230. | 230. | 45. | ug/kg | 39.81 |
| 05479 | Isopropylbenzene | 98-82-8 | < 230. | 230. | 45. | ug/kg | 39.81 |
| 06301 | Xylene (Total) | 1330-20-7 | < 230. | 230. | 45. | ug/kg | 39.81 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5382600 SW  Group No. 1094907**

**N-117-1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 0156515 N-117**

Collected:06/04/2008 13:20  by TD  Account Number: 10132

Submitted: 06/06/2008 14:25
Reported: 06/19/2008 at 12:07
Discard: 08/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PN117

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/17/2008 11:26 | David K Beck | 5 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/09/2008 16:26 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/17/2008 04:45 | Linda M Hartenstine | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/12/2008 10:34 | Stephanie A Selis | 39.81 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/12/2008 20:45 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035A | 1 | 06/04/2008 13:20 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/12/2008 07:30 | Joseph S Feister | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1094907
Reported: 06/19/08 at 12:07 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08161820007A | Sample number(s): 5382600 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08163SLF026 | Sample number(s): 5382600 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 84 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 83 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 88 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 90 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 86 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 89 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 87 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 90 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 91 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 95 | | 65-122 | | |
| Batch number: 081646150002A | Sample number(s): 5382600 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 104 | | 82-118 | | |
| Batch number: Q081641AA | Sample number(s): 5382600 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 104 | 101 | 72-117 | 3 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 96 | 93 | 84-115 | 4 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 110 | 108 | 76-135 | 2 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 95 | 92 | 81-116 | 3 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 94 | 92 | 77-114 | 2 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 95 | 93 | 82-115 | 2 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 91 | 90 | 82-110 | 2 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 93 | 91 | 82-117 | 2 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08161820007A | Sample number(s): 5382600 BKG: P364193 | | | | | | | | |
| Moisture | | | | | | 14.3 | 14.0 | 2 | 15 |
| Batch number: 08163SLF026 | Sample number(s): 5382600 UNSPK: P383118 | | | | | | | | |
| Pyrene | 84 | 80 | 19-162 | 5 | 30 | | | | |
| Naphthalene | 94 | 93 | 29-140 | 0 | 30 | | | | |
| Fluorene | 85 | 86 | 42-139 | 2 | 30 | | | | |
| Phenanthrene | 95 | 95 | 1-181 | 0 | 30 | | | | |
| Anthracene | 91 | 93 | 34-148 | 2 | 30 | | | | |
| Benzo(a)anthracene | 94 | 93 | 20-156 | 1 | 30 | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1094907
Reported: 06/19/08 at 12:07 PM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Chrysene | 90 | 89 | 19-158 | 1 | 30 | | | | |
| Benzo(b)fluoranthene | 103 | 97 | 13-161 | 6 | 30 | | | | |
| Benzo(a)pyrene | 93 | 92 | 24-154 | 2 | 30 | | | | |
| Benzo(g,h,i)perylene | 117 | 122 | 26-154 | 4 | 30 | | | | |
| Batch number: 081646150002A | Sample number(s): 5382600 UNSPK: P385625 BKG: P385625 | | | | | | | | |
| Lead | -379 (2) | -168 (2) | 75-125 | 15 | 20 | 25.4 | 21.0 | 19 | 20 |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed
unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08163SLF026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5382600 | 85 | 91 | 81 |
| Blank | 74 | 78 | 70 |
| LCS | 79 | 81 | 79 |
| MS | 90 | 95 | 82 |
| MSD | 88 | 92 | 79 |
| Limits: | 49-120 | 55-117 | 43-131 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081641AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5382600 | 87 | 82 | 78 | 75 |
| Blank | 99 | 96 | 94 | 93 |
| LCS | 98 | 94 | 94 | 93 |
| LCSD | 98 | 94 | 94 | 93 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1094907 Sample # 5382600

**COC # 0156515**

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: Aquaterra Acct. #:

Project Name/#: Sun Philly Refinery AOI 8 WSID #:

Project Manager: T. Doerr P.O.#:

Sampler: T. Doerr Quote #:

Name of state where samples were collected: PA

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water | Other | Total # of Containers | (5) Analyses Requested / Preservation Codes: PA UST 8260B | PA UST 8270C | Lead | | | | | | | | For Lab Use Only: Filtered (if applicable) | Preservation # (Lab Only) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-117 – 1.0-2.0 | 6/4/08 | 1320 | X | | X | | | 2 | x | x | x | | | | | | | | | |

**For Lab Use Only**
FSC:
SCR#: 461650

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(6) Remarks

*Analyte List per previously provided table!

* Copy results to Langan

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes No

| (9) Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| Brett Storage | 6/4/08 | 7:15 | Marion McFadden | 6/4/08 | 7:15 |
| Marion McFadden | 6/4/08 | 10:10 | | | |
| | 6/4/08 | 1600 | Aquaterra Fridge | 6/4/08 | 1600 |
| | 6/6/08 | 0945 | Erma Ullman | 6/6/08 | 9:45 |
| Erma Ullman | 6/6/08 | 14:35 | | 6/6/08 | 1935 |

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# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

**WARRANTY AND LIMITS OF LIABILITY –** In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

Lancaster Laboratories

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1094908. Samples arrived at the laboratory on Friday, June 06, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-106_1.0-2.0 Grab Soil | 5382601 |
| N-102_1.0-2.0 Grab Soil | 5382602 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Dorothy M. Love

Dorothy M. Love
Group Leader

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5382601 SW  Group No. 1094908**

**N-106_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 178086 N-106**

Collected:06/05/2008 09:30  by SS  Account Number: 10132

Submitted: 06/06/2008 14:25
Reported: 06/19/2008 at 12:07
Discard: 08/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PN106

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 76.7 | 0.546 | 0.0819 | mg/kg | 5 |
| 00111 | Moisture | n.a. | 11.1 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 270. | 190. | 37. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 190. | 190. | 37. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 190. | 190. | 37. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | < 190. | 190. | 37. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 190. | 190. | 37. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 190. | 190. | 37. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | 190. | 190. | 37. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 300. | 190. | 37. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 190. | 190. | 37. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 220. | 190. | 37. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 190. | 190. | 19. | ug/kg | 34.39 |
| 05460 | Benzene | 71-43-2 | < 190. | 190. | 19. | ug/kg | 34.39 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 190. | 190. | 39. | ug/kg | 34.39 |
| 05466 | Toluene | 108-88-3 | < 190. | 190. | 39. | ug/kg | 34.39 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 190. | 190. | 39. | ug/kg | 34.39 |
| 05474 | Ethylbenzene | 100-41-4 | < 190. | 190. | 39. | ug/kg | 34.39 |
| 05479 | Isopropylbenzene | 98-82-8 | < 190. | 190. | 39. | ug/kg | 34.39 |
| 06301 | Xylene (Total) | 1330-20-7 | < 190. | 190. | 39. | ug/kg | 34.39 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5382601 SW  Group No. 1094908**

**N-106_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 178086 N-106**

Collected:06/05/2008 09:30  by SS  Account Number: 10132

Submitted: 06/06/2008 14:25
Reported: 06/19/2008 at 12:07
Discard: 08/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PN106

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/17/2008 11:30 | David K Beck | 5 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/09/2008 16:26 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/17/2008 05:57 | Linda M Hartenstine | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/12/2008 10:57 | Stephanie A Selis | 34.39 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/12/2008 20:45 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035A | 1 | 06/05/2008 09:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/12/2008 07:30 | Joseph S Feister | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5382602 SW  Group No. 1094908**

**N-102_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 178086 N-102**

Collected:06/05/2008 13:30  by SS  Account Number: 10132

Submitted: 06/06/2008 14:25
Reported: 06/19/2008 at 12:07
Discard: 08/19/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PN102

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 24.7 | 0.115 | 0.0172 | mg/kg | 1 |
| 00111 | Moisture | n.a. | 13.6 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 390. | 190. | 39. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 190. | 190. | 39. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 190. | 190. | 39. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | 310. | 190. | 39. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 190. | 190. | 39. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 190. | 190. | 39. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | 270. | 190. | 39. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 320. | 190. | 39. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 200. | 190. | 39. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 190. | 190. | 39. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 250. | 250. | 25. | ug/kg | 42.44 |
| 05460 | Benzene | 71-43-2 | < 250. | 250. | 25. | ug/kg | 42.44 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 250. | 250. | 49. | ug/kg | 42.44 |
| 05466 | Toluene | 108-88-3 | < 250. | 250. | 49. | ug/kg | 42.44 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 250. | 250. | 49. | ug/kg | 42.44 |
| 05474 | Ethylbenzene | 100-41-4 | < 250. | 250. | 49. | ug/kg | 42.44 |
| 05479 | Isopropylbenzene | 98-82-8 | < 250. | 250. | 49. | ug/kg | 42.44 |
| 06301 | Xylene (Total) | 1330-20-7 | < 250. | 250. | 49. | ug/kg | 42.44 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5382602 SW  Group No. 1094908**

**N-102_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 178086 N-102**

Collected:06/05/2008 13:30  by SS  Account Number: 10132

Submitted: 06/06/2008 14:25  SUN: Aquaterra Tech.
Reported: 06/19/2008 at 12:07  PO Box 744
Discard: 08/19/2008  West Chester PA 19381

PN102

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/16/2008 16:28 | David K Beck | 1 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/09/2008 16:26 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/17/2008 06:21 | Linda M Hartenstine | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/12/2008 11:20 | Stephanie A Selis | 42.44 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/12/2008 20:45 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035A | 1 | 06/05/2008 13:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/12/2008 07:30 | Joseph S Feister | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1094908
Reported: 06/19/08 at 12:07 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08161820007A | Sample number(s): 5382601-5382602 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08163SLF026 | Sample number(s): 5382601-5382602 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 84 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 83 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 88 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 90 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 86 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 89 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 87 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 90 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 91 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 95 | | 65-122 | | |
| Batch number: 081646150002A | Sample number(s): 5382601-5382602 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 104 | | 82-118 | | |
| Batch number: Q081641AA | Sample number(s): 5382601-5382602 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 104 | 101 | 72-117 | 3 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 96 | 93 | 84-115 | 4 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 110 | 108 | 76-135 | 2 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 95 | 92 | 81-116 | 3 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 94 | 92 | 77-114 | 2 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 95 | 93 | 82-115 | 2 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 91 | 90 | 82-110 | 2 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 93 | 91 | 82-117 | 2 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08161820007A | Sample number(s): 5382601-5382602 BKG: P364193 | | | | | | | | |
| Moisture | | | | | | 14.3 | 14.0 | 2 | 15 |
| Batch number: 08163SLF026 | Sample number(s): 5382601-5382602 UNSPK: P383118 | | | | | | | | |
| Pyrene | 84 | 80 | 19-162 | 5 | 30 | | | | |
| Naphthalene | 94 | 93 | 29-140 | 0 | 30 | | | | |
| Fluorene | 85 | 86 | 42-139 | 2 | 30 | | | | |
| Phenanthrene | 95 | 95 | 1-181 | 0 | 30 | | | | |
| Anthracene | 91 | 93 | 34-148 | 2 | 30 | | | | |
| Benzo(a)anthracene | 94 | 93 | 20-156 | 1 | 30 | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1094908
Reported: 06/19/08 at 12:07 PM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Chrysene | 90 | 89 | 19-158 | 1 | 30 | | | | |
| Benzo(b)fluoranthene | 103 | 97 | 13-161 | 6 | 30 | | | | |
| Benzo(a)pyrene | 93 | 92 | 24-154 | 2 | 30 | | | | |
| Benzo(g,h,i)perylene | 117 | 122 | 26-154 | 4 | 30 | | | | |
| Batch number: 081646150002A | Sample number(s): 5382601-5382602 UNSPK: P385625 BKG: P385625 | | | | | | | | |
| Lead | -379 (2) | -168 (2) | 75-125 | 15 | 20 | 25.4 | 21.0 | 19 | 20 |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08163SLF026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5382601 | 80 | 87 | 77 |
| 5382602 | 79 | 86 | 74 |
| Blank | 74 | 78 | 70 |
| LCS | 79 | 81 | 79 |
| MS | 90 | 95 | 82 |
| MSD | 88 | 92 | 79 |
| Limits: | 49-120 | 55-117 | 43-131 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081641AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5382601 | 88 | 85 | 81 | 78 |
| 5382602 | 85 | 81 | 78 | 75 |
| Blank | 99 | 96 | 94 | 93 |
| LCS | 98 | 94 | 94 | 93 |
| LCSD | 98 | 94 | 94 | 93 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1094908 Sample # 5382601-02

**COC # 178086**

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: SUN-AQUATERRA Acct. #:

Project Name/#: PHILA REF AOI-8 PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: S. SYKES Quote #:

Name of state where samples were collected: PA

**For Lab Use Only**

FSC:

SCR#:

**Preservation Codes**

H=HCl T=Thiosulfate

N=$HNO_3$ B=NaOH

S=$H_2SO_4$ O=Other

(6) Temperature upon receipt (preservation of samples)

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water (Potable / NPDES) | Other | Total # of Containers | (5) Analyses Requested: PAHs 8260 | Moisture | Lead | PAHs by 8270 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-106_1.0-2.0 | 6/5/08 | 930 | X | | X | | | 2 | X | X | X | X |
| N-102_1.0-2.0 | 6/5/08 | 1330 | X | | X | | | 2 | X | X | X | X |

**Remarks**

☆ PLS copy Karin Martin & Jason O Langan

☆ Analyses per table provided

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush

(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)

Date results are needed:

Rush results requested by (please circle): Phone Fax E-mail

Phone #: Fax #:

E-mail address:

(8) **Data Package Options** (please circle if required)

Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)

TX TRRP-13
MA MCP CT RCP

SDG Complete? Yes No

Site-specific QC (MS/MSD/Dup)? Yes No

(If yes, indicate QC sample and submit triplicate volume.)

Internal COC Required? Yes / No

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| [signature] / Aquaterra | 6/5/08 | 1745 | AQUATERRA FROM | 6/5/08 | 1745 |
| [signature] | 6/6/08 | 0945 | Erma Hillman | 6/6/08 | 9:45 |
| Erma Hillman | 6/6/08 | 14:25 | | | |
| | | | | | |
| | | | [signature] | 6/6/08 | 1425 |

(9)

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766

Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

**WARRANTY AND LIMITS OF LIABILITY –** In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

Lancaster Laboratories

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1095356. Samples arrived at the laboratory on Tuesday, June 10, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-103_1.0-2.0 Grab Soil | 5385262 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

Lancaster Laboratories

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Chad A. Moline
Group Leader

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report



**Lancaster Laboratories Sample No. 5385262 SW  Group No. 1095356**

**N-103_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 178085 N-103_1.0-2.0**

Collected:06/06/2008 08:30  by SS  Account Number: 10132

Submitted: 06/10/2008 15:55
Reported: 06/20/2008 at 11:10
Discard: 08/20/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

AOI8N

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 174. | 0.567 | 0.0851 | mg/kg | 5 |
| 00111 | Moisture | n.a. | 12.7 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 950. | 950. | 190. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 950. | 950. | 190. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 950. | 950. | 190. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | < 950. | 950. | 190. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 950. | 950. | 190. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 950. | 950. | 190. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | < 950. | 950. | 190. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 950. | 950. | 190. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 950. | 950. | 190. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 1,000. | 950. | 190. | ug/kg | 1 |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 260. | 260. | 26. | ug/kg | 45.96 |
| 05460 | Benzene | 71-43-2 | < 260. | 260. | 26. | ug/kg | 45.96 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 260. | 260. | 53. | ug/kg | 45.96 |
| 05466 | Toluene | 108-88-3 | < 260. | 260. | 53. | ug/kg | 45.96 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 260. | 260. | 53. | ug/kg | 45.96 |
| 05474 | Ethylbenzene | 100-41-4 | < 260. | 260. | 53. | ug/kg | 45.96 |
| 05479 | Isopropylbenzene | 98-82-8 | < 260. | 260. | 53. | ug/kg | 45.96 |
| 06301 | Xylene (Total) | 1330-20-7 | < 260. | 260. | 53. | ug/kg | 45.96 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5385262 SW  Group No. 1095356**

**N-103_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 178085 N-103_1.0-2.0**

Collected:06/06/2008 08:30  by SS  Account Number: 10132

Submitted: 06/10/2008 15:55  SUN: Aquaterra Tech.
Reported: 06/20/2008 at 11:10  PO Box 744
Discard: 08/20/2008  West Chester PA 19381

AOI8N

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/17/2008 11:46 | David K Beck | 5 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/11/2008 18:01 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/19/2008 04:20 | William T Parker | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/13/2008 04:51 | Stephanie A Selis | 45.96 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/12/2008 20:45 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035A | 1 | 06/06/2008 08:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/16/2008 18:40 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1095356
Reported: 06/20/08 at 11:10 AM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

### Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08163820009B | Sample number(s): 5385262 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 081646150002A | Sample number(s): 5385262 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 104 | | 82-118 | | |
| Batch number: 08165SLC026 | Sample number(s): 5385262 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 91 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 87 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 92 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 95 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 90 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 92 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 88 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 107 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 101 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 111 | | 65-122 | | |
| Batch number: Q081651AA | Sample number(s): 5385262 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 102 | 102 | 72-117 | 0 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 93 | 96 | 84-115 | 3 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 111 | 115 | 76-135 | 3 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 92 | 96 | 81-116 | 4 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 96 | 99 | 77-114 | 3 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 95 | 98 | 82-115 | 3 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 92 | 95 | 82-110 | 3 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 92 | 95 | 82-117 | 3 | 30 |

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08163820009B | Sample number(s): 5385262 BKG: P383045 | | | | | | | | |
| Moisture | | | | | | 21.0 | 17.1 | 21* | 15 |
| Batch number: 081646150002A | Sample number(s): 5385262 UNSPK: P385625 BKG: P385625 | | | | | | | | |
| Lead | -379 (2) | -168 (2) | 75-125 | 15 | 20 | 25.4 | 21.0 | 19 | 20 |
| Batch number: 08165SLC026 | Sample number(s): 5385262 UNSPK: P383302 | | | | | | | | |
| Pyrene | 89 | 90 | 19-162 | 1 | 30 | | | | |
| Naphthalene | 83 | 86 | 29-140 | 3 | 30 | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1095356
Reported: 06/20/08 at 11:10 AM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Fluorene | 90 | 92 | 42-139 | 2 | 30 | | | | |
| Phenanthrene | 92 | 91 | 1-181 | 1 | 30 | | | | |
| Anthracene | 88 | 89 | 34-148 | 1 | 30 | | | | |
| Benzo(a)anthracene | 90 | 92 | 20-156 | 2 | 30 | | | | |
| Chrysene | 85 | 86 | 19-158 | 1 | 30 | | | | |
| Benzo(b)fluoranthene | 104 | 105 | 13-161 | 1 | 30 | | | | |
| Benzo(a)pyrene | 98 | 99 | 24-154 | 1 | 30 | | | | |
| Benzo(g,h,i)perylene | 109 | 106 | 26-154 | 2 | 30 | | | | |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08165SLC026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5385262 | 99 | 107 | 110 |
| Blank | 88 | 93 | 98 |
| LCS | 89 | 94 | 95 |
| MS | 83 | 90 | 92 |
| MSD | 86 | 91 | 94 |
| Limits: | 49-120 | 55-117 | 43-131 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081651AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5385262 | 83 | 78 | 79 | 75 |
| Blank | 99 | 94 | 92 | 94 |
| LCS | 92 | 86 | 88 | 89 |
| LCSD | 98 | 94 | 96 | 101 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1095356 Sample # 5385262

**COC # 178085**

Please print. Instructions on reverse side correspond with circled numbers. 1.5°C

(1) Client: SUN-AQUATERRA Acct. #:

Project Name/#: PHILA REF AOI-8 PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: S. SYKES Quote #:

Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#: 516493

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | (3) Composite | (4) Matrix: Soil | Matrix: Water | Matrix: Other | Total # of Containers | (5) Analyses Requested / Preservation Codes: PAN 826(6) | Moisture | Lead | PAHs by GC/MS 8270 | Temperature of Sample(s) Received (°C) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-103_1.0-2.0 | 6/16/08 | 830 | X | | X | | | 2 | X | X | X | X | | * Analyses per table provided |
| | | | | | | | | | | | | | | * Pls copy Kevin Martin & Jason @ Langan |

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

(9)

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| [signature] | 6/16/08 | 7:30 | [signature] | 6/16/08 | 7:30 |
| [signature] | 6/17/08 | 10:00 | | | |
| [signature] / Aquaterra | 6/16/08 | 1300 | AQUATERRA FRIDGE | 6/16/08 | 1300 |
| [signature] | 6/16/08 | 1:50p | [signature] | 6/16/08 | 1359 |
| [signature] | 6/16/08 | 1535 | [signature] | 6/16/08 | 1559 |

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1095850. Samples arrived at the laboratory on Thursday, June 12, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-121_1.0-2.0 Grab Soil | 5388263 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Dorothy M. Love

Dorothy M. Love
Group Leader

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report



**Lancaster Laboratories Sample No. 5388263 SW  Group No. 1095850**

**N-121_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 177767 N-121_1.0-2.0**

Collected:06/09/2008 13:30  by SS  Account Number: 10132

Submitted: 06/12/2008 15:15
Reported: 06/27/2008 at 08:30
Discard: 08/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

12110

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 64.0 | 1.17 | 0.176 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 15.6 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 2,500. | 990. | 200. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 990. | 990. | 200. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 990. | 990. | 200. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | 2,500. | 990. | 200. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 990. | 990. | 200. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 990. | 990. | 200. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | 1,500. | 990. | 200. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 990. | 990. | 200. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 990. | 990. | 200. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 990. | 990. | 200. | ug/kg | 1 |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 230. | 230. | 23. | ug/kg | 38.94 |
| 05460 | Benzene | 71-43-2 | < 230. | 230. | 23. | ug/kg | 38.94 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 230. | 230. | 46. | ug/kg | 38.94 |
| 05466 | Toluene | 108-88-3 | < 230. | 230. | 46. | ug/kg | 38.94 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 230. | 230. | 46. | ug/kg | 38.94 |
| 05474 | Ethylbenzene | 100-41-4 | < 230. | 230. | 46. | ug/kg | 38.94 |
| 05479 | Isopropylbenzene | 98-82-8 | < 230. | 230. | 46. | ug/kg | 38.94 |
| 06301 | Xylene (Total) | 1330-20-7 | < 230. | 230. | 46. | ug/kg | 38.94 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5388263 SW  Group No. 1095850**

**N-121_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**COC: 177767 N-121_1.0-2.0**

Collected:06/09/2008 13:30  by SS  Account Number: 10132

Submitted: 06/12/2008 15:15
Reported: 06/27/2008 at 08:30
Discard: 08/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

12110

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/26/2008 21:09 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/13/2008 15:39 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/19/2008 04:43 | William T Parker | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/18/2008 17:36 | Nicholas R Rossi | 38.94 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/18/2008 19:55 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 06/09/2008 13:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/16/2008 18:40 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1095850
Reported: 06/27/08 at 08:30 AM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08165820003B | Sample number(s): 5388263 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08165SLC026 | Sample number(s): 5388263 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 91 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 87 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 92 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 95 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 90 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 92 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 88 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 107 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 101 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 111 | | 65-122 | | |
| Batch number: 081706150003A | Sample number(s): 5388263 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 103 | | 82-118 | | |
| Batch number: Q081701AA | Sample number(s): 5388263 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 109 | 106 | 72-117 | 2 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 97 | 96 | 84-115 | 2 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 122 | 116 | 76-135 | 5 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 98 | 94 | 81-116 | 4 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 101 | 97 | 77-114 | 4 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 100 | 95 | 82-115 | 5 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 96 | 94 | 82-110 | 2 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 97 | 93 | 82-117 | 4 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08165820003B | Sample number(s): 5388263 BKG: P387347 | | | | | | | | |
| Moisture | | | | | | 11.0 | 10.7 | 3 | 15 |
| Batch number: 08165SLC026 | Sample number(s): 5388263 UNSPK: P383302 | | | | | | | | |
| Pyrene | 89 | 90 | 19-162 | 1 | 30 | | | | |
| Naphthalene | 83 | 86 | 29-140 | 3 | 30 | | | | |
| Fluorene | 90 | 92 | 42-139 | 2 | 30 | | | | |
| Phenanthrene | 92 | 91 | 1-181 | 1 | 30 | | | | |
| Anthracene | 88 | 89 | 34-148 | 1 | 30 | | | | |
| Benzo(a)anthracene | 90 | 92 | 20-156 | 2 | 30 | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1095850
Reported: 06/27/08 at 08:30 AM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Chrysene | 85 | 86 | 19-158 | 1 | 30 | | | | |
| Benzo(b)fluoranthene | 104 | 105 | 13-161 | 1 | 30 | | | | |
| Benzo(a)pyrene | 98 | 99 | 24-154 | 1 | 30 | | | | |
| Benzo(g,h,i)perylene | 109 | 106 | 26-154 | 2 | 30 | | | | |
| Batch number: 081706150003A | Sample number(s): 5388263 UNSPK: P377658 BKG: P377658 | | | | | | | | |
| Lead | -266426 (2) | -166027 (2) | 75-125 | 11 | 20 | 16,800. | 13,000. | 25* | 20 |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08165SLC026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5388263 | 112 | 117 | 112 |
| Blank | 88 | 93 | 98 |
| LCS | 89 | 94 | 95 |
| MS | 83 | 90 | 92 |
| MSD | 86 | 91 | 94 |
| Limits: | 49-120 | 55-117 | 43-131 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081701AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5388263 | 86 | 80 | 79 | 86 |
| Blank | 82 | 76 | 75 | 74 |
| LCS | 106 | 97 | 101 | 100 |
| LCSD | 103 | 96 | 97 | 95 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1095850 Sample # 5388263

**COC # 177767**

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: SUN-AQUATERRA Acct. #:

Project Name/#: PHILA REF AOI-8 PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: S. SYKES Quote #:

Name of state where samples were collected: PA

For Lab Use Only

FSC:

SCR#: 56494

**Preservation Codes**

H=HCl T=Thiosulfate

N=$HNO_3$ B=NaOH

S=$H_2SO_4$ O=Other

(6) Temperature of samples upon receipt (if requested)

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water (☐ Potable ☐ NPDES) | Other | Total # of Containers | (5) Analyses Requested / Preservation Codes: PAH 8260 B | Moisture | Lead | Pahs by 8270 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-121_1.0-2.0 | 6/9/08 | 1330 | X | | X | | | 2 | X | X | X | X | ⊗ Analyses per table provided ⊗ Pls Copy Kevin Martin & Jason @ Langan |

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush

(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)

Date results are needed:

Rush results requested by (please circle): Phone Fax E-mail

Phone #: Fax #:

E-mail address:

(8) **Data Package Options** (please circle if required)

Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)

TX TRRP-13
MA MCP CT RCP

SDG Complete? Yes No

Site-specific QC (MS/MSD/Dup)? Yes No

(If yes, indicate QC sample and submit triplicate volume.)

Internal COC Required? Yes / No

(9)

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| [signature] | 6/10/08 | 17:30 | [signature] | 6/10/08 | 17:30 |
| [signature] | 6/10/08 | 10:00 | | | |
| [signature] AQUATERRA | 6/10/08 | 1700 | AQUATERRA FRIDAY | 6/10/08 | 1700 |
| [signature] | 6/12/08 | 11:40 | [signature] | 6/12/08 | 11:40 |
| [signature] | 6/12/08 | 15:15 | [signature] | 6/12/08 | 1515 |

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

**WARRANTY AND LIMITS OF LIABILITY –** In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 1096046. Samples arrived at the laboratory on Friday, June 13, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-100_0.0-2.0 Grab Soil | 5389508 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

Lancaster Laboratories

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Dorothy M. Love

Dorothy M. Love
Group Leader

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5389508 SW  Group No. 1096046**

**N-100_0.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 177179 N-100_0.0-2.0**

Collected:06/11/2008 08:30  by TD  Account Number: 10132

Submitted: 06/13/2008 15:30
Reported: 06/27/2008 at 08:35
Discard: 08/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

AQ100

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 135. | 1.09 | 0.164 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 10.3 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 1,900. | 190. | 37. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 190. | 190. | 37. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 190. | 190. | 37. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | 1,500. | 190. | 37. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | 320. | 190. | 37. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 1,100. | 190. | 37. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | 1,100. | 190. | 37. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 1,200. | 190. | 37. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 920. | 190. | 37. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 620. | 190. | 37. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 280. | 280. | 28. | ug/kg | 51.12 |
| 05460 | Benzene | 71-43-2 | < 280. | 280. | 28. | ug/kg | 51.12 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 280. | 280. | 57. | ug/kg | 51.12 |
| 05466 | Toluene | 108-88-3 | < 280. | 280. | 57. | ug/kg | 51.12 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 280. | 280. | 57. | ug/kg | 51.12 |
| 05474 | Ethylbenzene | 100-41-4 | < 280. | 280. | 57. | ug/kg | 51.12 |
| 05479 | Isopropylbenzene | 98-82-8 | < 280. | 280. | 57. | ug/kg | 51.12 |
| 06301 | Xylene (Total) | 1330-20-7 | < 280. | 280. | 57. | ug/kg | 51.12 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5389508 SW  Group No. 1096046**

**N-100_0.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 177179 N-100_0.0-2.0**

Collected:06/11/2008 08:30 by TD

Account Number: 10132

Submitted: 06/13/2008 15:30
Reported: 06/27/2008 at 08:35
Discard: 08/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

AQ100

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/26/2008 21:11 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/13/2008 20:10 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/19/2008 07:00 | William T Parker | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/18/2008 17:59 | Nicholas R Rossi | 51.12 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/18/2008 19:55 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 06/11/2008 08:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/17/2008 23:30 | Patricia L Foreman | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1096046
Reported: 06/27/08 at 08:35 AM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08165820006A | Sample number(s): 5389508 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08169SLD026 | Sample number(s): 5389508 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 98 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 87 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 95 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 101 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 95 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 94 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 92 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 89 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 86 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 81 | | 65-122 | | |
| Batch number: 081706150003A | Sample number(s): 5389508 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 103 | | 82-118 | | |
| Batch number: Q081701AA | Sample number(s): 5389508 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 109 | 106 | 72-117 | 2 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 97 | 96 | 84-115 | 2 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 122 | 116 | 76-135 | 5 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 98 | 94 | 81-116 | 4 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 101 | 97 | 77-114 | 4 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 100 | 95 | 82-115 | 5 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 96 | 94 | 82-110 | 2 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 97 | 93 | 82-117 | 4 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08165820006A | Sample number(s): 5389508 BKG: P389572 | | | | | | | | |
| Moisture | | | | | | 24.5 | 22.7 | 8 | 15 |
| Batch number: 08169SLD026 | Sample number(s): 5389508 UNSPK: P389704 | | | | | | | | |
| Pyrene | 92 | 95 | 19-162 | 3 | 30 | | | | |
| Naphthalene | 87 | 90 | 29-140 | 3 | 30 | | | | |
| Fluorene | 90 | 97 | 42-139 | 8 | 30 | | | | |
| Phenanthrene | 94 | 99 | 1-181 | 5 | 30 | | | | |
| Anthracene | 90 | 94 | 34-148 | 5 | 30 | | | | |
| Benzo(a)anthracene | 89 | 93 | 20-156 | 4 | 30 | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1096046
Reported: 06/27/08 at 08:35 AM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Chrysene | 86 | 89 | 19-158 | 3 | 30 | | | | |
| Benzo(b)fluoranthene | 83 | 82 | 13-161 | 1 | 30 | | | | |
| Benzo(a)pyrene | 79 | 84 | 24-154 | 6 | 30 | | | | |
| Benzo(g,h,i)perylene | 81 | 87 | 26-154 | 7 | 30 | | | | |
| Batch number: 081706150003A | Sample number(s): 5389508 UNSPK: P377658 BKG: P377658 | | | | | | | | |
| Lead | -266426 (2) | -166027 (2) | 75-125 | 11 | 20 | 16,800. | 13,000. | 25* | 20 |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08169SLD026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5389508 | 83 | 87 | 82 |
| Blank | 88 | 89 | 91 |
| LCS | 88 | 93 | 95 |
| MS | 90 | 94 | 94 |
| MSD | 90 | 96 | 92 |
| Limits: | 49-120 | 55-117 | 43-131 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081701AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5389508 | 91 | 83 | 83 | 88 |
| Blank | 82 | 76 | 75 | 74 |
| LCS | 106 | 97 | 101 | 100 |
| LCSD | 103 | 96 | 97 | 95 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1096046 Sample # 5389508

**COC # 177179**

Please print. Instructions on reverse side correspond with circled numbers. 3.5°C

(1) Client: Aquatera (Sun) Acct. #:

Project Name/#: Philly-Refinery AW-8 PWSID #:

Project Manager: T. Beer P.O.#:

Sampler: T.D. Quote #:

Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#: 569762

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | Matrix: Soil | Water (Potable / NPDES) | Other | (4) Total # of Containers | (5) Analyses Requested: 8260 B | 8270 C | Lead | (6) Temperature of samples upon receipt (if requested) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-100-0.0-2.0 | 6/11/08 | 0830 | X | | X | | | 2 | X | X | X | | * Analytes for each method provided in table |
| | | | | | | | | | | | | | * CC data to Langan |

(7) **Turnaround Time Requested** (TAT) (please circle): Normal / Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg) TX TRRP-13
Type II (Tier II) MA MCP CT RCP
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)

SDG Complete? Yes / No

Site-specific QC (MS/MSD/Dup)? Yes / No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| Bottle Storage | 3/24/08 | 800 | P. Lefever | 3/24/08 | 800 |
| P. Lefever | 3/24/08 | 1050 | | | |
| | 6/12/08 | 1500 | Aquatera Bridge | 6/12/08 | 1500 |
| | 6/13/08 | 1035 | Gina Kellman | 6/13/08 | 10:30 |
| Gina Kellman | 6/13/08 | 15:30 | | 6/13/08 | 530 |

(9)

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

**WARRANTY AND LIMITS OF LIABILITY –** In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

Lancaster Laboratories

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1096740. Samples arrived at the laboratory on Wednesday, June 18, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-101_1.0-2.0 Grab Soil | 5393378 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Michele M. Turner

Michele M. Turner
Director

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report



**Lancaster Laboratories Sample No. 5393378 SW  Group No. 1096740**

**N-101_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 0330 N-101_1.0-2.0**

Collected:06/16/2008 13:30  by SS  Account Number: 10132

Submitted: 06/18/2008 17:40
Reported: 06/26/2008 at 14:38
Discard: 08/26/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

A8101

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 78.1 | 1.15 | 0.173 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 14.9 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 440. | 200. | 39. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 200. | 200. | 39. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | 280. | 200. | 39. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | 530. | 200. | 39. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | 240. | 200. | 39. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 200. | 200. | 39. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | 250. | 200. | 39. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 200. | 200. | 39. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 200. | 200. | 39. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 200. | 200. | 39. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 210. | 210. | 21. | ug/kg | 35.87 |
| 05460 | Benzene | 71-43-2 | < 210. | 210. | 21. | ug/kg | 35.87 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 210. | 210. | 42. | ug/kg | 35.87 |
| 05466 | Toluene | 108-88-3 | < 210. | 210. | 42. | ug/kg | 35.87 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 210. | 210. | 42. | ug/kg | 35.87 |
| 05474 | Ethylbenzene | 100-41-4 | < 210. | 210. | 42. | ug/kg | 35.87 |
| 05479 | Isopropylbenzene | 98-82-8 | < 210. | 210. | 42. | ug/kg | 35.87 |
| 06301 | Xylene (Total) | 1330-20-7 | < 210. | 210. | 42. | ug/kg | 35.87 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5393378 SW  Group No. 1096740**

**N-101_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 0330 N-101_1.0-2.0**

Collected:06/16/2008 13:30  by SS  Account Number: 10132

Submitted: 06/18/2008 17:40  SUN: Aquaterra Tech.
Reported: 06/26/2008 at 14:38  PO Box 744
Discard: 08/26/2008  West Chester PA 19381

A8101

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/25/2008 03:27 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/19/2008 15:57 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/20/2008 17:20 | Linda M Hartenstine | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/20/2008 16:30 | Nicholas R Rossi | 35.87 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/19/2008 19:35 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035A | 1 | 06/16/2008 13:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/19/2008 23:15 | Patricia L Foreman | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1096740
Reported: 06/26/08 at 02:38 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 081716150003A | Sample number(s): 5393378 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 107 | | 82-118 | | |
| Batch number: 08171820004A | Sample number(s): 5393378 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08171SLD026 | Sample number(s): 5393378 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 81 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 78 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 88 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 90 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 87 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 83 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 85 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 75 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 76 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 80 | | 65-122 | | |
| Batch number: Q081721AA | Sample number(s): 5393378 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 103 | 106 | 72-117 | 3 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 93 | 94 | 84-115 | 1 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 117 | 120 | 76-135 | 3 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 95 | 95 | 81-116 | 1 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 96 | 100 | 77-114 | 4 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 96 | 98 | 82-115 | 2 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 95 | 96 | 82-110 | 1 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 94 | 95 | 82-117 | 2 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 081716150003A | Sample number(s): 5393378 UNSPK: P391409 BKG: P391409 | | | | | | | | |
| Lead | -414 (2) | -185 (2) | 75-125 | 7 | 20 | 50.4 | 70.4 | 33* | 20 |
| Batch number: 08171820004A | Sample number(s): 5393378 BKG: P393413 | | | | | | | | |
| Moisture | | | | | | 61.5 | 61.4 | 0 | 15 |
| Batch number: 08171SLD026 | Sample number(s): 5393378 UNSPK: 5393378 | | | | | | | | |
| Pyrene | 75 | 82 | 19-162 | 7 | 30 | | | | |
| Naphthalene | 82 | 89 | 29-140 | 8 | 30 | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1096740
Reported: 06/26/08 at 02:38 PM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Fluorene | 77 | 86 | 42-139 | 9 | 30 | | | | |
| Phenanthrene | 95 | 106 | 1-181 | 8 | 30 | | | | |
| Anthracene | 90 | 98 | 34-148 | 8 | 30 | | | | |
| Benzo(a)anthracene | 83 | 89 | 20-156 | 6 | 30 | | | | |
| Chrysene | 81 | 86 | 19-158 | 6 | 30 | | | | |
| Benzo(b)fluoranthene | 73 | 75 | 13-161 | 2 | 30 | | | | |
| Benzo(a)pyrene | 74 | 77 | 24-154 | 4 | 30 | | | | |
| Benzo(g,h,i)perylene | 82 | 85 | 26-154 | 4 | 30 | | | | |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08171SLD026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5393378 | 103 | 96 | 79 |
| Blank | 86 | 84 | 84 |
| LCS | 79 | 80 | 78 |
| MS | 89 | 85 | 73 |
| MSD | 99 | 94 | 82 |
| Limits: | 49-120 | 55-117 | 43-131 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: Q081721AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5393378 | 86 | 80 | 78 | 85 |
| Blank | 81 | 77 | 76 | 75 |
| LCS | 101 | 93 | 96 | 97 |
| LCSD | 103 | 94 | 99 | 100 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# PA UST Analysis Request/Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only
Acct. #: 10132 Group #: 1096740 Sample #: 5393378 0330
SCR #:

Consultant/Office #: Aquaterra (Sun)
Consultant Prj. Mgr.: T. Doerr
Consultant Phone #: 610-431-9733 Fax #:
Site Name: Philly Refinery AOI-8
Site Address:
Sampler: SS

| Sample Identification | Date Collected | Time Collected | Grab | Composite | Matrix: Soil | Matrix: Water (Potable ☐ NPDES ☐) | Matrix: Oil ☐ Air ☐ | Total Number of Containers | Number of EnCores | PA Unleaded Gasoline | PA Leaded Gasoline | PA Kerosene (No. 1) | PA Diesel Fuel (No. 2) | PA Fuel Oil No. 4, 5, 6 | PA Used Motor Oil | 8260B | 8270C | Lead | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-101 - 1.0-2.0 | 6/16/08 | 1330 | X | | X | | | 2 | | | | | | | | X | X | X | | | * Specific analyte list previously provided. |

Analyses Requested — List total number of containers in the box under each analyses.

Turnaround Time: STD (7-10) RUSH

Comments:

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| [signature] | 6/18/08 | 1142 | P. Lefever | 6/18/08 | 1740 |
| P. Lefever | 6/18/08 | 1740 | | | |
| | | | | | |
| | | | Katie Hartline | 6/18/08 | 17:40 |

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1096931. Samples arrived at the laboratory on Thursday, June 19, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-129_1.0-2.0 Grab Soil | 5394557 |
| N-126_1.0-2.0 Grab Soil | 5394558 |
| N-109_1.0-2.0 Grab Soil | 5394559 |
| N-131_1.0-2.0 Grab Soil | 5394560 |
| N-119_1.0-2.0 Grab Soil | 5394561 |
| BH-08-01_1.0-2.0 Grab Soil | 5394562 |
| N-104_1.0-2.0 Grab Soil | 5394563 |
| N-105_1.0-2.0 Grab Soil | 5394564 |
| N-107_1.0-2.0 Grab Soil | 5394565 |
| N-99_1.0-2.0 Grab Soil | 5394566 |
| N-125_1.0-2.0 Grab Soil | 5394567 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Chad A. Moline
Group Leader

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5394557 SW  Group No. 1096931**

**N-129_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-129_1.0-2.0**

Collected:06/17/2008 08:00  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15
Reported: 07/08/2008 at 08:53
Discard: 09/07/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-129

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 31.3 | 1.14 | 0.171 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 14.0 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 970. | 970. | 190. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 970. | 970. | 190. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 970. | 970. | 190. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 970. | 970. | 190. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 970. | 970. | 190. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 970. | 970. | 190. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | 1,000. | 970. | 190. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 970. | 970. | 190. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 970. | 970. | 190. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 1,700. | 970. | 190. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 230. | 230. | 23. | ug/kg | 39.31 |
| 05460 | Benzene | 71-43-2 | < 230. | 230. | 23. | ug/kg | 39.31 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 230. | 230. | 46. | ug/kg | 39.31 |
| 05466 | Toluene | 108-88-3 | < 230. | 230. | 46. | ug/kg | 39.31 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 230. | 230. | 46. | ug/kg | 39.31 |
| 05474 | Ethylbenzene | 100-41-4 | < 230. | 230. | 46. | ug/kg | 39.31 |
| 05479 | Isopropylbenzene | 98-82-8 | < 230. | 230. | 46. | ug/kg | 39.31 |
| 06301 | Xylene (Total) | 1330-20-7 | < 230. | 230. | 46. | ug/kg | 39.31 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5394557 SW  Group No. 1096931**

**N-129_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-129_1.0-2.0**

Collected:06/17/2008 08:00  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15  SUN: Aquaterra Tech.
Reported: 07/08/2008 at 08:53  PO Box 744
Discard: 09/07/2008  West Chester PA 19381

N-129

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/29/2008 14:18 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/23/2008 16:35 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/24/2008 07:30 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/23/2008 19:51 | Kelly E Brickley | 39.31 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/22/2008 14:30 | Mirit S Shenouda | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 06/17/2008 08:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/22/2008 07:55 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5394558 SW  Group No. 1096931**

**N-126_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-126_1.0-2.0**

Collected:06/17/2008 08:10  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15
Reported: 07/08/2008 at 08:53
Discard: 09/07/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-126

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 912. | 2.36 | 0.354 | mg/kg | 20 |
| 00111 | Moisture | n.a. | 17.7 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 2,200. | 1,000. | 200. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 1,000. | 1,000. | 200. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | 1,200. | 1,000. | 200. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 1,100. | 1,000. | 200. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | 1,100. | 1,000. | 200. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 1,000. | 1,000. | 200. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | 1,400. | 1,000. | 200. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 1,000. | 1,000. | 200. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 1,000. | 1,000. | 200. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 1,000. | 1,000. | 200. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 3,100. | 3,100. | 310. | ug/kg | 517.6 |
| 05460 | Benzene | 71-43-2 | < 3,100. | 3,100. | 310. | ug/kg | 517.6 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 3,100. | 3,100. | 630. | ug/kg | 517.6 |
| 05466 | Toluene | 108-88-3 | < 3,100. | 3,100. | 630. | ug/kg | 517.6 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 3,100. | 3,100. | 630. | ug/kg | 517.6 |
| 05474 | Ethylbenzene | 100-41-4 | < 3,100. | 3,100. | 630. | ug/kg | 517.6 |
| 05479 | Isopropylbenzene | 98-82-8 | < 3,100. | 3,100. | 630. | ug/kg | 517.6 |
| 06301 | Xylene (Total) | 1330-20-7 | < 3,100. | 3,100. | 630. | ug/kg | 517.6 |
| | The reporting limits for the GC/MS volatile compounds were raised due to sample foaming. | | | | | | |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5394558 SW  Group No. 1096931**

**N-126_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-126_1.0-2.0**

Collected:06/17/2008 08:10  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15  SUN: Aquaterra Tech.
Reported: 07/08/2008 at 08:53  PO Box 744
Discard: 09/07/2008  West Chester PA 19381

N-126

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 07/07/2008 06:58 | David K Beck | 20 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/23/2008 16:35 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/24/2008 08:42 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/23/2008 20:13 | Kelly E Brickley | 517.6 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/22/2008 14:30 | Mirit S Shenouda | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 06/17/2008 08:10 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/22/2008 07:55 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5394559 SW  Group No. 1096931**

**N-109_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-109_1.0-2.0**

Collected:06/17/2008 08:20  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15
Reported: 07/08/2008 at 08:53
Discard: 09/07/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-109

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 294. | 1.13 | 0.169 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 12.2 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 950. | 950. | 190. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 950. | 950. | 190. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 950. | 950. | 190. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 950. | 950. | 190. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 950. | 950. | 190. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 950. | 950. | 190. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 950. | 950. | 190. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 950. | 950. | 190. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 950. | 950. | 190. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 950. | 950. | 190. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 3,100. | 3,100. | 310. | ug/kg | 539.96 |
| 05460 | Benzene | 71-43-2 | < 3,100. | 3,100. | 310. | ug/kg | 539.96 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 3,100. | 3,100. | 610. | ug/kg | 539.96 |
| 05466 | Toluene | 108-88-3 | < 3,100. | 3,100. | 610. | ug/kg | 539.96 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 3,100. | 3,100. | 610. | ug/kg | 539.96 |
| 05474 | Ethylbenzene | 100-41-4 | < 3,100. | 3,100. | 610. | ug/kg | 539.96 |
| 05479 | Isopropylbenzene | 98-82-8 | < 3,100. | 3,100. | 610. | ug/kg | 539.96 |
| 06301 | Xylene (Total) | 1330-20-7 | < 3,100. | 3,100. | 610. | ug/kg | 539.96 |
| | The reporting limits for the GC/MS volatile compounds were raised due to sample foaming. | | | | | | |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5394559 SW  Group No. 1096931**

**N-109_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-109_1.0-2.0**

Collected:06/17/2008 08:20  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15  SUN: Aquaterra Tech.
Reported: 07/08/2008 at 08:53  PO Box 744
Discard: 09/07/2008  West Chester PA 19381

N-109

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/29/2008 14:33 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/23/2008 16:35 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/30/2008 23:54 | Gregory J Drahovsky | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/23/2008 20:35 | Kelly E Brickley | 539.96 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/22/2008 14:30 | Mirit S Shenouda | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 06/17/2008 08:20 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 2 | 06/27/2008 14:55 | Adrienne E Fellenbaum | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5394560 SW  Group No. 1096931**

**N-131_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-131_1.0-2.0**

Collected:06/17/2008 08:40  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15
Reported: 07/08/2008 at 08:53
Discard: 09/07/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-131

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 88.8 | 1.23 | 0.185 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 19.7 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 1,000. | 1,000. | 210. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 1,000. | 1,000. | 210. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 1,000. | 1,000. | 210. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 1,000. | 1,000. | 210. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 1,000. | 1,000. | 210. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 1,000. | 1,000. | 210. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 1,000. | 1,000. | 210. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 1,000. | 1,000. | 210. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 1,000. | 1,000. | 210. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 1,000. | 1,000. | 210. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 380. | 380. | 38. | ug/kg | 61.12 |
| 05460 | Benzene | 71-43-2 | < 380. | 380. | 38. | ug/kg | 61.12 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 380. | 380. | 76. | ug/kg | 61.12 |
| 05466 | Toluene | 108-88-3 | < 380. | 380. | 76. | ug/kg | 61.12 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 380. | 380. | 76. | ug/kg | 61.12 |
| 05474 | Ethylbenzene | 100-41-4 | < 380. | 380. | 76. | ug/kg | 61.12 |
| 05479 | Isopropylbenzene | 98-82-8 | < 380. | 380. | 76. | ug/kg | 61.12 |
| 06301 | Xylene (Total) | 1330-20-7 | < 380. | 380. | 76. | ug/kg | 61.12 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5394560 SW  Group No. 1096931**

**N-131_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-131_1.0-2.0**

Collected:06/17/2008 08:40  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15  SUN: Aquaterra Tech.
Reported: 07/08/2008 at 08:53  PO Box 744
Discard: 09/07/2008  West Chester PA 19381

N-131

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/29/2008 14:37 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/23/2008 16:35 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/24/2008 09:30 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/23/2008 20:58 | Kelly E Brickley | 61.12 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/22/2008 14:30 | Mirit S Shenouda | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 06/17/2008 08:40 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/22/2008 07:55 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5394561 SW  Group No. 1096931**

**N-119_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-119_1.0-2.0**

Collected:06/17/2008 09:00  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15
Reported: 07/08/2008 at 08:53
Discard: 09/07/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-119

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 101. | 1.17 | 0.176 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 15.7 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 560. | 200. | 40. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 200. | 200. | 40. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 200. | 200. | 40. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | < 200. | 200. | 40. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 200. | 200. | 40. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 340. | 200. | 40. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | 650. | 200. | 40. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 210. | 200. | 40. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 430. | 200. | 40. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 330. | 200. | 40. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 240. | 240. | 24. | ug/kg | 40.26 |
| 05460 | Benzene | 71-43-2 | < 240. | 240. | 24. | ug/kg | 40.26 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 240. | 240. | 48. | ug/kg | 40.26 |
| 05466 | Toluene | 108-88-3 | < 240. | 240. | 48. | ug/kg | 40.26 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 240. | 240. | 48. | ug/kg | 40.26 |
| 05474 | Ethylbenzene | 100-41-4 | < 240. | 240. | 48. | ug/kg | 40.26 |
| 05479 | Isopropylbenzene | 98-82-8 | < 240. | 240. | 48. | ug/kg | 40.26 |
| 06301 | Xylene (Total) | 1330-20-7 | < 240. | 240. | 48. | ug/kg | 40.26 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted.  Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

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# Analysis Report



**Lancaster Laboratories Sample No. 5394561 SW  Group No. 1096931**

**N-119_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-119_1.0-2.0**

Collected:06/17/2008 09:00  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15  SUN: Aquaterra Tech.
Reported: 07/08/2008 at 08:53  PO Box 744
Discard: 09/07/2008  West Chester PA 19381

N-119

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/29/2008 14:41 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/23/2008 16:35 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/24/2008 09:54 | Joseph M Gambler | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/23/2008 21:42 | Kelly E Brickley | 40.26 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/22/2008 14:30 | Mirit S Shenouda | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 06/17/2008 09:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/22/2008 07:55 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5394562 SW  Group No. 1096931**

**BH-08-01_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 BH-08-01_1.0-2.0**

Collected:06/17/2008 09:30  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15
Reported: 07/08/2008 at 08:53
Discard: 09/07/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

BH081

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 69.7 | 1.08 | 0.162 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 9.5 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 180. | 180. | 37. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 180. | 180. | 37. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 180. | 180. | 37. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | < 180. | 180. | 37. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | < 180. | 180. | 37. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 180. | 180. | 37. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | < 180. | 180. | 37. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 180. | 180. | 37. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 180. | 180. | 37. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 180. | 180. | 37. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 240. | 240. | 24. | ug/kg | 43.78 |
| 05460 | Benzene | 71-43-2 | < 240. | 240. | 24. | ug/kg | 43.78 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 240. | 240. | 48. | ug/kg | 43.78 |
| 05466 | Toluene | 108-88-3 | < 240. | 240. | 48. | ug/kg | 43.78 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 240. | 240. | 48. | ug/kg | 43.78 |
| 05474 | Ethylbenzene | 100-41-4 | < 240. | 240. | 48. | ug/kg | 43.78 |
| 05479 | Isopropylbenzene | 98-82-8 | < 240. | 240. | 48. | ug/kg | 43.78 |
| 06301 | Xylene (Total) | 1330-20-7 | < 240. | 240. | 48. | ug/kg | 43.78 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

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## Laboratory Chronicle

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# Analysis Report



**Lancaster Laboratories Sample No. 5394562 SW  Group No. 1096931**

**BH-08-01_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 BH-08-01_1.0-2.0**

Collected:06/17/2008 09:30  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15  SUN: Aquaterra Tech.
Reported: 07/08/2008 at 08:53  PO Box 744
Discard: 09/07/2008  West Chester PA 19381

BH081

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/29/2008 14:44 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/23/2008 16:35 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/24/2008 10:18 | Joseph M Gambler | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/23/2008 22:05 | Kelly E Brickley | 43.78 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/22/2008 14:30 | Mirit S Shenouda | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 06/17/2008 09:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/22/2008 07:55 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5394563 SW  Group No. 1096931**

**N-104_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-104_1.0-2.0**

Collected:06/17/2008 09:45  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15
Reported: 07/08/2008 at 08:53
Discard: 09/07/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-104

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 164. | 1.07 | 0.161 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 9.3 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 2,200. | 920. | 180. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 920. | 920. | 180. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 920. | 920. | 180. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 1,500. | 920. | 180. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 920. | 920. | 180. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 920. | 920. | 180. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | 1,200. | 920. | 180. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 920. | 920. | 180. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 920. | 920. | 180. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 920. | 920. | 180. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 230. | 230. | 23. | ug/kg | 41.19 |
| 05460 | Benzene | 71-43-2 | < 230. | 230. | 23. | ug/kg | 41.19 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 230. | 230. | 45. | ug/kg | 41.19 |
| 05466 | Toluene | 108-88-3 | < 230. | 230. | 45. | ug/kg | 41.19 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 230. | 230. | 45. | ug/kg | 41.19 |
| 05474 | Ethylbenzene | 100-41-4 | < 230. | 230. | 45. | ug/kg | 41.19 |
| 05479 | Isopropylbenzene | 98-82-8 | < 230. | 230. | 45. | ug/kg | 41.19 |
| 06301 | Xylene (Total) | 1330-20-7 | < 230. | 230. | 45. | ug/kg | 41.19 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5394563 SW  Group No. 1096931**

**N-104_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-104_1.0-2.0**

Collected:06/17/2008 09:45  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15
Reported: 07/08/2008 at 08:53
Discard: 09/07/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-104

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/29/2008 14:48 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/23/2008 16:35 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/24/2008 10:42 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/23/2008 22:27 | Kelly E Brickley | 41.19 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/22/2008 14:30 | Mirit S Shenouda | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 06/17/2008 09:45 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/22/2008 07:55 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5394564 SW  Group No. 1096931**

**N-105_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-105_1.0-2.0**

Collected:06/17/2008 10:00  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15
Reported: 07/08/2008 at 08:53
Discard: 09/07/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-105

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 36.4 | 1.08 | 0.162 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 9.0 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 920. | 920. | 180. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 920. | 920. | 180. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 920. | 920. | 180. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 920. | 920. | 180. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 920. | 920. | 180. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 920. | 920. | 180. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 920. | 920. | 180. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 920. | 920. | 180. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 920. | 920. | 180. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 920. | 920. | 180. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 240. | 240. | 24. | ug/kg | 43.03 |
| 05460 | Benzene | 71-43-2 | < 240. | 240. | 24. | ug/kg | 43.03 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 240. | 240. | 47. | ug/kg | 43.03 |
| 05466 | Toluene | 108-88-3 | < 240. | 240. | 47. | ug/kg | 43.03 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 240. | 240. | 47. | ug/kg | 43.03 |
| 05474 | Ethylbenzene | 100-41-4 | < 240. | 240. | 47. | ug/kg | 43.03 |
| 05479 | Isopropylbenzene | 98-82-8 | < 240. | 240. | 47. | ug/kg | 43.03 |
| 06301 | Xylene (Total) | 1330-20-7 | < 240. | 240. | 47. | ug/kg | 43.03 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5394564 SW  Group No. 1096931**

**N-105_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-105_1.0-2.0**

Collected:06/17/2008 10:00  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15  SUN: Aquaterra Tech.
Reported: 07/08/2008 at 08:53  PO Box 744
Discard: 09/07/2008  West Chester PA 19381

N-105

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/29/2008 14:52 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/23/2008 16:35 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/24/2008 11:06 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/23/2008 22:49 | Kelly E Brickley | 43.03 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/22/2008 14:30 | Mirit S Shenouda | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 06/17/2008 10:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/22/2008 07:55 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5394565 SW  Group No. 1096931**

**N-107_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-107_1.0-2.0**

Collected:06/17/2008 10:15  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15
Reported: 07/08/2008 at 08:53
Discard: 09/07/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-107

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 173. | 1.07 | 0.161 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 7.7 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | < 1,800. | 1,800. | 360. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 1,800. | 1,800. | 360. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 1,800. | 1,800. | 360. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | < 1,800. | 1,800. | 360. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 1,800. | 1,800. | 360. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | < 1,800. | 1,800. | 360. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | < 1,800. | 1,800. | 360. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | < 1,800. | 1,800. | 360. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | < 1,800. | 1,800. | 360. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 1,800. | 1,800. | 360. | ug/kg | 5 |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 220. | 220. | 22. | ug/kg | 40.19 |
| 05460 | Benzene | 71-43-2 | 740. | 220. | 22. | ug/kg | 40.19 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 220. | 220. | 44. | ug/kg | 40.19 |
| 05466 | Toluene | 108-88-3 | 420. | 220. | 44. | ug/kg | 40.19 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 220. | 220. | 44. | ug/kg | 40.19 |
| 05474 | Ethylbenzene | 100-41-4 | 1,600. | 220. | 44. | ug/kg | 40.19 |
| 05479 | Isopropylbenzene | 98-82-8 | 360. | 220. | 44. | ug/kg | 40.19 |
| 06301 | Xylene (Total) | 1330-20-7 | 2,700. | 220. | 44. | ug/kg | 40.19 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5394565 SW  Group No. 1096931**

**N-107_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-107_1.0-2.0**

Collected:06/17/2008 10:15  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15  SUN: Aquaterra Tech.
Reported: 07/08/2008 at 08:53  PO Box 744
Discard: 09/07/2008  West Chester PA 19381

N-107

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/29/2008 14:56 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/23/2008 16:35 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/24/2008 11:31 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/23/2008 23:12 | Kelly E Brickley | 40.19 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/22/2008 14:30 | Mirit S Shenouda | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 06/17/2008 10:15 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/22/2008 07:55 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5394566 SW  Group No. 1096931**

**N-99_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-99_1.0-2.0**

Collected:06/17/2008 10:30  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15
Reported: 07/08/2008 at 08:53
Discard: 09/07/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-99-

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 146. | 1.14 | 0.170 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 16.2 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 140,000. | 25,000. | 5,000. | ug/kg | 125 |
| 03761 | Naphthalene | 91-20-3 | 53,000. | 5,000. | 990. | ug/kg | 25 |
| 03768 | Fluorene | 86-73-7 | 78,000. | 5,000. | 990. | ug/kg | 25 |
| 03775 | Phenanthrene | 85-01-8 | 280,000. | 25,000. | 5,000. | ug/kg | 125 |
| 03776 | Anthracene | 120-12-7 | 64,000. | 5,000. | 990. | ug/kg | 25 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 82,000. | 5,000. | 990. | ug/kg | 25 |
| 03782 | Chrysene | 218-01-9 | 71,000. | 5,000. | 990. | ug/kg | 25 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 69,000. | 5,000. | 990. | ug/kg | 25 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 61,000. | 5,000. | 990. | ug/kg | 25 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 29,000. | 5,000. | 990. | ug/kg | 25 |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 270. | 270. | 27. | ug/kg | 45.79 |
| 05460 | Benzene | 71-43-2 | < 270. | 270. | 27. | ug/kg | 45.79 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 270. | 270. | 55. | ug/kg | 45.79 |
| 05466 | Toluene | 108-88-3 | < 270. | 270. | 55. | ug/kg | 45.79 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 270. | 270. | 55. | ug/kg | 45.79 |
| 05474 | Ethylbenzene | 100-41-4 | < 270. | 270. | 55. | ug/kg | 45.79 |
| 05479 | Isopropylbenzene | 98-82-8 | < 270. | 270. | 55. | ug/kg | 45.79 |
| 06301 | Xylene (Total) | 1330-20-7 | < 270. | 270. | 55. | ug/kg | 45.79 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted.  Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5394566 SW  Group No. 1096931**

**N-99_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-99_1.0-2.0**

Collected:06/17/2008 10:30  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15
Reported: 07/08/2008 at 08:53
Discard: 09/07/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-99-

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/29/2008 14:59 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/23/2008 16:35 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/24/2008 15:33 | Joseph M Gambler | 25 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/24/2008 15:57 | Joseph M Gambler | 125 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/23/2008 23:34 | Kelly E Brickley | 45.79 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/22/2008 14:30 | Mirit S Shenouda | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 06/17/2008 10:30 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/22/2008 07:55 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5394567 SW  Group No. 1096931**

**N-125_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-125_1.0-2.0**

Collected:06/17/2008 15:00  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15
Reported: 07/08/2008 at 08:53
Discard: 09/07/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-125

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 150. | 1.07 | 0.160 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 10.7 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 2,500. | 930. | 190. | ug/kg | 5 |
| 03761 | Naphthalene | 91-20-3 | < 930. | 930. | 190. | ug/kg | 5 |
| 03768 | Fluorene | 86-73-7 | < 930. | 930. | 190. | ug/kg | 5 |
| 03775 | Phenanthrene | 85-01-8 | 1,600. | 930. | 190. | ug/kg | 5 |
| 03776 | Anthracene | 120-12-7 | < 930. | 930. | 190. | ug/kg | 5 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 2,000. | 930. | 190. | ug/kg | 5 |
| 03782 | Chrysene | 218-01-9 | 2,100. | 930. | 190. | ug/kg | 5 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 1,600. | 930. | 190. | ug/kg | 5 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 1,500. | 930. | 190. | ug/kg | 5 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | < 930. | 930. | 190. | ug/kg | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 230. | 230. | 23. | ug/kg | 41.88 |
| 05460 | Benzene | 71-43-2 | < 230. | 230. | 23. | ug/kg | 41.88 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 230. | 230. | 47. | ug/kg | 41.88 |
| 05466 | Toluene | 108-88-3 | < 230. | 230. | 47. | ug/kg | 41.88 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 230. | 230. | 47. | ug/kg | 41.88 |
| 05474 | Ethylbenzene | 100-41-4 | < 230. | 230. | 47. | ug/kg | 41.88 |
| 05479 | Isopropylbenzene | 98-82-8 | < 230. | 230. | 47. | ug/kg | 41.88 |
| 06301 | Xylene (Total) | 1330-20-7 | < 230. | 230. | 47. | ug/kg | 41.88 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5394567 SW  Group No. 1096931**

**N-125_1.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS#  COC: 0153804 N-125_1.0-2.0**

Collected:06/17/2008 15:00  by SS  Account Number: 10132

Submitted: 06/19/2008 16:15  SUN: Aquaterra Tech.
Reported: 07/08/2008 at 08:53  PO Box 744
Discard: 09/07/2008  West Chester PA 19381

N-125

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 06/29/2008 15:03 | James R Williams II | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 06/23/2008 16:35 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 06/26/2008 10:38 | Joseph M Gambler | 5 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 06/23/2008 23:56 | Kelly E Brickley | 41.88 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 06/22/2008 14:30 | Mirit S Shenouda | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035 | 1 | 06/17/2008 15:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 06/25/2008 14:45 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1096931
Reported: 07/08/08 at 08:53 AM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 081726150001A | Sample number(s): 5394557-5394567 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 111 | | 82-118 | | |
| Batch number: 08173SLA026 | Sample number(s): 5394557-5394558,5394560-5394566 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 101 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 93 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 101 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 103 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 98 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 94 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 100 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 88 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 98 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 98 | | 65-122 | | |
| Batch number: 08175820005A | Sample number(s): 5394557-5394567 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 08177SLA026 | Sample number(s): 5394567 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 104 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 95 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 107 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 105 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 98 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 96 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 100 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 84 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 95 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 90 | | 65-122 | | |
| Batch number: 08179SLB026 | Sample number(s): 5394559 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 104 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 96 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 107 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 104 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 100 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 97 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 101 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 84 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 93 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 89 | | 65-122 | | |
| Batch number: R081751AA | Sample number(s): 5394557-5394567 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 93 | 94 | 72-117 | 1 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 97 | 96 | 84-115 | 1 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 103 | 103 | 76-135 | 1 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 102 | 102 | 81-116 | 0 | 30 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1096931
Reported: 07/08/08 at 08:53 AM

### Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 100 | 99 | 77-114 | 2 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 101 | 100 | 82-115 | 1 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 96 | 95 | 82-110 | 1 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 101 | 99 | 82-117 | 1 | 30 |

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 081726150001A | Sample number(s): 5394557-5394567 UNSPK: P393503 BKG: P393503 | | | | | | | | |
| Lead | -29 (2) | 190 (2) | 75-125 | 7 | 20 | 44.6 | 45.7 | 2 | 20 |
| Batch number: 08173SLA026 | Sample number(s): 5394557-5394558,5394560-5394566 UNSPK: 5394557 | | | | | | | | |
| Pyrene | 88 | 111 | 19-162 | 19 | 30 | | | | |
| Naphthalene | 78 | 91 | 29-140 | 16 | 30 | | | | |
| Fluorene | 82 | 97 | 42-139 | 17 | 30 | | | | |
| Phenanthrene | 91 | 106 | 1-181 | 15 | 30 | | | | |
| Anthracene | 82 | 99 | 34-148 | 19 | 30 | | | | |
| Benzo(a)anthracene | 83 | 111 | 20-156 | 22 | 30 | | | | |
| Chrysene | 95 | 120 | 19-158 | 15 | 30 | | | | |
| Benzo(b)fluoranthene | 77 | 99 | 13-161 | 19 | 30 | | | | |
| Benzo(a)pyrene | 84 | 113 | 24-154 | 20 | 30 | | | | |
| Benzo(g,h,i)perylene | 105 | 123 | 26-154 | 9 | 30 | | | | |
| Batch number: 08175820005A | Sample number(s): 5394557-5394567 BKG: P395348 | | | | | | | | |
| Moisture | | | | | | 17.9 | 17.0 | 5 | 15 |
| Batch number: 08177SLA026 | Sample number(s): 5394567 UNSPK: P77LAUS | | | | | | | | |
| Pyrene | 64 | 74 | 19-162 | 6 | 30 | | | | |
| Naphthalene | 74 | 79 | 29-140 | 6 | 30 | | | | |
| Fluorene | 76 | 81 | 42-139 | 7 | 30 | | | | |
| Phenanthrene | 67 | 77 | 1-181 | 9 | 30 | | | | |
| Anthracene | 69 | 77 | 34-148 | 10 | 30 | | | | |
| Benzo(a)anthracene | 55 | 67 | 20-156 | 9 | 30 | | | | |
| Chrysene | 60 | 63 | 19-158 | 2 | 30 | | | | |
| Benzo(b)fluoranthene | 48 | 52 | 13-161 | 2 | 30 | | | | |
| Benzo(a)pyrene | 53 | 61 | 24-154 | 6 | 30 | | | | |
| Benzo(g,h,i)perylene | 52 | 62 | 26-154 | 10 | 30 | | | | |
| Batch number: 08179SLB026 | Sample number(s): 5394559 UNSPK: P401644 | | | | | | | | |
| Pyrene | 81 | 63 | 19-162 | 13 | 30 | | | | |
| Naphthalene | 64 (2) | 60 (2) | 29-140 | 1 | 30 | | | | |
| Fluorene | 95 | 77 | 42-139 | 17 | 30 | | | | |
| Phenanthrene | 92 | 74 | 1-181 | 11 | 30 | | | | |
| Anthracene | 111 | 96 | 34-148 | 15 | 30 | | | | |
| Benzo(a)anthracene | 99 | 80 | 20-156 | 16 | 30 | | | | |
| Chrysene | 66 | 57 | 19-158 | 6 | 30 | | | | |
| Benzo(b)fluoranthene | 82 | 74 | 13-161 | 11 | 30 | | | | |
| Benzo(a)pyrene | 103 | 82 | 24-154 | 23 | 30 | | | | |
| Benzo(g,h,i)perylene | 95 | 75 | 26-154 | 24 | 30 | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1096931
Reported: 07/08/08 at 08:53 AM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed
unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08173SLA026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5394557 | 81 | 90 | 89 |
| 5394558 | 69 | 75 | 74 |
| 5394560 | 75 | 80 | 76 |
| 5394561 | 87 | 91 | 95 |
| 5394562 | 83 | 88 | 86 |
| 5394563 | 86 | 91 | 91 |
| 5394564 | 77 | 84 | 82 |
| 5394565 | 78 | 84 | 81 |
| 5394566 | 77 | 88 | 91 |
| Blank | 85 | 90 | 92 |
| LCS | 93 | 98 | 97 |
| MS | 79 | 84 | 83 |
| MSD | 91 | 94 | 95 |
| Limits: | 49-120 | 55-117 | 43-131 |

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08177SLA026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5394567 | 87 | 95 | 95 |
| Blank | 89 | 91 | 95 |
| LCS | 95 | 93 | 98 |
| MS | 74 | 77 | 75 |
| MSD | 75 | 78 | 78 |
| Limits: | 49-120 | 55-117 | 43-131 |

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08179SLB026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5394559 | 71 | 72 | 69 |
| Blank | 102 | 100 | 102 |
| LCS | 98 | 95 | 97 |
| MS | 95 | 93 | 91 |
| MSD | 84 | 83 | 79 |
| Limits: | 49-120 | 55-117 | 43-131 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1096931
Reported: 07/08/08 at 08:53 AM

## Surrogate Quality Control

Analysis Name: UST-Leaded Soils by 8260B
Batch number: R081751AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5394557 | 73 | 72 | 75 | 66* |
| 5394558 | 58* | 58* | 48* | 49* |
| 5394559 | 65* | 68* | 64* | 60* |
| 5394560 | 68* | 67* | 68* | 63* |
| 5394561 | 75 | 76 | 78 | 74 |
| 5394562 | 79 | 79 | 80 | 73 |
| 5394563 | 82 | 84 | 85 | 78 |
| 5394564 | 77 | 77 | 79 | 72 |
| 5394565 | 76 | 76 | 74 | 71 |
| 5394566 | 74 | 74 | 75 | 70 |
| 5394567 | 78 | 78 | 79 | 75 |
| Blank | 97 | 98 | 100 | 94 |
| LCS | 92 | 90 | 96 | 91 |
| LCSD | 90 | 90 | 94 | 90 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1096931 Sample # 5394557-67

**COC # 0153804**

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: SUN-AQUATERRA Acct. #:

Project Name/#: PHILA REF AOI-8 PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: S. SYKES Quote #:

Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#:

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(6) Preservation Codes

+PER T. DOERR LANCASTER WILL FOLLOW ANALYSES ON TABLE.
Remarks ls 6-20-08

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water | Other | Total # of Containers | (5) Analyses Requested: Preservation Codes: BTEX + MTBE (8260) |
|---|---|---|---|---|---|---|---|---|---|
| N-129_1.0-2.0 | 6/17/08 | 800 | X | | X | | | 2 | X |
| N-126_1.0-2.0 | | 810 | X | | X | | | 2 | X |
| N-109_1.0-2.0 | | 820 | X | | X | | | 2 | X |
| N-131_1.0-2.0 | | 840 | X | | X | | | 2 | X |
| N-119_1.0-2.0 | | 900 | X | | X | | | 2 | X |
| BH-08-01_1.0-2.0 | | 930 | X | | X | | | 2 | X |
| N-104_1.0-2.0 | | 945 | X | | X | | | 2 | X |
| N-105_1.0-2.0 | | 1000 | X | | X | | | 2 | X |
| N-107_1.0-2.0 | | 1015 | X | | X | | | 2 | X |
| N-99_1.0-2.0 | | 1030 | X | | X | | | 2 | X |

* Analyses per table provided

* Pls Copy Kevin Martin & Jason Langan

temp 4.7°C

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and ~~surcharge~~.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg) TX TRRP-13
Type II (Tier II) MA MCP CT RCP
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)

SDG Complete? Yes No

Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| Sun Sy / AQUATERRA | 6/18/08 | 1730 | AQUATERRA FRIDGE | 6/18/08 | 1730 |
| AT FRIDGE | 6/19/08 | 1300 | Kristina Hall / Aquaterra | 6/19/08 | 1300 |
| Kristina Hall / Aquaterra | 6/19/08 | 1300 | P. Lefever | 6/19/08 | 1300 |
| P. Lefever 6/19/08 | 1615 | | | | |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| | | | Katie Nantlane | 6/19/08 | 16:15 |

(9)

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1096931 Sample # 5394557-67

**COC # 0153803**

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: SUN-AQUATERRA Acct. #:

Project Name/#: PHILA REF AOI#8 PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: S. SYKES Quote #:

Name of state where samples were collected: PA

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water | Other | Total # of Containers | (5) Analyses Requested: Preservation Codes — BTEX + MTBE (PAH 8260) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| N-125_1.0-2.0 | 6/17/08 | 1500 | X | | X | | | 2 | X | ☆ Analyses per table provided |
| | | | | | | | | | | ☆ Pls copy Kevin Martin + Jason Langan |
| | | | | | | | | | | temp 4.7°C |

**For Lab Use Only**

FSC:

SCR#:

**Preservation Codes**

H=HCl T=Thiosulfate

N=$HNO_3$ B=NaOH

S=$H_2SO_4$ O=Other

(6) Preservation Codes (Preservative should be noted if sample is modified after collection)

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush

(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)

Date results are needed:

Rush results requested by (please circle): Phone Fax E-mail

Phone #: Fax #:

E-mail address:

(8) **Data Package Options** (please circle if required)

Type I (validation/NJ Reg) TX TRRP-13

Type II (Tier II) MA MCP CT RCP

Type III (Reduced NJ)

Type IV (CLP SOW)

Type VI (Raw Data Only)

SDG Complete? Yes No

Site-specific QC (MS/MSD/Dup)? Yes No

(If yes, indicate QC sample and submit triplicate volume.)

Internal COC Required? Yes / No

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| Sun Qu / AQUATERRA | 6/18/08 | 1730 | AQUATERRA FRIDGE | 6/18/08 | 1730 |
| AT FRIDGE | 6/19/08 | 1300 | Aquaterra | 6/19/08 | 1300 |
| | 6/19/08 | 1300 | P. Lefever | 6/19/08 | 1300 |
| P. Lefever | 6/19/08 | 1615 | | | |
| | | | Katie Hawthorne | 6/19/08 | 16:15 |

(9)

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766

Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1099596. Samples arrived at the laboratory on Tuesday, July 08, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| BH-08-32_0.0-2.0 Grab Soil | 5409889 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

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Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Robert Strocko Jr.
Manager

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5409889 SW  Group No. 1099596**

**BH-08-32_0.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 0334 BH-08-32_0.0-2.0**

Collected:07/03/2008 11:00  by TD  Account Number: 10132

Submitted: 07/08/2008 18:15
Reported: 07/16/2008 at 17:26
Discard: 09/15/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

AOI08

| CAT No. | Analysis Name | CAS Number | Dry Result | Dry Limit of Quantitation* | Dry Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06135 | Lead | 7439-92-1 | 128. | 1.01 | 0.152 | mg/kg | 10 |
| 00111 | Moisture | n.a. | 3.2 | 0.50 | 0.50 | % | 1 |
| | "Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis. | | | | | | |
| 07804 | PAHs in Soil by GC/MS | | | | | | |
| 01195 | Pyrene | 129-00-0 | 1,600. | 170. | 34. | ug/kg | 1 |
| 03761 | Naphthalene | 91-20-3 | < 170. | 170. | 34. | ug/kg | 1 |
| 03768 | Fluorene | 86-73-7 | < 170. | 170. | 34. | ug/kg | 1 |
| 03775 | Phenanthrene | 85-01-8 | 1,400. | 170. | 34. | ug/kg | 1 |
| 03776 | Anthracene | 120-12-7 | 350. | 170. | 34. | ug/kg | 1 |
| 03781 | Benzo(a)anthracene | 56-55-3 | 920. | 170. | 34. | ug/kg | 1 |
| 03782 | Chrysene | 218-01-9 | 950. | 170. | 34. | ug/kg | 1 |
| 03786 | Benzo(b)fluoranthene | 205-99-2 | 1,200. | 170. | 34. | ug/kg | 1 |
| 03788 | Benzo(a)pyrene | 50-32-8 | 900. | 170. | 34. | ug/kg | 1 |
| 03791 | Benzo(g,h,i)perylene | 191-24-2 | 730. | 170. | 34. | ug/kg | 1 |
| 02308 | UST-Leaded Soils by 8260B | | | | | | |
| 02016 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 300. | 300. | 30. | ug/kg | 57.34 |
| 05460 | Benzene | 71-43-2 | < 300. | 300. | 30. | ug/kg | 57.34 |
| 05461 | 1,2-Dichloroethane | 107-06-2 | < 300. | 300. | 59. | ug/kg | 57.34 |
| 05466 | Toluene | 108-88-3 | < 300. | 300. | 59. | ug/kg | 57.34 |
| 05471 | 1,2-Dibromoethane | 106-93-4 | < 300. | 300. | 59. | ug/kg | 57.34 |
| 05474 | Ethylbenzene | 100-41-4 | < 300. | 300. | 59. | ug/kg | 57.34 |
| 05479 | Isopropylbenzene | 98-82-8 | < 300. | 300. | 59. | ug/kg | 57.34 |
| 06301 | Xylene (Total) | 1330-20-7 | < 300. | 300. | 59. | ug/kg | 57.34 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5409889 SW  Group No. 1099596**

**BH-08-32_0.0-2.0 Grab Soil**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 0334 BH-08-32_0.0-2.0**

Collected:07/03/2008 11:00  by TD  Account Number: 10132

Submitted: 07/08/2008 18:15  SUN: Aquaterra Tech.
Reported: 07/16/2008 at 17:26  PO Box 744
Discard: 09/15/2008  West Chester PA 19381

AOI08

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06135 | Lead | SW-846 6020 | 1 | 07/14/2008 08:31 | David K Beck | 10 |
| 00111 | Moisture | SM20 2540 G | 1 | 07/10/2008 15:35 | Scott W Freisher | 1 |
| 07804 | PAHs in Soil by GC/MS | SW-846 8270C | 1 | 07/10/2008 16:52 | Joseph M Gambler | 1 |
| 02308 | UST-Leaded Soils by 8260B | SW-846 8260B | 1 | 07/15/2008 15:07 | Nicholas R Rossi | 57.34 |
| 06150 | ICP/MS SW-846 Solid digest | SW-846 3050B | 1 | 07/13/2008 20:45 | Annamaria Stipkovits | 1 |
| 06171 | GC/MS - Field Preserved MeOH | SW-846 5035A | 1 | 07/03/2008 11:00 | Client Supplied | 1 |
| 07806 | BNA Soil Extraction | SW-846 3550B | 1 | 07/09/2008 15:20 | Doreen K Robles | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1099596
Reported: 07/16/08 at 05:26 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08191SLB026 | Sample number(s): 5409889 | | | | | | | | |
| Pyrene | < 170. | 170. | 33. | ug/kg | 96 | | 75-115 | | |
| Naphthalene | < 170. | 170. | 33. | ug/kg | 84 | | 73-106 | | |
| Fluorene | < 170. | 170. | 33. | ug/kg | 85 | | 75-116 | | |
| Phenanthrene | < 170. | 170. | 33. | ug/kg | 92 | | 77-113 | | |
| Anthracene | < 170. | 170. | 33. | ug/kg | 88 | | 76-112 | | |
| Benzo(a)anthracene | < 170. | 170. | 33. | ug/kg | 87 | | 73-112 | | |
| Chrysene | < 170. | 170. | 33. | ug/kg | 89 | | 76-113 | | |
| Benzo(b)fluoranthene | < 170. | 170. | 33. | ug/kg | 80 | | 61-127 | | |
| Benzo(a)pyrene | < 170. | 170. | 33. | ug/kg | 86 | | 69-122 | | |
| Benzo(g,h,i)perylene | < 170. | 170. | 33. | ug/kg | 83 | | 65-122 | | |
| Batch number: 08192820006A | Sample number(s): 5409889 | | | | | | | | |
| Moisture | | | | | 100 | | 99-101 | | |
| Batch number: 081936150001A | Sample number(s): 5409889 | | | | | | | | |
| Lead | < 0.100 | 0.100 | 0.0150 | mg/kg | 105 | | 82-118 | | |
| Batch number: R081971AA | Sample number(s): 5409889 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 250. | 250. | 25. | ug/kg | 95 | 95 | 72-117 | 1 | 30 |
| Benzene | < 250. | 250. | 25. | ug/kg | 98 | 98 | 84-115 | 0 | 30 |
| 1,2-Dichloroethane | < 250. | 250. | 50. | ug/kg | 106 | 106 | 76-135 | 0 | 30 |
| Toluene | < 250. | 250. | 50. | ug/kg | 101 | 99 | 81-116 | 2 | 30 |
| 1,2-Dibromoethane | < 250. | 250. | 50. | ug/kg | 98 | 98 | 77-114 | 1 | 30 |
| Ethylbenzene | < 250. | 250. | 50. | ug/kg | 99 | 97 | 82-115 | 2 | 30 |
| Isopropylbenzene | < 250. | 250. | 50. | ug/kg | 94 | 92 | 82-110 | 2 | 30 |
| Xylene (Total) | < 250. | 250. | 50. | ug/kg | 99 | 97 | 82-117 | 2 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08191SLB026 | Sample number(s): 5409889 | | | UNSPK: 5409889 | | | | | |
| Pyrene | 102 | 253* | 19-162 | 56* | 30 | | | | |
| Naphthalene | 85 | 94 | 29-140 | 9 | 30 | | | | |
| Fluorene | 87 | 102 | 42-139 | 14 | 30 | | | | |
| Phenanthrene | 105 | 270* | 1-181 | 62* | 30 | | | | |
| Anthracene | 91 | 125 | 34-148 | 27 | 30 | | | | |
| Benzo(a)anthracene | 90 | 153 | 20-156 | 36* | 30 | | | | |
| Chrysene | 84 | 145 | 19-158 | 36* | 30 | | | | |
| Benzo(b)fluoranthene | 66 | 145 | 13-161 | 45* | 30 | | | | |
| Benzo(a)pyrene | 89 | 140 | 24-154 | 31* | 30 | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1099596
Reported: 07/16/08 at 05:26 PM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Benzo(g,h,i)perylene | 85 | 121 | 26-154 | 25 | 30 | | | | |
| Batch number: 08192820006A | Sample number(s): 5409889 BKG: P410435 | | | | | | | | |
| Moisture | | | | | | 27.3 | 27.4 | 1 | 15 |
| Batch number: 081936150001A | Sample number(s): 5409889 UNSPK: P411178 BKG: P411178 | | | | | | | | |
| Lead | -279 (2) | -88 (2) | 75-125 | 4 | 20 | 67.1 | 61.8 | 8 | 20 |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Soil by GC/MS
Batch number: 08191SLB026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5409889 | 92 | 95 | 99 |
| Blank | 89 | 88 | 101 |
| LCS | 92 | 91 | 97 |
| MS | 88 | 91 | 96 |
| MSD | 98 | 99 | 106 |
| Limits: | 49-120 | 55-117 | 43-131 |

Analysis Name: UST-Leaded Soils by 8260B
Batch number: R081971AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5409889 | 86 | 88 | 83 | 78 |
| Blank | 93 | 96 | 94 | 87 |
| LCS | 96 | 95 | 98 | 92 |
| LCSD | 96 | 96 | 95 | 90 |
| Limits: | 71-114 | 70-109 | 70-123 | 70-111 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# PA UST Analysis Request/Chain of Custody

Lancaster Laboratories

0334

For Lancaster Laboratories use only

Acct. #: 10132 Group #: 109596 Sample #: 541989

SCR #:

Consultant/Office #: Aquaterra

Consultant Prj. Mgr.: T. Deer

Consultant Phone #: 610-431-9733 Fax #:

Site Name: Sun Philly Refinery ACI-8

Site Address:

Sampler: T. Deer

| Sample Identification | Date Collected | Time Collected | Grab | Composite | Matrix: Soil | Matrix: Water | Matrix: Oil | Matrix: Air | Matrix: Potable | Matrix: NPDES | Total Number of Containers | Number of EnCores | PA Unleaded Gasoline | PA Leaded Gasoline | PA Kerosene (No. 1) | PA Diesel Fuel (No. 2) | PA Fuel Oil No. 4, 5, 6 | PA Used Motor Oil | 8260 | 8270 | Lead | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BH-08-32-0.0-2.0 | 7/3/08 | 1100 | X | | X | | | | | | 2 | | | | | | | | X | X | X | | (X) Specific analyte list provided to Lancaster (Jessica Huen) temp 1.5°C |

Analyses Requested — List total number of containers in the box under each analyses.

Turnaround Time: STD (7-10) RUSH

Comments:

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| | 7/3/08 | 1300 | Aquaterra Fridg | 7/3/08 | 1300 |
| AT RELEASE | 7/8/08 | 1400 | | 7/8/08 | 1400 |
| | 7/8/08 | 1400 | | 7/8/08 | 1400 |
| | 7/8/08 | 1515 | | 7/9/08 | 1015 |

Lancaster Laboratories, Inc., 2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 (717) 656-2300

Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

4400 Rev. 4/26/05

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

**WARRANTY AND LIMITS OF LIABILITY –** In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1100643. Samples arrived at the laboratory on Tuesday, July 15, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-100 Grab Water | 5415095 |
| N-98 Grab Water | 5415096 |
| N-106 Grab Water | 5415097 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Marla S. Lord
Senior Specialist

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5415095 WW  Group No. 1100643**

**N-100 Grab Water**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 336 N-100**

Collected:07/14/2008 11:30  by TD  Account Number: 10132

Submitted: 07/15/2008 16:20
Reported: 07/24/2008 at 08:49
Discard: 09/23/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-100

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5415095 WW  Group No. 1100643**

**N-100 Grab Water**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 336 N-100**

Collected:07/14/2008 11:30  by TD  Account Number: 10132

Submitted: 07/15/2008 16:20  SUN: Aquaterra Tech.
Reported: 07/24/2008 at 08:49  PO Box 744
Discard: 09/23/2008  West Chester PA 19381

N-100

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/18/2008 19:04 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/18/2008 01:59 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/18/2008 22:08 | Ryan P Byrne | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/18/2008 23:16 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/18/2008 23:16 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/17/2008 07:45 | Suzette L Lehman | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/17/2008 10:00 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/17/2008 09:20 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5415096 WW  Group No. 1100643**

**N-98 Grab Water**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 336 N-98**

Collected:07/14/2008 12:30  by TD  Account Number: 10132

Submitted: 07/15/2008 16:20
Reported: 07/24/2008 at 08:49
Discard: 09/23/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N--98

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5415096 WW  Group No. 1100643**

**N-98 Grab Water**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 336 N-98**

Collected:07/14/2008 12:30  by TD  Account Number: 10132

Submitted: 07/15/2008 16:20  SUN: Aquaterra Tech.
Reported: 07/24/2008 at 08:49  PO Box 744
Discard: 09/23/2008  West Chester PA 19381

N--98

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/18/2008 19:13 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/18/2008 02:59 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/18/2008 22:31 | Ryan P Byrne | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/18/2008 23:43 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/18/2008 23:43 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/17/2008 07:45 | Suzette L Lehman | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/17/2008 10:00 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/17/2008 09:20 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5415097 WW  Group No. 1100643**

**N-106 Grab Water**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 336 N-106**

Collected:07/14/2008 13:00  by TD  Account Number: 10132

Submitted: 07/15/2008 16:20
Reported: 07/24/2008 at 08:49
Discard: 09/23/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N-106

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | 20. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 2. | 2. | 1. | ug/l | 2 |
| 05401 | Benzene | 71-43-2 | 410. | 20. | 10. | ug/l | 20 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 2. | 2. | 1. | ug/l | 2 |
| 05407 | Toluene | 108-88-3 | 60. | 2. | 1. | ug/l | 2 |
| 05415 | Ethylbenzene | 100-41-4 | 22. | 2. | 1. | ug/l | 2 |
| 05420 | Isopropylbenzene | 98-82-8 | 57. | 4. | 1. | ug/l | 2 |
| 06310 | Xylene (Total) | 1330-20-7 | 120. | 2. | 1. | ug/l | 2 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5415097 WW  Group No. 1100643**

**N-106 Grab Water**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 336 N-106**

Collected:07/14/2008 13:00  by TD  Account Number: 10132

Submitted: 07/15/2008 16:20  SUN: Aquaterra Tech.
Reported: 07/24/2008 at 08:49  PO Box 744
Discard: 09/23/2008  West Chester PA 19381

N-106

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/18/2008 19:16 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/18/2008 03:29 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/18/2008 22:55 | Ryan P Byrne | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/19/2008 00:36 | Kelly E Brickley | 2 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/19/2008 01:03 | Kelly E Brickley | 20 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/19/2008 00:36 | Kelly E Brickley | 2 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 2 | 07/19/2008 01:03 | Kelly E Brickley | 20 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/17/2008 07:45 | Suzette L Lehman | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/17/2008 10:00 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/17/2008 09:20 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1100643
Reported: 07/24/08 at 08:49 AM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 081980022A | Sample number(s): 5415095-5415097 | | | | | | | | |
| Ethylene dibromide | < 0.030 | 0.030 | 0.010 | ug/l | 92 | 92 | 60-140 | 0 | 20 |
| Batch number: 081986050001A | Sample number(s): 5415095-5415097 | | | | | | | | |
| Lead | < 0.0010 | 0.0010 | 0.00005 0 | mg/l | 110 | | 90-115 | | |
| Batch number: 08198WAJ026 | Sample number(s): 5415095-5415097 | | | | | | | | |
| Naphthalene | < 5. | 5. | 1. | ug/l | 100 | 94 | 77-107 | 6 | 30 |
| Fluorene | < 5. | 5. | 1. | ug/l | 106 | 107 | 82-113 | 1 | 30 |
| Phenanthrene | < 5. | 5. | 1. | ug/l | 106 | 102 | 83-112 | 4 | 30 |
| Pyrene | < 5. | 5. | 1. | ug/l | 97 | 94 | 80-115 | 3 | 30 |
| Chrysene | < 5. | 5. | 1. | ug/l | 106 | 106 | 82-112 | 0 | 30 |
| Batch number: P082003AA | Sample number(s): 5415095-5415097 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 91 | 95 | 73-119 | 4 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 90 | 92 | 78-119 | 2 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 91 | 94 | 69-135 | 3 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 89 | 92 | 85-115 | 4 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 88 | 90 | 82-119 | 3 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 87 | 90 | 80-113 | 3 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 88 | 92 | 83-113 | 4 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 081980022A | Sample number(s): 5415095-5415097 UNSPK: 5415095 BKG: P415064 | | | | | | | | |
| Ethylene dibromide | 83 | | 65-135 | | | < 0.029 | < 0.030 | 0 (1) | 30 |
| Batch number: 081986050001A | Sample number(s): 5415095-5415097 UNSPK: P414402 BKG: P414402 | | | | | | | | |
| Lead | 108 | 106 | 75-125 | 1 | 20 | 0.0049 | 0.0052 | 6 (1) | 20 |
| Batch number: P082003AA | Sample number(s): 5415095-5415097 UNSPK: 5415096 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 94 | | 69-127 | | | | | | |
| Benzene | 93 | | 83-128 | | | | | | |
| 1,2-Dichloroethane | 92 | | 70-143 | | | | | | |
| Toluene | 94 | | 83-127 | | | | | | |
| Ethylbenzene | 92 | | 82-129 | | | | | | |
| Isopropylbenzene | 93 | | 81-130 | | | | | | |
| Xylene (Total) | 92 | | 82-130 | | | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1100643
Reported: 07/24/08 at 08:49 AM

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: EDB in Wastewater
Batch number: 081980022A

| | 1,1,2,2-Tetrachloroethane |
|---|---|
| 5415095 | 84 |
| 5415096 | 91 |
| 5415097 | 83 |
| Blank | 97 |
| DUP | 92 |
| LCS | 96 |
| LCSD | 99 |
| MS | 80 |
| Limits: | 46-136 |

Analysis Name: PAHs in Water by GC/MS
Batch number: 08198WAJ026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5415095 | 107 | 113 | 102 |
| 5415096 | 100 | 107 | 93 |
| 5415097 | 102 | 96 | 75 |
| Blank | 103 | 109 | 92 |
| LCS | 101 | 107 | 91 |
| LCSD | 96 | 105 | 89 |
| Limits: | 44-127 | 63-114 | 30-126 |

Analysis Name: UST-Waters by 8260B
Batch number: P082003AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5415095 | 86 | 84 | 84 | 85 |
| 5415096 | 87 | 87 | 85 | 83 |
| 5415097 | 86 | 83 | 85 | 87 |
| Blank | 87 | 86 | 84 | 82 |
| LCS | 87 | 86 | 84 | 85 |
| LCSD | 87 | 85 | 84 | 84 |
| MS | 85 | 85 | 84 | 85 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# PA UST Analysis Request/Chain of Custody

0336

Lancaster Laboratories

3.0 °C

For Lancaster Laboratories use only

Acct. #: 10132 Group #: 1100643 Sample #: 5415095-97

SCR #:

Consultant/Office #: Aquaterra (Sun)

Consultant Prj. Mgr.: T. Doerr

Consultant Phone #: _____ Fax #: _____

Site Name: Sun - Philly Refinery AOI-8

Site Address: _____

Sampler: T. Doerr

| Sample Identification | Date Collected | Time Collected | Grab | Composite | Matrix: Soil | Matrix: Water | Matrix: Oil ☐ Air ☐ | Total Number of Containers | Number of EnCores | PA Unleaded Gasoline | PA Leaded Gasoline | PA Kerosene (No. 1) | PA Diesel Fuel (No. 2) | PA Fuel Oil No. 4, 5, 6 | PA Used Motor Oil | 8260 | 8270 | Lead | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-100 | 7/14/08 | 1130 | X | | | X | | 8 | | | | | | | | X | X | X | | | See attached table for Specific analyte list. |
| N-98 | 7/14/08 | 1230 | X | | | X | | 8 | | | | | | | | X | X | X | | | |
| N-106 | 7/14/08 | 1300 | X | | | X | | 8 | | | | | | | | X | X | X | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |

Turnaround Time: ~~STD (7-10)~~ RUSH

Comments:

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| | 7/14/08 | 1500 | Locked Fridge | 7/14/08 | 1500 |
| AT LODGE | 7/18/08 | 1110 | | 7/18/08 | 1110 |
| | 7/18/08 | 1110 | | 7/15/08 | 11:10 |
| | 7/15/08 | 1620 | | 7/15/08 | 1620 |

10132 | 1100643 | 5415095-97

# Table 1
## Constituents of Concern for Groundwater
## AOI 8 Work Plan for Site Characterization
## Sunoco Philadelphia Refinery
## Philadelphia, Pennsylvania

| METALS | CAS No. |
|---|---|
| Lead (dissolved) | 7439-92-1 |

| VOLATILE ORGANIC COMPOUNDS | CAS No. |
|---|---|
| 1,2-dichloroethane | 107-06-2 |
| Benzene | 71-43-2 |
| Cumene | 98-82-8 |
| Ethylbenzene | 100-41-4 |
| Ethylene dibromide | 106-93-4 |
| Methyl tertiary butyl ether | 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.

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1100865. Samples arrived at the laboratory on Wednesday, July 16, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-1 Grab Water | 5416333 |
| N-3 Grab Water | 5416334 |
| N-4 Grab Water | 5416335 |
| N-101 Grab Water | 5416336 |
| N-11 Grab Water | 5416337 |
| N-10 Grab Water | 5416338 |
| N-5 Grab Water | 5416339 |
| N-102 Grab Water | 5416340 |
| N-15 Grab Water | 5416341 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |

Lancaster Laboratories

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Chad A. Moline
Group Leader

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5416333 WW  Group No. 1100865**

**N-1 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-1**

Collected:07/15/2008 10:00  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRA01

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5416333 WW  Group No. 1100865**

**N-1 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-1**

Collected:07/15/2008 10:00  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRA01

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 23:09 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/19/2008 03:55 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/19/2008 00:28 | Ryan P Byrne | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/22/2008 03:34 | Florida A Cimino | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/22/2008 03:34 | Florida A Cimino | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/21/2008 19:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/18/2008 10:00 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/18/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5416334 WW  Group No. 1100865**

**N-3 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-3**

Collected:07/15/2008 10:40  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRA03

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | 0.0011 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5416334 WW  Group No. 1100865**

**N-3 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-3**

Collected:07/15/2008 10:40  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRA03

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 23:11 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/19/2008 04:55 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/19/2008 00:52 | Ryan P Byrne | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/22/2008 04:01 | Florida A Cimino | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/22/2008 04:01 | Florida A Cimino | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/21/2008 19:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/18/2008 10:00 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/18/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5416335 WW  Group No. 1100865**

**N-4 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-4**

Collected:07/15/2008 10:55  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRA04

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | 2. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 5. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 3. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 2. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5416335 WW  Group No. 1100865**

**N-4 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-4**

Collected:07/15/2008 10:55  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRA04

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 23:18 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/19/2008 06:25 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/19/2008 01:15 | Ryan P Byrne | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/22/2008 04:28 | Florida A Cimino | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/22/2008 04:28 | Florida A Cimino | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/21/2008 19:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/18/2008 10:00 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/18/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5416336 WW  Group No. 1100865**

**N-101 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-101**

Collected:07/15/2008 11:40  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR101

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 28. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 67. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 9. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 8. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 5. | 5. | 3. | ug/l | 5 |
| 05401 | Benzene | 71-43-2 | < 5. | 5. | 3. | ug/l | 5 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 5. | 5. | 3. | ug/l | 5 |
| 05407 | Toluene | 108-88-3 | < 5. | 5. | 3. | ug/l | 5 |
| 05415 | Ethylbenzene | 100-41-4 | < 5. | 5. | 3. | ug/l | 5 |
| 05420 | Isopropylbenzene | 98-82-8 | 26. | 10. | 3. | ug/l | 5 |
| 06310 | Xylene (Total) | 1330-20-7 | 12. | 5. | 3. | ug/l | 5 |

The reporting limits for the GC/MS volatile compounds were raised due to the level of non-target compounds.

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5416336 WW  Group No. 1100865**

**N-101 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-101**

Collected:07/15/2008 11:40  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR101

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 23:21 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/19/2008 06:55 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/19/2008 01:38 | Ryan P Byrne | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/22/2008 04:55 | Florida A Cimino | 5 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/22/2008 04:55 | Florida A Cimino | 5 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/21/2008 19:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/18/2008 10:00 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/18/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5416337 WW  Group No. 1100865**

**N-11 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-11**

Collected:07/15/2008 12:10  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRA11

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 6. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 9. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | 2. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 38. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 13. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5416337 WW  Group No. 1100865**

**N-11 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-11**

Collected:07/15/2008 12:10  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRA11

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/23/2008 12:33 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/19/2008 07:25 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 03:27 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/22/2008 05:21 | Florida A Cimino | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/22/2008 05:21 | Florida A Cimino | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/18/2008 09:23 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/18/2008 10:00 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/18/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5416338 WW  Group No. 1100865**

**N-10 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-10**

Collected:07/15/2008 12:40  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRA10

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5416338 WW  Group No. 1100865**

**N-10 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-10**

Collected:07/15/2008 12:40  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRA10

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/23/2008 12:36 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/19/2008 07:55 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 03:50 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/22/2008 05:48 | Florida A Cimino | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/22/2008 05:48 | Florida A Cimino | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/18/2008 09:23 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/18/2008 10:00 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/18/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5416339 WW  Group No. 1100865**

**N-5 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-5**

Collected:07/15/2008 13:15  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRA05

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | 1.13 | 0.0050 | 0.00025 | mg/l | 5 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 5. | 5. | 3. | ug/l | 5 |
| 05401 | Benzene | 71-43-2 | < 5. | 5. | 3. | ug/l | 5 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 5. | 5. | 3. | ug/l | 5 |
| 05407 | Toluene | 108-88-3 | < 5. | 5. | 3. | ug/l | 5 |
| 05415 | Ethylbenzene | 100-41-4 | < 5. | 5. | 3. | ug/l | 5 |
| 05420 | Isopropylbenzene | 98-82-8 | < 10. | 10. | 3. | ug/l | 5 |
| 06310 | Xylene (Total) | 1330-20-7 | < 5. | 5. | 3. | ug/l | 5 |

The reporting limits for the GC/MS volatile compounds were raised due to sample foaming.

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5416339 WW  Group No. 1100865**

**N-5 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-5**

Collected:07/15/2008 13:15  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRA05

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 15:23 | James R Williams II | 5 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/19/2008 08:25 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 04:14 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/22/2008 06:15 | Florida A Cimino | 5 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/22/2008 06:15 | Florida A Cimino | 5 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/18/2008 09:23 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/18/2008 10:00 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/18/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5416340 WW  Group No. 1100865**

**N-102 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-102**

Collected:07/15/2008 13:45  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR102

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | 10. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 22. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 77. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 9. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 15. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 25. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 4. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | 8. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 7. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 16. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5416340 WW  Group No. 1100865**

**N-102 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-102**

Collected:07/15/2008 13:45  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR102

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/23/2008 12:45 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/19/2008 08:55 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 04:37 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/22/2008 06:41 | Florida A Cimino | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/22/2008 06:41 | Florida A Cimino | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/18/2008 09:23 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/18/2008 10:00 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/18/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5416341 WW  Group No. 1100865**

**N-15 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-15**

Collected:07/15/2008 14:15  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRA15

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | 0.0011 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 99. | 99. | 20. | ug/l | 10 |
| 03956 | Fluorene | 86-73-7 | 180. | 99. | 20. | ug/l | 10 |
| 03963 | Phenanthrene | 85-01-8 | 440. | 99. | 20. | ug/l | 10 |
| 03967 | Pyrene | 129-00-0 | < 99. | 99. | 20. | ug/l | 10 |
| 03971 | Chrysene | 218-01-9 | < 99. | 99. | 20. | ug/l | 10 |

Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised.

Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 2. | 2. | 1. | ug/l | 2 |
| 05401 | Benzene | 71-43-2 | 3. | 2. | 1. | ug/l | 2 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 2. | 2. | 1. | ug/l | 2 |
| 05407 | Toluene | 108-88-3 | 6. | 2. | 1. | ug/l | 2 |
| 05415 | Ethylbenzene | 100-41-4 | < 2. | 2. | 1. | ug/l | 2 |
| 05420 | Isopropylbenzene | 98-82-8 | 230. | 4. | 1. | ug/l | 2 |
| 06310 | Xylene (Total) | 1330-20-7 | 10. | 2. | 1. | ug/l | 2 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5416341 WW  Group No. 1100865**

**N-15 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187456 N-15**

Collected:07/15/2008 14:15  by SS  Account Number: 10132

Submitted: 07/16/2008 15:15
Reported: 07/25/2008 at 08:50
Discard: 09/24/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRA15

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/23/2008 12:47 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/19/2008 09:25 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 06:34 | Linda M Hartenstine | 10 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/23/2008 04:06 | Florida A Cimino | 2 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/23/2008 04:06 | Florida A Cimino | 2 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/18/2008 09:23 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/18/2008 10:00 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/18/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1100865
Reported: 07/25/08 at 08:50 AM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 081990023A | Sample number(s): 5416333-5416341 | | | | | | | | |
| Ethylene dibromide | < 0.030 | 0.030 | 0.010 | ug/l | 100 | 100 | 60-140 | 0 | 20 |
| Batch number: 081996050004A | Sample number(s): 5416337-5416341 | | | | | | | | |
| Lead | < 0.0010 | 0.0010 | 0.00005 0 | mg/l | 105 | | 90-115 | | |
| Batch number: 08199WAI026 | Sample number(s): 5416333-5416341 | | | | | | | | |
| Naphthalene | < 5. | 5. | 1. | ug/l | 93 | 98 | 77-107 | 6 | 30 |
| Fluorene | < 5. | 5. | 1. | ug/l | 100 | 102 | 82-113 | 3 | 30 |
| Phenanthrene | < 5. | 5. | 1. | ug/l | 98 | 102 | 83-112 | 4 | 30 |
| Pyrene | < 5. | 5. | 1. | ug/l | 86 | 92 | 80-115 | 7 | 30 |
| Chrysene | < 5. | 5. | 1. | ug/l | 104 | 109 | 82-112 | 5 | 30 |
| Batch number: 082036050002A | Sample number(s): 5416333-5416336 | | | | | | | | |
| Lead | < 0.0010 | 0.0010 | 0.00005 0 | mg/l | 103 | | 90-115 | | |
| Batch number: P082034AA | Sample number(s): 5416333-5416340 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 93 | 93 | 73-119 | 0 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 86 | 88 | 78-119 | 1 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 94 | 94 | 69-135 | 0 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 87 | 88 | 85-115 | 1 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 87 | 89 | 82-119 | 3 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 86 | 90 | 80-113 | 4 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 86 | 90 | 83-113 | 4 | 30 |
| Batch number: P082043AA | Sample number(s): 5416341 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 92 | 95 | 73-119 | 3 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 88 | 90 | 78-119 | 2 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 93 | 92 | 69-135 | 0 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 85 | 87 | 85-115 | 3 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 85 | 87 | 82-119 | 2 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 84 | 87 | 80-113 | 4 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 86 | 88 | 83-113 | 3 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 081990023A | Sample number(s): 5416333-5416341 UNSPK: 5416333 BKG: 5416334 | | | | | | | | |
| Ethylene dibromide | 87 | | 65-135 | | | < 0.029 | < 0.030 | 0 (1) | 30 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1100865
Reported: 07/25/08 at 08:50 AM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 081996050004A | Sample number(s): 5416337-5416341 UNSPK: P416638 BKG: P416638 | | | | | | | | |
| Lead | 103 | 104 | 75-125 | 1 | 20 | 0.0090 | 0.0090 | 0 | 20 |
| Batch number: 082036050002A | Sample number(s): 5416333-5416336 UNSPK: P417253 BKG: P417253 | | | | | | | | |
| Lead | 98 | 100 | 75-125 | 2 | 20 | < 0.0010 | < 0.0010 | 0 (1) | 20 |
| Batch number: P082034AA | Sample number(s): 5416333-5416340 UNSPK: P415066 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 96 | | 69-127 | | | | | | |
| Benzene | 93 | | 83-128 | | | | | | |
| 1,2-Dichloroethane | 98 | | 70-143 | | | | | | |
| Toluene | 93 | | 83-127 | | | | | | |
| Ethylbenzene | 93 | | 82-129 | | | | | | |
| Isopropylbenzene | 94 | | 81-130 | | | | | | |
| Xylene (Total) | 93 | | 82-130 | | | | | | |
| Batch number: P082043AA | Sample number(s): 5416341 UNSPK: P417522 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 96 | | 69-127 | | | | | | |
| Benzene | 96 | | 83-128 | | | | | | |
| 1,2-Dichloroethane | 95 | | 70-143 | | | | | | |
| Toluene | 95 | | 83-127 | | | | | | |
| Ethylbenzene | 95 | | 82-129 | | | | | | |
| Isopropylbenzene | 95 | | 81-130 | | | | | | |
| Xylene (Total) | 94 | | 82-130 | | | | | | |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: EDB in Wastewater
Batch number: 081990023A

| | 1,1,2,2-Tetrachloroethane |
|---|---|
| 5416333 | 84 |
| 5416334 | 77 |
| 5416335 | 81 |
| 5416336 | 79 |
| 5416337 | 84 |
| 5416338 | 80 |
| 5416339 | 80 |
| 5416340 | 81 |
| 5416341 | 66 |
| Blank | 100 |
| DUP | 82 |
| LCS | 99 |
| LCSD | 100 |
| MS | 83 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1100865
Reported: 07/25/08 at 08:50 AM

### Surrogate Quality Control

Limits: 46-136

Analysis Name: PAHs in Water by GC/MS
Batch number: 08199WAI026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5416333 | 96 | 104 | 87 |
| 5416334 | 101 | 109 | 85 |
| 5416335 | 97 | 101 | 84 |
| 5416336 | 119 | 91 | 66 |
| 5416337 | 97 | 99 | 93 |
| 5416338 | 98 | 102 | 90 |
| 5416339 | 94 | 104 | 85 |
| 5416340 | 100 | 87 | 60 |
| 5416341 | 239* | 105 | 91 |
| Blank | 98 | 105 | 88 |
| LCS | 98 | 104 | 81 |
| LCSD | 99 | 103 | 88 |
| Limits: | 44-127 | 63-114 | 30-126 |

Analysis Name: UST-Waters by 8260B
Batch number: P082034AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5416333 | 93 | 90 | 89 | 86 |
| 5416334 | 92 | 92 | 88 | 87 |
| 5416335 | 92 | 88 | 89 | 91 |
| 5416336 | 92 | 90 | 90 | 90 |
| 5416337 | 92 | 90 | 89 | 89 |
| 5416338 | 91 | 91 | 91 | 89 |
| 5416339 | 93 | 92 | 89 | 86 |
| 5416340 | 92 | 90 | 89 | 89 |
| Blank | 93 | 91 | 89 | 86 |
| LCS | 91 | 91 | 89 | 89 |
| LCSD | 91 | 93 | 89 | 88 |
| MS | 92 | 94 | 89 | 88 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

Analysis Name: UST-Waters by 8260B
Batch number: P082043AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5416341 | 87 | 86 | 84 | 88 |
| Blank | 88 | 84 | 83 | 82 |
| LCS | 87 | 87 | 82 | 84 |
| LCSD | 87 | 88 | 82 | 83 |
| MS | 87 | 85 | 83 | 85 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1100865 Sample # 5416333-41

**COC #** 187456

Please print. Instructions on reverse side correspond with circled numbers. Cooler temp 1.9-5.6°C

(1) Client: SUN-AQUATERRA Acct. #:

Project Name/#: PHILA REF AOI-8 PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: S. SYKES Quote #:

Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#:

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water (Potable / NPDES) | Other | Total # of Containers | (5) Analyses Requested: Preservation Codes — Pb (Unfiltered) 8260B | Lead | EDB | PAHs by 6270 SIM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-1 | 7/15/08 | 1000 | X | | | X | | 8 | 3 | 1 | 2 | 2 |
| N-3 | | 1040 | X | | | X | | 8 | 3 | 1 | 2 | 2 |
| N-4 | | 1055 | X | | | X | | 8 | 3 | 1 | 2 | 2 |
| N-101 | | 1140 | X | | | X | | 8 | 3 | 1 | 2 | 2 |
| N-11 | | 1210 | X | | | X | | 8 | 3 | 1 | 2 | 2 |
| N-10 | | 1240 | X | | | X | | 8 | 3 | 1 | 2 | 2 |
| N-5 | | 1315 | X | | | X | | 8 | 3 | 1 | 2 | 2 |
| N-102 | | 1345 | X | | | X | | 8 | 3 | 1 | 2 | 2 |
| N-15 | | 1415 | X | | | X | | 8 | 3 | 1 | 2 | 2 |

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(6) Temperature of samples upon receipt (if requested)

**Remarks**

* One Amber for N-102 broken at time of pick-up.

(7) **Turnaround Time Requested** (TAT) (please circle): (Normal) Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax (E-mail)
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? (Yes) No
Site-specific QC (MS/MSD/Dup)? Yes (No)
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / (No)

| (9) Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| [signature] / AQUATERRA | 7/15/08 | | | | |
| [signature] | 7/16/08 | 1310 | [signature] | 7/16/08 | 1310 |
| [signature] | 7/16/08 | 1515 | | | |
| | | | | | |
| | | | [signature] | 7/16/08 | 1515 |

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

**WARRANTY AND LIMITS OF LIABILITY –** In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1101087. Samples arrived at the laboratory on Thursday, July 17, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-8 Grab Water | 5417522 |
| N-9 Grab Water | 5417523 |
| N-16 Grab Water | 5417524 |
| N-17 Grab Water | 5417525 |
| N-18 Grab Water | 5417526 |
| N-19 Grab Water | 5417527 |
| N-85 Grab Water | 5417528 |
| N-84 Grab Water | 5417529 |
| N-28 Grab Water | 5417530 |
| N-134 Grab Water | 5417531 |
| N-65 Grab Water | 5417532 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

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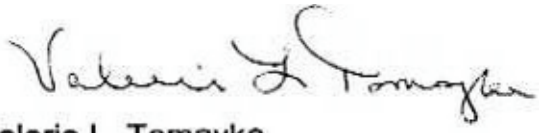
Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,



Valerie L. Tomayko
Group Leader

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5417522 WW  Group No. 1101087**

**N-8 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-8**

Collected:07/16/2008 09:30  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR808

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5417522 WW  Group No. 1101087**

**N-8 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-8**

Collected:07/16/2008 09:30  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR808

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/23/2008 03:19 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/21/2008 23:09 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 05:24 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/22/2008 22:17 | Florida A Cimino | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/22/2008 22:17 | Florida A Cimino | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/21/2008 06:40 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/19/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 04:30 | Tracy L Schickel | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5417523 WW  Group No. 1101087**

**N-9 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-9**

Collected:07/16/2008 09:45 by SS

Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR809

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 8. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | 2. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 6. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5417523 WW  Group No. 1101087**

**N-9 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-9**

Collected:07/16/2008 09:45  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30  SUN: Aquaterra Tech.
Reported: 07/28/2008 at 12:58  PO Box 744
Discard: 09/27/2008  West Chester PA 19381

PR809

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/23/2008 03:22 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/22/2008 00:09 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 05:47 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/22/2008 21:50 | Florida A Cimino | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/22/2008 21:50 | Florida A Cimino | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/21/2008 06:40 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/19/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 04:30 | Tracy L Schickel | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5417524 WW  Group No. 1101087**

**N-16 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-16**

Collected:07/16/2008 10:30  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR816

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 50. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 50. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 50. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 50. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5417524 WW  Group No. 1101087**

**N-16 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-16**

Collected:07/16/2008 10:30  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR816

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/23/2008 03:25 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/22/2008 00:39 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 06:11 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/22/2008 23:11 | Florida A Cimino | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/22/2008 23:11 | Florida A Cimino | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/21/2008 06:40 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/19/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 04:30 | Tracy L Schickel | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5417525 WW  Group No. 1101087**

**N-17 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-17**

Collected:07/16/2008 10:45  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR817

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.010 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 50. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 50. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 130. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 50. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5417525 WW  Group No. 1101087**

**N-17 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-17**

Collected:07/16/2008 10:45  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30  SUN: Aquaterra Tech.
Reported: 07/28/2008 at 12:58  PO Box 744
Discard: 09/27/2008  West Chester PA 19381

PR817

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/23/2008 03:28 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/22/2008 01:09 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 06:57 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/22/2008 23:37 | Florida A Cimino | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/22/2008 23:37 | Florida A Cimino | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/21/2008 06:40 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/19/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 04:30 | Tracy L Schickel | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5417526 WW  Group No. 1101087**

**N-18 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-18**

Collected:07/16/2008 11:25  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR818

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 25. | 25. | 5. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 25. | 25. | 5. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 25. | 25. | 5. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 25. | 25. | 5. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 25. | 25. | 5. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 3. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 20. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5417526 WW  Group No. 1101087**

**N-18 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-18**

Collected:07/16/2008 11:25  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR818

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/23/2008 03:31 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/22/2008 01:39 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 07:21 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/24/2008 03:35 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/24/2008 03:35 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/21/2008 06:40 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/19/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 04:30 | Tracy L Schickel | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5417527 WW  Group No. 1101087**

**N-19 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-19**

Collected:07/16/2008 11:45  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR819

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5417527 WW  Group No. 1101087**

**N-19 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-19**

Collected:07/16/2008 11:45  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR819

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/23/2008 03:34 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/22/2008 02:09 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 07:44 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/24/2008 03:56 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/24/2008 03:56 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/21/2008 06:40 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/19/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 04:30 | Tracy L Schickel | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5417528 WW  Group No. 1101087**

**N-85 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-85**

Collected:07/16/2008 12:35  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR885

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 50. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 50. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 50. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 50. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5417528 WW  Group No. 1101087**

**N-85 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-85**

Collected:07/16/2008 12:35  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR885

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/23/2008 03:37 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/22/2008 03:09 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 08:08 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/23/2008 01:25 | Florida A Cimino | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/23/2008 01:25 | Florida A Cimino | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/21/2008 06:40 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/19/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 04:30 | Tracy L Schickel | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5417529 WW  Group No. 1101087**

**N-84 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-84**

Collected:07/16/2008 12:55  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR884

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 11. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5417529 WW  Group No. 1101087**

**N-84 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-84**

Collected:07/16/2008 12:55  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30  SUN: Aquaterra Tech.
Reported: 07/28/2008 at 12:58  PO Box 744
Discard: 09/27/2008  West Chester PA 19381

PR884

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/23/2008 03:40 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/22/2008 03:39 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 08:31 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/23/2008 01:52 | Florida A Cimino | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/23/2008 01:52 | Florida A Cimino | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/21/2008 06:40 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/19/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 04:30 | Tracy L Schickel | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5417530 WW  Group No. 1101087**

**N-28 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-28**

Collected:07/16/2008 13:20  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR828

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5417530 WW  Group No. 1101087**

**N-28 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-28**

Collected:07/16/2008 13:20  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR828

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/23/2008 03:49 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/22/2008 04:09 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 08:55 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/23/2008 02:19 | Florida A Cimino | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/23/2008 02:19 | Florida A Cimino | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/21/2008 06:40 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/19/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 04:30 | Tracy L Schickel | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5417531 WW  Group No. 1101087**

**N-134 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-134**

Collected:07/16/2008 13:45  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30  SUN: Aquaterra Tech.
Reported: 07/28/2008 at 12:58  PO Box 744
Discard: 09/27/2008  West Chester PA 19381

PR134

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 50. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 50. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 50. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 50. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5417531 WW  Group No. 1101087**

**N-134 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-134**

Collected:07/16/2008 13:45  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR134

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/23/2008 03:52 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/22/2008 04:39 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 09:18 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/23/2008 02:45 | Florida A Cimino | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/23/2008 02:45 | Florida A Cimino | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/21/2008 06:40 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/19/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 04:30 | Tracy L Schickel | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5417532 WW  Group No. 1101087**

**N-65 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-65**

Collected:07/16/2008 14:30  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR865

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5417532 WW  Group No. 1101087**

**N-65 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187458 N-65**

Collected:07/16/2008 14:30  by SS  Account Number: 10132

Submitted: 07/17/2008 13:30
Reported: 07/28/2008 at 12:58
Discard: 09/27/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR865

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/23/2008 03:55 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/22/2008 05:09 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 09:41 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/23/2008 03:12 | Florida A Cimino | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/23/2008 03:12 | Florida A Cimino | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/21/2008 06:40 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/19/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 04:30 | Tracy L Schickel | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1101087
Reported: 07/28/08 at 12:58 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082000009A | Sample number(s): 5417522-5417532 | | | | | | | | |
| Ethylene dibromide | < 0.030 | 0.030 | 0.010 | ug/l | 104 | 104 | 60-140 | 0 | 20 |
| Batch number: 082006050004A | Sample number(s): 5417522-5417532 | | | | | | | | |
| Lead | < 0.0010 | 0.0010 | 0.00005 0 | mg/l | 105 | | 90-115 | | |
| Batch number: 08201WAH026 | Sample number(s): 5417522-5417532 | | | | | | | | |
| Naphthalene | < 5. | 5. | 1. | ug/l | 96 | 97 | 77-107 | 1 | 30 |
| Fluorene | < 5. | 5. | 1. | ug/l | 101 | 99 | 82-113 | 1 | 30 |
| Phenanthrene | < 5. | 5. | 1. | ug/l | 106 | 108 | 83-112 | 2 | 30 |
| Pyrene | < 5. | 5. | 1. | ug/l | 105 | 107 | 80-115 | 2 | 30 |
| Chrysene | < 5. | 5. | 1. | ug/l | 104 | 108 | 82-112 | 4 | 30 |
| Batch number: P082043AA | Sample number(s): 5417522-5417525,5417528-5417532 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 92 | 95 | 73-119 | 3 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 88 | 90 | 78-119 | 2 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 93 | 92 | 69-135 | 0 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 85 | 87 | 85-115 | 3 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 85 | 87 | 82-119 | 2 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 84 | 87 | 80-113 | 4 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 86 | 88 | 83-113 | 3 | 30 |
| Batch number: P082053AA | Sample number(s): 5417526-5417527 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 92 | 93 | 73-119 | 1 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 89 | 89 | 78-119 | 0 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 93 | 91 | 69-135 | 2 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 86 | 88 | 85-115 | 1 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 84 | 85 | 82-119 | 2 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 85 | 85 | 80-113 | 0 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 85 | 86 | 83-113 | 1 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082000009A | Sample number(s): 5417522-5417532 UNSPK: 5417522 BKG: P417548 | | | | | | | | |
| Ethylene dibromide | 100 | | 65-135 | | | < 0.029 | < 0.029 | 0 (1) | 30 |
| Batch number: 082006050004A | Sample number(s): 5417522-5417532 UNSPK: P416579 BKG: P416579 | | | | | | | | |
| Lead | 107 | 106 | 75-125 | 0 | 20 | 0.0174 | 0.0178 | 2 | 20 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1101087
Reported: 07/28/08 at 12:58 PM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: P082043AA | Sample number(s): 5417522-5417525,5417528-5417532 UNSPK: 5417522 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 96 | | 69-127 | | | | | | |
| Benzene | 96 | | 83-128 | | | | | | |
| 1,2-Dichloroethane | 95 | | 70-143 | | | | | | |
| Toluene | 95 | | 83-127 | | | | | | |
| Ethylbenzene | 95 | | 82-129 | | | | | | |
| Isopropylbenzene | 95 | | 81-130 | | | | | | |
| Xylene (Total) | 94 | | 82-130 | | | | | | |
| Batch number: P082053AA | Sample number(s): 5417526-5417527 UNSPK: P418824 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 96 | | 69-127 | | | | | | |
| Benzene | 94 | | 83-128 | | | | | | |
| 1,2-Dichloroethane | 95 | | 70-143 | | | | | | |
| Toluene | 82* | | 83-127 | | | | | | |
| Ethylbenzene | 65* | | 82-129 | | | | | | |
| Isopropylbenzene | 67 (2) | | 81-130 | | | | | | |
| Xylene (Total) | 64* | | 82-130 | | | | | | |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed
unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: EDB in Wastewater
Batch number: 082000009A

| | 1,1,2,2-Tetrachloroethane |
|---|---|
| 5417522 | 92 |
| 5417523 | 87 |
| 5417524 | 88 |
| 5417525 | 91 |
| 5417526 | 77 |
| 5417527 | 124 |
| 5417528 | 101 |
| 5417529 | 135 |
| 5417530 | 91 |
| 5417531 | 86 |
| 5417532 | 79 |
| Blank | 100 |
| DUP | 90 |
| LCS | 100 |
| LCSD | 100 |
| MS | 92 |
| Limits: | 46-136 |

Analysis Name: PAHs in Water by GC/MS
Batch number: 08201WAH026

| Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1101087
Reported: 07/28/08 at 12:58 PM

### Surrogate Quality Control

| | | | | |
|---|---|---|---|---|
| 5417522 | 100 | 127* | 96 | |
| 5417523 | 92 | 100 | 97 | |
| 5417524 | 94 | 100 | 96 | |
| 5417525 | 101 | 107 | 94 | |
| 5417526 | 110 | 102 | 93 | |
| 5417527 | 92 | 98 | 96 | |
| 5417528 | 98 | 105 | 96 | |
| 5417529 | 88 | 94 | 105 | |
| 5417530 | 91 | 97 | 111 | |
| 5417531 | 101 | 109 | 82 | |
| 5417532 | 94 | 101 | 89 | |
| Blank | 98 | 104 | 101 | |
| LCS | 100 | 103 | 101 | |
| LCSD | 101 | 102 | 102 | |
| Limits: | 44-127 | 63-114 | 30-126 | |

Analysis Name: UST-Waters by 8260B
Batch number: P082043AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5417522 | 88 | 85 | 82 | 82 |
| 5417523 | 87 | 84 | 83 | 83 |
| 5417524 | 87 | 85 | 83 | 82 |
| 5417525 | 88 | 84 | 84 | 82 |
| 5417528 | 87 | 83 | 84 | 83 |
| 5417529 | 87 | 83 | 83 | 85 |
| 5417530 | 87 | 85 | 82 | 82 |
| 5417531 | 88 | 85 | 83 | 82 |
| 5417532 | 89 | 84 | 83 | 82 |
| Blank | 88 | 84 | 83 | 82 |
| LCS | 87 | 87 | 82 | 84 |
| LCSD | 87 | 88 | 82 | 83 |
| MS | 87 | 85 | 83 | 85 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

Analysis Name: UST-Waters by 8260B
Batch number: P082053AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5417526 | 87 | 84 | 82 | 86 |
| 5417527 | 88 | 87 | 82 | 83 |
| Blank | 88 | 85 | 83 | 83 |
| LCS | 87 | 87 | 81 | 84 |
| LCSD | 87 | 86 | 82 | 83 |
| MS | 87 | 85 | 83 | 85 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1101087 Sample # 5417522-32

**COC #** 187458

Please print. Instructions on reverse side correspond with circled numbers. Cooler temp 2.1-2.5°C

**For Lab Use Only**
FSC:
SCR#:

(1)
Client: SUN-AQUATERRA Acct. #:
Project Name/#: PHILA REF AOI-8 PWSID #:
Project Manager: T. DOERR P.O.#:
Sampler: S. SYKES Quote #:
Name of state where samples were collected: PA

(4) Matrix: Potable / NPDES (Check if Applicable)

(5) Analyses Requested — Preservation Codes

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | Soil | Water | Other | Total # of Containers | Pb Unleaded 8260 | Lead | PAHs by GC/MS 8270 | EDB | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-8 | 7/16/08 | 930 | X | | X | X | | 8 | 3 | 1 | 2 | 2 | |
| N-9 | | 945 | X | | X | X | | 8 | 3 | 1 | 2 | 2 | |
| N-16 | | 1030 | X | | X | X | | 8 | 3 | 1 | 2 | 2 | |
| N-17 | | 1045 | X | | X | X | | 8 | 3 | 1 | 2 | 2 | |
| N-18 | | 1125 | X | | X | X | | 8 | 3 | 1 | 2 | 2 | |
| N-19 | | 1145 | X | | | X | | 8 | 3 | 1 | 2 | 2 | |
| N-85 | | 1235 | X | | | X | | 8 | 3 | 1 | 2 | 2 | |
| N-84 | | 1255 | X | | | X | | 8 | 3 | 1 | 2 | 2 | |
| N-28 | | 1320 | X | | | X | | 8 | 3 | 1 | 2 | 2 | |
| N-134 | | 1345 | X | | | X | | 8 | 3 | 1 | 2 | 2 | |

(6) Temperature of samples upon receipt (if requested)

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

(9)

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| SUN-AQUATERRA | 7/16/08 | 1630 | | 7/16/08 | 1630 |
| | 7/16/08 | 1045 | P. Lefever | 7/17/08 | 1045 |
| P. Lefever | 7/17/08 | 1330 | | | |
| | | | | | |
| | | | | 7-17-08 | 0945 1330 |

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Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1101087 Sample # 5417522-32

**COC # 187459**

Please print. Instructions on reverse side correspond with circled numbers. Cooler temp 2.1-2.5°C

**For Lab Use Only**
FSC:
SCR#:

(1) Client: SUN-AQUATERRA Acct. #:
Project Name/#: PHILA REF AOI-8 PWSID #:
Project Manager: T. DOERR P.O.#:
Sampler: S. SYKES Quote #:
Name of state where samples were collected: PA

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water | Other | Potable Check if NPDES Applicable | Total # of Containers | (5) Analyses Requested / Preservation Codes: Pb Unleaded 82606 | Lead | PAHs by GC/MS 8270 | EDB | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-65 | 7/16/08 | 1430 | X | | | X | | | 8 | 3 | 1 | 2 | 2 | |

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(6) Temperature of samples upon receipt (if requested)

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg) TX TRRP-13
Type II (Tier II) MA MCP CT RCP
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)

SDG Complete? Yes No

Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| (9) Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| S. Sykes / AQUATERRA | 7/16/08 | 1630 | [signature] | 7/16/08 | 1630 |
| [signature] | 7/17/08 | 1045 | P. Lefever | 7/17/08 | 1045 |
| P. Lefever | 7/17/08 | 1330 | | | |
| | | | | | |
| | | | [signature] | 7/17/08 | 0940 1330 |

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Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1101339. Samples arrived at the laboratory on Friday, July 18, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-27 Grab Water | 5418823 |
| N-120 Grab Water | 5418824 |
| N-26 Grab Water | 5418825 |
| N-92 Grab Water | 5418826 |
| N-93 Grab Water | 5418827 |
| N-87 Grab Water | 5418828 |
| N-86 Grab Water | 5418829 |
| N-119 Grab Water | 5418830 |
| N-121 Grab Water | 5418831 |
| N-117 Grab Water | 5418832 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Valerie L. Tomayko
Group Leader

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5418823 WW  Group No. 1101339**

**N-27 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-27**

Collected:07/17/2008 09:35  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20
Reported: 07/29/2008 at 12:28
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR027

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | 4. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5418823 WW  Group No. 1101339**

**N-27 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-27**

Collected:07/17/2008 09:35  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20
Reported: 07/29/2008 at 12:28
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR027

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 11:47 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/24/2008 00:59 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 12:13 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/23/2008 23:07 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/23/2008 23:07 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/23/2008 06:45 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/22/2008 12:15 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 14:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5418824 WW  Group No. 1101339**

**N-120 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-120**

Collected:07/17/2008 09:50  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20
Reported: 07/29/2008 at 12:28
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR120

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 13. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 21. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 7. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 130. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5418824 WW  Group No. 1101339**

**N-120 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-120**

Collected:07/17/2008 09:50  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20  SUN: Aquaterra Tech.
Reported: 07/29/2008 at 12:28  PO Box 744
Discard: 09/28/2008  West Chester PA 19381

PR120

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 11:50 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/24/2008 01:59 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 12:36 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/23/2008 23:27 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/23/2008 23:27 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/23/2008 06:45 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/22/2008 12:15 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 14:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5418825 WW  Group No. 1101339**

**N-26 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-26**

Collected:07/17/2008 10:20  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20
Reported: 07/29/2008 at 12:28
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR026

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5418825 WW  Group No. 1101339**

**N-26 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-26**

Collected:07/17/2008 10:20  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20
Reported: 07/29/2008 at 12:28
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR026

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 11:57 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/24/2008 02:29 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 13:00 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/24/2008 00:09 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/24/2008 00:09 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/23/2008 06:45 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/22/2008 12:15 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 14:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5418826 WW  Group No. 1101339**

**N-92 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-92**

Collected:07/17/2008 11:00  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20
Reported: 07/29/2008 at 12:28
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR092

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 17. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 27. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 11. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5418826 WW  Group No. 1101339**

**N-92 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-92**

Collected:07/17/2008 11:00  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20
Reported: 07/29/2008 at 12:28
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR092

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 11:59 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/24/2008 02:59 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 13:24 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/24/2008 00:29 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/24/2008 00:29 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/23/2008 06:45 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/22/2008 12:15 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 14:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5418827 WW  Group No. 1101339**

**N-93 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-93**

Collected:07/17/2008 11:40  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20
Reported: 07/29/2008 at 12:28
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR093

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 17. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

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# Analysis Report



**Lancaster Laboratories Sample No. 5418827 WW  Group No. 1101339**

**N-93 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-93**

Collected:07/17/2008 11:40  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20  SUN: Aquaterra Tech.
Reported: 07/29/2008 at 12:28  PO Box 744
Discard: 09/28/2008  West Chester PA 19381

PR093

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 12:01 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/24/2008 03:29 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 13:47 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/24/2008 00:50 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/24/2008 00:50 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/23/2008 06:45 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/22/2008 12:15 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 14:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5418828 WW  Group No. 1101339**

**N-87 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-87**

Collected:07/17/2008 12:45  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20
Reported: 07/29/2008 at 12:28
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR087

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 34. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5418828 WW  Group No. 1101339**

**N-87 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-87**

Collected:07/17/2008 12:45  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20  SUN: Aquaterra Tech.
Reported: 07/29/2008 at 12:28  PO Box 744
Discard: 09/28/2008  West Chester PA 19381

PR087

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 12:04 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/24/2008 05:32 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 14:11 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/24/2008 01:11 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/24/2008 01:11 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/23/2008 06:45 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/23/2008 10:15 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 14:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5418829 WW  Group No. 1101339**

**N-86 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-86**

Collected:07/17/2008 13:15  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20
Reported: 07/29/2008 at 12:28
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR086

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 9. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 13. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 21. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5418829 WW  Group No. 1101339**

**N-86 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-86**

Collected:07/17/2008 13:15  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20  SUN: Aquaterra Tech.
Reported: 07/29/2008 at 12:28  PO Box 744
Discard: 09/28/2008  West Chester PA 19381

PR086

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 12:06 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/24/2008 07:02 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 14:34 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/24/2008 01:31 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/24/2008 01:31 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/23/2008 06:45 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/23/2008 10:15 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 14:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5418830 WW  Group No. 1101339**

**N-119 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-119**

Collected:07/17/2008 13:35  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20
Reported: 07/29/2008 at 12:28
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR119

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | 220. | 48. | 10. | ug/l | 10 |
| 03956 | Fluorene | 86-73-7 | 31. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 63. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 6. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 20. | 20. | 10. | ug/l | 20 |
| 05401 | Benzene | 71-43-2 | 81. | 20. | 10. | ug/l | 20 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 20. | 20. | 10. | ug/l | 20 |
| 05407 | Toluene | 108-88-3 | 64. | 20. | 10. | ug/l | 20 |
| 05415 | Ethylbenzene | 100-41-4 | 210. | 20. | 10. | ug/l | 20 |
| 05420 | Isopropylbenzene | 98-82-8 | 520. | 40. | 10. | ug/l | 20 |
| 06310 | Xylene (Total) | 1330-20-7 | 570. | 20. | 10. | ug/l | 20 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5418830 WW  Group No. 1101339**

**N-119 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-119**

Collected:07/17/2008 13:35  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20
Reported: 07/29/2008 at 12:28
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR119

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 12:08 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/24/2008 07:32 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 19:48 | William T Parker | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/23/2008 00:30 | William T Parker | 10 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/24/2008 01:52 | Kelly E Brickley | 20 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/24/2008 01:52 | Kelly E Brickley | 20 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/23/2008 06:45 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/23/2008 10:15 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 14:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5418831 WW  Group No. 1101339**

**N-121 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-121**

Collected:07/17/2008 14:10  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20
Reported: 07/29/2008 at 12:28
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR121

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.028 | 0.028 | 0.0095 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 20. | 20. | 4. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 20. | 20. | 4. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 20. | 20. | 4. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 20. | 20. | 4. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 20. | 20. | 4. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 27. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 11. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | 2. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 34. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 36. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5418831 WW  Group No. 1101339**

**N-121 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-121**

Collected:07/17/2008 14:10  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20
Reported: 07/29/2008 at 12:28
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR121

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 12:11 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/24/2008 08:02 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 20:12 | William T Parker | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/24/2008 02:33 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/24/2008 02:33 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/23/2008 06:45 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/23/2008 10:15 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 14:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5418832 WW  Group No. 1101339**

**N-117 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-117**

Collected:07/17/2008 14:45  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20
Reported: 07/29/2008 at 12:28
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR117

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 24. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 71. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 11. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 11. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 14. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5418832 WW  Group No. 1101339**

**N-117 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187468 N-117**

Collected:07/17/2008 14:45  by SS  Account Number: 10132

Submitted: 07/18/2008 13:20  SUN: Aquaterra Tech.
Reported: 07/29/2008 at 12:28  PO Box 744
Discard: 09/28/2008  West Chester PA 19381

PR117

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 12:13 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/24/2008 08:32 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 20:35 | William T Parker | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/24/2008 02:54 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/24/2008 02:54 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/23/2008 06:45 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/23/2008 10:15 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/21/2008 14:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1101339
Reported: 07/29/08 at 12:28 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082030022A | Sample number(s): 5418823-5418827 | | | | | | | | |
| Ethylene dibromide | < 0.030 | 0.030 | 0.010 | ug/l | 104 | 108 | 60-140 | 4 | 20 |
| Batch number: 08203WAB026 | Sample number(s): 5418823-5418832 | | | | | | | | |
| Naphthalene | < 5. | 5. | 1. | ug/l | 99 | 89 | 77-107 | 11 | 30 |
| Fluorene | < 5. | 5. | 1. | ug/l | 104 | 93 | 82-113 | 11 | 30 |
| Phenanthrene | < 5. | 5. | 1. | ug/l | 105 | 96 | 83-112 | 9 | 30 |
| Pyrene | < 5. | 5. | 1. | ug/l | 96 | 91 | 80-115 | 6 | 30 |
| Chrysene | < 5. | 5. | 1. | ug/l | 99 | 91 | 82-112 | 9 | 30 |
| Batch number: 082040017A | Sample number(s): 5418828-5418832 | | | | | | | | |
| Ethylene dibromide | < 0.030 | 0.030 | 0.010 | ug/l | 100 | 113 | 60-140 | 12 | 20 |
| Batch number: 082046050002A | Sample number(s): 5418823-5418832 | | | | | | | | |
| Lead | < 0.0010 | 0.0010 | 0.00005 0 | mg/l | 105 | | 90-115 | | |
| Batch number: P082053AA | Sample number(s): 5418823-5418832 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 92 | 93 | 73-119 | 1 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 89 | 89 | 78-119 | 0 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 93 | 91 | 69-135 | 2 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 86 | 88 | 85-115 | 1 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 84 | 85 | 82-119 | 2 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 85 | 85 | 80-113 | 0 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 85 | 86 | 83-113 | 1 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082030022A | Sample number(s): 5418823-5418827 UNSPK: P416213 BKG: 5418823 | | | | | | | | |
| Ethylene dibromide | 109 | | 65-135 | | | < 0.030 | < 0.029 | 0 (1) | 30 |
| Batch number: 082040017A | Sample number(s): 5418828-5418832 UNSPK: 5418828 BKG: P420233 | | | | | | | | |
| Ethylene dibromide | 92 | | 65-135 | | | < 0.029 | < 0.029 | 0 (1) | 30 |
| Batch number: 082046050002A | Sample number(s): 5418823-5418832 UNSPK: P417553 BKG: P417553 | | | | | | | | |
| Lead | 105 | 104 | 75-125 | 2 | 20 | < 0.0010 | < 0.0010 | 0 (1) | 20 |
| Batch number: P082053AA | Sample number(s): 5418823-5418832 UNSPK: 5418824 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 96 | | 69-127 | | | | | | |
| Benzene | 94 | | 83-128 | | | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1101339
Reported: 07/29/08 at 12:28 PM

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| 1,2-Dichloroethane | 95 | | 70-143 | | | | | | |
| Toluene | 82* | | 83-127 | | | | | | |
| Ethylbenzene | 65* | | 82-129 | | | | | | |
| Isopropylbenzene | 67 (2) | | 81-130 | | | | | | |
| Xylene (Total) | 64* | | 82-130 | | | | | | |

## Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: EDB in Wastewater
Batch number: 082030022A

| | 1,1,2,2-Tetrachloroethane |
|---|---|
| 5418823 | 97 |
| 5418824 | 222* |
| 5418825 | 95 |
| 5418826 | 92 |
| 5418827 | 135 |
| Blank | 100 |
| DUP | 84 |
| LCS | 99 |
| LCSD | 102 |
| MS | 97 |
| Limits: | 46-136 |

Analysis Name: PAHs in Water by GC/MS
Batch number: 08203WAB026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5418823 | 103 | 99 | 98 |
| 5418824 | 98 | 82 | 69 |
| 5418825 | 103 | 97 | 91 |
| 5418826 | 125 | 98 | 91 |
| 5418827 | 94 | 92 | 92 |
| 5418828 | 92 | 88 | 85 |
| 5418829 | 97 | 96 | 89 |
| 5418830 | 100 | 89 | 79 |
| 5418831 | 103 | 98 | 79 |
| 5418832 | 93 | 72 | 65 |
| Blank | 103 | 97 | 89 |
| LCS | 103 | 100 | 91 |
| LCSD | 92 | 90 | 85 |
| Limits: | 44-127 | 63-114 | 30-126 |

Analysis Name: EDB in Wastewater

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1101339
Reported: 07/29/08 at 12:28 PM

### Surrogate Quality Control

Batch number: 082040017A

| | 1,1,2,2-Tetrachloroethane |
|---|---|
| 5418828 | 158* |
| 5418829 | 130 |
| 5418830 | 86 |
| 5418831 | 98 |
| 5418832 | 87 |
| Blank | 106 |
| DUP | 86 |
| LCS | 91 |
| LCSD | 108 |
| MS | 161* |
| Limits: | 46-136 |

Analysis Name: UST-Waters by 8260B
Batch number: P082053AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5418823 | 88 | 84 | 83 | 83 |
| 5418824 | 88 | 85 | 81 | 85 |
| 5418825 | 87 | 84 | 82 | 83 |
| 5418826 | 88 | 86 | 82 | 84 |
| 5418827 | 88 | 85 | 82 | 84 |
| 5418828 | 87 | 85 | 83 | 86 |
| 5418829 | 87 | 85 | 81 | 84 |
| 5418830 | 87 | 84 | 82 | 86 |
| 5418831 | 88 | 86 | 86 | 85 |
| 5418832 | 88 | 84 | 83 | 83 |
| Blank | 88 | 85 | 83 | 83 |
| LCS | 87 | 87 | 81 | 84 |
| LCSD | 87 | 86 | 82 | 83 |
| MS | 87 | 85 | 83 | 85 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1101339 Sample # 5418823-32

**COC # 187468**

Please print. Instructions on reverse side correspond with circled numbers. Cooler temp 0.9-2.6°C

**For Lab Use Only**
FSC: _____
SCR#: _____

(1)
Client: SUN-AQUATERRA Acct. #: _____
Project Name/#: PHILA REF AOI-8 PWSID #: _____
Project Manager: T. DOERR P.O.#: _____
Sampler: S. SYKES Quote #: _____
Name of state where samples were collected: PA

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | Matrix (4) Soil | Water (Potable / NPDES) | Other | Total # of Containers | (5) Analyses Requested / Preservation Codes: PA Unleaded 8260 | Lead | PAHs by 6270 | EDB | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-27 | 7/17/08 | 935 | X | | | X | | 8 | 3 | 1 | 2 | 2 | |
| N-120 | | 950 | | | | | | | | | | | |
| N-26 | | 1020 | | | | | | | | | | | |
| N-92 | | 1100 | | | | | | | | | | | |
| N-93 | | 1140 | | | | | | | | | | | |
| N-87 | | 1245 | | | | | | | | | | | |
| N-86 | | 1315 | | | | | | | | | | | |
| N-119 | | 1335 | | | | | | | | | | | |
| N-121 | | 1410 | | | | | | | | | | | |
| N-117 | | 1445 | | | | | | | | | | | |

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(6) Temperature of samples upon receipt (if requested)

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: _____
Rush results requested by (please circle): Phone Fax E-mail
Phone #: _____ Fax #: _____
E-mail address: _____

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

(9)

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| S. Sykes / AQUATERRA | 7/17/08 | 1730 | L. Wolf | 7/18/08 | 10:30 |
| L. Wolf | 7/18/08 | 13:20 | | | |
| | | | | | |
| | | | | | |
| | | | | 7/18 08 | 1320 |

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-2766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1101473. Samples arrived at the laboratory on Saturday, July 19, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-69 Grab Water | 5419603 |
| N-70 Grab Water | 5419604 |
| N-24 Grab Water | 5419605 |
| N-94 Grab Water | 5419606 |
| N-67 Grab Water | 5419607 |
| N-77 Grab Water | 5419608 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

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Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Valerie L. Tomayko
Group Leader

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5419603 WW  Group No. 1101473**

**N-69 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187460 N-69**

Collected:07/18/2008 10:10  by SS  Account Number: 10132

Submitted: 07/19/2008 10:10
Reported: 07/29/2008 at 08:31
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRF69

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5419603 WW  Group No. 1101473**

**N-69 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187460 N-69**

Collected:07/18/2008 10:10  by SS  Account Number: 10132

Submitted: 07/19/2008 10:10  SUN: Aquaterra Tech.
Reported: 07/29/2008 at 08:31  PO Box 744
Discard: 09/28/2008  West Chester PA 19381

PRF69

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 12:25 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/24/2008 09:02 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 23:08 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/24/2008 22:03 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/24/2008 22:03 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/23/2008 06:45 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/23/2008 10:15 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/22/2008 10:15 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5419604 WW  Group No. 1101473**

**N-70 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187460 N-70**

Collected:07/18/2008 11:20  by SS  Account Number: 10132

Submitted: 07/19/2008 10:10
Reported: 07/29/2008 at 08:31
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRF70

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 35. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

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# Analysis Report



**Lancaster Laboratories Sample No. 5419604 WW  Group No. 1101473**

**N-70 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187460 N-70**

Collected:07/18/2008 11:20  by SS  Account Number: 10132

Submitted: 07/19/2008 10:10
Reported: 07/29/2008 at 08:31
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRF70

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 12:27 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/24/2008 09:32 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 23:31 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/24/2008 22:30 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/24/2008 22:30 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/23/2008 06:45 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/23/2008 10:15 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/22/2008 10:15 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5419605 WW  Group No. 1101473**

**N-24 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187460 N-24**

Collected:07/18/2008 12:25  by SS  Account Number: 10132

Submitted: 07/19/2008 10:10
Reported: 07/29/2008 at 08:31
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRF24

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 47. | 47. | 9. | ug/l | 10 |
| 03956 | Fluorene | 86-73-7 | < 47. | 47. | 9. | ug/l | 10 |
| 03963 | Phenanthrene | 85-01-8 | < 47. | 47. | 9. | ug/l | 10 |
| 03967 | Pyrene | 129-00-0 | < 47. | 47. | 9. | ug/l | 10 |
| 03971 | Chrysene | 218-01-9 | < 47. | 47. | 9. | ug/l | 10 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 3. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 44. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 3. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5419605 WW  Group No. 1101473**

**N-24 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187460 N-24**

Collected:07/18/2008 12:25  by SS  Account Number: 10132

Submitted: 07/19/2008 10:10
Reported: 07/29/2008 at 08:31
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRF24

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 12:29 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/24/2008 10:02 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/23/2008 01:07 | Gregory J Drahovsky | 10 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/24/2008 23:23 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/24/2008 23:23 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/23/2008 06:45 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/23/2008 10:15 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/22/2008 10:15 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5419606 WW  Group No. 1101473**

**N-94 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187460 N-94**

Collected:07/18/2008 12:00  by SS  Account Number: 10132

Submitted: 07/19/2008 10:10
Reported: 07/29/2008 at 08:31
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRF94

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.010 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5419606 WW  Group No. 1101473**

**N-94 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187460 N-94**

Collected:07/18/2008 12:00  by SS  Account Number: 10132

Submitted: 07/19/2008 10:10  SUN: Aquaterra Tech.
Reported: 07/29/2008 at 08:31  PO Box 744
Discard: 09/28/2008  West Chester PA 19381

PRF94

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 12:32 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/24/2008 10:32 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/22/2008 23:55 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/24/2008 23:50 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/24/2008 23:50 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/23/2008 06:45 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/23/2008 10:15 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/22/2008 10:15 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5419607 WW  Group No. 1101473**

**N-67 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187460 N-67**

Collected:07/18/2008 13:10  by SS  Account Number: 10132

Submitted: 07/19/2008 10:10
Reported: 07/29/2008 at 08:31
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRF67

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

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# Analysis Report



**Lancaster Laboratories Sample No. 5419607 WW  Group No. 1101473**

**N-67 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187460 N-67**

Collected:07/18/2008 13:10  by SS  Account Number: 10132

Submitted: 07/19/2008 10:10
Reported: 07/29/2008 at 08:31
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRF67

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 12:34 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/24/2008 11:02 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/23/2008 00:19 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/25/2008 00:17 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/25/2008 00:17 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/23/2008 06:45 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/23/2008 10:15 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/22/2008 10:15 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report



**Lancaster Laboratories Sample No. 5419608 WW  Group No. 1101473**

**N-77 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187460 N-77**

Collected:07/18/2008 14:15  by SS  Account Number: 10132

Submitted: 07/19/2008 10:10
Reported: 07/29/2008 at 08:31
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRF77

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 7. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 15. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report



**Lancaster Laboratories Sample No. 5419608 WW  Group No. 1101473**

**N-77 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187460 N-77**

Collected:07/18/2008 14:15  by SS  Account Number: 10132

Submitted: 07/19/2008 10:10
Reported: 07/29/2008 at 08:31
Discard: 09/28/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PRF77

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/24/2008 12:37 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/24/2008 12:02 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/23/2008 00:43 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/25/2008 00:44 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/25/2008 00:44 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/23/2008 06:45 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/23/2008 10:15 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/22/2008 10:15 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1101473
Reported: 07/29/08 at 08:31 AM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08203WAK026 | Sample number(s): 5419603-5419608 | | | | | | | | |
| Naphthalene | < 5. | 5. | 1. | ug/l | 100 | 98 | 77-107 | 1 | 30 |
| Fluorene | < 5. | 5. | 1. | ug/l | 102 | 102 | 82-113 | 0 | 30 |
| Phenanthrene | < 5. | 5. | 1. | ug/l | 108 | 105 | 83-112 | 3 | 30 |
| Pyrene | < 5. | 5. | 1. | ug/l | 108 | 109 | 80-115 | 2 | 30 |
| Chrysene | < 5. | 5. | 1. | ug/l | 103 | 102 | 82-112 | 1 | 30 |
| Batch number: 082040017A | Sample number(s): 5419603-5419608 | | | | | | | | |
| Ethylene dibromide | < 0.030 | 0.030 | 0.010 | ug/l | 100 | 113 | 60-140 | 12 | 20 |
| Batch number: 082046050002A | Sample number(s): 5419603-5419608 | | | | | | | | |
| Lead | < 0.0010 | 0.0010 | 0.00050 | mg/l | 105 | | 90-115 | | |
| Batch number: P082062AA | Sample number(s): 5419603-5419608 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 98 | 91 | 73-119 | 7 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 87 | 85 | 78-119 | 2 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 96 | 93 | 69-135 | 3 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 85 | 85 | 85-115 | 1 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 87 | 86 | 82-119 | 1 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 86 | 85 | 80-113 | 1 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 87 | 86 | 83-113 | 1 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082040017A | Sample number(s): 5419603-5419608 UNSPK: P418828 BKG: P420233 | | | | | | | | |
| Ethylene dibromide | 92 | | 65-135 | | | < 0.029 | < 0.029 | 0 (1) | 30 |
| Batch number: 082046050002A | Sample number(s): 5419603-5419608 UNSPK: P417553 BKG: P417553 | | | | | | | | |
| Lead | 105 | 104 | 75-125 | 2 | 20 | < 0.0010 | < 0.0010 | 0 (1) | 20 |
| Batch number: P082062AA | Sample number(s): 5419603-5419608 UNSPK: 5419604 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 97 | | 69-127 | | | | | | |
| Benzene | 93 | | 83-128 | | | | | | |
| 1,2-Dichloroethane | 96 | | 70-143 | | | | | | |
| Toluene | 92 | | 83-127 | | | | | | |
| Ethylbenzene | 90 | | 82-129 | | | | | | |
| Isopropylbenzene | 88 | | 81-130 | | | | | | |
| Xylene (Total) | 90 | | 82-130 | | | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1101473
Reported: 07/29/08 at 08:31 AM

## Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Water by GC/MS
Batch number: 08203WAK026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5419603 | 103 | 105 | 117 |
| 5419604 | 108 | 104 | 120 |
| 5419605 | 84 | 85 | 88 |
| 5419606 | 105 | 104 | 116 |
| 5419607 | 106 | 105 | 110 |
| 5419608 | 106 | 105 | 117 |
| Blank | 110 | 106 | 118 |
| LCS | 111 | 105 | 113 |
| LCSD | 108 | 104 | 115 |
| Limits: | 44-127 | 63-114 | 30-126 |

Analysis Name: EDB in Wastewater
Batch number: 082040017A

| | 1,1,2,2-Tetrachloroethane |
|---|---|
| 5419603 | 70 |
| 5419604 | 67 |
| 5419605 | 124 |
| 5419606 | 74 |
| 5419607 | 88 |
| 5419608 | 102 |
| Blank | 106 |
| DUP | 86 |
| LCS | 91 |
| LCSD | 108 |
| MS | 161* |
| Limits: | 46-136 |

Analysis Name: UST-Waters by 8260B
Batch number: P082062AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5419603 | 92 | 89 | 91 | 94 |
| 5419604 | 92 | 89 | 87 | 97 |
| 5419605 | 92 | 91 | 89 | 90 |
| 5419606 | 93 | 91 | 89 | 87 |
| 5419607 | 93 | 89 | 89 | 87 |
| 5419608 | 92 | 90 | 88 | 86 |
| Blank | 92 | 89 | 89 | 85 |
| LCS | 92 | 92 | 88 | 87 |
| LCSD | 91 | 92 | 88 | 88 |
| MS | 91 | 90 | 97 | 97 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1101473
Reported: 07/29/08 at 08:31 AM

## Surrogate Quality Control

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1101473 Sample # 5419603-08

**COC #** 187460

Please print. Instructions on reverse side correspond with circled numbers. Cooler temp 2.7-3.8°C

(1)
Client: SUN-AQUATERRA Acct. #:
Project Name/#: PHILA REF AOI-8 PWSID #:
Project Manager: T. DOERR P.O.#:
Sampler: S. SYKES Quote #:
Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#:

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water | Other (Potable / NPDES) | Total # of Containers | (5) Analyses Requested / Preservation Codes: PA Unleaded 8260B | Lead | PAHs by GCMS 8270 | EDB | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-69 | 7/18/08 | 1010 | X | | | X | | 8 | 3 | 1 | 2 | 2 | |
| N-70 | | 1120 | X | | | X | | 8 | 3 | 1 | 2 | 2 | |
| N-24 | | 1225 | X | | | X | | 8 | 3 | 1 | 2 | 2 | |
| N-94 | | 1200 | X | | | X | | 8 | 3 | 1 | 2 | 2 | |
| N-67 | | 1310 | X | | | X | | 8 | 3 | 1 | 2 | 2 | |
| N-77 | | 1415 | X | | | X | | 8 | 3 | 1 | 2 | 2 | |

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(6) Temperature of samples upon receipt (if requested)

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

(9)

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| [signature] AQUATERRA | 7/18/08 | 1700 | | | |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| Relinquished by: | Date | Time | Received by: [signature] | 7/19/08 | 1010 |

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-2766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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Lancaster Laboratories

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1102042. Samples arrived at the laboratory on Wednesday, July 23, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-124 Grab Water | 5422552 |
| N-29 Grab Water | 5422553 |
| N-30 Grab Water | 5422554 |
| N-123 Grab Water | 5422555 |
| N-32 Grab Water | 5422556 |
| N-122 Grab Water | 5422557 |
| N-126 Grab Water | 5422558 |
| N-66 Grab Water | 5422559 |
| N-118 Grab Water | 5422560 |
| N-89 Grab Water | 5422561 |
| N-23 Grab Water | 5422562 |
| N-90 Grab Water | 5422563 |
| RW-301 Grab Water | 5422564 |
| N-108 Grab Water | 5422565 |
| RW-305 Grab Water | 5422566 |
| RW-304 Grab Water | 5422567 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |

Lancaster Laboratories

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# Analysis Report

COPY TO
ELECTRONIC LLI Attn: EDD Group
COPY TO

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Sarah Snyder
Specialist

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5422552 WW  Group No. 1102042**

**N-124 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-124**

Collected:07/22/2008 08:30  by MH  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:14
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR124

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5422552 WW  Group No. 1102042**

**N-124 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-124**

Collected:07/22/2008 08:30  by MH  Account Number: 10132

Submitted: 07/23/2008 16:20  SUN: Aquaterra Tech.
Reported: 08/01/2008 at 14:14  PO Box 744
Discard: 10/01/2008  West Chester PA 19381

PR124

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/27/2008 16:22 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/25/2008 03:35 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 12:58 | Joseph M Gambler | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/28/2008 11:57 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/28/2008 11:57 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/25/2008 09:32 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/24/2008 11:00 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/24/2008 16:45 | JoElla L Rice | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report



**Lancaster Laboratories Sample No. 5422553 WW  Group No. 1102042**

**N-29 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-29**

Collected:07/22/2008 09:45  by MH  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:14
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR029

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5422553 WW  Group No. 1102042**

**N-29 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-29**

Collected:07/22/2008 09:45  by MH  Account Number: 10132

Submitted: 07/23/2008 16:20  SUN: Aquaterra Tech.
Reported: 08/01/2008 at 14:14  PO Box 744
Discard: 10/01/2008  West Chester PA 19381

PR029

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/27/2008 16:25 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/25/2008 04:05 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 13:22 | Joseph M Gambler | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/28/2008 12:18 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/28/2008 12:18 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/25/2008 09:32 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/24/2008 11:00 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/24/2008 16:45 | JoElla L Rice | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5422554 WW  Group No. 1102042**

**N-30 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-30**

Collected:07/22/2008 09:30  by MH  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:14
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR030

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

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# Analysis Report



**Lancaster Laboratories Sample No. 5422554 WW  Group No. 1102042**

**N-30 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-30**

Collected:07/22/2008 09:30  by MH  Account Number: 10132

Submitted: 07/23/2008 16:20  SUN: Aquaterra Tech.
Reported: 08/01/2008 at 14:14  PO Box 744
Discard: 10/01/2008  West Chester PA 19381

PR030

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/27/2008 16:27 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/25/2008 17:01 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 13:46 | Joseph M Gambler | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/28/2008 12:39 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/28/2008 12:39 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/25/2008 09:32 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/24/2008 17:40 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/24/2008 16:45 | JoElla L Rice | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5422555 WW  Group No. 1102042**

**N-123 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-123**

Collected:07/22/2008 10:35  by MH  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:14
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR123

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | 140. | 24. | 5. | ug/l | 5 |
| 03956 | Fluorene | 86-73-7 | 60. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 170. | 24. | 5. | ug/l | 5 |
| 03967 | Pyrene | 129-00-0 | 110. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 66. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 6. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | 5. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 34. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 2. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

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# Analysis Report



**Lancaster Laboratories Sample No. 5422555 WW  Group No. 1102042**

**N-123 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-123**

Collected:07/22/2008 10:35  by MH  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:14
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR123

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/27/2008 16:34 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/25/2008 18:31 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 14:09 | Joseph M Gambler | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 22:31 | Gregory J Drahovsky | 5 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/28/2008 12:59 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/28/2008 12:59 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/25/2008 09:32 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/24/2008 17:40 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/24/2008 16:45 | JoElla L Rice | 1 |

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# Analysis Report



**Lancaster Laboratories Sample No. 5422556 WW  Group No. 1102042**

**N-32 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-32**

Collected:07/22/2008 11:10  by MH  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:14
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR032

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5422556 WW  Group No. 1102042**

**N-32 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-32**

Collected:07/22/2008 11:10  by MH  Account Number: 10132

Submitted: 07/23/2008 16:20  SUN: Aquaterra Tech.
Reported: 08/01/2008 at 14:14  PO Box 744
Discard: 10/01/2008  West Chester PA 19381

PR032

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/27/2008 16:36 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/25/2008 19:01 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 14:33 | Joseph M Gambler | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/28/2008 13:20 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/28/2008 13:20 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/25/2008 09:32 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/24/2008 17:40 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/24/2008 16:45 | JoElla L Rice | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5422557 WW  Group No. 1102042**

**N-122 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-122**

Collected:07/22/2008 12:15  by MH  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:14
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR122

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 84. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 250. | 24. | 5. | ug/l | 5 |
| 03967 | Pyrene | 129-00-0 | 16. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 5. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5422557 WW  Group No. 1102042**

**N-122 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-122**

Collected:07/22/2008 12:15  by MH  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:14
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR122

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/27/2008 16:39 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/25/2008 19:31 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 14:57 | Joseph M Gambler | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 22:55 | Gregory J Drahovsky | 5 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/28/2008 14:01 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/28/2008 14:01 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/25/2008 09:32 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/24/2008 17:40 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/24/2008 16:45 | JoElla L Rice | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5422558 WW  Group No. 1102042**

**N-126 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-126**

Collected:07/22/2008 12:40  by MH  Account Number: 10132

Submitted: 07/23/2008 16:20  SUN: Aquaterra Tech.
Reported: 08/01/2008 at 14:15  PO Box 744
Discard: 10/01/2008  West Chester PA 19381

PR126

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | 14. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 13. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 45. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 20. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 30. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 3. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 2. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5422558 WW  Group No. 1102042**

**N-126 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-126**

Collected:07/22/2008 12:40  by MH  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:15
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR126

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/27/2008 16:41 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/25/2008 20:31 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 15:21 | Joseph M Gambler | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/28/2008 14:21 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/28/2008 14:21 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/25/2008 09:32 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/24/2008 17:40 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/24/2008 16:45 | JoElla L Rice | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5422559 WW  Group No. 1102042**

**N-66 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-66**

Collected:07/22/2008 13:15  by MH  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:15
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR066

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | 48. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 31. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 67. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 19. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 7. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 4. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5422559 WW  Group No. 1102042**

**N-66 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-66**

Collected:07/22/2008 13:15  by MH  Account Number: 10132

Submitted: 07/23/2008 16:20  SUN: Aquaterra Tech.
Reported: 08/01/2008 at 14:15  PO Box 744
Discard: 10/01/2008  West Chester PA 19381

PR066

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/27/2008 16:43 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/25/2008 21:01 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 15:45 | Joseph M Gambler | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/28/2008 14:42 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/28/2008 14:42 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/25/2008 09:32 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/24/2008 17:40 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/24/2008 16:45 | JoElla L Rice | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5422560 WW  Group No. 1102042**

**N-118 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-118**

Collected:07/22/2008 08:30  by SS  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:15
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR118

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 34. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 70. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 9. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 9. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 9. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 7. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | 3. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 97. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 18. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5422560 WW  Group No. 1102042**

**N-118 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-118**

Collected:07/22/2008 08:30  by SS  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:15
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR118

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/27/2008 16:46 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/25/2008 21:31 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 16:09 | Joseph M Gambler | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/31/2008 06:18 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/31/2008 06:18 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/25/2008 09:32 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/24/2008 17:40 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/24/2008 16:45 | JoElla L Rice | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5422561 WW  Group No. 1102042**

**N-89 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-89**

Collected:07/22/2008 09:20  by SS  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:15
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR089

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 7. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 2. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 23. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 5. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5422561 WW  Group No. 1102042**

**N-89 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-89**

Collected:07/22/2008 09:20  by SS  Account Number: 10132

Submitted: 07/23/2008 16:20  SUN: Aquaterra Tech.
Reported: 08/01/2008 at 14:15  PO Box 744
Discard: 10/01/2008  West Chester PA 19381

PR089

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/27/2008 16:48 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/25/2008 22:01 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 16:32 | Joseph M Gambler | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/28/2008 15:45 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/28/2008 15:45 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/25/2008 09:32 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/24/2008 17:40 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/24/2008 16:45 | JoElla L Rice | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5422562 WW  Group No. 1102042**

**N-23 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-23**

Collected:07/22/2008 09:45  by SS  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:15
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR023

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.013 | ug/l | 1 |
| | Due to interfering peaks on the chromatogram, the values reported represent the lowest reporting limits attainable. | | | | | | |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | 260. | 120. | 24. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 1,100. | 120. | 24. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 520. | 120. | 24. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 1,900. | 120. | 24. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 620. | 120. | 24. | ug/l | 1 |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 10. | 10. | 5. | ug/l | 10 |
| 05401 | Benzene | 71-43-2 | < 10. | 10. | 5. | ug/l | 10 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 10. | 10. | 5. | ug/l | 10 |
| 05407 | Toluene | 108-88-3 | < 10. | 10. | 5. | ug/l | 10 |
| 05415 | Ethylbenzene | 100-41-4 | < 10. | 10. | 5. | ug/l | 10 |
| 05420 | Isopropylbenzene | 98-82-8 | < 20. | 20. | 5. | ug/l | 10 |
| 06310 | Xylene (Total) | 1330-20-7 | < 10. | 10. | 5. | ug/l | 10 |
| | The usual reporting limits were not attained due to the matrix of the sample in the GC/MS volatile analysis. | | | | | | |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5422562 WW  Group No. 1102042**

**N-23 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-23**

Collected:07/22/2008 09:45  by SS  Account Number: 10132

Submitted: 07/23/2008 16:20  SUN: Aquaterra Tech.
Reported: 08/01/2008 at 14:15  PO Box 744
Discard: 10/01/2008  West Chester PA 19381

PR023

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 06:55 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/25/2008 22:31 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 19:44 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/28/2008 16:06 | Anita M Dale | 10 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/28/2008 16:06 | Anita M Dale | 10 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/24/2008 17:40 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/25/2008 09:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5422563 WW  Group No. 1102042**

**N-90 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-90**

Collected:07/22/2008 10:20  by SS  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:15
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR090

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 5. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 4. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 8. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 6. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5422563 WW  Group No. 1102042**

**N-90 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-90**

Collected:07/22/2008 10:20  by SS  Account Number: 10132

Submitted: 07/23/2008 16:20  SUN: Aquaterra Tech.
Reported: 08/01/2008 at 14:15  PO Box 744
Discard: 10/01/2008  West Chester PA 19381

PR090

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:05 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/25/2008 23:01 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 20:08 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/28/2008 16:26 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/28/2008 16:26 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/24/2008 17:40 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/25/2008 09:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5422564 WW  Group No. 1102042**

**RW-301 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 RW-301**

Collected:07/22/2008 11:15  by SS  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:15
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR301

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 10. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 16. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 18. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 21. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5422564 WW  Group No. 1102042**

**RW-301 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 RW-301**

Collected:07/22/2008 11:15  by SS  Account Number: 10132

Submitted: 07/23/2008 16:20  SUN: Aquaterra Tech.
Reported: 08/01/2008 at 14:15  PO Box 744
Discard: 10/01/2008  West Chester PA 19381

PR301

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:07 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/25/2008 23:31 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 20:32 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/28/2008 16:47 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/28/2008 16:47 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/24/2008 17:40 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/25/2008 09:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5422565 WW  Group No. 1102042**

**N-108 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-108**

Collected:07/22/2008 11:35  by SS  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:15
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR108

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 19. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 47. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 13. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 8. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 5. | 5. | 3. | ug/l | 5 |
| 05401 | Benzene | 71-43-2 | 14. | 5. | 3. | ug/l | 5 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 5. | 5. | 3. | ug/l | 5 |
| 05407 | Toluene | 108-88-3 | 11. | 5. | 3. | ug/l | 5 |
| 05415 | Ethylbenzene | 100-41-4 | < 5. | 5. | 3. | ug/l | 5 |
| 05420 | Isopropylbenzene | 98-82-8 | 28. | 10. | 3. | ug/l | 5 |
| 06310 | Xylene (Total) | 1330-20-7 | 15. | 5. | 3. | ug/l | 5 |

The reporting limits for the GC/MS volatile compounds were raised due to the level of non-target compounds.

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5422565 WW  Group No. 1102042**

**N-108 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 N-108**

Collected:07/22/2008 11:35  by SS  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:15
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR108

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:12 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/26/2008 00:01 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 20:56 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/28/2008 17:08 | Anita M Dale | 5 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/28/2008 17:08 | Anita M Dale | 5 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/24/2008 17:40 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/25/2008 09:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5422566 WW  Group No. 1102042**

**RW-305 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 RW-305**

Collected:07/22/2008 12:20  by SS  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:15
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR305

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 10. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 15. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 6. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 6. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 3. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 4. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 18. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 10. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5422566 WW  Group No. 1102042**

**RW-305 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 RW-305**

Collected:07/22/2008 12:20  by SS  Account Number: 10132

Submitted: 07/23/2008 16:20  SUN: Aquaterra Tech.
Reported: 08/01/2008 at 14:15  PO Box 744
Discard: 10/01/2008  West Chester PA 19381

PR305

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:14 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/26/2008 00:32 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 21:20 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/31/2008 05:51 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/31/2008 05:51 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/24/2008 17:40 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/25/2008 09:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5422567 WW  Group No. 1102042**

**RW-304 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 RW-304**

Collected:07/22/2008 13:30  by SS  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:15
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR304

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 9. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 9. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 13. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 15. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5422567 WW  Group No. 1102042**

**RW-304 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187462 RW-304**

Collected:07/22/2008 13:30  by SS  Account Number: 10132

Submitted: 07/23/2008 16:20
Reported: 08/01/2008 at 14:15
Discard: 10/01/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR304

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:15 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/26/2008 01:02 | James H Place | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/25/2008 21:44 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 07/28/2008 17:49 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 07/28/2008 17:49 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/24/2008 17:40 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/25/2008 09:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1102042
Reported: 08/01/08 at 02:15 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082060000A | Sample number(s): 5422552-5422553 | | | | | | | | |
| Ethylene dibromide | < 0.030 | 0.030 | 0.010 | ug/l | 113 | 113 | 60-140 | 0 | 20 |
| Batch number: 082060014A | Sample number(s): 5422554-5422567 | | | | | | | | |
| Ethylene dibromide | < 0.030 | 0.030 | 0.010 | ug/l | 100 | 100 | 60-140 | 0 | 20 |
| Batch number: 082066050003A | Sample number(s): 5422552-5422561 | | | | | | | | |
| Lead | < 0.0010 | 0.0010 | 0.00005 0 | mg/l | 109 | | 90-115 | | |
| Batch number: 08206WAD026 | Sample number(s): 5422552-5422561 | | | | | | | | |
| Naphthalene | < 5. | 5. | 1. | ug/l | 90 | 92 | 77-107 | 2 | 30 |
| Fluorene | < 5. | 5. | 1. | ug/l | 90 | 94 | 82-113 | 5 | 30 |
| Phenanthrene | < 5. | 5. | 1. | ug/l | 97 | 102 | 83-112 | 5 | 30 |
| Pyrene | < 5. | 5. | 1. | ug/l | 103 | 106 | 80-115 | 3 | 30 |
| Chrysene | < 5. | 5. | 1. | ug/l | 95 | 97 | 82-112 | 2 | 30 |
| Batch number: 08206WAK026 | Sample number(s): 5422562-5422567 | | | | | | | | |
| Naphthalene | < 5. | 5. | 1. | ug/l | 98 | 100 | 77-107 | 2 | 30 |
| Fluorene | < 5. | 5. | 1. | ug/l | 106 | 104 | 82-113 | 2 | 30 |
| Phenanthrene | < 5. | 5. | 1. | ug/l | 108 | 109 | 83-112 | 1 | 30 |
| Pyrene | < 5. | 5. | 1. | ug/l | 106 | 106 | 80-115 | 1 | 30 |
| Chrysene | < 5. | 5. | 1. | ug/l | 102 | 100 | 82-112 | 1 | 30 |
| Batch number: 082116050002A | Sample number(s): 5422562-5422567 | | | | | | | | |
| Lead | < 0.0010 | 0.0010 | 0.00005 0 | mg/l | 105 | | 90-115 | | |
| Batch number: F082102AA | Sample number(s): 5422552-5422559,5422561-5422565,5422567 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 85 | 85 | 73-119 | 1 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 94 | 92 | 78-119 | 1 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 90 | 93 | 69-135 | 2 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 93 | 92 | 85-115 | 1 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 93 | 90 | 82-119 | 2 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 92 | 91 | 80-113 | 1 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 91 | 90 | 83-113 | 1 | 30 |
| Batch number: P082122AA | Sample number(s): 5422560,5422566 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 103 | 100 | 73-119 | 3 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 100 | 99 | 78-119 | 1 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 99 | 97 | 69-135 | 1 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 98 | 98 | 85-115 | 0 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 98 | 98 | 82-119 | 0 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 98 | 100 | 80-113 | 2 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 99 | 99 | 83-113 | 1 | 30 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1102042
Reported: 08/01/08 at 02:15 PM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082060000A | Sample number(s): 5422552-5422553 UNSPK: P422319 BKG: P422318 | | | | | | | | |
| Ethylene dibromide | 87 | | 65-135 | | | < 0.029 | < 0.029 | 0 (1) | 30 |
| Batch number: 082060014A | Sample number(s): 5422554-5422567 UNSPK: 5422554 BKG: 5422555 | | | | | | | | |
| Ethylene dibromide | 96 | | 65-135 | | | < 0.029 | < 0.029 | 0 (1) | 30 |
| Batch number: 082066050003A | Sample number(s): 5422552-5422561 UNSPK: P421516 BKG: P421516 | | | | | | | | |
| Lead | 104 | 105 | 75-125 | 0 | 20 | 0.0257 | 0.0265 | 3 | 20 |
| Batch number: 082116050002A | Sample number(s): 5422562-5422567 UNSPK: 5422562 BKG: 5422562 | | | | | | | | |
| Lead | 98 | 96 | 75-125 | 2 | 20 | < 0.0010 | < 0.0010 | 0 (1) | 20 |
| Batch number: F082102AA | Sample number(s): 5422552-5422559,5422561-5422565,5422567 UNSPK: 5422556 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 89 | | 69-127 | | | | | | |
| Benzene | 99 | | 83-128 | | | | | | |
| 1,2-Dichloroethane | 98 | | 70-143 | | | | | | |
| Toluene | 99 | | 83-127 | | | | | | |
| Ethylbenzene | 98 | | 82-129 | | | | | | |
| Isopropylbenzene | 98 | | 81-130 | | | | | | |
| Xylene (Total) | 96 | | 82-130 | | | | | | |
| Batch number: P082122AA | Sample number(s): 5422560,5422566 UNSPK: P422377 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 100 | | 69-127 | | | | | | |
| Benzene | 101 | | 83-128 | | | | | | |
| 1,2-Dichloroethane | 98 | | 70-143 | | | | | | |
| Toluene | 102 | | 83-127 | | | | | | |
| Ethylbenzene | 101 | | 82-129 | | | | | | |
| Isopropylbenzene | 101 | | 81-130 | | | | | | |
| Xylene (Total) | 100 | | 82-130 | | | | | | |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: EDB in Wastewater
Batch number: 082060000A

| | 1,1,2,2-Tetrachloroethane |
|---|---|
| 5422552 | 96 |
| 5422553 | 100 |
| Blank | 107 |
| DUP | 66 |
| LCS | 106 |
| LCSD | 104 |
| MS | 61 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1102042
Reported: 08/01/08 at 02:15 PM

## Surrogate Quality Control

Limits: 46-136

Analysis Name: EDB in Wastewater
Batch number: 082060014A

| | 1,1,2,2-Tetrachloroethane |
|---|---|
| 5422554 | 88 |
| 5422555 | 69 |
| 5422556 | 88 |
| 5422557 | 94 |
| 5422558 | 81 |
| 5422559 | 98 |
| 5422560 | 75 |
| 5422561 | 90 |
| 5422562 | 62 |
| 5422563 | 89 |
| 5422564 | 103 |
| 5422565 | 75 |
| 5422566 | 70 |
| 5422567 | 57 |
| Blank | 104 |
| DUP | 77 |
| LCS | 103 |
| LCSD | 99 |
| MS | 92 |
| Limits: | 46-136 |

Analysis Name: PAHs in Water by GC/MS
Batch number: 08206WAD026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5422552 | 90 | 90 | 83 |
| 5422553 | 92 | 97 | 89 |
| 5422554 | 88 | 92 | 97 |
| 5422555 | 90 | 90 | 91 |
| 5422556 | 90 | 89 | 63 |
| 5422557 | 85 | 89 | 77 |
| 5422558 | 81 | 75 | 86 |
| 5422559 | 86 | 89 | 98 |
| 5422560 | 78 | 88 | 85 |
| 5422561 | 89 | 98 | 104 |
| Blank | 96 | 91 | 113 |
| LCS | 95 | 94 | 111 |
| LCSD | 98 | 96 | 116 |
| Limits: | 44-127 | 63-114 | 30-126 |

Analysis Name: PAHs in Water by GC/MS
Batch number: 08206WAK026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5422562 | 148* | 154* | 111 |
| 5422563 | 94 | 101 | 113 |
| 5422564 | 74 | 80 | 94 |
| 5422565 | 96 | 112 | 115 |
| 5422566 | 99 | 113 | 122 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1102042
Reported: 08/01/08 at 02:15 PM

### Surrogate Quality Control

| | | | |
|---|---|---|---|
| 5422567 | 96 | 107 | 117 |
| Blank | 106 | 109 | 126 |
| LCS | 100 | 108 | 117 |
| LCSD | 99 | 102 | 114 |
| Limits: | 44-127 | 63-114 | 30-126 |

Analysis Name: UST-Waters by 8260B
Batch number: F082102AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5422552 | 87 | 90 | 88 | 87 |
| 5422553 | 87 | 94 | 87 | 87 |
| 5422554 | 86 | 90 | 88 | 87 |
| 5422555 | 88 | 92 | 87 | 95 |
| 5422556 | 87 | 94 | 88 | 89 |
| 5422557 | 85 | 92 | 88 | 93 |
| 5422558 | 91 | 91 | 89 | 92 |
| 5422559 | 86 | 91 | 87 | 91 |
| 5422561 | 86 | 91 | 88 | 92 |
| 5422562 | 89 | 92 | 86 | 89 |
| 5422563 | 88 | 91 | 88 | 90 |
| 5422564 | 90 | 90 | 87 | 90 |
| 5422565 | 87 | 94 | 89 | 100 |
| 5422567 | 90 | 95 | 91 | 101 |
| Blank | 88 | 93 | 87 | 86 |
| LCS | 89 | 93 | 88 | 89 |
| LCSD | 90 | 93 | 89 | 90 |
| MS | 90 | 94 | 88 | 88 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

Analysis Name: UST-Waters by 8260B
Batch number: P082122AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5422560 | 98 | 99 | 98 | 103 |
| 5422566 | 98 | 98 | 103 | 103 |
| Blank | 98 | 97 | 99 | 93 |
| LCS | 99 | 99 | 98 | 93 |
| LCSD | 98 | 98 | 99 | 95 |
| MS | 99 | 101 | 98 | 94 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1102042 Sample # 5422552-67

**COC #** 187462

Please print. Instructions on reverse side correspond with circled numbers. Cooler Temp 1.0-4.0°C

(1) Client: Sunoco, AquaTerra Acct. #:

Project Name/#: A01-8 PWSID #:

Project Manager: Tiffani Doerr P.O.#:

Sampler: Mike Hinderling Quote #:

Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#:

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | Matrix (4): Soil | Potable / NPDES Check if Applicable: Water | Other | Total # of Containers | (5) Analyses Requested — Preservation Codes: H | O | | O | | | | | Remarks | (6) Temperature of samples upon receipt (if requested) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 8260 | 8011 | Pb | PAHs 8270 | | | | | | |
| N-124 | 7/22/08 | 830 | X | | | X | | 8 | X | X | X | X | | | | | | |
| N-29 | 7/22/08 | 945 | X | | | X | | 8 | X | X | X | X | | | | | | |
| N-30 | 7/22/08 | 930 | X | | | X | | 8 | X | X | X | X | | | | | | |
| N-123 | 7/22/08 | 1035 | X | | | X | | 8 | X | X | X | X | | | | | | |
| N-32 | 7/22/08 | 1110 | X | | | X | | 8 | X | X | X | X | | | | | | |
| N-122 | 7/22/08 | 1215 | X | | | X | | 8 | X | X | X | X | | | | | | |
| N-126 | 7/22/08 | 1240 | X | | | X | | 8 | X | X | X | X | | | | | | |
| N-66 | 7/22/08 | 1315 | X | | | X | | 8 | X | X | X | X | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |

(7) **Turnaround Time Requested** (TAT) (please circle): (Normal) Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg) TX TRRP-13
Type II (Tier II) MA MCP CT RCP
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)

SDG Complete? (Yes) No

Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| (9) Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| [signature] | 7/22/08 | 1400 | Aquatherma Fridge | 7/22/08 | 1400 |
| AT PHOSE | 7/23/08 | 1145 | [signature] | 7/23/08 | 1145 |
| [signature] | 7/23/08 | 1145 | P. Lefever | 7/23/08 | 1145 |
| P. Lefever | 7/23/08 | 1620 | | | |
| | | | Katie Hartline | 7/24/08 | 16:30 |

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2102.03

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1102042 Sample # 5422552-67

**COC # 187469**

Please print. Instructions on reverse side correspond with circled numbers. Cooler temp 1.0-4.0°C

(1) Client: SUN-AQUATERRA Acct. #:

Project Name/#: PHILA REF AOI-8 PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: S. SYKES Quote #:

Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#:

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water | Other (Potable / NPDES) | Total # of Containers | (5) Analyses Requested / Preservation Codes: PA Unleaded 8260B | Lead | PAHs by GC/MS 8270 | EDB | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-118 | 7/22/08 | 830 | X | | | X | | 8 | 3 | 1 | 2 | 2 | |
| N-89 | | 920 | | | | | | | | | | | |
| N-23 | | 945 | | | | | | | | | | | |
| N-90 | | 1020 | | | | | | | | | | | |
| RW-301 | | 1115 | | | | | | | | | | | |
| N-108 | | 1135 | | | | | | | | | | | |
| RW-305 | | 1220 | | | | | | | | | | | |
| RW-304 | | 1330 | | | | | | | | | | | |

(6) Temperature of Samples (if required)

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| Sun Sys / AQUATERRA | 7/22/08 | 1530 | Aquatterra Fridge | 7/22/08 | 1530 |
| AT PRUDGE | 7/23/08 | 1145 | Lisa Stuhl | 7/23/08 | 1145 |
| Lisa Stuhl | 7/23/08 | 1145 | P. Lefever | 7/23/08 | 1145 |
| P. Lefever | 7/23/08 | 1620 | | | |
| | | | Katie Hartman | 7/23/08 | 16:20 |

(9)

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Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1102389. Samples arrived at the laboratory on Friday, July 25, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| PZ-504 Grab Water | 5424682 |
| N-74 Grab Water | 5424683 |
| PZ-503 Grab Water | 5424684 |
| N-61 Grab Water | 5424685 |
| RW-500 Grab Water | 5424686 |
| N-73 Grab Water | 5424687 |
| N-58 Grab Water | 5424688 |
| N-57 Grab Water | 5424689 |
| N-136 Grab Water | 5424690 |
| RW-308 Grab Water | 5424691 |
| RW-303 Grab Water | 5424692 |
| N-36 Grab Water | 5424693 |
| N-40 Grab Water | 5424694 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Marla S. Lord
Senior Specialist

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5424682 WW  Group No. 1102389**

**PZ-504 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 PZ-504**

Collected:07/25/2008 07:30  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40
Reported: 08/06/2008 at 16:46
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR504

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 2. | 2. | 1. | ug/l | 2 |
| 05401 | Benzene | 71-43-2 | 2,400. | 20. | 10. | ug/l | 20 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 2. | 2. | 1. | ug/l | 2 |
| 05407 | Toluene | 108-88-3 | < 2. | 2. | 1. | ug/l | 2 |
| 05415 | Ethylbenzene | 100-41-4 | < 2. | 2. | 1. | ug/l | 2 |
| 05420 | Isopropylbenzene | 98-82-8 | < 4. | 4. | 1. | ug/l | 2 |
| 06310 | Xylene (Total) | 1330-20-7 | 6. | 2. | 1. | ug/l | 2 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5424682 WW  Group No. 1102389**

**PZ-504 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 PZ-504**

Collected:07/25/2008 07:30  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 16:46  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR504

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/01/2008 10:43 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 00:15 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/30/2008 14:08 | Joseph M Gambler | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 19:26 | Anita M Dale | 2 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 19:53 | Anita M Dale | 20 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 19:26 | Anita M Dale | 2 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 2 | 08/04/2008 19:53 | Anita M Dale | 20 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/31/2008 19:02 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/29/2008 14:00 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5424683 WW  Group No. 1102389**

**N-74 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 N-74**

Collected:07/25/2008 07:45  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40
Reported: 08/06/2008 at 16:46
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR074

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 4. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424683 WW  Group No. 1102389**

**N-74 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 N-74**

Collected:07/25/2008 07:45  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 16:46  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR074

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/01/2008 10:45 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 13:48 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/30/2008 14:32 | Joseph M Gambler | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 20:20 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 20:20 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/31/2008 19:02 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/29/2008 14:00 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5424684 WW  Group No. 1102389**

**PZ-503 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 PZ-503**

Collected:07/25/2008 08:15  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40
Reported: 08/06/2008 at 16:46
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR503

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 50. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 50. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 62. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 51. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 13. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 6. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 3. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424684 WW  Group No. 1102389**

**PZ-503 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 PZ-503**

Collected:07/25/2008 08:15  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 16:46  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR503

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/01/2008 10:52 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 15:18 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/30/2008 14:55 | Joseph M Gambler | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 20:46 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 20:46 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/31/2008 19:02 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/29/2008 14:00 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5424685 WW  Group No. 1102389**

**N-61 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 N-61**

Collected:07/25/2008 08:40  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40
Reported: 08/06/2008 at 16:46
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR061

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 24. | 24. | 5. | ug/l | 5 |
| 03956 | Fluorene | 86-73-7 | < 24. | 24. | 5. | ug/l | 5 |
| 03963 | Phenanthrene | 85-01-8 | < 24. | 24. | 5. | ug/l | 5 |
| 03967 | Pyrene | 129-00-0 | < 24. | 24. | 5. | ug/l | 5 |
| 03971 | Chrysene | 218-01-9 | < 24. | 24. | 5. | ug/l | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 10. | 10. | 5. | ug/l | 10 |
| 05401 | Benzene | 71-43-2 | 8,700. | 50. | 25. | ug/l | 50 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 10. | 10. | 5. | ug/l | 10 |
| 05407 | Toluene | 108-88-3 | < 10. | 10. | 5. | ug/l | 10 |
| 05415 | Ethylbenzene | 100-41-4 | < 10. | 10. | 5. | ug/l | 10 |
| 05420 | Isopropylbenzene | 98-82-8 | < 20. | 20. | 5. | ug/l | 10 |
| 06310 | Xylene (Total) | 1330-20-7 | 23. | 10. | 5. | ug/l | 10 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424685 WW  Group No. 1102389**

**N-61 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 N-61**

Collected:07/25/2008 08:40  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 16:46  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR061

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/01/2008 10:55 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 16:19 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/31/2008 00:25 | Gregory J Drahovsky | 5 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 21:13 | Anita M Dale | 10 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 21:40 | Anita M Dale | 50 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 21:13 | Anita M Dale | 10 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 2 | 08/04/2008 21:40 | Anita M Dale | 50 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/31/2008 19:02 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/30/2008 00:35 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424686 WW  Group No. 1102389**

**RW-500 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 RW-500**

Collected:07/25/2008 09:30 by MH

Account Number: 10132

Submitted: 07/25/2008 14:40
Reported: 08/06/2008 at 16:46
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR500

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 5. | 5. | 3. | ug/l | 5 |
| 05401 | Benzene | 71-43-2 | 300. | 5. | 3. | ug/l | 5 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 5. | 5. | 3. | ug/l | 5 |
| 05407 | Toluene | 108-88-3 | < 5. | 5. | 3. | ug/l | 5 |
| 05415 | Ethylbenzene | 100-41-4 | < 5. | 5. | 3. | ug/l | 5 |
| 05420 | Isopropylbenzene | 98-82-8 | < 10. | 10. | 3. | ug/l | 5 |
| 06310 | Xylene (Total) | 1330-20-7 | < 5. | 5. | 3. | ug/l | 5 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424686 WW  Group No. 1102389**

**RW-500 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 RW-500**

Collected:07/25/2008 09:30  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40
Reported: 08/06/2008 at 16:46
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR500

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/01/2008 10:57 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 16:49 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/31/2008 00:49 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 22:07 | Anita M Dale | 5 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 22:07 | Anita M Dale | 5 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/31/2008 19:02 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/30/2008 00:35 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424687 WW  Group No. 1102389**

**N-73 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 N-73**

Collected:07/25/2008 10:55  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40
Reported: 08/06/2008 at 16:46
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR073

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 4. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424687 WW  Group No. 1102389**

**N-73 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 N-73**

Collected:07/25/2008 10:55  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 16:46  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR073

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/01/2008 10:59 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 17:19 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/31/2008 01:13 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 22:33 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 22:33 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/31/2008 19:02 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/30/2008 00:35 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424688 WW  Group No. 1102389**

**N-58 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 N-58**

Collected:07/25/2008 11:30  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40
Reported: 08/06/2008 at 16:46
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR058

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 10. | 10. | 5. | ug/l | 10 |
| 05401 | Benzene | 71-43-2 | < 10. | 10. | 5. | ug/l | 10 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 10. | 10. | 5. | ug/l | 10 |
| 05407 | Toluene | 108-88-3 | < 10. | 10. | 5. | ug/l | 10 |
| 05415 | Ethylbenzene | 100-41-4 | < 10. | 10. | 5. | ug/l | 10 |
| 05420 | Isopropylbenzene | 98-82-8 | < 20. | 20. | 5. | ug/l | 10 |
| 06310 | Xylene (Total) | 1330-20-7 | 100. | 10. | 5. | ug/l | 10 |

The reporting limits for the GC/MS volatile compounds were raised due to sample foaming.

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424688 WW  Group No. 1102389**

**N-58 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 N-58**

Collected:07/25/2008 11:30  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 16:46  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR058

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/01/2008 11:02 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 17:49 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/31/2008 01:37 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/05/2008 12:26 | Daniel H Heller | 10 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/05/2008 12:26 | Daniel H Heller | 10 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/31/2008 19:02 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/30/2008 00:35 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424689 WW  Group No. 1102389**

**N-57 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 N-57**

Collected:07/25/2008 12:00  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40
Reported: 08/06/2008 at 16:46
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR057

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 24. | 24. | 5. | ug/l | 5 |
| 03956 | Fluorene | 86-73-7 | < 24. | 24. | 5. | ug/l | 5 |
| 03963 | Phenanthrene | 85-01-8 | < 24. | 24. | 5. | ug/l | 5 |
| 03967 | Pyrene | 129-00-0 | < 24. | 24. | 5. | ug/l | 5 |
| 03971 | Chrysene | 218-01-9 | < 24. | 24. | 5. | ug/l | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 5. | 5. | 3. | ug/l | 5 |
| 05401 | Benzene | 71-43-2 | < 5. | 5. | 3. | ug/l | 5 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 5. | 5. | 3. | ug/l | 5 |
| 05407 | Toluene | 108-88-3 | < 5. | 5. | 3. | ug/l | 5 |
| 05415 | Ethylbenzene | 100-41-4 | < 5. | 5. | 3. | ug/l | 5 |
| 05420 | Isopropylbenzene | 98-82-8 | < 10. | 10. | 3. | ug/l | 5 |
| 06310 | Xylene (Total) | 1330-20-7 | 120. | 5. | 3. | ug/l | 5 |
| | The reporting limits for the GC/MS volatile compounds were raised due to sample foaming. | | | | | | |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424689 WW  Group No. 1102389**

**N-57 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 N-57**

Collected:07/25/2008 12:00  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 16:46  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR057

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/01/2008 11:04 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 18:19 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/31/2008 02:01 | Gregory J Drahovsky | 5 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/05/2008 12:51 | Daniel H Heller | 5 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/05/2008 12:51 | Daniel H Heller | 5 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/31/2008 19:02 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/30/2008 00:35 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424690 WW  Group No. 1102389**

**N-136 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 N-136**

Collected:07/25/2008 12:15  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 16:46  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR136

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 24. | 24. | 5. | ug/l | 5 |
| 03956 | Fluorene | 86-73-7 | < 24. | 24. | 5. | ug/l | 5 |
| 03963 | Phenanthrene | 85-01-8 | < 24. | 24. | 5. | ug/l | 5 |
| 03967 | Pyrene | 129-00-0 | < 24. | 24. | 5. | ug/l | 5 |
| 03971 | Chrysene | 218-01-9 | < 24. | 24. | 5. | ug/l | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 5. | 5. | 3. | ug/l | 5 |
| 05401 | Benzene | 71-43-2 | 110. | 5. | 3. | ug/l | 5 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 5. | 5. | 3. | ug/l | 5 |
| 05407 | Toluene | 108-88-3 | < 5. | 5. | 3. | ug/l | 5 |
| 05415 | Ethylbenzene | 100-41-4 | < 5. | 5. | 3. | ug/l | 5 |
| 05420 | Isopropylbenzene | 98-82-8 | < 10. | 10. | 3. | ug/l | 5 |
| 06310 | Xylene (Total) | 1330-20-7 | < 5. | 5. | 3. | ug/l | 5 |
| | The reporting limits for the GC/MS volatile compounds were raised due to sample foaming. | | | | | | |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424690 WW  Group No. 1102389**

**N-136 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 N-136**

Collected:07/25/2008 12:15  by MH  Account Number: 10132

Submitted: 07/25/2008 14:40  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 16:46  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR136

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/01/2008 11:06 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 18:49 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/31/2008 02:25 | Gregory J Drahovsky | 5 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/05/2008 13:11 | Daniel H Heller | 5 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/05/2008 13:11 | Daniel H Heller | 5 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/31/2008 19:02 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/30/2008 00:35 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424691 WW  Group No. 1102389**

**RW-308 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 RW-308**

Collected:07/25/2008 09:30  by SS  Account Number: 10132

Submitted: 07/25/2008 14:40
Reported: 08/06/2008 at 16:46
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR308

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.016 | 0.016 | 0.0054 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 46. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 5. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424691 WW  Group No. 1102389**

**RW-308 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 RW-308**

Collected:07/25/2008 09:30  by SS  Account Number: 10132

Submitted: 07/25/2008 14:40  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 16:46  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR308

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/01/2008 11:09 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 19:19 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/31/2008 02:49 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/05/2008 11:08 | Daniel H Heller | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/05/2008 11:08 | Daniel H Heller | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/31/2008 19:02 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/30/2008 00:35 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424692 WW  Group No. 1102389**

**RW-303 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 RW-303**

Collected:07/25/2008 10:00  by SS  Account Number: 10132

Submitted: 07/25/2008 14:40
Reported: 08/06/2008 at 16:46
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR303

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 14. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 13. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 16. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 21. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424692 WW  Group No. 1102389**

**RW-303 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 RW-303**

Collected:07/25/2008 10:00  by SS  Account Number: 10132

Submitted: 07/25/2008 14:40
Reported: 08/06/2008 at 16:46
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR303

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/01/2008 11:11 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 19:49 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/31/2008 03:12 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/05/2008 11:27 | Daniel H Heller | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/05/2008 11:27 | Daniel H Heller | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/31/2008 19:02 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/30/2008 00:35 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424693 WW  Group No. 1102389**

**N-36 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 N-36**

Collected:07/25/2008 10:45  by SS  Account Number: 10132

Submitted: 07/25/2008 14:40
Reported: 08/06/2008 at 16:46
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR036

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 120. | 120. | 24. | ug/l | 5 |
| 03956 | Fluorene | 86-73-7 | < 120. | 120. | 24. | ug/l | 5 |
| 03963 | Phenanthrene | 85-01-8 | < 120. | 120. | 24. | ug/l | 5 |
| 03967 | Pyrene | 129-00-0 | < 120. | 120. | 24. | ug/l | 5 |
| 03971 | Chrysene | 218-01-9 | < 120. | 120. | 24. | ug/l | 5 |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424693 WW  Group No. 1102389**

**N-36 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 N-36**

Collected:07/25/2008 10:45  by SS  Account Number: 10132

Submitted: 07/25/2008 14:40  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 16:46  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR036

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/01/2008 11:13 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 20:49 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/31/2008 03:36 | Gregory J Drahovsky | 5 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/05/2008 11:47 | Daniel H Heller | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/05/2008 11:47 | Daniel H Heller | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/31/2008 19:02 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/30/2008 00:35 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424694 WW  Group No. 1102389**

**N-40 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 N-40**

Collected:07/25/2008 11:30  by SS  Account Number: 10132

Submitted: 07/25/2008 14:40
Reported: 08/06/2008 at 16:46
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR040

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.010 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 24. | 24. | 5. | ug/l | 5 |
| 03956 | Fluorene | 86-73-7 | < 24. | 24. | 5. | ug/l | 5 |
| 03963 | Phenanthrene | 85-01-8 | < 24. | 24. | 5. | ug/l | 5 |
| 03967 | Pyrene | 129-00-0 | < 24. | 24. | 5. | ug/l | 5 |
| 03971 | Chrysene | 218-01-9 | < 24. | 24. | 5. | ug/l | 5 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 7. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424694 WW  Group No. 1102389**

**N-40 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187465 N-40**

Collected:07/25/2008 11:30  by SS  Account Number: 10132

Submitted: 07/25/2008 14:40  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 16:46  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR040

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/01/2008 11:20 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 21:19 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/31/2008 04:00 | Gregory J Drahovsky | 5 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/05/2008 17:16 | Daniel H Heller | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/05/2008 17:16 | Daniel H Heller | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/31/2008 19:02 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/30/2008 00:35 | David V Hershey Jr | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1102389
Reported: 08/06/08 at 04:46 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082100028A | Sample number(s): 5424682 | | | | | | | | |
| Ethylene dibromide | < 0.030 | 0.030 | 0.010 | ug/l | 88 | 88 | 60-140 | 0 | 20 |
| Batch number: 082110017A | Sample number(s): 5424683-5424694 | | | | | | | | |
| Ethylene dibromide | < 0.030 | 0.030 | 0.010 | ug/l | 88 | 92 | 60-140 | 5 | 20 |
| Batch number: 08211WAC026 | Sample number(s): 5424682-5424684 | | | | | | | | |
| Naphthalene | < 5. | 5. | 1. | ug/l | 98 | 97 | 77-107 | 1 | 30 |
| Fluorene | < 5. | 5. | 1. | ug/l | 97 | 99 | 82-113 | 2 | 30 |
| Phenanthrene | < 5. | 5. | 1. | ug/l | 104 | 105 | 83-112 | 1 | 30 |
| Pyrene | < 5. | 5. | 1. | ug/l | 109 | 105 | 80-115 | 3 | 30 |
| Chrysene | < 5. | 5. | 1. | ug/l | 100 | 99 | 82-112 | 1 | 30 |
| Batch number: 08211WAE026 | Sample number(s): 5424685-5424694 | | | | | | | | |
| Naphthalene | < 5. | 5. | 1. | ug/l | 99 | 104 | 77-107 | 4 | 30 |
| Fluorene | < 5. | 5. | 1. | ug/l | 103 | 105 | 82-113 | 2 | 30 |
| Phenanthrene | < 5. | 5. | 1. | ug/l | 106 | 109 | 83-112 | 3 | 30 |
| Pyrene | < 5. | 5. | 1. | ug/l | 107 | 107 | 80-115 | 0 | 30 |
| Chrysene | < 5. | 5. | 1. | ug/l | 102 | 106 | 82-112 | 4 | 30 |
| Batch number: 082136050003A | Sample number(s): 5424682-5424694 | | | | | | | | |
| Lead | < 0.0010 | 0.0010 | 0.00005 0 | mg/l | 103 | | 90-115 | | |
| Batch number: P082171AA | Sample number(s): 5424682-5424687 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 105 | 106 | 73-119 | 1 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 105 | 101 | 78-119 | 4 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 107 | 106 | 69-135 | 1 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 94 | 93 | 85-115 | 1 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 94 | 92 | 82-119 | 2 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 94 | 92 | 80-113 | 3 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 95 | 93 | 83-113 | 2 | 30 |
| Batch number: P082182AA | Sample number(s): 5424688-5424694 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 102 | 103 | 73-119 | 1 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 98 | 97 | 78-119 | 0 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 98 | 97 | 69-135 | 0 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 97 | 97 | 85-115 | 1 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 98 | 97 | 82-119 | 1 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 98 | 98 | 80-113 | 0 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 99 | 99 | 83-113 | 0 | 30 |

## Sample Matrix Quality Control

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1102389
Reported: 08/06/08 at 04:46 PM
Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082100028A | Sample number(s): 5424682 UNSPK: P424695 BKG: P424696 | | | | | | | | |
| Ethylene dibromide | 83 | | 65-135 | | | < 0.029 | < 0.030 | 0 (1) | 30 |
| Batch number: 082110017A | Sample number(s): 5424683-5424694 UNSPK: 5424683 BKG: 5424684 | | | | | | | | |
| Ethylene dibromide | 87 | | 65-135 | | | < 0.029 | < 0.029 | 0 (1) | 30 |
| Batch number: 082136050003A | Sample number(s): 5424682-5424694 UNSPK: P425860 BKG: P425860 | | | | | | | | |
| Lead | 99 | 129* | 75-125 | 12 | 20 | 0.0209 | 0.0184 | 13 | 20 |
| Batch number: P082171AA | Sample number(s): 5424682-5424687 UNSPK: P424700 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 108 | | 69-127 | | | | | | |
| Benzene | 112 | | 83-128 | | | | | | |
| 1,2-Dichloroethane | 108 | | 70-143 | | | | | | |
| Toluene | 100 | | 83-127 | | | | | | |
| Ethylbenzene | 98 | | 82-129 | | | | | | |
| Isopropylbenzene | 99 | | 81-130 | | | | | | |
| Xylene (Total) | 98 | | 82-130 | | | | | | |
| Batch number: P082182AA | Sample number(s): 5424688-5424694 UNSPK: 5424693 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 99 | | 69-127 | | | | | | |
| Benzene | 101 | | 83-128 | | | | | | |
| 1,2-Dichloroethane | 100 | | 70-143 | | | | | | |
| Toluene | 98 | | 83-127 | | | | | | |
| Ethylbenzene | 95 | | 82-129 | | | | | | |
| Isopropylbenzene | 92 | | 81-130 | | | | | | |
| Xylene (Total) | 95 | | 82-130 | | | | | | |

## Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed
unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: EDB in Wastewater
Batch number: 082100028A

| | 1,1,2,2-Tetrachloroethane |
|---|---|
| 5424682 | 103 |
| Blank | 98 |
| DUP | 59 |
| LCS | 97 |
| LCSD | 98 |
| MS | 73 |
| Limits: | 46-136 |

Analysis Name: EDB in Wastewater
Batch number: 082110017A

| | 1,1,2,2-Tetrachloroethane |
|---|---|

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1102389
Reported: 08/06/08 at 04:46 PM

## Surrogate Quality Control

| | |
|---|---|
| 5424683 | 133 |
| 5424684 | 76 |
| 5424685 | 114 |
| 5424686 | 111 |
| 5424687 | 70 |
| 5424688 | 147* |
| 5424689 | 136 |
| 5424690 | 97 |
| 5424691 | 151* |
| 5424692 | 155* |
| 5424693 | 80 |
| 5424694 | 122 |
| Blank | 96 |
| DUP | 77 |
| LCS | 103 |
| LCSD | 102 |
| MS | 135 |
| Limits: | 46-136 |

Analysis Name: PAHs in Water by GC/MS
Batch number: 08211WAC026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5424682 | 93 | 93 | 97 |
| 5424683 | 89 | 94 | 95 |
| 5424684 | 95 | 99 | 100 |
| Blank | 97 | 97 | 108 |
| LCS | 99 | 101 | 109 |
| LCSD | 98 | 103 | 104 |
| Limits: | 44-127 | 63-114 | 30-126 |

Analysis Name: PAHs in Water by GC/MS
Batch number: 08211WAE026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5424685 | 109 | 100 | 106 |
| 5424686 | 100 | 98 | 112 |
| 5424687 | 100 | 92 | 112 |
| 5424688 | 100 | 99 | 107 |
| 5424689 | 92 | 91 | 91 |
| 5424690 | 102 | 97 | 98 |
| 5424691 | 102 | 100 | 109 |
| 5424692 | 101 | 99 | 112 |
| 5424693 | 129* | 116* | 127* |
| 5424694 | 95 | 98 | 106 |
| Blank | 112 | 114 | 119 |
| LCS | 103 | 104 | 108 |
| LCSD | 104 | 106 | 110 |
| Limits: | 44-127 | 63-114 | 30-126 |

Analysis Name: UST-Waters by 8260B
Batch number: P082171AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5424682 | 91 | 83 | 86 | 93 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1102389
Reported: 08/06/08 at 04:46 PM

## Surrogate Quality Control

| | | | | |
|---|---|---|---|---|
| 5424683 | 93 | 86 | 86 | 93 |
| 5424684 | 93 | 85 | 87 | 95 |
| 5424685 | 93 | 86 | 87 | 93 |
| 5424686 | 94 | 85 | 86 | 93 |
| 5424687 | 94 | 85 | 85 | 93 |
| Blank | 94 | 85 | 86 | 93 |
| LCS | 94 | 88 | 85 | 93 |
| LCSD | 93 | 88 | 87 | 93 |
| MS | 95 | 89 | 86 | 93 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

Analysis Name: UST-Waters by 8260B
Batch number: P082182AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5424688 | 98 | 98 | 96 | 90 |
| 5424689 | 97 | 97 | 97 | 92 |
| 5424690 | 97 | 98 | 97 | 92 |
| 5424691 | 98 | 95 | 96 | 96 |
| 5424692 | 98 | 98 | 99 | 95 |
| 5424693 | 97 | 93 | 97 | 94 |
| 5424694 | 97 | 96 | 95 | 93 |
| Blank | 99 | 96 | 97 | 91 |
| LCS | 98 | 98 | 98 | 92 |
| LCSD | 99 | 98 | 97 | 92 |
| MS | 97 | 98 | 98 | 93 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only
Acct. # 10132 Group# 1102389 Sample # 5424682-94

**COC # 187465**

Please print. Instructions on reverse side correspond with circled numbers. Cooler temp 1.1-4.0°C

For Lab Use Only
FSC:
SCR#:

(1) Client: Sunoco, Aquaterra Acct. #:
Project Name/#: A01-8 philly Refinery PWSID #:
Project Manager: Tiffani Doerr P.O.#:
Sampler: Mike Hinderling Quote #:
Name of state where samples were collected: PA

(4) Matrix: Soil | Water (☐ Potable ☐ NPDES Check if Ammonia) | Other | Total # of Containers

(5) Analyses Requested — Preservation Codes

Preservation Codes: H=HCl T=Thiosulfate; N=$HNO_3$ B=NaOH; S=$H_2SO_4$ O=Other

(6) Temperature of samples upon receipt (if requested)

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | Soil | Water | Other | Total # of Containers | 8260 | 8011 | PAHs 8270 | Pb | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PZ-504 | 7/25/08 | 730 | X | | | X | | 8 | X | X | X | X | |
| N-74 | 7/25/08 | 745 | X | | | X | | 8 | X | X | X | X | |
| PZ-503 | 7/25/08 | 815 | X | | | X | | 8 | X | X | X | X | |
| N-61 | 7/25/08 | 840 | X | | | X | | 8 | X | X | X | X | |
| RW-500 | 7/25/08 | 930 | X | | | X | | 8 | X | X | X | X | |
| ~~PZ-501~~ N-73 | 7/25/08 | 1055 | X | | | X | | 8 | X | X | X | X | |
| N-58 | 7/25/08 | 1130 | X | | | X | | 8 | X | X | X | X | |
| N-57 | 7/25/08 | 1200 | X | | | X | | 8 | X | X | X | X | |
| N-136 | 7/25/08 | 1215 | X | | | X | | 8 | X | X | X | X | |
| | | | | | | | | | | | | | |

(7) **Turnaround Time Requested** (TAT) (please circle): (Normal) Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

SDG Complete? (Yes) No

(9)

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| Steve Lee / AQUATERRA | 7/25/08 | 1440 | | | |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| Relinquished by: | Date | Time | Received by: | 7/29/08 | 1440 |

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only
Acct. # 10132 Group# 1102389 Sample # 5424682-94

**COC # 187457**

Please print. Instructions on reverse side correspond with circled numbers. Cooler temp 1.1-4.0°C

(1) Client: SUN- AQUATERRA Acct. #:
Project Name/#: PHILA REF AOI-8 PWSID #:
Project Manager: T. DOERR P.O.#:
Sampler: S. SYKES Quote #:
Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#:

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water (☐ Potable ☐ Check if for NPDES Assessment) | Other | Total # of Containers | (5) Analyses Requested: Preservation Codes — PA Unleaded 8260 | Lead | PAHs by GC/MS 8270 | EDB | Remarks | (6) Temperature of samples upon receipt (if requested) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RW-308 | 7/25/08 | 930 | X | | | X | | 8 | 3 | 1 | 2 | 2 | | |
| RW-303 | " | 1000 | " | | | " | | " | " | " | " | " | | |
| N-36 | " | 1045 | " | | | " | | " | " | " | " | " | | |
| N-40 | " | 1130 | " | | | " | | " | " | " | " | " | | |

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(7) **Turnaround Time Requested** (TAT) (please circle): (Normal) Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? (Yes) No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

(9)

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| [signature] / AQUATERRA | 7/25/08 | 1440 | | | |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| Relinquished by: | Date | Time | Received by: [signature] | 7/25/08 | 1440 |

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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Lancaster Laboratories
2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1102390. Samples arrived at the laboratory on Thursday, July 24, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-21 Grab Water | 5424695 |
| N-20 Grab Water | 5424696 |
| N-103 Grab Water | 5424697 |
| N-105 Grab Water | 5424698 |
| N-104 Grab Water | 5424699 |
| N-99 Grab Water | 5424700 |
| N-13 Grab Water | 5424701 |
| N-12 Grab Water | 5424702 |
| N-307 Grab Water | 5424703 |
| N-302 Grab Water | 5424704 |
| N-128 Grab Water | 5424705 |
| N-50D Grab Water | 5424706 |
| RW-200 Grab Water | 5424707 |
| N-64 Grab Water | 5424708 |
| PZ-507 Grab Water | 5424709 |
| PZ-506 Grab Water | 5424710 |
| RW-501 Grab Water | 5424711 |
| PZ-505 Grab Water | 5424712 |
| N-133 Grab Water | 5424713 |

ELECTRONIC COPY TO SUN: Aquaterra Tech. Attn: Kevin Martin

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report

| | | |
|---|---|---|
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Marla S. Lord
Senior Specialist

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report



**Lancaster Laboratories Sample No. 5424695 WW  Group No. 1102390**

**N-21 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-21**

Collected:07/23/2008 08:45  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR021

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 16. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 190. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 3. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424695 WW  Group No. 1102390**

**N-21 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-21**

Collected:07/23/2008 08:45  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR021

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:17 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 00:47 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 08:03 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 14:05 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 14:05 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5424696 WW  Group No. 1102390**

**N-20 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-20**

Collected:07/23/2008 09:00  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR020

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 66. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 50. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 90. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 70. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 42. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424696 WW  Group No. 1102390**

**N-20 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-20**

Collected:07/23/2008 09:00  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 19:53  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR020

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:19 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 02:17 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 08:26 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 14:32 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 14:32 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424697 WW  Group No. 1102390**

**N-103 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-103**

Collected:07/23/2008 09:30 by SS

Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR103

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 740. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 2,500. | 250. | 50. | ug/l | 5 |
| 03967 | Pyrene | 129-00-0 | 390. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 360. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 5. | 5. | 3. | ug/l | 5 |
| 05401 | Benzene | 71-43-2 | 16. | 5. | 3. | ug/l | 5 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 5. | 5. | 3. | ug/l | 5 |
| 05407 | Toluene | 108-88-3 | 22. | 5. | 3. | ug/l | 5 |
| 05415 | Ethylbenzene | 100-41-4 | < 5. | 5. | 3. | ug/l | 5 |
| 05420 | Isopropylbenzene | 98-82-8 | 360. | 10. | 3. | ug/l | 5 |
| 06310 | Xylene (Total) | 1330-20-7 | 47. | 5. | 3. | ug/l | 5 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424697 WW  Group No. 1102390**

**N-103 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-103**

Collected:07/23/2008 09:30  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 19:53  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR103

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:21 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 02:47 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 08:49 | Brian K Graham | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 21:35 | William T Parker | 5 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 14:59 | Anita M Dale | 5 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 14:59 | Anita M Dale | 5 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424698 WW  Group No. 1102390**

**N-105 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-105**

Collected:07/23/2008 10:00  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR105

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 72. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 100. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 50. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 50. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 3. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 9. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 7. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424698 WW  Group No. 1102390**

**N-105 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-105**

Collected:07/23/2008 10:00  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR105

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:22 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 03:17 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 09:13 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/05/2008 16:18 | Daniel H Heller | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/05/2008 16:18 | Daniel H Heller | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424699 WW  Group No. 1102390**

**N-104 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-104**

Collected:07/23/2008 10:25  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR104

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 310. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 740. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 150. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 85. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 7. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 13. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | 2. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 44. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 30. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424699 WW  Group No. 1102390**

**N-104 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-104**

Collected:07/23/2008 10:25  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR104

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:24 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 04:17 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 09:37 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/05/2008 16:37 | Daniel H Heller | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/05/2008 16:37 | Daniel H Heller | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424700 WW  Group No. 1102390**

**N-99 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-99**

Collected:07/23/2008 11:05  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR099

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 50. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 50. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 50. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 50. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424700 WW  Group No. 1102390**

**N-99 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-99**

Collected:07/23/2008 11:05  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 19:53  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR099

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:26 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 04:47 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 10:00 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 16:19 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 16:19 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424701 WW  Group No. 1102390**

**N-13 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-13**

Collected:07/23/2008 11:45  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR013

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | 2. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424701 WW  Group No. 1102390**

**N-13 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-13**

Collected:07/23/2008 11:45  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 19:53  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR013

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:28 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 05:17 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 10:24 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 17:12 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 17:12 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424702 WW  Group No. 1102390**

**N-12 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-12**

Collected:07/23/2008 12:00  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR012

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 1,600. | 500. | 100. | ug/l | 10 |
| 03963 | Phenanthrene | 85-01-8 | 5,500. | 500. | 100. | ug/l | 10 |
| 03967 | Pyrene | 129-00-0 | 870. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 470. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 6. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 10. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 15. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 14. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424702 WW  Group No. 1102390**

**N-12 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-12**

Collected:07/23/2008 12:00  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR012

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:33 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 05:47 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 10:47 | Brian K Graham | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 21:59 | William T Parker | 10 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 17:39 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 17:39 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424703 WW  Group No. 1102390**

**N-307 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-307**

Collected:07/23/2008 13:00  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR307

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 52. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 30. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | 3. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 30. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 34. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424703 WW  Group No. 1102390**

**N-307 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-307**

Collected:07/23/2008 13:00  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR307

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:35 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 06:17 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 11:11 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 18:06 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 18:06 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424704 WW  Group No. 1102390**

**N-302 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-302**

Collected:07/23/2008 14:10  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR302

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 8. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 3. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 2. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 17. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 4. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424704 WW  Group No. 1102390**

**N-302 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-302**

Collected:07/23/2008 14:10  by SS  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR302

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:36 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 06:47 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 11:34 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 18:33 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 18:33 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424705 WW  Group No. 1102390**

**N-128 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-128**

Collected:07/23/2008 08:15  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 19:53  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR128

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 100. | 100. | 20. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 100. | 100. | 20. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 4,300. | 500. | 100. | ug/l | 5 |
| 03967 | Pyrene | 129-00-0 | 940. | 100. | 20. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 470. | 100. | 20. | ug/l | 1 |
| | Due to sample matrix interferences observed during the extraction, the normal reporting limits were not attained. | | | | | | |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 30. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424705 WW  Group No. 1102390**

**N-128 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-128**

Collected:07/23/2008 08:15  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR128

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:38 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 07:17 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 11:57 | Brian K Graham | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 22:22 | William T Parker | 5 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 18:59 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 18:59 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424706 WW  Group No. 1102390**

**N-50D Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-50D**

Collected:07/23/2008 09:15  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR50D

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424706 WW  Group No. 1102390**

**N-50D Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-50D**

Collected:07/23/2008 09:15  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR50D

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:40 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 07:47 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 12:21 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 14:18 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 14:18 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424707 WW  Group No. 1102390**

**RW-200 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 RW-200**

Collected:07/23/2008 10:20  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR200

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 72. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 100. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 300. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 97. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424707 WW  Group No. 1102390**

**RW-200 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 RW-200**

Collected:07/23/2008 10:20  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR200

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:42 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 08:17 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 12:44 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 14:45 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 14:45 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424708 WW  Group No. 1102390**

**N-64 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-64**

Collected:07/23/2008 10:45  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR064

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424708 WW  Group No. 1102390**

**N-64 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-64**

Collected:07/23/2008 10:45  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR064

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 07:43 | David K Beck | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 08:47 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 13:07 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 15:11 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 15:11 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 18:45 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424709 WW  Group No. 1102390**

**PZ-507 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 PZ-507**

Collected:07/23/2008 11:10  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR507

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 50. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 50. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 120. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 120. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424709 WW  Group No. 1102390**

**PZ-507 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 PZ-507**

Collected:07/23/2008 11:10  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 19:53  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR507

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 10:18 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 09:47 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 13:31 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 16:05 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 16:05 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 19:05 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424710 WW  Group No. 1102390**

**PZ-506 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 PZ-506**

Collected:07/23/2008 11:40  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR506

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 11. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 8. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 10. | 10. | 5. | ug/l | 10 |
| 05401 | Benzene | 71-43-2 | < 10. | 10. | 5. | ug/l | 10 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 10. | 10. | 5. | ug/l | 10 |
| 05407 | Toluene | 108-88-3 | < 10. | 10. | 5. | ug/l | 10 |
| 05415 | Ethylbenzene | 100-41-4 | < 10. | 10. | 5. | ug/l | 10 |
| 05420 | Isopropylbenzene | 98-82-8 | < 20. | 20. | 5. | ug/l | 10 |
| 06310 | Xylene (Total) | 1330-20-7 | < 10. | 10. | 5. | ug/l | 10 |

The usual reporting limits were not attained due to the matrix of the sample in the GC/MS volatile analysis.

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424710 WW  Group No. 1102390**

**PZ-506 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 PZ-506**

Collected:07/23/2008 11:40  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 19:53  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR506

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 10:19 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 10:17 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 13:55 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 16:32 | Anita M Dale | 10 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 16:32 | Anita M Dale | 10 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 19:05 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424711 WW  Group No. 1102390**

**RW-501 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 RW-501**

Collected:07/23/2008 12:45  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR501

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0095 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 3. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424711 WW  Group No. 1102390**

**RW-501 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 RW-501**

Collected:07/23/2008 12:45  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 19:53  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR501

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 10:21 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 10:47 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 14:18 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 16:58 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 16:58 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 19:05 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5424712 WW  Group No. 1102390**

**PZ-505 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 PZ-505**

Collected:07/23/2008 13:00  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR505

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 10. | 10. | 2. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 11. | 10. | 2. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 10. | 10. | 2. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 61. | 10. | 2. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 41. | 10. | 2. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 160. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 3. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 2. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424712 WW  Group No. 1102390**

**PZ-505 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 PZ-505**

Collected:07/23/2008 13:00  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10  SUN: Aquaterra Tech.
Reported: 08/06/2008 at 19:53  PO Box 744
Discard: 10/06/2008  West Chester PA 19381

PR505

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 10:23 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 11:17 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/29/2008 14:41 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 17:25 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 17:25 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 19:05 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/28/2008 10:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5424713 WW  Group No. 1102390**

**N-133 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-133**

Collected:07/23/2008 13:20  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR133

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | 31. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 9. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 6. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 10. | 10. | 5. | ug/l | 10 |
| 05401 | Benzene | 71-43-2 | 10,000. | 100. | 50. | ug/l | 100 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 10. | 10. | 5. | ug/l | 10 |
| 05407 | Toluene | 108-88-3 | < 10. | 10. | 5. | ug/l | 10 |
| 05415 | Ethylbenzene | 100-41-4 | 11. | 10. | 5. | ug/l | 10 |
| 05420 | Isopropylbenzene | 98-82-8 | < 20. | 20. | 5. | ug/l | 10 |
| 05439 | Naphthalene | 91-20-3 | < 40. | 40. | 10. | ug/l | 10 |
| 06310 | Xylene (Total) | 1330-20-7 | 17. | 10. | 5. | ug/l | 10 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5424713 WW  Group No. 1102390**

**N-133 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187467 N-133**

Collected:07/23/2008 13:20  by MH  Account Number: 10132

Submitted: 07/24/2008 17:10
Reported: 08/06/2008 at 19:53
Discard: 10/06/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR133

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 10:24 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 11:48 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/31/2008 09:33 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 17:52 | Anita M Dale | 10 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/06/2008 12:06 | Daniel H Heller | 100 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 17:52 | Anita M Dale | 10 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 2 | 08/06/2008 12:06 | Daniel H Heller | 100 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 19:05 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 10:45 | Deborah M Zimmerman | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/29/2008 04:30 | Tracy L Schickel | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1102390
Reported: 08/06/08 at 07:53 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 08208WAH026 | Sample number(s): 5424695-5424712 | | | | | | | | |
| Naphthalene | < 5. | 5. | 1. | ug/l | 93 | 87 | 77-107 | 6 | 30 |
| Fluorene | < 5. | 5. | 1. | ug/l | 99 | 94 | 82-113 | 5 | 30 |
| Phenanthrene | < 5. | 5. | 1. | ug/l | 104 | 97 | 83-112 | 7 | 30 |
| Pyrene | < 5. | 5. | 1. | ug/l | 102 | 94 | 80-115 | 9 | 30 |
| Chrysene | < 5. | 5. | 1. | ug/l | 101 | 95 | 82-112 | 7 | 30 |
| Batch number: 082100028A | Sample number(s): 5424695-5424713 | | | | | | | | |
| Ethylene dibromide | < 0.030 | 0.030 | 0.010 | ug/l | 88 | 88 | 60-140 | 0 | 20 |
| Batch number: 08210WAH026 | Sample number(s): 5424713 | | | | | | | | |
| Naphthalene | < 5. | 5. | 1. | ug/l | 92 | 100 | 77-107 | 9 | 30 |
| Fluorene | < 5. | 5. | 1. | ug/l | 95 | 102 | 82-113 | 7 | 30 |
| Phenanthrene | < 5. | 5. | 1. | ug/l | 99 | 106 | 83-112 | 7 | 30 |
| Pyrene | < 5. | 5. | 1. | ug/l | 95 | 99 | 80-115 | 4 | 30 |
| Chrysene | < 5. | 5. | 1. | ug/l | 92 | 99 | 82-112 | 7 | 30 |
| Batch number: 082116050002A | Sample number(s): 5424695-5424708 | | | | | | | | |
| Lead | < 0.0010 | 0.0010 | 0.00005 0 | mg/l | 105 | | 90-115 | | |
| Batch number: 082126050001A | Sample number(s): 5424709-5424713 | | | | | | | | |
| Lead | < 0.0010 | 0.0010 | 0.00005 0 | mg/l | 102 | | 90-115 | | |
| Batch number: P082171AA | Sample number(s): 5424695-5424697,5424700-5424705 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 105 | 106 | 73-119 | 1 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 105 | 101 | 78-119 | 4 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 107 | 106 | 69-135 | 1 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 94 | 93 | 85-115 | 1 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 94 | 92 | 82-119 | 2 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 94 | 92 | 80-113 | 3 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 95 | 93 | 83-113 | 2 | 30 |
| Batch number: P082172AA | Sample number(s): 5424706-5424713 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 98 | 98 | 73-119 | 1 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 95 | 96 | 78-119 | 1 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 99 | 97 | 69-135 | 2 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 96 | 99 | 85-115 | 4 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 96 | 99 | 82-119 | 3 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 96 | 100 | 80-113 | 4 | 30 |
| Naphthalene | < 4. | 4. | 1. | ug/l | 93 | 96 | 61-116 | 3 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 97 | 100 | 83-113 | 3 | 30 |
| Batch number: P082182AA | Sample number(s): 5424698-5424699 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 102 | 103 | 73-119 | 1 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 98 | 97 | 78-119 | 0 | 30 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1102390
Reported: 08/06/08 at 07:53 PM

### Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 98 | 97 | 69-135 | 0 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 97 | 97 | 85-115 | 1 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 98 | 97 | 82-119 | 1 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 98 | 98 | 80-113 | 0 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 99 | 99 | 83-113 | 0 | 30 |
| Batch number: P082191AA | Sample number(s): 5424713 | | | | | | | | |
| Benzene | < 1. | 1. | 0.5 | ug/l | 91 | 89 | 78-119 | 2 | 30 |

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082100028A | Sample number(s): 5424695-5424713 UNSPK: 5424695 BKG: 5424696 | | | | | | | | |
| Ethylene dibromide | 83 | | 65-135 | | | < 0.029 | < 0.030 | 0 (1) | 30 |
| Batch number: 082116050002A | Sample number(s): 5424695-5424708 UNSPK: P422562 BKG: P422562 | | | | | | | | |
| Lead | 98 | 96 | 75-125 | 2 | 20 | < 0.0010 | < 0.0010 | 0 (1) | 20 |
| Batch number: 082126050001A | Sample number(s): 5424709-5424713 UNSPK: P425132 BKG: P425132 | | | | | | | | |
| Lead | 122 | 119 | 75-125 | 1 | 20 | 0.0424 | 0.0441 | 4 | 20 |
| Batch number: P082171AA | Sample number(s): 5424695-5424697,5424700-5424705 UNSPK: 5424700 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 108 | | 69-127 | | | | | | |
| Benzene | 112 | | 83-128 | | | | | | |
| 1,2-Dichloroethane | 108 | | 70-143 | | | | | | |
| Toluene | 100 | | 83-127 | | | | | | |
| Ethylbenzene | 98 | | 82-129 | | | | | | |
| Isopropylbenzene | 99 | | 81-130 | | | | | | |
| Xylene (Total) | 98 | | 82-130 | | | | | | |
| Batch number: P082172AA | Sample number(s): 5424706-5424713 UNSPK: 5424708 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 102 | | 69-127 | | | | | | |
| Benzene | 104 | | 83-128 | | | | | | |
| 1,2-Dichloroethane | 101 | | 70-143 | | | | | | |
| Toluene | 104 | | 83-127 | | | | | | |
| Ethylbenzene | 103 | | 82-129 | | | | | | |
| Isopropylbenzene | 106 | | 81-130 | | | | | | |
| Naphthalene | 108 | | 57-125 | | | | | | |
| Xylene (Total) | 104 | | 82-130 | | | | | | |
| Batch number: P082182AA | Sample number(s): 5424698-5424699 UNSPK: P424693 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 99 | | 69-127 | | | | | | |
| Benzene | 101 | | 83-128 | | | | | | |
| 1,2-Dichloroethane | 100 | | 70-143 | | | | | | |
| Toluene | 98 | | 83-127 | | | | | | |
| Ethylbenzene | 95 | | 82-129 | | | | | | |
| Isopropylbenzene | 92 | | 81-130 | | | | | | |
| Xylene (Total) | 95 | | 82-130 | | | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1102390
Reported: 08/06/08 at 07:53 PM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: P082191AA | Sample number(s): 5424713 | | | UNSPK: P432328 | | | | | |
| Benzene | 89 | | 83-128 | | | | | | |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed
unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: PAHs in Water by GC/MS
Batch number: 08208WAH026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5424695 | 105 | 95 | 93 |
| 5424696 | 105 | 96 | 90 |
| 5424697 | 126 | 91 | 67 |
| 5424698 | 111 | 90 | 86 |
| 5424699 | 110 | 86 | 71 |
| 5424700 | 102 | 92 | 64 |
| 5424701 | 102 | 94 | 88 |
| 5424702 | 141* | 88 | 83 |
| 5424703 | 104 | 98 | 93 |
| 5424704 | 109 | 94 | 90 |
| 5424705 | 276* | 101 | 87 |
| 5424706 | 104 | 97 | 97 |
| 5424707 | 95 | 89 | 88 |
| 5424708 | 99 | 99 | 88 |
| 5424709 | 96 | 91 | 87 |
| 5424710 | 101 | 97 | 87 |
| 5424711 | 93 | 89 | 88 |
| 5424712 | 102 | 97 | 89 |
| Blank | 102 | 96 | 93 |
| LCS | 103 | 94 | 95 |
| LCSD | 93 | 89 | 86 |
| Limits: | 44-127 | 63-114 | 30-126 |

Analysis Name: EDB in Wastewater
Batch number: 082100028A

| | 1,1,2,2-Tetrachloroethane |
|---|---|
| 5424695 | 70 |
| 5424696 | 57 |
| 5424697 | 58 |
| 5424698 | 89 |
| 5424699 | 80 |
| 5424700 | 90 |
| 5424701 | 129 |
| 5424702 | 69 |
| 5424703 | 127 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1102390
Reported: 08/06/08 at 07:53 PM

## Surrogate Quality Control

| | |
|---|---|
| 5424704 | 79 |
| 5424705 | 85 |
| 5424706 | 93 |
| 5424707 | 95 |
| 5424708 | 108 |
| 5424709 | 96 |
| 5424710 | 99 |
| 5424711 | 127 |
| 5424712 | 104 |
| 5424713 | 154* |
| Blank | 98 |
| DUP | 59 |
| LCS | 97 |
| LCSD | 98 |
| MS | 73 |
| Limits: | 46-136 |

Analysis Name: PAHs in Water by GC/MS
Batch number: 08210WAH026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5424713 | 107 | 96 | 91 |
| Blank | 104 | 100 | 91 |
| LCS | 97 | 90 | 89 |
| LCSD | 105 | 99 | 92 |
| Limits: | 44-127 | 63-114 | 30-126 |

Analysis Name: UST-Waters by 8260B
Batch number: P082171AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5424695 | 92 | 85 | 85 | 108 |
| 5424696 | 94 | 86 | 87 | 95 |
| 5424697 | 94 | 88 | 88 | 95 |
| 5424700 | 94 | 85 | 87 | 93 |
| 5424701 | 94 | 87 | 86 | 94 |
| 5424702 | 95 | 87 | 89 | 98 |
| 5424703 | 94 | 85 | 88 | 95 |
| 5424704 | 93 | 85 | 87 | 93 |
| 5424705 | 94 | 85 | 84 | 92 |
| Blank | 94 | 85 | 86 | 93 |
| LCS | 94 | 88 | 85 | 93 |
| LCSD | 93 | 88 | 87 | 93 |
| MS | 95 | 89 | 86 | 93 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

Analysis Name: UST-Waters by 8260B
Batch number: P082172AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5424706 | 97 | 96 | 98 | 91 |
| 5424707 | 98 | 96 | 97 | 94 |
| 5424708 | 98 | 98 | 97 | 92 |
| 5424709 | 98 | 97 | 97 | 92 |
| 5424710 | 97 | 98 | 98 | 91 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1102390
Reported: 08/06/08 at 07:53 PM

### Surrogate Quality Control

| | | | | |
|---|---|---|---|---|
| 5424711 | 97 | 97 | 98 | 91 |
| 5424712 | 97 | 96 | 97 | 94 |
| 5424713 | 97 | 95 | 97 | 92 |
| Blank | 99 | 98 | 98 | 93 |
| LCS | 99 | 100 | 98 | 93 |
| LCSD | 98 | 100 | 98 | 92 |
| MS | 100 | 99 | 97 | 92 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

Analysis Name: UST-Waters by 8260B
Batch number: P082182AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5424698 | 99 | 98 | 96 | 101 |
| 5424699 | 98 | 95 | 99 | 107 |
| Blank | 99 | 96 | 97 | 91 |
| LCS | 98 | 98 | 98 | 92 |
| LCSD | 99 | 98 | 97 | 92 |
| MS | 97 | 98 | 98 | 93 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

Analysis Name: 8260 Master Scan (water)
Batch number: P082191AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| Blank | 90 | 84 | 93 | 91 |
| LCS | 91 | 88 | 91 | 90 |
| LCSD | 91 | 85 | 92 | 91 |
| MS | 93 | 87 | 92 | 91 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only
Acct. # 10132 Group# 1102390 Sample # 5424695-713

**COC # 187467**

Please print. Instructions on reverse side correspond with circled numbers. Cooler temp 1.5-5.6°C

(1) Client: SUN-AQUATERRA Acct. #:
Project Name/#: PHILA REF AOT-8 PWSID #:
Project Manager: T. DOERR P.O.#:
Sampler: S. SYKES Quote #:
Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#:

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water | Other | Potable / NPDES (Check if Applicable) | Total # of Containers | (5) Analyses Requested / Preservation Codes: PA Unbodied 82606 | Lead | PAHs by 4ms 8270 | EDB | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-21 | 7/23/08 | 845 | X | | | X | | | 8 | 3 | 1 | 2 | 2 | |
| N-20 | | 900 | | | | | | | | | | | | |
| N-103 | | 930 | | | | | | | | | | | | |
| N-105 | | 1000 | | | | | | | | | | | | |
| N-104 | | 1025 | | | | | | | | | | | | |
| N-99 | | 1105 | | | | | | | | | | | | |
| N-13 | | 1145 | | | | | | | | | | | | |
| N-12 | | 1200 | | | | | | | | | | | | |
| N-307 | | 1300 | | | | | | | | | | | | |
| N-302 | | 1410 | | | | | | | | | | | | |

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(6) Temperature of samples upon receipt (if requested)

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No
SDG Complete? Yes No

(9)

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| Steve Sr / AQUATERRA | 7/23/08 | 1600 | Bill DeJong | 7-24-08 | 11:35 |
| Bill DeJong | 7-24-08 | 17:10 | | | |
| | | | | | |
| | | | | | |
| | | | Katie Hoffine | 7/24/08 | 7:10 |

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1102390 Sample # 5424695-713

**COC # 187463**

Please print. Instructions on reverse side correspond with circled numbers. cooler temp 1.5-5.6°C

**For Lab Use Only**
FSC:
SCR#:

(1) Client: Sunoco, Aquaterra Acct. #:
Project Name/#: A01-8 philly Refinery PWSID #:
Project Manager: Tiffani Doerr P.O.#:
Sampler: Mike Hinderling Quote #:
Name of state where samples were collected: PA

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water (Potable / NPDES) | Other | Total # of Containers | (5) Analyses Requested: 8260 | PAHs 8270 | 8011 | Pb | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-128 | 7/23/08 | 815 | X | | | X | | 8 | X | X | X | X | |
| N-50D | 7/23/08 | 915 | X | | | X | | 8 | X | X | X | X | |
| RW-200 | 7/23/08 | 1020 | X | | | X | | 8 | X | X | X | X | |
| N-64 | 7/23/08 | 1045 | X | | | X | | 8 | X | X | X | X | |
| PZ-507 | 7/23/08 | 1110 | X | | | X | | 8 | X | X | X | X | |
| PZ-506 | 7/23/08 | 1140 | X | | | X | | 8 | X | X | X | X | |
| RW-501 | 7/23/08 | 1245 | X | | | X | | 8 | X | X | X | X | |
| PZ-505 | 7/23/08 | 1300 | X | | | X | | 8 | X | X | X | X | |
| N-133 | 7/23/08 | 1320 | X | | | X | | 8 | X | X | X | X | |

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(6) Temperature of samples upon receipt (if requested)

(7) **Turnaround Time Requested** (TAT) (please circle): (Normal) Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg) TX TRRP-13
Type II (Tier II) MA MCP CT RCP
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
SDG Complete? (Yes) No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| (9) Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| [signature] | 7/23/08 | 1345 | Bill DeLong | 7-24-08 | 11:45 |
| Bill DeLong | 7-24-08 | 17:10 | | | |
| | | | | | |
| | | | | | |
| | | | Katie Hartline | 7/24/08 | 17:10 |

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

**WARRANTY AND LIMITS OF LIABILITY –** In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1102391. Samples arrived at the laboratory on Friday, July 25, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-34 Grab Water | 5424714 |
| N-35 Grab Water | 5424715 |
| N-109 Grab Water | 5424716 |
| N-37 Grab Water | 5424717 |
| N-38 Grab Water | 5424718 |
| N-38D Grab Water | 5424719 |
| N-111 Grab Water | 5424720 |
| N-110 Grab Water | 5424721 |
| N-112 Grab Water | 5424722 |
| N-114 Grab Water | 5424723 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Chad A. Moline
Group Leader

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5424714 WW  Group No. 1102391**

**N-34 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-34**

Collected:07/24/2008 09:05  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10
Reported: 08/05/2008 at 16:22
Discard: 10/05/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR034

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.028 | 0.028 | 0.0093 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 200. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 200. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 610. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 290. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 10. | 10. | 5. | ug/l | 10 |
| 05401 | Benzene | 71-43-2 | < 10. | 10. | 5. | ug/l | 10 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 10. | 10. | 5. | ug/l | 10 |
| 05407 | Toluene | 108-88-3 | < 10. | 10. | 5. | ug/l | 10 |
| 05415 | Ethylbenzene | 100-41-4 | < 10. | 10. | 5. | ug/l | 10 |
| 05420 | Isopropylbenzene | 98-82-8 | < 20. | 20. | 5. | ug/l | 10 |
| 06310 | Xylene (Total) | 1330-20-7 | < 10. | 10. | 5. | ug/l | 10 |
| | The usual reporting limits were not attained due to the matrix of the sample in the GC/MS volatile analysis. | | | | | | |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424714 WW  Group No. 1102391**

**N-34 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-34**

Collected:07/24/2008 09:05  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10
Reported: 08/05/2008 at 16:22
Discard: 10/05/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR034

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 10:28 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 21:49 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/30/2008 15:19 | Joseph M Gambler | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 18:45 | Anita M Dale | 10 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 18:45 | Anita M Dale | 10 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 19:05 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/29/2008 14:00 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424715 WW  Group No. 1102391**

**N-35 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-35**

Collected:07/24/2008 09:40  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10
Reported: 08/05/2008 at 16:22
Discard: 10/05/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR035

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 47. | 47. | 9. | ug/l | 10 |
| 03956 | Fluorene | 86-73-7 | < 47. | 47. | 9. | ug/l | 10 |
| 03963 | Phenanthrene | 85-01-8 | < 47. | 47. | 9. | ug/l | 10 |
| 03967 | Pyrene | 129-00-0 | 70. | 47. | 9. | ug/l | 10 |
| 03971 | Chrysene | 218-01-9 | 61. | 47. | 9. | ug/l | 10 |
| | Due to the sample matrix an initial dilution was necessary to perform the analysis. Therefore, the reporting limits for the GC/MS semivolatile compounds were raised. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 10. | 10. | 5. | ug/l | 10 |
| 05401 | Benzene | 71-43-2 | < 10. | 10. | 5. | ug/l | 10 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 10. | 10. | 5. | ug/l | 10 |
| 05407 | Toluene | 108-88-3 | < 10. | 10. | 5. | ug/l | 10 |
| 05415 | Ethylbenzene | 100-41-4 | < 10. | 10. | 5. | ug/l | 10 |
| 05420 | Isopropylbenzene | 98-82-8 | < 20. | 20. | 5. | ug/l | 10 |
| 06310 | Xylene (Total) | 1330-20-7 | < 10. | 10. | 5. | ug/l | 10 |
| | The usual reporting limits were not attained due to the matrix of the sample in the GC/MS volatile analysis. | | | | | | |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424715 WW  Group No. 1102391**

**N-35 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-35**

Collected:07/24/2008 09:40  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10
Reported: 08/05/2008 at 16:22
Discard: 10/05/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR035

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 10:30 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 22:19 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/30/2008 15:44 | Joseph M Gambler | 10 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 19:12 | Anita M Dale | 10 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 19:12 | Anita M Dale | 10 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 19:05 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/29/2008 14:00 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424716 WW  Group No. 1102391**

**N-109 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-109**

Collected:07/24/2008 10:10  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10  SUN: Aquaterra Tech.
Reported: 08/05/2008 at 16:22  PO Box 744
Discard: 10/05/2008  West Chester PA 19381

PR109

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 140. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 230. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 63. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 50. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 11. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424716 WW  Group No. 1102391**

**N-109 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-109**

Collected:07/24/2008 10:10  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10
Reported: 08/05/2008 at 16:22
Discard: 10/05/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR109

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 10:31 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 22:49 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/30/2008 16:08 | Joseph M Gambler | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 19:39 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 19:39 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 19:05 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/29/2008 14:00 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5424717 WW  Group No. 1102391**

**N-37 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-37**

Collected:07/24/2008 10:35  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10
Reported: 08/05/2008 at 16:22
Discard: 10/05/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR037

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424717 WW  Group No. 1102391**

**N-37 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-37**

Collected:07/24/2008 10:35  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10  SUN: Aquaterra Tech.
Reported: 08/05/2008 at 16:22  PO Box 744
Discard: 10/05/2008  West Chester PA 19381

PR037

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 10:37 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 23:20 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/30/2008 16:32 | Joseph M Gambler | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 20:06 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 20:06 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 19:05 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/29/2008 14:00 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424718 WW  Group No. 1102391**

**N-38 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-38**

Collected:07/24/2008 11:15  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10
Reported: 08/05/2008 at 16:22
Discard: 10/05/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR038

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424718 WW  Group No. 1102391**

**N-38 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-38**

Collected:07/24/2008 11:15  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10
Reported: 08/05/2008 at 16:22
Discard: 10/05/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR038

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 10:38 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/30/2008 23:50 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/30/2008 16:56 | Joseph M Gambler | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 20:32 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 20:32 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 19:05 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/29/2008 14:00 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424719 WW  Group No. 1102391**

**N-38D Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-38D**

Collected:07/24/2008 11:50  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10
Reported: 08/05/2008 at 16:22
Discard: 10/05/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR38D

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424719 WW  Group No. 1102391**

**N-38D Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-38D**

Collected:07/24/2008 11:50  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10
Reported: 08/05/2008 at 16:22
Discard: 10/05/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR38D

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 10:40 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/31/2008 00:20 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/30/2008 17:21 | Joseph M Gambler | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 20:59 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 20:59 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 19:05 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/29/2008 14:00 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424720 WW  Group No. 1102391**

**N-111 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-111**

Collected:07/24/2008 13:00  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10
Reported: 08/05/2008 at 16:22
Discard: 10/05/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR111

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 170. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 380. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 160. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 110. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 8. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424720 WW  Group No. 1102391**

**N-111 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-111**

Collected:07/24/2008 13:00  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10
Reported: 08/05/2008 at 16:22
Discard: 10/05/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR111

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 10:42 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/31/2008 00:50 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/30/2008 20:01 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 21:26 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 21:26 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 19:05 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/29/2008 14:00 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424721 WW  Group No. 1102391**

**N-110 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-110**

Collected:07/24/2008 13:40  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10
Reported: 08/05/2008 at 16:22
Discard: 10/05/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR110

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 50. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 50. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 50. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 50. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424721 WW  Group No. 1102391**

**N-110 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-110**

Collected:07/24/2008 13:40  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10  SUN: Aquaterra Tech.
Reported: 08/05/2008 at 16:22  PO Box 744
Discard: 10/05/2008  West Chester PA 19381

PR110

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 10:44 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 07/31/2008 01:20 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/30/2008 20:25 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 21:53 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 21:53 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 19:05 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/29/2008 13:30 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/29/2008 14:00 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424722 WW  Group No. 1102391**

**N-112 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-112**

Collected:07/24/2008 14:15  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10
Reported: 08/05/2008 at 16:22
Discard: 10/05/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR112

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0095 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 380. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 1,400. | 250. | 50. | ug/l | 5 |
| 03967 | Pyrene | 129-00-0 | 760. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 290. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 22. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5424722 WW  Group No. 1102391**

**N-112 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-112**

Collected:07/24/2008 14:15  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10
Reported: 08/05/2008 at 16:22
Discard: 10/05/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR112

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 10:45 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 08/01/2008 15:03 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/30/2008 20:49 | Gregory J Drahovsky | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/31/2008 04:44 | Gregory J Drahovsky | 5 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 22:46 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 22:46 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 19:05 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/30/2008 14:00 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/29/2008 14:00 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5424723 WW  Group No. 1102391**

**N-114 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-114**

Collected:07/24/2008 14:45  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10
Reported: 08/05/2008 at 16:22
Discard: 10/05/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR114

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 9. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 7. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 24. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 3. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5424723 WW  Group No. 1102391**

**N-114 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 188249 N-114**

Collected:07/24/2008 14:45  by SS  Account Number: 10132

Submitted: 07/25/2008 14:10  SUN: Aquaterra Tech.
Reported: 08/05/2008 at 16:22  PO Box 744
Discard: 10/05/2008  West Chester PA 19381

PR114

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 07/31/2008 10:47 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 08/01/2008 16:03 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 07/30/2008 21:12 | Gregory J Drahovsky | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/04/2008 23:13 | Anita M Dale | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/04/2008 23:13 | Anita M Dale | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 07/30/2008 19:05 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/30/2008 14:00 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 07/29/2008 14:00 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1102391
Reported: 08/05/08 at 04:22 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082110017A | Sample number(s): 5424714-5424721 | | | | | | | | |
| Ethylene dibromide | < 0.030 | 0.030 | 0.010 | ug/l | 88 | 92 | 60-140 | 5 | 20 |
| Batch number: 08211WAC026 | Sample number(s): 5424714-5424723 | | | | | | | | |
| Naphthalene | < 5. | 5. | 1. | ug/l | 98 | 97 | 77-107 | 1 | 30 |
| Fluorene | < 5. | 5. | 1. | ug/l | 97 | 99 | 82-113 | 2 | 30 |
| Phenanthrene | < 5. | 5. | 1. | ug/l | 104 | 105 | 83-112 | 1 | 30 |
| Pyrene | < 5. | 5. | 1. | ug/l | 109 | 105 | 80-115 | 3 | 30 |
| Chrysene | < 5. | 5. | 1. | ug/l | 100 | 99 | 82-112 | 1 | 30 |
| Batch number: 082120007A | Sample number(s): 5424722-5424723 | | | | | | | | |
| Ethylene dibromide | < 0.030 | 0.030 | 0.010 | ug/l | 96 | 96 | 60-140 | 0 | 20 |
| Batch number: 082126050001A | Sample number(s): 5424714-5424723 | | | | | | | | |
| Lead | < 0.0010 | 0.0010 | 0.00005 0 | mg/l | 102 | | 90-115 | | |
| Batch number: P082172AA | Sample number(s): 5424714-5424723 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 98 | 98 | 73-119 | 1 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 95 | 96 | 78-119 | 1 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 99 | 97 | 69-135 | 2 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 96 | 99 | 85-115 | 4 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 96 | 99 | 82-119 | 3 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 96 | 100 | 80-113 | 4 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 97 | 100 | 83-113 | 3 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082110017A | Sample number(s): 5424714-5424721 UNSPK: P424683 BKG: P424684 | | | | | | | | |
| Ethylene dibromide | 87 | | 65-135 | | | < 0.029 | < 0.029 | 0 (1) | 30 |
| Batch number: 082120007A | Sample number(s): 5424722-5424723 UNSPK: 5424722 BKG: P425132 | | | | | | | | |
| Ethylene dibromide | 70 | | 65-135 | | | < 0.029 | < 0.030 | 0 (1) | 30 |
| Batch number: 082126050001A | Sample number(s): 5424714-5424723 UNSPK: P425132 BKG: P425132 | | | | | | | | |
| Lead | 122 | 119 | 75-125 | 1 | 20 | 0.0424 | 0.0441 | 4 | 20 |
| Batch number: P082172AA | Sample number(s): 5424714-5424723 UNSPK: P424708 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 102 | | 69-127 | | | | | | |
| Benzene | 104 | | 83-128 | | | | | | |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1102391
Reported: 08/05/08 at 04:22 PM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| 1,2-Dichloroethane | 101 | | 70-143 | | | | | | |
| Toluene | 104 | | 83-127 | | | | | | |
| Ethylbenzene | 103 | | 82-129 | | | | | | |
| Isopropylbenzene | 106 | | 81-130 | | | | | | |
| Xylene (Total) | 104 | | 82-130 | | | | | | |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: EDB in Wastewater
Batch number: 082110017A

| | 1,1,2,2-Tetrachloroethane |
|---|---|
| 5424714 | 52 |
| 5424715 | 68 |
| 5424716 | 86 |
| 5424717 | 93 |
| 5424718 | 102 |
| 5424719 | 96 |
| 5424720 | 86 |
| 5424721 | 92 |
| Blank | 96 |
| DUP | 77 |
| LCS | 103 |
| LCSD | 102 |
| MS | 135 |
| Limits: | 46-136 |

Analysis Name: PAHs in Water by GC/MS
Batch number: 08211WAC026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5424714 | 92 | 89 | 95 |
| 5424715 | 61 | 66 | 66 |
| 5424716 | 91 | 95 | 85 |
| 5424717 | 88 | 95 | 89 |
| 5424718 | 91 | 100 | 96 |
| 5424719 | 82 | 87 | 86 |
| 5424720 | 98 | 96 | 107 |
| 5424721 | 94 | 92 | 101 |
| 5424722 | 85 | 84 | 97 |
| 5424723 | 92 | 97 | 109 |
| Blank | 97 | 97 | 108 |
| LCS | 99 | 101 | 109 |
| LCSD | 98 | 103 | 104 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1102391
Reported: 08/05/08 at 04:22 PM

### Surrogate Quality Control

| | | | |
|---|---|---|---|
| Limits: | 44-127 | 63-114 | 30-126 |

Analysis Name: EDB in Wastewater
Batch number: 082120007A

| | 1,1,2,2-Tetrachloroethane |
|---|---|
| 5424722 | 67 |
| 5424723 | 132 |
| Blank | 109 |
| DUP | 102 |
| LCS | 109 |
| LCSD | 108 |
| MS | 59 |
| Limits: | 46-136 |

Analysis Name: UST-Waters by 8260B
Batch number: P082172AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5424714 | 99 | 97 | 96 | 92 |
| 5424715 | 97 | 96 | 98 | 92 |
| 5424716 | 98 | 94 | 96 | 102 |
| 5424717 | 99 | 99 | 96 | 94 |
| 5424718 | 97 | 96 | 97 | 94 |
| 5424719 | 98 | 95 | 97 | 92 |
| 5424720 | 98 | 97 | 97 | 93 |
| 5424721 | 98 | 97 | 97 | 91 |
| 5424722 | 98 | 97 | 96 | 93 |
| 5424723 | 99 | 97 | 98 | 91 |
| Blank | 99 | 98 | 98 | 93 |
| LCS | 99 | 100 | 98 | 93 |
| LCSD | 98 | 100 | 98 | 92 |
| MS | 100 | 99 | 97 | 92 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1102391 Sample # 5424714-23

**COC # 188249**

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: SUN-AQUATERRA Acct. #:

Project Name/#: PHILA REF AOI-8 PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: S. SYKES Quote #:

Name of state where samples were collected: PA

**For Lab Use Only**

FSC:

SCR#:

**Preservation Codes**

H=HCl T=Thiosulfate

N=$HNO_3$ B=NaOH

S=$H_2SO_4$ O=Other

(6) Temperature of samples upon receipt (if requested)

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | Matrix (4): Soil | Water (Potable / NPDES) | Other | Total # of Containers | (5) Analyses Requested: PAHs 8260 (Unleaded) | Lead | PAHs 625/ms 8270 | EDB | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-34 | 7/24/08 | 905 | X | | | X | | 8 | 3 | 1 | 2 | 2 | 2.5-4.5 °C |
| N-35 | | 940 | | | | | | | | | | | |
| N-109 | | 1010 | | | | | | | | | | | |
| N-37 | | 1035 | | | | | | | | | | | |
| N-38 | | 1115 | | | | | | | | | | | |
| N-38D | | 1150 | | | | | | | | | | | |
| N-[redacted]111 | | 1300 | | | | | | | | | | | |
| N-110 | | 1340 | | | | | | | | | | | |
| N-112 | | 1415 | | | | | | | | | | | |
| N-114 | | 1445 | | | | | | | | | | | |

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush

(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)

Date results are needed:

Rush results requested by (please circle): Phone Fax E-mail

Phone #: Fax #:

E-mail address:

(8) **Data Package Options** (please circle if required)

Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)

TX TRRP-13
MA MCP CT RCP

SDG Complete? Yes No

Site-specific QC (MS/MSD/Dup)? Yes No

(If yes, indicate QC sample and submit triplicate volume.)

Internal COC Required? Yes / No

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| [redacted] / AQUATERRA | 7/24/08 | 1600 | Aquaterra Fridge | 7/24/08 | 1600 |
| from Fridge | 7/25/08 | 0855 | Erma Allman | 7/25/08 | 9:55 |
| Erma Allman | 7/25/08 | 1410 | | | |
| | | | | | |
| | | | Deborah Nesel | 7/25/08 | 1410 |

(9)

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766

Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

**WARRANTY AND LIMITS OF LIABILITY –** In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

## SAMPLE GROUP

The sample group for this submittal is 1103058. Samples arrived at the laboratory on Wednesday, July 30, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-60 Grab Water | 5428282 |
| N-44D Grab Water | 5428283 |
| N-115 Grab Water | 5428284 |
| N-41 Grab Water | 5428285 |
| N-53 Grab Water | 5428286 |
| N-55 Grab Water | 5428287 |
| N-132 Grab Water | 5428288 |
| N-131 Grab Water | 5428289 |
| N-39 Grab Water | 5428290 |
| RW-202 Grab Water | 5428291 |
| PZ-300 Grab Water | 5428292 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

Lancaster Laboratories

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Christine Dulaney
Senior Specialist

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5428282 WW  Group No. 1103058**

**N-60 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-60**

Collected:07/25/2008 12:55  by MH  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR060

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 12. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 14. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5428282 WW  Group No. 1103058**

**N-60 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-60**

Collected:07/25/2008 12:55  by MH  Account Number: 10132

Submitted: 07/30/2008 15:55  SUN: Aquaterra Tech.
Reported: 08/08/2008 at 16:31  PO Box 744
Discard: 10/08/2008  West Chester PA 19381

PR060

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/05/2008 14:18 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 08/01/2008 06:02 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 08/04/2008 09:29 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/07/2008 00:04 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/07/2008 00:04 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 08/04/2008 09:40 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/31/2008 14:00 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 08/01/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5428283 WW  Group No. 1103058**

**N-44D Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-44D**

Collected:07/25/2008 13:45  by MH  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR44D

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 6. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 5. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 4. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5428283 WW  Group No. 1103058**

**N-44D Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-44D**

Collected:07/25/2008 13:45  by MH  Account Number: 10132

Submitted: 07/30/2008 15:55  SUN: Aquaterra Tech.
Reported: 08/08/2008 at 16:31  PO Box 744
Discard: 10/08/2008  West Chester PA 19381

PR44D

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/05/2008 14:22 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 08/01/2008 07:02 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 08/04/2008 09:52 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/07/2008 00:31 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/07/2008 00:31 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 08/04/2008 09:40 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/31/2008 14:00 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 08/01/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5428284 WW  Group No. 1103058**

**N-115 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-115**

Collected:07/28/2008 08:50  by MH  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR115

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0096 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 10. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 8. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 7. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 6. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5428284 WW  Group No. 1103058**

**N-115 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-115**

Collected:07/28/2008 08:50  by MH  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR115

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/05/2008 14:25 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 08/01/2008 08:32 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 08/04/2008 10:16 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/07/2008 01:24 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/07/2008 01:24 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 08/04/2008 09:40 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/31/2008 14:00 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 08/01/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5428285 WW  Group No. 1103058**

**N-41 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-41**

Collected:07/28/2008 09:30  by MH  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR041

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | 0.0017 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 450. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 1,100. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 390. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 280. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 8. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5428285 WW  Group No. 1103058**

**N-41 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-41**

Collected:07/28/2008 09:30  by MH  Account Number: 10132

Submitted: 07/30/2008 15:55  SUN: Aquaterra Tech.
Reported: 08/08/2008 at 16:31  PO Box 744
Discard: 10/08/2008  West Chester PA 19381

PR041

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/05/2008 14:29 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 08/01/2008 09:02 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 08/04/2008 10:40 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/08/2008 01:30 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/08/2008 01:30 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 08/04/2008 09:40 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/31/2008 14:00 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 08/01/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5428286 WW  Group No. 1103058**

**N-53 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-53**

Collected:07/28/2008 09:30  by SS  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR053

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 360. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 610. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 220. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 180. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 17. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 11. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5428286 WW  Group No. 1103058**

**N-53 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-53**

Collected:07/28/2008 09:30  by SS  Account Number: 10132

Submitted: 07/30/2008 15:55  SUN: Aquaterra Tech.
Reported: 08/08/2008 at 16:31  PO Box 744
Discard: 10/08/2008  West Chester PA 19381

PR053

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/07/2008 15:02 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 08/01/2008 09:32 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 08/04/2008 11:03 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/08/2008 01:56 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/08/2008 01:56 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 08/06/2008 09:20 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/31/2008 14:00 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 08/01/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5428287 WW  Group No. 1103058**

**N-55 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-55**

Collected:07/28/2008 10:00  by SS  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR055

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5428287 WW  Group No. 1103058**

**N-55 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-55**

Collected:07/28/2008 10:00  by SS  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR055

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/07/2008 15:05 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 08/01/2008 10:02 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 08/04/2008 11:27 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/07/2008 03:38 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/07/2008 03:38 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 08/06/2008 09:20 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/31/2008 14:00 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 08/01/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5428288 WW  Group No. 1103058**

**N-132 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-132**

Collected:07/28/2008 10:30  by SS  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR132

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | < 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 4. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5428288 WW  Group No. 1103058**

**N-132 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-132**

Collected:07/28/2008 10:30  by SS  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR132

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/07/2008 15:13 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 08/01/2008 10:32 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 08/04/2008 11:50 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/07/2008 04:05 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/07/2008 04:05 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 08/06/2008 09:20 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/31/2008 14:00 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 08/01/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5428289 WW  Group No. 1103058**

**N-131 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-131**

Collected:07/28/2008 11:00  by SS  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR131

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 50. | 50. | 10. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 50. | 50. | 10. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 50. | 50. | 10. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 50. | 50. | 10. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 86. | 50. | 10. | ug/l | 1 |
| | Due to the nature of the sample matrix, a reduced aliquot was used for analysis. The reporting limits were raised accordingly. | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 2. | 2. | 1. | ug/l | 2 |
| 05401 | Benzene | 71-43-2 | 3. | 2. | 1. | ug/l | 2 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 2. | 2. | 1. | ug/l | 2 |
| 05407 | Toluene | 108-88-3 | < 2. | 2. | 1. | ug/l | 2 |
| 05415 | Ethylbenzene | 100-41-4 | < 2. | 2. | 1. | ug/l | 2 |
| 05420 | Isopropylbenzene | 98-82-8 | 370. | 4. | 1. | ug/l | 2 |
| 06310 | Xylene (Total) | 1330-20-7 | < 2. | 2. | 1. | ug/l | 2 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5428289 WW  Group No. 1103058**

**N-131 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-131**

Collected:07/28/2008 11:00  by SS  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR131

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/07/2008 15:16 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 08/01/2008 11:02 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 08/04/2008 12:13 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/07/2008 04:31 | Kelly E Brickley | 2 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/07/2008 04:31 | Kelly E Brickley | 2 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 08/06/2008 09:20 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/31/2008 14:00 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 08/01/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5428290 WW  Group No. 1103058**

**N-39 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-39**

Collected:07/28/2008 11:45  by SS  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR039

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 9. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 7. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 25. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 41. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 24. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 3. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5428290 WW  Group No. 1103058**

**N-39 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 N-39**

Collected:07/28/2008 11:45  by SS  Account Number: 10132

Submitted: 07/30/2008 15:55  SUN: Aquaterra Tech.
Reported: 08/08/2008 at 16:31  PO Box 744
Discard: 10/08/2008  West Chester PA 19381

PR039

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/07/2008 15:19 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 08/01/2008 11:32 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 08/04/2008 12:37 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/07/2008 04:58 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/07/2008 04:58 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 08/06/2008 09:20 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/31/2008 14:00 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 08/01/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5428291 WW  Group No. 1103058**

**RW-202 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 RW-202**

Collected:07/29/2008 11:00  by SS  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR202

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0098 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 0.9 | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 19. | 5. | 0.9 | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 33. | 5. | 0.9 | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 36. | 5. | 0.9 | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 17. | 5. | 0.9 | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | 2. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 17. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5428291 WW  Group No. 1103058**

**RW-202 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 RW-202**

Collected:07/29/2008 11:00  by SS  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR202

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/07/2008 15:22 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 08/01/2008 12:02 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 08/04/2008 13:01 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/08/2008 02:23 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/08/2008 02:23 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 08/06/2008 09:20 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/31/2008 14:00 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 08/01/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5428292 WW  Group No. 1103058**

**PZ-300 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 PZ-300**

Collected:07/29/2008 11:50  by SS  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR300

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.0099 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 6. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 110. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | 9. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 6. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 9. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

**Lancaster Laboratories Sample No. 5428292 WW  Group No. 1103058**

**PZ-300 Grab Water**
**Philadelphia Refinery AOI-8**
**COC: 187464 PZ-300**

Collected:07/29/2008 11:50  by SS  Account Number: 10132

Submitted: 07/30/2008 15:55
Reported: 08/08/2008 at 16:31
Discard: 10/08/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

PR300

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/07/2008 15:25 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 08/01/2008 12:32 | Jamie L Brillhart | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 08/04/2008 13:25 | Brian K Graham | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/07/2008 05:52 | Kelly E Brickley | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/07/2008 05:52 | Kelly E Brickley | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 08/06/2008 09:20 | Denise K Conners | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 07/31/2008 14:00 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 08/01/2008 09:30 | Cynthia J Stoltzfus | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1103058
Reported: 08/08/08 at 04:31 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082130022A | Sample number(s): 5428282-5428292 | | | | | | | | |
| Ethylene dibromide | < 0.030 | 0.030 | 0.010 | ug/l | 92 | 92 | 60-140 | 0 | 20 |
| Batch number: 08213WAG026 | Sample number(s): 5428282-5428292 | | | | | | | | |
| Naphthalene | < 5. | 5. | 1. | ug/l | 96 | 97 | 77-107 | 1 | 30 |
| Fluorene | < 5. | 5. | 1. | ug/l | 96 | 101 | 82-113 | 5 | 30 |
| Phenanthrene | < 5. | 5. | 1. | ug/l | 101 | 104 | 83-112 | 3 | 30 |
| Pyrene | < 5. | 5. | 1. | ug/l | 100 | 106 | 80-115 | 6 | 30 |
| Chrysene | < 5. | 5. | 1. | ug/l | 95 | 101 | 82-112 | 6 | 30 |
| Batch number: 082146050002A | Sample number(s): 5428282-5428285 | | | | | | | | |
| Lead | < 0.0010 | 0.0010 | 0.00005 0 | mg/l | 102 | | 90-115 | | |
| Batch number: 082186050001A | Sample number(s): 5428286-5428292 | | | | | | | | |
| Lead | < 0.0010 | 0.0010 | 0.00005 0 | mg/l | 102 | | 90-115 | | |
| Batch number: P082193AA | Sample number(s): 5428282-5428284,5428287-5428290,5428292 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 91 | 91 | 73-119 | 0 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 91 | 90 | 78-119 | 1 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 92 | 93 | 69-135 | 1 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 94 | 93 | 85-115 | 1 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 93 | 92 | 82-119 | 1 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 94 | 93 | 80-113 | 1 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 95 | 94 | 83-113 | 1 | 30 |
| Batch number: P082204AA | Sample number(s): 5428285-5428286,5428291 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 98 | | 73-119 | | |
| Benzene | < 1. | 1. | 0.5 | ug/l | 96 | | 78-119 | | |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 95 | | 69-135 | | |
| Toluene | < 1. | 1. | 0.5 | ug/l | 98 | | 85-115 | | |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 97 | | 82-119 | | |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 97 | | 80-113 | | |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 98 | | 83-113 | | |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082130022A | Sample number(s): 5428282-5428292 UNSPK: 5428282 BKG: 5428283 | | | | | | | | |
| Ethylene dibromide | 96 | | 65-135 | | | < 0.029 | < 0.029 | 0 (1) | 30 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1103058
Reported: 08/08/08 at 04:31 PM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082146050002A | Sample number(s): 5428282-5428285 UNSPK: P427002 BKG: P427002 | | | | | | | | |
| Lead | 102 | 191* | 75-125 | 50* | 20 | 0.0046 | 0.0048 | 3 (1) | 20 |
| Batch number: 082186050001A | Sample number(s): 5428286-5428292 UNSPK: P430633 BKG: P430633 | | | | | | | | |
| Lead | 102 | 101 | 75-125 | 1 | 20 | < 0.0010 | < 0.0010 | 6 (1) | 20 |
| Batch number: P082193AA | Sample number(s): 5428282-5428284,5428287-5428290,5428292 UNSPK: 5428283 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 96 | | 69-127 | | | | | | |
| Benzene | 100 | | 83-128 | | | | | | |
| 1,2-Dichloroethane | 97 | | 70-143 | | | | | | |
| Toluene | 103 | | 83-127 | | | | | | |
| Ethylbenzene | 101 | | 82-129 | | | | | | |
| Isopropylbenzene | 99 | | 81-130 | | | | | | |
| Xylene (Total) | 102 | | 82-130 | | | | | | |
| Batch number: P082204AA | Sample number(s): 5428285-5428286,5428291 UNSPK: P427882 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 113 (2) | 106 (2) | 69-127 | 1 | 30 | | | | |
| Benzene | 109 | 107 | 83-128 | 1 | 30 | | | | |
| 1,2-Dichloroethane | 108 | 105 | 70-143 | 3 | 30 | | | | |
| Toluene | 109 | 108 | 83-127 | 1 | 30 | | | | |
| Ethylbenzene | 111 | 108 | 82-129 | 3 | 30 | | | | |
| Isopropylbenzene | 110 | 107 | 81-130 | 3 | 30 | | | | |
| Xylene (Total) | 110 | 108 | 82-130 | 2 | 30 | | | | |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: EDB in Wastewater
Batch number: 082130022A

| | 1,1,2,2-Tetrachloroethane |
|---|---|
| 5428282 | 86 |
| 5428283 | 162* |
| 5428284 | 137* |
| 5428285 | 88 |
| 5428286 | 93 |
| 5428287 | 99 |
| 5428288 | 137* |
| 5428289 | 116 |
| 5428290 | 117 |
| 5428291 | 89 |
| 5428292 | 138* |
| Blank | 105 |
| DUP | 160* |
| LCS | 103 |
| LCSD | 104 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1103058
Reported: 08/08/08 at 04:31 PM

## Surrogate Quality Control

MS 87

Limits: 46-136

Analysis Name: PAHs in Water by GC/MS
Batch number: 08213WAG026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5428282 | 93 | 90 | 91 |
| 5428283 | 100 | 99 | 95 |
| 5428284 | 99 | 95 | 81 |
| 5428285 | 129* | 94 | 89 |
| 5428286 | 136* | 94 | 87 |
| 5428287 | 95 | 98 | 95 |
| 5428288 | 102 | 63 | 95 |
| 5428289 | 98 | 91 | 90 |
| 5428290 | 103 | 96 | 90 |
| 5428291 | 128* | 88 | 88 |
| 5428292 | 106 | 94 | 92 |
| Blank | 100 | 97 | 90 |
| LCS | 102 | 98 | 89 |
| LCSD | 104 | 100 | 94 |
| Limits: | 44-127 | 63-114 | 30-126 |

Analysis Name: UST-Waters by 8260B
Batch number: P082193AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5428282 | 89 | 84 | 92 | 92 |
| 5428283 | 89 | 84 | 89 | 89 |
| 5428284 | 91 | 84 | 91 | 90 |
| 5428287 | 90 | 85 | 91 | 91 |
| 5428288 | 91 | 85 | 93 | 94 |
| 5428289 | 92 | 87 | 91 | 91 |
| 5428290 | 92 | 85 | 90 | 94 |
| 5428292 | 91 | 86 | 93 | 103 |
| Blank | 91 | 85 | 92 | 90 |
| LCS | 90 | 87 | 92 | 91 |
| LCSD | 90 | 88 | 92 | 90 |
| MS | 90 | 87 | 90 | 93 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

Analysis Name: UST-Waters by 8260B
Batch number: P082204AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5428285 | 98 | 98 | 97 | 90 |
| 5428286 | 99 | 95 | 96 | 93 |
| 5428291 | 99 | 98 | 98 | 91 |
| Blank | 98 | 96 | 98 | 88 |
| LCS | 99 | 99 | 97 | 91 |
| MS | 99 | 101 | 95 | 92 |
| MSD | 98 | 98 | 96 | 91 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1103058
Reported: 08/08/08 at 04:31 PM

## Surrogate Quality Control

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only
Acct. # 10132 Group# 1103058 Sample # H28282-92

**COC #** 187464

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: Sunoco, Aquaterra Acct. #:
Project Name/#: A01-8 Philly Refinery PWSID #:
Project Manager: Tiffani Doerr P.O.#:
Sampler: Mike Hinderling Quote #:
Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#:

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water (Potable / Non-Potable) | Other | Total # of Containers | (5) Analyses Requested: VOC 8260 | Pb | PAHs 8270 | 8011 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-60 | 7/25/08 | 1255 | X | | | X | | 8 | X | X | X | X | 2.7-3.3°C |
| N-44D | 7/25/08 | 1345 | X | | | X | | 8 | X | X | X | X | |
| N-115 | 7/28/08 | 850 | X | | | X | | 8 | X | X | X | X | |
| N-41 | 7/28/08 | 930 | X | | | X | | 8 | X | X | X | X | |

(6) Temperature of samples upon receipt (if required)

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg) TX TRRP-13
Type II (Tier II) MA MCP CT RCP
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
SDG Complete? (Yes) No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| [signature] | 7/30/08 | 1400 | AT PRIDE | 7/30/08 | 1400 |
| AT PRIDE | 7/30/08 | 1215 | [signature] | 7/30/08 | 1215 |
| [signature] | 7/30/08 | 1215 | T. Lefever | 7/30/08 | 1215 |
| T. Lefever | 7/30/08 | 1555 | | | |
| | | | Wesley Miller | 7/31/08 | 1555 |

(9)

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Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only
Acct. # 10132 Group# 1103058 Sample # 5428282-92

**COC #** 187466

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: SUN- AQUATERRA Acct. #:
Project Name/#: PHILA REF AOI-8 PWSID #:
Project Manager: T. DOERR P.O.#:
Sampler: S. SYKES Quote #:
Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#:

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water (☐ Potable ☐ NPDES) | Other | Total # of Containers | (5) Analyses Requested / Preservation Codes: PA Unloaded 82606 | Lead | PAH's by 625 ms 8270 | EDB | Remarks | (6) Temperature of samples upon receipt (if requested) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-53 | 7/28/08 | 930 | X | | | X | | 8 | 3 | 1 | 2 | 2 | | 2.7-3.3°C |
| N-55 | | 1000 | | | | | | | | | | | | |
| N-132 | | 1030 | | | | | | | | | | | | |
| N-131 | | 1100 | | | | | | | | | | | | |
| N-39 | | 1145 | | | | | | | | | | | | |

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

(7) **Turnaround Time Requested** (TAT) (please circle): (Normal) Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg) TX TRRP-13
Type II (Tier II) MA MCP CT RCP
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)

SDG Complete? (Yes) No

Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| (9) Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| Sun Sa / AQUATERRA | 7/28/08 | 1400 | AT PILOT | 7/28/8 | 1400 |
| AT PILOT | 7/30/8 | 1215 | Kristine Jr | 7/30/8 | 1215 |
| Kristine Jr | 7/30/8 | 1215 | P. Lefever | 7/30/08 | 1215 |
| P. Lefever | 7/30/08 | 1555 | | | |
| | | | Wesley Miller | 7/30/08 | 1555 |

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# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1103058 Sample # 5428282-92

**COC # 187461**

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: SUN-AQUATERRA Acct. #:

Project Name/#: PHILA REF AOI-8 PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: S. SYKES Quote #:

Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#:

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Soil | Water (Potable / NPDES) | Other | Total # of Containers | (5) Analyses Requested / Preservation Codes: PA Unleaded 8260 | Lead | PAHs by 8270 64/ms | EDB | Remarks | (6) Temperature of samples upon receipt (if requested) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RW-202 | 7/29/08 | 1100 | X | | | X | | 8 | 3 | 1 | 2 | 2 | | 2.7-3.3°C |
| PZ-300 | 7/29/08 | 1150 | X | | | X | | 8 | 3 | 1 | 2 | 2 | | ↓ |

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| S. Sykes / AQUATERRA | 7/29/08 | 1400 | AT PRIDGE | 7/29/08 | 1400 |
| AT PRIDGE | 7/30/08 | 1215 | Ann Stumpf | 7/30/08 | 1215 |
| Ann Stumpf | 7/30/08 | 1215 | J. Lefever | 7/30/08 | 1215 |
| J. Lefever | 7/30/08 | 1535 | | | |
| Relinquished by: | Date | Time | Received by: | Date | Time |
| | | | Mebley Miller | 7/30/08 | 1555 |

(9)

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# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 1104406. Samples arrived at the laboratory on Thursday, August 07, 2008. The PO# for this group is SUNOCO PHILLY REFINER.

| Client Description | Lancaster Labs Number |
|---|---|
| S-117 Grab Water | 5435926 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Oknefski at (717) 656-2300

Respectfully Submitted,

Christine Dulaney
Senior Specialist

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report



**Lancaster Laboratories Sample No. 5435926 WW  Group No. 1104406**

**S-117 Grab Water**
**Philadelphia Refinery AOI-1**
**DUNS# COC: 188637 S-117**

Collected:08/06/2008 11:45  by SS  Account Number: 10132

Submitted: 08/07/2008 16:15
Reported: 08/15/2008 at 18:58
Discard: 10/15/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

S-117

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 02300 | UST-Unleaded Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | 89. | 10. | 5. | ug/l | 10 |
| 05401 | Benzene | 71-43-2 | 7,400. | 50. | 25. | ug/l | 50 |
| 05407 | Toluene | 108-88-3 | 43. | 10. | 5. | ug/l | 10 |
| 05415 | Ethylbenzene | 100-41-4 | 900. | 10. | 5. | ug/l | 10 |
| 06310 | Xylene (Total) | 1330-20-7 | 69. | 10. | 5. | ug/l | 10 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 02300 | UST-Unleaded Waters by 8260B | SW-846 8260B | 1 | 08/15/2008 04:48 | Kathrine K Muramatsu | 10 |
| 02300 | UST-Unleaded Waters by 8260B | SW-846 8260B | 1 | 08/15/2008 05:15 | Kathrine K Muramatsu | 50 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/15/2008 04:48 | Kathrine K Muramatsu | 10 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 2 | 08/15/2008 05:15 | Kathrine K Muramatsu | 50 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1104406
Reported: 08/15/08 at 06:58 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: P082273AA | Sample number(s): 5435926 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 94 | 93 | 73-119 | 1 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 94 | 91 | 78-119 | 3 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 92 | 91 | 85-115 | 1 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 91 | 88 | 82-119 | 3 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 93 | 93 | 83-113 | 0 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: P082273AA | Sample number(s): 5435926 UNSPK: P438031 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 96 | | 69-127 | | | | | | |
| Benzene | 99 | | 83-128 | | | | | | |
| Toluene | 101 | | 83-127 | | | | | | |
| Ethylbenzene | 98 | | 82-129 | | | | | | |
| Xylene (Total) | 101 | | 82-130 | | | | | | |

## Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: UST-Unleaded Waters by 8260B
Batch number: P082273AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5435926 | 93 | 86 | 89 | 88 |
| Blank | 91 | 86 | 89 | 88 |
| LCS | 93 | 85 | 88 | 88 |
| LCSD | 91 | 88 | 88 | 87 |
| MS | 93 | 90 | 88 | 90 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1104406 Sample # 5435926

**COC #** 188637

Please print. Instructions on reverse side correspond with circled numbers.

(1)
Client: SUN- AQUATERRA Acct. #:
Project Name/#: PHREF AOI-1 PWSID #:
Project Manager: T. DOERR P.O.#:
Sampler: S. SYKES Quote #:
Name of state where samples were collected: PA

**For Lab Use Only**
FSC:
SCR#:

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | (4) Matrix: Potable / Non-Potable (Check if Applicable) Soil | Water | Other | Total # of Containers | (5) Analyses Requested: Preservation Codes — BTEX MTBE PAH 8260b | Remarks | (6) Temperature of samples upon receipt (if requested) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S-117 | 8/6/08 | 1145 | X | | | X | | 3 | X | temp 1.2°C | |

(7) **Turnaround Time Requested** (TAT) (please circle) Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: No Rush
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| Sun Ex / AQUATERRA | 8/6/08 | 1530 | AQUATERRA FRIDGE | 8/6/08 | 1530 |
| AT FRIDGE | 8/7/08 | 0930 | | 8/7/08 | 0930 |
| | 8/7/08 | 0930 | P. Lefever | 8/7/08 | 950 |
| P. Lefever | 8/7/08 | 1615 | | | |
| | | | Mary Miller | 8/7/08 | 1615 |

(9)

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

**WARRANTY AND LIMITS OF LIABILITY –** In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 1104407. Samples arrived at the laboratory on Thursday, August 07, 2008. The PO# for this group is PHILADELPHIA.

| Client Description | Lancaster Labs Number |
|---|---|
| N-59 Grab Water | 5435927 |
| N-97 Grab Water | 5435928 |

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Kevin Martin |
| ELECTRONIC COPY TO | Langan | Attn: Joseph Catricks |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Heun at (717) 656-2300

Respectfully Submitted,

Chad A. Moline
Group Leader

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5435927 WW  Group No. 1104407**

**N-59 Grab Water**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 187350 N-59**

Collected:08/06/2008 13:00  by SS  Account Number: 10132

Submitted: 08/07/2008 16:15
Reported: 08/12/2008 at 14:27
Discard: 10/12/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N59--

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.030 | 0.030 | 0.010 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | < 5. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | < 5. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | < 5. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | < 5. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | < 5. | 5. | 1. | ug/l | 1 |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 98. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | 3. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 2. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | 4. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. 5435927 WW  Group No. 1104407**

**N-59 Grab Water**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 187350 N-59**

Collected:08/06/2008 13:00  by SS  Account Number: 10132

Submitted: 08/07/2008 16:15  SUN: Aquaterra Tech.
Reported: 08/12/2008 at 14:27  PO Box 744
Discard: 10/12/2008  West Chester PA 19381

N59--

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/12/2008 11:35 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 08/09/2008 09:22 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 08/08/2008 17:17 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/11/2008 12:52 | Daniel H Heller | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/11/2008 12:52 | Daniel H Heller | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 08/10/2008 19:40 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 08/08/2008 14:45 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 08/08/2008 09:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5435928 WW  Group No. 1104407**

**N-97 Grab Water**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 187350 N-97**

Collected:08/06/2008 14:00  by SS  Account Number: 10132

Submitted: 08/07/2008 16:15
Reported: 08/12/2008 at 14:27
Discard: 10/12/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N97--

| CAT No. | Analysis Name | CAS Number | As Received Result | As Received Limit of Quantitation* | As Received Method Detection Limit | Units | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 06035 | Lead | 7439-92-1 | < 0.0010 | 0.0010 | 0.000050 | mg/l | 1 |
| 07879 | EDB in Wastewater | | | | | | |
| 01087 | Ethylene dibromide | 106-93-4 | < 0.029 | 0.029 | 0.0097 | ug/l | 1 |
| 07805 | PAHs in Water by GC/MS | | | | | | |
| 03947 | Naphthalene | 91-20-3 | 50. | 5. | 1. | ug/l | 1 |
| 03956 | Fluorene | 86-73-7 | 13. | 5. | 1. | ug/l | 1 |
| 03963 | Phenanthrene | 85-01-8 | 45. | 5. | 1. | ug/l | 1 |
| 03967 | Pyrene | 129-00-0 | 10. | 5. | 1. | ug/l | 1 |
| 03971 | Chrysene | 218-01-9 | 6. | 5. | 1. | ug/l | 1 |
| | The LCS recovery is outside the stated QC window but within the marginal exceedance allowance of +/- 4 standard deviations as defined in the NELAC Standards. The following analytes are accepted based on this allowance: phenanthrene | | | | | | |
| 02302 | UST-Waters by 8260B | | | | | | |
| 02010 | Methyl Tertiary Butyl Ether | 1634-04-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05401 | Benzene | 71-43-2 | 2. | 1. | 0.5 | ug/l | 1 |
| 05402 | 1,2-Dichloroethane | 107-06-2 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05407 | Toluene | 108-88-3 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05415 | Ethylbenzene | 100-41-4 | < 1. | 1. | 0.5 | ug/l | 1 |
| 05420 | Isopropylbenzene | 98-82-8 | 140. | 2. | 0.5 | ug/l | 1 |
| 06310 | Xylene (Total) | 1330-20-7 | < 1. | 1. | 0.5 | ug/l | 1 |

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/09
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

*=This limit was used in the evaluation of the final result

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# Analysis Report



**Lancaster Laboratories Sample No. 5435928 WW  Group No. 1104407**

**N-97 Grab Water**
**Philadelphia Refinery AOI-8**
**DUNS# COC: 187350 N-97**

Collected:08/06/2008 14:00  by SS  Account Number: 10132

Submitted: 08/07/2008 16:15
Reported: 08/12/2008 at 14:27
Discard: 10/12/2008

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

N97--

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|
| 06035 | Lead | SW-846 6020 | 1 | 08/12/2008 11:37 | James R Williams II | 1 |
| 07879 | EDB in Wastewater | SW-846 8011 | 1 | 08/09/2008 10:22 | Mark E McNulty | 1 |
| 07805 | PAHs in Water by GC/MS | SW-846 8270C | 1 | 08/08/2008 17:40 | Linda M Hartenstine | 1 |
| 02302 | UST-Waters by 8260B | SW-846 8260B | 1 | 08/12/2008 11:29 | Daniel H Heller | 1 |
| 01163 | GC/MS VOA Water Prep | SW-846 5030B | 1 | 08/12/2008 11:29 | Daniel H Heller | 1 |
| 06050 | ICP/MS SW-846 Water | SW-846 3010A modified | 1 | 08/10/2008 19:40 | James L Mertz | 1 |
| 07786 | EDB Extraction | SW-846 8011 | 1 | 08/08/2008 14:45 | Kelli M Barto | 1 |
| 07807 | BNA Water Extraction | SW-846 3510C | 1 | 08/08/2008 09:15 | Kevin P Love | 1 |

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1104407
Reported: 08/12/08 at 02:27 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ** | Blank MDL | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082210007A | Sample number(s): 5435927-5435928 | | | | | | | | |
| Ethylene dibromide | < 0.030 | 0.030 | 0.010 | ug/l | 92 | 88 | 60-140 | 5 | 20 |
| Batch number: 082216050001A | Sample number(s): 5435927-5435928 | | | | | | | | |
| Lead | < 0.0010 | 0.0010 | 0.00005 0 | mg/l | 103 | | 90-115 | | |
| Batch number: 08221WAA026 | Sample number(s): 5435927-5435928 | | | | | | | | |
| Naphthalene | < 5. | 5. | 1. | ug/l | 93 | 100 | 77-107 | 7 | 30 |
| Fluorene | < 5. | 5. | 1. | ug/l | 99 | 103 | 82-113 | 4 | 30 |
| Phenanthrene | < 5. | 5. | 1. | ug/l | 110 | 113* | 83-112 | 3 | 30 |
| Pyrene | < 5. | 5. | 1. | ug/l | 109 | 115 | 80-115 | 5 | 30 |
| Chrysene | < 5. | 5. | 1. | ug/l | 101 | 105 | 82-112 | 4 | 30 |
| Batch number: P082241AA | Sample number(s): 5435927 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 95 | 94 | 73-119 | 1 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 94 | 95 | 78-119 | 1 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 94 | 95 | 69-135 | 1 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 92 | 93 | 85-115 | 1 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 90 | 91 | 82-119 | 1 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 91 | 92 | 80-113 | 1 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 92 | 94 | 83-113 | 2 | 30 |
| Batch number: P082252AA | Sample number(s): 5435928 | | | | | | | | |
| Methyl Tertiary Butyl Ether | < 1. | 1. | 0.5 | ug/l | 100 | 100 | 73-119 | 0 | 30 |
| Benzene | < 1. | 1. | 0.5 | ug/l | 99 | 98 | 78-119 | 1 | 30 |
| 1,2-Dichloroethane | < 1. | 1. | 0.5 | ug/l | 99 | 97 | 69-135 | 3 | 30 |
| Toluene | < 1. | 1. | 0.5 | ug/l | 99 | 98 | 85-115 | 1 | 30 |
| Ethylbenzene | < 1. | 1. | 0.5 | ug/l | 98 | 98 | 82-119 | 0 | 30 |
| Isopropylbenzene | < 2. | 2. | 0.5 | ug/l | 101 | 99 | 80-113 | 1 | 30 |
| Xylene (Total) | < 1. | 1. | 0.5 | ug/l | 102 | 100 | 83-113 | 2 | 30 |

## Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: 082210007A | Sample number(s): 5435927-5435928 UNSPK: 5435927 BKG: 5435928 | | | | | | | | |
| Ethylene dibromide | 100 | | 65-135 | | | < 0.029 | < 0.029 | 0 (1) | 30 |
| Batch number: 082216050001A | Sample number(s): 5435927-5435928 UNSPK: P435033 BKG: P435033 | | | | | | | | |
| Lead | 100 | 100 | 75-125 | 0 | 20 | < 0.0010 | < 0.0010 | 7 (1) | 20 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1104407
Reported: 08/12/08 at 02:27 PM

### Sample Matrix Quality Control

Unspiked (UNSPK) = the sample used in conjunction with the matrix spike
Background (BKG) = the sample used in conjunction with the duplicate

| Analysis Name | MS %REC | MSD %REC | MS/MSD Limits | RPD | RPD MAX | BKG Conc | DUP Conc | DUP RPD | Dup RPD Max |
|---|---|---|---|---|---|---|---|---|---|
| Batch number: P082241AA | Sample number(s): 5435927 UNSPK: P433219 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 98 | | 69-127 | | | | | | |
| Benzene | 103 | | 83-128 | | | | | | |
| 1,2-Dichloroethane | 100 | | 70-143 | | | | | | |
| Toluene | 98 | | 83-127 | | | | | | |
| Ethylbenzene | 98 | | 82-129 | | | | | | |
| Isopropylbenzene | 100 | | 81-130 | | | | | | |
| Xylene (Total) | 99 | | 82-130 | | | | | | |
| Batch number: P082252AA | Sample number(s): 5435928 UNSPK: P433695 | | | | | | | | |
| Methyl Tertiary Butyl Ether | 100 | | 69-127 | | | | | | |
| Benzene | 103 | | 83-128 | | | | | | |
| 1,2-Dichloroethane | 100 | | 70-143 | | | | | | |
| Toluene | 106 | | 83-127 | | | | | | |
| Ethylbenzene | 105 | | 82-129 | | | | | | |
| Isopropylbenzene | 108 | | 81-130 | | | | | | |
| Xylene (Total) | 107 | | 82-130 | | | | | | |

### Surrogate Quality Control

Surrogate recoveries which are outside of the QC window are confirmed unless attributed to dilution or otherwise noted on the Analysis Report.

Analysis Name: EDB in Wastewater
Batch number: 082210007A

| | 1,1,2,2-Tetrachloroethane |
|---|---|
| 5435927 | 104 |
| 5435928 | 93 |
| Blank | 106 |
| DUP | 78 |
| LCS | 107 |
| LCSD | 104 |
| MS | 100 |
| Limits: | 46-136 |

Analysis Name: PAHs in Water by GC/MS
Batch number: 08221WAA026

| | Nitrobenzene-d5 | 2-Fluorobiphenyl | Terphenyl-d14 |
|---|---|---|---|
| 5435927 | 68 | 77 | 86 |
| 5435928 | 86 | 95 | 90 |
| Blank | 86 | 101 | 112 |
| LCS | 82 | 97 | 104 |
| LCSD | 86 | 102 | 109 |
| Limits: | 44-127 | 63-114 | 30-126 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1104407
Reported: 08/12/08 at 02:27 PM

## Surrogate Quality Control

Analysis Name: UST-Waters by 8260B
Batch number: P082241AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5435927 | 90 | 82 | 89 | 89 |
| Blank | 93 | 85 | 87 | 90 |
| LCS | 94 | 87 | 88 | 89 |
| LCSD | 93 | 87 | 88 | 90 |
| MS | 93 | 88 | 88 | 90 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

Analysis Name: UST-Waters by 8260B
Batch number: P082252AA

| | Dibromofluoromethane | 1,2-Dichloroethane-d4 | Toluene-d8 | 4-Bromofluorobenzene |
|---|---|---|---|---|
| 5435928 | 97 | 98 | 100 | 100 |
| Blank | 99 | 98 | 96 | 88 |
| LCS | 100 | 100 | 96 | 88 |
| LCSD | 97 | 99 | 97 | 88 |
| MS | 99 | 100 | 96 | 89 |
| Limits: | 80-116 | 77-113 | 80-113 | 78-113 |

*- Outside of specification
**-This limit was used in the evaluation of the final result for the blank
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1104407 Sample # 5435927-28

**COC #** 187350

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: SUN-AQUATERRA Acct. #:

Project Name/#: PH REF AOI-8 PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: S. SYKES Quote #:

Name of state where samples were collected: PA

**For Lab Use Only**
FSC:
SCR#:

**Preservation Codes**
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | Matrix (4) Soil | Water | Other | Potable ☐ NPDES ☐ Check if Applicable | Total # of Containers | (5) Analyses Requested / Preservation Codes: PAV6 8260 6 | Lead | PAHs by 6C/MS | EDB | Remarks | (6) Temperature of samples upon receipt (if requested) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-59 | 8/6/08 | 1300 | X | | | X | | | 8 | 3 | 1 | 2 | 2 | * See table per analyses | |
| N-97 | 8/6/08 | 1400 | X | | | X | | | 8 | 3 | 1 | 2 | 2 | | |
| | | | | | | | | | | | | | | * Pls copy Kevin Martin + Jason @ Langan | |
| | | | | | | | | | | | | | | temp 1.2°C | |

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: ASAP as discussed (4-5 day)
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg) TX TRRP-13
Type II (Tier II) MA MCP CT RCP
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)

SDG Complete? Yes No

Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| Steve Eye / AQUATERRA | 8/6/08 | 1530 | AQUATERRA FRIDGE | 8/6/08 | 1530 |
| AQUATERRA FRIDGE | 8/7/08 | 0930 | | 8/7/08 | 0930 |
| | 8/7/08 | 0930 | C. Lefevre | 8/7/08 | 950 |
| C. Lefevre | 8/7/08 | 1615 | | | |
| | | | | 8/7/08 | 1615 |

(9)

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

May 07, 2009

## SAMPLE GROUP

The sample group for this submittal is 1142359. Samples arrived at the laboratory on Tuesday, April 28, 2009. The PO# for this group is SUN PHILLY REF. AOI-8.

| Client Description | Lancaster Labs Number |
|---|---|
| SG-3_AOI8 Grab Air | 5656946 |
| SG-2_AOI8 Grab Air | 5656947 |
| SG-1_AOI8 Grab Air | 5656948 |
| SG-4_AOI8 Grab Air | 5656949 |
| TRIP BLANK Air | 5656950 |

## METHODOLOGY

The specific methodologies used in obtaining the enclosed analytical results are indicated on the Laboratory Chronicle.

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Megan Breen |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Oknefski at (717) 656-2300

Respectfully Submitted,

Barbara F. Reedy
Senior Specialist

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. AQ 5656946**

**Group No. 1142359**
**PA**

**SG-3_AOI8 Grab Air**
**Summa #1008 Philadelphia Ref. AOI-8**
**COC: 203870 SG-3_AOI8**

Collected: 04/23/2009 13:07 by TD

Account Number: 10132

Submitted: 04/28/2009 14:45
Reported: 05/07/2009 at 17:37
Discard: 07/07/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA TO-15/Naph** | **Volatiles in Air** | | mg/m3 | mg/m3 | ppm(v) | ppm(v) | |
| 00015 | Benzene | 71-43-2 | 0.60 | 0.32 | 0.19 | 0.10 | 100 |
| 00015 | Cumene | 98-82-8 | < 0.49 | 0.49 | < 0.10 | 0.10 | 100 |
| 00015 | 1,2-Dibromoethane | 106-93-4 | < 0.77 | 0.77 | < 0.10 | 0.10 | 100 |
| 00015 | 1,2-Dichloroethane | 107-06-2 | < 0.40 | 0.40 | < 0.10 | 0.10 | 100 |
| 00015 | Ethylbenzene | 100-41-4 | < 0.43 | 0.43 | < 0.10 | 0.10 | 100 |
| 00015 | Methyl t-Butyl Ether | 1634-04-4 | < 0.36 | 0.36 | < 0.10 | 0.10 | 100 |
| 00015 | Naphthalene | 91-20-3 | < 0.52 | 0.52 | < 0.10 | 0.10 | 100 |
| 00015 | Toluene | 108-88-3 | < 0.38 | 0.38 | < 0.10 | 0.10 | 100 |
| 00015 | m/p-Xylene | n.a. | 0.53 | 0.43 | 0.12 | 0.10 | 100 |
| 00015 | o-Xylene | 95-47-6 | < 0.43 | 0.43 | < 0.10 | 0.10 | 100 |

LOQ = Limit of Quantitation

## General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/10

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Batch# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 00015 | TO-15 VOA special compounds | EPA TO-15/Naph | 1 | D0912130AB | 05/04/2009 18:14 | Jonathan K Nardelli | 100 |

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# Analysis Report



**Lancaster Laboratories Sample No. AQ 5656947**

**Group No. 1142359**
**PA**

**SG-2_AOI8 Grab Air**
**Summa #1006 Philadelphia Ref. AOI-8**
**COC: 203870 SG-2_AOI8**

Collected: 04/23/2009 13:49 by TD

Account Number: 10132

Submitted: 04/28/2009 14:45
Reported: 05/07/2009 at 17:37
Discard: 07/07/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA TO-15/Naph** | **Volatiles in Air** | | **mg/m3** | **mg/m3** | **ppm(v)** | **ppm(v)** | |
| 00015 | Benzene | 71-43-2 | 3.0 | 0.32 | 0.92 | 0.10 | 100 |
| 00015 | Cumene | 98-82-8 | < 0.49 | 0.49 | < 0.10 | 0.10 | 100 |
| 00015 | 1,2-Dibromoethane | 106-93-4 | < 0.77 | 0.77 | < 0.10 | 0.10 | 100 |
| 00015 | 1,2-Dichloroethane | 107-06-2 | < 0.40 | 0.40 | < 0.10 | 0.10 | 100 |
| 00015 | Ethylbenzene | 100-41-4 | 1.0 | 0.43 | 0.23 | 0.10 | 100 |
| 00015 | Methyl t-Butyl Ether | 1634-04-4 | < 0.36 | 0.36 | < 0.10 | 0.10 | 100 |
| 00015 | Naphthalene | 91-20-3 | < 0.52 | 0.52 | < 0.10 | 0.10 | 100 |
| 00015 | Toluene | 108-88-3 | 0.81 | 0.38 | 0.21 | 0.10 | 100 |
| 00015 | m/p-Xylene | n.a. | 4.5 | 0.43 | 1.0 | 0.10 | 100 |
| 00015 | o-Xylene | 95-47-6 | 2.1 | 0.43 | 0.48 | 0.10 | 100 |

The GC/MS volatile internal standard peak areas were outside the QC limits for both the initial analysis and the re-analysis. The values reported here are from the initial analysis of the sample.

LOQ = Limit of Quantitation

## General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/10

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Batch# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 00015 | TO-15 VOA special compounds | EPA TO-15/Naph | 1 | D0912130AB | 05/04/2009 19:42 | Jonathan K Nardelli | 100 |

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# Analysis Report



**Lancaster Laboratories Sample No. AQ 5656948**

**Group No. 1142359**
**PA**

**SG-1_AOI8 Grab Air**
**Summa #929 Philadelphia Ref. AOI-8**
**COC: 203870 SG-1_AOI8**

Collected: 04/23/2009 14:11 by TD

Account Number: 10132

Submitted: 04/28/2009 14:45
Reported: 05/07/2009 at 17:37
Discard: 07/07/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA TO-15/Naph** | **Volatiles in Air** | | **mg/m3** | **mg/m3** | **ppm(v)** | **ppm(v)** | |
| 00015 | Benzene | 71-43-2 | 140 | 6.4 | 44 | 2.0 | 2000 |
| 00015 | Cumene | 98-82-8 | < 9.8 | 9.8 | < 2.0 | 2.0 | 2000 |
| 00015 | 1,2-Dibromoethane | 106-93-4 | < 15 | 15 | < 2.0 | 2.0 | 2000 |
| 00015 | 1,2-Dichloroethane | 107-06-2 | < 8.1 | 8.1 | < 2.0 | 2.0 | 2000 |
| 00015 | Ethylbenzene | 100-41-4 | < 8.7 | 8.7 | < 2.0 | 2.0 | 2000 |
| 00015 | Methyl t-Butyl Ether | 1634-04-4 | < 7.2 | 7.2 | < 2.0 | 2.0 | 2000 |
| 00015 | Naphthalene | 91-20-3 | < 10 | 10 | < 2.0 | 2.0 | 2000 |
| 00015 | Toluene | 108-88-3 | 42 | 7.5 | 11 | 2.0 | 2000 |
| 00015 | m/p-Xylene | n.a. | < 8.7 | 8.7 | < 2.0 | 2.0 | 2000 |
| 00015 | o-Xylene | 95-47-6 | < 8.7 | 8.7 | < 2.0 | 2.0 | 2000 |

LOQ = Limit of Quantitation

## General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/10

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Batch# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 00015 | TO-15 VOA special compounds | EPA TO-15/Naph | 1 | D0912530BA | 05/06/2009 16:20 | Jonathan K Nardelli | 2000 |

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# Analysis Report



**Lancaster Laboratories Sample No. AQ 5656949**

**Group No. 1142359**
**PA**

**SG-4_AOI8 Grab Air**
**Summa #942 Philadelphia Ref. AOI-8**
**COC: 203870 SG-4_AOI8**

Collected: 04/23/2009 14:34 by TD

Account Number: 10132

Submitted: 04/28/2009 14:45
Reported: 05/07/2009 at 17:37
Discard: 07/07/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA TO-15/Naph** | **Volatiles in Air** | | mg/m3 | mg/m3 | ppm(v) | ppm(v) | |
| 00015 | Benzene | 71-43-2 | 4.6 | 0.64 | 1.4 | 0.20 | 200 |
| 00015 | Cumene | 98-82-8 | < 0.98 | 0.98 | < 0.20 | 0.20 | 200 |
| 00015 | 1,2-Dibromoethane | 106-93-4 | < 1.5 | 1.5 | < 0.20 | 0.20 | 200 |
| 00015 | 1,2-Dichloroethane | 107-06-2 | < 0.81 | 0.81 | < 0.20 | 0.20 | 200 |
| 00015 | Ethylbenzene | 100-41-4 | < 0.87 | 0.87 | < 0.20 | 0.20 | 200 |
| 00015 | Methyl t-Butyl Ether | 1634-04-4 | < 0.72 | 0.72 | < 0.20 | 0.20 | 200 |
| 00015 | Naphthalene | 91-20-3 | < 1.0 | 1.0 | < 0.20 | 0.20 | 200 |
| 00015 | Toluene | 108-88-3 | 4.1 | 0.75 | 1.1 | 0.20 | 200 |
| 00015 | m/p-Xylene | n.a. | 2.3 | 0.87 | 0.52 | 0.20 | 200 |
| 00015 | o-Xylene | 95-47-6 | 1.0 | 0.87 | 0.24 | 0.20 | 200 |

The GC/MS volatile internal standard peak areas were outside the QC limits for both the initial analysis and the re-analysis. The values reported here are from the initial analysis of the sample.

LOQ = Limit of Quantitation

## General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/10

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Batch# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 00015 | TO-15 VOA special compounds | EPA TO-15/Naph | 1 | D0912130AB | 05/05/2009 07:05 | Jonathan K Nardelli | 200 |

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# Analysis Report



**Lancaster Laboratories Sample No. AQ 5656950**

**Group No. 1142359**
**PA**

**TRIP BLANK Air**
**Summa #986 Philadelphia Ref. AOI-8**
**COC: 203870**

Collected: 04/23/2009

Account Number: 10132

Submitted: 04/28/2009 14:45
Reported: 05/07/2009 at 17:37
Discard: 07/07/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA TO-15/Naph** | **Volatiles in Air** | | mg/m3 | mg/m3 | ppm(v) | ppm(v) | |
| 00015 | Benzene | 71-43-2 | < 0.0032 | 0.0032 | < 0.0010 | 0.0010 | 1 |
| 00015 | Cumene | 98-82-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 00015 | 1,2-Dibromoethane | 106-93-4 | < 0.0077 | 0.0077 | < 0.0010 | 0.0010 | 1 |
| 00015 | 1,2-Dichloroethane | 107-06-2 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 00015 | Ethylbenzene | 100-41-4 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 00015 | Methyl t-Butyl Ether | 1634-04-4 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 00015 | Naphthalene | 91-20-3 | < 0.0052 | 0.0052 | < 0.0010 | 0.0010 | 1 |
| 00015 | Toluene | 108-88-3 | < 0.0038 | 0.0038 | < 0.0010 | 0.0010 | 1 |
| 00015 | m/p-Xylene | n.a. | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 00015 | o-Xylene | 95-47-6 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |

LOQ = Limit of Quantitation

## General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/10

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Batch# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 00015 | TO-15 VOA special compounds | EPA TO-15/Naph | 1 | D0911930AB | 05/01/2009 09:17 | Jonathan K Nardelli | 1 |

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1142359
Reported: 05/07/09 at 05:37 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|
| Batch number: D0911930AB | Sample number(s): 5656950 | | | | | | | |
| Benzene | < 0.0032 | 0.0032 | mg/m3 | 89 | 89 | 70-130 | 1 | 25 |
| Cumene | < 0.0049 | 0.0049 | mg/m3 | 106 | 103 | 53-137 | 2 | 25 |
| 1,2-Dibromoethane | < 0.0077 | 0.0077 | mg/m3 | | | | | |
| 1,2-Dichloroethane | < 0.0040 | 0.0040 | mg/m3 | | | | | |
| Ethylbenzene | < 0.0043 | 0.0043 | mg/m3 | 94 | 92 | 70-130 | 2 | 25 |
| Methyl t-Butyl Ether | < 0.0036 | 0.0036 | mg/m3 | 118 | 120 | 51-142 | 2 | 25 |
| Naphthalene | < 0.0052 | 0.0052 | mg/m3 | 129 | 119 | 26-151 | 8 | 25 |
| Toluene | < 0.0038 | 0.0038 | mg/m3 | 94 | 94 | 70-130 | 1 | 25 |
| m/p-Xylene | < 0.0043 | 0.0043 | mg/m3 | 99 | 98 | 70-130 | 1 | 25 |
| o-Xylene | < 0.0043 | 0.0043 | mg/m3 | 95 | 93 | 70-130 | 2 | 25 |
| Batch number: D0912130AB | Sample number(s): 5656946-5656947,5656949 | | | | | | | |
| Benzene | < 0.0032 | 0.0032 | mg/m3 | 86 | 81 | 70-130 | 5 | 25 |
| Cumene | < 0.0049 | 0.0049 | mg/m3 | 107 | 109 | 53-137 | 2 | 25 |
| 1,2-Dibromoethane | < 0.0077 | 0.0077 | mg/m3 | | | | | |
| 1,2-Dichloroethane | < 0.0040 | 0.0040 | mg/m3 | | | | | |
| Ethylbenzene | < 0.0043 | 0.0043 | mg/m3 | 93 | 94 | 70-130 | 1 | 25 |
| Methyl t-Butyl Ether | < 0.0036 | 0.0036 | mg/m3 | 90 | 93 | 51-142 | 4 | 25 |
| Naphthalene | < 0.0052 | 0.0052 | mg/m3 | 120 | 121 | 26-151 | 1 | 25 |
| Toluene | < 0.0038 | 0.0038 | mg/m3 | 93 | 94 | 70-130 | 1 | 25 |
| m/p-Xylene | < 0.0043 | 0.0043 | mg/m3 | 101 | 101 | 70-130 | 0 | 25 |
| o-Xylene | < 0.0043 | 0.0043 | mg/m3 | 95 | 96 | 70-130 | 1 | 25 |
| Batch number: D0912530BA | Sample number(s): 5656948 | | | | | | | |
| Benzene | < 0.0032 | 0.0032 | mg/m3 | 88 | 91 | 70-130 | 3 | 25 |
| Cumene | < 0.0049 | 0.0049 | mg/m3 | 110 | 110 | 53-137 | 0 | 25 |
| 1,2-Dibromoethane | < 0.0077 | 0.0077 | mg/m3 | | | | | |
| 1,2-Dichloroethane | < 0.0040 | 0.0040 | mg/m3 | | | | | |
| Ethylbenzene | < 0.0043 | 0.0043 | mg/m3 | 98 | 99 | 70-130 | 1 | 25 |
| Methyl t-Butyl Ether | < 0.0036 | 0.0036 | mg/m3 | 89 | 95 | 51-142 | 6 | 25 |
| Naphthalene | < 0.0052 | 0.0052 | mg/m3 | 130 | 131 | 26-151 | 1 | 25 |
| Toluene | < 0.0038 | 0.0038 | mg/m3 | 95 | 98 | 70-130 | 3 | 25 |
| m/p-Xylene | < 0.0043 | 0.0043 | mg/m3 | 100 | 100 | 70-130 | 1 | 25 |
| o-Xylene | < 0.0043 | 0.0043 | mg/m3 | 98 | 98 | 70-130 | 0 | 25 |

*- Outside of specification
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1142359 Sample # 5656946-50

**COC #** 203870

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: Aquatera Tech. Acct. #:

Project Name/#: Sun Philly PL- A01-8 PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: T. DOERR Quote #:

Name of state where samples were collected: PA

**For Lab Use Only**

FSC:

SCR#:

**Preservation Codes**

H=HCl T=Thiosulfate

N=$HNO_3$ B=NaOH

S=$H_2SO_4$ O=Other

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | Matrix (4) Soil | Potable / NPDES | Water | Other | Total # of Containers | (5) Analyses Requested / Preservation Codes: TO-15: BTEX, MTBE, Cumene, EDB, naphthalene, EDC | Remarks | (6) Temperature of samples upon receipt (if requested) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SG-3_A018 | 4/23/09 | 1307 | X | | | | | X | 1 | X | Summa 1008 | |
| SG-2_A018 | 4/23/09 | 1349 | X | | | | | X | 1 | X | Summa 1006 | |
| SG-1_A018 | 4/23/09 | 1411 | X | | | | | X | 1 | X | Summa 929 | |
| SG-4_A018 | 4/23/09 | 1434 | X | | | | | X | 1 | X | Summa 942 | |
| TRIP BLANK | — | — | — | | | | | X | 1 | X | Summa 986 | |

(7) **Turnaround Time Requested** (TAT) (please circle): (Normal) Rush

(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)

Date results are needed:

Rush results requested by (please circle): Phone Fax (E-mail)

Phone #: Fax #:

E-mail address: dl@aquatera-tech.com jstricks@langan.com

(8) **Data Package Options** (please circle if required)

Type I (validation/NJ Reg) TX TRRP-13

Type II (Tier II) MA MCP CT RCP

Type III (Reduced NJ)

Type IV (CLP SOW)

Type VI (Raw Data Only)

SDG Complete? (Yes) No

Site-specific QC (MS/MSD/Dup)? Yes (No)

(If yes, indicate QC sample and submit triplicate volume.)

Internal COC Required? Yes (No)

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| | 4/23/09 | 1600 | Aquatera Sample Room | 4/23/09 | 1600 |
| | 4/28/09 | 1035 | Jim Lydely | 4/28/09 | 1035 |
| | 4/28 | 1445 | | | |
| | | | | | |
| | | | Deborah A Neslund | 4/28/09 | 1445 |

(9)

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766

Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

**WARRANTY AND LIMITS OF LIABILITY –** In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. THE FOREGOING EXPRESS WARRANTY IS EXCLUSIVE AND IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. WE DISCLAIM ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING A WARRANTY OF FITNESS FOR PARTICULAR PURPOSE AND WARRANTY OF MERCHANTABILITY. IN NO EVENT SHALL LANCASTER LABORATORIES BE LIABLE FOR INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFIT OR GOODWILL REGARDLESS OF (A) THE NEGLIGENCE (EITHER SOLE OR CONCURRENT) OF LANCASTER LABORATORIES AND (B) WHETHER LANCASTER LABORATORIES HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. We accept no legal responsibility for the purposes for which the client uses the test results. No purchase order or other order for work shall be accepted by Lancaster Laboratories which includes any conditions that vary from the Standard Terms and Conditions of Lancaster Laboratories and we hereby object to any conflicting terms contained in any acceptance or order submitted by client.

Lancaster Laboratories

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

June 18, 2009

## SAMPLE GROUP

The sample group for this submittal is 1148396. Samples arrived at the laboratory on Tuesday, June 09, 2009. The PO# for this group is PHILA REF JACKSON ST.

| Client Description | Lancaster Labs Number |
|---|---|
| Manhole #1 Summa #509 Grab Air | 5695002 |
| Manhole #3 Summa #515 Grab Air | 5695003 |
| Manhole #6 Summa #102 Grab Air | 5695004 |
| Jackson Ambient Can #062 Grab Air | 5695005 |

## METHODOLOGY

The specific methodologies used in obtaining the enclosed analytical results are indicated on the Laboratory Chronicle.

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Megan Breen |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |
| ELECTRONIC COPY TO | Langan | Attn: Dennis Webster |

Lancaster Laboratories

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# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Oknefski at (717) 656-2300

Respectfully Submitted,

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. AQ 5695002**

**Group No. 1148396**
**PA**

**Manhole #1 Summa #509 Grab Air**
**Philadelphia Refinery Jackson St**
**COC: 209188 Manhole #1**

Collected: 06/05/2009 09:42 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA 18 modified** | **Volatiles in Air** | | **mg/m3** | **mg/m3** | **ppm(v)** | **ppm(v)** | |
| 07056 | Methane | 74-82-8 | < 6.6 | 6.6 | < 10 | 10 | 2 |
| **EPA TO-15** | **Volatiles in Air** | | **mg/m3** | **mg/m3** | **ppm(v)** | **ppm(v)** | |
| 05298 | Acetone | 67-64-1 | 0.018 | 0.0048 | 0.0076 | 0.0020 | 1 |
| 05298 | Acetonitrile | 75-05-8 | < 0.0034 | 0.0034 | < 0.0020 | 0.0020 | 1 |
| 05298 | Acrolein | 107-02-8 | < 0.0046 | 0.0046 | < 0.0020 | 0.0020 | 1 |
| 05298 | Acrylonitrile | 107-13-1 | < 0.0043 | 0.0043 | < 0.0020 | 0.0020 | 1 |
| 05298 | Benzene | 71-43-2 | < 0.0032 | 0.0032 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromobenzene | 108-86-1 | < 0.0064 | 0.0064 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromodichloromethane | 75-27-4 | < 0.0067 | 0.0067 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromoform | 75-25-2 | < 0.010 | 0.010 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromomethane | 74-83-9 | < 0.0039 | 0.0039 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3-Butadiene | 106-99-0 | < 0.0044 | 0.0044 | < 0.0020 | 0.0020 | 1 |
| 05298 | 2-Butanone | 78-93-3 | < 0.0059 | 0.0059 | < 0.0020 | 0.0020 | 1 |
| 05298 | tert-Butyl Alcohol | 75-65-0 | < 0.0030 | 0.0030 | < 0.0010 | 0.0010 | 1 |
| 05298 | Carbon Disulfide | 75-15-0 | < 0.0031 | 0.0031 | < 0.0010 | 0.0010 | 1 |
| 05298 | Carbon Tetrachloride | 56-23-5 | < 0.0063 | 0.0063 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chlorobenzene | 108-90-7 | < 0.0046 | 0.0046 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chlorodifluoromethane | 75-45-6 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chloroethane | 75-00-3 | < 0.0026 | 0.0026 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chloroform | 67-66-3 | 0.0055 | 0.0049 | 0.0011 | 0.0010 | 1 |
| 05298 | Chloromethane | 74-87-3 | < 0.0021 | 0.0021 | < 0.0010 | 0.0010 | 1 |
| 05298 | 3-Chloropropene | 107-05-1 | < 0.0031 | 0.0031 | < 0.0010 | 0.0010 | 1 |
| 05298 | Cumene | 98-82-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dibromochloromethane | 124-48-1 | < 0.0085 | 0.0085 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dibromoethane | 106-93-4 | < 0.0077 | 0.0077 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dibromomethane | 74-95-3 | < 0.0071 | 0.0071 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichlorobenzene | 95-50-1 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3-Dichlorobenzene | 541-73-1 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,4-Dichlorobenzene | 106-46-7 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dichlorodifluoromethane | 75-71-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1-Dichloroethane | 75-34-3 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichloroethane | 107-06-2 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1-Dichloroethene | 75-35-4 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | cis-1,2-Dichloroethene | 156-59-2 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | trans-1,2-Dichloroethene | 156-60-5 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dichlorofluoromethane | 75-43-4 | < 0.0042 | 0.0042 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichloropropane | 78-87-5 | < 0.0046 | 0.0046 | < 0.0010 | 0.0010 | 1 |
| 05298 | cis-1,3-Dichloropropene | 10061-01-5 | < 0.0045 | 0.0045 | < 0.0010 | 0.0010 | 1 |
| 05298 | trans-1,3-Dichloropropene | 10061-02-6 | < 0.0045 | 0.0045 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,4-Dioxane | 123-91-1 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Acetate | 141-78-6 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Acrylate | 140-88-5 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Methacrylate | 97-63-2 | < 0.0047 | 0.0047 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethylbenzene | 100-41-4 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 05298 | 4-Ethyltoluene | 622-96-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Freon 113 | 76-13-1 | < 0.015 | 0.015 | < 0.0020 | 0.0020 | 1 |
| 05298 | Freon 114 | 76-14-2 | < 0.0070 | 0.0070 | < 0.0010 | 0.0010 | 1 |
| 05298 | Heptane | 142-82-5 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |

**Lancaster Laboratories Sample No. AQ 5695002**

**Group No. 1148396**
**PA**

**Manhole #1 Summa #509 Grab Air**
**Philadelphia Refinery Jackson St**
**COC: 209188 Manhole #1**

Collected: 06/05/2009 09:42 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA TO-15** | **Volatiles in Air** | | mg/m3 | mg/m3 | ppm(v) | ppm(v) | |
| 05298 | Hexachlorobutadiene | 87-68-3 | < 0.021 | 0.021 | < 0.0020 | 0.0020 | 1 |
| 05298 | Hexachloroethane | 67-72-1 | < 0.0097 | 0.0097 | < 0.0010 | 0.0010 | 1 |
| 05298 | Hexane | 110-54-3 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | 2-Hexanone | 591-78-6 | < 0.0082 | 0.0082 | < 0.0020 | 0.0020 | 1 |
| 05298 | Isooctane | 540-84-1 | 0.016 | 0.0047 | 0.0035 | 0.0010 | 1 |
| 05298 | Methyl Acrylate | 96-33-3 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl Iodide | 74-88-4 | < 0.0058 | 0.0058 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl Methacrylate | 80-62-6 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |
| 05298 | Alpha Methyl Styrene | 98-83-9 | < 0.0048 | 0.0048 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl t-Butyl Ether | 1634-04-4 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | 4-Methyl-2-Pentanone | 108-10-1 | < 0.0082 | 0.0082 | < 0.0020 | 0.0020 | 1 |
| 05298 | Methylene Chloride | 75-09-2 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Octane | 111-65-9 | < 0.0047 | 0.0047 | < 0.0010 | 0.0010 | 1 |
| 05298 | Pentane | 109-66-0 | < 0.0030 | 0.0030 | < 0.0010 | 0.0010 | 1 |
| 05298 | Propene | 115-07-1 | 0.0023 | 0.0017 | 0.0013 | 0.0010 | 1 |
| 05298 | Styrene | 100-42-5 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,1,2-Tetrachloroethane | 630-20-6 | < 0.0069 | 0.0069 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,2,2-Tetrachloroethane | 79-34-5 | < 0.0069 | 0.0069 | < 0.0010 | 0.0010 | 1 |
| 05298 | Tetrachloroethene | 127-18-4 | < 0.0068 | 0.0068 | < 0.0010 | 0.0010 | 1 |
| 05298 | Toluene | 108-88-3 | 0.0041 | 0.0038 | 0.0011 | 0.0010 | 1 |
| 05298 | 1,2,4-Trichlorobenzene | 120-82-1 | < 0.015 | 0.015 | < 0.0020 | 0.0020 | 1 |
| 05298 | 1,1,1-Trichloroethane | 71-55-6 | < 0.0055 | 0.0055 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,2-Trichloroethane | 79-00-5 | < 0.0055 | 0.0055 | < 0.0010 | 0.0010 | 1 |
| 05298 | Trichloroethene | 79-01-6 | < 0.0054 | 0.0054 | < 0.0010 | 0.0010 | 1 |
| 05298 | Trichlorofluoromethane | 75-69-4 | < 0.0056 | 0.0056 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,3-Trichloropropane | 96-18-4 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,4-Trimethylbenzene | 95-63-6 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3,5-Trimethylbenzene | 108-67-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Vinyl Acetate | 108-05-4 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Vinyl Chloride | 75-01-4 | < 0.0026 | 0.0026 | < 0.0010 | 0.0010 | 1 |
| 05298 | m/p-Xylene | n.a. | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 05298 | o-Xylene | 95-47-6 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |

QC %Recovery limits for Vinyl Acetate, 1,4-Dioxane, and 2-Hexanone are advisory only.

LOQ = Limit of Quantitation

## General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/10

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. AQ 5695002**

**Group No. 1148396**
**PA**

**Manhole #1 Summa #509 Grab Air**
**Philadelphia Refinery Jackson St**
**COC: 209188 Manhole #1**

Collected: 06/05/2009 09:42 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Batch# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 05298 | TO 15 VOA Ext. List | EPA TO-15 | 1 | C0916730AA | 06/16/2009 15:41 | Jonathan K Nardelli | 1 |
| 07056 | Methane | EPA 18 modified | 1 | M091621ZA | 06/10/2009 18:01 | David I Ressler | 2 |

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# Analysis Report



**Lancaster Laboratories Sample No. AQ 5695003**

**Group No. 1148396**
**PA**

**Manhole #3 Summa #515 Grab Air**
**Philadelphia Refinery Jackson St**
**COC: 209188 Manhole #3**

Collected: 06/05/2009 09:48 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA 18 modified** | **Volatiles in Air** | | **mg/m3** | **mg/m3** | **ppm(v)** | **ppm(v)** | |
| 07056 | Methane | 74-82-8 | 30 | 6.6 | 45 | 10 | 2 |
| **EPA TO-15** | **Volatiles in Air** | | **mg/m3** | **mg/m3** | **ppm(v)** | **ppm(v)** | |
| 05298 | Acetone | 67-64-1 | 0.022 | 0.0048 | 0.0094 | 0.0020 | 1 |
| 05298 | Acetonitrile | 75-05-8 | < 0.0034 | 0.0034 | < 0.0020 | 0.0020 | 1 |
| 05298 | Acrolein | 107-02-8 | < 0.0046 | 0.0046 | < 0.0020 | 0.0020 | 1 |
| 05298 | Acrylonitrile | 107-13-1 | < 0.0043 | 0.0043 | < 0.0020 | 0.0020 | 1 |
| 05298 | Benzene | 71-43-2 | 0.0036 | 0.0032 | 0.0011 | 0.0010 | 1 |
| 05298 | Bromobenzene | 108-86-1 | < 0.0064 | 0.0064 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromodichloromethane | 75-27-4 | < 0.0067 | 0.0067 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromoform | 75-25-2 | < 0.010 | 0.010 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromomethane | 74-83-9 | < 0.0039 | 0.0039 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3-Butadiene | 106-99-0 | < 0.0044 | 0.0044 | < 0.0020 | 0.0020 | 1 |
| 05298 | 2-Butanone | 78-93-3 | 0.0066 | 0.0059 | 0.0022 | 0.0020 | 1 |
| 05298 | tert-Butyl Alcohol | 75-65-0 | < 0.0030 | 0.0030 | < 0.0010 | 0.0010 | 1 |
| 05298 | Carbon Disulfide | 75-15-0 | < 0.0031 | 0.0031 | < 0.0010 | 0.0010 | 1 |
| 05298 | Carbon Tetrachloride | 56-23-5 | < 0.0063 | 0.0063 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chlorobenzene | 108-90-7 | < 0.0046 | 0.0046 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chlorodifluoromethane | 75-45-6 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chloroethane | 75-00-3 | < 0.0026 | 0.0026 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chloroform | 67-66-3 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chloromethane | 74-87-3 | < 0.0021 | 0.0021 | < 0.0010 | 0.0010 | 1 |
| 05298 | 3-Chloropropene | 107-05-1 | < 0.0031 | 0.0031 | < 0.0010 | 0.0010 | 1 |
| 05298 | Cumene | 98-82-8 | 0.046 | 0.0049 | 0.0093 | 0.0010 | 1 |
| 05298 | Dibromochloromethane | 124-48-1 | < 0.0085 | 0.0085 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dibromoethane | 106-93-4 | < 0.0077 | 0.0077 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dibromomethane | 74-95-3 | < 0.0071 | 0.0071 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichlorobenzene | 95-50-1 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3-Dichlorobenzene | 541-73-1 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,4-Dichlorobenzene | 106-46-7 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dichlorodifluoromethane | 75-71-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1-Dichloroethane | 75-34-3 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichloroethane | 107-06-2 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1-Dichloroethene | 75-35-4 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | cis-1,2-Dichloroethene | 156-59-2 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | trans-1,2-Dichloroethene | 156-60-5 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dichlorofluoromethane | 75-43-4 | < 0.0042 | 0.0042 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichloropropane | 78-87-5 | < 0.0046 | 0.0046 | < 0.0010 | 0.0010 | 1 |
| 05298 | cis-1,3-Dichloropropene | 10061-01-5 | < 0.0045 | 0.0045 | < 0.0010 | 0.0010 | 1 |
| 05298 | trans-1,3-Dichloropropene | 10061-02-6 | < 0.0045 | 0.0045 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,4-Dioxane | 123-91-1 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Acetate | 141-78-6 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Acrylate | 140-88-5 | 0.34 | 0.041 | 0.083 | 0.010 | 10 |
| 05298 | Ethyl Methacrylate | 97-63-2 | < 0.0047 | 0.0047 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethylbenzene | 100-41-4 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 05298 | 4-Ethyltoluene | 622-96-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Freon 113 | 76-13-1 | < 0.015 | 0.015 | < 0.0020 | 0.0020 | 1 |
| 05298 | Freon 114 | 76-14-2 | < 0.0070 | 0.0070 | < 0.0010 | 0.0010 | 1 |
| 05298 | Heptane | 142-82-5 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |

**Lancaster Laboratories Sample No. AQ 5695003**

**Group No. 1148396**
**PA**

**Manhole #3 Summa #515 Grab Air**
**Philadelphia Refinery Jackson St**
**COC: 209188 Manhole #3**

Collected: 06/05/2009 09:48 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA TO-15** | **Volatiles in Air** | | mg/m3 | mg/m3 | ppm(v) | ppm(v) | |
| 05298 | Hexachlorobutadiene | 87-68-3 | < 0.021 | 0.021 | < 0.0020 | 0.0020 | 1 |
| 05298 | Hexachloroethane | 67-72-1 | < 0.0097 | 0.0097 | < 0.0010 | 0.0010 | 1 |
| 05298 | Hexane | 110-54-3 | 0.016 | 0.0035 | 0.0046 | 0.0010 | 1 |
| 05298 | 2-Hexanone | 591-78-6 | < 0.0082 | 0.0082 | < 0.0020 | 0.0020 | 1 |
| 05298 | Isooctane | 540-84-1 | 0.94 | 0.047 | 0.20 | 0.010 | 10 |
| 05298 | Methyl Acrylate | 96-33-3 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl Iodide | 74-88-4 | < 0.0058 | 0.0058 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl Methacrylate | 80-62-6 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |
| 05298 | Alpha Methyl Styrene | 98-83-9 | < 0.0048 | 0.0048 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl t-Butyl Ether | 1634-04-4 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | 4-Methyl-2-Pentanone | 108-10-1 | < 0.0082 | 0.0082 | < 0.0020 | 0.0020 | 1 |
| 05298 | Methylene Chloride | 75-09-2 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Octane | 111-65-9 | < 0.0047 | 0.0047 | < 0.0010 | 0.0010 | 1 |
| 05298 | Pentane | 109-66-0 | 0.059 | 0.0030 | 0.020 | 0.0010 | 1 |
| 05298 | Propene | 115-07-1 | < 0.0017 | 0.0017 | < 0.0010 | 0.0010 | 1 |
| 05298 | Styrene | 100-42-5 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,1,2-Tetrachloroethane | 630-20-6 | < 0.0069 | 0.0069 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,2,2-Tetrachloroethane | 79-34-5 | < 0.0069 | 0.0069 | < 0.0010 | 0.0010 | 1 |
| 05298 | Tetrachloroethene | 127-18-4 | < 0.0068 | 0.0068 | < 0.0010 | 0.0010 | 1 |
| 05298 | Toluene | 108-88-3 | < 0.0038 | 0.0038 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,4-Trichlorobenzene | 120-82-1 | < 0.015 | 0.015 | < 0.0020 | 0.0020 | 1 |
| 05298 | 1,1,1-Trichloroethane | 71-55-6 | < 0.0055 | 0.0055 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,2-Trichloroethane | 79-00-5 | < 0.0055 | 0.0055 | < 0.0010 | 0.0010 | 1 |
| 05298 | Trichloroethene | 79-01-6 | < 0.0054 | 0.0054 | < 0.0010 | 0.0010 | 1 |
| 05298 | Trichlorofluoromethane | 75-69-4 | < 0.0056 | 0.0056 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,3-Trichloropropane | 96-18-4 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,4-Trimethylbenzene | 95-63-6 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3,5-Trimethylbenzene | 108-67-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Vinyl Acetate | 108-05-4 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Vinyl Chloride | 75-01-4 | < 0.0026 | 0.0026 | < 0.0010 | 0.0010 | 1 |
| 05298 | m/p-Xylene | n.a. | 0.0069 | 0.0043 | 0.0016 | 0.0010 | 1 |
| 05298 | o-Xylene | 95-47-6 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |

QC %Recovery limits for Vinyl Acetate, 1,4-Dioxane, and 2-Hexanone are advisory only.

LOQ = Limit of Quantitation

## General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/10

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

**Lancaster Laboratories Sample No. AQ 5695003**

**Group No. 1148396**
**PA**

**Manhole #3 Summa #515 Grab Air**
**Philadelphia Refinery Jackson St**
**COC: 209188 Manhole #3**

Collected: 06/05/2009 09:48 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Batch# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 05298 | TO 15 VOA Ext. List | EPA TO-15 | 1 | C0916730AA | 06/17/2009 04:30 | Jonathan K Nardelli | 1 |
| 05298 | TO 15 VOA Ext. List | EPA TO-15 | 1 | C0916730AA | 06/17/2009 05:13 | Jonathan K Nardelli | 10 |
| 07056 | Methane | EPA 18 modified | 1 | M091621ZA | 06/10/2009 18:29 | David I Ressler | 2 |

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. AQ 5695004**

**Group No. 1148396**
**PA**

**Manhole #6 Summa #102 Grab Air**
**Philadelphia Refinery Jackson St**
**COC: 209188 Manhole #6**

Collected: 06/05/2009 10:55 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA 18 modified** | **Volatiles in Air** | | **mg/m3** | **mg/m3** | **ppm(v)** | **ppm(v)** | |
| 07056 | Methane | 74-82-8 | 9.8 | 6.6 | 15 | 10 | 2 |
| **EPA TO-15** | **Volatiles in Air** | | **mg/m3** | **mg/m3** | **ppm(v)** | **ppm(v)** | |
| 05298 | Acetone | 67-64-1 | 0.012 | 0.0048 | 0.0050 | 0.0020 | 1 |
| 05298 | Acetonitrile | 75-05-8 | < 0.0034 | 0.0034 | < 0.0020 | 0.0020 | 1 |
| 05298 | Acrolein | 107-02-8 | < 0.0046 | 0.0046 | < 0.0020 | 0.0020 | 1 |
| 05298 | Acrylonitrile | 107-13-1 | < 0.0043 | 0.0043 | < 0.0020 | 0.0020 | 1 |
| 05298 | Benzene | 71-43-2 | < 0.0032 | 0.0032 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromobenzene | 108-86-1 | < 0.0064 | 0.0064 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromodichloromethane | 75-27-4 | < 0.0067 | 0.0067 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromoform | 75-25-2 | < 0.010 | 0.010 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromomethane | 74-83-9 | < 0.0039 | 0.0039 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3-Butadiene | 106-99-0 | < 0.0044 | 0.0044 | < 0.0020 | 0.0020 | 1 |
| 05298 | 2-Butanone | 78-93-3 | < 0.0059 | 0.0059 | < 0.0020 | 0.0020 | 1 |
| 05298 | tert-Butyl Alcohol | 75-65-0 | < 0.0030 | 0.0030 | < 0.0010 | 0.0010 | 1 |
| 05298 | Carbon Disulfide | 75-15-0 | < 0.0031 | 0.0031 | < 0.0010 | 0.0010 | 1 |
| 05298 | Carbon Tetrachloride | 56-23-5 | < 0.0063 | 0.0063 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chlorobenzene | 108-90-7 | < 0.0046 | 0.0046 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chlorodifluoromethane | 75-45-6 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chloroethane | 75-00-3 | < 0.0026 | 0.0026 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chloroform | 67-66-3 | 0.0067 | 0.0049 | 0.0014 | 0.0010 | 1 |
| 05298 | Chloromethane | 74-87-3 | < 0.0021 | 0.0021 | < 0.0010 | 0.0010 | 1 |
| 05298 | 3-Chloropropene | 107-05-1 | < 0.0031 | 0.0031 | < 0.0010 | 0.0010 | 1 |
| 05298 | Cumene | 98-82-8 | 0.0075 | 0.0049 | 0.0015 | 0.0010 | 1 |
| 05298 | Dibromochloromethane | 124-48-1 | < 0.0085 | 0.0085 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dibromoethane | 106-93-4 | < 0.0077 | 0.0077 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dibromomethane | 74-95-3 | < 0.0071 | 0.0071 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichlorobenzene | 95-50-1 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3-Dichlorobenzene | 541-73-1 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,4-Dichlorobenzene | 106-46-7 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dichlorodifluoromethane | 75-71-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1-Dichloroethane | 75-34-3 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichloroethane | 107-06-2 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1-Dichloroethene | 75-35-4 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | cis-1,2-Dichloroethene | 156-59-2 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | trans-1,2-Dichloroethene | 156-60-5 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dichlorofluoromethane | 75-43-4 | < 0.0042 | 0.0042 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichloropropane | 78-87-5 | < 0.0046 | 0.0046 | < 0.0010 | 0.0010 | 1 |
| 05298 | cis-1,3-Dichloropropene | 10061-01-5 | < 0.0045 | 0.0045 | < 0.0010 | 0.0010 | 1 |
| 05298 | trans-1,3-Dichloropropene | 10061-02-6 | < 0.0045 | 0.0045 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,4-Dioxane | 123-91-1 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Acetate | 141-78-6 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Acrylate | 140-88-5 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Methacrylate | 97-63-2 | < 0.0047 | 0.0047 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethylbenzene | 100-41-4 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 05298 | 4-Ethyltoluene | 622-96-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Freon 113 | 76-13-1 | < 0.015 | 0.015 | < 0.0020 | 0.0020 | 1 |
| 05298 | Freon 114 | 76-14-2 | < 0.0070 | 0.0070 | < 0.0010 | 0.0010 | 1 |
| 05298 | Heptane | 142-82-5 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |

**Lancaster Laboratories Sample No. AQ 5695004**

**Group No. 1148396**
**PA**

**Manhole #6 Summa #102 Grab Air**
**Philadelphia Refinery Jackson St**
**COC: 209188 Manhole #6**

Collected: 06/05/2009 10:55 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA TO-15** | **Volatiles in Air** | | **mg/m3** | **mg/m3** | **ppm(v)** | **ppm(v)** | |
| 05298 | Hexachlorobutadiene | 87-68-3 | < 0.021 | 0.021 | < 0.0020 | 0.0020 | 1 |
| 05298 | Hexachloroethane | 67-72-1 | < 0.0097 | 0.0097 | < 0.0010 | 0.0010 | 1 |
| 05298 | Hexane | 110-54-3 | 0.0036 | 0.0035 | 0.0010 | 0.0010 | 1 |
| 05298 | 2-Hexanone | 591-78-6 | < 0.0082 | 0.0082 | < 0.0020 | 0.0020 | 1 |
| 05298 | Isooctane | 540-84-1 | 0.25 | 0.047 | 0.054 | 0.010 | 10 |
| 05298 | Methyl Acrylate | 96-33-3 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl Iodide | 74-88-4 | < 0.0058 | 0.0058 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl Methacrylate | 80-62-6 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |
| 05298 | Alpha Methyl Styrene | 98-83-9 | < 0.0048 | 0.0048 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl t-Butyl Ether | 1634-04-4 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | 4-Methyl-2-Pentanone | 108-10-1 | < 0.0082 | 0.0082 | < 0.0020 | 0.0020 | 1 |
| 05298 | Methylene Chloride | 75-09-2 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Octane | 111-65-9 | < 0.0047 | 0.0047 | < 0.0010 | 0.0010 | 1 |
| 05298 | Pentane | 109-66-0 | 0.013 | 0.0030 | 0.0044 | 0.0010 | 1 |
| 05298 | Propene | 115-07-1 | < 0.0017 | 0.0017 | < 0.0010 | 0.0010 | 1 |
| 05298 | Styrene | 100-42-5 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,1,2-Tetrachloroethane | 630-20-6 | < 0.0069 | 0.0069 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,2,2-Tetrachloroethane | 79-34-5 | < 0.0069 | 0.0069 | < 0.0010 | 0.0010 | 1 |
| 05298 | Tetrachloroethene | 127-18-4 | < 0.0068 | 0.0068 | < 0.0010 | 0.0010 | 1 |
| 05298 | Toluene | 108-88-3 | < 0.0038 | 0.0038 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,4-Trichlorobenzene | 120-82-1 | < 0.015 | 0.015 | < 0.0020 | 0.0020 | 1 |
| 05298 | 1,1,1-Trichloroethane | 71-55-6 | < 0.0055 | 0.0055 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,2-Trichloroethane | 79-00-5 | < 0.0055 | 0.0055 | < 0.0010 | 0.0010 | 1 |
| 05298 | Trichloroethene | 79-01-6 | < 0.0054 | 0.0054 | < 0.0010 | 0.0010 | 1 |
| 05298 | Trichlorofluoromethane | 75-69-4 | < 0.0056 | 0.0056 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,3-Trichloropropane | 96-18-4 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,4-Trimethylbenzene | 95-63-6 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3,5-Trimethylbenzene | 108-67-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Vinyl Acetate | 108-05-4 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Vinyl Chloride | 75-01-4 | < 0.0026 | 0.0026 | < 0.0010 | 0.0010 | 1 |
| 05298 | m/p-Xylene | n.a. | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 05298 | o-Xylene | 95-47-6 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |

QC %Recovery limits for Vinyl Acetate, 1,4-Dioxane, and 2-Hexanone are advisory only.

LOQ = Limit of Quantitation

## General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/10

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. AQ 5695004**

**Group No. 1148396**
**PA**

**Manhole #6 Summa #102 Grab Air**
**Philadelphia Refinery Jackson St**
**COC: 209188 Manhole #6**

Collected: 06/05/2009 10:55 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Batch# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 05298 | TO 15 VOA Ext. List | EPA TO-15 | 1 | C0916730AA | 06/17/2009 03:00 | Jonathan K Nardelli | 1 |
| 05298 | TO 15 VOA Ext. List | EPA TO-15 | 1 | C0916730AA | 06/17/2009 03:43 | Jonathan K Nardelli | 10 |
| 07056 | Methane | EPA 18 modified | 1 | M091621ZA | 06/10/2009 18:58 | David I Ressler | 2 |

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. AQ 5695005**

**Group No. 1148396**
**PA**

**Jackson Ambient Can #062 Grab Air**
**Philadelphia Refinery Jackson St**
**COC: 209188 Jackson Ambient**

Collected: 06/05/2009 09:41 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA 18 modified** | **Volatiles in Air** | | **mg/m3** | **mg/m3** | **ppm(v)** | **ppm(v)** | |
| 07056 | Methane | 74-82-8 | < 6.6 | 6.6 | < 10 | 10 | 2 |
| **EPA TO-15** | **Volatiles in Air** | | **mg/m3** | **mg/m3** | **ppm(v)** | **ppm(v)** | |
| 05298 | Acetone | 67-64-1 | 0.018 | 0.0048 | 0.0077 | 0.0020 | 1 |
| 05298 | Acetonitrile | 75-05-8 | < 0.0034 | 0.0034 | < 0.0020 | 0.0020 | 1 |
| 05298 | Acrolein | 107-02-8 | < 0.0046 | 0.0046 | < 0.0020 | 0.0020 | 1 |
| 05298 | Acrylonitrile | 107-13-1 | < 0.0043 | 0.0043 | < 0.0020 | 0.0020 | 1 |
| 05298 | Benzene | 71-43-2 | < 0.0032 | 0.0032 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromobenzene | 108-86-1 | < 0.0064 | 0.0064 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromodichloromethane | 75-27-4 | < 0.0067 | 0.0067 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromoform | 75-25-2 | < 0.010 | 0.010 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromomethane | 74-83-9 | < 0.0039 | 0.0039 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3-Butadiene | 106-99-0 | < 0.0044 | 0.0044 | < 0.0020 | 0.0020 | 1 |
| 05298 | 2-Butanone | 78-93-3 | 0.0059 | 0.0059 | 0.0020 | 0.0020 | 1 |
| 05298 | tert-Butyl Alcohol | 75-65-0 | < 0.0030 | 0.0030 | < 0.0010 | 0.0010 | 1 |
| 05298 | Carbon Disulfide | 75-15-0 | 0.0067 | 0.0031 | 0.0021 | 0.0010 | 1 |
| 05298 | Carbon Tetrachloride | 56-23-5 | < 0.0063 | 0.0063 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chlorobenzene | 108-90-7 | < 0.0046 | 0.0046 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chlorodifluoromethane | 75-45-6 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chloroethane | 75-00-3 | < 0.0026 | 0.0026 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chloroform | 67-66-3 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chloromethane | 74-87-3 | < 0.0021 | 0.0021 | < 0.0010 | 0.0010 | 1 |
| 05298 | 3-Chloropropene | 107-05-1 | < 0.0031 | 0.0031 | < 0.0010 | 0.0010 | 1 |
| 05298 | Cumene | 98-82-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dibromochloromethane | 124-48-1 | < 0.0085 | 0.0085 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dibromoethane | 106-93-4 | < 0.0077 | 0.0077 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dibromomethane | 74-95-3 | < 0.0071 | 0.0071 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichlorobenzene | 95-50-1 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3-Dichlorobenzene | 541-73-1 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,4-Dichlorobenzene | 106-46-7 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dichlorodifluoromethane | 75-71-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1-Dichloroethane | 75-34-3 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichloroethane | 107-06-2 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1-Dichloroethene | 75-35-4 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | cis-1,2-Dichloroethene | 156-59-2 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | trans-1,2-Dichloroethene | 156-60-5 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dichlorofluoromethane | 75-43-4 | < 0.0042 | 0.0042 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichloropropane | 78-87-5 | < 0.0046 | 0.0046 | < 0.0010 | 0.0010 | 1 |
| 05298 | cis-1,3-Dichloropropene | 10061-01-5 | < 0.0045 | 0.0045 | < 0.0010 | 0.0010 | 1 |
| 05298 | trans-1,3-Dichloropropene | 10061-02-6 | < 0.0045 | 0.0045 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,4-Dioxane | 123-91-1 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Acetate | 141-78-6 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Acrylate | 140-88-5 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Methacrylate | 97-63-2 | < 0.0047 | 0.0047 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethylbenzene | 100-41-4 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 05298 | 4-Ethyltoluene | 622-96-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Freon 113 | 76-13-1 | < 0.015 | 0.015 | < 0.0020 | 0.0020 | 1 |
| 05298 | Freon 114 | 76-14-2 | < 0.0070 | 0.0070 | < 0.0010 | 0.0010 | 1 |
| 05298 | Heptane | 142-82-5 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |

**Lancaster Laboratories Sample No. AQ 5695005**

**Group No. 1148396**
**PA**

**Jackson Ambient Can #062 Grab Air**
**Philadelphia Refinery Jackson St**
**COC: 209188 Jackson Ambient**

Collected: 06/05/2009 09:41 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA TO-15** | **Volatiles in Air** | | mg/m3 | mg/m3 | ppm(v) | ppm(v) | |
| 05298 | Hexachlorobutadiene | 87-68-3 | < 0.021 | 0.021 | < 0.0020 | 0.0020 | 1 |
| 05298 | Hexachloroethane | 67-72-1 | < 0.0097 | 0.0097 | < 0.0010 | 0.0010 | 1 |
| 05298 | Hexane | 110-54-3 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | 2-Hexanone | 591-78-6 | < 0.0082 | 0.0082 | < 0.0020 | 0.0020 | 1 |
| 05298 | Isooctane | 540-84-1 | < 0.0047 | 0.0047 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl Acrylate | 96-33-3 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl Iodide | 74-88-4 | < 0.0058 | 0.0058 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl Methacrylate | 80-62-6 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |
| 05298 | Alpha Methyl Styrene | 98-83-9 | < 0.0048 | 0.0048 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl t-Butyl Ether | 1634-04-4 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | 4-Methyl-2-Pentanone | 108-10-1 | < 0.0082 | 0.0082 | < 0.0020 | 0.0020 | 1 |
| 05298 | Methylene Chloride | 75-09-2 | 0.042 | 0.0035 | 0.012 | 0.0010 | 1 |
| 05298 | Octane | 111-65-9 | < 0.0047 | 0.0047 | < 0.0010 | 0.0010 | 1 |
| 05298 | Pentane | 109-66-0 | < 0.0030 | 0.0030 | < 0.0010 | 0.0010 | 1 |
| 05298 | Propene | 115-07-1 | < 0.0017 | 0.0017 | < 0.0010 | 0.0010 | 1 |
| 05298 | Styrene | 100-42-5 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,1,2-Tetrachloroethane | 630-20-6 | < 0.0069 | 0.0069 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,2,2-Tetrachloroethane | 79-34-5 | < 0.0069 | 0.0069 | < 0.0010 | 0.0010 | 1 |
| 05298 | Tetrachloroethene | 127-18-4 | < 0.0068 | 0.0068 | < 0.0010 | 0.0010 | 1 |
| 05298 | Toluene | 108-88-3 | < 0.0038 | 0.0038 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,4-Trichlorobenzene | 120-82-1 | < 0.015 | 0.015 | < 0.0020 | 0.0020 | 1 |
| 05298 | 1,1,1-Trichloroethane | 71-55-6 | < 0.0055 | 0.0055 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,2-Trichloroethane | 79-00-5 | < 0.0055 | 0.0055 | < 0.0010 | 0.0010 | 1 |
| 05298 | Trichloroethene | 79-01-6 | < 0.0054 | 0.0054 | < 0.0010 | 0.0010 | 1 |
| 05298 | Trichlorofluoromethane | 75-69-4 | < 0.0056 | 0.0056 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,3-Trichloropropane | 96-18-4 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,4-Trimethylbenzene | 95-63-6 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3,5-Trimethylbenzene | 108-67-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Vinyl Acetate | 108-05-4 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Vinyl Chloride | 75-01-4 | < 0.0026 | 0.0026 | < 0.0010 | 0.0010 | 1 |
| 05298 | m/p-Xylene | n.a. | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 05298 | o-Xylene | 95-47-6 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |

QC %Recovery limits for Vinyl Acetate, 1,4-Dioxane, and 2-Hexanone are advisory only.

LOQ = Limit of Quantitation

## General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/10

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report



**Lancaster Laboratories Sample No. AQ 5695005**

**Group No. 1148396**
**PA**

**Jackson Ambient Can #062 Grab Air**
**Philadelphia Refinery Jackson St**
**COC: 209188 Jackson Ambient**

Collected: 06/05/2009 09:41 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Batch# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 05298 | TO 15 VOA Ext. List | EPA TO-15 | 1 | C0916730AB | 06/17/2009 17:22 | Jonathan K Nardelli | 1 |
| 07056 | Methane | EPA 18 modified | 1 | M091621ZA | 06/10/2009 19:27 | David I Ressler | 2 |

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1148396
Reported: 06/18/09 at 02:42 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|
| Batch number: C0916730AA | Sample number(s): 5695002-5695004 | | | | | | | |
| Acetone | < 0.0048 | 0.0048 | mg/m3 | 121 | 128 | 70-130 | 6 | 25 |
| Acetonitrile | < 0.0034 | 0.0034 | mg/m3 | | | | | |
| Acrolein | < 0.0046 | 0.0046 | mg/m3 | | | | | |
| Acrylonitrile | < 0.0043 | 0.0043 | mg/m3 | | | | | |
| Benzene | < 0.0032 | 0.0032 | mg/m3 | 102 | 106 | 70-130 | 4 | 25 |
| Bromobenzene | < 0.0064 | 0.0064 | mg/m3 | | | | | |
| Bromodichloromethane | < 0.0067 | 0.0067 | mg/m3 | 91 | 94 | 70-130 | 3 | 25 |
| Bromoform | < 0.010 | 0.010 | mg/m3 | 73 | 76 | 70-130 | 4 | 25 |
| Bromomethane | < 0.0039 | 0.0039 | mg/m3 | 107 | 113 | 70-130 | 5 | 25 |
| 1,3-Butadiene | < 0.0044 | 0.0044 | mg/m3 | 117 | 122 | 70-130 | 4 | 25 |
| 2-Butanone | < 0.0059 | 0.0059 | mg/m3 | 116 | 118 | 70-130 | 2 | 25 |
| tert-Butyl Alcohol | < 0.0030 | 0.0030 | mg/m3 | | | | | |
| Carbon Disulfide | < 0.0031 | 0.0031 | mg/m3 | 77 | 80 | 70-130 | 4 | 25 |
| Carbon Tetrachloride | < 0.0063 | 0.0063 | mg/m3 | 90 | 95 | 70-130 | 5 | 25 |
| Chlorobenzene | < 0.0046 | 0.0046 | mg/m3 | 95 | 98 | 70-130 | 4 | 25 |
| Chlorodifluoromethane | < 0.0035 | 0.0035 | mg/m3 | | | | | |
| Chloroethane | < 0.0026 | 0.0026 | mg/m3 | 106 | 111 | 57-131 | 4 | 25 |
| Chloroform | < 0.0049 | 0.0049 | mg/m3 | 105 | 109 | 70-130 | 4 | 25 |
| Chloromethane | < 0.0021 | 0.0021 | mg/m3 | 100 | 107 | 50-127 | 7 | 25 |
| 3-Chloropropene | < 0.0031 | 0.0031 | mg/m3 | | | | | |
| Cumene | < 0.0049 | 0.0049 | mg/m3 | | | | | |
| Dibromochloromethane | < 0.0085 | 0.0085 | mg/m3 | 85 | 88 | 70-130 | 3 | 25 |
| 1,2-Dibromoethane | < 0.0077 | 0.0077 | mg/m3 | 99 | 102 | 53-158 | 3 | 25 |
| Dibromomethane | < 0.0071 | 0.0071 | mg/m3 | | | | | |
| 1,2-Dichlorobenzene | < 0.0060 | 0.0060 | mg/m3 | 94 | 99 | 46-171 | 5 | 25 |
| 1,3-Dichlorobenzene | < 0.0060 | 0.0060 | mg/m3 | 85 | 90 | 46-170 | 6 | 25 |
| 1,4-Dichlorobenzene | < 0.0060 | 0.0060 | mg/m3 | 90 | 94 | 39-169 | 5 | 25 |
| Dichlorodifluoromethane | < 0.0049 | 0.0049 | mg/m3 | 101 | 108 | 54-122 | 7 | 25 |
| 1,1-Dichloroethane | < 0.0040 | 0.0040 | mg/m3 | 97 | 102 | 56-128 | 4 | 25 |
| 1,2-Dichloroethane | < 0.0040 | 0.0040 | mg/m3 | 98 | 102 | 70-130 | 3 | 25 |
| 1,1-Dichloroethene | < 0.0040 | 0.0040 | mg/m3 | 98 | 103 | 56-127 | 5 | 25 |
| cis-1,2-Dichloroethene | < 0.0040 | 0.0040 | mg/m3 | 103 | 107 | 52-125 | 4 | 25 |
| trans-1,2-Dichloroethene | < 0.0040 | 0.0040 | mg/m3 | 93 | 97 | 70-130 | 4 | 25 |
| Dichlorofluoromethane | < 0.0042 | 0.0042 | mg/m3 | | | | | |
| 1,2-Dichloropropane | < 0.0046 | 0.0046 | mg/m3 | 93 | 96 | 70-130 | 3 | 25 |
| cis-1,3-Dichloropropene | < 0.0045 | 0.0045 | mg/m3 | 97 | 101 | 48-132 | 3 | 25 |
| trans-1,3-Dichloropropene | < 0.0045 | 0.0045 | mg/m3 | 91 | 95 | 53-147 | 4 | 25 |
| 1,4-Dioxane | < 0.0036 | 0.0036 | mg/m3 | 167* | 160* | 70-130 | 4 | 25 |
| Ethyl Acetate | < 0.0036 | 0.0036 | mg/m3 | 96 | 99 | 70-130 | 4 | 25 |
| Ethyl Acrylate | < 0.0041 | 0.0041 | mg/m3 | | | | | |
| Ethyl Methacrylate | < 0.0047 | 0.0047 | mg/m3 | | | | | |
| Ethylbenzene | < 0.0043 | 0.0043 | mg/m3 | 104 | 108 | 70-130 | 4 | 25 |
| 4-Ethyltoluene | < 0.0049 | 0.0049 | mg/m3 | 91 | 96 | 70-130 | 5 | 25 |
| Freon 113 | < 0.015 | 0.015 | mg/m3 | 93 | 96 | 61-135 | 3 | 25 |
| Freon 114 | < 0.0070 | 0.0070 | mg/m3 | 108 | 115 | 58-125 | 6 | 25 |
| Heptane | < 0.0041 | 0.0041 | mg/m3 | 106 | 110 | 70-130 | 3 | 25 |

*- Outside of specification
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1148396
Reported: 06/18/09 at 02:42 PM

### Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|
| Hexachlorobutadiene | < 0.021 | 0.021 | mg/m3 | 85 | 88 | 32-200 | 4 | 25 |
| Hexachloroethane | < 0.0097 | 0.0097 | mg/m3 | | | | | |
| Hexane | < 0.0035 | 0.0035 | mg/m3 | 108 | 110 | 70-130 | 2 | 25 |
| 2-Hexanone | < 0.0082 | 0.0082 | mg/m3 | 133* | 140* | 70-130 | 5 | 25 |
| Isooctane | < 0.0047 | 0.0047 | mg/m3 | | | | | |
| Methyl Acrylate | < 0.0035 | 0.0035 | mg/m3 | | | | | |
| Methyl Iodide | < 0.0058 | 0.0058 | mg/m3 | | | | | |
| Methyl Methacrylate | < 0.0041 | 0.0041 | mg/m3 | | | | | |
| Alpha Methyl Styrene | < 0.0048 | 0.0048 | mg/m3 | | | | | |
| Methyl t-Butyl Ether | < 0.0036 | 0.0036 | mg/m3 | 99 | 103 | 70-130 | 4 | 25 |
| 4-Methyl-2-Pentanone | < 0.0082 | 0.0082 | mg/m3 | 123 | 127 | 70-130 | 3 | 25 |
| Methylene Chloride | < 0.0035 | 0.0035 | mg/m3 | 91 | 94 | 70-130 | 3 | 25 |
| Octane | < 0.0047 | 0.0047 | mg/m3 | | | | | |
| Pentane | < 0.0030 | 0.0030 | mg/m3 | | | | | |
| Propene | < 0.0017 | 0.0017 | mg/m3 | 84 | 91 | 70-130 | 8 | 25 |
| Styrene | < 0.0043 | 0.0043 | mg/m3 | 97 | 100 | 58-169 | 4 | 25 |
| 1,1,1,2-Tetrachloroethane | < 0.0069 | 0.0069 | mg/m3 | | | | | |
| 1,1,2,2-Tetrachloroethane | < 0.0069 | 0.0069 | mg/m3 | 94 | 98 | 43-171 | 5 | 25 |
| Tetrachloroethene | < 0.0068 | 0.0068 | mg/m3 | 94 | 98 | 70-130 | 4 | 25 |
| Toluene | < 0.0038 | 0.0038 | mg/m3 | 106 | 110 | 70-130 | 3 | 25 |
| 1,2,4-Trichlorobenzene | < 0.015 | 0.015 | mg/m3 | 94 | 98 | 32-200 | 4 | 25 |
| 1,1,1-Trichloroethane | < 0.0055 | 0.0055 | mg/m3 | 92 | 96 | 70-130 | 5 | 25 |
| 1,1,2-Trichloroethane | < 0.0055 | 0.0055 | mg/m3 | 90 | 93 | 54-132 | 3 | 25 |
| Trichloroethene | < 0.0054 | 0.0054 | mg/m3 | 100 | 103 | 70-130 | 2 | 25 |
| Trichlorofluoromethane | < 0.0056 | 0.0056 | mg/m3 | 99 | 104 | 70-130 | 5 | 25 |
| 1,2,3-Trichloropropane | < 0.0060 | 0.0060 | mg/m3 | | | | | |
| 1,2,4-Trimethylbenzene | < 0.0049 | 0.0049 | mg/m3 | 97 | 102 | 44-164 | 5 | 25 |
| 1,3,5-Trimethylbenzene | < 0.0049 | 0.0049 | mg/m3 | 101 | 105 | 49-157 | 4 | 25 |
| Vinyl Acetate | < 0.0035 | 0.0035 | mg/m3 | 58* | 60* | 70-130 | 4 | 25 |
| Vinyl Chloride | < 0.0026 | 0.0026 | mg/m3 | 114 | 120 | 70-130 | 5 | 25 |
| m/p-Xylene | < 0.0043 | 0.0043 | mg/m3 | 116 | 121 | 70-130 | 4 | 25 |
| o-Xylene | < 0.0043 | 0.0043 | mg/m3 | 110 | 115 | 70-130 | 5 | 25 |
| Batch number: C0916730AB | Sample number(s): 5695005 | | | | | | | |
| Acetone | < 0.0048 | 0.0048 | mg/m3 | 121 | 128 | 70-130 | 6 | 25 |
| Acetonitrile | < 0.0034 | 0.0034 | mg/m3 | | | | | |
| Acrolein | < 0.0046 | 0.0046 | mg/m3 | | | | | |
| Acrylonitrile | < 0.0043 | 0.0043 | mg/m3 | | | | | |
| Benzene | < 0.0032 | 0.0032 | mg/m3 | 102 | 106 | 70-130 | 4 | 25 |
| Bromobenzene | < 0.0064 | 0.0064 | mg/m3 | | | | | |
| Bromodichloromethane | < 0.0067 | 0.0067 | mg/m3 | 91 | 94 | 70-130 | 3 | 25 |
| Bromoform | < 0.010 | 0.010 | mg/m3 | 73 | 76 | 70-130 | 4 | 25 |
| Bromomethane | < 0.0039 | 0.0039 | mg/m3 | 107 | 113 | 70-130 | 5 | 25 |
| 1,3-Butadiene | < 0.0044 | 0.0044 | mg/m3 | 117 | 122 | 70-130 | 4 | 25 |
| 2-Butanone | < 0.0059 | 0.0059 | mg/m3 | 116 | 118 | 70-130 | 2 | 25 |
| tert-Butyl Alcohol | < 0.0030 | 0.0030 | mg/m3 | | | | | |
| Carbon Disulfide | < 0.0031 | 0.0031 | mg/m3 | 77 | 80 | 70-130 | 4 | 25 |
| Carbon Tetrachloride | < 0.0063 | 0.0063 | mg/m3 | 90 | 95 | 70-130 | 5 | 25 |
| Chlorobenzene | < 0.0046 | 0.0046 | mg/m3 | 95 | 98 | 70-130 | 4 | 25 |
| Chlorodifluoromethane | < 0.0035 | 0.0035 | mg/m3 | | | | | |
| Chloroethane | < 0.0026 | 0.0026 | mg/m3 | 106 | 111 | 57-131 | 4 | 25 |
| Chloroform | < 0.0049 | 0.0049 | mg/m3 | 105 | 109 | 70-130 | 4 | 25 |
| Chloromethane | < 0.0021 | 0.0021 | mg/m3 | 100 | 107 | 50-127 | 7 | 25 |
| 3-Chloropropene | < 0.0031 | 0.0031 | mg/m3 | | | | | |
| Cumene | < 0.0049 | 0.0049 | mg/m3 | | | | | |

*- Outside of specification
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1148396
Reported: 06/18/09 at 02:42 PM

### Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|
| Dibromochloromethane | < 0.0085 | 0.0085 | mg/m3 | 85 | 88 | 70-130 | 3 | 25 |
| 1,2-Dibromoethane | < 0.0077 | 0.0077 | mg/m3 | 99 | 102 | 53-158 | 3 | 25 |
| Dibromomethane | < 0.0071 | 0.0071 | mg/m3 | | | | | |
| 1,2-Dichlorobenzene | < 0.0060 | 0.0060 | mg/m3 | 94 | 99 | 46-171 | 5 | 25 |
| 1,3-Dichlorobenzene | < 0.0060 | 0.0060 | mg/m3 | 85 | 90 | 46-170 | 6 | 25 |
| 1,4-Dichlorobenzene | < 0.0060 | 0.0060 | mg/m3 | 90 | 94 | 39-169 | 5 | 25 |
| Dichlorodifluoromethane | < 0.0049 | 0.0049 | mg/m3 | 101 | 108 | 54-122 | 7 | 25 |
| 1,1-Dichloroethane | < 0.0040 | 0.0040 | mg/m3 | 97 | 102 | 56-128 | 4 | 25 |
| 1,2-Dichloroethane | < 0.0040 | 0.0040 | mg/m3 | 98 | 102 | 70-130 | 3 | 25 |
| 1,1-Dichloroethene | < 0.0040 | 0.0040 | mg/m3 | 98 | 103 | 56-127 | 5 | 25 |
| cis-1,2-Dichloroethene | < 0.0040 | 0.0040 | mg/m3 | 103 | 107 | 52-125 | 4 | 25 |
| trans-1,2-Dichloroethene | < 0.0040 | 0.0040 | mg/m3 | 93 | 97 | 70-130 | 4 | 25 |
| Dichlorofluoromethane | < 0.0042 | 0.0042 | mg/m3 | | | | | |
| 1,2-Dichloropropane | < 0.0046 | 0.0046 | mg/m3 | 93 | 96 | 70-130 | 3 | 25 |
| cis-1,3-Dichloropropene | < 0.0045 | 0.0045 | mg/m3 | 97 | 101 | 48-132 | 3 | 25 |
| trans-1,3-Dichloropropene | < 0.0045 | 0.0045 | mg/m3 | 91 | 95 | 53-147 | 4 | 25 |
| 1,4-Dioxane | < 0.0036 | 0.0036 | mg/m3 | 167* | 160* | 70-130 | 4 | 25 |
| Ethyl Acetate | < 0.0036 | 0.0036 | mg/m3 | 96 | 99 | 70-130 | 4 | 25 |
| Ethyl Acrylate | < 0.0041 | 0.0041 | mg/m3 | | | | | |
| Ethyl Methacrylate | < 0.0047 | 0.0047 | mg/m3 | | | | | |
| Ethylbenzene | < 0.0043 | 0.0043 | mg/m3 | 104 | 108 | 70-130 | 4 | 25 |
| 4-Ethyltoluene | < 0.0049 | 0.0049 | mg/m3 | 91 | 96 | 70-130 | 5 | 25 |
| Freon 113 | < 0.015 | 0.015 | mg/m3 | 93 | 96 | 61-135 | 3 | 25 |
| Freon 114 | < 0.0070 | 0.0070 | mg/m3 | 108 | 115 | 58-125 | 6 | 25 |
| Heptane | < 0.0041 | 0.0041 | mg/m3 | 106 | 110 | 70-130 | 3 | 25 |
| Hexachlorobutadiene | < 0.021 | 0.021 | mg/m3 | 85 | 88 | 32-200 | 4 | 25 |
| Hexachloroethane | < 0.0097 | 0.0097 | mg/m3 | | | | | |
| Hexane | < 0.0035 | 0.0035 | mg/m3 | 108 | 110 | 70-130 | 2 | 25 |
| 2-Hexanone | < 0.0082 | 0.0082 | mg/m3 | 133* | 140* | 70-130 | 5 | 25 |
| Isooctane | < 0.0047 | 0.0047 | mg/m3 | | | | | |
| Methyl Acrylate | < 0.0035 | 0.0035 | mg/m3 | | | | | |
| Methyl Iodide | < 0.0058 | 0.0058 | mg/m3 | | | | | |
| Methyl Methacrylate | < 0.0041 | 0.0041 | mg/m3 | | | | | |
| Alpha Methyl Styrene | < 0.0048 | 0.0048 | mg/m3 | | | | | |
| Methyl t-Butyl Ether | < 0.0036 | 0.0036 | mg/m3 | 99 | 103 | 70-130 | 4 | 25 |
| 4-Methyl-2-Pentanone | < 0.0082 | 0.0082 | mg/m3 | 123 | 127 | 70-130 | 3 | 25 |
| Methylene Chloride | < 0.0035 | 0.0035 | mg/m3 | 91 | 94 | 70-130 | 3 | 25 |
| Octane | < 0.0047 | 0.0047 | mg/m3 | | | | | |
| Pentane | < 0.0030 | 0.0030 | mg/m3 | | | | | |
| Propene | < 0.0017 | 0.0017 | mg/m3 | 84 | 91 | 70-130 | 8 | 25 |
| Styrene | < 0.0043 | 0.0043 | mg/m3 | 97 | 100 | 58-169 | 4 | 25 |
| 1,1,1,2-Tetrachloroethane | < 0.0069 | 0.0069 | mg/m3 | | | | | |
| 1,1,2,2-Tetrachloroethane | < 0.0069 | 0.0069 | mg/m3 | 94 | 98 | 43-171 | 5 | 25 |
| Tetrachloroethene | < 0.0068 | 0.0068 | mg/m3 | 94 | 98 | 70-130 | 4 | 25 |
| Toluene | < 0.0038 | 0.0038 | mg/m3 | 106 | 110 | 70-130 | 3 | 25 |
| 1,2,4-Trichlorobenzene | < 0.015 | 0.015 | mg/m3 | 94 | 98 | 32-200 | 4 | 25 |
| 1,1,1-Trichloroethane | < 0.0055 | 0.0055 | mg/m3 | 92 | 96 | 70-130 | 5 | 25 |
| 1,1,2-Trichloroethane | < 0.0055 | 0.0055 | mg/m3 | 90 | 93 | 54-132 | 3 | 25 |
| Trichloroethene | < 0.0054 | 0.0054 | mg/m3 | 100 | 103 | 70-130 | 2 | 25 |
| Trichlorofluoromethane | < 0.0056 | 0.0056 | mg/m3 | 99 | 104 | 70-130 | 5 | 25 |
| 1,2,3-Trichloropropane | < 0.0060 | 0.0060 | mg/m3 | | | | | |
| 1,2,4-Trimethylbenzene | < 0.0049 | 0.0049 | mg/m3 | 97 | 102 | 44-164 | 5 | 25 |
| 1,3,5-Trimethylbenzene | < 0.0049 | 0.0049 | mg/m3 | 101 | 105 | 49-157 | 4 | 25 |
| Vinyl Acetate | < 0.0035 | 0.0035 | mg/m3 | 58* | 60* | 70-130 | 4 | 25 |
| Vinyl Chloride | < 0.0026 | 0.0026 | mg/m3 | 114 | 120 | 70-130 | 5 | 25 |

*- Outside of specification
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1148396
Reported: 06/18/09 at 02:42 PM

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|
| m/p-Xylene | < 0.0043 | 0.0043 | mg/m3 | 116 | 121 | 70-130 | 4 | 25 |
| o-Xylene | < 0.0043 | 0.0043 | mg/m3 | 110 | 115 | 70-130 | 5 | 25 |
| Batch number: M091621ZA | Sample number(s): 5695002-5695005 | | | | | | | |
| Methane | < 3.3 | 3.3 | mg/m3 | | | | | |

*- Outside of specification
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1148396 Sample # 5695002-05

**COC #** 209188

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: Aquatecna Technologies Acct. #:

Project Name/#: Sun-Philly Pgl. Jackson St. PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: T. DOERR Quote #:

Name of state where samples were collected: PA

For Lab Use Only
FSC:
SCR#:

Preservation Codes
H=HCl T=Thiosulfate
N=$HNO_3$ B=NaOH
S=$H_2SO_4$ O=Other

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | Matrix (4) Soil | Water | Other | Total # of Containers | (5) Analyses Requested: Preservation Codes — Full TO-15 VOCs + Methane | Remarks | Temperature of samples upon receipt (if requested) (6) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Manhole #1 | 6/5/09 | 0942 | X | | | | X | 1 | X | Summa # 509 | |
| Manhole #3 | 6/5/09 | 0948 | X | | | | X | 1 | X | Summa # 515 | |
| Manhole #6 | 6/5/09 | 1055 | X | | | | X | 1 | X | Summa # 102 | |
| Jackson St. Ambient | 6/5/09 | 0941 | X | | | | X | 1 | X | Summa # 062 | |
| | | | | | | | | | | * Attached is sheet w/ start/stop times & gauge pressures | |

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #: td@aquatecna-tech.com
E-mail address: CC: dwebster@langan.com

(8) **Data Package Options** (please circle if required)
Type I (validation/NJ Reg)
Type II (Tier II)
Type III (Reduced NJ)
Type IV (CLP SOW)
Type VI (Raw Data Only)
TX TRRP-13
MA MCP CT RCP
SDG Complete? Yes No
Site-specific QC (MS/MSD/Dup)? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal COC Required? Yes / No

| Relinquished by: | Date | Time | Received by: | Date | Time (9) |
|---|---|---|---|---|---|
| | 6/5/09 | 1345 | Sample Room | 6/6/09 | 1345 |
| | 6/6/09 | 1005 | | 6/6/09 | 1005 |
| | 6/9/09 | 1005 | | 6/9/09 | 1005 |
| | 6/9 | 1645 | | | |
| | | | | 6/9/09 | 1645 |

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

## Summa Canister Sampling Field Data Sheet

Site: Jackson Street Sewer
Samplers: Tiffani Doerr
Date: 6/4/09 (24-hrs)

| Sample # | Ambient Air (062) | Man Hole #1 (Above Curtain) | Man Hole #2 @ Blower | Main Hole @ Manhole 6 m, W/Alton & 29th | |
|---|---|---|---|---|---|
| Location | 100' off (W) 28th St. | 50' W of 28th St. | @ Blower | | |
| Summa Canister ID | 062 | 509 | 515 | 102 | |
| Flow Controller ID | 337854 | 337461 | 316942 | 338071 | |
| Additional Tubing Added | (NO) YES - How much | (NO) YES - How much | (NO) YES - How much | (NO) YES - How much | NO / YES - How much |
| Purge Time (Start) | — | — | — | — | |
| Purge Time (Stop) | — | — | — | — | |
| Total Purge Time (min) | — | — | — | — | |
| Purge Volume | — | — | — | — | |
| PID Test of Purge Air | — | — | — | — | |
| Initial Tracer Gas Results | — | — | — | — | |
| Pressure Gauge - before sampling | (Started) 24 Hg | (Started) 27 Hg | 27 Hg | 29.5 Hg | |
| Sample Time (Start) 6/4 | 0907 | 0942 | 0952 | 1125 | |
| Sample Time (Stop) 6/5 | 0941 | 0942 | 0948 | 1055 | |
| Total Sample Time (min) | 1,474 | 1,440 | 1,436 | 1,410 | |
| Pressure Gauge - after sampling | 0 | 5 Hg | 5 Hg | 9 Hg | |
| Sample Volume | 6L | 6L | 6L | 6L | |
| Canister Pressure Went To Ambient Pressure? | (YES) / NO | YES / (NO) | YES / (NO) | YES / NO | YES / NO |
| Final Tracer Gas Results | — | — | — | — | |
| Associated Ambient Air Sample Number | 062 | 062 | 062 | 062 | |

General Comments:

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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Lancaster Laboratories

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# Analysis Report

ANALYTICAL RESULTS

Prepared for:

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

610-431-5733

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

June 18, 2009

## SAMPLE GROUP

The sample group for this submittal is 1148395. Samples arrived at the laboratory on Tuesday, June 09, 2009. The PO# for this group is PHILA REFINERY AOI-8.

| Client Description | Lancaster Labs Number |
|---|---|
| Firehouse Indoor #413 Grab Air | 5695000 |
| Firehouse Ambient #420 Grab Air | 5695001 |

## METHODOLOGY

The specific methodologies used in obtaining the enclosed analytical results are indicated on the Laboratory Chronicle.

| | | |
|---|---|---|
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Megan Breen |
| ELECTRONIC COPY TO | SUN: Aquaterra Tech. | Attn: Tiffani Doerr |
| ELECTRONIC COPY TO | LLI | Attn: EDD Group |
| ELECTRONIC COPY TO | Langan | Attn: Dennis Webster |

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report

Questions? Contact your Client Services Representative
Jessica A Oknefski at (717) 656-2300

Respectfully Submitted,

Chad A. Moline
Group Leader

Lancaster Laboratories

2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 • 717-656-2300 Fax: 717-656-2681 • www.lancasterlabs.com

# Analysis Report



**Lancaster Laboratories Sample No. AQ 5695000**

**Group No. 1148395**
**PA**

**Firehouse Indoor #413 Grab Air**
**Philadelphia Refinery AOI-8**
**COC: 209187 Firehouse Indoor**

Collected: 06/05/2009 10:11 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA 18 modified** | **Volatiles in Air** | | **mg/m3** | **mg/m3** | **ppm(v)** | **ppm(v)** | |
| 07056 | Methane | 74-82-8 | < 6.6 | 6.6 | < 10 | 10 | 2 |
| **EPA TO-15** | **Volatiles in Air** | | **mg/m3** | **mg/m3** | **ppm(v)** | **ppm(v)** | |
| 05298 | Acetone | 67-64-1 | 0.044 | 0.0048 | 0.019 | 0.0020 | 1 |
| 05298 | Acetonitrile | 75-05-8 | < 0.0034 | 0.0034 | < 0.0020 | 0.0020 | 1 |
| 05298 | Acrolein | 107-02-8 | < 0.0046 | 0.0046 | < 0.0020 | 0.0020 | 1 |
| 05298 | Acrylonitrile | 107-13-1 | < 0.0043 | 0.0043 | < 0.0020 | 0.0020 | 1 |
| 05298 | Benzene | 71-43-2 | < 0.0032 | 0.0032 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromobenzene | 108-86-1 | < 0.0064 | 0.0064 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromodichloromethane | 75-27-4 | < 0.0067 | 0.0067 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromoform | 75-25-2 | < 0.010 | 0.010 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromomethane | 74-83-9 | < 0.0039 | 0.0039 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3-Butadiene | 106-99-0 | < 0.0044 | 0.0044 | < 0.0020 | 0.0020 | 1 |
| 05298 | 2-Butanone | 78-93-3 | 0.015 | 0.0059 | 0.0052 | 0.0020 | 1 |
| 05298 | tert-Butyl Alcohol | 75-65-0 | < 0.0030 | 0.0030 | < 0.0010 | 0.0010 | 1 |
| 05298 | Carbon Disulfide | 75-15-0 | < 0.0031 | 0.0031 | < 0.0010 | 0.0010 | 1 |
| 05298 | Carbon Tetrachloride | 56-23-5 | < 0.0063 | 0.0063 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chlorobenzene | 108-90-7 | < 0.0046 | 0.0046 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chlorodifluoromethane | 75-45-6 | 0.020 | 0.0035 | 0.0056 | 0.0010 | 1 |
| 05298 | Chloroethane | 75-00-3 | < 0.0026 | 0.0026 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chloroform | 67-66-3 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chloromethane | 74-87-3 | < 0.0021 | 0.0021 | < 0.0010 | 0.0010 | 1 |
| 05298 | 3-Chloropropene | 107-05-1 | < 0.0031 | 0.0031 | < 0.0010 | 0.0010 | 1 |
| 05298 | Cumene | 98-82-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dibromochloromethane | 124-48-1 | < 0.0085 | 0.0085 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dibromoethane | 106-93-4 | < 0.0077 | 0.0077 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dibromomethane | 74-95-3 | < 0.0071 | 0.0071 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichlorobenzene | 95-50-1 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3-Dichlorobenzene | 541-73-1 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,4-Dichlorobenzene | 106-46-7 | 0.039 | 0.0060 | 0.0065 | 0.0010 | 1 |
| 05298 | Dichlorodifluoromethane | 75-71-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1-Dichloroethane | 75-34-3 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichloroethane | 107-06-2 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1-Dichloroethene | 75-35-4 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | cis-1,2-Dichloroethene | 156-59-2 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | trans-1,2-Dichloroethene | 156-60-5 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dichlorofluoromethane | 75-43-4 | < 0.0042 | 0.0042 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichloropropane | 78-87-5 | < 0.0046 | 0.0046 | < 0.0010 | 0.0010 | 1 |
| 05298 | cis-1,3-Dichloropropene | 10061-01-5 | < 0.0045 | 0.0045 | < 0.0010 | 0.0010 | 1 |
| 05298 | trans-1,3-Dichloropropene | 10061-02-6 | < 0.0045 | 0.0045 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,4-Dioxane | 123-91-1 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Acetate | 141-78-6 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Acrylate | 140-88-5 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Methacrylate | 97-63-2 | < 0.0047 | 0.0047 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethylbenzene | 100-41-4 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 05298 | 4-Ethyltoluene | 622-96-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Freon 113 | 76-13-1 | < 0.015 | 0.015 | < 0.0020 | 0.0020 | 1 |
| 05298 | Freon 114 | 76-14-2 | < 0.0070 | 0.0070 | < 0.0010 | 0.0010 | 1 |
| 05298 | Heptane | 142-82-5 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |

**Lancaster Laboratories Sample No. AQ 5695000**

**Group No. 1148395**
**PA**

**Firehouse Indoor #413 Grab Air**
**Philadelphia Refinery AOI-8**
**COC: 209187 Firehouse Indoor**

Collected: 06/05/2009 10:11 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA TO-15** | **Volatiles in Air** | | mg/m3 | mg/m3 | ppm(v) | ppm(v) | |
| 05298 | Hexachlorobutadiene | 87-68-3 | < 0.021 | 0.021 | < 0.0020 | 0.0020 | 1 |
| 05298 | Hexachloroethane | 67-72-1 | < 0.0097 | 0.0097 | < 0.0010 | 0.0010 | 1 |
| 05298 | Hexane | 110-54-3 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | 2-Hexanone | 591-78-6 | < 0.0082 | 0.0082 | < 0.0020 | 0.0020 | 1 |
| 05298 | Isooctane | 540-84-1 | < 0.0047 | 0.0047 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl Acrylate | 96-33-3 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl Iodide | 74-88-4 | < 0.0058 | 0.0058 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl Methacrylate | 80-62-6 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |
| 05298 | Alpha Methyl Styrene | 98-83-9 | < 0.0048 | 0.0048 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl t-Butyl Ether | 1634-04-4 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | 4-Methyl-2-Pentanone | 108-10-1 | < 0.0082 | 0.0082 | < 0.0020 | 0.0020 | 1 |
| 05298 | Methylene Chloride | 75-09-2 | 0.015 | 0.0035 | 0.0042 | 0.0010 | 1 |
| 05298 | Octane | 111-65-9 | < 0.0047 | 0.0047 | < 0.0010 | 0.0010 | 1 |
| 05298 | Pentane | 109-66-0 | 0.0045 | 0.0030 | 0.0015 | 0.0010 | 1 |
| 05298 | Propene | 115-07-1 | 0.0041 | 0.0017 | 0.0024 | 0.0010 | 1 |
| 05298 | Styrene | 100-42-5 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,1,2-Tetrachloroethane | 630-20-6 | < 0.0069 | 0.0069 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,2,2-Tetrachloroethane | 79-34-5 | < 0.0069 | 0.0069 | < 0.0010 | 0.0010 | 1 |
| 05298 | Tetrachloroethene | 127-18-4 | < 0.0068 | 0.0068 | < 0.0010 | 0.0010 | 1 |
| 05298 | Toluene | 108-88-3 | < 0.0038 | 0.0038 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,4-Trichlorobenzene | 120-82-1 | < 0.015 | 0.015 | < 0.0020 | 0.0020 | 1 |
| 05298 | 1,1,1-Trichloroethane | 71-55-6 | < 0.0055 | 0.0055 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,2-Trichloroethane | 79-00-5 | < 0.0055 | 0.0055 | < 0.0010 | 0.0010 | 1 |
| 05298 | Trichloroethene | 79-01-6 | < 0.0054 | 0.0054 | < 0.0010 | 0.0010 | 1 |
| 05298 | Trichlorofluoromethane | 75-69-4 | < 0.0056 | 0.0056 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,3-Trichloropropane | 96-18-4 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,4-Trimethylbenzene | 95-63-6 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3,5-Trimethylbenzene | 108-67-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Vinyl Acetate | 108-05-4 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Vinyl Chloride | 75-01-4 | < 0.0026 | 0.0026 | < 0.0010 | 0.0010 | 1 |
| 05298 | m/p-Xylene | n.a. | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 05298 | o-Xylene | 95-47-6 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |

QC %Recovery limits for Vinyl Acetate, 1,4-Dioxane, and 2-Hexanone are advisory only.

LOQ = Limit of Quantitation

## General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/10

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. AQ 5695000**

**Group No. 1148395**
**PA**

**Firehouse Indoor #413 Grab Air**
**Philadelphia Refinery AOI-8**
**COC: 209187 Firehouse Indoor**

Collected: 06/05/2009 10:11 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Batch# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 05298 | TO 15 VOA Ext. List | EPA TO-15 | 1 | C0916730AA | 06/16/2009 14:10 | Jonathan K Nardelli | 1 |
| 07056 | Methane | EPA 18 modified | 1 | M091621ZA | 06/10/2009 17:03 | David I Ressler | 2 |

Lancaster Laboratories

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# Analysis Report



**Lancaster Laboratories Sample No. AQ 5695001**

**Group No. 1148395**
**PA**

**Firehouse Ambient #420 Grab Air**
**Philadelphia Refinery AOI-8**
**COC: 209187 Firehouse Ambient**

Collected: 06/05/2009 10:07 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA 18 modified** | **Volatiles in Air** | | **mg/m3** | **mg/m3** | **ppm(v)** | **ppm(v)** | |
| 07056 | Methane | 74-82-8 | < 6.6 | 6.6 | < 10 | 10 | 2 |
| **EPA TO-15** | **Volatiles in Air** | | **mg/m3** | **mg/m3** | **ppm(v)** | **ppm(v)** | |
| 05298 | Acetone | 67-64-1 | 0.013 | 0.0048 | 0.0056 | 0.0020 | 1 |
| 05298 | Acetonitrile | 75-05-8 | < 0.0034 | 0.0034 | < 0.0020 | 0.0020 | 1 |
| 05298 | Acrolein | 107-02-8 | < 0.0046 | 0.0046 | < 0.0020 | 0.0020 | 1 |
| 05298 | Acrylonitrile | 107-13-1 | < 0.0043 | 0.0043 | < 0.0020 | 0.0020 | 1 |
| 05298 | Benzene | 71-43-2 | < 0.0032 | 0.0032 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromobenzene | 108-86-1 | < 0.0064 | 0.0064 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromodichloromethane | 75-27-4 | < 0.0067 | 0.0067 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromoform | 75-25-2 | < 0.010 | 0.010 | < 0.0010 | 0.0010 | 1 |
| 05298 | Bromomethane | 74-83-9 | < 0.0039 | 0.0039 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3-Butadiene | 106-99-0 | < 0.0044 | 0.0044 | < 0.0020 | 0.0020 | 1 |
| 05298 | 2-Butanone | 78-93-3 | < 0.0059 | 0.0059 | < 0.0020 | 0.0020 | 1 |
| 05298 | tert-Butyl Alcohol | 75-65-0 | < 0.0030 | 0.0030 | < 0.0010 | 0.0010 | 1 |
| 05298 | Carbon Disulfide | 75-15-0 | < 0.0031 | 0.0031 | < 0.0010 | 0.0010 | 1 |
| 05298 | Carbon Tetrachloride | 56-23-5 | < 0.0063 | 0.0063 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chlorobenzene | 108-90-7 | < 0.0046 | 0.0046 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chlorodifluoromethane | 75-45-6 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chloroethane | 75-00-3 | < 0.0026 | 0.0026 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chloroform | 67-66-3 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Chloromethane | 74-87-3 | < 0.0021 | 0.0021 | < 0.0010 | 0.0010 | 1 |
| 05298 | 3-Chloropropene | 107-05-1 | < 0.0031 | 0.0031 | < 0.0010 | 0.0010 | 1 |
| 05298 | Cumene | 98-82-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dibromochloromethane | 124-48-1 | < 0.0085 | 0.0085 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dibromoethane | 106-93-4 | < 0.0077 | 0.0077 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dibromomethane | 74-95-3 | < 0.0071 | 0.0071 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichlorobenzene | 95-50-1 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3-Dichlorobenzene | 541-73-1 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,4-Dichlorobenzene | 106-46-7 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dichlorodifluoromethane | 75-71-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1-Dichloroethane | 75-34-3 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichloroethane | 107-06-2 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1-Dichloroethene | 75-35-4 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | cis-1,2-Dichloroethene | 156-59-2 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | trans-1,2-Dichloroethene | 156-60-5 | < 0.0040 | 0.0040 | < 0.0010 | 0.0010 | 1 |
| 05298 | Dichlorofluoromethane | 75-43-4 | < 0.0042 | 0.0042 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2-Dichloropropane | 78-87-5 | < 0.0046 | 0.0046 | < 0.0010 | 0.0010 | 1 |
| 05298 | cis-1,3-Dichloropropene | 10061-01-5 | < 0.0045 | 0.0045 | < 0.0010 | 0.0010 | 1 |
| 05298 | trans-1,3-Dichloropropene | 10061-02-6 | < 0.0045 | 0.0045 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,4-Dioxane | 123-91-1 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Acetate | 141-78-6 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Acrylate | 140-88-5 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethyl Methacrylate | 97-63-2 | < 0.0047 | 0.0047 | < 0.0010 | 0.0010 | 1 |
| 05298 | Ethylbenzene | 100-41-4 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 05298 | 4-Ethyltoluene | 622-96-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Freon 113 | 76-13-1 | < 0.015 | 0.015 | < 0.0020 | 0.0020 | 1 |
| 05298 | Freon 114 | 76-14-2 | < 0.0070 | 0.0070 | < 0.0010 | 0.0010 | 1 |
| 05298 | Heptane | 142-82-5 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |

**Lancaster Laboratories Sample No. AQ 5695001**

**Group No. 1148395**
**PA**

**Firehouse Ambient #420 Grab Air**
**Philadelphia Refinery AOI-8**
**COC: 209187 Firehouse Ambient**

Collected: 06/05/2009 10:07 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

| CAT No. | Analysis Name | CAS Number | As Received Final Result | LOQ | As Received Final Result | LOQ | DF |
|---|---|---|---|---|---|---|---|
| **EPA TO-15** | **Volatiles in Air** | | mg/m3 | mg/m3 | ppm(v) | ppm(v) | |
| 05298 | Hexachlorobutadiene | 87-68-3 | < 0.021 | 0.021 | < 0.0020 | 0.0020 | 1 |
| 05298 | Hexachloroethane | 67-72-1 | < 0.0097 | 0.0097 | < 0.0010 | 0.0010 | 1 |
| 05298 | Hexane | 110-54-3 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | 2-Hexanone | 591-78-6 | < 0.0082 | 0.0082 | < 0.0020 | 0.0020 | 1 |
| 05298 | Isooctane | 540-84-1 | < 0.0047 | 0.0047 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl Acrylate | 96-33-3 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl Iodide | 74-88-4 | < 0.0058 | 0.0058 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl Methacrylate | 80-62-6 | < 0.0041 | 0.0041 | < 0.0010 | 0.0010 | 1 |
| 05298 | Alpha Methyl Styrene | 98-83-9 | < 0.0048 | 0.0048 | < 0.0010 | 0.0010 | 1 |
| 05298 | Methyl t-Butyl Ether | 1634-04-4 | < 0.0036 | 0.0036 | < 0.0010 | 0.0010 | 1 |
| 05298 | 4-Methyl-2-Pentanone | 108-10-1 | < 0.0082 | 0.0082 | < 0.0020 | 0.0020 | 1 |
| 05298 | Methylene Chloride | 75-09-2 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Octane | 111-65-9 | < 0.0047 | 0.0047 | < 0.0010 | 0.0010 | 1 |
| 05298 | Pentane | 109-66-0 | 0.0059 | 0.0030 | 0.0020 | 0.0010 | 1 |
| 05298 | Propene | 115-07-1 | 0.0026 | 0.0017 | 0.0015 | 0.0010 | 1 |
| 05298 | Styrene | 100-42-5 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,1,2-Tetrachloroethane | 630-20-6 | < 0.0069 | 0.0069 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,2,2-Tetrachloroethane | 79-34-5 | < 0.0069 | 0.0069 | < 0.0010 | 0.0010 | 1 |
| 05298 | Tetrachloroethene | 127-18-4 | < 0.0068 | 0.0068 | < 0.0010 | 0.0010 | 1 |
| 05298 | Toluene | 108-88-3 | < 0.0038 | 0.0038 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,4-Trichlorobenzene | 120-82-1 | < 0.015 | 0.015 | < 0.0020 | 0.0020 | 1 |
| 05298 | 1,1,1-Trichloroethane | 71-55-6 | < 0.0055 | 0.0055 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,1,2-Trichloroethane | 79-00-5 | < 0.0055 | 0.0055 | < 0.0010 | 0.0010 | 1 |
| 05298 | Trichloroethene | 79-01-6 | < 0.0054 | 0.0054 | < 0.0010 | 0.0010 | 1 |
| 05298 | Trichlorofluoromethane | 75-69-4 | < 0.0056 | 0.0056 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,3-Trichloropropane | 96-18-4 | < 0.0060 | 0.0060 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,2,4-Trimethylbenzene | 95-63-6 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | 1,3,5-Trimethylbenzene | 108-67-8 | < 0.0049 | 0.0049 | < 0.0010 | 0.0010 | 1 |
| 05298 | Vinyl Acetate | 108-05-4 | < 0.0035 | 0.0035 | < 0.0010 | 0.0010 | 1 |
| 05298 | Vinyl Chloride | 75-01-4 | < 0.0026 | 0.0026 | < 0.0010 | 0.0010 | 1 |
| 05298 | m/p-Xylene | n.a. | 0.0046 | 0.0043 | 0.0011 | 0.0010 | 1 |
| 05298 | o-Xylene | 95-47-6 | < 0.0043 | 0.0043 | < 0.0010 | 0.0010 | 1 |

QC %Recovery limits for Vinyl Acetate, 1,4-Dioxane, and 2-Hexanone are advisory only.

LOQ = Limit of Quantitation

## General Sample Comments

PA DEP Lab Certification ID 36-00037, Expiration Date: 1/31/10

All QC is compliant unless otherwise noted. Please refer to the Quality Control Summary for overall QC performance data and associated samples.

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# Analysis Report



**Lancaster Laboratories Sample No. AQ 5695001**

**Group No. 1148395**
**PA**

**Firehouse Ambient #420 Grab Air**
**Philadelphia Refinery AOI-8**
**COC: 209187 Firehouse Ambient**

Collected: 06/05/2009 10:07 by TD

Account Number: 10132

Submitted: 06/09/2009 16:45
Reported: 06/18/2009 at 14:42
Discard: 08/18/2009

SUN: Aquaterra Tech.
PO Box 744
West Chester PA 19381

## Laboratory Chronicle

| CAT No. | Analysis Name | Method | Trial# | Batch# | Analysis Date and Time | Analyst | Dilution Factor |
|---|---|---|---|---|---|---|---|
| 05298 | TO 15 VOA Ext. List | EPA TO-15 | 1 | C0916730AA | 06/16/2009 14:55 | Jonathan K Nardelli | 1 |
| 07056 | Methane | EPA 18 modified | 1 | M091621ZA | 06/10/2009 17:32 | David I Ressler | 2 |

Lancaster Laboratories

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# Analysis Report



## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1148395
Reported: 06/18/09 at 02:42 PM

Matrix QC may not be reported if site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD was performed, unless otherwise specified in the method.

## Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|
| Batch number: C0916730AA | Sample number(s): 5695000-5695001 | | | | | | | |
| Acetone | < 0.0048 | 0.0048 | mg/m3 | 121 | 128 | 70-130 | 6 | 25 |
| Acetonitrile | < 0.0034 | 0.0034 | mg/m3 | | | | | |
| Acrolein | < 0.0046 | 0.0046 | mg/m3 | | | | | |
| Acrylonitrile | < 0.0043 | 0.0043 | mg/m3 | | | | | |
| Benzene | < 0.0032 | 0.0032 | mg/m3 | 102 | 106 | 70-130 | 4 | 25 |
| Bromobenzene | < 0.0064 | 0.0064 | mg/m3 | | | | | |
| Bromodichloromethane | < 0.0067 | 0.0067 | mg/m3 | 91 | 94 | 70-130 | 3 | 25 |
| Bromoform | < 0.010 | 0.010 | mg/m3 | 73 | 76 | 70-130 | 4 | 25 |
| Bromomethane | < 0.0039 | 0.0039 | mg/m3 | 107 | 113 | 70-130 | 5 | 25 |
| 1,3-Butadiene | < 0.0044 | 0.0044 | mg/m3 | 117 | 122 | 70-130 | 4 | 25 |
| 2-Butanone | < 0.0059 | 0.0059 | mg/m3 | 116 | 118 | 70-130 | 2 | 25 |
| tert-Butyl Alcohol | < 0.0030 | 0.0030 | mg/m3 | | | | | |
| Carbon Disulfide | < 0.0031 | 0.0031 | mg/m3 | 77 | 80 | 70-130 | 4 | 25 |
| Carbon Tetrachloride | < 0.0063 | 0.0063 | mg/m3 | 90 | 95 | 70-130 | 5 | 25 |
| Chlorobenzene | < 0.0046 | 0.0046 | mg/m3 | 95 | 98 | 70-130 | 4 | 25 |
| Chlorodifluoromethane | < 0.0035 | 0.0035 | mg/m3 | | | | | |
| Chloroethane | < 0.0026 | 0.0026 | mg/m3 | 106 | 111 | 57-131 | 4 | 25 |
| Chloroform | < 0.0049 | 0.0049 | mg/m3 | 105 | 109 | 70-130 | 4 | 25 |
| Chloromethane | < 0.0021 | 0.0021 | mg/m3 | 100 | 107 | 50-127 | 7 | 25 |
| 3-Chloropropene | < 0.0031 | 0.0031 | mg/m3 | | | | | |
| Cumene | < 0.0049 | 0.0049 | mg/m3 | | | | | |
| Dibromochloromethane | < 0.0085 | 0.0085 | mg/m3 | 85 | 88 | 70-130 | 3 | 25 |
| 1,2-Dibromoethane | < 0.0077 | 0.0077 | mg/m3 | 99 | 102 | 53-158 | 3 | 25 |
| Dibromomethane | < 0.0071 | 0.0071 | mg/m3 | | | | | |
| 1,2-Dichlorobenzene | < 0.0060 | 0.0060 | mg/m3 | 94 | 99 | 46-171 | 5 | 25 |
| 1,3-Dichlorobenzene | < 0.0060 | 0.0060 | mg/m3 | 85 | 90 | 46-170 | 6 | 25 |
| 1,4-Dichlorobenzene | < 0.0060 | 0.0060 | mg/m3 | 90 | 94 | 39-169 | 5 | 25 |
| Dichlorodifluoromethane | < 0.0049 | 0.0049 | mg/m3 | 101 | 108 | 54-122 | 7 | 25 |
| 1,1-Dichloroethane | < 0.0040 | 0.0040 | mg/m3 | 97 | 102 | 56-128 | 4 | 25 |
| 1,2-Dichloroethane | < 0.0040 | 0.0040 | mg/m3 | 98 | 102 | 70-130 | 3 | 25 |
| 1,1-Dichloroethene | < 0.0040 | 0.0040 | mg/m3 | 98 | 103 | 56-127 | 5 | 25 |
| cis-1,2-Dichloroethene | < 0.0040 | 0.0040 | mg/m3 | 103 | 107 | 52-125 | 4 | 25 |
| trans-1,2-Dichloroethene | < 0.0040 | 0.0040 | mg/m3 | 93 | 97 | 70-130 | 4 | 25 |
| Dichlorofluoromethane | < 0.0042 | 0.0042 | mg/m3 | | | | | |
| 1,2-Dichloropropane | < 0.0046 | 0.0046 | mg/m3 | 93 | 96 | 70-130 | 3 | 25 |
| cis-1,3-Dichloropropene | < 0.0045 | 0.0045 | mg/m3 | 97 | 101 | 48-132 | 3 | 25 |
| trans-1,3-Dichloropropene | < 0.0045 | 0.0045 | mg/m3 | 91 | 95 | 53-147 | 4 | 25 |
| 1,4-Dioxane | < 0.0036 | 0.0036 | mg/m3 | 167* | 160* | 70-130 | 4 | 25 |
| Ethyl Acetate | < 0.0036 | 0.0036 | mg/m3 | 96 | 99 | 70-130 | 4 | 25 |
| Ethyl Acrylate | < 0.0041 | 0.0041 | mg/m3 | | | | | |
| Ethyl Methacrylate | < 0.0047 | 0.0047 | mg/m3 | | | | | |
| Ethylbenzene | < 0.0043 | 0.0043 | mg/m3 | 104 | 108 | 70-130 | 4 | 25 |
| 4-Ethyltoluene | < 0.0049 | 0.0049 | mg/m3 | 91 | 96 | 70-130 | 5 | 25 |
| Freon 113 | < 0.015 | 0.015 | mg/m3 | 93 | 96 | 61-135 | 3 | 25 |
| Freon 114 | < 0.0070 | 0.0070 | mg/m3 | 108 | 115 | 58-125 | 6 | 25 |
| Heptane | < 0.0041 | 0.0041 | mg/m3 | 106 | 110 | 70-130 | 3 | 25 |

*- Outside of specification
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

## Quality Control Summary

Client Name: SUN: Aquaterra Tech. Group Number: 1148395
Reported: 06/18/09 at 02:42 PM

### Laboratory Compliance Quality Control

| Analysis Name | Blank Result | Blank LOQ | Report Units | LCS %REC | LCSD %REC | LCS/LCSD Limits | RPD | RPD Max |
|---|---|---|---|---|---|---|---|---|
| Hexachlorobutadiene | < 0.021 | 0.021 | mg/m3 | 85 | 88 | 32-200 | 4 | 25 |
| Hexachloroethane | < 0.0097 | 0.0097 | mg/m3 | | | | | |
| Hexane | < 0.0035 | 0.0035 | mg/m3 | 108 | 110 | 70-130 | 2 | 25 |
| 2-Hexanone | < 0.0082 | 0.0082 | mg/m3 | 133* | 140* | 70-130 | 5 | 25 |
| Isooctane | < 0.0047 | 0.0047 | mg/m3 | | | | | |
| Methyl Acrylate | < 0.0035 | 0.0035 | mg/m3 | | | | | |
| Methyl Iodide | < 0.0058 | 0.0058 | mg/m3 | | | | | |
| Methyl Methacrylate | < 0.0041 | 0.0041 | mg/m3 | | | | | |
| Alpha Methyl Styrene | < 0.0048 | 0.0048 | mg/m3 | | | | | |
| Methyl t-Butyl Ether | < 0.0036 | 0.0036 | mg/m3 | 99 | 103 | 70-130 | 4 | 25 |
| 4-Methyl-2-Pentanone | < 0.0082 | 0.0082 | mg/m3 | 123 | 127 | 70-130 | 3 | 25 |
| Methylene Chloride | < 0.0035 | 0.0035 | mg/m3 | 91 | 94 | 70-130 | 3 | 25 |
| Octane | < 0.0047 | 0.0047 | mg/m3 | | | | | |
| Pentane | < 0.0030 | 0.0030 | mg/m3 | | | | | |
| Propene | < 0.0017 | 0.0017 | mg/m3 | 84 | 91 | 70-130 | 8 | 25 |
| Styrene | < 0.0043 | 0.0043 | mg/m3 | 97 | 100 | 58-169 | 4 | 25 |
| 1,1,1,2-Tetrachloroethane | < 0.0069 | 0.0069 | mg/m3 | | | | | |
| 1,1,2,2-Tetrachloroethane | < 0.0069 | 0.0069 | mg/m3 | 94 | 98 | 43-171 | 5 | 25 |
| Tetrachloroethene | < 0.0068 | 0.0068 | mg/m3 | 94 | 98 | 70-130 | 4 | 25 |
| Toluene | < 0.0038 | 0.0038 | mg/m3 | 106 | 110 | 70-130 | 3 | 25 |
| 1,2,4-Trichlorobenzene | < 0.015 | 0.015 | mg/m3 | 94 | 98 | 32-200 | 4 | 25 |
| 1,1,1-Trichloroethane | < 0.0055 | 0.0055 | mg/m3 | 92 | 96 | 70-130 | 5 | 25 |
| 1,1,2-Trichloroethane | < 0.0055 | 0.0055 | mg/m3 | 90 | 93 | 54-132 | 3 | 25 |
| Trichloroethene | < 0.0054 | 0.0054 | mg/m3 | 100 | 103 | 70-130 | 2 | 25 |
| Trichlorofluoromethane | < 0.0056 | 0.0056 | mg/m3 | 99 | 104 | 70-130 | 5 | 25 |
| 1,2,3-Trichloropropane | < 0.0060 | 0.0060 | mg/m3 | | | | | |
| 1,2,4-Trimethylbenzene | < 0.0049 | 0.0049 | mg/m3 | 97 | 102 | 44-164 | 5 | 25 |
| 1,3,5-Trimethylbenzene | < 0.0049 | 0.0049 | mg/m3 | 101 | 105 | 49-157 | 4 | 25 |
| Vinyl Acetate | < 0.0035 | 0.0035 | mg/m3 | 58* | 60* | 70-130 | 4 | 25 |
| Vinyl Chloride | < 0.0026 | 0.0026 | mg/m3 | 114 | 120 | 70-130 | 5 | 25 |
| m/p-Xylene | < 0.0043 | 0.0043 | mg/m3 | 116 | 121 | 70-130 | 4 | 25 |
| o-Xylene | < 0.0043 | 0.0043 | mg/m3 | 110 | 115 | 70-130 | 5 | 25 |

Batch number: M091621ZA Sample number(s): 5695000-5695001
Methane < 3.3 3.3 mg/m3

*- Outside of specification
(1) The result for one or both determinations was less than five times the LOQ.
(2) The unspiked result was more than four times the spike added.

# Analysis Request/ Environmental Services Chain of Custody

Lancaster Laboratories

For Lancaster Laboratories use only

Acct. # 10132 Group# 1148395 Sample # 5695000-01

**COC #** 209187

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: Aquaterra Tech Acct. #:

Project Name/#: Sun-Philly Ref. AOI-8 PWSID #:

Project Manager: T. DOERR P.O.#:

Sampler: T. DOERR Quote #:

Name of state where samples were collected: PA

**For Lab Use Only**

FSC:

SCR#:

**Preservation Codes**

H=HCl T=Thiosulfate

N=$HNO_3$ B=NaOH

S=$H_2SO_4$ O=Other

| (2) Sample Identification | Date Collected | Time Collected | (3) Grab | Composite | Matrix (4) Soil | Water | Other | Total # of Containers | (5) Analyses Requested / Preservation Codes: Full TO-15 VOC's + Methane | Remarks | (6) Temperature of samples upon receipt (if requested) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Firehouse Indoor | 6/5/09 | 1011 | X | | | | X | 1 | X | Summa # 413 | |
| Firehouse Ambient | 6/5/09 | 1007 | X | | | | X | 1 | X | Summa # 420 | |
| | | | | | | | | | | * Attached is sheet w/ start/stop times & gauge pressures | |

(7) **Turnaround Time Requested** (TAT) (please circle): (Normal) Rush

(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)

Date results are needed:

Rush results requested by (please circle): Phone Fax (E-mail)

Phone #: Fax #: tdoer@aquaterra-tech.com

E-mail address: CC: dwebster@langan.com

(8) **Data Package Options** (please circle if required)

Type I (validation/NJ Reg) TX TRRP-13

Type II (Tier II) MA MCP CT RCP

Type III (Reduced NJ)

Type IV (CLP SOW)

Type VI (Raw Data Only)

SDG Complete? (Yes) No

Site-specific QC (MS/MSD/Dup)? Yes (No)

(If yes, indicate QC sample and submit triplicate volume.)

Internal COC Required? Yes (No)

| Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|
| | 6/5/09 | 1345 | Sample Room | 6/5/09 | 1345 |
| | 6/9/09 | 1005 | | 6/9/09 | 1005 |
| | 6/9/09 | 1005 | | 6/9/09 | 1005 |
| | 6/9 | 1645 | | | |
| | | | | 6/9/09 | 1645 |

(9)

Lancaster Laboratories, Inc., 2425 New Holland Pike, Lancaster, PA 17601 (717) 656-2300 Fax: (717) 656-6766

Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.

2102.03

## Summa Canister Sampling Field Data Sheet

Site: Philly Fire Dept. Bldg.
Samplers: Tiffany Doerr
Date: 6/4/09 (24 hrs)

| Sample # | 11 | 11 | | | |
|---|---|---|---|---|---|
| Location | SE Corner Inside Bldg BR crawlspace | Firehouse Ambient | | | |
| Summa Canister ID | 413 | 420 | | | |
| Flow Controller ID | 236977 | 338068 | | | |
| Additional Tubing Added | NO/ YES - How much | NO/ YES - How much | NO/ YES - How much | NO/ YES - How much | NO/ YES - How much |
| Purge Time (Start) | — | — | | | |
| Purge Time (Stop) | — | — | | | |
| Total Purge Time (min) | — | — | | | |
| Purge Volume | — | — | | | |
| PID Test of Purge Air | — | — | | | |
| Initial Tracer Gas Results | — | — | | | |
| Pressure Gauge - before sampling | 30 ~~Hg~~ PSI | 30+ ~~Hg~~ PSI | | | |
| Sample Time (Start) 6/4 | 1041 | 1036 | | | |
| Sample Time (Stop) 6/5 | 1011 | 1007 | | | |
| Total Sample Time (min) | 1,410 | 1,411 | | | |
| Pressure Gauge - after sampling | 8 Hg | 8 Hg | | | |
| Sample Volume | 6L | 6L | | | |
| Canister Pressure Went To Ambient Pressure? | YES / NO | YES / NO | YES / NO | YES / NO | YES / NO |
| Final Tracer Gas Results | — | — | | | |
| Associated Ambient Air Sample Number | 420 | 420 | | | |
| General Comments: | | | | | |

# Lancaster Laboratories
# Explanation of Symbols and Abbreviations

*The following defines common symbols and abbreviations used in reporting technical data:*

| | | | |
|---|---|---|---|
| **N.D.** | none detected | **BMQL** | Below Minimum Quantitation Level |
| **TNTC** | Too Numerous To Count | **MPN** | Most Probable Number |
| **IU** | International Units | **CP Units** | cobalt-chloroplatinate units |
| **umhos/cm** | micromhos/cm | **NTU** | nephelometric turbidity units |
| **C** | degrees Celsius | **F** | degrees Fahrenheit |
| **Cal** | (diet) calories | **lb.** | pound(s) |
| **meq** | milliequivalents | **kg** | kilogram(s) |
| **g** | gram(s) | **mg** | milligram(s) |
| **ug** | microgram(s) | **l** | liter(s) |
| **ml** | milliliter(s) | **ul** | microliter(s) |
| **m3** | cubic meter(s) | **fib >5 um/ml** | fibers greater than 5 microns in length per ml |

**<** less than – The number following the sign is the limit of quantitation, the smallest amount of analyte which can be reliably determined using this specific test.

**>** greater than

**ppm** parts per million – One ppm is equivalent to one milligram per kilogram (mg/kg), or one gram per million grams. For aqueous liquids, ppm is usually taken to be equivalent to milligrams per liter (mg/l), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas.

**ppb** parts per billion

**Dry weight basis** Results printed under this heading have been adjusted for moisture content. This increases the analyte weight concentration to approximate the value present in a similar sample without moisture.

*U.S. EPA data qualifiers:*

**Organic Qualifiers**

| | |
|---|---|
| **A** | TIC is a possible aldol-condensation product |
| **B** | Analyte was also detected in the blank |
| **C** | Pesticide result confirmed by GC/MS |
| **D** | Compound quatitated on a diluted sample |
| **E** | Concentration exceeds the calibration range of the instrument |
| **J** | Estimated value |
| **N** | Presumptive evidence of a compound (TICs only) |
| **P** | Concentration difference between primary and confirmation columns >25% |
| **U** | Compound was not detected |
| **X,Y,Z** | Defined in case narrative |

**Inorganic Qualifiers**

| | |
|---|---|
| **B** | Value is <CRDL, but ≥IDL |
| **E** | Estimated due to interference |
| **M** | Duplicate injection precision not met |
| **N** | Spike amount not within control limits |
| **S** | Method of standard additions (MSA) used for calculation |
| **U** | Compound was not detected |
| **W** | Post digestion spike out of control limits |
| ***** | Duplicate analysis not within control limits |
| **+** | Correlation coefficient for MSA <0.995 |

Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Tests results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. This report shall not be reproduced except in full, without the written approval of the laboratory.

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**APPENDIX F**
**GROUNDWATER SAMPLING SUMMARY**
**SUNOCO PHILADELPHIA REFINERY**
**PHILADELPHIA, PENNSYLVANIA**

| Well ID | Sample Date | Depth to Product | Depth to Water | Product Thickness | Total Depth of Well | Conversion Factor (Well Diameter) | Well Volume (gallons) | Purge Volume (gallons) |
|---|---|---|---|---|---|---|---|---|
| N-1 | 7/15/2008 | | 14.53 | | 22.00 | 0.65 | 4.9 | 14.6 |
| N-10 | 7/15/2008 | | 4.77 | | 10.00 | 0.65 | 3.4 | 10.2 |
| N-11 | 7/15/2008 | | 18.26 | | 23.50 | 0.65 | 3.4 | 10.2 |
| N-12 | 7/23/2008 | | 15.89 | | 20.70 | 0.65 | 3.1 | 9.4 |
| N-13 | 7/23/2008 | | 22.34 | | 52.00 | 0.65 | 19.3 | 57.8 |
| N-14 | NS | 21.21 | 21.22 | 0.01 | - | 0.65 | - | - |
| N-15 | 7/15/2008 | | 20.83 | | 25.00 | 0.65 | 2.7 | 8.1 |
| N-16 | 7/16/2008 | | 21.91 | | 26.80 | 0.65 | 3.2 | 9.5 |
| N-17 | 7/16/2008 | | 23.39 | | 25.70 | 0.65 | 1.5 | 4.5 |
| N-18 | 7/16/2008 | | 22.11 | | 25.50 | 0.65 | 2.2 | 6.6 |
| N-19 | 7/16/2008 | | 30.16 | | 59.40 | 0.65 | 19.0 | 57.0 |
| N-2 | NS | - | - | | - | 0.65 | - | - |
| N-20 | 7/23/2008 | | 17.49 | | 22.70 | 0.65 | 3.4 | 10.2 |
| N-21 | 7/23/2008 | | 20.97 | | 55.00 | 0.65 | 22.1 | 66.4 |
| N-22 | NS | - | - | | - | 0.65 | - | - |
| N-23 | 7/22/2008 | | 10.17 | | 18.00 | 0.65 | 5.1 | 15.3 |
| N-24 | 7/18/2008 | | 11.54 | | 16.60 | 0.65 | 3.3 | 9.9 |
| N-25 | NS | 2.78 | 3.3 | 0.52 | - | 0.65 | - | - |
| N-26 | 7/17/2008 | | 5.74 | | 9.60 | 0.65 | 2.5 | 7.5 |
| N-27 | 7/17/2008 | | 21.03 | | 62.00 | 0.65 | 26.6 | 79.9 |
| N-28 | 7/16/2008 | | 9.77 | | 16.80 | 0.65 | 4.6 | 13.7 |
| N-29 | 7/22/2008 | | 30.50 | | 33.00 | 0.65 | 1.6 | 4.9 |
| N-3 | 7/15/2008 | | 16.24 | | 22.80 | 0.65 | 4.3 | 12.8 |
| N-30 | 7/22/2008 | | 37.47 | | - | 0.65 | - | NA |
| N-31 | NS | 14.87 | 15.15 | 0.28 | - | 0.65 | - | - |
| N-32 | 7/22/2008 | | 8.26 | | 22.50 | 0.65 | 9.3 | 27.8 |
| N-33 | NS | - | - | | - | 0.65 | - | - |
| N-34 | 7/24/2008 | | 6.23 | | 15.00 | 0.65 | 5.7 | 17.1 |
| N-35 | 7/24/2008 | | 9.33 | | 14.60 | 0.65 | 3.4 | 10.3 |
| N-36 | 7/25/2008 | | 8.29 | | 14.00 | 0.65 | 3.7 | 11.1 |
| N-37 | 7/24/2008 | | 11.90 | | 17.80 | 0.65 | 3.8 | 11.5 |
| N-38 | 7/24/2008 | | 5.76 | | 18.00 | 0.65 | 8.0 | 23.9 |
| N-38D | 7/24/2008 | | 9.91 | | 84.00 | 0.16 | 11.9 | 35.6 |
| N-39 | 7/28/2008 | | 3.69 | | 13.40 | 0.65 | 6.3 | 18.9 |
| N-4 | 7/15/2008 | | 19.37 | | 47.00 | 0.65 | 18.0 | 53.9 |
| N-40 | 7/25/2008 | | 5.94 | | 15.00 | 0.65 | 5.9 | 17.7 |
| N-41 | 7/28/208 | | 4.29 | | 12.00 | 0.65 | 5.0 | 15.0 |
| N-42 | NS | 7.37 | 8.18 | 0.81 | - | 0.65 | - | - |
| N-43 | Dry | | 20.07 | | 21.00 | 0.65 | 0.6 | 1.8 |
| N-44D | 7/25/2008 | | 26.34 | | 58.00 | 0.65 | 20.6 | 61.7 |
| N-45 | NS | 13.05 | 13.27 | 0.22 | - | 0.65 | - | - |
| N-46D | NS | - | - | | - | 0.65 | - | - |
| N-47 | NS | 19.69 | 20.57 | 0.88 | - | 0.65 | - | - |
| N-48 | NS | 21.4 | 21.65 | 0.25 | - | 0.65 | - | - |
| N-49 | NS | 24.41 | 26.42 | 2.01 | - | 0.65 | - | - |
| N-5 | 7/15/2008 | | 9.12 | | 15.00 | 0.65 | 3.8 | 11.5 |
| N-503 | NS | 7.84 | 8.61 | 0.77 | - | 0.65 | - | - |
| N-504 | NS | 8.21 | 8.21 | <0.01 | 23.20 | 0.65 | - | - |
| N-50D | 7/23/2008 | | 28.56 | | 58.00 | 0.65 | 19.1 | 57.4 |
| N-51 | NS | 22.25 | 23.65 | 1.4 | - | 0.65 | - | - |
| N-52 | NS | 24.48 | 24.5 | 0.02 | - | 0.65 | - | - |
| N-53 | 7/28/2008 | | 20.08 | | 26.60 | 0.65 | 4.2 | 12.7 |
| N-54 | NS | | | | | 0.65 | - | - |
| N-55 | 7/28/208 | | 2.65 | | 9.60 | 0.65 | 4.5 | 13.6 |
| N-56 | NS | | 6.87 | | 15.00 | 0.65 | - | - |
| N-57 | 7/25/2008 | | 4.74 | | 12.00 | 0.65 | 4.7 | 14.2 |
| N-58 | 7/25/2008 | | 3.21 | | 18.60 | 0.65 | 10.0 | 30.0 |
| N-59 | 8/6/2008 | | 1.29 | | 20.00 | 0.65 | 12.2 | 36.5 |
| N-6 | NS | - | - | | - | 0.65 | - | - |
| N-60 | 7/25/2008 | | 4.30 | | 15.00 | 0.65 | 7.0 | 20.9 |
| N-61 | 7/25/2008 | | 3.72 | | 19.50 | 0.65 | 10.3 | 30.8 |
| N-64 | 7/23/2008 | | 6.55 | | 16.00 | 0.65 | 6.1 | 18.4 |

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**SUNOCO PHILADELPHIA REFINERY**
**PHILADELPHIA, PENNSYLVANIA**

| Well ID | Sample Date | Depth to Product | Depth to Water | Product Thickness | Total Depth of Well | Conversion Factor (Well Diameter) | Well Volume (gallons) | Purge Volume (gallons) |
|---|---|---|---|---|---|---|---|---|
| N-65 | 7/16/2008 | | 12.59 | | 14.00 | 0.65 | 0.9 | 2.7 |
| N-66 | 7/22/2008 | | 8.05 | | 16.00 | 0.65 | 5.2 | 15.5 |
| N-67 | 7/18/2008 | | 5.63 | | 25.40 | 0.16 | 3.2 | 9.5 |
| N-68 | NS | 11.33 | 11.59 | 0.26 | - | 0.65 | - | - |
| N-69 | 7/18/2008 | | 15.42 | | 42.00 | 5.875 | 156.2 | 468.5 |
| N-7 | NS | - | - | | - | 0.65 | - | - |
| N-70 | 7/18/2008 | | 14.91 | | 38.00 | 5.875 | | 407.0 |
| N-71 | NS | - | - | | - | 0.65 | - | - |
| N-72 | NS | | 8.21 | | - | 0.65 | - | - |
| N-73 | 7/25/2008 | | 7.62 | | 45.60 | 0.16 | 6.1 | 18.2 |
| N-73D | NS | - | - | | - | 0.65 | - | - |
| N-74 | 7/25/2008 | | 6.17 | | 35.40 | 0.65 | 19.0 | 57.0 |
| N-75 | NS | 6.14 | 6.21 | 0.07 | - | 0.16 | - | - |
| N-76 | NS | 24.85 | 26.93 | 2.08 | - | 2.56 | - | - |
| N-77 | 7/18/2008 | | | | 31.00 | 0.65 | 20.2 | 60.5 |
| N-78 | NS | | - | | 10.40 | 0.65 | - | - |
| N-79 | NS | 11.1 | 11.13 | 0.03 | 28.00 | 0.65 | - | - |
| N-8 | 7/16/2008 | | 25.85 | | 32.50 | 0.65 | 4.3 | 13.0 |
| N-81 | NS | 18.17 | 18.18 | 0.01 | - | 0.65 | - | - |
| N-82 | NS | 23.29 | 23.91 | 0.62 | - | 0.65 | - | - |
| N-83 | NS | | 15.39 | 15.39 | 30.00 | 0.65 | - | - |
| N-84 | 7/16/2008 | | 6.52 | | 25.00 | 0.65 | 12.0 | 36.0 |
| N-85 | 7/16/2008 | | 14.5 | | 24.00 | 0.65 | 6.2 | 18.5 |
| N-86 | 7/17/2008 | | 14.87 | | 20.30 | 0.65 | 3.5 | 10.6 |
| N-87 | 7/17/2008 | | 15.31 | | 20.30 | 0.65 | 3.2 | 9.7 |
| N-88 | NS | - | - | | - | 0.65 | - | - |
| N-89 | 7/22/2008 | | 14.01 | | 23.40 | 0.65 | 6.1 | 18.3 |
| N-9 | 7/16/2008 | | 35.24 | | 65.00 | 0.65 | 19.3 | 58.0 |
| N-90 | 7/22/2008 | | 15.01 | | 25.00 | 0.65 | 6.5 | 19.5 |
| N-91 | NS | 8.21 | 10.79 | 2.58 | - | 0.65 | - | - |
| N-92 | 7/17/2008 | | 7.38 | | 18.00 | 0.65 | 6.9 | 20.7 |
| N-93 | 7/17/2008 | | 14.66 | | 20.20 | 0.65 | 3.6 | 10.8 |
| N-94 | 7/18/2008 | | 5.61 | | 23.40 | 0.65 | 11.6 | 34.7 |
| N-95 | NS | - | - | | - | 0.65 | - | - |
| N-97 | 8/6/2008 | | 13.8 | | 17.10 | 0.16 | 0.5 | 1.6 |
| P-30 | NS | 20.11 | 21.18 | 1.07 | - | 0.16 | - | - |
| P-42 | NS | | 12.14 | | 35.35 | 0.16 | - | - |
| P-44 | NS | | 21.65 | | 24.70 | 0.16 | - | - |
| P-45 | NS | | 23.59 | | 34.85 | 0.16 | - | - |
| PZ-201 | NS | 22.2 | 22.21 | 0.01 | 23.00 | 0.16 | - | - |
| PZ-202 | NS | | 22.15 | | 23.00 | 0.16 | - | - |
| PZ-203 | NS | | 19.93 | | 20.70 | 0.16 | - | - |
| PZ-204 | NS | 19.96 | 21.01 | 1.05 | - | 0.16 | - | - |
| PZ-300 | 7/29/2008 | | 17.13 | | 26.80 | 0.04 | 0.4 | 1.2 |
| PZ-500 | NS | | 2.01 | | 10.00 | 0.16 | - | - |
| PZ-501 | NS | | 2.88 | | 9.50 | 0.16 | - | - |
| PZ-502 | NS | 1.91 | 4.31 | 2.4 | - | 0.16 | - | - |
| PZ-503 | 7/25/2008 | | 3.65 | | 9.00 | 0.16 | 0.9 | 2.6 |
| PZ-504 | 7/25/2008 | | 2.64 | | 6.00 | 0.16 | 0.5 | 1.6 |
| PZ-505 | 7/23/2008 | | 3.44 | | 8.50 | 0.16 | 0.8 | 2.4 |
| PZ-506 | 7/23/2008 | | 6.23 | | 10.30 | 0.16 | 0.7 | 2.0 |
| PZ-507 | 7/23/2008 | | 7.89 | | 9.60 | 0.16 | 0.3 | 0.8 |
| RW-200 | 7/23/2008 | | 5.57 | | 20.50 | 1.46 | 21.8 | 65.4 |
| RW-201 | NS | 22.9 | 23.02 | 0.12 | - | 1.46 | - | - |
| RW-202 | 7/29/2008 | | 20.13 | | 35.00 | 1.46 | 21.7 | 65.1 |
| RW-203 | NS | 22.67 | 22.69 | 0.02 | - | 1.46 | - | - |
| RW-204 | NS | 19.32 | 19.91 | 0.59 | - | 1.46 | - | - |
| RW-205 | NS | 19.45 | 23.43 | 3.98 | - | 1.46 | - | - |
| RW-206 | NS | | 21.38 | | - | 1.46 | - | - |
| RW-300 | NS | 14.6 | 15.46 | 0.86 | - | 0.65 | - | - |
| RW-301 | 7/22/2008 | | 12.02 | | 25.30 | 1.46 | 19.4 | 58.2 |
| RW-302 | 7/23/2008 | | 13.39 | | 28.40 | 1.46 | 21.9 | 65.7 |

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**GROUNDWATER SAMPLING SUMMARY**
**SUNOCO PHILADELPHIA REFINERY**
**PHILADELPHIA, PENNSYLVANIA**

| Well ID | Sample Date | Depth to Product | Depth to Water | Product Thickness | Total Depth of Well | Conversion Factor (Well Diameter) | Well Volume (gallons) | Purge Volume (gallons) |
|---|---|---|---|---|---|---|---|---|
| RW-303 | 7/25/2008 | | 14.17 | | 17.00 | 1.46 | 4.1 | 12.4 |
| RW-304 | 7/22/2008 | | 14.86 | | 29.60 | 1.46 | 21.5 | 64.6 |
| RW-305 | 7/22/2008 | | 14.91 | | 25.00 | 1.46 | 14.7 | 44.2 |
| RW-306 | NS | 13.02 | 13.14 | 0.12 | 26.00 | 1.46 | - | - |
| RW-307 | 7/23/2008 | | 14.60 | | 28.00 | 1.46 | 19.6 | 58.7 |
| RW-308 | 7/25/2008 | | 16.72 | | 25.00 | 1.46 | 12.1 | 36.3 |
| RW-309 | NS | | 15.55 | | 15.80 | 1.46 | - | - |
| RW-500 | 7/25/2008 | | 2.01 | | - | 1.46 | - | NA |
| RW-501 | 7/23/2008 | | 4.58 | | - | 1.46 | - | NA |
| RW-502 | NS | 8.22 | 8.23 | 0.01 | - | 1.46 | - | - |
| N-98 | 7/14/2008 | | 23.33 | | 30 | 0.16 | 1.1 | 3.2 |
| N-99 | 7/23/2008 | | 20.07 | | 28 | 0.16 | 1.3 | 3.8 |
| N-100 | 7/14/2008 | | 18.84 | | 20 | 0.16 | 0.2 | 0.6 |
| N-101 | 7/15/2008 | | 15.69 | | 23 | 0.16 | 1.2 | 3.5 |
| N-102 | 7/15/2008 | | 22.22 | | 30 | 0.16 | 1.2 | 3.7 |
| N-103 | 7/23/2008 | | 18.37 | | 27 | 0.16 | 1.4 | 4.1 |
| N-104 | 7/23/2008 | | 16.70 | | 25 | 0.16 | 1.3 | 4.0 |
| N-105 | 7/23/2008 | | 17.25 | | 25 | 0.16 | 1.2 | 3.7 |
| N-106 | 7/14/2008 | | 10.62 | | 19 | 0.16 | 1.3 | 4.0 |
| N-107 | NS | 15.44 | 16.27 | 0.83 | 22 | 0.16 | - | - |
| N-108 | 7/22/2008 | | 14.03 | | 18 | 0.16 | 0.6 | 1.9 |
| N-109 | 7/24/2008 | | 11.65 | | 20 | 0.16 | 1.3 | 4.0 |
| N-110 | 7/24/2008 | | 7.41 | | 15 | 0.16 | 1.2 | 3.6 |
| N-111 | 7/24/2008 | | 6.00 | | 15 | 0.16 | 1.4 | 4.3 |
| N-112 | 7/24/2008 | | 9.06 | | 20 | 0.16 | 1.8 | 5.3 |
| N-113 | NS | | 7.86 | | 15 | 0.16 | - | - |
| N-114 | 7/24/2008 | | 8.01 | | 25 | 0.16 | 2.7 | 8.2 |
| N-115 | 7/28/2008 | | 7.44 | | 14 | 0.16 | 1.0 | 3.1 |
| N-116 | NS | 5.29 | 6.02 | 0.73 | 12 | 0.16 | - | - |
| N-117 | 7/17/2008 | | 14.65 | | 20 | 0.16 | 0.9 | 2.6 |
| N-118 | 7/22/2008 | | 14.36 | | 20 | 0.16 | 0.9 | 2.7 |
| N-119 | 7/17/2008 | | 9.17 | | 18 | 0.16 | 1.4 | 4.2 |
| N-120 | 7/17/2008 | | 11.15 | | 18 | 0.16 | 1.1 | 3.3 |
| N-121 | 7/17/2008 | | 11.13 | | 20 | 0.16 | 1.4 | 4.3 |
| N-122 | 7/22/2008 | | 9.83 | | 18 | 0.16 | 1.3 | 3.9 |
| N-123 | 7/22/2008 | | 11.82 | | 20 | 0.16 | 1.3 | 3.9 |
| N-124 | 7/22/2008 | | 15.08 | | 25 | 0.16 | 1.6 | 4.8 |
| N-125 | NS | 16.46 | 16.72 | 0.26 | 25 | 0.16 | - | - |
| N-126 | 7/22/2008 | | 5.09 | | 14 | 0.16 | 1.4 | 4.3 |
| N-127 | NS | 24.30 | 24.86 | 0.56 | 34 | 0.16 | - | - |
| N-128 | 7/23/2008 | | 18.82 | | 25 | 0.16 | 1.0 | 3.0 |
| N-129 | NS | 19.46 | 20.49 | 1.03 | 30 | 0.16 | - | - |
| N-130 | NS | 22.53 | 23.25 | 0.72 | 30 | 0.16 | - | - |
| N-131 | 7/28/2008 | | 2.75 | | 15 | 0.16 | 2.0 | 5.9 |
| N-132 | 7/28/2008 | | 4.54 | | 25 | 0.16 | 3.3 | 9.8 |
| N-133 | 7/23/2008 | | 3.93 | | 12 | 0.16 | 1.3 | 3.9 |
| N-134 | 7/16/2008 | | 18.04 | | 20 | 0.16 | 0.3 | 0.9 |
| N-135 | NS | 4.35 | 4.98 | 0.63 | 12 | 0.16 | - | - |
| N-136 | 7/25/2008 | | 4.09 | | 12 | 0.16 | 1.3 | 3.8 |

All Gauging Info provided by Secor (gauged on 7/14 & 7/15/2008)
NA = Information not available
NS = Not Sampled

# ATTACHMENT G
# LNAPL MODELING PROCEDURES
# AOI 8: SUNOCO PHILADELPHIA REFINERY
# PHILADELPHIA, PENNSYLVANIA

## G.1 INTRODUCTION AND OVERVIEW

Models which assess volume, mobility, and recoverability of light non-aqueous phase liquid (LNAPL) contamination have progressed beyond simply extrapolating LNAPL monitoring well thicknesses into the surrounding geologic materials. Instead, these models incorporate the physical properties of groundwater, LNAPL, and soil, in conjunction with an improved understanding of how fluids interact with each other and the surrounding geologic materials, and provide better estimates of LNAPL volume, mobility, and recoverability. These scientific improvements have allowed more realistic endpoints to be set during the remediation process.

For the LNAPL modeling in AOI 8 at the Sunoco Refinery in Philadelphia, PA (the Facility), Langan utilized the American Petroleum Institute (API) Publication Number 4682, "Free-Product Recovery of Petroleum Hydrocarbon Liquids," dated June 1999, as a guide for assessing LNAPL volume, mobility, and recoverability. The parameters discussed in subsequent sections are presented in API Publication 4682 as the significant variables and parameters needed to evaluate the nature and extent of free LNAPL. An updated version of the API model found in the API publication "API Interactive LNAPL Guide," version 2.0.4, dated July 2004, was used. These parameters and the API model were utilized to estimate the specific volume and mobility of LNAPL at the Facility.

## G.2 INPUT PARAMETERS

Representative values obtained from the API's LNAPL and Environmental Canada's Reference Database were used to identify input parameters. Table G-1 of this attachment summarizes the LNAPL modeling input parameters used for this phase of the project. The individual input parameters used for the LNAPL models are described in detail below.

## G.3 FLUID PROPERTIES

The fluids of concern in LNAPL modeling are LNAPL, groundwater, and air. Key physical properties of these fluids are density ($\rho$), interfacial tension ($\sigma$) and viscosity ($\mu$). Chromatographic and mass spectroscopic hydrocarbon LNAPL characterization analyses were

conducted on collected LNAPL samples in an attempt to identify and categorize LNAPLs on site.

### G.3.1 Fluid Density and Specific Gravity

Fluid density,$\rho$, is the mass of fluid per unit volume. Specific gravity, $\rho_r$, is the relative density of LNAPL with respect to the density of water. The density of LNAPL is related to its specific gravity through the following relationship:

$$\rho_r = \rho_o/\rho_w \qquad \text{(G.1)}$$

where $\rho_o$ and $\rho_w$ are the LNAPL and water densities, respectively.

Density estimates for LNAPL samples collected from wells within the Facility were determined from LNAPL and groundwater density data. If a density value was not available for the LNAPL in a particular monitoring well, a value was assigned based on the physical characteristics of the LNAPL observed in neighboring wells.

### G.3.2 LNAPL Viscosity

Viscosity is the measure of friction between molecules within a given fluid. The dynamic (or absolute) viscosity, $\mu$, is defined as the ratio of the shear stress to the strain rate for a Newtonian fluid (Newtonian fluids have constant viscosity and flow immediately on the application of a force). The kinematic viscosity ($\nu$) is the ratio of the dynamic viscosity to the density of a fluid.

If a kinematic viscosity value was not available for the LNAPL within a monitoring well, a value was assigned based on the physical characteristics of the LNAPL in relation to neighboring monitor wells, or a representative viscocity value was selected from the API or Environmental Canada Database chosen based upon other LNAPL physical characteristics.

## G.4 FORMATION PHYSICAL PROPERTIES

Where available, site-specific geologic and hydrogeologic data were obtained from site soil boring investigations, monitoring and recovery wells installation and sampling activities, and aquifer characteristic testing. All remaining physical property input values were obtained from reference literature.

Variations in soil type were noted from boring log descriptions. For the purpose of determining modeling parameters, generalizations of the geologic characteristics were made based on the occurrence and distribution of soil types within the LNAPL wetted screen interval of monitoring wells. Consistent with the API guidance publication, the geologic parameters of interest include: soil texture, porosity, bulk density, fluid saturation, capillary pressure relationships, and total organic carbon (TOC). These parameters are discussed in detail below.

### G.4.1 Formation Texture

One of the most important parameters in determining the properties of porous media is the size range of particles in a soil, which is referred to as soil texture. Grain size is closely related to soil texture, and a grain size distribution gives the relative percentage of grain sizes within a formation.

Where available, historic site-specific grain size distribution data were used to describe the relative percentage of grain size within the various geologic units at the Facility. Regions with similar grain size distributions were grouped together, and representative values were selected. Soil within the historic maximum LNAPL wetted interval was used for this selection. Note, however, that in any given boring log, the soil type spanning the LNAPL wetted interval may actually include a range of soil types. In addition to the grain size analyses, the soil Atterberg Limits were referenced for select soil types. The Atterberg limits were used to correlate and characterize the fine-grained soil (i.e., silt and clay) in conjunction with the grain size distribution analyses.

### G.4.2 Porosity

The ratio of the volume of void space in a soil to the total volume is defined as the porosity (n), which is usually written as a fraction or a percent of void space. Generally,

wider variations in particle sizes result in smaller porosity values, as the void space between the larger particles are filled by smaller particles. The effective porosity (or kinematic porosity) refers to the volume of interconnected pore spaces through which fluids can flow.

### G.4.3 Bulk Density

Bulk density is a measure of the weight of the soil per unit volume, usually given on an oven-dry (110° C) basis. Variation in bulk density is attributable to the relative proportion and specific gravity of solid organic and inorganic particles and to the porosity of the soil. Most mineral soils have bulk densities between 1.0 and 2.0.

### G.4.4 Fluid Saturation

According to the API guidance documents, the void space of a natural porous medium affected by an LNAPL release is filled with water, air and LNAPL. The fraction of the pore space of a representative volume of material that is occupied by a particular fluid is called the fluid saturation. The fluid saturation of each phase can range from 0 to 1, and the sum of the three phases must equal 1.

### G.4.5 Capillary Pressure Relationships

According to the API guidance document, molecules located near the interface between two fluids (i.e. water and LNAPL) in one void space have a greater energy than molecules of the same fluid located within the bulk volume due to cohesive forces between the molecules. The excess energy associated with a fluid interface results in interfacial tension between the fluids, and surface tension between the liquid and vapor.

These relationships are incorporated into the API model for determining formation specific volume under vertical equilibrium.

## G.5 LNAPL EFFECTIVE PERMEABILITY

Water, air, and LNAPL are in competition for the interstitial spaces within the formation. Relative permeability describes the ability of one fluid to flow in the presence of other fluids, compared to the ability of the fluid to flow if it were the only fluid present. Typically, these

differences in permeability between water and LNAPL are observed as LNAPL reaches the water table in sufficient quantities, pools, and spreads laterally as a floating layer.

The API modeling approach is to predict the LNAPL saturation and relative permeability distributions under vertical equilibrium conditions. The effective saturation and relative permeability values depend on the LNAPL thicknesses within the formation, for which the apparent monitoring well LNAPL thicknesses serve as a useful measure. The modeling objective is to replace the layer with varying saturation and relative permeability with an equivalent layer with vertically uniform characteristics.

For each well with reported apparent LNAPL thickness, the API model was run to determine the effective relative permeability of LNAPL within that well. As a first approximation, the residual saturation of LNAPL (the portion of LNAPL that is adhered to soil and not recoverable) was considered to be zero for the calculation of effective relative permeability. The residual saturation of LNAPL will be determined based on the soil grain size, fluid saturation and capillary curves for the recoverability analysis.

## G.6 SOIL INTRINSIC PERMEABILITY

The intrinsic permeability of the soil was estimated using the following equation:

$$k_{soil} = \frac{K_W \mu_W}{\rho_W g} \qquad \text{(G.2)}$$

where,

$k_{soil}$ = permeability of soil

$K_w$ = hydraulic conductivity of groundwater for fill horizon

$\mu_w$ = dynamic viscosity of water

$p_w$ = density of water

g = gravity

The estimates of the ground water density and viscosity were used to determine the intrinsic soil permeability. The gravity constant was assumed to be 32.2 feet/s$^2$ (9.81 m/s$^2$).

## G.7 LNAPL HYDRAULIC CONDUCTIVITY AT SATURATION

To estimate the seepage velocity of the free-phase LNAPL, the hydraulic conductivity of the formation with respect to LNAPL must be known. The hydraulic conductivity of LNAPL is first calculated at 100% saturation at the LNAPL phase. Then it is corrected from the effective LNAPL relative permeability. This corrected hydraulic conductivity of LNAPL is the hydraulic conductivity of LNAPL in the formation at the estimated saturation of LNAPL. This can be estimated based on the following equation:

$$K_{oil} = k_{ro} \frac{k_{soil} \rho_{oil} g}{\mu_{oil}} \quad \text{(G.3)}$$

where,

$K_{oil}$ = hydraulic conductivity of LNAPL in the soil at saturation

$k_{ro}$ = effective LNAPL relative permeability

$k_{soil}$ = permeability of soil relative to groundwater (Equation D.2)

$\mu_{oil}$ = dynamic viscosity of LNAPL

$p_{oil}$ = density of LNAPL

g = gravity

## G.8 LNAPL SPECIFIC DISCHARGE

The result of the corrected hydraulic conductivity for LNAPL saturation (Equation G.3) was used to calculate the specific velocity of the LNAPL based on hydraulic gradient of the groundwater using the following equation:

$$q_{oil} = K_{oil} \times i_W \quad \text{(G.4)}$$

where,

$q_{oil}$ = LNAPL specific velocity of LNAPL discharge

$K_{oil}$ = hydraulic conductivity of LNAPL in the soil at the corrected saturation

$i_w$ = water table gradient

The water table gradient was assumed to be similar to the LNAPL table gradient. Based on the groundwater monitoring data collected to date, average water table gradients were selected.

The seepage velocity or mobility of the LNAPL was calculated based on the specific velocity calculated in Equation G.4, and correcting it for the effective porosity of the formation as follows:

$$v_{oil} = \frac{q_{oil}}{\phi_{eff}} \quad \text{(G.5)}$$

where,

$v_{oil}$ = LNAPL seepage velocity

$q_{oil}$ = LNAPL specific velocity of LNAPL discharge

$\phi_{eff}$ = effective porosity

The specific velocity of the LNAPL discharge from the previous calculation was divided by the effective porosity to determine the seepage velocity of LNAPL for all wells. For this calculation, total porosity values associated with each soil type were reduced for use as an effective porosity for LNAPL mobility.

Located in Tables G-2 and G-3 are the output results of the LNAPL modeling. Located in Table G-4 of this attachment is the LNAPL characterization data provided by Torkelson Laboratories.

**Table G.1**
**API Model Input Parameters**
**AOI 8 Site Characterization Report**
**Sunoco Philadelphia Refinery and Belmont Terminal**
**Philadelphia, Pennsylvania**

| Well ID | Apparent LNAPL Thickness Field Measurement[1] | | API Database | | | | | | LNAPL Density (Torkelson Geochemistry) (gm/cc) | LNAPL Type or Source of Surrogate LNAPL Type (Torkelson Geochemistry) | API or Environment Canada Database | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Porosity Well ID (unitless) | USCS Soil Type Surrounding Well Screen[2] | Source of Soil Type | van Genuchten "N" (unitless) | van Genuchten "a" [$m^{-1}$] | Irreducible Water Saturation[3] (unitless) | | | Air/Water Surface Tension[4] (dynes/cm) | Air/LNAPL Surface Tension (dynes/cm) | LNAPL/Water Surface Tension (dynes/cm) |
| | meter | feet | | | | | | | | | | | |
| N-14 | 0.003 | 0.010 | 0.426 | SP | Boring Log | 1.980 | 1.350 | 0.321 | 0.9299 | Residual Oil | 65.000 | 32.100 | 30.200 |
| N-23 | 0.076 | 0.250 | 0.428 | SM | Boring Log | 2.160 | 2.750 | 0.313 | 0.9211 | Middle Distillate (N-68) | 65.000 | 26.900 | 22.300 |
| N-25 | 0.122 | 0.400 | 0.426 | SP | Boring Log | 1.980 | 1.350 | 0.321 | 0.9402 | Residual Oil | 65.000 | 32.100 | 30.200 |
| N-31 | 0.137 | 0.450 | 0.426 | SP | Boring Log | 1.980 | 1.350 | 0.321 | 0.9016 | Lube Oil (PZ-204) | 65.000 | 21.000 | 50.000 |
| N-42 | 0.003 | 0.010 | 0.426 | SP | Boring Log | 1.980 | 1.350 | 0.321 | 0.8900 | Middle Distillate | 65.000 | 26.900 | 22.300 |
| N-45 | 0.067 | 0.220 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.8922 | Residual Oil (N-125) | 65.000 | 32.100 | 30.200 |
| N-47 | 0.186 | 0.610 | 0.426 | SP | Boring Log | 1.980 | 1.350 | 0.321 | 0.8834 | Residual Oil | 65.000 | 32.100 | 30.200 |
| N-48 | 0.040 | 0.130 | 0.426 | SP | Boring Log | 1.980 | 1.350 | 0.321 | 0.9049 | Lube Oil | 65.000 | 21.000 | 50.000 |
| N-49 | 0.430 | 1.410 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.8995 | Residual Oil (N-51) | 65.000 | 32.100 | 30.200 |
| N-51 | 0.317 | 1.040 | 0.428 | SM | Boring Log | 2.160 | 2.750 | 0.313 | 0.8995 | Residual Oil | 65.000 | 32.100 | 30.200 |
| N-52 | 0.006 | 0.020 | 0.428 | SM | Boring Log | 2.160 | 2.750 | 0.313 | 0.8613 | Residual Oil | 65.000 | 32.100 | 30.200 |
| N-68 | 0.006 | 0.020 | 0.428 | SM | Boring Log | 2.160 | 2.750 | 0.313 | 0.9211 | Middle Distillate | 65.000 | 26.900 | 22.300 |
| N-75 | 0.351 | 1.150 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.9371 | Residual Oil | 65.000 | 32.100 | 30.200 |
| N-76 | 0.634 | 2.080 | 0.426 | SP | Boring Log | 1.980 | 1.350 | 0.321 | 0.8899 | Residual Oil | 65.000 | 32.100 | 30.200 |
| N-79 | 0.003 | 0.010 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.8169 | Middle Distillate | 65.000 | 26.900 | 22.300 |
| N-81 | 0.006 | 0.020 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.9016 | Lube Oil (PZ-204) | 65.000 | 21.000 | 50.000 |
| N-82 | 0.040 | 0.130 | 0.426 | SP | Boring Log | 1.980 | 1.350 | 0.321 | 0.9132 | Residual Oil | 65.000 | 32.100 | 30.200 |
| N-91 | 0.634 | 2.080 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.9471 | Residual Oil | 65.000 | 32.100 | 30.200 |
| N-107 | 0.003 | 0.010 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.9033 | Middle Distillate | 65.000 | 26.900 | 22.300 |
| N-112 | 0.975 | 3.200 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.9167 | Residual Oil (N-113) | 65.000 | 32.100 | 30.200 |
| N-113 | 0.244 | 0.800 | 0.426 | SP | Boring Log | 1.980 | 1.350 | 0.321 | 0.9167 | Residual Oil | 65.000 | 32.100 | 30.200 |
| N-115 | 0.003 | 0.010 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.8900 | Middle Distillate (N-42) | 65.000 | 26.900 | 22.300 |
| N-116 | 0.223 | 0.730 | 0.426 | SP | Boring Log | 1.980 | 1.350 | 0.321 | 0.8985 | Middle Distillate | 65.000 | 26.900 | 22.300 |
| N-125 | 0.881 | 2.890 | 0.426 | SP | Boring Log | 1.980 | 1.350 | 0.321 | 0.8922 | Residual Oil | 65.000 | 32.100 | 30.200 |
| N-127 | 0.149 | 0.490 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.8785 | Residual Oil | 65.000 | 32.100 | 30.200 |
| N-128 | 0.198 | 0.650 | 0.428 | SM | Boring Log | 2.160 | 2.750 | 0.313 | 0.8995 | Residual Oil (N-51) | 65.000 | 32.100 | 30.200 |
| N-129 | 0.344 | 1.130 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.9017 | Residual Oil | 65.000 | 32.100 | 30.200 |
| N-130 | 0.064 | 0.210 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.7893 | Residual Oil | 65.000 | 32.100 | 30.200 |
| N-135 | 0.341 | 1.120 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.9148 | Residual Oil | 65.000 | 32.100 | 30.200 |
| N-503 | 0.177 | 0.580 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.9065 | Residual Oil | 65.000 | 32.100 | 30.200 |
| N-504 | 0.003 | 0.010 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.9065 | Residual Oil (N-503) | 65.000 | 32.100 | 30.200 |
| P-30 | 0.744 | 2.440 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.9016 | Lube Oil (PZ-204) | 65.000 | 21.000 | 50.000 |
| PZ-204 | 0.366 | 1.200 | 0.426 | SP | N-31 | 1.980 | 1.350 | 0.321 | 0.9016 | Lube Oil | 65.000 | 21.000 | 50.000 |
| PZ-502 | 0.469 | 1.540 | 0.426 | SP | N-35 | 1.980 | 1.350 | 0.321 | 0.9155 | Residual Oil | 65.000 | 32.100 | 30.200 |
| RW-201 | 0.003 | 0.010 | 0.428 | SM | Boring Log | 2.160 | 2.750 | 0.313 | 0.8785 | Residual Oil (N-127) | 65.000 | 32.100 | 30.200 |
| RW-203 | 0.006 | 0.020 | 0.428 | SM | Boring Log | 2.160 | 2.750 | 0.313 | 0.8995 | Residual Oil (N-51) | 65.000 | 32.100 | 30.200 |
| RW-204 | 0.341 | 1.120 | 0.428 | SM | Boring Log | 2.160 | 2.750 | 0.313 | 0.8995 | Residual Oil (N-51) | 65.000 | 32.100 | 30.200 |
| RW-205 | 0.866 | 2.840 | 0.426 | SP | Boring Log | 1.980 | 1.350 | 0.321 | 0.9112 | Lube Oil | 65.000 | 21.000 | 50.000 |
| RW-206 | 0.003 | 0.010 | 0.426 | SP | Boring Log | 1.980 | 1.350 | 0.321 | 0.8899 | Residual Oil (N-76) | 65.000 | 32.100 | 30.200 |
| RW-300 | 0.107 | 0.350 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.8358 | Residual Oil | 65.000 | 32.100 | 30.200 |
| RW-306 | 0.003 | 0.010 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.8169 | Middle Distillate (N-79) | 65.000 | 26.900 | 22.300 |
| RW-502 | 0.015 | 0.050 | 0.388 | SW-SM | Boring Log | 2.040 | 1.990 | 0.253 | 0.9065 | Residual Oil (N-503) | 65.000 | 32.100 | 30.200 |

NOTES:
(1) Groundwater/LNAPL gauging event May 2011.
(2) Unified Soil Classification System

| USCS Symbol | API Database/Folk Description |
|---|---|
| SW-SM | Silty/gravelly sand |
| SP | Sand |
| SM | Silty sand |

(3) Residual LNAPL saturation in the saturated and vadose zones are considered to be negligible.
(4) SPL Interfacial Tensions:

| NAPL Type | Source |
|---|---|
| Light Lube Oil/Lube Oil | Environment Canada (Gasoline Engine) |
| Middle Distillate | Environment Canada (Diesel) |
| Residual Oil | Environment Canada (Residual Fuel Oil #4) |

LNAPL at N-59 to viscous to measure
N-54 Product type unknown. Apparent LNAPL thickness = 0.10 feet.

**Table G.2**
**API Model Output**
**AOI 8**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Well ID | Apparent LNAPL Thickness Field Measurement[1] | | API Model Results | | |
|---|---|---|---|---|---|
| | | | Specific Volume | Specific Volume | Relative Permeabilty |
| | meter | feet | meters | feet | unitless |
| N-14 | 0.003 | 0.010 | 6.240E-11 | 2.047E-10 | 5.879E-11 |
| N-23 | 0.076 | 0.250 | 5.395E-06 | 1.770E-05 | 5.481E-06 |
| N-25 | 0.122 | 0.400 | 2.884E-06 | 9.462E-06 | 2.055E-06 |
| N-31 | 0.137 | 0.450 | 3.970E-06 | 1.302E-05 | 2.841E-06 |
| N-42 | 0.003 | 0.010 | 2.776E-10 | 9.108E-10 | 5.434E-10 |
| N-45 | 0.067 | 0.220 | 2.771E-06 | 9.091E-06 | 3.637E-06 |
| N-47 | 0.186 | 0.610 | 4.835E-05 | 1.586E-04 | 6.105E-05 |
| N-48 | 0.040 | 0.130 | 9.467E-08 | 3.106E-07 | 6.803E-08 |
| N-49 | 0.430 | 1.410 | 8.503E-04 | 2.790E-03 | 1.066E-03 |
| N-51 | 0.317 | 1.040 | 5.509E-04 | 1.807E-03 | 6.751E-04 |
| N-52 | 0.006 | 0.020 | 3.109E-09 | 1.020E-08 | 2.375E-09 |
| N-68 | 0.006 | 0.020 | 1.770E-09 | 5.807E-09 | 9.782E-10 |
| N-75 | 0.351 | 1.150 | 1.602E-04 | 5.256E-04 | 1.279E-04 |
| N-76 | 0.634 | 2.080 | 1.667E-03 | 5.469E-03 | 1.832E-03 |
| N-79 | 0.003 | 0.010 | 1.176E-09 | 3.858E-09 | 3.168E-09 |
| N-81 | 0.006 | 0.020 | 5.249E-10 | 1.722E-09 | 3.242E-10 |
| N-82 | 0.040 | 0.130 | 2.144E-07 | 7.034E-07 | 2.299E-07 |
| N-91 | 0.634 | 2.080 | 6.603E-04 | 2.166E-03 | 4.520E-04 |
| N-107 | 0.003 | 0.010 | 3.198E-10 | 1.049E-09 | 4.379E-10 |
| N-112 | 0.975 | 3.200 | 6.359E-03 | 2.086E-02 | 6.725E-03 |
| N-113 | 0.244 | 0.800 | 5.205E-05 | 1.708E-04 | 4.765E-05 |
| N-115 | 0.003 | 0.010 | 4.159E-10 | 1.364E-09 | 6.528E-10 |
| N-116 | 0.223 | 0.730 | 1.177E-04 | 3.862E-04 | 1.685E-04 |
| N-125 | 0.881 | 2.890 | 4.153E-03 | 1.363E-02 | 4.353E-03 |
| N-127 | 0.149 | 0.490 | 5.309E-05 | 1.742E-04 | 7.727E-05 |
| N-128 | 0.198 | 0.650 | 1.264E-04 | 4.147E-04 | 1.391E-04 |
| N-129 | 0.344 | 1.130 | 4.110E-04 | 1.348E-03 | 5.031E-04 |
| N-130 | 0.064 | 0.210 | 1.760E-05 | 5.774E-05 | 3.939E-05 |
| N-135 | 0.341 | 1.120 | 2.900E-04 | 9.514E-04 | 3.085E-04 |
| N-503 | 0.177 | 0.580 | 4.904E-05 | 1.609E-04 | 5.536E-05 |
| N-504 | 0.003 | 0.010 | 1.603E-10 | 5.259E-10 | 1.541E-10 |
| P-30 | 0.744 | 2.440 | 1.291E-03 | 4.236E-03 | 1.013E-03 |
| PZ-204 | 0.366 | 1.200 | 7.956E-05 | 2.610E-04 | 5.426E-05 |
| PZ-502 | 0.469 | 1.540 | 3.798E-04 | 1.246E-03 | 3.391E-04 |
| RW-201 | 0.003 | 0.010 | 2.613E-10 | 8.573E-10 | 1.434E-10 |
| RW-203 | 0.006 | 0.020 | 1.550E-09 | 5.085E-09 | 7.942E-10 |
| RW-204 | 0.341 | 1.120 | 6.986E-04 | 2.292E-03 | 8.624E-04 |
| RW-205 | 0.866 | 2.840 | 8.507E-04 | 2.791E-03 | 5.021E-04 |
| RW-206 | 0.003 | 0.010 | 1.526E-10 | 5.007E-10 | 2.227E-10 |
| RW-300 | 0.107 | 0.350 | 4.259E-05 | 1.397E-04 | 7.861E-05 |
| RW-306 | 0.003 | 0.010 | 1.176E-09 | 3.858E-09 | 3.168E-09 |
| RW-502 | 0.015 | 0.050 | 2.144E-08 | 7.034E-08 | 2.262E-08 |

NOTES:
(1) Groundwater/LNAPL gauging event July 2011.
N-54 product type unknown

Table G.3
Seepage Velocity Calculations
AOI 8
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

| Well ID | API Database USCS Soil Type Equivalent | LNAPL Density | Dominant LNAPL Type at Each Well Location | API Model Calculated LNAPL Relative Permeabilty | Effective Porosity | Groundwater Density @ 60F (kg/m$^3$) | Groundwater Dynamic Viscosity (N·s/m$^2$) | Soil Permeabililty (m$^2$) | Kro (%) | Groundwater Gradient | Dynamic Viscosity of LNAPL (N·s/m2) | LNAPL Density (kg/m3) | LNAPL K @ 100% Saturation (m/day) | Corrected LNAPL K (m/day) | LNAPL Specific Discharge (m/day) | LNAPL Seepage Velocity (m/year) | LNAPL Seepage Velocity (cm/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (gm/cc) | | Unitless | API Database | CRC | API Database | API Database | API Model | May 2011 AOI-8 Contour Map | API/Env. Canada Databases | Torkelson Geochemistry Inc. | Calculated | Calculated | Calculated | Calculated | Calculated |
| N-14 | SP | 0.9299 | Residual Oil | 5.879E-11 | 0.43 | 999.19 | 1.124E-03 | 3.34E-12 | 0.00% | 0.002 | 2.300E-02 | 929.90 | 1.14E-01 | 6.73E-12 | 1.63E-14 | 1.38E-11 | 4.36E-17 |
| N-23 | SM | 0.9211 | Middle Distillate (N-68) | 5.481E-06 | 0.43 | 999.19 | 1.124E-03 | 3.2E-12 | 0.00% | 0.015 | 4.000E-03 | 921.10 | 6.25E-01 | 3.42E-06 | 5.26E-08 | 4.46E-05 | 1.41E-10 |
| N-25 | SP | 0.9402 | Residual Oil | 2.055E-06 | 0.43 | 999.19 | 1.124E-03 | 3.34E-12 | 0.00% | 0.054 | 2.300E-02 | 940.20 | 1.16E-01 | 2.38E-07 | 1.29E-08 | 1.09E-05 | 3.45E-11 |
| N-31 | SP | 0.9016 | Lube Oil (PZ-204) | 2.841E-06 | 0.43 | 999.19 | 1.124E-03 | 3.34E-12 | 0.00% | 0.011 | 1.750E-01 | 901.60 | 1.46E-02 | 4.14E-08 | 4.38E-10 | 3.71E-07 | 1.17E-12 |
| N-42 | SP | 0.8900 | Middle Distillate | 5.434E-10 | 0.43 | 999.19 | 1.124E-03 | 3.34E-12 | 0.00% | 0.010 | 4.000E-03 | 890.00 | 6.30E-01 | 3.42E-10 | 3.59E-12 | 3.04E-09 | 9.60E-15 |
| N-45 | SW-SM | 0.8922 | Residual Oil (N-125) | 3.637E-06 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.00% | 0.014 | 2.300E-02 | 892.20 | 2.02E-01 | 7.35E-07 | 1.01E-08 | 9.42E-06 | 2.97E-11 |
| N-47 | SP | 0.8834 | Residual Oil | 6.105E-05 | 0.43 | 999.19 | 1.124E-03 | 3.34E-12 | 0.01% | 0.012 | 2.300E-02 | 883.40 | 1.09E-01 | 6.64E-06 | 7.91E-08 | 6.71E-05 | 2.12E-10 |
| N-48 | SP | 0.9049 | Lube Oil | 6.803E-08 | 0.43 | 999.19 | 1.124E-03 | 3.34E-12 | 0.00% | 0.006 | 1.750E-01 | 904.90 | 1.46E-02 | 9.96E-10 | 6.02E-12 | 5.11E-09 | 1.61E-14 |
| N-49 | SW-SM | 0.8995 | Residual Oil (N-51) | 1.066E-03 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.11% | 0.009 | 2.300E-02 | 899.50 | 2.04E-01 | 2.17E-04 | 2.05E-06 | 1.92E-03 | 6.05E-09 |
| N-51 | SM | 0.8995 | Residual Oil | 6.751E-04 | 0.43 | 999.19 | 1.124E-03 | 3.2E-12 | 0.07% | 0.005 | 2.300E-02 | 899.50 | 1.06E-01 | 7.16E-05 | 3.64E-07 | 3.09E-04 | 9.73E-10 |
| N-52 | SM | 0.8613 | Residual Oil | 2.375E-09 | 0.43 | 999.19 | 1.124E-03 | 3.2E-12 | 0.00% | 0.011 | 2.300E-02 | 861.30 | 1.02E-01 | 2.41E-10 | 2.73E-12 | 2.32E-09 | 7.31E-15 |
| N-68 | SM | 0.9211 | Middle Distillate | 9.782E-10 | 0.43 | 999.19 | 1.124E-03 | 3.2E-12 | 0.00% | 0.020 | 4.000E-03 | 921.10 | 6.25E-01 | 6.11E-10 | 1.21E-11 | 1.03E-08 | 3.23E-14 |
| N-75 | SW-SM | 0.9371 | Residual Oil | 9.782E-10 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.00% | 0.091 | 2.300E-02 | 937.10 | 2.12E-01 | 2.08E-10 | 1.88E-11 | 1.76E-08 | 5.56E-14 |
| N-76 | SP | 0.8899 | Residual Oil | 1.279E-04 | 0.43 | 999.19 | 1.124E-03 | 3.34E-12 | 0.01% | 0.022 | 2.300E-02 | 889.90 | 1.10E-01 | 1.40E-05 | 3.12E-07 | 2.65E-04 | 8.35E-10 |
| N-79 | SW-SM | 0.8169 | Middle Distillate | 1.832E-03 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.18% | 0.004 | 4.000E-03 | 816.90 | 1.06E+00 | 1.95E-03 | 7.48E-06 | 7.00E-03 | 2.21E-08 |
| N-81 | SW-SM | 0.9016 | Lube Oil (PZ-204) | 3.168E-09 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.00% | 0.101 | 1.750E-01 | 901.60 | 2.69E-02 | 8.51E-11 | 8.57E-12 | 8.02E-09 | 2.53E-14 |
| N-82 | SP | 0.9132 | Residual Oil | 3.242E-10 | 0.43 | 999.19 | 1.124E-03 | 3.34E-12 | 0.00% | 0.001 | 2.300E-02 | 913.20 | 1.12E-01 | 3.64E-11 | 5.40E-14 | 4.58E-11 | 1.45E-16 |
| N-91 | SW-SM | 0.9471 | Residual Oil | 2.299E-07 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.00% | 0.050 | 2.300E-02 | 947.10 | 2.15E-01 | 4.93E-08 | 2.48E-09 | 2.32E-06 | 7.31E-12 |
| N-107 | SW-SM | 0.9033 | Middle Distillate | 4.520E-04 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.05% | 0.015 | 4.000E-03 | 903.30 | 1.18E+00 | 5.32E-04 | 8.09E-06 | 7.57E-03 | 2.39E-08 |
| N-112 | SW-SM | 0.9167 | Residual Oil (N-113) | 4.379E-10 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.00% | 0.022 | 2.300E-02 | 916.70 | 2.08E-01 | 9.10E-11 | 1.96E-12 | 1.83E-09 | 5.78E-15 |
| N-113 | SP | 0.9167 | Residual Oil | 6.725E-03 | 0.43 | 999.19 | 1.124E-03 | 3.34E-12 | 0.67% | 0.012 | 2.300E-02 | 916.70 | 1.13E-01 | 7.59E-04 | 8.95E-06 | 7.60E-03 | 2.40E-08 |
| N-115 | SW-SM | 0.8900 | Middle Distillate (N-42) | 4.765E-05 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.00% | 0.006 | 4.000E-03 | 890.00 | 1.16E+00 | 5.53E-05 | 3.13E-07 | 2.92E-04 | 9.22E-10 |
| N-116 | SP | 0.8985 | Middle Distillate | 6.528E-10 | 0.43 | 999.19 | 1.124E-03 | 3.34E-12 | 0.00% | 0.025 | 4.000E-03 | 898.50 | 6.36E-01 | 4.15E-10 | 1.02E-11 | 8.68E-09 | 2.74E-14 |
| N-125 | SP | 0.8922 | Residual Oil | 1.685E-04 | 0.43 | 999.19 | 1.124E-03 | 3.34E-12 | 0.02% | 0.002 | 2.300E-02 | 892.20 | 1.10E-01 | 1.85E-05 | 3.82E-08 | 3.24E-05 | 1.02E-10 |
| N-127 | SW-SM | 0.8785 | Residual Oil | 4.353E-03 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.44% | 0.003 | 2.300E-02 | 878.50 | 1.99E-01 | 8.67E-04 | 2.55E-06 | 2.39E-03 | 7.54E-09 |
| N-128 | SM | 0.8995 | Residual Oil (N-51) | 7.727E-05 | 0.43 | 999.19 | 1.124E-03 | 3.2E-12 | 0.01% | 0.002 | 2.300E-02 | 899.50 | 1.06E-01 | 8.20E-06 | 1.25E-08 | 1.07E-05 | 3.36E-11 |
| N-129 | SW-SM | 0.9017 | Residual Oil | 1.391E-04 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.01% | 0.001 | 2.300E-02 | 901.70 | 2.04E-01 | 2.84E-05 | 1.99E-08 | 1.87E-05 | 5.89E-11 |
| N-130 | SW-SM | 0.7893 | Residual Oil | 5.031E-04 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.05% | 0.013 | 2.300E-02 | 789.30 | 1.79E-01 | 9.00E-05 | 1.17E-06 | 1.09E-03 | 3.45E-09 |
| N-135 | SW-SM | 0.9148 | Residual Oil | 3.939E-05 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.00% | 0.002 | 2.300E-02 | 914.80 | 2.07E-01 | 8.17E-06 | 1.82E-08 | 1.71E-05 | 5.38E-11 |
| N-503 | SW-SM | 0.9065 | Residual Oil | 3.085E-04 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.03% | 0.001 | 2.300E-02 | 906.50 | 2.05E-01 | 6.34E-05 | 4.74E-08 | 4.44E-05 | 1.40E-10 |
| N-504 | SW-SM | 0.9065 | Residual Oil (N-503) | 5.536E-05 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.01% | 0.002 | 2.300E-02 | 906.50 | 2.05E-01 | 1.14E-05 | 1.93E-08 | 1.81E-05 | 5.71E-11 |
| P-30 | SW-SM | 0.9016 | Lube Oil (PZ-204) | 1.541E-10 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.00% | 0.020 | 1.750E-01 | 901.60 | 2.69E-02 | 4.14E-12 | 8.16E-14 | 7.64E-11 | 2.41E-16 |
| PZ-204 | SP | 0.9016 | Lube Oil | 1.013E-03 | 0.43 | 999.19 | 1.124E-03 | 3.34E-12 | 0.10% | 0.011 | 1.750E-01 | 901.60 | 1.46E-02 | 1.48E-05 | 1.56E-07 | 1.32E-04 | 4.18E-10 |
| PZ-502 | SP | 0.9155 | Residual Oil | 5.426E-05 | 0.43 | 999.19 | 1.124E-03 | 3.34E-12 | 0.01% | 0.004 | 2.300E-02 | 915.50 | 1.13E-01 | 6.11E-06 | 2.44E-08 | 2.07E-05 | 6.54E-11 |
| RW-201 | SM | 0.8785 | Residual Oil (N-127) | 3.391E-04 | 0.43 | 999.19 | 1.124E-03 | 3.2E-12 | 0.03% | 0.000 | 2.300E-02 | 878.50 | 1.04E-01 | 3.51E-05 | 9.70E-09 | 8.24E-06 | 2.60E-11 |
| RW-203 | SM | 0.8995 | Residual Oil (N-51) | 1.434E-10 | 0.43 | 999.19 | 1.124E-03 | 3.2E-12 | 0.00% | 0.009 | 2.300E-02 | 899.50 | 1.06E-01 | 1.52E-11 | 1.43E-13 | 1.22E-10 | 3.84E-16 |
| RW-204 | SM | 0.8995 | Residual Oil (N-51) | 7.942E-10 | 0.43 | 999.19 | 1.124E-03 | 3.2E-12 | 0.00% | 0.006 | 2.300E-02 | 899.50 | 1.06E-01 | 8.42E-11 | 5.09E-13 | 4.32E-10 | 1.36E-15 |
| RW-205 | SP | 0.9112 | Lube Oil | 8.624E-04 | 0.43 | 999.19 | 1.124E-03 | 3.34E-12 | 0.09% | 0.006 | 1.750E-01 | 911.20 | 1.47E-02 | 1.27E-05 | 7.81E-08 | 6.63E-05 | 2.09E-10 |
| RW-206 | SP | 0.8899 | Residual Oil (N-76) | 5.021E-04 | 0.43 | 999.19 | 1.124E-03 | 3.34E-12 | 0.05% | 0.022 | 2.300E-02 | 889.90 | 1.10E-01 | 5.50E-05 | 1.22E-06 | 1.04E-03 | 3.28E-09 |
| RW-300 | SW-SM | 0.8358 | Residual Oil | 2.227E-10 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.00% | 0.108 | 2.300E-02 | 835.80 | 1.89E-01 | 4.22E-11 | 4.57E-12 | 4.28E-09 | 1.35E-14 |
| RW-306 | SW-SM | 0.8169 | Middle Distillate (N-79) | 7.861E-05 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.01% | 0.007 | 4.000E-03 | 816.90 | 1.06E+00 | 8.37E-05 | 5.59E-07 | 5.23E-04 | 1.65E-09 |
| RW-502 | SW-SM | 0.9065 | Residual Oil (N-503) | 3.168E-09 | 0.39 | 999.19 | 1.124E-03 | 6.15E-12 | 0.00% | 0.001 | 2.300E-02 | 906.50 | 2.05E-01 | 6.51E-10 | 4.87E-13 | 4.56E-10 | 1.44E-15 |

Appendix G
LNAPL Characterization Data

| Characterization Results Compiled for Current Conditions Report<br>Interpretation of Product Type(s), Proportion, Weathering | | | | | |
|---|---|---|---|---|---|
| **Well ID** | **Density gm/ml (60°F)** | **LNAPL Type(s)** | **Torkelson LNAPL Type(s)** | **Proportion (%)** | **Weathering** |
| N-14 | 0.9299 | Residual Oil | ?Gasoline | 2 | Extreme |
| | | | Residual Oil | 98 | Extreme |
| N-25 | 0.9402 | Residual Oil | Aviation Gasoline | 3 | Extreme |
| | | | Residual Oil | 97 | Extreme |
| N-31 | NS | Lube Oil | Lube Oil | 100 | Extreme |
| N-35 | 0.9205 | Lube Oil | Lube Oil | 90 | Extreme |
| | | | Residual Oil | 10 | Extreme |
| N-48 | 0.9049 | Lube Oil | Lube Oil | 95 | Extreme |
| | | | Unknown Light Material | 5 | High |
| N-52 | 0.8613 | Residual Oil | ? Gasoline | 5 | Extreme |
| | | | Residual Oil | 95 | Extreme |
| N-68 | 0.9211 | Lube Oil/ Middle Distillate | Lube Oil | 50 | Extreme |
| | | | Middle Distillate | 50 | Extreme |
| N-78 | NS | Residual Oil | Residual Oil | 100 | Extreme |
| N-79 | 0.8169 | Middle Distillate | ?Gasoline | 60 | Extreme |
| | | | Middle Distillate | 40 | Severe |
| PZ-204 | 0.9016 | Lube Oil | Lube Oil | 100 | Severe |
| PZ-502 | 0.9155 | Residual Oil | 2-3 unknown products | unknown | unknown |
| | | | Residual Oil | 50 | Extreme |
| **Characterization Results Compiled for AOI 8 Work Plan<br>Interpretation of Product Type(s), Proportion, Weathering** | | | | | |
| N-42 | 0.89 | Residual Oil/Middle Distillate | Middle Distillate | 50 | Extreme |
| | | | Heavier Material | 50 | Extreme |
| N-47 | 0.8834 | Residual Oil | Heavier Material | 80 | Extreme |
| | | | Light Material | 20 | ? |
| N-51 | 0.8995 | Residual Oil | Heavier Material | 65 | Extreme |
| | | | Lube Oil | 20 | Extreme |
| | | | Light Material | 15 | ? |
| N-75 | 0.9371 | Residual Oil | Heavier Material | 75 | Extreme |
| | | | Lube Oil | 25 | Extreme |
| N-76 | 0.8899 | Residual Oil | Heavier Material | 80 | Extreme |
| | | | Light Material | 20 | ? |
| N-82 | 0.9132 | Residual Oil | Heavier Material | 70 | Extreme |
| | | | Aromatics | 30 | ? |
| N-91 | 0.9471 | Residual Oil | Heavier Material | 100 | Extreme |
| N-503 | 0.9065 | Residual Oil | Heavier Material | 75 | Extreme |
| | | | Middle Distillate | 25 | Extreme |
| RW-205 | 0.9112 | Lube Oil/ Middle Distillate | Heavier Material | 50 | Extreme |
| | | | Lube Oil | 50 | Extreme |
| RW-300 | 0.8358 | Residual Oil | Heavier Material | 60 | Extreme |
| | | | Light Material | 30 | ? |
| | | | Stoddard Solvent | 10 | Extreme |
| RW-305 | 0.9186 | Residual Oil | Heavier Material | 100 | Extreme |
| **Characterization Results Compiled for AOI 8 Site Characterization<br>Interpretation of Product Type(s), Proportion, Weathering** | | | | | |
| **Well ID** | **Density gm/ml (60°F)** | **LNAPL Type(s)** | **Torkelson LNAPL Type(s)** | **Proportion (%)** | **Weathering** |
| N-107 | 0.9033 | Middle Distillate | Aviation Gasoline | 5 | Severe |
| | | | Middle Distillate | 70 | Extreme |
| | | | Heavier Material | 25 | Extreme |
| N-113 | 0.9167 | Residual Oil | Unknown Light Mateial | 10 | Extreme |
| | | | ? Middle Distillate | unknown | Extreme |
| | | | Heavier Material | 90 | Extreme |
| N-116 | 0.8985 | Middle Distillate | Unknown Light Mateial | 2 | Severe |
| | | | Middle Distillate | 79 | Extreme |
| | | | Heavier Material | 19 | Extreme |
| N-125 | 0.8922 | Residual Oil | Heavy Virgin Naphtha | 15 | Extreme |
| | | | Heavier Material | 85 | Extreme |
| N-127 | 0.8785 | Residual Oil | Heavy Virgin Naphtha | 20 | Extreme |
| | | | Middle Distillate | 30 | Extreme |
| | | | Heavier Material | 50 | Extreme |
| N-129 | 0.9017 | Residual Oil | Heavy Virgin Naphtha | 5 | Extreme |
| | | | ? Middle Distillate | unknown | Extreme |
| | | | Heavier Material | 95 | Extreme |
| N-130 | 0.7893 | Residual Oil | Heavy Virgin Naphtha | 10 | Extreme |
| | | | ? Middle Distillate | unknown | Extreme |
| | | | Heavier Material | 90 | Extreme |
| N-135 | 0.9148 | Residual Oil | Unknown Light Mateial | 1 | Extreme |
| | | | ? Middle Distillate | unknown | Extreme |
| | | | Heavier Material | 99 | Extreme |

NOTES:
Torkelson notes that "heavier material" could either be crude oil or residual oil. Residual oil was selected due to abundance of residual oil identified in CCR.
? = Tentative identification.

| Sunoco Refinery - Philadelphia | | | | | | |
|---|---|---|---|---|---|---|
| TGI Job 08018 | | | | | | |
| **Interpretation of Product Type(s), Proportions and Weathering** | | | | **Similarities to Other Samples in this Study** | | |
| **Sample** | **Product Type(s)** | **Proportions** | **Weathering** | **Quite Similar to** | **Fairly Similar to** | **Somewhat Similar to** |
| N-42 LNAPL | Middle Distillate | 50 | Extreme | Unique | | |
| | Heavier Material | 50 | Extreme | | RW-300 | N-503 |
| | | | | | | |
| N-47 LNAPL | Heavier Material | 80 | Extreme | N-76 | | |
| | Light Material | 20 | ? | N-76 | | RW-300 |
| | | | | | | |
| N-51 LNAPL | Heavier Material | 65 | Extreme | | RW-205 | |
| | Lube Oil | 20 | Extreme | RW-205 | N-75 | |
| | Light Material | 15 | ? | | RW-300 | |
| | | | | | | |
| N-75 LNAPL | Heavier Material | 75 | Extreme | Unique | | |
| | Lube Oil | 25 | Extreme | | N-51, RW-205 | |
| | | | | | | |
| N-76 LNAPL | Heavier Material | 80 | Extreme | N-47 | | |
| | Light Material | 20 | ? | N-47 | | RW-300 |
| | | | | | | |
| N-82 LNAPL | Heavier Material | 70 | Extreme | Unique | | |
| | Aromatics | 30 | ? | Unique | | |
| | | | | | | |
| N-91 LNAPL | Heavier Material | 100 | Extreme | Unique | | |
| | | | | | | |
| N-503 LNAPL | Heavier Material | 75 | Extreme | | | N-42, RW-300 |
| | Middle Distillate | 25 | Extreme | Unique | | |
| | | | | | | |
| RW-205 LNAPL | Heavier Material | 50 | Extreme | | N-51 | |
| | Lube Oil | 50 | Extreme | N-51 | N-75 | |
| | | | | | | |
| RW-300 LNAPL | Heavier Material | 60 | Extreme | | N-42 | N-503 |
| | Light Material | 30 | ? | | N-51 | N-47, N-76 |
| | Stoddard Solvent | 10 | Extreme | Unique | | |
| | | | | | | |
| RW-305 LNAPL | Heavier Material | 100 | Extreme | Unique | | |
| | | | | | | |
| | Note: Heavier material could be either crude oil or residual oil | | | | | |

# Torkelson Geochemistry, Inc.

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## CHAIN-OF-CUSTODY RECORD



Project: Sunoco Philadelphia Refinery
Location: Philadelphia, PA

Proj. No.: 2574601
P.O.: 2574601
Sampled By: T. DOERR

Report/Bill To: Joseph Catricks-Langan Engineering
Address:
PO Box 1569, Doylestown, PA 18901-0219

Phone: 215-491-6500
Fax: 215-491-6501
e-mail: jcatricks@langan.com

**Additional Instructions**

Samples to be analyzed for Fingerprint (GC Characterization) and Density . Please include a 'Brief Description' of LNAPL, to be consistent with existing LNAPL types for the project.
Contact Joe Catricks at 215-491-6540 with questions.

Requested Turn-Around Time: Standard

| ITEM NO. | SAMPLE DESCRIPTION | DATE | MATRIX | LAB NO. | Total # OF Vials | PRESERVATIVES: None | ANALYSES REQUESTED: GC Characterization | Density | Viscosity | Water Surface Tension | NAPL Surface Tension | NAPL/Water Interfac. Tens. | Lead | Sulfur | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | RW-305_LNAPL | 2/4/08 | | | 1 | X | X | X | | | | | | | Sampled 1000 |
| 2 | RW-300_LNAPL | 2/4/08 | | | 1 | X | | | | | | | | | Sampled 1040 |
| 3 | N-91_LNAPL | 2/4/08 | | | 1 | X | | | | | | | | | Sampled 1120 |
| 4 | N-51_LNAPL | 2/4/08 | | | 1 | X | | | | | | | | | Sampled 1205 |
| 5 | RW-205_LNAPL | 2/4/08 | | | 1 | X | | | | | | | | | Sampled 1235 |
| 6 | N-76_LNAPL | 2/4/08 | | | 1 | X | | | | | | | | | Sampled 1300 |
| 7 | N-47_LNAPL | 2/4/08 | | | 1 | X | | | | | | | | | Sampled 1315 |
| 8 | N-82_LNAPL | 2/4/08 | | | 1 | X | | | | | | | | | Sampled 1345 |
| 9 | N-42_LNAPL | 2/5/08 | | | 1 | X | | | | | | | | | Sampled 1200 |
| 10 | N-503_LNAPL | 2/5/08 | | | 1 | X | | | | | | | | | Sampled 1240 |

| RELINQUISHED BY | DATE | TIME | ACCEPTED BY | DATE | TIME |
|---|---|---|---|---|---|
| [signature] | 2/7/08 | 0900 | Fed-Ex Box | 2/7/08 | 0900 |
| [signature] | | | [signature] | 2-8-08 | 1310 |
| | | | | | |

# Torkelson Geochemistry, Inc.

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## CHAIN-OF-CUSTODY RECORD



| | |
|---|---|
| Project: | Sunoco Philadelphia Refinery |
| Location: | Philadelphia, PA |
| Proj. No.: | 2574601 |
| P.O.: | 2574601 |
| Sampled By: | T. DOEBLER |

| | |
|---|---|
| Report/Bill To: | Joseph Catricks-Langan Engineering |
| Address: | PO Box 1569, Doylestown, PA 18901-0219 |
| Phone: | 215-491-6500 |
| Fax: | 215-491-6501 |
| e-mail: | jcatricks@langan.com |

**Additional Instructions**

Samples to be analyzed for Fingerprint (GC Characterization) and Density . Please include a 'Brief Description' of LNAPL, to be consistent with existing LNAPL types for the project.
Contact Joe Catricks at 215-491-6540 with questions.

Requested Turn-Around Time: Standard

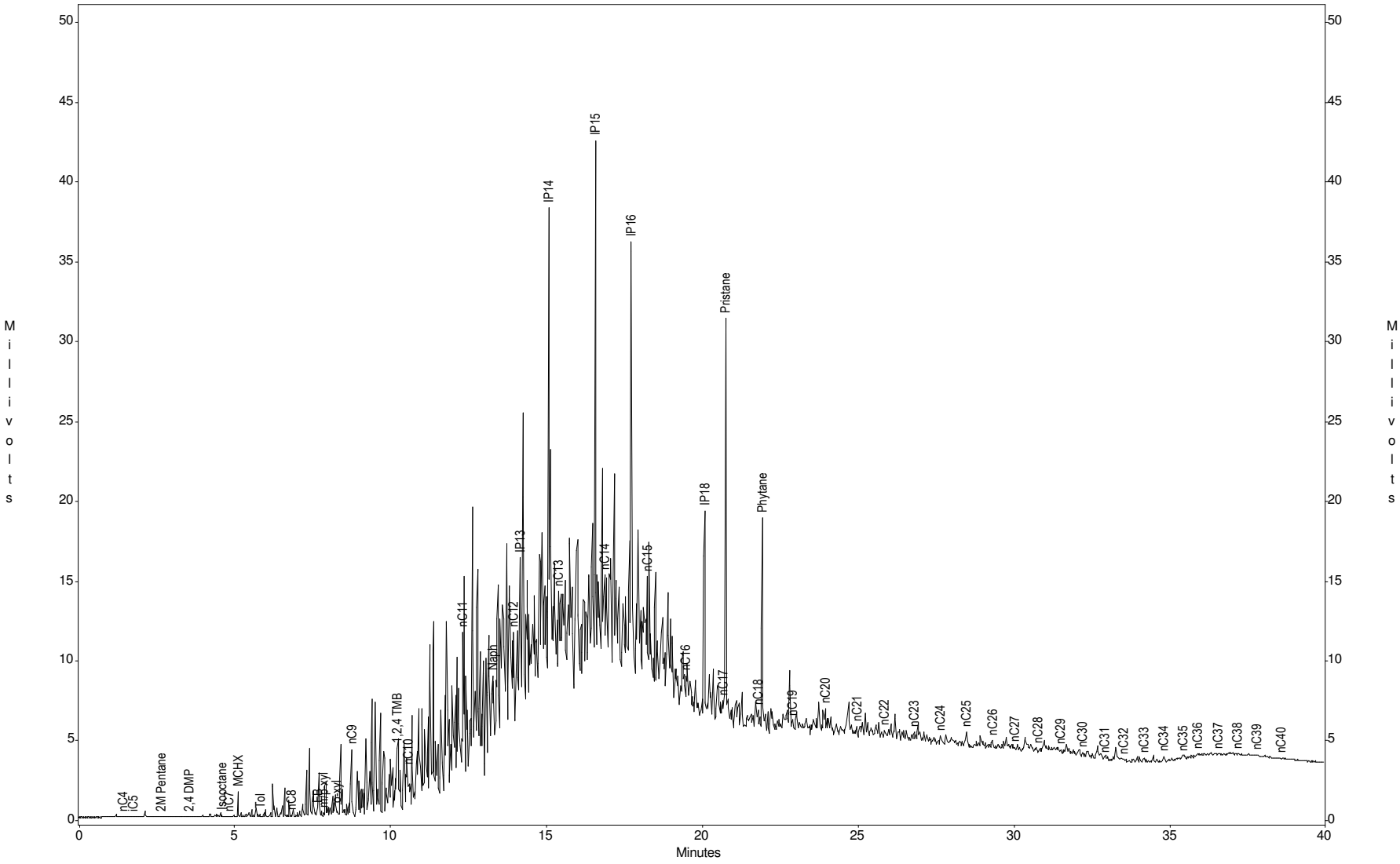
| ITEM NO. | SAMPLE DESCRIPTION | DATE | MATRIX | LAB NO. | Total # OF Vials | PRESERVATIVES: None | GC Characterization | Density | Viscosity | Water Surface Tension | NAPL Surface Tension | NAPL/Water Interfac. Tens. | Lead | Sulfur | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | N-75_LNAPL | 2/5/03 | | | 1 | X | x | x | | | | | | | Sampled 1320 |
| 2 | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | |

| RELINQUISHED BY | DATE | TIME | ACCEPTED BY | DATE | TIME |
|---|---|---|---|---|---|
| [signature] | 2/7/03 | 0900 | Fed-Ex Box | 2/7/03 | 0900 |
| | | | [signature] | 2-8-03 | 1310 |

# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : N-42 LNAPL
Acquired : Feb 12, 2008 12:43:00

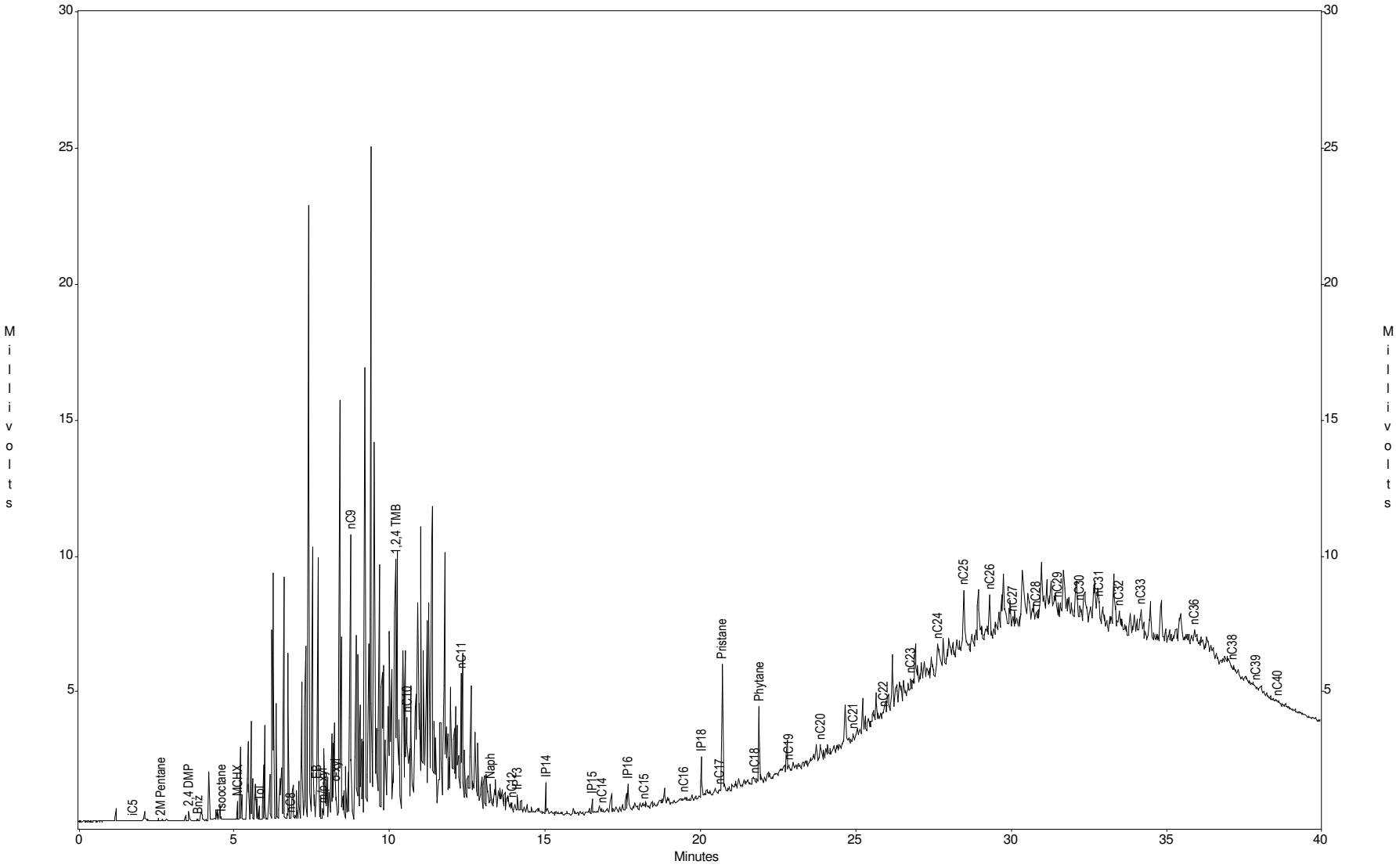
c:\ezchrom\chrom\08018\n-42 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : N-47 LNAPL
Acquired : Feb 12, 2008 13:32:10

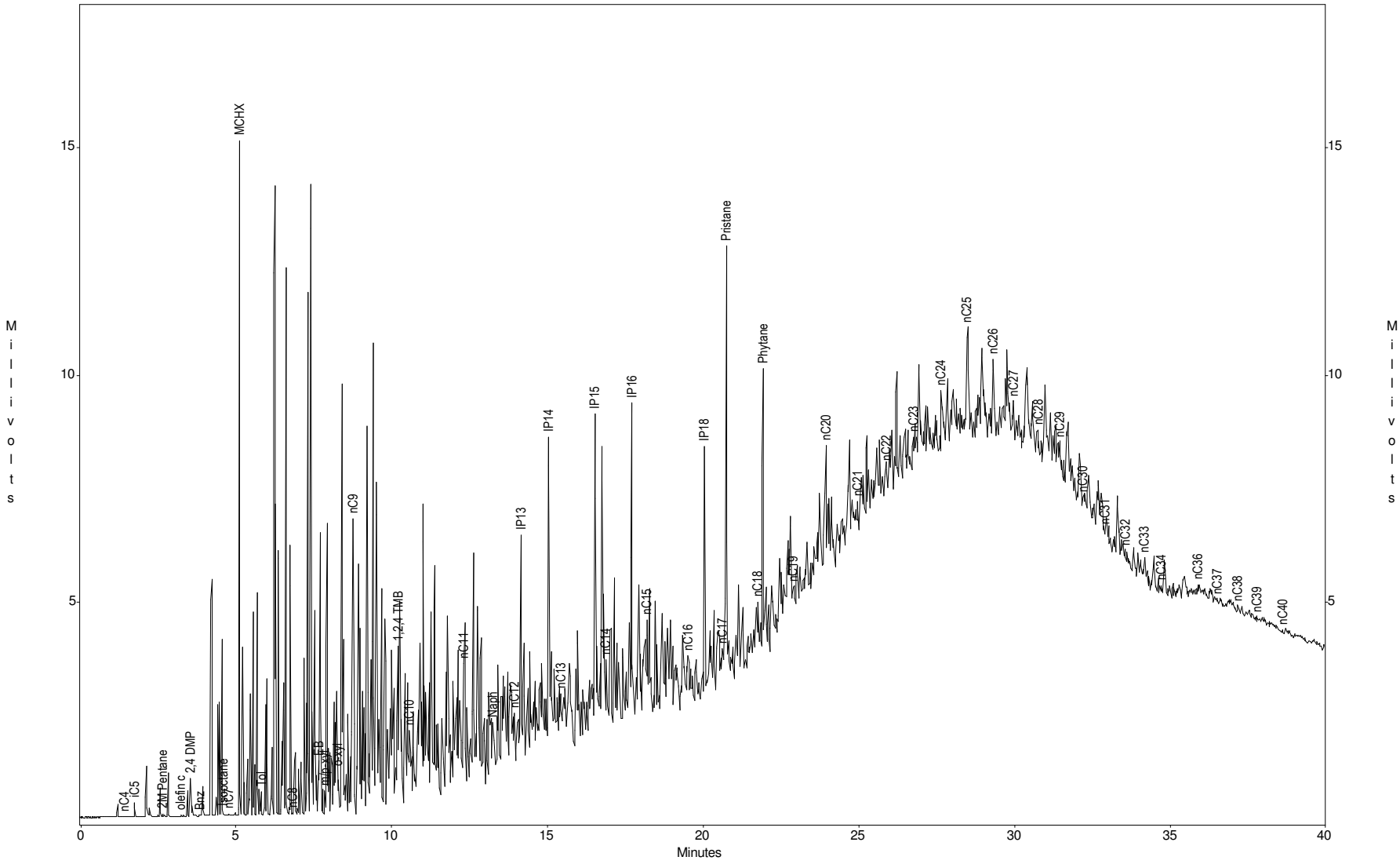
c:\ezchrom\chrom\08018\n-47 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : N-51 LNAPL
Acquired : Feb 12, 2008 10:07:28

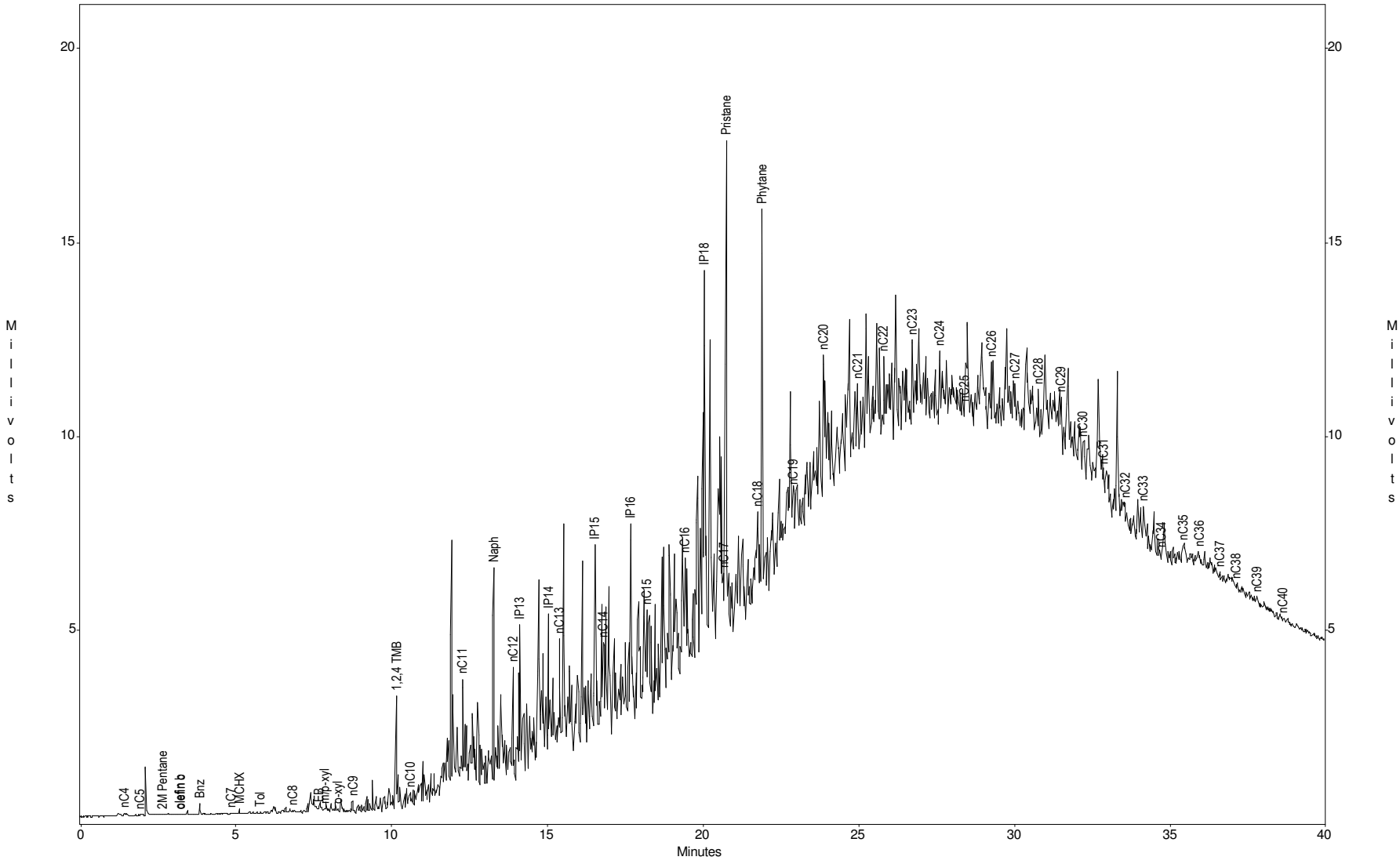
c:\ezchrom\chrom\08018\n-51 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : N-75 LNAPL
Acquired : Feb 12, 2008 17:47:22

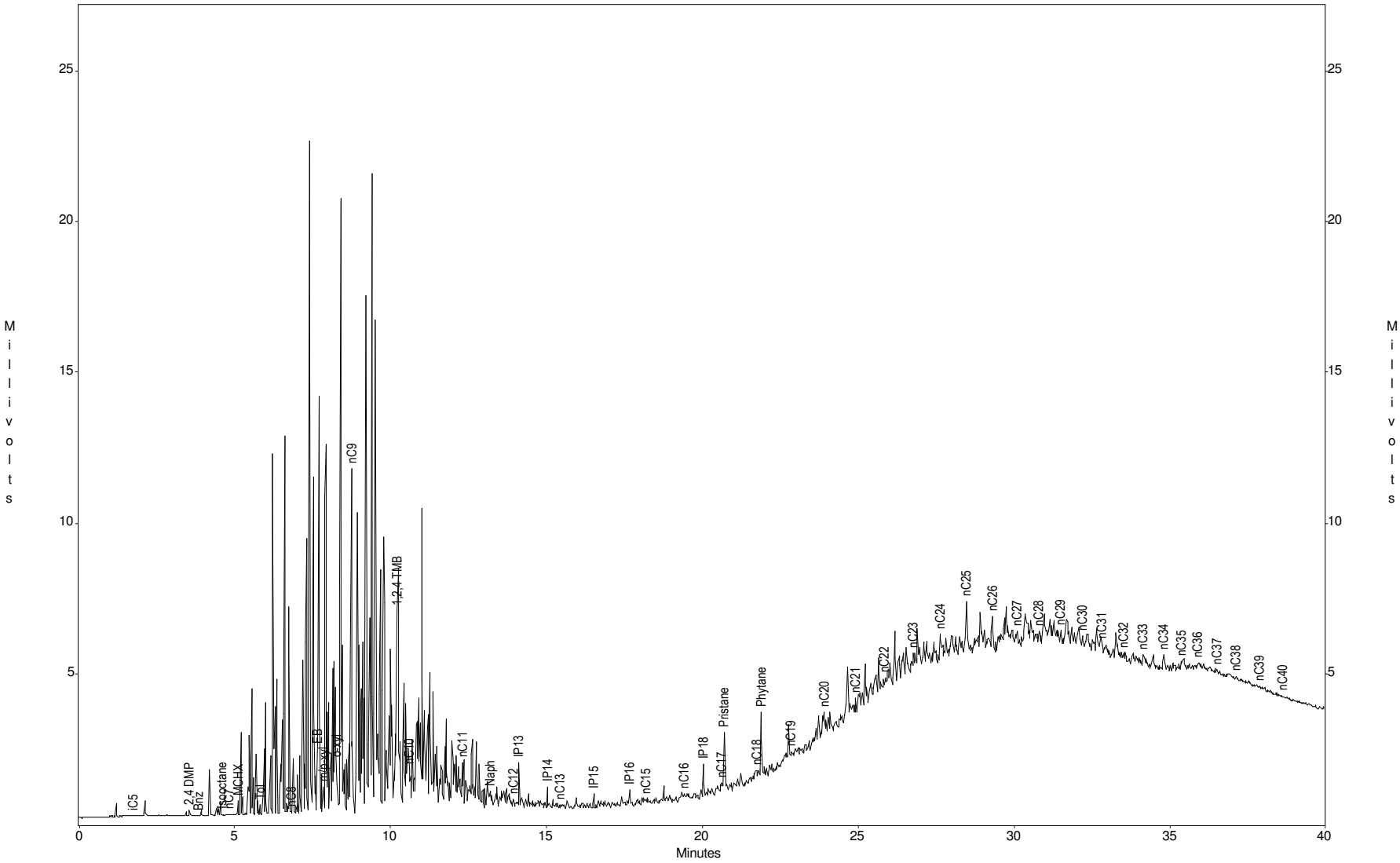
c:\ezchrom\chrom\08018\n-75 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : N-76 LNAPL
Acquired : Feb 12, 2008 15:14:12

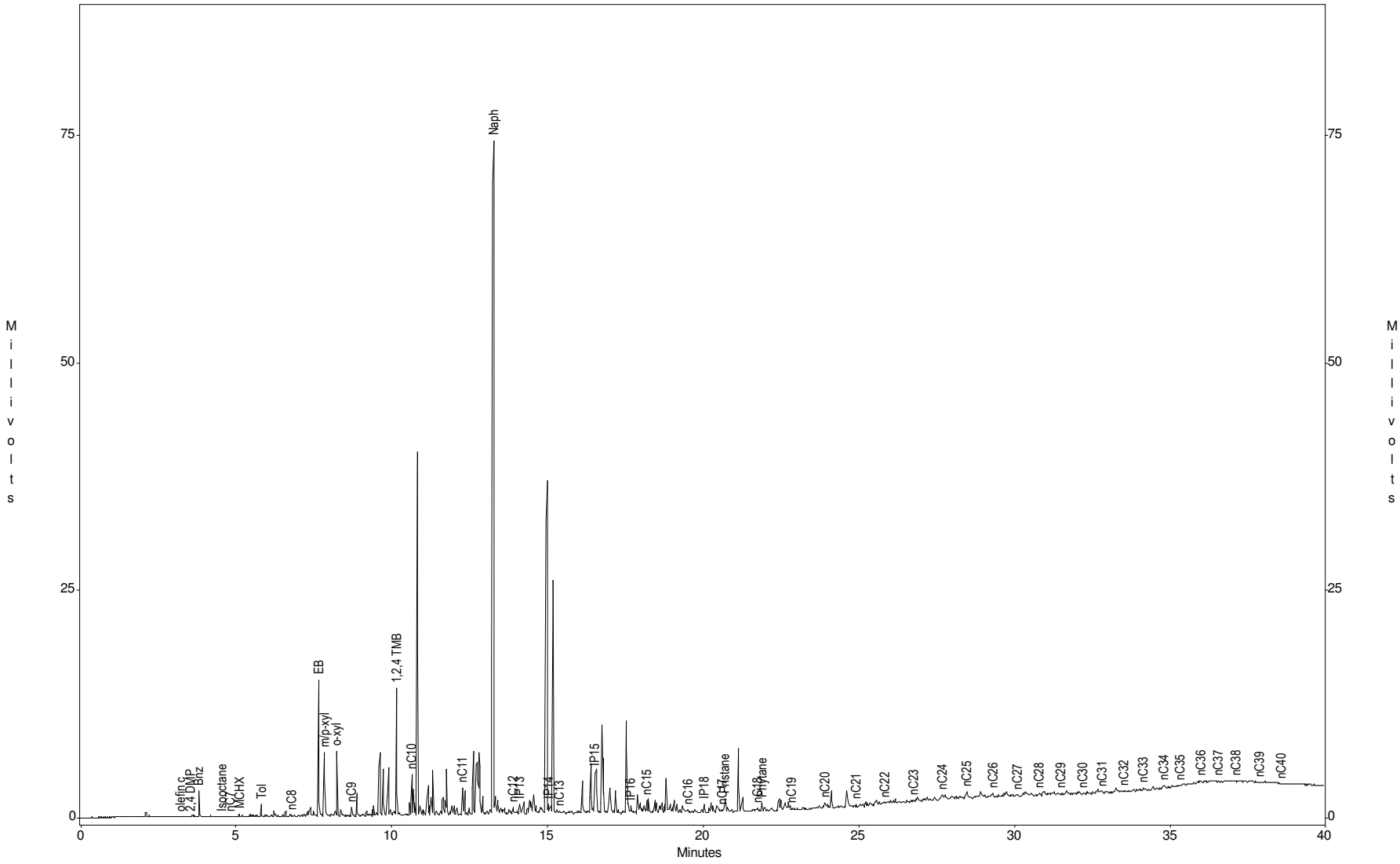
c:\ezchrom\chrom\08018\n-76 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : N-82 LNAPL
Acquired : Feb 12, 2008 18:57:06

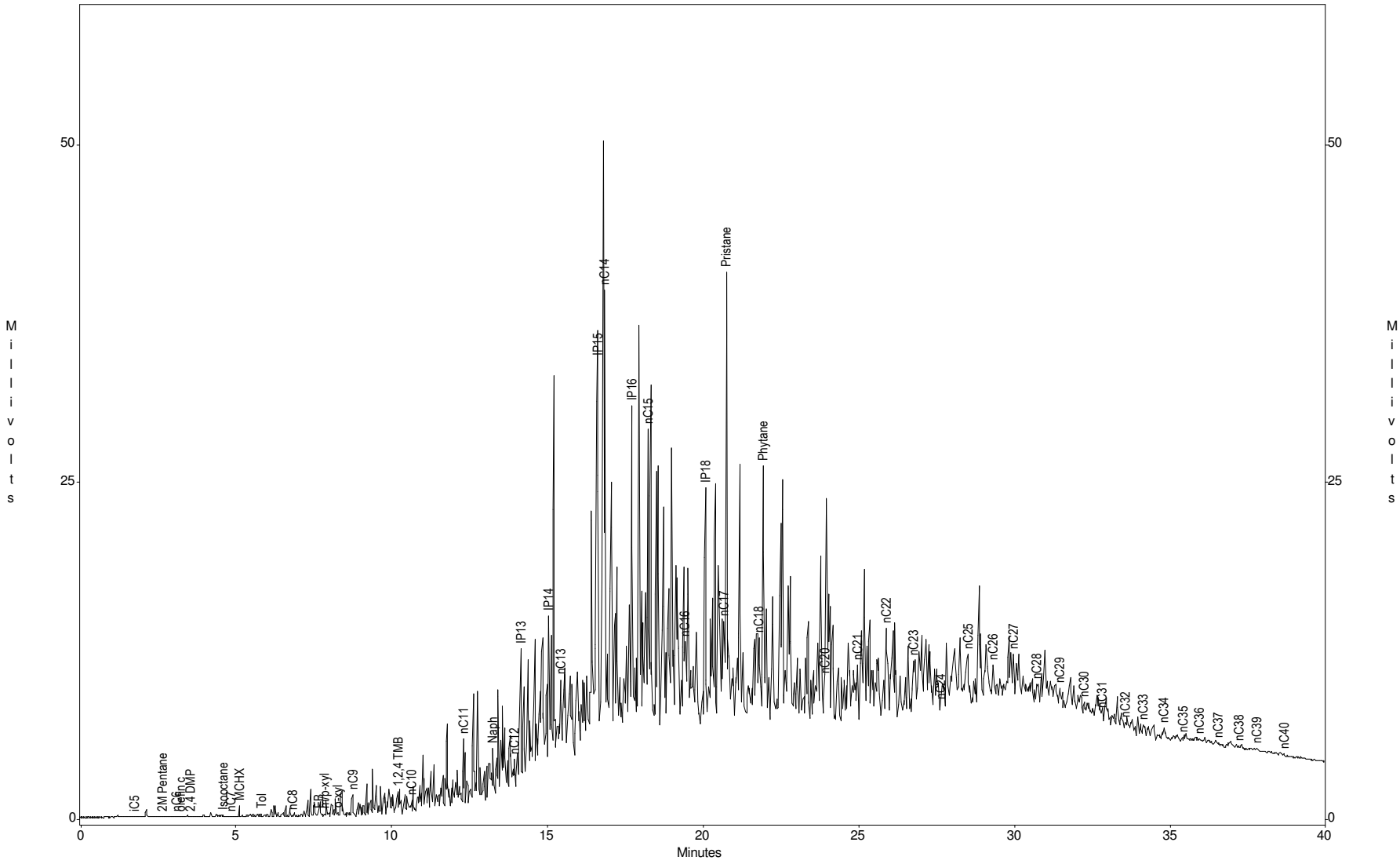
c:\ezchrom\chrom\08018\n-82.2 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : N-91 LNAPL
Acquired : Feb 12, 2008 16:03:11

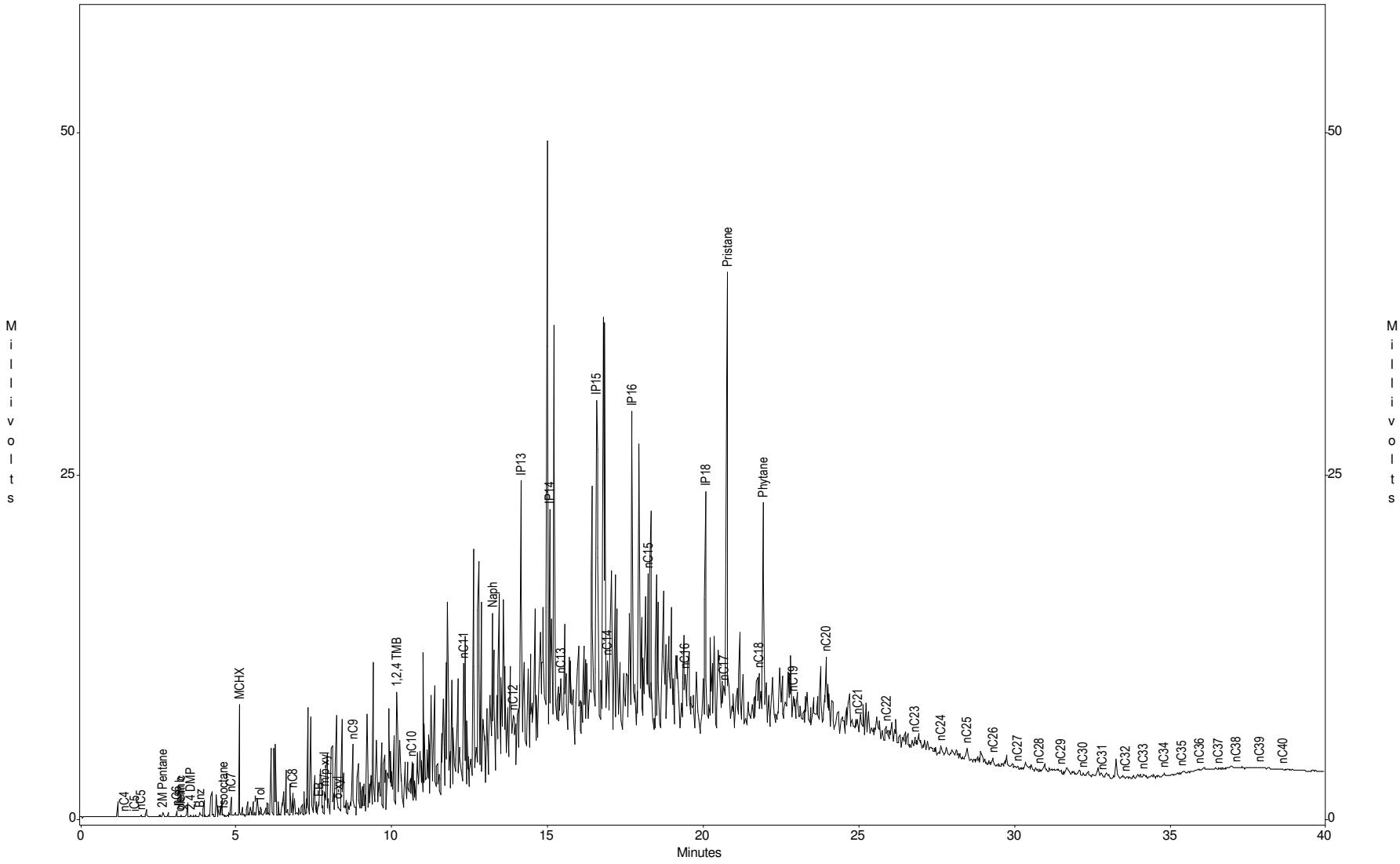
c:\ezchrom\chrom\08018\n-91 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : N-503 LNAPL
Acquired : Feb 12, 2008 10:55:46

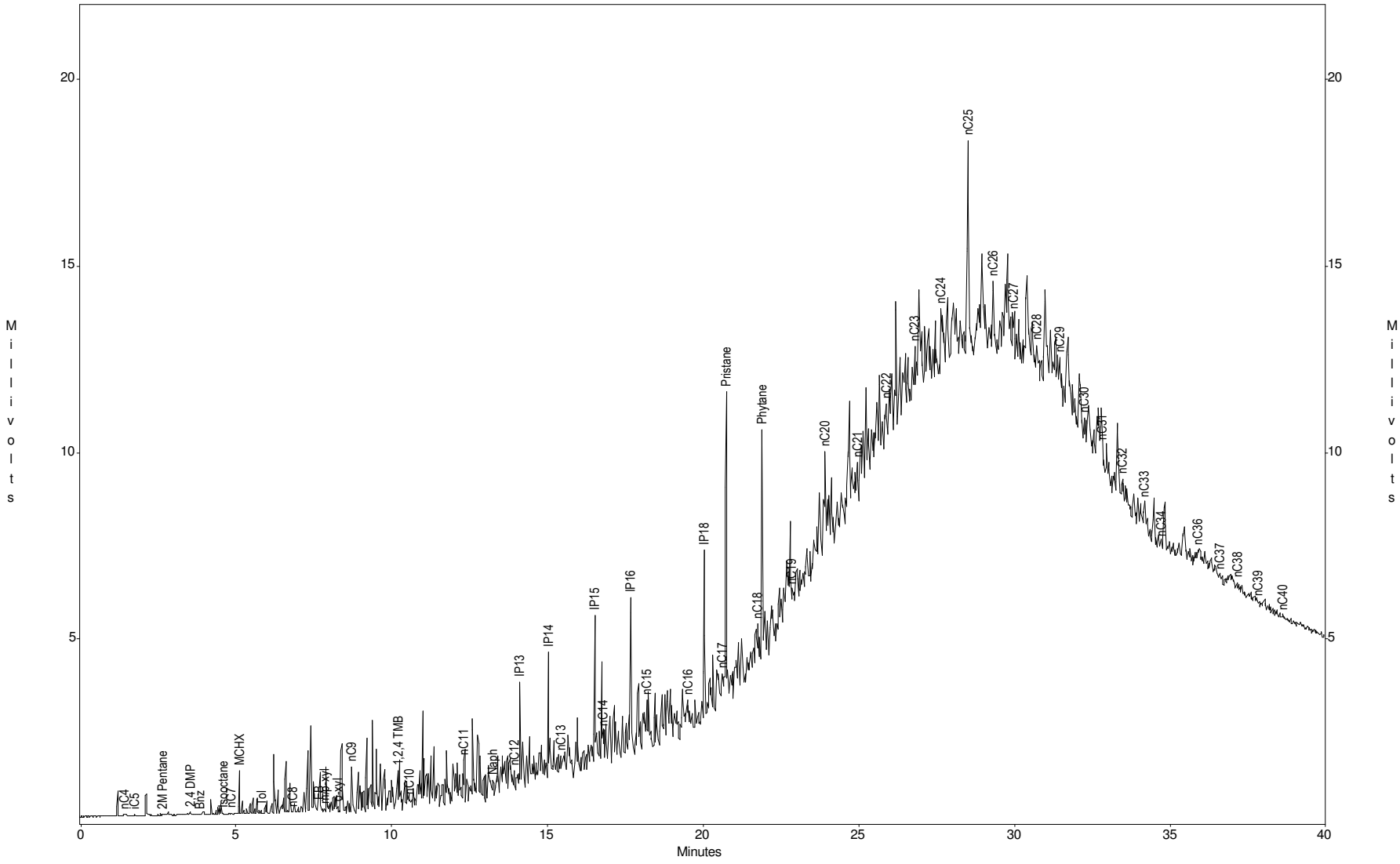
c:\ezchrom\chrom\08018\n-503 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : RW-205 LNAPL
Acquired : Feb 12, 2008 16:51:50

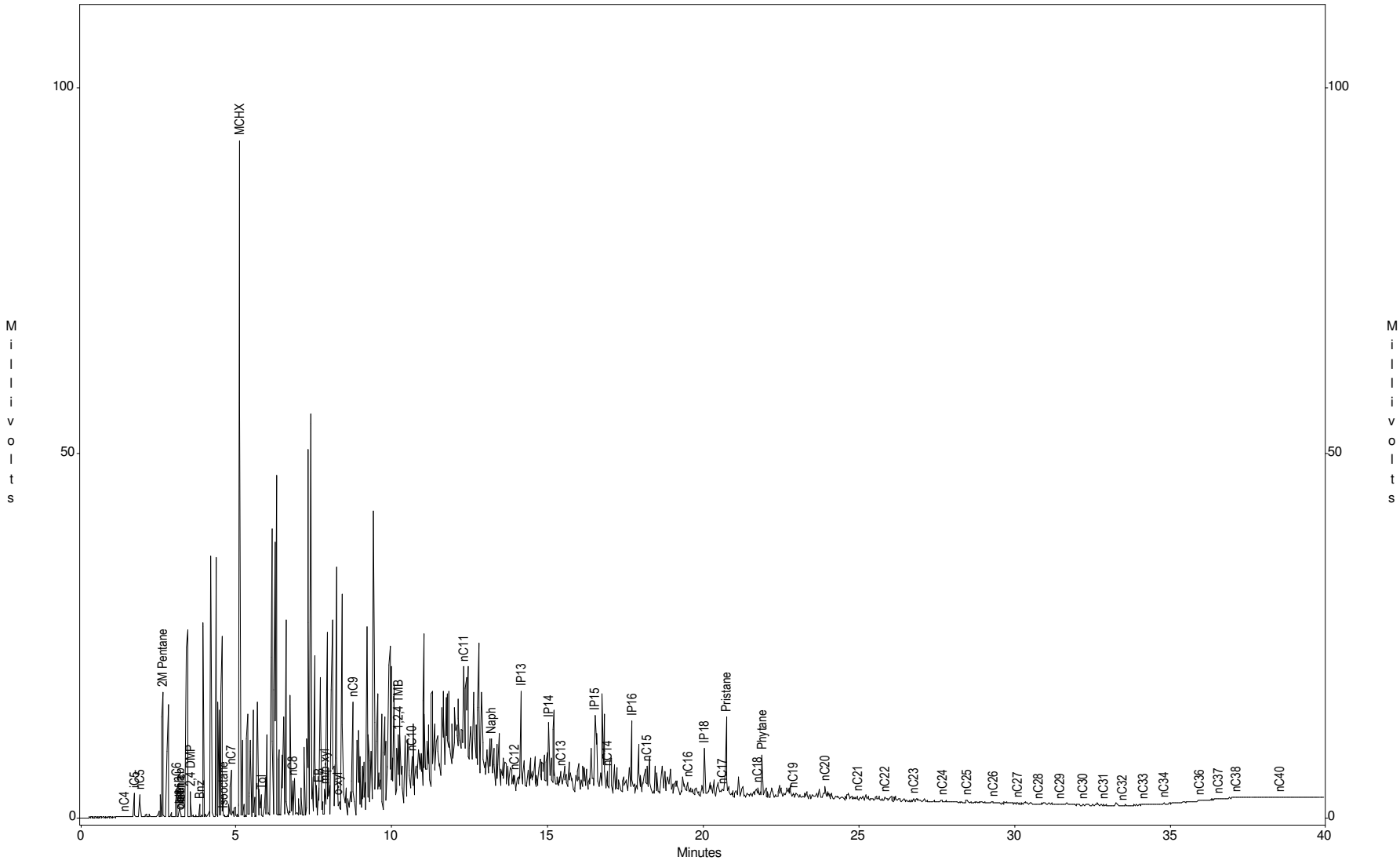
c:\ezchrom\chrom\08018\rw-205 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : RW-300 LNAPL
Acquired : Feb 12, 2008 08:30:15

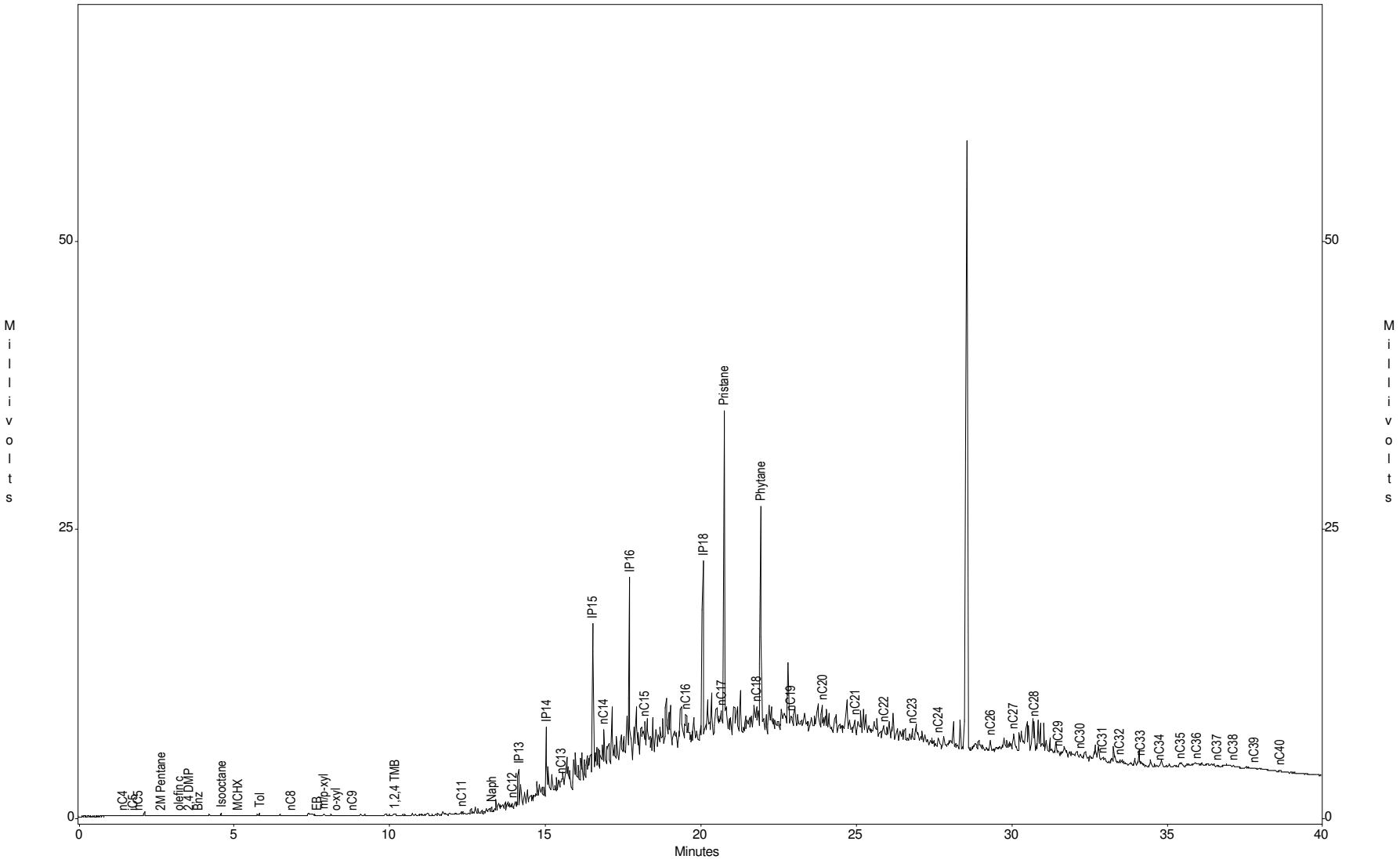
c:\ezchrom\chrom\08018\rw-300 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : RW-305 LNAPL
Acquired : Feb 12, 2008 14:25:40

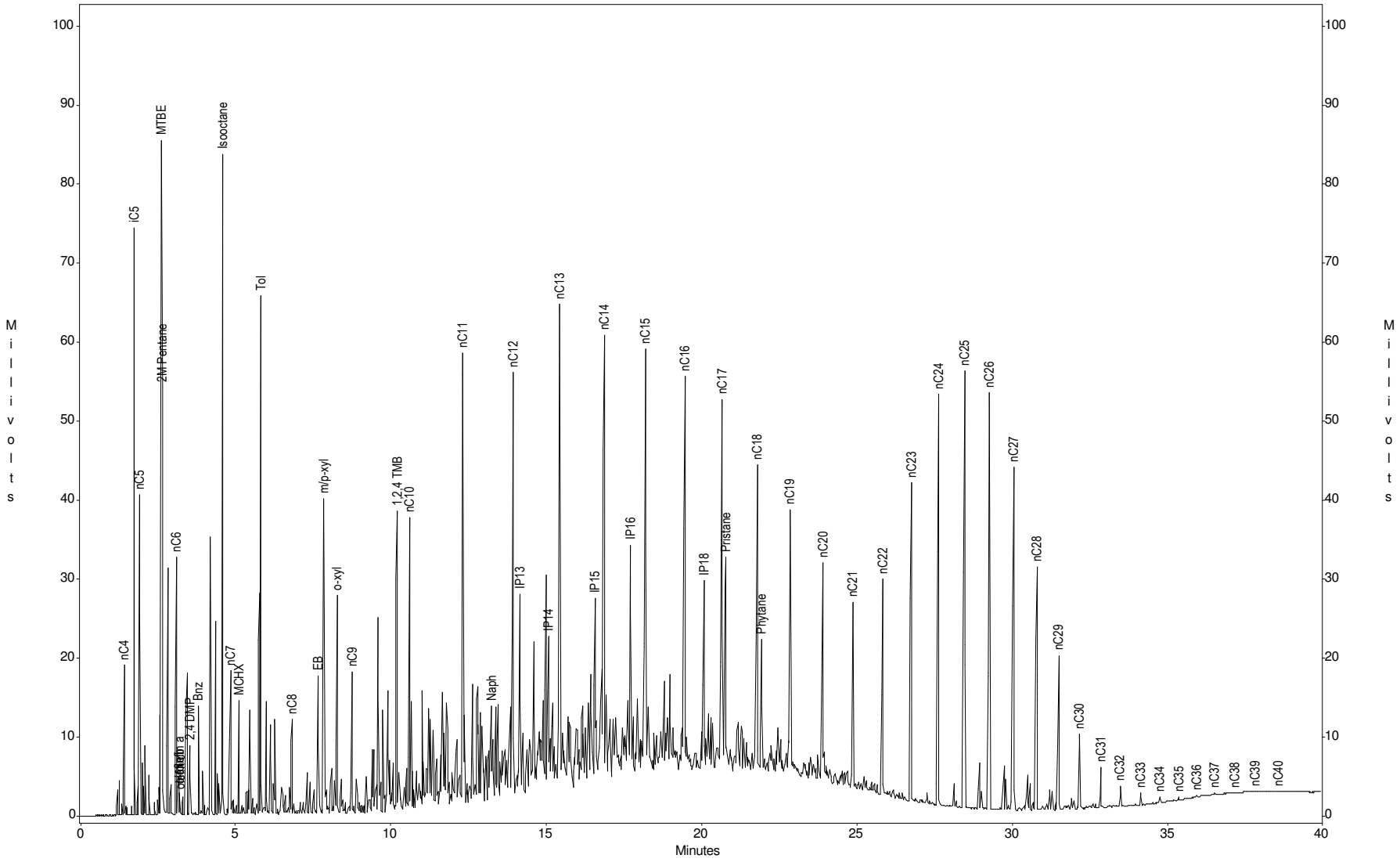
c:\ezchrom\chrom\08018\rw-305 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : Gas/Dies/Wax std
Acquired : Feb 12, 2008 11:48:01

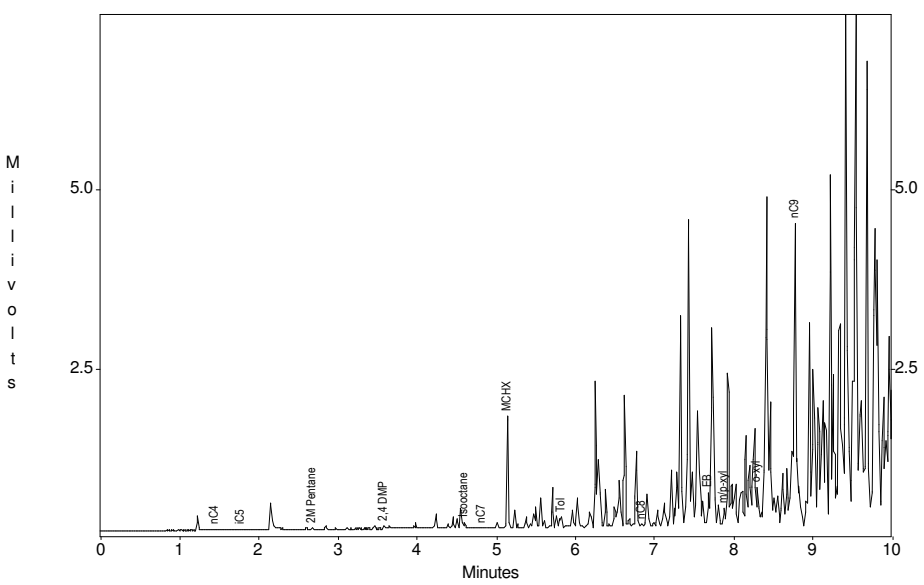
c:\ezchrom\chrom\08018\gadiwax2 -- Channel A



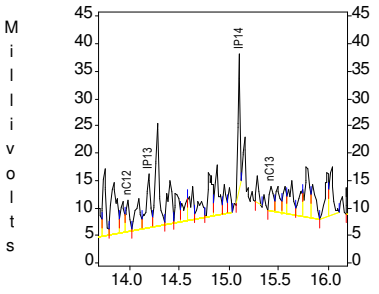
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : N-42 LNAPL
Acquired : Feb 12, 2008 12:43:00

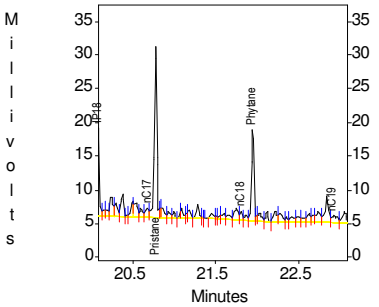
c:\ezchrom\chrom\08018\n-42 -- Channel A



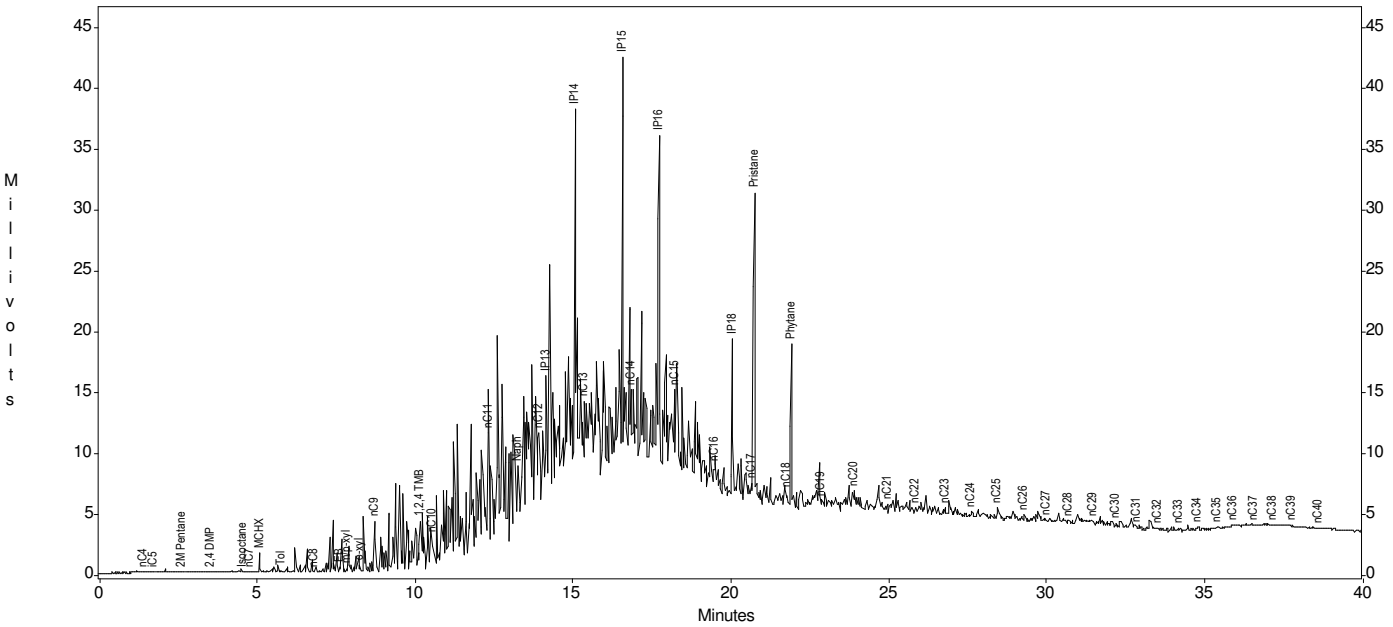

c:\ezchrom\chrom\08018\n-42 -- Channel A




c:\ezchrom\chrom\08018\n-42 -- Channel A




c:\ezchrom\chrom\08018\n-42 -- Channel A

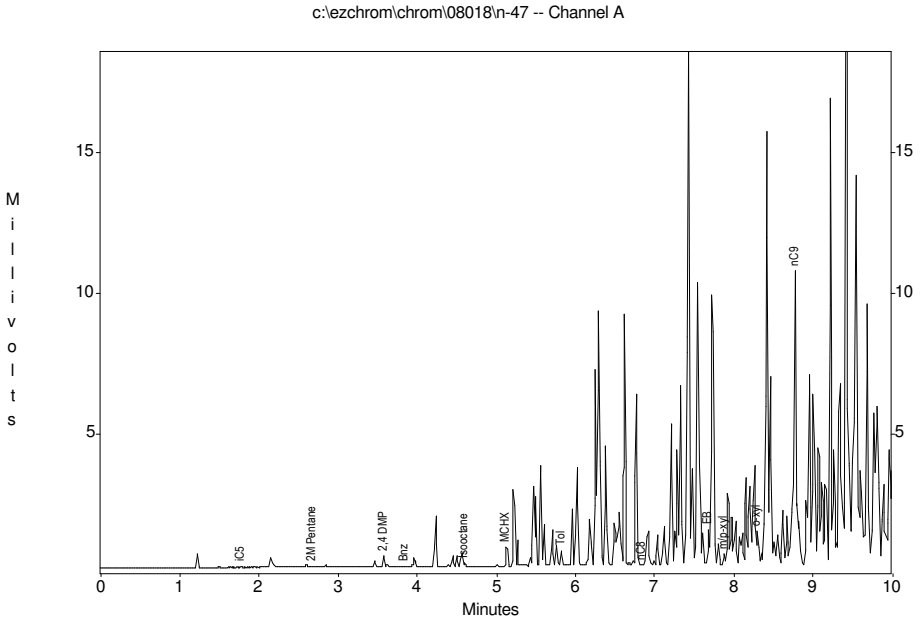


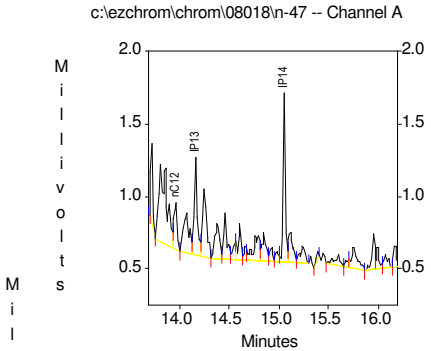

Channel A Results

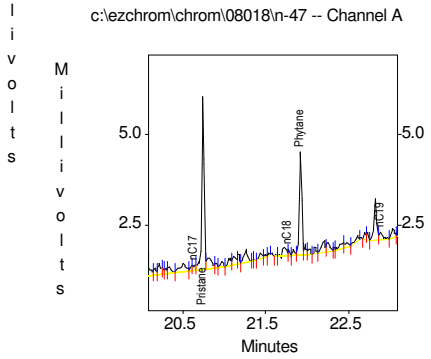
| Peak | Area | Height |
|---|---|---|
| nC4 | 21 | 10 |
| iC5 | 14 | 14 |
| nC5 | 0 | 0 |
| MTBE | 0 | 0 |
| 2M Pentane | 16 | 14 |
| nC6 | 0 | 0 |
| olefin a | 0 | 0 |
| olefin b | 0 | 0 |
| olefin c | 0 | 0 |
| 2,4 DMP | 54 | 45 |
| Bnz | 0 | 0 |
| Isooctane | 97 | 74 |
| nC7 | 16 | 14 |
| MCHX | 1843 | 1541 |
| Tol | 192 | 148 |
| nC8 | 52 | 34 |
| EB | 693 | 457 |
| m/p-xyl | 442 | 246 |
| o-xyl | 1021 | 524 |
| nC9 | 7723 | 4177 |
| 1,2,4 TMB | 11845 | 3905 |
| nC10 | 3714 | 2390 |
| nC11 | 20500 | 9507 |
| Naph | 25628 | 5399 |
| nC12 | 14996 | 5800 |
| IP13 | 27934 | 9796 |
| IP14 | 33392 | 24802 |
| nC13 | 12922 | 4799 |
| IP15 | 51389 | 31731 |
| nC14 | 14669 | 4894 |
| IP16 | 62858 | 26941 |
| nC15 | 7860 | 4741 |
| nC16 | 3635 | 2046 |
| IP18 | 30794 | 12965 |
| nC17 | 4005 | 1475 |
| Pristane | 57135 | 25486 |
| nC18 | 2650 | 1276 |
| Phytane | 28533 | 13392 |
| nC19 | 4736 | 834 |
| nC20 | 4102 | 1761 |
| nC21 | 1888 | 780 |
| nC22 | 3473 | 648 |
| nC23 | 1810 | 680 |
| nC24 | 1669 | 567 |
| nC25 | 4331 | 898 |
| nC26 | 1727 | 452 |
| nC27 | 288 | 182 |
| nC28 | 279 | 185 |
| nC29 | 479 | 275 |
| nC30 | 157 | 130 |
| nC31 | 65 | 82 |
| nC32 | 174 | 103 |
| nC33 | 135 | 91 |
| nC34 | 292 | 147 |
| nC35 | 167 | 62 |
| nC36 | 362 | 120 |
| nC37 | 266 | 81 |
| nC38 | 272 | 67 |
| nC39 | 180 | 65 |
| nC40 | 31 | 18 |

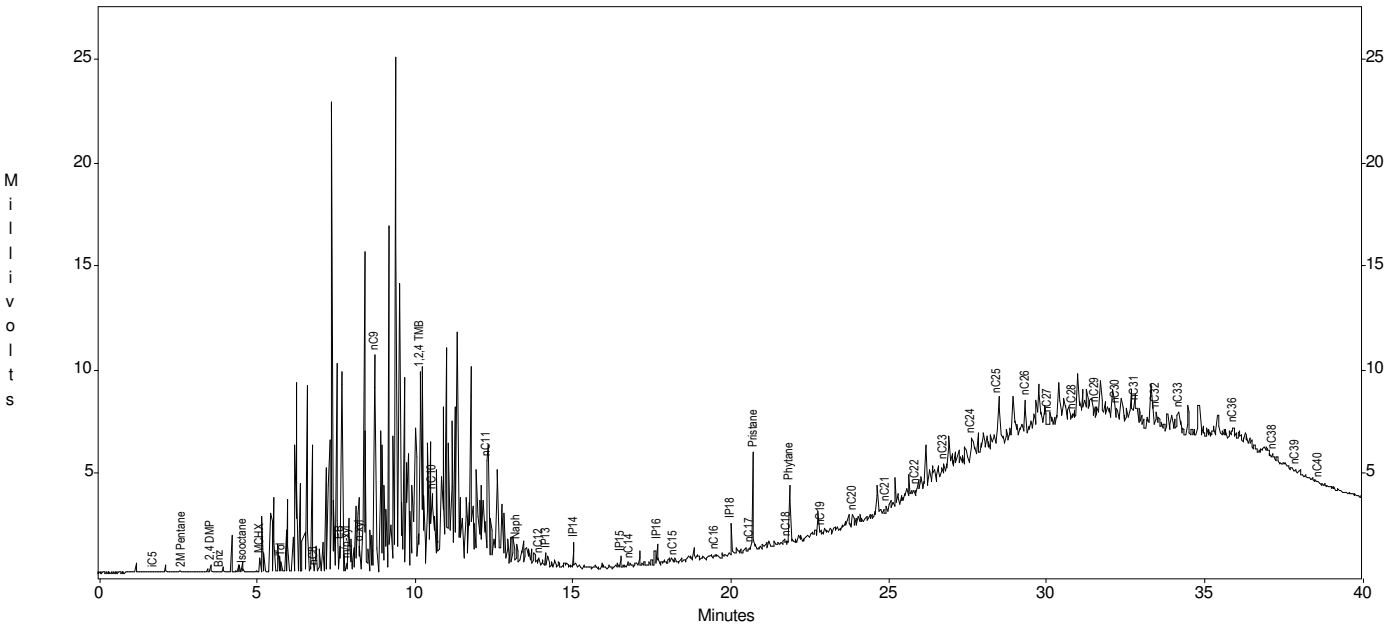
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : N-47 LNAPL
Acquired : Feb 12, 2008 13:32:10



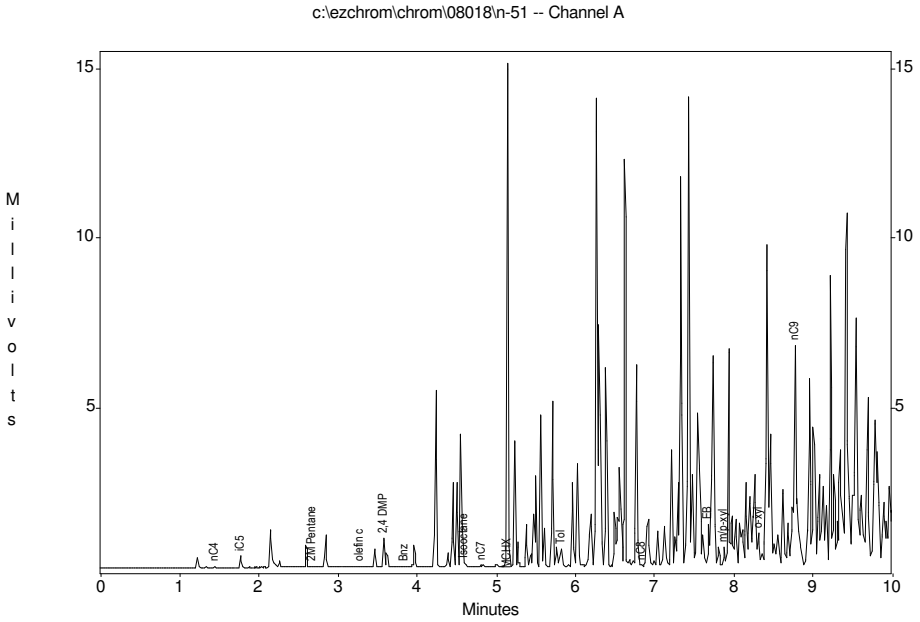



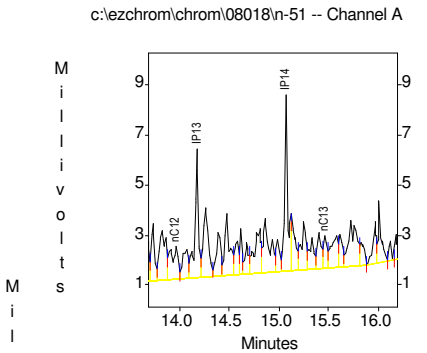

Channel A Results

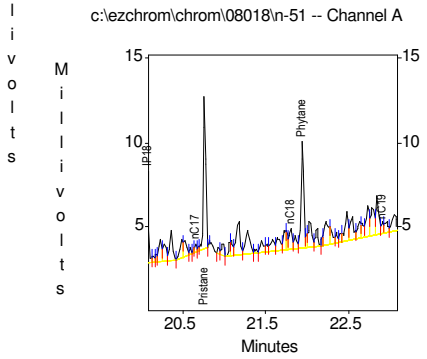
| Peak | Area | Height |
|---|---|---|
| nC4 | 0 | 0 |
| iC5 | 31 | 28 |
| nC5 | 0 | 0 |
| MTBE | 0 | 0 |
| 2M Pentane | 21 | 10 |
| nC6 | 0 | 0 |
| olefin a | 0 | 0 |
| olefin b | 0 | 0 |
| olefin c | 0 | 0 |
| 2,4 DMP | 381 | 346 |
| Bnz | 12 | 11 |
| Isooctane | 140 | 116 |
| nC7 | 0 | 0 |
| MCHX | 827 | 648 |
| Tol | 653 | 505 |
| nC8 | 90 | 58 |
| EB | 1816 | 1281 |
| m/p-xyl | 664 | 418 |
| o-xyl | 2443 | 1199 |
| nC9 | 20971 | 10457 |
| 1,2,4 TMB | 13818 | 9436 |
| nC10 | 7862 | 3583 |
| nC11 | 10140 | 5022 |
| Naph | 2618 | 858 |
| nC12 | 885 | 321 |
| IP13 | 1413 | 667 |
| IP14 | 1671 | 1167 |
| nC13 | 0 | 0 |
| IP15 | 757 | 523 |
| nC14 | 490 | 161 |
| IP16 | 2062 | 968 |
| nC15 | 443 | 157 |
| nC16 | 470 | 158 |
| IP18 | 4054 | 1522 |
| nC17 | 299 | 178 |
| Pristane | 9856 | 4763 |
| nC18 | 202 | 158 |
| Phytane | 5441 | 2822 |
| nC19 | 727 | 250 |
| nC20 | 1321 | 594 |
| nC21 | 636 | 247 |
| nC22 | 310 | 248 |
| nC23 | 529 | 391 |
| nC24 | 2911 | 1032 |
| nC25 | 10755 | 2250 |
| nC26 | 4959 | 1693 |
| nC27 | 479 | 338 |
| nC28 | 618 | 243 |
| nC29 | 883 | 494 |
| nC30 | 518 | 332 |
| nC31 | 62 | 0 |
| nC32 | 1070 | 493 |
| nC33 | 772 | 333 |
| nC34 | 0 | 0 |
| nC35 | 0 | 0 |
| nC36 | 202 | 191 |
| nC37 | 0 | 0 |
| nC38 | 224 | 111 |
| nC39 | 61 | 81 |
| nC40 | 199 | 45 |

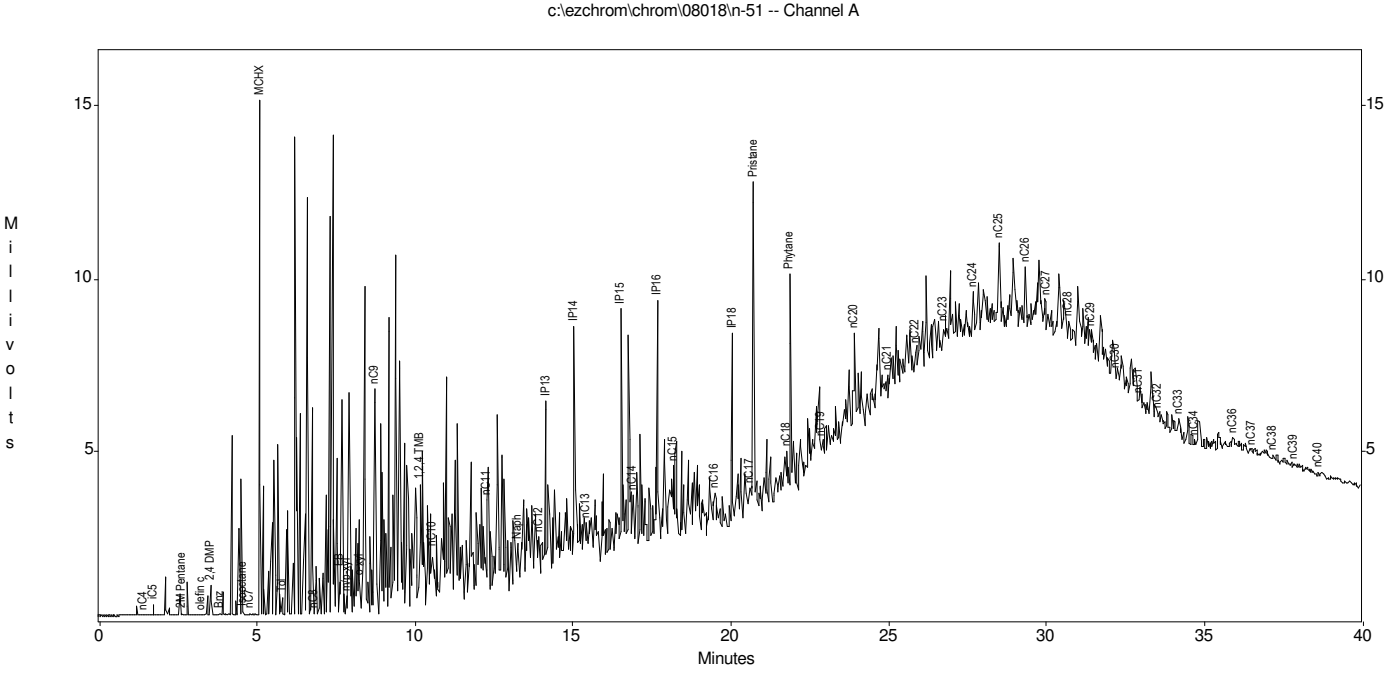
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : N-51 LNAPL
Acquired : Feb 12, 2008 10:07:28



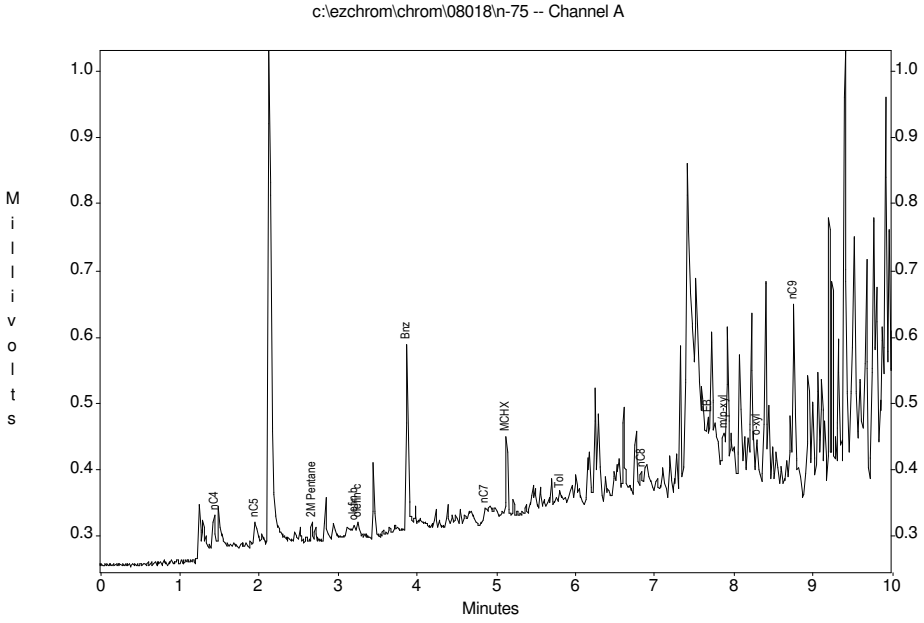

Channel A Results

| Peak | Area | Height |
|---|---|---|
| nC4 | 15 | 11 |
| iC5 | 293 | 314 |
| nC5 | 0 | 0 |
| MTBE | 0 | 0 |
| 2M Pentane | 50 | 41 |
| nC6 | 0 | 0 |
| olefin a | 0 | 0 |
| olefin b | 0 | 0 |
| olefin c | 36 | 17 |
| 2,4 DMP | 865 | 830 |
| Bnz | 37 | 27 |
| Isooctane | 125 | 110 |
| nC7 | 57 | 47 |
| MCHX | 17263 | 14823 |
| Tol | 646 | 490 |
| nC8 | 32 | 27 |
| EB | 1619 | 1177 |
| m/p-xyl | 728 | 487 |
| o-xyl | 1354 | 773 |
| nC9 | 11288 | 6441 |
| 1,2,4 TMB | 10062 | 3489 |
| nC10 | 3357 | 1552 |
| nC11 | 5890 | 2739 |
| Naph | 6141 | 1264 |
| nC12 | 6582 | 1283 |
| IP13 | 11907 | 5108 |
| IP14 | 13429 | 7005 |
| nC13 | 3225 | 1265 |
| IP15 | 9666 | 6597 |
| nC14 | 2233 | 1147 |
| IP16 | 13915 | 6905 |
| nC15 | 4776 | 2018 |
| nC16 | 2470 | 1101 |
| IP18 | 12742 | 5478 |
| nC17 | 881 | 436 |
| Pristane | 17031 | 9037 |
| nC18 | 2702 | 1264 |
| Phytane | 14057 | 6326 |
| nC19 | 1544 | 635 |
| nC20 | 6017 | 2656 |
| nC21 | 2138 | 920 |
| nC22 | 4522 | 1016 |
| nC23 | 3340 | 997 |
| nC24 | 4086 | 1342 |
| nC25 | 9484 | 2278 |
| nC26 | 5780 | 1817 |
| nC27 | 2663 | 992 |
| nC28 | 437 | 290 |
| nC29 | 3101 | 748 |
| nC30 | 129 | 90 |
| nC31 | 91 | 87 |
| nC32 | 445 | 163 |
| nC33 | 1282 | 406 |
| nC34 | 228 | 142 |
| nC35 | 0 | 0 |
| nC36 | 226 | 175 |
| nC37 | 78 | 65 |
| nC38 | 155 | 92 |
| nC39 | 50 | 50 |
| nC40 | 150 | 70 |

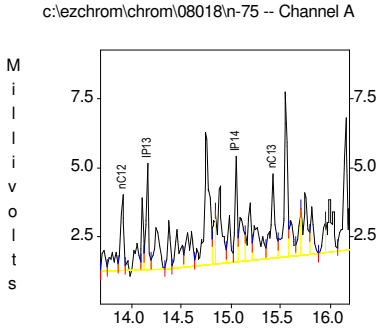
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : N-75 LNAPL
Acquired : Feb 12, 2008 17:47:22

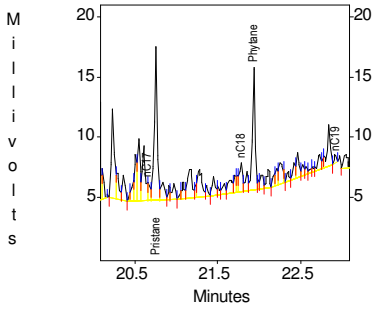
c:\ezchrom\chrom\08018\n-75 -- Channel A



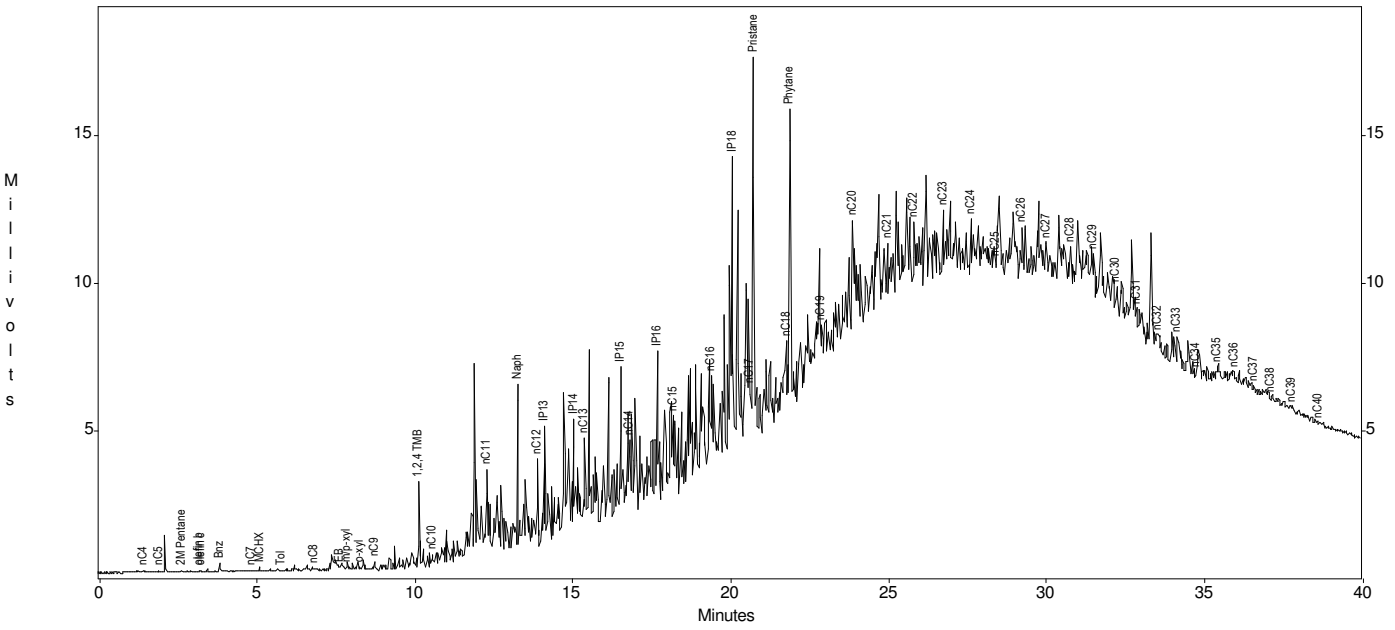

c:\ezchrom\chrom\08018\n-75 -- Channel A




c:\ezchrom\chrom\08018\n-75 -- Channel A




c:\ezchrom\chrom\08018\n-75 -- Channel A

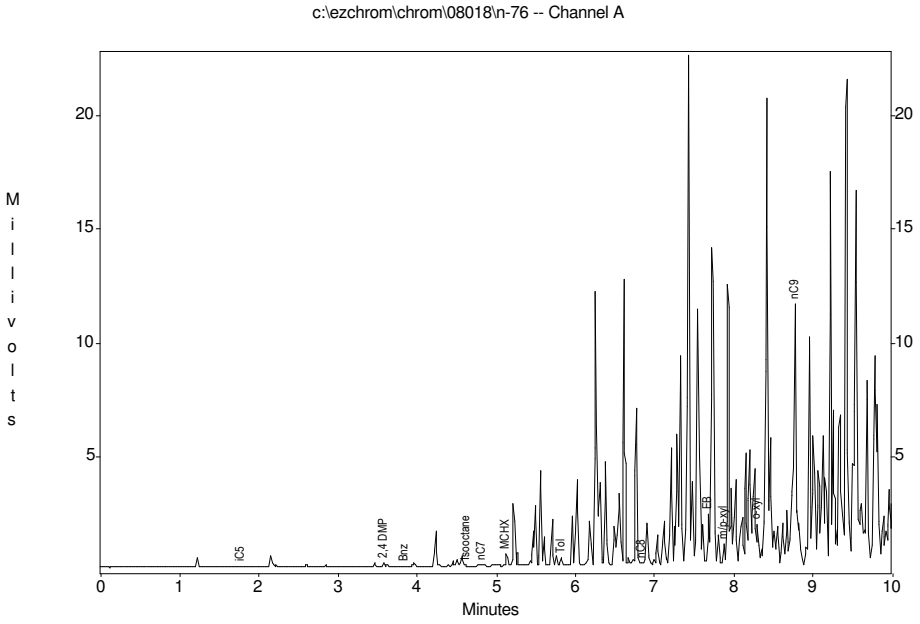


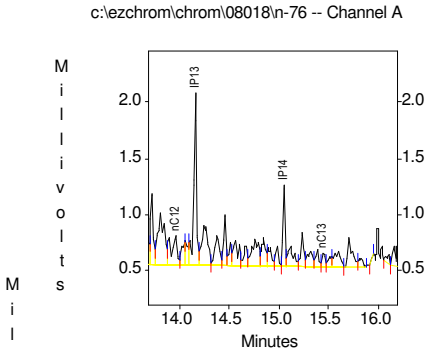

Channel A Results

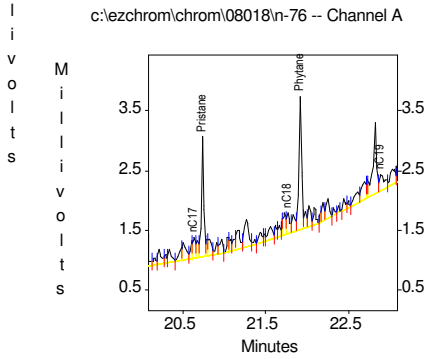
| Peak | Area | Height |
|---|---|---|
| nC4 | 120 | 57 |
| iC5 | 0 | 0 |
| nC5 | 114 | 37 |
| MTBE | 0 | 0 |
| 2M Pentane | 35 | 28 |
| nC6 | 0 | 0 |
| olefin a | 0 | 0 |
| olefin b | 11 | 9 |
| olefin c | 36 | 17 |
| 2,4 DMP | 0 | 0 |
| Bnz | 471 | 278 |
| Isooctane | 0 | 0 |
| nC7 | 35 | 14 |
| MCHX | 175 | 120 |
| Tol | 93 | 32 |
| nC8 | 135 | 54 |
| EB | 244 | 129 |
| m/p-xyl | 299 | 104 |
| o-xyl | 272 | 90 |
| nC9 | 659 | 291 |
| 1,2,4 TMB | 4658 | 2913 |
| nC10 | 684 | 373 |
| nC11 | 5838 | 2872 |
| Naph | 8742 | 5477 |
| nC12 | 4869 | 2716 |
| IP13 | 5861 | 3801 |
| IP14 | 6222 | 3806 |
| nC13 | 8486 | 3016 |
| IP15 | 8599 | 4788 |
| nC14 | 7533 | 1933 |
| IP16 | 12324 | 5070 |
| nC15 | 2534 | 1722 |
| nC16 | 8721 | 2885 |
| IP18 | 20344 | 9386 |
| nC17 | 3451 | 1606 |
| Pristane | 32928 | 12733 |
| nC18 | 5938 | 2391 |
| Phytane | 22697 | 10055 |
| nC19 | 1162 | 607 |
| nC20 | 7400 | 3707 |
| nC21 | 4479 | 2097 |
| nC22 | 4811 | 2437 |
| nC23 | 6507 | 2498 |
| nC24 | 2977 | 1686 |
| nC25 | 242 | 258 |
| nC26 | 3499 | 1690 |
| nC27 | 1410 | 965 |
| nC28 | 2367 | 1212 |
| nC29 | 3815 | 1203 |
| nC30 | 1431 | 519 |
| nC31 | 640 | 427 |
| nC32 | 299 | 163 |
| nC33 | 2179 | 796 |
| nC34 | 89 | 112 |
| nC35 | 80 | 102 |
| nC36 | 339 | 177 |
| nC37 | 284 | 159 |
| nC38 | 58 | 101 |
| nC39 | 238 | 107 |
| nC40 | 45 | 55 |

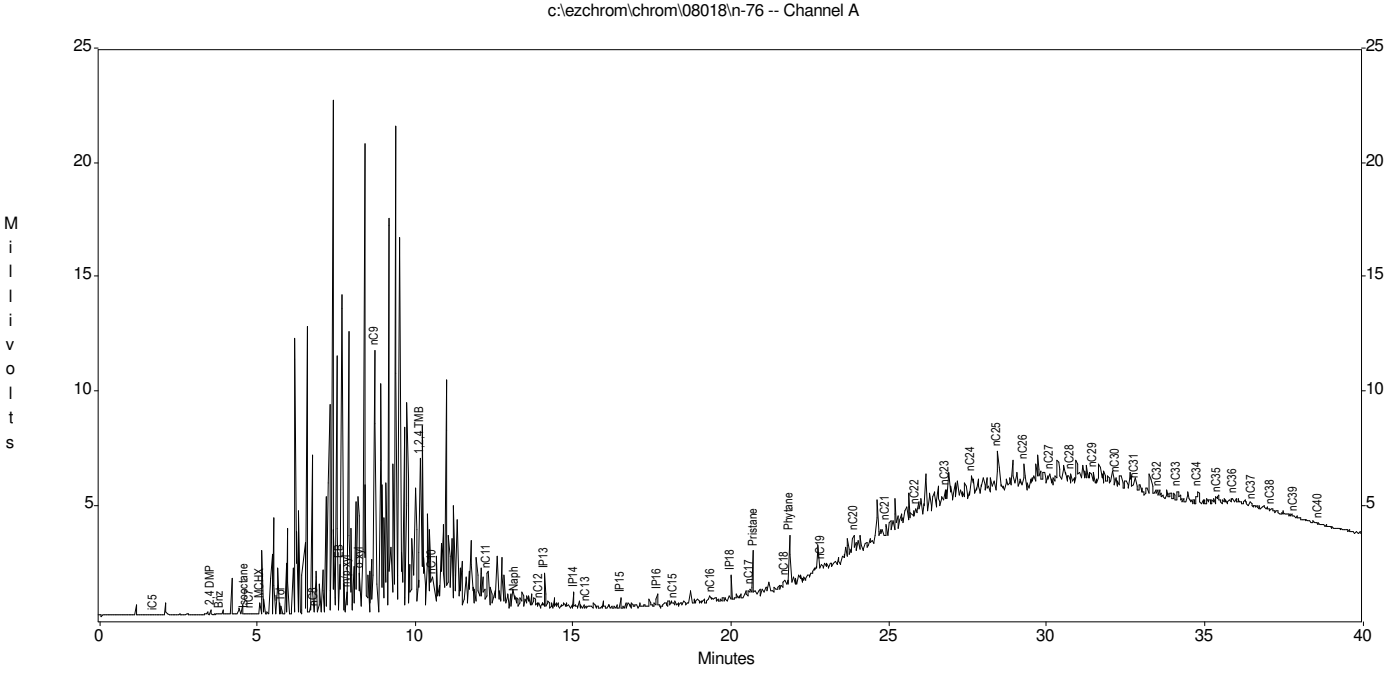
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : N-76 LNAPL
Acquired : Feb 12, 2008 15:14:12



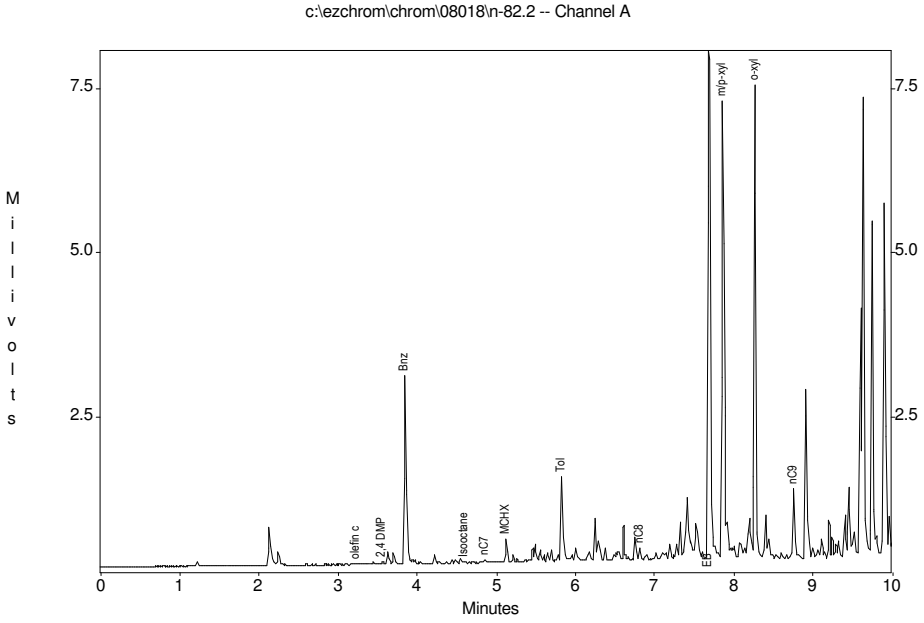

Channel A Results

| Peak | Area | Height |
|---|---|---|
| nC4 | 0 | 0 |
| iC5 | 15 | 10 |
| nC5 | 0 | 0 |
| MTBE | 0 | 0 |
| 2M Pentane | 0 | 0 |
| nC6 | 0 | 0 |
| olefin a | 0 | 0 |
| olefin b | 0 | 0 |
| olefin c | 0 | 0 |
| 2,4 DMP | 189 | 168 |
| Bnz | 13 | 7 |
| Isooctane | 12 | 10 |
| nC7 | 82 | 18 |
| MCHX | 615 | 460 |
| Tol | 524 | 334 |
| nC8 | 156 | 100 |
| EB | 3059 | 2173 |
| m/p-xyl | 1457 | 872 |
| o-xyl | 3419 | 1710 |
| nC9 | 21237 | 11428 |
| 1,2,4 TMB | 16615 | 6559 |
| nC10 | 2632 | 1215 |
| nC11 | 2821 | 1361 |
| Naph | 1863 | 547 |
| nC12 | 1235 | 264 |
| IP13 | 2778 | 1532 |
| IP14 | 1081 | 722 |
| nC13 | 256 | 122 |
| IP15 | 715 | 478 |
| nC14 | 0 | 0 |
| IP16 | 1382 | 548 |
| nC15 | 407 | 174 |
| nC16 | 526 | 233 |
| IP18 | 3015 | 1120 |
| nC17 | 720 | 356 |
| Pristane | 4321 | 2018 |
| nC18 | 727 | 346 |
| Phytane | 4804 | 2226 |
| nC19 | 1080 | 268 |
| nC20 | 2588 | 954 |
| nC21 | 2250 | 697 |
| nC22 | 2422 | 726 |
| nC23 | 2431 | 901 |
| nC24 | 2840 | 919 |
| nC25 | 7298 | 1752 |
| nC26 | 3877 | 1124 |
| nC27 | 281 | 130 |
| nC28 | 601 | 412 |
| nC29 | 795 | 411 |
| nC30 | 185 | 201 |
| nC31 | 103 | 89 |
| nC32 | 403 | 154 |
| nC33 | 1035 | 300 |
| nC34 | 945 | 229 |
| nC35 | 241 | 147 |
| nC36 | 416 | 137 |
| nC37 | 188 | 103 |
| nC38 | 247 | 75 |
| nC39 | 63 | 51 |
| nC40 | 51 | 42 |

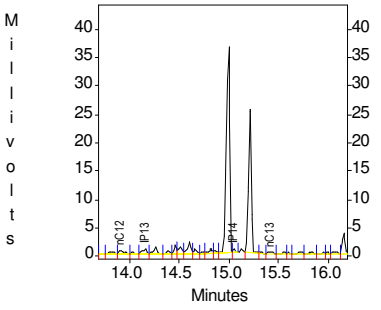
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : N-82 LNAPL
Acquired : Feb 12, 2008 18:57:06

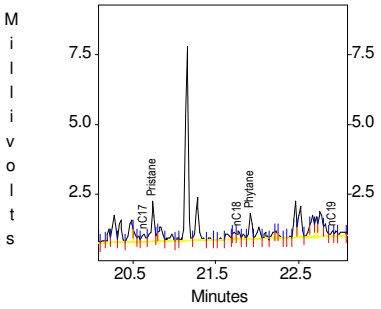
c:\ezchrom\chrom\08018\n-82.2 -- Channel A



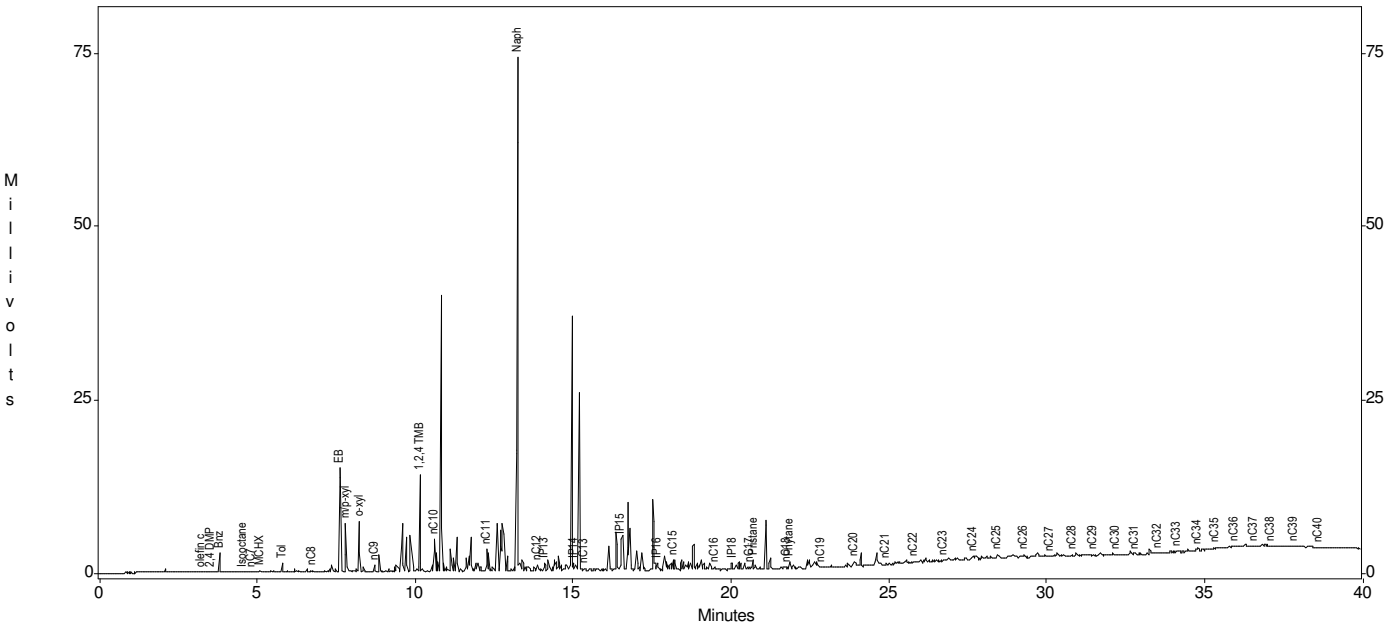

c:\ezchrom\chrom\08018\n-82.2 -- Channel A




c:\ezchrom\chrom\08018\n-82.2 -- Channel A




c:\ezchrom\chrom\08018\n-82.2 -- Channel A

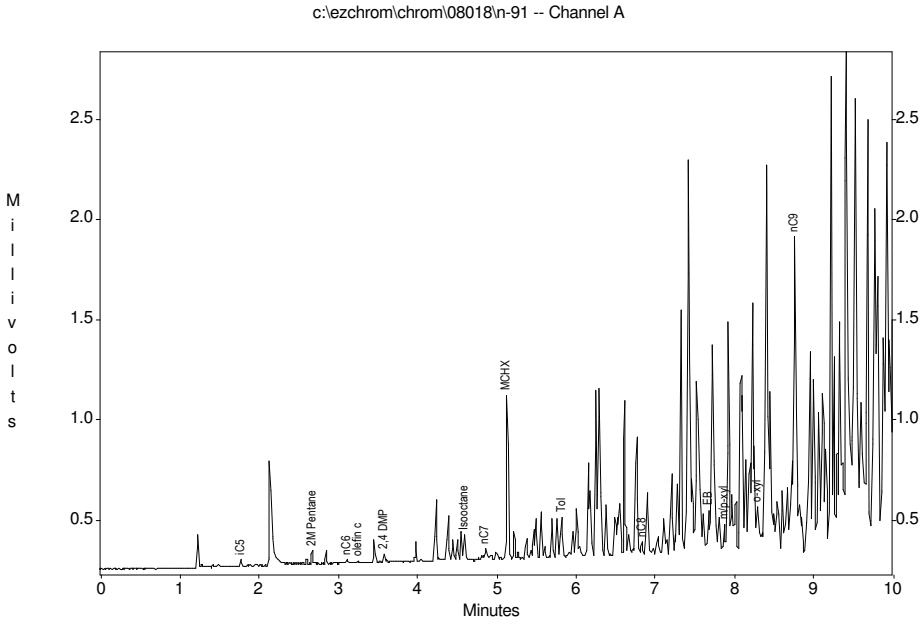


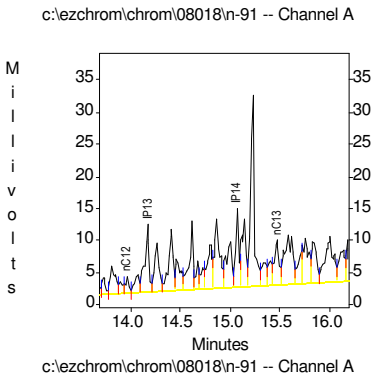

Channel A Results

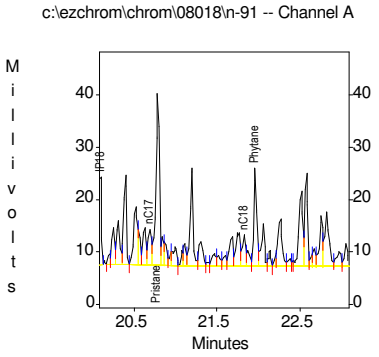
| Peak | Area | Height |
|---|---|---|
| nC4 | 0 | 0 |
| iC5 | 0 | 0 |
| nC5 | 0 | 0 |
| MTBE | 0 | 0 |
| 2M Pentane | 0 | 0 |
| nC6 | 0 | 0 |
| olefin a | 0 | 0 |
| olefin b | 0 | 0 |
| olefin c | 12 | 7 |
| 2,4 DMP | 42 | 34 |
| Bnz | 3883 | 2869 |
| Isooctane | 12 | 12 |
| nC7 | 91 | 35 |
| MCHX | 486 | 353 |
| Tol | 2186 | 1307 |
| nC8 | 297 | 194 |
| EB | 20013 | 15003 |
| m/p-xyl | 14551 | 6972 |
| o-xyl | 10711 | 7225 |
| nC9 | 1792 | 1057 |
| 1,2,4 TMB | 21422 | 13928 |
| nC10 | 6918 | 4578 |
| nC11 | 5415 | 3012 |
| Naph | 187952 | 73349 |
| nC12 | 2468 | 778 |
| IP13 | 3225 | 1097 |
| IP14 | 1124 | 700 |
| nC13 | 678 | 244 |
| IP15 | 17557 | 4486 |
| nC14 | 0 | 0 |
| IP16 | 3091 | 922 |
| nC15 | 2823 | 1425 |
| nC16 | 1291 | 422 |
| IP18 | 2570 | 997 |
| nC17 | 962 | 272 |
| Pristane | 3817 | 1451 |
| nC18 | 673 | 327 |
| Phytane | 2071 | 923 |
| nC19 | 411 | 177 |
| nC20 | 1966 | 711 |
| nC21 | 478 | 196 |
| nC22 | 1228 | 257 |
| nC23 | 599 | 239 |
| nC24 | 2391 | 529 |
| nC25 | 3136 | 619 |
| nC26 | 1982 | 491 |
| nC27 | 634 | 188 |
| nC28 | 378 | 222 |
| nC29 | 349 | 132 |
| nC30 | 248 | 98 |
| nC31 | 59 | 56 |
| nC32 | 161 | 84 |
| nC33 | 500 | 156 |
| nC34 | 408 | 151 |
| nC35 | 71 | 51 |
| nC36 | 102 | 72 |
| nC37 | 59 | 39 |
| nC38 | 87 | 43 |
| nC39 | 104 | 35 |
| nC40 | 92 | 35 |

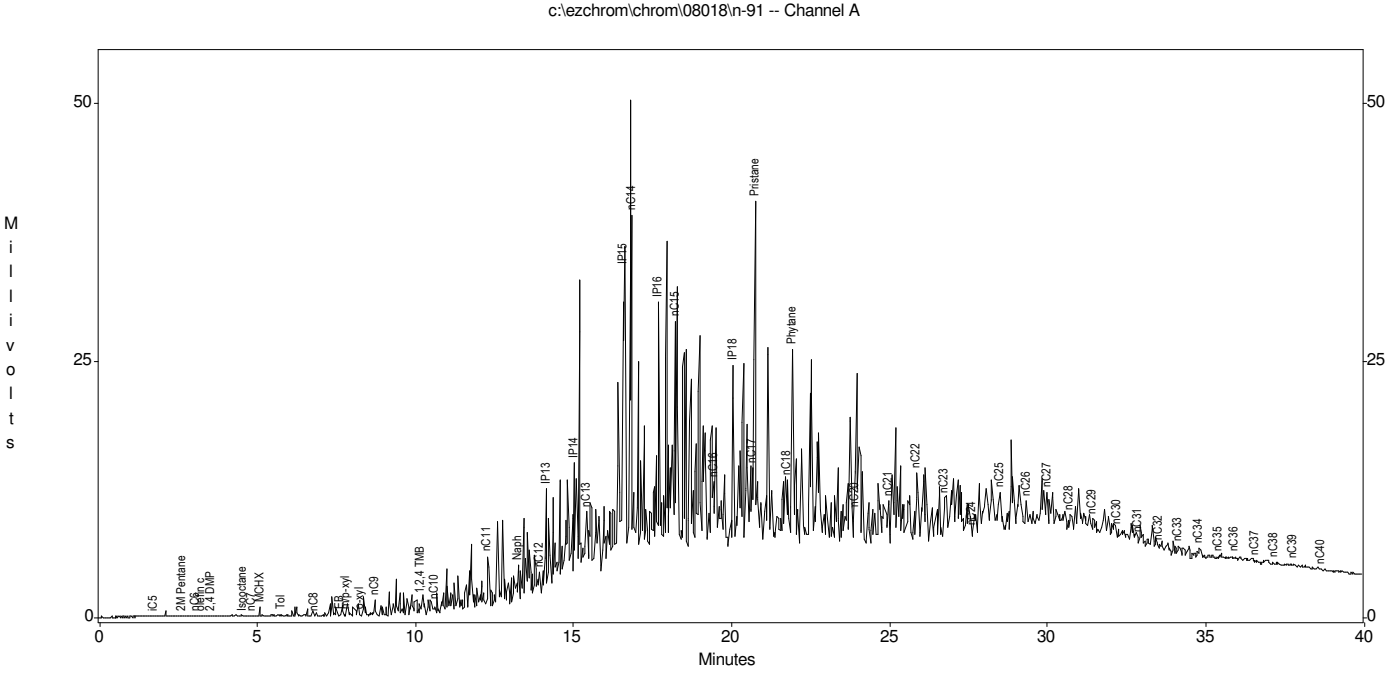
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : N-91 LNAPL
Acquired : Feb 12, 2008 16:03:11



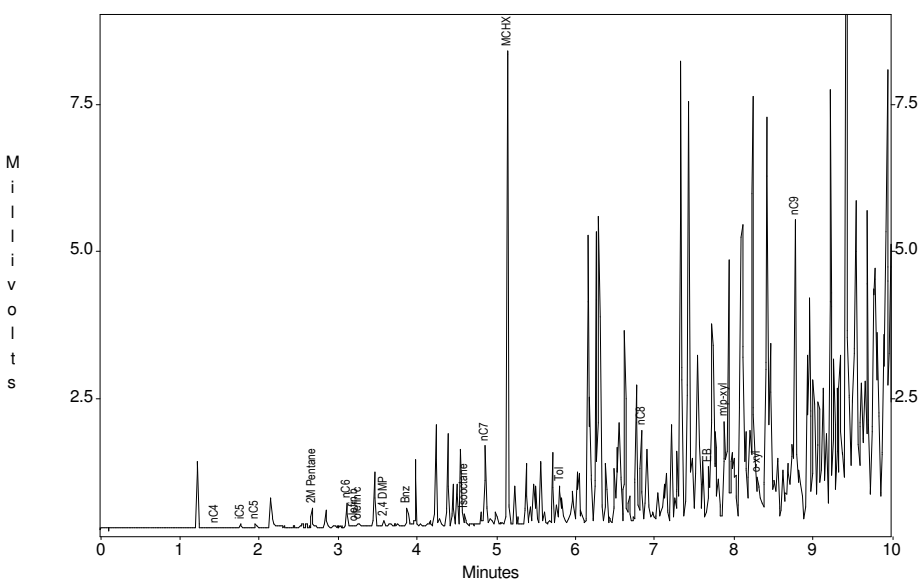

Channel A Results

| Peak | Area | Height |
|---|---|---|
| nC4 | 0 | 0 |
| iC5 | 26 | 31 |
| nC5 | 0 | 0 |
| MTBE | 0 | 0 |
| 2M Pentane | 69 | 64 |
| nC6 | 23 | 19 |
| olefin a | 0 | 0 |
| olefin b | 0 | 0 |
| olefin c | 16 | 8 |
| 2,4 DMP | 42 | 37 |
| Bnz | 0 | 0 |
| Isooctane | 148 | 123 |
| nC7 | 97 | 54 |
| MCHX | 1014 | 815 |
| Tol | 378 | 203 |
| nC8 | 102 | 67 |
| EB | 397 | 216 |
| m/p-xyl | 264 | 144 |
| o-xyl | 526 | 232 |
| nC9 | 2921 | 1569 |
| 1,2,4 TMB | 2423 | 1602 |
| nC10 | 788 | 614 |
| nC11 | 8067 | 4743 |
| Naph | 9500 | 3595 |
| nC12 | 6025 | 2284 |
| IP13 | 29603 | 10288 |
| IP14 | 23496 | 12019 |
| nC13 | 19453 | 6923 |
| IP15 | 175043 | 29660 |
| nC14 | 66687 | 34679 |
| IP16 | 80041 | 25407 |
| nC15 | 58839 | 23217 |
| nC16 | 20949 | 6496 |
| IP18 | 44063 | 16745 |
| nC17 | 20303 | 6900 |
| Pristane | 80294 | 32866 |
| nC18 | 14499 | 5930 |
| Phytane | 45712 | 18702 |
| nC19 | 0 | 0 |
| nC20 | 6953 | 3129 |
| nC21 | 10330 | 4076 |
| nC22 | 19220 | 6616 |
| nC23 | 13510 | 4029 |
| nC24 | 364 | 451 |
| nC25 | 21576 | 3747 |
| nC26 | 8164 | 2458 |
| nC27 | 7662 | 2898 |
| nC28 | 3624 | 1311 |
| nC29 | 4517 | 1379 |
| nC30 | 1825 | 694 |
| nC31 | 62 | 0 |
| nC32 | 545 | 353 |
| nC33 | 1020 | 347 |
| nC34 | 992 | 418 |
| nC35 | 359 | 187 |
| nC36 | 447 | 121 |
| nC37 | 117 | 73 |
| nC38 | 119 | 76 |
| nC39 | 483 | 174 |
| nC40 | 257 | 86 |

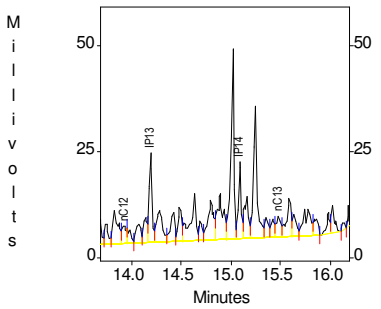
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : N-503 LNAPL
Acquired : Feb 12, 2008 10:55:46

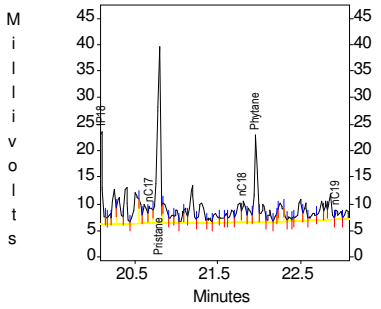
c:\ezchrom\chrom\08018\n-503 -- Channel A



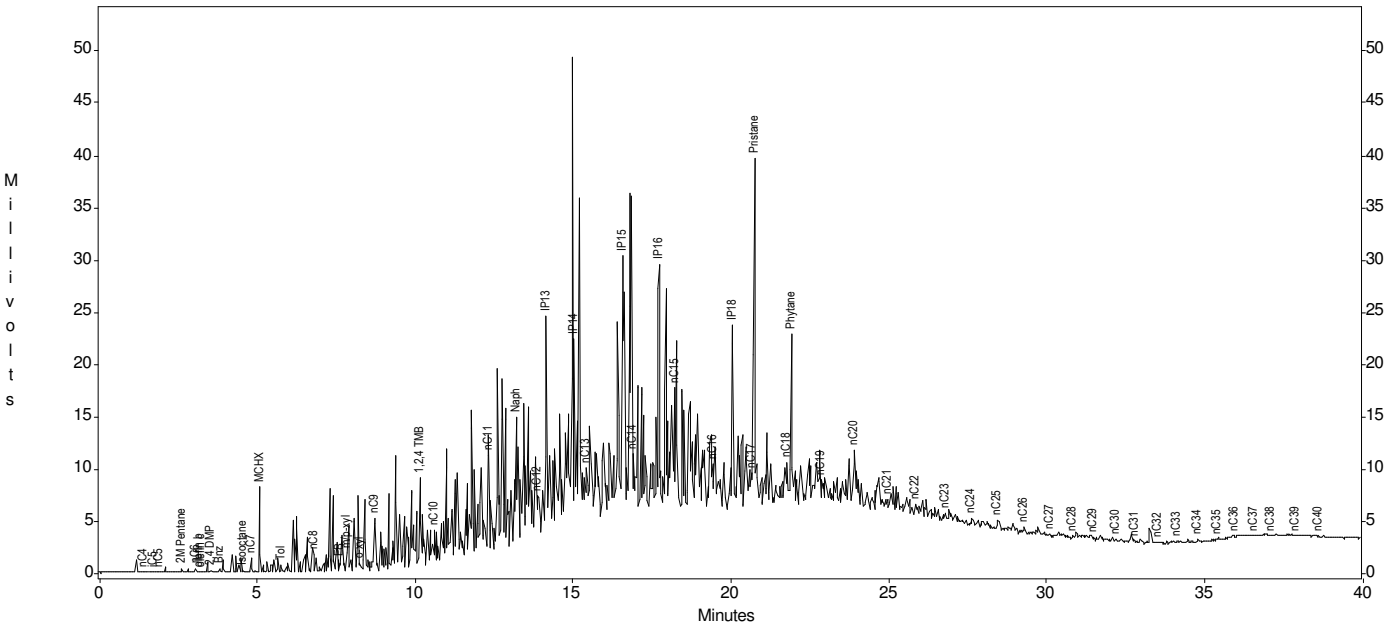

c:\ezchrom\chrom\08018\n-503 -- Channel A




c:\ezchrom\chrom\08018\n-503 -- Channel A




c:\ezchrom\chrom\08018\n-503 -- Channel A



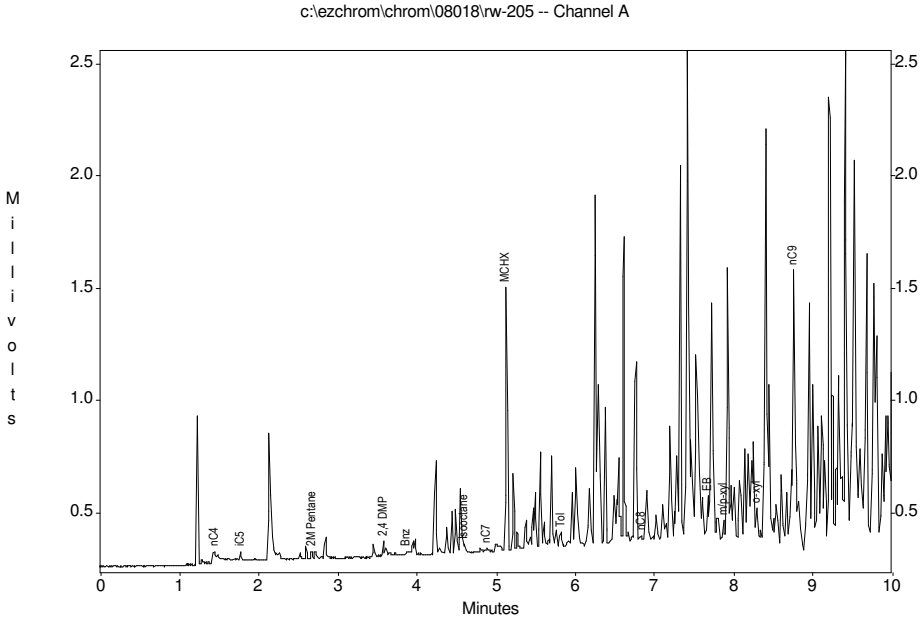

Channel A Results

| Peak | Area | Height |
|---|---|---|
| nC4 | 25 | 15 |
| iC5 | 48 | 49 |
| nC5 | 71 | 65 |
| MTBE | 0 | 0 |
| 2M Pentane | 319 | 314 |
| nC6 | 464 | 406 |
| olefin a | 0 | 0 |
| olefin b | 36 | 25 |
| olefin c | 105 | 44 |
| 2,4 DMP | 117 | 108 |
| Bnz | 458 | 281 |
| Isooctane | 273 | 197 |
| nC7 | 1606 | 1344 |
| MCHX | 9442 | 8086 |
| Tol | 822 | 649 |
| nC8 | 2062 | 1573 |
| EB | 1481 | 880 |
| m/p-xyl | 2654 | 1629 |
| o-xyl | 1312 | 522 |
| nC9 | 9263 | 5085 |
| 1,2,4 TMB | 16986 | 8425 |
| nC10 | 4534 | 2938 |
| nC11 | 17877 | 9055 |
| Naph | 24963 | 12164 |
| nC12 | 12993 | 4069 |
| IP13 | 40125 | 20878 |
| IP14 | 33242 | 17865 |
| nC13 | 15524 | 5176 |
| IP15 | 96067 | 23235 |
| nC14 | 5500 | 3531 |
| IP16 | 51498 | 23146 |
| nC15 | 24853 | 11401 |
| nC16 | 8259 | 4145 |
| IP18 | 45467 | 17473 |
| nC17 | 11151 | 3244 |
| Pristane | 82400 | 33381 |
| nC18 | 8991 | 4010 |
| Phytane | 39516 | 16387 |
| nC19 | 7518 | 1844 |
| nC20 | 13625 | 5292 |
| nC21 | 3754 | 1235 |
| nC22 | 3814 | 1206 |
| nC23 | 2504 | 858 |
| nC24 | 1721 | 699 |
| nC25 | 5300 | 943 |
| nC26 | 1921 | 577 |
| nC27 | 365 | 201 |
| nC28 | 303 | 205 |
| nC29 | 928 | 243 |
| nC30 | 163 | 87 |
| nC31 | 32 | 0 |
| nC32 | 73 | 49 |
| nC33 | 593 | 199 |
| nC34 | 1175 | 238 |
| nC35 | 86 | 79 |
| nC36 | 79 | 58 |
| nC37 | 74 | 28 |
| nC38 | 56 | 27 |
| nC39 | 104 | 26 |
| nC40 | 71 | 39 |

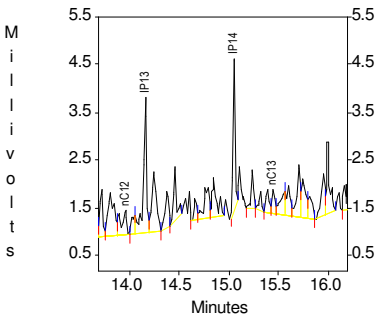
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : RW-205 LNAPL
Acquired : Feb 12, 2008 16:51:50

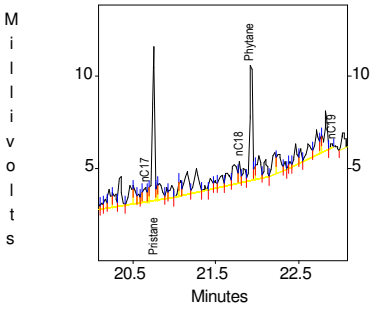
c:\ezchrom\chrom\08018\rw-205 -- Channel A



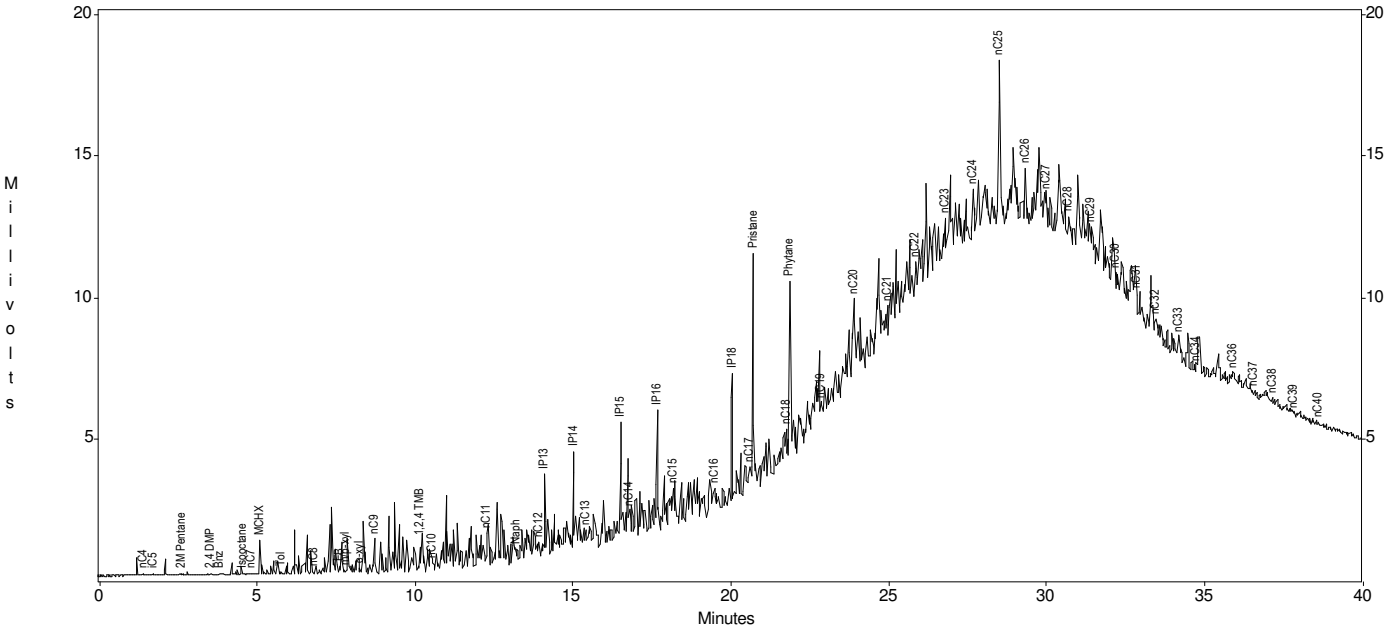

c:\ezchrom\chrom\08018\rw-205 -- Channel A




c:\ezchrom\chrom\08018\rw-205 -- Channel A




c:\ezchrom\chrom\08018\rw-205 -- Channel A



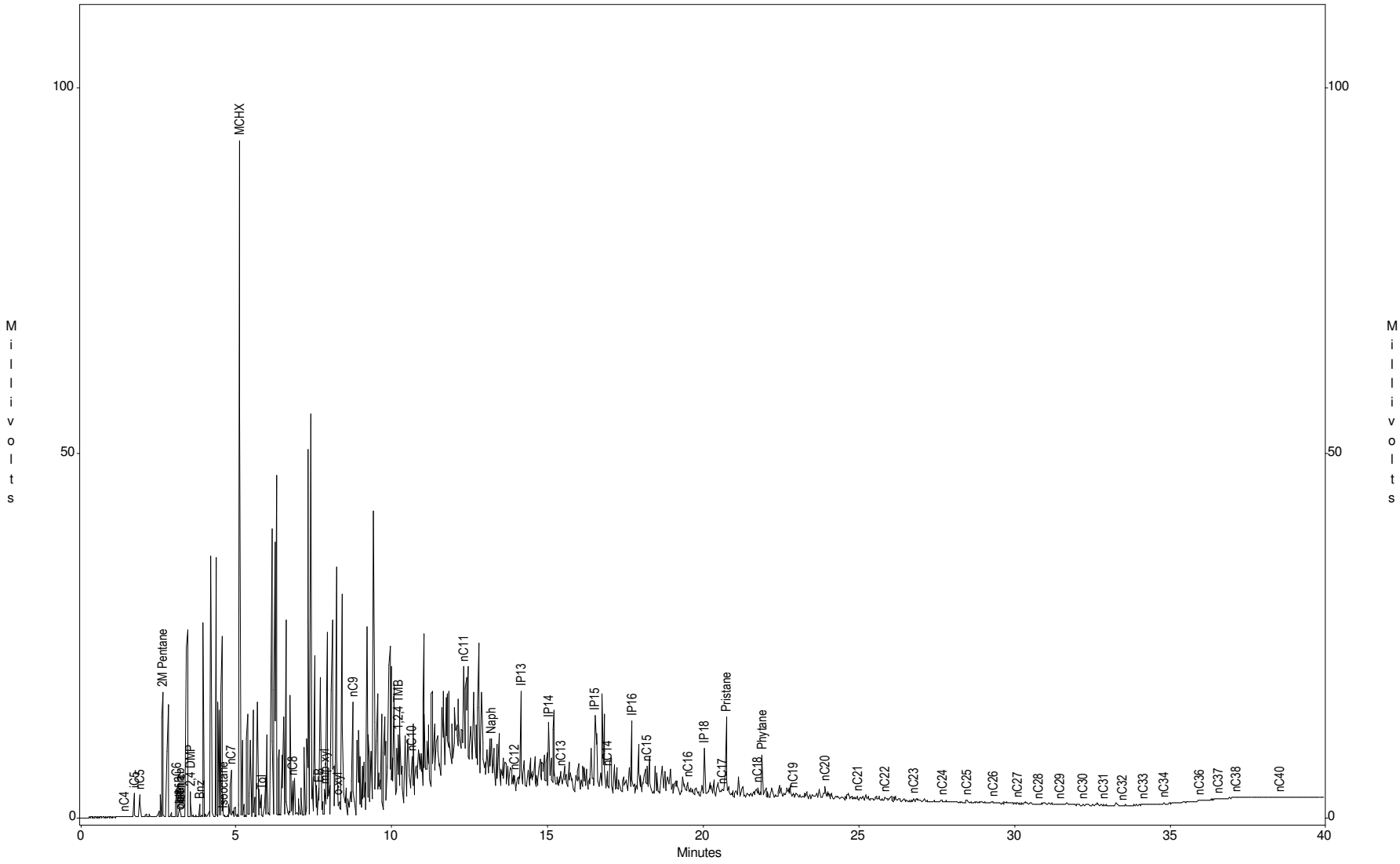

Channel A Results

| Peak | Area | Height |
|---|---|---|
| nC4 | 125 | 50 |
| iC5 | 35 | 40 |
| nC5 | 0 | 0 |
| MTBE | 0 | 0 |
| 2M Pentane | 39 | 31 |
| nC6 | 0 | 0 |
| olefin a | 0 | 0 |
| olefin b | 0 | 0 |
| olefin c | 0 | 0 |
| 2,4 DMP | 75 | 69 |
| Bnz | 81 | 22 |
| Isooctane | 61 | 33 |
| nC7 | 48 | 14 |
| MCHX | 1410 | 1173 |
| Tol | 242 | 80 |
| nC8 | 166 | 63 |
| EB | 442 | 243 |
| m/p-xyl | 265 | 134 |
| o-xyl | 370 | 181 |
| nC9 | 2376 | 1243 |
| 1,2,4 TMB | 2809 | 1073 |
| nC10 | 649 | 283 |
| nC11 | 2247 | 1149 |
| Naph | 896 | 294 |
| nC12 | 2221 | 525 |
| IP13 | 6179 | 2858 |
| IP14 | 4041 | 3080 |
| nC13 | 931 | 473 |
| IP15 | 6354 | 3921 |
| nC14 | 1959 | 750 |
| IP16 | 9015 | 4248 |
| nC15 | 3453 | 1356 |
| nC16 | 1403 | 717 |
| IP18 | 10942 | 4619 |
| nC17 | 2235 | 882 |
| Pristane | 17054 | 8376 |
| nC18 | 2340 | 1207 |
| Phytane | 13907 | 6265 |
| nC19 | 486 | 201 |
| nC20 | 7095 | 2855 |
| nC21 | 2776 | 1114 |
| nC22 | 3019 | 1167 |
| nC23 | 3433 | 1348 |
| nC24 | 4773 | 1855 |
| nC25 | 21118 | 5825 |
| nC26 | 6168 | 1906 |
| nC27 | 2827 | 1186 |
| nC28 | 1358 | 762 |
| nC29 | 2771 | 898 |
| nC30 | 899 | 509 |
| nC31 | 248 | 89 |
| nC32 | 310 | 274 |
| nC33 | 200 | 188 |
| nC34 | 133 | 118 |
| nC35 | 0 | 0 |
| nC36 | 151 | 94 |
| nC37 | 259 | 25 |
| nC38 | 201 | 130 |
| nC39 | 114 | 53 |
| nC40 | 72 | 27 |

# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : RW-300 LNAPL
Acquired : Feb 12, 2008 08:30:15

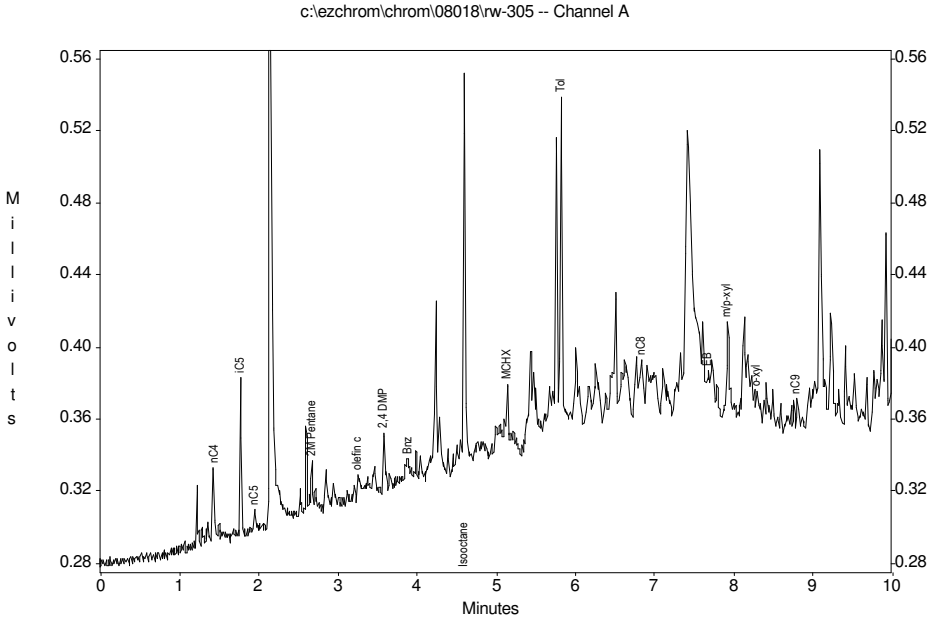
c:\ezchrom\chrom\08018\rw-300 -- Channel A



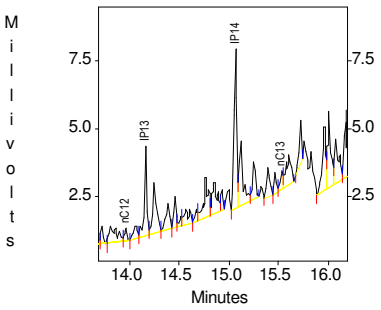
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : RW-305 LNAPL
Acquired : Feb 12, 2008 14:25:40

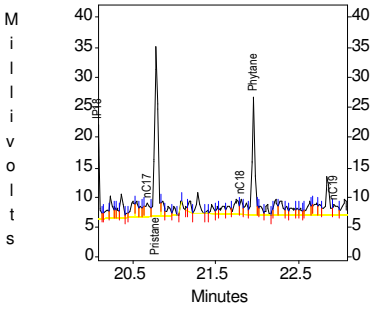
c:\ezchrom\chrom\08018\rw-305 -- Channel A



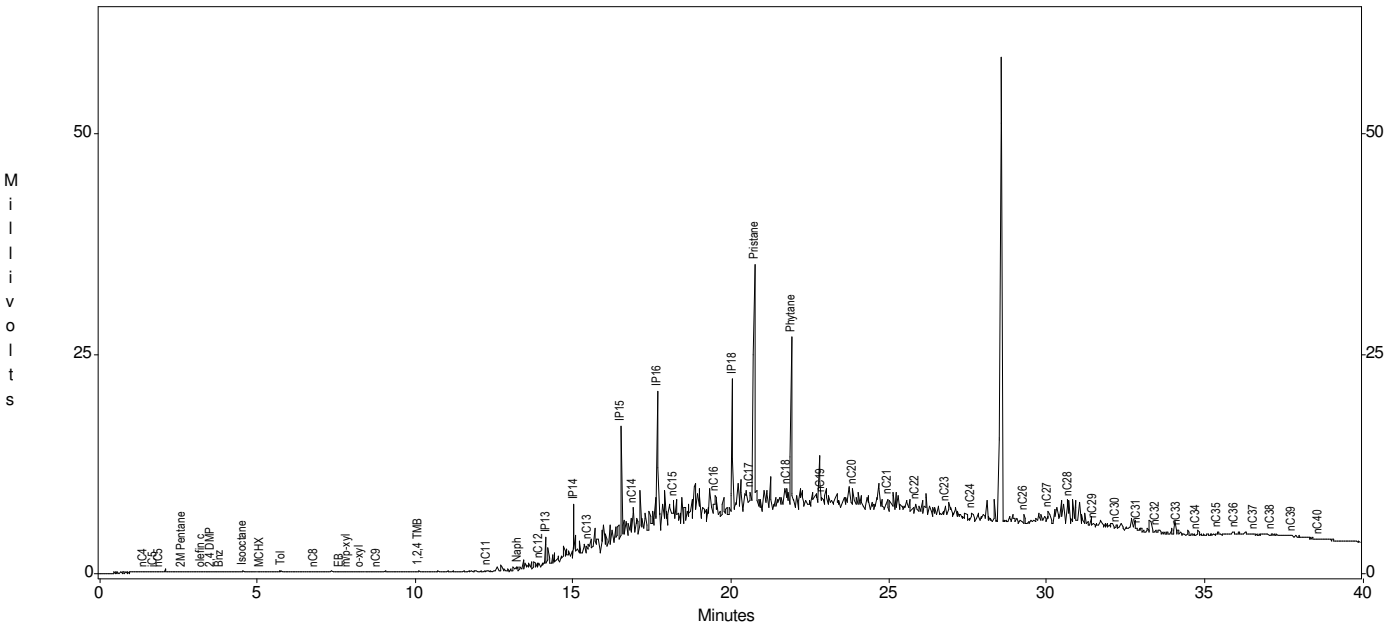

c:\ezchrom\chrom\08018\rw-305 -- Channel A




c:\ezchrom\chrom\08018\rw-305 -- Channel A




c:\ezchrom\chrom\08018\rw-305 -- Channel A

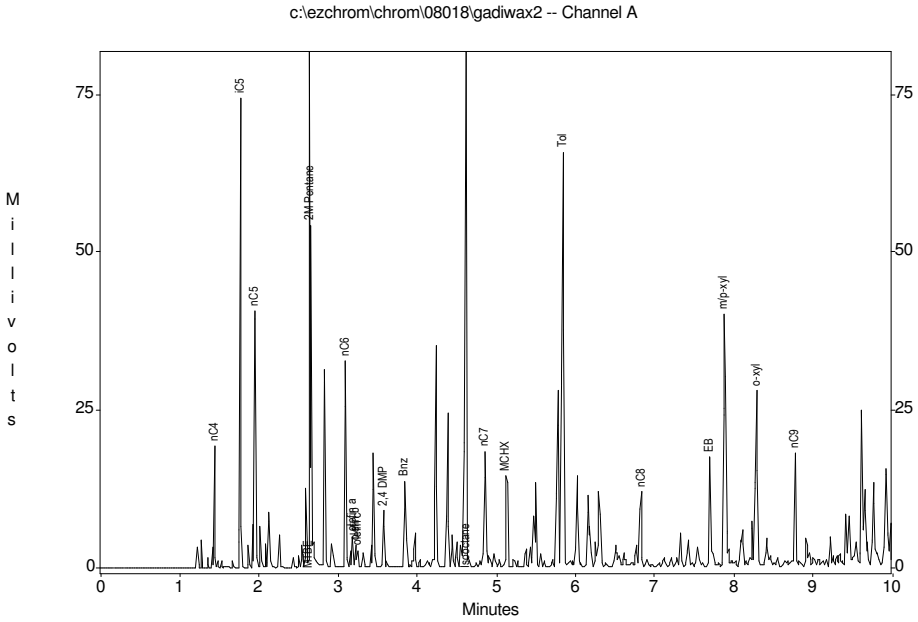


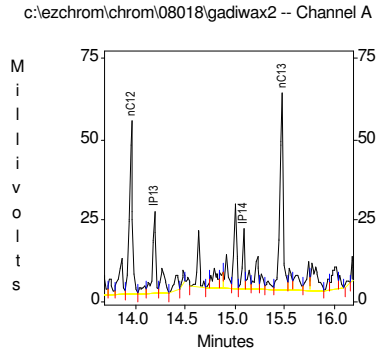

Channel A Results

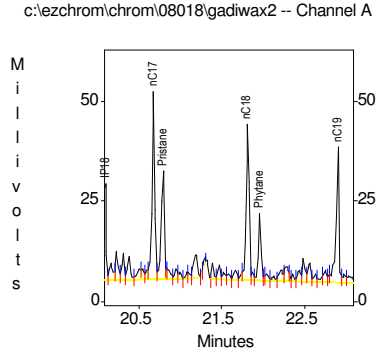
| Peak | Area | Height |
|---|---|---|
| nC4 | 70 | 41 |
| iC5 | 81 | 88 |
| nC5 | 21 | 12 |
| MTBE | 0 | 0 |
| 2M Pentane | 48 | 27 |
| nC6 | 0 | 0 |
| olefin a | 0 | 0 |
| olefin b | 0 | 0 |
| olefin c | 32 | 13 |
| 2,4 DMP | 54 | 33 |
| Bnz | 33 | 11 |
| Isooctane | 277 | 215 |
| nC7 | 0 | 0 |
| MCHX | 41 | 28 |
| Tol | 246 | 178 |
| nC8 | 69 | 26 |
| EB | 69 | 28 |
| m/p-xyl | 175 | 57 |
| o-xyl | 76 | 21 |
| nC9 | 32 | 20 |
| 1,2,4 TMB | 365 | 156 |
| nC10 | 0 | 0 |
| nC11 | 496 | 239 |
| Naph | 1155 | 401 |
| nC12 | 1036 | 462 |
| IP13 | 6075 | 3299 |
| IP14 | 8956 | 5935 |
| nC13 | 1365 | 674 |
| IP15 | 19171 | 12690 |
| nC14 | 5151 | 2788 |
| IP16 | 35097 | 15949 |
| nC15 | 8689 | 3084 |
| nC16 | 6511 | 2817 |
| IP18 | 37249 | 15725 |
| nC17 | 7757 | 2318 |
| Pristane | 70366 | 28317 |
| nC18 | 5036 | 2360 |
| Phytane | 45421 | 19670 |
| nC19 | 7099 | 1521 |
| nC20 | 5818 | 2419 |
| nC21 | 3706 | 1289 |
| nC22 | 2769 | 958 |
| nC23 | 3638 | 1266 |
| nC24 | 2506 | 878 |
| nC25 | 0 | 0 |
| nC26 | 2340 | 922 |
| nC27 | 4177 | 1374 |
| nC28 | 5520 | 2609 |
| nC29 | 344 | 121 |
| nC30 | 118 | 79 |
| nC31 | 73 | 74 |
| nC32 | 369 | 225 |
| nC33 | 531 | 242 |
| nC34 | 79 | 93 |
| nC35 | 209 | 107 |
| nC36 | 157 | 48 |
| nC37 | 298 | 112 |
| nC38 | 172 | 76 |
| nC39 | 91 | 78 |
| nC40 | 124 | 44 |

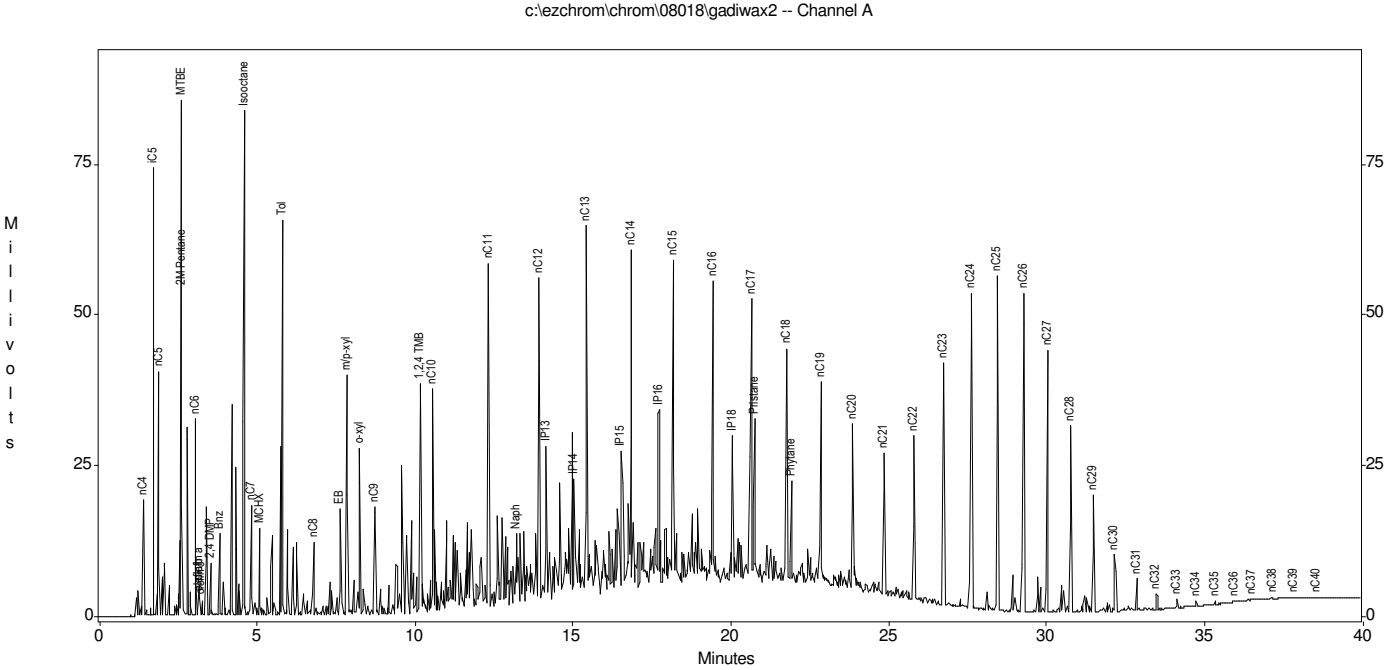
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery, Philadelphia, PA
Sample ID : Gas/Dies/Wax std
Acquired : Feb 12, 2008 11:48:01




Channel A Results

| Peak | Area | Height |
|---|---|---|
| nC4 | 10953 | 19102 |
| iC5 | 51604 | 74396 |
| nC5 | 30361 | 40645 |
| MTBE | 69425 | 85376 |
| 2M Pentane | 51469 | 54127 |
| nC6 | 30726 | 32577 |
| olefin a | 5020 | 4812 |
| olefin b | 3273 | 3277 |
| olefin c | 3009 | 2620 |
| 2,4 DMP | 8865 | 8806 |
| Bnz | 17732 | 13724 |
| Isooctane | 115797 | 83648 |
| nC7 | 24195 | 18277 |
| MCHX | 17960 | 14428 |
| Tol | 90969 | 65565 |
| nC8 | 14305 | 12008 |
| EB | 24171 | 17414 |
| m/p-xyl | 83914 | 39875 |
| o-xyl | 40237 | 27687 |
| nC9 | 24927 | 17925 |
| 1,2,4 TMB | 67448 | 37915 |
| nC10 | 57588 | 36880 |
| nC11 | 110778 | 56916 |
| Naph | 29084 | 11889 |
| nC12 | 116024 | 53659 |
| IP13 | 49003 | 25350 |
| IP14 | 29193 | 18507 |
| nC13 | 148522 | 60802 |
| IP15 | 43017 | 22669 |
| nC14 | 130476 | 55988 |
| IP16 | 61019 | 29259 |
| nC15 | 135279 | 54003 |
| nC16 | 117334 | 50283 |
| IP18 | 54476 | 24326 |
| nC17 | 105162 | 47136 |
| Pristane | 61949 | 27129 |
| nC18 | 82464 | 38707 |
| Phytane | 35962 | 16783 |
| nC19 | 80606 | 33629 |
| nC20 | 54289 | 27711 |
| nC21 | 45872 | 23603 |
| nC22 | 57487 | 27448 |
| nC23 | 90749 | 40367 |
| nC24 | 133557 | 52182 |
| nC25 | 154936 | 55446 |
| nC26 | 153087 | 52881 |
| nC27 | 112487 | 43335 |
| nC28 | 68439 | 30838 |
| nC29 | 36953 | 19475 |
| nC30 | 17394 | 9385 |
| nC31 | 7931 | 4954 |
| nC32 | 4708 | 2538 |
| nC33 | 2485 | 1455 |
| nC34 | 1394 | 746 |
| nC35 | 886 | 434 |
| nC36 | 407 | 239 |
| nC37 | 611 | 160 |
| nC38 | 211 | 74 |
| nC39 | 226 | 62 |
| nC40 | 148 | 43 |

| Torkelson Geochemistry, Inc. | | | |
|---|---|---|---|
| Density Measurements | | | |
| Paar DMA 512 / DMA 60 | | ASTM Method 4052 | |
| Sample | Density gm/ml @ 60F | Job Number | Date |
| N-42 | 0.8900 | 08018 | 2/12/08 |
| N-47 | 0.8834 | 08018 | 2/12/08 |
| N-51 | 0.8995 | 08018 | 2/12/08 |
| N-75 | 0.9371 | 08018 | 2/12/08 |
| N-76 | 0.8899 | 08018 | 2/12/08 |
| N-82 | 0.9132 | 08018 | 2/12/08 |
| N-91 | 0.9471 | 08018 | 2/12/08 |
| N-503 | 0.9065 | 08018 | 2/12/08 |
| RW-205 | 0.9112 | 08018 | 2/12/08 |
| RW-300 | 0.8358 | 08018 | 2/12/08 |
| RW-305 | 0.9186 | 08018 | 2/12/08 |

# Torkelson Geochemistry, Inc.

2528 S. Columbia Place
Tulsa, OK 74114-3233
Phone: 918-749-8441
Fax: 918-749-6005
e-mail: BTorkelson@torkelsongeochemistry.com

## CHAIN-OF-CUSTODY RECORD



Project: Sunoco Philadelphia Refinery - AOI 8 SCR
Location: Philadelphia, PA

Proj. No.: 2574601
P.O.:
Sampled By:

Report/Bill To: Joseph Catricks
Address:
PO Box 1569, Doylestown PA 18901

Phone: 215-491.6540
Fax: 215.491.6501
e-mail: jcatricks@langan.com

**Additional Instructions**
Please include a brief interpretation of product type constant other samples from this project

Requested Turn-Around Time: Standard

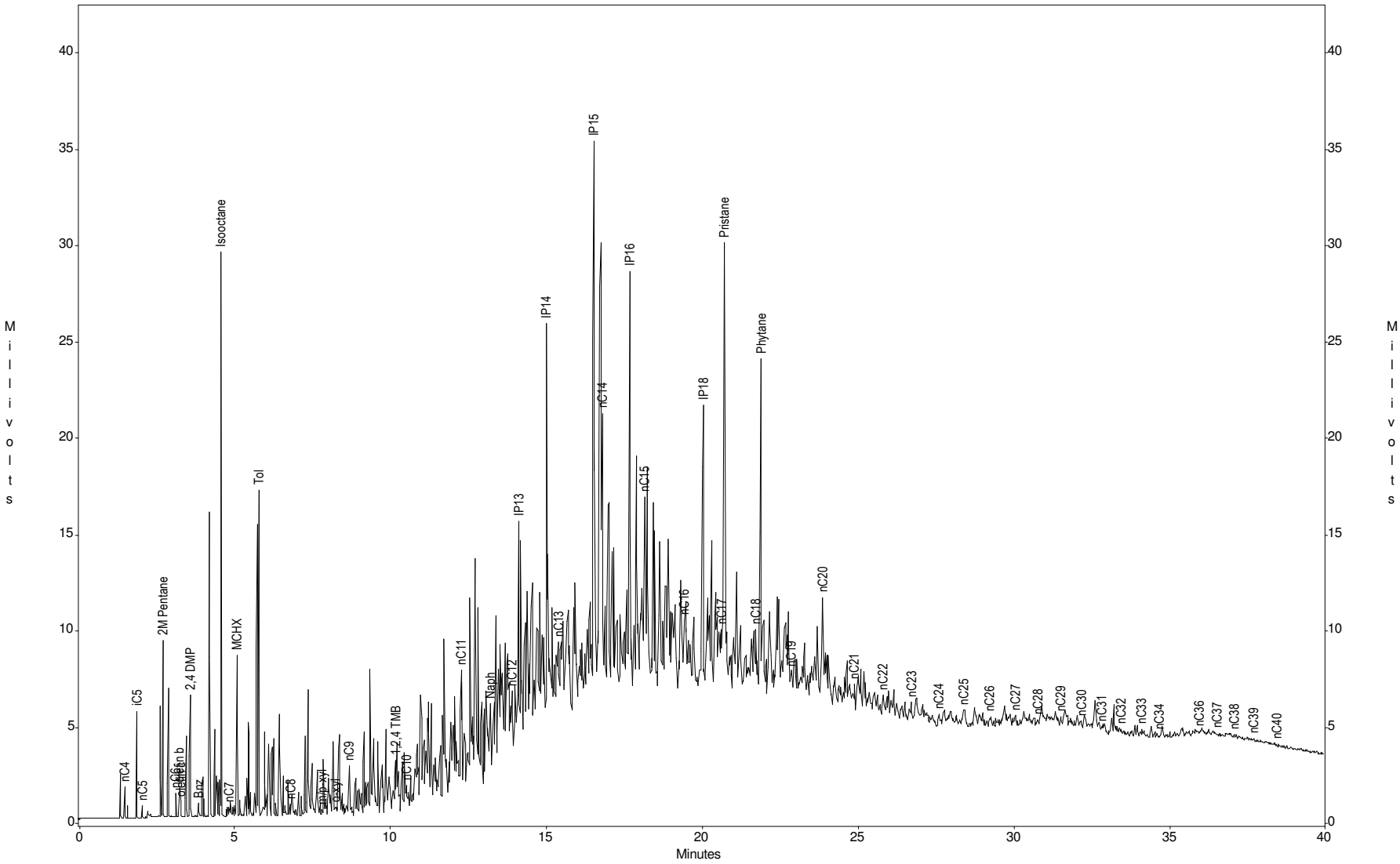
| ITEM NO. | SAMPLE DESCRIPTION | DATE | MATRIX | LAB NO. | Total # OF Vials | PRESERVATIVES: None | ANALYSES REQUESTED: GC Characterization | Density | Viscosity | Water Surface Tension | NAPL Surface Tension | NAPL/Water Interfac. Tens. | Lead | Sulfur | TIME | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | N-107 | 7/28/08 | | | 1 | X | x | x | | | | | | | | 1320 |
| 2 | N-116 | 7/28/08 | | | 1 | X | x | x | | | | | | | | 1235 |
| 3 | N-125 | 7/28/08 | | | 1 | X | x | x | | | | | | | | 1240 |
| 4 | N-127 | 7/28/08 | | | 1 | X | x | x | | | | | | | | 1220 |
| 5 | N-129 | 7/28/08 | | | 1 | X | x | x | | | | | | | | 1230 |
| 6 | N-130 | 7/28/08 | | | 1 | X | x | x | | | | | | | | 1215 |
| 7 | N-135 | 7/28/08 | | | 1 | X | x | x | | | | | | | | 1200 |
| 8 | N-113 | 7-28-08 | | | 1 | X | X | X | | | | | | | | 1130 |
| 9 | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | |

| RELINQUISHED BY | DATE | TIME | ACCEPTED BY | DATE | TIME |
|---|---|---|---|---|---|
| | | | | | |
| | | | | 7-30-08 | |
| | | | | | |

# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : N-107
Acquired : Jul 31, 2008 12:21:28

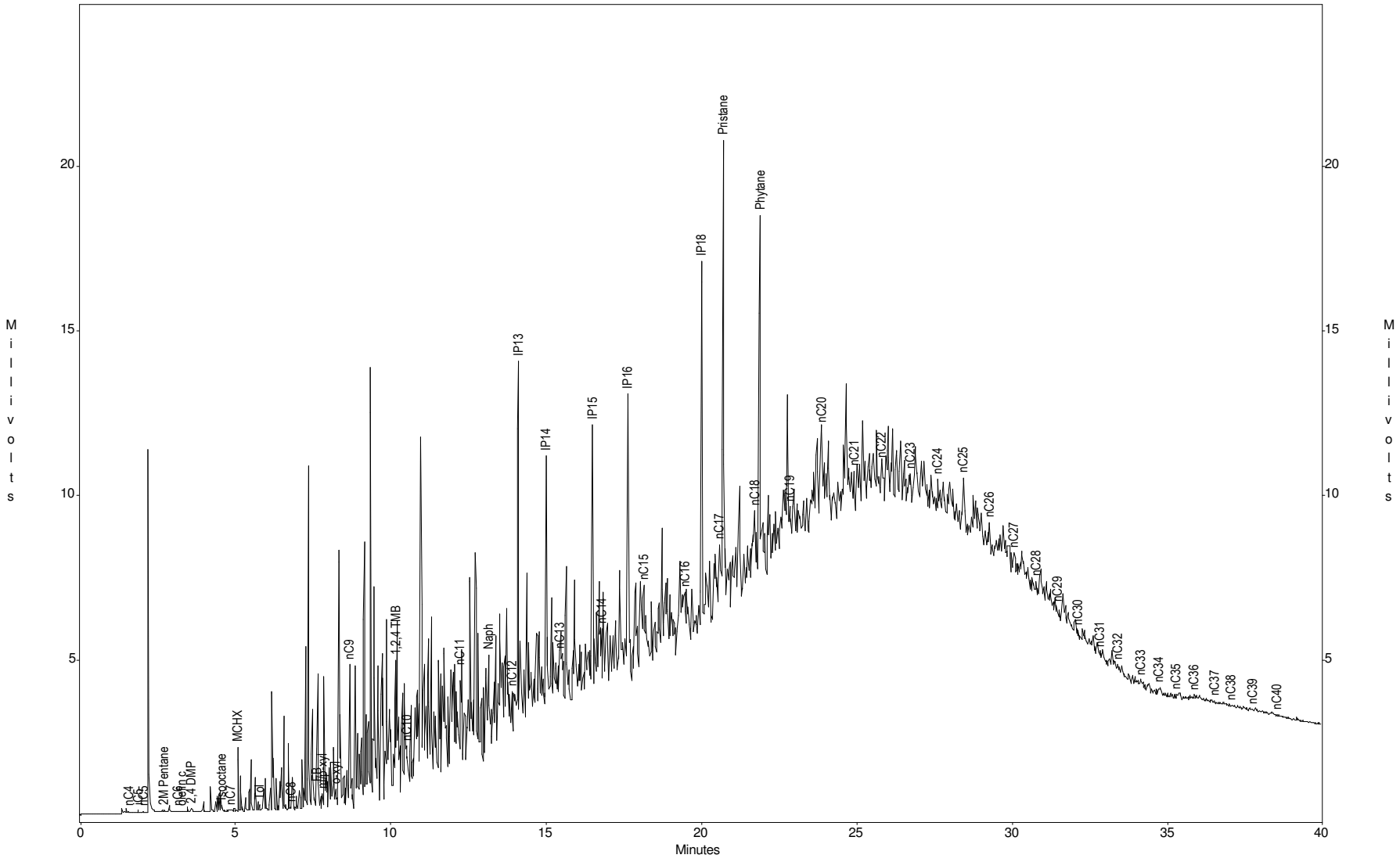
c:\ezchrom\chrom\08134\n-107 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : N-113
Acquired : Jul 31, 2008 14:27:34

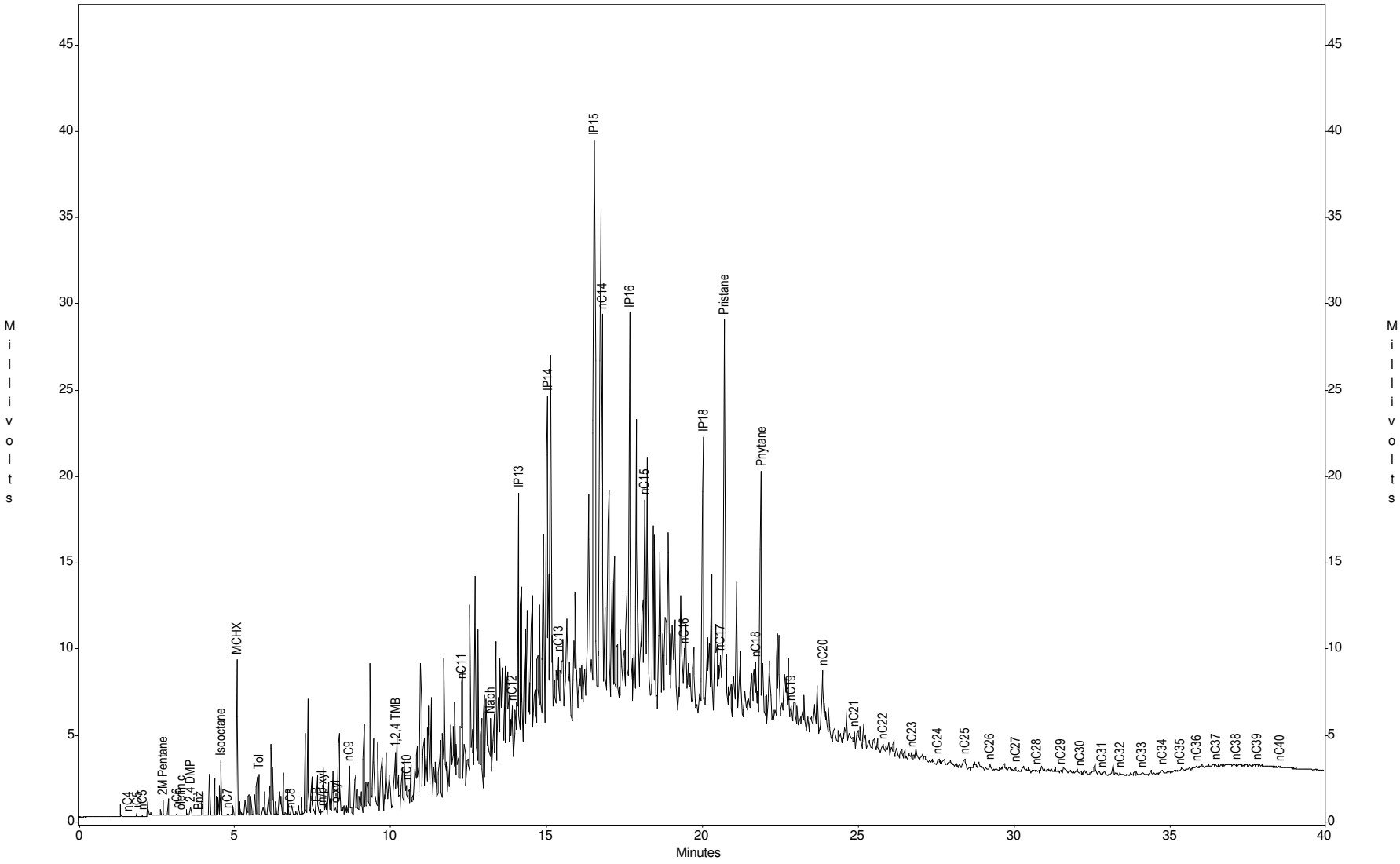
c:\ezchrom\chrom\08134\n-113 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : N-116
Acquired : Jul 31, 2008 15:18:40

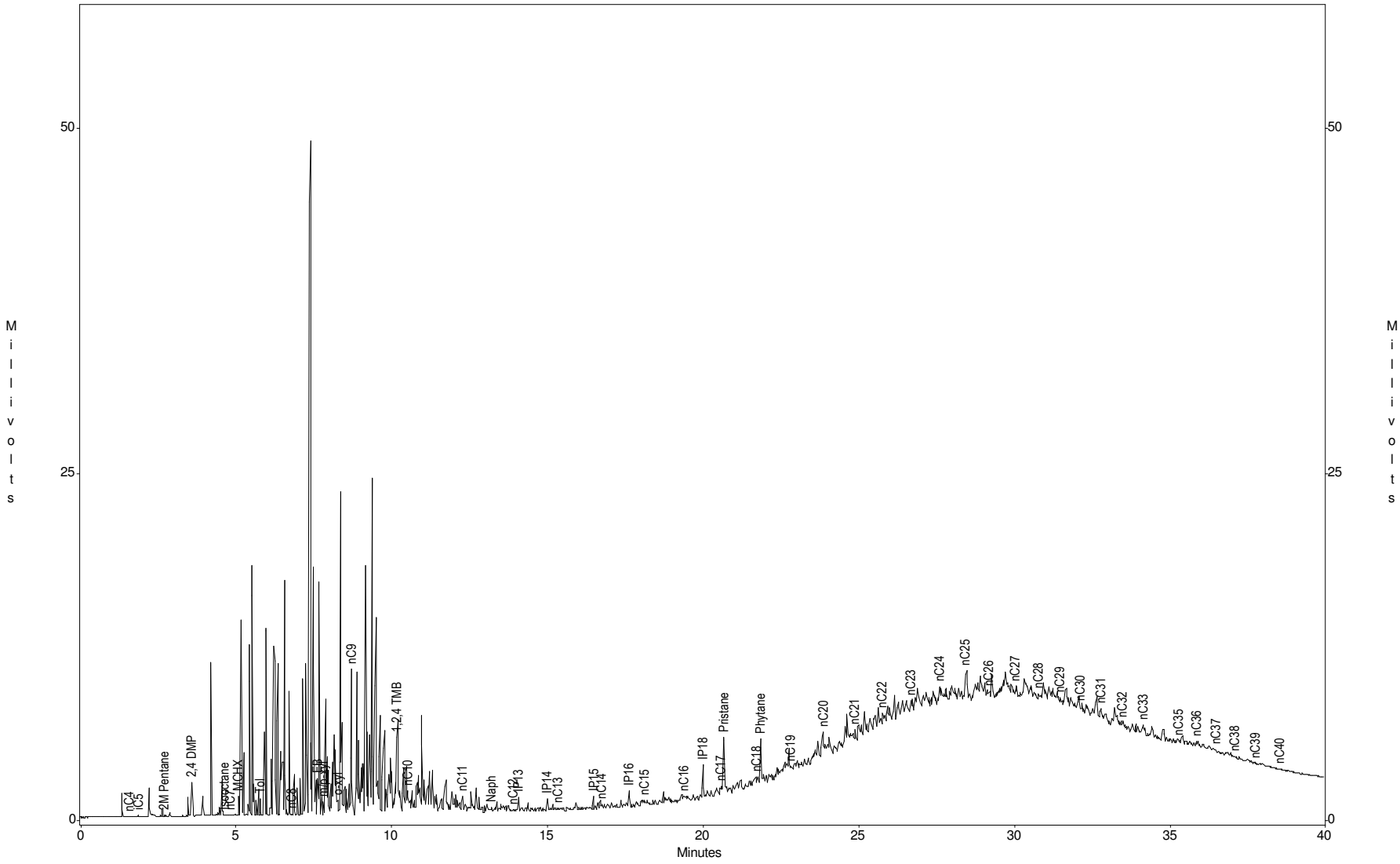
c:\ezchrom\chrom\08134\n-116 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : N-125
Acquired : Jul 31, 2008 09:41:17

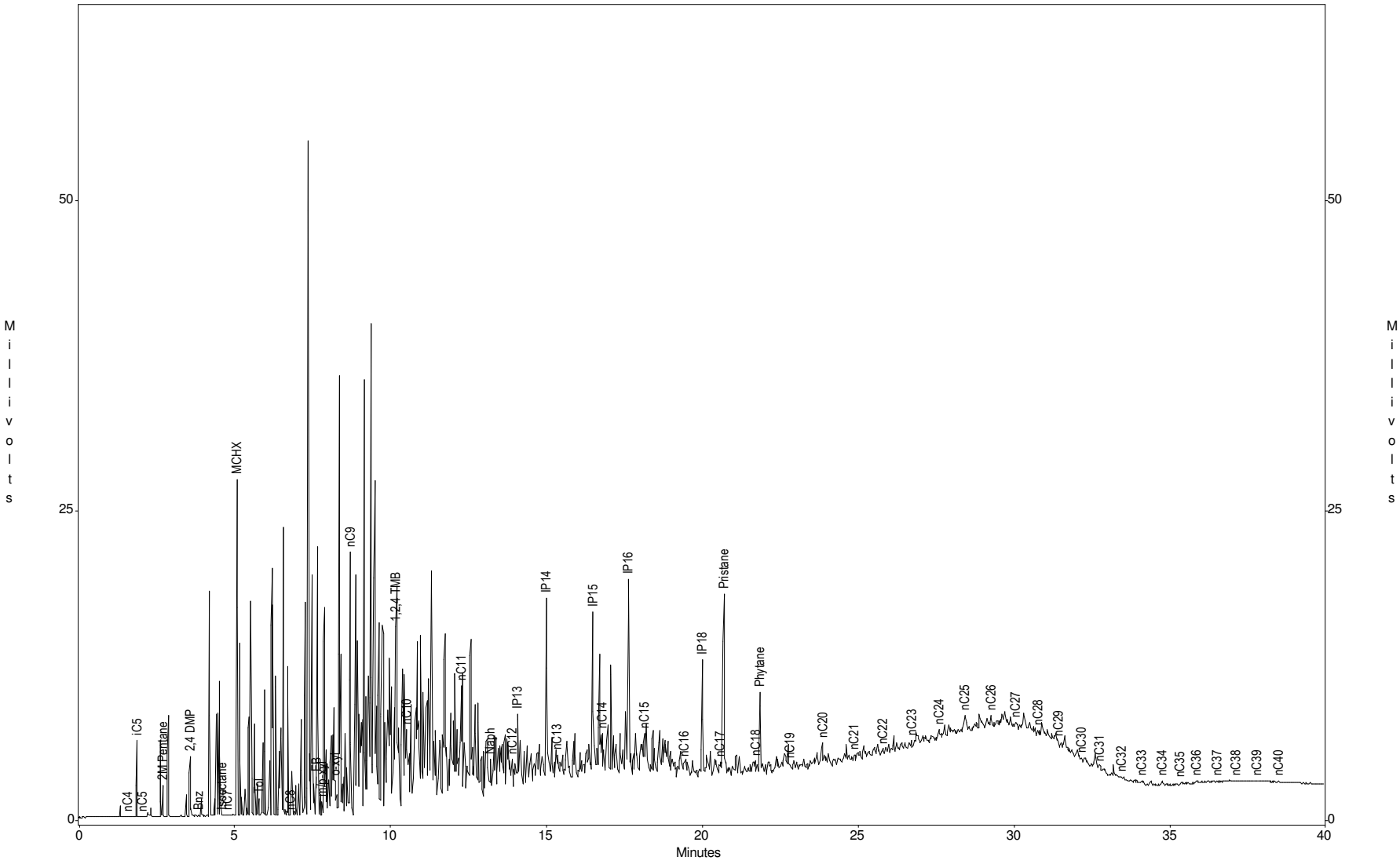
c:\ezchrom\chrom\08134\n-125 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : N-127
Acquired : Jul 31, 2008 11:29:45

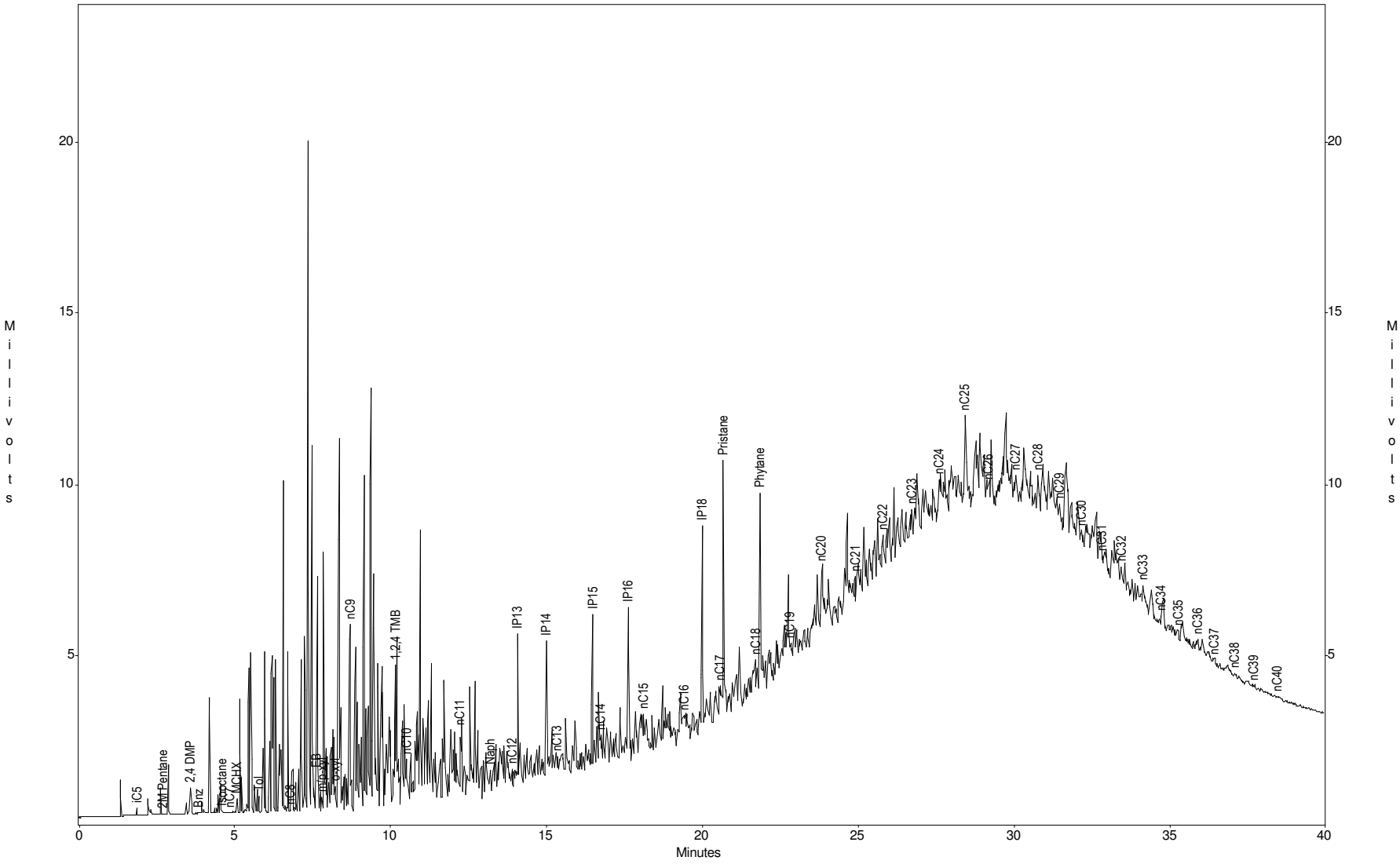
c:\ezchrom\chrom\08134\n-127 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : N-129
Acquired : Jul 31, 2008 16:09:46

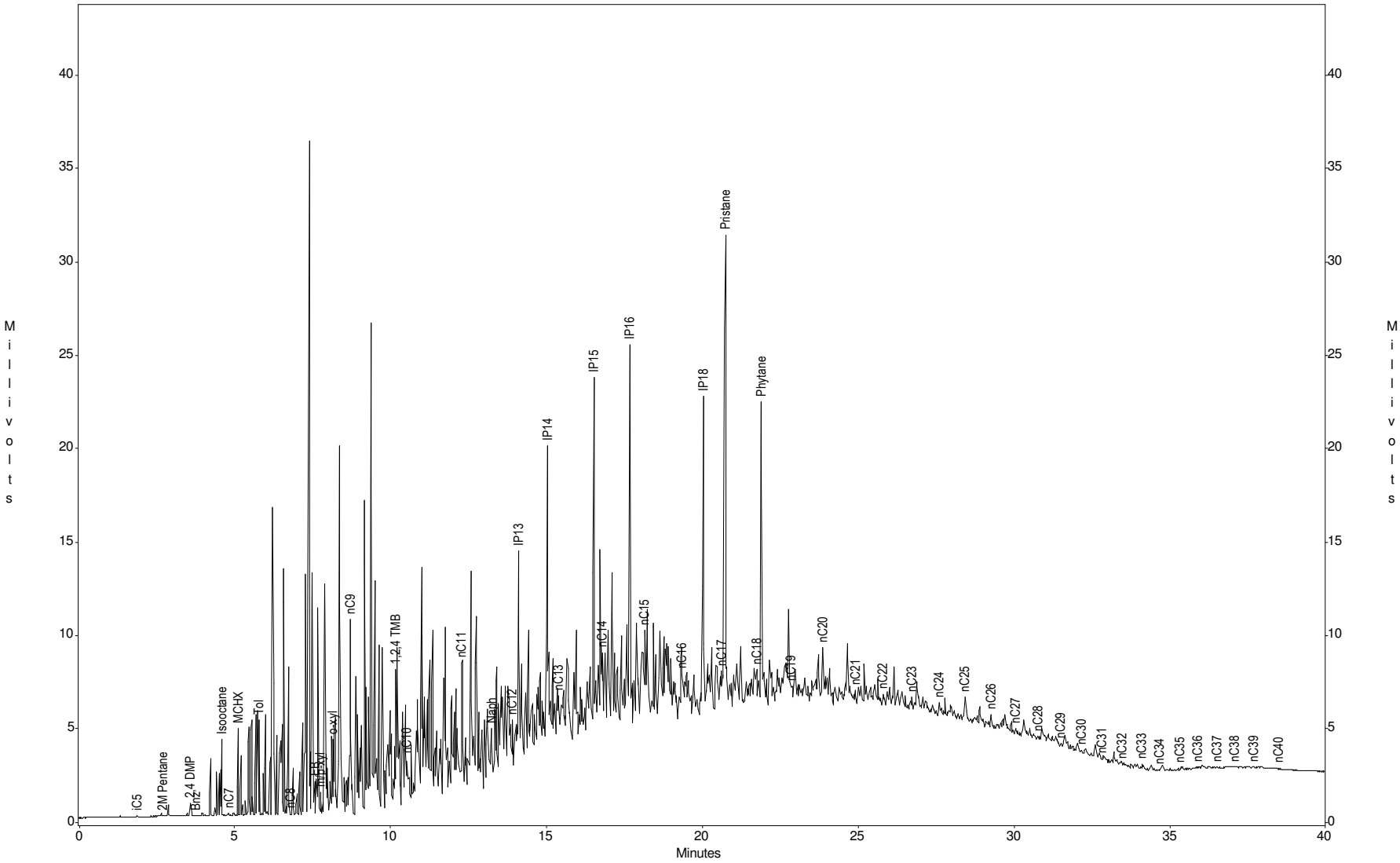
c:\ezchrom\chrom\08134\n-129 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : N-130
Acquired : Jul 31, 2008 08:50:57

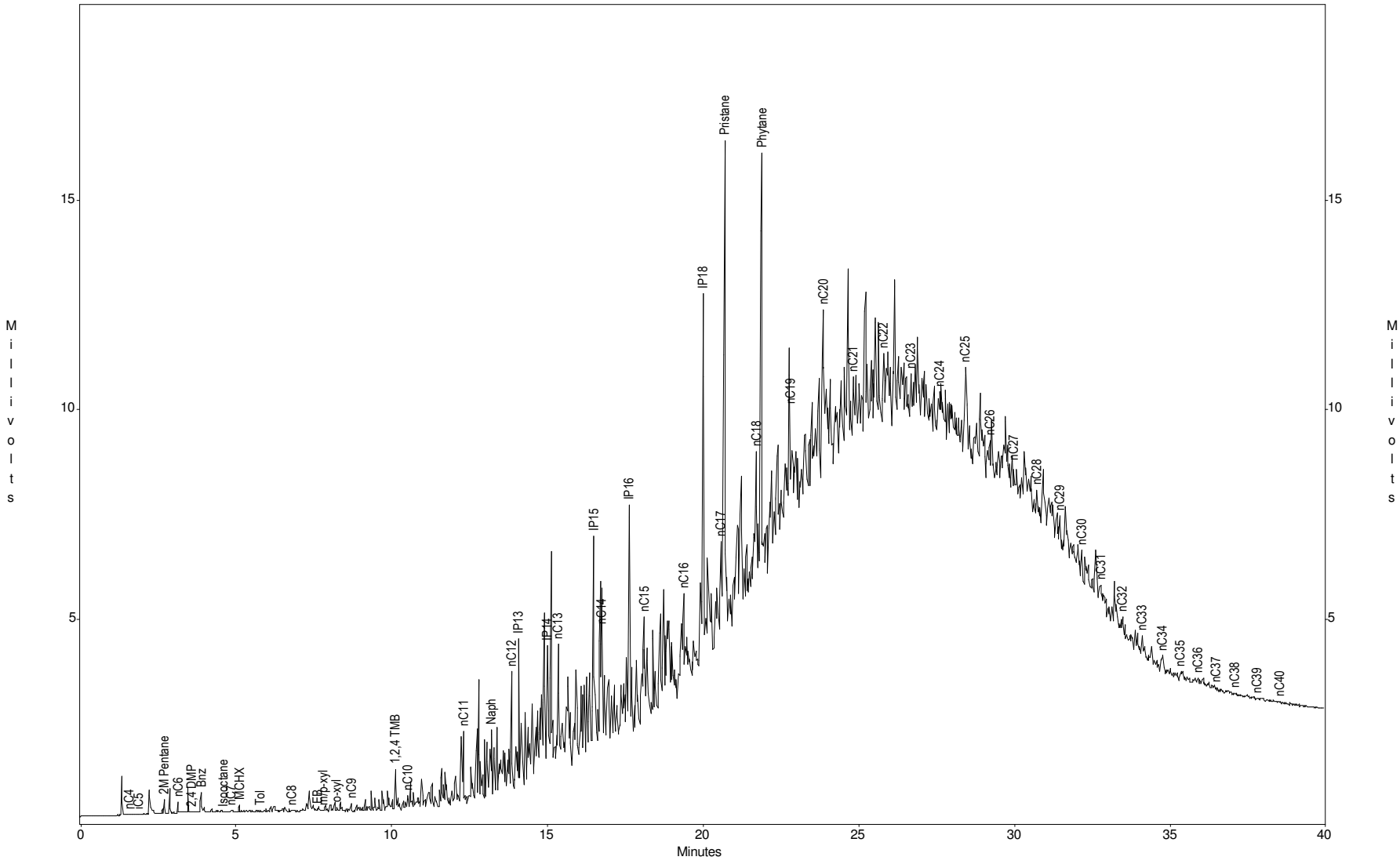
c:\ezchrom\chrom\08134\n-130 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : N-135
Acquired : Jul 31, 2008 10:35:35

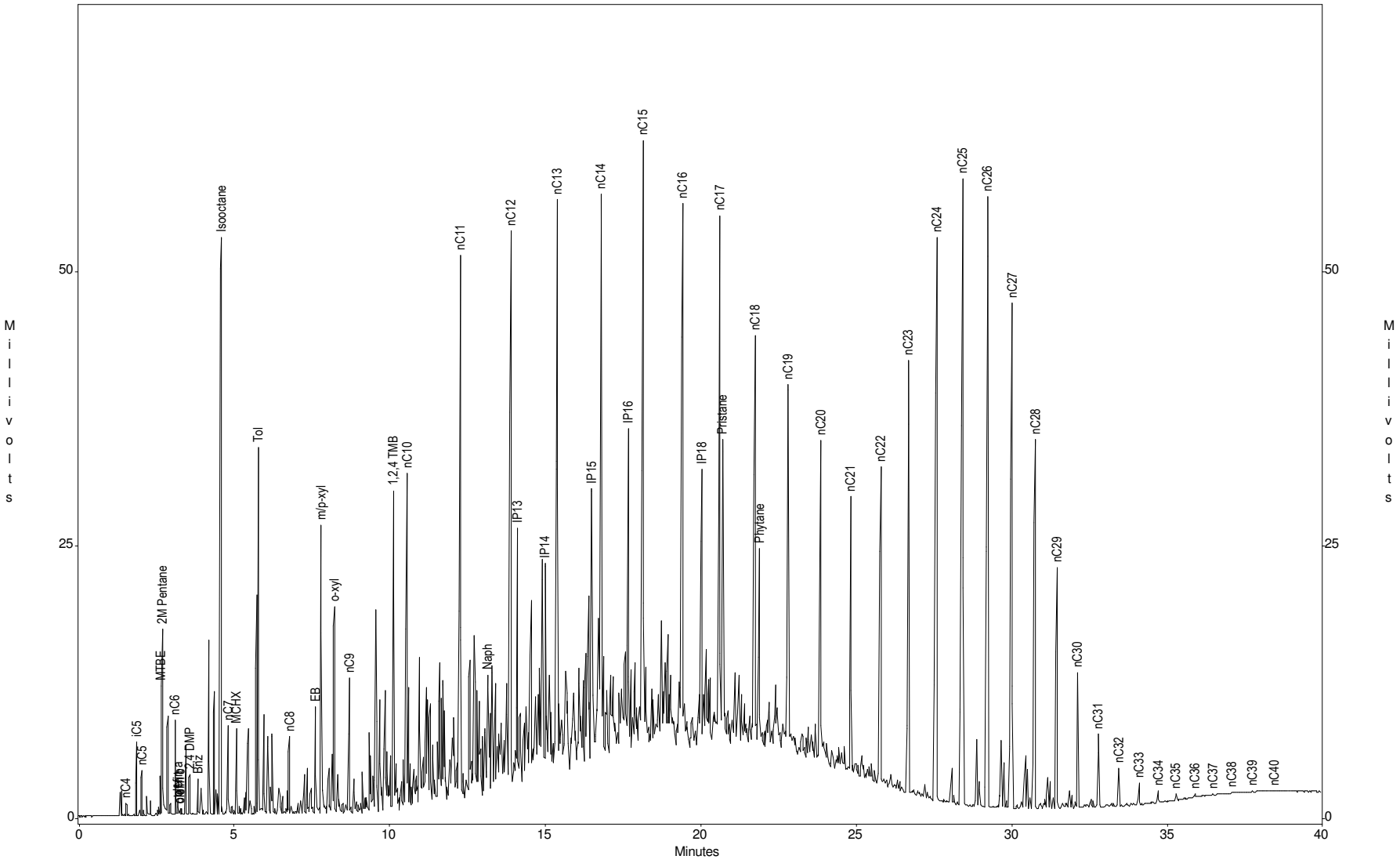
c:\ezchrom\chrom\08134\n-135 -- Channel A



# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : Gas/Dies/Wax std
Acquired : Jul 31, 2008 13:18:39

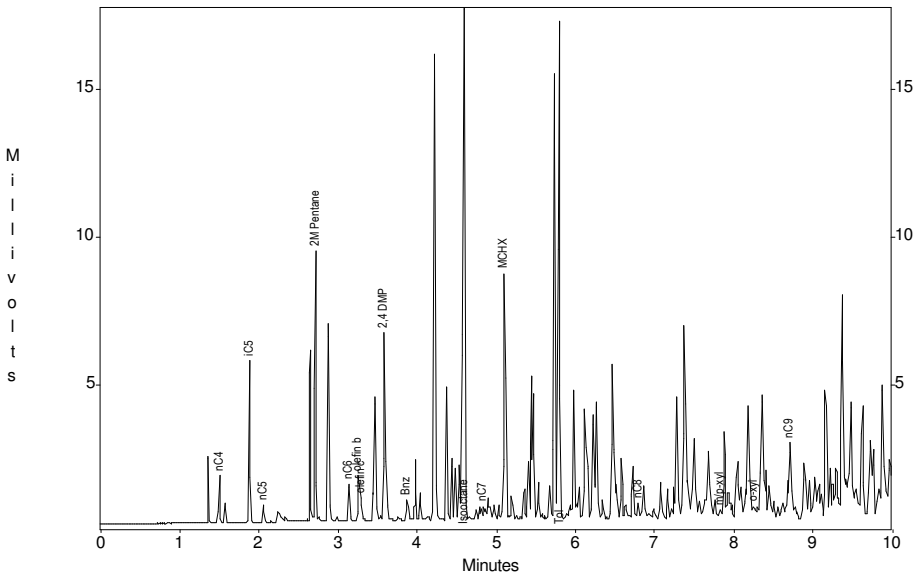
c:\ezchrom\chrom\08134\gadiwax2 -- Channel A



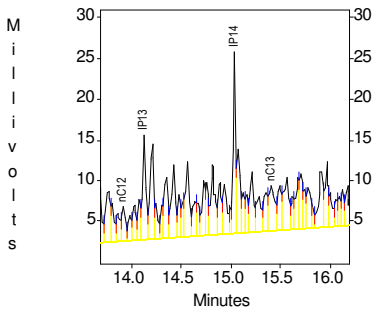
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : N-107
Acquired : Jul 31, 2008 12:21:28

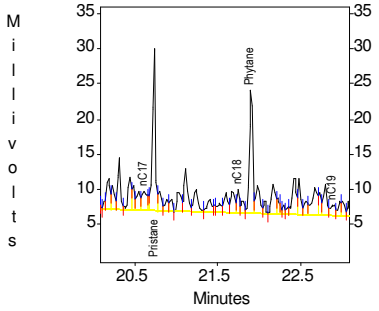
c:\ezchrom\chrom\08134\n-107 -- Channel A



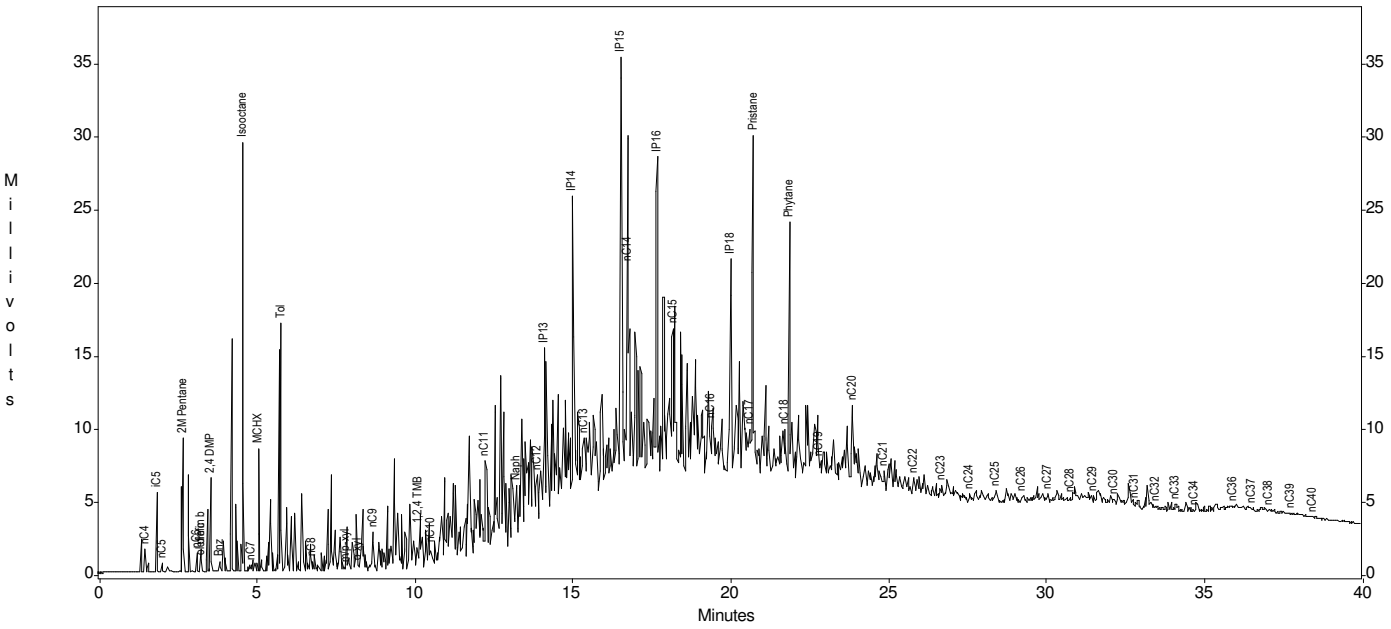

c:\ezchrom\chrom\08134\n-107 -- Channel A




c:\ezchrom\chrom\08134\n-107 -- Channel A




c:\ezchrom\chrom\08134\n-107 -- Channel A



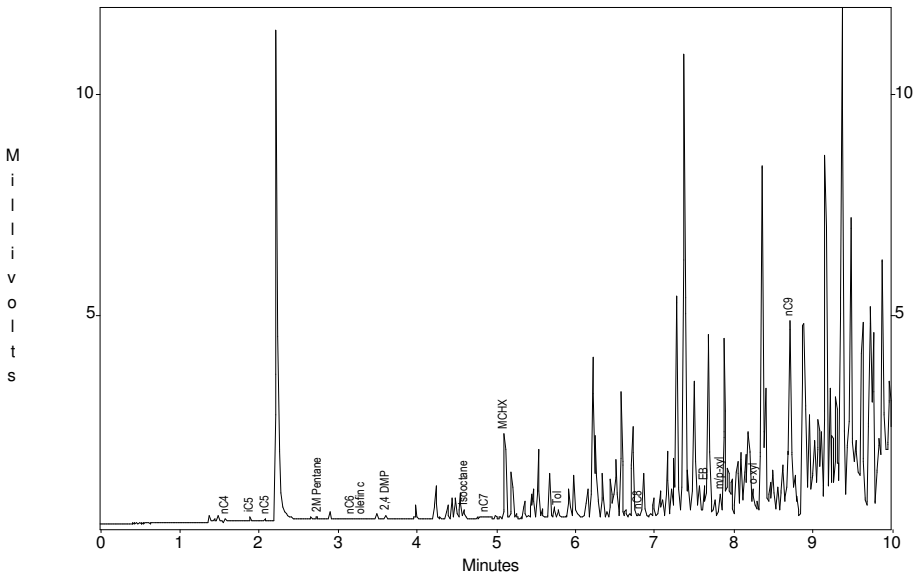

Channel A Results

| Peak | Area | Height |
|---|---|---|
| nC4 | 1153 | 1612 |
| iC5 | 4452 | 5495 |
| nC5 | 610 | 591 |
| MTBE | 0 | 0 |
| 2M Pentane | 8642 | 9154 |
| nC6 | 1397 | 1248 |
| olefin a | 0 | 0 |
| olefin b | 1551 | 1515 |
| olefin c | 1255 | 799 |
| 2,4 DMP | 7271 | 6348 |
| Bnz | 1127 | 678 |
| Isooctane | 34028 | 29254 |
| nC7 | 539 | 475 |
| MCHX | 10500 | 8371 |
| Tol | 21556 | 16899 |
| nC8 | 881 | 577 |
| EB | 0 | 0 |
| m/p-xyl | 503 | 316 |
| o-xyl | 1037 | 430 |
| nC9 | 4787 | 2568 |
| 1,2,4 TMB | 4347 | 2628 |
| nC10 | 3886 | 1219 |
| nC11 | 10664 | 6269 |
| Naph | 9487 | 3959 |
| nC12 | 10964 | 4102 |
| IP13 | 27169 | 12681 |
| IP14 | 41097 | 22236 |
| nC13 | 22626 | 5466 |
| IP15 | 60426 | 30505 |
| nC14 | 43212 | 16163 |
| IP16 | 57337 | 22844 |
| nC15 | 28028 | 10722 |
| nC16 | 4024 | 2672 |
| IP18 | 33209 | 14421 |
| nC17 | 10338 | 2922 |
| Pristane | 59900 | 23039 |
| nC18 | 7717 | 3278 |
| Phytane | 40808 | 17385 |
| nC19 | 6018 | 1449 |
| nC20 | 15122 | 5548 |
| nC21 | 3818 | 1414 |
| nC22 | 4207 | 1144 |
| nC23 | 2683 | 1008 |
| nC24 | 3409 | 634 |
| nC25 | 4634 | 880 |
| nC26 | 2738 | 474 |
| nC27 | 2064 | 559 |
| nC28 | 1336 | 360 |
| nC29 | 1255 | 479 |
| nC30 | 154 | 163 |
| nC31 | 49 | 62 |
| nC32 | 358 | 158 |
| nC33 | 614 | 263 |
| nC34 | 50 | 67 |
| nC35 | 0 | 0 |
| nC36 | 94 | 67 |
| nC37 | 115 | 72 |
| nC38 | 130 | 82 |
| nC39 | 96 | 83 |
| nC40 | 100 | 69 |

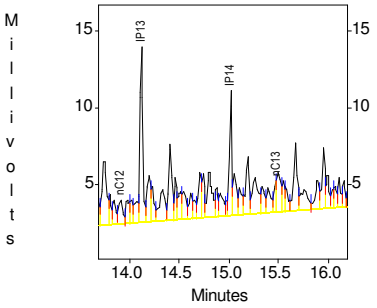
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : N-113
Acquired : Jul 31, 2008 14:27:34

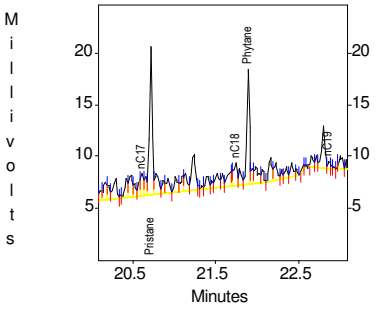
c:\ezchrom\chrom\08134\n-113 -- Channel A



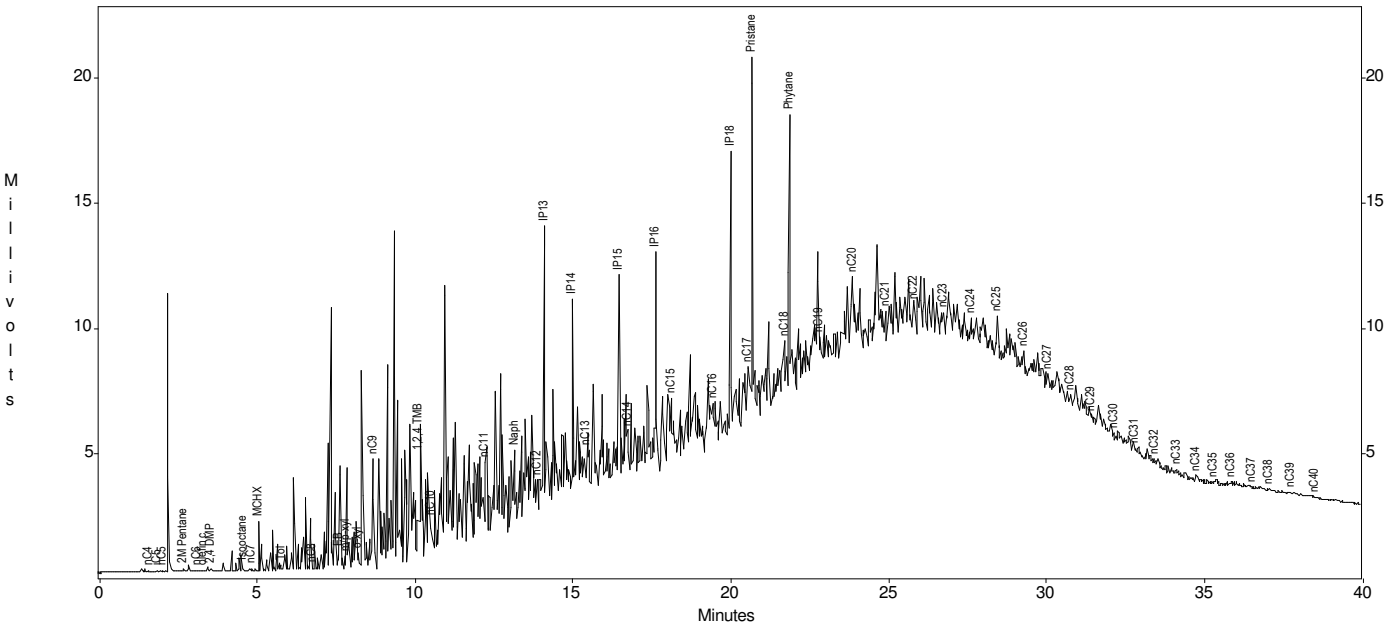

c:\ezchrom\chrom\08134\n-113 -- Channel A




c:\ezchrom\chrom\08134\n-113 -- Channel A




c:\ezchrom\chrom\08134\n-113 -- Channel A



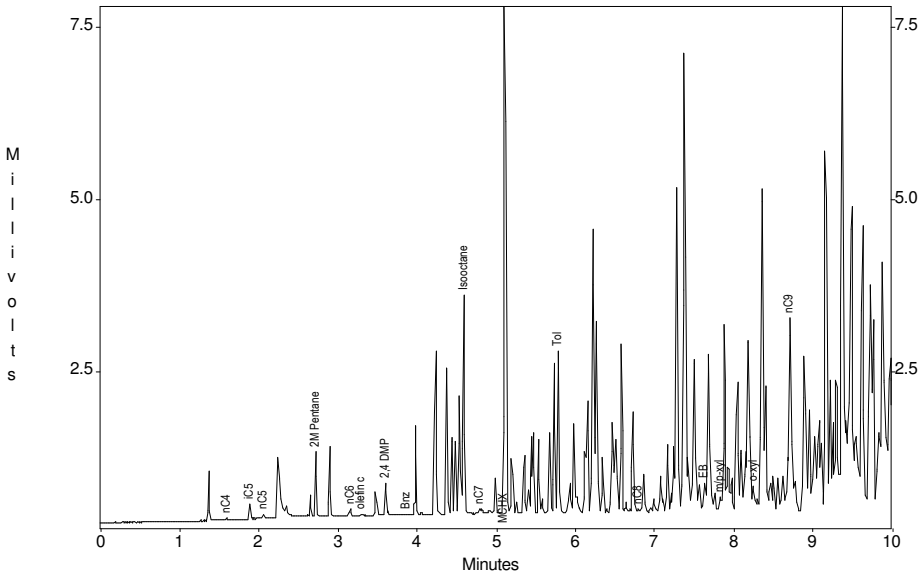

Channel A Results

| Peak | Area | Height |
|---|---|---|
| nC4 | 96 | 47 |
| iC5 | 88 | 75 |
| nC5 | 58 | 27 |
| MTBE | 0 | 0 |
| 2M Pentane | 65 | 53 |
| nC6 | 24 | 13 |
| olefin a | 0 | 0 |
| olefin b | 0 | 0 |
| olefin c | 47 | 11 |
| 2,4 DMP | 101 | 89 |
| Bnz | 0 | 0 |
| Isooctane | 247 | 170 |
| nC7 | 94 | 35 |
| MCHX | 2466 | 1925 |
| Tol | 281 | 164 |
| nC8 | 89 | 63 |
| EB | 845 | 655 |
| m/p-xyl | 749 | 450 |
| o-xyl | 783 | 438 |
| nC9 | 9190 | 4356 |
| 1,2,4 TMB | 6441 | 4085 |
| nC10 | 2461 | 1341 |
| nC11 | 4529 | 2797 |
| Naph | 8212 | 3129 |
| nC12 | 4306 | 1625 |
| IP13 | 20618 | 11585 |
| IP14 | 12990 | 8231 |
| nC13 | 3413 | 2007 |
| IP15 | 14668 | 8424 |
| nC14 | 3595 | 2054 |
| IP16 | 21613 | 8783 |
| nC15 | 5909 | 2543 |
| nC16 | 3409 | 1686 |
| IP18 | 25856 | 11281 |
| nC17 | 5286 | 2208 |
| Pristane | 34964 | 14413 |
| nC18 | 5356 | 2276 |
| Phytane | 26199 | 11107 |
| nC19 | 1227 | 746 |
| nC20 | 14203 | 2996 |
| nC21 | 4008 | 1382 |
| nC22 | 7849 | 1593 |
| nC23 | 3848 | 1216 |
| nC24 | 3766 | 976 |
| nC25 | 7977 | 1657 |
| nC26 | 3576 | 939 |
| nC27 | 1508 | 624 |
| nC28 | 1184 | 443 |
| nC29 | 547 | 295 |
| nC30 | 433 | 214 |
| nC31 | 152 | 93 |
| nC32 | 104 | 129 |
| nC33 | 143 | 85 |
| nC34 | 90 | 91 |
| nC35 | 58 | 84 |
| nC36 | 392 | 100 |
| nC37 | 51 | 30 |
| nC38 | 178 | 53 |
| nC39 | 64 | 22 |
| nC40 | 50 | 38 |

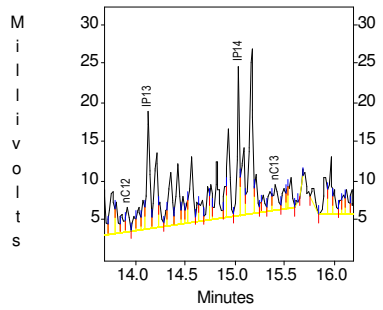
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : N-116
Acquired : Jul 31, 2008 15:18:40

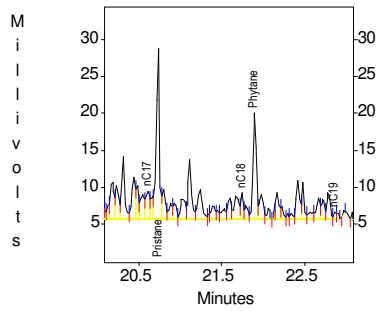
c:\ezchrom\chrom\08134\n-116 -- Channel A



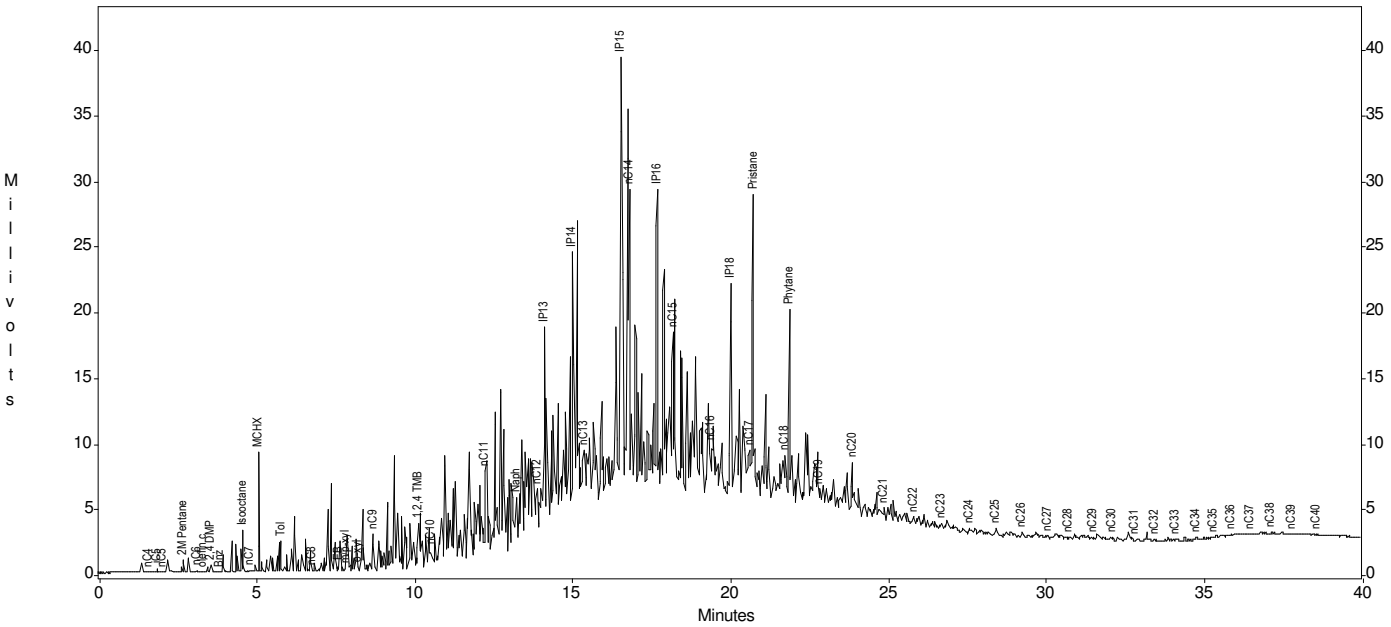

c:\ezchrom\chrom\08134\n-116 -- Channel A




c:\ezchrom\chrom\08134\n-116 -- Channel A




c:\ezchrom\chrom\08134\n-116 -- Channel A



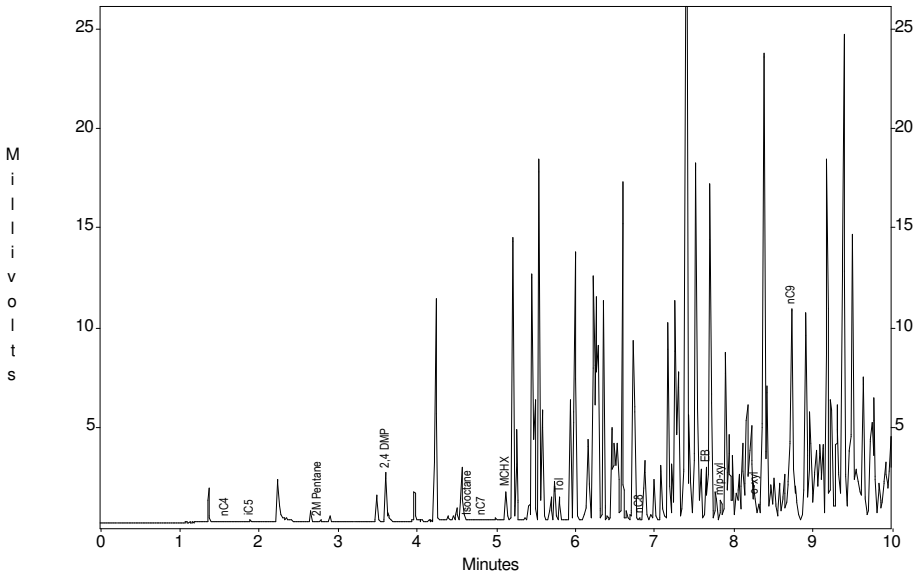

Channel A Results

| Peak | Area | Height |
|---|---|---|
| nC4 | 24 | 18 |
| iC5 | 203 | 220 |
| nC5 | 63 | 60 |
| MTBE | 0 | 0 |
| 2M Pentane | 1031 | 929 |
| nC6 | 142 | 105 |
| olefin a | 0 | 0 |
| olefin b | 0 | 0 |
| olefin c | 62 | 23 |
| 2,4 DMP | 530 | 467 |
| Bnz | 51 | 19 |
| Isooctane | 3757 | 3174 |
| nC7 | 129 | 92 |
| MCHX | 10954 | 9024 |
| Tol | 3214 | 2361 |
| nC8 | 95 | 59 |
| EB | 678 | 420 |
| m/p-xyl | 405 | 225 |
| o-xyl | 858 | 371 |
| nC9 | 5856 | 2819 |
| 1,2,4 TMB | 8619 | 3341 |
| nC10 | 3987 | 1308 |
| nC11 | 8664 | 5497 |
| Naph | 7554 | 3596 |
| nC12 | 6831 | 3065 |
| IP13 | 27662 | 14984 |
| IP14 | 32887 | 18936 |
| nC13 | 9414 | 3196 |
| IP15 | 69957 | 33635 |
| nC14 | 55327 | 23571 |
| IP16 | 59594 | 23657 |
| nC15 | 33902 | 12830 |
| nC16 | 7528 | 4284 |
| IP18 | 43536 | 16526 |
| nC17 | 15083 | 3913 |
| Pristane | 61927 | 23342 |
| nC18 | 7827 | 3552 |
| Phytane | 36350 | 14647 |
| nC19 | 1726 | 841 |
| nC20 | 11339 | 3871 |
| nC21 | 1321 | 663 |
| nC22 | 2242 | 599 |
| nC23 | 1187 | 384 |
| nC24 | 946 | 358 |
| nC25 | 3080 | 564 |
| nC26 | 1353 | 367 |
| nC27 | 442 | 217 |
| nC28 | 379 | 142 |
| nC29 | 282 | 125 |
| nC30 | 35 | 66 |
| nC31 | 111 | 62 |
| nC32 | 281 | 94 |
| nC33 | 282 | 102 |
| nC34 | 166 | 80 |
| nC35 | 27 | 22 |
| nC36 | 176 | 59 |
| nC37 | 109 | 33 |
| nC38 | 116 | 53 |
| nC39 | 90 | 35 |
| nC40 | 55 | 33 |

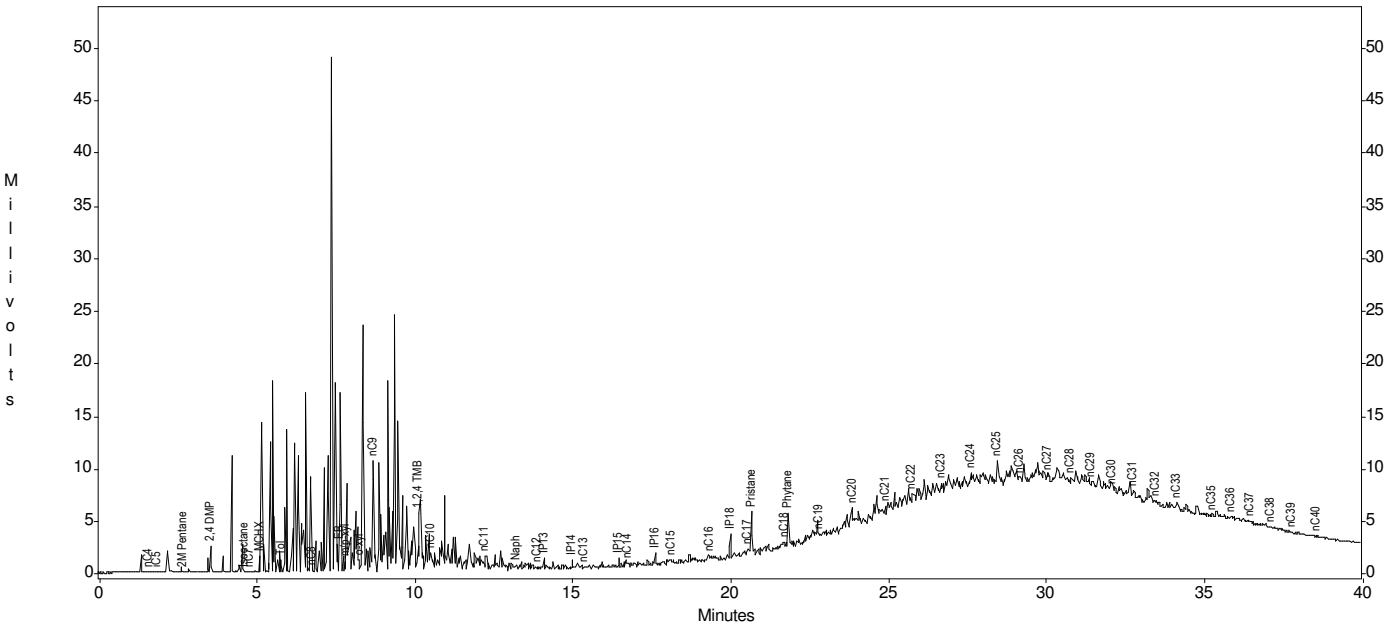
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : N-125
Acquired : Jul 31, 2008 09:41:17

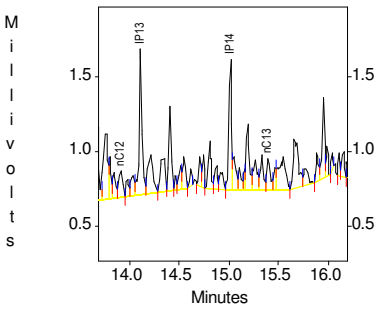
c:\ezchrom\chrom\08134\n-125 -- Channel A



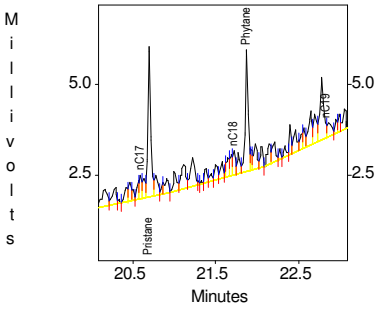

c:\ezchrom\chrom\08134\n-125 -- Channel A




c:\ezchrom\chrom\08134\n-125 -- Channel A




c:\ezchrom\chrom\08134\n-125 -- Channel A



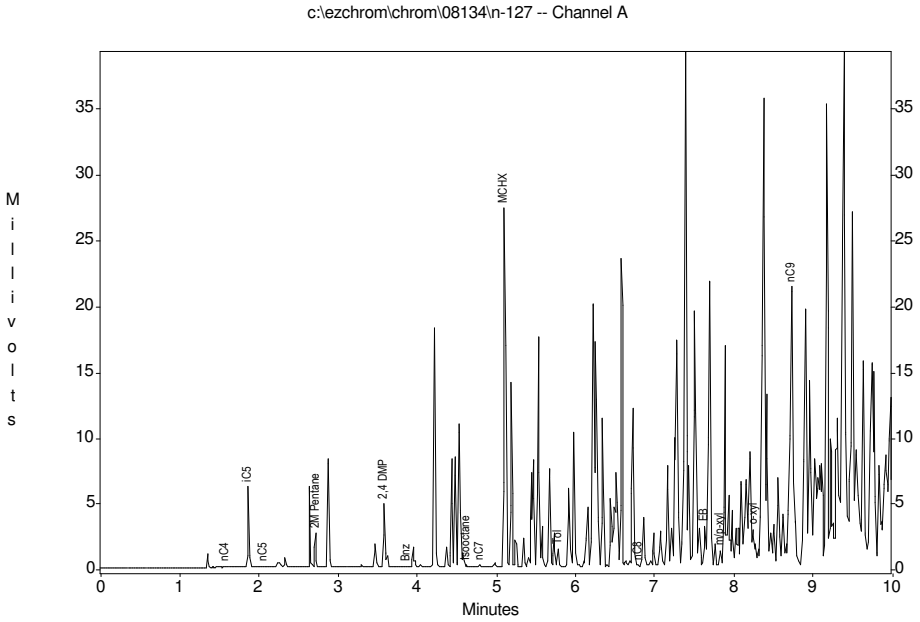

Channel A Results

| Peak | Area | Height |
|---|---|---|
| nC4 | 47 | 23 |
| iC5 | 72 | 66 |
| nC5 | 0 | 0 |
| MTBE | 0 | 0 |
| 2M Pentane | 53 | 28 |
| nC6 | 0 | 0 |
| olefin a | 0 | 0 |
| olefin b | 0 | 0 |
| olefin c | 0 | 0 |
| 2,4 DMP | 2577 | 2388 |
| Bnz | 0 | 0 |
| Isooctane | 44 | 26 |
| nC7 | 23 | 10 |
| MCHX | 1879 | 1427 |
| Tol | 1507 | 1180 |
| nC8 | 120 | 100 |
| EB | 3613 | 2617 |
| m/p-xyl | 1348 | 893 |
| o-xyl | 205 | 235 |
| nC9 | 20447 | 10514 |
| 1,2,4 TMB | 13310 | 5561 |
| nC10 | 6239 | 1696 |
| nC11 | 2903 | 1266 |
| Naph | 1086 | 359 |
| nC12 | 432 | 177 |
| IP13 | 1890 | 974 |
| IP14 | 1363 | 863 |
| nC13 | 531 | 207 |
| IP15 | 1322 | 930 |
| nC14 | 663 | 366 |
| IP16 | 3054 | 1223 |
| nC15 | 1387 | 367 |
| nC16 | 738 | 405 |
| IP18 | 5649 | 2477 |
| nC17 | 1339 | 672 |
| Pristane | 9295 | 4167 |
| nC18 | 1327 | 704 |
| Phytane | 7858 | 3377 |
| nC19 | 1333 | 386 |
| nC20 | 7370 | 1926 |
| nC21 | 2465 | 888 |
| nC22 | 3395 | 1024 |
| nC23 | 1679 | 842 |
| nC24 | 4216 | 1263 |
| nC25 | 10649 | 2239 |
| nC26 | 1169 | 488 |
| nC27 | 1381 | 681 |
| nC28 | 902 | 396 |
| nC29 | 998 | 495 |
| nC30 | 70 | 0 |
| nC31 | 2175 | 578 |
| nC32 | 794 | 281 |
| nC33 | 1238 | 404 |
| nC34 | 0 | 0 |
| nC35 | 228 | 136 |
| nC36 | 338 | 219 |
| nC37 | 314 | 82 |
| nC38 | 142 | 82 |
| nC39 | 96 | 63 |
| nC40 | 85 | 46 |

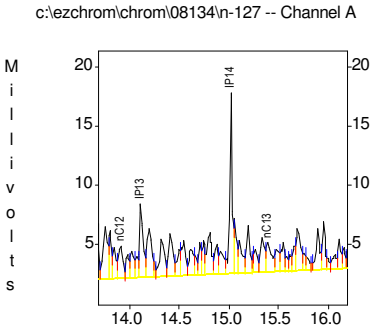
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : N-127
Acquired : Jul 31, 2008 11:29:45

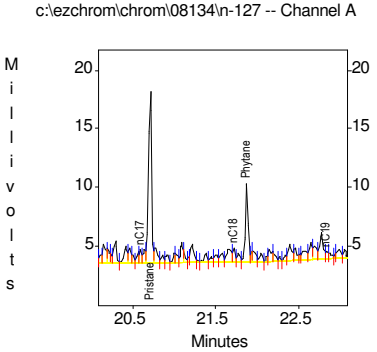
c:\ezchrom\chrom\08134\n-127 -- Channel A



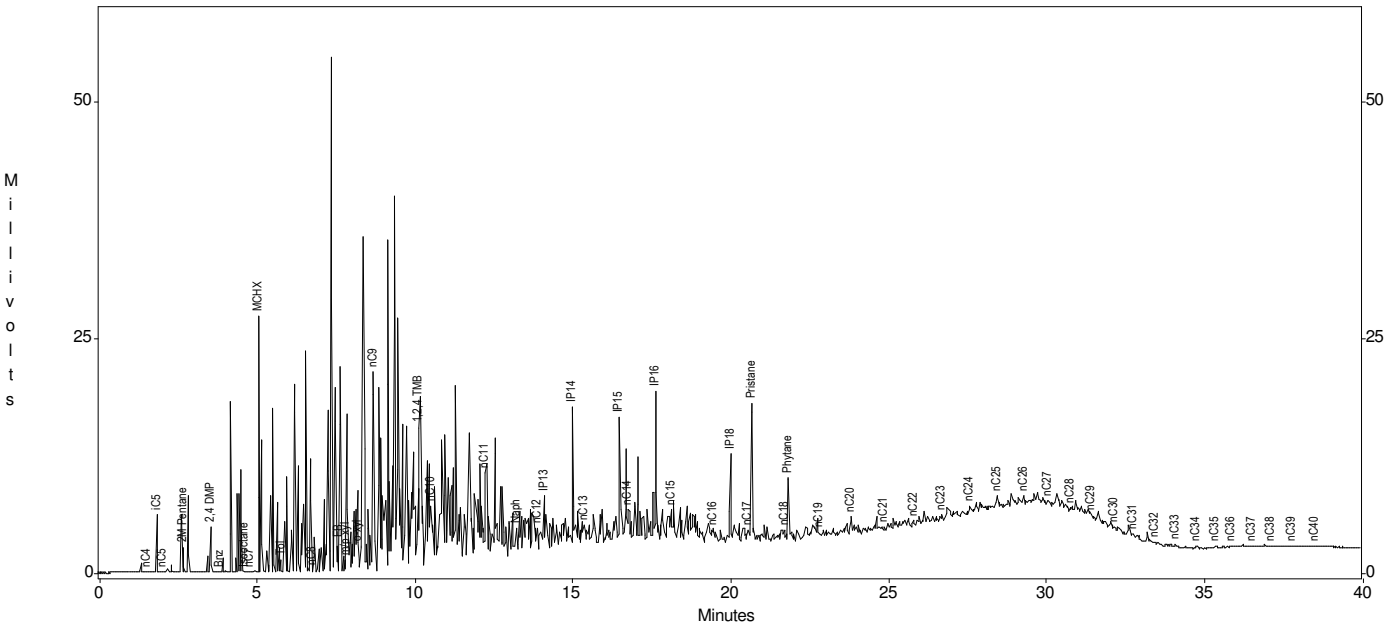

c:\ezchrom\chrom\08134\n-127 -- Channel A




c:\ezchrom\chrom\08134\n-127 -- Channel A




c:\ezchrom\chrom\08134\n-127 -- Channel A



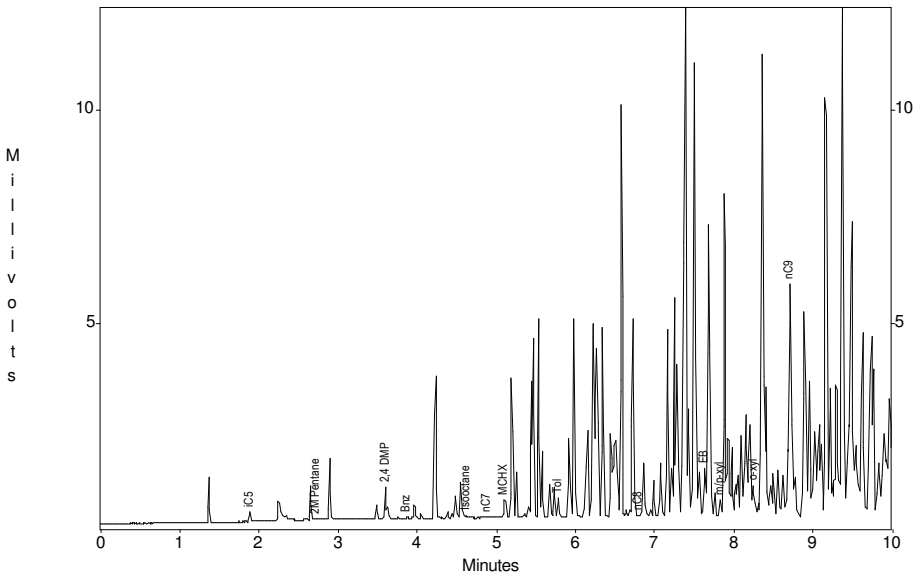

Channel A Results

| Peak | Area | Height |
|---|---|---|
| nC4 | 17 | 19 |
| iC5 | 4910 | 6189 |
| nC5 | 84 | 56 |
| MTBE | 0 | 0 |
| 2M Pentane | 2592 | 2549 |
| nC6 | 0 | 0 |
| olefin a | 0 | 0 |
| olefin b | 0 | 0 |
| olefin c | 0 | 0 |
| 2,4 DMP | 5025 | 4777 |
| Bnz | 75 | 41 |
| Isooctane | 113 | 67 |
| nC7 | 96 | 72 |
| MCHX | 33032 | 27162 |
| Tol | 2092 | 1325 |
| nC8 | 59 | 52 |
| EB | 4401 | 3021 |
| m/p-xyl | 1642 | 1134 |
| o-xyl | 3858 | 2738 |
| nC9 | 51916 | 21180 |
| 1,2,4 TMB | 25429 | 14507 |
| nC10 | 23403 | 6181 |
| nC11 | 15784 | 9213 |
| Naph | 5722 | 2876 |
| nC12 | 8124 | 2743 |
| IP13 | 14502 | 6235 |
| IP14 | 27677 | 15257 |
| nC13 | 9689 | 2541 |
| IP15 | 24550 | 13698 |
| nC14 | 8141 | 3810 |
| IP16 | 33304 | 15891 |
| nC15 | 7509 | 3278 |
| nC16 | 1761 | 1194 |
| IP18 | 21967 | 9405 |
| nC17 | 2647 | 1123 |
| Pristane | 35352 | 14653 |
| nC18 | 2594 | 1163 |
| Phytane | 15046 | 6635 |
| nC19 | 1147 | 583 |
| nC20 | 6929 | 1967 |
| nC21 | 1326 | 451 |
| nC22 | 1356 | 447 |
| nC23 | 1331 | 526 |
| nC24 | 2317 | 776 |
| nC25 | 7779 | 1337 |
| nC26 | 2200 | 872 |
| nC27 | 809 | 415 |
| nC28 | 1713 | 563 |
| nC29 | 905 | 477 |
| nC30 | 140 | 88 |
| nC31 | 185 | 44 |
| nC32 | 53 | 21 |
| nC33 | 330 | 147 |
| nC34 | 1550 | 311 |
| nC35 | 55 | 52 |
| nC36 | 198 | 66 |
| nC37 | 86 | 41 |
| nC38 | 87 | 30 |
| nC39 | 32 | 41 |
| nC40 | 64 | 34 |

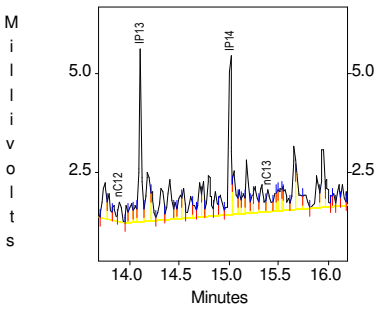
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : N-129
Acquired : Jul 31, 2008 16:09:46

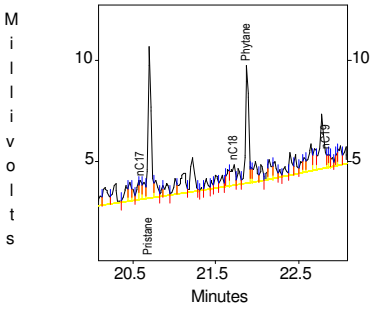
c:\ezchrom\chrom\08134\n-129 -- Channel A



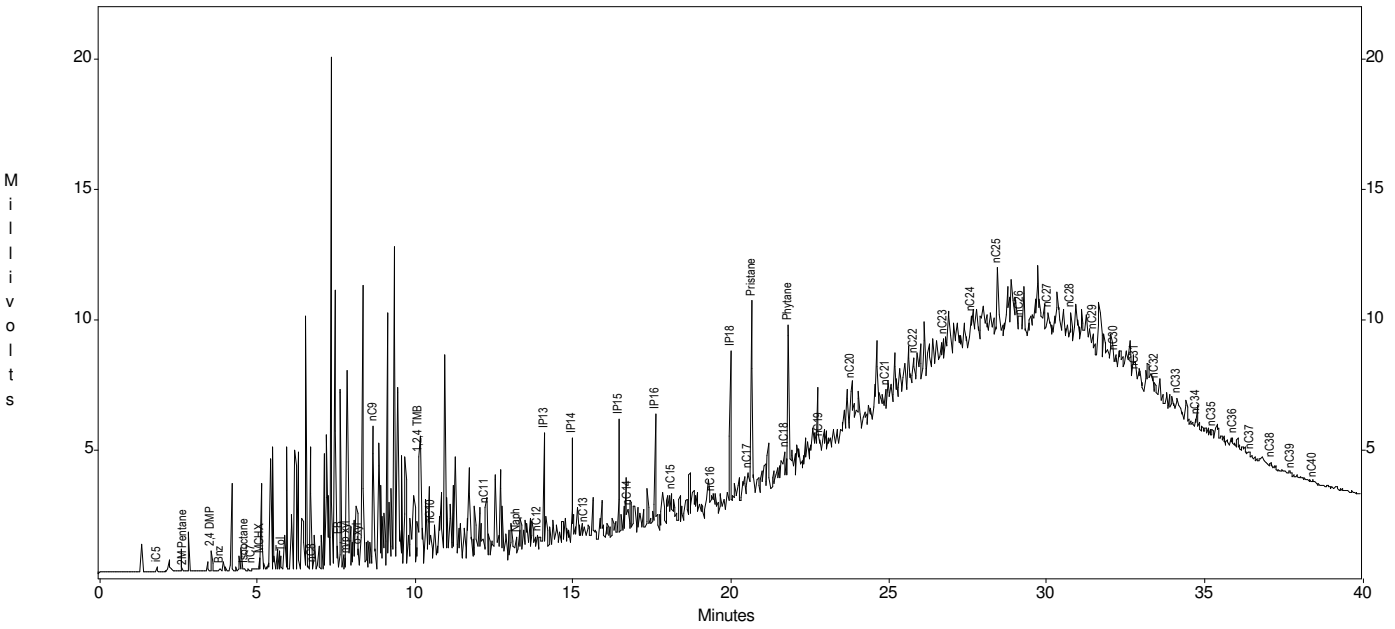

c:\ezchrom\chrom\08134\n-129 -- Channel A




c:\ezchrom\chrom\08134\n-129 -- Channel A




c:\ezchrom\chrom\08134\n-129 -- Channel A



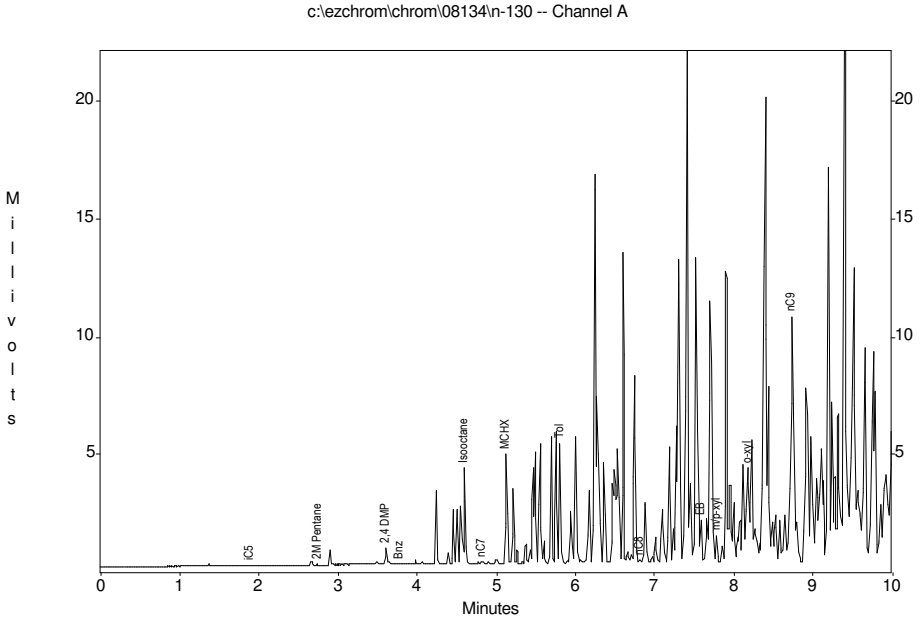

Channel A Results

| Peak | Area | Height |
|---|---|---|
| nC4 | 0 | 0 |
| iC5 | 250 | 209 |
| nC5 | 0 | 0 |
| MTBE | 0 | 0 |
| 2M Pentane | 40 | 26 |
| nC6 | 0 | 0 |
| olefin a | 0 | 0 |
| olefin b | 0 | 0 |
| olefin c | 0 | 0 |
| 2,4 DMP | 831 | 730 |
| Bnz | 41 | 26 |
| Isooctane | 178 | 66 |
| nC7 | 50 | 28 |
| MCHX | 680 | 416 |
| Tol | 700 | 481 |
| nC8 | 106 | 58 |
| EB | 1613 | 1136 |
| m/p-xyl | 706 | 426 |
| o-xyl | 1606 | 725 |
| nC9 | 11446 | 5488 |
| 1,2,4 TMB | 6591 | 4176 |
| nC10 | 5000 | 1382 |
| nC11 | 3476 | 2067 |
| Naph | 1980 | 652 |
| nC12 | 1194 | 494 |
| IP13 | 7380 | 4428 |
| IP14 | 6374 | 4060 |
| nC13 | 1634 | 583 |
| IP15 | 7102 | 4500 |
| nC14 | 1776 | 956 |
| IP16 | 9984 | 4496 |
| nC15 | 3719 | 1178 |
| nC16 | 1849 | 754 |
| IP18 | 13462 | 5994 |
| nC17 | 2353 | 1001 |
| Pristane | 17045 | 7517 |
| nC18 | 3993 | 1090 |
| Phytane | 14275 | 5857 |
| nC19 | 835 | 668 |
| nC20 | 7842 | 2026 |
| nC21 | 1965 | 770 |
| nC22 | 2875 | 1116 |
| nC23 | 2499 | 937 |
| nC24 | 3370 | 1157 |
| nC25 | 11460 | 2579 |
| nC26 | 2233 | 579 |
| nC27 | 1884 | 723 |
| nC28 | 3158 | 1007 |
| nC29 | 1503 | 540 |
| nC30 | 340 | 210 |
| nC31 | 180 | 178 |
| nC32 | 134 | 181 |
| nC33 | 1200 | 418 |
| nC34 | 50 | 125 |
| nC35 | 232 | 150 |
| nC36 | 466 | 212 |
| nC37 | 72 | 0 |
| nC38 | 150 | 92 |
| nC39 | 69 | 31 |
| nC40 | 121 | 48 |

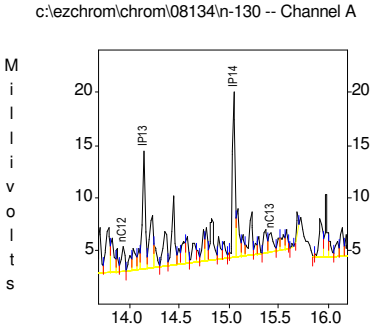
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : N-130
Acquired : Jul 31, 2008 08:50:57

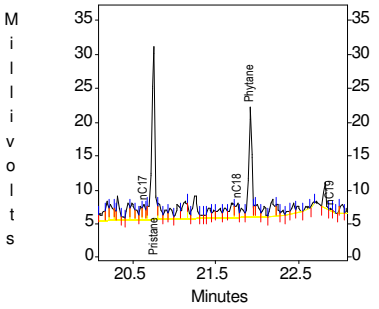
c:\ezchrom\chrom\08134\n-130 -- Channel A



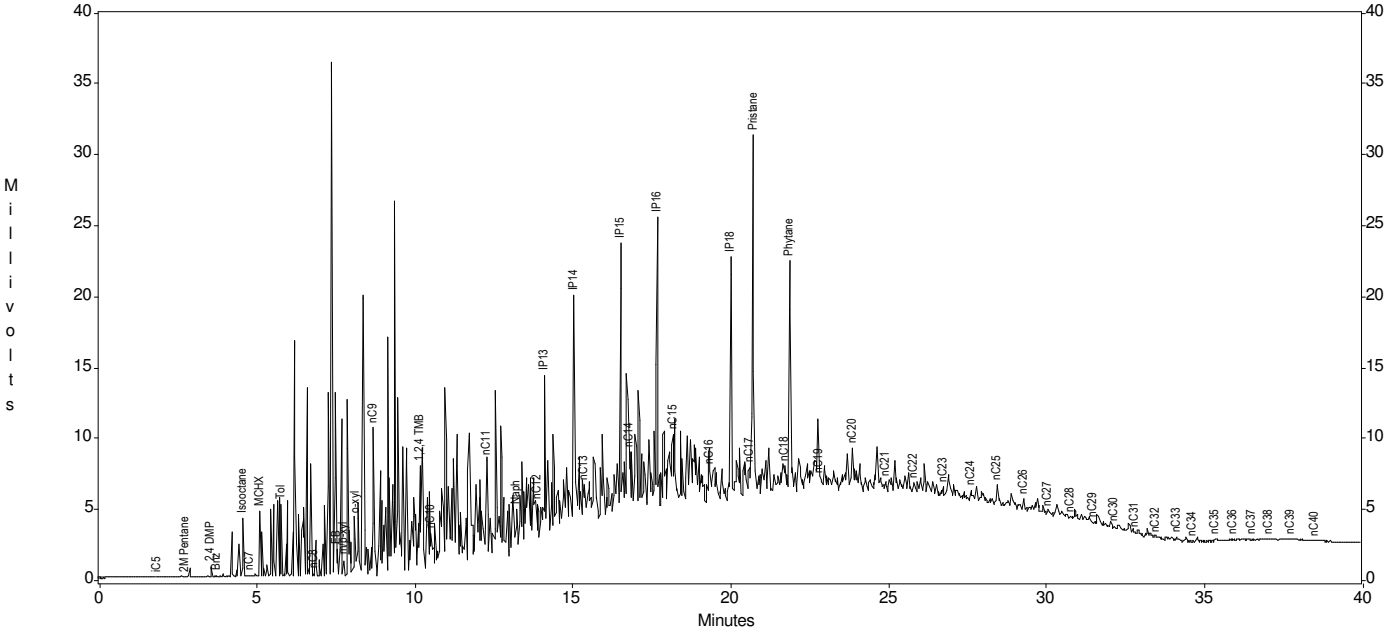

c:\ezchrom\chrom\08134\n-130 -- Channel A




c:\ezchrom\chrom\08134\n-130 -- Channel A




c:\ezchrom\chrom\08134\n-130 -- Channel A



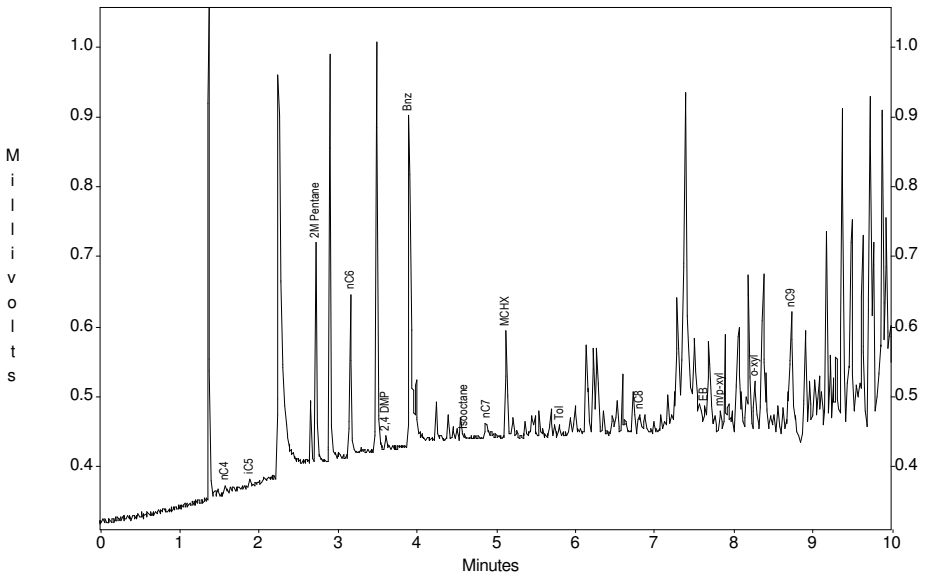

Channel A Results

| Peak | Area | Height |
|---|---|---|
| nC4 | 0 | 0 |
| iC5 | 21 | 24 |
| nC5 | 0 | 0 |
| MTBE | 0 | 0 |
| 2M Pentane | 20 | 16 |
| nC6 | 0 | 0 |
| olefin a | 0 | 0 |
| olefin b | 0 | 0 |
| olefin c | 0 | 0 |
| 2,4 DMP | 745 | 673 |
| Bnz | 101 | 33 |
| Isooctane | 4886 | 4099 |
| nC7 | 133 | 102 |
| MCHX | 5987 | 4646 |
| Tol | 6686 | 5092 |
| nC8 | 151 | 115 |
| EB | 2496 | 1799 |
| m/p-xyl | 1741 | 1158 |
| o-xyl | 7722 | 4000 |
| nC9 | 22010 | 10445 |
| 1,2,4 TMB | 11786 | 7315 |
| nC10 | 8611 | 2412 |
| nC11 | 10853 | 6609 |
| Naph | 3337 | 2083 |
| nC12 | 5473 | 2392 |
| IP13 | 21152 | 11274 |
| IP14 | 26304 | 15793 |
| nC13 | 5854 | 1915 |
| IP15 | 34853 | 19196 |
| nC14 | 9002 | 4341 |
| IP16 | 44924 | 20594 |
| nC15 | 13951 | 5179 |
| nC16 | 3292 | 2434 |
| IP18 | 40549 | 17120 |
| nC17 | 5048 | 2220 |
| Pristane | 68880 | 25557 |
| nC18 | 4922 | 1996 |
| Phytane | 38404 | 16319 |
| nC19 | 363 | 193 |
| nC20 | 11336 | 2984 |
| nC21 | 954 | 615 |
| nC22 | 1280 | 770 |
| nC23 | 2101 | 831 |
| nC24 | 2145 | 762 |
| nC25 | 6705 | 1339 |
| nC26 | 1532 | 721 |
| nC27 | 731 | 280 |
| nC28 | 562 | 215 |
| nC29 | 569 | 227 |
| nC30 | 353 | 141 |
| nC31 | 54 | 32 |
| nC32 | 45 | 47 |
| nC33 | 373 | 154 |
| nC34 | 77 | 94 |
| nC35 | 102 | 71 |
| nC36 | 160 | 75 |
| nC37 | 109 | 42 |
| nC38 | 125 | 25 |
| nC39 | 36 | 28 |
| nC40 | 140 | 15 |

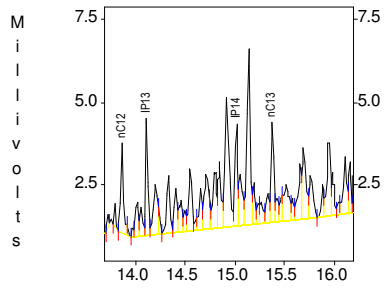
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : N-135
Acquired : Jul 31, 2008 10:35:35

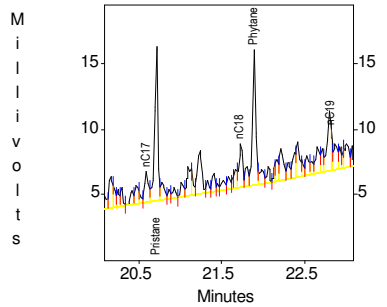
c:\ezchrom\chrom\08134\n-135 -- Channel A



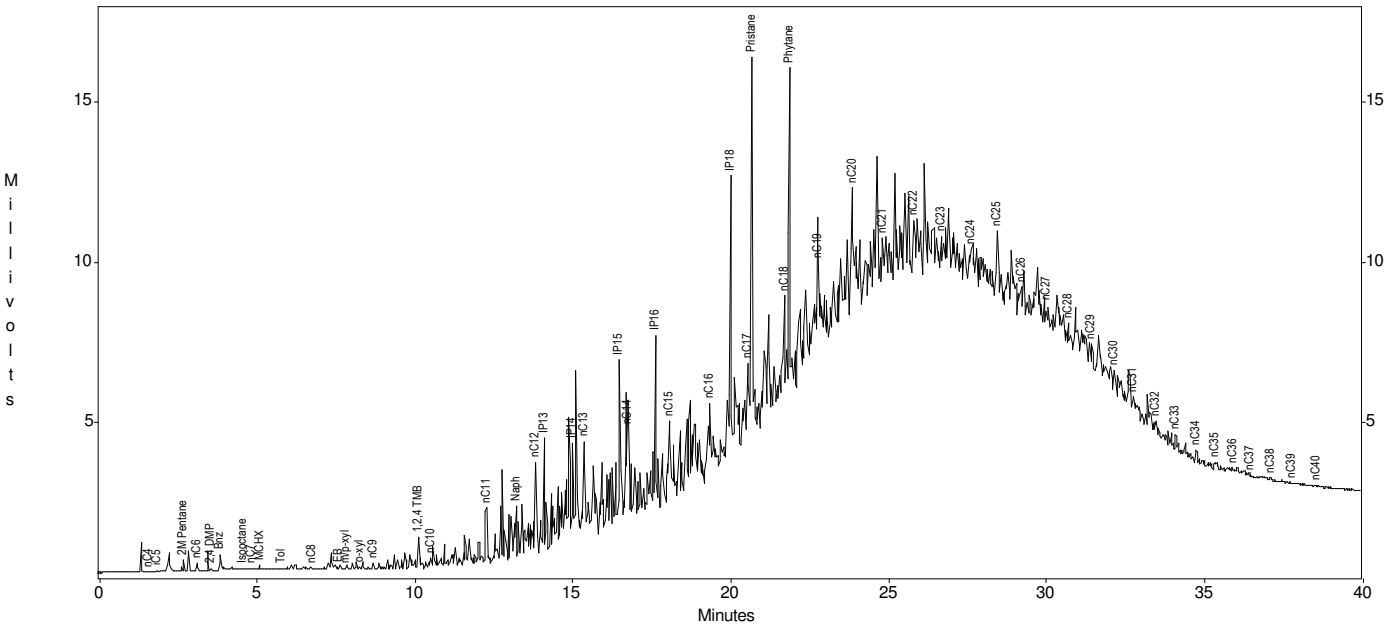

c:\ezchrom\chrom\08134\n-135 -- Channel A




c:\ezchrom\chrom\08134\n-135 -- Channel A




c:\ezchrom\chrom\08134\n-135 -- Channel A



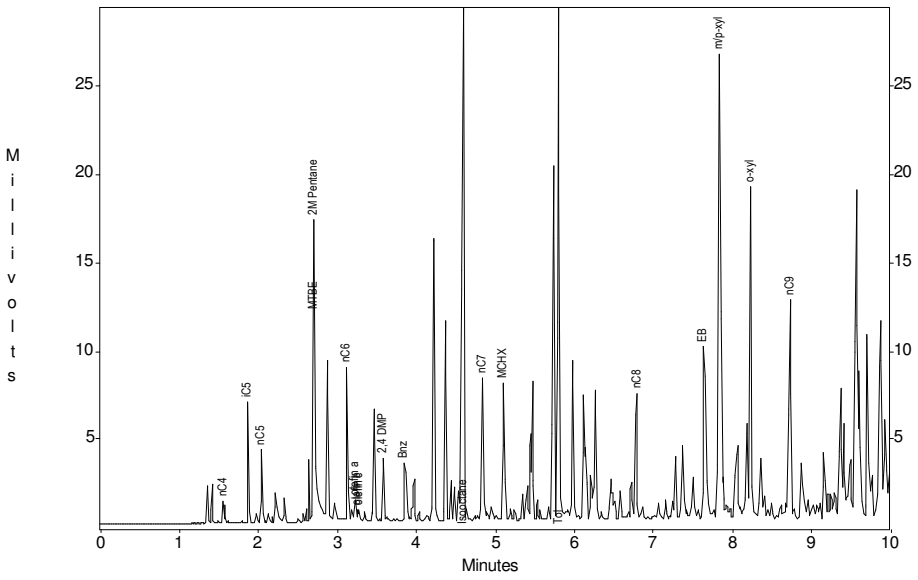

Channel A Results

| Peak | Area | Height |
|---|---|---|
| nC4 | 21 | 11 |
| iC5 | 15 | 11 |
| nC5 | 0 | 0 |
| MTBE | 0 | 0 |
| 2M Pentane | 404 | 312 |
| nC6 | 338 | 232 |
| olefin a | 0 | 0 |
| olefin b | 0 | 0 |
| olefin c | 0 | 0 |
| 2,4 DMP | 29 | 19 |
| Bnz | 1035 | 472 |
| Isooctane | 10 | 9 |
| nC7 | 43 | 20 |
| MCHX | 218 | 151 |
| Tol | 26 | 16 |
| nC8 | 81 | 31 |
| EB | 78 | 46 |
| m/p-xyl | 90 | 40 |
| o-xyl | 234 | 84 |
| nC9 | 622 | 184 |
| 1,2,4 TMB | 2108 | 964 |
| nC10 | 716 | 322 |
| nC11 | 3298 | 1712 |
| Naph | 3965 | 1567 |
| nC12 | 5283 | 2733 |
| IP13 | 6040 | 3539 |
| IP14 | 4922 | 3110 |
| nC13 | 5957 | 3018 |
| IP15 | 12047 | 5182 |
| nC14 | 5226 | 2861 |
| IP16 | 11626 | 5427 |
| nC15 | 6778 | 2541 |
| nC16 | 4795 | 2342 |
| IP18 | 20954 | 8867 |
| nC17 | 8105 | 2385 |
| Pristane | 31107 | 11857 |
| nC18 | 8680 | 3296 |
| Phytane | 25947 | 10264 |
| nC19 | 4190 | 3021 |
| nC20 | 14032 | 4097 |
| nC21 | 4009 | 1395 |
| nC22 | 4643 | 1979 |
| nC23 | 5304 | 1541 |
| nC24 | 4841 | 1156 |
| nC25 | 10876 | 2105 |
| nC26 | 2637 | 965 |
| nC27 | 2851 | 842 |
| nC28 | 1489 | 720 |
| nC29 | 1881 | 719 |
| nC30 | 1037 | 497 |
| nC31 | 360 | 208 |
| nC32 | 753 | 326 |
| nC33 | 801 | 386 |
| nC34 | 589 | 160 |
| nC35 | 101 | 67 |
| nC36 | 367 | 110 |
| nC37 | 63 | 46 |
| nC38 | 114 | 42 |
| nC39 | 48 | 30 |
| nC40 | 60 | 33 |

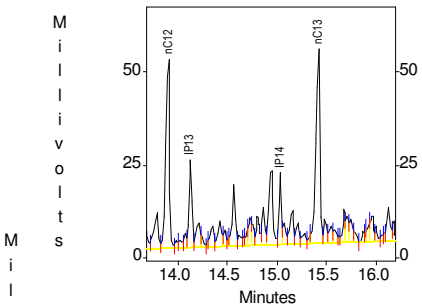
# Torkelson Geochemistry, Inc.

Sunoco Philadelphia Refinery - AOI 8 SCR
Sample ID : Gas/Dies/Wax std
Acquired : Jul 31, 2008 13:18:39

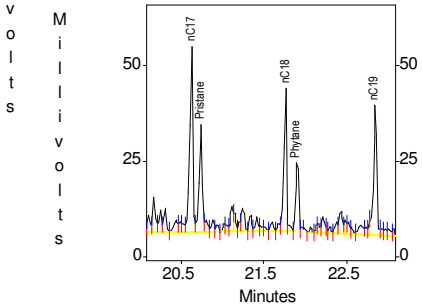
c:\ezchrom\chrom\08134\gadiwax2 -- Channel A



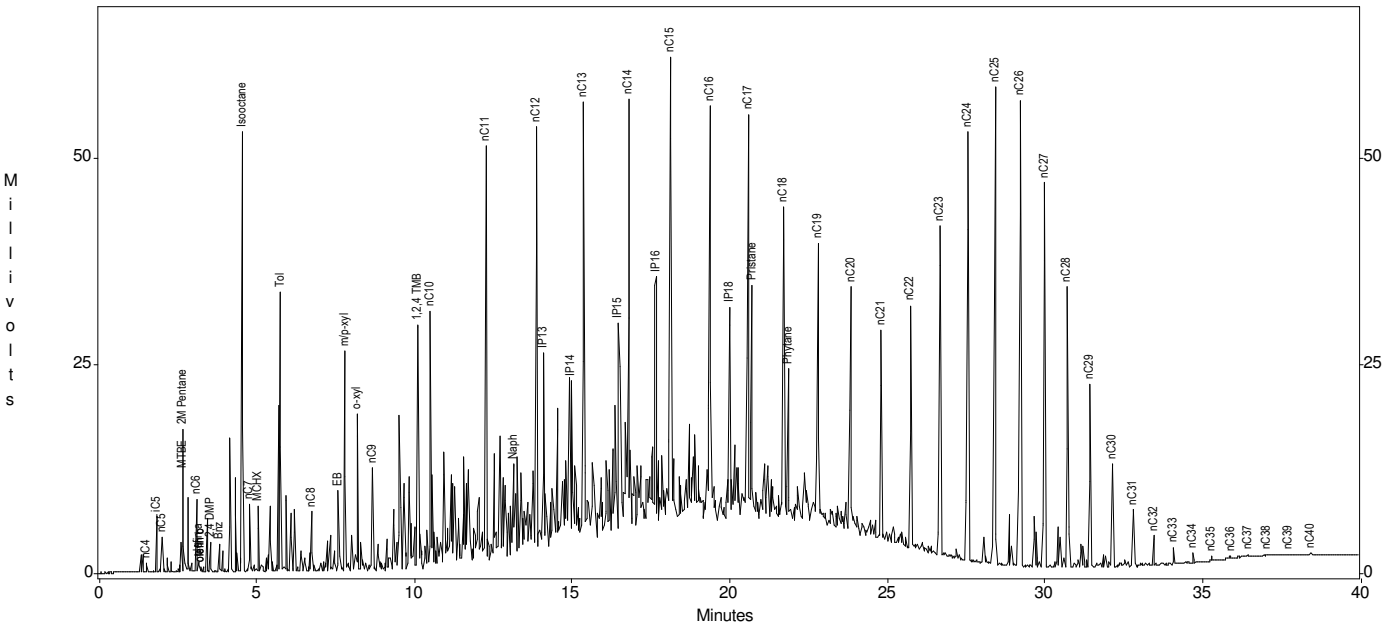

c:\ezchrom\chrom\08134\gadiwax2 -- Channel A




c:\ezchrom\chrom\08134\gadiwax2 -- Channel A




c:\ezchrom\chrom\08134\gadiwax2 -- Channel A




Channel A Results

| Peak | Area | Height |
|---|---|---|
| nC4 | 844 | 1197 |
| iC5 | 5237 | 6801 |
| nC5 | 3556 | 4178 |
| MTBE | 7110 | 11744 |
| 2M Pentane | 19226 | 17013 |
| nC6 | 8381 | 8568 |
| olefin a | 1201 | 1097 |
| olefin b | 589 | 523 |
| olefin c | 640 | 522 |
| 2,4 DMP | 3628 | 3584 |
| Bnz | 4616 | 3202 |
| Isooctane | 67342 | 52743 |
| nC7 | 10732 | 8058 |
| MCHX | 9891 | 7788 |
| Tol | 46099 | 33546 |
| nC8 | 8895 | 7111 |
| EB | 15060 | 9784 |
| m/p-xyl | 52242 | 26351 |
| o-xyl | 28562 | 18847 |
| nC9 | 19381 | 12387 |
| 1,2,4 TMB | 54430 | 29156 |
| nC10 | 50580 | 30692 |
| nC11 | 125205 | 49772 |
| Naph | 26419 | 10838 |
| nC12 | 111988 | 50866 |
| IP13 | 42314 | 23440 |
| IP14 | 33440 | 19534 |
| nC13 | 148615 | 52467 |
| IP15 | 46608 | 24865 |
| nC14 | 138215 | 51455 |
| IP16 | 61655 | 29152 |
| nC15 | 144672 | 55541 |
| nC16 | 129943 | 49763 |
| IP18 | 61028 | 25394 |
| nC17 | 120104 | 48415 |
| Pristane | 72271 | 27954 |
| nC18 | 88772 | 37001 |
| Phytane | 36788 | 17273 |
| nC19 | 85744 | 33847 |
| nC20 | 70856 | 29690 |
| nC21 | 52259 | 25456 |
| nC22 | 66568 | 29140 |
| nC23 | 103851 | 39616 |
| nC24 | 156908 | 51563 |
| nC25 | 187403 | 57282 |
| nC26 | 193674 | 55832 |
| nC27 | 149116 | 46256 |
| nC28 | 94360 | 33770 |
| nC29 | 52340 | 22034 |
| nC30 | 25143 | 12289 |
| nC31 | 11594 | 6435 |
| nC32 | 6824 | 3513 |
| nC33 | 3654 | 2051 |
| nC34 | 2023 | 1098 |
| nC35 | 1190 | 603 |
| nC36 | 665 | 329 |
| nC37 | 376 | 162 |
| nC38 | 277 | 105 |
| nC39 | 221 | 68 |
| nC40 | 142 | 45 |

| Torkelson Geochemistry, Inc. | | | | | | | |
|---|---|---|---|---|---|---|---|
| Physical Properties Measurements | | | | | | | |
| Sample | TGI Job | Density (gm/ml) | Viscosity (centipoise) | Surface Tension Air/Water (dynes/cm) | Interfacial Tension NAPL/Water (dynes/cm) | Surface Tension Air/NAPL (dynes/cm) | Temperature of Measurements |
| N-107 | 08134 | 0.9033 | NA | NA | NA | NA | 60F |
| N-113 | 08134 | 0.9167 | NA | NA | NA | NA | 60F |
| N-116 | 08134 | 0.8985 | NA | NA | NA | NA | 60F |
| N-125 | 08134 | 0.8922 | NA | NA | NA | NA | 60F |
| N-127 | 08134 | 0.8785 | NA | NA | NA | NA | 60F |
| N-129 | 08134 | 0.9017 | NA | NA | NA | NA | 60F |
| N-130 | 08134 | 0.7893 | NA | NA | NA | NA | 60F |
| N-135 | 08134 | 0.9148 | NA | NA | NA | NA | 60F |

NA = Not Analyzed

| Sunoco Refinery - Philadelphia | | | | | | |
|---|---|---|---|---|---|---|
| TGI Job 08134 | | | | | | |
| **Interpretation of Product Type(s), Proportions and Weathering** | | | | **Similarities to Other Samples in this Study** | | |
| **Sample** | **Product Type(s)** | **Proportions** | **Weathering** | **Quite Similar to** | **Fairly Similar to** | **Somewhat Similar to** |
| N-107 | Aviation Gasoline | 5 | Severe | Unique | | |
| | Middle Distillate | 70 | Extreme | | | |
| | Heavier Material | 25 | Extreme | | | |
| | | | | | | |
| N-113 | Unknown Light Mateial | 10 | Extreme | Unique | | |
| | ? Middle Distillate | ? | Extreme | | | |
| | Heavier Material | 90 | Extreme | | | |
| | | | | | | |
| N-116 | Unknown Light Mateial | 2 | Severe | Unique | | |
| | Middle Distillate | 79 | Extreme | | | |
| | Heavier Material | 19 | Extreme | | | |
| | | | | | | |
| N-125 | Heavy Virgin Naphtha | 15 | Extreme | Unique | | |
| | Heavier Material | 85 | Extreme | | | |
| | | | | | | |
| N-127 | Heavy Virgin Naphtha | 20 | Extreme | Unique | | |
| | Middle Distillate | 30 | Extreme | | | |
| | Heavier Material | 50 | Extreme | | | |
| | | | | | | |
| N-129 | Heavy Virgin Naphtha | 5 | Extreme | Unique | | |
| | ? Middle Distillate | ? | Extreme | | | |
| | Heavier Material | 95 | Extreme | | | |
| | | | | | | |
| N-130 | Heavy Virgin Naphtha | 10 | Extreme | Unique | | |
| | ? Middle Distillate | ? | Extreme | | | |
| | Heavier Material | 90 | Extreme | | | |
| | | | | | | |
| N-135 | Unknown Light Mateial | 1 | Extreme | Unique | | |
| | ? Middle Distillate | ? | Extreme | | | |
| | Heavier Material | 99 | Extreme | | | |
| | | | | | | |
| | | | | | | |
| | Note: Heavier material could be either crude oil or residual oil | | | | | |

# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.003 |

Gauged May 2011

**AOI 8 / N-14**

0.010 feet

| Soil Characteristic | | |
|---|---|---|
| | | **SP** |
| n = | 0.426 | porosity |
| N = | 1.980 | van Genuchten "N" |
| $\alpha$ = | 1.350 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.321 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | |
|---|---|---|
| | | **Residual Oil** |
| $\rho_o$ = | 0.930 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.495 | van Genuchten "M" |
| $\alpha_{ao}$ = | 2.542 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.204 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.000 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.003 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.000 | maximum free-product elevation |
| $\lambda$ = | 0.738 | pore-size distribution index |
| $\Psi_b$ = | 0.461 | B-C displacement pressure head [m] |

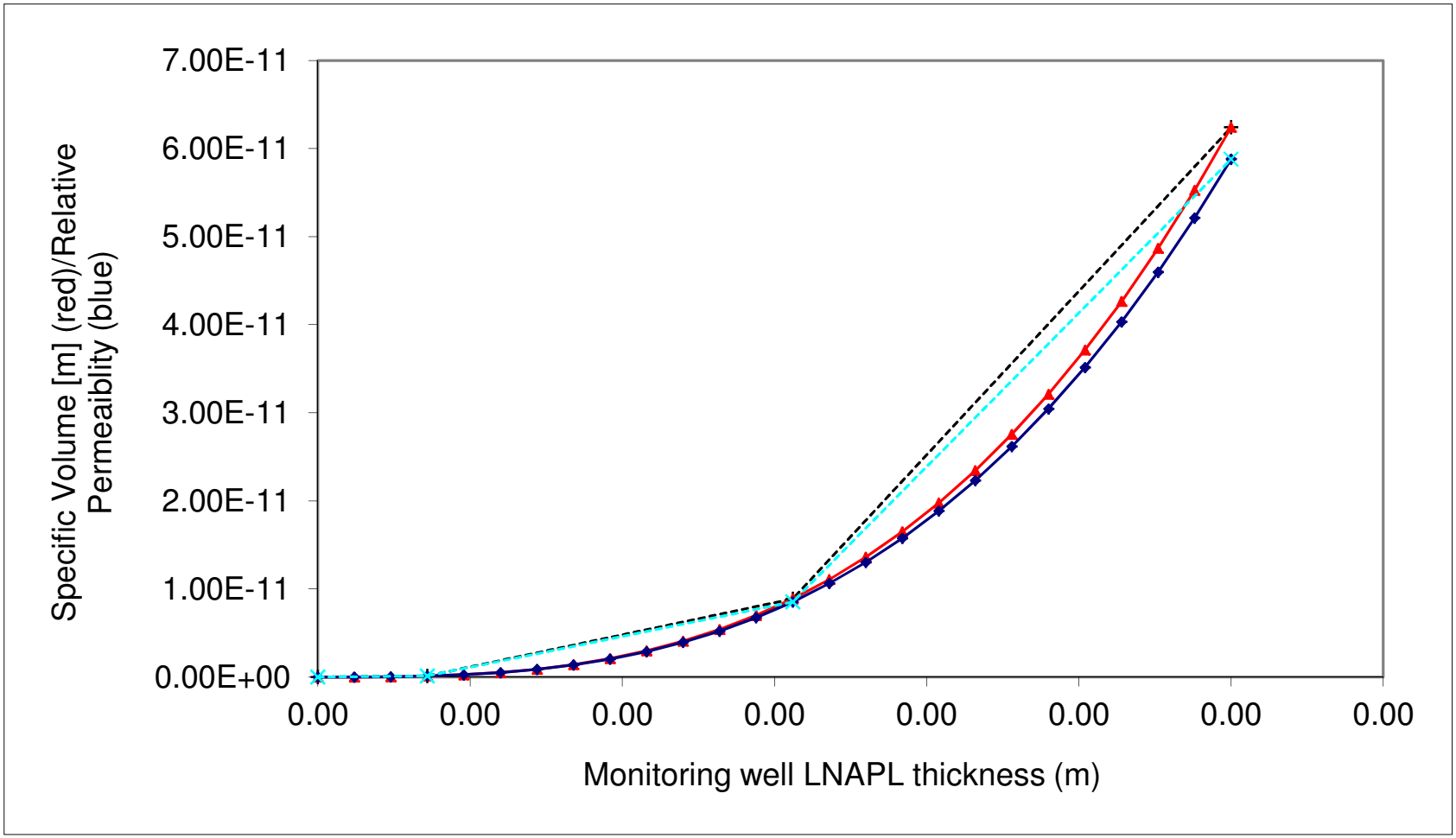
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.000 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.002 | 0.000 | 0.000 | 0.0003 | 0.000000 | 0.0003 | 0.000000 | 0.001 | Eps-Do |
| 0.003 | 0.000 | 0.000 | 0.0013 | 0.000000 | 0.0013 | 0.000000 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

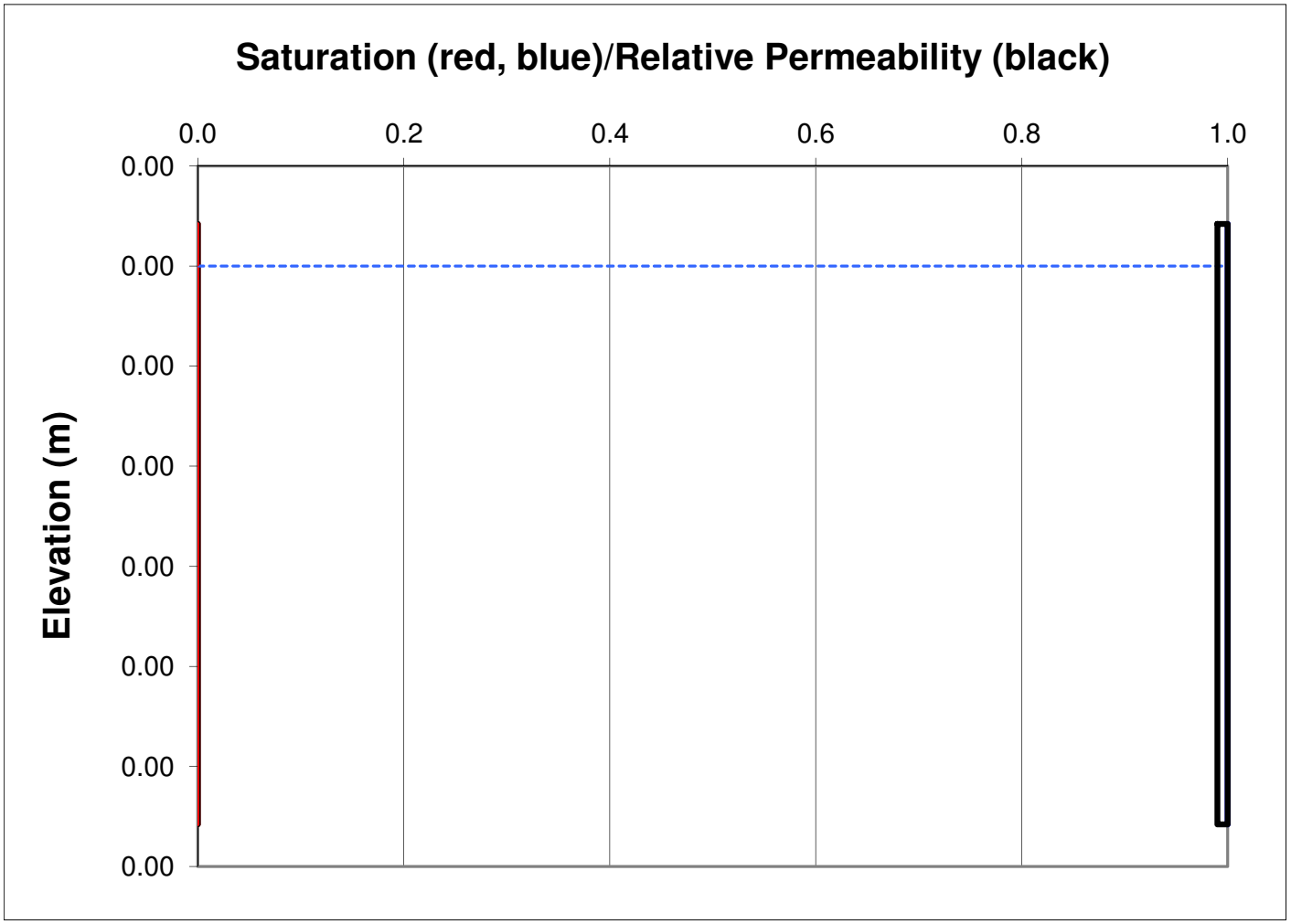
**Gauged May 2011**

**AOI 8 / N-14**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.003 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = 6.240E-11 | $k_{ro}$ = | 5.879E-11 | AOI 8 / N-14 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | | |
|---|---|---|
| $b_o$ = | 0.122 | Gauged May 2011 **AOI 8 / N-25** 0.400 feet |

| Soil Characteristic | | SP |
|---|---|---|
| n = | 0.426 | porosity |
| N = | 1.980 | van Genuchten "N" |
| $\alpha$ = | 1.350 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.321 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | Middle Distillate |
|---|---|---|
| $\rho_o$ = | 0.940 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.495 | van Genuchten "M" |
| $\alpha_{ao}$ = | 2.570 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.174 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.007 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.115 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.007 | maximum free-product elevation |
| $\lambda$ = | 0.738 | pore-size distribution index |
| $\Psi_b$ = | 0.461 | B-C displacement pressure head [m] |

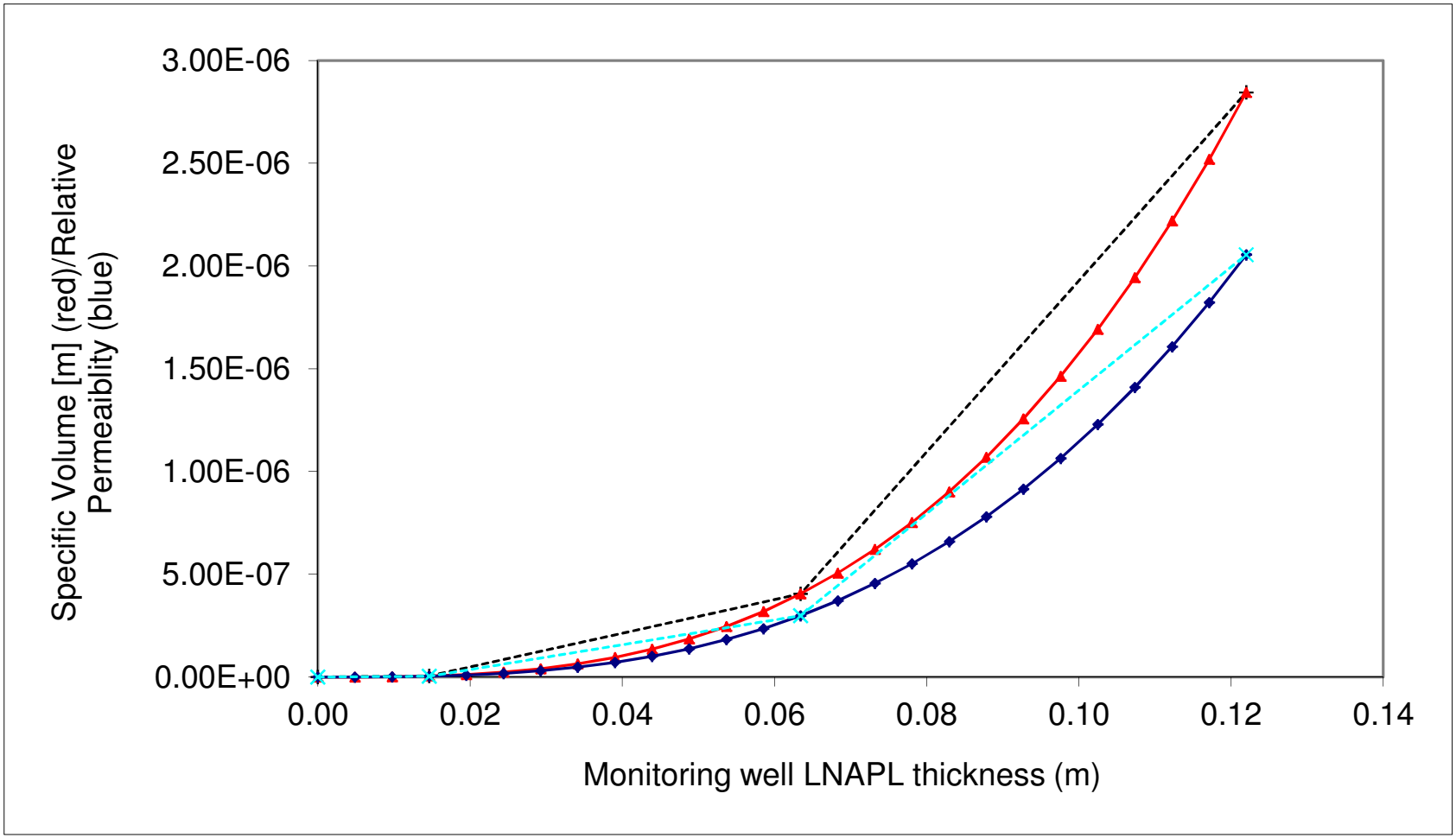
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.015 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.063 | 0.000 | 0.000 | 0.0140 | 0.000008 | 0.0140 | 0.000006 | 0.001 | Eps-Do |
| 0.122 | 0.000 | 0.000 | 0.0537 | 0.000042 | 0.0535 | 0.000030 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

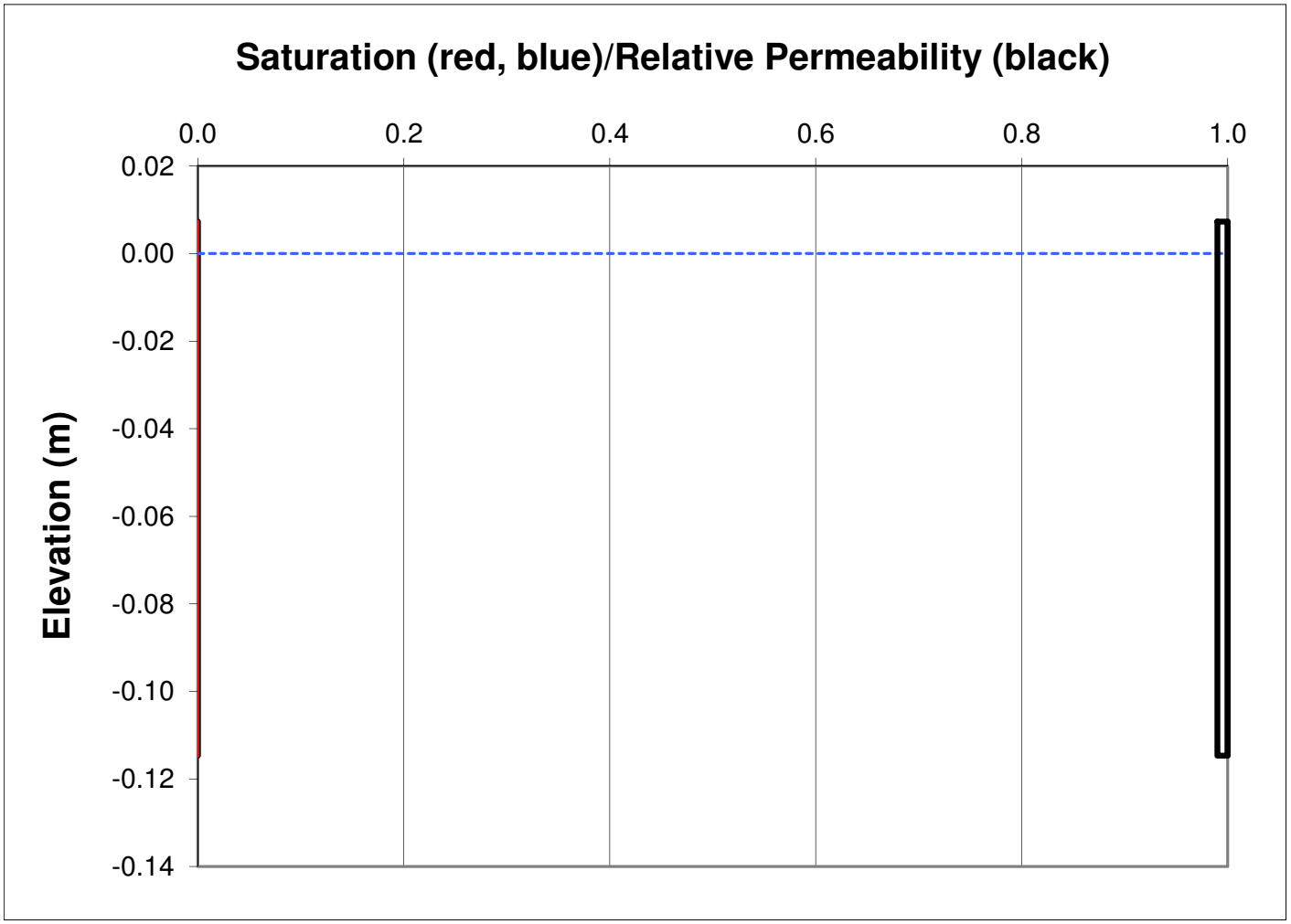
**Gauged May 2011**

**AOI 8 / N-25**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.122 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 2.844E-06 | $k_{ro}$ = 2.055E-06 | AOI 8 / N-25 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.186 |

Gauged May 2011

**AOI 8 / N-47**

0.610 feet

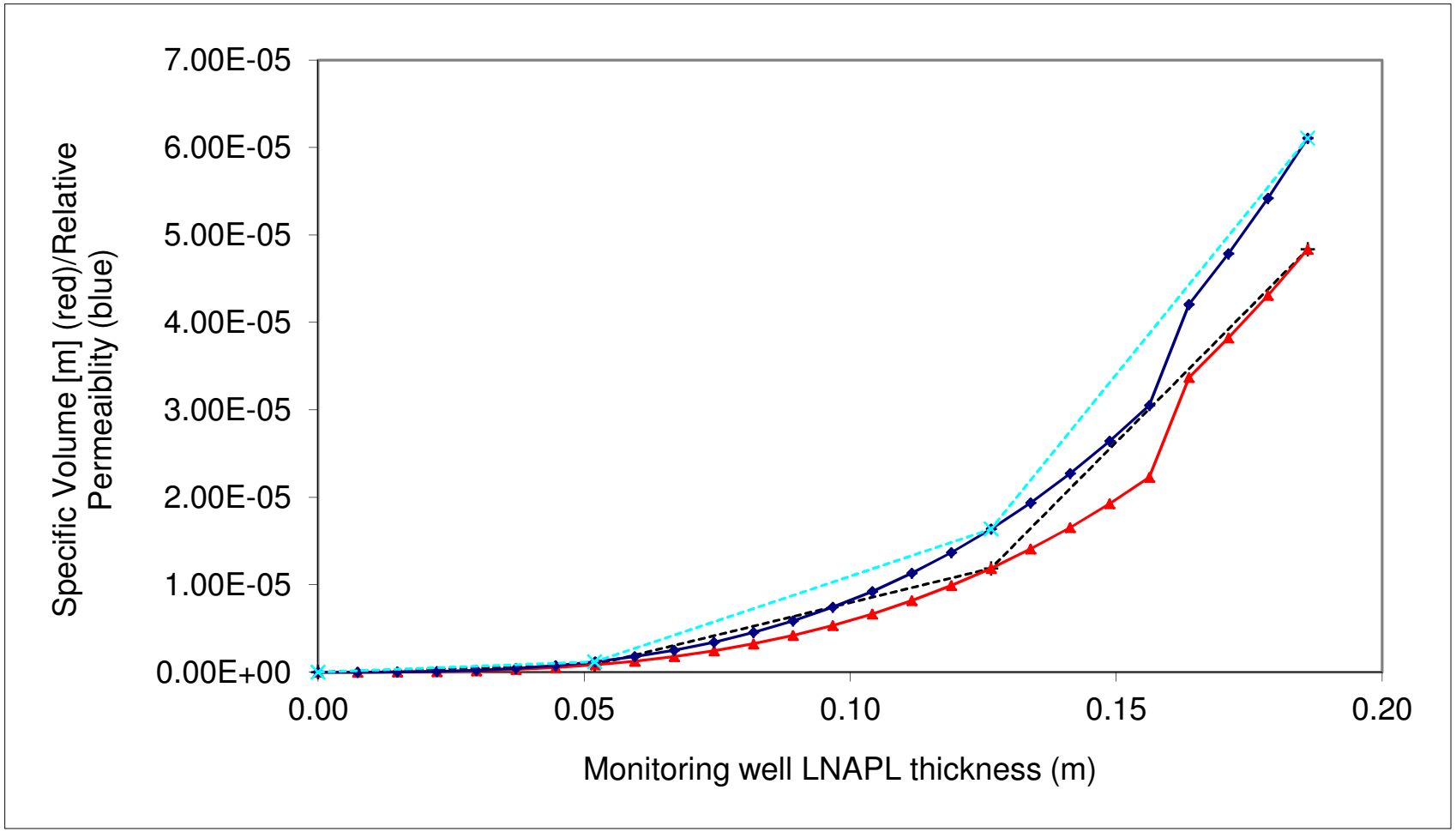
| Soil Characteristic | | **SP** |
|---|---|---|
| n = | 0.426 | porosity |
| N = | 1.980 | van Genuchten "N" |
| $\alpha$ = | 1.350 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.321 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Residual Oil** |
|---|---|---|
| $\rho_o$ = | 0.883 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.495 | van Genuchten "M" |
| $\alpha_{ao}$ = | 2.415 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.339 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.022 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.164 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.042 | maximum free-product elevation |
| $\lambda$ = | 0.738 | pore-size distribution index |
| $\Psi_b$ = | 0.461 | B-C displacement pressure head [m] |

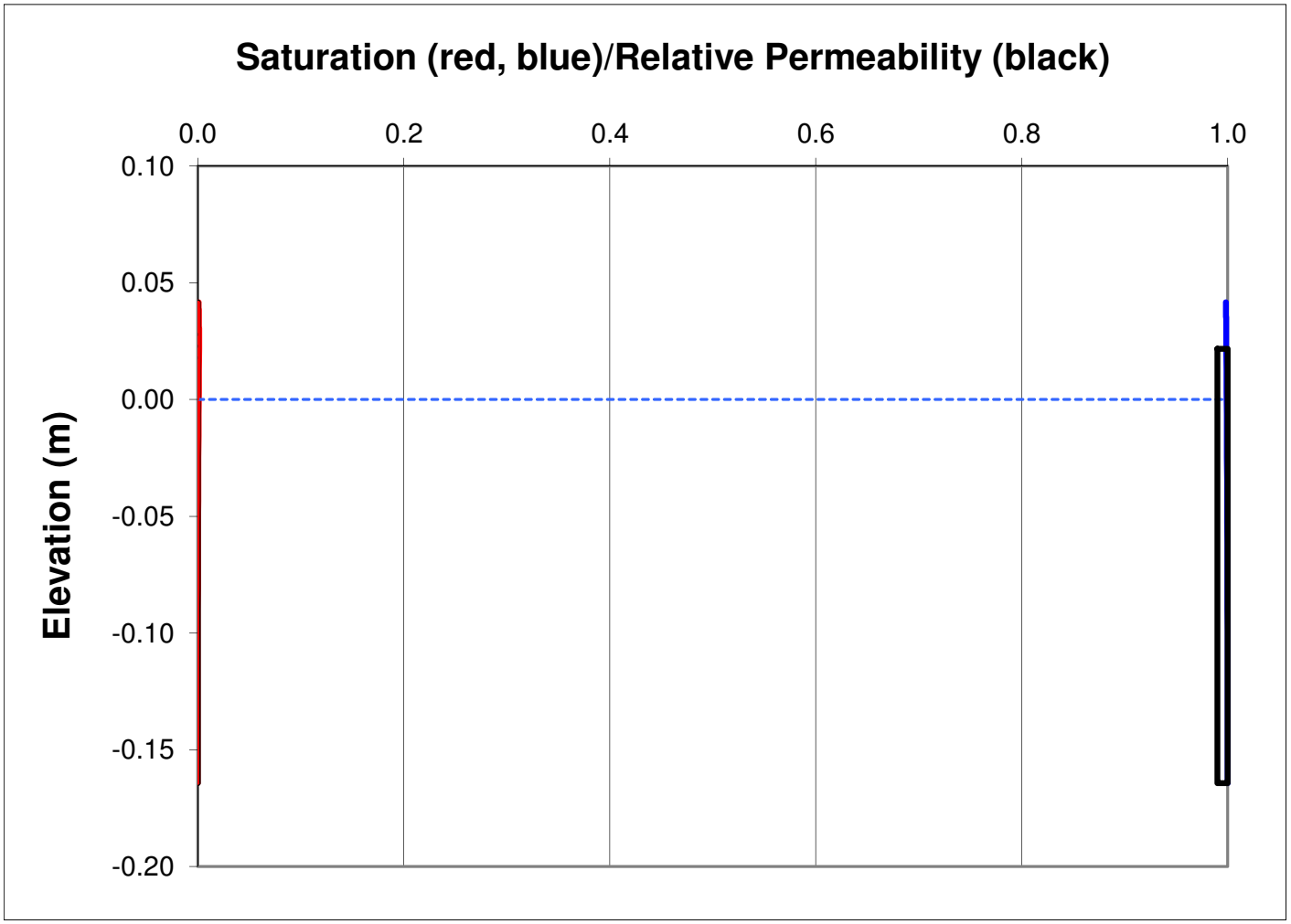
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | Press Ctrl+Shift+S to calculate sheet | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | **Gauged May 2011** | |
| 0.000 | 0.000E+00 | 0.000E+00 | | | | | **AOI 8 / N-47** | |
| 0.052 | 8.444E-07 | 1.196E-06 | 0.0000 | 0.000016 | 0.0000 | 0.000023 | | |
| 0.126 | 1.187E-05 | 1.637E-05 | 0.0463 | 0.000148 | 0.0461 | 0.000204 | 0.001 | Eps-Do |
| 0.186 | 4.835E-05 | 6.105E-05 | 0.1071 | 0.000613 | 0.1047 | 0.000751 | 0.001 | Eps-kro |



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.186 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 4.835E-05 | $k_{ro}$ = 6.105E-05 | AOI 8 / N-47 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | | |
|---|---|---|
| $b_o$ = | 0.634 | Gauged May 2011 **AOI 8 / N-76** 2.080 feet |

| Soil Characteristic | | **SP** |
|---|---|---|
| n = | 0.426 | porosity |
| N = | 1.980 | van Genuchten "N" |
| $\alpha$ = | 1.350 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.321 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Residual Oil** |
|---|---|---|
| $\rho_o$ = | 0.890 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.495 | van Genuchten "M" |
| $\alpha_{ao}$ = | 2.433 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.320 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.070 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.564 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.170 | maximum free-product elevation |
| $\lambda$ = | 0.738 | pore-size distribution index |
| $\Psi_b$ = | 0.461 | B-C displacement pressure head [m] |

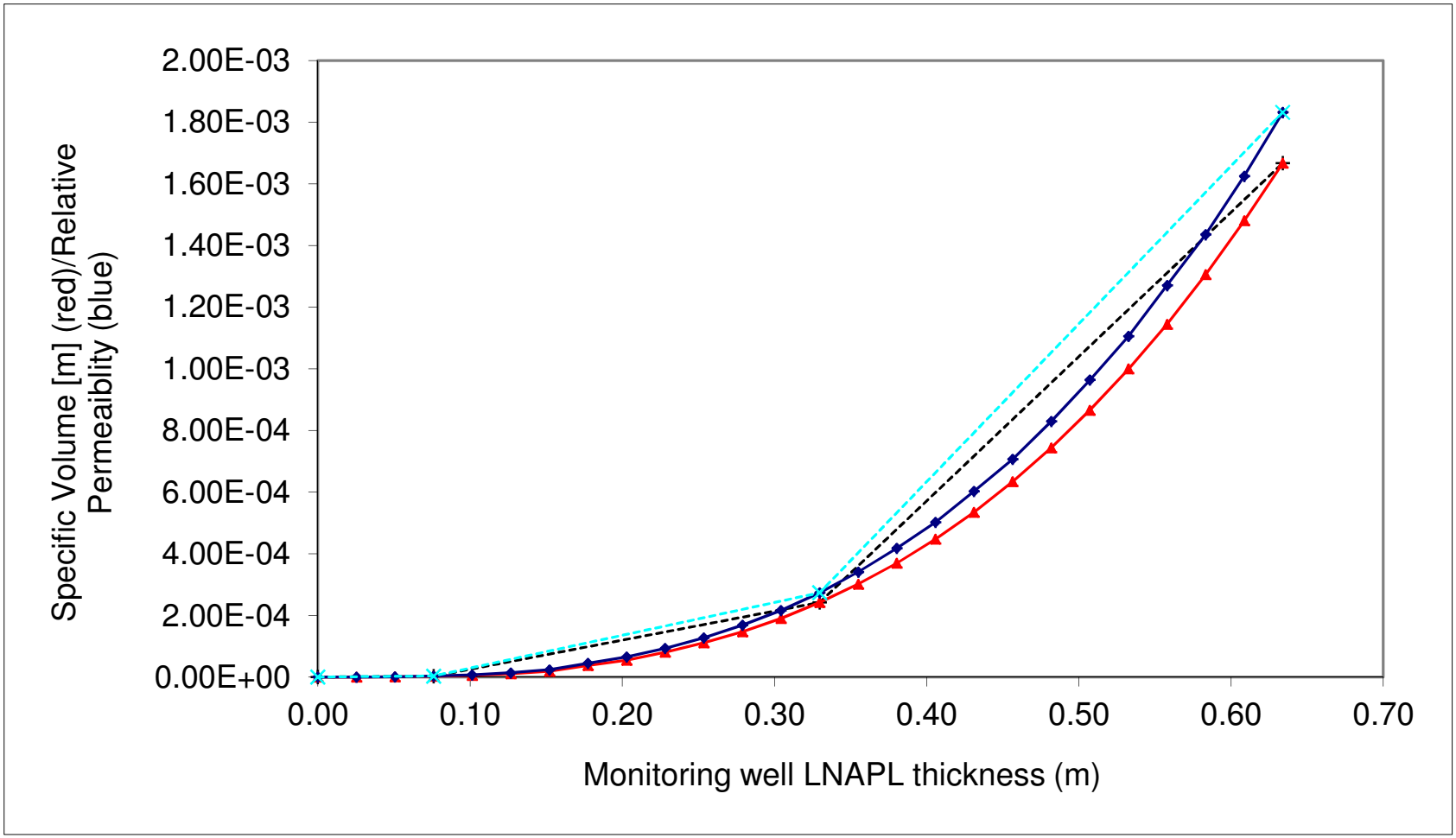
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.076 | 0.000 | 0.000 | 0.0000 | 0.000031 | 0.0000 | 0.000040 | | |
| 0.330 | 0.000 | 0.000 | 0.0736 | 0.000945 | 0.0732 | 0.001067 | 0.01 | Eps-Do |
| 0.634 | 0.002 | 0.002 | 0.2780 | 0.004683 | 0.2762 | 0.005120 | 0.01 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

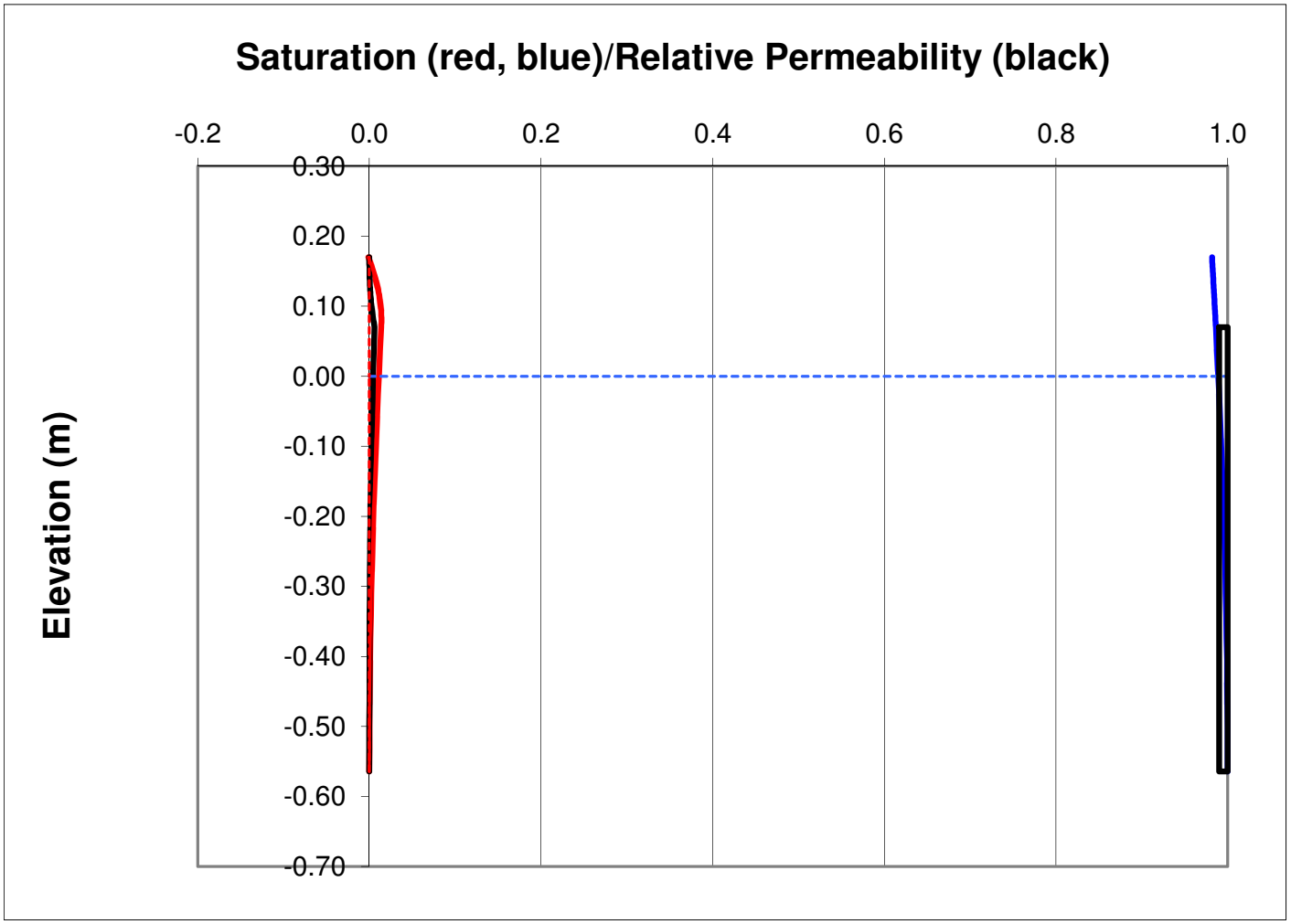
**Gauged May 2011**

**AOI 8 / N-76**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.634 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = 1.667E-03 | $k_{ro}$ = | 1.832E-03 | AOI 8 / N-76 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.040 |

Gauged May 2011

**AOI 8 / N-82**

0.130 feet

| Soil Characteristic | | **SP** |
|---|---|---|
| n = | 0.426 | porosity |
| N = | 1.980 | van Genuchten "N" |
| $\alpha$ = | 1.350 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.321 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

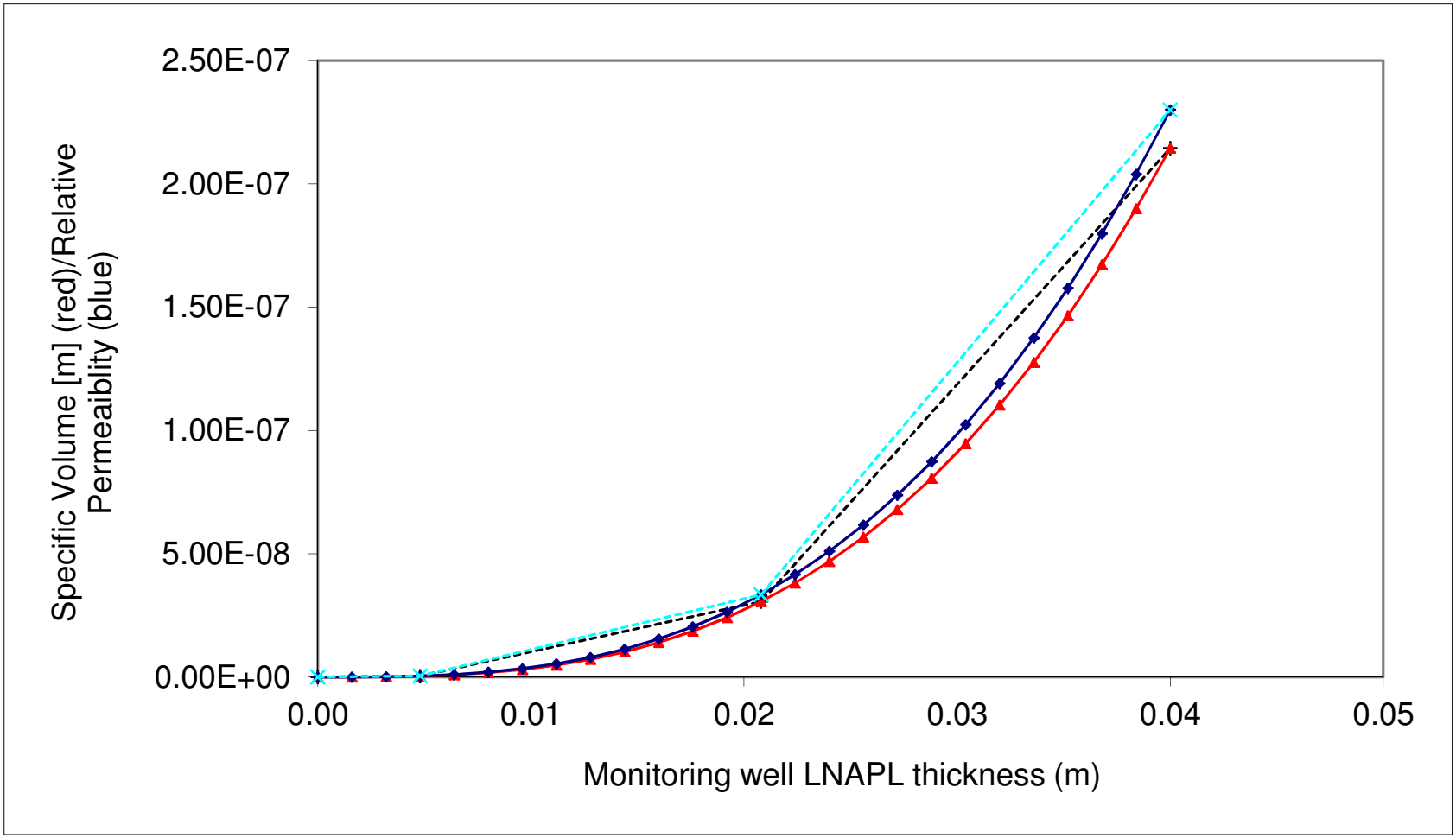
| Fluid Characteristics: | | **Residual Oil** |
|---|---|---|
| $\rho_o$ = | 0.913 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.495 | van Genuchten "M" |
| $\alpha_{ao}$ = | 2.496 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.252 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.003 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.037 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.003 | maximum free-product elevation |
| $\lambda$ = | 0.738 | pore-size distribution index |
| $\Psi_b$ = | 0.461 | B-C displacement pressure head [m] |

**Press Ctrl+Shift+S to calculate sheet**

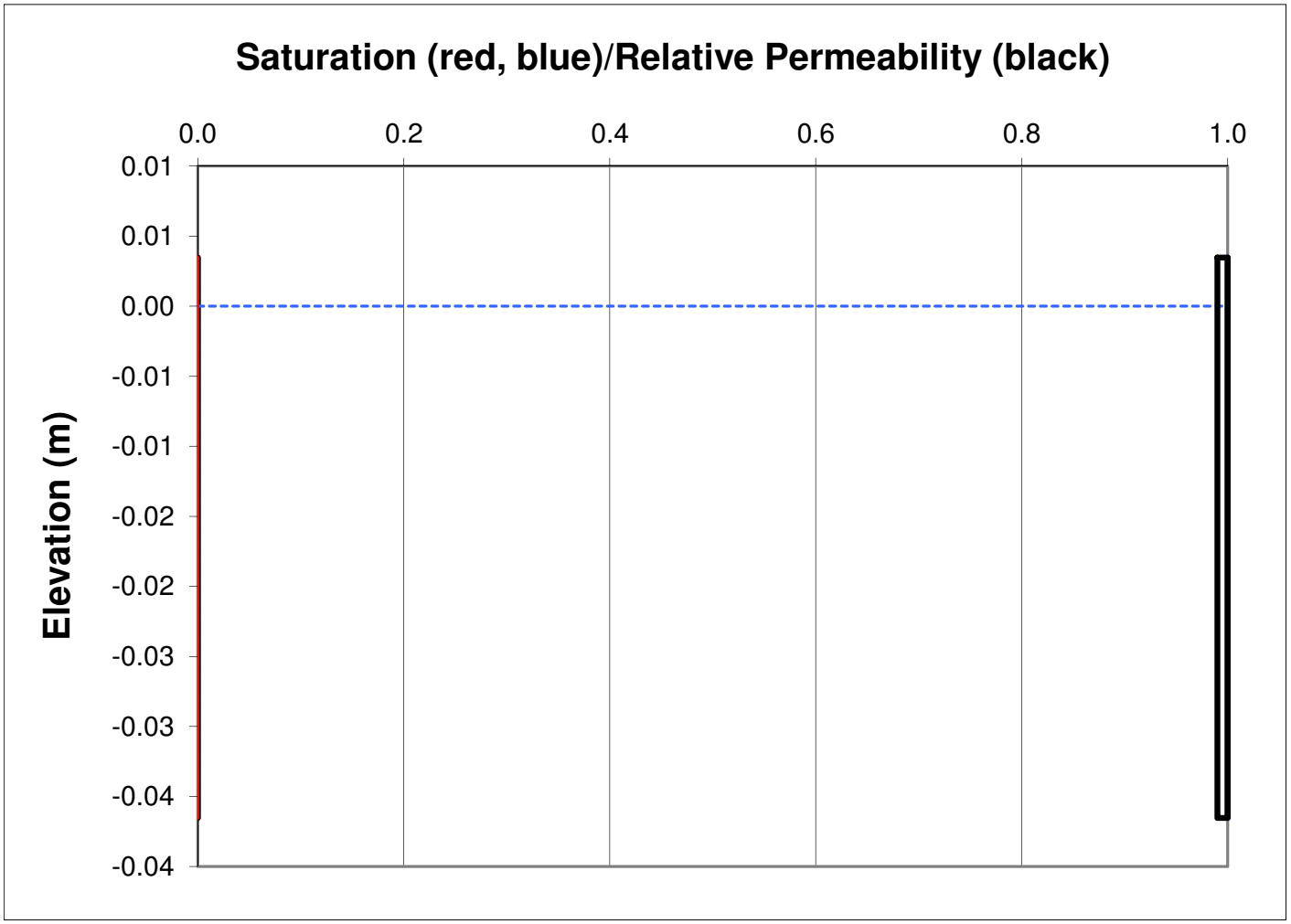
**Data for curve-fitting segments** — **Press Ctrl+Shift+S to calculate sheet**

| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | **Gauged May 2011** | |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 0.000 | | | | | **AOI 8 / N-82** | |
| 0.005 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.021 | 0.000 | 0.000 | 0.0046 | 0.000002 | 0.0046 | 0.000002 | 0.001 | Eps-Do |
| 0.040 | 0.000 | 0.000 | 0.0176 | 0.000010 | 0.0175 | 0.000010 | 0.001 | Eps-kro |



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.040 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = 2.144E-07 | $k_{ro}$ = | 2.299E-07 | AOI 8 / N-82 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.244 |

Gauged May 2011

**AOI 8 / N-113**

0.800 feet

| Soil Characteristic | | **SP** |
|---|---|---|
| n = | 0.426 | porosity |
| N = | 1.980 | van Genuchten "N" |
| $\alpha$ = | 1.350 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.321 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

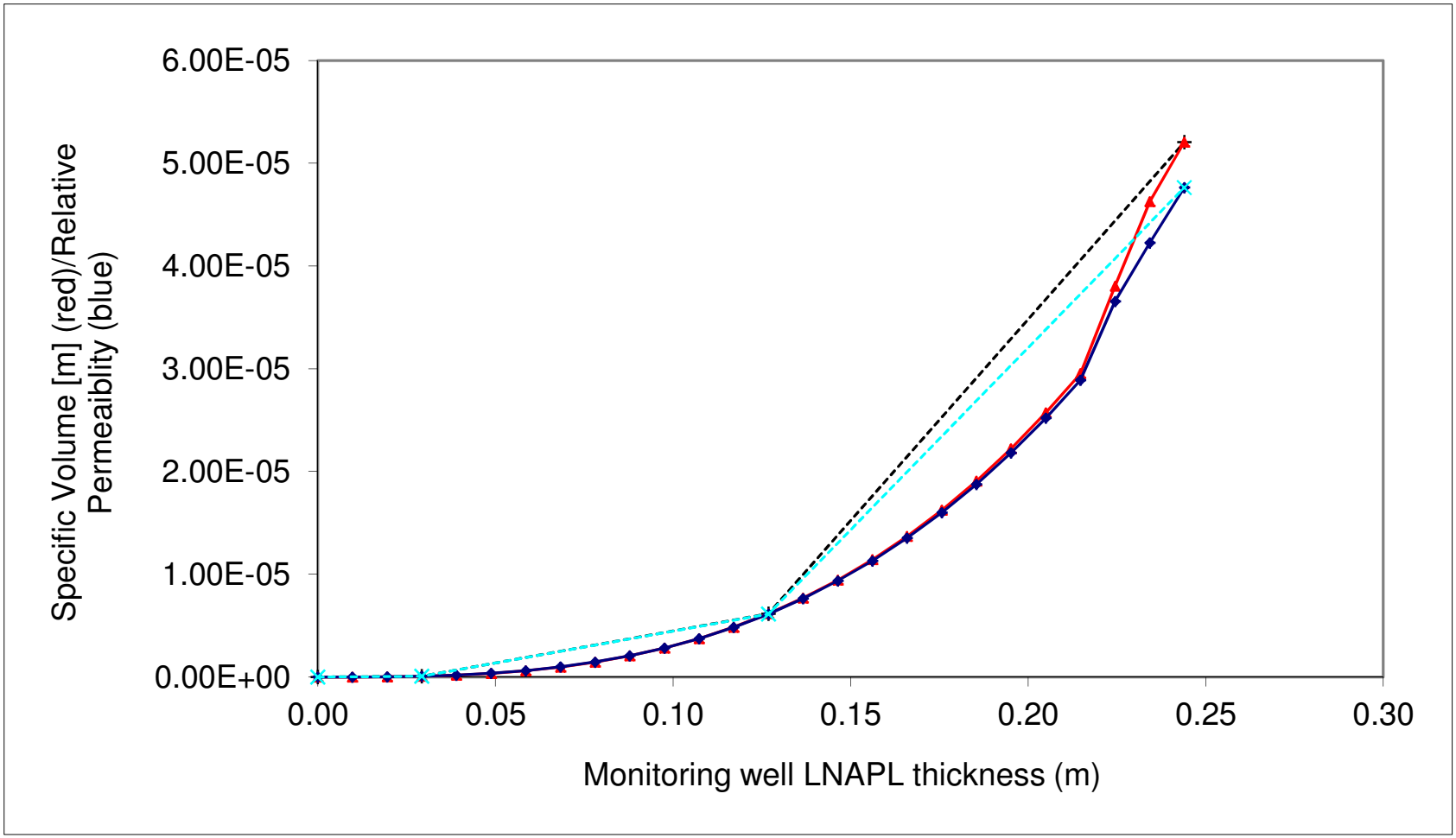
| Fluid Characteristics: | | **Residual Oil** |
|---|---|---|
| $\rho_o$ = | 0.917 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.495 | van Genuchten "M" |
| $\alpha_{ao}$ = | 2.506 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.242 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.020 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.224 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.040 | maximum free-product elevation |
| $\lambda$ = | 0.738 | pore-size distribution index |
| $\Psi_b$ = | 0.461 | B-C displacement pressure head [m] |

**Press Ctrl+Shift+S to calculate sheet**

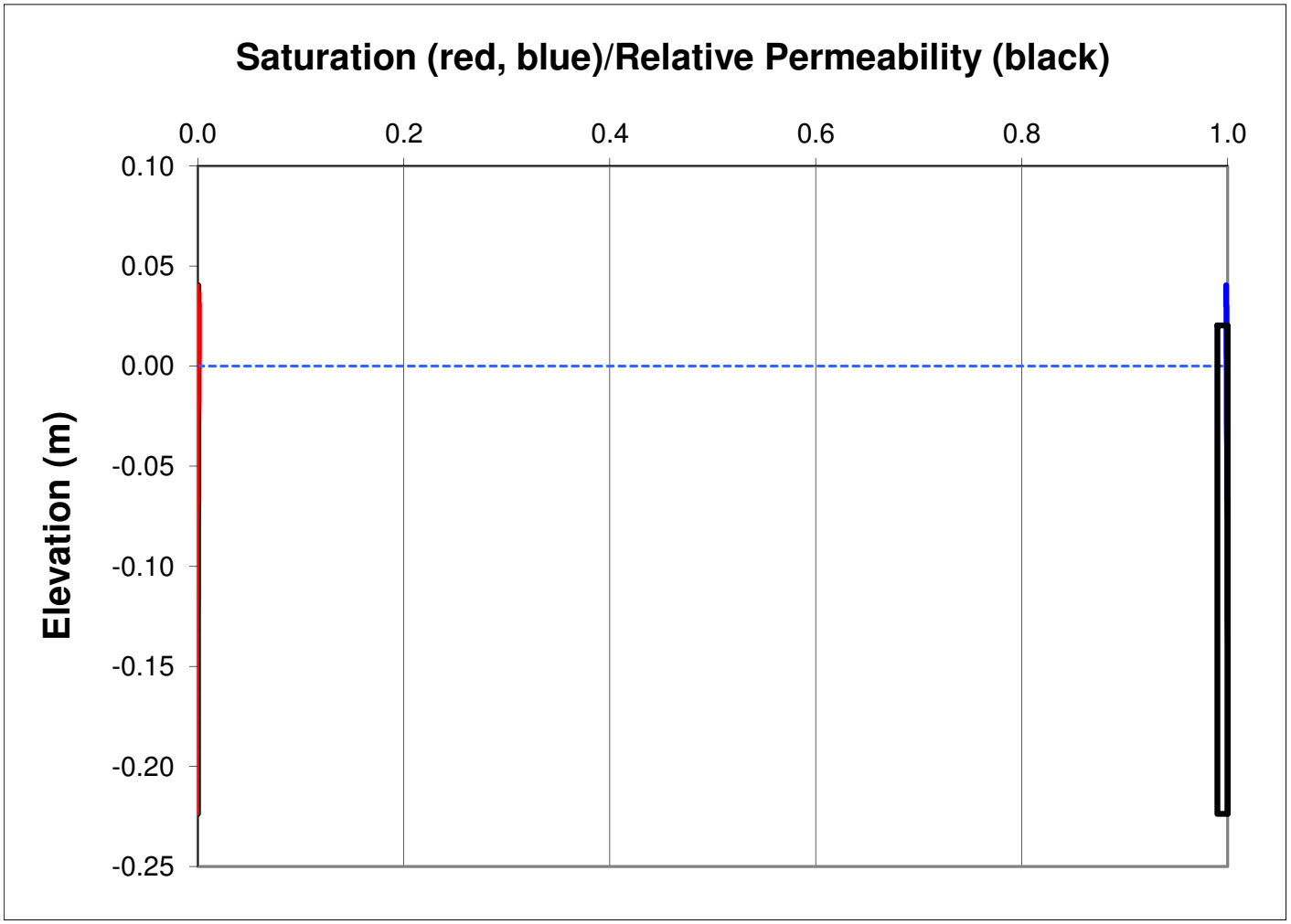
**Data for curve-fitting segments** — **Press Ctrl+Shift+S to calculate sheet**

| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | **Gauged May 2011** | |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 0.000 | | | | | **AOI 8 / N-113** | |
| 0.029 | 0.000 | 0.000 | 0.0000 | 0.000003 | 0.0000 | 0.000003 | | |
| 0.127 | 0.000 | 0.000 | 0.0280 | 0.000062 | 0.0280 | 0.000062 | 0.001 | Eps-Do |
| 0.244 | 0.000 | 0.000 | 0.1112 | 0.000392 | 0.1096 | 0.000354 | 0.001 | Eps-kro |



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.244 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 5.205E-05 | $k_{ro}$ = 4.765E-05 | AOI 8 / N-113 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.469 |

Gauged May 2011

**AOI 8 / PZ-502**

1.540 feet

| Soil Characteristic | | |
|---|---|---|
| | | **SP** |
| n = | 0.426 | porosity |
| N = | 1.980 | van Genuchten "N" |
| $\alpha$ = | 1.350 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.321 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | |
|---|---|---|
| | | **Residual Oil** |
| $\rho_o$ = | 0.916 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.495 | van Genuchten "M" |
| $\alpha_{ao}$ = | 2.503 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.246 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.040 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.429 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.090 | maximum free-product elevation |
| $\lambda$ = | 0.738 | pore-size distribution index |
| $\Psi_b$ = | 0.461 | B-C displacement pressure head [m] |

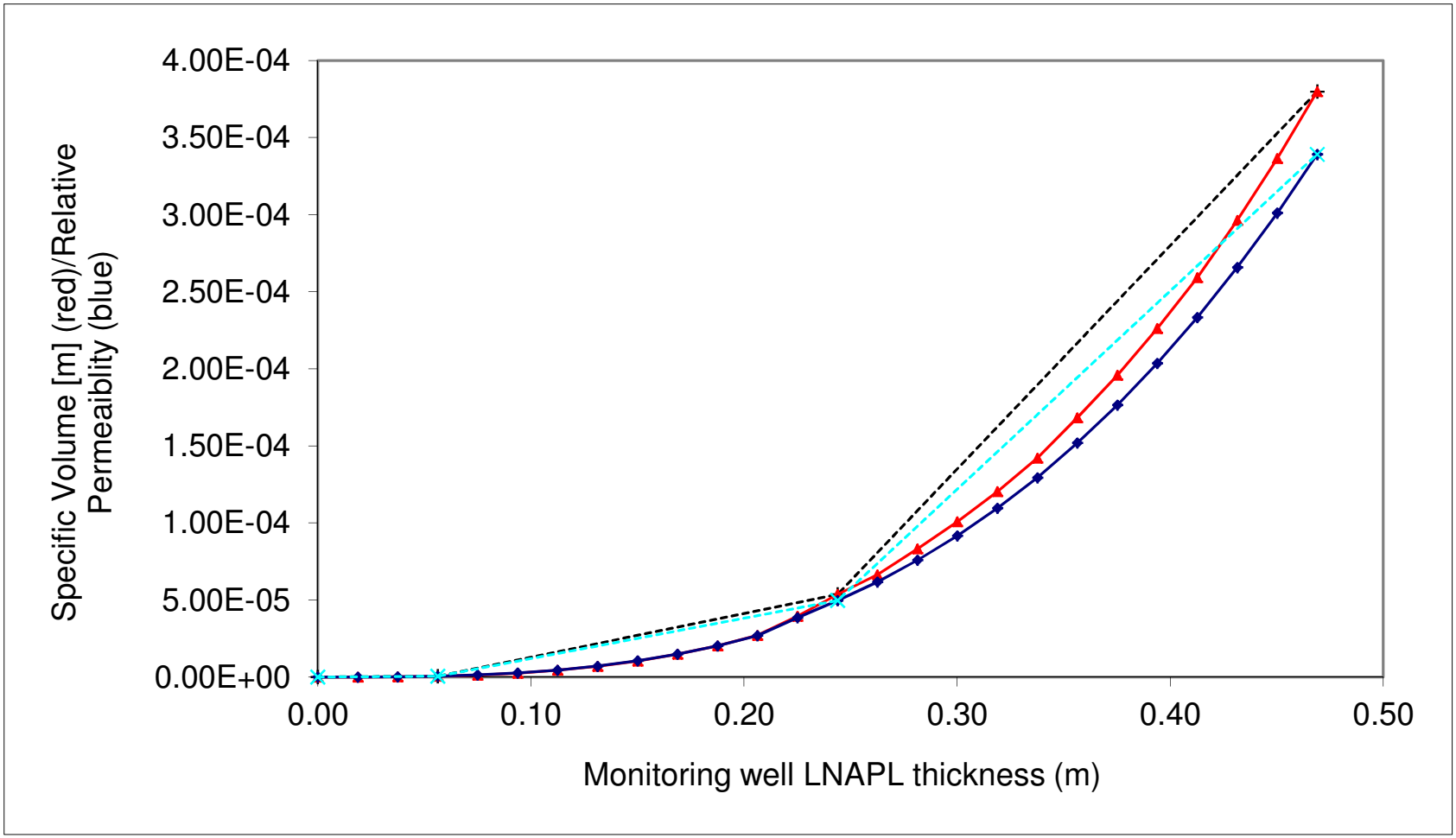
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.056 | 0.000 | 0.000 | 0.0000 | 0.000010 | 0.0000 | 0.000010 | | |
| 0.244 | 0.000 | 0.000 | 0.0543 | 0.000282 | 0.0541 | 0.000262 | 0.001 | Eps-Do |
| 0.469 | 0.000 | 0.000 | 0.2069 | 0.001449 | 0.2052 | 0.001285 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

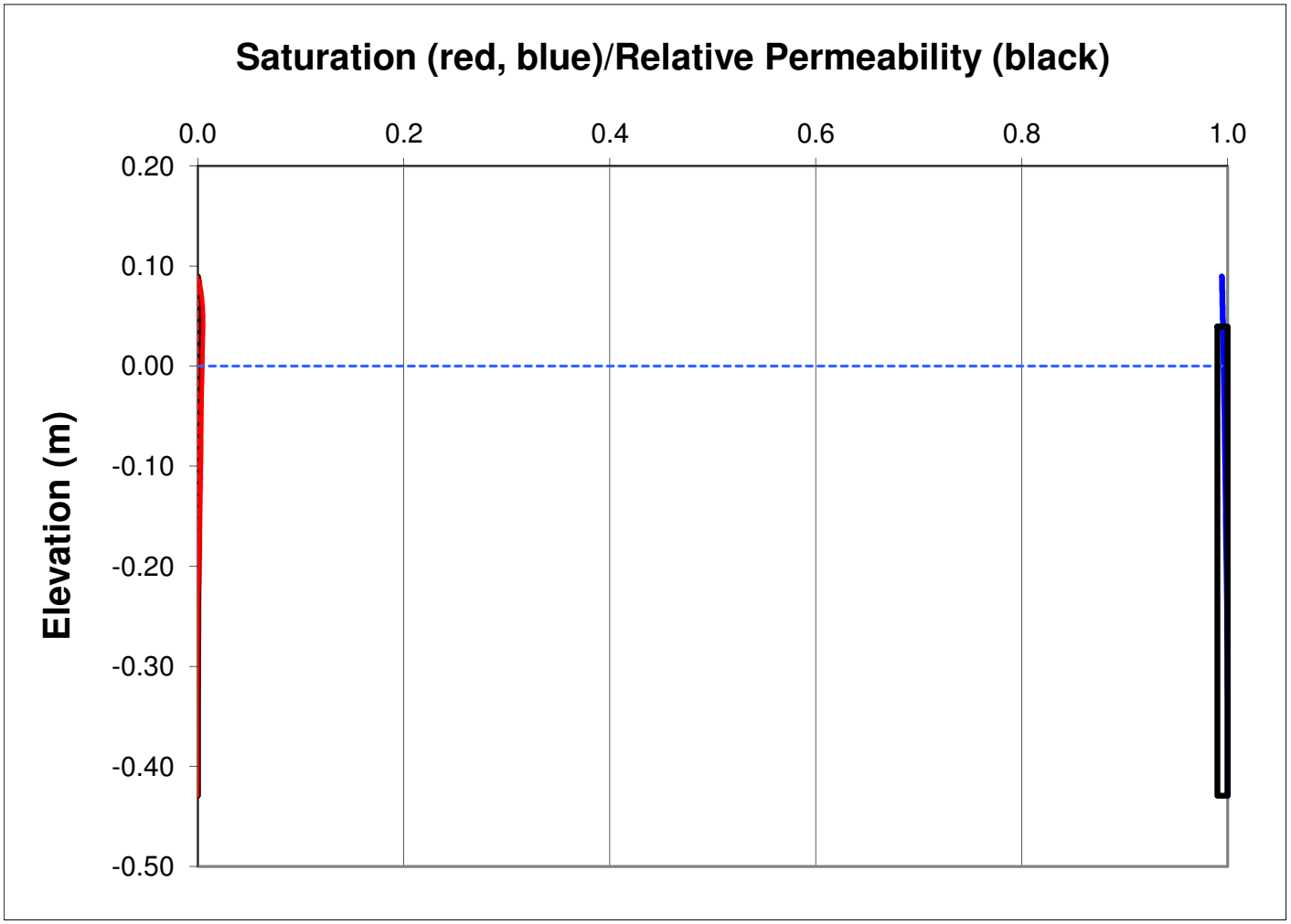
**Gauged May 2011**

**AOI 8 / PZ-502**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.469 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 3.798E-04 | $k_{ro}$ = 3.391E-04 | AOI 8 / PZ-502 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.006 |

Gauged May 2011

**AOI 8 / N-68**

0.020 feet

| Soil Characteristic | | **SM** |
|---|---|---|
| n = | 0.428 | porosity |
| N = | 2.160 | van Genuchten "N" |
| $\alpha$ = | 2.750 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.313 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Middle Distillate** |
|---|---|---|
| $\rho_o$ = | 0.921 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 26.900 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 22.300 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.537 | van Genuchten "M" |
| $\alpha_{ao}$ = | 6.121 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.632 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.000 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.006 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.000 | maximum free-product elevation |
| $\lambda$ = | 0.841 | pore-size distribution index |
| $\Psi_b$ = | 0.227 | B-C displacement pressure head [m] |

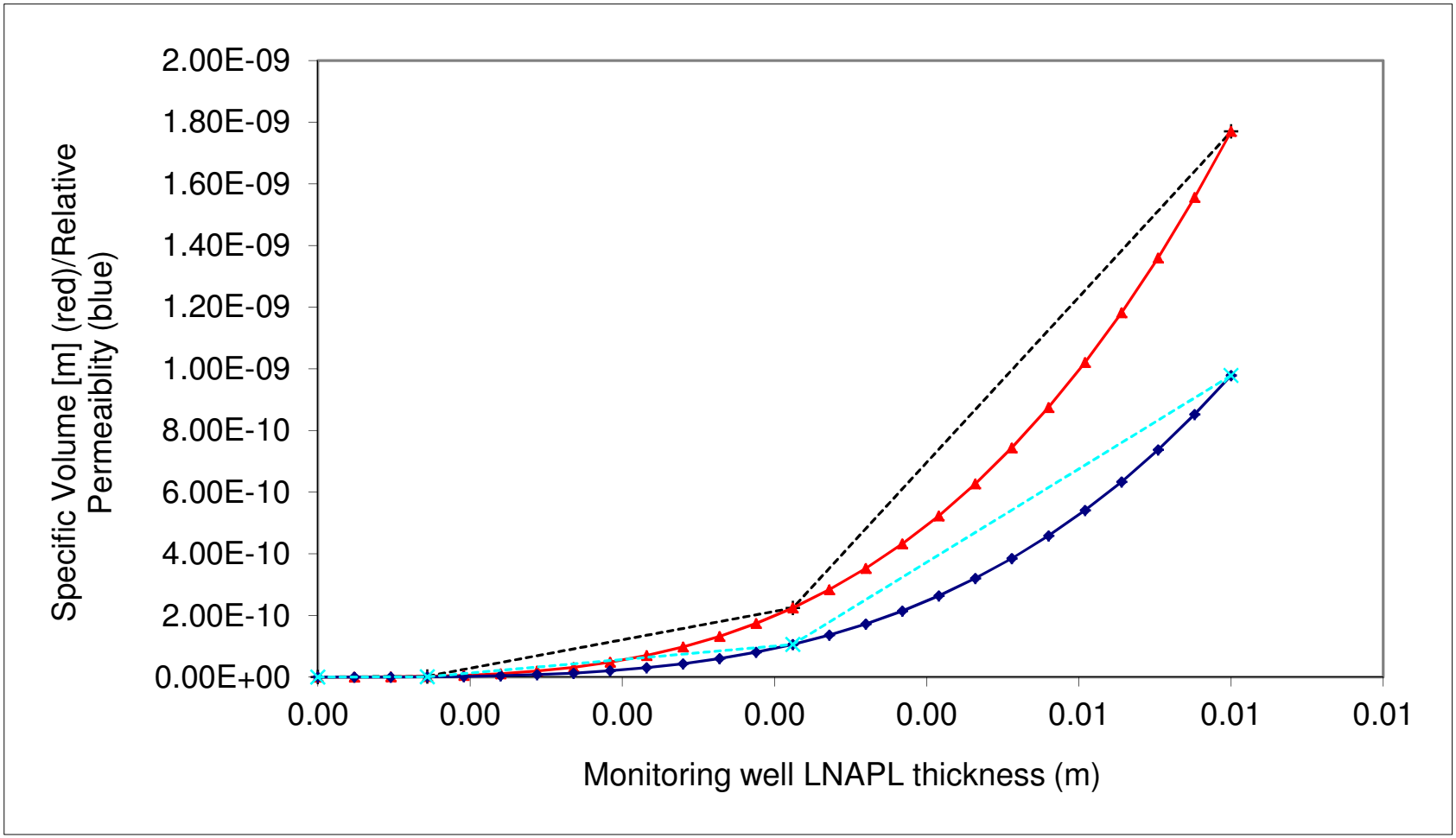
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.001 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.003 | 0.000 | 0.000 | 0.0007 | 0.000000 | 0.0007 | 0.000000 | 0.001 | Eps-Do |
| 0.006 | 0.000 | 0.000 | 0.0027 | 0.000001 | 0.0028 | 0.000000 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

**Gauged May 2011**

**AOI 8 / N-68**

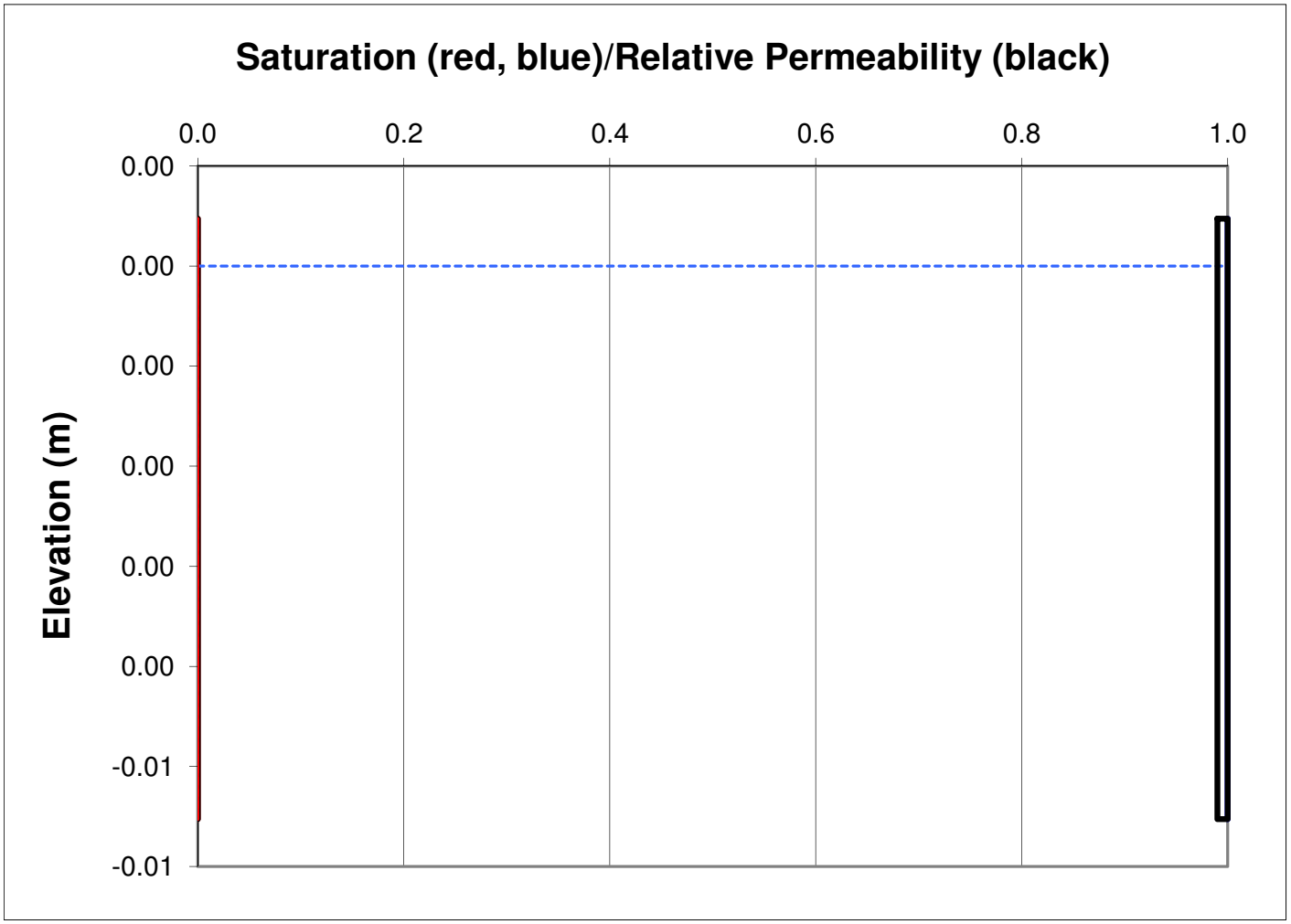


| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.006 |
|---|---|---|---|
| | $D_o$ = 1.770E-09 | $k_{ro}$ = | 9.782E-10 |

**Gauged May 2011**

**AOI 8 / N-68**

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.076 |

Gauged May 2011

**AOI 8 / N-23**

0.250 feet

| Soil Characteristic | | |
|---|---|---|
| | | **SM** |
| n = | 0.428 | porosity |
| N = | 2.160 | van Genuchten "N" |
| $\alpha$ = | 2.750 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.313 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | |
|---|---|---|
| | | **Middle Distillate** |
| $\rho_o$ = | 0.921 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 26.900 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 22.300 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.537 | van Genuchten "M" |
| $\alpha_{ao}$ = | 6.121 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.632 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.006 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.070 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.006 | maximum free-product elevation |
| $\lambda$ = | 0.841 | pore-size distribution index |
| $\Psi_b$ = | 0.227 | B-C displacement pressure head [m] |

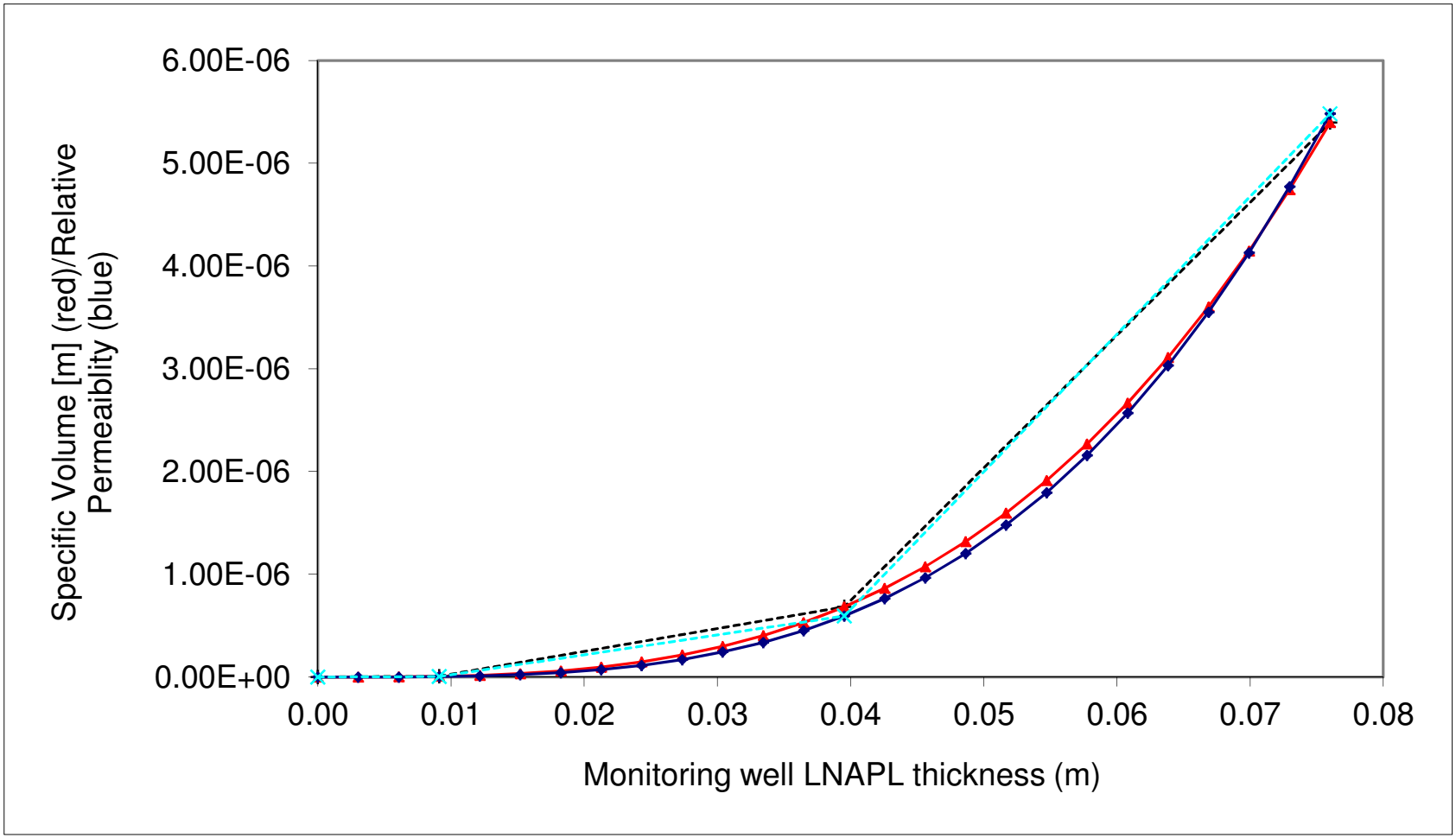
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.009 | 0.000 | 0.000 | 0.0000 | 0.000001 | 0.0000 | 0.000000 | | |
| 0.040 | 0.000 | 0.000 | 0.0088 | 0.000022 | 0.0089 | 0.000019 | 0.001 | Eps-Do |
| 0.076 | 0.000 | 0.000 | 0.0342 | 0.000129 | 0.0351 | 0.000134 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

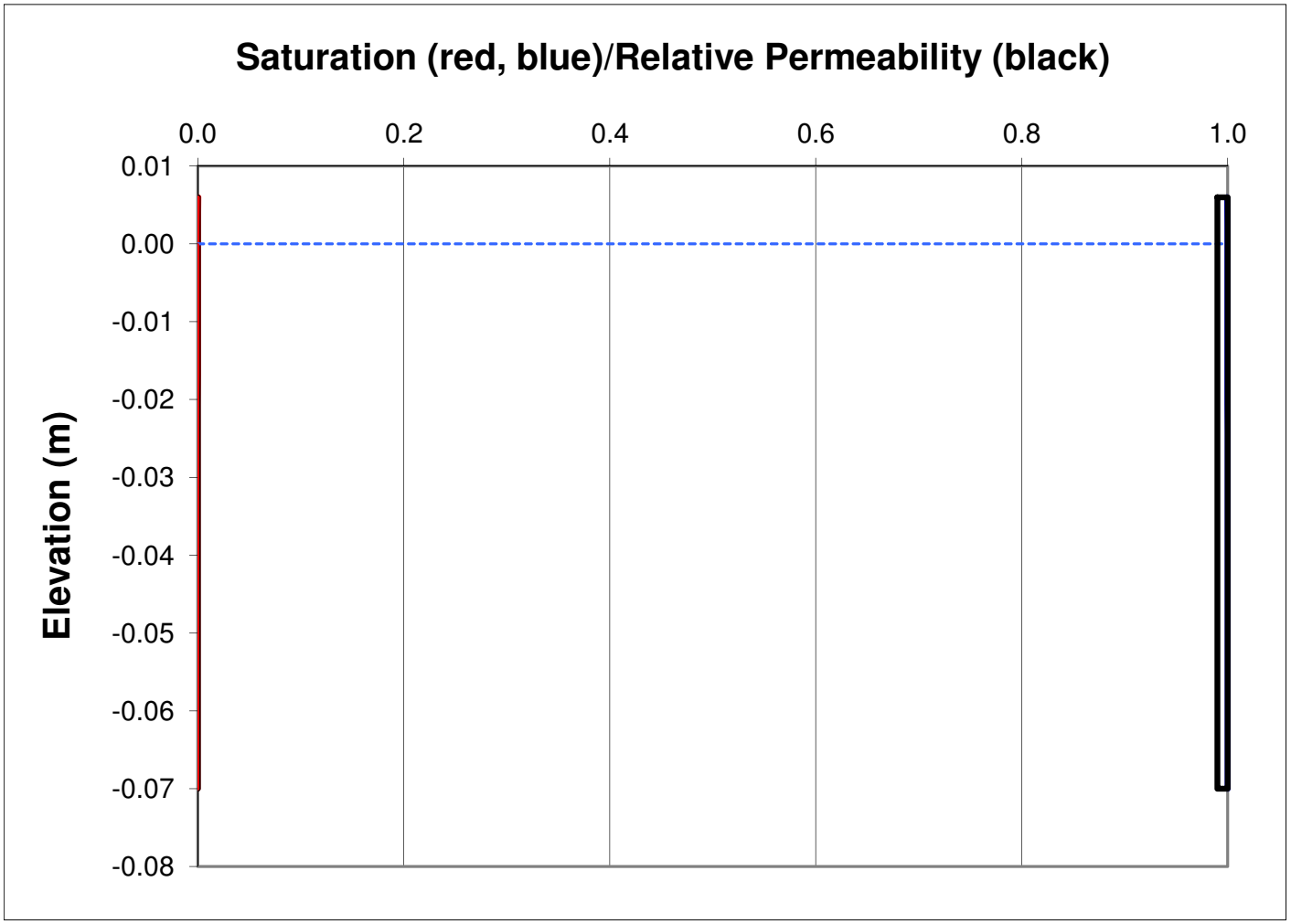
**Gauged May 2011**

**AOI 8 / N-23**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.076 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 5.395E-06 | $k_{ro}$ = 5.481E-06 | AOI 8 / N-23 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.137 |

Gauged May 2011

**AOI 8 / N-31**

0.450 feet

| Soil Characteristic | | **SP** |
|---|---|---|
| n = | 0.426 | porosity |
| N = | 1.980 | van Genuchten "N" |
| $\alpha$ = | 1.350 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.321 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Lube Oil** |
|---|---|---|
| $\rho_o$ = | 0.902 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 21.000 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 50.000 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.495 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.767 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.173 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.013 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.124 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.013 | maximum free-product elevation |
| $\lambda$ = | 0.738 | pore-size distribution index |
| $\Psi_b$ = | 0.461 | B-C displacement pressure head [m] |

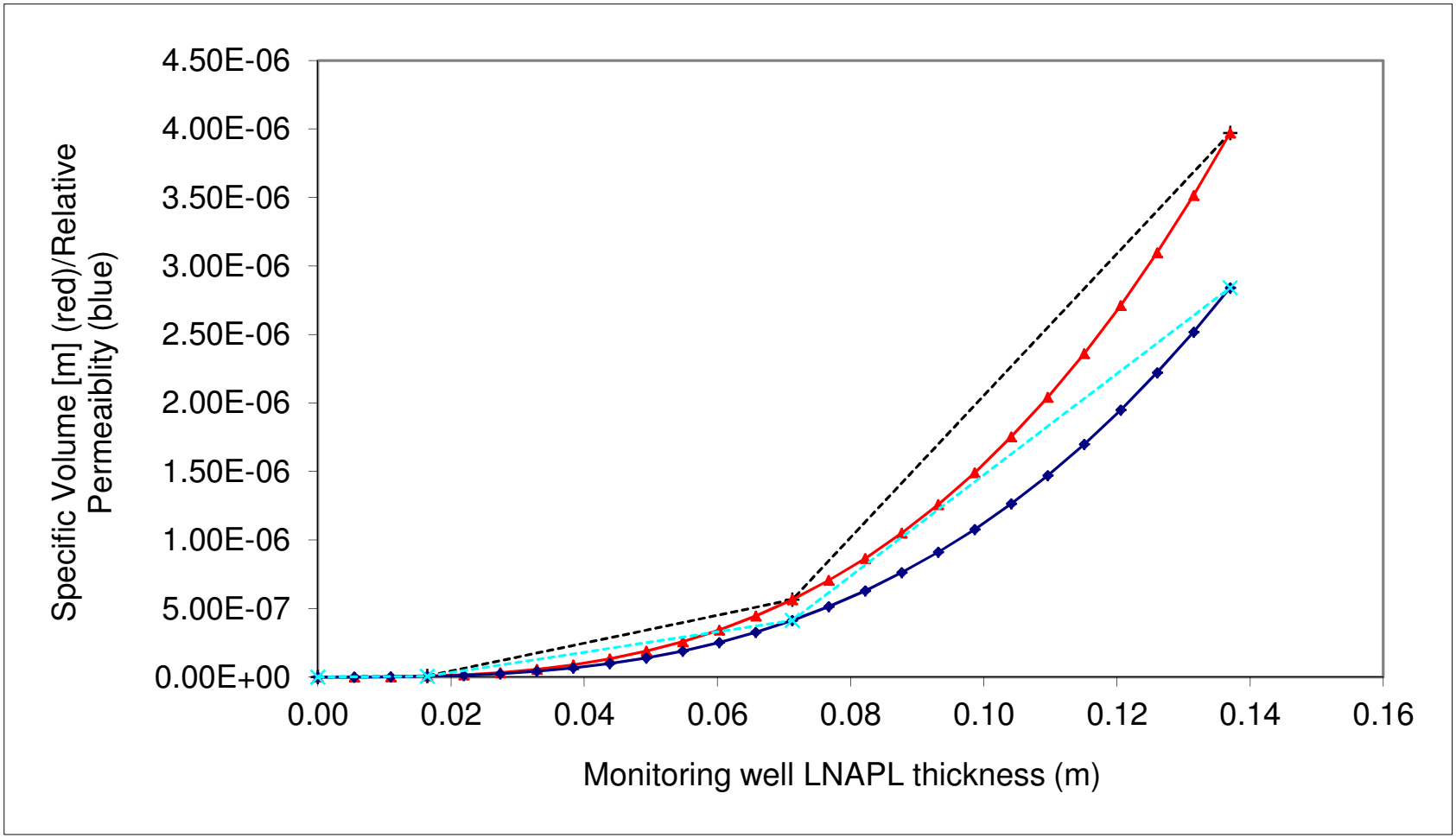
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.016 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.071 | 0.000 | 0.000 | 0.0157 | 0.000010 | 0.0157 | 0.000007 | 0.001 | Eps-Do |
| 0.137 | 0.000 | 0.000 | 0.0603 | 0.000052 | 0.0601 | 0.000037 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

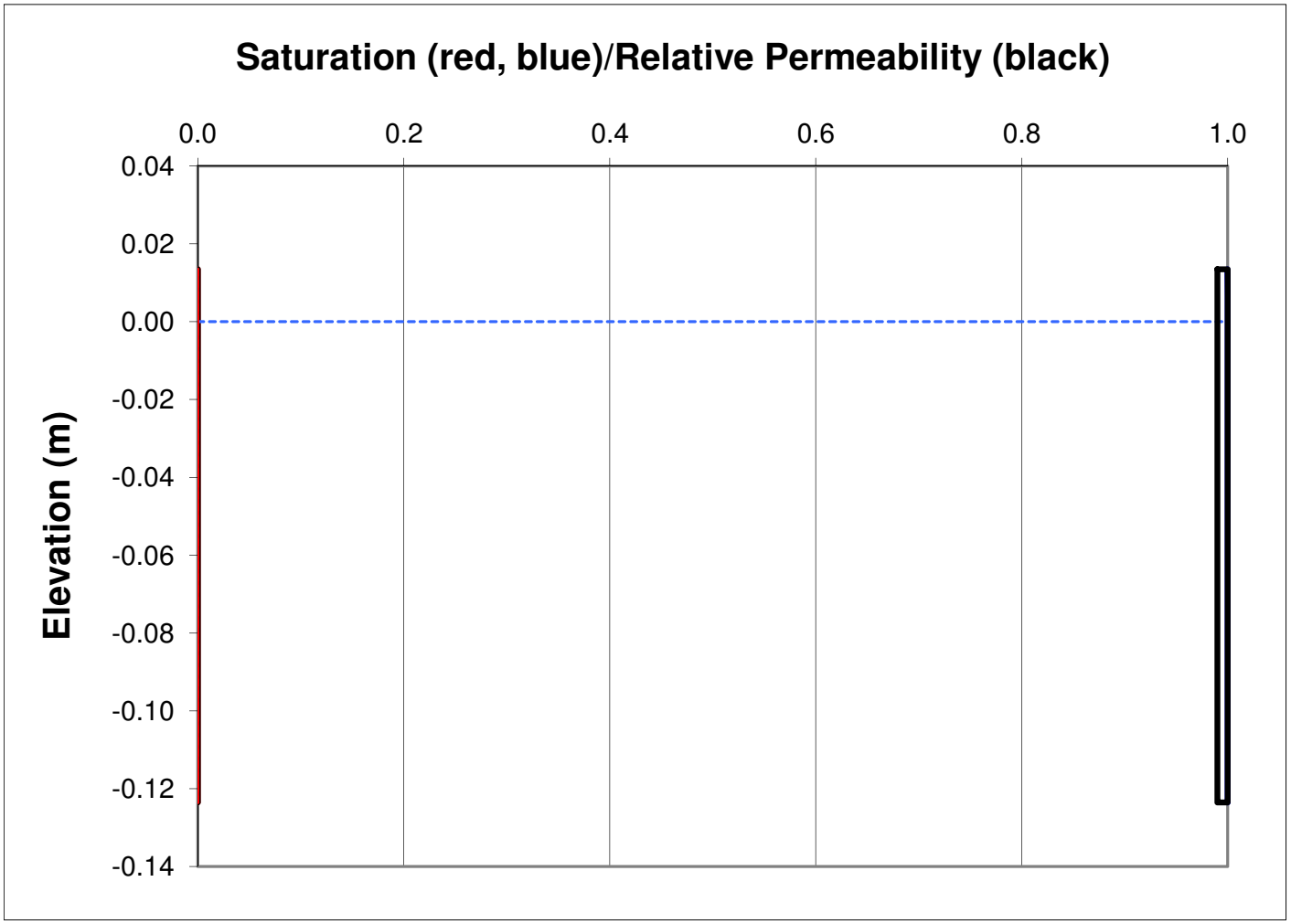
**Gauged May 2011**

**AOI 8 / N-31**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.137 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 3.970E-06 | $k_{ro}$ = 2.841E-06 | AOI 8 / N-31 |

**Press Ctrl+Shift+S to calculate sheet**



# *van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability*

**Enter Data in Yellow Region**

| **Maximum Monitoring Well LNAPL Thickness (meters)** | | Gauged May 2011 |
|---|---|---|
| $b_o$ = | 0.366 | **AOI 8 / PZ-204** 1.200 feet |

| **Soil Characteristic** | | **SP** |
|---|---|---|
| n = | 0.426 | porosity |
| N = | 1.980 | van Genuchten "N" |
| $\alpha$ = | 1.350 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.321 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

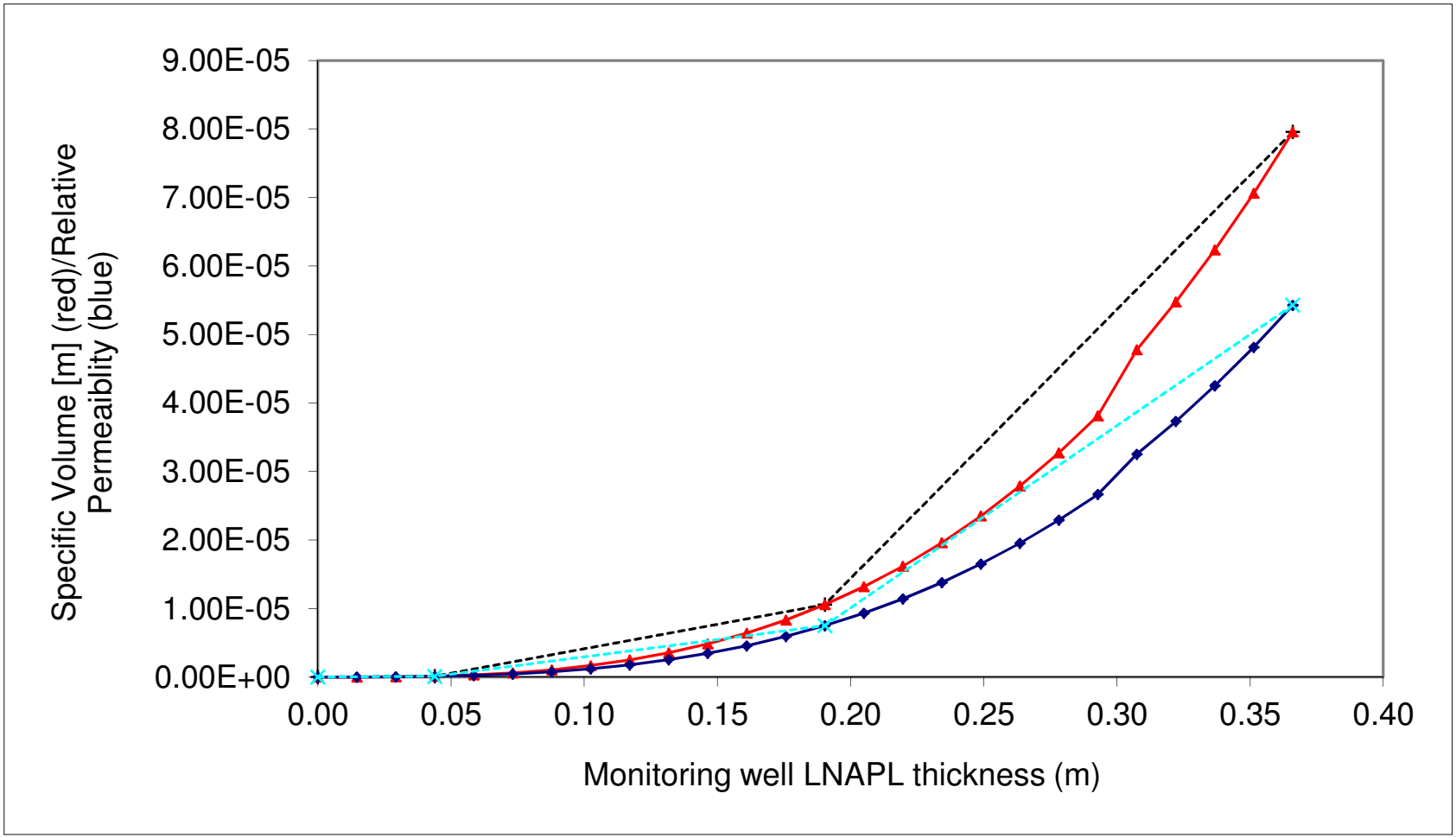
| **Fluid Characteristics:** | | **Lube Oil** |
|---|---|---|
| $\rho_o$ = | 0.902 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 21.000 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 50.000 | oil/water (dynes/cm) |

| **Calculated Parameters** | | |
|---|---|---|
| M = | 0.495 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.767 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.173 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.036 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.330 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.046 | maximum free-product elevation |
| $\lambda$ = | 0.738 | pore-size distribution index |
| $\Psi_b$ = | 0.461 | B-C displacement pressure head [m] |

**Press Ctrl+Shift+S to calculate sheet**

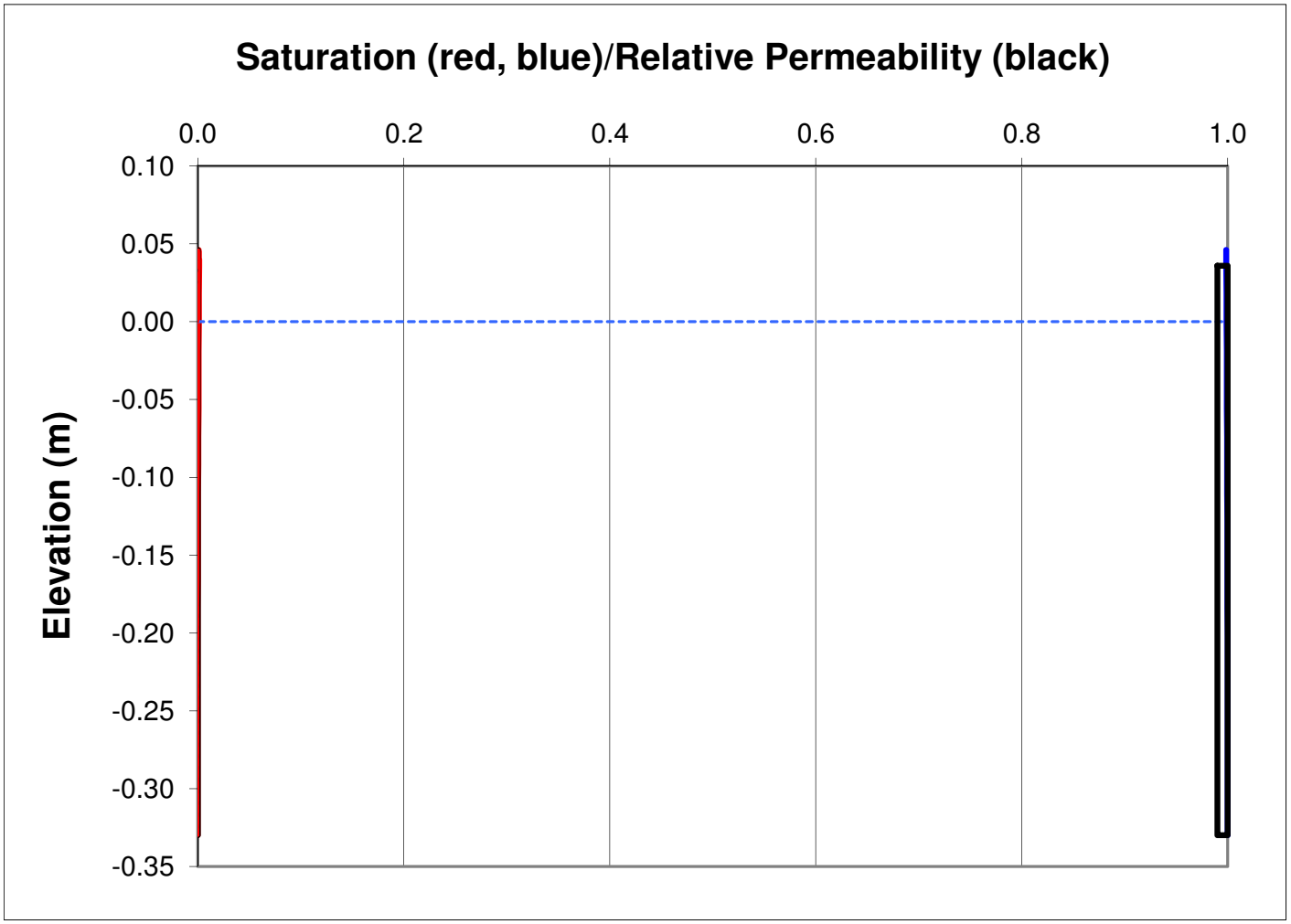
**Data for curve-fitting segments** — **Press Ctrl+Shift+S to calculate sheet**

| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | |
|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 0.000 | | | | | **Gauged May 2011** |
| 0.044 | 0.000 | 0.000 | 0.0000 | 0.000003 | 0.0000 | 0.000002 | **AOI 8 / PZ-204** |
| 0.190 | 0.000 | 0.000 | 0.0420 | 0.000071 | 0.0420 | 0.000050 | 0.001 Eps-Do |
| 0.366 | 0.000 | 0.000 | 0.1634 | 0.000393 | 0.1622 | 0.000266 | 0.001 Eps-kro |



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.366 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 7.956E-05 | $k_{ro}$ = 5.426E-05 | AOI 8 / PZ-204 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.040 |

Gauged May 2011

**AOI 8 / N-48**

0.130 feet

| Soil Characteristic | | **SP** |
|---|---|---|
| n = | 0.426 | porosity |
| N = | 1.980 | van Genuchten "N" |
| $\alpha$ = | 1.350 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.321 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Lube Oil** |
|---|---|---|
| $\rho_o$ = | 0.905 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 21.000 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 50.000 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.495 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.781 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.167 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.004 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.036 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.004 | maximum free-product elevation |
| $\lambda$ = | 0.738 | pore-size distribution index |
| $\Psi_b$ = | 0.461 | B-C displacement pressure head [m] |

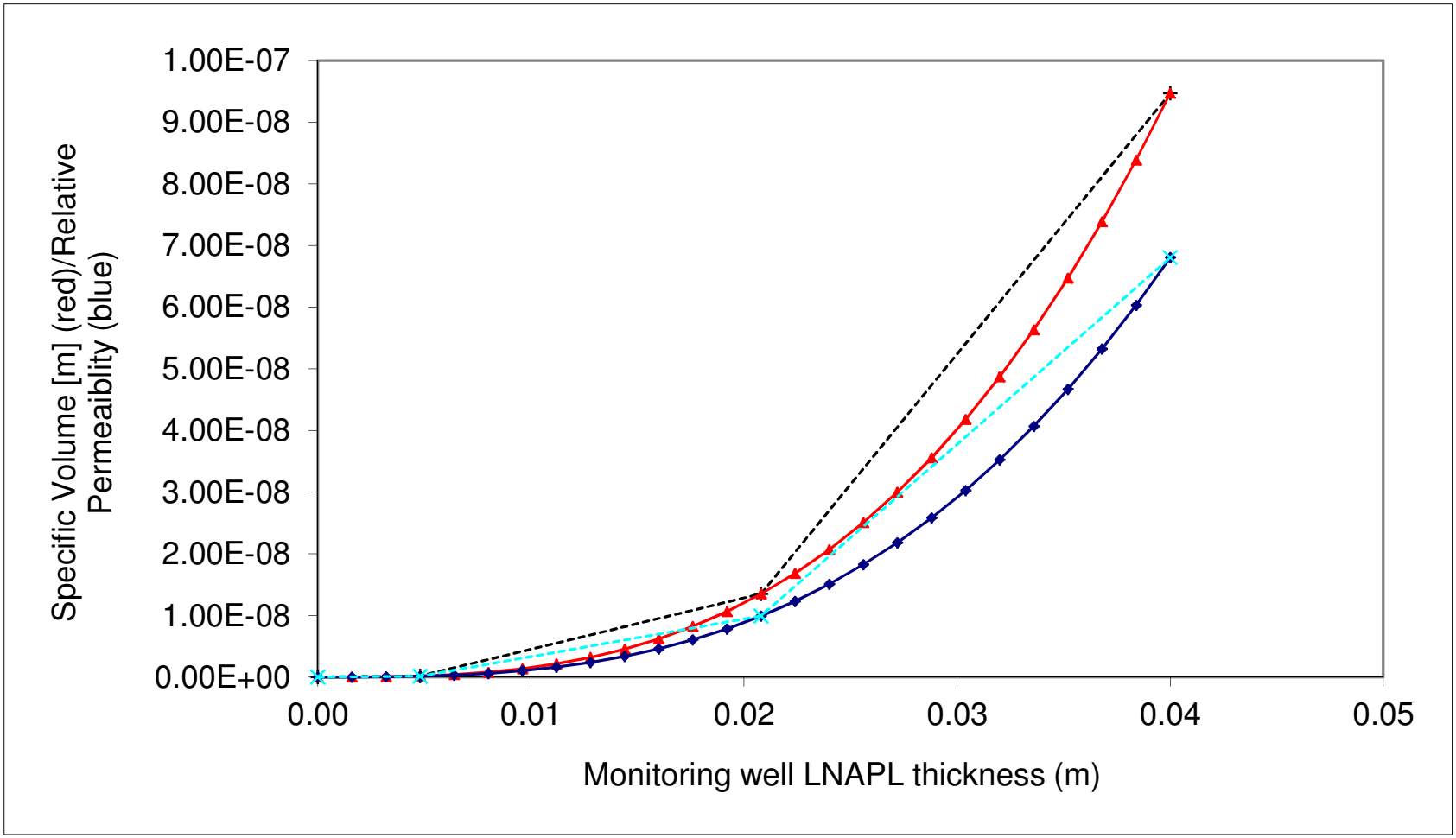
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.005 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.021 | 0.000 | 0.000 | 0.0046 | 0.000001 | 0.0046 | 0.000001 | 0.001 | Eps-Do |
| 0.040 | 0.000 | 0.000 | 0.0176 | 0.000004 | 0.0175 | 0.000003 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

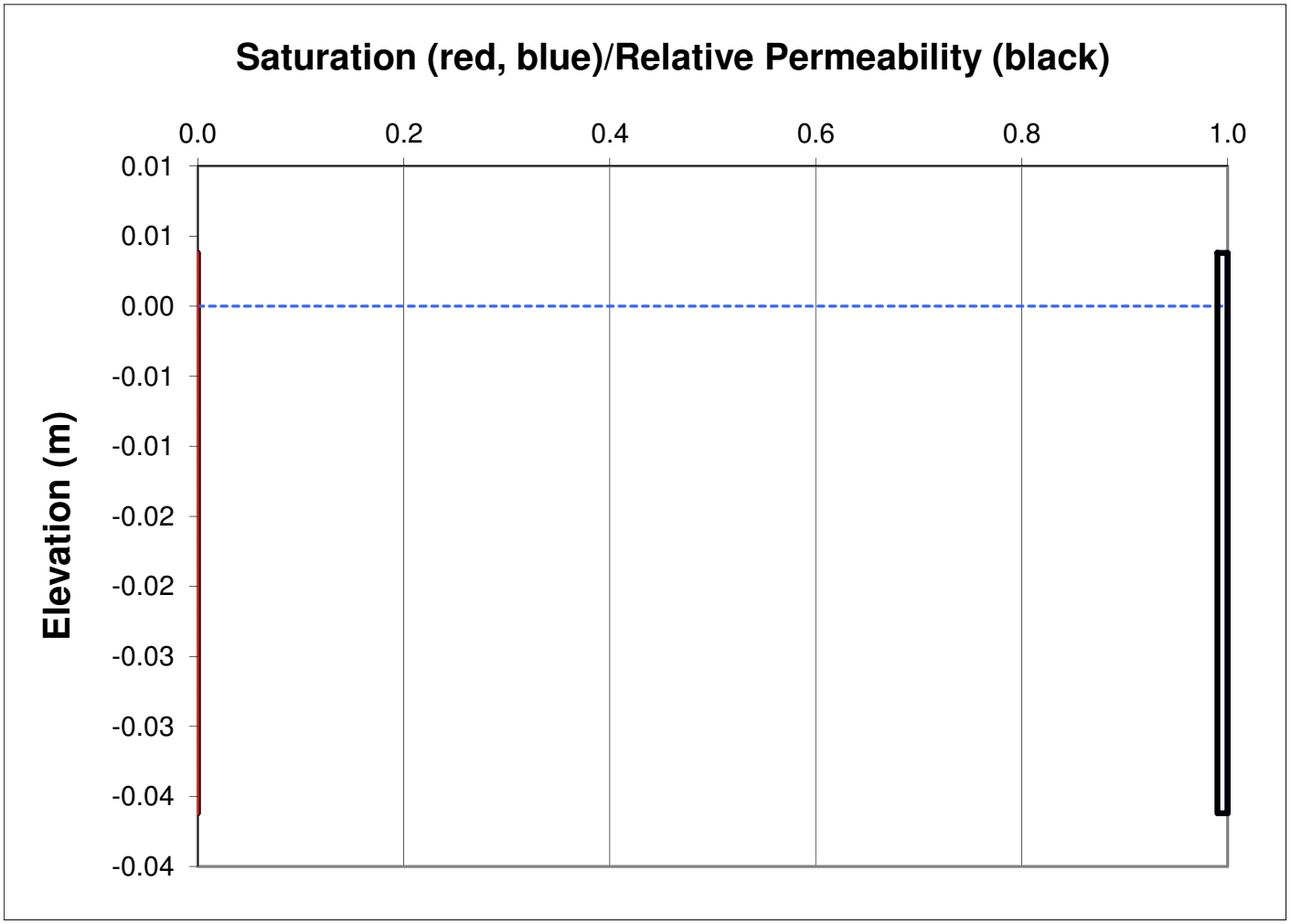
**Gauged May 2011**

**AOI 8 / N-48**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.040 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = 9.467E-08 | $k_{ro}$ = | 6.803E-08 | AOI 8 / N-48 |

**Press Ctrl+Shift+S to calculate sheet**



# *van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability*

**Enter Data in Yellow Region**

| **Maximum Monitoring Well LNAPL Thickness (meters)** | |
|---|---|
| $b_o$ = | 0.866 |

Gauged May 2011

**AOI 8 / RW-205**

2.840 feet

| **Soil Characteristic** | | **SP** |
|---|---|---|
| n = | 0.426 | porosity |
| N = | 1.980 | van Genuchten "N" |
| $\alpha$ = | 1.350 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.321 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| **Fluid Characteristics:** | | **Lube Oil** |
|---|---|---|
| $\rho_o$ = | 0.911 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 21.000 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 50.000 | oil/water (dynes/cm) |

| **Calculated Parameters** | | |
|---|---|---|
| M = | 0.495 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.808 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.156 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.077 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.789 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.117 | maximum free-product elevation |
| $\lambda$ = | 0.738 | pore-size distribution index |
| $\Psi_b$ = | 0.461 | B-C displacement pressure head [m] |

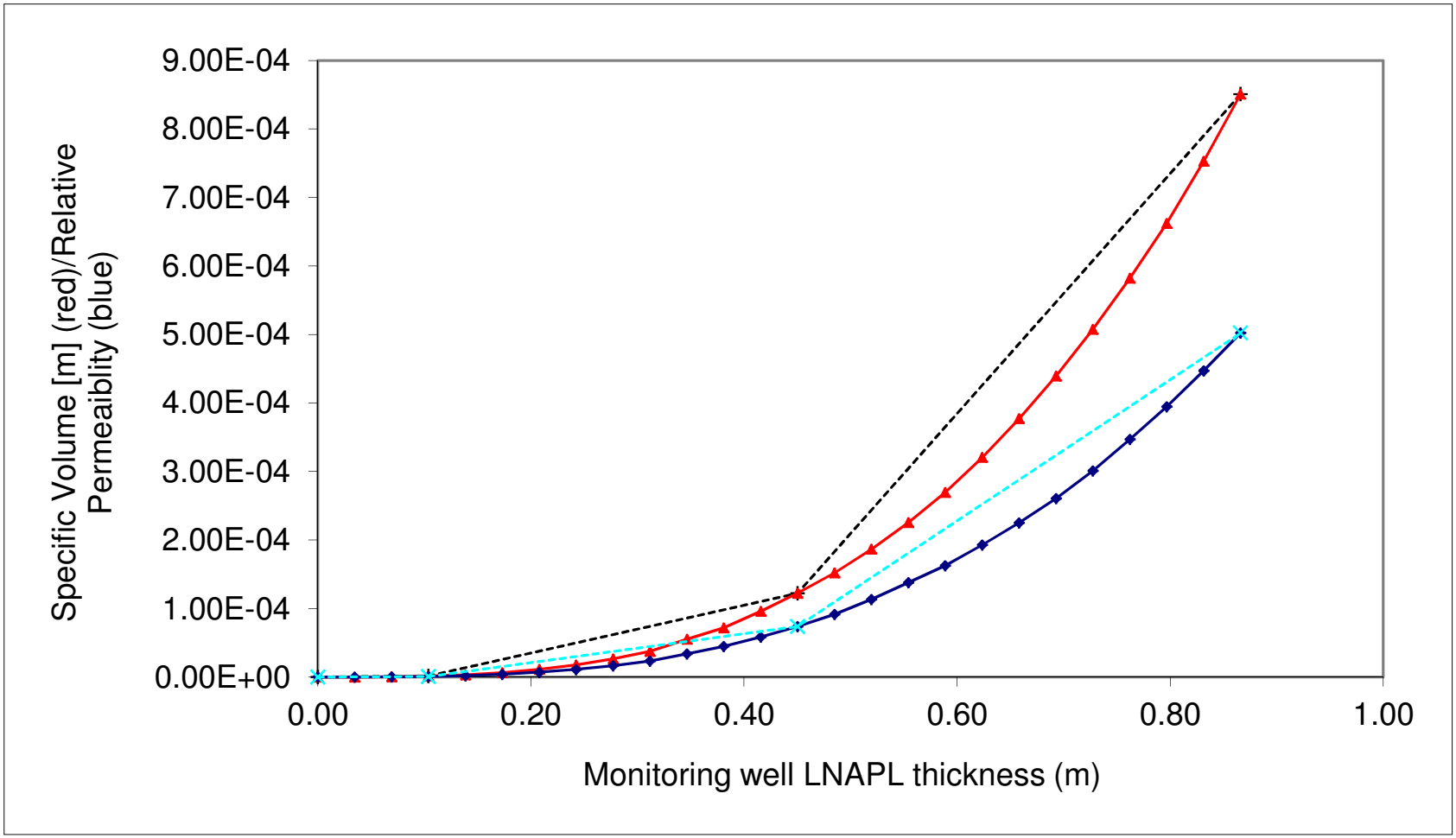
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.104 | 0.000 | 0.000 | 0.0000 | 0.000014 | 0.0000 | 0.000009 | | |
| 0.450 | 0.000 | 0.000 | 0.0998 | 0.000348 | 0.0996 | 0.000210 | 0.03 | Eps-Do |
| 0.866 | 0.001 | 0.001 | 0.3807 | 0.001753 | 0.3788 | 0.001031 | 0.03 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

**Gauged May 2011**

**AOI 8 / RW-205**

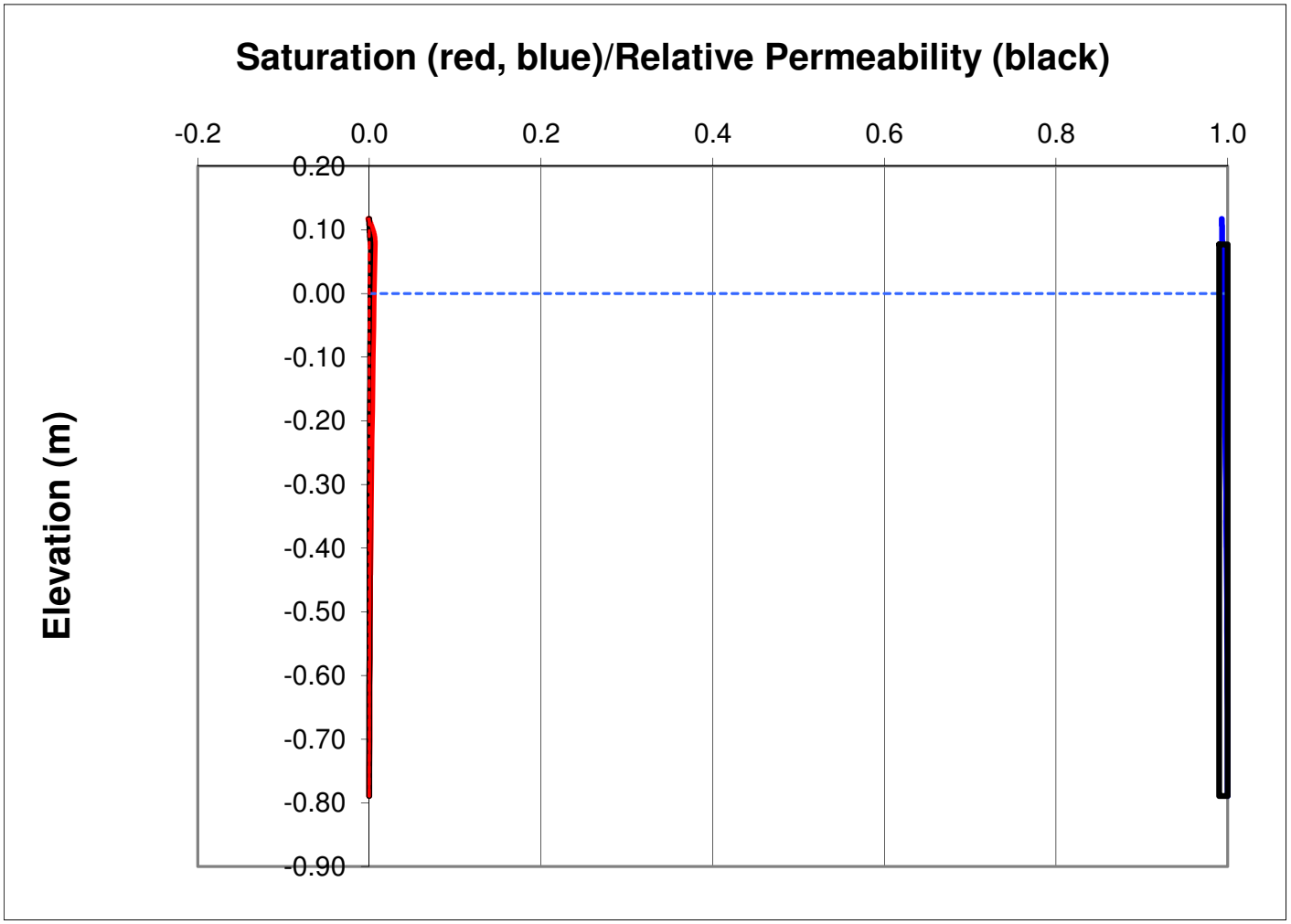


| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.866 |
|---|---|---|---|
| | $D_o$ = 8.507E-04 | $k_{ro}$ = | 5.021E-04 |

**Gauged May 2011**

**AOI 8 / RW-205**

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.003 |

Gauged May 2011

**AOI 8 / N-42**

0.010 feet

| Soil Characteristic | | **SP** |
|---|---|---|
| n = | 0.426 | porosity |
| N = | 1.980 | van Genuchten "N" |
| $\alpha$ = | 1.350 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.321 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Lube Oil** |
|---|---|---|
| $\rho_o$ = | 0.890 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 26.900 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 22.300 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.495 | van Genuchten "M" |
| $\alpha_{ao}$ = | 2.903 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.433 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.000 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.003 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.000 | maximum free-product elevation |
| $\lambda$ = | 0.738 | pore-size distribution index |
| $\Psi_b$ = | 0.461 | B-C displacement pressure head [m] |

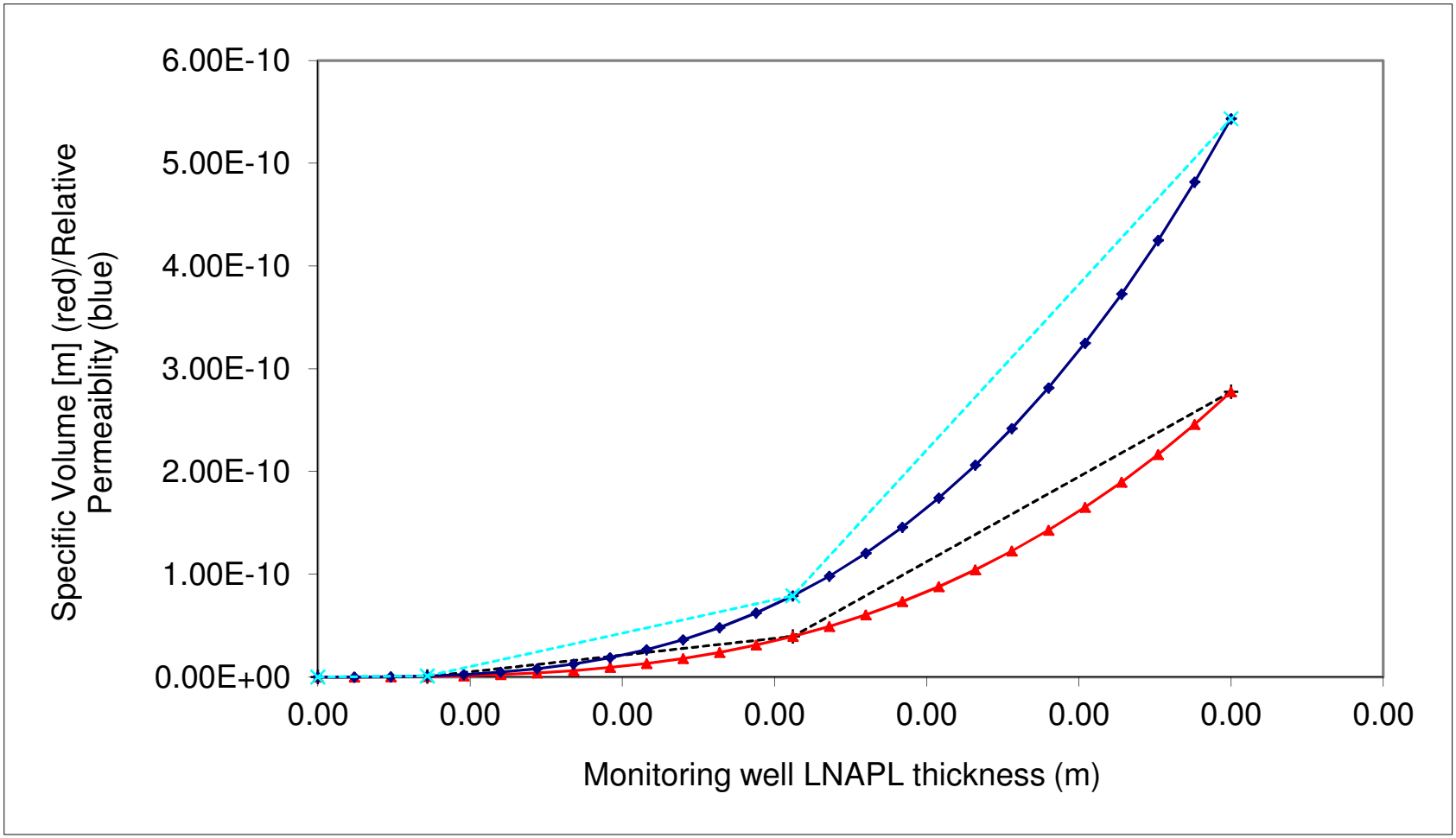
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.000 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.002 | 0.000 | 0.000 | 0.0003 | 0.000000 | 0.0003 | 0.000000 | 0.001 | Eps-Do |
| 0.003 | 0.000 | 0.000 | 0.0013 | 0.000000 | 0.0013 | 0.000000 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

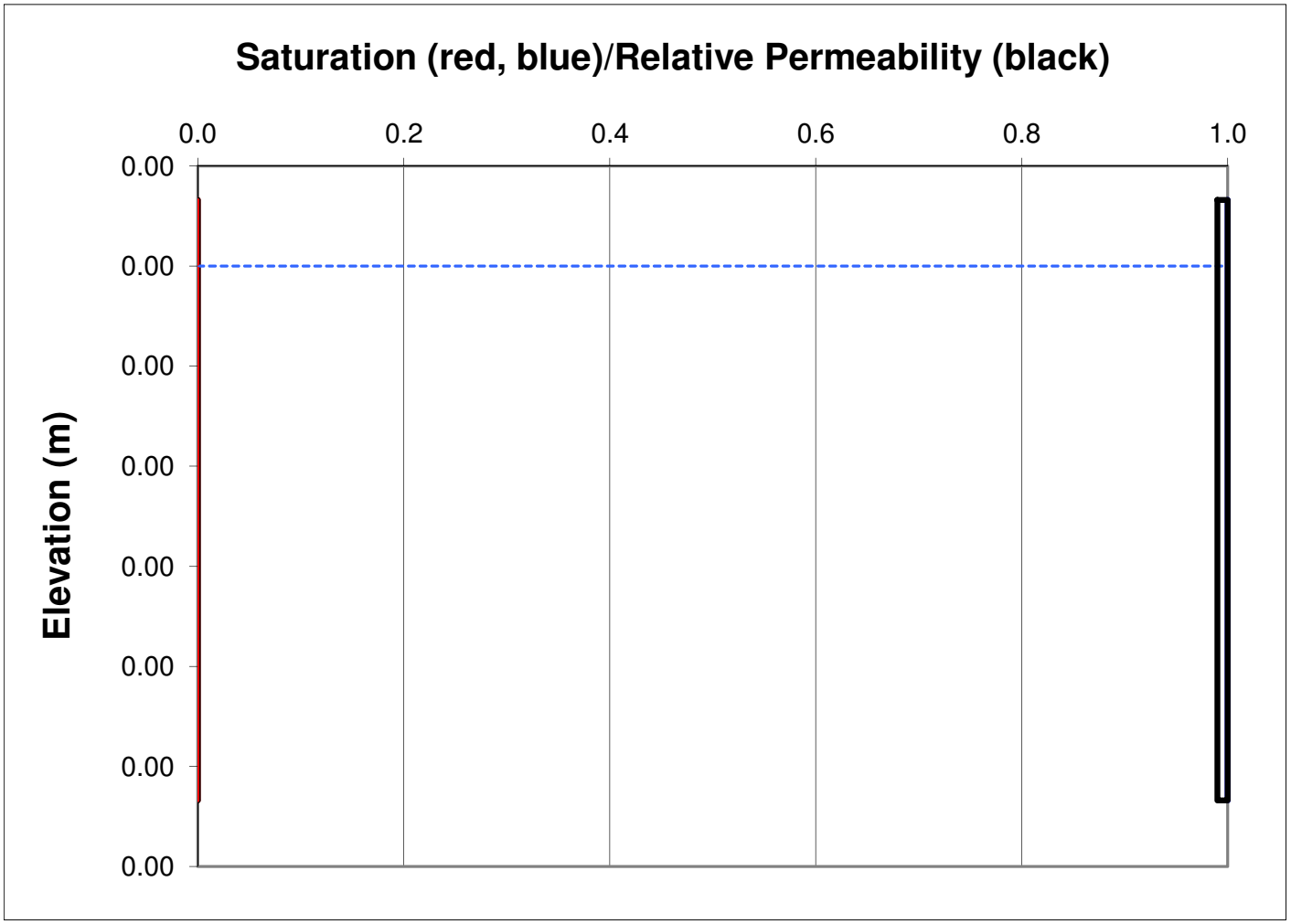
**Gauged May 2011**

**AOI 8 / N-42**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.003 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 2.776E-10 | $k_{ro}$ = 5.434E-10 | AOI 8 / N-42 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.003 |

Gauged May 2011

**AOI 8 / N-42**

0.010 feet

| Soil Characteristic | | **SP** |
|---|---|---|
| n = | 0.426 | porosity |
| N = | 1.980 | van Genuchten "N" |
| $\alpha$ = | 1.350 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.321 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Lube Oil** |
|---|---|---|
| $\rho_o$ = | 0.890 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 26.900 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 22.300 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.495 | van Genuchten "M" |
| $\alpha_{ao}$ = | 2.903 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.433 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.000 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.003 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.000 | maximum free-product elevation |
| $\lambda$ = | 0.738 | pore-size distribution index |
| $\Psi_b$ = | 0.461 | B-C displacement pressure head [m] |

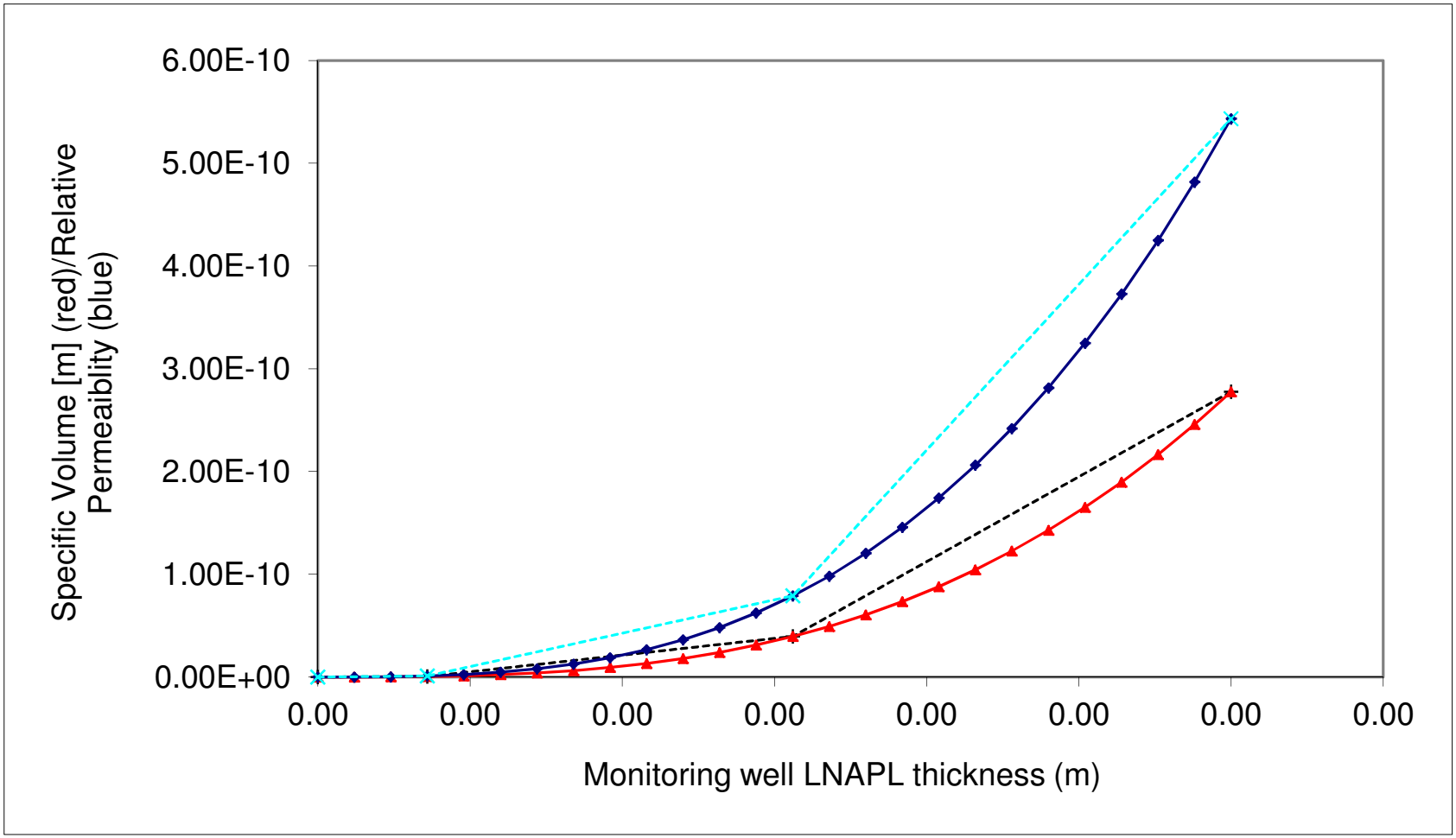
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.000 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.002 | 0.000 | 0.000 | 0.0003 | 0.000000 | 0.0003 | 0.000000 | 0.001 | Eps-Do |
| 0.003 | 0.000 | 0.000 | 0.0013 | 0.000000 | 0.0013 | 0.000000 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

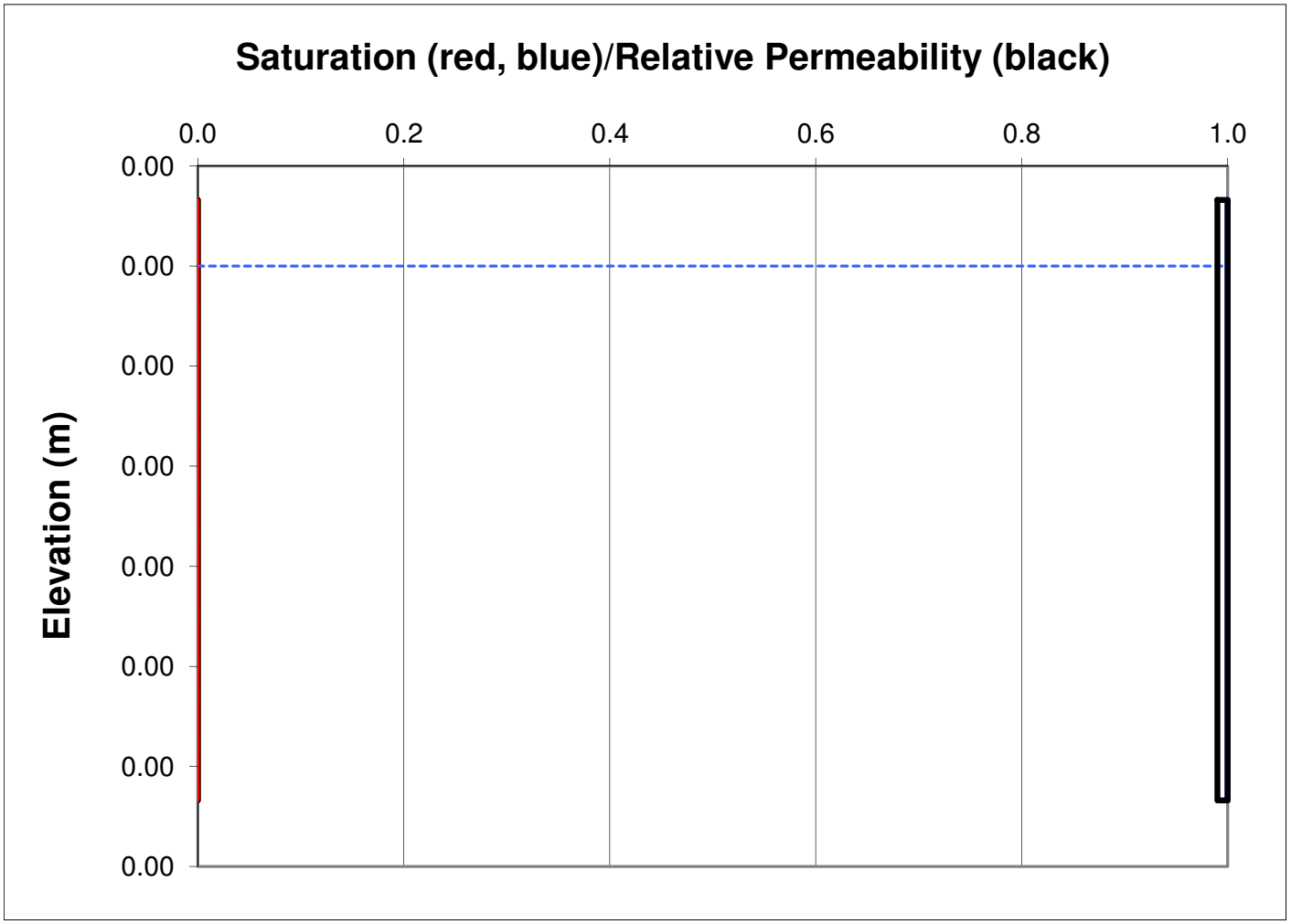
**Gauged May 2011**

**AOI 8 / N-42**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.003 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 2.776E-10 | $k_{ro}$ = 5.434E-10 | AOI 8 / N-42 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.430 |

Gauged May 2011

**AOI 8 / N-49**

1.410 feet

| Soil Characteristic | | |
|---|---|---|
| | | **SW-SM** |
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | |
|---|---|---|
| | | **Residual Oil** |
| $\rho_o$ = | 0.900 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.625 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.430 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.043 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.387 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.103 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

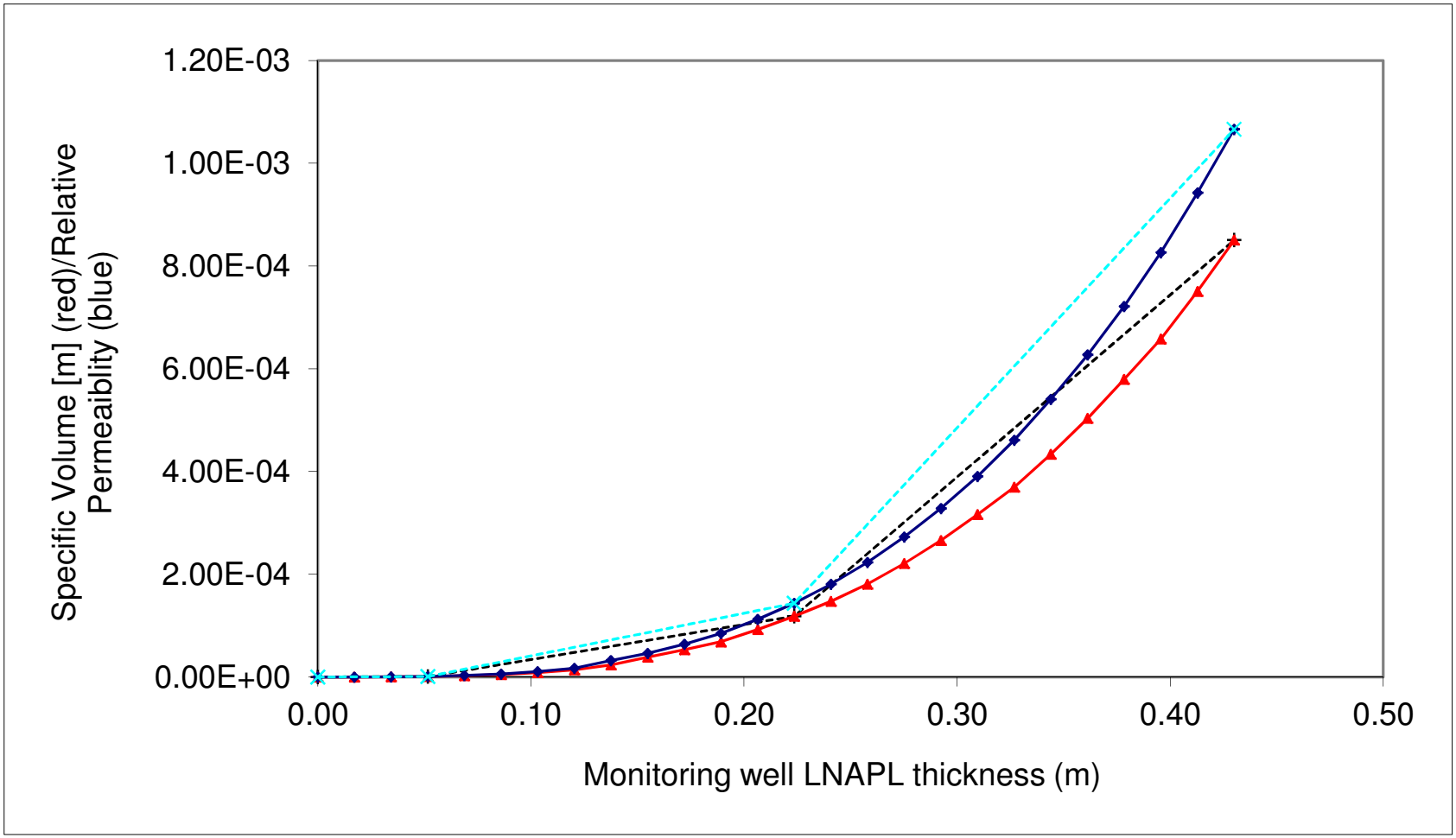
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.052 | 0.000 | 0.000 | 0.0000 | 0.000021 | 0.0000 | 0.000024 | | |
| 0.224 | 0.000 | 0.000 | 0.0500 | 0.000681 | 0.0501 | 0.000829 | 0.1 | Eps-Do |
| 0.430 | 0.001 | 0.001 | 0.1903 | 0.003547 | 0.1914 | 0.004468 | 0.1 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

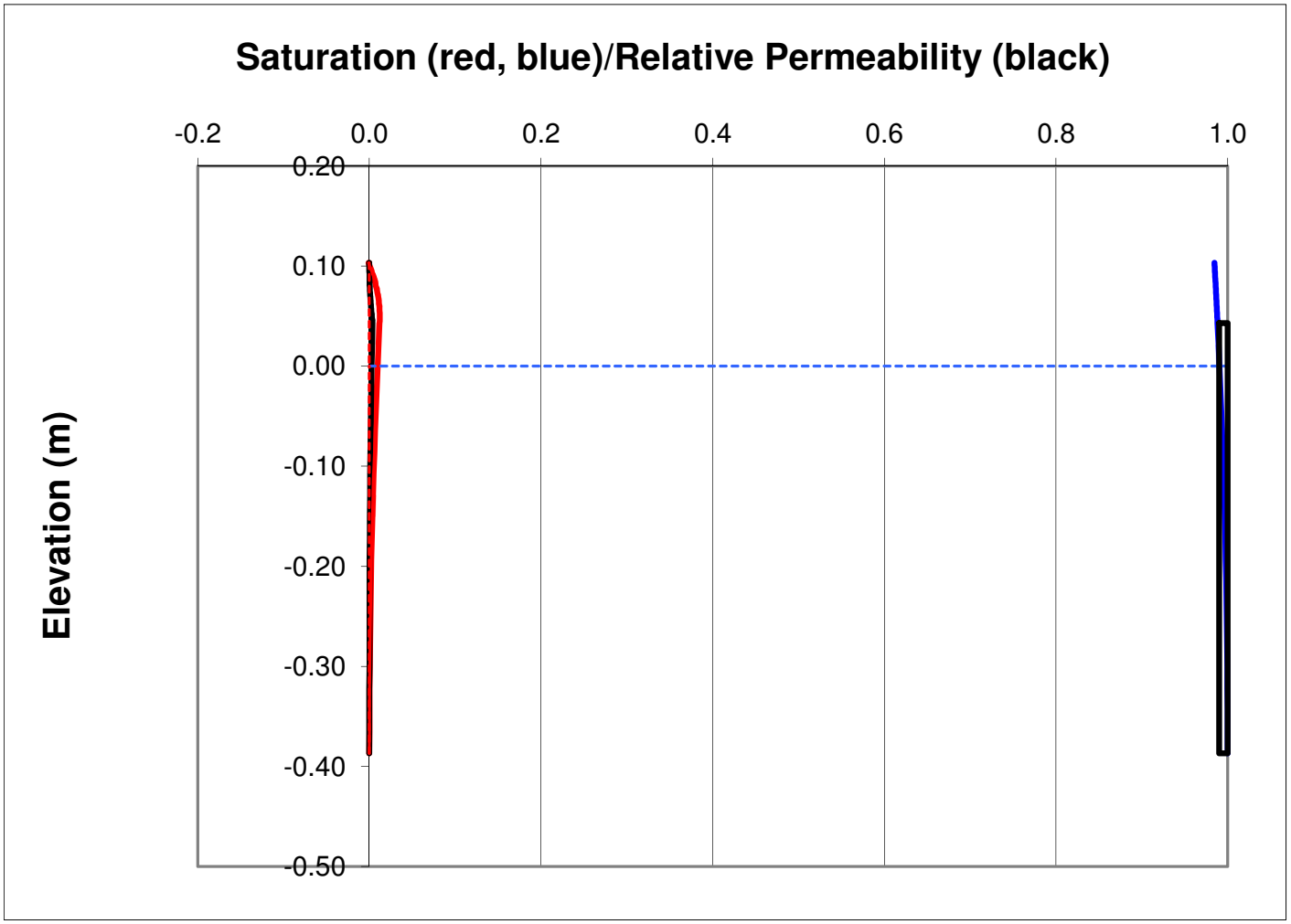
**Gauged May 2011**

**AOI 8 / N-49**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.430 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = 8.503E-04 | $k_{ro}$ = | 1.066E-03 | AOI 8 / N-49 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.351 |

Gauged May 2011

**AOI 8 / N-75**

1.150 feet

| Soil Characteristic | | |
|---|---|---|
| | | **SW-SM** |
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | |
|---|---|---|
| | | **Residual Oil** |
| $\rho_o$ = | 0.937 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.776 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.269 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.022 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.329 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.052 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

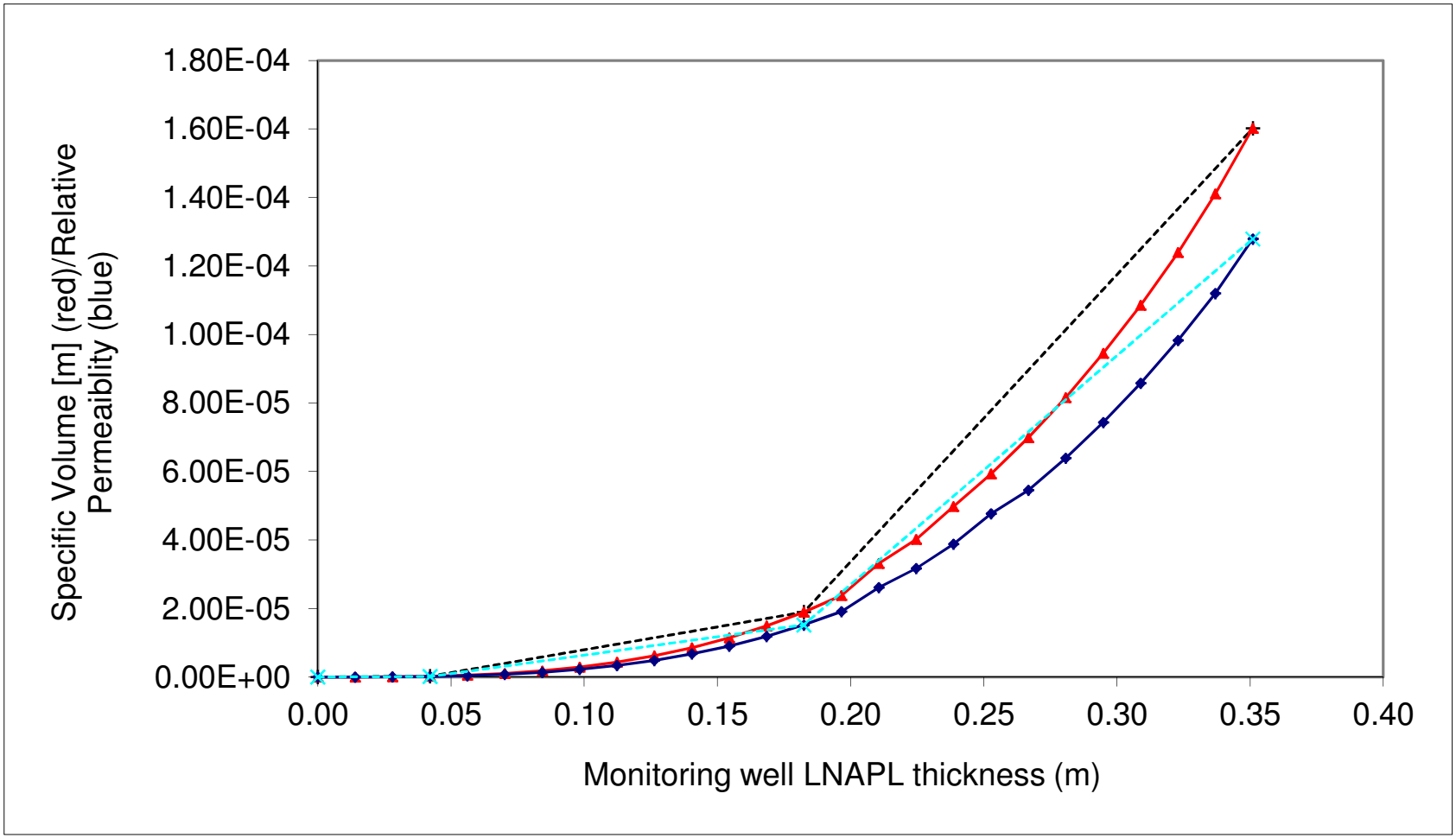
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.042 | 0.000 | 0.000 | 0.0000 | 0.000005 | 0.0000 | 0.000004 | | |
| 0.183 | 0.000 | 0.000 | 0.0405 | 0.000134 | 0.0406 | 0.000107 | 0.01 | Eps-Do |
| 0.351 | 0.000 | 0.000 | 0.1598 | 0.000838 | 0.1598 | 0.000669 | 0.01 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

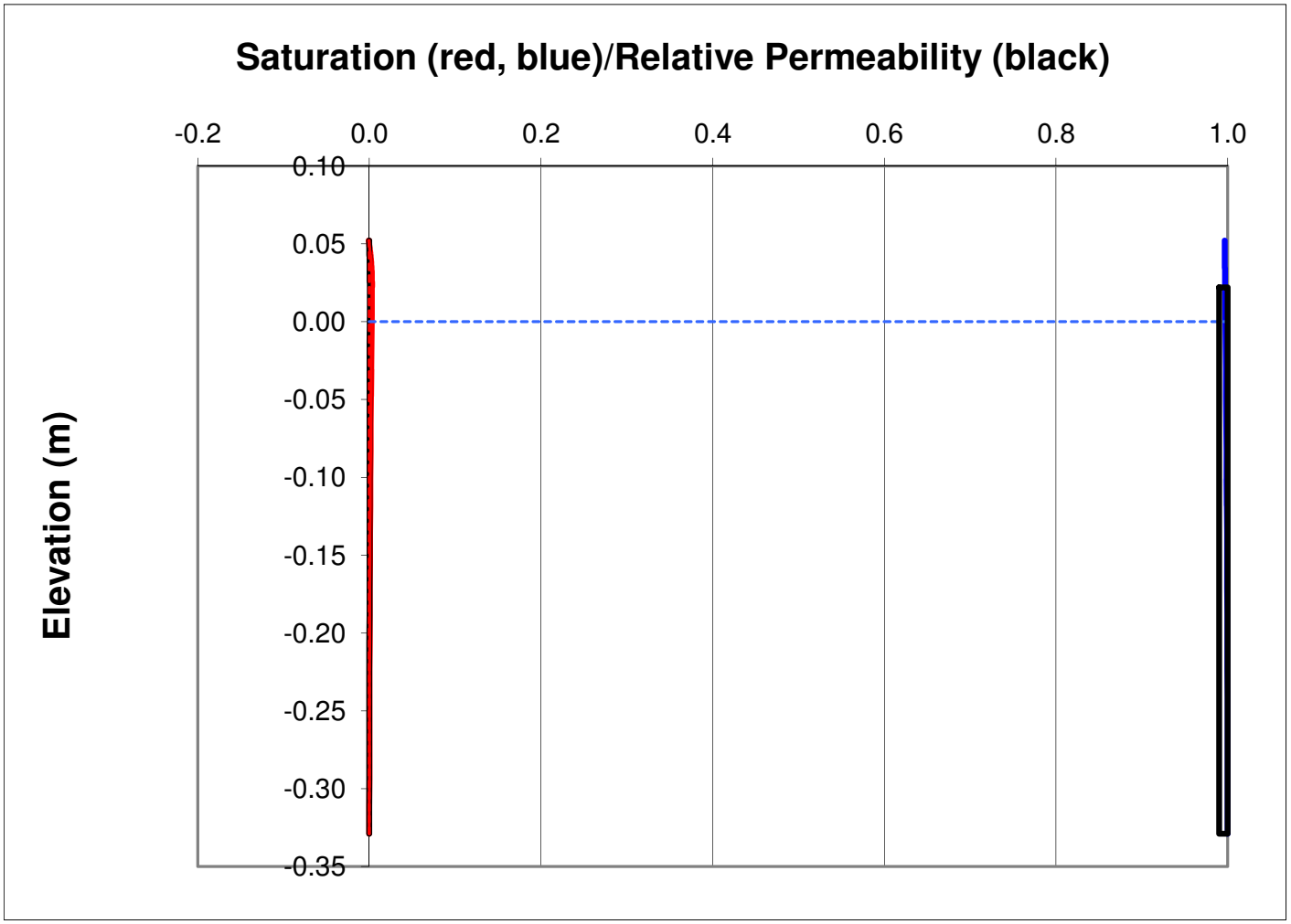
**Gauged May 2011**

**AOI 8 / N-75**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.351 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = 1.602E-04 | $k_{ro}$ = | 1.279E-04 | AOI 8 / N-75 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.634 |

Gauged May 2011

**AOI 8 / N-91**

2.080 feet

| Soil Characteristic | | |
|---|---|---|
| | | **SW-SM** |
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

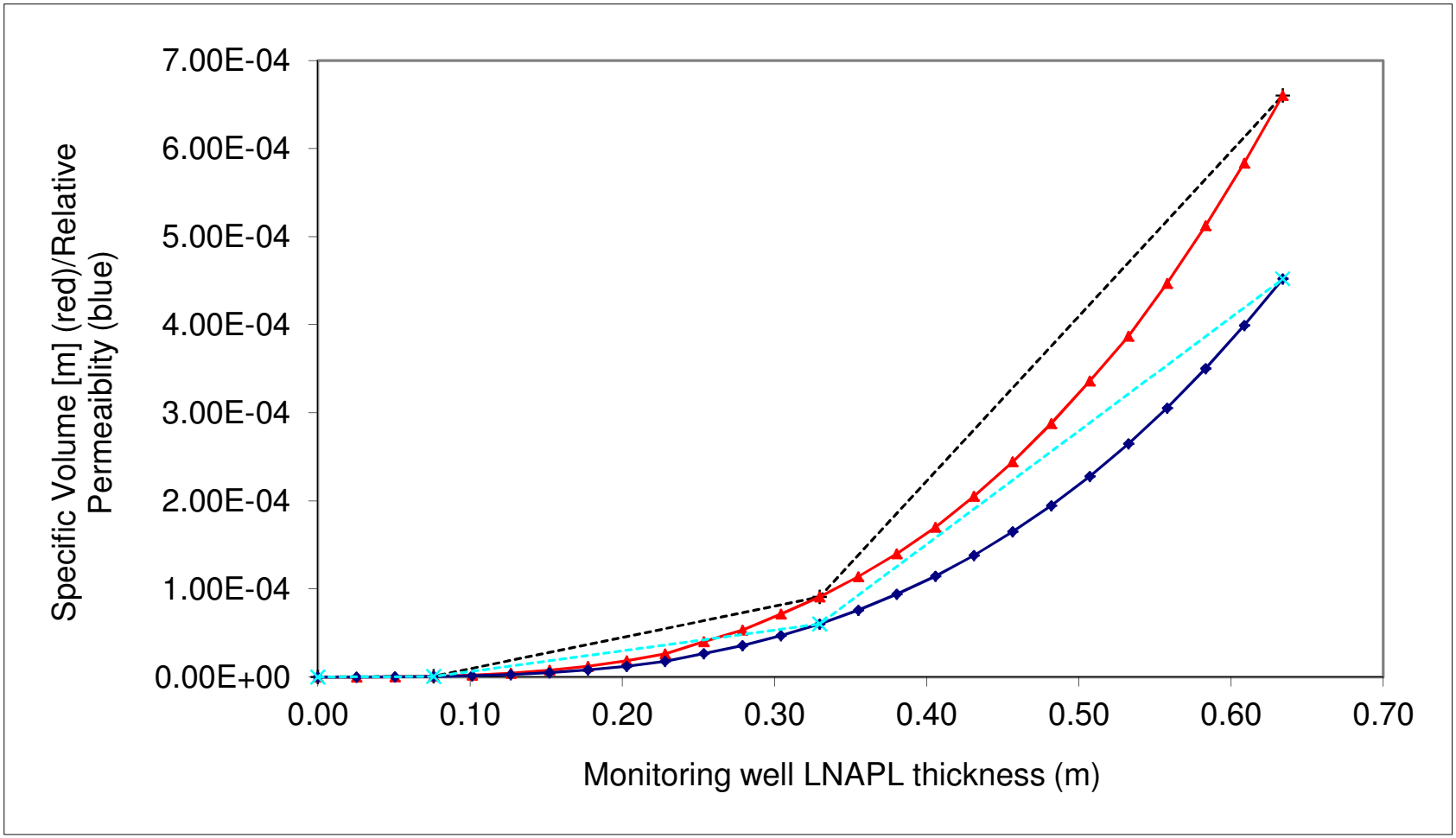
| Fluid Characteristics: | | |
|---|---|---|
| | | **Residual Oil** |
| $\rho_o$ = | 0.947 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.816 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.227 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.034 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.600 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.074 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

**Press Ctrl+Shift+S to calculate sheet**

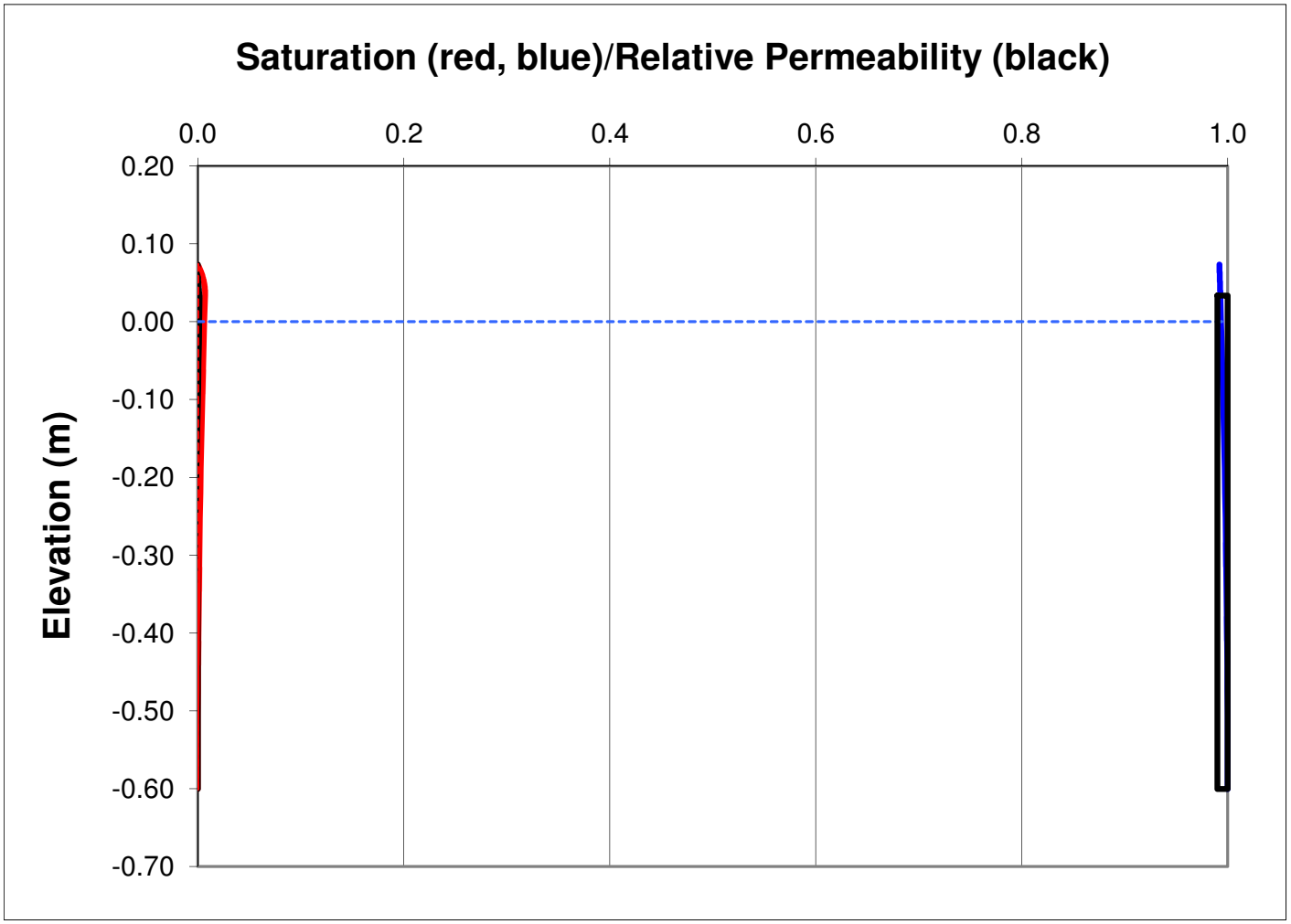
| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | Gauged May 2011 AOI 8 / N-91 | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.076 | 0.000 | 0.000 | 0.0000 | 0.000012 | 0.0000 | 0.000008 | | |
| 0.330 | 0.000 | 0.000 | 0.0735 | 0.000355 | 0.0736 | 0.000236 | 0.01 | Eps-Do |
| 0.634 | 0.001 | 0.000 | 0.2810 | 0.001871 | 0.2828 | 0.001287 | 0.01 | Eps-kro |

Press Ctrl+Shift+S to calculate sheet



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | | 0.634 | Gauged May 2011 |
|---|---|---|---|---|---|
| | $D_o$ = | 6.603E-04 | $k_{ro}$ = | 4.520E-04 | AOI 8 / N-91 |

**Press Ctrl+Shift+S to calculate sheet**



# *van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability*

**Enter Data in Yellow Region**

| **Maximum Monitoring Well LNAPL Thickness (meters)** | |
|---|---|
| $b_o$ = | 0.975 |

Gauged May 2011

**AOI 8 / N-112**

3.200 feet

| **Soil Characteristic** | | **SW-SM** |
|---|---|---|
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

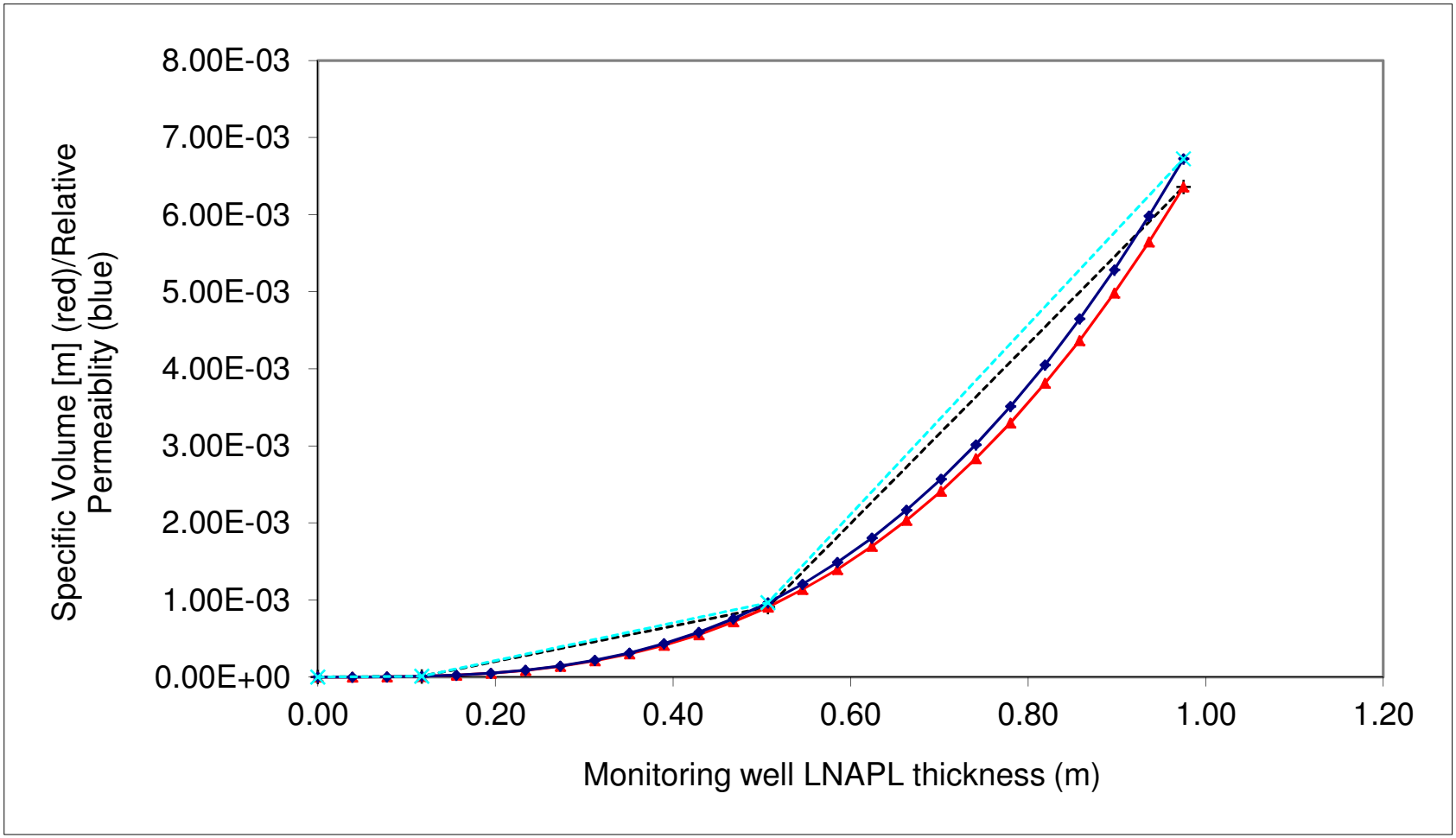
| **Fluid Characteristics:** | | **Residual Oil** |
|---|---|---|
| $\rho_o$ = | 0.917 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| **Calculated Parameters** | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.694 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.357 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.081 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.894 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.191 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

**Press Ctrl+Shift+S to calculate sheet**

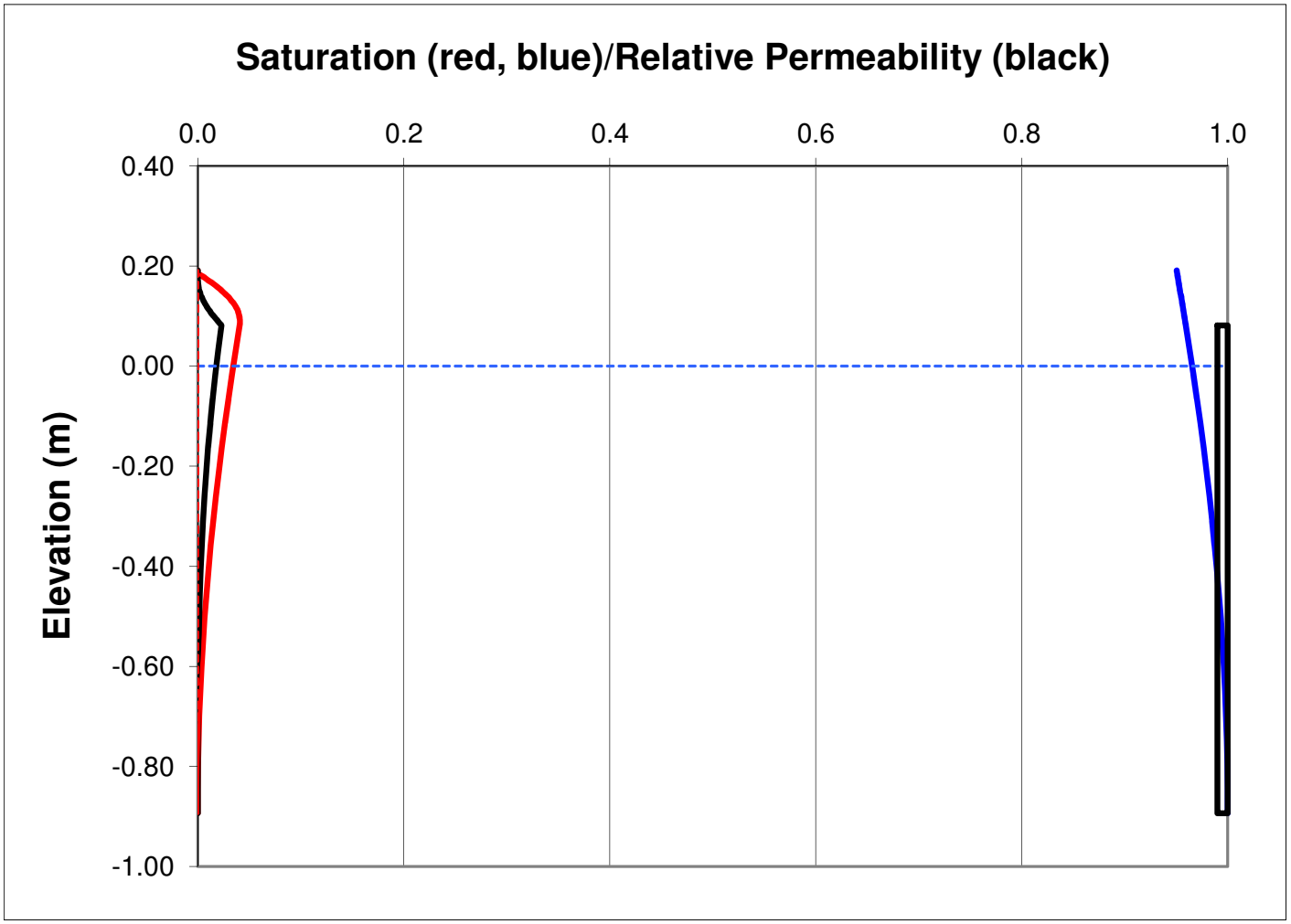
**Data for curve-fitting segments** — **Press Ctrl+Shift+S to calculate sheet**

| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 0.000 | | | | | **Gauged May 2011** | |
| 0.117 | 0.000 | 0.000 | 0.0000 | 0.000075 | 0.0000 | 0.000078 | **AOI 8 / N-112** | |
| 0.507 | 0.001 | 0.001 | 0.1132 | 0.002307 | 0.1133 | 0.002451 | 0.01 | Eps-Do |
| 0.975 | 0.006 | 0.007 | 0.4290 | 0.011647 | 0.4286 | 0.012308 | 0.01 | Eps-kro |



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.975 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 6.359E-03 | $k_{ro}$ = 6.725E-03 | AOI 8 / N-112 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.149 |

Gauged May 2011

**AOI 8 / N-127**

0.490 feet

| Soil Characteristic | | **SW-SM** |
|---|---|---|
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

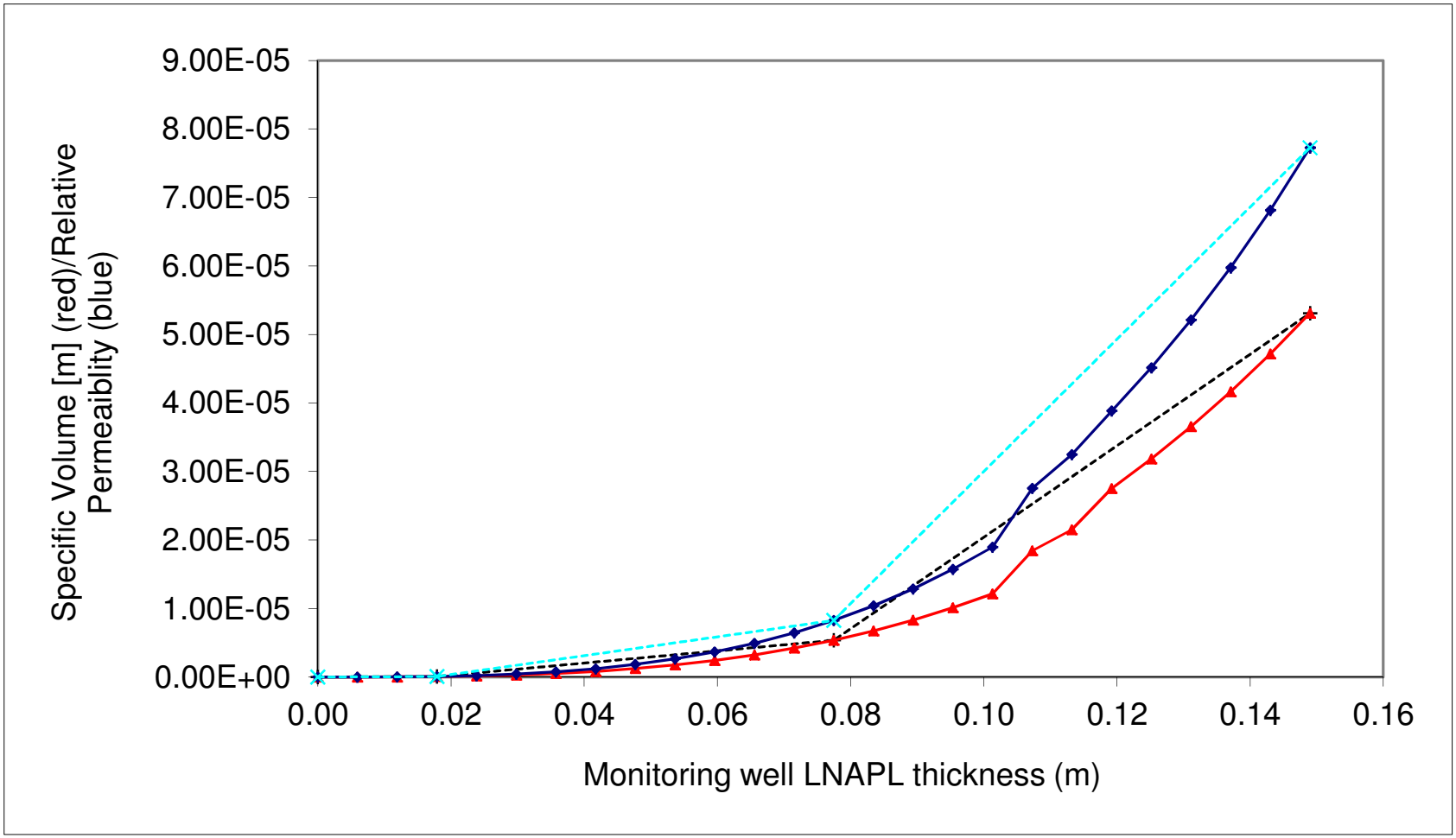
| Fluid Characteristics: | | **Residual Oil** |
|---|---|---|
| $\rho_o$ = | 0.879 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.540 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.520 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.018 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.131 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.038 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

**Press Ctrl+Shift+S to calculate sheet**

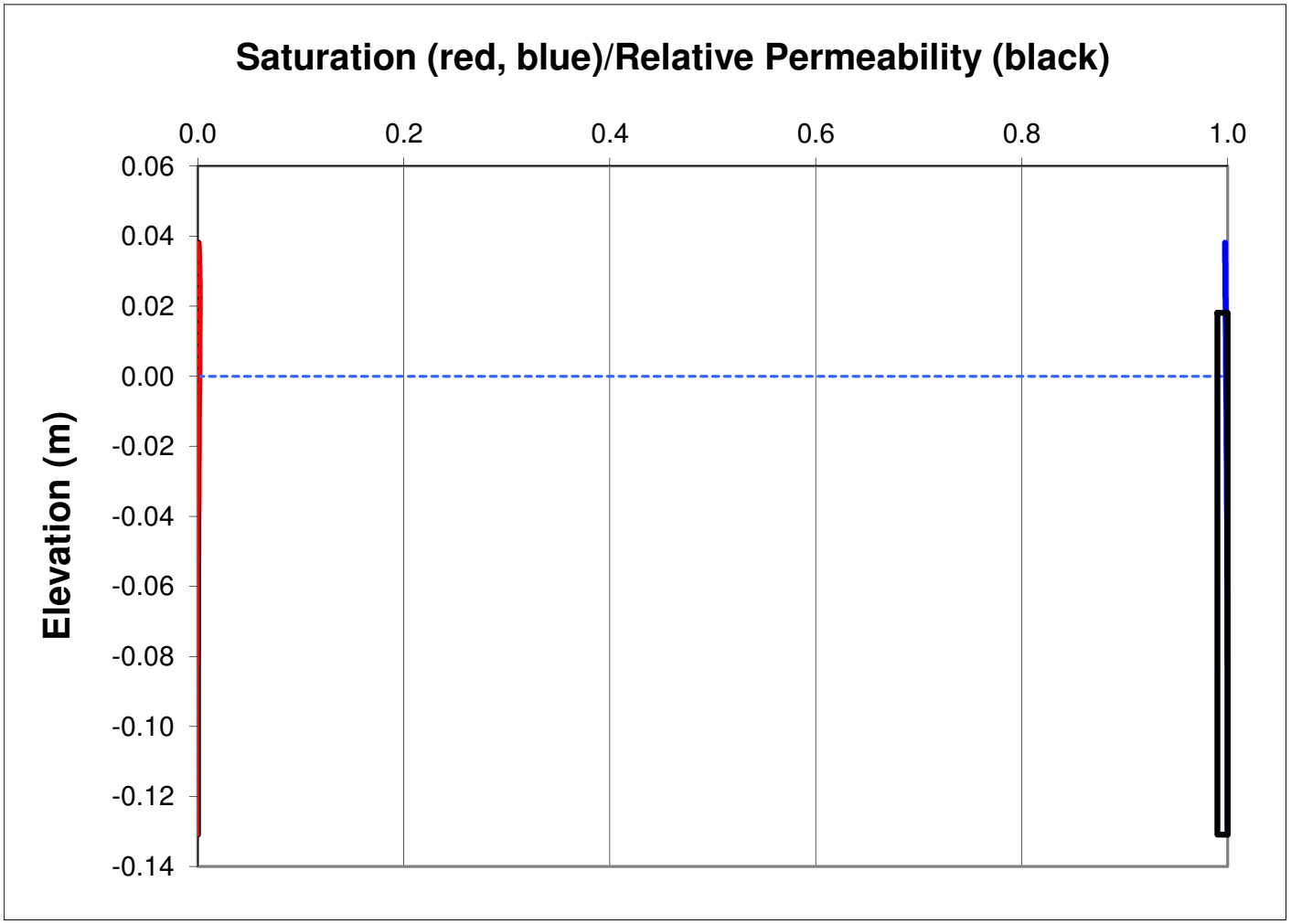
**Data for curve-fitting segments** — **Press Ctrl+Shift+S to calculate sheet**

| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | **Gauged May 2011** | |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 0.000 | | | | | **AOI 8 / N-127** | |
| 0.018 | 0.000 | 0.000 | 0.0000 | 0.000003 | 0.0000 | 0.000005 | | |
| 0.077 | 0.000 | 0.000 | 0.0172 | 0.000089 | 0.0172 | 0.000137 | 0.001 | Eps-Do |
| 0.149 | 0.000 | 0.000 | 0.0694 | 0.000667 | 0.0689 | 0.000965 | 0.001 | Eps-kro |



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.149 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 5.309E-05 | $k_{ro}$ = 7.727E-05 | AOI 8 / N-127 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.344 |

Gauged May 2011

**AOI 8 / N-129**

1.130 feet

| Soil Characteristic | | |
|---|---|---|
| | | **SW-SM** |
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | |
|---|---|---|
| | | **Residual Oil** |
| $\rho_o$ = | 0.902 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.633 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.421 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.034 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.310 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.084 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

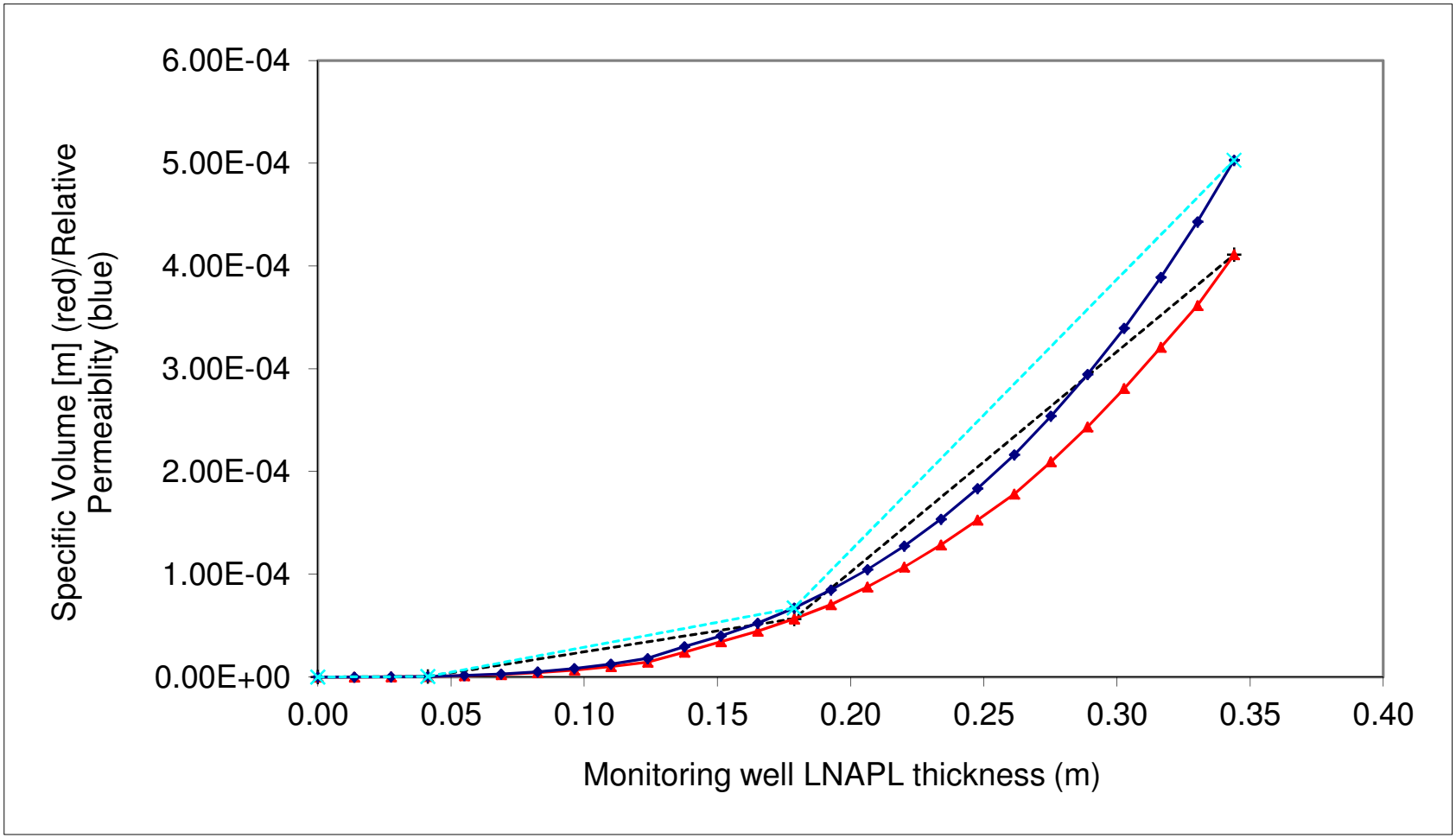
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.041 | 0.000 | 0.000 | 0.0000 | 0.000012 | 0.0000 | 0.000015 | | |
| 0.179 | 0.000 | 0.000 | 0.0400 | 0.000408 | 0.0400 | 0.000485 | 0.02 | Eps-Do |
| 0.344 | 0.000 | 0.001 | 0.1525 | 0.002146 | 0.1534 | 0.002639 | 0.02 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

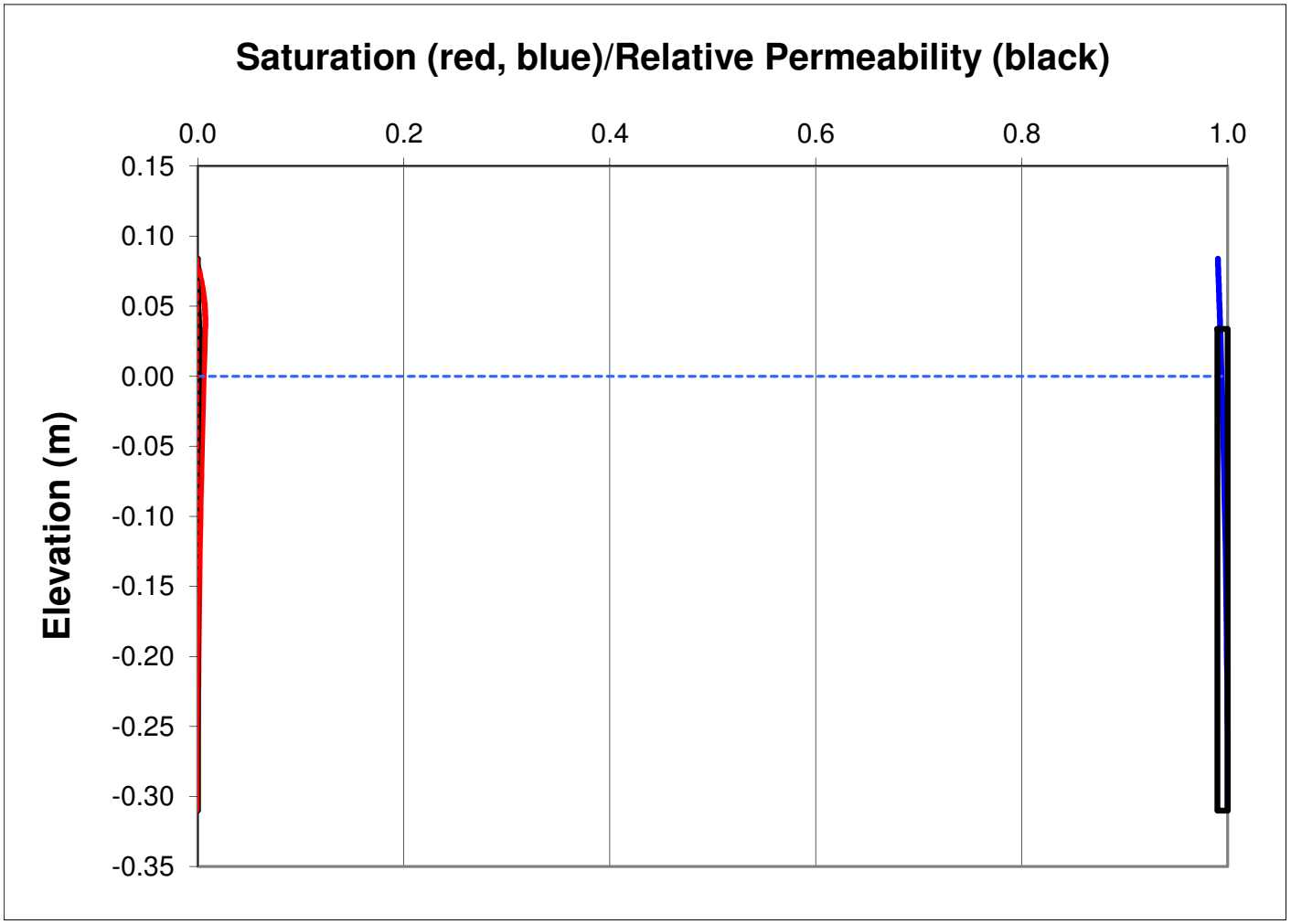
**Gauged May 2011**

**AOI 8 / N-129**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.344 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 4.110E-04 | $k_{ro}$ = 5.031E-04 | AOI 8 / N-129 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.064 |

Gauged May 2011

**AOI 8 / N-130**

0.210 feet

| Soil Characteristic | | **SW-SM** |
|---|---|---|
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Residual Oil** |
|---|---|---|
| $\rho_o$ = | 0.789 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.181 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.902 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.013 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.051 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.033 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

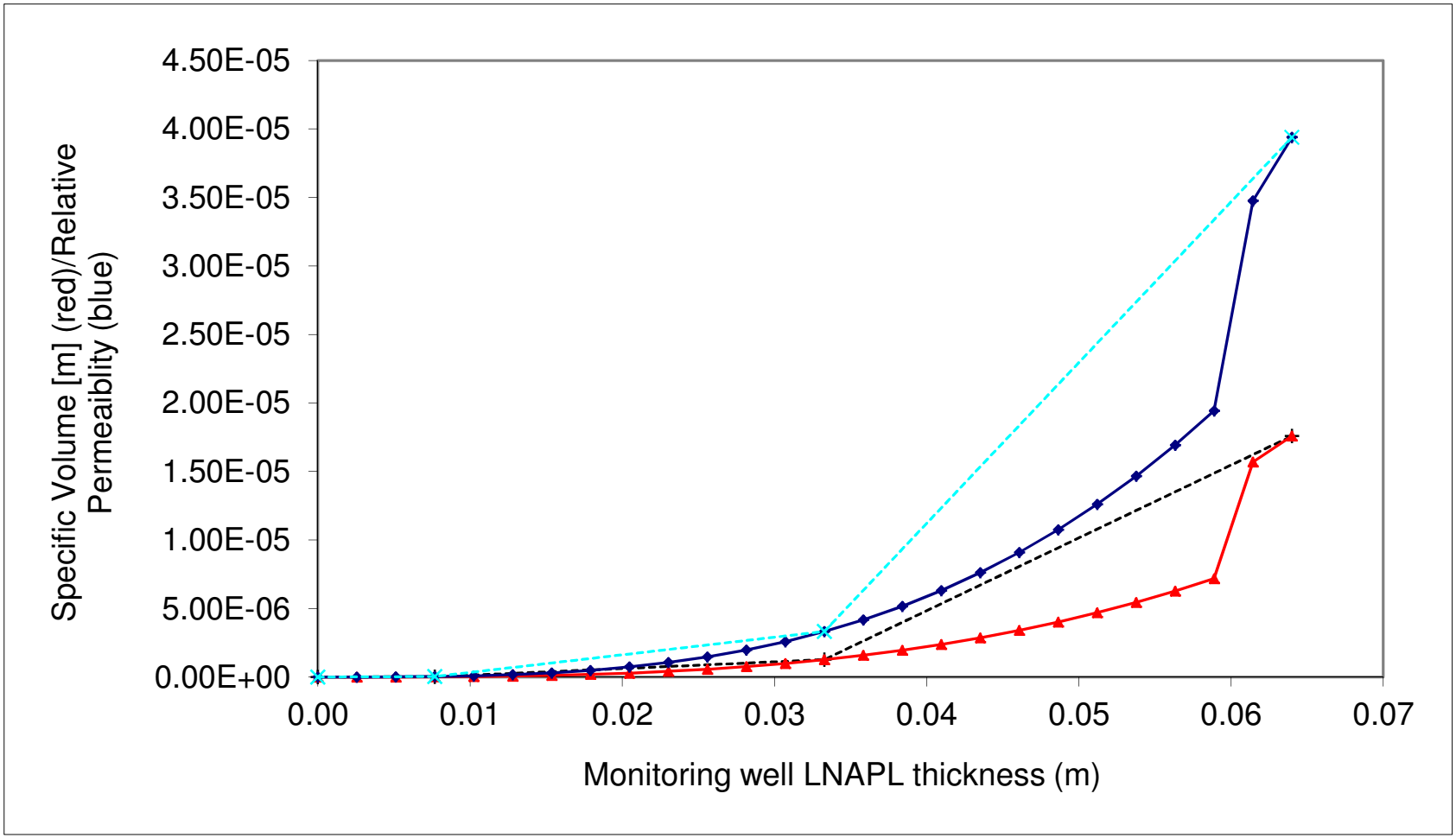
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.008 | 0.000 | 0.000 | 0.0000 | 0.000002 | 0.0000 | 0.000005 | | |
| 0.033 | 0.000 | 0.000 | 0.0074 | 0.000049 | 0.0074 | 0.000128 | 0.001 | Eps-Do |
| 0.064 | 0.000 | 0.000 | 0.0309 | 0.000532 | 0.0305 | 0.001174 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

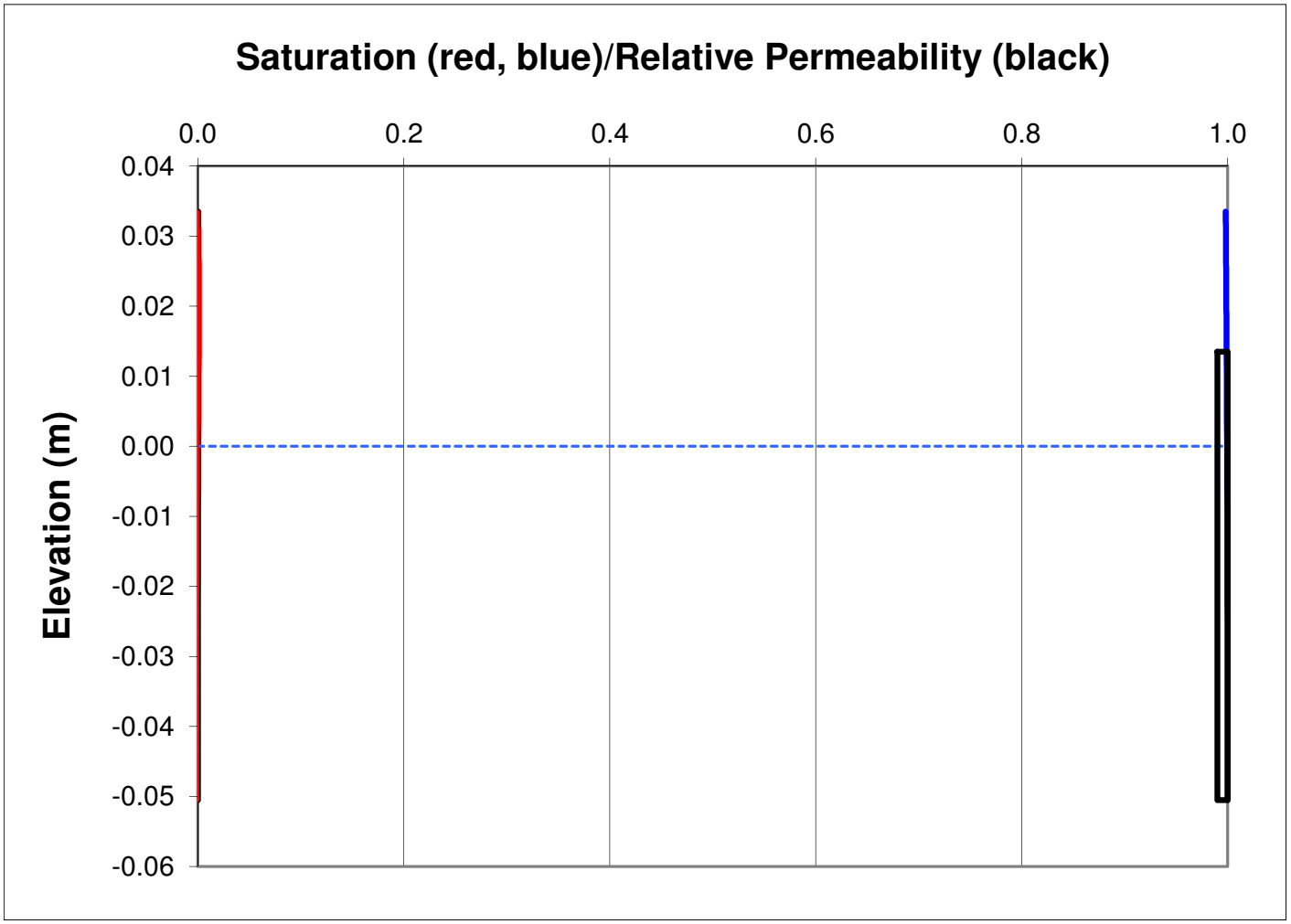
**Gauged May 2011**

**AOI 8 / N-130**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.064 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 1.760E-05 | $k_{ro}$ = 3.939E-05 | AOI 8 / N-130 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.341 |

Gauged May 2011

**AOI 8 / N-135**

1.120 feet

| Soil Characteristic | | |
|---|---|---|
| | | **SW-SM** |
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

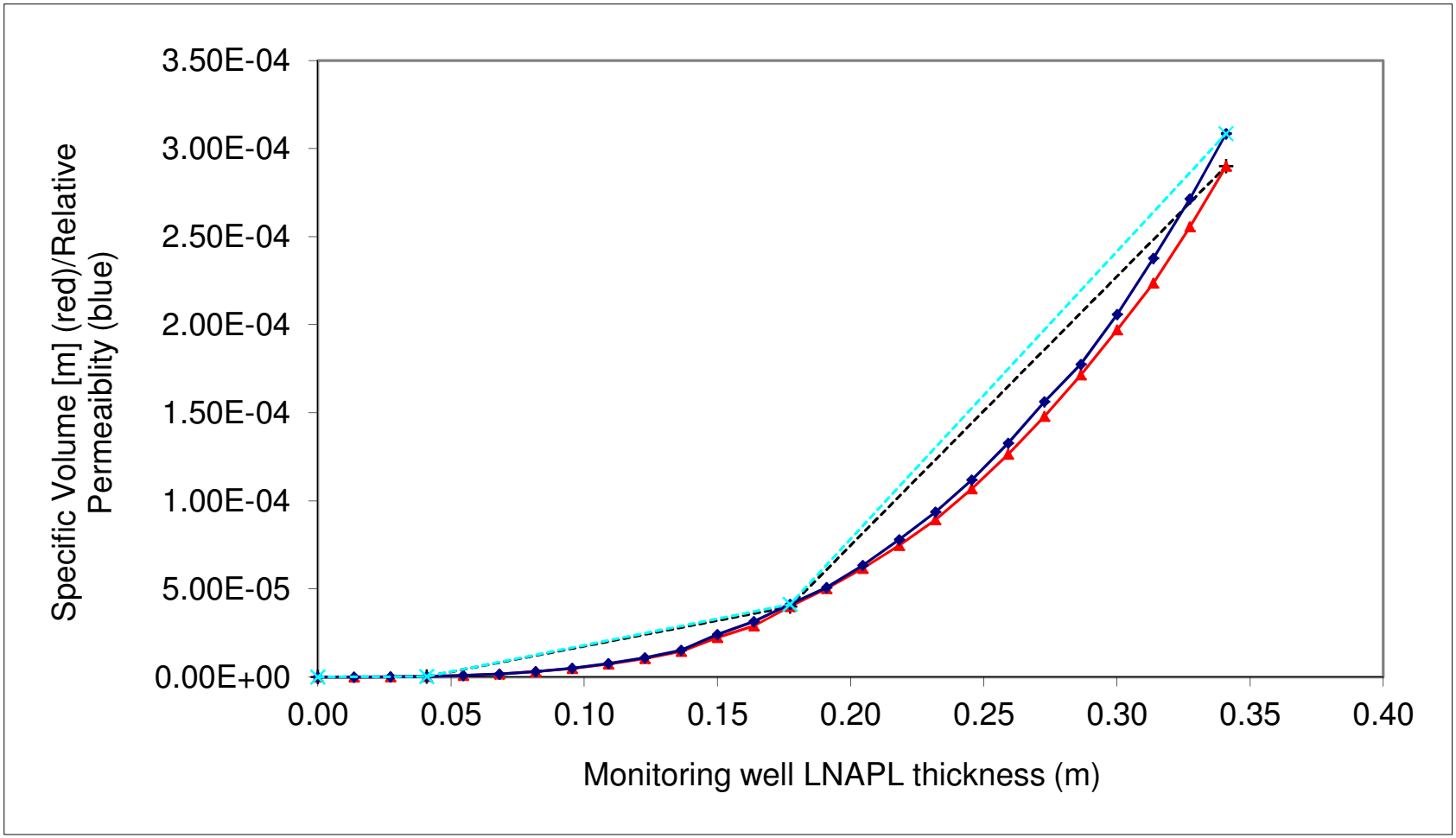
| Fluid Characteristics: | | |
|---|---|---|
| | | **Residual Oil** |
| $\rho_o$ = | 0.915 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.686 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.365 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.029 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.312 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.069 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

**Press Ctrl+Shift+S to calculate sheet**

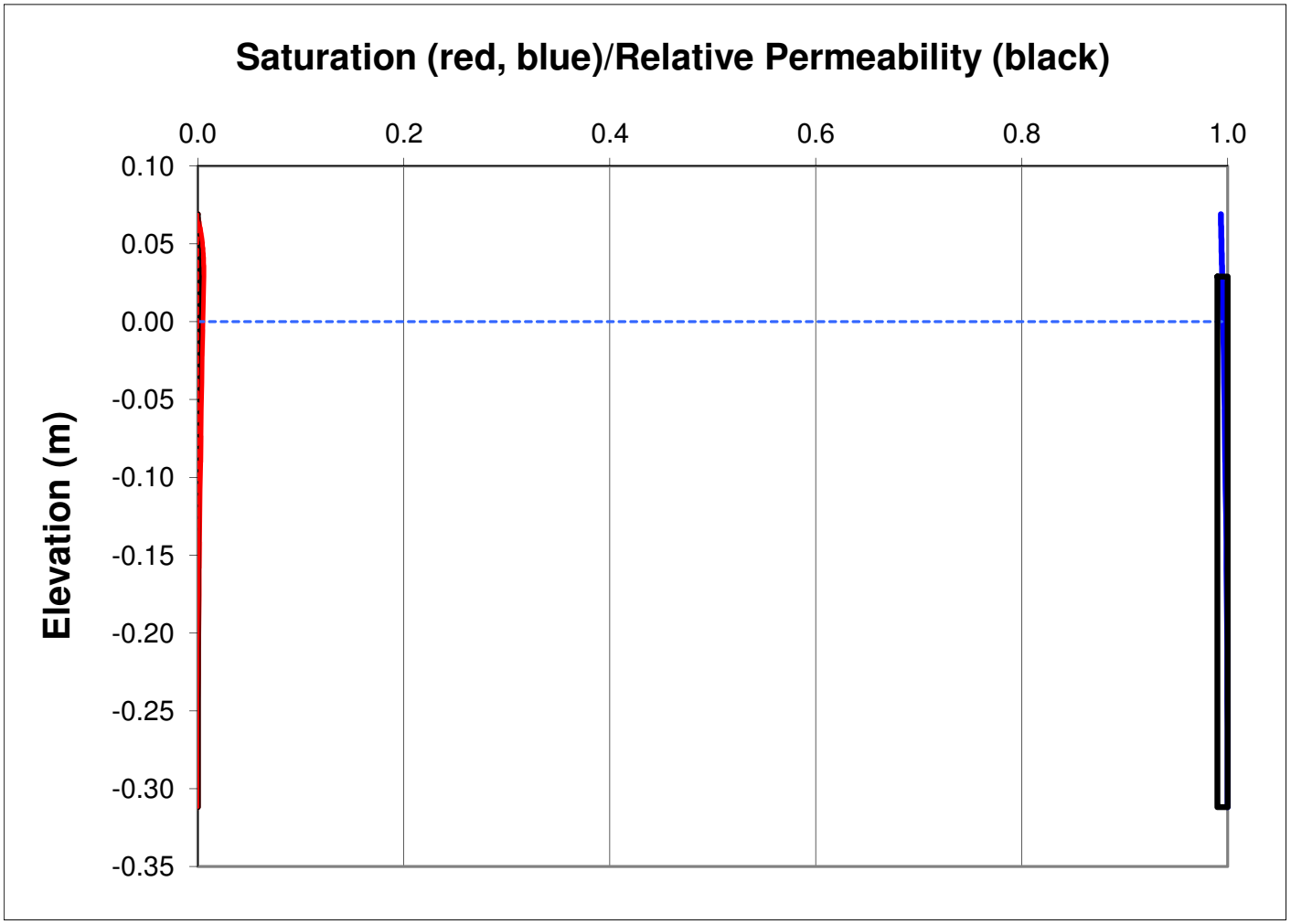
| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | Gauged May 2011 | |
| 0.000 | 0.000 | 0.000 | | | | | AOI 8 / N-135 | |
| 0.041 | 0.000 | 0.000 | 0.0000 | 0.000009 | 0.0000 | 0.000009 | | |
| 0.177 | 0.000 | 0.000 | 0.0396 | 0.000291 | 0.0397 | 0.000300 | 0.1 | Eps-Do |
| 0.341 | 0.000 | 0.000 | 0.1511 | 0.001527 | 0.1521 | 0.001633 | 0.1 | Eps-kro |

Press Ctrl+Shift+S to calculate sheet



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.341 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 2.900E-04 | $k_{ro}$ = 3.085E-04 | AOI 8 / N-135 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.177 |

Gauged May 2011

**AOI 8 / N-503**

0.580 feet

| Soil Characteristic | | |
|---|---|---|
| | | **SW-SM** |
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | |
|---|---|---|
| | | **Residual Oil** |
| $\rho_o$ = | 0.907 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.653 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.400 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.017 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.160 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.037 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

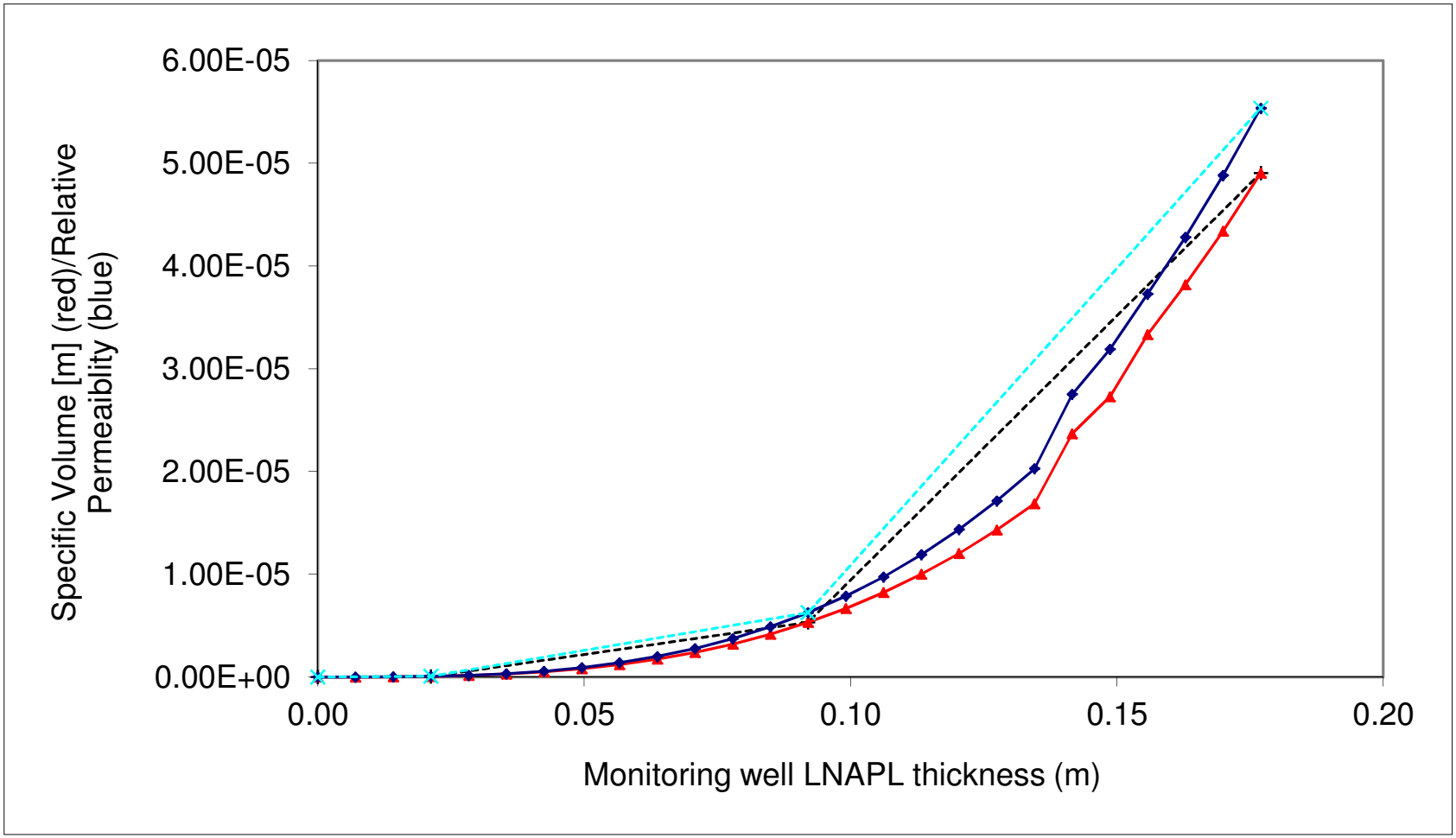
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.021 | 0.000 | 0.000 | 0.0000 | 0.000003 | 0.0000 | 0.000003 | | |
| 0.092 | 0.000 | 0.000 | 0.0204 | 0.000074 | 0.0205 | 0.000087 | 0.001 | Eps-Do |
| 0.177 | 0.000 | 0.000 | 0.0817 | 0.000515 | 0.0812 | 0.000578 | 0.001 | Eps-kro |

Press Ctrl+Shift+S to calculate sheet

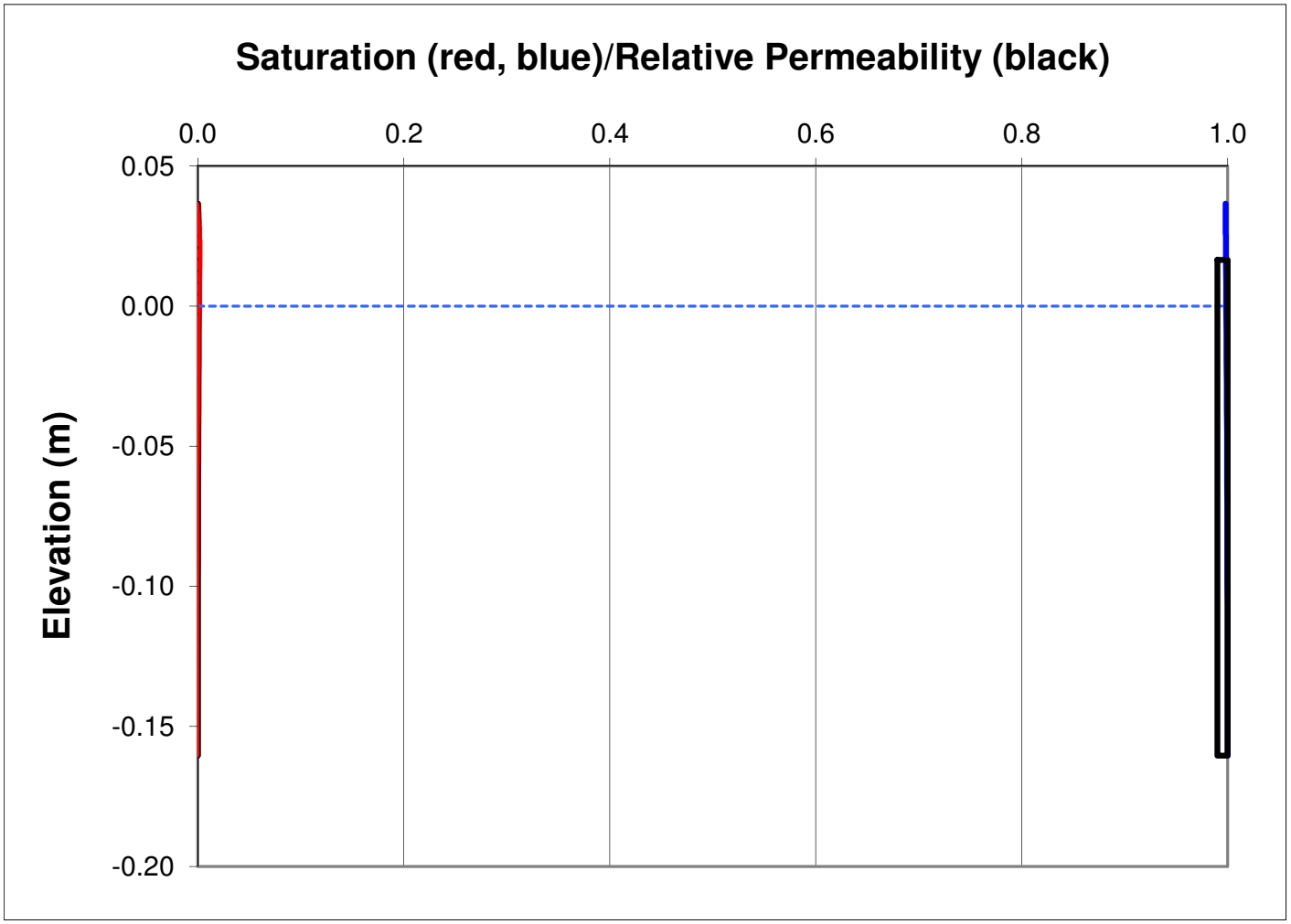
**Gauged May 2011**

**AOI 8 / N-503**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.177 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 4.904E-05 | $k_{ro}$ = 5.536E-05 | AOI 8 / N-503 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.015 |

Gauged May 2011

**AOI 8 / RW-502**

0.050 feet

| Soil Characteristic | | |
|---|---|---|
| | | **SW-SM** |
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | |
|---|---|---|
| | | **Residual Oil** |
| $\rho_o$ = | 0.907 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.653 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.400 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.001 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.014 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.001 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

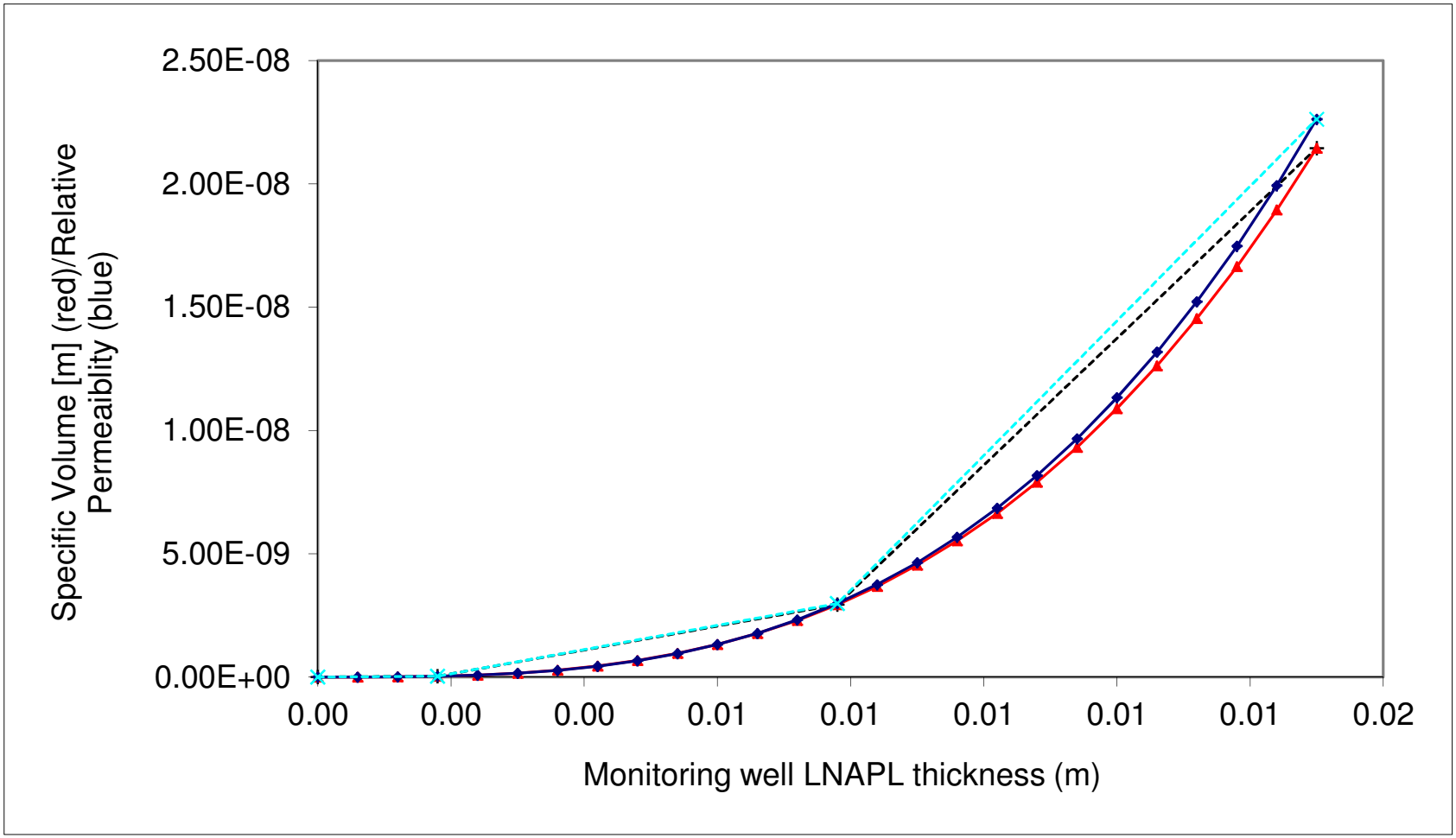
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.002 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.008 | 0.000 | 0.000 | 0.0017 | 0.000000 | 0.0017 | 0.000000 | 0.001 | Eps-Do |
| 0.015 | 0.000 | 0.000 | 0.0067 | 0.000003 | 0.0067 | 0.000003 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

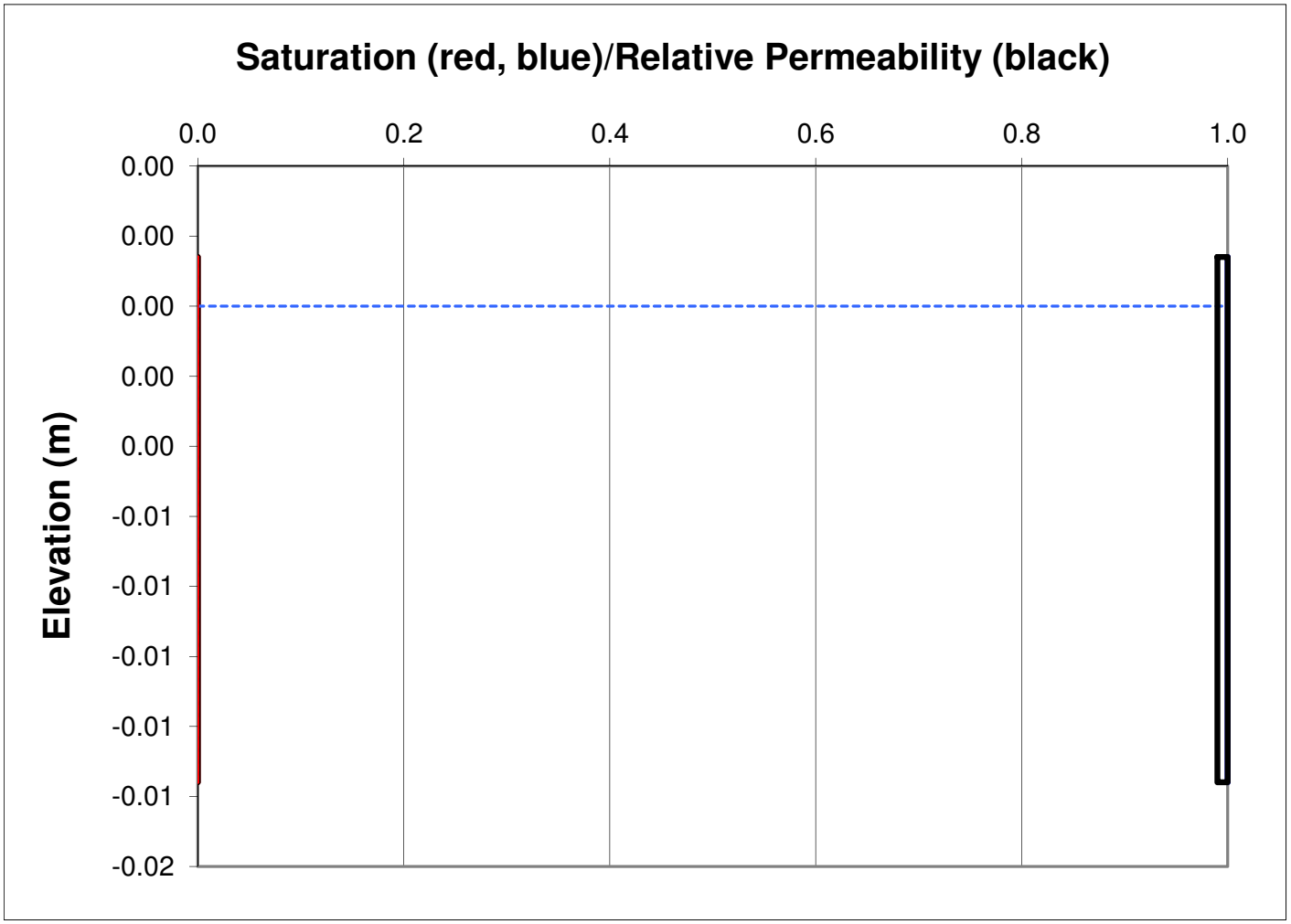
**Gauged May 2011**

**AOI 8 / RW-502**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.015 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = 2.144E-08 | $k_{ro}$ = | 2.262E-08 | AOI 8 / RW-502 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.107 |

Gauged May 2011

**AOI 8 / RW-300**

0.350 feet

| Soil Characteristic | | **SW-SM** |
|---|---|---|
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Residual Oil** |
|---|---|---|
| $\rho_o$ = | 0.836 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.368 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.703 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.018 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.089 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.048 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

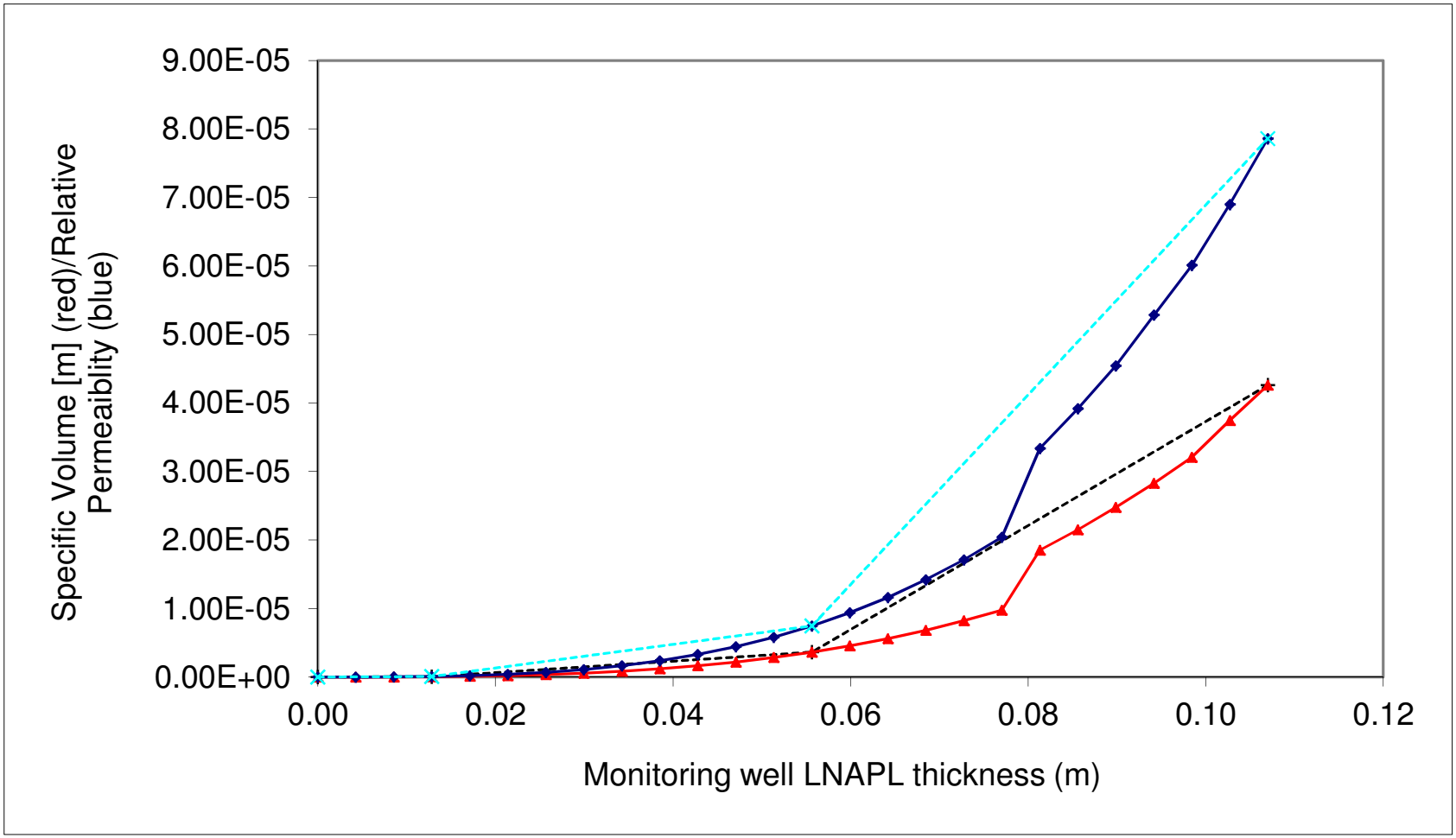
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.013 | 0.000 | 0.000 | 0.0000 | 0.000003 | 0.0000 | 0.000006 | | |
| 0.056 | 0.000 | 0.000 | 0.0123 | 0.000084 | 0.0124 | 0.000172 | 0.02 | Eps-Do |
| 0.107 | 0.000 | 0.000 | 0.0508 | 0.000759 | 0.0503 | 0.001385 | 0.02 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

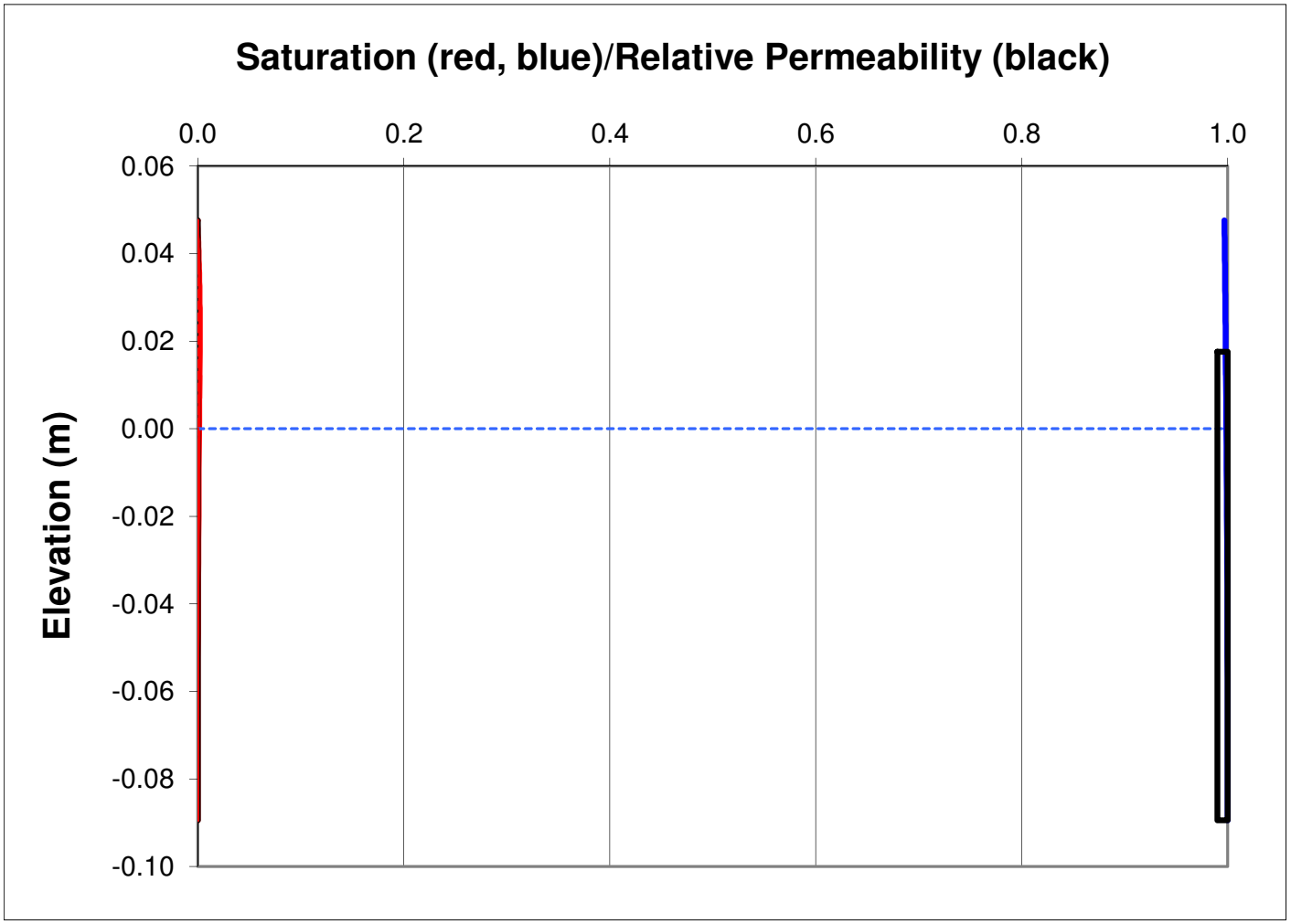
**Gauged May 2011**

**AOI 8 / RW-300**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.107 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 4.259E-05 | $k_{ro}$ = 7.861E-05 | AOI 8 / RW-300 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.003 |

Gauged May 2011

**AOI 8 / RW-206**

0.010 feet

| Soil Characteristic | | |
|---|---|---|
| | | **SP** |
| n = | 0.426 | porosity |
| N = | 1.980 | van Genuchten "N" |
| $\alpha$ = | 1.350 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.321 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | |
|---|---|---|
| | | **Residual Oil** |
| $\rho_o$ = | 0.890 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.495 | van Genuchten "M" |
| $\alpha_{ao}$ = | 2.433 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.320 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.000 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.003 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.000 | maximum free-product elevation |
| $\lambda$ = | 0.738 | pore-size distribution index |
| $\Psi_b$ = | 0.461 | B-C displacement pressure head [m] |

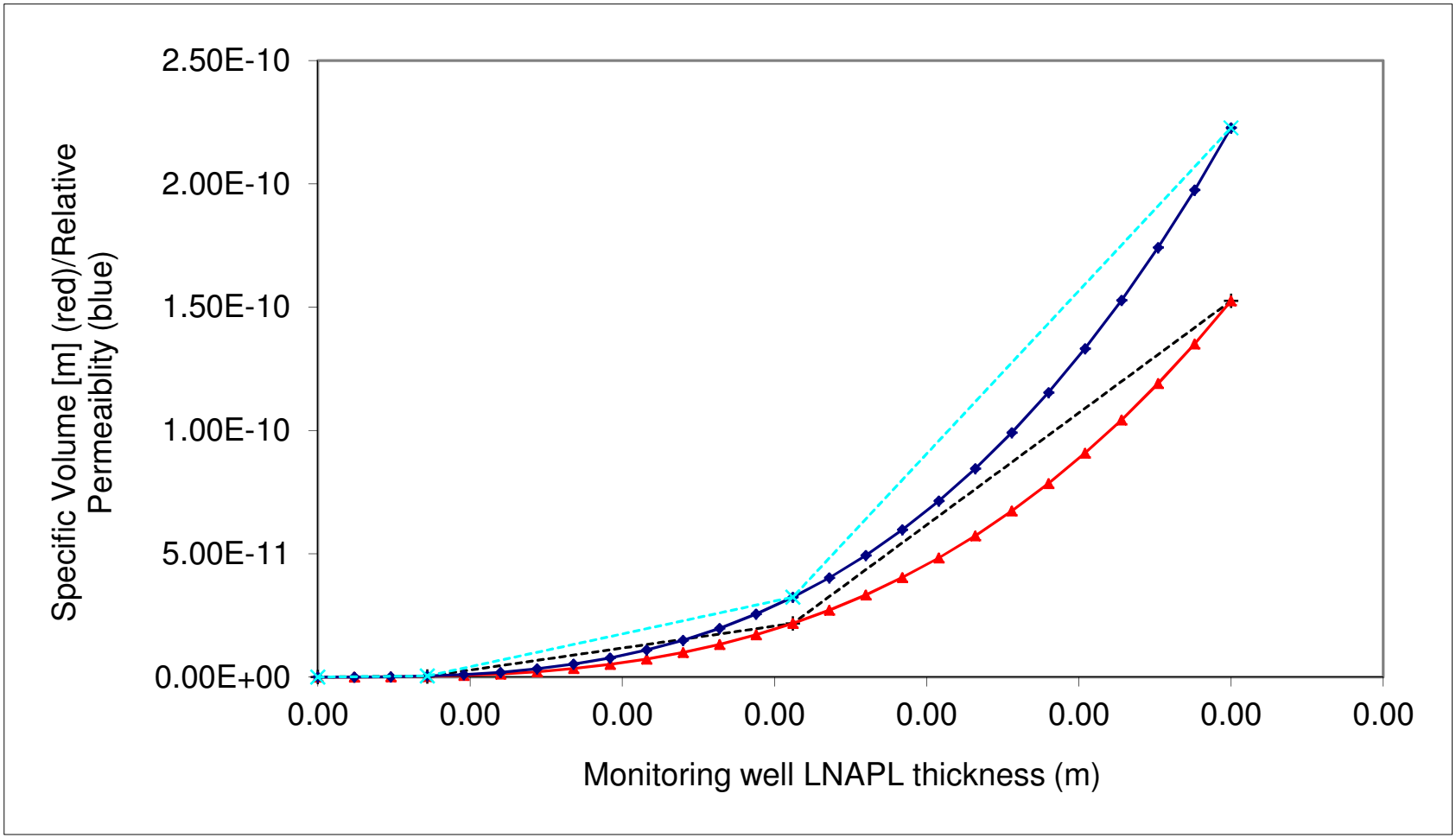
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.000 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.002 | 0.000 | 0.000 | 0.0003 | 0.000000 | 0.0003 | 0.000000 | 0.001 | Eps-Do |
| 0.003 | 0.000 | 0.000 | 0.0013 | 0.000000 | 0.0013 | 0.000000 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

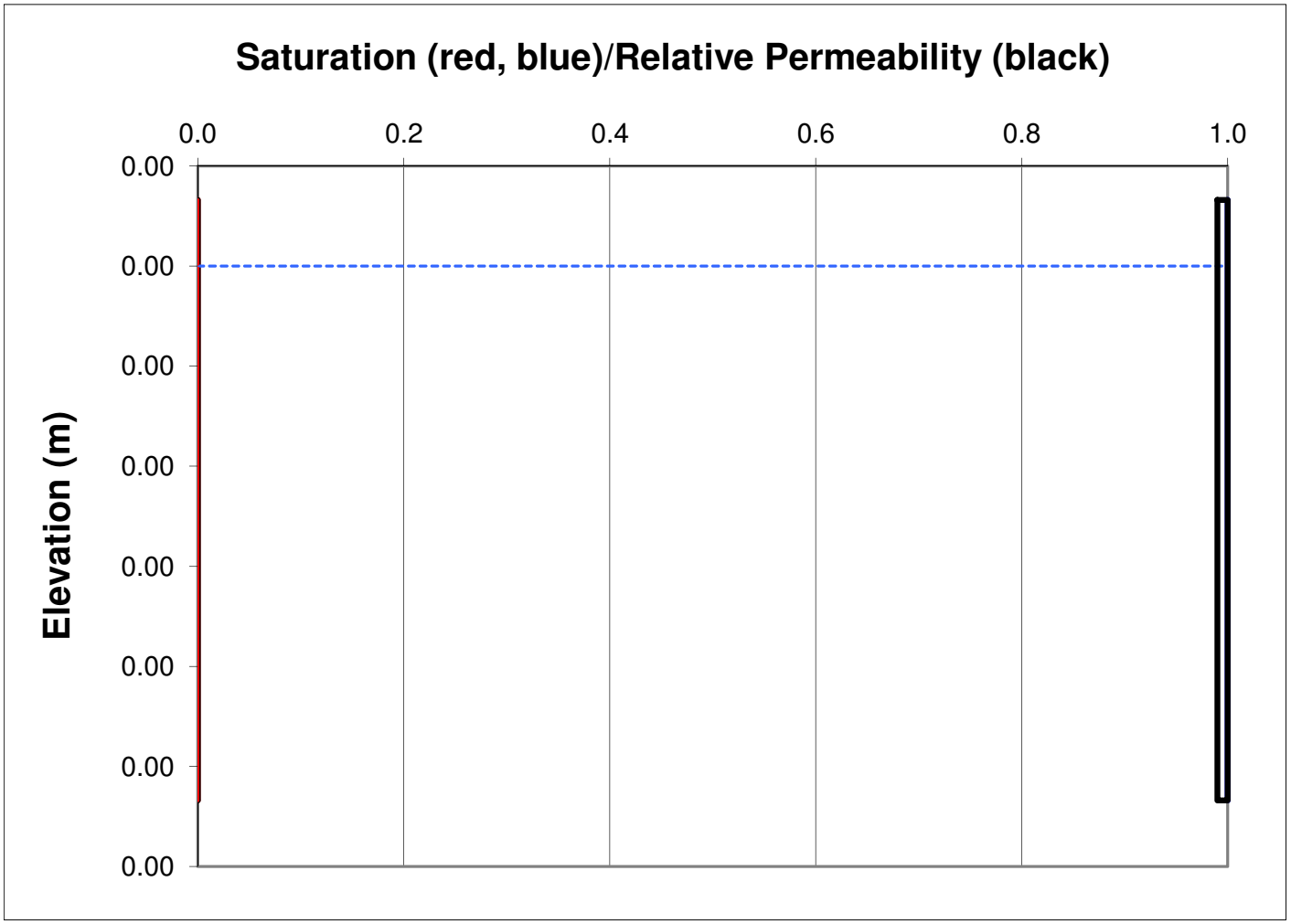
**Gauged May 2011**

**AOI 8 / RW-206**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.003 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 1.526E-10 | $k_{ro}$ = 2.227E-10 | AOI 8 / RW-206 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.003 |

Gauged May 2011

**AOI 8 / N-504**

0.010 feet

| Soil Characteristic | | |
|---|---|---|
| | | **SW-SM** |
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | |
|---|---|---|
| | | **Residual Oil** |
| $\rho_o$ = | 0.907 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.653 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.400 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.000 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.003 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.000 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

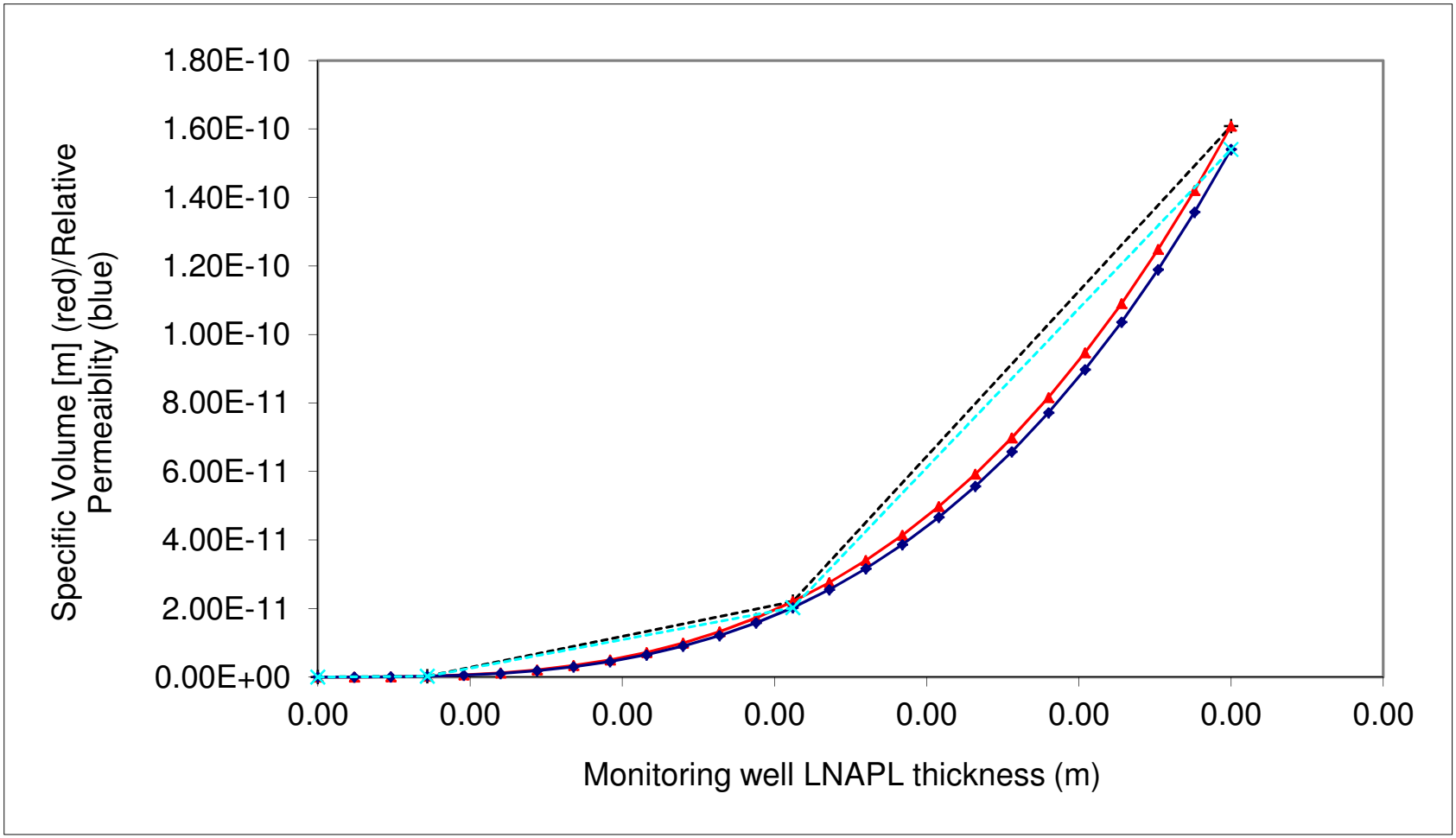
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.000 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.002 | 0.000 | 0.000 | 0.0003 | 0.000000 | 0.0003 | 0.000000 | 0.001 | Eps-Do |
| 0.003 | 0.000 | 0.000 | 0.0013 | 0.000000 | 0.0013 | 0.000000 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

**Gauged May 2011**

**AOI 8 / N-504**

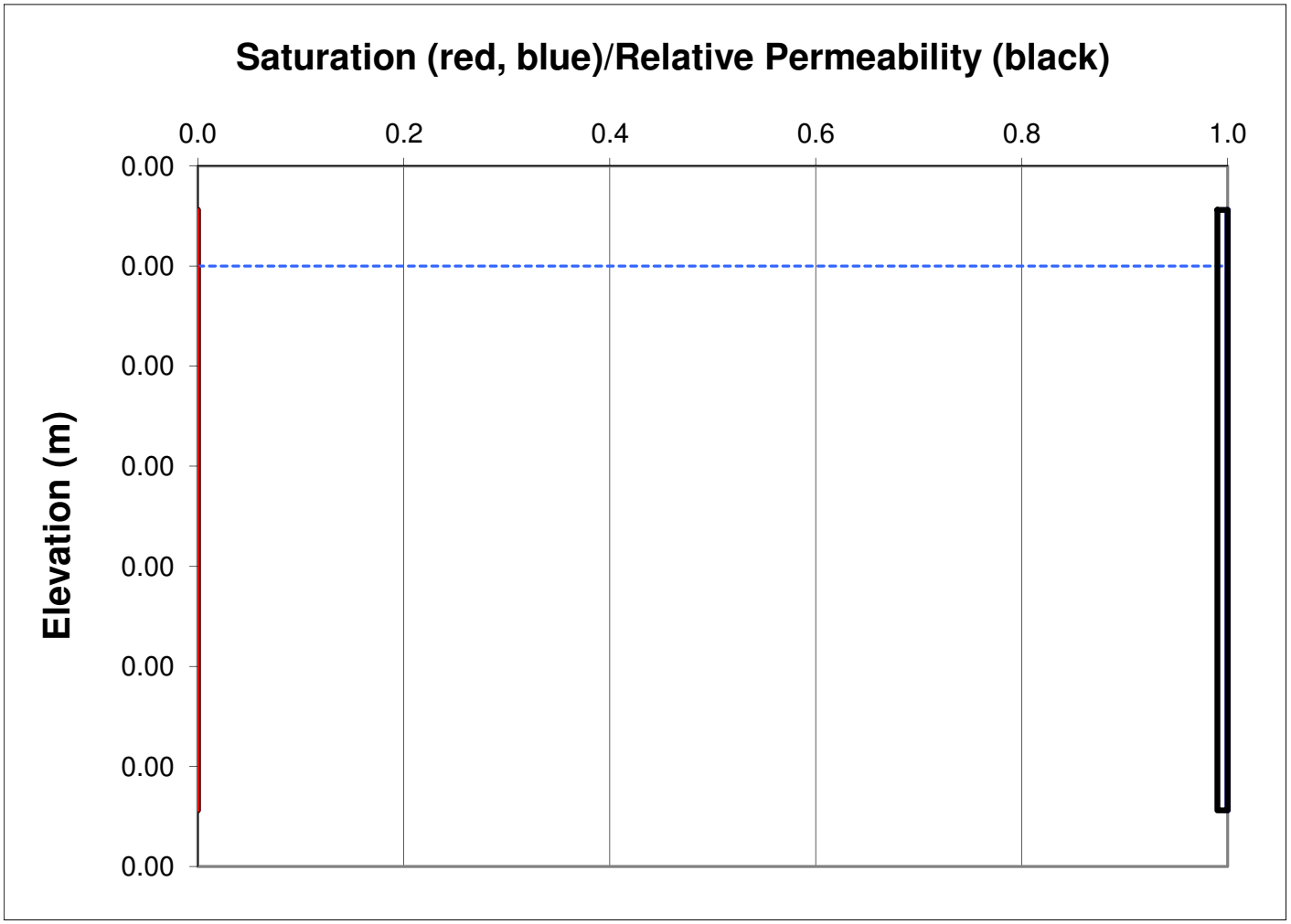


| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.003 |
|---|---|---|---|
| | $D_o$ = 1.608E-10 | $k_{ro}$ = | 1.541E-10 |

**Gauged May 2011**

**AOI 8 / N-504**

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | | |
|---|---|---|
| $b_o$ = | 0.881 | Gauged May 2011 **AOI 8 / N-125** 2.890 feet |

| Soil Characteristic | | **SP** |
|---|---|---|
| n = | 0.426 | porosity |
| N = | 1.980 | van Genuchten "N" |
| $\alpha$ = | 1.350 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.321 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Residual Oil** |
|---|---|---|
| $\rho_o$ = | 0.892 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.495 | van Genuchten "M" |
| $\alpha_{ao}$ = | 2.439 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.313 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.095 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.786 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.225 | maximum free-product elevation |
| $\lambda$ = | 0.738 | pore-size distribution index |
| $\Psi_b$ = | 0.461 | B-C displacement pressure head [m] |

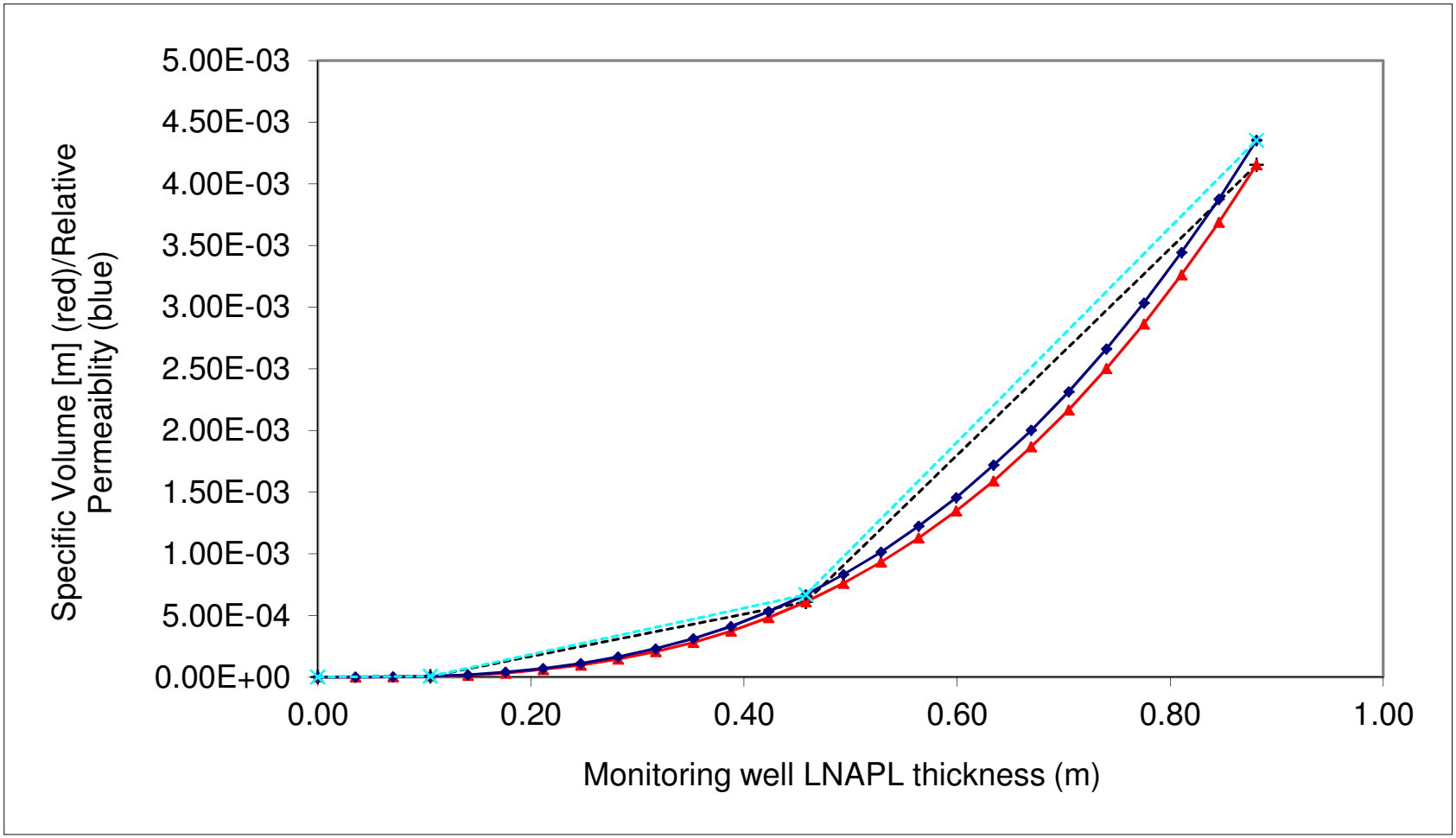
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.106 | 0.000 | 0.000 | 0.0000 | 0.000056 | 0.0000 | 0.000072 | | |
| 0.458 | 0.001 | 0.001 | 0.1022 | 0.001715 | 0.1017 | 0.001876 | 0.01 | Eps-Do |
| 0.881 | 0.004 | 0.004 | 0.3853 | 0.008378 | 0.3813 | 0.008712 | 0.01 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

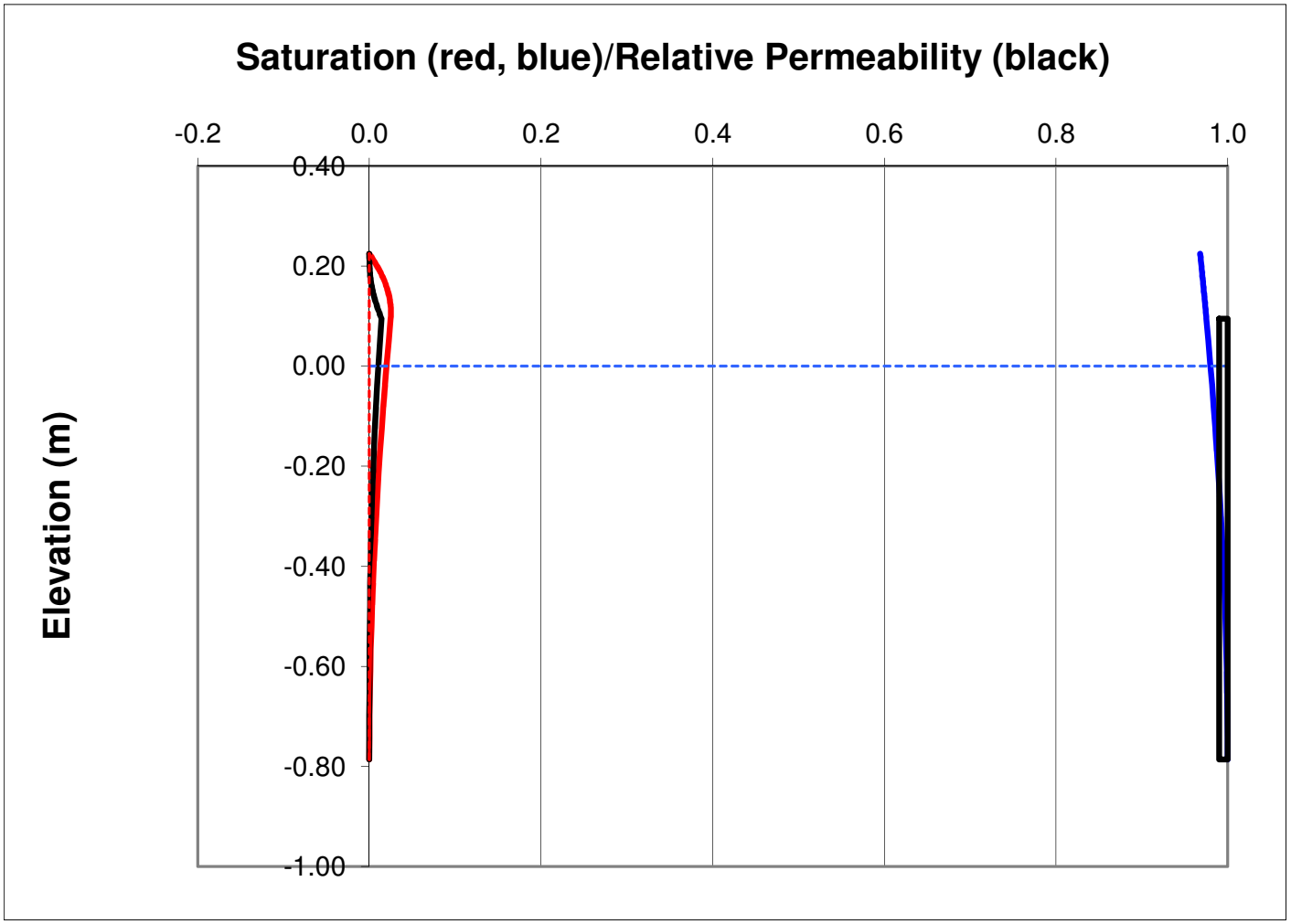
**Gauged May 2011**

**AOI 8 / N-125**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.881 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 4.153E-03 | $k_{ro}$ = 4.353E-03 | AOI 8 / N-125 |

**Press Ctrl+Shift+S to calculate sheet**



# *van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability*

**Enter Data in Yellow Region**

| **Maximum Monitoring Well LNAPL Thickness (meters)** | |
|---|---|
| $b_o$ = | 0.067 |

Gauged May 2011

**AOI 8 / N-45**

0.220 feet

| **Soil Characteristic** | | |
|---|---|---|
| | | **SW-SM** |
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| **Fluid Characteristics:** | | |
|---|---|---|
| | | **Residual Oil** |
| $\rho_o$ = | 0.892 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| **Calculated Parameters** | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.595 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.462 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.007 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.060 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.007 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

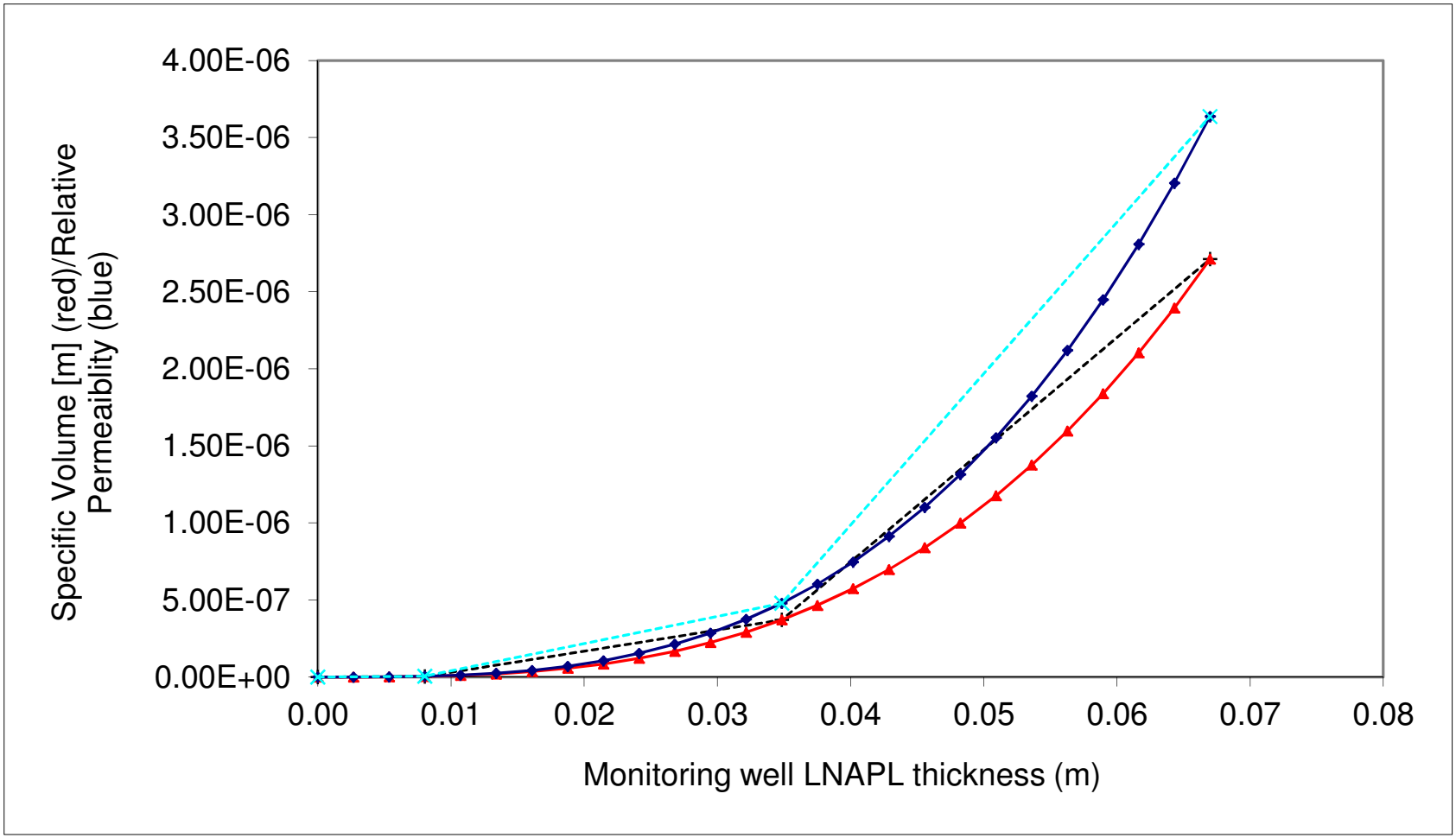
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.008 | 0.000 | 0.000 | 0.0000 | 0.000001 | 0.0000 | 0.000001 | | |
| 0.035 | 0.000 | 0.000 | 0.0077 | 0.000014 | 0.0078 | 0.000018 | 0.001 | Eps-Do |
| 0.067 | 0.000 | 0.000 | 0.0297 | 0.000073 | 0.0300 | 0.000098 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

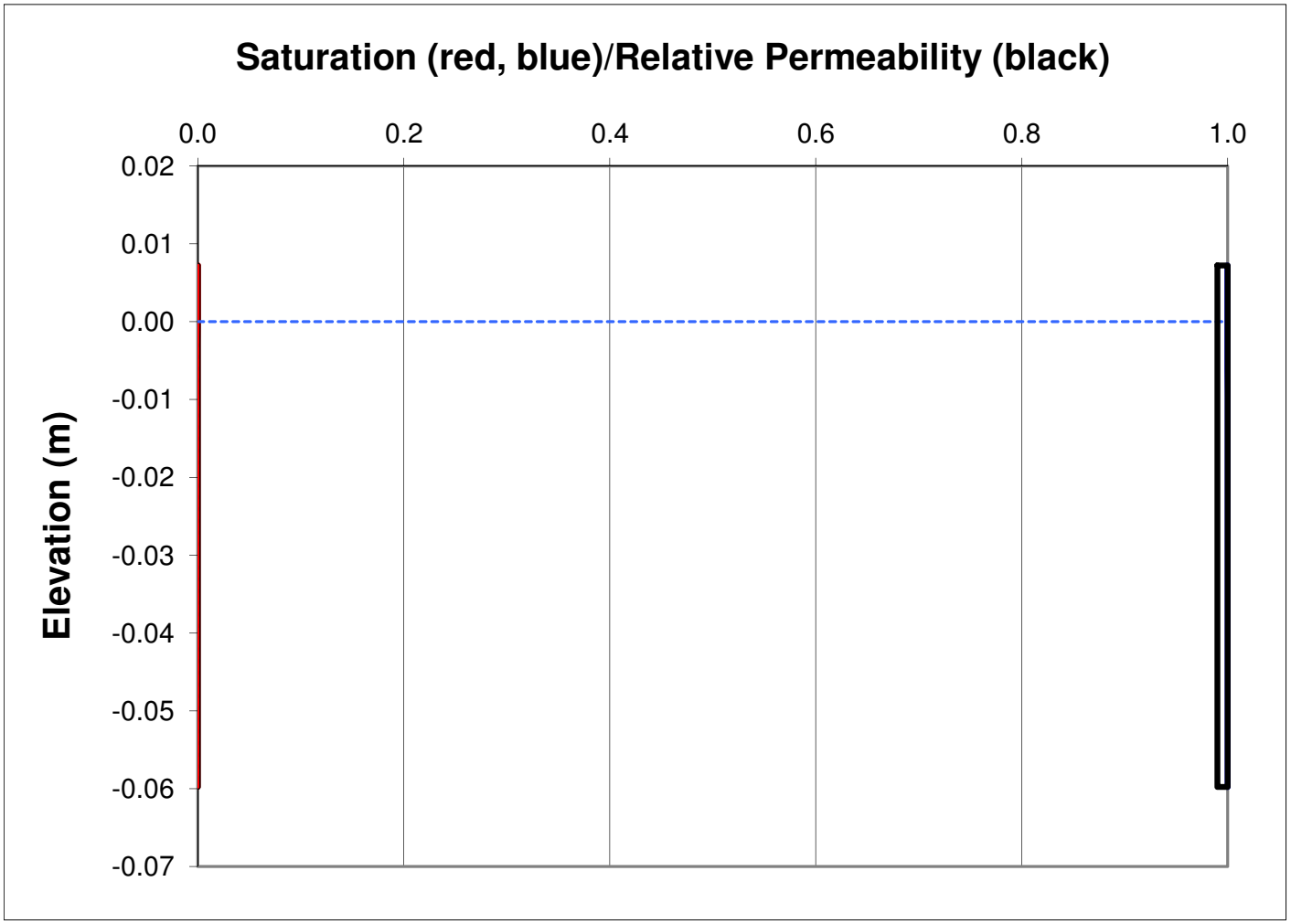
**Gauged May 2011**

**AOI 8 / N-45**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.067 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = 2.711E-06 | $k_{ro}$ = | 3.637E-06 | AOI 8 / N-45 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.317 |

Gauged May 2011

**AOI 8 / N-51**

1.040 feet

| Soil Characteristic | | **SM** |
|---|---|---|
| n = | 0.428 | porosity |
| N = | 2.160 | van Genuchten "N" |
| $\alpha$ = | 2.750 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.313 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Residual Oil** |
|---|---|---|
| $\rho_o$ = | 0.900 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.537 | van Genuchten "M" |
| $\alpha_{ao}$ = | 5.009 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.595 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.032 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.285 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.082 | maximum free-product elevation |
| $\lambda$ = | 0.841 | pore-size distribution index |
| $\Psi_b$ = | 0.227 | B-C displacement pressure head [m] |

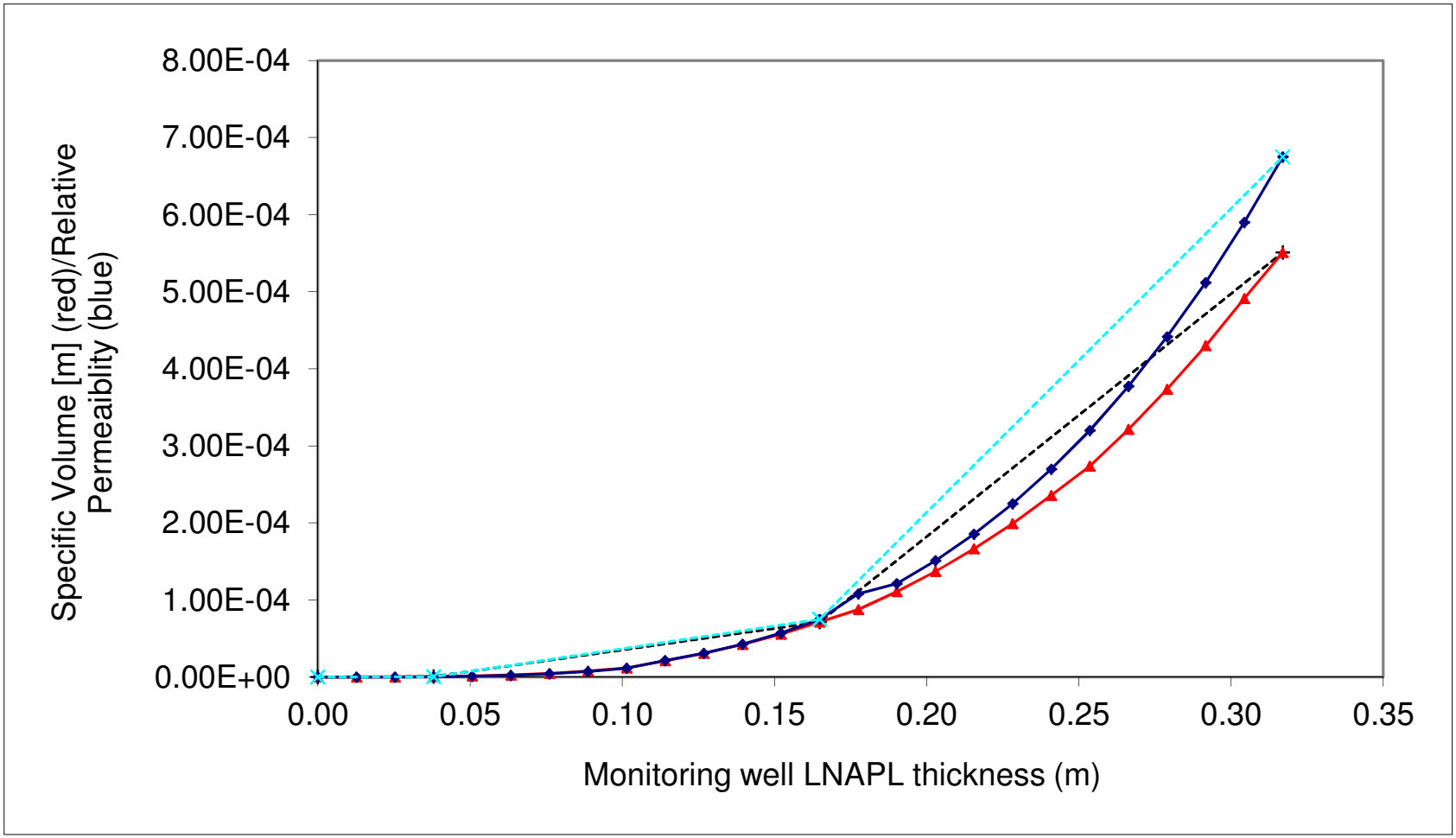
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.038 | 0.000 | 0.000 | 0.0000 | 0.000014 | 0.0000 | 0.000011 | | |
| 0.165 | 0.000 | 0.000 | 0.0371 | 0.000558 | 0.0374 | 0.000589 | 0.1 | Eps-Do |
| 0.317 | 0.001 | 0.001 | 0.1422 | 0.003152 | 0.1458 | 0.003944 | 0.1 | Eps-kro |

Press Ctrl+Shift+S to calculate sheet

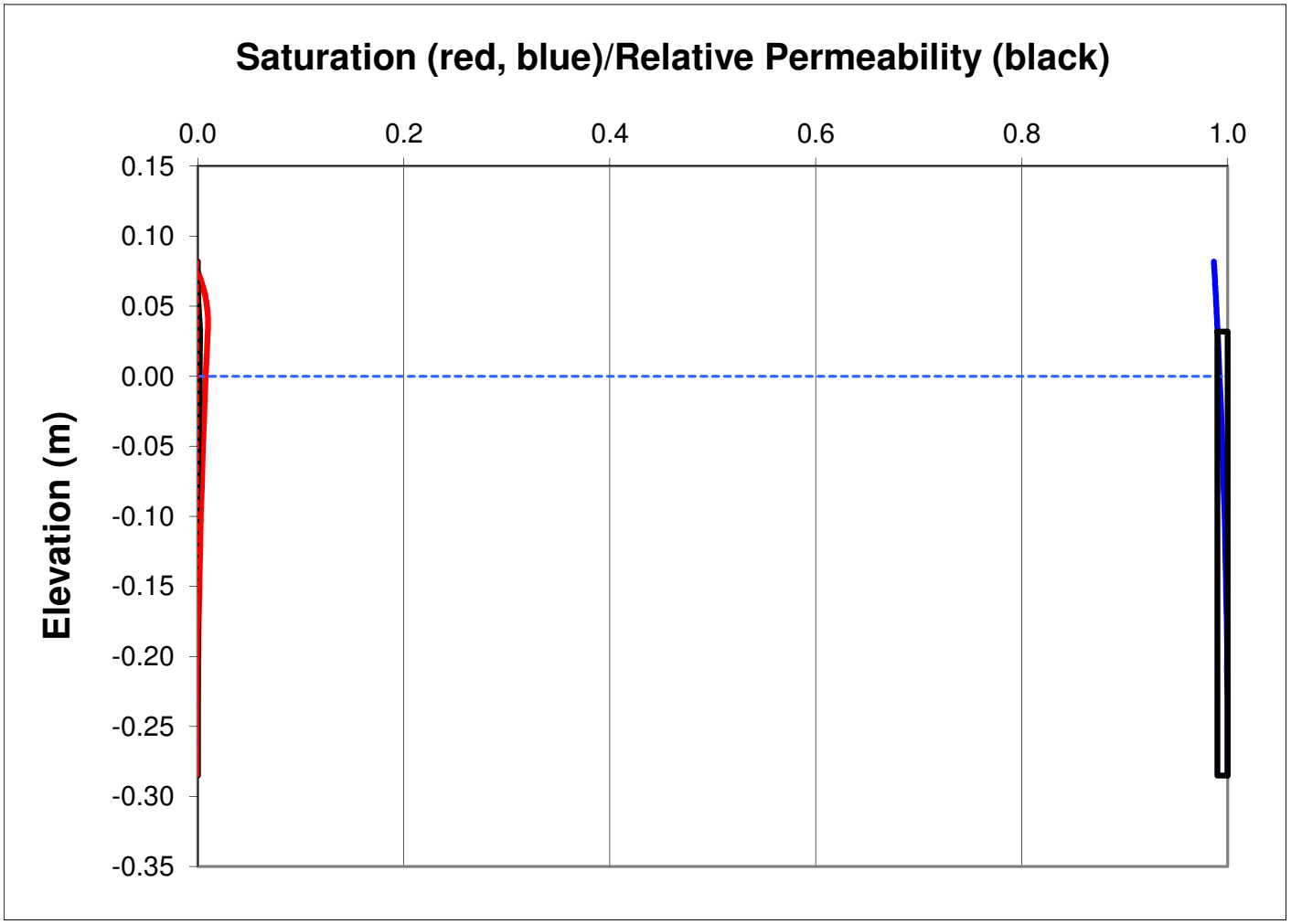
**Gauged May 2011**

**AOI 8 / N-51**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.317 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = 5.509E-04 | $k_{ro}$ = | 6.751E-04 | AOI 8 / N-51 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.006 |

Gauged May 2011

**AOI 8 / N-52**

0.020 feet

| Soil Characteristic | | |
|---|---|---|
| | | **SM** |
| n = | 0.428 | porosity |
| N = | 2.160 | van Genuchten "N" |
| $\alpha$ = | 2.750 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.313 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | |
|---|---|---|
| | | **Residual Oil** |
| $\rho_o$ = | 0.861 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.537 | van Genuchten "M" |
| $\alpha_{ao}$ = | 4.796 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.821 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.001 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.005 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.001 | maximum free-product elevation |
| $\lambda$ = | 0.841 | pore-size distribution index |
| $\Psi_b$ = | 0.227 | B-C displacement pressure head [m] |

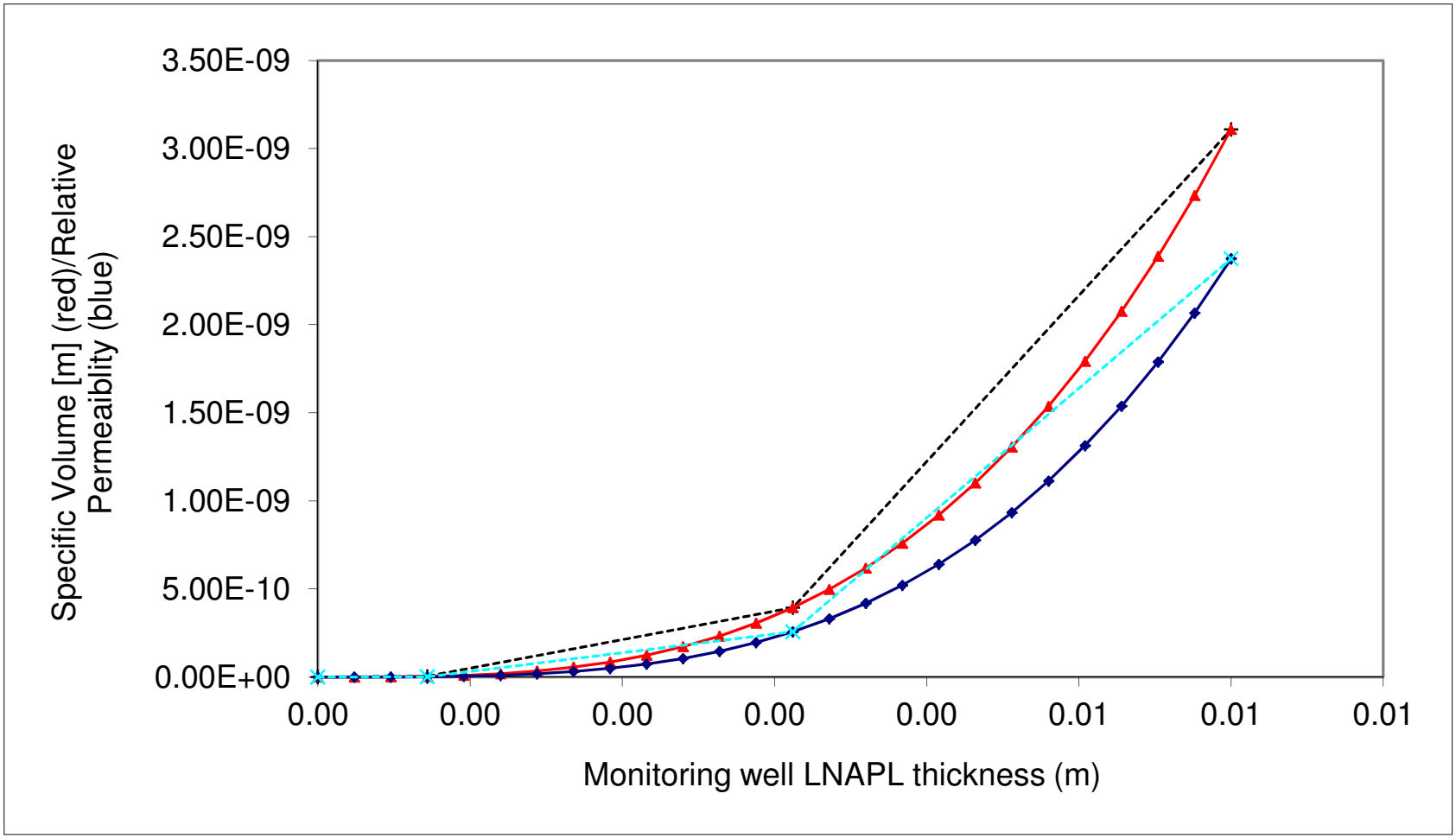
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.001 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.003 | 0.000 | 0.000 | 0.0007 | 0.000000 | 0.0007 | 0.000000 | 0.001 | Eps-Do |
| 0.006 | 0.000 | 0.000 | 0.0027 | 0.000001 | 0.0028 | 0.000001 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

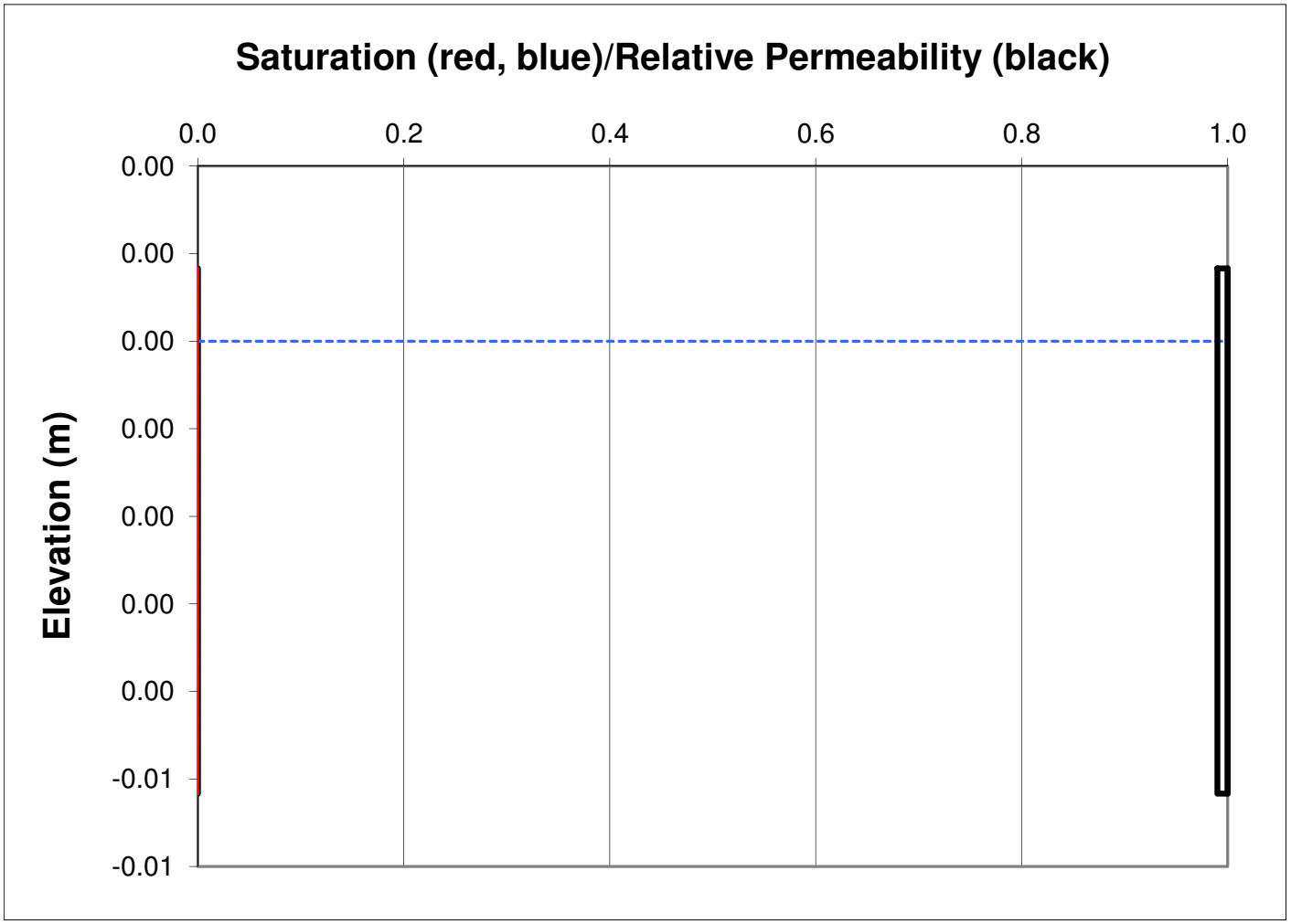
**Gauged May 2011**

**AOI 8 / N-52**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.006 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 3.109E-09 | $k_{ro}$ = 2.375E-09 | AOI 8 / N-52 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.198 |

Gauged May 2011

**AOI 8 / N-128**

0.650 feet

| Soil Characteristic | | **SM** |
|---|---|---|
| n = | 0.428 | porosity |
| N = | 2.160 | van Genuchten "N" |
| $\alpha$ = | 2.750 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.313 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

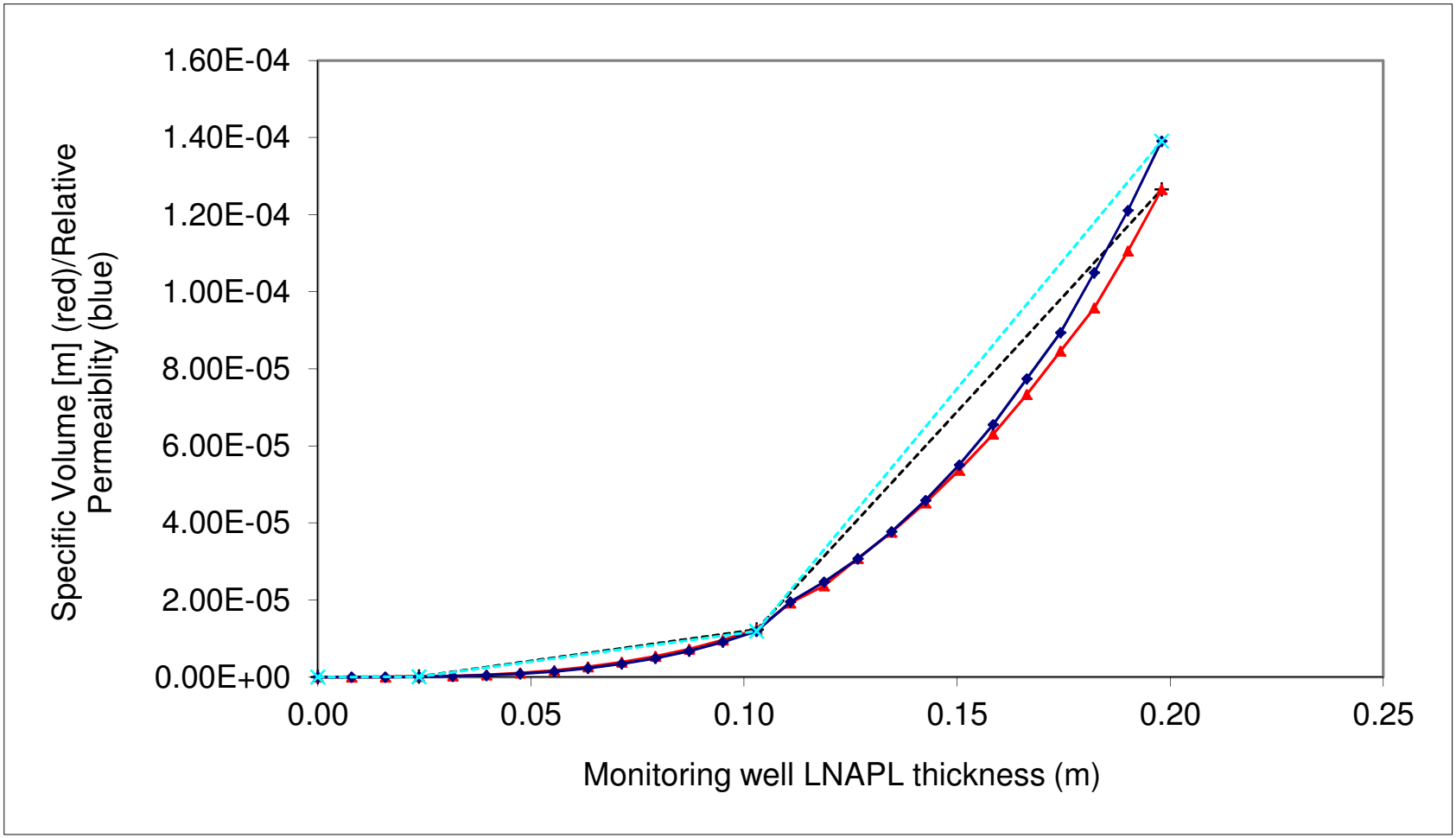
| Fluid Characteristics: | | **Residual Oil** |
|---|---|---|
| $\rho_o$ = | 0.900 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.537 | van Genuchten "M" |
| $\alpha_{ao}$ = | 5.009 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.595 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.020 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.178 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.050 | maximum free-product elevation |
| $\lambda$ = | 0.841 | pore-size distribution index |
| $\Psi_b$ = | 0.227 | B-C displacement pressure head [m] |

**Press Ctrl+Shift+S to calculate sheet**

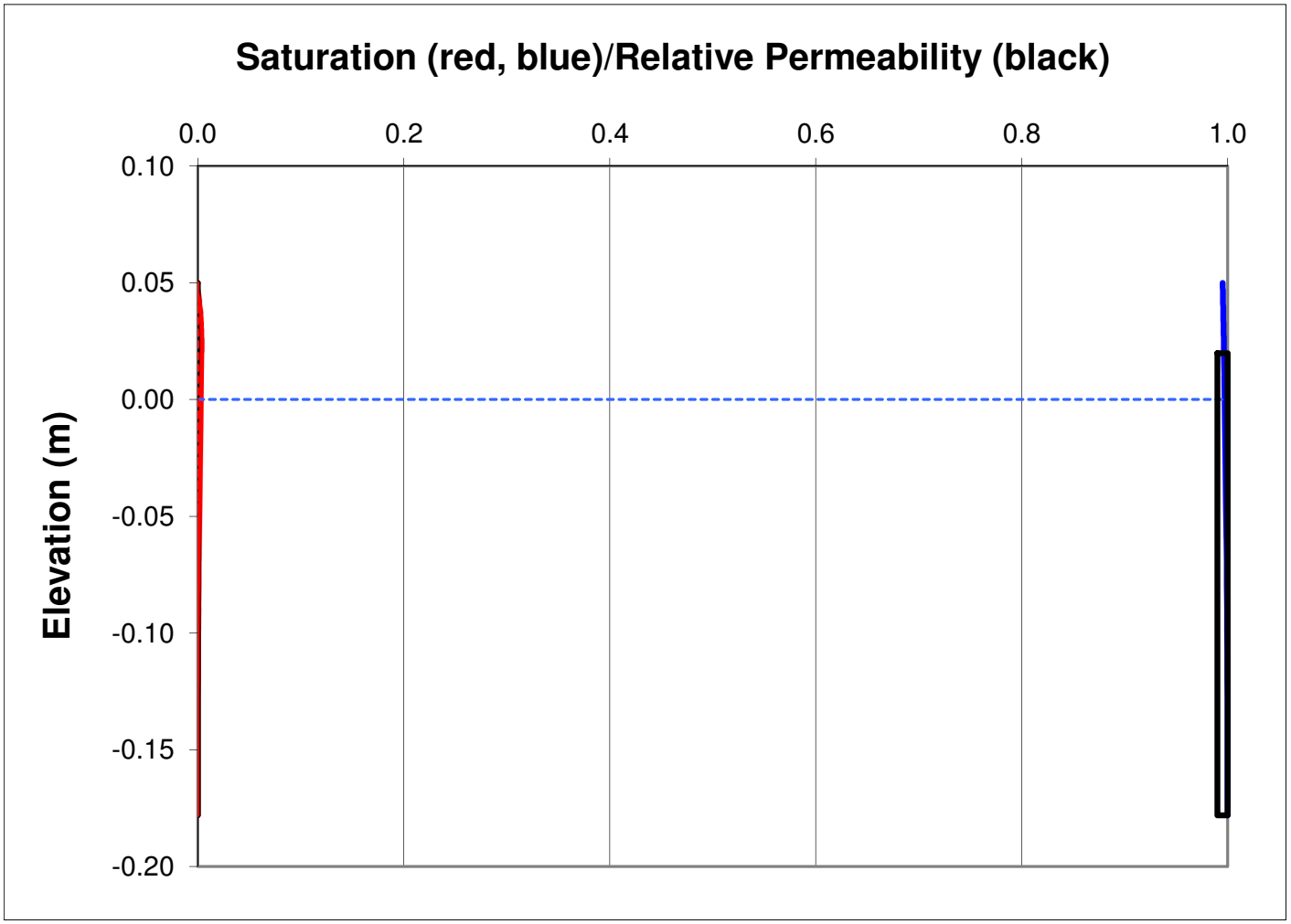
| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | Gauged May 2011 | |
| 0.000 | 0.000 | 0.000 | | | | | AOI 8 / N-128 | |
| 0.024 | 0.000 | 0.000 | 0.0000 | 0.000005 | 0.0000 | 0.000003 | | |
| 0.103 | 0.000 | 0.000 | 0.0230 | 0.000154 | 0.0232 | 0.000149 | 0.1 | Eps-Do |
| 0.198 | 0.000 | 0.000 | 0.0927 | 0.001202 | 0.0941 | 0.001338 | 0.1 | Eps-kro |

Press Ctrl+Shift+S to calculate sheet



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.198 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 1.265E-04 | $k_{ro}$ = 1.391E-04 | AOI 8 / N-128 |

**Press Ctrl+Shift+S to calculate sheet**



# *van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability*

**Enter Data in Yellow Region**

| **Maximum Monitoring Well LNAPL Thickness (meters)** | |
|---|---|
| $b_o$ = | 0.003 |

Gauged May 2011

**AOI 8 / RW-201**

0.010 feet

| **Soil Characteristic** | | **SM** |
|---|---|---|
| n = | 0.428 | porosity |
| N = | 2.160 | van Genuchten "N" |
| $\alpha$ = | 2.750 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.313 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| **Fluid Characteristics:** | | **Residual Oil** |
|---|---|---|
| $\rho_o$ = | 0.879 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| **Calculated Parameters** | | |
|---|---|---|
| M = | 0.537 | van Genuchten "M" |
| $\alpha_{ao}$ = | 4.892 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.719 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.000 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.003 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.000 | maximum free-product elevation |
| $\lambda$ = | 0.841 | pore-size distribution index |
| $\Psi_b$ = | 0.227 | B-C displacement pressure head [m] |

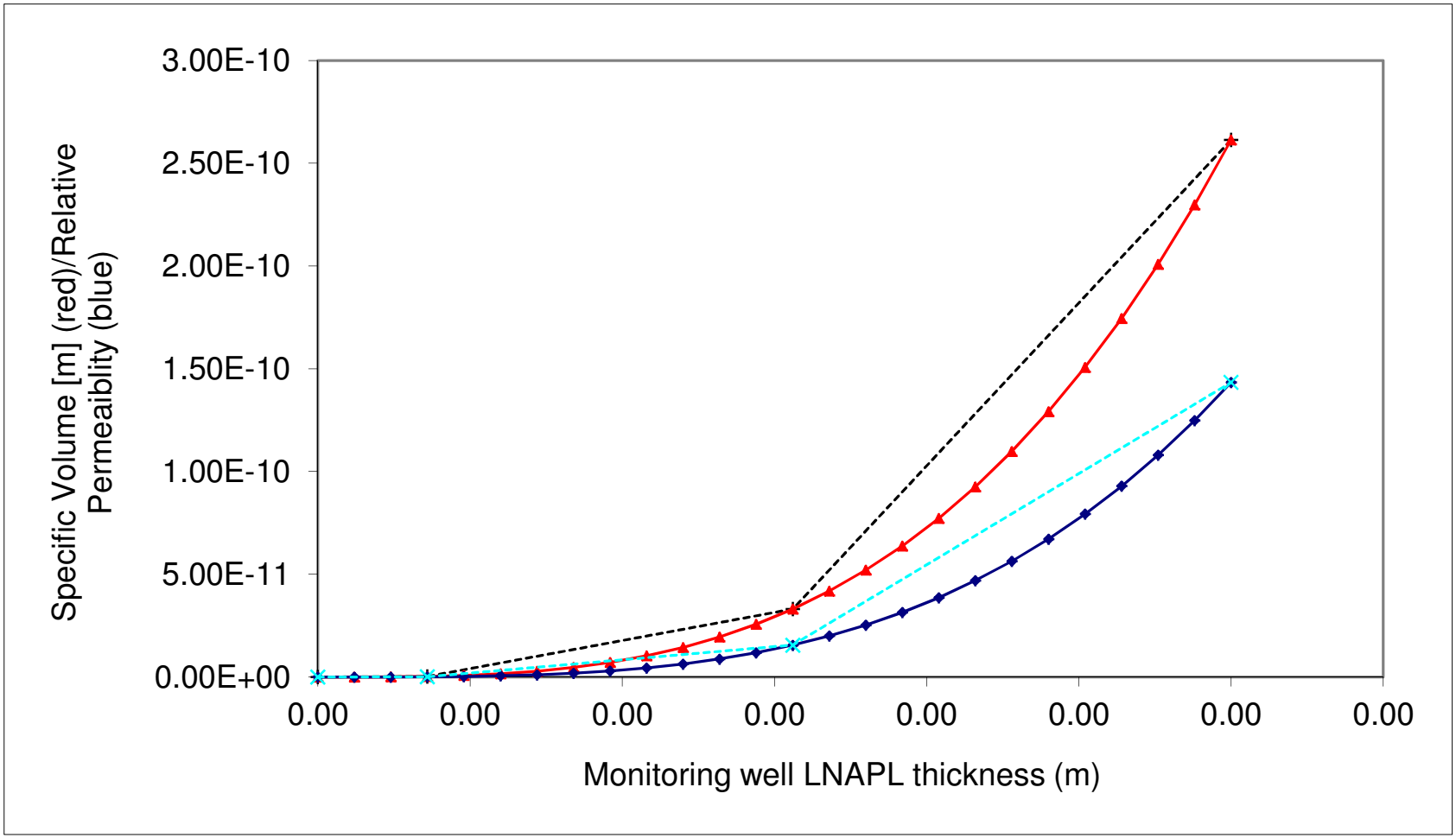
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.000 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.002 | 0.000 | 0.000 | 0.0003 | 0.000000 | 0.0004 | 0.000000 | 0.001 | Eps-Do |
| 0.003 | 0.000 | 0.000 | 0.0014 | 0.000000 | 0.0014 | 0.000000 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

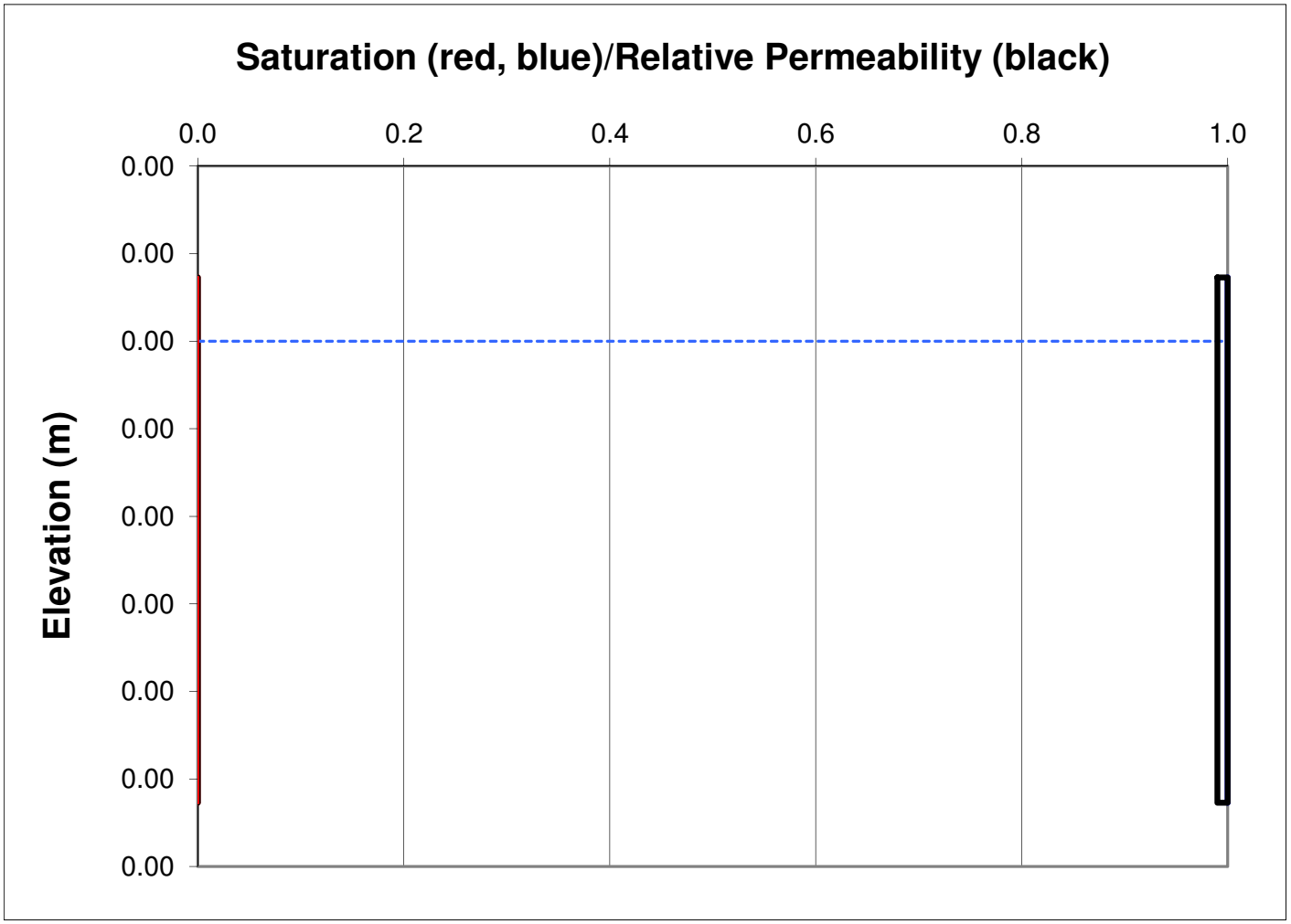
**Gauged May 2011**

**AOI 8 / RW-201**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.003 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = 2.613E-10 | $k_{ro}$ = | 1.434E-10 | AOI 8 / RW-201 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.006 |

Gauged May 2011

**AOI 8 / RW-203**

0.020 feet

| Soil Characteristic | | **SM** |
|---|---|---|
| n = | 0.428 | porosity |
| N = | 2.160 | van Genuchten "N" |
| $\alpha$ = | 2.750 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.313 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Residual Oil** |
|---|---|---|
| $\rho_o$ = | 0.900 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.537 | van Genuchten "M" |
| $\alpha_{ao}$ = | 5.009 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.595 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.001 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.005 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.001 | maximum free-product elevation |
| $\lambda$ = | 0.841 | pore-size distribution index |
| $\Psi_b$ = | 0.227 | B-C displacement pressure head [m] |

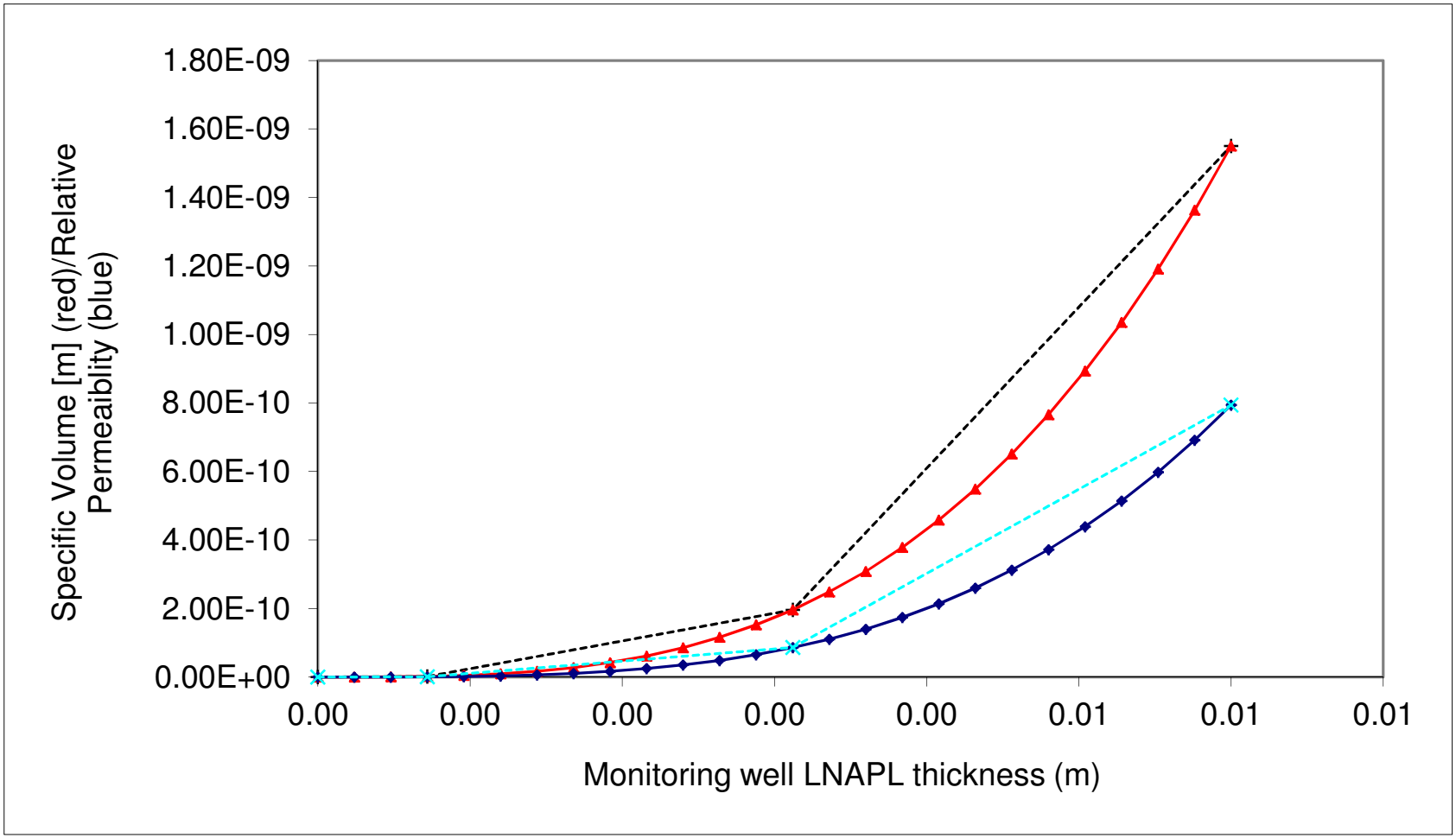
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.001 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.003 | 0.000 | 0.000 | 0.0007 | 0.000000 | 0.0007 | 0.000000 | 0.001 | Eps-Do |
| 0.006 | 0.000 | 0.000 | 0.0027 | 0.000000 | 0.0028 | 0.000000 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

**Gauged May 2011**

**AOI 8 / RW-203**

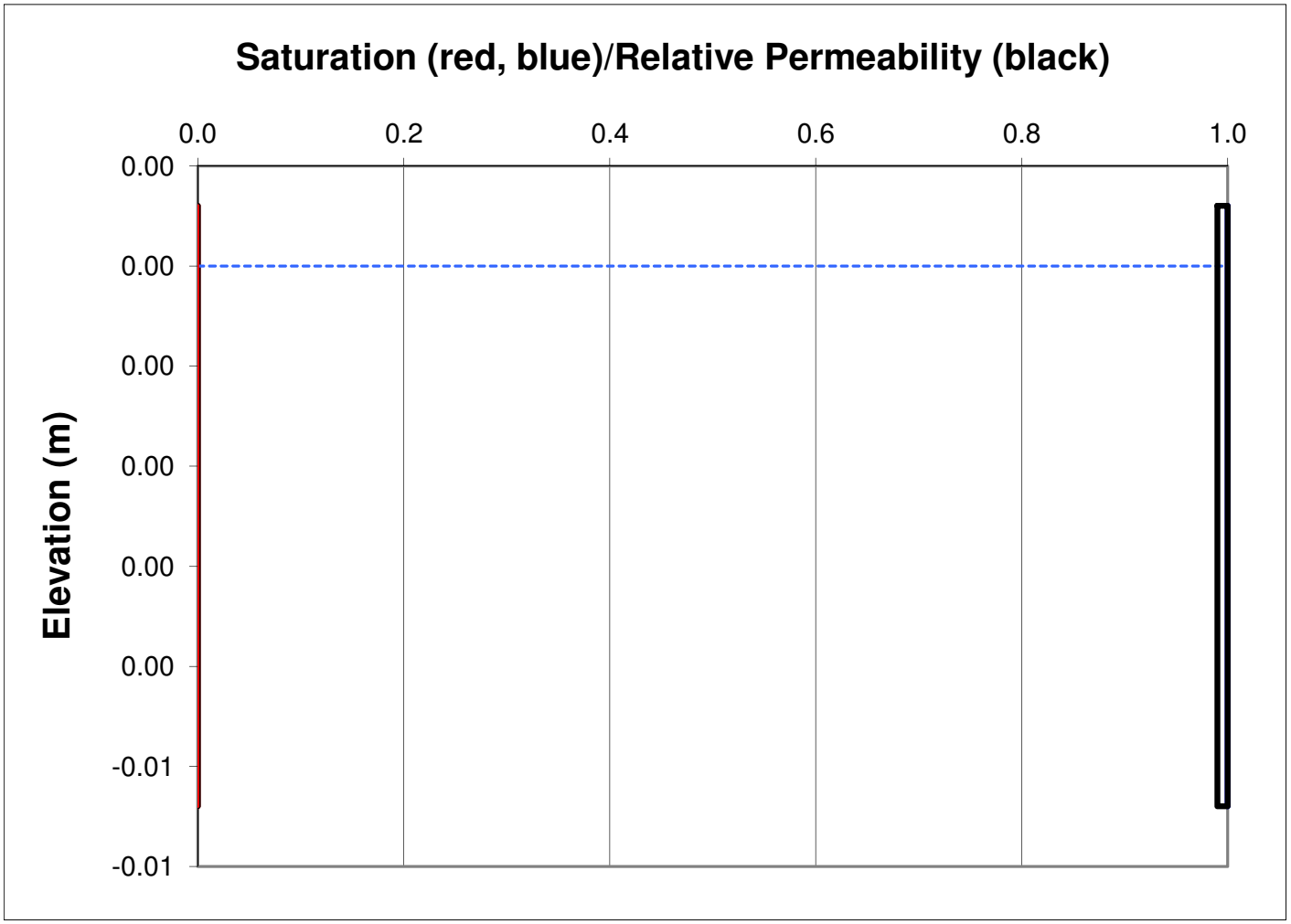


| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.006 |
|---|---|---|---|
| | $D_o$ = 1.550E-09 | $k_{ro}$ = | 7.942E-10 |

**Gauged May 2011**

**AOI 8 / RW-203**

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.341 |

Gauged May 2011

**AOI 8 / RW-204**

1.120 feet

| Soil Characteristic | | **SM** |
|---|---|---|
| n = | 0.428 | porosity |
| N = | 2.160 | van Genuchten "N" |
| $\alpha$ = | 2.750 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.313 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Residual Oil** |
|---|---|---|
| $\rho_o$ = | 0.900 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 32.100 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 30.200 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.537 | van Genuchten "M" |
| $\alpha_{ao}$ = | 5.009 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.595 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.034 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.307 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.084 | maximum free-product elevation |
| $\lambda$ = | 0.841 | pore-size distribution index |
| $\Psi_b$ = | 0.227 | B-C displacement pressure head [m] |

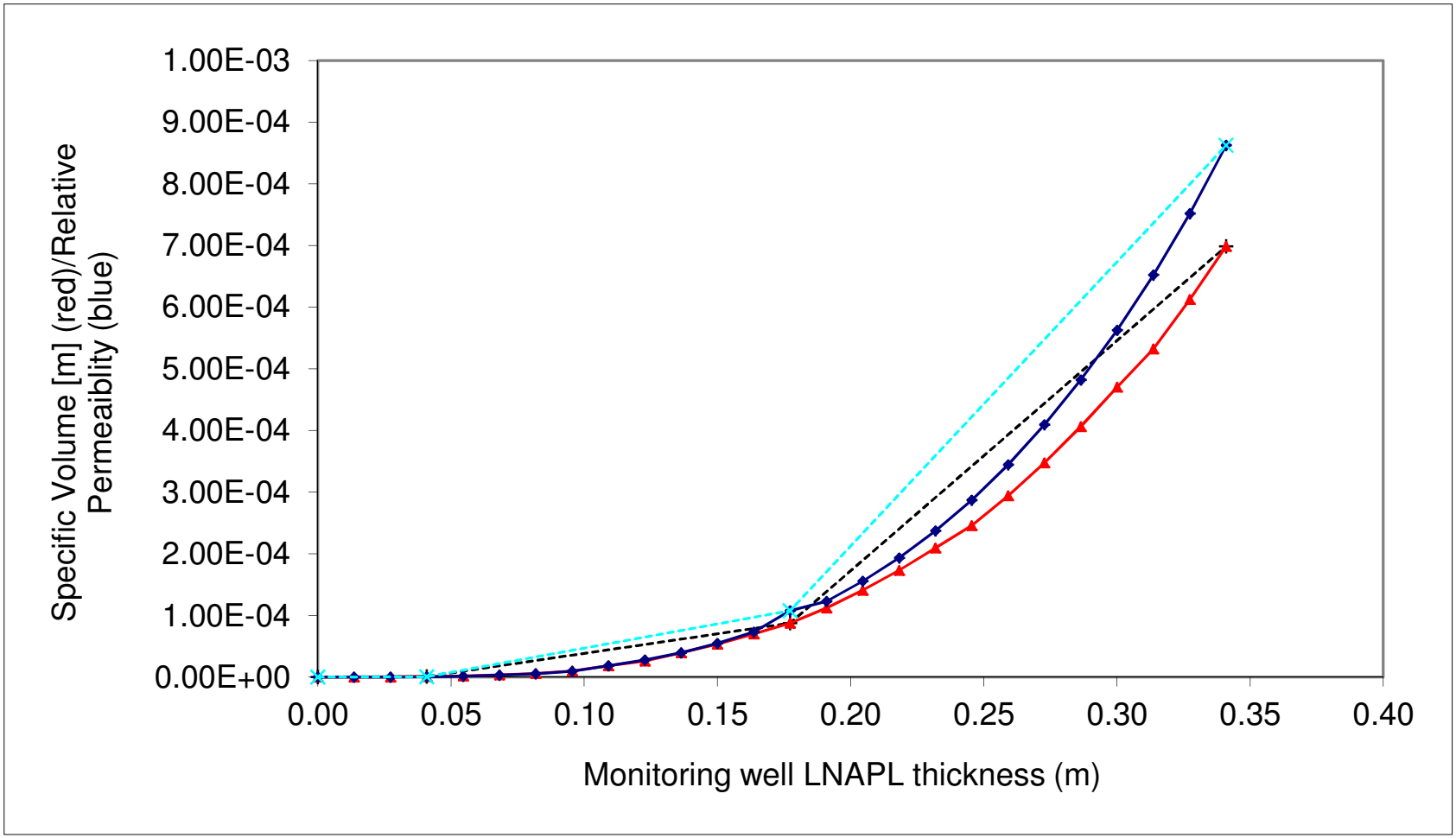
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.041 | 0.000 | 0.000 | 0.0000 | 0.000016 | 0.0000 | 0.000013 | | |
| 0.177 | 0.000 | 0.000 | 0.0399 | 0.000635 | 0.0403 | 0.000784 | 0.1 | Eps-Do |
| 0.341 | 0.001 | 0.001 | 0.1540 | 0.003735 | 0.1540 | 0.004612 | 0.1 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

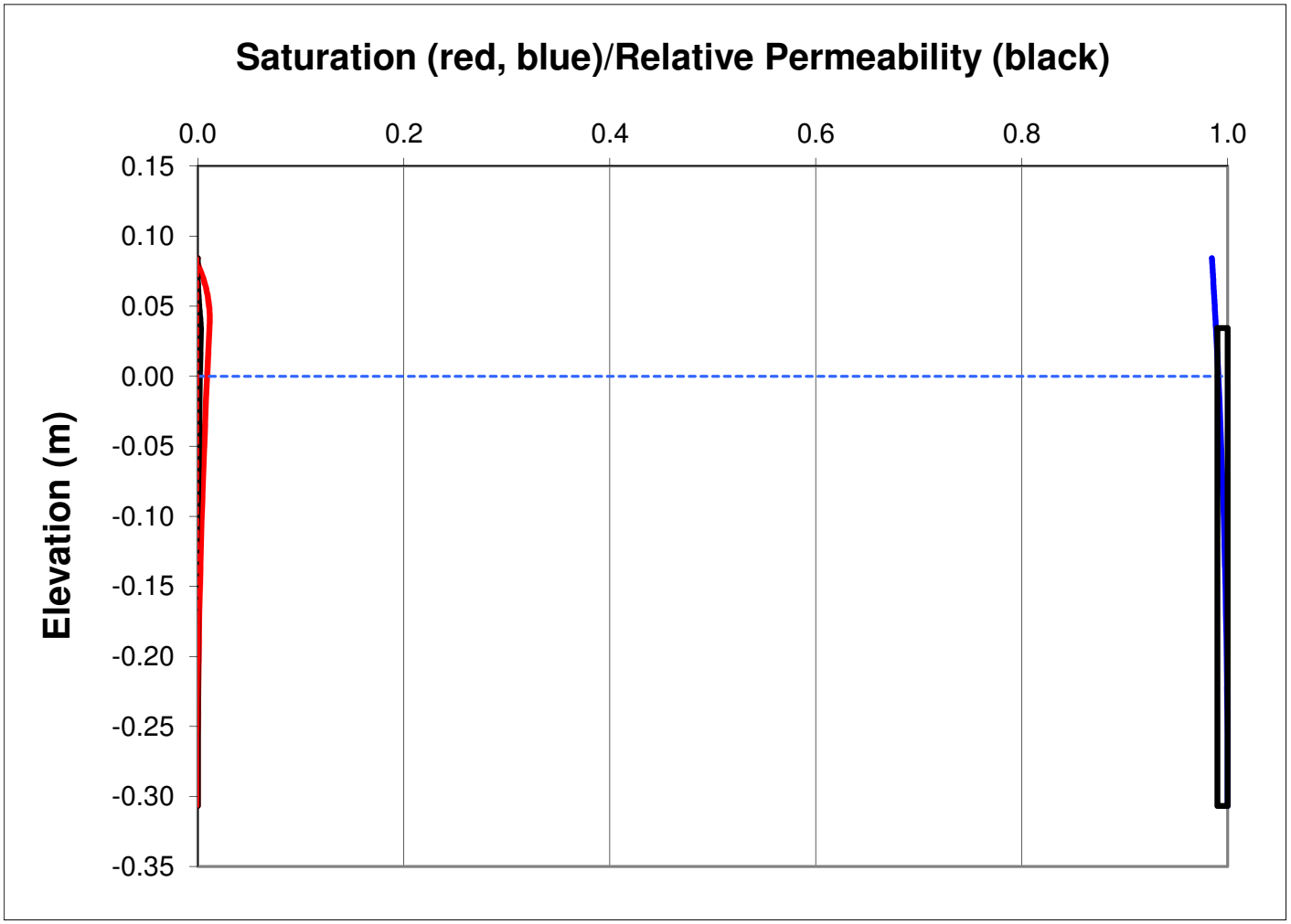
**Gauged May 2011**

**AOI 8 / RW-204**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.341 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 6.986E-04 | $k_{ro}$ = 8.624E-04 | AOI 8 / RW-204 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.003 |

Gauged May 2011

**AOI 8 / N-79**

0.010 feet

| Soil Characteristic | | |
|---|---|---|
| | | **SW-SM** |
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | |
|---|---|---|
| | | **Middle Distillate** |
| $\rho_o$ = | 0.817 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 26.900 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 22.300 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.928 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 1.062 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.001 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.002 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.001 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

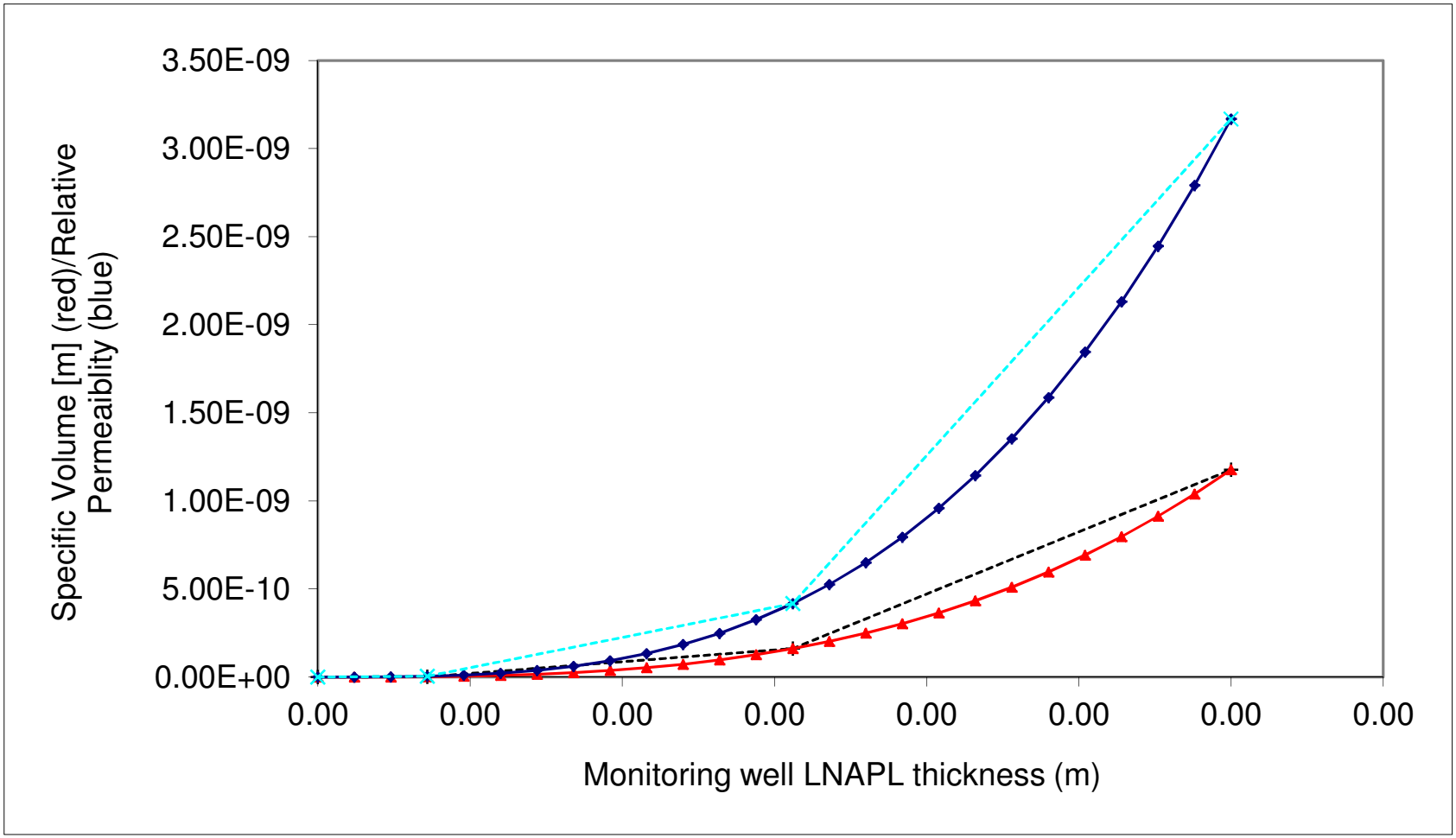
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.000 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.002 | 0.000 | 0.000 | 0.0003 | 0.000000 | 0.0003 | 0.000000 | 0.001 | Eps-Do |
| 0.003 | 0.000 | 0.000 | 0.0013 | 0.000001 | 0.0013 | 0.000002 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

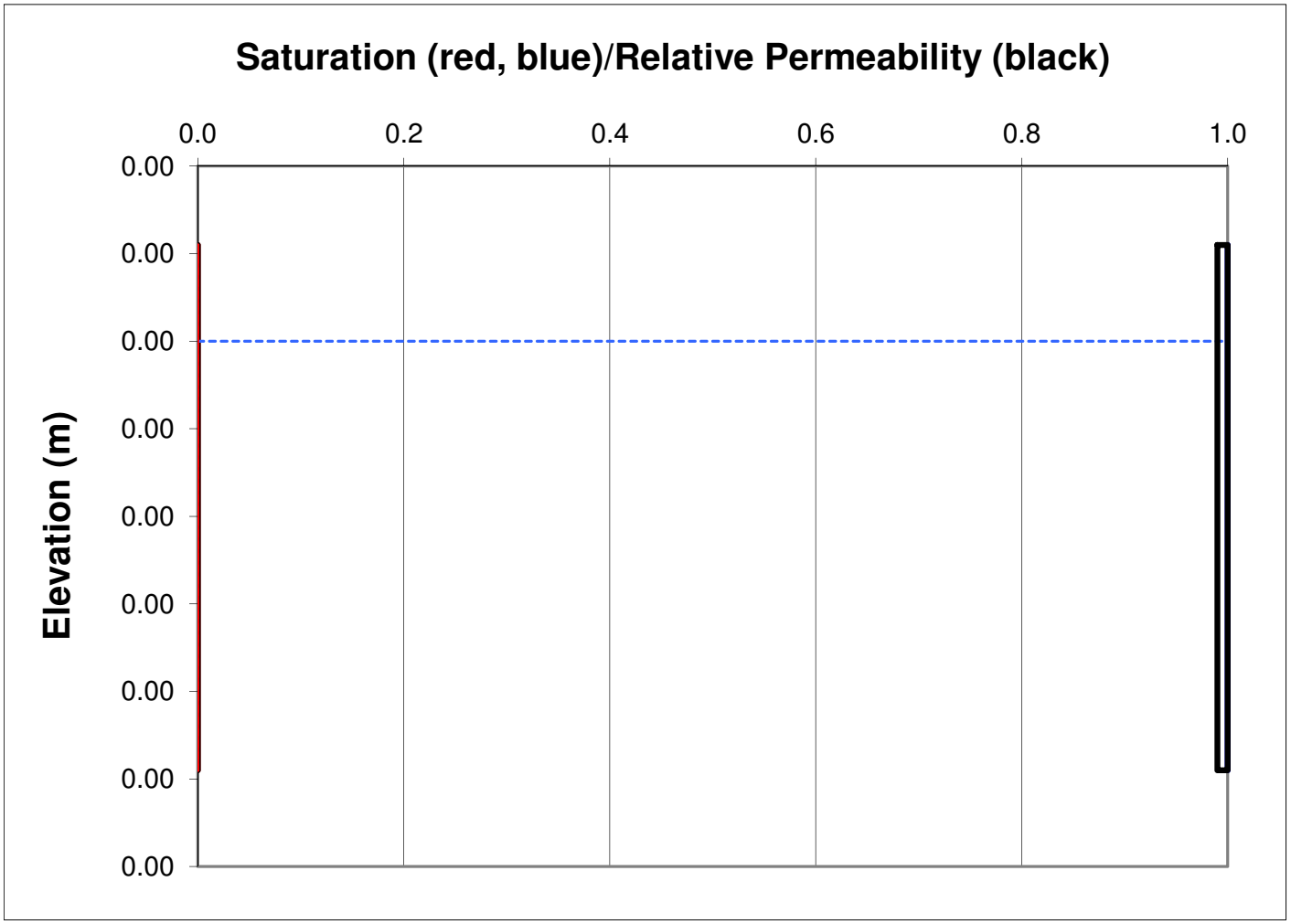
**Gauged May 2011**

**AOI 8 / N-79**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.003 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = 1.176E-09 | $k_{ro}$ = | 3.168E-09 | AOI 8 / N-79 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | |
|---|---|
| $b_o$ = | 0.003 |

Gauged May 2011

**AOI 8 / N-115**

0.010 feet

| Soil Characteristic | | **SW-SM** |
|---|---|---|
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Middle Distillate** |
|---|---|---|
| $\rho_o$ = | 0.890 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 26.900 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 22.300 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 4.280 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.638 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.000 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.003 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.000 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

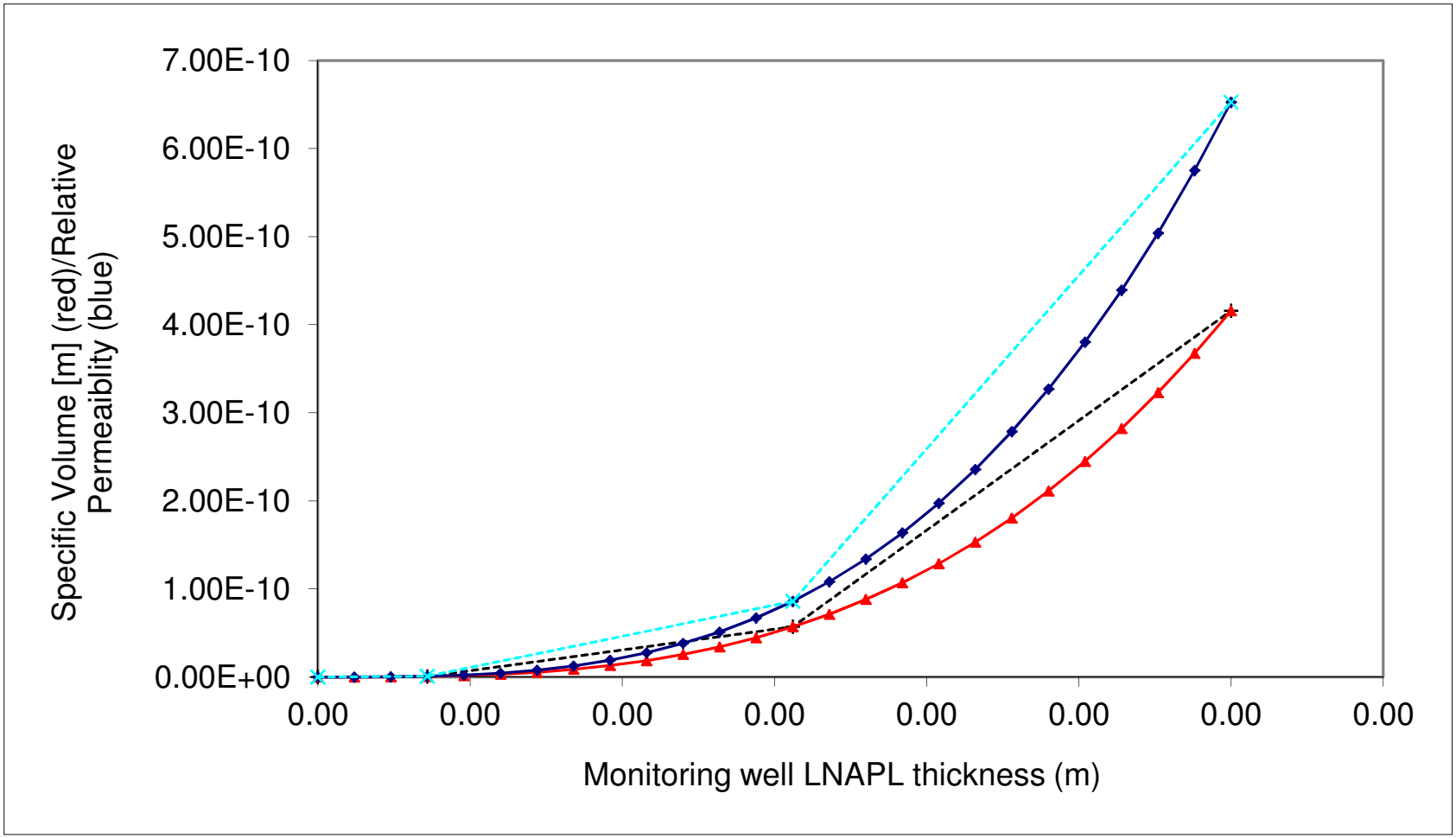
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.000 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.002 | 0.000 | 0.000 | 0.0003 | 0.000000 | 0.0003 | 0.000000 | 0.001 | Eps-Do |
| 0.003 | 0.000 | 0.000 | 0.0013 | 0.000000 | 0.0013 | 0.000000 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

**Gauged May 2011**

**AOI 8 / N-115**

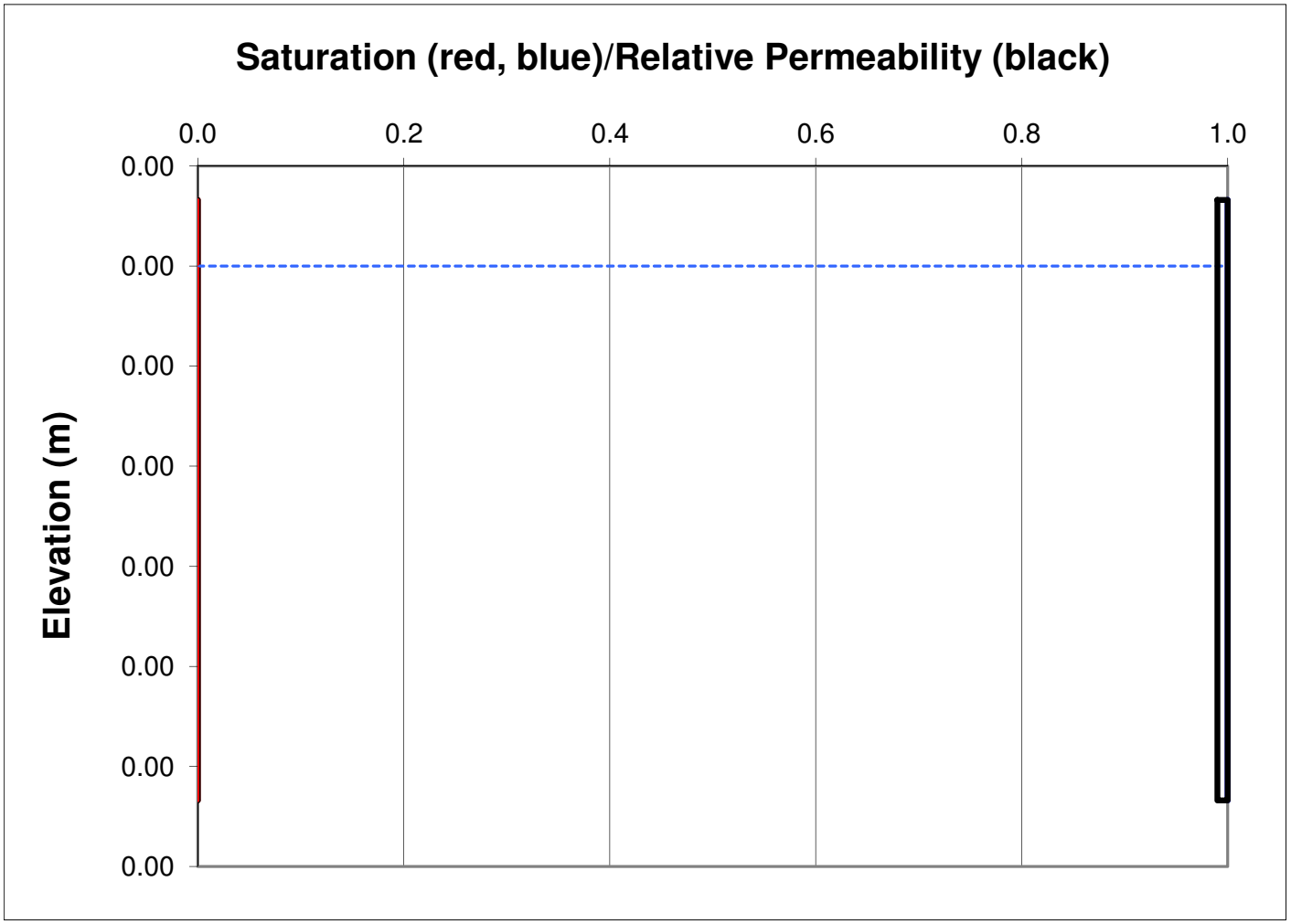


| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.003 |
|---|---|---|---|
| | $D_o$ = 4.159E-10 | $k_{ro}$ = | 6.528E-10 |

**Gauged May 2011**

**AOI 8 / N-115**

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | | |
|---|---|---|
| $b_o$ = | 0.003 | Gauged May 2011 **AOI 8 / RW-306** 0.010 feet |

| Soil Characteristic | | **SW-SM** |
|---|---|---|
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Middle Distillate** |
|---|---|---|
| $\rho_o$ = | 0.817 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 26.900 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 22.300 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 3.928 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 1.062 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.001 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.002 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.001 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

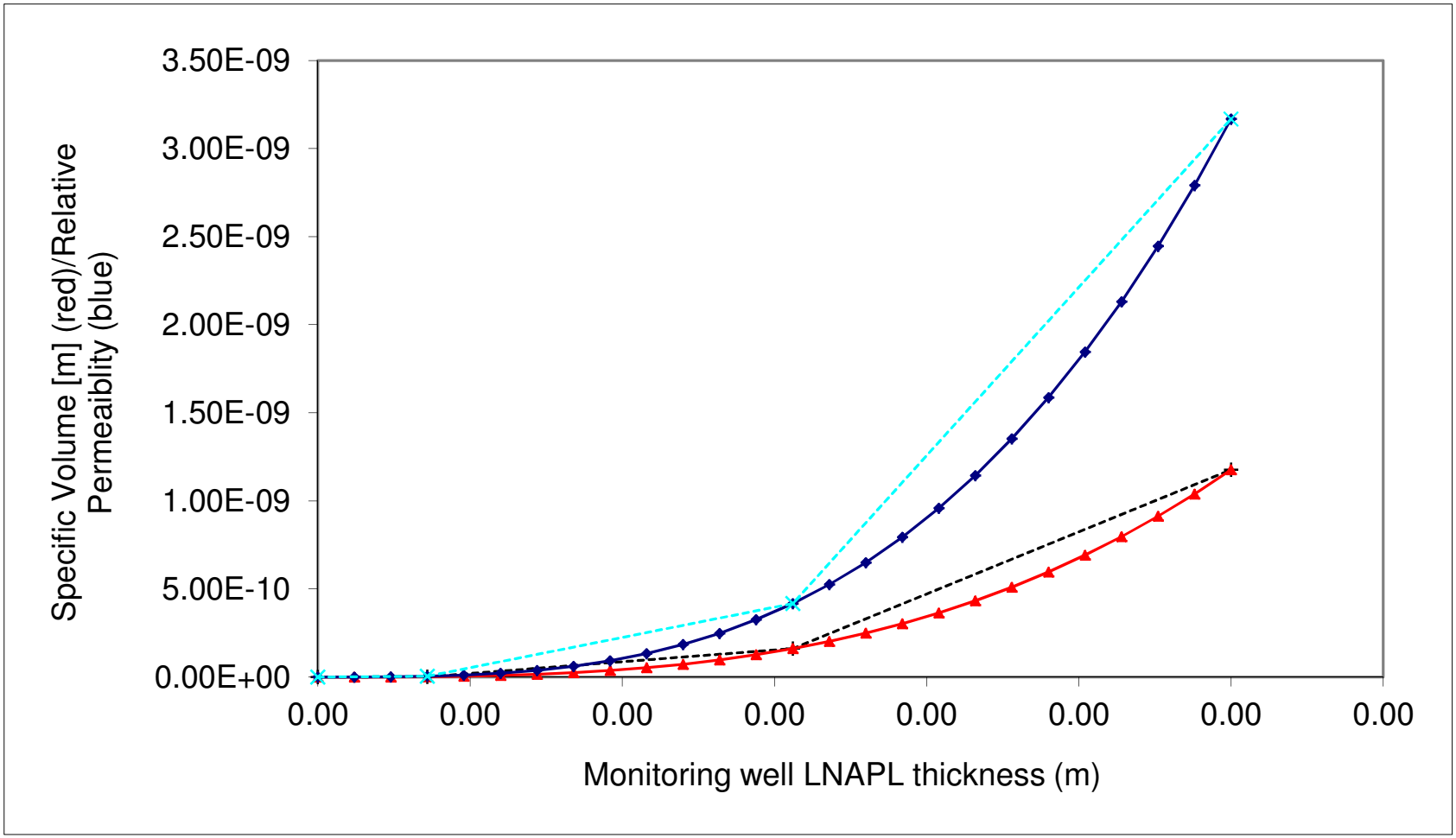
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.000 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.002 | 0.000 | 0.000 | 0.0003 | 0.000000 | 0.0003 | 0.000000 | 0.001 | Eps-Do |
| 0.003 | 0.000 | 0.000 | 0.0013 | 0.000001 | 0.0013 | 0.000002 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

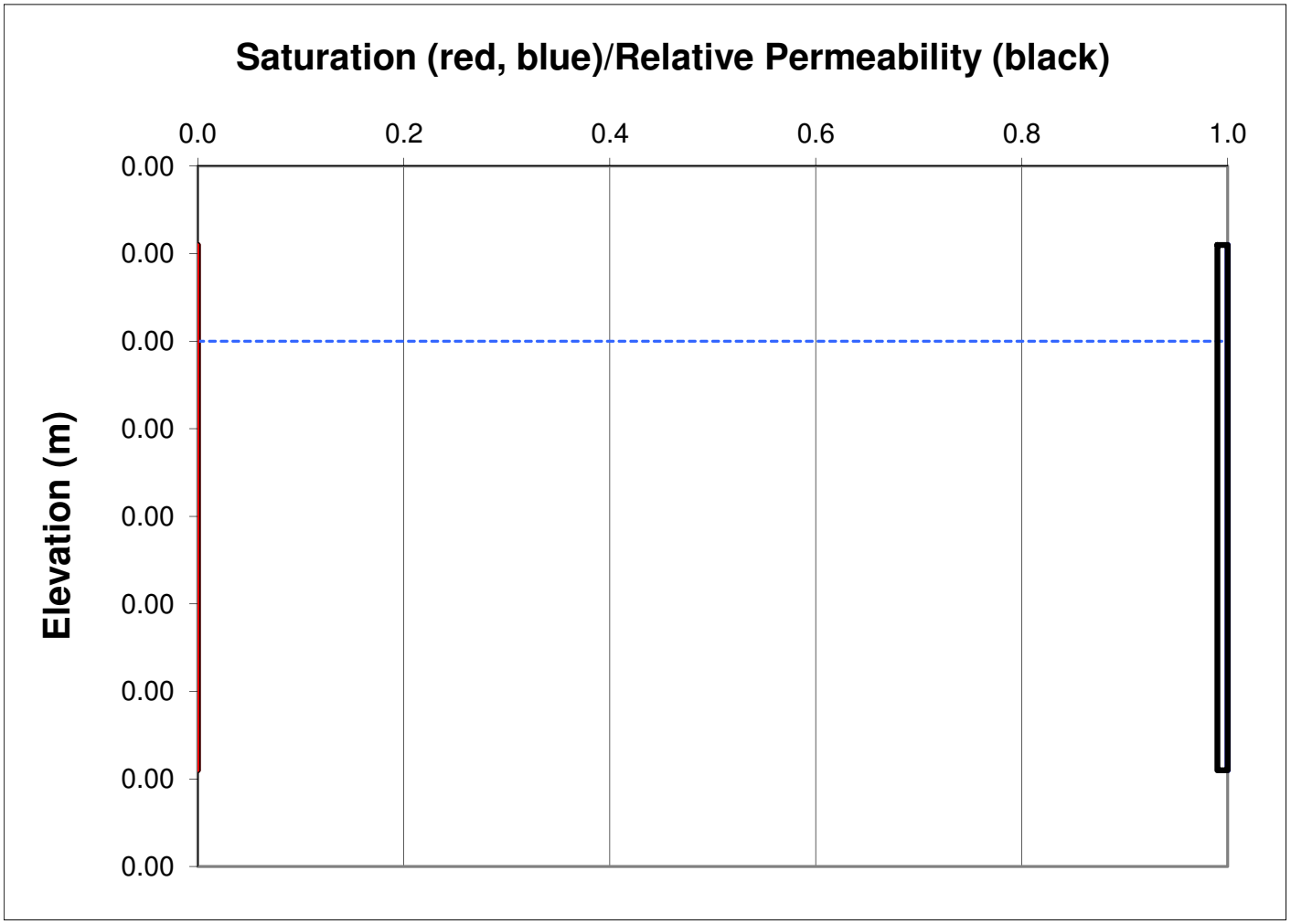
**Gauged May 2011**

**AOI 8 / RW-306**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.003 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = 1.176E-09 | $k_{ro}$ = | 3.168E-09 | AOI 8 / RW-306 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | | Gauged May 2011 |
|---|---|---|
| | | **AOI 8 / N-81** |
| $b_o$ = | 0.006 | 0.020 feet |

| Soil Characteristic | | **SW-SM** |
|---|---|---|
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Lube Oil** |
|---|---|---|
| $\rho_o$ = | 0.902 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 21.000 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 50.000 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 5.553 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.255 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.001 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.005 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.001 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

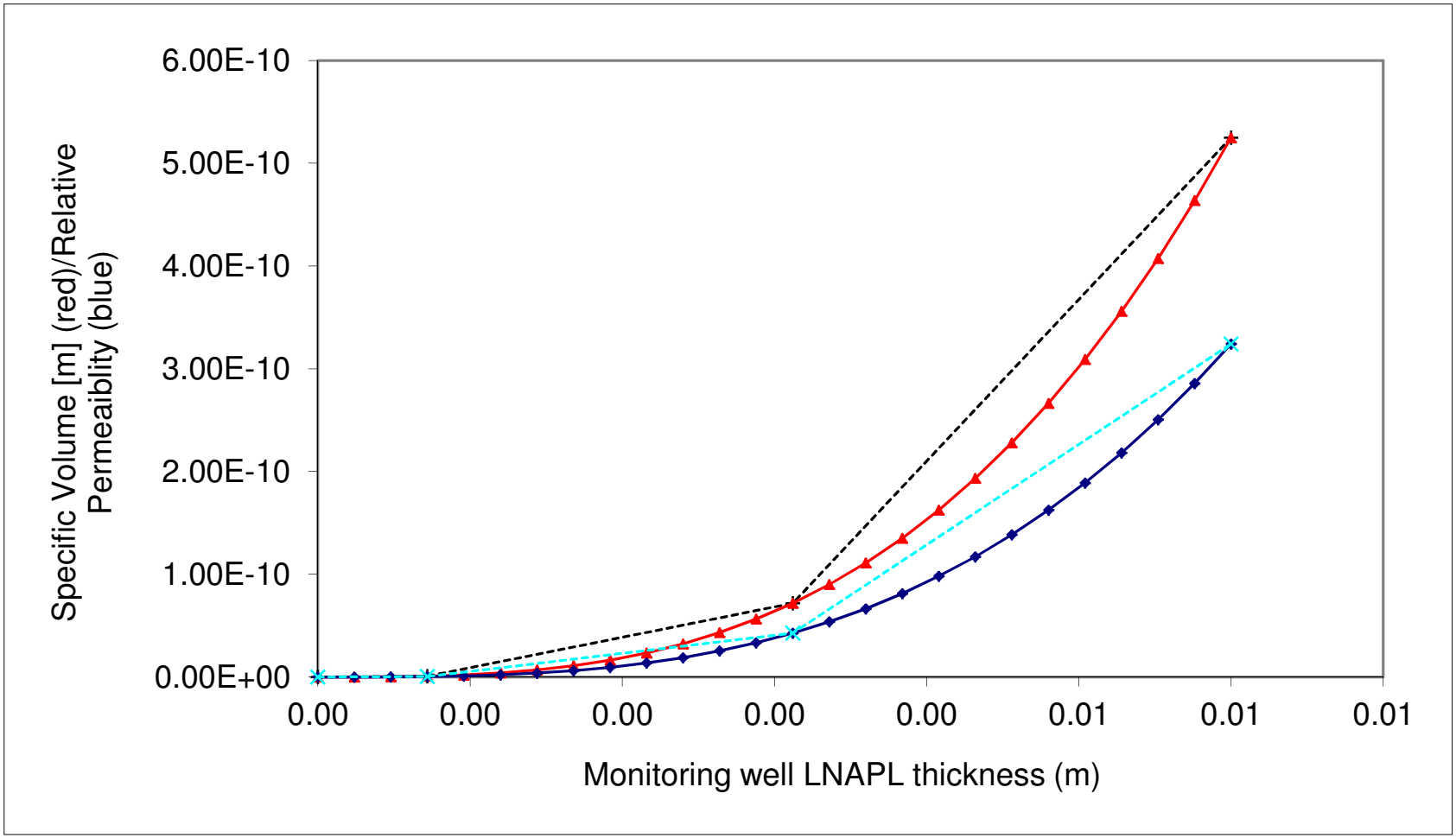
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.001 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.003 | 0.000 | 0.000 | 0.0007 | 0.000000 | 0.0007 | 0.000000 | 0.001 | Eps-Do |
| 0.006 | 0.000 | 0.000 | 0.0027 | 0.000000 | 0.0027 | 0.000000 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

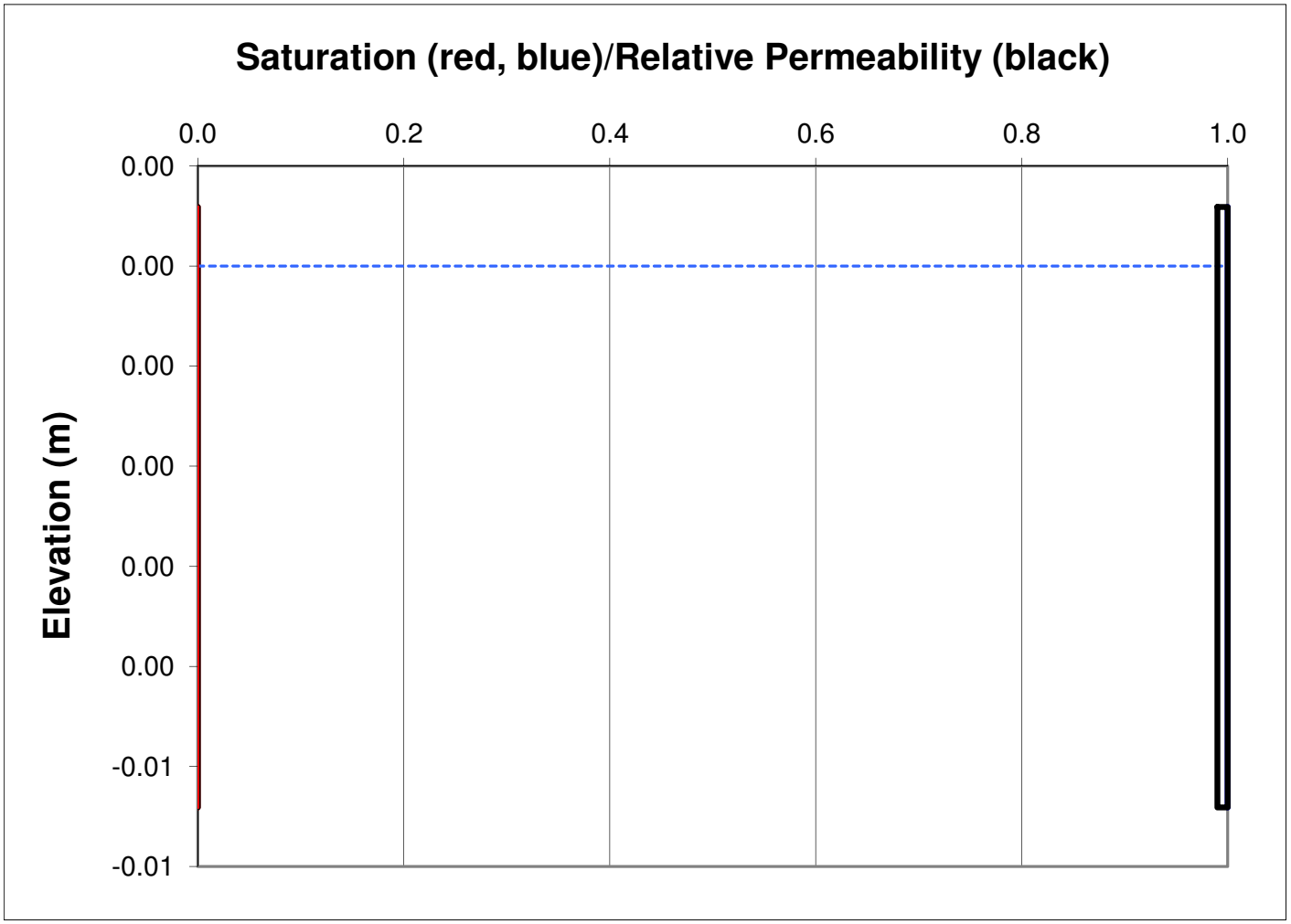
**Gauged May 2011**

**AOI 8 / N-81**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.006 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 5.249E-10 | $k_{ro}$ = 3.242E-10 | AOI 8 / N-81 |

**Press Ctrl+Shift+S to calculate sheet**



# *van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability*

**Enter Data in Yellow Region**

| **Maximum Monitoring Well LNAPL Thickness (meters)** | |
|---|---|
| $b_o$ = | 0.003 |

Gauged May 2011

**AOI 8 / N-107**

0.010 feet

| **Soil Characteristic** | | **SW-SM** |
|---|---|---|
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| **Fluid Characteristics:** | | **Middle Distillate** |
|---|---|---|
| $\rho_o$ = | 0.903 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 26.900 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 22.300 | oil/water (dynes/cm) |

| **Calculated Parameters** | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 4.344 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.561 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.000 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.003 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.000 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

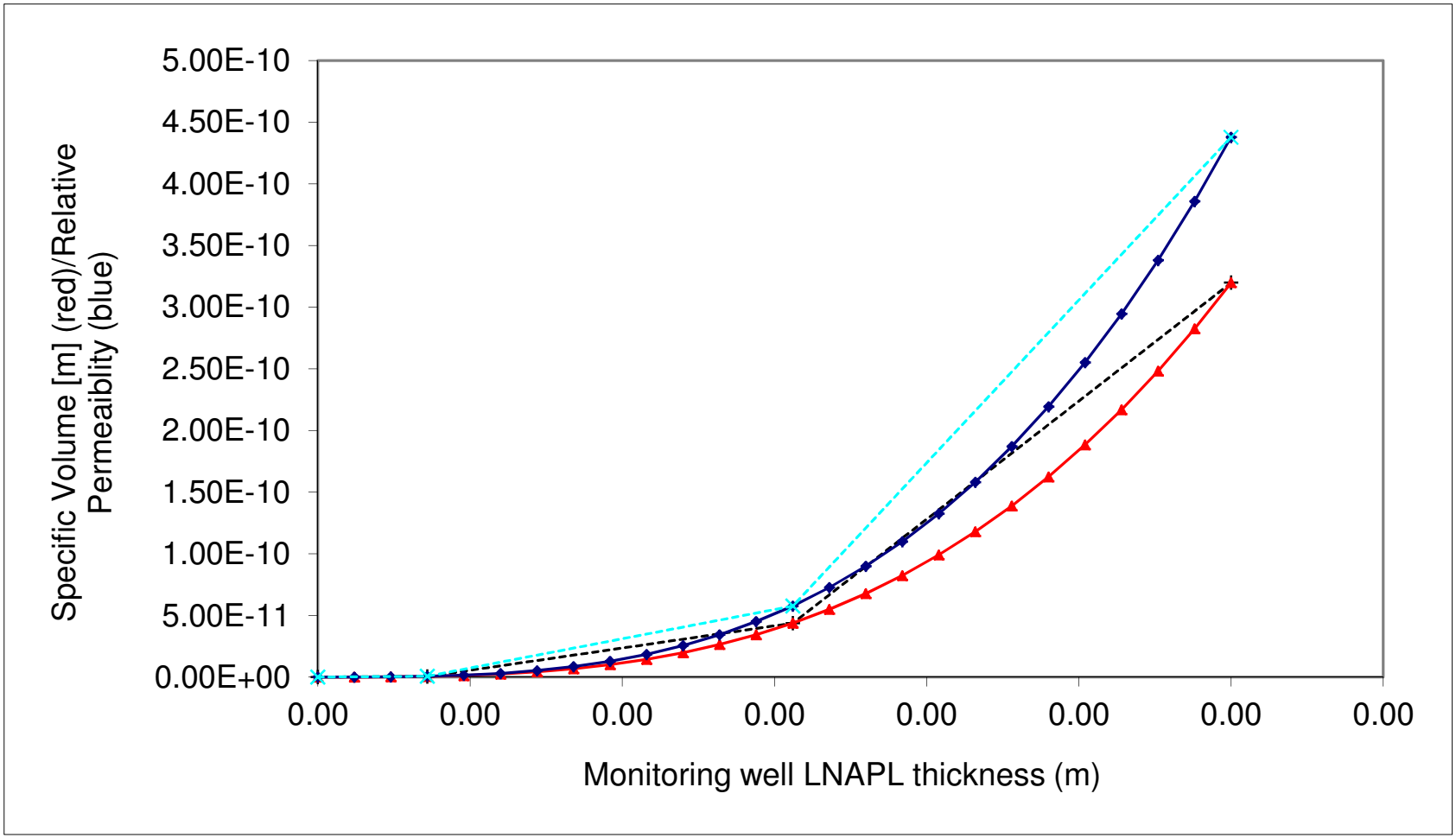
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.000 | 0.000 | 0.000 | 0.0000 | 0.000000 | 0.0000 | 0.000000 | | |
| 0.002 | 0.000 | 0.000 | 0.0003 | 0.000000 | 0.0003 | 0.000000 | 0.001 | Eps-Do |
| 0.003 | 0.000 | 0.000 | 0.0013 | 0.000000 | 0.0013 | 0.000000 | 0.001 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

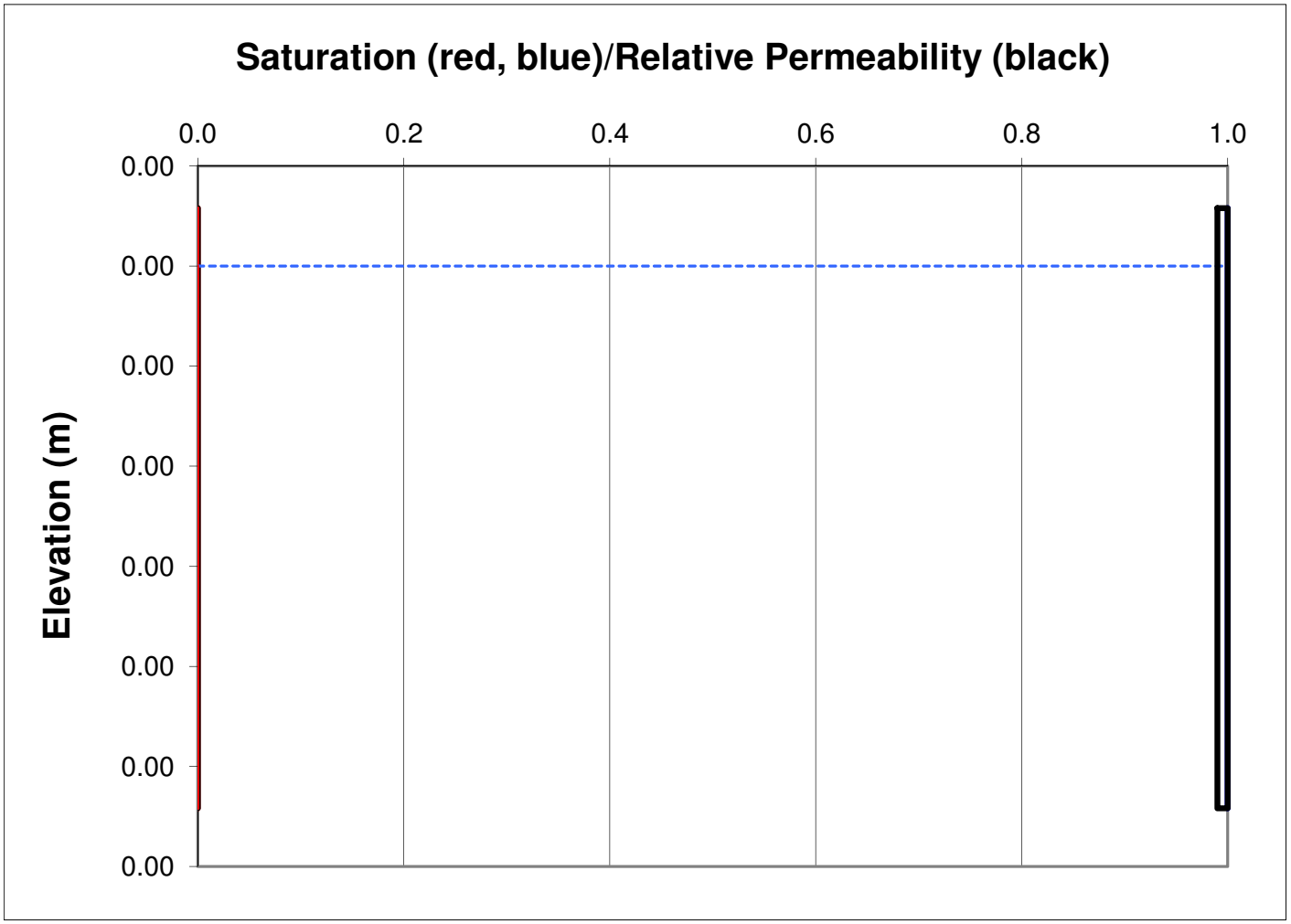
**Gauged May 2011**

**AOI 8 / N-107**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.003 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 3.198E-10 | $k_{ro}$ = 4.378E-10 | AOI 8 / N-107 |

**Press Ctrl+Shift+S to calculate sheet**



# van Genuchten-Mualem Model of LNAPL Distribution and Relative Permeability

**Enter Data in Yellow Region**

| Maximum Monitoring Well LNAPL Thickness (meters) | | Gauged May 2011 |
|---|---|---|
| $b_o$ = | 0.744 | **AOI 8 / P-30** 2.440 feet |

| Soil Characteristic | | **SW-SM** |
|---|---|---|
| n = | 0.388 | porosity |
| N = | 2.040 | van Genuchten "N" |
| $\alpha$ = | 1.990 | van Genuchten "$\alpha$" [$m^{-1}$] |
| $S_{wr}$ = | 0.253 | irreducible water saturation |
| $S_{orv}$ = | 0.000 | residual LNAPL saturation (saturated) |
| $S_{ors}$ = | 0.000 | residual LNAPL saturation (vadose) |

| Fluid Characteristics: | | **Lube Oil** |
|---|---|---|
| $\rho_o$ = | 0.902 | LNAPL density (gm/cc) |
| $\sigma_{aw}$ = | 65.000 | air/water (dynes/cm) |
| $\sigma_{ao}$ = | 21.000 | air/oil (dynes/cm) |
| $\sigma_{ow}$ = | 50.000 | oil/water (dynes/cm) |

| Calculated Parameters | | |
|---|---|---|
| M = | 0.510 | van Genuchten "M" |
| $\alpha_{ao}$ = | 5.553 | air/LNAPL "$\alpha$" |
| $\alpha_{ow}$ = | 0.255 | LNAPL/water "$\alpha$" |
| $z_{ao}$ = | 0.073 | elevation of air-LNAPL interface |
| $z_{ow}$ = | -0.671 | elevation of LNAPL-water interface |
| $z_{max}$ = | 0.113 | maximum free-product elevation |
| $\lambda$ = | 0.773 | pore-size distribution index |
| $\Psi_b$ = | 0.313 | B-C displacement pressure head [m] |

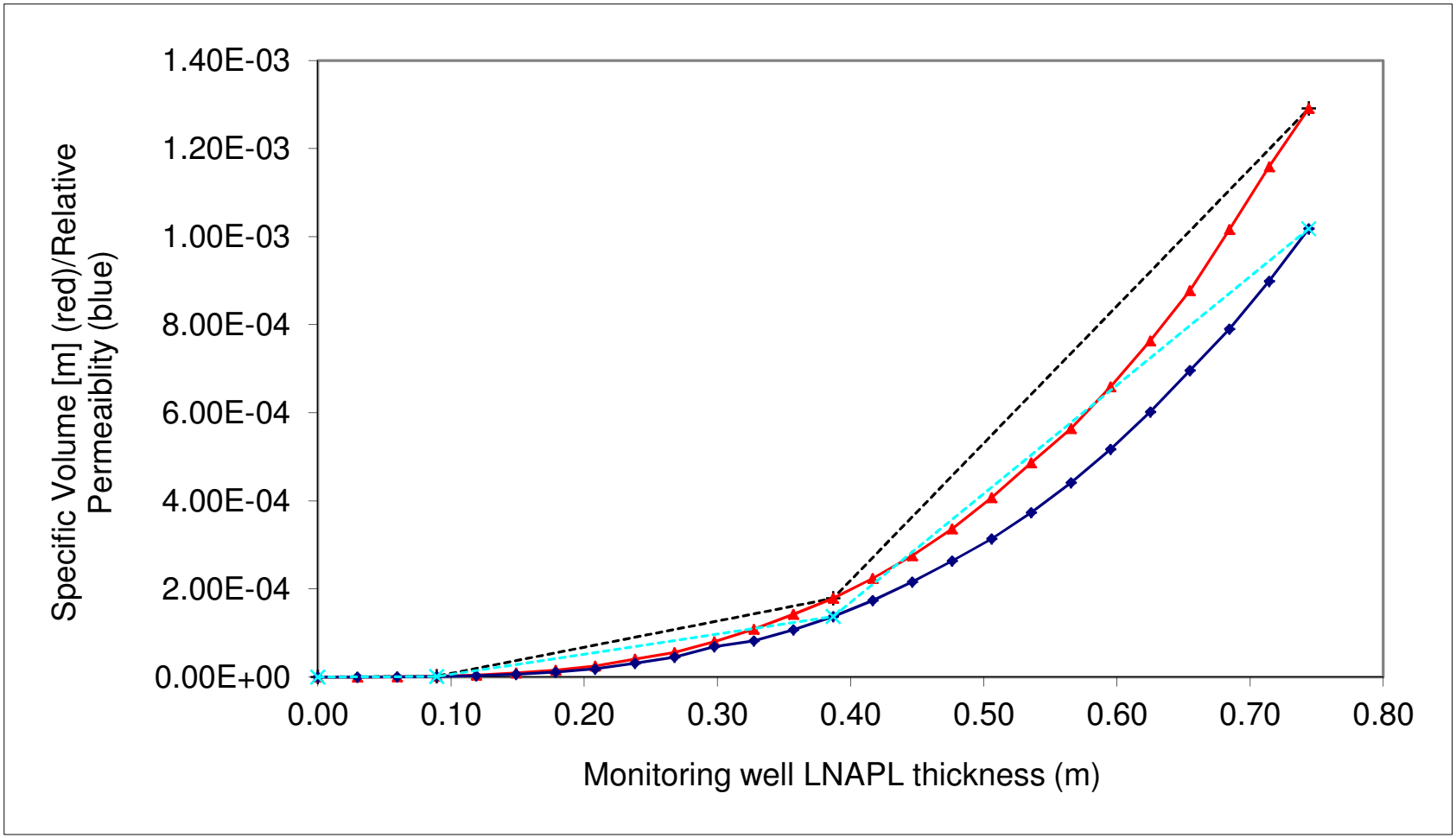
**Press Ctrl+Shift+S to calculate sheet**

| Data for curve-fitting segments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $b_o$ | $D_o$ | $k_{ro}$ | $\alpha$ | $\beta$ | $\xi$ | $\eta$ | | |
| 0.000 | 0.000 | 0.000 | | | | | | |
| 0.089 | 0.000 | 0.000 | 0.0000 | 0.000022 | 0.0000 | 0.000015 | | |
| 0.387 | 0.000 | 0.000 | 0.0860 | 0.000595 | 0.0864 | 0.000458 | 0.1 | Eps-Do |
| 0.744 | 0.001 | 0.001 | 0.3294 | 0.003115 | 0.3311 | 0.002466 | 0.1 | Eps-kro |

**Press Ctrl+Shift+S to calculate sheet**

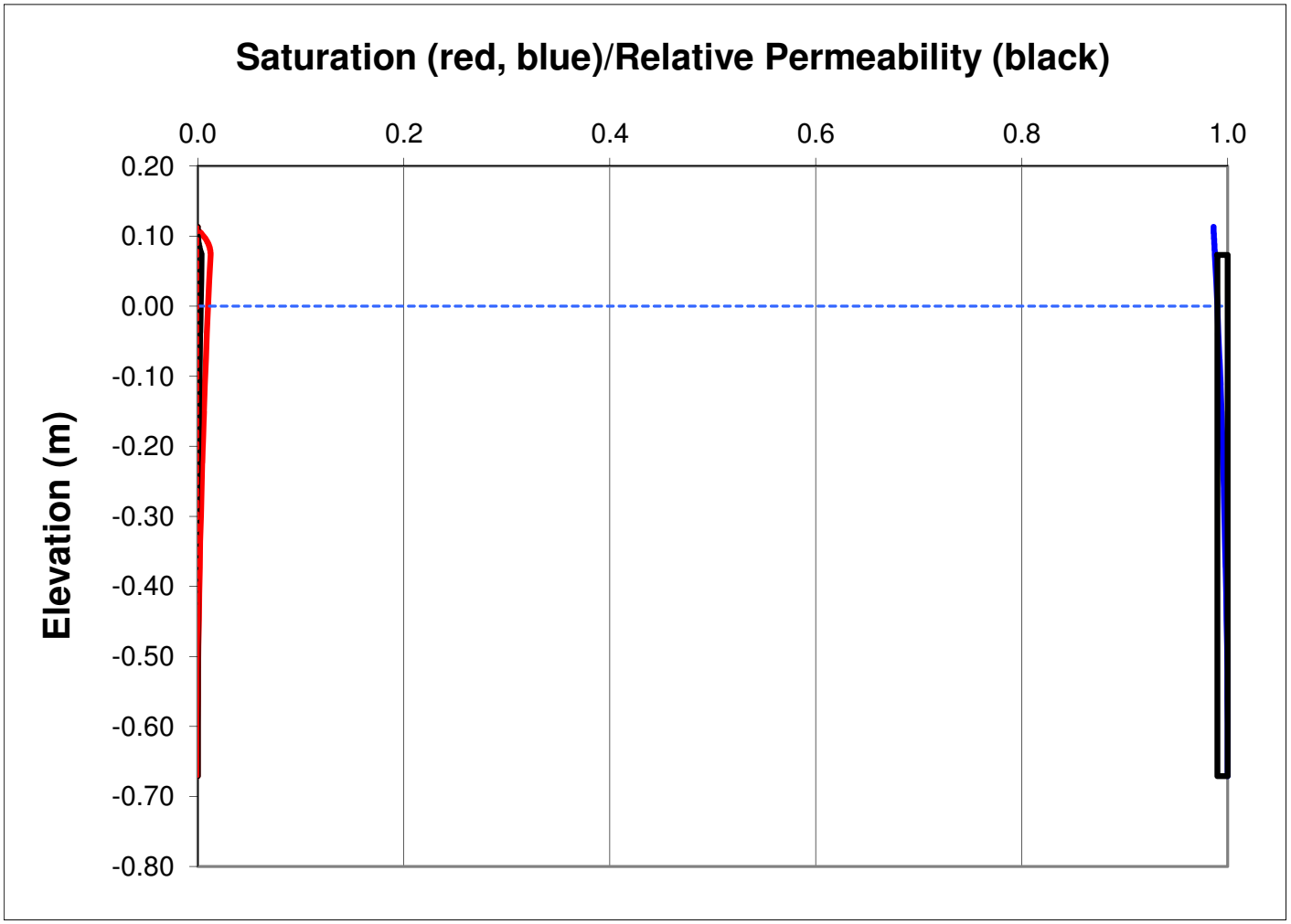
**Gauged May 2011**

**AOI 8 / P-30**



| Monitoring Well LNAPL Thickness $b_o$ (m) = | | | 0.744 | Gauged May 2011 |
|---|---|---|---|---|
| | $D_o$ = | 1.291E-03 | $k_{ro}$ = 1.018E-03 | AOI 8 / P-30 |

**Press Ctrl+Shift+S to calculate sheet**



# INDOOR AIR BUILDING SURVEY and SAMPLING FORM

Preparer's name: Tiffani Doerr Date: 3/19/09

Preparer's affiliation: Aquaterra Technologies Phone #: _____

Site Name: Philly Refinery AOI-8 Case #: _____

Part I - Occupants

Building Address: _____

Property Contact: _____ Owner / Renter / other: _____

Contact's Phone: ~~home~~ facility 215 685-1784 work ( ) _____ cell ( ) _____

# of Building occupants: Children under age 13 ____ Children age 13-18 ____ Adults 2 per shift (occupied 24/7)

Part II – Building Characteristics

Building type: residential / multi-family residential / office / strip mall / commercial / industrial

Describe building: Cynder Block Year constructed: ORIGINAL STRUCTURE 1954 & Addition later date unknown

Sensitive population: day care / nursing home / hospital / school / other (specify): None

Number of floors below grade: X (full basement / (crawl space) / slab on grade) Crawl space under original bldg only.

Number of floors at or above grade: 1

Depth of basement below grade surface: ~4 ft. Basement size: ~969 ft²

Basement floor construction: (concrete) / dirt / floating / stone / other (specify): _____

Foundation walls: poured concrete / (cinder blocks) / stone / other (specify) _____

Basement sump present? *Yes* / (*No*) Sump pump? *Yes* / (*No*) Water in sump? *Yes* / (*No*) * Sometimes get water in crawl space – no pump or sump

Type of heating system (circle all that apply):

hot air circulation — hot air radiation — wood — steam radiation
heat pump — (hot water radiation) — kerosene heater — electric baseboard
other (specify): _____

Type of ventilation system (circle all that apply): Large fan in Kitchen

central air conditioning — (mechanical fans) — bathroom ventilation fans
(individual air conditioning units) — kitchen range hood fan — outside air intake
other (specify): _____

Type of ~~fuel~~ utilized (circle all that apply):

(Natural gas) / electric / fuel oil / wood / coal / solar / kerosene

Are the basement walls or floor sealed with waterproof paint or epoxy coatings? *Yes* / (*No*)

Is there a whole house fan? *Yes / No*

Septic system? *Yes / Yes (but not used) / No*

Irrigation/private well? *Yes / Yes (but not used) / No*

Type of ground cover outside of building: grass / concrete / asphalt / other (specify) _____

Existing subsurface depressurization (radon) system in place? *Yes* (No) *active / passive*

Sub-slab vapor/moisture barrier in place? *Yes* / (No)
Type of barrier: _____

## Part III - Outside Contaminant Sources

NJDEP contaminated site (1000-ft. radius): _____

Other stationary sources nearby (gas stations, emission stacks, etc.): _____

Heavy vehicular traffic nearby (or other mobile sources): _____

## Part IV – Indoor Contaminant Sources

Identify all potential indoor sources found in the building (including attached garages), the location of the source (floor and room), and whether the item was removed from the building 48 hours prior to indoor air sampling event. Any ventilation implemented after removal of the items should be completed at least 24 hours prior to the commencement of the indoor air sampling event.

| **Potential Sources** | **Location(s)** | **Removed** (Yes / No / NA) |
|---|---|---|
| Gasoline storage cans | | |
| Gas-powered equipment | | |
| Kerosene storage cans | | |
| Paints / thinners / strippers | | |
| Cleaning solvents | | |
| Oven cleaners | | |
| Carpet / upholstery cleaners | | |
| Other house cleaning products | | |
| Moth balls | | |
| Polishes / waxes | | |
| Insecticides | | |
| Furniture / floor polish | | |
| Nail polish / polish remover | | |
| Hairspray | | |
| Cologne / perfume | | |
| Air fresheners | | |
| Fuel tank (inside building) | | NA |
| Wood stove or fireplace | | NA |
| New furniture / upholstery | | |
| New carpeting / flooring | | NA |
| Hobbies - glues, paints, etc. | | |

Part V – Miscellaneous Items

Do any occupants of the building smoke? *Yes* / (*No*) How often? _____

Last time someone smoked in the building? _____ hours / *days* *ago*

Does the building have an attached garage directly connected to living space? *Yes* (*No*)

If so, is a car usually parked in the garage? *Yes* / *No*

Are gas-powered equipment or cans of gasoline/fuels stored in the garage? *Yes* / *No*

Do the occupants of the building have their clothes dry cleaned? *Yes* (*No*)

If yes, how often? weekly / monthly / 3-4 times a year

Do any of the occupants use solvents in work? *Yes* / *No*

If yes, what types of solvents are used? _____

If yes, are their clothes washed at work? *Yes* / *No*

Have any pesticides/herbicides been applied around the building or in the yard? *Yes* / (No)

If so, when and which chemicals? _____

Has there ever been a fire in the building? *Yes* / (*No*) If yes, when? _____

Has painting or staining been done in the building in the last 6 months? *Yes* / (*No*)

If yes, when _____ and where? _____

*have separate Storage bldg for most items although some engine parts (old water pumps) noted in storage area of bldg.

Part VI – Sampling Information (Separate sheet.)

Sample Technician: _____ Phone number: ( ) _____ - _____

Sample Source: Indoor Air / Sub-Slab / Near Slab Soil Gas / Exterior Soil Gas

Sampler Type: Tedlar bag / Sorbent / Stainless Steel Canister / Other (specify): _____

Analytical Method: TO-15 / TO-17 / other: _____ Cert. Laboratory: _____

Sample locations (floor, room):

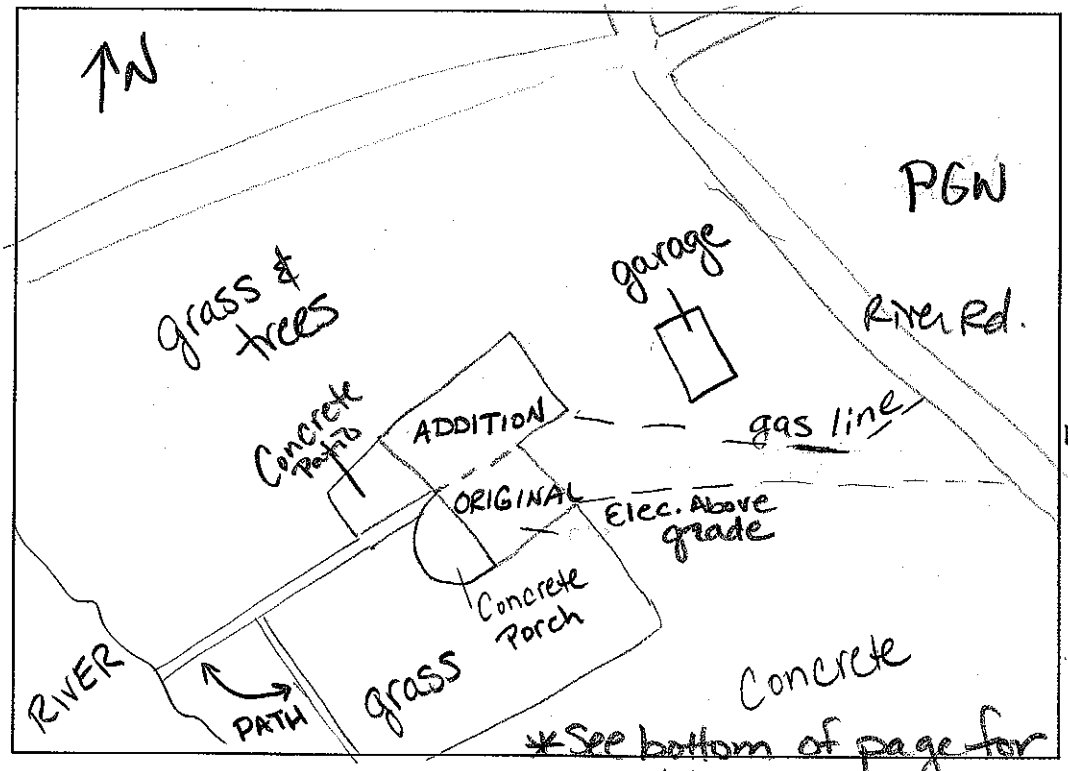
Field ID # _____ - _____ Field ID # _____ - _____

Field ID # _____ - _____ Field ID # _____ - _____

Were "Instructions for Occupants" followed? *Yes* / *No*

If not, describe modifications: _____

*Provide Drawing of Sample Location(s) in Building*




*Water line not known (no meter), but in bldg. where electric comes in.

*See bottom of page for bldg. measurements.

Part VII - Meteorological Conditions

Was there significant precipitation within 12 hours prior to (or during) the sampling event? *Yes / No*

Describe the general weather conditions: _____

_____

Part VIII – General Observations

Provide any information that may be pertinent to the sampling event and may assist in the data interpretation process.

_____

_____

_____

(NJDEP 1997; NHDES 1998; VDOH 1998; MassDEP 2002; NYSDOH 2005; CalEPA 2005)

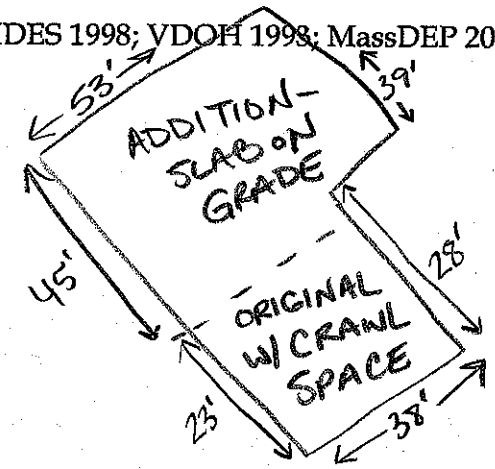


**Table H-1**
**Summary of Soil Gas Sample Analytical Results**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| | CAS No | PADEP Indoor Air Criteria Non-Residential MSC x100 | Location ID Sample ID Sample Matrix Sample Date | SG-1 SG-1_AOI 8 Grab Air SG 4/23/2009 | | | SG-2 SG-2_AOI 8 Grab Air SG 4/23/2009 | | | SG-3 SG-3_AOI 8 Grab Air SG 4/23/2009 | | | SG-4 SG-4_AOI 8 Grab Air SG 4/23/2009 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organic Compounds** | | | Unit | Result | Q | RL | Result | Q | RL | Result | Q | RL | Result | Q | RL |
| Naphthalene | 91-20-3 | 0.88 | $mg/m^3$ | ND | | **10** | ND | | 0.52 | ND | | 0.52 | ND | | **1** |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 31 | $mg/m^3$ | ND | | 7.2 | ND | | 0.36 | ND | | 0.36 | ND | | 0.72 |
| Benzene | 71-43-2 | 1.1 | $mg/m^3$ | 140 | | **6.4** | 3 | | 0.32 | 0.6 | | 0.32 | 4.6 | | 0.64 |
| 1,2-Dichloroethane | 107-06-2 | 0.31 | $mg/m^3$ | ND | | **8.1** | ND | | **0.4** | ND | | **0.4** | ND | | **0.81** |
| Toluene | 108-88-3 | 120 | $mg/m^3$ | 42 | | 7.5 | 0.81 | | 0.38 | ND | | 0.38 | 4.1 | | 0.75 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.037 | $mg/m^3$ | ND | | **15** | ND | | **0.77** | ND | | **0.77** | ND | | **1.5** |
| Ethylbenzene | 100-41-4 | 7.3 | $mg/m^3$ | ND | | **8.7** | 1 | | 0.43 | ND | | 0.43 | ND | | 0.87 |
| Cumene | 98-82-8 | 110 | $mg/m^3$ | ND | | 9.8 | ND | | 0.49 | ND | | 0.49 | ND | | 0.98 |
| Xylene (Total) | 1330-20-7 | 30 | $mg/m^3$ | ND | | 8.7 | 6.6 | | 0.43 | 0.53 | | 0.43 | 3.3 | | 0.87 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
mg/kg - milligram per kilogram
MSC - PADEP's Medium Specific Concentration for Soil
RL - Reporting Limit
ND - Not Detected

**Qualifiers:**
Q - Qualifier

**Exceedance Summary:**
**10** - RL exceeds the PADEP Non-Residential Soil MSC
10 - Concentration cxceeds the PADEP Non-Residential Soil MSC

**Table H-2**
**Summary of Indoor Air Sample Analytical Results**
**AOI 8 (Firehouse Bldg.)**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| TO-15 Volatile Organic Compounds | CAS Number | PADEP Nonresidential Indoor Air MSC (mg/m3) | Sample ID | Firehouse Ambient #420 | | | | Firehouse Indoor #413 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample Date | 6/5/2009 | | | | 6/5/2009 | | | |
| | | | Sample Matrix | Air | | | | Air | | | |
| | | | Unit | Result | Q | MDL | RL | Result | Q | MDL | RL |
| Ethylbenzene | 100-41-4 | 0.073 | mg/m3 | ND | U | 0.00087 | 0.0043 | ND | U | 0.00087 | 0.0043 |
| Styrene (Monomer) | 100-42-5 | 2.9 | mg/m3 | ND | U | 0.00085 | 0.0043 | ND | U | 0.00085 | 0.0043 |
| cis-1,3-Dichloropropene | 10061-01-5 | NS | mg/m3 | ND | U | 0.00091 | 0.0045 | ND | U | 0.00091 | 0.0045 |
| trans-1,3-Dichloropropene | 10061-02-6 | NS | mg/m3 | ND | U | 0.00091 | 0.0045 | ND | U | 0.00091 | 0.0045 |
| 1,4-Dichlorobenzene | 106-46-7 | 0.013 | mg/m3 | ND | U | 0.0012 | 0.006 | ***0.039*** | | 0.0012 | 0.006 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.00037 | mg/m3 | ND | U | 0.0015 | **0.0077** | ND | U | 0.0015 | **0.0077** |
| 1,3-Butadiene | 106-99-0 | 0.0026 | mg/m3 | ND | U | 0.0011 | **0.0044** | ND | U | 0.0011 | **0.0044** |
| Acrolein | 107-02-8 | 0.000058 | mg/m3 | ND | U | 0.0011 | **0.0046** | ND | U | 0.0011 | **0.0046** |
| 3-Chloropropene | 107-05-1 | 0.0029 | mg/m3 | ND | U | 0.00063 | **0.0031** | ND | U | 0.00063 | **0.0031** |
| 1,2-Dichloroethane | 107-06-2 | 0.0031 | mg/m3 | ND | U | 0.00081 | **0.004** | ND | U | 0.00081 | **0.004** |
| Acrylonitrile | 107-13-1 | 0.0012 | mg/m3 | ND | U | 0.0011 | **0.0043** | ND | U | 0.0011 | **0.0043** |
| Vinyl Acetate | 108-05-4 | 0.58 | mg/m3 | ND | U | 0.0007 | 0.0035 | ND | U | 0.0007 | 0.0035 |
| 4-Methyl-2-pentanone | 108-10-1 | 0.2 | mg/m3 | ND | U | 0.002 | 0.0082 | ND | U | 0.002 | 0.0082 |
| 1,3,5-Trimethylbenzene | 108-67-8 | 0.017 | mg/m3 | ND | U | 0.00098 | 0.0049 | ND | U | 0.00098 | 0.0049 |
| Bromobenzene | 108-86-1 | NS | mg/m3 | ND | U | 0.0013 | 0.0064 | ND | U | 0.0013 | 0.0064 |
| Toluene | 108-88-3 | 1.2 | mg/m3 | ND | U | 0.00075 | 0.0038 | ND | U | 0.00075 | 0.0038 |
| Chlorobenzene | 108-90-7 | 0.051 | mg/m3 | ND | U | 0.00092 | 0.0046 | ND | U | 0.00092 | 0.0046 |
| Pentane | 109-66-0 | NS | mg/m3 | 0.0059 | | 0.00059 | 0.003 | 0.0045 | | 0.00059 | 0.003 |
| Hexane | 110-54-3 | 0.58 | mg/m3 | ND | U | 0.0007 | 0.0035 | ND | U | 0.0007 | 0.0035 |
| Octane | 111-65-9 | NS | mg/m3 | ND | U | 0.00093 | 0.0047 | ND | U | 0.00093 | 0.0047 |
| Propylene (Propene) | 115-07-1 | NS | mg/m3 | 0.0026 | | 0.00034 | 0.0017 | 0.0041 | | 0.00034 | 0.0017 |
| 1,2,4-Trichlorobenzene | 120-82-1 | 0.079 | mg/m3 | ND | U | 0.0037 | 0.015 | ND | U | 0.0037 | 0.015 |
| 1,4-Dioxane | 123-91-1 | 0.011 | mg/m3 | ND | U | 0.00072 | 0.0036 | ND | U | 0.00072 | 0.0036 |
| Chlorodibromomethane | 124-48-1 | 0.003 | mg/m3 | ND | U | 0.0017 | **0.0085** | ND | U | 0.0017 | **0.0085** |
| Tetrachloroethene | 127-18-4 | 0.14 | mg/m3 | ND | U | 0.0014 | 0.0068 | ND | U | 0.0014 | 0.0068 |
| Ethyl Acrylate | 140-88-5 | 0.006 | mg/m3 | ND | U | 0.00082 | 0.0041 | ND | U | 0.00082 | 0.0041 |
| Ethyl Acetate | 141-78-6 | 9.2 | mg/m3 | ND | U | 0.00072 | 0.0036 | ND | U | 0.00072 | 0.0036 |
| N-Heptane | 142-82-5 | NS | mg/m3 | ND | U | 0.00082 | 0.0041 | ND | U | 0.00082 | 0.0041 |
| cis-1,2-Dichloroethene | 156-59-2 | 0.1 | mg/m3 | ND | U | 0.00079 | 0.004 | ND | U | 0.00079 | 0.004 |
| trans-1,2-Dichloroethene | 156-60-5 | 0.2 | mg/m3 | ND | U | 0.00079 | 0.004 | ND | U | 0.00079 | 0.004 |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 0.31 | mg/m3 | ND | U | 0.00072 | 0.0036 | ND | U | 0.00072 | 0.0036 |
| m/p-Xylene | 179601-23-1 | NS | mg/m3 | 0.0046 | | 0.00087 | 0.0043 | ND | U | 0.00087 | 0.0043 |
| 2,2,4-Trimethylpentane | 540-84-1 | NS | mg/m3 | ND | U | 0.00093 | 0.0047 | ND | U | 0.00093 | 0.0047 |
| M-Dichlorobenzene | 541-73-1 | NS | mg/m3 | ND | U | 0.0012 | 0.006 | ND | U | 0.0012 | 0.006 |
| Carbon Tetrachloride | 56-23-5 | 0.0055 | mg/m3 | ND | U | 0.0013 | **0.0063** | ND | U | 0.0013 | **0.0063** |
| Methyl N-Butyl Ketone | 591-78-6 | NS | mg/m3 | ND | U | 0.002 | 0.0082 | ND | U | 0.002 | 0.0082 |
| 4-Ethyltoluene | 622-96-8 | NS | mg/m3 | ND | U | 0.00098 | 0.0049 | ND | U | 0.00098 | 0.0049 |
| 1,1,1,2-Tetrachlorroethane | 630-20-6 | 0.011 | mg/m3 | ND | U | 0.0014 | 0.0069 | ND | U | 0.0014 | 0.0069 |
| Acetone | 67-64-1 | 91 | mg/m3 | 0.013 | | 0.0012 | 0.0048 | 0.044 | | 0.0012 | 0.0048 |
| Chloroform | 67-66-3 | 0.00092 | mg/m3 | ND | U | 0.00098 | **0.0049** | ND | U | 0.00098 | **0.0049** |
| Hexachloroethane | 67-72-1 | NS | mg/m3 | ND | U | 0.0019 | 0.0097 | ND | U | 0.0019 | 0.0097 |
| Benzene | 71-43-2 | 0.011 | mg/m3 | ND | U | 0.00064 | 0.0032 | ND | U | 0.00064 | 0.0032 |
| 1,1,1-Trichloroethane | 71-55-6 | 6.1 | mg/m3 | ND | U | 0.0011 | 0.0055 | ND | U | 0.0011 | 0.0055 |
| Methane | 74-82-8 | NS | mg/m3 | ND | U | 1.3 | 6.6 | ND | U | 1.3 | 6.6 |
| Bromomethane | 74-83-9 | 0.014 | mg/m3 | ND | U | 0.00078 | 0.0039 | ND | U | 0.00078 | 0.0039 |
| Chloromethane | 74-87-3 | 0.045 | mg/m3 | ND | U | 0.00041 | 0.0021 | ND | U | 0.00041 | 0.0021 |
| Methyl Iodide | 74-88-4 | NS | mg/m3 | ND | U | 0.0012 | 0.0058 | ND | U | 0.0012 | 0.0058 |
| Dibromomethane | 74-95-3 | 0.1 | mg/m3 | ND | U | 0.0014 | 0.0071 | ND | U | 0.0014 | 0.0071 |
| Chloroethane | 75-00-3 | 0.099 | mg/m3 | ND | U | 0.00053 | 0.0026 | ND | U | 0.00053 | 0.0026 |
| Vinyl chloride | 75-01-4 | 0.0095 | mg/m3 | ND | U | 0.00051 | 0.0026 | ND | U | 0.00051 | 0.0026 |
| Acetonitrile | 75-05-8 | 0.17 | mg/m3 | ND | U | 0.00084 | 0.0034 | ND | U | 0.00084 | 0.0034 |
| Dichloromethane | 75-09-2 | 0.17 | mg/m3 | ND | U | 0.00069 | 0.0035 | 0.015 | | 0.00069 | 0.0035 |
| Carbon Disulfide | 75-15-0 | 2 | mg/m3 | ND | U | 0.00062 | 0.0031 | ND | U | 0.00062 | 0.0031 |
| Tribomomethane | 75-25-2 | 0.074 | mg/m3 | ND | U | 0.0021 | 0.01 | ND | U | 0.0021 | 0.01 |
| Bromodichloromethane | 75-27-4 | 0.0022 | mg/m3 | ND | U | 0.0013 | **0.0067** | ND | U | 0.0013 | **0.0067** |
| 1,1-Dichloroethane | 75-34-3 | 0.05 | mg/m3 | ND | U | 0.00081 | 0.004 | ND | U | 0.00081 | 0.004 |
| 1,1-Dichloroethylene | 75-35-4 | 0.58 | mg/m3 | ND | U | 0.00079 | 0.004 | ND | U | 0.00079 | 0.004 |
| Dichloromonofluoromethane | 75-43-4 | NS | mg/m3 | ND | U | 0.00084 | 0.0042 | ND | U | 0.00084 | 0.0042 |
| Chlorodifluoromethane | 75-45-6 | 140 | mg/m3 | ND | U | 0.00071 | 0.0035 | 0.02 | | 0.00071 | 0.0035 |
| Tert-Butyl Alcohol | 75-65-0 | NS | mg/m3 | ND | U | 0.00061 | 0.003 | ND | U | 0.00061 | 0.003 |
| CFC-11 | 75-69-4 | 2 | mg/m3 | ND | U | 0.0011 | 0.0056 | ND | U | 0.0011 | 0.0056 |
| CFC-12 | 75-71-8 | 0.51 | mg/m3 | ND | U | 0.00099 | 0.0049 | ND | U | 0.00099 | 0.0049 |
| Chlorinated Fluocarbon (Freon 113) | 76-13-1 | 88 | mg/m3 | ND | U | 0.0038 | 0.015 | ND | U | 0.0038 | 0.015 |
| 1,2-114 Dichlorotetrafluoroethane; Fluorocarbon 114 | 76-14-2 | NS | mg/m3 | ND | U | 0.0014 | 0.007 | ND | U | 0.0014 | 0.007 |
| 1,2-Dichloropropane | 78-87-5 | 0.0079 | mg/m3 | ND | U | 0.00092 | 0.0046 | ND | U | 0.00092 | 0.0046 |
| 2-Butanone | 78-93-3 | 2.9 | mg/m3 | ND | U | 0.0015 | 0.0059 | 0.015 | | 0.0015 | 0.0059 |
| 1,1,2-Trichloroethane | 79-00-5 | 0.0051 | mg/m3 | ND | U | 0.0011 | **0.0055** | ND | U | 0.0011 | **0.0055** |
| Trichloroethylene | 79-01-6 | 0.048 | mg/m3 | ND | U | 0.0011 | 0.0054 | ND | U | 0.0011 | 0.0054 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | 0.0014 | mg/m3 | ND | U | 0.0014 | **0.0069** | ND | U | 0.0014 | **0.0069** |
| Methyl Methacrylate | 80-62-6 | 2 | mg/m3 | ND | U | 0.00082 | 0.0041 | ND | U | 0.00082 | 0.0041 |
| Hexachloro-1,3-Butadiene | 87-68-3 | NS | mg/m3 | ND | U | 0.0053 | 0.021 | ND | U | 0.0053 | 0.021 |
| o-Xylene | 95-47-6 | NS | mg/m3 | ND | U | 0.00087 | 0.0043 | ND | U | 0.00087 | 0.0043 |
| 1,2-Dichlorobenzene | 95-50-1 | 0.41 | mg/m3 | ND | U | 0.0012 | 0.006 | ND | U | 0.0012 | 0.006 |
| 1,2,4-Trimethylbenzene | 95-63-6 | 0.017 | mg/m3 | ND | U | 0.00098 | 0.0049 | ND | U | 0.00098 | 0.0049 |
| 1,2,3-Trichloropropane | 96-18-4 | 0.000041 | mg/m3 | ND | U | 0.0012 | **0.006** | ND | U | 0.0012 | **0.006** |
| Methyl Acrylate | 96-33-3 | 0.31 | mg/m3 | ND | U | 0.0007 | 0.0035 | ND | U | 0.0007 | 0.0035 |
| Ethyl Methacrylate | 97-63-2 | 0.92 | mg/m3 | ND | U | 0.00093 | 0.0047 | ND | U | 0.00093 | 0.0047 |
| Cumene | 98-82-8 | 1.1 | mg/m3 | ND | U | 0.00098 | 0.0049 | ND | U | 0.00098 | 0.0049 |
| Alpha Methyl Styrene | 98-83-9 | 0.1 | mg/m3 | ND | U | 0.00097 | 0.0048 | ND | U | 0.00097 | 0.0048 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
mg/m3 - milligram per cubic meter
MSC - PADEP's Medium Specific Concentration for Air
RL - Reporting Limit
ND - Not Detected

**Qualifiers:**
Q - Qualifier
U - Undetected

**Exceedance Summary:**
10 - MDL exceeds the PADEP Non-Residential Indoor Air MSC
**10** - RL exceeds the PADEP Non-Residential Indoor Air MSC
***10*** - Concentration exceeds the PADEP Non-Residential Indoor Air MSC

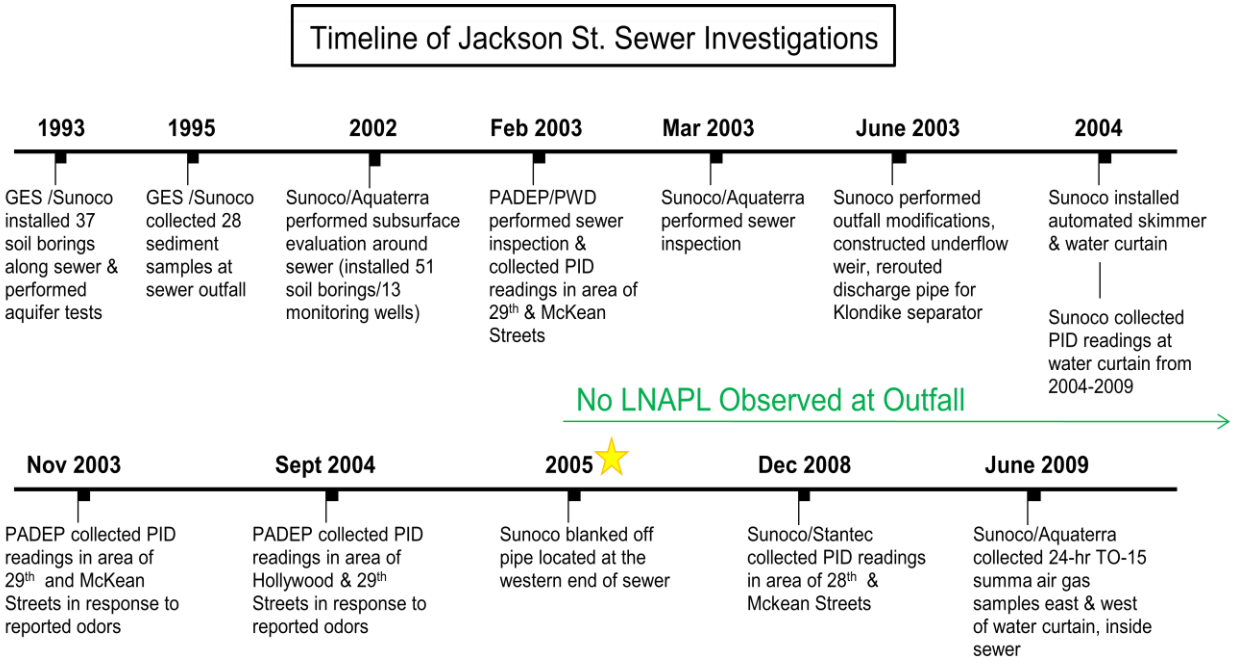
**Table H-3**
**Summary of Air Sample Analytical Results**
**AOI 8 (Jackson St. Sewer)**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| TO-15 Volatile Organic Compounds | CAS Number | PADEP Residential Indoor Air MSC (mg/m3) | Sample ID | Jackson Ambient Can #062 | | | | Manhole #1 Summa #509 | | | | Manhole #3 Summa #515 | | | | Manhole #6 Summa #102 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample Date | 6/5/2009 | | | | 6/5/2009 | | | | 6/5/2009 | | | | 6/5/2009 | | | |
| | | | Sample Matrix | Air | | | | Air | | | | Air | | | | Air | | | |
| | | | Unit | Result | Q | MDL | RL | Result | Q | MDL | RL | Result | Q | MDL | RL | Result | Q | MDL | RL |
| Ethylbenzene | 100-41-4 | 0.019 | mg/m3 | ND | U | 0.00087 | 0.0043 | ND | U | 0.00087 | 0.0043 | ND | U | 0.00087 | 0.0043 | ND | U | 0.00087 | 0.0043 |
| Styrene (Monomer) | 100-42-5 | 1.4 | mg/m3 | ND | U | 0.00085 | 0.0043 | ND | U | 0.00085 | 0.0043 | ND | U | 0.00085 | 0.0043 | ND | U | 0.00085 | 0.0043 |
| cis-1,3-Dichloropropene | 10061-01-5 | NS | mg/m3 | ND | U | 0.00091 | 0.0045 | ND | U | 0.00091 | 0.0045 | ND | U | 0.00091 | 0.0045 | ND | U | 0.00091 | 0.0045 |
| trans-1,3-Dichloropropene | 10061-02-6 | NS | mg/m3 | ND | U | 0.00091 | 0.0045 | ND | U | 0.00091 | 0.0045 | ND | U | 0.00091 | 0.0045 | ND | U | 0.00091 | 0.0045 |
| 1,4-Dichlorobenzene | 106-46-7 | 0.0033 | mg/m3 | ND | U | 0.0012 | **0.006** | ND | U | 0.0012 | **0.006** | ND | U | 0.0012 | **0.006** | ND | U | 0.0012 | **0.006** |
| Ethylene dibromide (EDB) | 106-93-4 | 0.000095 | mg/m3 | ND | U | 0.0015 | **0.0077** | ND | U | 0.0015 | **0.0077** | ND | U | 0.0015 | **0.0077** | ND | U | 0.0015 | **0.0077** |
| 1,3-Butadiene | 106-99-0 | 0.00067 | mg/m3 | ND | U | 0.0011 | **0.0044** | ND | U | 0.0011 | **0.0044** | ND | U | 0.0011 | **0.0044** | ND | U | 0.0011 | **0.0044** |
| Acrolein | 107-02-8 | 0.000028 | mg/m3 | ND | U | 0.0011 | **0.0046** | ND | U | 0.0011 | **0.0046** | ND | U | 0.0011 | **0.0046** | ND | U | 0.0011 | **0.0046** |
| 3-Chloropropene | 107-05-1 | 0.0014 | mg/m3 | ND | U | 0.00063 | **0.0031** | ND | U | 0.00063 | **0.0031** | ND | U | 0.00063 | **0.0031** | ND | U | 0.00063 | **0.0031** |
| 1,2-Dichloroethane | 107-06-2 | 0.00081 | mg/m3 | ND | U | 0.00081 | **0.004** | ND | U | 0.00081 | **0.004** | ND | U | 0.00081 | **0.004** | ND | U | 0.00081 | **0.004** |
| Acrylonitrile | 107-13-1 | 0.00031 | mg/m3 | ND | U | 0.0011 | **0.0043** | ND | U | 0.0011 | **0.0043** | ND | U | 0.0011 | **0.0043** | ND | U | 0.0011 | **0.0043** |
| Vinyl Acetate | 108-05-4 | 0.28 | mg/m3 | ND | U | 0.0007 | 0.0035 | ND | U | 0.0007 | 0.0035 | ND | U | 0.0007 | 0.0035 | ND | U | 0.0007 | 0.0035 |
| 4-Methyl-2-pentanone | 108-10-1 | 0.097 | mg/m3 | ND | U | 0.002 | 0.0082 | ND | U | 0.002 | 0.0082 | ND | U | 0.002 | 0.0082 | ND | U | 0.002 | 0.0082 |
| 1,3,5-Trimethylbenzene | 108-67-8 | 0.0083 | mg/m3 | ND | U | 0.00098 | 0.0049 | ND | U | 0.00098 | 0.0049 | ND | U | 0.00098 | 0.0049 | ND | U | 0.00098 | 0.0049 |
| Bromobenzene | 108-86-1 | NS | mg/m3 | ND | U | 0.0013 | 0.0064 | ND | U | 0.0013 | 0.0064 | ND | U | 0.0013 | 0.0064 | ND | U | 0.0013 | 0.0064 |
| Toluene | 108-88-3 | 0.56 | mg/m3 | ND | U | 0.00075 | 0.0038 | 0.0041 | | 0.00075 | 0.0038 | ND | U | 0.00075 | 0.0038 | ND | U | 0.00075 | 0.0038 |
| Chlorobenzene | 108-90-7 | 0.024 | mg/m3 | ND | U | 0.00092 | 0.0046 | ND | U | 0.00092 | 0.0046 | ND | U | 0.00092 | 0.0046 | ND | U | 0.00092 | 0.0046 |
| Pentane | 109-66-0 | NS | mg/m3 | ND | U | 0.00059 | 0.003 | ND | U | 0.00059 | 0.003 | 0.059 | | 0.00059 | 0.003 | 0.013 | | 0.00059 | 0.003 |
| Hexane | 110-54-3 | 0.28 | mg/m3 | ND | U | 0.0007 | 0.0035 | ND | U | 0.0007 | 0.0035 | 0.016 | | 0.0007 | 0.0035 | 0.0036 | | 0.0007 | 0.0035 |
| Octane | 111-65-9 | NS | mg/m3 | ND | U | 0.00093 | 0.0047 | ND | U | 0.00093 | 0.0047 | ND | U | 0.00093 | 0.0047 | ND | U | 0.00093 | 0.0047 |
| Propylene (Propene) | 115-07-1 | NS | mg/m3 | ND | U | 0.00034 | 0.0017 | 0.0023 | | 0.00034 | 0.0017 | ND | U | 0.00034 | 0.0017 | ND | U | 0.00034 | 0.0017 |
| 1,2,4-Trichlorobenzene | 120-82-1 | 0.02 | mg/m3 | ND | U | 0.0037 | 0.015 | ND | U | 0.0037 | 0.015 | ND | U | 0.0037 | 0.015 | ND | U | 0.0037 | 0.015 |
| 1,4-Dioxane | 123-91-1 | 0.0027 | mg/m3 | ND | U | 0.00072 | **0.0036** | ND | U | 0.00072 | **0.0036** | ND | U | 0.00072 | **0.0036** | ND | U | 0.00072 | **0.0036** |
| Chlorodibromomethane | 124-48-1 | 0.00078 | mg/m3 | ND | U | 0.0017 | **0.0085** | ND | U | 0.0017 | **0.0085** | ND | U | 0.0017 | **0.0085** | ND | U | 0.0017 | **0.0085** |
| Tetrachloroethene | 127-18-4 | 0.036 | mg/m3 | ND | U | 0.0014 | 0.0068 | ND | U | 0.0014 | 0.0068 | ND | U | 0.0014 | 0.0068 | ND | U | 0.0014 | 0.0068 |
| Ethyl Acrylate | 140-88-5 | 0.0015 | mg/m3 | ND | U | 0.00082 | **0.0041** | ND | U | 0.00082 | **0.0041** | ***0.34*** | | 0.00082 | **0.041** | ND | U | 0.00082 | **0.0041** |
| Ethyl Acetate | 141-78-6 | 4.4 | mg/m3 | ND | U | 0.00072 | 0.0036 | ND | U | 0.00072 | 0.0036 | ND | U | 0.00072 | 0.0036 | ND | U | 0.00072 | 0.0036 |
| N-Heptane | 142-82-5 | NS | mg/m3 | ND | U | 0.00082 | 0.0041 | ND | U | 0.00082 | 0.0041 | ND | U | 0.00082 | 0.0041 | ND | U | 0.00082 | 0.0041 |
| cis-1,2-Dichloroethene | 156-59-2 | 0.049 | mg/m3 | ND | U | 0.00079 | 0.004 | ND | U | 0.00079 | 0.004 | ND | U | 0.00079 | 0.004 | ND | U | 0.00079 | 0.004 |
| trans-1,2-Dichloroethene | 156-60-5 | 0.097 | mg/m3 | ND | U | 0.00079 | 0.004 | ND | U | 0.00079 | 0.004 | ND | U | 0.00079 | 0.004 | ND | U | 0.00079 | 0.004 |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 0.081 | mg/m3 | ND | U | 0.00072 | 0.0036 | ND | U | 0.00072 | 0.0036 | ND | U | 0.00072 | 0.0036 | ND | U | 0.00072 | 0.0036 |
| m/p-Xylene | 179601-23-1 | NS | mg/m3 | ND | U | 0.00087 | 0.0043 | ND | U | 0.00087 | 0.0043 | 0.0069 | | 0.00087 | 0.0043 | ND | U | 0.00087 | 0.0043 |
| 2,2,4-Trimethylpentane | 540-84-1 | NS | mg/m3 | ND | U | 0.00093 | 0.0047 | 0.016 | | 0.00093 | 0.0047 | 0.94 | | 0.00093 | 0.047 | 0.25 | | 0.00093 | 0.047 |
| M-Dichlorobenzene | 541-73-1 | NS | mg/m3 | ND | U | 0.0012 | 0.006 | ND | U | 0.0012 | 0.006 | ND | U | 0.0012 | 0.006 | ND | U | 0.0012 | 0.006 |
| Carbon Tetrachloride | 56-23-5 | 0.0014 | mg/m3 | ND | U | 0.0013 | **0.0063** | ND | U | 0.0013 | **0.0063** | ND | U | 0.0013 | **0.0063** | ND | U | 0.0013 | **0.0063** |
| Methyl N-Butyl Ketone | 591-78-6 | NS | mg/m3 | ND | U | 0.002 | 0.0082 | ND | U | 0.002 | 0.0082 | ND | U | 0.002 | 0.0082 | ND | U | 0.002 | 0.0082 |
| 4-Ethyltoluene | 622-96-8 | NS | mg/m3 | ND | U | 0.00098 | 0.0049 | ND | U | 0.00098 | 0.0049 | ND | U | 0.00098 | 0.0049 | ND | U | 0.00098 | 0.0049 |
| 1,1,1,2-Tetrachlorroethane | 630-20-6 | 0.0028 | mg/m3 | ND | U | 0.0014 | **0.0069** | ND | U | 0.0014 | **0.0069** | ND | U | 0.0014 | **0.0069** | ND | U | 0.0014 | **0.0069** |
| Acetone | 67-64-1 | 43 | mg/m3 | 0.018 | | 0.0012 | 0.0048 | 0.018 | | 0.0012 | 0.0048 | 0.022 | | 0.0012 | 0.0048 | 0.012 | | 0.0012 | 0.0048 |
| Chloroform | 67-66-3 | 0.00044 | mg/m3 | ND | U | 0.00098 | **0.0049** | ***0.0055*** | | 0.00098 | **0.0049** | ND | U | 0.00098 | **0.0049** | ***0.0067*** | | 0.00098 | **0.0049** |
| Hexachloroethane | 67-72-1 | NS | mg/m3 | ND | U | 0.0019 | 0.0097 | ND | U | 0.0019 | 0.0097 | ND | U | 0.0019 | 0.0097 | ND | U | 0.0019 | 0.0097 |
| Benzene | 71-43-2 | 0.0027 | mg/m3 | ND | U | 0.00064 | **0.0032** | ND | U | 0.00064 | **0.0032** | ***0.0036*** | | 0.00064 | **0.0032** | ND | U | 0.00064 | **0.0032** |
| 1,1,1-Trichloroethane | 71-55-6 | 2.9 | mg/m3 | ND | U | 0.0011 | 0.0055 | ND | U | 0.0011 | 0.0055 | ND | U | 0.0011 | 0.0055 | ND | U | 0.0011 | 0.0055 |
| Methane | 74-82-8 | NS | mg/m3 | ND | U | 1.3 | 6.6 | ND | U | 1.3 | 6.6 | 30 | | 1.3 | 6.6 | 9.8 | | 1.3 | 6.6 |
| Bromomethane | 74-83-9 | 0.0068 | mg/m3 | ND | U | 0.00078 | 0.0039 | ND | U | 0.00078 | 0.0039 | ND | U | 0.00078 | 0.0039 | ND | U | 0.00078 | 0.0039 |
| Chloromethane | 74-87-3 | 0.012 | mg/m3 | ND | U | 0.00041 | 0.0021 | ND | U | 0.00041 | 0.0021 | ND | U | 0.00041 | 0.0021 | ND | U | 0.00041 | 0.0021 |
| Methyl Iodide | 74-88-4 | NS | mg/m3 | ND | U | 0.0012 | 0.0058 | ND | U | 0.0012 | 0.0058 | ND | U | 0.0012 | 0.0058 | ND | U | 0.0012 | 0.0058 |
| Dibromomethane | 74-95-3 | 0.049 | mg/m3 | ND | U | 0.0014 | 0.0071 | ND | U | 0.0014 | 0.0071 | ND | U | 0.0014 | 0.0071 | ND | U | 0.0014 | 0.0071 |
| Chloroethane | 75-00-3 | 0.025 | mg/m3 | ND | U | 0.00053 | 0.0026 | ND | U | 0.00053 | 0.0026 | ND | U | 0.00053 | 0.0026 | ND | U | 0.00053 | 0.0026 |
| Vinyl chloride | 75-01-4 | 0.0024 | mg/m3 | ND | U | 0.00051 | **0.0026** | ND | U | 0.00051 | **0.0026** | ND | U | 0.00051 | **0.0026** | ND | U | 0.00051 | **0.0026** |
| Acetonitrile | 75-05-8 | 0.083 | mg/m3 | ND | U | 0.00084 | 0.0034 | ND | U | 0.00084 | 0.0034 | ND | U | 0.00084 | 0.0034 | ND | U | 0.00084 | 0.0034 |
| Dichloromethane | 75-09-2 | 0.044 | mg/m3 | 0.042 | | 0.00069 | 0.0035 | ND | U | 0.00069 | 0.0035 | ND | U | 0.00069 | 0.0035 | ND | U | 0.00069 | 0.0035 |
| Carbon Disulfide | 75-15-0 | 0.97 | mg/m3 | 0.0067 | | 0.00062 | 0.0031 | ND | U | 0.00062 | 0.0031 | ND | U | 0.00062 | 0.0031 | ND | U | 0.00062 | 0.0031 |
| Tribomomethane | 75-25-2 | 0.019 | mg/m3 | ND | U | 0.0021 | 0.01 | ND | U | 0.0021 | 0.01 | ND | U | 0.0021 | 0.01 | ND | U | 0.0021 | 0.01 |
| Bromodichloromethane | 75-27-4 | 0.00057 | mg/m3 | ND | U | 0.0013 | **0.0067** | ND | U | 0.0013 | **0.0067** | ND | U | 0.0013 | **0.0067** | ND | U | 0.0013 | **0.0067** |
| 1,1-Dichloroethane | 75-34-3 | 0.013 | mg/m3 | ND | U | 0.00081 | 0.004 | ND | U | 0.00081 | 0.004 | ND | U | 0.00081 | 0.004 | ND | U | 0.00081 | 0.004 |
| 1,1-Dichloroethylene | 75-35-4 | 0.28 | mg/m3 | ND | U | 0.00079 | 0.004 | ND | U | 0.00079 | 0.004 | ND | U | 0.00079 | 0.004 | ND | U | 0.00079 | 0.004 |
| Dichloromonofluoromethane | 75-43-4 | NS | mg/m3 | ND | U | 0.00084 | 0.0042 | ND | U | 0.00084 | 0.0042 | ND | U | 0.00084 | 0.0042 | ND | U | 0.00084 | 0.0042 |
| Chlorodifluoromethane | 75-45-6 | 68 | mg/m3 | ND | U | 0.00071 | 0.0035 | ND | U | 0.00071 | 0.0035 | ND | U | 0.00071 | 0.0035 | ND | U | 0.00071 | 0.0035 |
| Tert-Butyl Alcohol | 75-65-0 | NS | mg/m3 | ND | U | 0.00061 | 0.003 | ND | U | 0.00061 | 0.003 | ND | U | 0.00061 | 0.003 | ND | U | 0.00061 | 0.003 |
| CFC-11 | 75-69-4 | 0.97 | mg/m3 | ND | U | 0.0011 | 0.0056 | ND | U | 0.0011 | 0.0056 | ND | U | 0.0011 | 0.0056 | ND | U | 0.0011 | 0.0056 |
| CFC-12 | 75-71-8 | 0.24 | mg/m3 | ND | U | 0.00099 | 0.0049 | ND | U | 0.00099 | 0.0049 | ND | U | 0.00099 | 0.0049 | ND | U | 0.00099 | 0.0049 |
| Chlorinated Fluocarbon (Freon 113) | 76-13-1 | 42 | mg/m3 | ND | U | 0.0038 | 0.015 | ND | U | 0.0038 | 0.015 | ND | U | 0.0038 | 0.015 | ND | U | 0.0038 | 0.015 |
| 1,2-114 Dichlorotetrafluoroethane; Fluorocarbon 114 | 76-14-2 | NS | mg/m3 | ND | U | 0.0014 | 0.007 | ND | U | 0.0014 | 0.007 | ND | U | 0.0014 | 0.007 | ND | U | 0.0014 | 0.007 |
| 1,2-Dichloropropane | 78-87-5 | 0.002 | mg/m3 | ND | U | 0.00092 | **0.0046** | ND | U | 0.00092 | **0.0046** | ND | U | 0.00092 | **0.0046** | ND | U | 0.00092 | **0.0046** |
| 2-Butanone | 78-93-3 | 1.4 | mg/m3 | 0.0059 | | 0.0015 | 0.0059 | ND | U | 0.0015 | 0.0059 | 0.0066 | | 0.0015 | 0.0059 | ND | U | 0.0015 | 0.0059 |
| 1,1,2-Trichloroethane | 79-00-5 | 0.0013 | mg/m3 | ND | U | 0.0011 | **0.0055** | ND | U | 0.0011 | **0.0055** | ND | U | 0.0011 | **0.0055** | ND | U | 0.0011 | **0.0055** |
| Trichloroethylene | 79-01-6 | 0.012 | mg/m3 | ND | U | 0.0011 | 0.0054 | ND | U | 0.0011 | 0.0054 | ND | U | 0.0011 | 0.0054 | ND | U | 0.0011 | 0.0054 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | 0.00036 | mg/m3 | ND | U | 0.0014 | **0.0069** | ND | U | 0.0014 | **0.0069** | ND | U | 0.0014 | **0.0069** | ND | U | 0.0014 | **0.0069** |
| Methyl Methacrylate | 80-62-6 | 0.97 | mg/m3 | ND | U | 0.00082 | 0.0041 | ND | U | 0.00082 | 0.0041 | ND | U | 0.00082 | 0.0041 | ND | U | 0.00082 | 0.0041 |
| Hexachloro-1,3-Butadiene | 87-68-3 | NS | mg/m3 | ND | U | 0.0053 | 0.021 | ND | U | 0.0053 | 0.021 | ND | U | 0.0053 | 0.021 | ND | U | 0.0053 | 0.021 |
| o-Xylene | 95-47-6 | NS | mg/m3 | ND | U | 0.00087 | 0.0043 | ND | U | 0.00087 | 0.0043 | ND | U | 0.00087 | 0.0043 | ND | U | 0.00087 | 0.0043 |
| 1,2-Dichlorobenzene | 95-50-1 | 0.19 | mg/m3 | ND | U | 0.0012 | 0.006 | ND | U | 0.0012 | 0.006 | ND | U | 0.0012 | 0.006 | ND | U | 0.0012 | 0.006 |
| 1,2,4-Trimethylbenzene | 95-63-6 | 0.0083 | mg/m3 | ND | U | 0.00098 | 0.0049 | ND | U | 0.00098 | 0.0049 | ND | U | 0.00098 | 0.0049 | ND | U | 0.00098 | 0.0049 |
| 1,2,3-Trichloropropane | 96-18-4 | 0.00001 | mg/m3 | ND | U | 0.0012 | **0.006** | ND | U | 0.0012 | **0.006** | ND | U | 0.0012 | **0.006** | ND | U | 0.0012 | **0.006** |
| Methyl Acrylate | 96-33-3 | 0.15 | mg/m3 | ND | U | 0.0007 | 0.0035 | ND | U | 0.0007 | 0.0035 | ND | U | 0.0007 | 0.0035 | ND | U | 0.0007 | 0.0035 |
| Ethyl Methacrylate | 97-63-2 | 0.44 | mg/m3 | ND | U | 0.00093 | 0.0047 | ND | U | 0.00093 | 0.0047 | ND | U | 0.00093 | 0.0047 | ND | U | 0.00093 | 0.0047 |
| Cumene | 98-82-8 | 0.54 | mg/m3 | ND | U | 0.00098 | 0.0049 | ND | U | 0.00098 | 0.0049 | 0.046 | | 0.00098 | 0.0049 | 0.0075 | | 0.00098 | 0.0049 |
| Alpha Methyl Styrene | 98-83-9 | 0.049 | mg/m3 | ND | U | 0.00097 | 0.0048 | ND | U | 0.00097 | 0.0048 | ND | U | 0.00097 | 0.0048 | ND | U | 0.00097 | 0.0048 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
mg/m3 - milligram per cubic meter
MSC - PADEP's Medium Specific Concentration for Air
RL - Reporting Limit
ND - Not Detected

**Qualifiers:**
Q - Qualifier
U - Undetected

**Exceedance Summary:**
10 - MDL exceeds the PADEP Residential Indoor Air MSC
**10** - RL exceeds the PADEP Residential Indoor Air MSC
***10*** - Concentration exceeds the PADEP Residential Indoor Air MSC




**Jackson Street Sewer Detailed Investigation Timeline Description**

1993 – GES installed 37 soil borings along sewer and performed aquifer testing.

1995 – GES collected 28 sediment samples from sewer outfall.

December 2002 – PADEP performed inspection and collected PID readings in area of 29th and McKean Streets in response to residents complaining about odors coming from sewer.
Results: Petroleum odor present, PID readings ranged from 0.0 to 40.0 ppm/Source of odor

2002 – Sunoco/Aquaterra performed subsurface evaluation around sewer. Installed 51 soil borings and installed 13 monitoring wells.
Results: Separate phase hydrocarbons existed in subsurface proximal to sewer.

February 2003 - PADEP performed inspection and collected PID readings in area of 29th and McKean Streets in response to residents complaining about odors coming from sewer.
Results: Petroleum odors present and PID readings ranged from 0.0 to 53.7 ppm.

Feb 2003 – PADEP/PWD performed sewer inspection.
Results: Overall structural condition of sewer was good. Observed evidence of hydrocarbons in the sewer using UV light. Increased amounts of hydrocarbons observed towards western portion of sewer.

March 2003 – Sunoco/Aquaterra performed sewer inspection.
Results: Mapped locations of hydrocarbon seep areas by use of UV light and visual observations inside sewer. Identified locations of other pipes tying into sewer.

June 2003 – Sunoco performed outfall modifications. Constructed underflow weir. Rerouted the discharge pipe from Klondike separator.

September 2003 – Sunoco automated skimmer and installed water curtain.

November 2003 - PADEP performed inspection and collected PID readings in area of 29th and McKean Streets, and 27th Street and Snyder Avenue in response to residents complaining about odors coming from sewer.
Results: Petroleum odors present and PID readings ranged from 0.0 to 239 ppm.

September 2004 – PADEP performed inspection and collected PID readings in area of Hollywood and 29th Streets in response to residents complaining about odors coming from sewer.
Results: Petroleum odors present and PID readings ranged from 0.0 to 22.4 ppm.

September 2005 – PADEP performed inspection and collected PID readings to follow up on reports of odors coming from Hollywood and McKean Streets.
Results: No odors or PID readings reported.

2005 – Sunoco blanked off pipe located at the western end of the sewer which was discharging NAPL into sewer.
Results: Reduced amount of sheening/NAPL observed at outfall.

December 2008 – Sunoco/Stantec completed air monitoring in vicinity of Jackson and McKean Streets using a PID.
Results: No PID readings recorded.

2004 – 2009 – Sunoco monitors system weekly and collects PID monitoring data east and west of the water curtain area.

June 2009 – Sunoco/Aquaterra collected 24-hour TO-15 summa air gas samples east and west of the water curtain alongside and inside of sewer.
Results:

- Benzene was above the PADEP residential indoor air screening criteria on-site in Manhole No. 3 sample location;
- No benzene detections east of water curtain or off-site in sewer near residential neighborhood;
- Chloroform was above the residential MSC west of water curtain (Manhole No. 1) and off-site in sewer (Manhole No. 6); and
- No exceedances of residential MSCs in background ambient air sample.

With the exception of the above mentioned compounds, all other TO-15 compounds were below their respective PADEP residential indoor air screening criteria. Methane was present in two of the samples (Manhole No. 3 and Manhole No. 6), however there is no PADEP residential indoor air screening criteria for methane.

# Jackson Street Sewer Figures

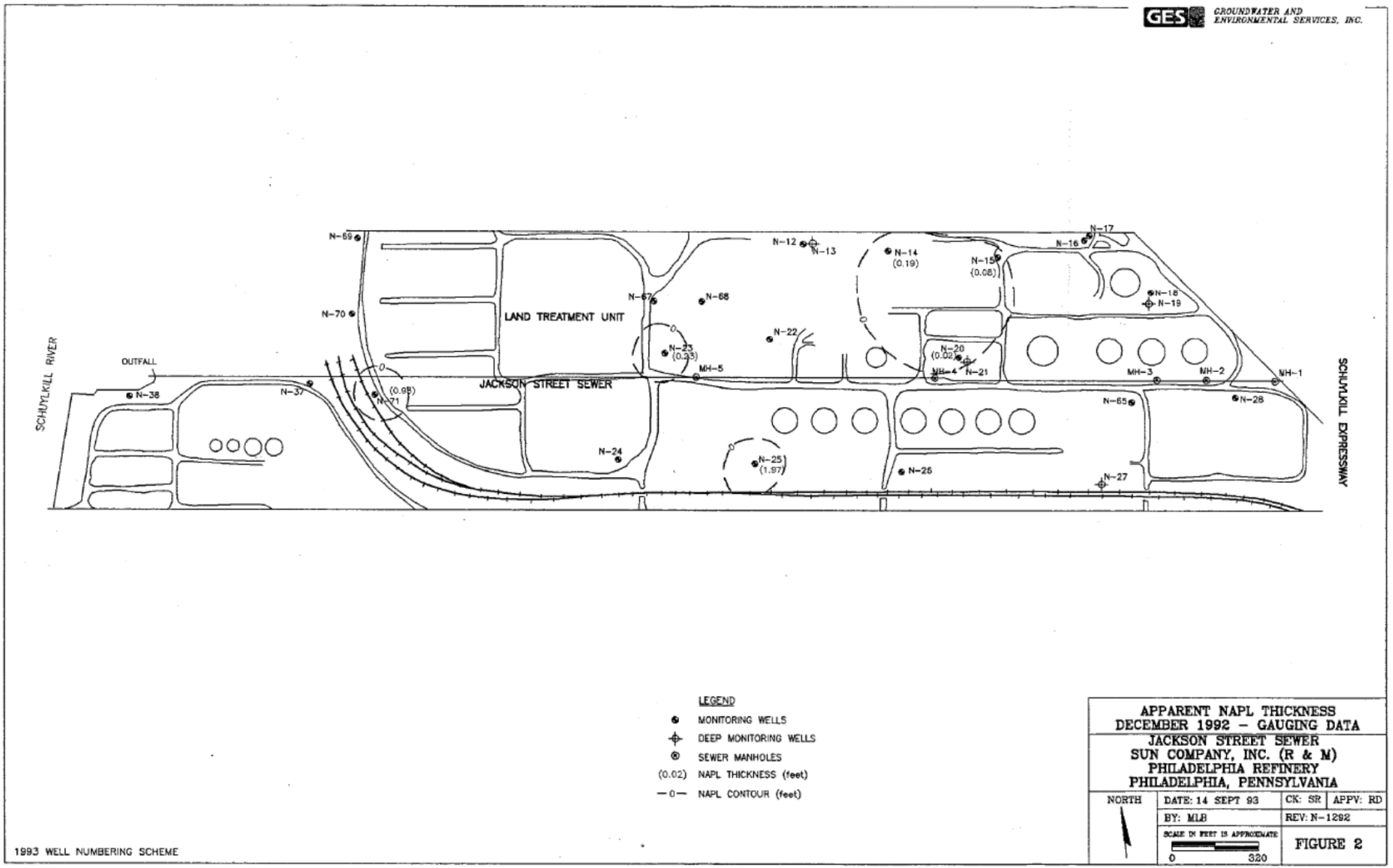
1992 & 2002-2008

1993
Comprehensive
Remedial Plan

OBSERVATIONS

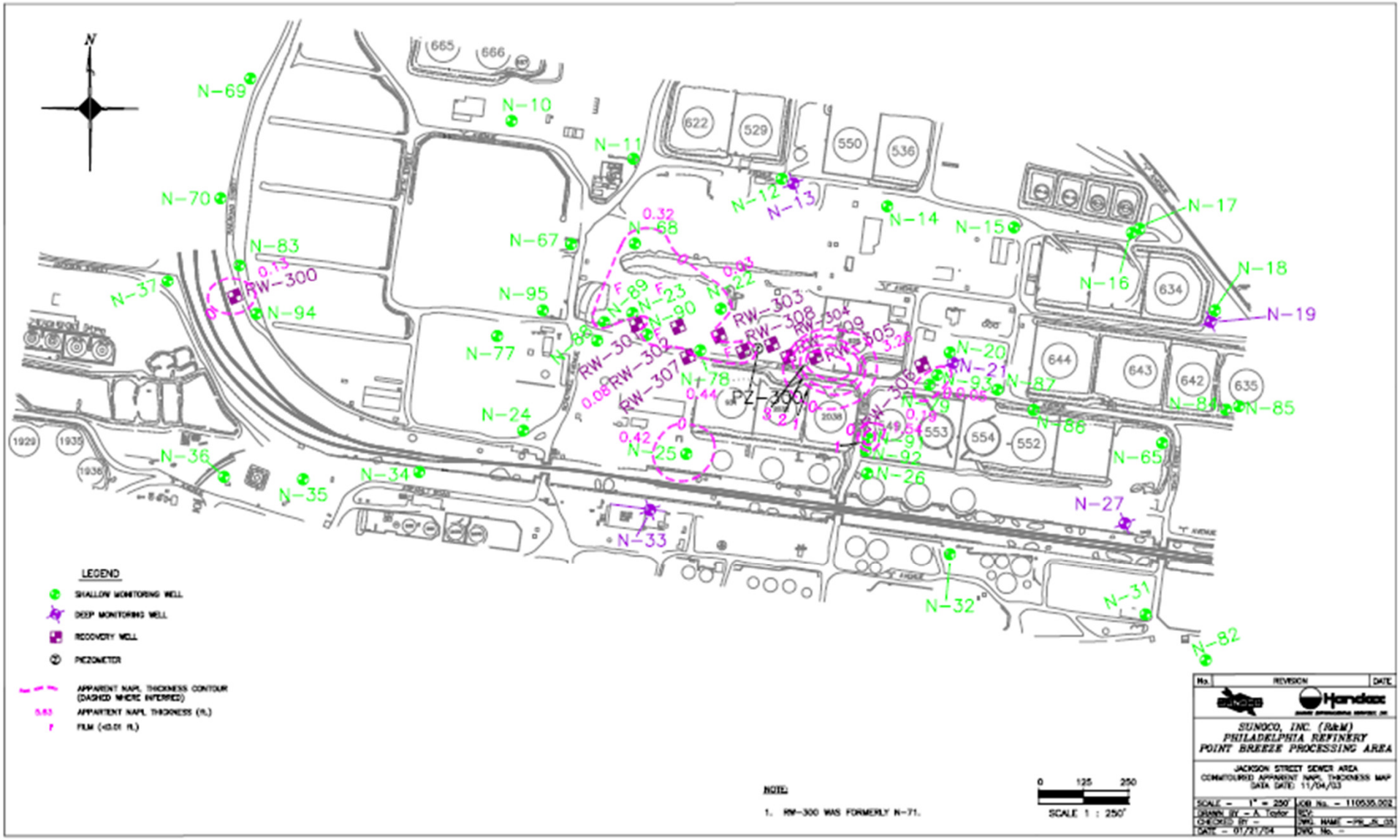
4 Plumes – N-71, N-23, N-25 and (N-14,N-15,N-20)

All but N-25 are less than 1 foot thick



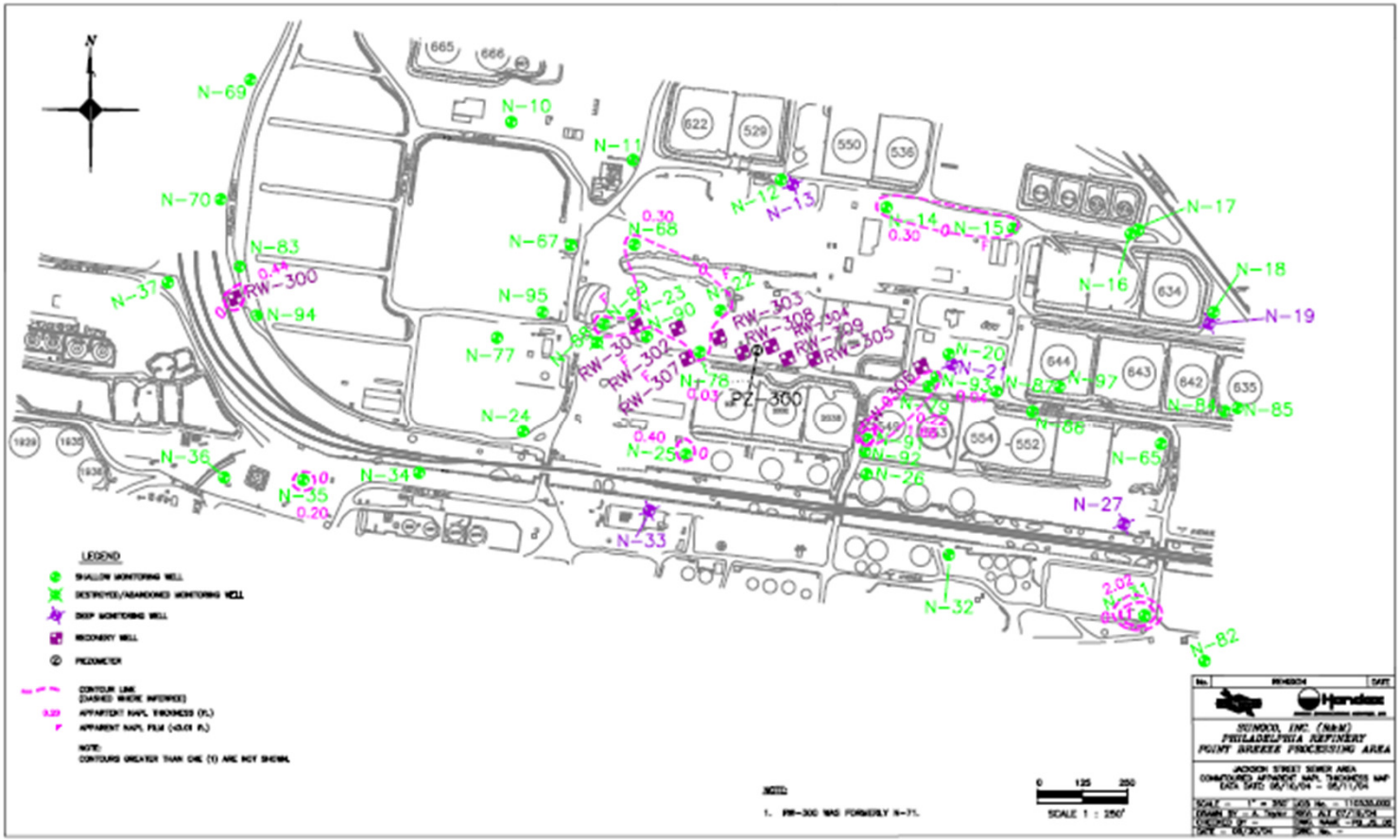
Point Breeze 4th Quarter 2003 Report (pg. 43)

OBSERVATIONS
N-71 now RW-300 – Plume thickness decreased
N-23 – Plume size increased to N-68,N-89,RW-302,N-78,RW-308, and N-22 (thickness less than .5 ft)
N-14,N-15,N-20 – Plume is gone
N-25 – Plume thickness decreased to less than .5 ft
New Plume – Around RW-305 and RW-309 more than 3 ft thick



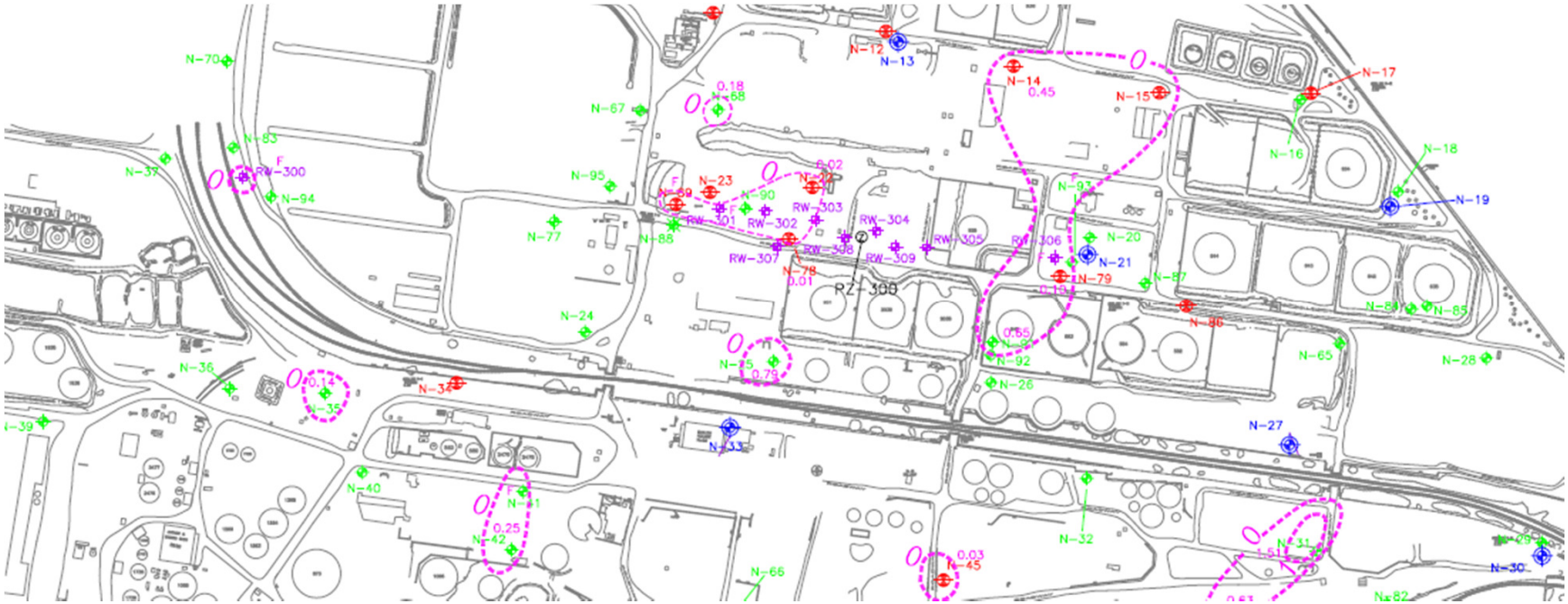
Point Breeze 2nd Quarter 2004 Report (pg. 41)

OBSERVATIONS
RW-300 – Plume thickness increased
N-23 – Plume size changed to N-68,N-89,RW-302,RW-301,N-78, and N-22 (thickness less than .5 ft)
N-14,N-15,N-20 – Plume is back around N-14 and N-15 (less than .5 ft)
N-25 – Plume thickness decreased slightly
Plume around RW-305 and RW-309 is gone
New Plume around N-91, N-79, and N-93 (more than a foot thick around N-91)
New Plume around N-35 (less than .5ft thick)



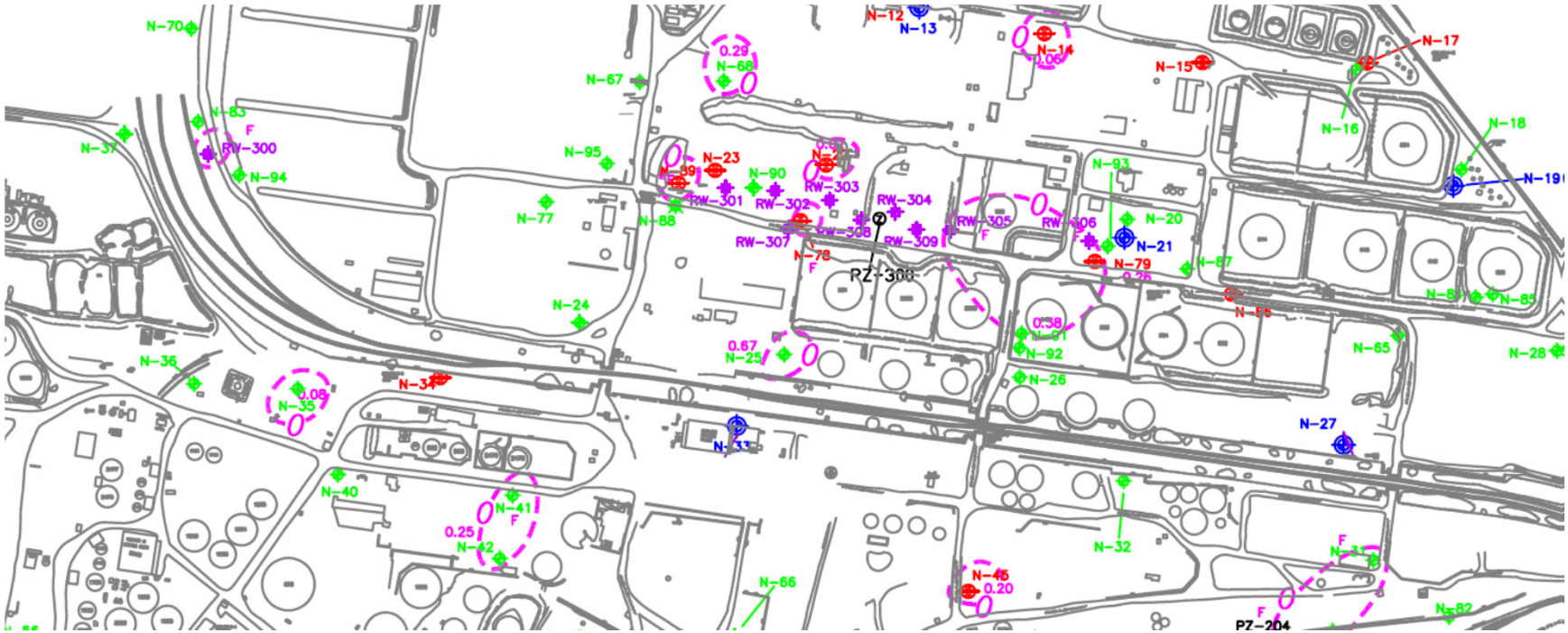
Point Breeze 4th
Quarter 2004
Report (pg. 257)

OBSERVATIONS
RW-300 – Plume thickness decreased to a film
N-23 no longer in the plume – Plume size changed to N-89,N-90,RW-302,RW-301,N-78, and N-22 (thickness increased to less than 1 ft)
New Plume at N-68 – separated from the N-23 plume
2 Plumes combined to include N-91, N-79, RW-306, N-93, N-14 and N-15 (less than 1 ft thick)
N-25 – Plume thickness increased
Plume around N-35 thickness decreased slightly



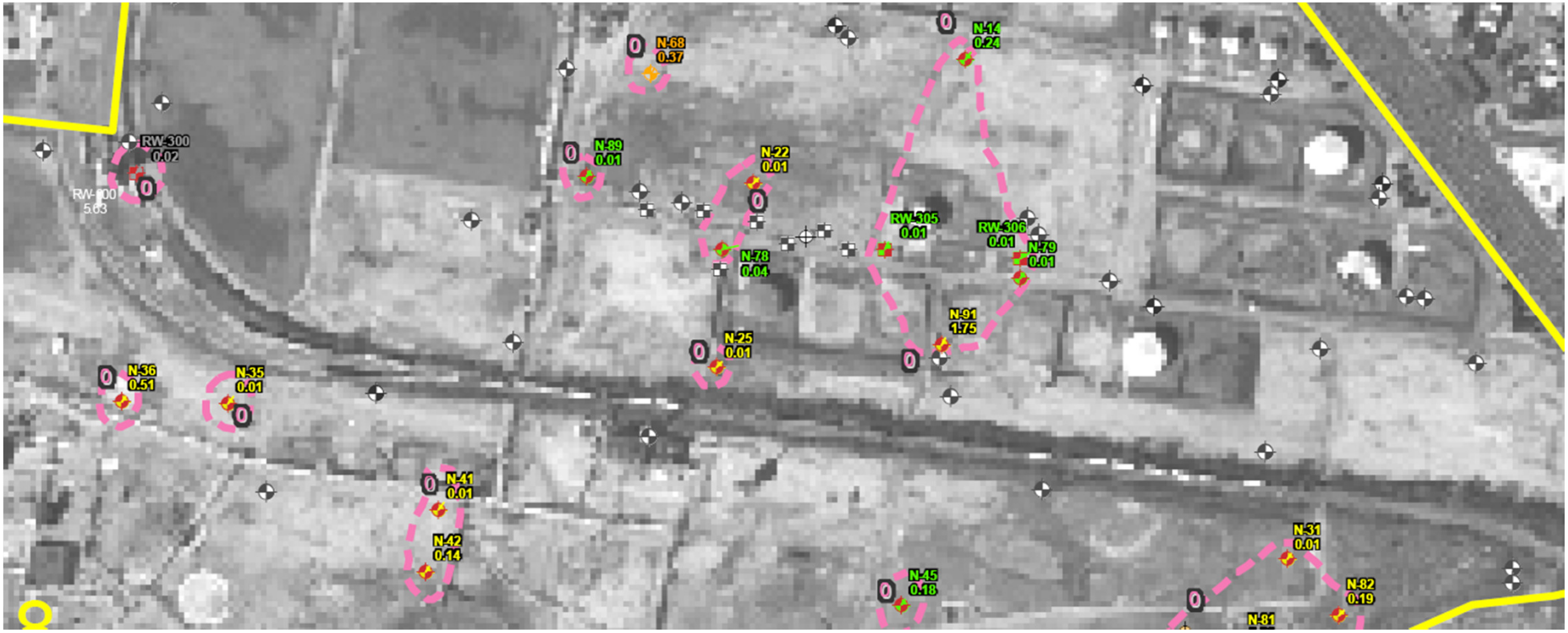
Point Breeze 2nd Quarter 2005 Report (pg. 83)

OBSERVATIONS
RW-300 – Plume thickness remained same
Plume size decreased to multiple separate plumes - N-89, N-78, and N-22 are all separate plumes (thickness decreased to film in N-89 and N-78, thickness less than .5 ft in N-22)
Plume at N-68 – increased in thickness slightly
Plume N-91, N-79, RW-306, N-93, N-14 and N-15 changed – Separate plume N-14 and Plume RW-305, RW-306, N-91 and N-79 thicknesses less than .5 ft
N-25 – Plume thickness decreased slightly
Plume around N-35 thickness decreased slightly



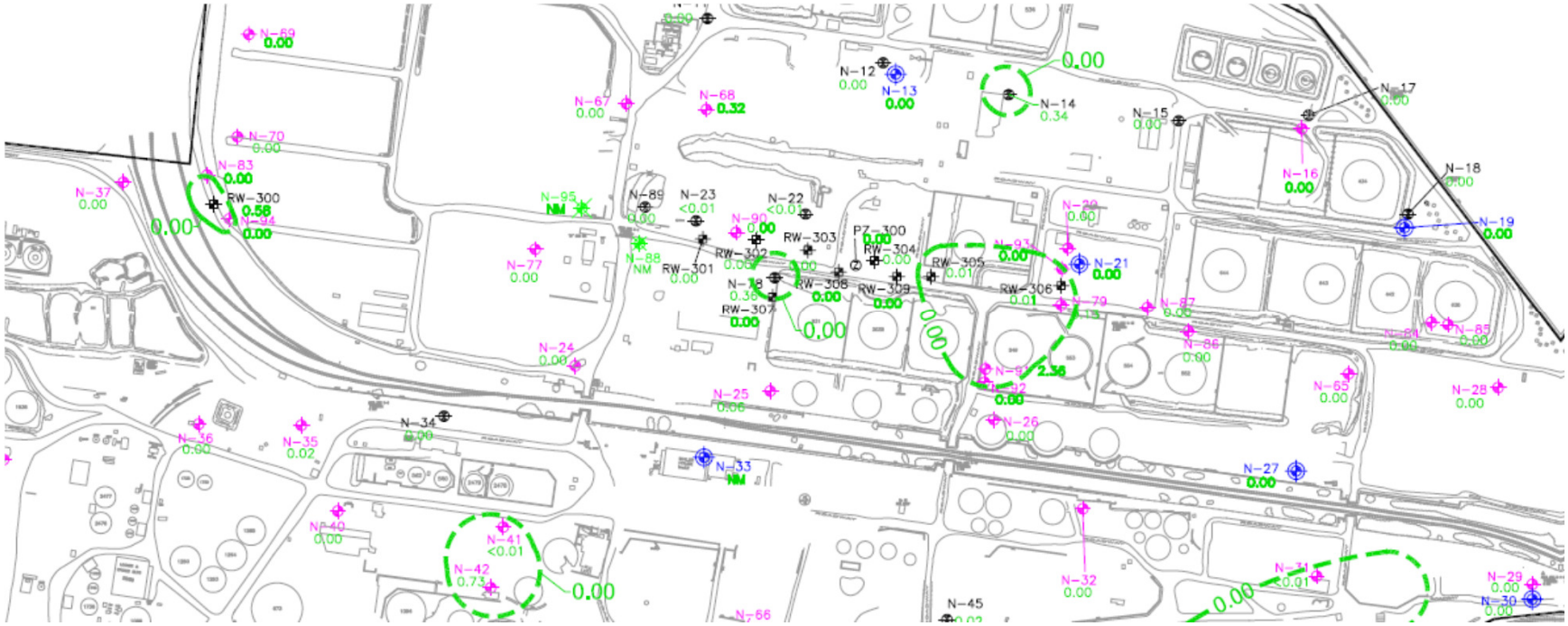
Point Breeze 4th
Quarter 2005
Report (pg. 50)

OBSERVATIONS
RW-300 – Plume thickness increased slightly
Plume size changed to plumes - N-89, and N-78 and N-22 as a combined plume
Plume at N-68 – increased in thickness slightly
Separate plume N-14 is now combined with Plume RW-305, RW-306, N-91 and N-79
N-25 – Plume thickness decreased slightly
Plume around N-35 thickness decreased slightly
New Plume around N-36 thickness around .5 ft



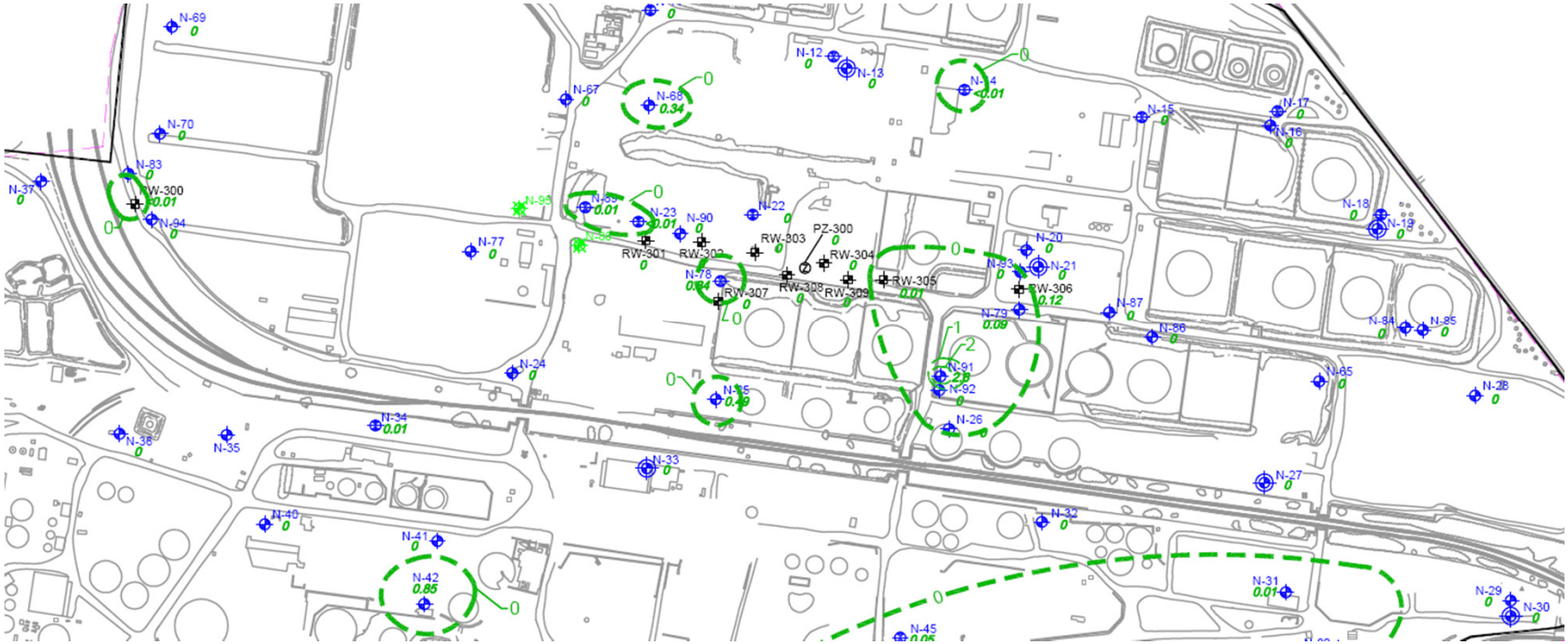
Point Breeze 2nd Quarter 2006 Report (pg. 97)

OBSERVATIONS
RW-300 – Plume thickness increased slightly and now includes N-94 and N-83
Plume size changed to plumes - N-89 no longer plume, and N-78 and N-22 as separate plumes
Plume at N-68 – decreased in thickness slightly
Separate plume N-14 is now separated from Plume RW-305, RW-306, N-91 and N-79 (now plume includes N-93, and N-92)
N-25 – Plume thickness increased slightly
Plume around N-35 thickness increased slightly
Plume around N-36 is now gone



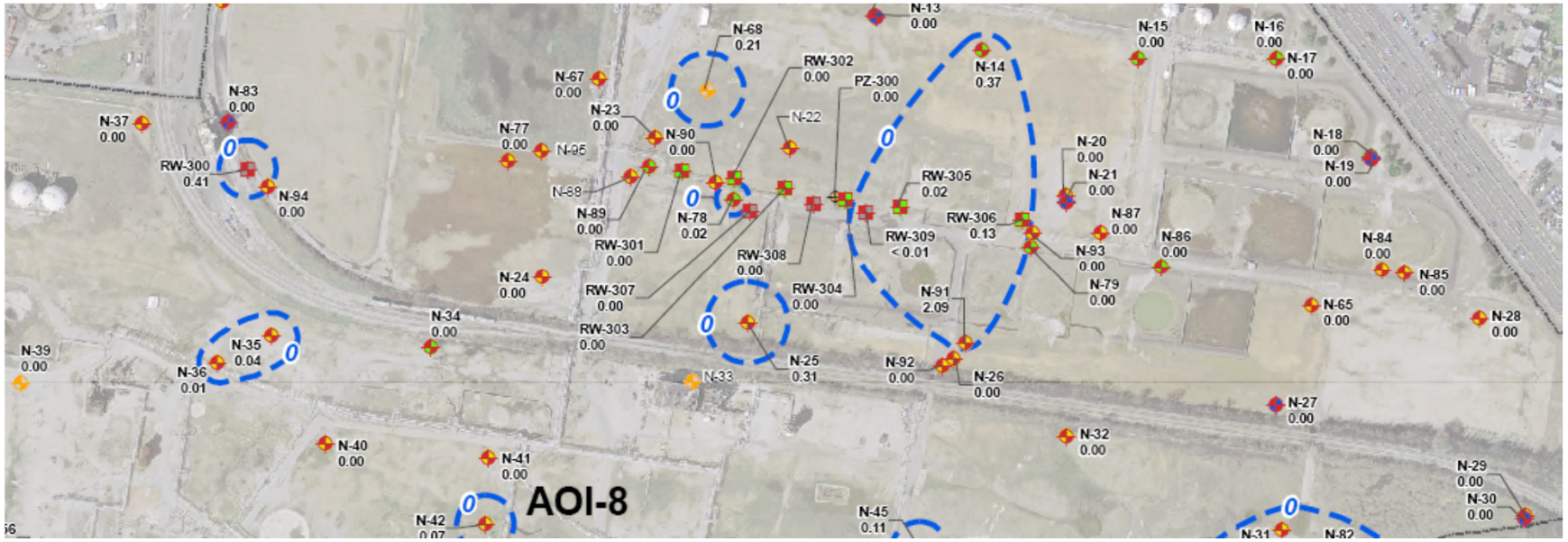
Point Breeze 4th Quarter 2006 Report (pg. 28)

OBSERVATIONS
RW-300, N-94 and N-83– Plume thickness decreased slightly
N-89 plume returns and includes N-23
Plume N-78 thickness increased slightly
Plume N-22 is no longer present
Plume at N-68 – increased in thickness slightly
Plume N-14 thickness decreased slightly
Plume RW-305, RW-306, N-91, N-79, N-93, and N-92 now includes N-26 and has increased in thickness
N-25 – Plume thickness increased
Plume around N-35 no longer present



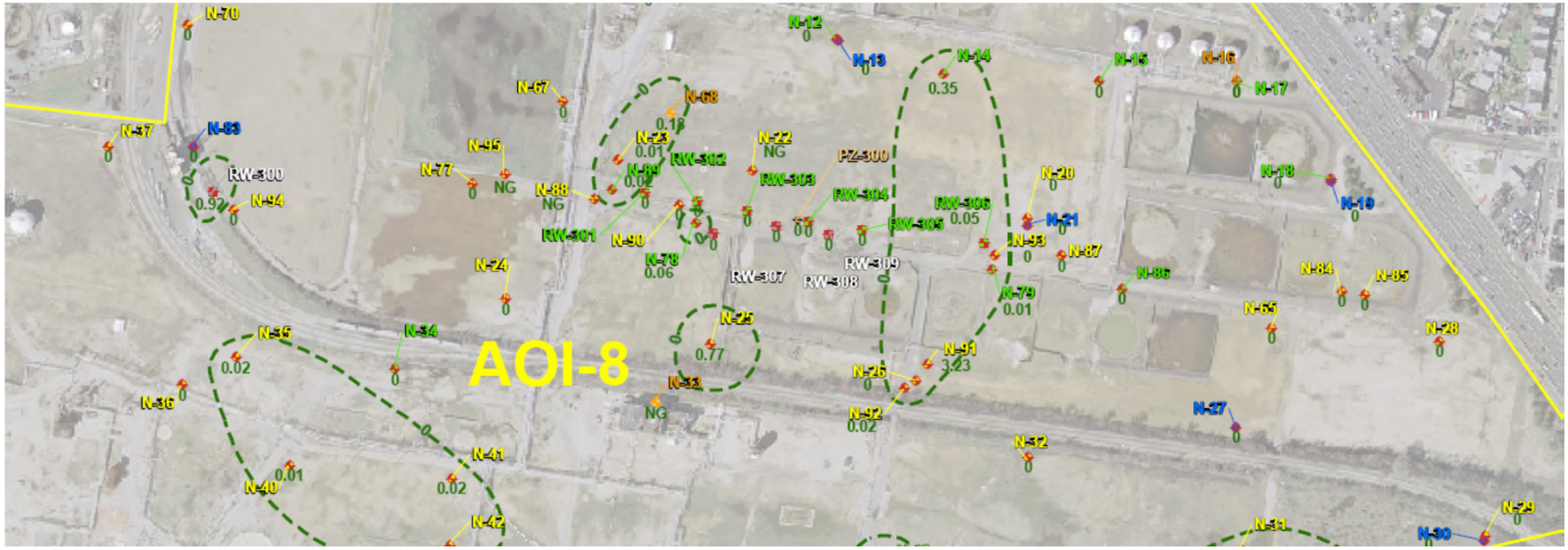
Point Breeze 4th Quarter 2007 Report (pg. 35)

OBSERVATIONS
RW-300, N-94 and N-83– Plume thickness increased slightly but no longer includes N-83
N-89 plume no longer present
Plume N-78 thickness decreased slightly
Plume at N-68 – decreased in thickness slightly
Plume N-14 combined with Plume RW-305, RW-306, N-91, N-79, N-93 now includes RW-309 and no longer includes N-92 and N-26
N-25 – Plume thickness decreased
Plume around N-35 returns and includes N-36



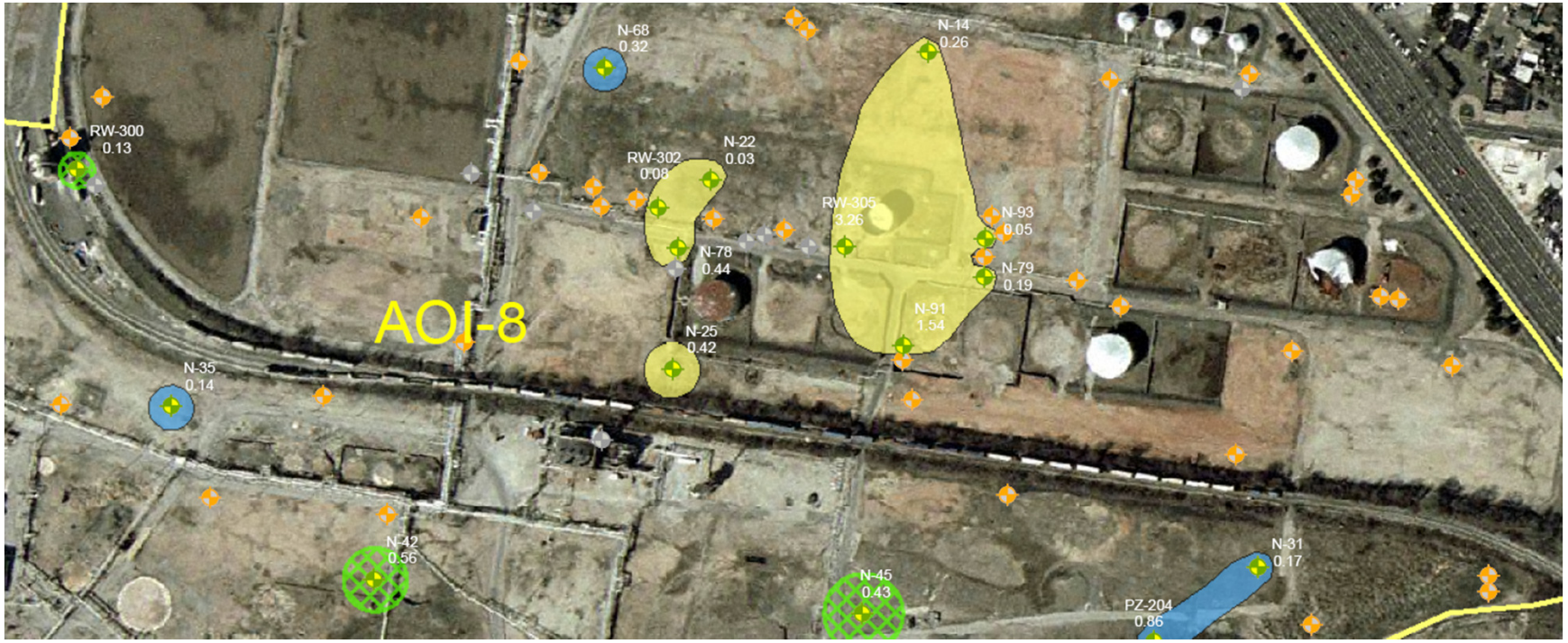
Point Breeze 2nd Quarter 2008 Report (pg. 32)

OBSERVATIONS
RW-300 and N-94– Plume thickness increased slightly but no longer includes N-94
N-89 plume returns and now includes N-23 and N-68
Plume N-78 thickness increased slightly
Plume N-14 combined with Plume RW-305, RW-306, N-91, N-79, N-93 now includes RW-309 and no longer includes N-92 and N-26
N-25 – Plume thickness decreased
Plume around N-35 and N-36 increases and now includes – N-35, N-40, N-45 and N-42



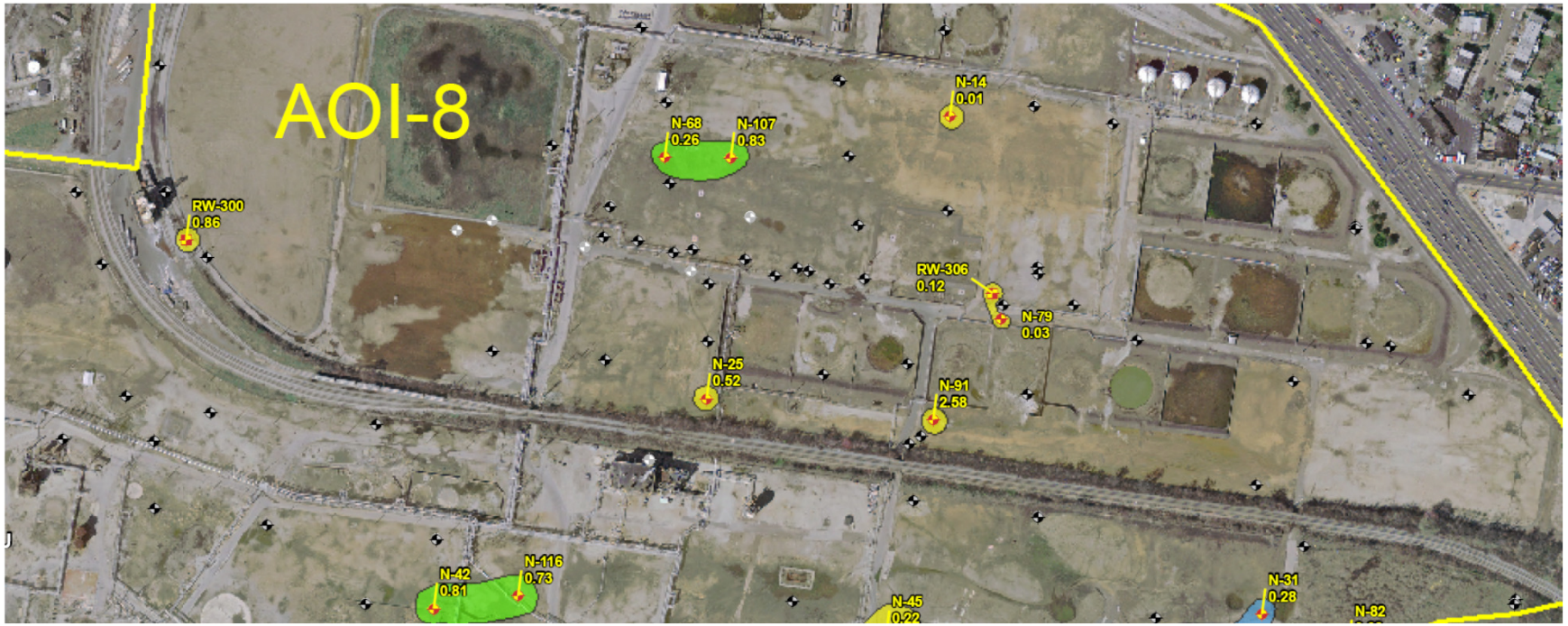
CCR - Figure 5
data collected
11/2003

OBSERVATIONS
RW-300 Plume thickness decreased slightly
N-89, N-23 and N-68 plume no longer present
Plume N-78 now includes RW-302 and N-22
Plume N-14, RW-305, RW-306, N-91, N-79, N-93 RW-309 no longer includes RW-306, or RW-309
Plume N-25 thickness decreased slightly
Plume around N-35, N-36, N-35, N-40, N-45 and N-42 changes to 2 small plumes – plume N-35 and plume N-42



AOI 8 SCR - Figure 11
10/2003

OBSERVATIONS
RW-300 Plume thickness increased slightly
N-68 plume returns and includes N-107
Plume N-78, RW-302 and N-22 no longer present
Plume N-14, RW-305, N-91, N-79, N-93 now broken into smaller plumes – Plume N-14, Plume N-91 and Plume N-79 and RW-306
Plume N-25 thickness increased slightly
Plume N-35 no longer present
Plume N-42 now includes N-116



# North Yard – Bulkhead Area Figures

2002 - 2008

Point Breeze 4th Quarter 2003 Report (pg. 97)

OBSERVATIONS

5 separate plumes present with thicknesses under .5ft

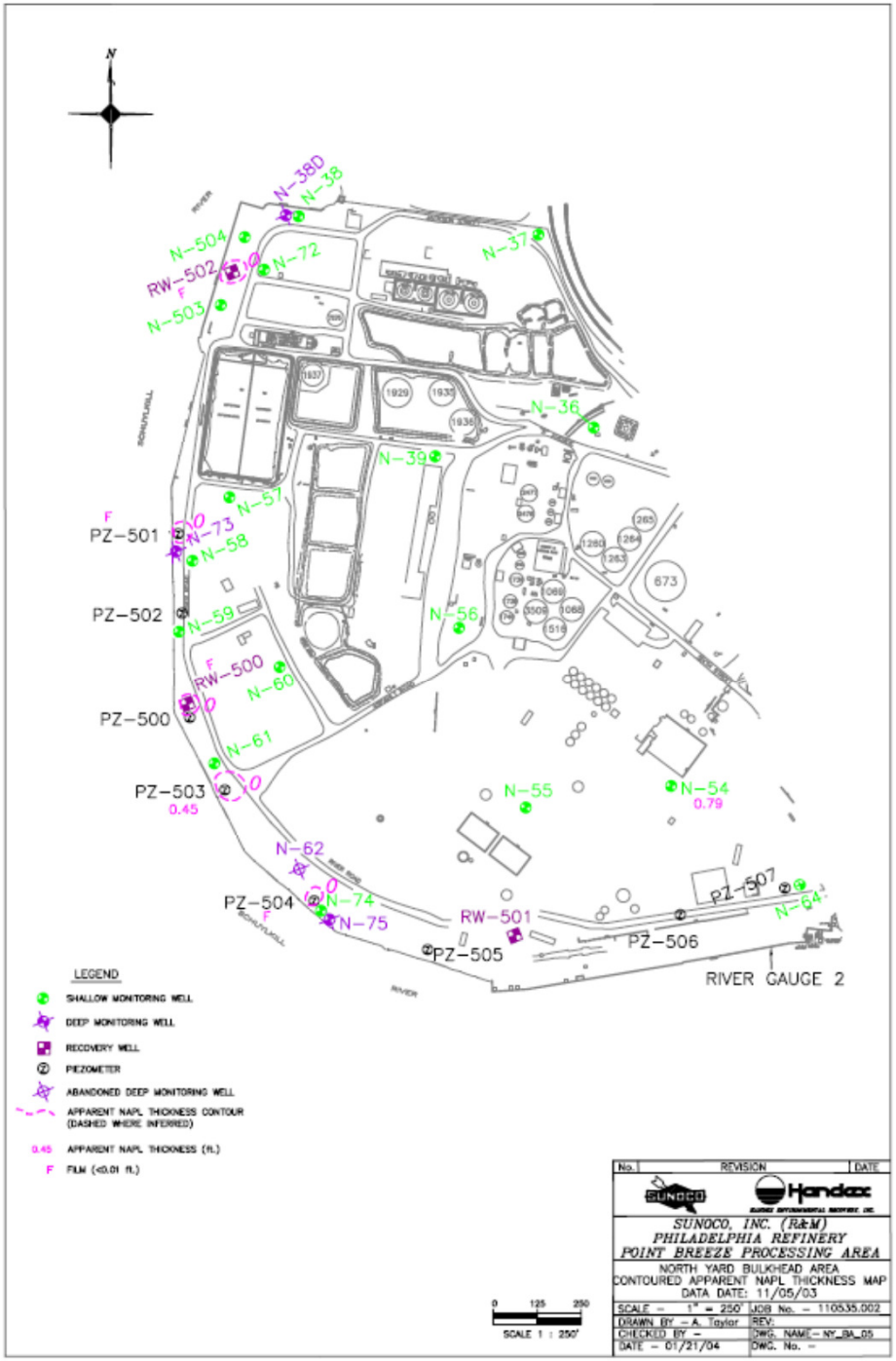
RW-502

PZ-501

RW-500

PZ-503

PZ-504



Point Breeze 2nd
Quarter 2004
Report (pg. 54)

OBSERVATIONS

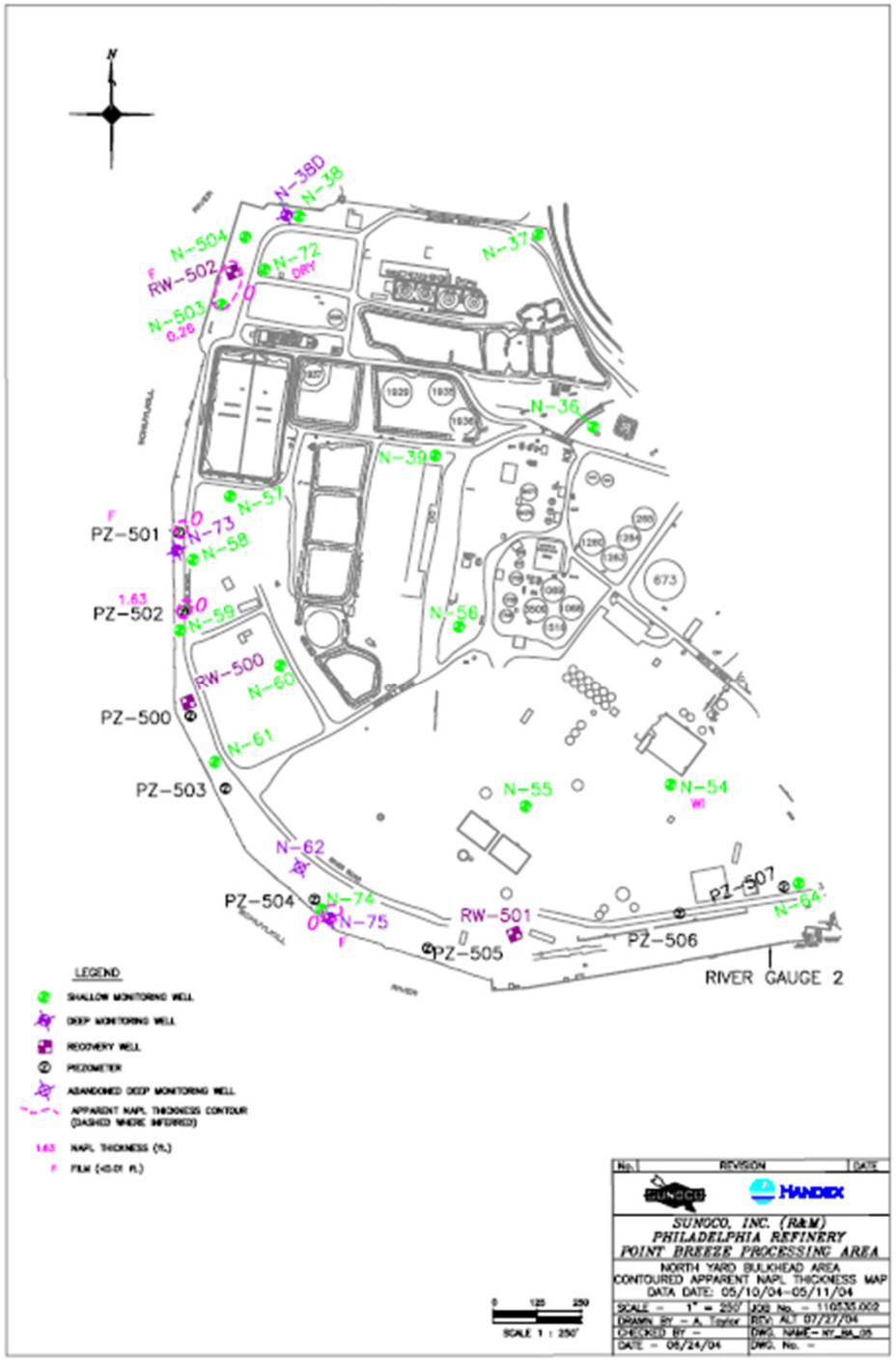
Plume RW-502 now includes N-503

PZ-501 – no change

RW-500 – no plume present

PZ-503 – no plume present

PZ-504 – no longer in plume –
plume moved to N-75



Point Breeze 4th
Quarter 2004
Report (pg. 257)

OBSERVATIONS

Plume RW-502 and N-503 now includes N-504

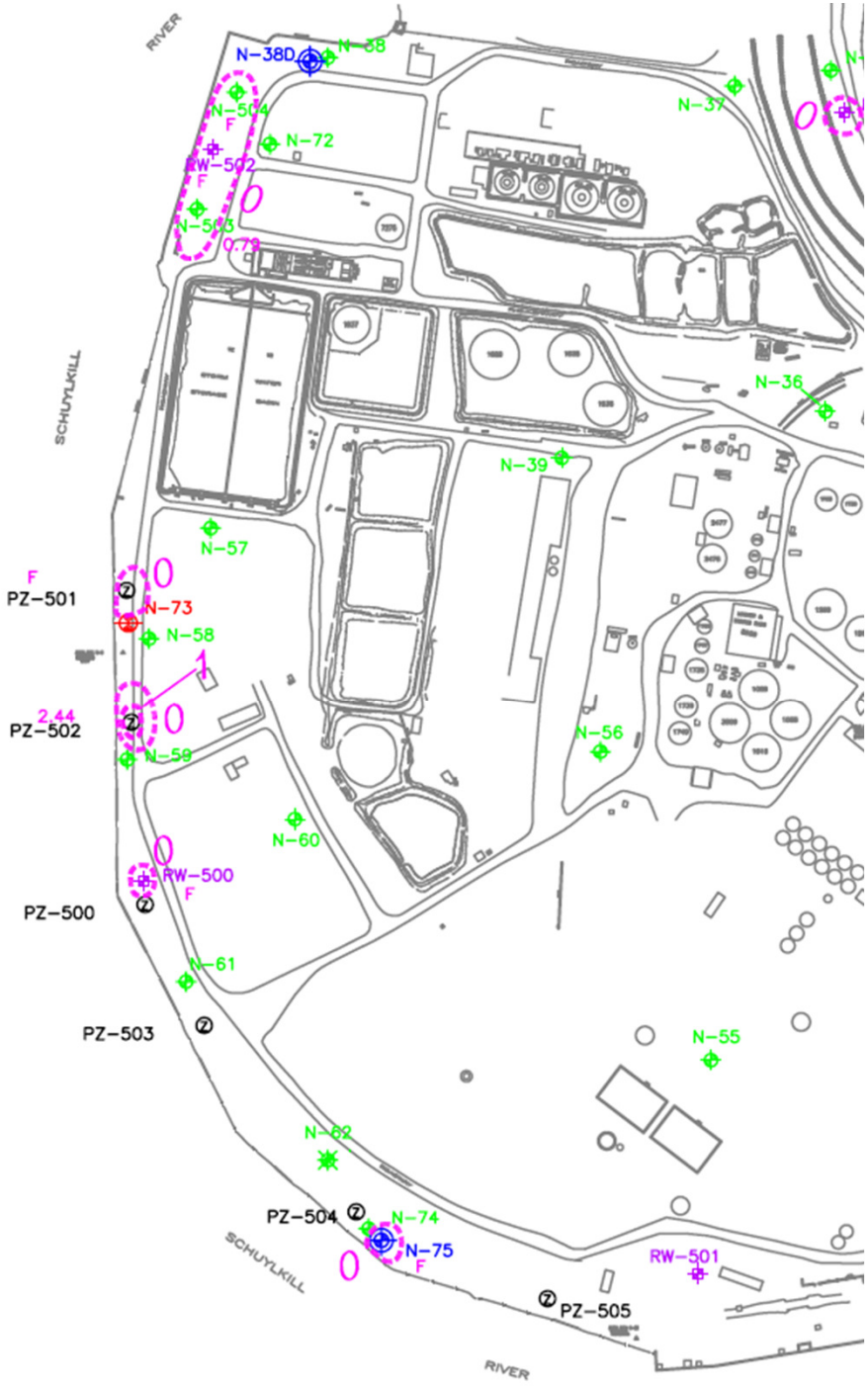
PZ-501 – no change

New Plume PZ-502 – more than 2 ft thick

RW-500 –plume returns

PZ-503 – no plume present

Plume N-75 – no change



Point Breeze 2nd
Quarter 2005
Report (pg. 83)

OBSERVATIONS

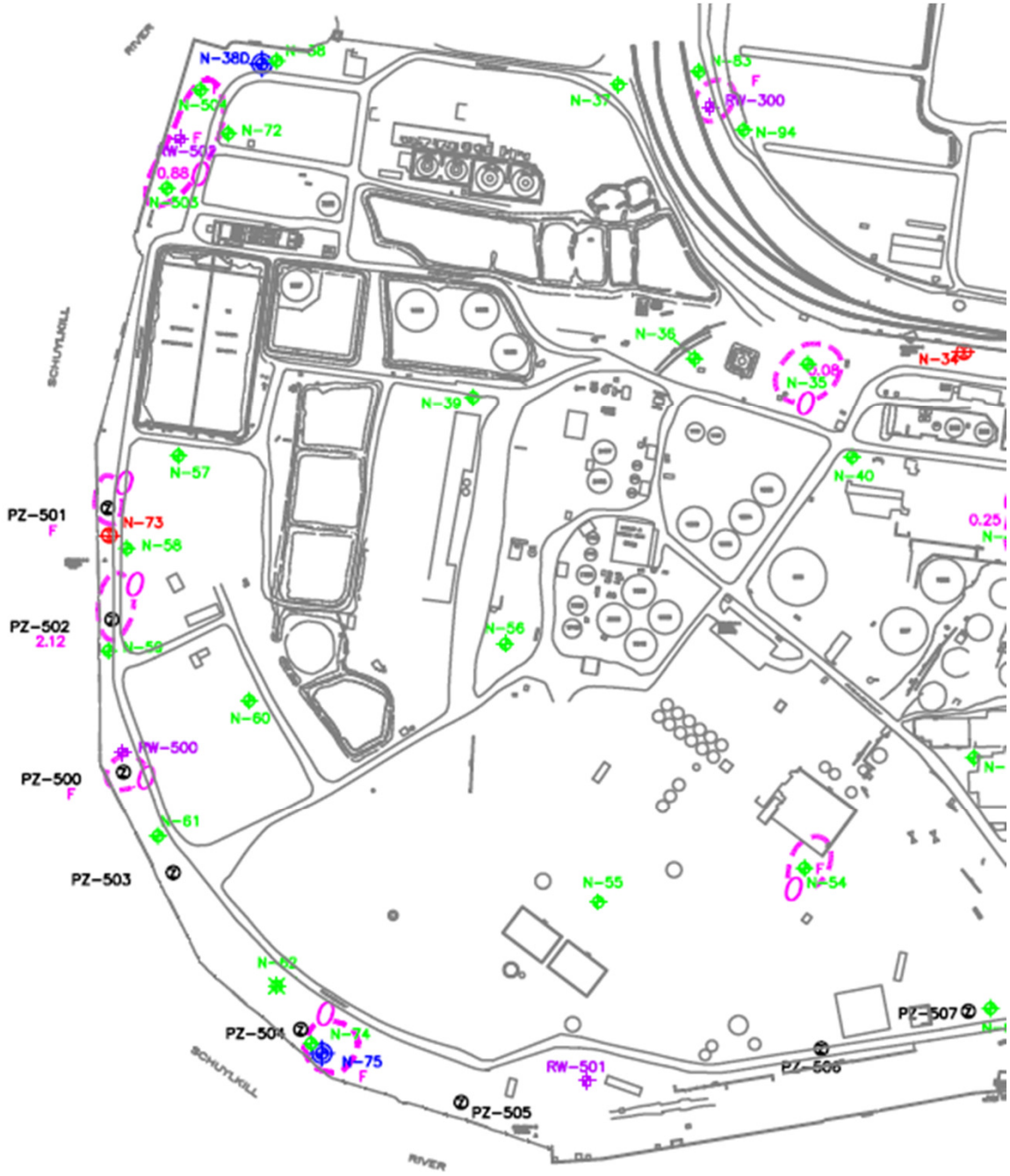
Plume RW-502, N-503 and N-504 – thickness increased slightly

Plume PZ-501 – no change

Plume PZ-502 – still more than 2 ft thick

Plume RW-500 –plume moved to PZ-500

Plume N-75 – now includes N-74



Point Breeze 4th
Quarter 2005
Report (pg. 50)

OBSERVATIONS

Plume RW-502, N-503 and N-504 – thickness decreased slightly

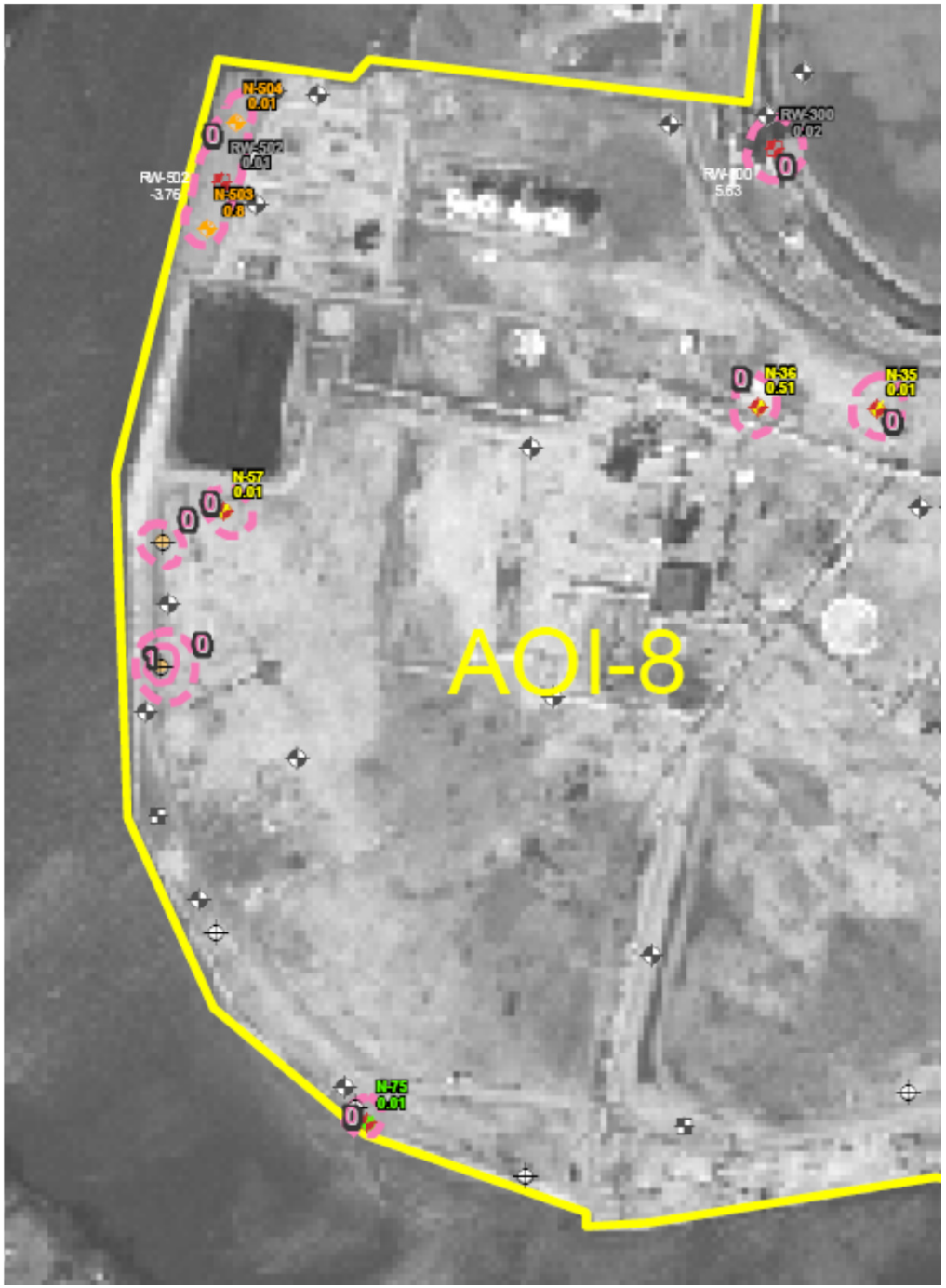
Plume PZ-501 – no change

New Plume N-57

Plume PZ-502 – thickness decreased to more than 1 ft thick

Plume PZ-500 – no longer present

Plume N-75, N-74 – decreased to only N-75



Point Breeze 2nd
Quarter 2006
Report (pg. 97)

OBSERVATIONS

Plume RW-502, N-503 and N-504 – no longer includes N-504

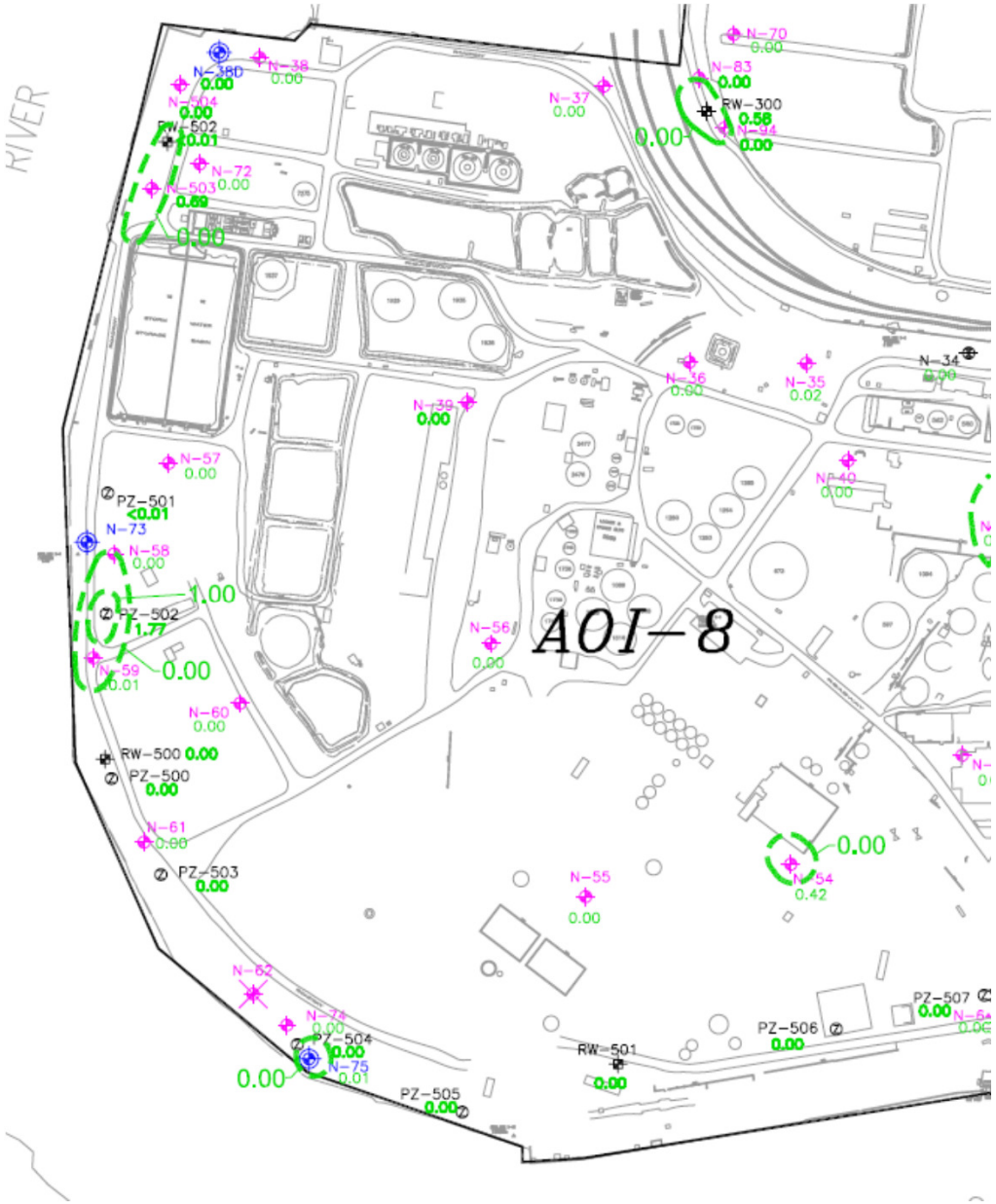
Plume PZ-501 – no longer present

Plume N-57 – no longer present

Plume PZ-502 – now includes N-58 and N-59

Plume PZ-500 – no longer present

Plume N-75 – no change



Point Breeze 4th
Quarter 2006
Report (pg. 28)

OBSERVATIONS

Plume RW-502, N-503 - now includes N-504

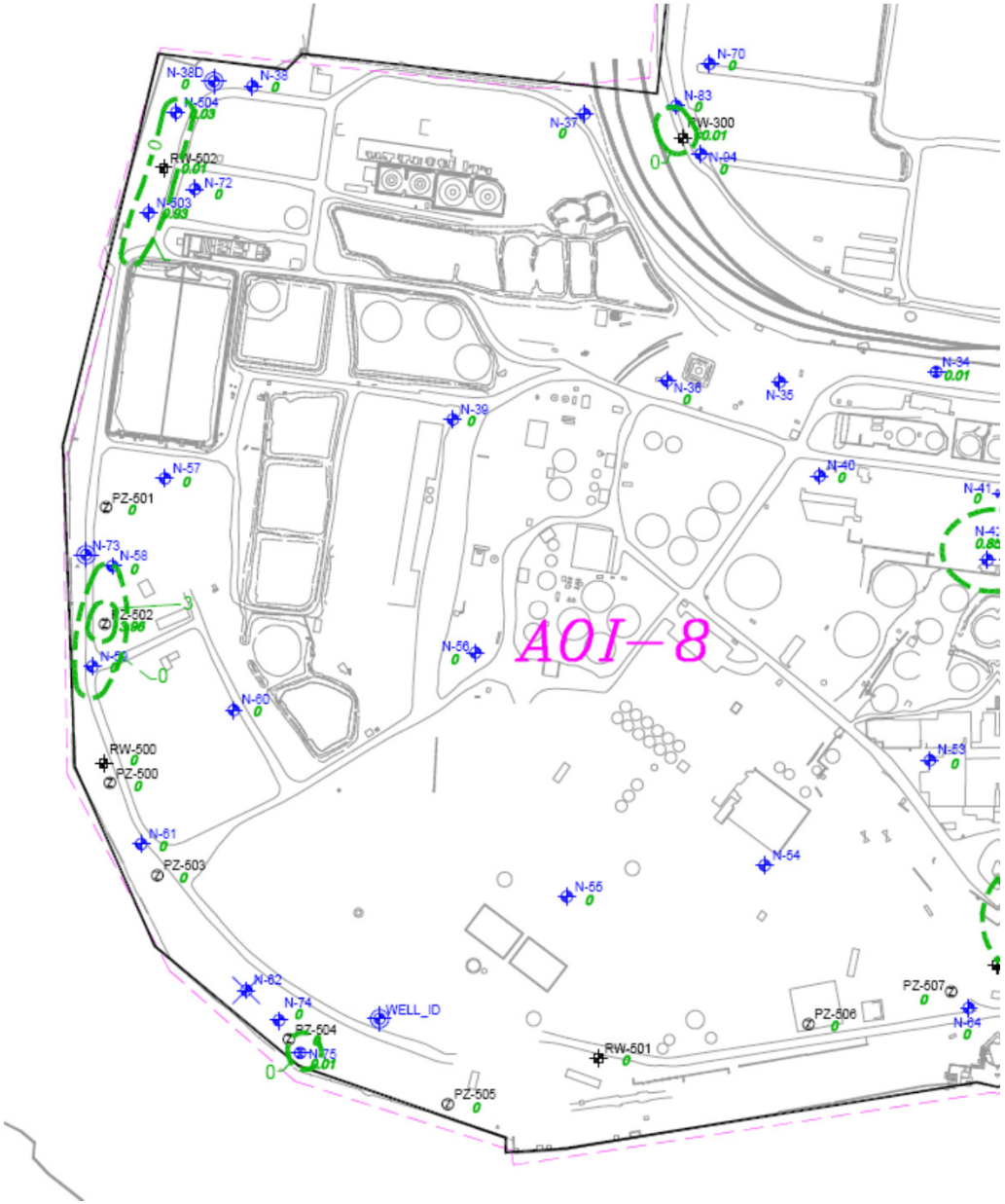
Plume PZ-501 – no longer present

Plume N-57 – no longer present

Plume PZ-502, N-58 and N-59- thickness increased to more than 3 ft

Plume PZ-500 – no longer present

Plume N-75 – no change



Point Breeze 4th
Quarter 2007
Report (pg. 35)

OBSERVATIONS

Plume RW-502, N-503 and N-504 – no longer includes N-504

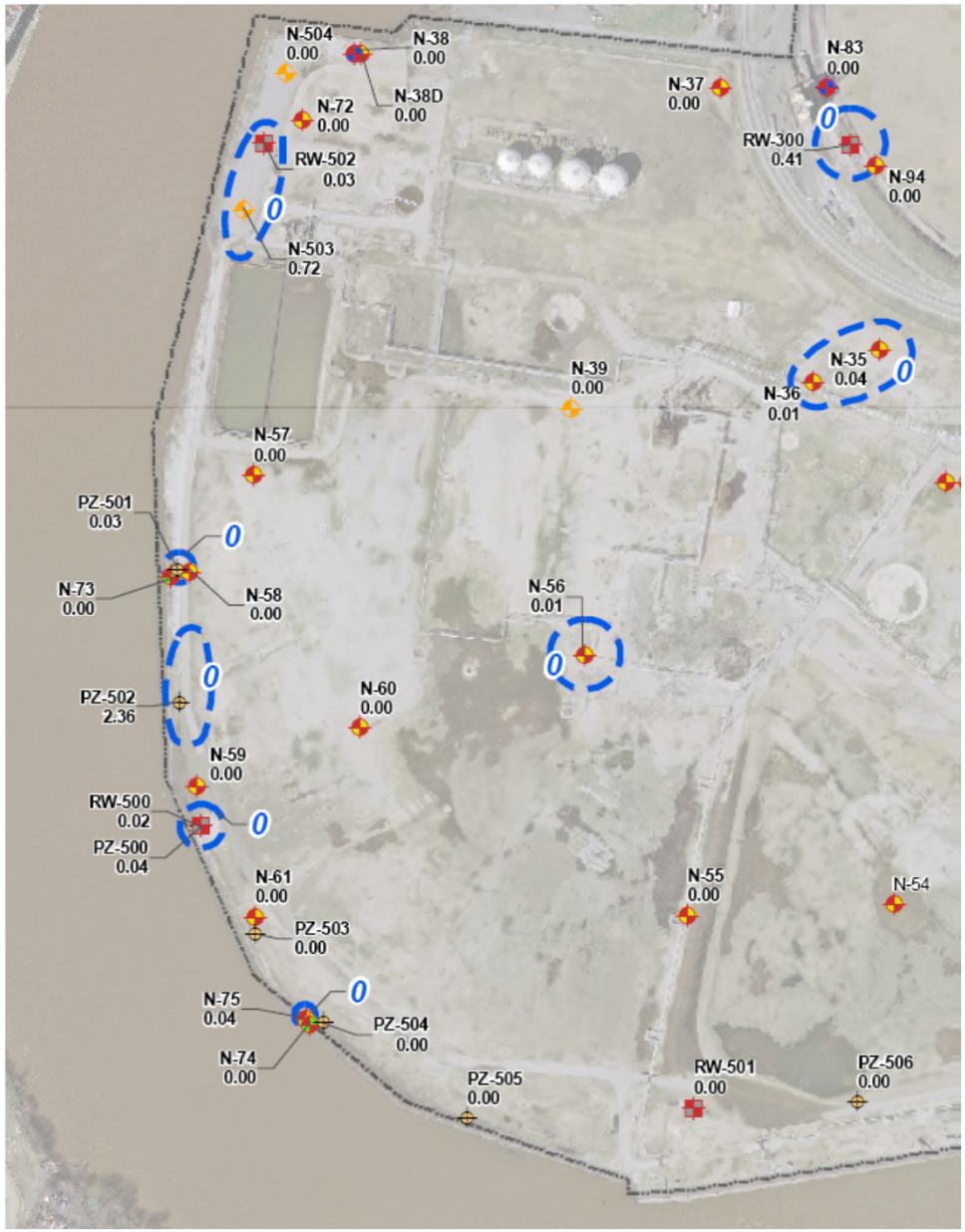
Plume PZ-501 – returned

Plume N-57 – no longer present

Plume PZ-502, N-58 and N-59- no longer includes N-58 and N-59

Plume PZ-500 – returned and includes RW-500

Plume N-75 – thickness increased slightly



Point Breeze 2nd
Quarter 2008
Report (pg. 32)

OBSERVATIONS

Plume RW-502, N-503 and N-504 – no change

Plume PZ-501 – returned and now includes N-73

Plume N-57 – no longer present

Plume PZ-502, N-58 and N-59 – no longer includes N-58 or N-59

Plume PZ-500 – no longer present

Plume N-75 – slight increase in thickness

CCR - Figure 5
data collected
11/2003

OBSERVATIONS

Plume RW-502, N-503 and N-504 – no longer include RW-502 or N-504

Plume PZ-501 – no longer present

Plume N-57 – no longer present

Plume PZ-502 – increased in thickness slightly

Plume PZ-500 – no longer present

Plume N-75 – slight decrease in thickness

AOI 8
SCR -
Figure 11
10/2003

OBSERVATIONS

Plume N-503– now includes RW-502

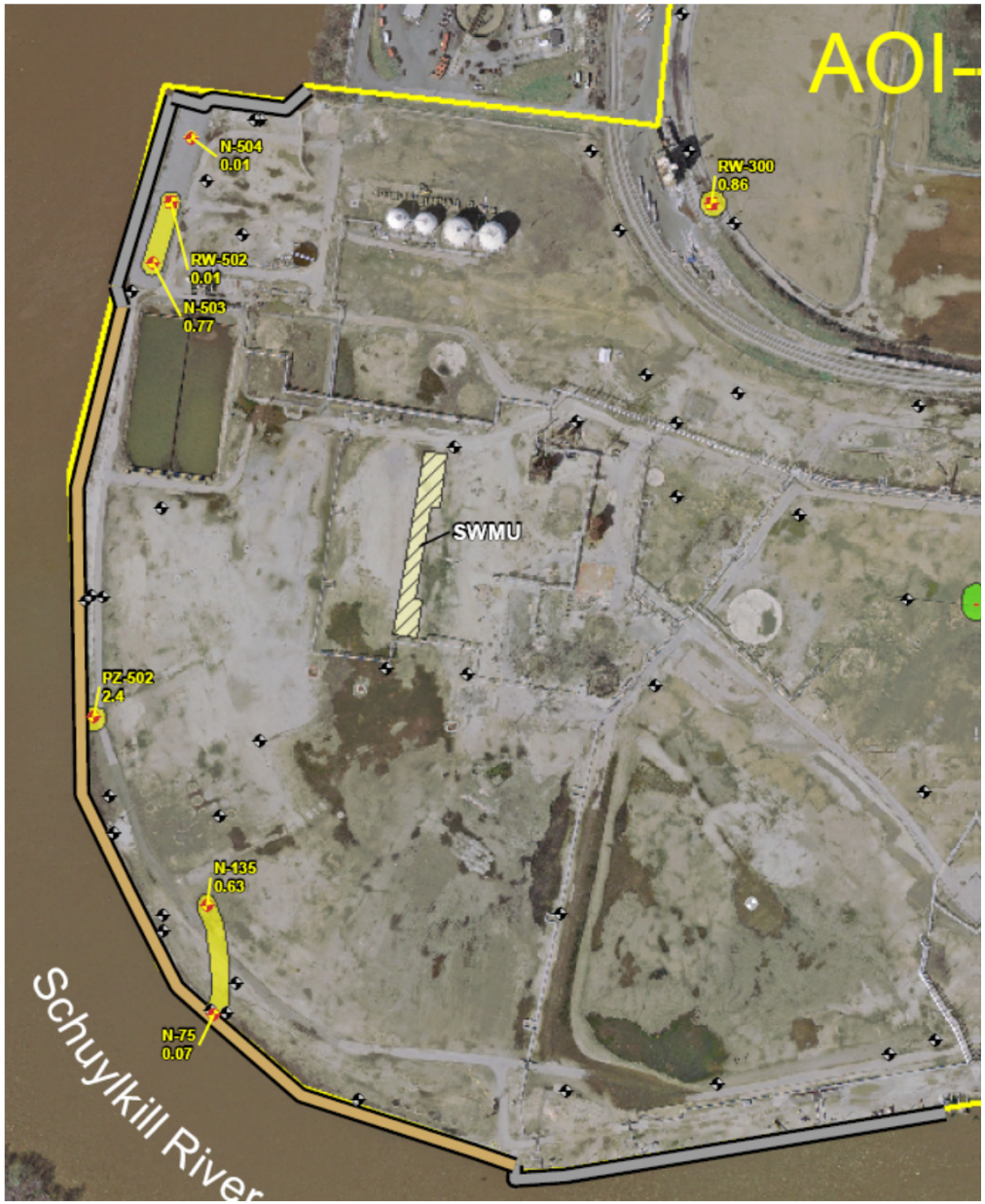
Plume PZ-501 – no longer present

Plume N-57 – no longer present

Plume PZ-502 – increased in thickness slightly

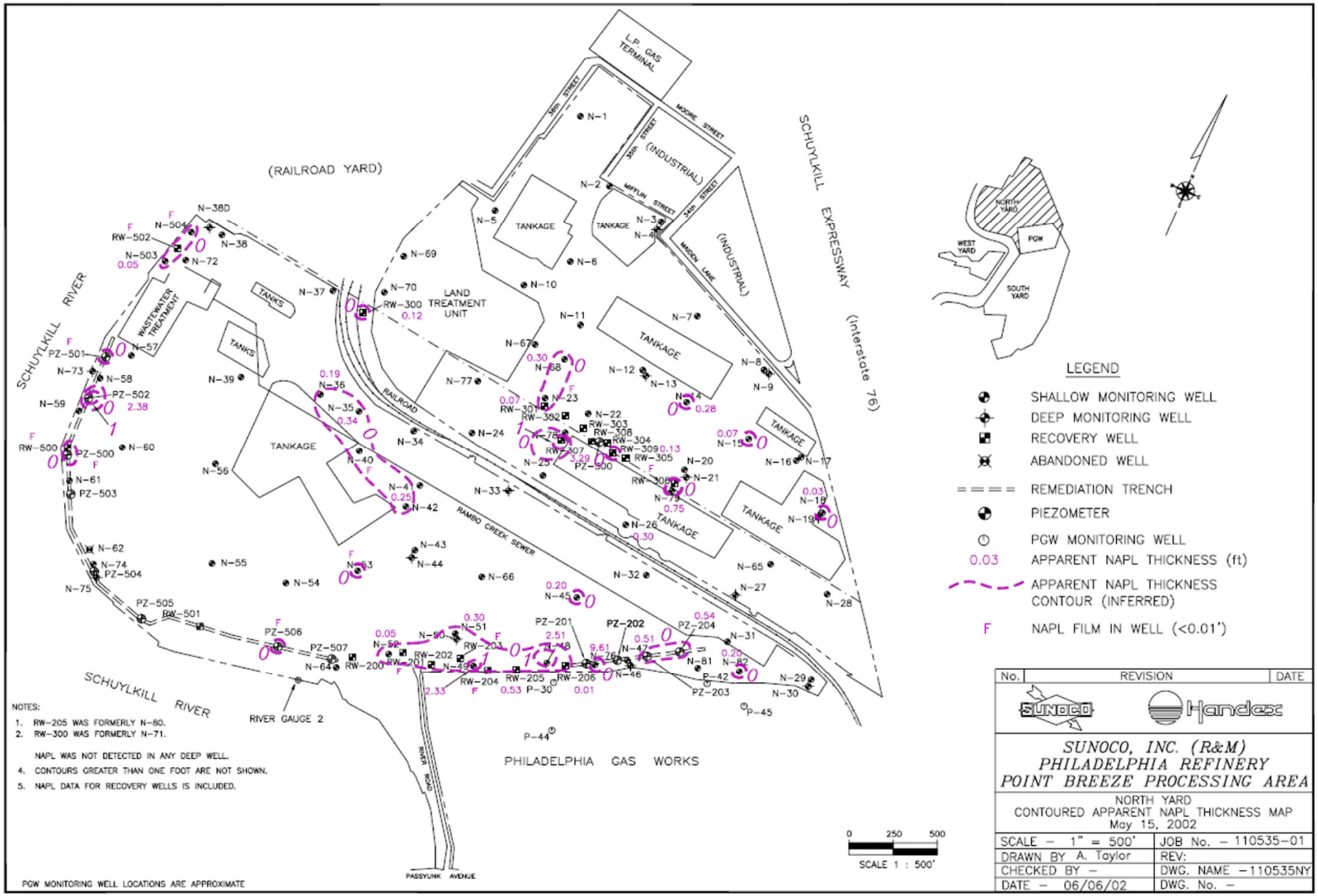
Plume PZ-500 – no longer present

Plume N-75 – increase in thickness and now includes N-135

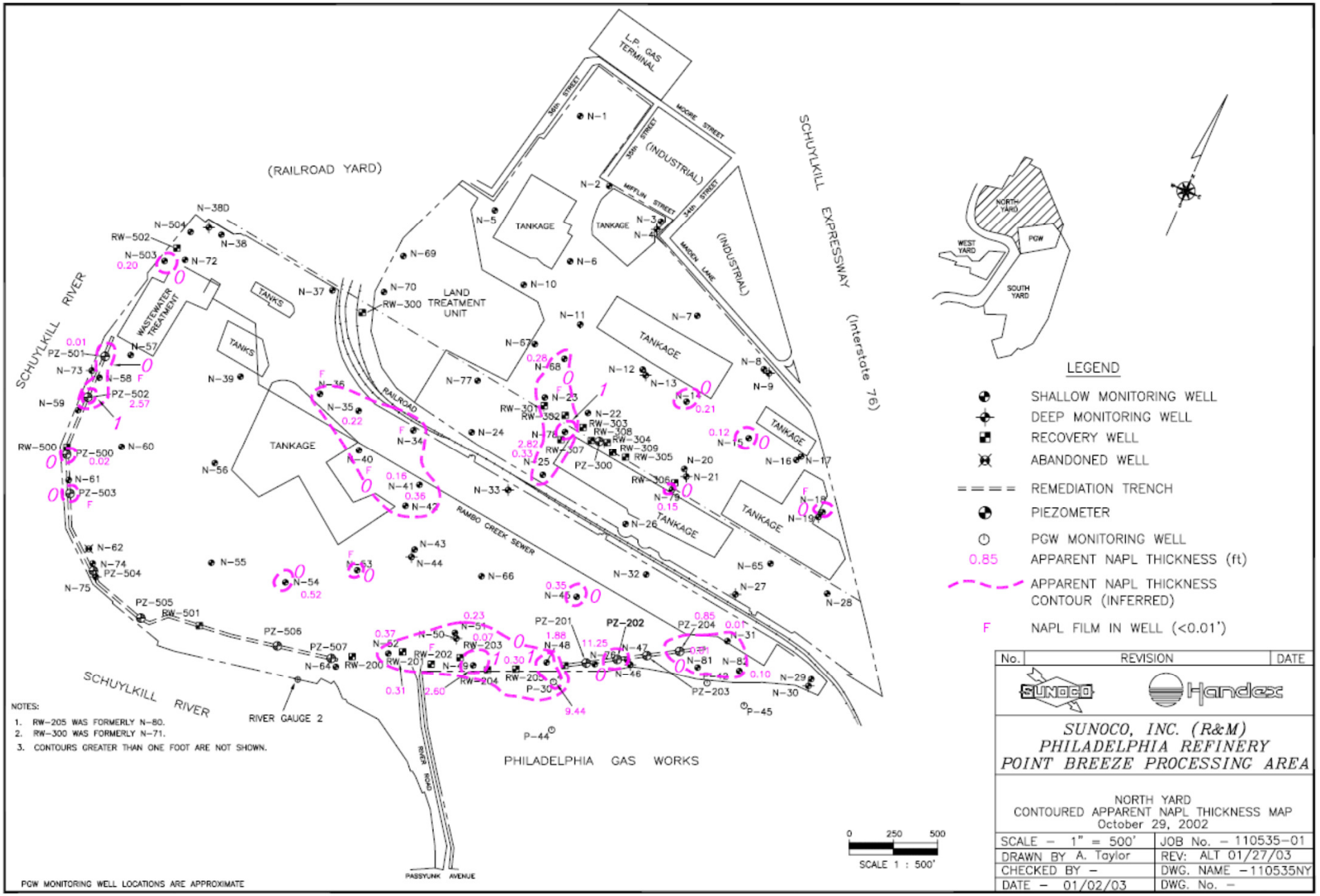


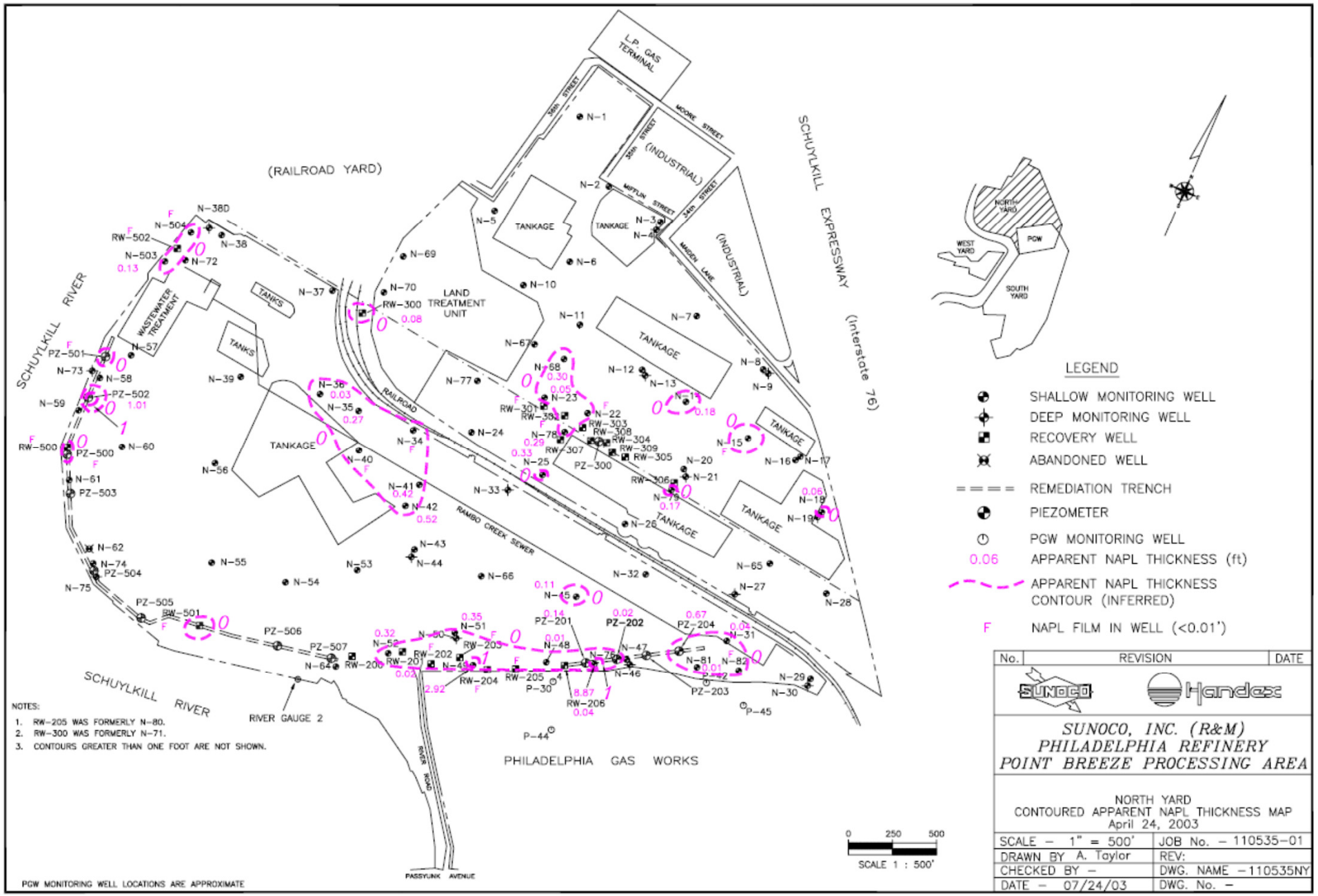
# North Yard Figures

2002 - 2008

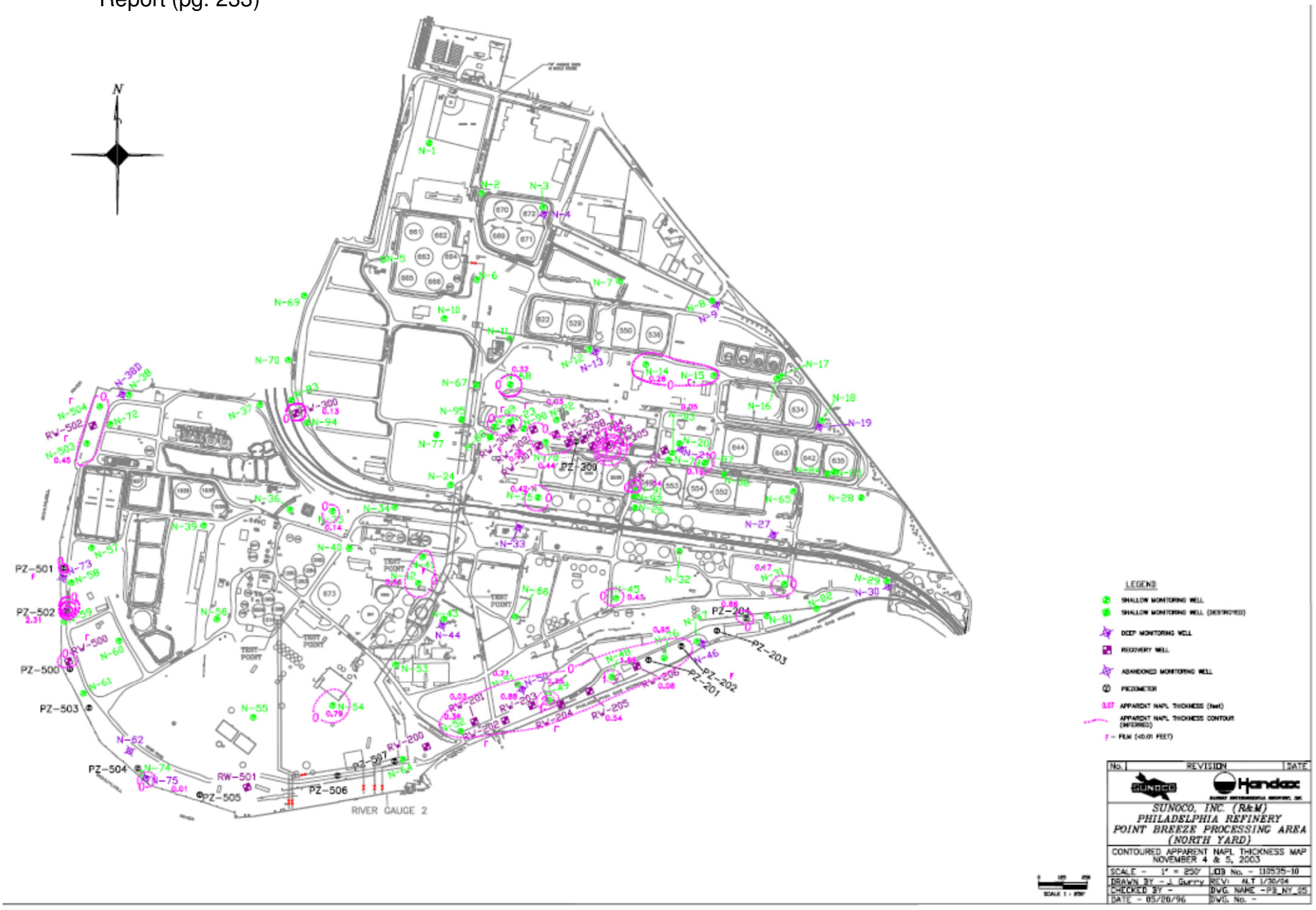

(RAILROAD YARD)
SCHUYLKILL EXPRESSWAY (Interstate 76)
SCHUYLKILL RIVER
SCHUYLKILL RIVER
L.P. GAS TERMINAL
(INDUSTRIAL)
(INDUSTRIAL)
TANKAGE
TANKAGE
TANKAGE
TANKAGE
TANKAGE
TANKAGE
TANKS
TANKS
WASTEWATER TREATMENT
LAND TREATMENT UNIT
RAILROAD
RAMBO CREEK SEWER
RIVER GAUGE 2
PHILADELPHIA GAS WORKS
PASSYUNK AVENUE
RIVER ROAD
MOORE STREET
MIFFLIN STREET
34th STREET
35th STREET
36th STREET
MAGEE LANE
NORTH YARD
WEST YARD
PGW
SOUTH YARD
LEGEND
SHALLOW MONITORING WELL
DEEP MONITORING WELL
RECOVERY WELL
ABANDONED WELL
REMEDIATION TRENCH
PIEZOMETER
PGW MONITORING WELL
0.03 APPARENT NAPL THICKNESS (ft)
APPARENT NAPL THICKNESS CONTOUR (INFERRED)
F NAPL FILM IN WELL (<0.01')
NOTES:
1. RW-205 WAS FORMERLY N-80.
2. RW-300 WAS FORMERLY N-71.
NAPL WAS NOT DETECTED IN ANY DEEP WELL.
4. CONTOURS GREATER THAN ONE FOOT ARE NOT SHOWN.
5. NAPL DATA FOR RECOVERY WELLS IS INCLUDED.
PGW MONITORING WELL LOCATIONS ARE APPROXIMATE
0 250 500
SCALE 1 : 500'
No. REVISION DATE
SUNOCO
Handex
SUNOCO, INC. (R&M)
PHILADELPHIA REFINERY
POINT BREEZE PROCESSING AREA
NORTH YARD
CONTOURED APPARENT NAPL THICKNESS MAP
May 15, 2002
SCALE - 1" = 500'
JOB No. - 110535-01
DRAWN BY A. Taylor
REV:
CHECKED BY -
DWG. NAME -110535NY
DATE - 06/06/02
DWG. No. -

Point Breeze 4th Quarter 2002 Report (pg. 230)

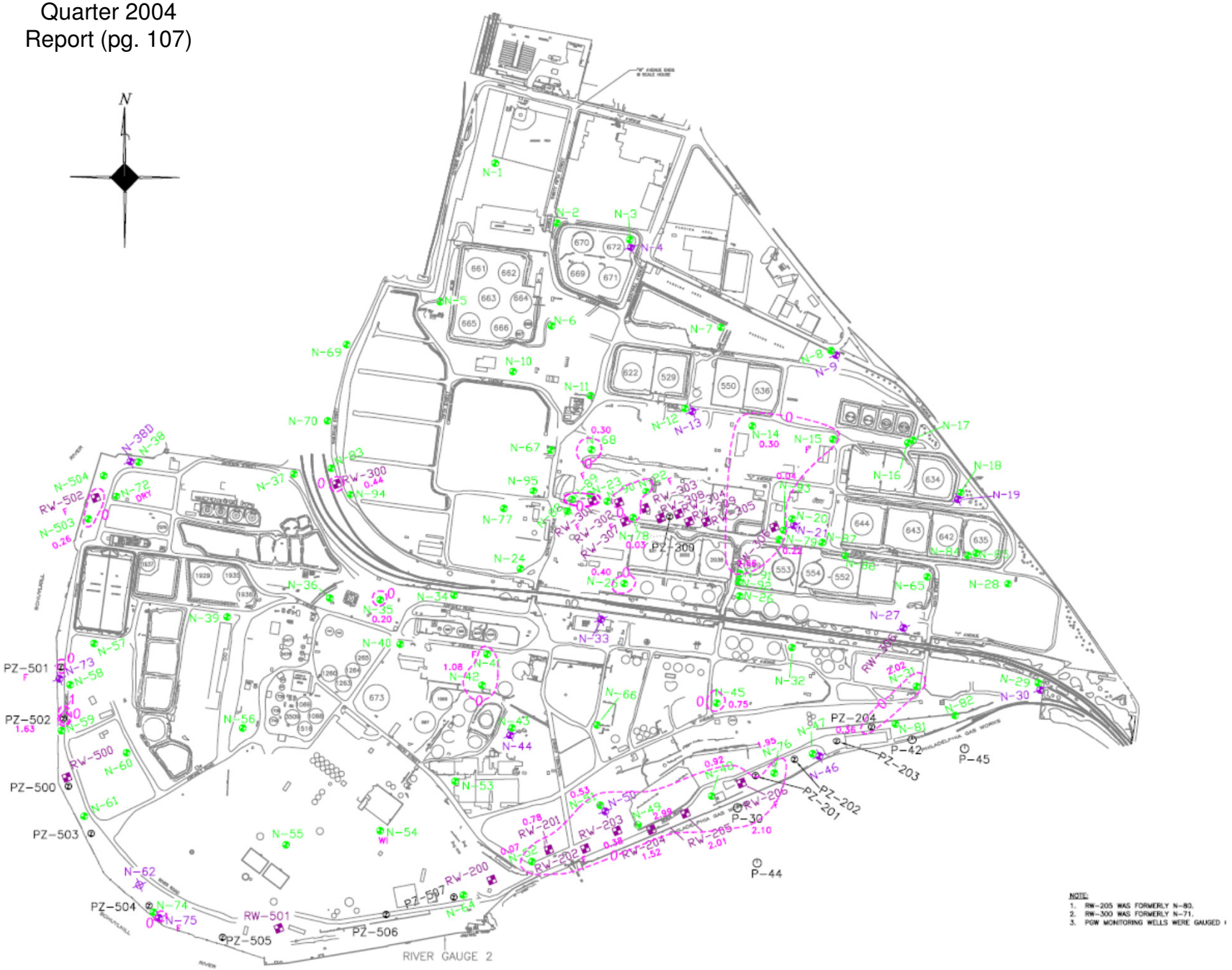



(RAILROAD YARD)
L.P. GAS TERMINAL
(INDUSTRIAL)
SCHUYLKILL EXPRESSWAY (Interstate 76)
SCHUYLKILL RIVER
WASTEWATER TREATMENT
TANKS
LAND TREATMENT UNIT
TANKAGE
RAILROAD
RAMBO CREEK SEWER
RIVER GAUGE 2
PHILADELPHIA GAS WORKS
PASSYUNK AVENUE
RIVER ROAD
NORTH YARD
WEST YARD
PGW
SOUTH YARD
LEGEND
SHALLOW MONITORING WELL
DEEP MONITORING WELL
RECOVERY WELL
ABANDONED WELL
REMEDIATION TRENCH
PIEZOMETER
PGW MONITORING WELL
0.06 APPARENT NAPL THICKNESS (ft)
APPARENT NAPL THICKNESS CONTOUR (INFERRED)
F NAPL FILM IN WELL (<0.01')
NOTES:
1. RW-205 WAS FORMERLY N-80.
2. RW-300 WAS FORMERLY N-71.
3. CONTOURS GREATER THAN ONE FOOT ARE NOT SHOWN.
PGW MONITORING WELL LOCATIONS ARE APPROXIMATE
0 250 500
SCALE 1 : 500'
No. REVISION DATE
SUNOCO
Handex
SUNOCO, INC. (R&M)
PHILADELPHIA REFINERY
POINT BREEZE PROCESSING AREA
NORTH YARD
CONTOURED APPARENT NAPL THICKNESS MAP
April 24, 2003
SCALE – 1" = 500'
JOB No. – 110535-01
DRAWN BY A. Taylor
REV:
CHECKED BY –
DWG. NAME –110535NY
DATE – 07/24/03
DWG. No. –

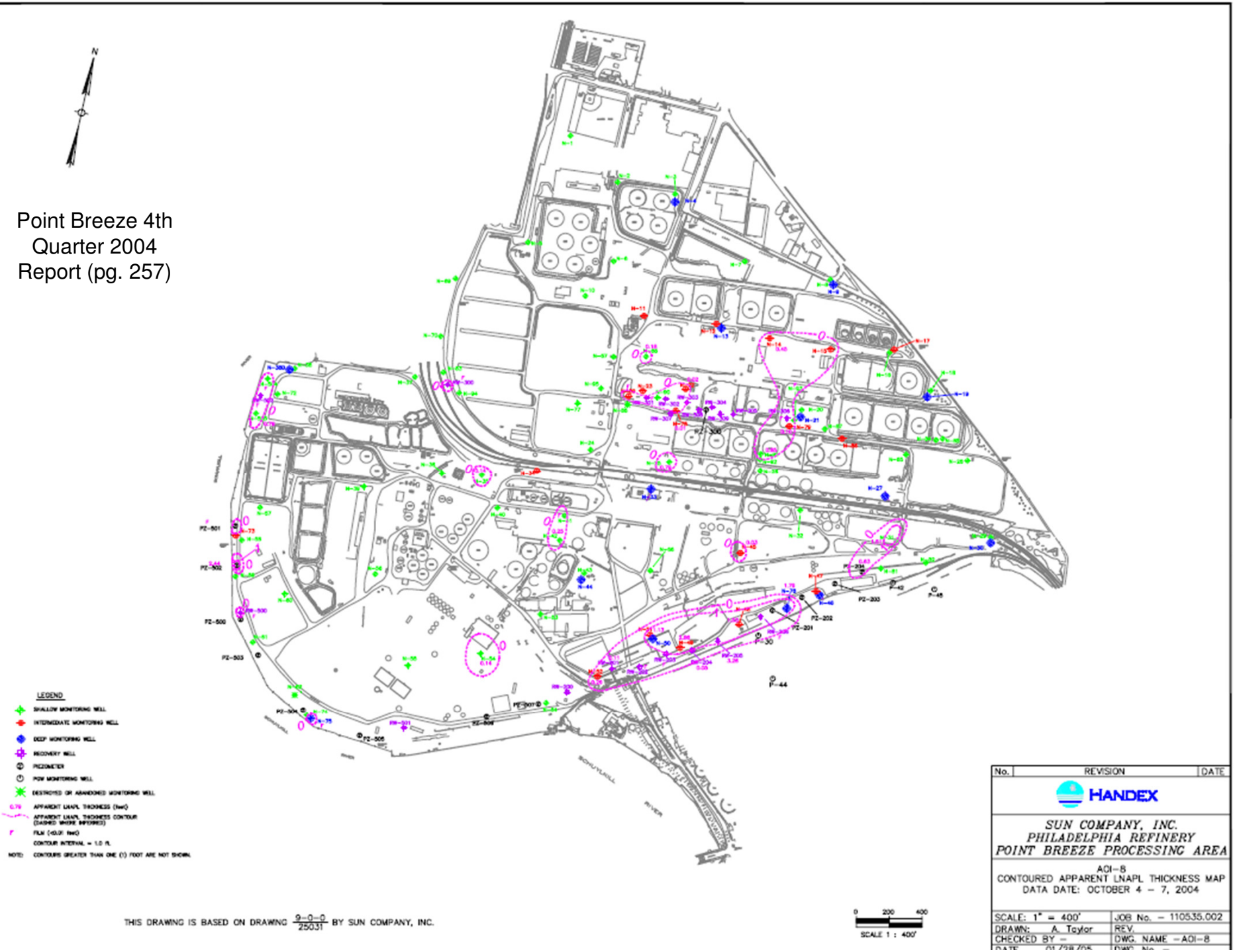
Point Breeze 4th
Quarter 2003
Report (pg. 233)



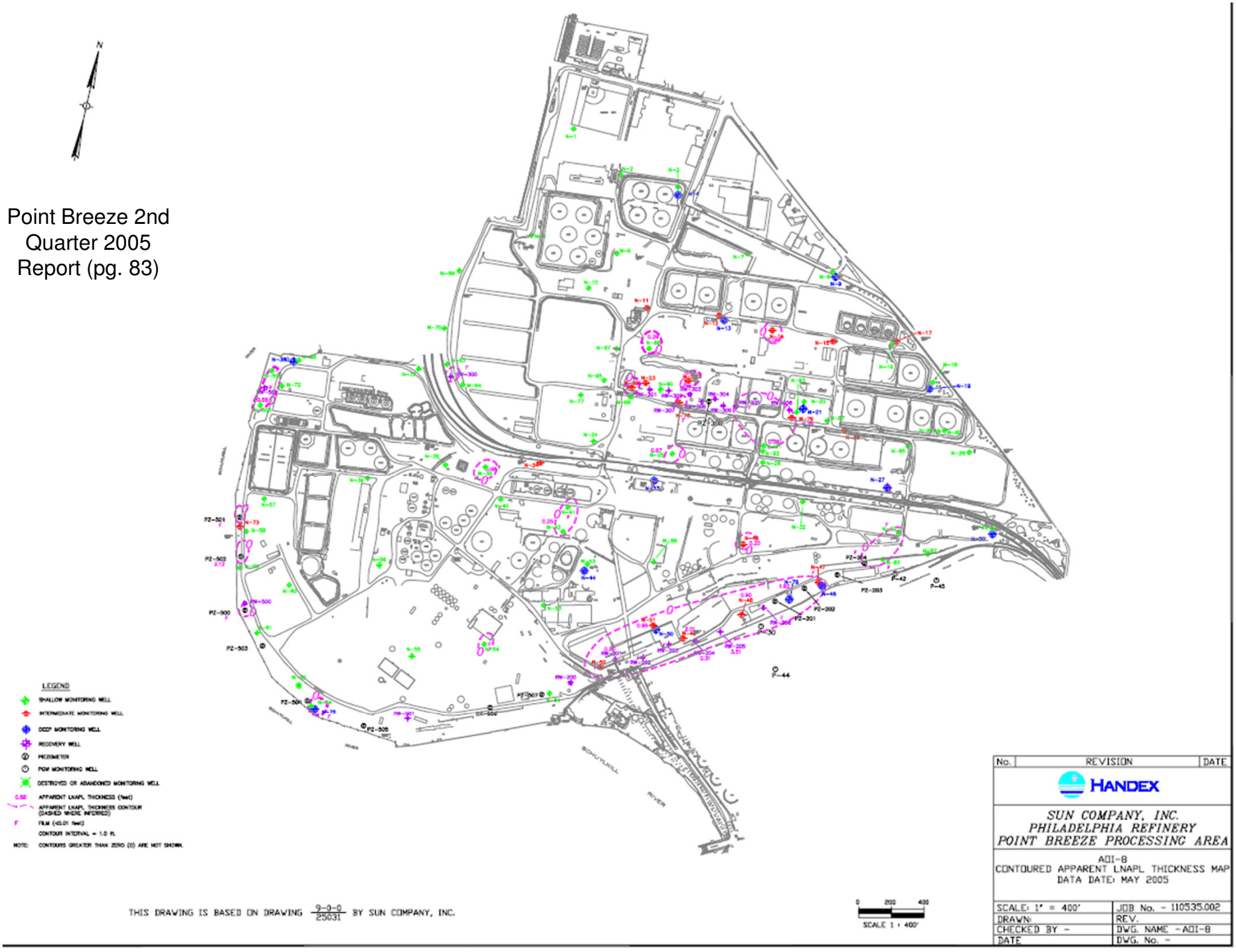
Point Breeze 2nd
Quarter 2004
Report (pg. 107)



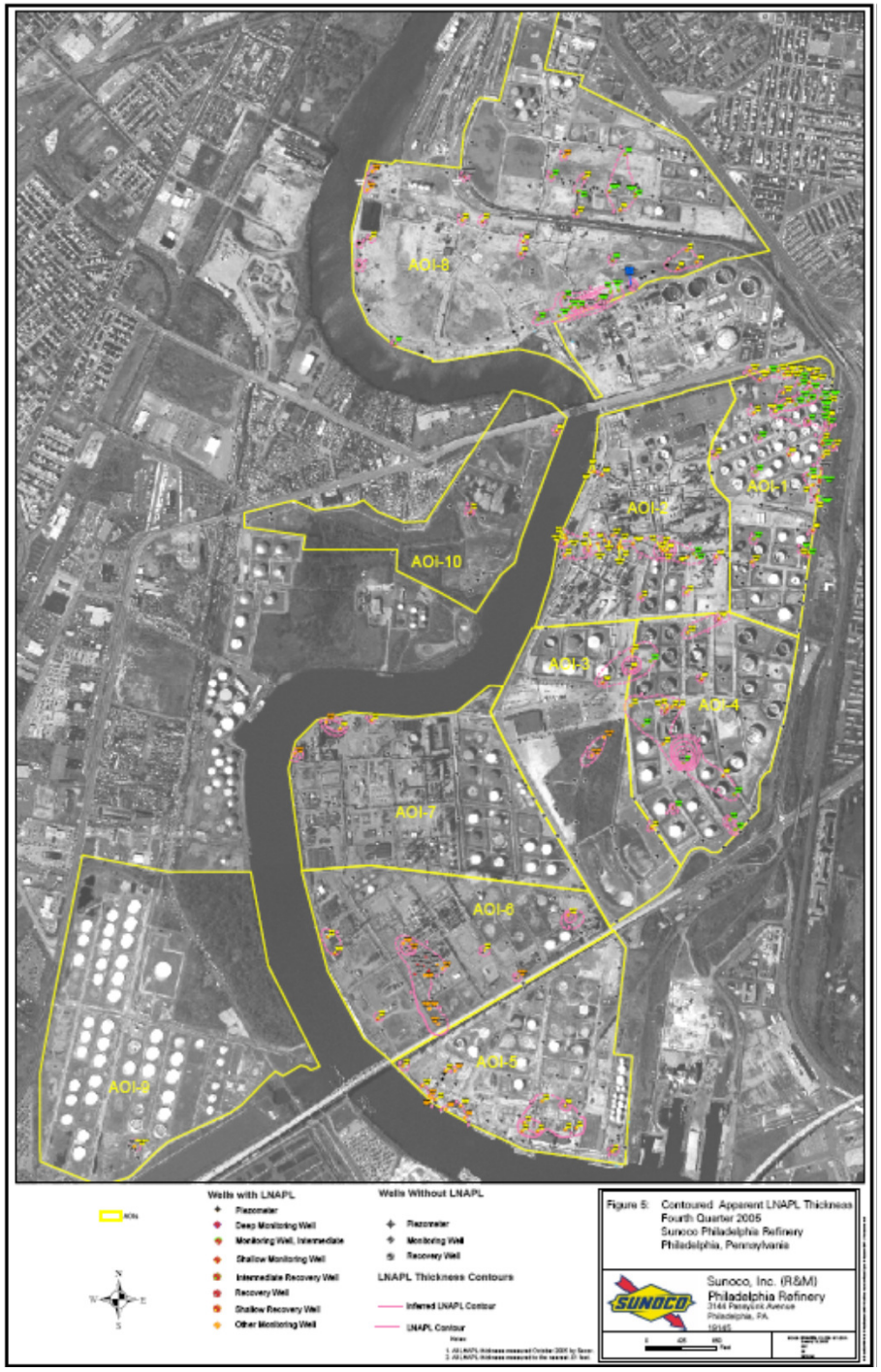
Point Breeze 4th Quarter 2004 Report (pg. 257)



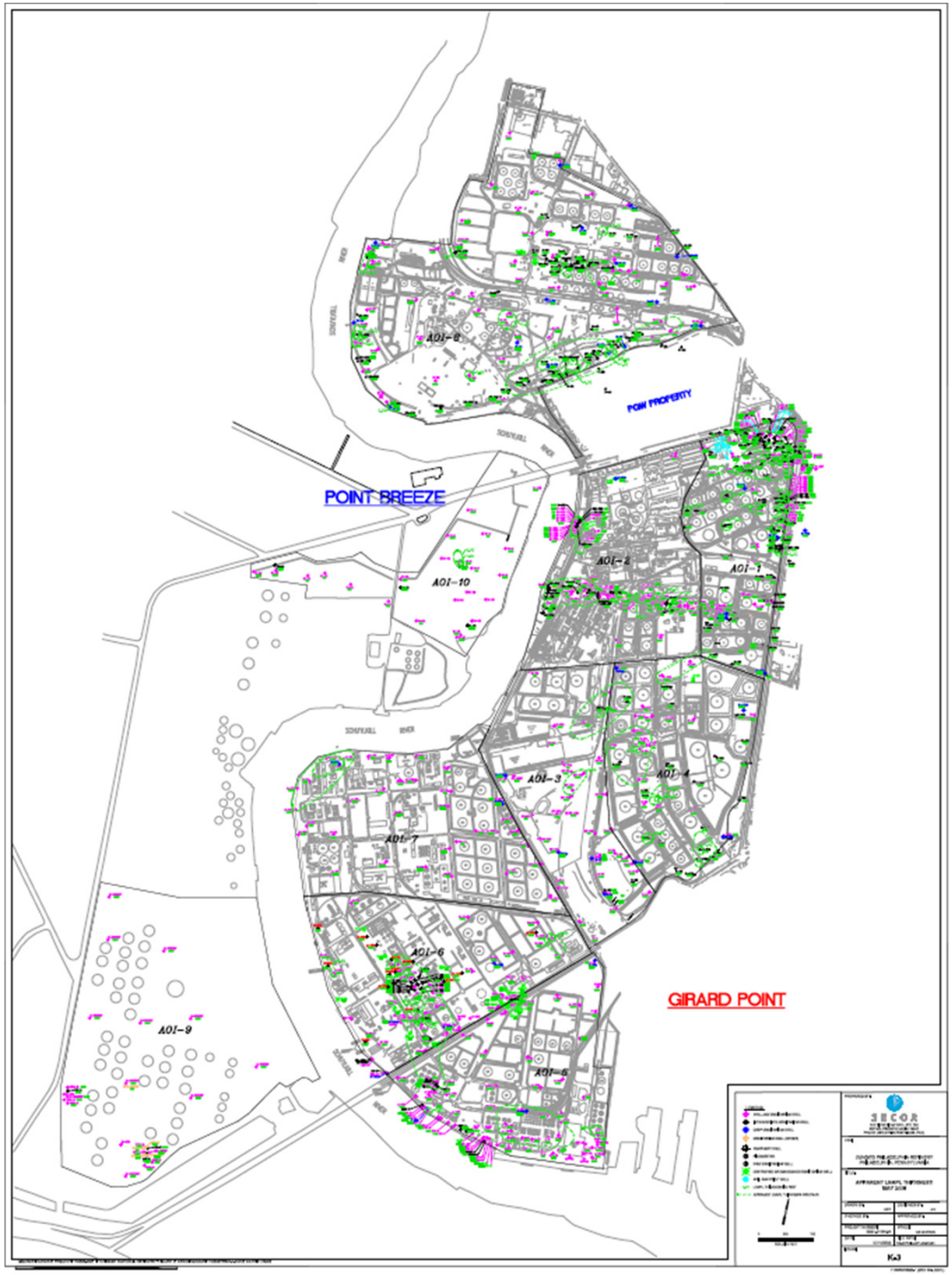
Point Breeze 2nd Quarter 2005 Report (pg. 83)



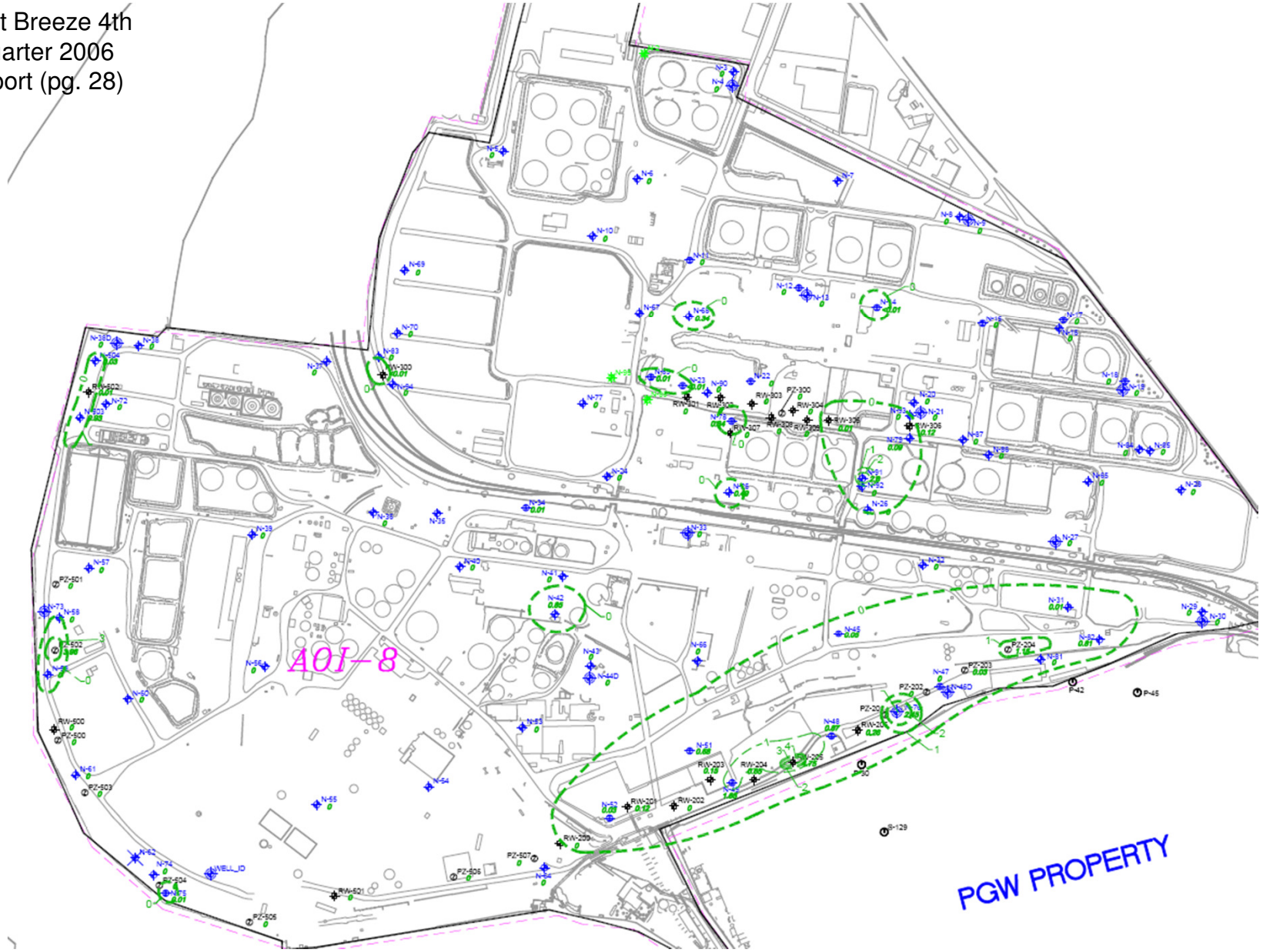
Point Breeze 4th Quarter 2005 Report (pg. 50)



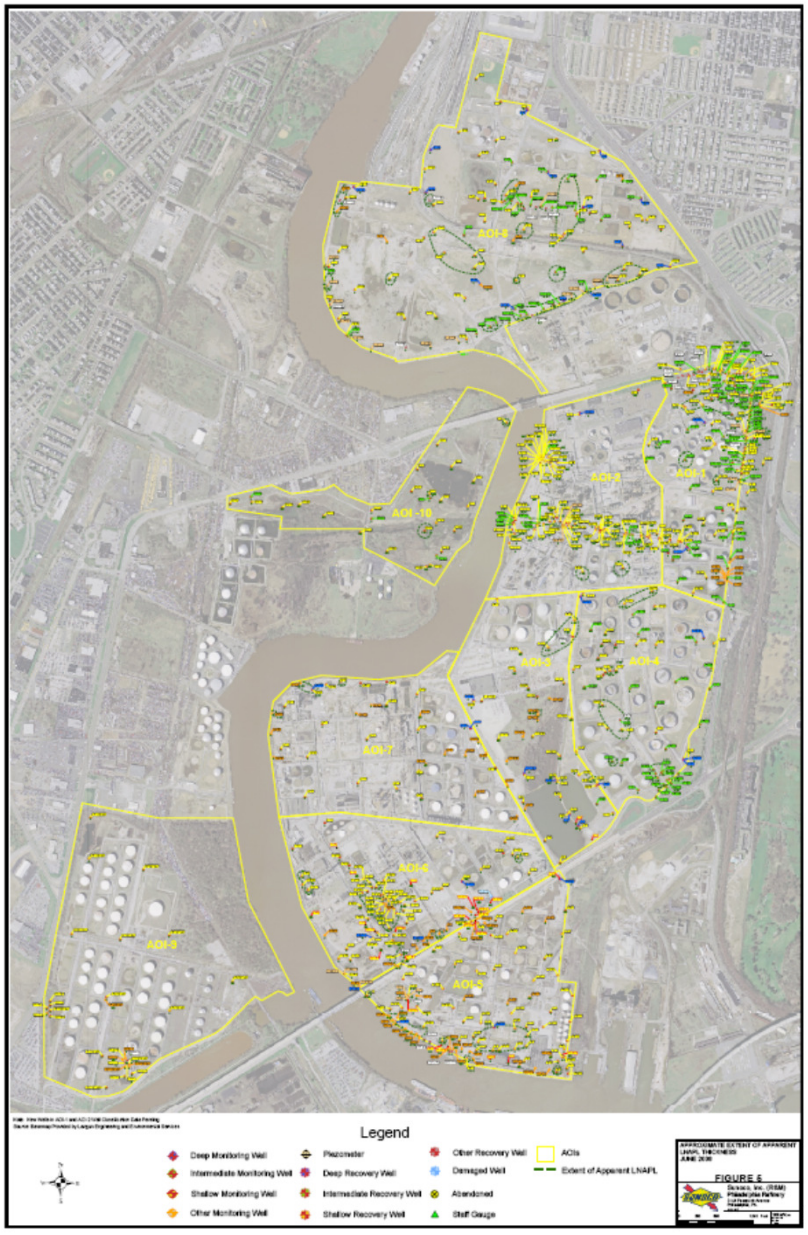
Point Breeze 2nd Quarter 2006 Report (pg. 97)



Point Breeze 4th
Quarter 2006
Report (pg. 28)

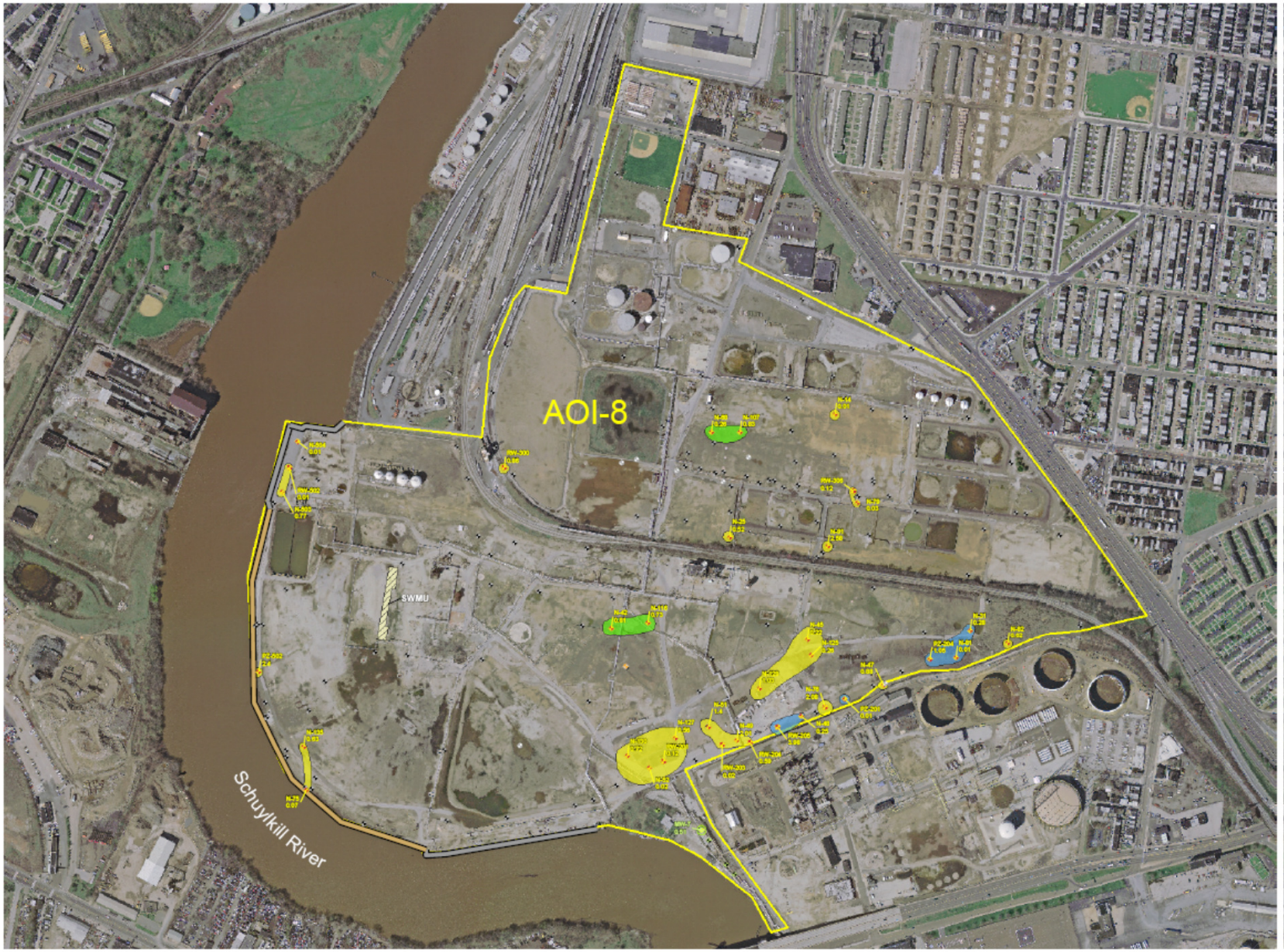


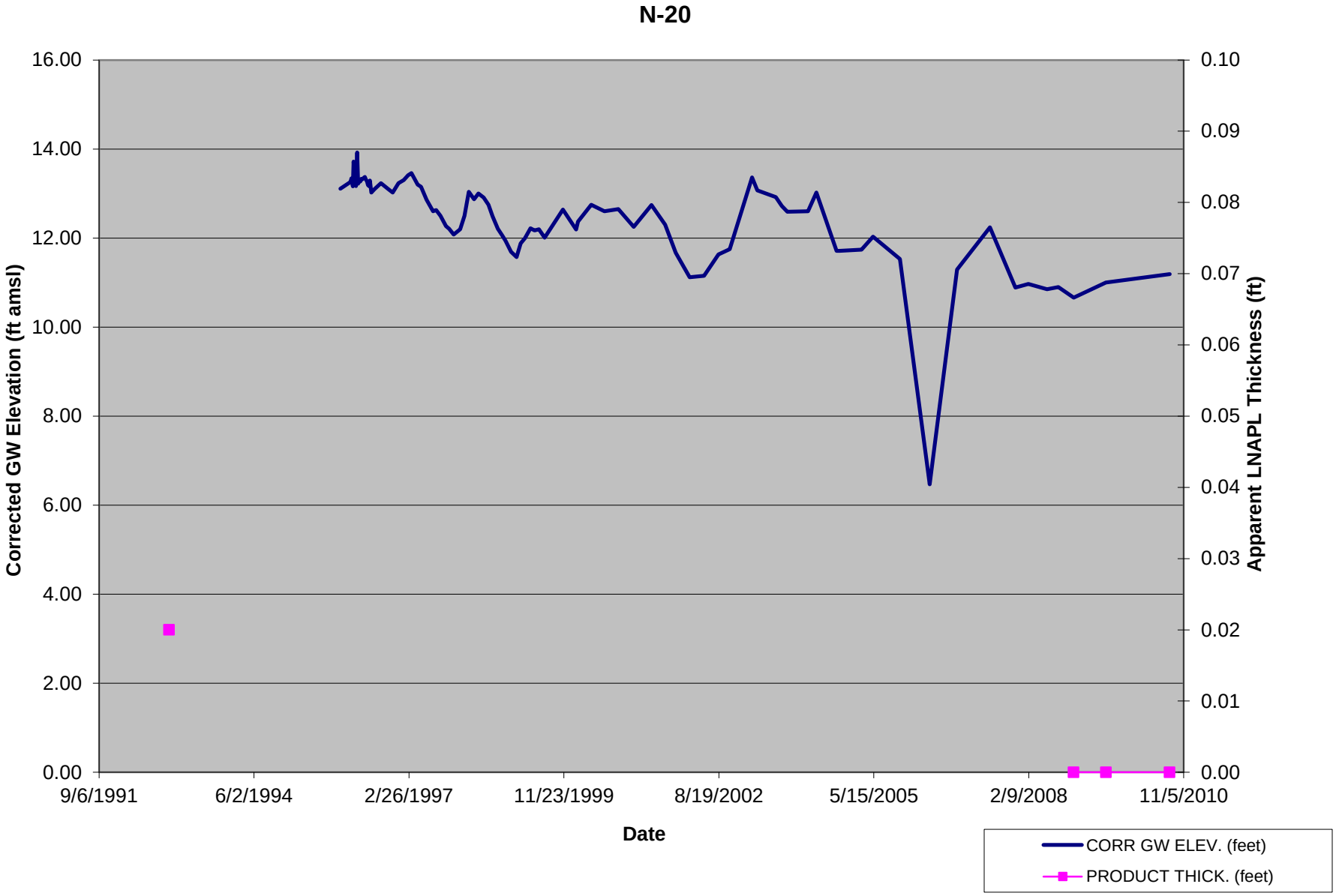
Point Breeze 2nd Quarter 2008 Report (pg. 32)

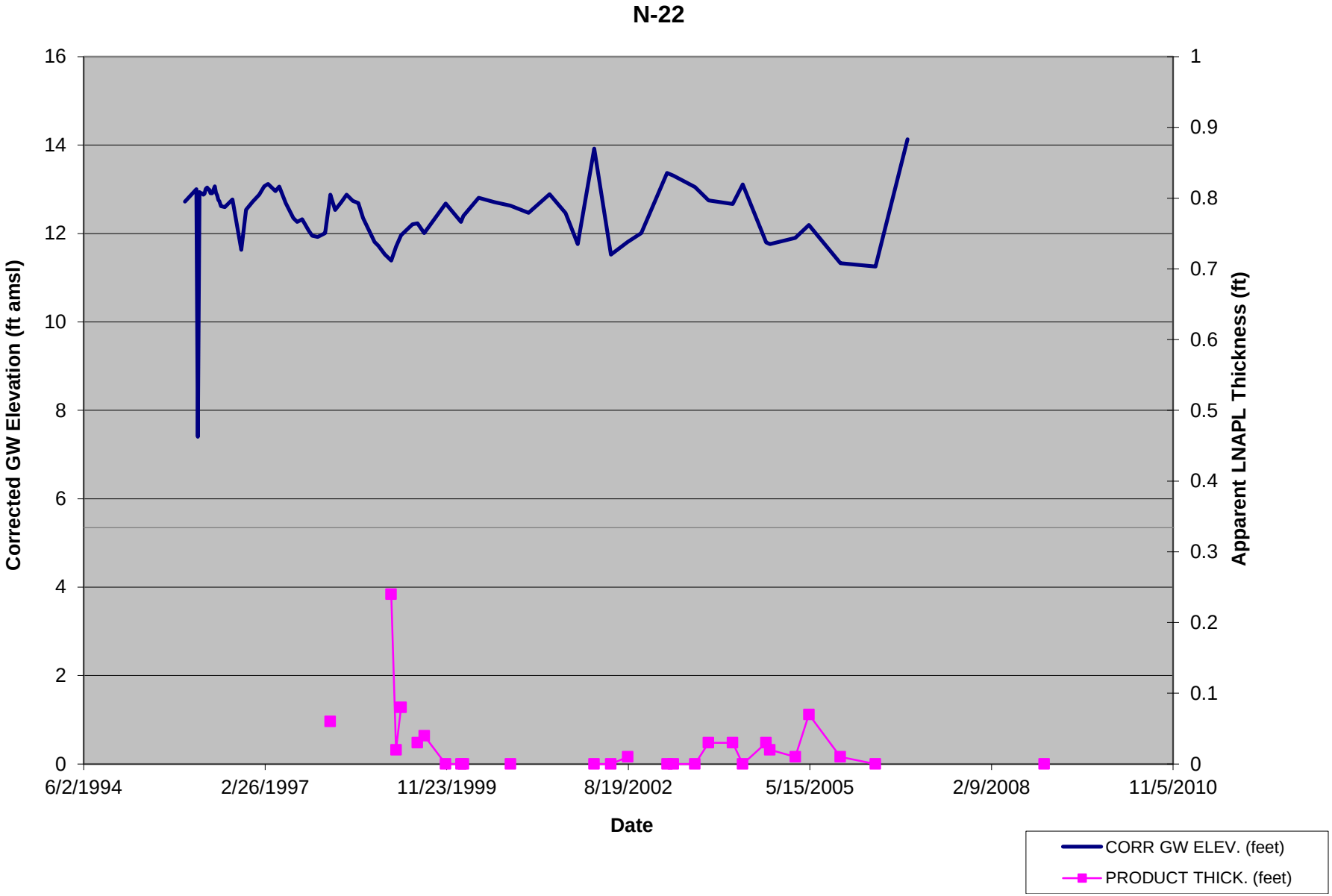


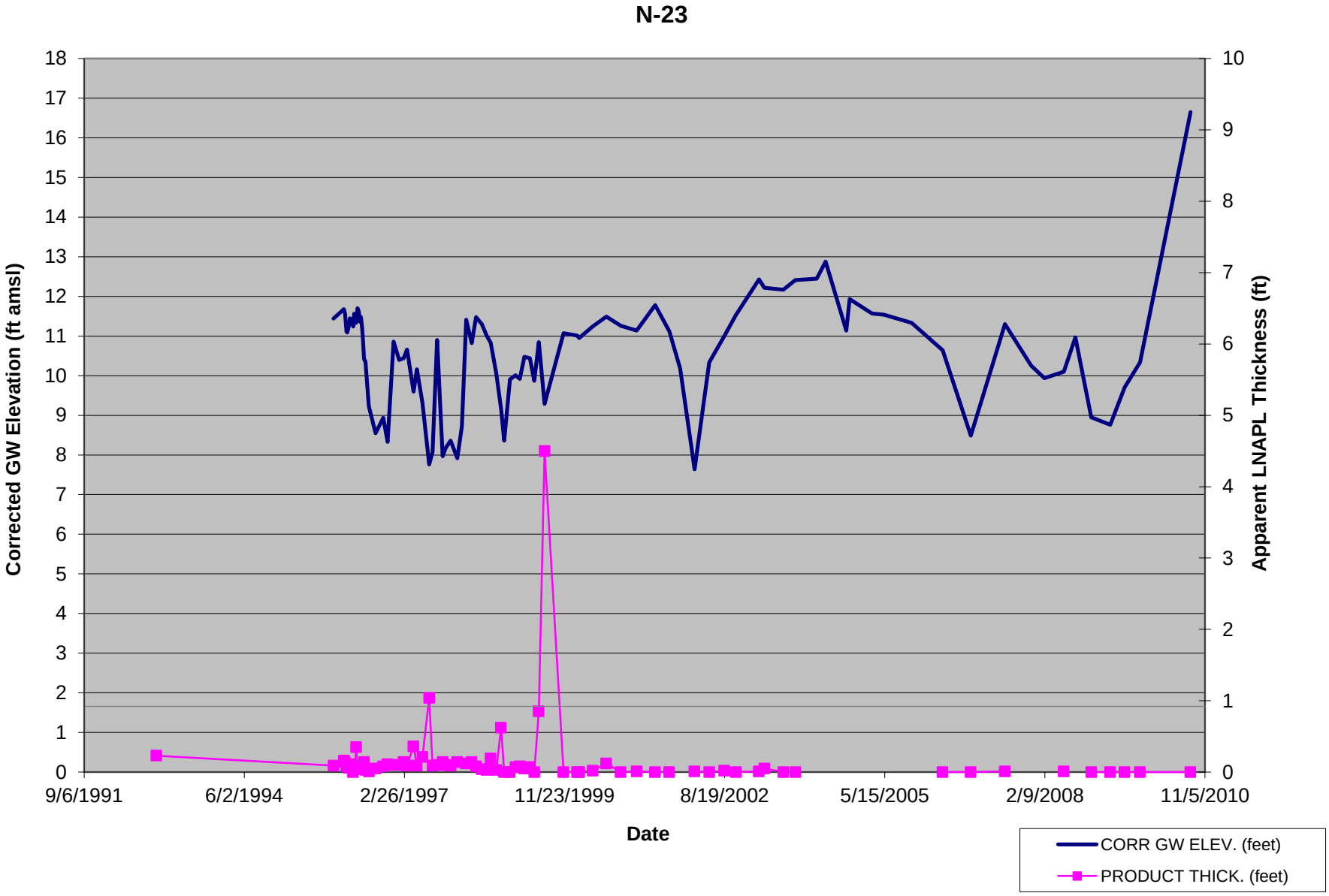
CCR - Figure 5 data collected 11/2003

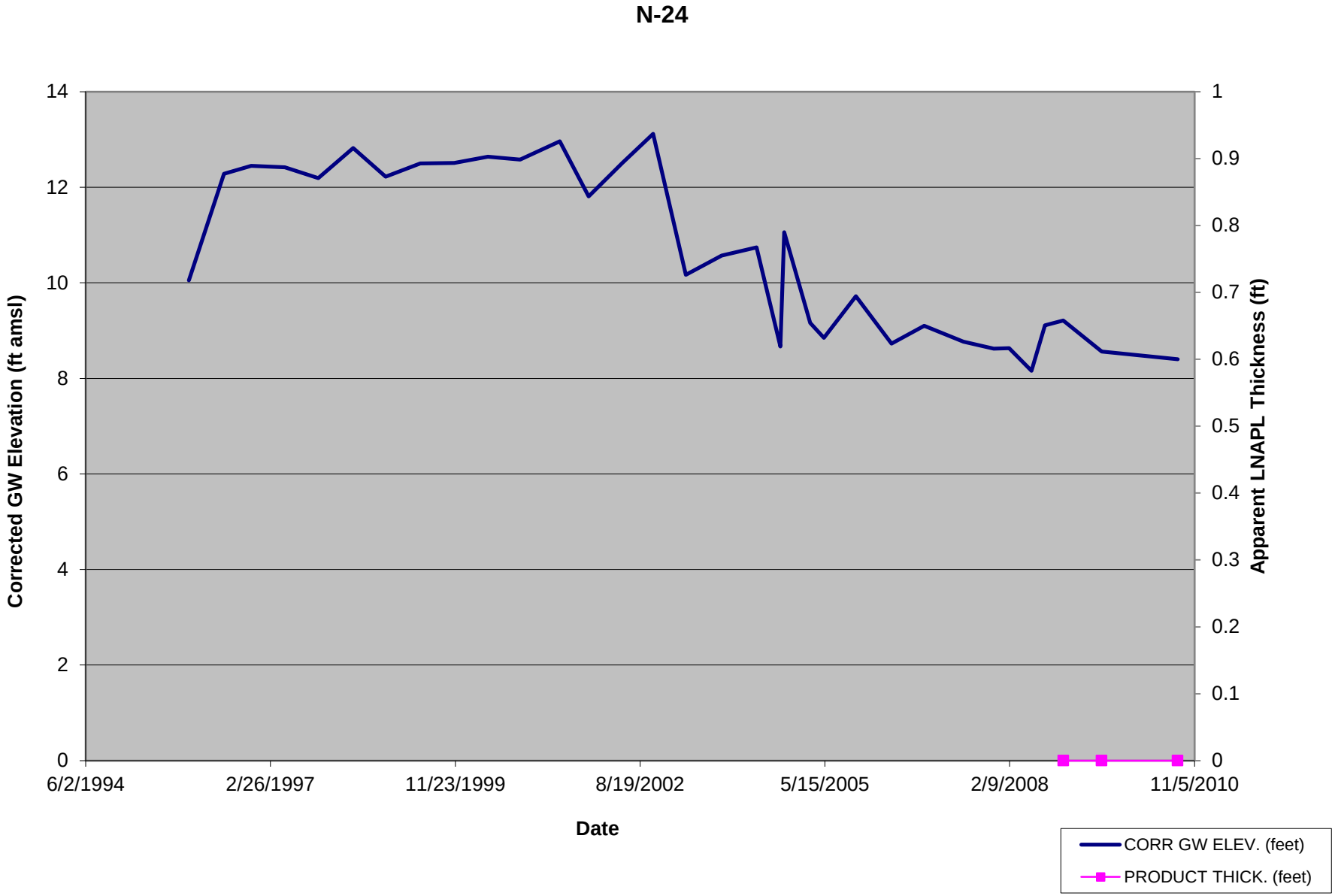
AOI 8
SCR -
Figure 11
10/2003

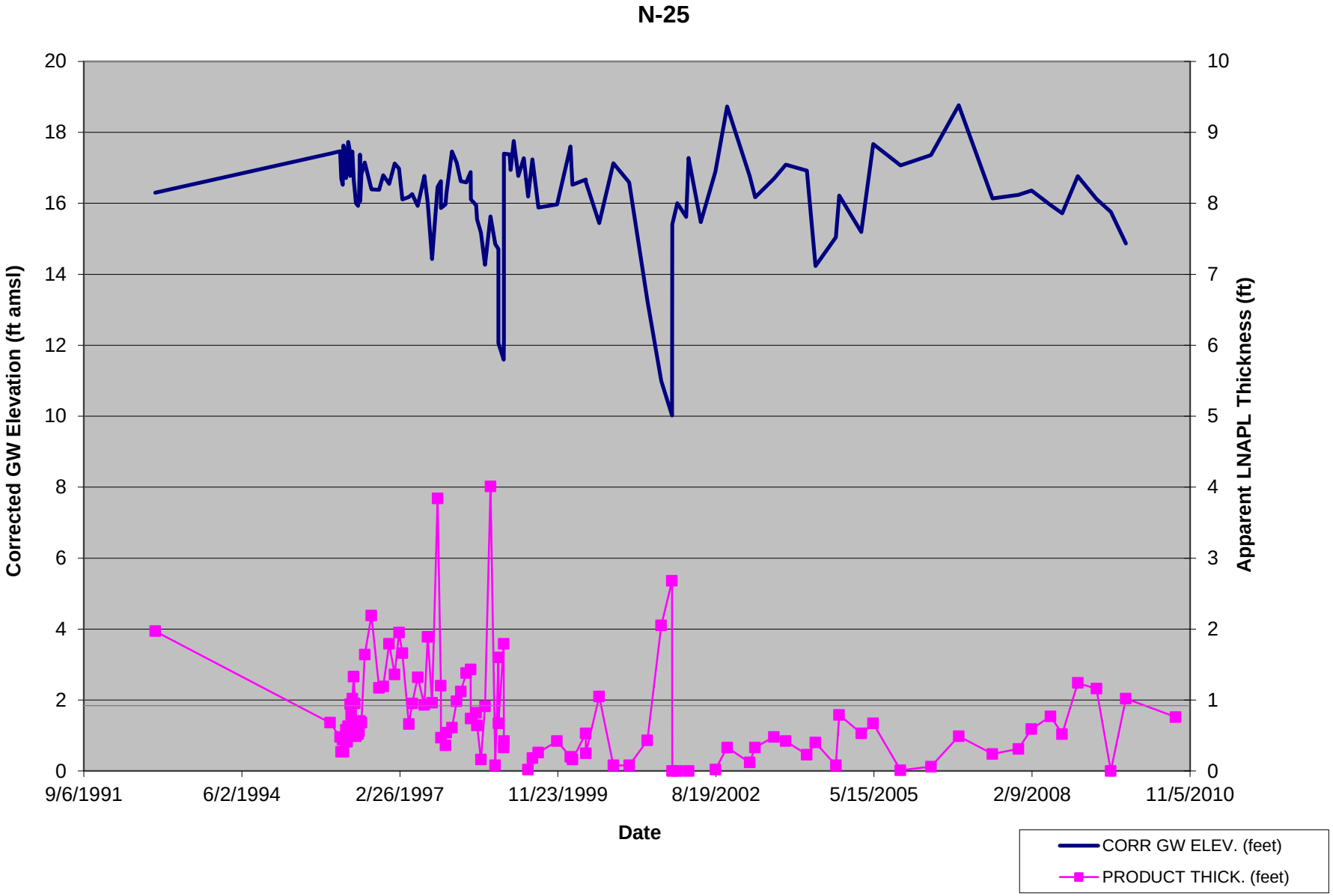


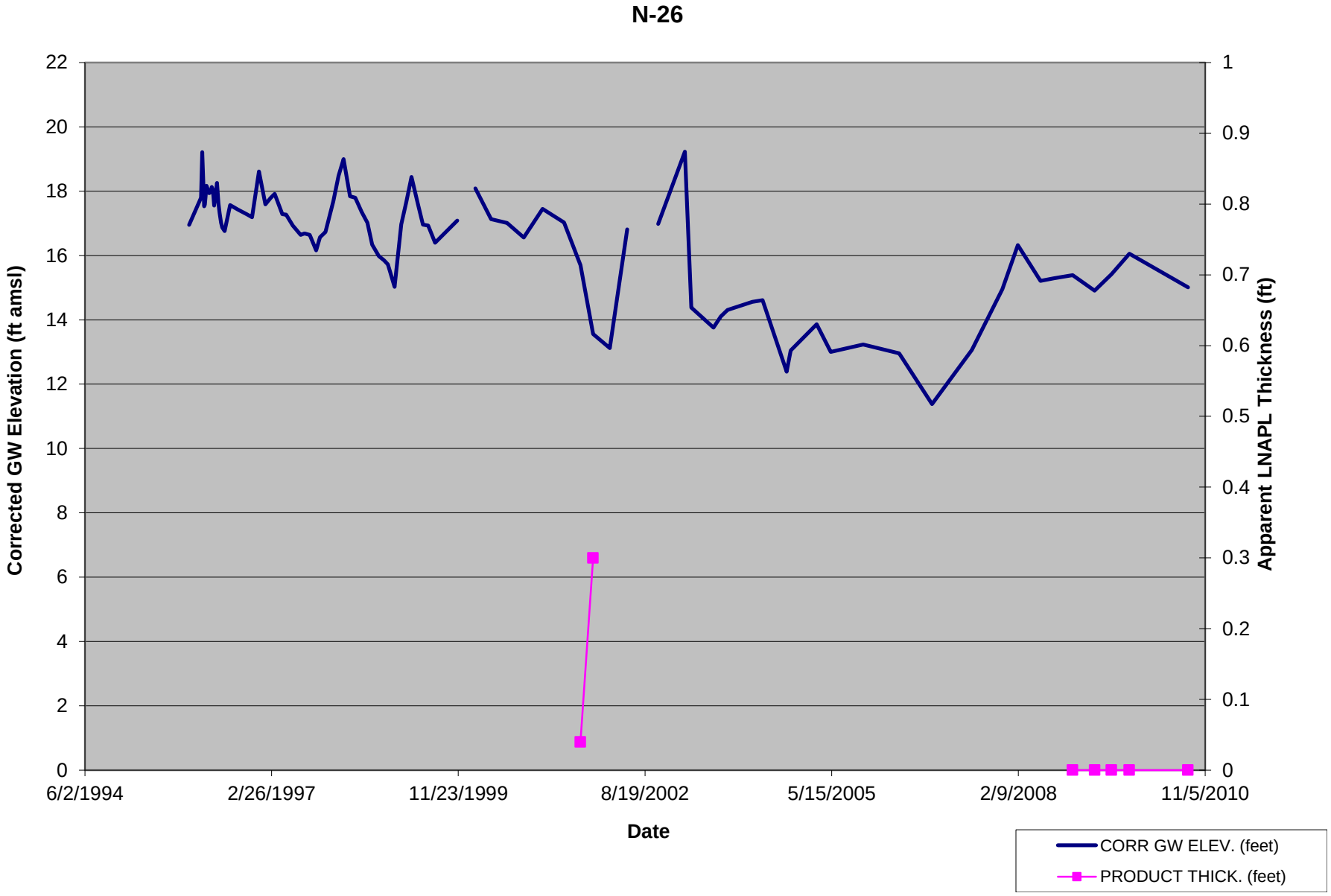

N-20
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
9/6/1991
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Date
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)

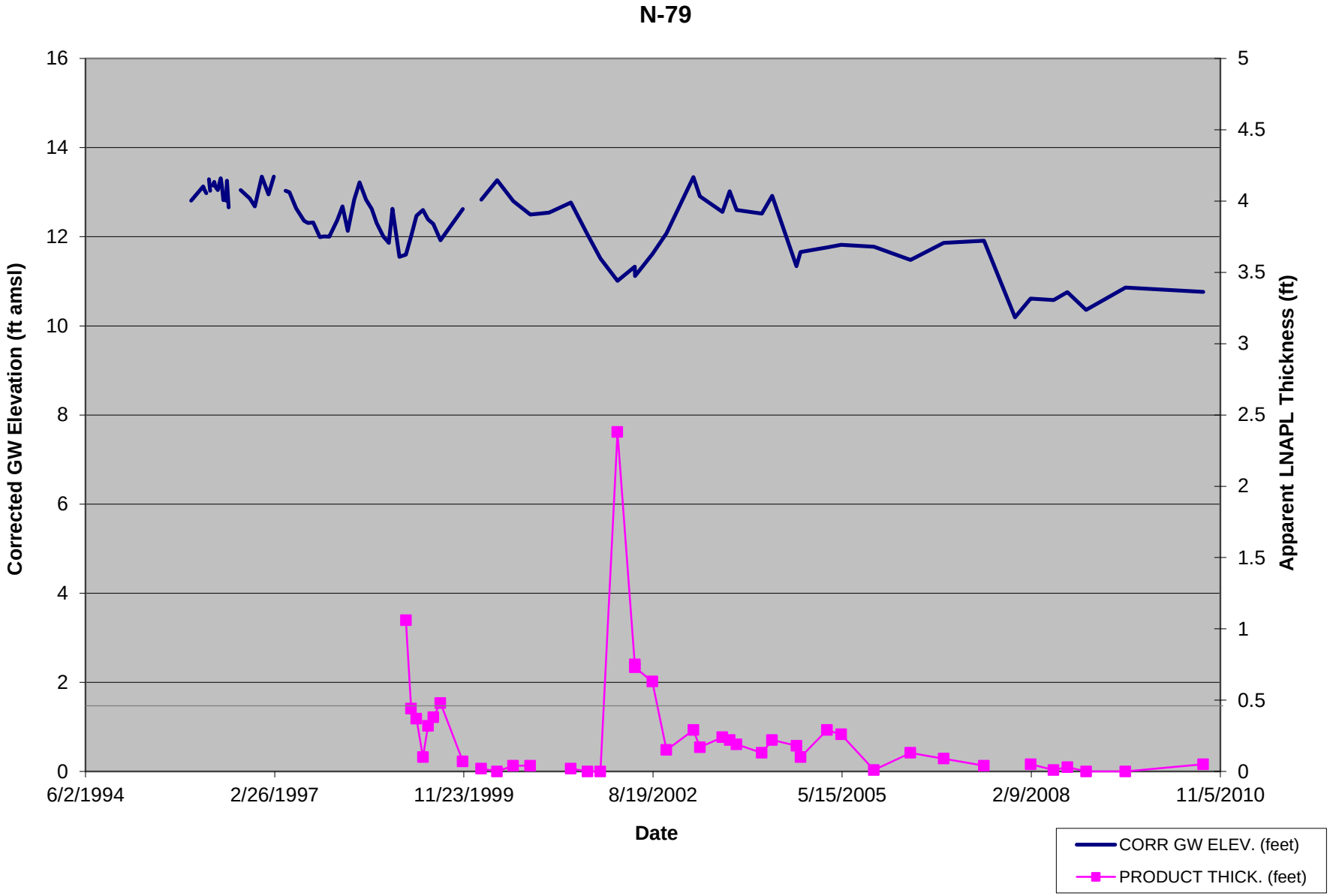

N-22
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
Date
16
14
12
10
8
6
4
2
0
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)


N-23
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
10
9
8
7
6
5
4
3
2
1
0
9/6/1991
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Date
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)

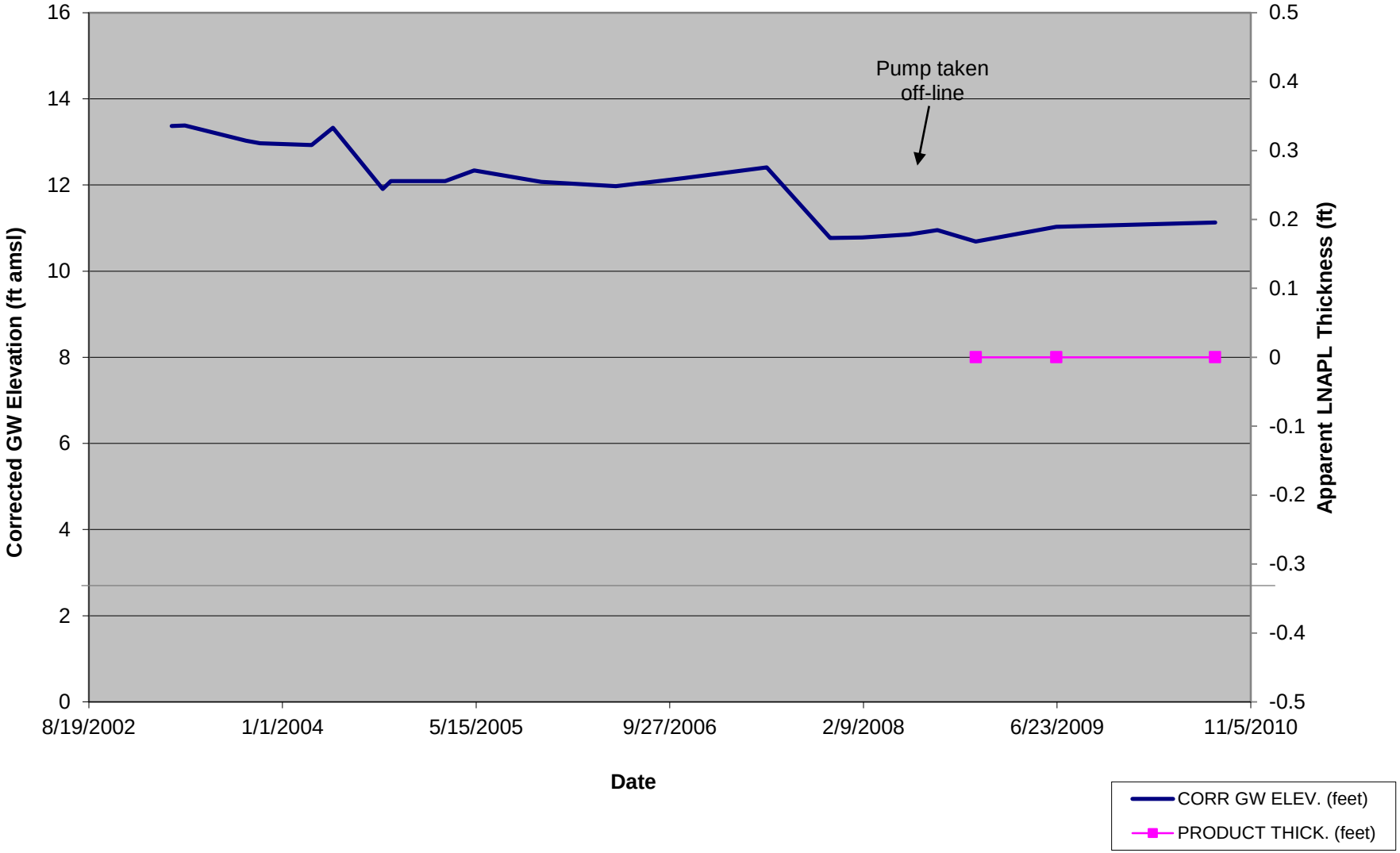

N-24
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
14
12
10
8
6
4
2
0
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Date
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)

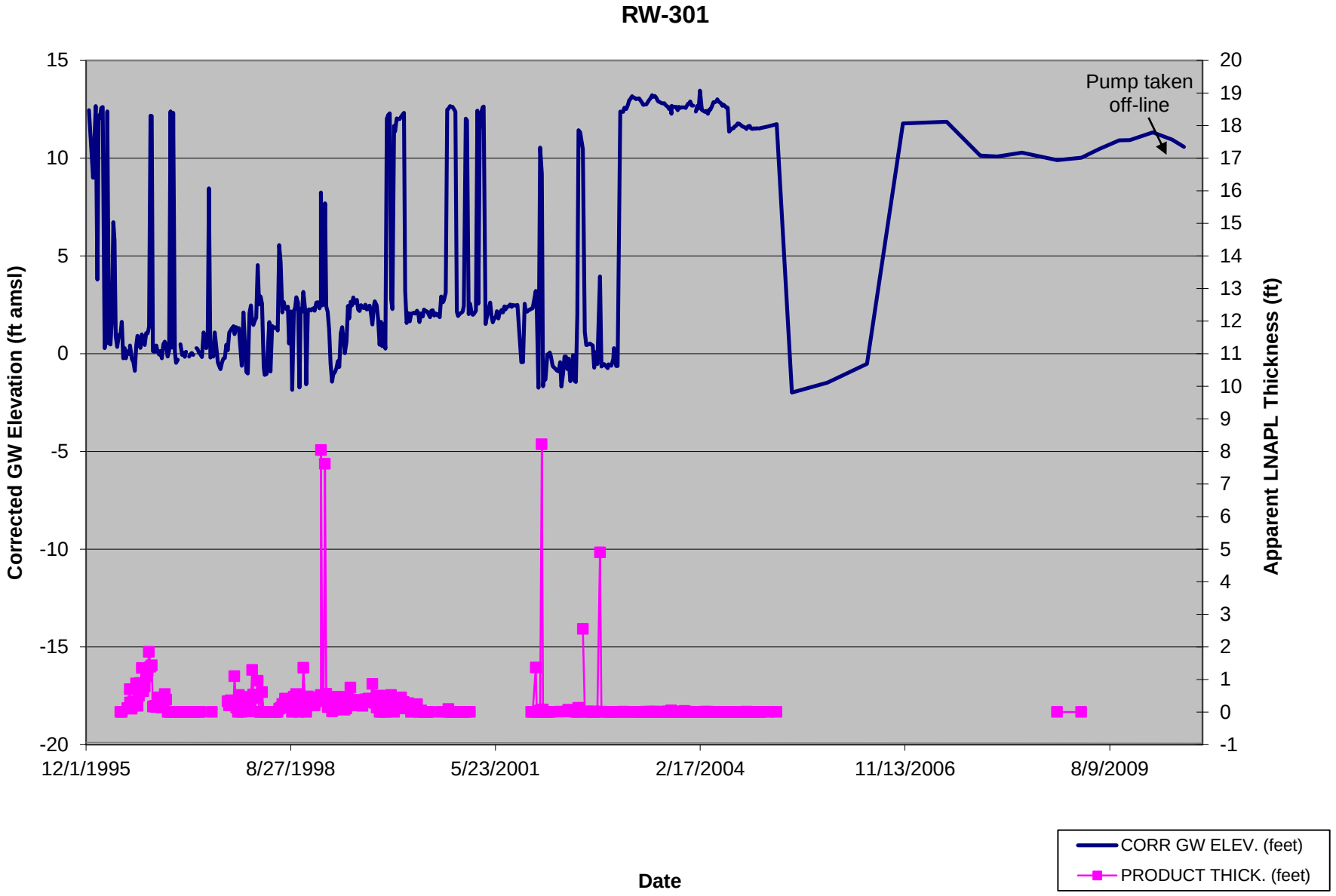

N-25
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
Date
20
18
16
14
12
10
8
6
4
2
0
10
9
8
7
6
5
4
3
2
1
0
9/6/1991
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)

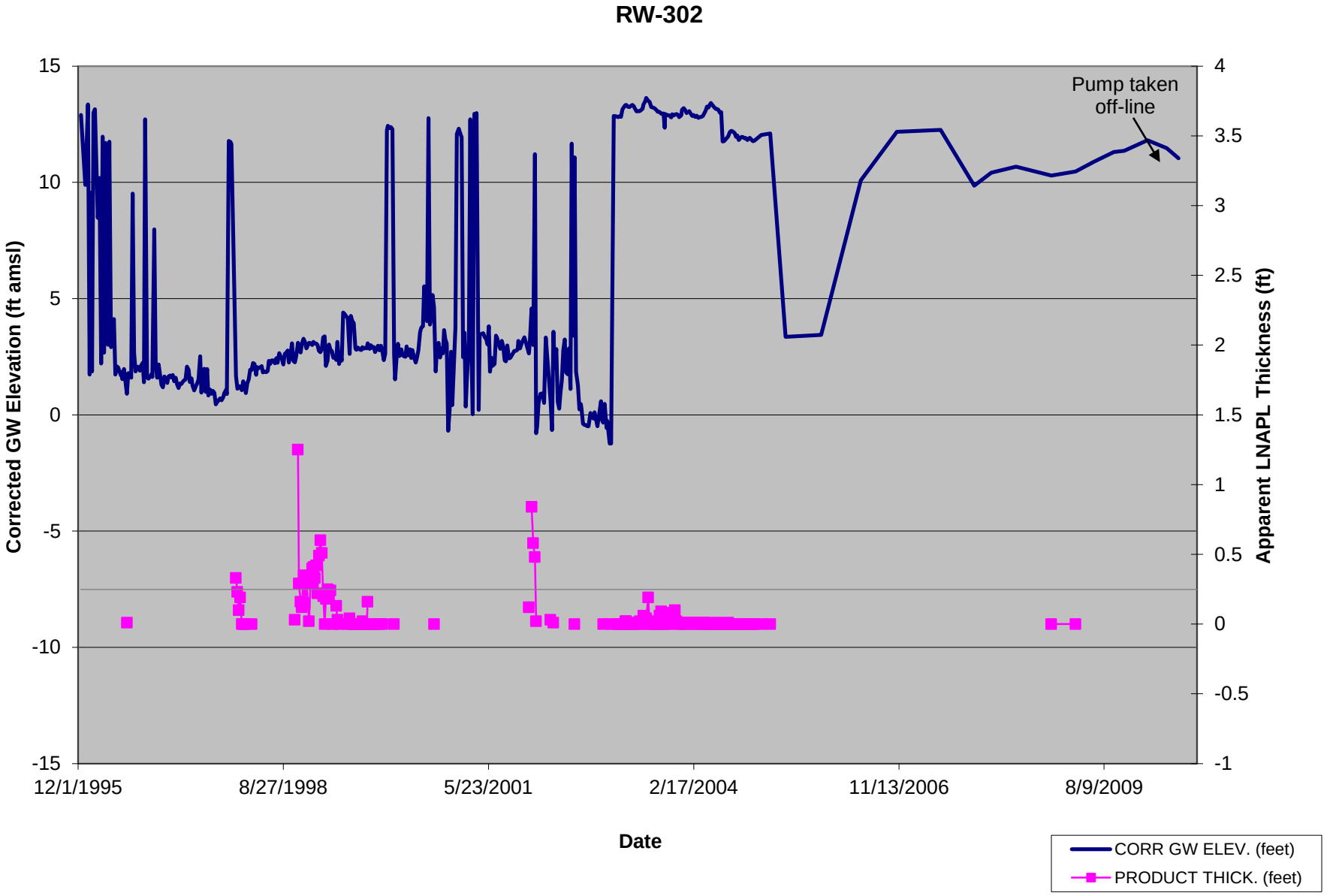

N-26
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
Date
22
20
18
16
14
12
10
8
6
4
2
0
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)


N-79
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
Date
16
14
12
10
8
6
4
2
0
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)

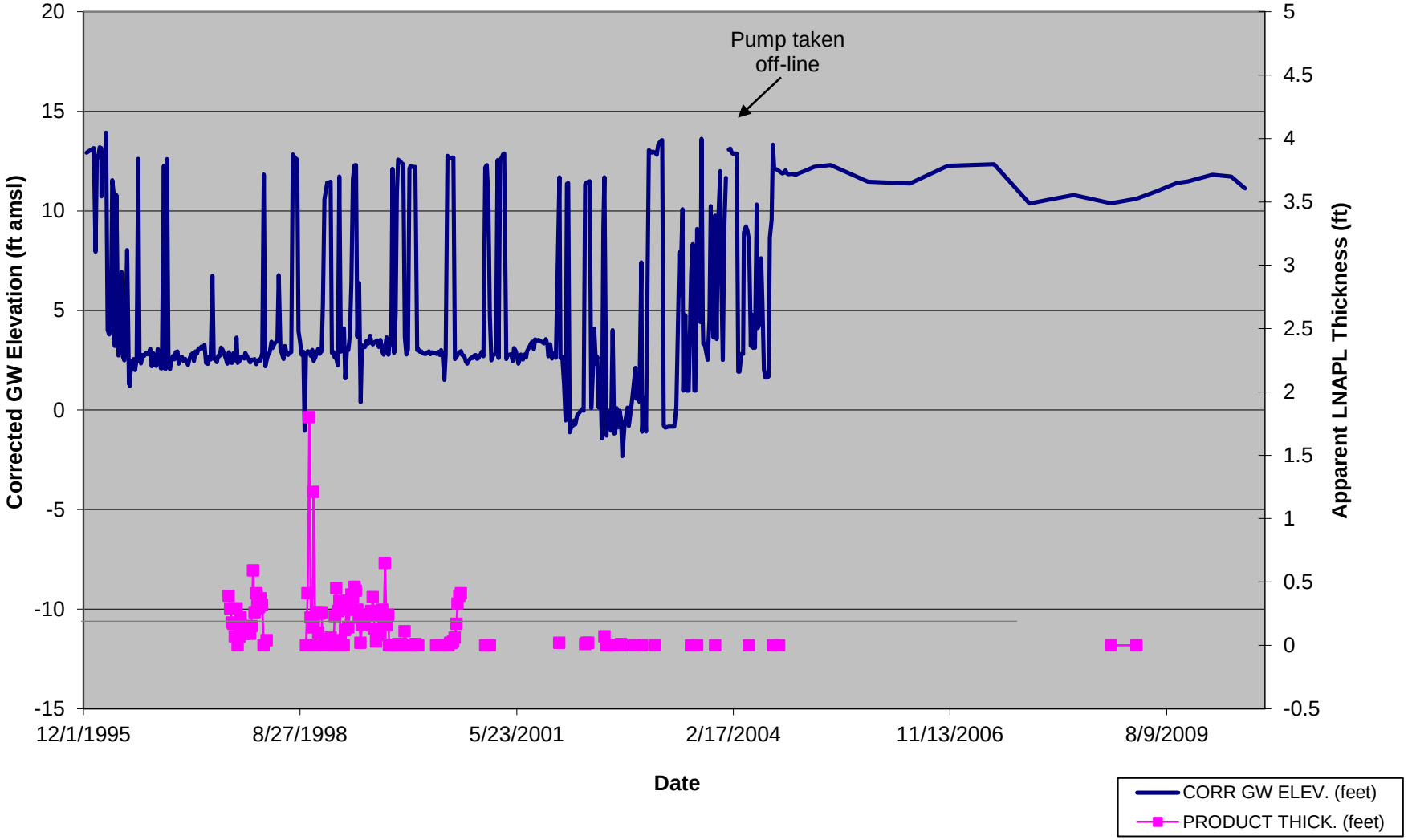
# N-87

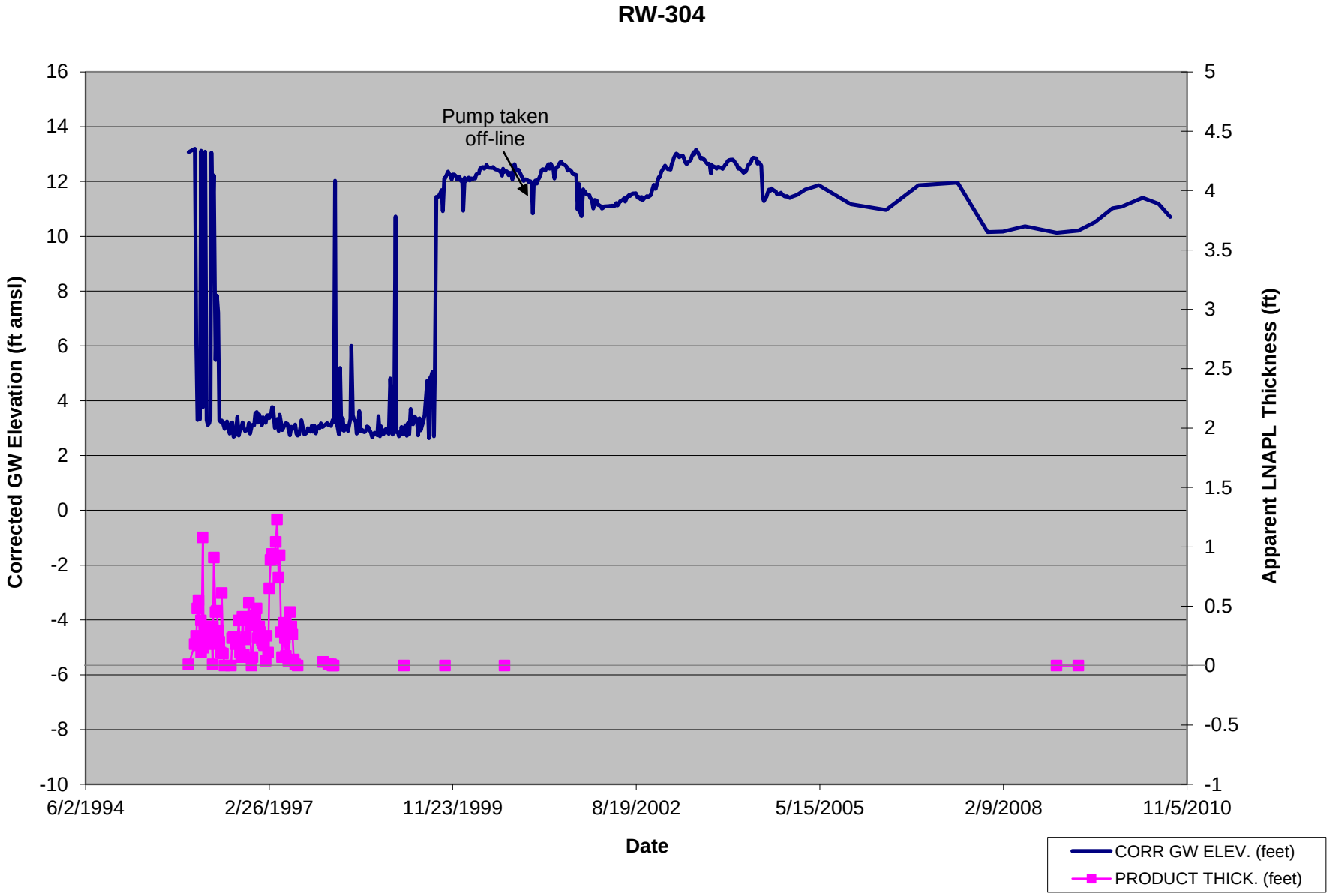

Pump taken off-line
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
16
14
12
10
8
6
4
2
0
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
8/19/2002
1/1/2004
5/15/2005
9/27/2006
2/9/2008
6/23/2009
11/5/2010
Date
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)

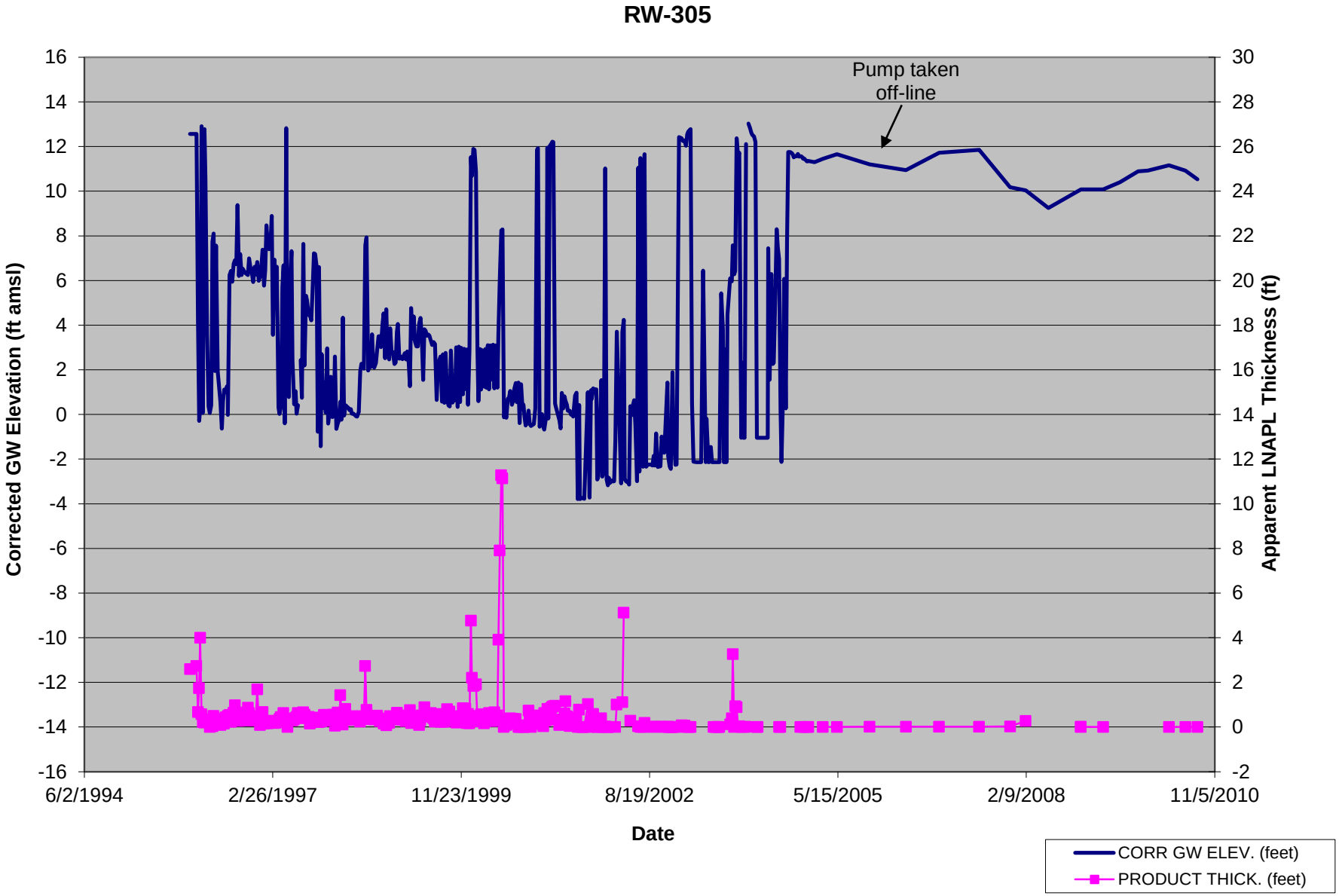

RW-301
Pump taken off-line
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
15
10
5
0
-5
-10
-15
-20
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
12/1/1995
8/27/1998
5/23/2001
2/17/2004
11/13/2006
8/9/2009
Date
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)

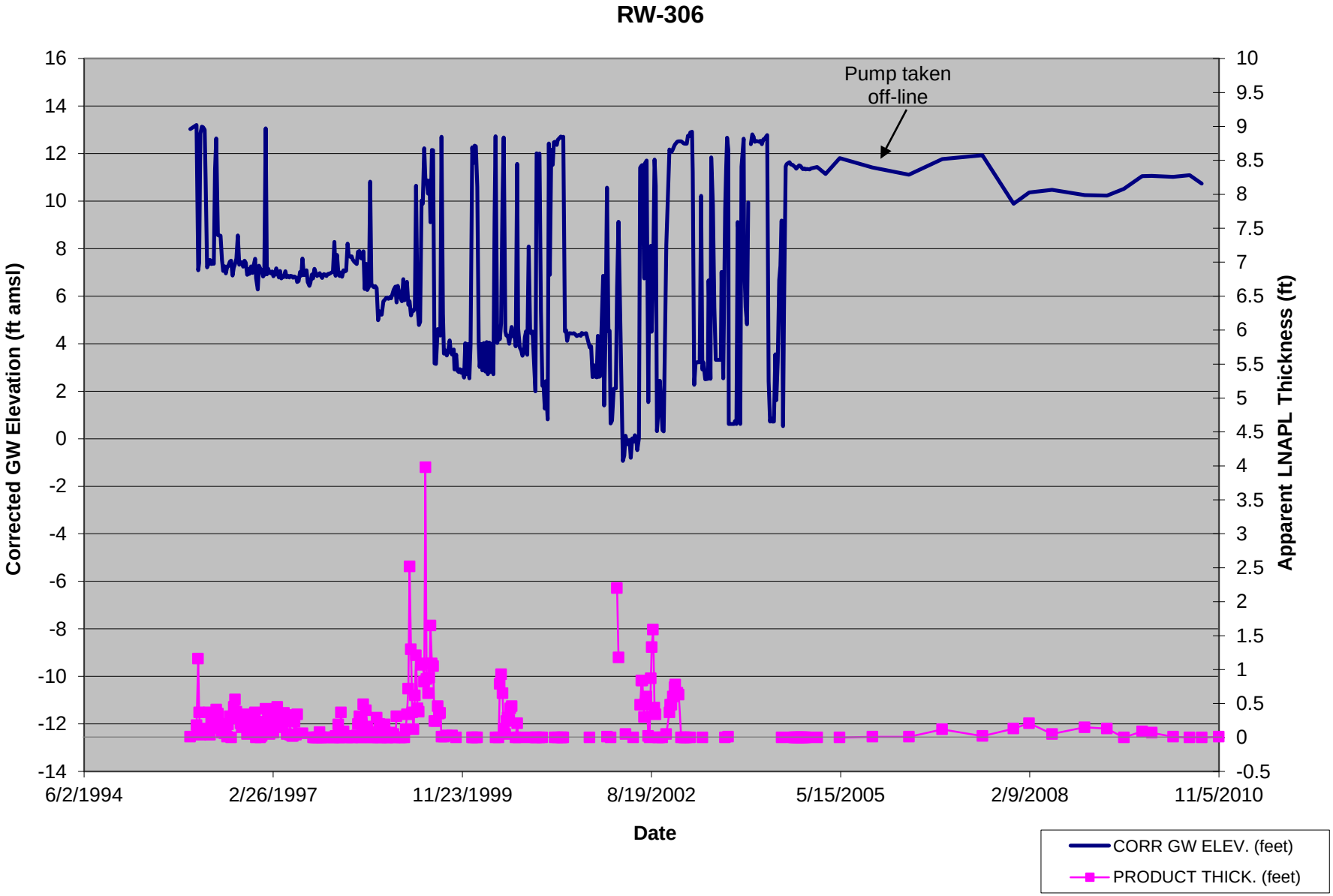

RW-302
Pump taken off-line
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
15
10
5
0
-5
-10
-15
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
12/1/1995
8/27/1998
5/23/2001
2/17/2004
11/13/2006
8/9/2009
Date
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)

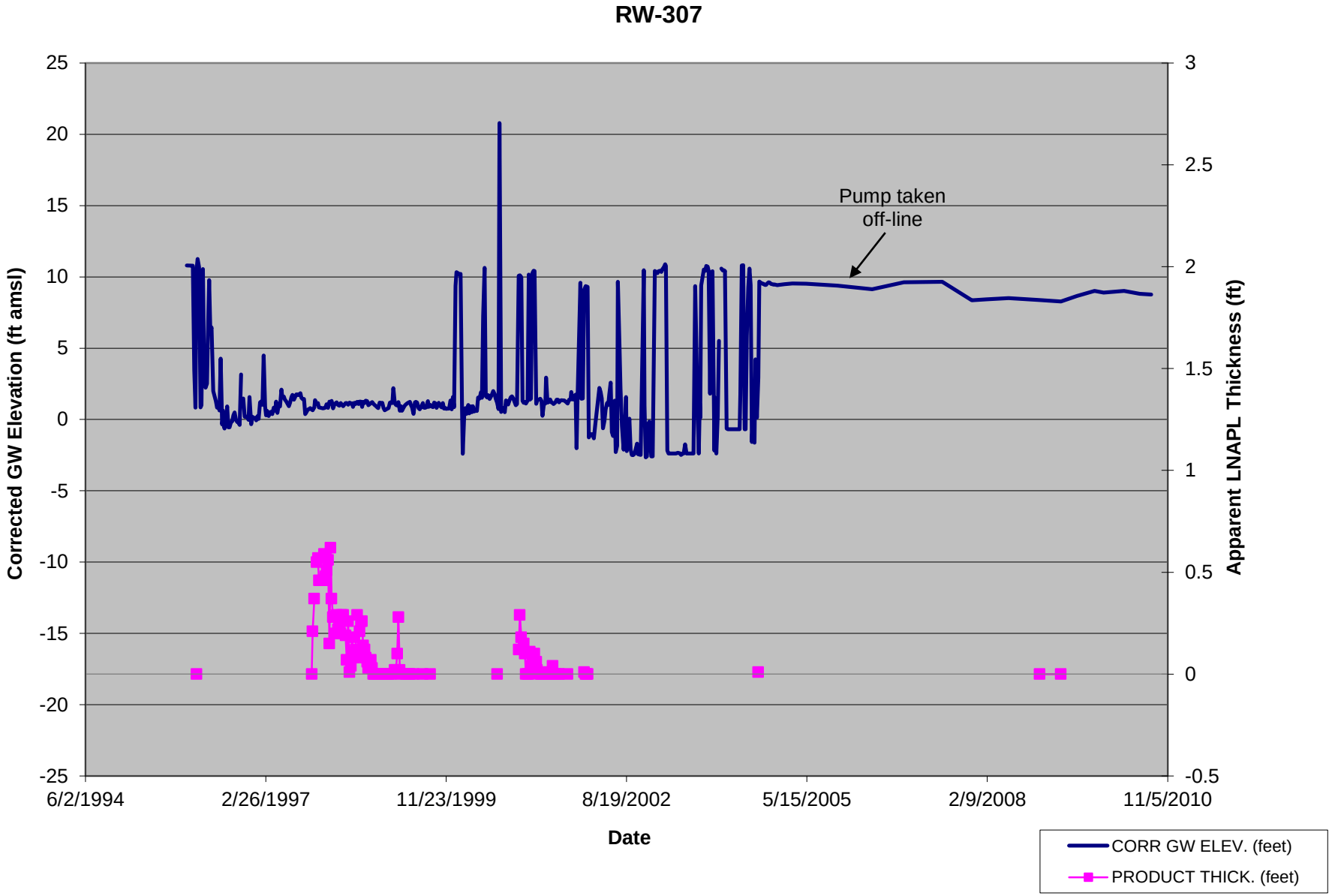
# RW-303

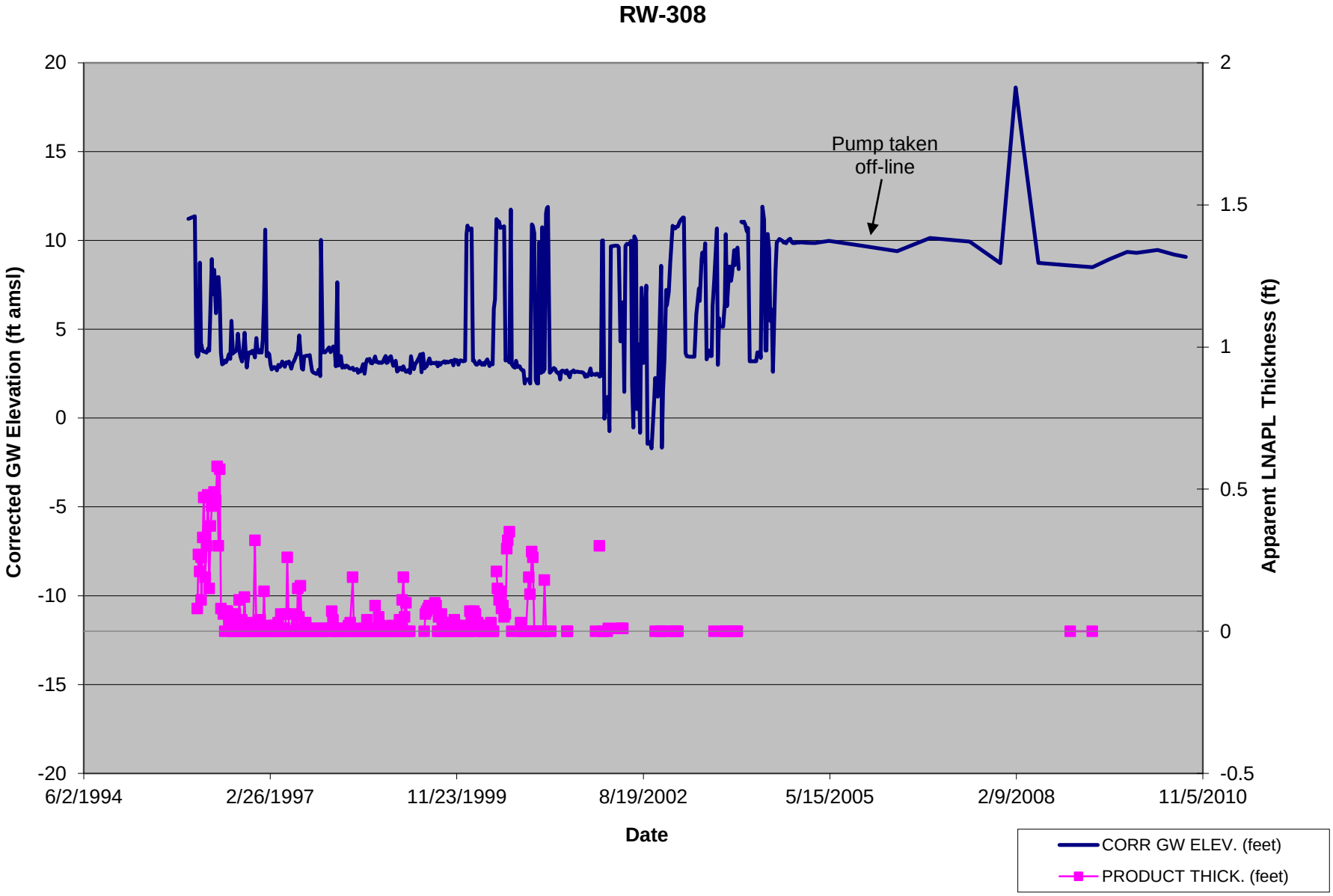

Pump taken off-line
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
Date
20
15
10
5
0
-5
-10
-15
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
12/1/1995
8/27/1998
5/23/2001
2/17/2004
11/13/2006
8/9/2009
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)

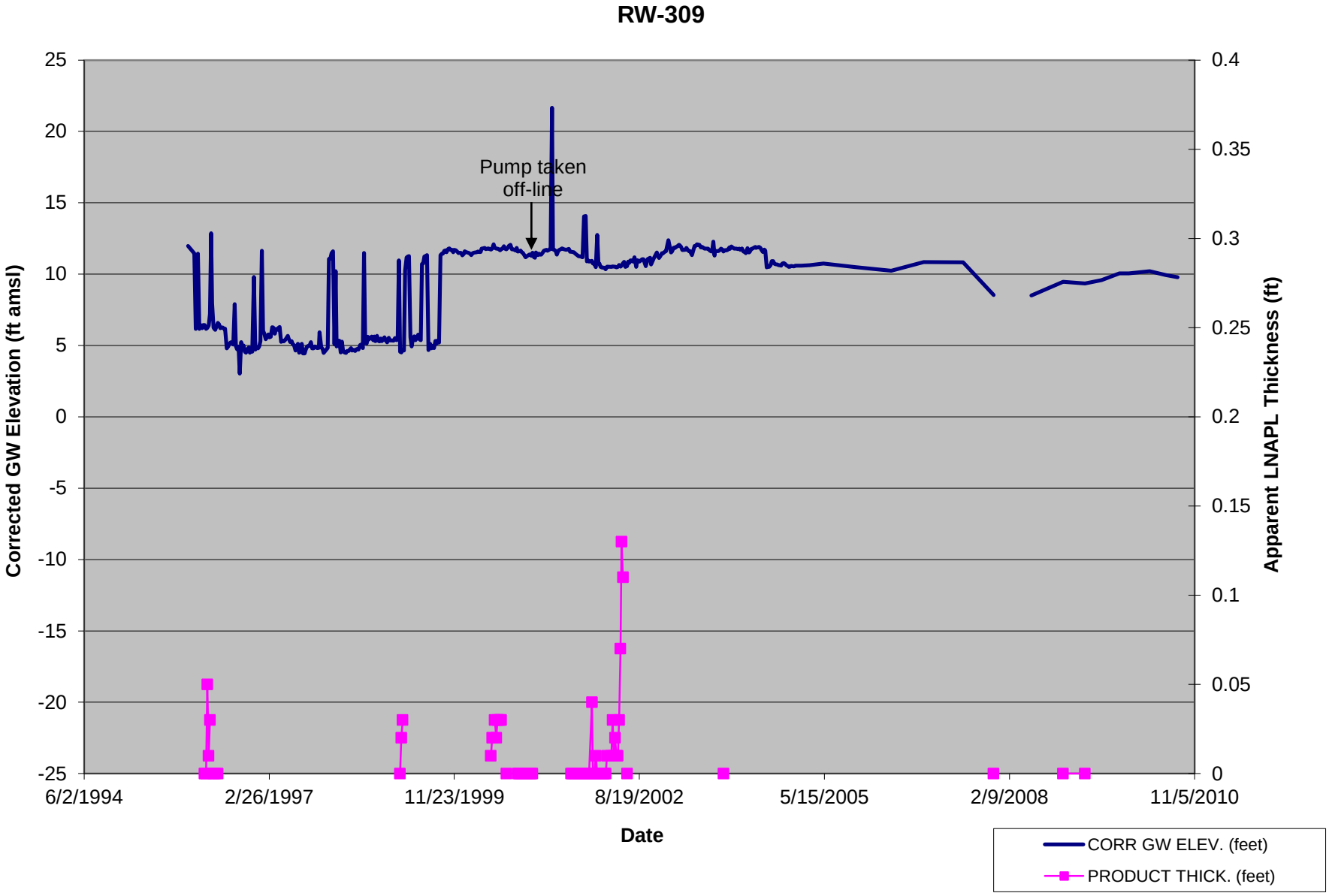

RW-304
Pump taken off-line
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
Date
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)

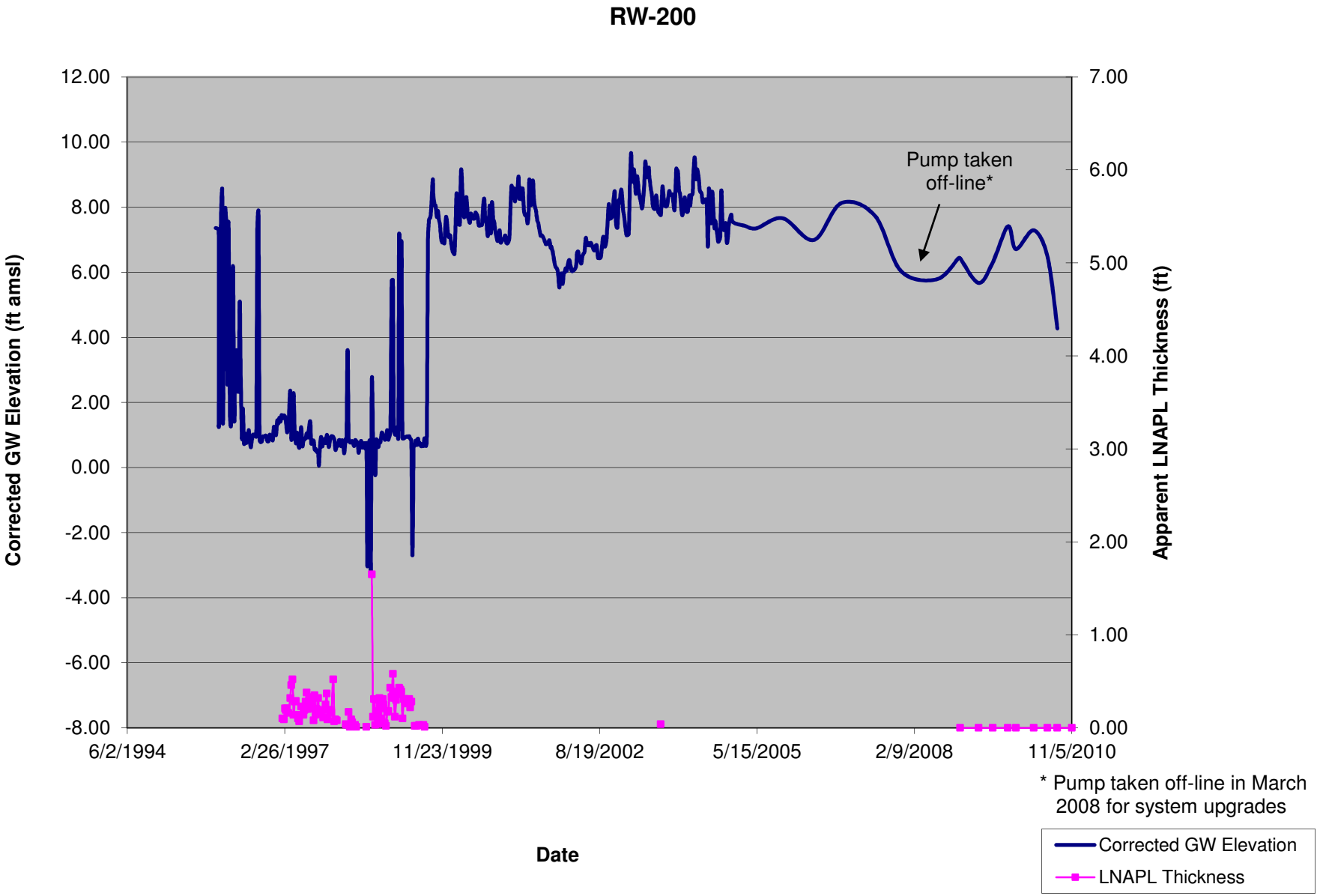

RW-305
Pump taken off-line
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
Date
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)

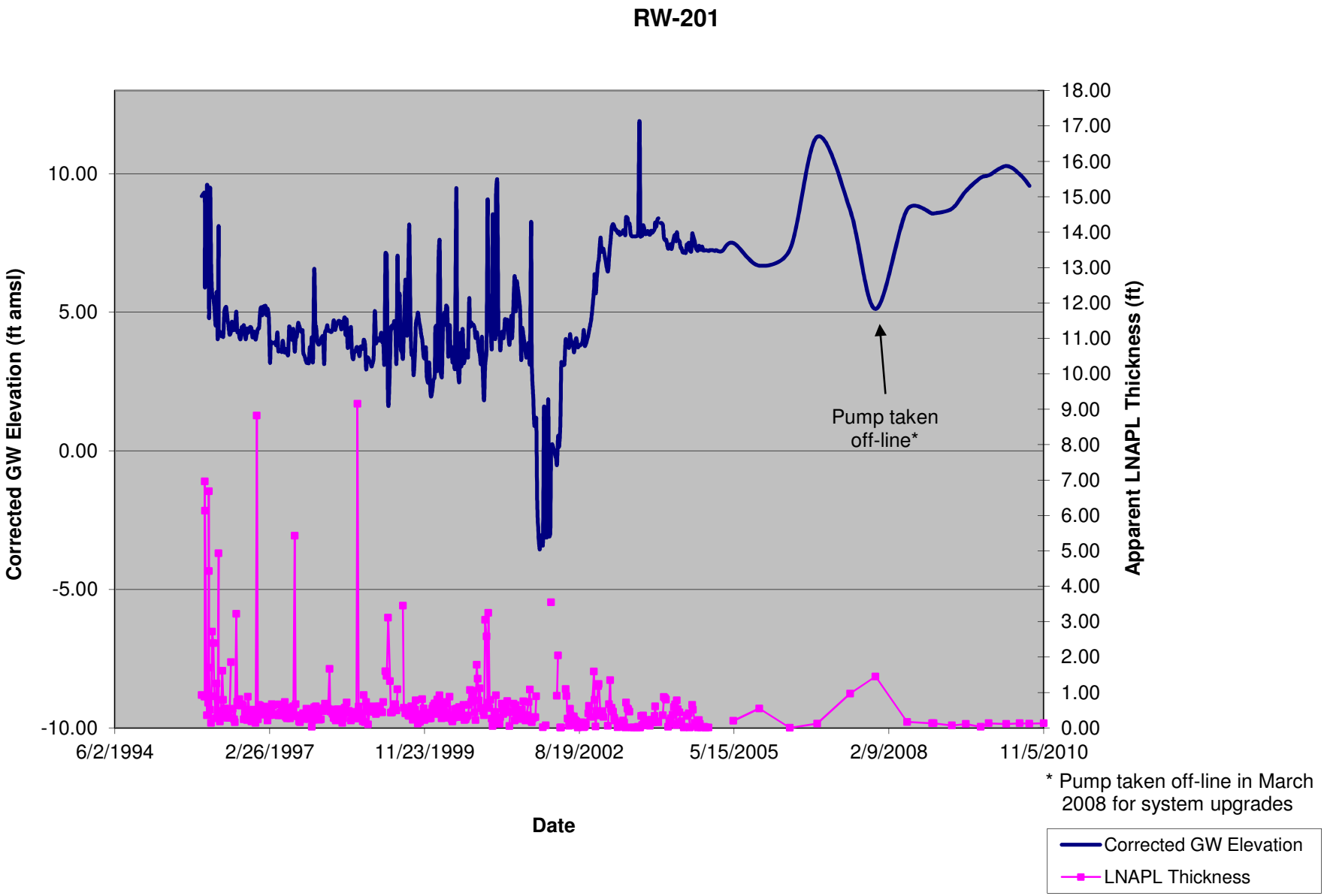

RW-306
Pump taken off-line
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
Date
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)

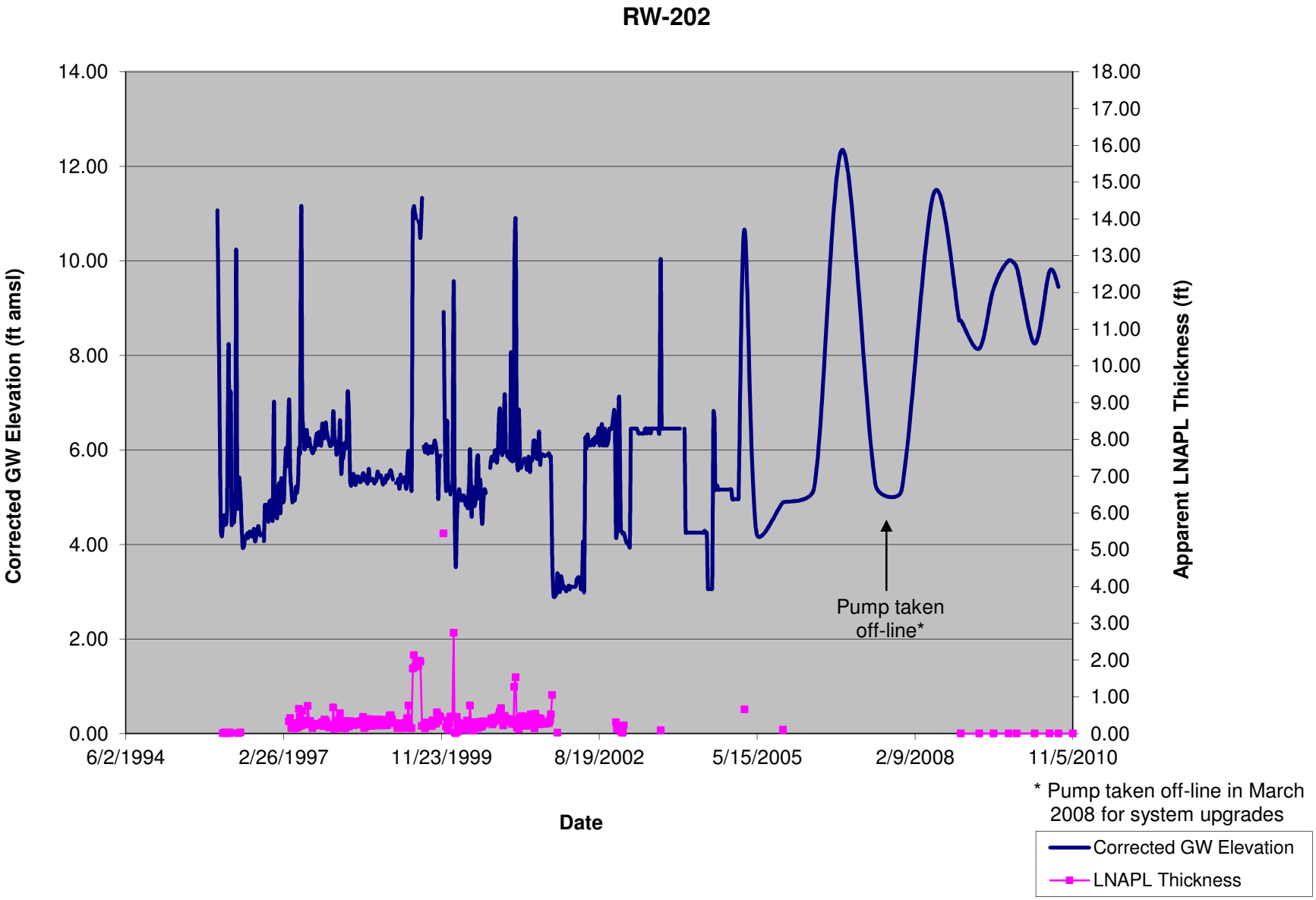

RW-307
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
Date
Pump taken off-line
25
20
15
10
5
0
-5
-10
-15
-20
-25
3
2.5
2
1.5
1
0.5
0
-0.5
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)

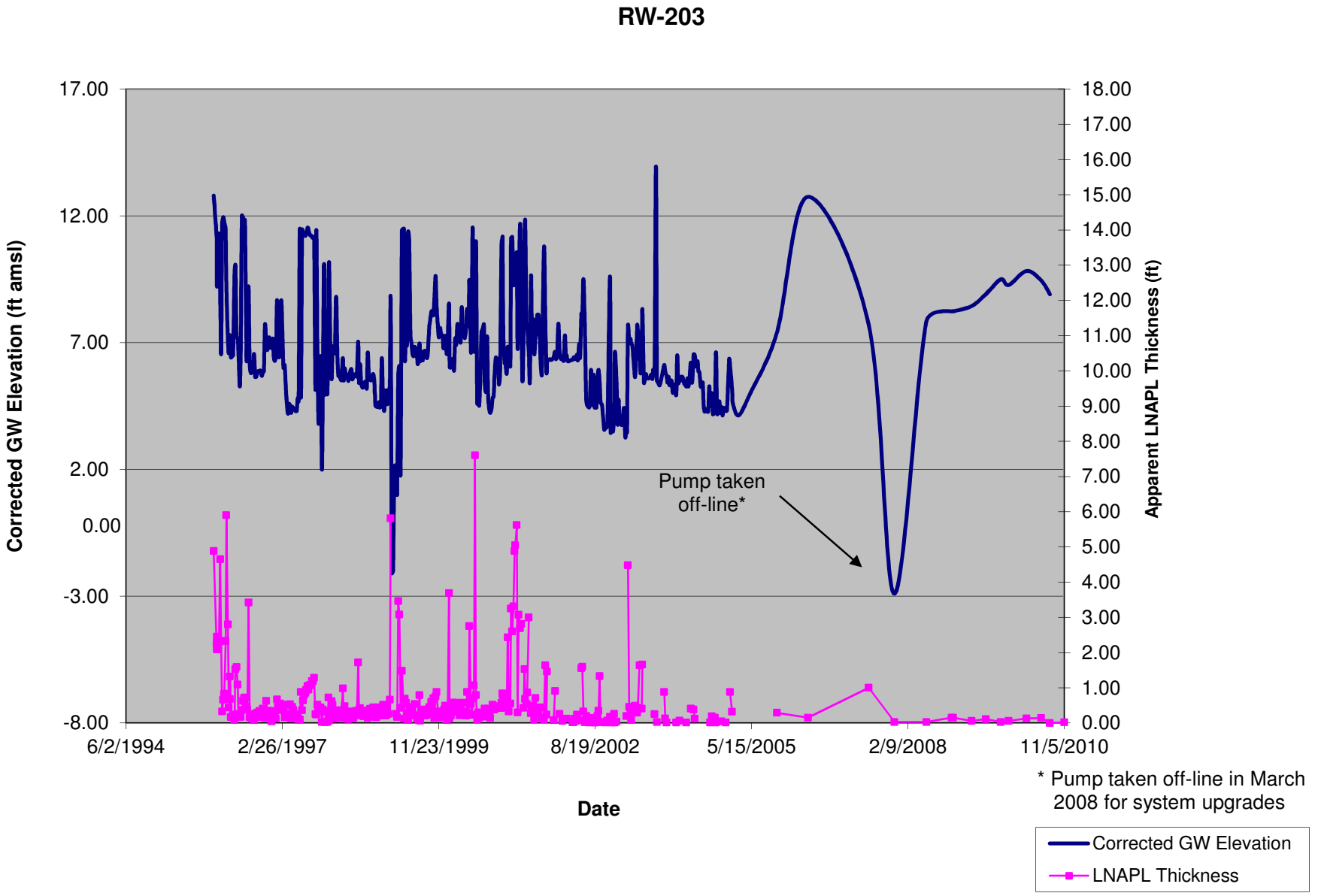

RW-308
Pump taken off-line
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
20
15
10
5
0
-5
-10
-15
-20
2
1.5
1
0.5
0
-0.5
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Date
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)


RW-309
Pump taken off-line
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
Date
25
20
15
10
5
0
-5
-10
-15
-20
-25
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
CORR GW ELEV. (feet)
PRODUCT THICK. (feet)

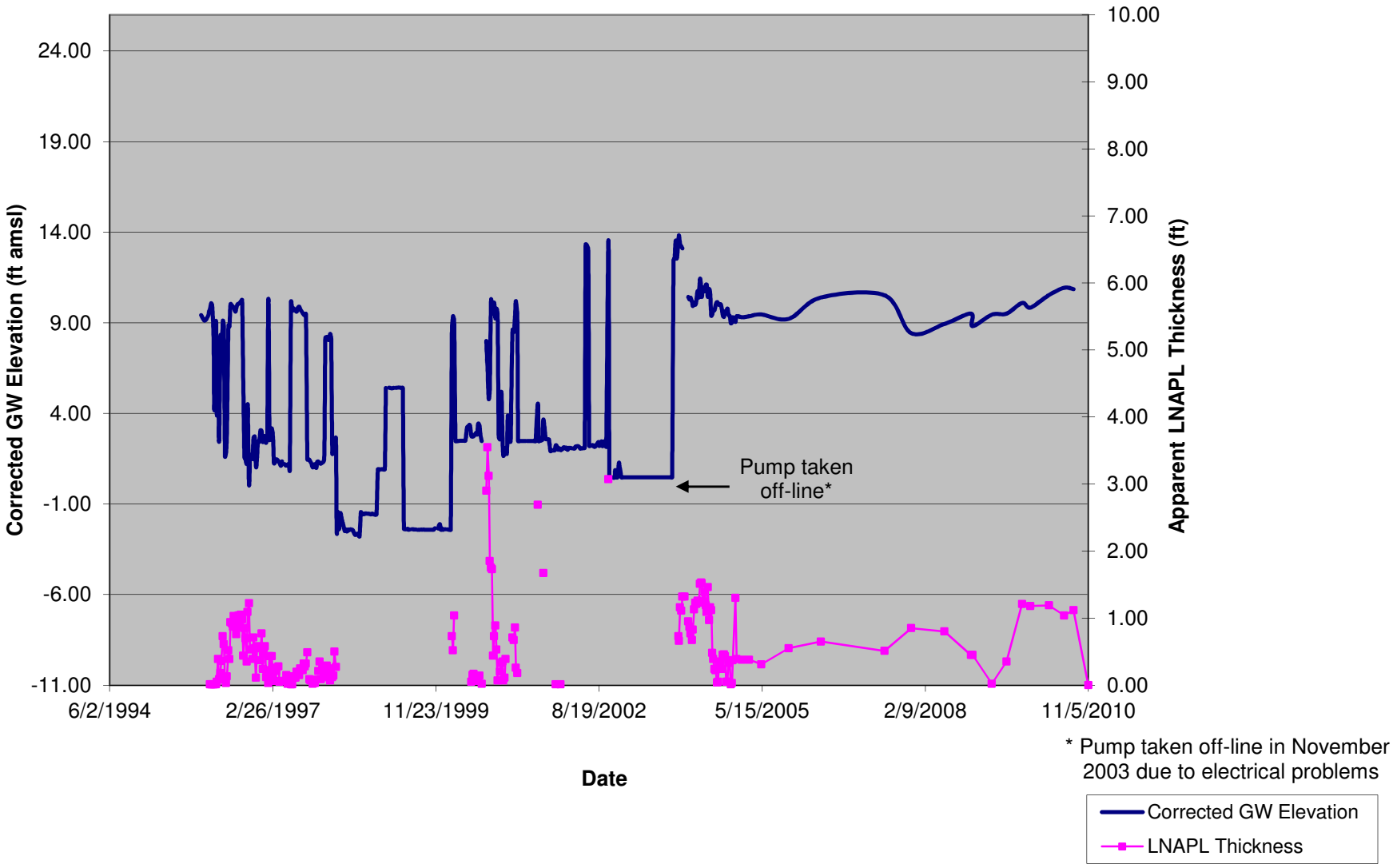

RW-200
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
12.00
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Pump taken off-line*
Date
* Pump taken off-line in March 2008 for system upgrades
Corrected GW Elevation
LNAPL Thickness

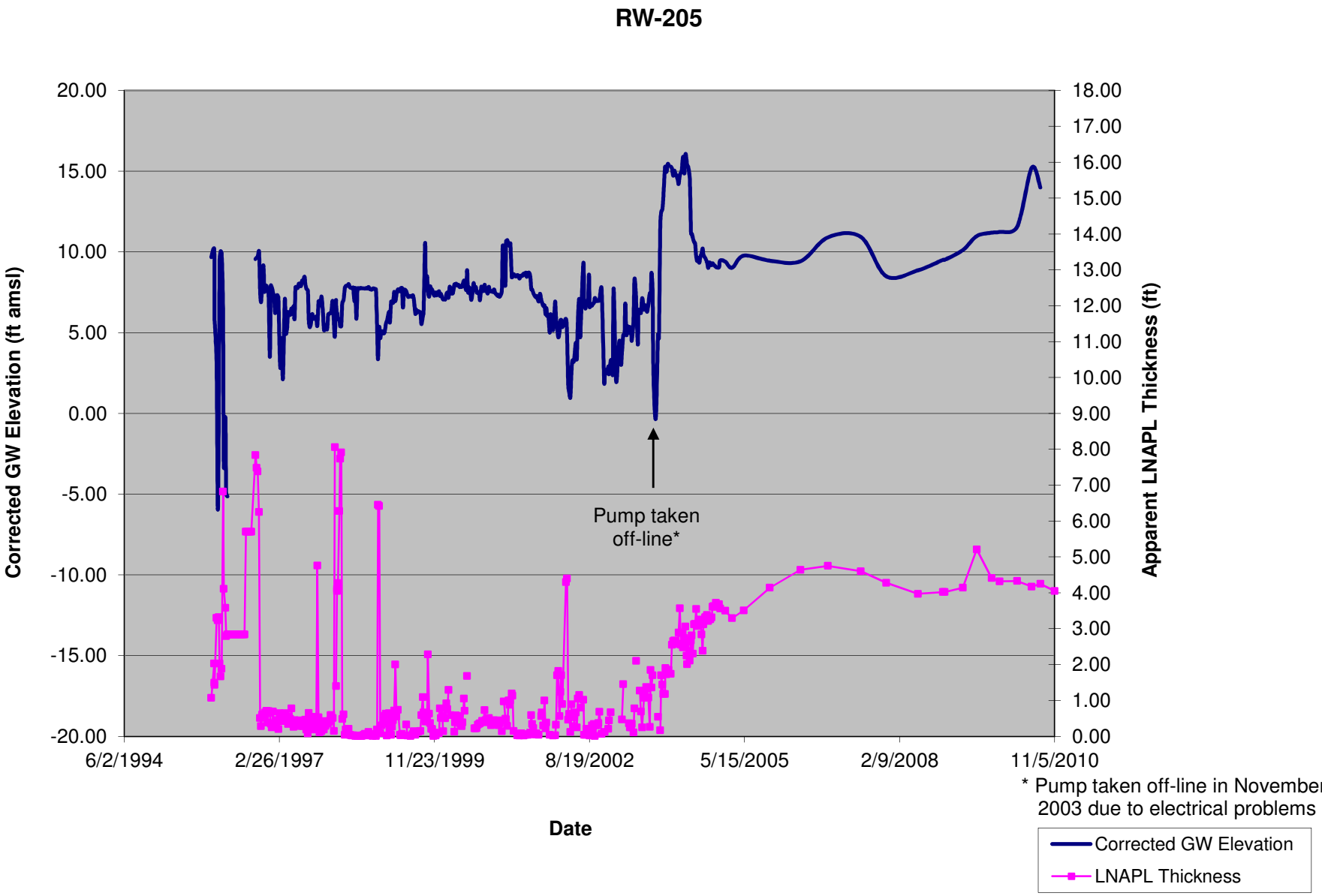

RW-201
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
10.00
5.00
0.00
-5.00
-10.00
18.00
17.00
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Pump taken off-line*
Date
* Pump taken off-line in March 2008 for system upgrades
Corrected GW Elevation
LNAPL Thickness

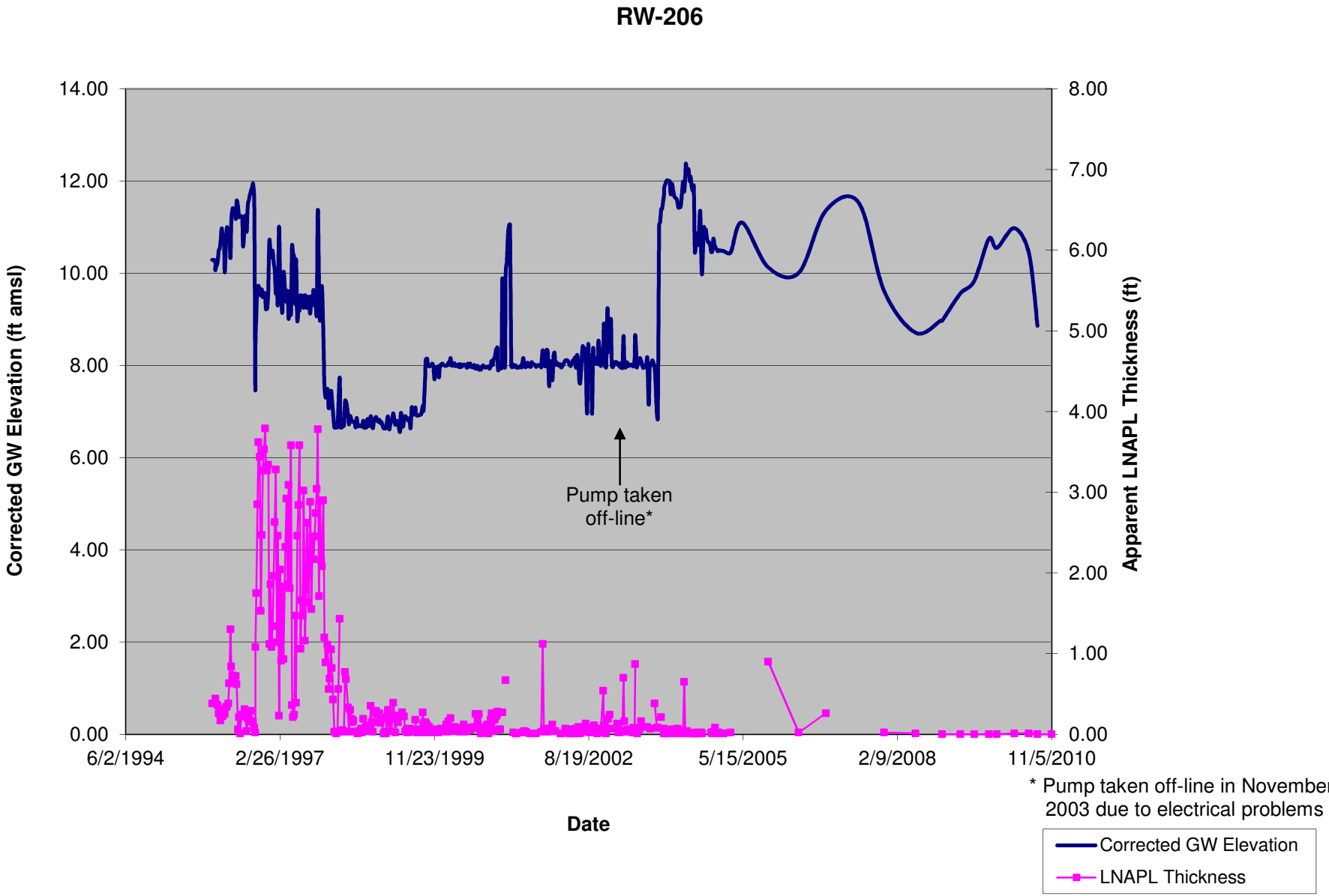

RW-202
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
18.00
17.00
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Pump taken off-line*
Date
* Pump taken off-line in March 2008 for system upgrades
Corrected GW Elevation
LNAPL Thickness


RW-203
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
17.00
12.00
7.00
2.00
0.00
-3.00
-8.00
18.00
17.00
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Pump taken off-line*
Date
* Pump taken off-line in March 2008 for system upgrades
Corrected GW Elevation
LNAPL Thickness

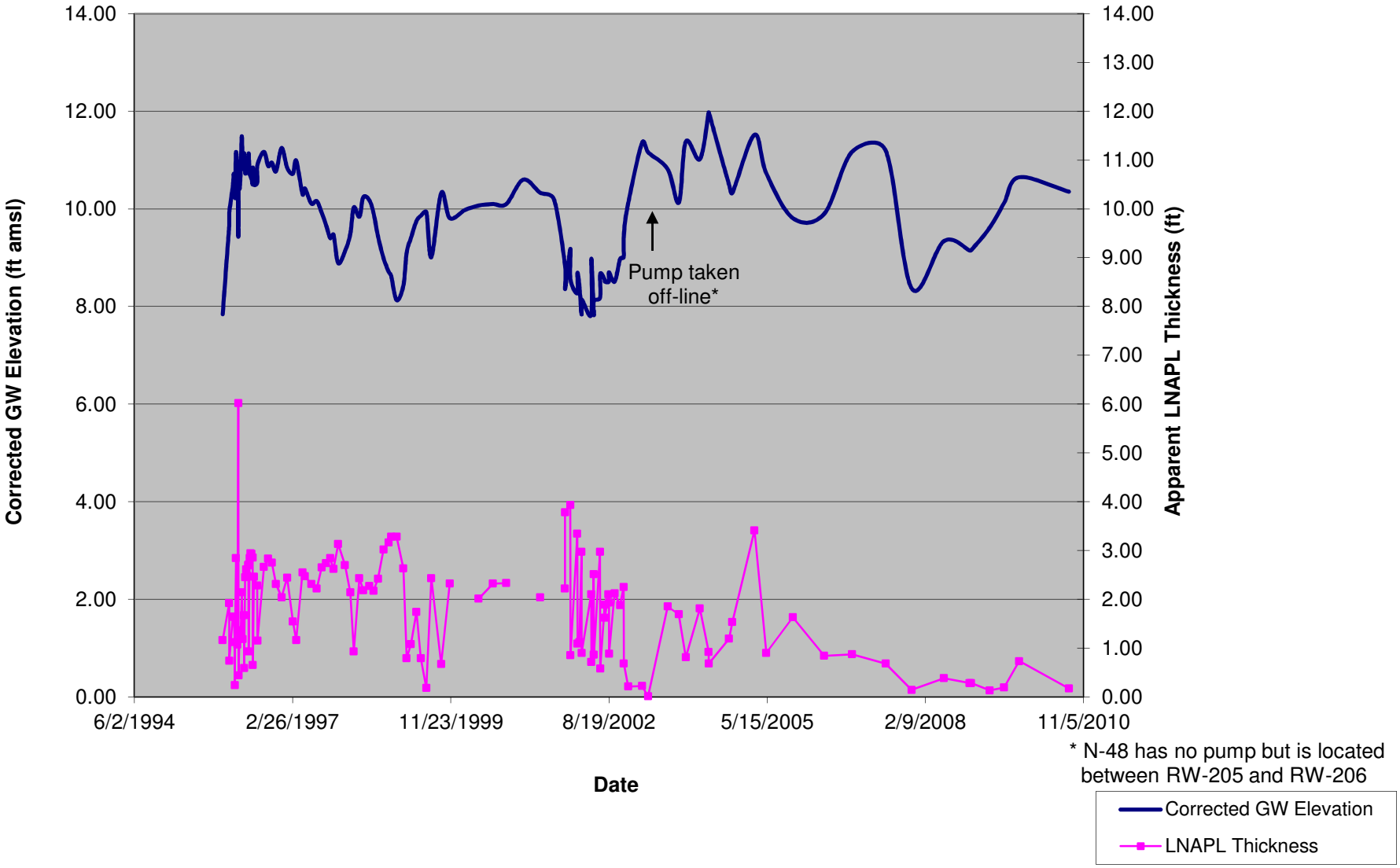
# RW-204


Corrected GW Elevation (ft amsl)
24.00
19.00
14.00
9.00
4.00
-1.00
-6.00
-11.00
Apparent LNAPL Thickness (ft)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Pump taken off-line*
Date
* Pump taken off-line in November 2003 due to electrical problems
Corrected GW Elevation
LNAPL Thickness

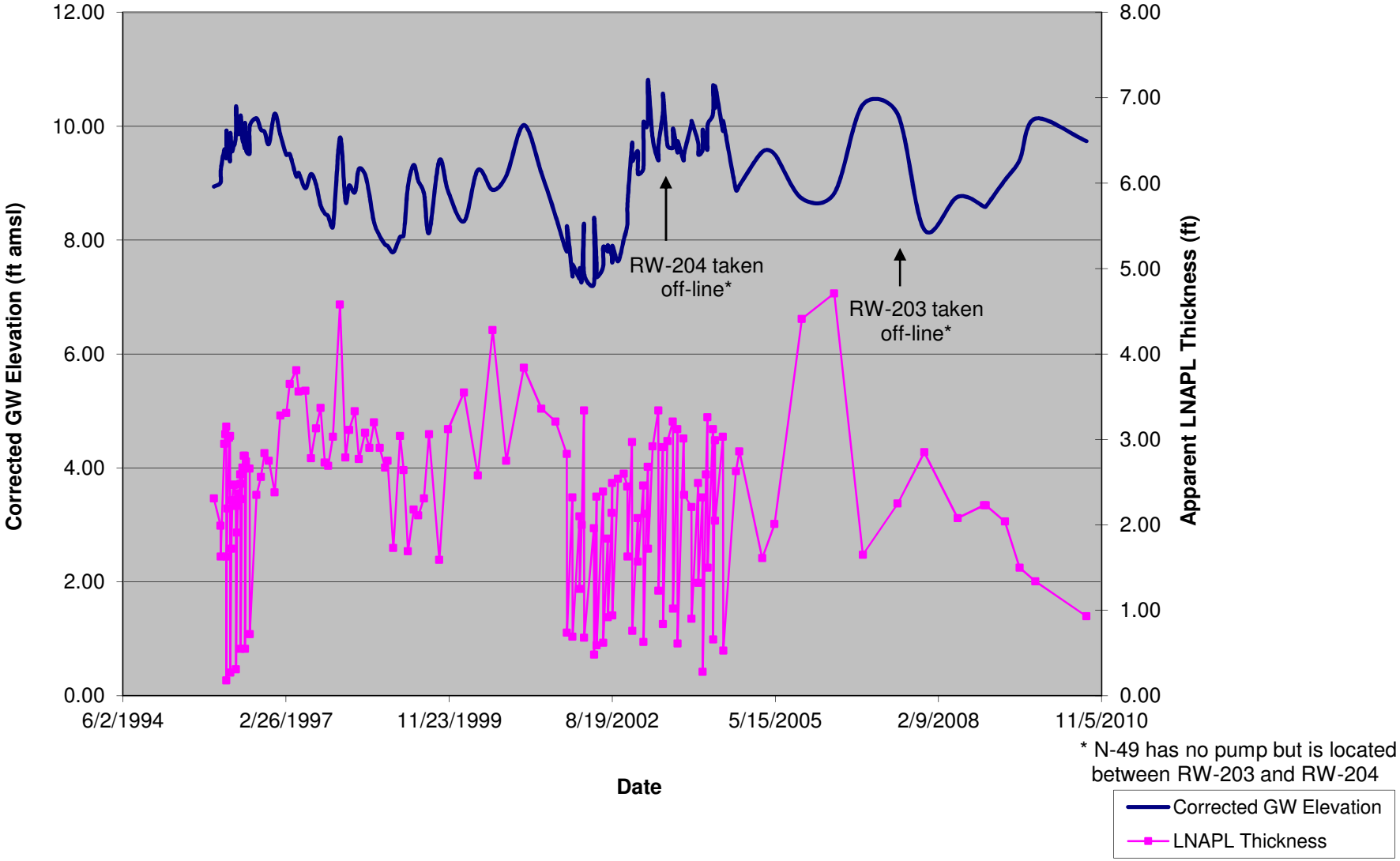

RW-205
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
20.00
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
-20.00
18.00
17.00
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Pump taken off-line*
Date
* Pump taken off-line in November 2003 due to electrical problems
Corrected GW Elevation
LNAPL Thickness


RW-206
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Pump taken off-line*
Date
* Pump taken off-line in November 2003 due to electrical problems
Corrected GW Elevation
LNAPL Thickness

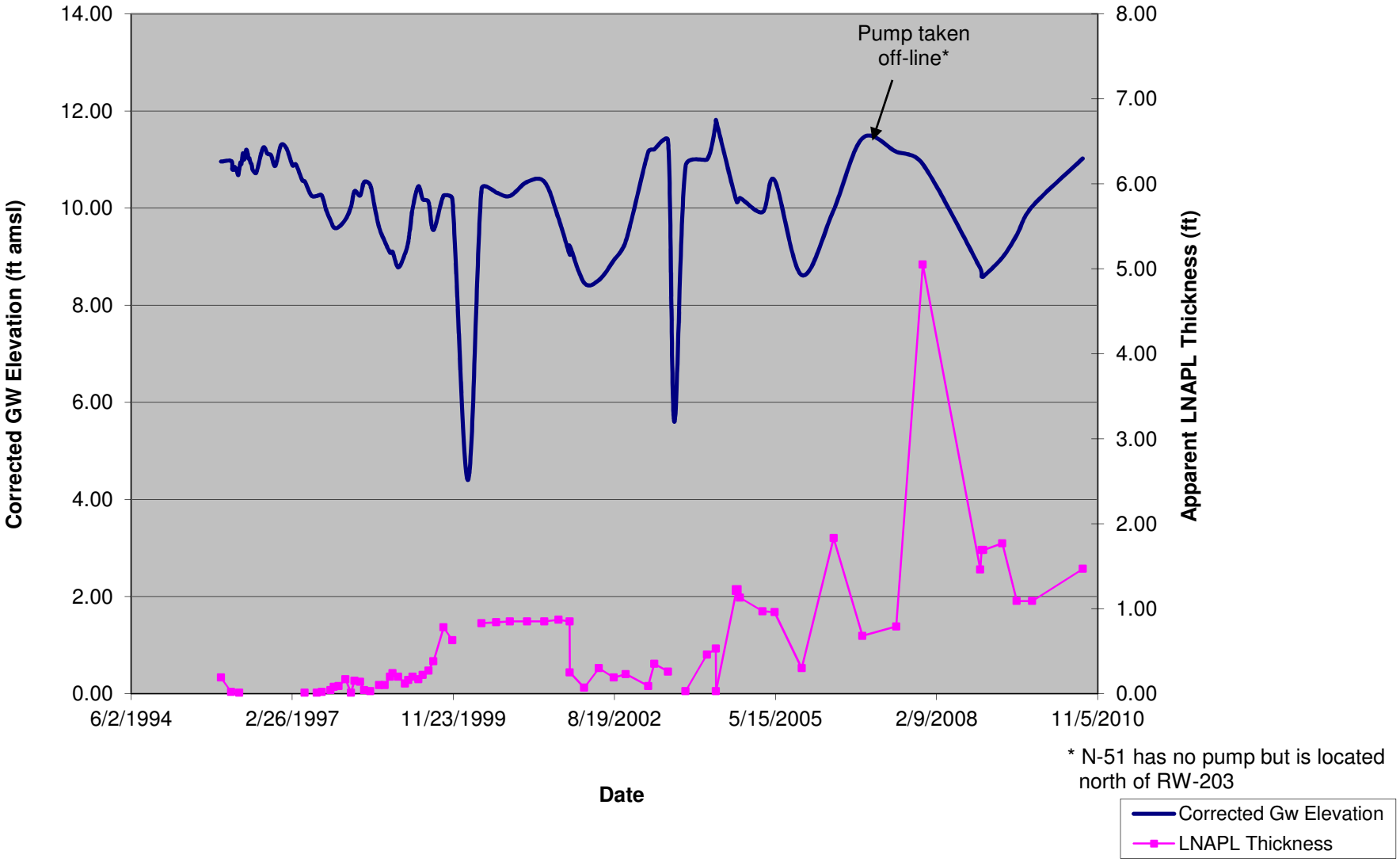
# N-48

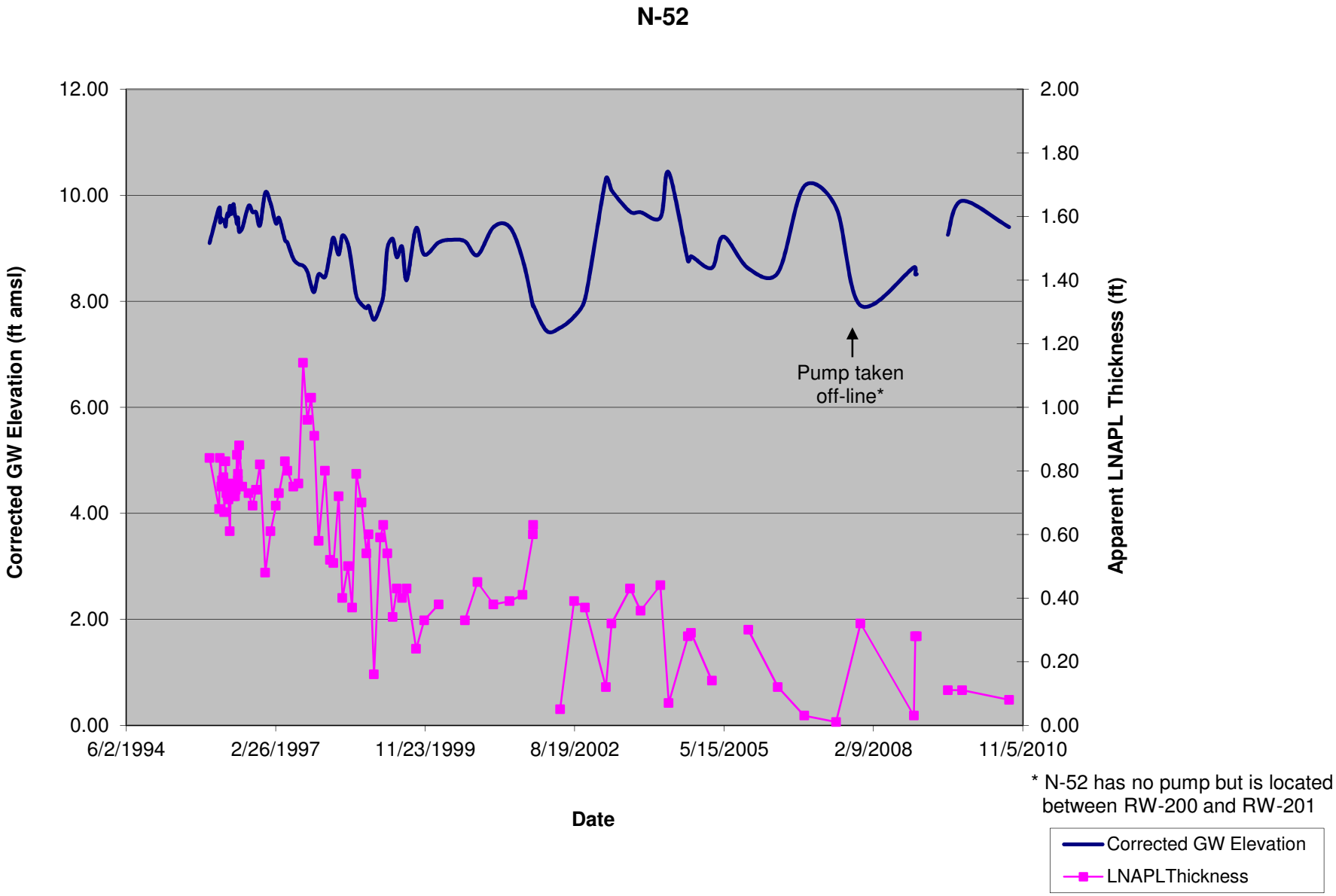

14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Corrected GW Elevation (ft amsl)
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Apparent LNAPL Thickness (ft)
Pump taken off-line*
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Date
* N-48 has no pump but is located between RW-205 and RW-206
Corrected GW Elevation
LNAPL Thickness

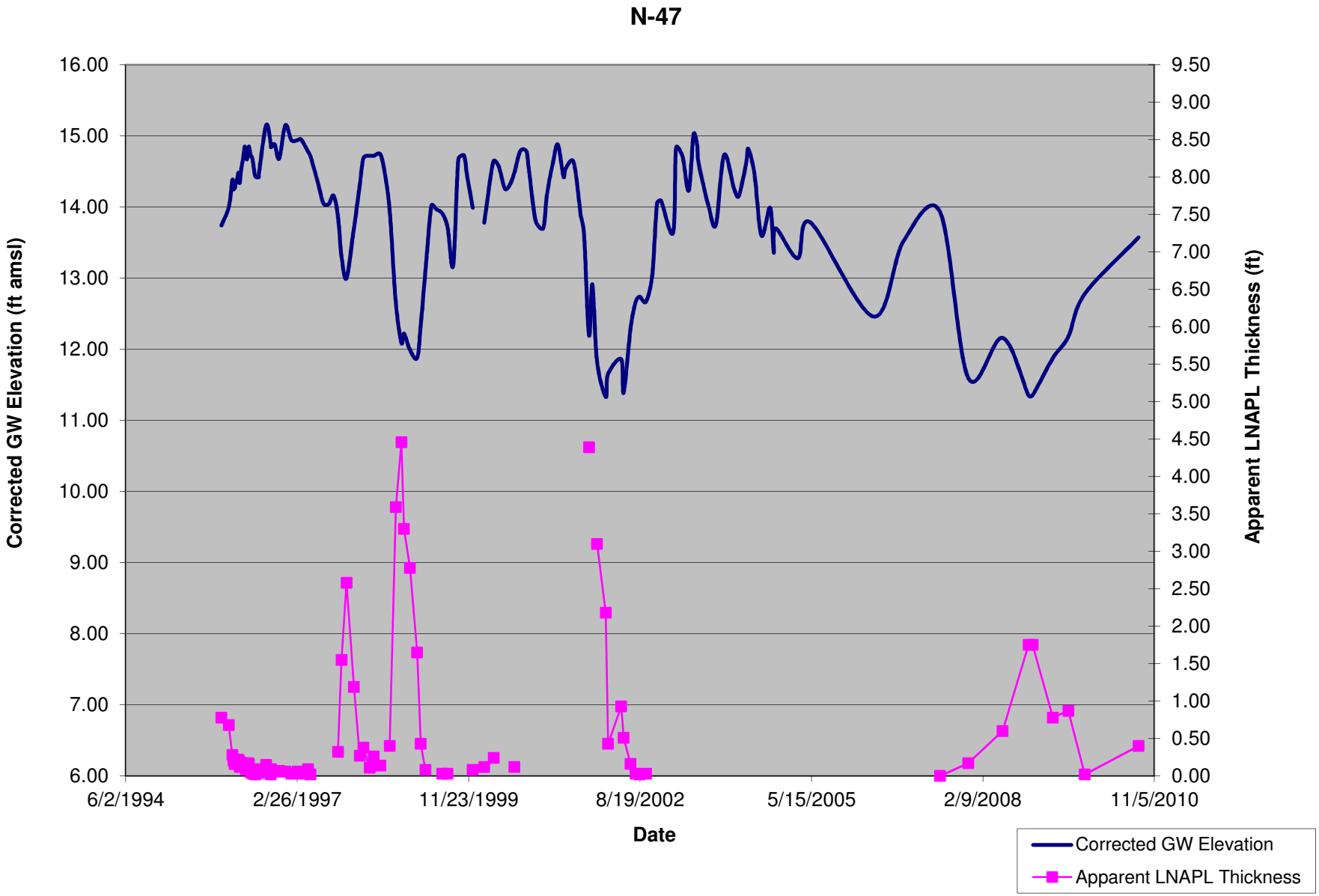
# N-49

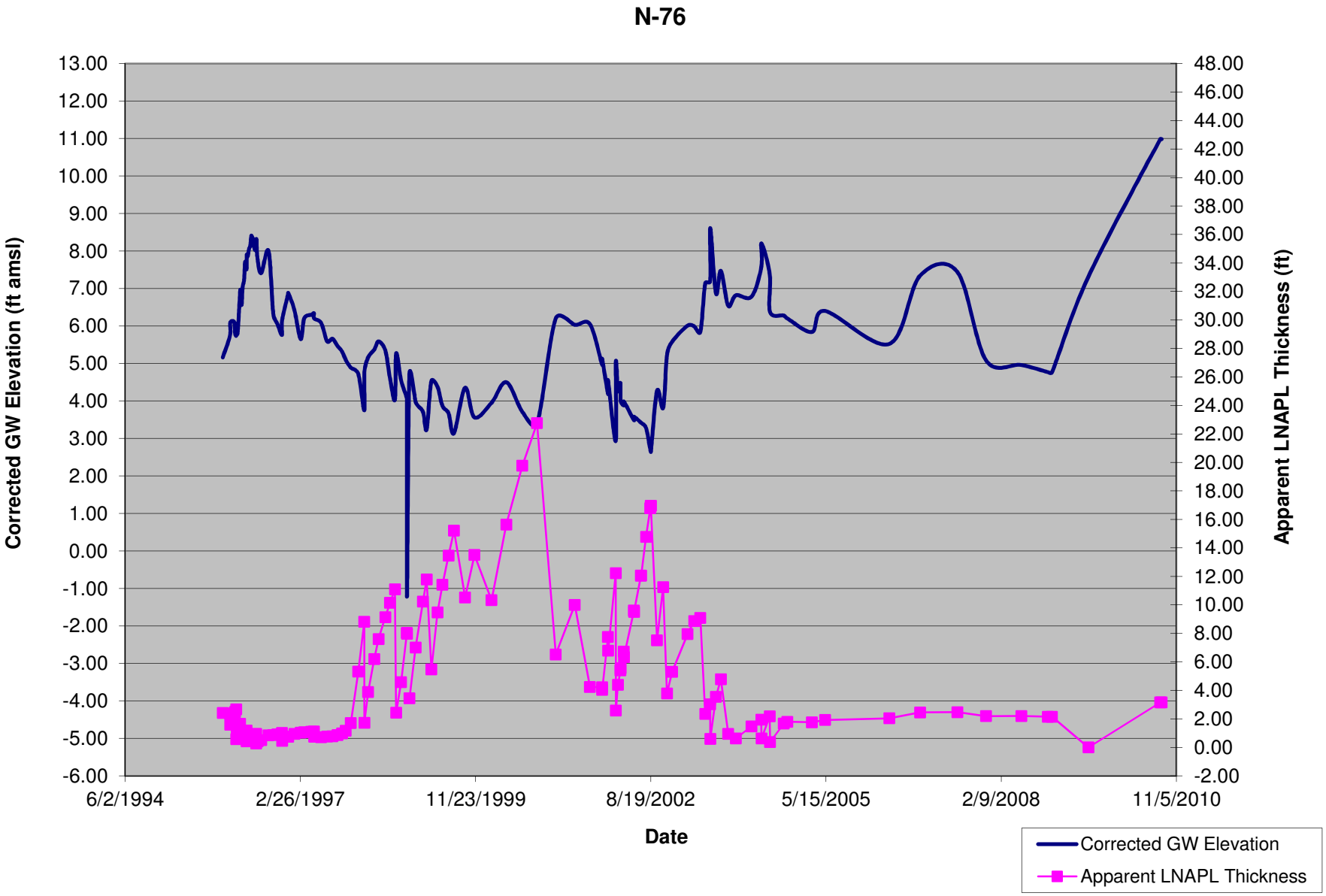

12.00
10.00
8.00
6.00
4.00
2.00
0.00
Corrected GW Elevation (ft amsl)
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Apparent LNAPL Thickness (ft)
RW-204 taken off-line*
RW-203 taken off-line*
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Date
* N-49 has no pump but is located between RW-203 and RW-204
Corrected GW Elevation
LNAPL Thickness

# N-51


Pump taken off-line*
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Date
* N-51 has no pump but is located north of RW-203
Corrected Gw Elevation
LNAPL Thickness


N-52
12.00
10.00
8.00
6.00
4.00
2.00
0.00
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
Pump taken off-line*
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Date
* N-52 has no pump but is located between RW-200 and RW-201
Corrected GW Elevation
LNAPLThickness


N-47
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
9.50
9.00
8.50
8.00
7.50
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Date
Corrected GW Elevation
Apparent LNAPL Thickness


N-76
Corrected GW Elevation (ft amsl)
Apparent LNAPL Thickness (ft)
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
-5.00
-6.00
48.00
46.00
44.00
42.00
40.00
38.00
36.00
34.00
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
6/2/1994
2/26/1997
11/23/1999
8/19/2002
5/15/2005
2/9/2008
11/5/2010
Date
Corrected GW Elevation
Apparent LNAPL Thickness

**APPENDIX J**

**FATE AND TRANSPORT MODELING PROCEDURES**

**AOI 8: SUNOCO PHILADELPHIA REFINERY**

**PHILADELPHIA, PENNSYLVNIA**

## J.1 INTRODUCTION

Fate and transport calculations were completed for groundwater in Area of Interest (AOI) 8 to evaluate potential migration pathways/potential impacts to receptors. Five compounds of concern (COCs) were detected in groundwater during the July 2008 groundwater sampling event at concentrations above their respective MSCs (Figure J.1). These COCs are benzene, pyrene, chrysene, phenanthrene and naphthalene. To address the potential future migration of these COCs, a fate and transport analysis was performed using three models developed by PADEP. The Quick Domenico Version 2 (QD) model and the SWLOAD model were used for fate and transport in groundwater. PENTOXSD was used when assessing potential impacts of groundwater on surface water. Site-specific data was used to complete the fate and transport calculations, when available.

## J.2 QUICK DOMENICO AND SWLOAD MODEL OVERVIEW

The QD and SWLOAD models are Microsoft Excel spreadsheet applications based on the analytical contaminant transport equation developed by P.A. Domenico in *"An Analytical Model For Multidimensional Transport of a Decaying Contaminant Species,"* Journal of Hydrology, 91 (1987), pp. 49-58. The QD model calculates contaminant concentrations at any down-gradient location after a specified interval of time. The SWLOAD model calculates groundwater contaminant concentrations just before discharge to surface water. Both models incorporate the processes of advection, first order decay, retardation, and dispersion to describe fate and transport of compounds.

## J.3 MODEL LIMITATIONS

Limitations of the QD and SWLOAD models include:

- Groundwater flow is assumed to be steady state, and one-dimensional;
- Aquifer properties are assumed to be reasonably uniform;
- Applicable only to unconsolidated aquifers;
- Intended for use primarily with dissolved organic compounds;
- Does not account for the transformation of parent compounds into daughter products as the result of biodegradation;
- Compounds are considered individually, and are assumed to not react with each other; and
- The contaminant source is limited to a single and continuous source concentration.

## J.4 SCREENING AND APPROACH TO FATE AND TRANSPORT ANALYSIS

Based on groundwater flow directions derived from May 2011 groundwater elevations (Figures 6 and 7) and the locations of potential off-site receptors AOI 8 were divided into three drainage areas for fate and transport analysis. Locations of each of these drainage areas are show on Figure J.1 of Appendix J.

- Drainage Area 1 is located in the eastern portion of AOI 8. The western boundary of Drainage Area 1 was defined as the groundwater divide where groundwater flow is generally east towards the AOI 8 property line. QD modeling was used to address potential off-site impacts along the AOI 8 northeast boundary.
- Drainage Area 2 consists of the central and western portions of AOI 8 where groundwater flow is generally towards the Schuylkill River. To address potential off-site impacts along the Schuylkill River the QD model was used first; then the SWLOAD model; then, as need, PENTOXSD.

- Drainage Area 3 was not defined hydraulically like Drainage Areas 1 and 2 but was used to delineate where active remediation will be conducted. Drainage Area 3 is located along the southern AOI 8 property boundary.

Groundwater concentrations at AOI 8 are assumed to be at or near steady-state for this analysis. A detailed description of the fate and transport modeling is presented below based on the three drainage areas and the July 2008 groundwater analytical results.

*Drainage Area 1 Wells*

1. Wells with exceedences of benzene, chrysene, pyrene and phenanthrene that are located hydraulically up-gradient of wells with non-exceedences of COCs and had stable groundwater trends did not undergo analysis by QD. The Drainage Area 1 wells that fall into this category include: N-11, N-106, N-12, N-102, N-103, N-104, N-20, N-21, and N-97. These wells are located up gradient of northeast property boundary wells N-3, N-4, N-8, N-16, N-17, N-19, N-84, N-85, N-28 and N-134 which do not contain COC concentrations above their respective MSCs.
2. N-9, N-12 and N-101, have exceedences of one or more COCs (benzene, pyrene, chrysene and phenanthrene) and are located up gradient of the northeast property boundary where no down gradient monitoring wells exist. To assess potential migration beyond the northeast property boundary for N-12 and N-101, a QD model was constructed. Fate and transport for benzene at deep well N-9 (screened in Lower Sand) was addressed in the AOI 11 report, where it was noted that benzene concentrations at N-9 exhibited decreasing trends to non-detect. Deep monitoring wells down gradient of N-9 also exhibited non-detects and was therefore not modeled.
3. As a check on the results of Drainage Area 1 fate and transport evaluation, a QD simulation was created for N-106 which had the highest benzene concentration in Drainage Area 1 (410 ug/l). Benzene is the most mobile of the COCs present therefore its ability to attenuate before it reaches N-98, near the northeast property line and where benzene was not detected, was further evaluated and the modeled results supported the observed groundwater concentrations.

4. At all sampled monitoring well locations in Drainage Area 1, laboratory RLs for chrysene were higher than the groundwater MSC of 1.9 ug/l. To ensure that the potential for chrysene to impact off-site groundwater was evaluated, an additional QD simulation was constructed using site conditions found at N-8 (located about 25 feet from the property boundary) using the most elevated, site-wide chrysene RL of 120 ug/l as the starting concentration.

*Drainage Area 2 Wells*

1. Benzene detections above the groundwater MSC in Drainage Area 2 wells could be found in two general areas. The first area was at the center of AOI 8 (which includes RW-301, RW-303, RW-304, RW-305, RW-307, RW-308, N-108, N-121, N-118, N-119, N-123, N-44D and PZ-300) and second area was near the Schuylkill River on the west side of Drainage Area 2 (which includes N-59, N-61, N-136, N-133, PZ-503, PZ-504, PZ-505 and RW-500). Fate and transport of benzene groundwater impacts originating in the center of AOI 8 were not modeled because benzene impacts were not detected hydraulically downgradient of this area. Four monitoring well locations (N-23, N-34, N-35 and N-36) at the center of AOI 8 had benzene RLs above the benzene groundwater MSC and were reported not detected. Well locations down-gradient of these four monitoring wells had no benzene detections above the groundwater MCS and therefore were not further evaluated.

   Benzene groundwater impacts in wells located along the Schuylkill River were further evaluated with QD. Based on the July 2008 groundwater data, eight wells along the wooden bulkhead had detected benzene concentrations ranging from 13 ug/l to 10,000 ug/l. These eight wells are located along a 1,500 feet stretch of the Schuylkill River within approximately 250 feet from the bulkhead. A benzene isoconcentration map was constructed using the July 2008 data as shown in Figure J.3. The highest benzene concentration detected along the bulkhead was found near monitoring wells N-133 (10,000 ug/L) and N-61 (8,700 ug/L). Benzene concentrations decreased to the north and south of N-133 and N-61. To assess the entire 1,500 feet stretch of benzene impacts, the impacted

area was broken into four zones to better define the variation in benzene concentration within the plume. For each zone a QD and SWLOAD model was constructed. If the SWLOAD results still exceeded the benzene surface water quality criteria (SWQC), PENTOXSD was used to derive a site-specific benzene wasteload allocation to re-screen the SWLOAD results.

N-58 and PZ-506 located along the Schuylkill River had elevated benzene RLs but was listed as not detected. QD and SWLOAD simulations for benzene at N-58 and PZ-506 were constructed using the benzene RLs as the starting concentration.

2. Naphthalene concentrations were detected above the groundwater MSC at three Drainage Area 2 wells (N-23, N119, and N-123) and evaluated using QD. The naphthalene RL at N-36 was greater than its MSC but listed as a not detect. No modeling was performed for naphthalene at this location because it was located in the center of AOI 8 and naphthalene impacts were not detected down-gradient of this monitoring well.

3. Phenanthrene concentrations were detected above the groundwater MSC at two monitoring wells (N-112 and N-128) in Drainage Area 2. Wells located down gradient of N-112 and N-128 were not impacted by phenanthrene, therefore, no fate and transport modeling was performed.

4. Chrysene detections above the groundwater MSC are ubiquitous in AOI 8. Due to the low affinity for transport (strong tendency to sorb to aquifer materials) and stable groundwater trends in interior wells potential impacts of chrysene on surface water were assessed at locations along the Schuylkill River only. The wells included in this evaluation included N-111, N-60, PZ-503, PZ-505, PZ-506, PZ-507 and RW-200.

   Chrysene impacts in Drainage Area 2 wells located along the Schuylkill River were first screened against the chrysene SWQC found in the PA Code Chapter

93.8c. Neither chronic nor acute SWQC for chrysene have been derived for the PA Code. Therefore additional screening was done with US EPA Lowest Observable Effect Level (LOELs) for acute exposure to chrysene in the marine environment of 300 ug/l. Screening results indicate that chrysene at present concentrations does not exceed the LOEL value along the bulkhead. Groundwater is impacted by chrysene near the Schuylkill River when compared to the human health SWQC of 0.0038 ug/l. Chrysene was assessed using QD and SWLOAD. If the SWLOAD results still exceeded the groundwater quality criteria, PENTOXSD was used to derive a site-specific wasteload allocation to re-screen the SWLOAD results.

Chrysene RLs at all sampled monitoring wells in Drainage Area 2 were higher than the chrysene groundwater MSC of 1.9 ug/l. To ensure chrysene will not impact off-site surface water, a simulation was constructed using site conditions found at PZ-504 (26 feet from the bulkhead) and the site-wide maximum chrysene RL of a 120 ug/l was used as the starting concentration. The result of this simulation was used to evaluate chrysene in Drainage Area 2 near the Schuylkill River.

5. Pyrene has a strong affinity to sorb to aquifer materials and a low affinity for transport. Therefore the assessment of pyrene for potential fate and transport was focused along the Schuylkill River.

   Based on the July 2008 groundwater data, pyrene was detected above its groundwater MSC of a 130 ug/l at two monitoring well locations (N-111 and RW-200) along the Schuylkill River. Chronic and acute SWQC for pyrene were not developed in Pennsylvania. The PA Code human health SWQC for pyrene is 830 ug/l. Pyrene concentrations at RW-200 (300 ug/l) and N-111 (160 ug/l) do not exceed the human health SWQC. A screening concentration for chronic exposure to pyrene in fresh water of 0.025 ug/l was derived by Environment Canada which is below the detected pyrene concentration at N-111 and RW-200. Therefore, fate and transport modeling for pyrene was performed.

6. 1,2-dichloroethane RLs were elevated above its groundwater MSC of 5 ug/l at four monitoring well locations (N-58, N-61, N-133 and PZ-506) along the bulkhead, and one location (N-119) in the interior of Drainage Area 2. Wells located down gradient of N-119 did not contain 1,2-dichloroethane above its groundwater MSC and was therefore not modeled. To address the potential for 1,2-dichloroethane to impact surface water QD, SWLOAD and PENTOXSD models were constructed for the four locations along the bulkhead using each RL as the starting concentration.

*Drainage Area 3 Wells*

Drainage Area 3 wells will be addressed through active remediation and therefore were not modeled.

In summary, for Drainage Area 1 wells QD simulations were constructed for benzene, chrysene, pyrene and phenanthrene at N-12 and chrysene at N-101 to assess potential migration beyond the northeast property boundary; and at N-106 to assess the ability of the model to predict benzene attenuation. A chrysene simulation was constructed at N-8 to assess problems with the RL exceeding the groundwater MSC.

For Drainage Area 2 wells N-59, RW-500, N-61, PZ-503, N-136, N-133, PZ-504 and PZ-505 were separated into four zones based on the benzene plume along the bulkhead and four QD, SWLOAD and PENTOXSD models were created. Benzene simulations were also constructed for N-58 and PZ-506 to address RL issues. For Drainage Area 2 chrysene detected above its MSC and RL in wells N-111, N-60, PZ-503, PZ-505, PZ-506, PZ-507 and RW-200, were modeled using QD and SWLOAD. To address site-wide concerns over chrysene RLs a QD and SWLOAD simulation for PZ-504 (26 feet from bulkhead) was constructed using the maximum reported site RL. For pyrene at N-111 and RW-200 QD and SWLOAD simulations were constructed. To address concern with 1,2-dichloroethane RLs, simulations were

constructed for N-58, N-61, PZ-506 and N-133 using each locations RL as the starting concentration.

No simulations for Drainage Area 3 were constructed. Monitoring wells, compounds and input-output data for all simulations can be found in Table J.1.

## J.5 MODEL INPUT PARAMTERS

In preparation of this report, input values for the QD and SWLOAD models were compiled from available site-specific data. When no site-specific data was available, estimated input values from the PADEP spreadsheet "Number Please!2011," which is based on PA Code, Chapter 250, Appendix A, Table 5; or other acceptable literature sources, were utilized. The input parameters are discussed in detail in the following sections. An Excel spreadsheet interface developed by Langan was used to construct the QD simulations. This interface allowed the simulation of multiple compounds simultaneously and saved in a single electronic file. Results of the QD and SWLOAD modeling can be found in Table J.1 in this appendix.

### J.5.1 Source Concentration

Analytical results (detections and reporting limits) from the most recent AOI 8 site wide groundwater sampling (July 2008) were used as the starting concentrations for QD and SWLOAD simulations. For benzene impacts along the wooden bulkhead the maximum detected benzene concentration from the July 2008 groundwater sampling event in each zone (as defined above) was used as the source concentration for the QD and SWLOAD simulations. The benzene source concentration for Zone 1 is 300 ug/l (N-133); for Zone 2 is 8,700 ug/l (N-61); for Zone 3 is 2,400 ug/l (PZ-504) and for Zone 4 is 160 ug/l (PZ-505), respectively.

### J.5.2 Distance to Location of Concern (x)

Distance to the Location of Concern (distance) for QD simulations is the distance from the subject well to the down gradient point where the predicted

groundwater concentration equals the groundwater screening standard. For SWLOAD the distance to the location of concern is the distance between the subject well and the Schuylkill River. Measurements were made using the GIS developed for the site. For benzene impacts along the wooden bulkhead the distance between the bulkhead and the closest well for each Zone was used as the distance to location of concern.

### J.5.3 Dispersivity

Dispersivity is the tendency of a dissolved plume to "spread out" as it moves down-gradient.

- Longitudinal dispersivity ($A_X$) occurs in the direction parallel to groundwater flow;
- Transverse dispersivity ($A_Y$) occurs in the same plane as longitudinal dispersivity but perpendicular to the direction of groundwater flow; and
- Vertical dispersivity ($A_Z$) occurs in the upward direction, normal to the plane in which longitudinal and transverse dispersivity occur (Vertical dispersivity is usually negligible and is typically omitted from most QD analyses).

Dispersivity estimates are difficult to quantify and are commonly estimated from the following relationships:

1. $A_X$ = X/10 (where, X is the distance a contaminant has traveled by advective transport)
2. $A_Y = A_X/10$
3. $A_Z = A_X/20$ to $A_X/100$ (generally, it is recommended that $A_Z$ be a small number (0.001) unless vertical monitoring can reliably justify a larger number. Additionally, a value of 0.0001 is suggested for un-calibrated or conceptual applications).

As stated above the value for $A_Y$ was estimated to be 10 percent of $A_X$. A value of 0.0001 was used as a value for $A_Z$.

### J.5.4 Lambda

Lambda is the first order decay constant. It is determined by dividing 0.693 by the half-life of the compound. The value can typically be estimated for shrinking plumes by evaluating at concentrations versus time or distance. Lambda can also sometimes be estimated for stable plumes by evaluating concentration versus time using the methodology outlined in Buscheck and Alcantar (1995). Important considerations to estimating Lambda from site data include:

1. Are the measured concentrations along the centerline of the plume?
2. Are the measured concentrations the result of the single source area?
3. Are there no remedial systems and/or activities that effected the migration of the plume during the time interval of evaluation?

If the answer is yes to these questions, the methodologies outlined in Buscheck and Alcantar may be utilized to estimate a site-specific lambda from site data.

Based on review of the available site data, the criteria necessary to calculate a site-specific lambda could not be met; therefore, a default value for lambda (when appropriate and available) was obtained from the PADEP spreadsheet "Number Please!2011" which is based on PA Code, Chapter 250, Appendix A, Table 5.

### J.5.5 Source Dimensions

Source width is the maximum width of the area measured perpendicular to the direction of groundwater flow. Source thickness is the thickness of the soils below the water table that contribute contamination to groundwater.

In the absence of a well-defined source a width of 100 feet was used. For benzene impacts along the wooden bulkhead the source width of each zone was derived from the benzene isoconcentration map (Figure J.3). Zone 1 is 500 feet wide; Zone 2 is 200 feet wide; Zone 3 is 240 feet wide and Zone 4 is 630 feet wide.

To define the thickness fluctuations in groundwater elevation that may create a smear zone in the unsaturated portion of an aquifer was taken into account. For well N-12, N-101 and N-106, screened in the Trenton Gravel, a source thicknesses based on boring logs and cross-section T-T' of 18 feet was used. The source thickness used for wells in the alluvium along the bulkhead north of PZ-505 is 30 feet based on cross-sections S-S'. For the remaining wells along the wooden bulkhead a source thickness of 70 feet was used based on cross-section U-U'.

**J.5.6 Hydraulic Conductivity (K)** The hydraulic conductivity of a geologic material is a measure of its ability to transmit water. For the wells located in the Trenton Gravel, a hydraulic conductivity of 24 ft/d was used. These values are the average hydraulic conductivity of these materials obtained from site-specific aquifer testing referenced in the CCR. Along the steel and wooden bulkheads the migration of groundwater and contaminants through the alluvium/fill towards the Schuylkill River (the POC) is limited by the hydraulic conductivity of the bulkhead. Groundwater behind the bulkhead can move towards the Schuylkill River no faster than the bulkhead permits because the unsealed bulkhead hydraulic conductivity (0.283 ft/d or $10^{-5}$ cm/sec, Waterloo Barrier, Inc.) is lower than the alluvium/fill (4.64 ft/d). The lower hydraulic conductivity of the bulkhead compared to the alluvium/fill causes groundwater to mound up behind it. To account for the presence of the sheet pile wall in the QD and SWLOAD models the hydraulic conductivity used for simulating locations along the bulkhead was 0.283 ft/d ($10^{-5}$ cm/sec). A hydraulic conductivity of 4.64 ft/d was used at RW-200 because it is screened in alluvium and not behind the bulkhead.

### J.5.7 Hydraulic Gradient

Hydraulic gradient is the change in hydraulic head relative to the distance between head measurement locations. The hydraulic gradient is measured parallel to the direction of ground water flow assuming horizontal flow and a uniform gradient. Site specific hydraulic gradients were derived from May 2011 groundwater elevations at all modeled locations.

For the QD and SWLOAD benzene simulations for Zones 1 through 4 along the wooden bulkhead, the general groundwater gradient in the vicinity of the bulkhead was used.

### J.5.8 Porosity (n)

Porosity is measured as the ratio of the volume of void space in a geologic material to the total volume of material. Porosity values used in the fate and transport modeling for AOI 8 were based on historical geotechnical analysis.

### J.5.9 Soil Bulk Density ($\rho_b$)

Soil bulk density is the dry weight of a sample divided by the total volume of the sample in an undisturbed state. Soil bulk density can either be determined by a laboratory or by the equation

$$\rho_b = 2.65 * (1- n).$$

Soil bulk density values used in the fate and transport modeling were based on historical geotechnical analysis.

### J.5.10 Organic Carbon Partition Coefficient ($K_{OC}$)

The organic carbon partition coefficient is chemical specific and is provided in the PADEP EP spreadsheet "Number Please!2011" which is based on PA Code,

Chapter 250, Appendix A, Table 5. These values were used in the fate and transport modeling.

### J.5.11 Fraction Organic Carbon ($f_{oc}$)

The fraction of organic carbon is the organic carbon content of a soil. A laboratory using ASTM methods can determine this value. Samples for organic carbon are taken from the same soil horizon in which the contaminant occurs, but outside of the impacted area. Since no site specific fraction of organic carbon data was available for the site, the fate and transport modeling used the model-recommended default concentration of 0.005, which is a conservative value based on the description of site soils.

### J.5.12 Time (t)

'Time zero' is the point at which contamination was introduced into the aquifer. Time since 'time zero' is measured in days. The final simulation time of $1 \times 10^{99}$ days was used to ensure that a steady-state plume was simulated.

## J.6 QD and SWLOAD Modeling Results

Drainage Area 1 Results

*N-12*

The QD modeling result for benzene, pyrene, chrysene and phenanthrene at N-12 indicates potential transport distances ranging from two to eight feet. N-12 is located 575 feet from the property line. These results indicate that there is little potential for these COCs to migrate beyond the property boundary. Individual QD and SWLOAD modeling spreadsheets can be found in Tables J.2 through J.5.

*N-101*

QD modeling results for chrysene at N-101 indicates potential transport distances of 4 feet. N-101 is located about 350 feet from the northeast property boundary, therefore

groundwater at N-101 impacted with chrysene is not likely to migrate to the AOI 8 northeast property boundary.

*N-8*

This simulation was constructed to address chrysene RL data quality issues. RLs for chrysene were not met in all AOI 8 groundwater analyzed from the July 2008 groundwater sampling event. RLs for chrysene ranged from 5 ug/l to 120 ug/l while the chrysene groundwater MSC is 1.9 ug/l. To address the potential impact of chrysene at concentrations between the groundwater MSC and the maximum RL, a QD model was constructed for N-8 because of its close proximity (25 feet) to the property boundary with a starting concentration of 120 ug/l (maximum RL for chrysene in July 2008 groundwater results). QD modeling results indicate that chrysene would attenuate to a concentration below its MSC within 11 feet from the source. Based on the distances of other site wells from the property boundary chrysene is not predicted to migrate beyond the property boundary above its respective MSC.

Drainage Area 2 Results

*Chrysene*

Chrysene starting concentrations used in the QD and SWLOAD modeling ranged from 8 ug/l to 120 ug/l for wells N-60, N-111, PZ-503, PZ-505, PZ-506, PZ-507 and RW-200 (Table J.1). Individual QD and SWLOAD modeling spreadsheets can be found in Tables J.6 through J.40. QD modeling results predicted chrysene transport under current aquifer conditions range from less than one to eleven feet before attenuating to its groundwater MSC of 1.9 ug/l. This suggests that chrysene at these locations will not impact the Schuylkill River.

To address RL issues with chrysene, the closest well to the Schuylkill River, PZ-504, was modeled with at starting concentration of 120 ug/l. QD modeling predicts that chrysene will attenuate below its groundwater MSC of 1.9 ug/l within eight feet of PZ-504. This suggests that chrysene in groundwater where the RLs were above the groundwater MSC will not impact the Schuylkill River.

*Benzene*

As discussed, the benzene concentrations in Drainage Area 2 were divided up into four "zones" based on the benzene isoconcentrations. Starting concentration for benzene in Zones 1 through 4 are, respectively, 300 ug/l (RW-500); 8,700 ug/l (N-61); 2,400 ug/l (PZ-504); and 160 ug/l (PZ-505). QD results for benzene in Zones 1 through 4 indicate that groundwater concentrations will attenuate below its groundwater MSC in 23 feet for Zone 1; 90 feet for Zone 2; 134 feet for Zone 3; and 59 feet for Zone 4. The distances to the Schuylkill River from the most down gradient impacted wells in each zone ranges between 26 to 29 feet. These results suggest that benzene in Zones 2 through 4 have the potential to migrate and reach the Schuylkill River at concentrations greater than the groundwater MSC. Benzene in Zone 1 does not have the potential to discharge to the Schuylkill River above its MSC. SWLOAD was then used to predict groundwater benzene concentration at the Schuylkill River for Zones 1 though 4.

SWLOAD modeling results for Zone 1 predicted a benzene concentration of 2.07 ug/l in groundwater at the Schuylkill River. This concentration does not exceed the groundwater MSC, therefore a PENTOXSD model was not needed for Zone 1.

The SWLOAD model predicted groundwater concentration for benzene in Zone 2 is 947.2 ug/l which exceeds the benzene groundwater MSC. This predicted concentration also exceeds the acute fish, chronic fish and human health SWQC. Therefore the groundwater discharge volume calculated by SWLOAD for Zone 2 was used to create a PENTOXSD model to derive acute fish, chronic fish and human health wasteload allocation for Zone 2.

The SWLOAD model predicted groundwater concentration for benzene in Zone 3 is 676.4 ug/l, which is above the benzene groundwater MSC. This value also exceeds the acute fish, chronic fish and human health SWQC. Therefore the groundwater discharge volume calculated by SWLOAD for Zone 3 was used to create a PENTOXSD model to derive acute fish, chronic fish and human health wasteload allocations for Zone 3.

The SWLOAD model predicted groundwater concentration for benzene in Zone 4 is 29.03 ug/l, which is above the benzene groundwater MSC. It does not exceed the acute or chronic fish SWQC, but does exceed the human health SWQC. Therefore the groundwater discharge volume calculated by SWLOAD for Zone 4 was used to create a PENTOXSD model to derive a human health wasteload allocation for Zone 4.

QD and SWLOAD results for benzene RL problems at N-58 and PZ-506 which used the maximum benzene RL of 10 ug/l, indicates that benzene will attenuate below its MSC (Tables J.1). within 41 feet of N-58 and 11 feet of PZ-506. N-58 is about 55 feet from the Schuylkill River and PZ-506 is 130 feet from the river; therefore, potential benzene impacts at N-58 and PZ-506 are not predicted to reach the river. SWLOAD predicted a benzene concentration in groundwater of 3.96 ug/l at N-58 and <0.001 at PZ-506 at the Schuylkill River.

*1,2-Dichloroethane*

Elevated RLs for 1,2-dichloroethane in Drainage Area 2 were found at N-58, N-61, N-133 and PZ-506. Because these wells are located close to the Schuylkill River, there is a possibility that groundwater could be impacted with a 1,2-dichloroethane concentration below the RL but above the MSC. This possibility was addressed by constructing QD and SWLOAD models with starting 1,2-dichloroethane concentrations equal to the RL for all four locations (10 ug/l). The groundwater MSC for 1,2-dichloroethane is 5 ug/l. QD and SWLOAD results for N-61, N-133 and PZ-506 indicate that 1,2-dichloroethane in groundwater attenuates to a concentration below the MSC before it reaches the Schuylkill River. 1,2-dichloroethane at N-58 required 75 feet to attenuate below the MSC while the distance to the Schuylkill River is 55 feet. SWLOAD calculated the 1,2-dichloroethane concentration in groundwater adjacent to the Schuylkill River at 5.97 ug/l. Therefore a PENTOXSD simulation was constructed using the SWLOAD calculated groundwater discharge rate for 1,2-dichloroethane at N-58.

*Pyrene*

Pyrene starting concentrations used in the QD and SWLOAD modeling was 160 ug/l at N-111 and 300 ug/l at RW-200. QD modeling results predicted pyrene transport

distance under current aquifer conditions would attenuate to its MSC of 130 ug/l at N-111 in <1 foot and nine feet for RW-200 (Table J.1). This suggests that pyrene at these locations will not impact the Schuylkill River.

## J.7 Potential Impacts to Surface Water (PENTOXSD) Results

Three PENTOXSD simulations were constructed to address benzene groundwater impacts along the Schuylkill River on the west side of AOI 8. PENTOXSD models were constructed for Zone 2 (N-61, PZ-503), Zone 3 (N-133, PZ-504) and Zone 4 (PZ-505) (Figure J.4). Input parameters for PENTOXSD are summarized in Table J.41. As directed by PADEP the Schuylkill River $Q_{7-10}$ flow was entered into PENTOXSD as 10% of the actual $Q_{7-10}$ flow of 101 cubic feet per second (CFS); the harmonic mean flow for the Schuylkill River was entered in PENTOXSD as 10% of the actual harmonic mean flow of 807 CFS. The resulting wasteload allocations for benzene range from a minimum of 417,325 ug/l for human health cancer risk in Zone 3 to a maximum of 11,360,000 ug/l for chronic fish criterion in Zone 2. These results indicate that benzene groundwater concentrations near the bulkhead will not impact the Schuylkill River.

A fifth PENTOXSD model was created to address the elevated RL for 1,2-dichloroethane at N-58 for the July 2008. Flow in the Schuylkill River was identical to the previous PENTOXSD simulations. Input parameters for PENTOXSD are summarized in Table J.41. Wasteload allocations for 1,2-dichloroethane ranged from 165,191.1 ug/l (human health cancer risk level) to 1.04e8 ug/l (chronic fish criterion). PENTOXSD modeling results can be found in Tables J.41 through J.45.

## J.8 Fate and Transport Modeling Summary

QD fate and transport analysis in Drainage Area 1 along the AOI 8 northeast property boundary indicate that groundwater concentrations of benzene, chrysene, pyrene and phenanthrene will not pose a threat to off-site receptors. All four of these compounds will attenuate below their respective groundwater MSCs within several feet of their source. The model constructed for benzene at N-106, which was used to gauge how

well QD predicted benzene distributions, resulted in a transport distance of 667 feet which is about 100 feet short of N-98 located down gradient of N-106; adjacent to the property boundary and non-detect for benzene in July 2008.

In Drainage Area 1 chrysene RLs were detected above the MSC of 1.9 ug/l throughout AOI 8 during the July 2008 event. Elevated RLs for chrysene were addressed by modeling chrysene transport at N-8 which is about 25 feet from the property line. The starting chrysene concentration used in the N-8 QD simulation was the maximum RL for chrysene (120 ug/l at N-23) from the July 2008 sampling. N-8 QD simulation results indicated that chrysene was immobile and would travel 11 feet from N-8. Therefore the potential presence of chrysene in groundwater at concentrations between the MSC and RL at other locations close to the property boundary should not pose a threat to off-site groundwater.

In Drainage Area 2; QD, SWLOAD and PENTOXSD fate and transport analysis of benzene and chrysene were performed. Simulations were also constructed to address elevated RLs for benzene, chrysene and 1,2-dichloroethane.

The benzene plume along the Schuylkill River in AOI 8 was simulated by grouping the impacted wells into four zones where each zone represents a different part of the plume and concentration nearest the bulkhead (Figure J.4). QD results indicated that benzene transport distances for Zones 1 through 4 were between 23 to 134 feet. In Zones 1 through 4, the distances between the bulkhead and the nearest impacted well ranged from 16 to 29 feet (Table J.1). Four SWLOAD models were created from which it was determined that PENTOXSD would be needed for Zones 2 through 4. PENTOXSD wasteload allocation results in Zones 2 through 4 indicated that benzene would not impact surface water quality based on the July 2008 groundwater sampling results. The lowest water quality criteria calculated by PENTOXSD for benzene was 417,325 ug/l (at the human health cancer risk level) while the maximum detected benzene concentration in AOI 8 was 10,000 ug/L at N-133 in Zone 3. The maximum predicted benzene groundwater concentration at the Schuylkill River was 947.20 ug/L in Zone 2.

In Drainage Area 2 RLs for benzene at N-58 and PZ-506, which are located along the bulkhead but not included in any of the zones discussed previously were modeled using QD and SWLOAD with the maximum RL value of (10 ug/l) as the starting concentration. Modeling results indicate that benzene would attenuate below its respective groundwater MSC before reaching the bulkhead.

In Drainage Area 2 chrysene QD and SWLOAD results for wells with chrysene detected above its MSC (N-60, PZ-503, PZ-505, PZ-506, PZ-507 and RW-200) and wells with elevated RLs for chrysene (PZ-504) indicate that chrysene is immobile and will not reach the Schuylkill River.

In Drainage Area 2, 1,2-dichloroethane had a RL above its groundwater MSC of 5 ug/l at four locations (N-58, N-61, N-133 and PZ-506). The maximum RL for 1,2-dichloroethane was 10 ug/l which was used as the starting concentration for the QD and SWLOAD simulations. QD and SWLOAD simulation results indicated that 1,2-dichloroethane would not impact the Schuylkill River at N-61, N-133 and PZ-506. PENTOXSD results for N-58 indicate that 1,2-dichloroethane would not impact the Schuylkill River because the calculated wasteload allocations (acute, chronic and human health) for 1,2-dichloroethane were all several orders of magnitude greater than the predicted discharge concentration of 5.97 ug/l.

Based on this modeling the presence of impacted groundwater on AOI 8 should not pose a threat to offsite groundwater or surface water receptors provided LNAPL in Drainage Zone 3 is actively captured.

## J.9 Fate and Transport Modeling Conclusions

*Drainage Area 1*

Fate and Transport simulations indicate that groundwater concentrations of benzene, chrysene, pyrene and phenanthrene do not pose an unacceptable risk to off-site receptors.

*Drainage Area 2*

Fate and transport analysis of benzene, chrysene and 1,2-dichloroethane do not pose an unacceptable risk to off-site receptors.


## Legend

- N-436 — Shallow Monitoring Well with No Exceedance of PADEP Non-Residential MSCs
- N-20 SVOCs in ug/l Chrysene - 70 ug/l — Shallow Monitoring Well with Exceedance of PADEP Non-Residential MSCs
- N-27 — Lower Sand Monitoring Well with No Exceedance of PADEP Non-Residential MSCs
- N-9 VOCs in ug/l Benzene - 8 ug/l — Lower Sand Monitoring Well with Exceedance of PADEP Non-Residential MSCs
- N-43 — Monitoring Well (Unclassified) with No Exceedance of PADEP MSCs
- N-52 — Existing Monitoring Point Not Sampled
- Steel Bulkhead
- Wooden Bulkhead
- Solid Waste Management Unit (SWMU) No. 2
- AOI Boundary

***PADEP Non-Residential Used Aquifer TDS <2,500 ug/L GW MSCs***

Benzene = 5 ug/L
Pyrene = 130 ug/L
Chrysene = 1.9 ug/L
Phenanthrene = 1,100 ug/L
Naphthalene = 100 ug/L

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.
2. Bulkhead referenced from Remedial Action Plan for the North Yard Bulkhead, ENSR Consulting and Engineering, October 1993.

Figure J.1: Summary of Groundwater Sample Exceedances
AOI 8 Site Characterization Report/
Remedial Investigation Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 250 500 Feet

SCALE: 1" = 250'
DATE: April 13, 2011
DRN. BY: MH
CKD. BY: DW
JOB#: 2574601

Path: \\langan.com\data\DT\data\2574601\ArcGIS\MapDocuments\AOI 8 SCR\SCR_RIR\Figure J-1 - Summary of Groundwater Sample Exceedances_4-13-11.mxd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## Legend

- Fill / Alluvium Wells and Groundwater Elevations (ft amsl)
- Trenton Gravel Wells and Groundwater Elevations (ft amsl)
- Trenton Gravel Recovery Wells and Groundwater Elevations (ft amsl)
- Piezometer
- Abandoned Well
- Groundwater Elevation Contour (ft amsl)
- Groundwater Elevation Contour Depression (ft amsl)
- Steel Bulkhead
- Wooden Bulkhead
- Drainage Area 1
- Drainage Area 2
- Drainage Area 3
- AOIs

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.
2. Bulkhead referenced from Remedial Action Plan for the North Yard Bulkhead, ENSR Consulting and Engineering, October 1993.
3. Groundwater elevations and countours based on groundwater gauging data provided by Stantec, May 2011.
4. Only those wells accessible during the gauging were used for contouring.
5. ft amsl = feet above mean sea level.

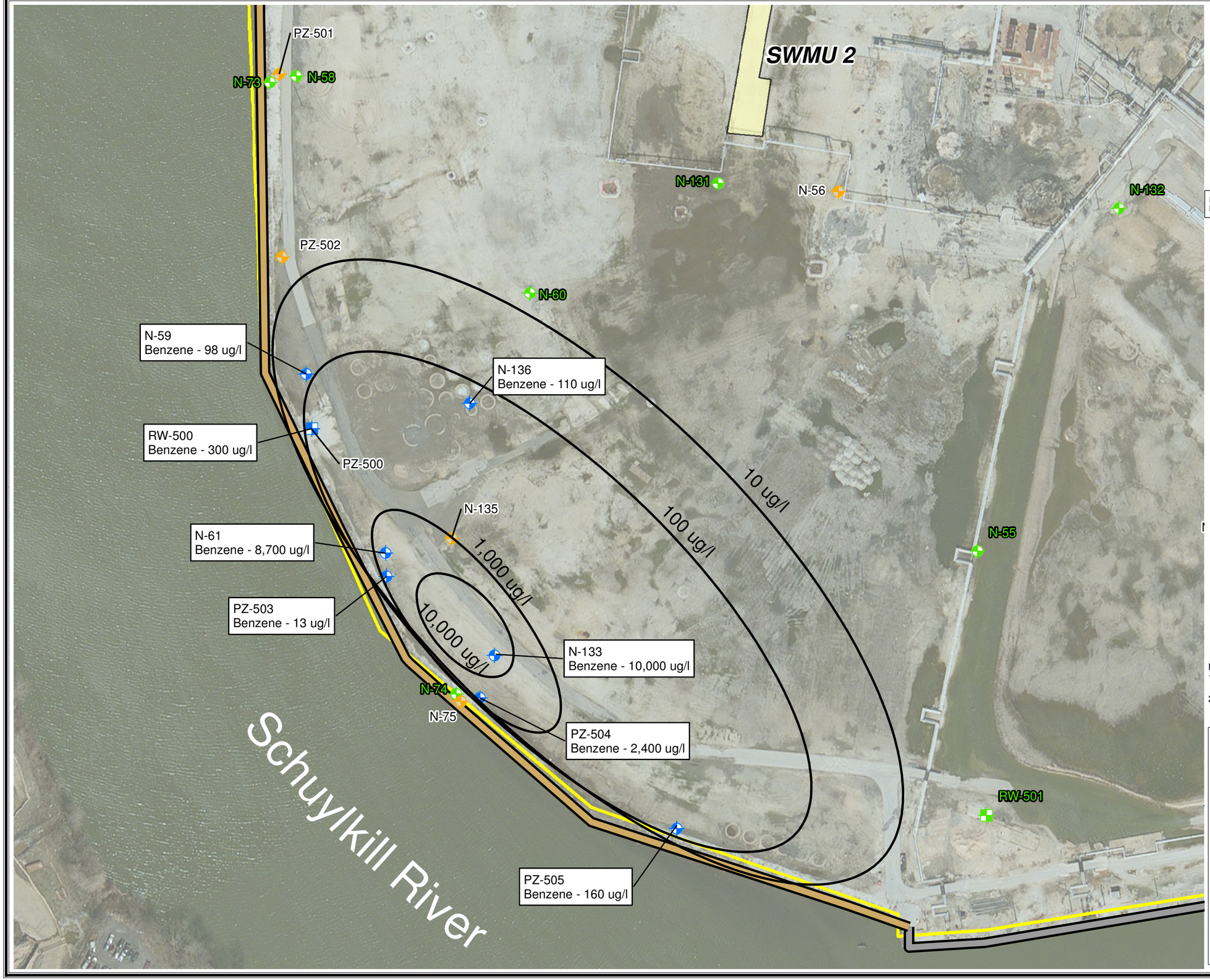
Figure J.2: May 2011 Shallow Groundwater Drainage Areas Delineated for Fate and Transport Modeling
AOI 8 Site Characterization Report/ Remedial Investigation Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 250 500 Feet

SCALE: 1" = 250'
DATE: November 3, 2011
DRN. BY: MFH
CKD. BY: DW
JOB#: 2574601

Path: I:\engrs.com\dm\DT data\2574601\ArcGIS\MapDocuments\AOI 8 SCRSCR_RIFigure J-2 - FI Alluvium GW Cntrs and Drainage Areas - 1-27-12.mxd

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W E

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## Legend

- N-134 — Shallow Monitoring Well with No Exceedance of Benzene
- PZ-505 Benzene - 160 ug/l — Shallow Monitoring Well with Exceedance of Benzene
- N-43 — Monitoring Well (Unclassified) with No Exceedance of Benzene
- N-52 — Existing Monitoring Point Not Sampled
- Steel Bulkhead
- Wooden Bulkhead
- Benzene Isopleths
- Solid Waste Management Unit (SWMU) No. 2
- AOI Boundary

***PADEP Non-Residential Used Aquifer TDS<2,500 ug/L GW MSCs***

Benzene = 5 ug/L

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.
2. Bulkhead referenced from Remedial Action Plan for the North Yard Bulkhead, ENSR Consulting and Engineering, October 1993.

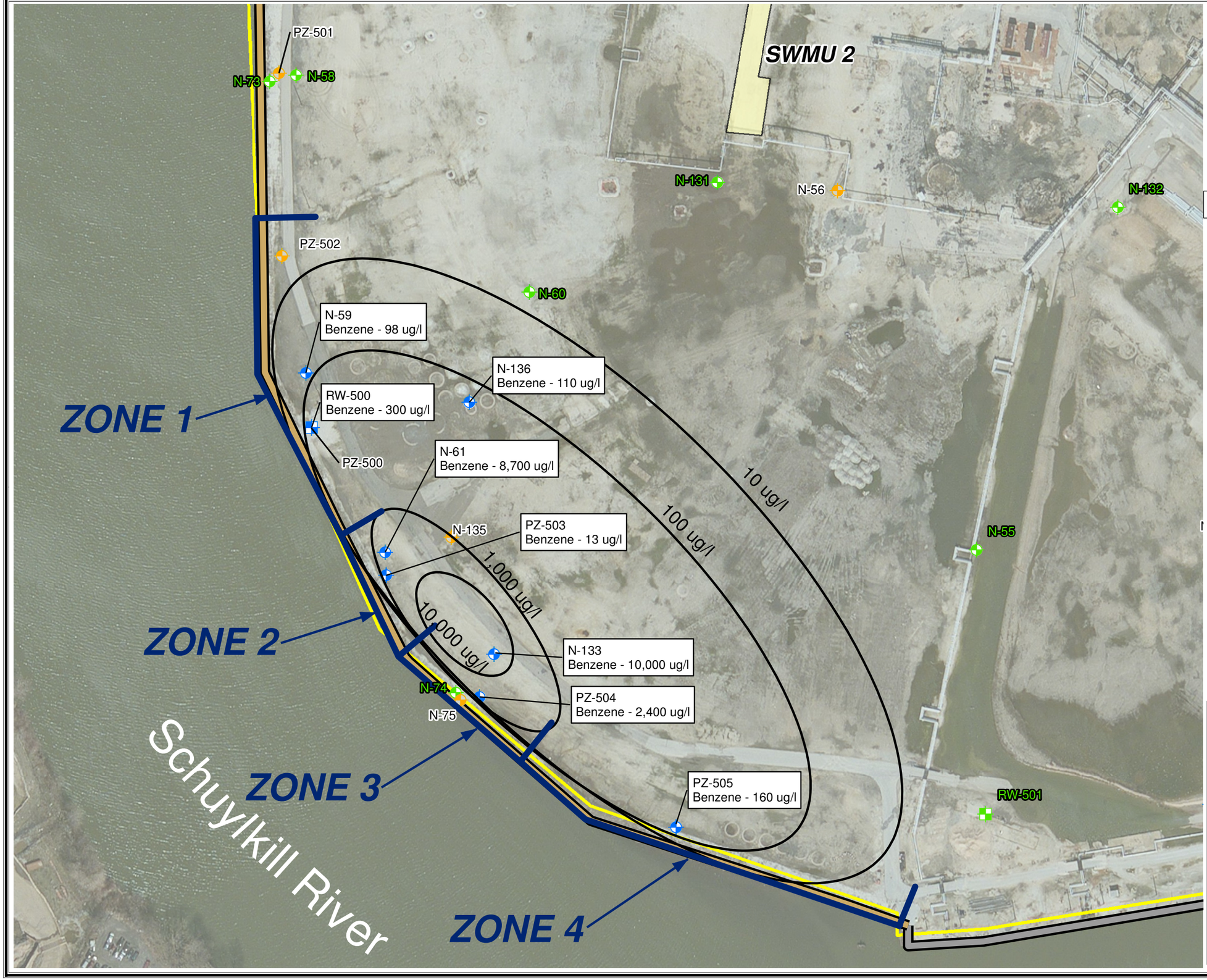
Figure J.3: August 2008 Benzene Concentrations
Near Schuylkill River
AOI 8 Site Characterization Report/
Remedial Investigation Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 140 280
Feet

SCALE: 1" = 140'
DATE: January 19, 2012
DRN. BY: MH
CKD. BY: DW
JOB#: 2574601

Path: \\langan.com\data\DT\data6\2574601\ArcGIS\MapDocuments\AOI 8 SCR\SCR_RIR\Figure J-3 - Aug2008 Benzene Concentrations Near River_1-19-12.mxd

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## Legend

- N-134 — Shallow Monitoring Well with No Exceedance of Benzene
- PZ-505 Benzene - 160 ug/l — Shallow Monitoring Well with Exceedance of Benzene
- N-43 — Monitoring Well (Unclassified) with No Exceedance of Benzene
- N-52 — Existing Monitoring Point Not Sampled
- Steel Bulkhead
- Wooden Bulkhead
- Benzene Isopleths
- Solid Waste Management Unit (SWMU) No. 2
- AOI Boundary

***PADEP Non-Residential Used Aquifer TDS<2,500 ug/L GW MSCs***

Benzene = 5 ug/L

Notes:
1. Bing Maps aerial imagery provided by © 2010 Microsoft Corporation and its data suppliers and obtained under the licensing agreement with ESRI.
2. Bulkhead referenced from Remedial Action Plan for the North Yard Bulkhead, ENSR Consulting and Engineering, October 1993.

Figure J.4: Locations of Benzene Groundwater Impact Zones Delineated for Fate & Transport Analysis
AOI 8 Site Characterization Report/ Remedial Investigation Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 140 280
Feet

SCALE: 1" = 140'
DATE: January 19, 2012
DRN. BY: MH
CKD. BY: DW
JOB#: 2574601

Path: \\langan.com\data\DT\data6\2574601\ArcGIS\MapDocuments\AOI 8 SCR\SCR_RIR\Figure J-4 - Locations of Benzene GW Impact Zones_1-20-12.mxd

**Table J.1**
**Quick Domenico, SWLOAD and PENTOXSD Results**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| Well ID | Compound | Group | Groundwater Medium Specific Concentration for QD | Groundwater Edge Criterion for SWLOAD[1] | Chronic Fish Criterion | Acute Fish Criterion | Human Health Risk Level | QD/SWLOAD Starting Groundwater Concentration | Measured Distance to Point of Concern | QD Predicted Distance to Achieve MSC | SWLOAD Maximum Groundwater Concentration at Receptor | Acute Fish Criterion Wasteload Allocation | Chronic Fish Criterion Wasteload Allocation | Human Health Level CRL Wasteload Allocation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ug/l | ug/l | ug/l | ug/l | ug/l | ug/l | feet | feet | ug/l | ug/l | ug/l | ug/l |
| N-12 | benzene | Drainage Area 1 | 5 | NA | NA | NA | NA | 6 | 575 | 8 | NA | NA | NA | NA |
| | pyrene | | 130 | | | | | 870 | 575 | 6 | | | | |
| | chrysene | | 1.9 | | | | | 470 | 575 | 5 | | | | |
| | phenanthrene | | 1,100 | | | | | 5,500 | 575 | 2 | | | | |
| N-101 | chrysene | | 1.9 | | | | | 8 | 350 | 4 | | | | |
| N-106 | benzene | | 5 | | | | | 410 | 810 | 667 | | | | |
| N-8 | chrysene (RL) | | 1.9 | | | | | 120 | 25 | 11 | | | | |
| N-58 | benzene (RL) | Drainage Area 2 | 5 | 5 | 130 | 640 | 1.2 | 10 | 55 | 41 | 3.96 | NA | NA | NA |
| | 12DCA (RL) | | 5 | 5 | 3,100 | 15,000 | 0.38 | 10 | 55 | 75 | **5.97** | 7.29E+07 | 1.04E+08 | 165,191.1 |
| N-60 | chrysene[2] | | 1.9 | 0.477 | NA | 300 | 0.0038 | 14 | 400 | <1 | <0.001 | NA | NA | NA |
| N-61 | 12DCA (RL) | | 5 | 5 | 3,100 | 15,000 | 0.38 | 10 | 42 | 20 | <0.001 | | | |
| N-111 | chrysene | | 1.9 | 0.477 | NA | 300 | 0.0038 | 110 | 33 | <1 | <0.001 | | | |
| | pyrene[3] | | 130 | 130 | 0.025 | 300 | 830 | 160 | 33 | <1 | <0.001 | | | |
| N-133 | 12DCA (RL) | | 5 | 5 | 3,100 | 15,000 | 0.38 | 10 | 82 | 59 | 3.82 | | | |
| PZ-503 | chrysene | | 1.9 | 0.477 | NA | 300 | 0.0038 | 51 | 27 | <1 | <0.001 | | | |
| PZ-504 | chrysene (RL) | | 1.9 | 0.477 | NA | 300 | 0.0038 | 120 | 26 | 8 | <0.001 | | | |
| PZ-505 | chrysene | | 1.9 | 0.477 | NA | 300 | 0.0038 | 41 | 35 | 1 | <0.001 | | | |
| PZ-506 | chrysene | | 1.9 | 0.477 | NA | 300 | 0.0038 | 8 | 130 | <1 | <0.001 | | | |
| | benzene (RL) | | 5 | 5 | 130 | 640 | 1.2 | 10 | 130 | 11 | <0.001 | | | |
| | 12DCA (RL) | | 5 | 5 | 3,100 | 15,000 | 0.38 | 10 | 130 | 26 | <0.001 | | | |
| PZ-507 | chrysene | | 1.9 | 0.477 | NA | 300 | 0.0038 | 120 | 150 | 2 | <0.001 | | | |
| RW-200 | chrysene | | 1.9 | 0.477 | NA | 300 | 0.0038 | 97 | 200 | 11 | <0.001 | | | |
| | pyrene | | 130 | 130 | 0.025 | 300 | 830 | 300 | 200 | 9 | <0.001 | | | |
| Zone 1 | benzene | | 5 | 5 | 130 | 640 | 1.2 | 300 | 28 | 23 | 2.07 | | | |
| Zone 2 | benzene | | 5 | 5 | 130 | 640 | 1.2 | 8,700 | 27 | 90 | **947.20** | 8,070,000 | 11,360,000 | 1,330,000 |
| Zone 3 | benzene | | 5 | 5 | 130 | 640 | 1.2 | 2,400 | 26 | 134 | **676.40** | 2,510,000 | 3,540,000 | 417,325 |
| Zone 4 | benzene | | 5 | 5 | 130 | 640 | 1.2 | 160 | 29 | 59 | **29.03** | 3,130,000 | 4,400,000 | 521,656 |

NOTES:

Groundwater MSC = ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

QD = Quick Domenico

(1) - For **chrysene** (ACT 2 TGM Table IV-3), If both the lowest surface water compliance value, LSWC, (0.0044 ug/l) and the Act 2 MSC

- For **benzene, pyrene and 1,2-dichloroethane** (Act 2 TGM Table IV-1) the edge criterion equals the non-rediential groundwater medium specific concentration of 5, 130 and 5 ug/l, respectively.
- For **phenanthrene** (Act 2 TGM Table IV-2) the edge criterion is the PQL which is 10 ug/L.

(2) - Marine acute criteria for chrysene in surface water is US-EPA Lowest Observed Effect Level.

(3) - Chronic fish criterion (fresh water) for pyrene in surface water is from Canadian Water Quality guidelines. Marine acute criteria for pyrene is US-EPA Lowest Observed Effect Level.

**Bold** = Maximum SWLOAD concentration exceeds the edge criterion and a PENTOXSD model is needed.

NA = Not Applicable.

RL = Reporting Limit

**Table J.2**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**N-12**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | 2574601 - Sunoco Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **N-12** | |
| Sample Date | | | July-08 | |
| Source Width | | ft | 100 | Delineated LNAPL (100' default if no plume is present) |
| Source Thickness | | ft | 18 | Trenton Gravel saturated thickness from Cross-Section T-T' at N-12/13 |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | Quick Domenico User's Manual |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | Quick Domenico User's Manual |
| Hydraulic Conductivty | k | ft/day | 24 | Trenton Gravel |
| Hydraulic Gradient | | ft/ft | 0.00025 | August 2010 Water Level Data for N-12 and N-98 |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $\rho_b$ | g/cm3 | 1.7225 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | Steady-State Conditions |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | Benzene | |
| Source Concentration (mg/L) | | mg/L | 0.0060 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 0.001 | PADEP Number Please!2011 Spreadsheet |
| KOC | | | 58 | PADEP Number Please!2011 Spreadsheet |
| **Sim 2** | | | | |
| Contaminant | | | Pyrene | |
| Source Concentration (mg/L) | | mg/L | 0.8700 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 0.000 | PADEP Number Please!2011 Spreadsheet |
| KOC | | | 68000 | PADEP Number Please!2011 Spreadsheet |
| **Sim 3** | | | | |
| Contaminant | | | Chrysene | |
| Source Concentration (mg/L) | | mg/L | 0.4700 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 0.000 | PADEP Number Please!2011 Spreadsheet |
| KOC | | | 490000 | PADEP Number Please!2011 Spreadsheet |
| **Sim 4** | | | | |
| Contaminant | | | Phenanthrene | |
| Source Concentration (mg/L) | | mg/L | 5.5000 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 0.002 | PADEP Number Please!2011 Spreadsheet |
| KOC | | | 38000 | PADEP Number Please!2011 Spreadsheet |

| Output (Distance from Source Where Concentration Equals Respective Ground Water MSC) | | | | |
|---|---|---|---|---|
| **Contaminant** | **Starting Concentration (mg/L)** | **GW MSC[1] Non-Residential (mg/L)** | **Predicted Concentration (mg/L)** | **Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot)** |
| Sim 1 - Benzene | 0.006000 | 0.005 | 0.005 | **8** |
| Sim 2 - Pyrene | 0.870000 | 0.130 | 0.130 | **6** |
| Sim 3 - Chrysene | 0.470000 | 0.0019 | 0.0019 | **5** |
| Sim 4 - Phenanthrene | 5.500000 | 1.100 | 1.100 | **2** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500 ug/l.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

Project: 2574601 - Sunoco Philadelphia Refinery
Date: 1/31/2012 Prepared by: TS
Contaminant: Benzene starting concentration = 0.006 mg/L

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.0009589 | 100 | 18 | 1E+99 |

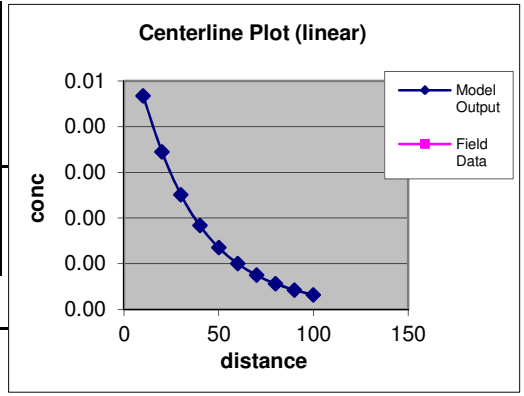
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density (g/cm³) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.40E+01 | 0.00025 | 0.35 | 1.7225 | 58 | 5.00E-03 | 2.427214286 | 0.00706277 |

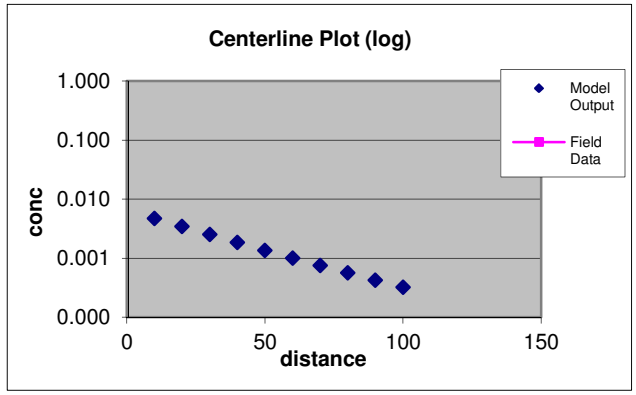
**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 7.54401584 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 7.54401584 | 0 | 0 |
| at | 1E+99 | days = | |

**0.005** mg/l




AREAL MODEL CALCULATION DOMAIN

Length (ft) 100
Width (ft) 100

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 50 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |
| 0 | 0.005 | 0.003 | 0.003 | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 |
| -50 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |
| -100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| Field Data: | Centerline C | Concentration | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Distance from Source | | | | | | | | |

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

Project: 2574601 - Sunoco Philadelphia Refinery
Date: 1/31/2012 Prepared by: TS
Contaminant: Pyrene starting concentration = 0.87 mg/L

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 1 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00019178 | 100 | 18 | 1E+99 |

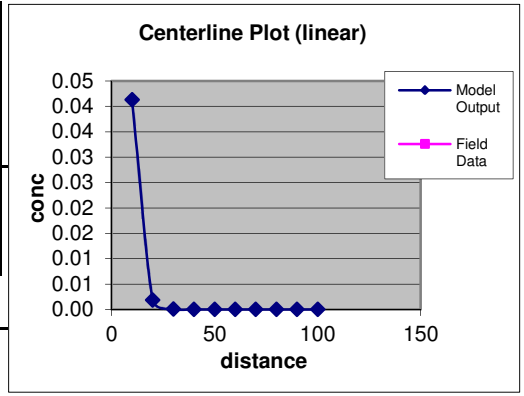
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density (g/cm³) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.40E+01 | 0.00025 | 0.35 | 1.7225 | 68000 | 5.00E-03 | 1674.285714 | 1.02389E-05 |

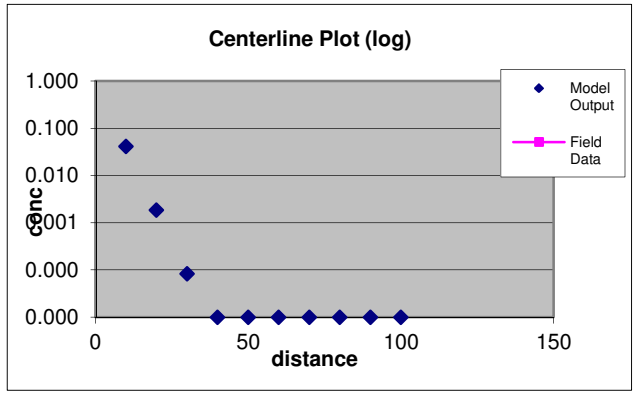
**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 6.257733609 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 6.257733609 | 0 | 0 |
| at | 1E+99 | days = | |

**0.130** mg/l




AREAL MODEL CALCULATION DOMAIN

Length (ft) 100
Width (ft) 100

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 50 | 0.021 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0 | 0.041 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| -50 | 0.021 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| -100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| Field Data: | Centerline C Concentration | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Distance from Source | | | | | | | | | |

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

Project: 2574601 - Sunoco Philadelphia Refinery
Date: 1/31/2012 Prepared by: TS
Contaminant: Chrysene starting concentration = 0.47 mg/L

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00035616 | 100 | 18 | 1E+99 |

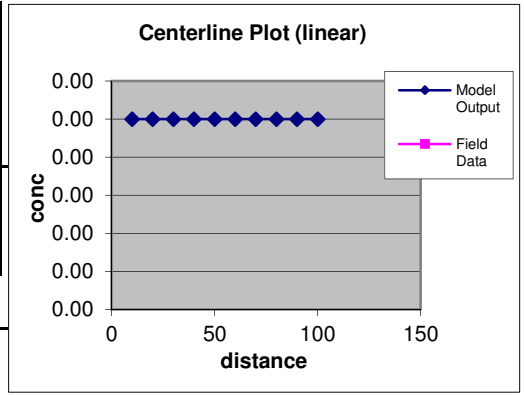
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density (g/cm³) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.40E+01 | 0.00025 | 0.35 | 1.7225 | 490000 | 5.00E-03 | 12058.5 | 1.42164E-06 |

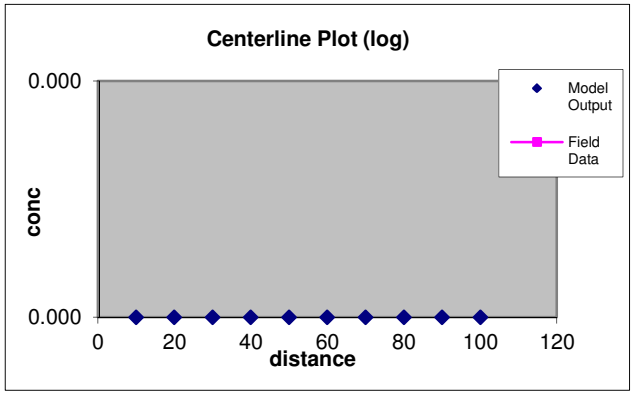
**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 4.934900854 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 4.934900854 | 0 | 0 |
| at | 1E+99 | days = | |

**0.002** mg/l




AREAL MODEL CALCULATION DOMAIN

Length (ft) 100
Width (ft) 100

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 50 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| -50 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| -100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| Field Data: | Centerline C | Concentration | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Distance from Source | | | | | | | | |

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

Project: 2574601 - Sunoco Philadelphia Refinery
Date: 1/31/2012 Prepared by: TS
Contaminant: **Phenanthrene starting concentration = 5.5 mg/L**

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 6 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00172603 | 100 | 18 | 1E+99 |

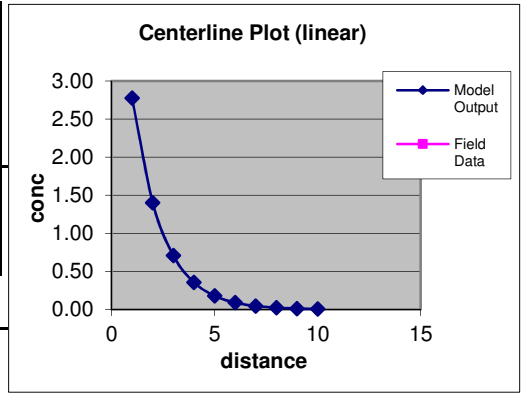
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density (g/cm³) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.40E+01 | 0.00025 | 0.35 | 1.7225 | 38000 | 5.00E-03 | 936.0714286 | 1.83136E-05 |

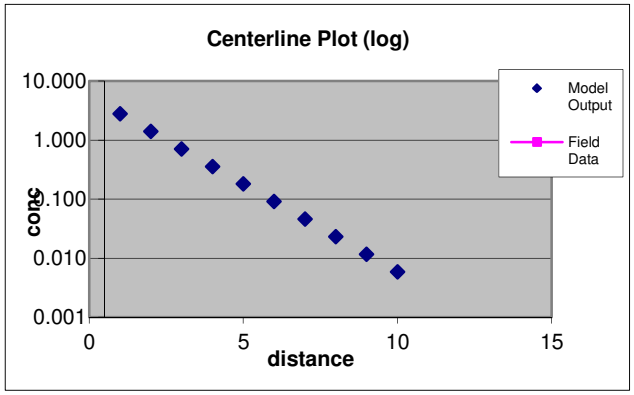
**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 2.353199999 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 2.353199999 | 0 | 0 |
| at | 1E+99 | days = | |

**1.100** mg/l




**AREAL MODEL CALCULATION DOMAIN**

Length (ft) 10
Width (ft) 10

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 2.775 | 1.400 | 0.707 | 0.356 | 0.180 | 0.090 | 0.045 | 0.023 | 0.011 | 0.006 |
| 5 | 2.775 | 1.400 | 0.707 | 0.357 | 0.180 | 0.091 | 0.046 | 0.023 | 0.012 | 0.006 |
| 0 | 2.775 | 1.400 | 0.707 | 0.357 | 0.180 | 0.091 | 0.046 | 0.023 | 0.012 | 0.006 |
| -5 | 2.775 | 1.400 | 0.707 | 0.357 | 0.180 | 0.091 | 0.046 | 0.023 | 0.012 | 0.006 |
| -10 | 2.775 | 1.400 | 0.707 | 0.356 | 0.180 | 0.090 | 0.045 | 0.023 | 0.011 | 0.006 |
| **Field Data:** | Centerline C | Concentration | | | | | | | | |
| | Distance from Source | | | | | | | | | |

**Table J.3**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**N-101**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | AOI 8 SUNOCO Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **N-101** | Jul-08 |
| Sample Date | | | July-08 | |
| Source Width | | ft | 100 | Delineated LNAPL (100' if no plume is present) |
| Source Thickness | | ft | 18 | Trenton Gravel saturated thickness (T-T') at N-103 |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | 0.1 x Longitudinal Dispersivity (QD User's Guide) |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | negligible QD User's Guide |
| Hydraulic Conductivty | k | ft/day | 24 | Trenton Gravel Conductivity From CCR |
| Hydraulic Gradient | | ft/ft | 0.002 | Derived from N-101 and N-14 (May 2011 groundwater contours) |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | steady-state |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | chrysene | N-101 |
| Source Concentration (mg/L) | | mg/L | 0.0080 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 0.000 | Number Please!2011 |
| KOC | | | 490000 | Number Please!2011 |

| Output (Distance from Source Where Concentration Equals Respective Ground Water MSC) | | | | |
|---|---|---|---|---|
| **Contaminant** | **Starting Concentration (mg/L)** | **GW MSC[1] Non-Residential (mg/L)** | **Predicted Concentration (mg/L)** | **Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot)** |
| Sim 1 - chrysene | 0.0080 | 0.002 | 0.002 | **4** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

Project: AOI 8 SUNOCO Philadelphia Refinery
Date: 1/31/2012 Prepared by: TS
Contaminant: chrysene starting concentration = 0.008 mg/L

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

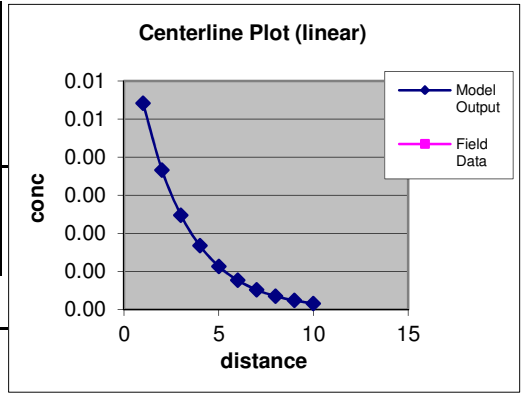
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00035616 | 100 | 18 | 1E+99 |

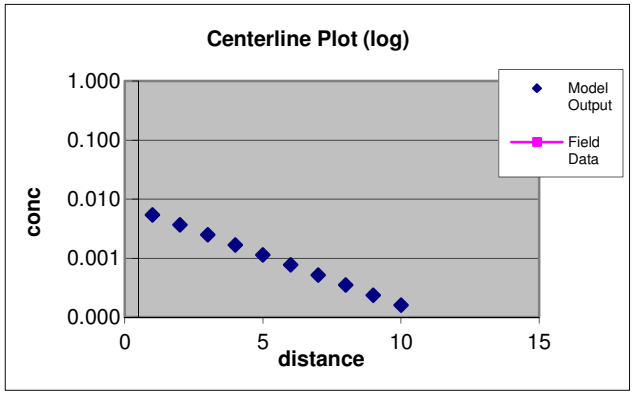
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density (g/cm³) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.40E+01 | 0.002 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 1.15236E-05 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 3.551286359 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 3.551286359 | 0 | 0 |
| at | 1E+99 | days = | 0.002 mg/l |




AREAL MODEL CALCULATION DOMAIN

Length (ft) 10
Width (ft) 10

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.005 | 0.004 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |
| 5 | 0.005 | 0.004 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |
| 0 | 0.005 | 0.004 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |
| -5 | 0.005 | 0.004 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |
| -10 | 0.005 | 0.004 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |

| Field Data: | Centerline C Concentration | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Distance from Source | | | | | | | | | |

**Table J.4**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**N-106**
**Sunoco Philadelphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | 2574601 - Sunoco Philadelphia Refinery |
| Prepared by | Terrance Stanley |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **N-106** | |
| Sample Date | | | | Jul-08 |
| Source Width | | ft | 100 | Delineated LNAPL (100' default if no plume is present) |
| Source Thickness | | ft | 18 | Trenton Gravel saturated thickness from Cross-Section T-T' at N-12/13 |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | Quick Domenico User's Manual |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | Quick Domenico User's Manual |
| Hydraulic Conductivty | k | ft/day | 24 | Trenton Gravel Conductivity From CCR |
| Hydraulic Gradient | | ft/ft | 0.004 | Derived from N-106 and N-98 (May 2011 groundwater contours) |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7225 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | Steady-State Conditions |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | Benzene | |
| Source Concentration (mg/L) | | mg/L | 0.4100 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 0.001 | PADEP Number Please!2011 Spreadsheet |
| KOC | | | 58 | PADEP Number Please!2011 Spreadsheet |

| Output (Distance from Source Where Concentration Equals Respective Ground Water MSC) | | | | |
|---|---|---|---|---|
| **Contaminant** | **Starting Concentration (mg/L)** | **GW MSC[1] Non-Residential (mg/L)** | **Predicted Concentration (mg/L)** | **Predicted Distance to Meet Non-Residential GW MSC (Rounded Upward to the Nearest foot)** |
| Sim 1 - Benzene | 0.410000 | 0.005 | 0.005 | **667** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500 ug/l.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | 2574601 - Sunoco Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | Terrance Stanley |
| | | Contaminant: | Benzene starting concentration = 0.41 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

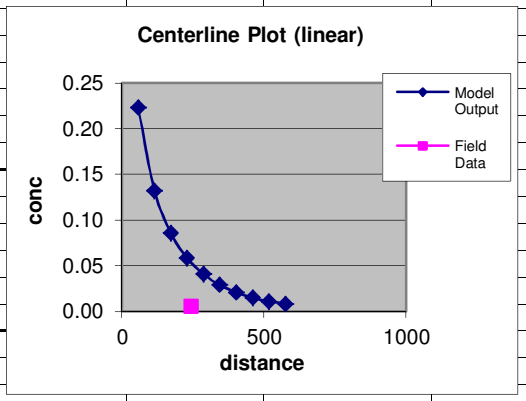
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.0009589 | 100 | 18 | 1E+99 |

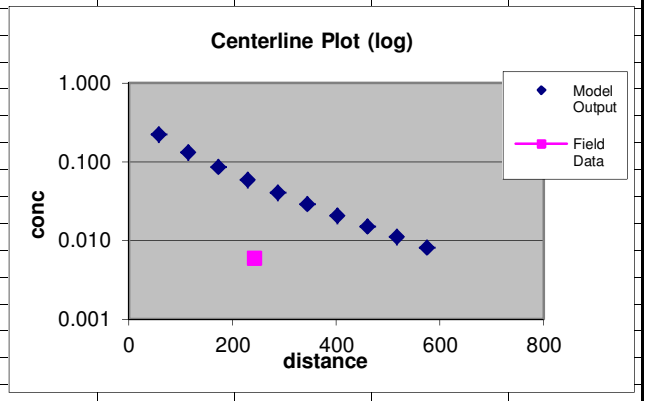
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.40E+01 | 0.004 | 0.35 | 1.7225 | 58 | 5.00E-03 | 2.427214286 | 0.113004326 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 666.5362075 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 666.5362075 | 0 | 0 |
| at | 1E+99 | days = | 0.005 mg/l |




| | AREAL MODEL | CALCULATION DOMAIN | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Length (ft) | 575 | | | | | | | | |
| | Width (ft) | 100 | | | | | | | | |
| | *57.5* | *115* | *172.5* | *230* | *287.5* | *345* | *402.5* | *460* | *517.5* | *575* |
| *100* | 0.047 | 0.053 | 0.045 | 0.035 | 0.027 | 0.021 | 0.015 | 0.012 | 0.009 | 0.007 |
| *50* | 0.153 | 0.105 | 0.073 | 0.051 | 0.037 | 0.026 | 0.019 | 0.014 | 0.010 | 0.008 |
| *0* | 0.223 | 0.132 | 0.086 | 0.058 | 0.041 | 0.029 | 0.021 | 0.015 | 0.011 | 0.008 |
| *-50* | 0.153 | 0.105 | 0.073 | 0.051 | 0.037 | 0.026 | 0.019 | 0.014 | 0.010 | 0.008 |
| *-100* | 0.047 | 0.053 | 0.045 | 0.035 | 0.027 | 0.021 | 0.015 | 0.012 | 0.009 | 0.007 |
| **Field Data:** | Centerline C | Concentration | | 0.006 | | | | | | |
| | Distance from Source | | | 242 | | | | | | |

**Table J.5**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**N-8**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | AOI 8 SUNOCO Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **N-8** | Jul-08 |
| Sample Date | | | July-08 | |
| Source Width | | ft | 100 | Delineated LNAPL (100' if no plume is present) |
| Source Thickness | | ft | 18 | Trenton Gravel saturated thickness (T-T') at N-103 |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | 0.1 x Longitudinal Dispersivity (QD User's Guide) |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | negligible QD User's Guide |
| Hydraulic Conductivty | k | ft/day | 24 | Trenton Gravel Conductivity From CCR |
| Hydraulic Gradient | | ft/ft | 0.00204 | Derived fromN-8 and N-102 (May 2011 groundwater contours) |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | steady-state |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | chrysene | N-8 |
| Source Concentration (mg/L) | | mg/L | 0.1200 | Max Reporting Limit |
| Lambda (per day) | | $day^{-1}$ | 3.562E-04 | Number Please!2011 |
| KOC | | | 490000 | Number Please!2011 |

| Output (Distance from Source Where Concentration Equals Respective Ground Water MSC) | | | | |
|---|---|---|---|---|
| **Contaminant** | **Starting Concentration (mg/L)** | **GW MSC[1] Non-Residential (mg/L)** | **Predicted Concentration (mg/L)** | **Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot)** |
| Sim 1 - chrysene | 0.1200 | 0.002 | 0.002 | **11** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | chrysene starting concentration = 0.12 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00035616 | 100 | 18 | 1E+99 |

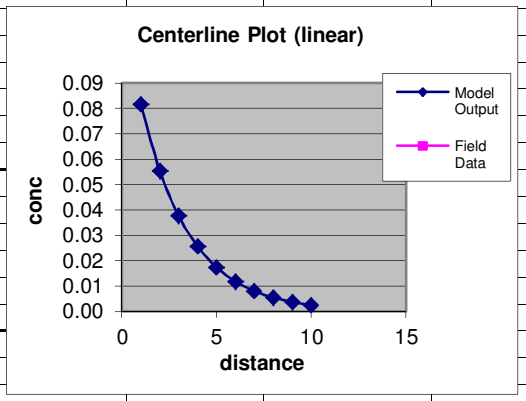
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^3$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.40E+01 | 0.00204 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 1.17541E-05 |

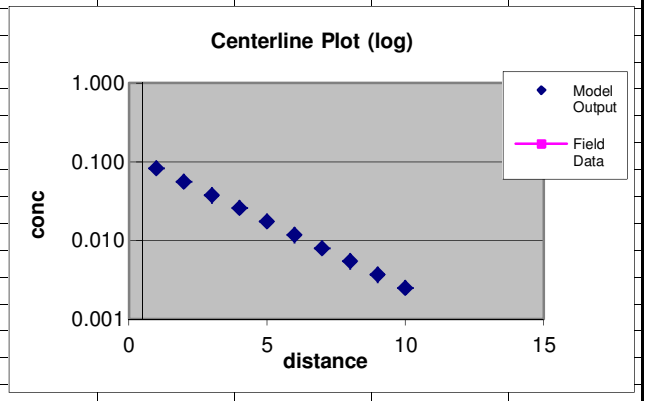
**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 10.55019297 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 10.55019297 | 0 | 0 |
| at | 1E+99 | days = | 0.002 mg/l |

| | AREAL MODEL | CALCULATION DOMAIN |
|---|---|---|
| | Length (ft) | 10 |
| | Width (ft) | 10 |




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.082 | 0.055 | 0.038 | 0.026 | 0.017 | 0.012 | 0.008 | 0.005 | 0.004 | 0.002 |
| 5 | 0.082 | 0.055 | 0.038 | 0.026 | 0.017 | 0.012 | 0.008 | 0.005 | 0.004 | 0.002 |
| 0 | 0.082 | 0.055 | 0.038 | 0.026 | 0.017 | 0.012 | 0.008 | 0.005 | 0.004 | 0.002 |
| -5 | 0.082 | 0.055 | 0.038 | 0.026 | 0.017 | 0.012 | 0.008 | 0.005 | 0.004 | 0.002 |
| -10 | 0.082 | 0.055 | 0.038 | 0.026 | 0.017 | 0.012 | 0.008 | 0.005 | 0.004 | 0.002 |
| **Field Data:** | Centerline C | Concentration | | | | | | | | |
| | Distance from Source | | | | | | | | | |

Table J.05 N-008 chrysene QD2 Model
SIM 1

**Table J.6**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**N-58**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | AOI 8 SUNOCO Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **N-58** | Jul-08 |
| Sample Date | | | July-08 | |
| Source Width | | ft | 100 | Delineated LNAPL (100' if no plume is present) |
| Source Thickness | | ft | 30 | Alluvium Thickness from X-Sections |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | 0.1 x Longitudinal Dispersivity (QD User's Guide) |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | negligible QD User's Guide |
| Hydraulic Conductivty | k | ft/day | 0.283 | Estimated Barrier Wall Permeability |
| Hydraulic Gradient | | ft/ft | 0.0865 | N-58/N-73 |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | steady-state |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | Benzene | |
| Source Concentration (mg/L) | | mg/L | 0.0100 | N-58 Reporting Limit |
| Lambda (per day) | | $day^{-1}$ | 0.001 | Number Please!2011 |
| KOC | | | 58 | Number Please!2011 |
| **Sim 2** | | | | |
| Contaminant | | | 1,2-dichloroethane | |
| Source Concentration (mg/L) | | mg/L | 0.0100 | N-58 Reporting Limit |
| Lambda (per day) | | $day^{-1}$ | 0.000 | Number Please!2011 |
| KOC | | | 38 | Number Please!2011 |

**Output (Distance from Source Where Concentration Equals Respective Ground Water MSC)**

| Contaminant | Starting Concentration (mg/L) | GW MSC[1] Non-Residential (mg/L) | Predicted Concentration (mg/L) | Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot) |
|---|---|---|---|---|
| Sim 1 - Benzene | 0.0100 | 0.005 | 0.005 | **42** |
| Sim 2 - 1,2-dichloroethane | 0.0100 | 0.005 | 0.005 | **76** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | Benzene starting concentration = 0.01 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

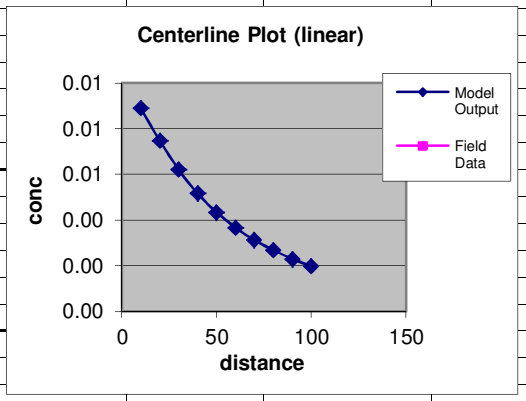
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.0009589 | 100 | 30 | 1E+99 |

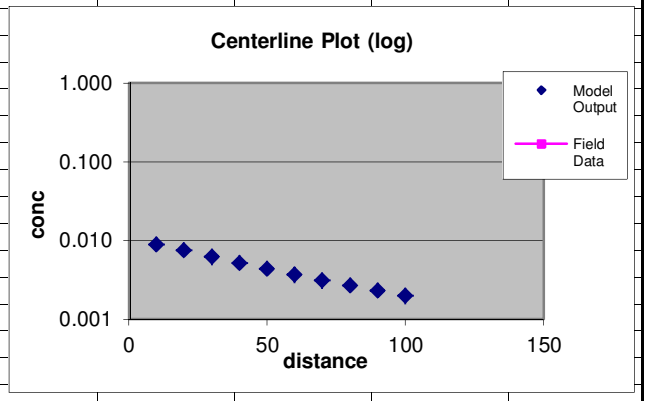
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^3$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.0865 | 0.35 | 1.7 | 58 | 5.00E-03 | 2.408571429 | 0.029038553 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 42 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 42 | 0 | 0 |
| at | 1E+99 | days = | 0.005 mg/l |




| | AREAL MODEL | CALCULATION DOMAIN |
|---|---|---|
| | Length (ft) | 100 |
| | Width (ft) | 100 |

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| 50 | 0.004 | 0.004 | 0.004 | 0.003 | 0.003 | 0.003 | 0.002 | 0.002 | 0.002 | 0.002 |
| 0 | 0.009 | 0.007 | 0.006 | 0.005 | 0.004 | 0.004 | 0.003 | 0.003 | 0.002 | 0.002 |
| -50 | 0.004 | 0.004 | 0.004 | 0.003 | 0.003 | 0.003 | 0.002 | 0.002 | 0.002 | 0.002 |
| -100 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |

| Field Data: | Centerline C | Concentration |
|---|---|---|
| | Distance from Source | |

Table J.7 N-58 Benzene

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project: | SWLOAD5B | | | | | | | | | | | | | | |
| Date: | 1/11/2012 | | | | | | | | | | | | | | |
| Contaminant: | N-58 Benzene | | | Prepared by: | | TS | | | | | | | | | |
| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) | | | | | | | | |
| mg/l | >.0001 | >.0001 | >=.0001 | | | | | | | | | | | | |
| 0.01 | 200 | 20 | 1.00E-04 | 9.59E-04 | 100 | 30 | 1.00E+99 | | | | | | | | |
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) | | | | | | | | |
| 2.83E-01 | 0.085 | 0.35 | 1.7 | 58 | 5.00E-03 | 2.408571 | 0.028535 | | | | | | | | |
| | | | | -93.875 | -75.1 | -56.325 | -37.55 | -18.775 | 0 | 18.775 | 37.55 | 56.325 | 75.1 | 93.875 | |
| Edge Criterion (mg/l) | | 0.005 | 0 | 0.000964 | 0.0016234 | 0.002413 | 0.0031845 | 0.00375205 | 0.00396109 | 0.003752 | 0.0031845 | 0.0024128 | 0.001623 | 0.000964 | |
| Higest modeled conc. | | 0.00396 | -1.0438 | 0.000964 | 0.0016234 | 0.002413 | 0.0031845 | 0.00375205 | 0.00396109 | 0.003752 | 0.0031845 | 0.0024128 | 0.001623 | 0.000964 | |
| | | | -2.0876 | 0.000964 | 0.0016234 | 0.002413 | 0.0031845 | 0.00375205 | 0.00396109 | 0.003752 | 0.0031845 | 0.0024128 | 0.001623 | 0.000964 | |
| SURFACE WATER LOADING GRID | | | -3.1314 | 0.000964 | 0.0016234 | 0.002413 | 0.0031845 | 0.00375205 | 0.00396109 | 0.003752 | 0.0031845 | 0.0024128 | 0.001623 | 0.000964 | |
| Distance to Stream (ft) | | 55 | -4.1752 | 0.000964 | 0.0016234 | 0.002413 | 0.0031845 | 0.00375205 | 0.00396109 | 0.003752 | 0.0031845 | 0.0024128 | 0.001623 | 0.000964 | |
| Plume View Width (ft) | | 187.75 | -5.219 | 0.000964 | 0.0016234 | 0.002413 | 0.0031845 | 0.00375205 | 0.00396109 | 0.003752 | 0.0031845 | 0.0024128 | 0.001623 | 0.000964 | |
| Plume View Depth (ft) | | 10.438 | -6.2628 | 0.000964 | 0.0016234 | 0.002413 | 0.0031845 | 0.00375205 | 0.00396109 | 0.003752 | 0.0031845 | 0.0024128 | 0.001623 | 0.000964 | |
| | | | -7.3066 | 0.000964 | 0.0016234 | 0.002413 | 0.0031845 | 0.00375205 | 0.00396109 | 0.003752 | 0.0031845 | 0.0024128 | 0.001623 | 0.000964 | |
| | | | -8.3504 | 0.000964 | 0.0016234 | 0.002413 | 0.0031845 | 0.00375205 | 0.00396109 | 0.003752 | 0.0031845 | 0.0024128 | 0.001623 | 0.000964 | |
| PENTOX NOT NEEDED | | | -9.3942 | 0.000964 | 0.0016234 | 0.002413 | 0.0031845 | 0.00375205 | 0.00396109 | 0.003752 | 0.0031845 | 0.0024128 | 0.001623 | 0.000964 | |
| | | | -10.438 | 0.000964 | 0.0016234 | 0.002413 | 0.0031845 | 0.00375205 | 0.00396109 | 0.003752 | 0.0031845 | 0.0024128 | 0.001623 | 0.000964 | |
| | | | | | | | | | | | | | | | |
| | | | | Average Groundwater Concentration | | | | 0.00253 | mg/l | | | | | | |
| | | | | Plume Flow | | | | 0.00054 | cfs | 0.00035 | MGD | | | | |
| | | | | Mass Loading to Stream | | | 3.38 | mg/day | | | | | | | |

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

Project: SWLOAD5B
Date: 1/11/2012
Contaminant: N-58 12DCA
Prepared by: TS

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) |
|---|---|---|---|---|---|---|---|
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | |
| 0.01 | 200 | 20 | 1.00E-04 | 1.92E-04 | 100 | 30 | 1.00E+99 |

| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.085 | 0.35 | 1.7 | 38 | 5.00E-03 | 1.922857 | 0.0357429 |

| | | | -32.5 | -26 | -19.5 | -13 | -6.5 | 0 | 6.5 | 13 | 19.5 | 26 | 32.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Edge Criterion (mg/l) | 0.005 | 0 | 0.005068 | 0.0053762 | 0.005627 | 0.0058135 | 0.00592787 | 0.00596645 | 0.0059279 | 0.0058135 | 0.0056275 | 0.005376 | 0.005068 |
| Higest modeled conc. | 0.00597 | -1.0438 | 0.005068 | 0.0053762 | 0.005627 | 0.0058135 | 0.00592787 | 0.00596645 | 0.0059279 | 0.0058135 | 0.0056275 | 0.005376 | 0.005068 |
| | | -2.0876 | 0.005068 | 0.0053762 | 0.005627 | 0.0058135 | 0.00592787 | 0.00596645 | 0.0059279 | 0.0058135 | 0.0056275 | 0.005376 | 0.005068 |
| SURFACE WATER LOADING GRID | | -3.1314 | 0.005068 | 0.0053762 | 0.005627 | 0.0058135 | 0.00592787 | 0.00596645 | 0.0059279 | 0.0058135 | 0.0056275 | 0.005376 | 0.005068 |
| Distance to Stream (ft) | 55 | -4.1752 | 0.005068 | 0.0053762 | 0.005627 | 0.0058135 | 0.00592787 | 0.00596645 | 0.0059279 | 0.0058135 | 0.0056275 | 0.005376 | 0.005068 |
| Plume View Width (ft) | 65 | -5.219 | 0.005068 | 0.0053762 | 0.005627 | 0.0058135 | 0.00592787 | 0.00596645 | 0.0059279 | 0.0058135 | 0.0056275 | 0.005376 | 0.005068 |
| Plume View Depth (ft) | 10.438 | -6.2628 | 0.005068 | 0.0053762 | 0.005627 | 0.0058135 | 0.00592787 | 0.00596645 | 0.0059279 | 0.0058135 | 0.0056275 | 0.005376 | 0.005068 |
| | | -7.3066 | 0.005068 | 0.0053762 | 0.005627 | 0.0058135 | 0.00592787 | 0.00596645 | 0.0059279 | 0.0058135 | 0.0056275 | 0.005376 | 0.005068 |
| | | -8.3504 | 0.005068 | 0.0053762 | 0.005627 | 0.0058135 | 0.00592787 | 0.00596645 | 0.0059279 | 0.0058135 | 0.0056275 | 0.005376 | 0.005068 |
| PENTOX NEEDED | | -9.3942 | 0.005068 | 0.0053762 | 0.005627 | 0.0058135 | 0.00592787 | 0.00596645 | 0.0059279 | 0.0058135 | 0.0056275 | 0.005376 | 0.005068 |
| | | -10.438 | 0.005068 | 0.0053762 | 0.005627 | 0.0058135 | 0.00592787 | 0.00596645 | 0.0059279 | 0.0058135 | 0.0056275 | 0.005376 | 0.005068 |

| | | |
|---|---|---|
| Average Groundwater Concentration | 0.0056 | mg/l |
| Plume Flow | 0.00019 cfs | 0.00012 MGD |
| Mass Loading to Stream | 2.59 | mg/day |

**Table J.9**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**N-60**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | AOI 8 SUNOCO Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **N-60** | Jul-08 |
| Sample Date | | | July-08 | |
| Source Width | | ft | 100 | Delineated LNAPL (100' if no plume is present) |
| Source Thickness | | ft | 30 | Alluvium Thickness from X-Sections |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | 0.1 x Longitudinal Dispersivity (QD User's Guide) |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | negligible QD User's Guide |
| Hydraulic Conductivty | k | ft/day | 0.283 | Estimated Barrier Wall Permeability |
| Hydraulic Gradient | | ft/ft | 0.0121 | N-60/N-136 |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | steady-state |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | Chrysene | N-60 |
| Source Concentration (mg/L) | | mg/L | 0.0140 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 3.562E-04 | Number Please!2011 |
| KOC | | | 490000 | Number Please!2011 |

**Output (Distance from Source Where Concentration Equals Respective Ground Water MSC)**

| Contaminant | Starting Concentration (mg/L) | GW MSC[1] Non-Residential (mg/L) | Predicted Concentration (mg/L) | Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot) |
|---|---|---|---|---|
| Sim 1 - Chrysene | 0.0140 | 0.002 | 0.002 | **1** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | Chrysene starting concentration = 0.014 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

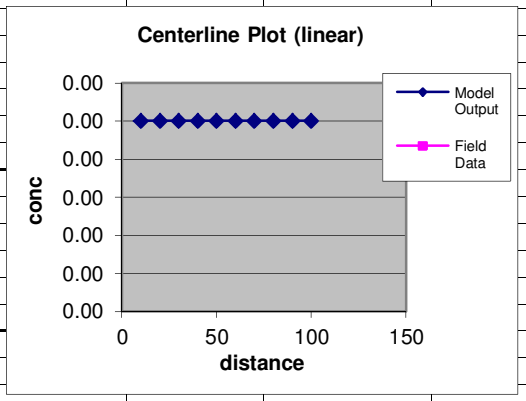
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00035616 | 100 | 30 | 1E+99 |

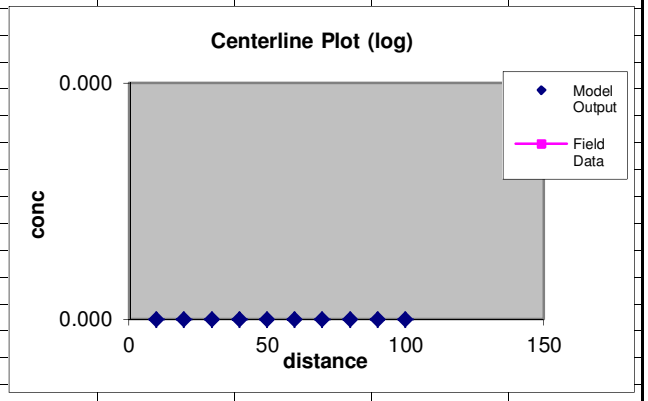
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.0121 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 8.22092E-07 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 1.324868125 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 1.324868125 | 0 | 0 |
| at | 1E+99 | days = | 0.002 mg/l |




| AREAL MODEL | CALCULATION DOMAIN |
|---|---|
| Length (ft) | 100 |
| Width (ft) | 100 |

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 50 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| -50 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| -100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| Field Data: | Centerline C | Concentration |
|---|---|---|
| | Distance from Source | |

Table J.10 N-60 Chrysene

| METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project: | Sunoco Philadelphia AOI 8 N-60 | | | | | | | | | | | | | | |
| Date: | 10/21/2011 | | | | | | | | | | | | | | |
| Contaminant: | N-60 Chrysene | | | Prepared by: | | TS | | | | | | | | | |
| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) | | | | | | | | |
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | | | | | | | | | |
| 0.014 | 200 | 20 | 1.00E-04 | 3.56E-04 | 100 | 30 | 1.00E+99 | | | | | | | | |
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) | | | | | | | | |
| 2.83E-01 | 0.0121 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 8.221E-07 | | | | | | | | |
| | | | | -50 | -40 | -30 | -20 | -10 | 0 | 10 | 20 | 30 | 40 | 50 | |
| Edge Criterion (mg/l) | | 0.00048 | 0 | 2.6E-258 | 2.68E-258 | 2.7E-258 | 2.77E-258 | 2.798E-258 | 2.806E-258 | 2.8E-258 | 2.77E-258 | 2.73E-258 | 2.7E-258 | 2.6E-258 | |
| Higest modeled conc. | | 3E-258 | -3 | 2.6E-258 | 2.68E-258 | 2.7E-258 | 2.77E-258 | 2.798E-258 | 2.806E-258 | 2.8E-258 | 2.77E-258 | 2.73E-258 | 2.7E-258 | 2.6E-258 | |
| | | | -6 | 2.6E-258 | 2.68E-258 | 2.7E-258 | 2.77E-258 | 2.798E-258 | 2.806E-258 | 2.8E-258 | 2.77E-258 | 2.73E-258 | 2.7E-258 | 2.6E-258 | |
| SURFACE WATER LOADING GRID | | | -9 | 2.6E-258 | 2.68E-258 | 2.7E-258 | 2.77E-258 | 2.798E-258 | 2.806E-258 | 2.8E-258 | 2.77E-258 | 2.73E-258 | 2.7E-258 | 2.6E-258 | |
| Distance to Stream (ft) | | 400 | -12 | 2.6E-258 | 2.68E-258 | 2.7E-258 | 2.77E-258 | 2.798E-258 | 2.806E-258 | 2.8E-258 | 2.77E-258 | 2.73E-258 | 2.7E-258 | 2.6E-258 | |
| Plume View Width (ft) | | 100 | -15 | 2.6E-258 | 2.68E-258 | 2.7E-258 | 2.77E-258 | 2.798E-258 | 2.806E-258 | 2.8E-258 | 2.77E-258 | 2.73E-258 | 2.7E-258 | 2.6E-258 | |
| Plume View Depth (ft) | | 30 | -18 | 2.6E-258 | 2.68E-258 | 2.7E-258 | 2.77E-258 | 2.798E-258 | 2.806E-258 | 2.8E-258 | 2.77E-258 | 2.73E-258 | 2.7E-258 | 2.6E-258 | |
| | | | -21 | 2.6E-258 | 2.68E-258 | 2.7E-258 | 2.77E-258 | 2.798E-258 | 2.806E-258 | 2.8E-258 | 2.77E-258 | 2.73E-258 | 2.7E-258 | 2.6E-258 | |
| | | | -24 | 2.6E-258 | 2.68E-258 | 2.7E-258 | 2.77E-258 | 2.798E-258 | 2.806E-258 | 2.8E-258 | 2.77E-258 | 2.73E-258 | 2.7E-258 | 2.6E-258 | |
| PENTOX NOT NEEDED | | | -27 | 2.6E-258 | 2.68E-258 | 2.7E-258 | 2.77E-258 | 2.798E-258 | 2.806E-258 | 2.8E-258 | 2.77E-258 | 2.73E-258 | 2.7E-258 | 2.6E-258 | |
| | | | -30 | 1.3E-258 | 1.34E-258 | 1.4E-258 | 1.39E-258 | 1.399E-258 | 1.403E-258 | 1.4E-258 | 1.39E-258 | 1.37E-258 | 1.3E-258 | 1.3E-258 | |
| | | | | | | | | | | | | | | | |
| | | | | Average Groundwater Concentration | | | | #DIV/0! | mg/l | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | Plume Flow | | | | 0.00000 cfs | | 0 MGD | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | Mass Loading to Stream | | | #DIV/0! | | mg/day | | | | | | |

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

**Table J.11**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**N-61**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | AOI 8 SUNOCO Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **N-61** | Jul-08 |
| Sample Date | | | July-08 | |
| Source Width | | ft | 100 | Delineated LNAPL (100' if no plume is present) |
| Source Thickness | | ft | 30 | Alluvium Thickness from X-Sections |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | 0.1 x Longitudinal Dispersivity (QD User's Guide) |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | negligible QD User's Guide |
| Hydraulic Conductivty | k | ft/day | 0.283 | Estimated Barrier Wall Permeability |
| Hydraulic Gradient | | ft/ft | 0.002 | N-61/N-135 |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | steady-state |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | 1,2-dichloroethane | |
| Source Concentration (mg/L) | | mg/L | 0.0100 | N-61 Reporting Limit |
| Lambda (per day) | | $day^{-1}$ | 0.000 | Number Please!2011 |
| KOC | | | 38 | Number Please!2011 |

**Output (Distance from Source Where Concentration Equals Respective Ground Water MSC)**

| Contaminant | Starting Concentration (mg/L) | GW MSC[1] Non-Residential (mg/L) | Predicted Concentration (mg/L) | Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot) |
|---|---|---|---|---|
| Sim 1 - 1,2-dichloroethane | 0.0100 | 0.005 | 0.005 | **20** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | 1,2-dichloroethane starting concentration = 10 ug/l |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00019178 | 100 | 30 | 1E+99 |

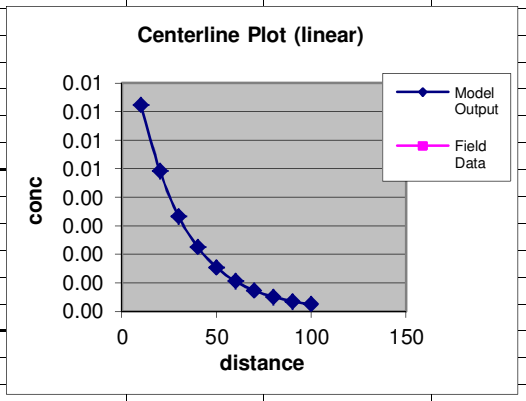
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.002 | 0.35 | 1.7 | 38 | 5.00E-03 | 1.922857143 | 0.00084101 |

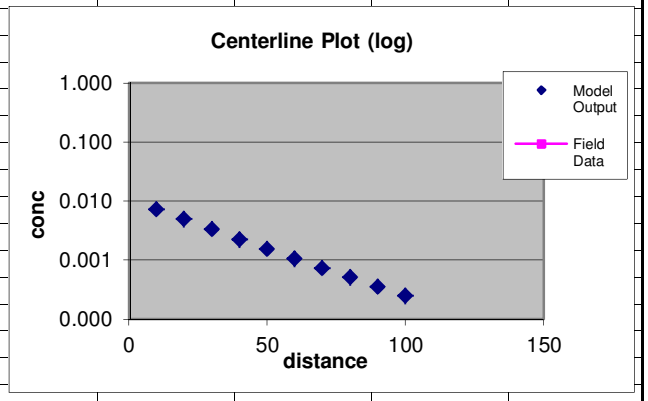
**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 20.03284586 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 20.03284586 | 0 | 0 |
| at | 1E+99 | days = | |

**0.005** mg/l




| AREAL MODEL | CALCULATION DOMAIN |
|---|---|
| Length (ft) | 100 |
| Width (ft) | 100 |

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 50 | 0.004 | 0.003 | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |
| 0 | 0.007 | 0.005 | 0.003 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 |
| -50 | 0.004 | 0.003 | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |
| -100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| Field Data: | Centerline C | Concentration |
|---|---|---|
| | Distance from Source | |

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

Project: SWLOAD5B
Date: 1/11/2012
Contaminant: N-61 12DCA
Prepared by: TS

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) |
|---|---|---|---|---|---|---|---|
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | |
| 0.01 | 200 | 20 | 1.00E-04 | 1.92E-04 | 100 | 30 | 1.00E+99 |

| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.002 | 0.35 | 1.7 | 38 | 5.00E-03 | 1.922857 | 0.000841 |

Edge Criterion (mg/l) 0.005
Higest modeled conc. 0.00025

SURFACE WATER LOADING GRID
Distance to Stream (ft) 100
Plume View Width (ft) 40
Plume View Depth (ft) 10.438

PENTOX NOT NEEDED

| | -20 | -16 | -12 | -8 | -4 | 0 | 4 | 8 | 12 | 16 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.000238 | 0.0002413 | 0.000244 | 0.000246 | 0.0002472 | 0.0002476 | 0.0002472 | 0.000246 | 0.000244 | 0.000241 | 0.000238 |
| -1.0438 | 0.000238 | 0.0002413 | 0.000244 | 0.000246 | 0.0002472 | 0.0002476 | 0.0002472 | 0.000246 | 0.000244 | 0.000241 | 0.000238 |
| -2.0876 | 0.000238 | 0.0002413 | 0.000244 | 0.000246 | 0.0002472 | 0.0002476 | 0.0002472 | 0.000246 | 0.000244 | 0.000241 | 0.000238 |
| -3.1314 | 0.000238 | 0.0002413 | 0.000244 | 0.000246 | 0.0002472 | 0.0002476 | 0.0002472 | 0.000246 | 0.000244 | 0.000241 | 0.000238 |
| -4.1752 | 0.000238 | 0.0002413 | 0.000244 | 0.000246 | 0.0002472 | 0.0002476 | 0.0002472 | 0.000246 | 0.000244 | 0.000241 | 0.000238 |
| -5.219 | 0.000238 | 0.0002413 | 0.000244 | 0.000246 | 0.0002472 | 0.0002476 | 0.0002472 | 0.000246 | 0.000244 | 0.000241 | 0.000238 |
| -6.2628 | 0.000238 | 0.0002413 | 0.000244 | 0.000246 | 0.0002472 | 0.0002476 | 0.0002472 | 0.000246 | 0.000244 | 0.000241 | 0.000238 |
| -7.3066 | 0.000238 | 0.0002413 | 0.000244 | 0.000246 | 0.0002472 | 0.0002476 | 0.0002472 | 0.000246 | 0.000244 | 0.000241 | 0.000238 |
| -8.3504 | 0.000238 | 0.0002413 | 0.000244 | 0.000246 | 0.0002472 | 0.0002476 | 0.0002472 | 0.000246 | 0.000244 | 0.000241 | 0.000238 |
| -9.3942 | 0.000238 | 0.0002413 | 0.000244 | 0.000246 | 0.0002472 | 0.0002476 | 0.0002472 | 0.000246 | 0.000244 | 0.000241 | 0.000238 |
| -10.438 | 0.000238 | 0.0002413 | 0.000244 | 0.000246 | 0.0002472 | 0.0002476 | 0.0002472 | 0.000246 | 0.000244 | 0.000241 | 0.000238 |

Average Groundwater Concentration #DIV/0! mg/l

Plume Flow 0.00000 cfs 0 MGD

Mass Loading to Stream #DIV/0! mg/day

**Table J.13**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**Sunoco Philadelphia Refinery AOI 8**
**N-111**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | 2574601 - Sunoco Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **N-111** | |
| Sample Date | | | | Jul-08 |
| Source Width | | ft | 100 | Delineated LNAPL (100' default if no plume is present) |
| Source Thickness | | ft | 30 | Alluvium Thickness from X-Sections |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | Quick Domenico User's Manual |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | Quick Domenico User's Manual |
| Hydraulic Conductivty | k | ft/day | 0.283 | Unsealed sheet pile (Waterloo Barrier, Inc.) |
| Hydraulic Gradient | | ft/ft | 0.0033 | Derived from N-111 and N-503 (May 2011 groundwater contours) |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7225 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | Steady-State Conditions |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | Chrysene | |
| Source Concentration (mg/L) | | mg/L | 0.1100 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 0.000 | PADEP Number Please!2011 Spreadsheet |
| KOC | | | 490000 | PADEP Number Please!2011 Spreadsheet |
| **Sim 2** | | | | |
| Contaminant | | | Pyrene | |
| Source Concentration (mg/L) | | mg/L | 0.1600 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 0.000 | PADEP Number Please!2011 Spreadsheet |
| KOC | | | 68000 | PADEP Number Please!2011 Spreadsheet |

| Output (Distance from Source Where Concentration Equals Respective Ground Water MSC) | | | | |
|---|---|---|---|---|
| **Contaminant** | **Starting Concentration (mg/L)** | **GW MSC[1] Non-Residential (mg/L)** | **Predicted Concentration (mg/L)** | **Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot)** |
| Sim 1 - Chrysene | 0.110000 | 0.002 | 0.002 | **1** |
| Sim 2 - Pyrene | 0.160000 | 0.130 | 0.130 | **0** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500 ug/l.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project: | 2574601 - Sunoco Philadelphia Refinery | | | | | | |
| Date: | 1/31/2012 | Prepared by: | TS | | | | |
| | | Contaminant: | Pyrene starting concentration = 0.16 mg/L | | | | |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF
"AN ANALYTICAL MODEL FOR
MULTIDIMENSIONAL TRANSPORT OF A DECAYING
CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

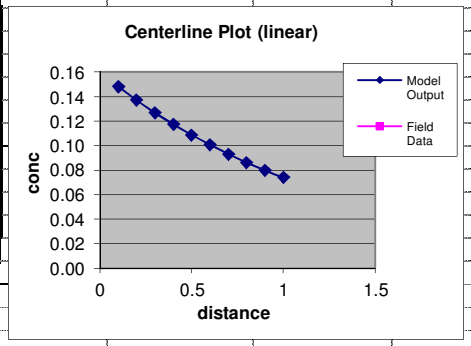
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.0001918 | 100 | 30 | 1E+99 |

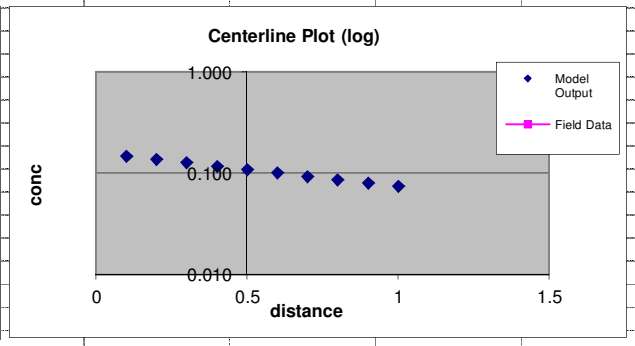
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^3$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.0033 | 0.35 | 1.7225 | 68000 | 5.00E-03 | 1674.285714 | 1.59369E-06 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 0.268651 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 0.268651 | 0 | 0 |
| at | 1E+99 | days = | 0.130 |
| | | | mg/l |




| | AREAL MODEL | CALCULATION DOMAIN |
|---|---|---|
| | Length (ft) | 1 |
| | Width (ft) | 1 |

| | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.148 | 0.137 | 0.127 | 0.117 | 0.109 | 0.101 | 0.093 | 0.086 | 0.080 | 0.074 |
| 0.5 | 0.148 | 0.137 | 0.127 | 0.117 | 0.109 | 0.101 | 0.093 | 0.086 | 0.080 | 0.074 |
| 0 | 0.148 | 0.137 | 0.127 | 0.117 | 0.109 | 0.101 | 0.093 | 0.086 | 0.080 | 0.074 |
| -0.5 | 0.148 | 0.137 | 0.127 | 0.117 | 0.109 | 0.101 | 0.093 | 0.086 | 0.080 | 0.074 |
| -1 | 0.148 | 0.137 | 0.127 | 0.117 | 0.109 | 0.101 | 0.093 | 0.086 | 0.080 | 0.074 |

| Field Data: | Centerline Conc. | Concentration |
|---|---|---|
| | Distance from Source | |

Table J.13 N-111 Chrysene Pyrene QD2 Model
SIM 2

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | 2574601 - Sunoco Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | Chrysene starting concentration = 0.11 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF
"AN ANALYTICAL MODEL FOR
MULTIDIMENSIONAL TRANSPORT OF A
DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

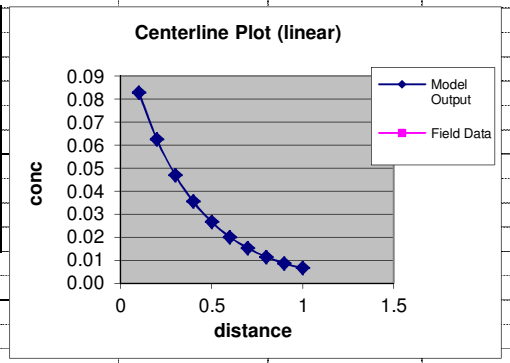
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00035616 | 100 | 30 | 1E+99 |

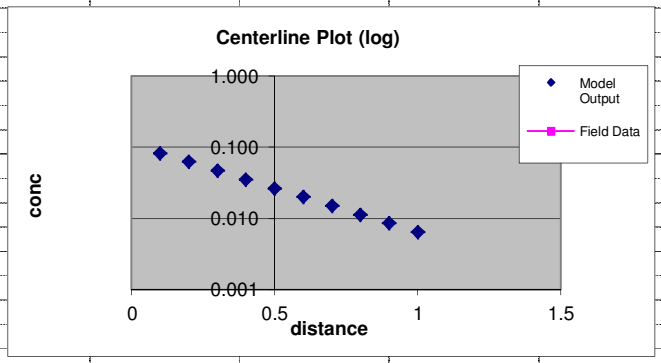
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^3$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.0033 | 0.35 | 1.7225 | 490000 | 5.00E-03 | 12058.5 | 2.21278E-07 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 1.414061033 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 1.414061033 | 0 | 0 |
| at | 1E+99 | days = | 0.002 |
| | | | mg/l |




| | AREAL MODEL | CALCULATION DOMAIN |
|---|---|---|
| | Length (ft) | 1 |
| | Width (ft) | 1 |

| | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.083 | 0.062 | 0.047 | 0.035 | 0.027 | 0.020 | 0.015 | 0.011 | 0.009 | 0.006 |
| 0.5 | 0.083 | 0.062 | 0.047 | 0.035 | 0.027 | 0.020 | 0.015 | 0.011 | 0.009 | 0.006 |
| 0 | 0.083 | 0.062 | 0.047 | 0.035 | 0.027 | 0.020 | 0.015 | 0.011 | 0.009 | 0.006 |
| -0.5 | 0.083 | 0.062 | 0.047 | 0.035 | 0.027 | 0.020 | 0.015 | 0.011 | 0.009 | 0.006 |
| -1 | 0.083 | 0.062 | 0.047 | 0.035 | 0.027 | 0.020 | 0.015 | 0.011 | 0.009 | 0.006 |

| Field Data: | Centerline C | Concentration |
|---|---|---|
| | Distance from Source | |

Table J.14 N-111 Chrysene

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

Project: Sunoco Philadelphia AOI 8 N-111

Date: 10/21/2011

Contaminant: N-111 Chrysene

Prepared by: TS

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) |
|---|---|---|---|---|---|---|---|
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | |
| 0.11 | 200 | 20 | 1.00E-04 | 3.56E-04 | 100 | 30 | 1.00E+99 |

| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.0033 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 2.242E-07 |

Edge Criterion (mg/l) 0.00048

Higest modeled conc. 4.1E-42

SURFACE WATER LOADING GRID

Distance to Stream (ft) 33

Plume View Width (ft) 202

Plume View Depth (ft) 30

PENTOX NOT NEEDED

| | -101 | -80.8 | -60.6 | -40.4 | -20.2 | 0 | 20.2 | 40.4 | 60.6 | 80.8 | 101 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 3.98E-43 | 9.83E-43 | 1.91E-42 | 2.966E-42 | 3.8066E-42 | 4.1239E-42 | 3.807E-42 | 2.966E-42 | 1.905E-42 | 9.83E-43 | 3.98E-43 |
| -3 | 3.98E-43 | 9.83E-43 | 1.91E-42 | 2.966E-42 | 3.8066E-42 | 4.1239E-42 | 3.807E-42 | 2.966E-42 | 1.905E-42 | 9.83E-43 | 3.98E-43 |
| -6 | 3.98E-43 | 9.83E-43 | 1.91E-42 | 2.966E-42 | 3.8066E-42 | 4.1239E-42 | 3.807E-42 | 2.966E-42 | 1.905E-42 | 9.83E-43 | 3.98E-43 |
| -9 | 3.98E-43 | 9.83E-43 | 1.91E-42 | 2.966E-42 | 3.8066E-42 | 4.1239E-42 | 3.807E-42 | 2.966E-42 | 1.905E-42 | 9.83E-43 | 3.98E-43 |
| -12 | 3.98E-43 | 9.83E-43 | 1.91E-42 | 2.966E-42 | 3.8066E-42 | 4.1239E-42 | 3.807E-42 | 2.966E-42 | 1.905E-42 | 9.83E-43 | 3.98E-43 |
| -15 | 3.98E-43 | 9.83E-43 | 1.91E-42 | 2.966E-42 | 3.8066E-42 | 4.1239E-42 | 3.807E-42 | 2.966E-42 | 1.905E-42 | 9.83E-43 | 3.98E-43 |
| -18 | 3.98E-43 | 9.83E-43 | 1.91E-42 | 2.966E-42 | 3.8066E-42 | 4.1239E-42 | 3.807E-42 | 2.966E-42 | 1.905E-42 | 9.83E-43 | 3.98E-43 |
| -21 | 3.98E-43 | 9.83E-43 | 1.91E-42 | 2.966E-42 | 3.8066E-42 | 4.1239E-42 | 3.807E-42 | 2.966E-42 | 1.905E-42 | 9.83E-43 | 3.98E-43 |
| -24 | 3.98E-43 | 9.83E-43 | 1.91E-42 | 2.966E-42 | 3.8066E-42 | 4.1239E-42 | 3.807E-42 | 2.966E-42 | 1.905E-42 | 9.83E-43 | 3.98E-43 |
| -27 | 3.98E-43 | 9.83E-43 | 1.91E-42 | 2.966E-42 | 3.8066E-42 | 4.1239E-42 | 3.807E-42 | 2.966E-42 | 1.905E-42 | 9.83E-43 | 3.98E-43 |
| -30 | 1.99E-43 | 4.915E-43 | 9.53E-43 | 1.483E-42 | 1.9033E-42 | 2.0619E-42 | 1.903E-42 | 1.483E-42 | 9.527E-43 | 4.91E-43 | 1.99E-43 |

**Average Groundwater Concentration** #DIV/0! mg/l

**Plume Flow** 0.00000 cfs 0 MGD

**Mass Loading to Stream** #DIV/0! mg/day

Table J.15 N-111 Pyrene

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

Project: Sunoco Philadelphia AOI 8 N-111

Date: 10/21/2011

Contaminant: N-111 Pyrene

Prepared by: TS

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) |
|---|---|---|---|---|---|---|---|
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | |
| 0.16 | 200 | 20 | 1.00E-04 | 1.92E-04 | 100 | 30 | 1.00E+99 |

| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.0033 | 0.35 | 1.7 | 68000 | 5.00E-03 | 1652.429 | 1.615E-06 |

| | -101 | -80.8 | -60.6 | -40.4 | -20.2 | 0 | 20.2 | 40.4 | 60.6 | 80.8 | 101 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Edge Criterion (mg/l) 130 | 0 | 1.26E-13 | 3.11E-13 | 6.03E-13 | 9.383E-13 | 1.2044E-12 | 1.3047E-12 | 1.204E-12 | 9.383E-13 | 6.028E-13 | 3.11E-13 | 1.26E-13 |
| Higest modeled conc. 1.3E-12 | -3 | 1.26E-13 | 3.11E-13 | 6.03E-13 | 9.383E-13 | 1.2044E-12 | 1.3047E-12 | 1.204E-12 | 9.383E-13 | 6.028E-13 | 3.11E-13 | 1.26E-13 |
| | -6 | 1.26E-13 | 3.11E-13 | 6.03E-13 | 9.383E-13 | 1.2044E-12 | 1.3047E-12 | 1.204E-12 | 9.383E-13 | 6.028E-13 | 3.11E-13 | 1.26E-13 |
| SURFACE WATER LOADING GRID | -9 | 1.26E-13 | 3.11E-13 | 6.03E-13 | 9.383E-13 | 1.2044E-12 | 1.3047E-12 | 1.204E-12 | 9.383E-13 | 6.028E-13 | 3.11E-13 | 1.26E-13 |
| Distance to Stream (ft) 33 | -12 | 1.26E-13 | 3.11E-13 | 6.03E-13 | 9.383E-13 | 1.2044E-12 | 1.3047E-12 | 1.204E-12 | 9.383E-13 | 6.028E-13 | 3.11E-13 | 1.26E-13 |
| Plume View Width (ft) 202 | -15 | 1.26E-13 | 3.11E-13 | 6.03E-13 | 9.383E-13 | 1.2044E-12 | 1.3047E-12 | 1.204E-12 | 9.383E-13 | 6.028E-13 | 3.11E-13 | 1.26E-13 |
| Plume View Depth (ft) 30 | -18 | 1.26E-13 | 3.11E-13 | 6.03E-13 | 9.383E-13 | 1.2044E-12 | 1.3047E-12 | 1.204E-12 | 9.383E-13 | 6.028E-13 | 3.11E-13 | 1.26E-13 |
| | -21 | 1.26E-13 | 3.11E-13 | 6.03E-13 | 9.383E-13 | 1.2044E-12 | 1.3047E-12 | 1.204E-12 | 9.383E-13 | 6.028E-13 | 3.11E-13 | 1.26E-13 |
| | -24 | 1.26E-13 | 3.11E-13 | 6.03E-13 | 9.383E-13 | 1.2044E-12 | 1.3047E-12 | 1.204E-12 | 9.383E-13 | 6.028E-13 | 3.11E-13 | 1.26E-13 |
| PENTOX NOT NEEDED | -27 | 1.26E-13 | 3.11E-13 | 6.03E-13 | 9.383E-13 | 1.2044E-12 | 1.3047E-12 | 1.204E-12 | 9.383E-13 | 6.028E-13 | 3.11E-13 | 1.26E-13 |
| | -30 | 6.29E-14 | 1.555E-13 | 3.01E-13 | 4.691E-13 | 6.0218E-13 | 6.5237E-13 | 6.022E-13 | 4.691E-13 | 3.014E-13 | 1.55E-13 | 6.29E-14 |

**Average Groundwater Concentration** #DIV/0! mg/l

**Plume Flow** 0.00000 cfs 0 MGD

**Mass Loading to Stream** #DIV/0! mg/day

**Table J.16**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**N-133**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | AOI 8 SUNOCO Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **N-133** | Jul-08 |
| Sample Date | | | July-08 | |
| Source Width | | ft | 100 | Delineated LNAPL (100' if no plume is present) |
| Source Thickness | | ft | 30 | Alluvium Thickness from X-Sections |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | 0.1 x Longitudinal Dispersivity (QD User's Guide) |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | negligible QD User's Guide |
| Hydraulic Conductivty | k | ft/day | 0.283 | Estimated Barrier Wall Permeability |
| Hydraulic Gradient | | ft/ft | 0.036 | N-133/N-74 |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | steady-state |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | 1,2-dichloroethane | N-60 |
| Source Concentration (mg/L) | | mg/L | 0.0100 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 1.918E-04 | Number Please!2011 |
| KOC | | | 38 | Number Please!2011 |

**Output (Distance from Source Where Concentration Equals Respective Ground Water MSC)**

| Contaminant | Starting Concentration (mg/L) | GW MSC[1] Non-Residential (mg/L) | Predicted Concentration (mg/L) | Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot) |
|---|---|---|---|---|
| Sim 1 - 1,2-dichloroethane | 0.0100 | 0.005 | 0.005 | **59** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | 1,2-dichloroethane starting concentration = 0.01 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

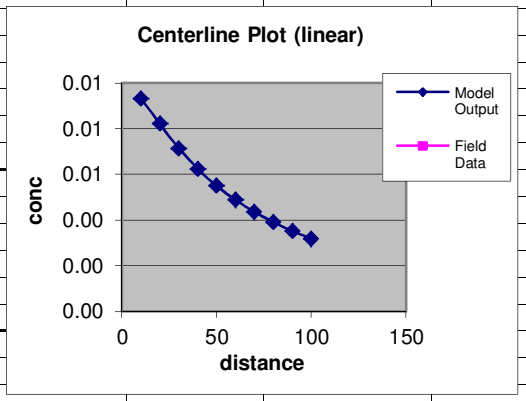
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00019178 | 100 | 30 | 1E+99 |

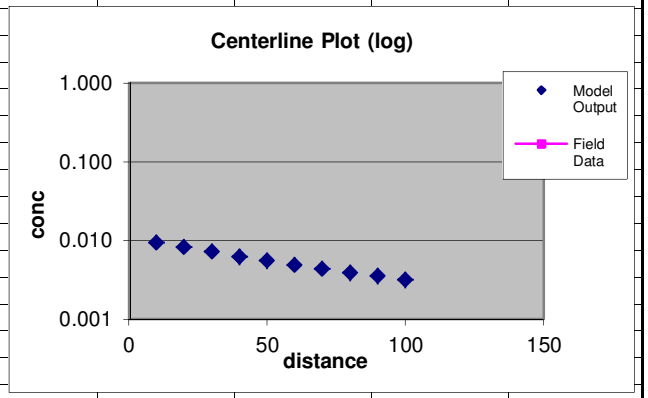
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^3$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.036 | 0.35 | 1.7 | 38 | 5.00E-03 | 1.922857143 | 0.015138187 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 58.76192216 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 58.76192216 | 0 | 0 |
| at | 1E+99 | days = | 0.005 mg/l |




| | AREAL MODEL | CALCULATION DOMAIN |
|---|---|---|
| | Length (ft) | 100 |
| | Width (ft) | 100 |

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| 50 | 0.005 | 0.004 | 0.004 | 0.004 | 0.004 | 0.003 | 0.003 | 0.003 | 0.003 | 0.002 |
| 0 | 0.009 | 0.008 | 0.007 | 0.006 | 0.005 | 0.005 | 0.004 | 0.004 | 0.004 | 0.003 |
| -50 | 0.005 | 0.004 | 0.004 | 0.004 | 0.004 | 0.003 | 0.003 | 0.003 | 0.003 | 0.002 |
| -100 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |

| Field Data: | Centerline C | Concentration |
|---|---|---|
| | Distance from Source | |

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project: | SWLOAD5B | | | | | | | | | | | | | | |
| Date: | 1/11/2012 | | | | | | | | | | | | | | |
| Contaminant: | N-133 12DCA | | | Prepared by: | | TS | | | | | | | | | |
| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) | | | | | | | | |
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | | | | | | | | | |
| 0.01 | 200 | 20 | 1.00E-04 | 1.92E-04 | 100 | 30 | 1.00E+99 | | | | | | | | |
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) | | | | | | | | |
| 2.83E-01 | 0.036 | 0.35 | 1.7 | 38 | 5.00E-03 | 1.922857 | 0.0151382 | | | | | | | | |
| | | | | -32.5 | -26 | -19.5 | -13 | -6.5 | 0 | 6.5 | 13 | 19.5 | 26 | 32.5 | |
| Edge Criterion (mg/l) | | 0.005 | 0 | 0.003375 | 0.0035301 | 0.003655 | 0.0037471 | 0.00380339 | 0.00382232 | 0.0038034 | 0.0037471 | 0.0036552 | 0.00353 | 0.003375 | |
| Higest modeled conc. | | 0.00382 | -1.0438 | 0.003375 | 0.0035301 | 0.003655 | 0.0037471 | 0.00380339 | 0.00382232 | 0.0038034 | 0.0037471 | 0.0036552 | 0.00353 | 0.003375 | |
| | | | -2.0876 | 0.003375 | 0.0035301 | 0.003655 | 0.0037471 | 0.00380339 | 0.00382232 | 0.0038034 | 0.0037471 | 0.0036552 | 0.00353 | 0.003375 | |
| SURFACE WATER LOADING GRID | | | -3.1314 | 0.003375 | 0.0035301 | 0.003655 | 0.0037471 | 0.00380339 | 0.00382232 | 0.0038034 | 0.0037471 | 0.0036552 | 0.00353 | 0.003375 | |
| Distance to Stream (ft) | | 82 | -4.1752 | 0.003375 | 0.0035301 | 0.003655 | 0.0037471 | 0.00380339 | 0.00382232 | 0.0038034 | 0.0037471 | 0.0036552 | 0.00353 | 0.003375 | |
| Plume View Width (ft) | | 65 | -5.219 | 0.003375 | 0.0035301 | 0.003655 | 0.0037471 | 0.00380339 | 0.00382232 | 0.0038034 | 0.0037471 | 0.0036552 | 0.00353 | 0.003375 | |
| Plume View Depth (ft) | | 10.438 | -6.2628 | 0.003375 | 0.0035301 | 0.003655 | 0.0037471 | 0.00380339 | 0.00382232 | 0.0038034 | 0.0037471 | 0.0036552 | 0.00353 | 0.003375 | |
| | | | -7.3066 | 0.003375 | 0.0035301 | 0.003655 | 0.0037471 | 0.00380339 | 0.00382232 | 0.0038034 | 0.0037471 | 0.0036552 | 0.00353 | 0.003375 | |
| | | | -8.3504 | 0.003375 | 0.0035301 | 0.003655 | 0.0037471 | 0.00380339 | 0.00382232 | 0.0038034 | 0.0037471 | 0.0036552 | 0.00353 | 0.003375 | |
| PENTOX NOT NEEDED | | | -9.3942 | 0.003375 | 0.0035301 | 0.003655 | 0.0037471 | 0.00380339 | 0.00382232 | 0.0038034 | 0.0037471 | 0.0036552 | 0.00353 | 0.003375 | |
| | | | -10.438 | 0.003375 | 0.0035301 | 0.003655 | 0.0037471 | 0.00380339 | 0.00382232 | 0.0038034 | 0.0037471 | 0.0036552 | 0.00353 | 0.003375 | |
| | | | | | | | | | | | | | | | |
| | | | | Average Groundwater Concentration | | | | 0.00364 | mg/l | | | | | | |
| | | | | Plume Flow | | | | 0.00008 | cfs | 5.2E-05 MGD | | | | | |
| | | | | Mass Loading to Stream | | | 0.71 | mg/day | | | | | | | |

PA DEPARTMENT
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SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

**Table J.18**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**PZ-503**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | AOI 8 SUNOCO Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **PZ-503** | Jul-08 |
| Sample Date | | | July-08 | |
| Source Width | | ft | 100 | Delineated LNAPL (100' if no plume is present) |
| Source Thickness | | ft | 30 | Alluvium Thickness from X-Sections |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | 0.1 x Longitudinal Dispersivity (QD User's Guide) |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | negligible QD User's Guide |
| Hydraulic Conductivty | k | ft/day | 0.283 | Estimated Barrier Wall Permeability |
| Hydraulic Gradient | | ft/ft | 0.0054 | N-135/PZ-503 |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | steady-state |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | Chrysene | PZ-503 |
| Source Concentration (mg/L) | | mg/L | 0.0510 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 0.000 | Number Please!2011 |
| KOC | | | 490000 | Number Please!2011 |

| Output (Distance from Source Where Concentration Equals Respective Ground Water MSC) | | | | |
|---|---|---|---|---|
| **Contaminant** | **Starting Concentration (mg/L)** | **GW MSC[1] Non-Residential (mg/L)** | **Predicted Concentration (mg/L)** | **Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot)** |
| Sim 1 - Chrysene | 0.0510 | 0.002 | 0.002 | **1** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | Chrysene starting concentration = 0.051 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

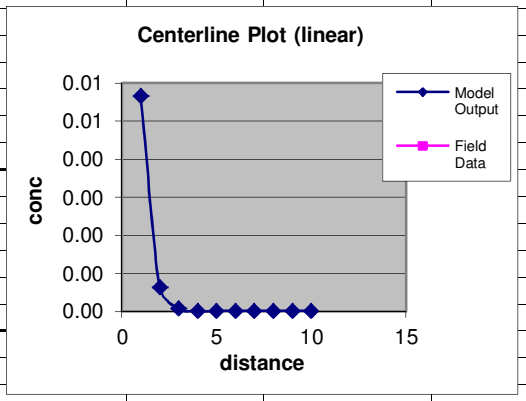
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00035616 | 100 | 30 | 1E+99 |

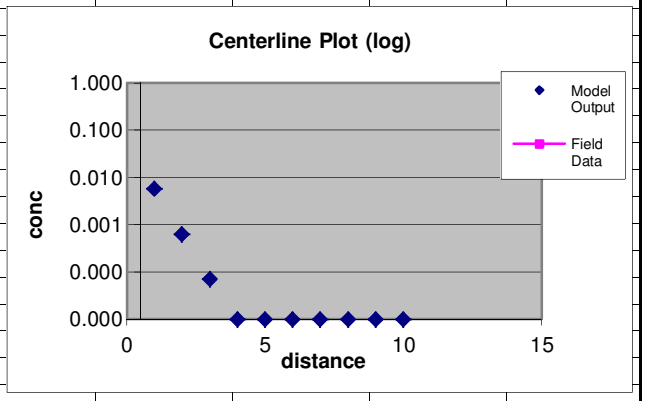
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.0054 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 3.66884E-07 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 1.471974583 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 1.471974583 | 0 | 0 |
| at | 1E+99 | days = | 0.002 mg/l |




| AREAL MODEL | CALCULATION DOMAIN |
|---|---|
| Length (ft) | 10 |
| Width (ft) | 10 |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.006 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 0.006 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0 | 0.006 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| -5 | 0.006 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| -10 | 0.006 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Field Data: | Centerline C | Concentration | | | | | | | | |
| | Distance from Source | | | | | | | | | |

Table J.19 PZ-503 Chrysene

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project: | Sunoco Philadelphia AOI 8 PZ-503 | | | | | | | | | | | | | | |
| Date: | 10/21/2011 | | | | | | | | | | | | | | |
| Contaminant: | PZ-503 Chrysene | | | Prepared by: | | TS | | | | | | | | | |
| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) | | | | | | | | |
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | | | | | | | | | |
| 0.051 | 200 | 20 | 1.00E-04 | 3.56E-04 | 100 | 30 | 1.00E+99 | | | | | | | | |
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) | | | | | | | | |
| 2.83E-01 | 0.0054 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 3.669E-07 | | | | | | | | |

PA DEPARTMENT
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SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

| | -50 | -40 | -30 | -20 | -10 | 0 | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Edge Criterion (mg/l) 0.00048 | 0 | 4.04E-28 | 4.996E-28 | 5.84E-28 | 6.505E-28 | 6.923E-28 | 7.0654E-28 | 6.923E-28 | 6.505E-28 | 5.844E-28 | 5E-28 | 4.04E-28 |
| Higest modeled conc. 7.1E-28 | -3 | 4.04E-28 | 4.996E-28 | 5.84E-28 | 6.505E-28 | 6.923E-28 | 7.0654E-28 | 6.923E-28 | 6.505E-28 | 5.844E-28 | 5E-28 | 4.04E-28 |
| | -6 | 4.04E-28 | 4.996E-28 | 5.84E-28 | 6.505E-28 | 6.923E-28 | 7.0654E-28 | 6.923E-28 | 6.505E-28 | 5.844E-28 | 5E-28 | 4.04E-28 |
| SURFACE WATER LOADING GRID | -9 | 4.04E-28 | 4.996E-28 | 5.84E-28 | 6.505E-28 | 6.923E-28 | 7.0654E-28 | 6.923E-28 | 6.505E-28 | 5.844E-28 | 5E-28 | 4.04E-28 |
| Distance to Stream (ft) 27 | -12 | 4.04E-28 | 4.996E-28 | 5.84E-28 | 6.505E-28 | 6.923E-28 | 7.0654E-28 | 6.923E-28 | 6.505E-28 | 5.844E-28 | 5E-28 | 4.04E-28 |
| Plume View Width (ft) 100 | -15 | 4.04E-28 | 4.996E-28 | 5.84E-28 | 6.505E-28 | 6.923E-28 | 7.0654E-28 | 6.923E-28 | 6.505E-28 | 5.844E-28 | 5E-28 | 4.04E-28 |
| Plume View Depth (ft) 30 | -18 | 4.04E-28 | 4.996E-28 | 5.84E-28 | 6.505E-28 | 6.923E-28 | 7.0654E-28 | 6.923E-28 | 6.505E-28 | 5.844E-28 | 5E-28 | 4.04E-28 |
| | -21 | 4.04E-28 | 4.996E-28 | 5.84E-28 | 6.505E-28 | 6.923E-28 | 7.0654E-28 | 6.923E-28 | 6.505E-28 | 5.844E-28 | 5E-28 | 4.04E-28 |
| | -24 | 4.04E-28 | 4.996E-28 | 5.84E-28 | 6.505E-28 | 6.923E-28 | 7.0654E-28 | 6.923E-28 | 6.505E-28 | 5.844E-28 | 5E-28 | 4.04E-28 |
| PENTOX NOT NEEDED | -27 | 4.04E-28 | 4.996E-28 | 5.84E-28 | 6.505E-28 | 6.923E-28 | 7.0654E-28 | 6.923E-28 | 6.505E-28 | 5.844E-28 | 5E-28 | 4.04E-28 |
| | -30 | 2.02E-28 | 2.498E-28 | 2.92E-28 | 3.253E-28 | 3.4615E-28 | 3.5327E-28 | 3.462E-28 | 3.253E-28 | 2.922E-28 | 2.5E-28 | 2.02E-28 |

**Average Groundwater Concentration** #DIV/0! mg/l

**Plume Flow** 0.00000 cfs 0 MGD

**Mass Loading to Stream** #DIV/0! mg/day

**Table J.20**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**PZ-504**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | AOI 8 SUNOCO Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **PZ-504** | Jul-08 |
| Sample Date | | | July-08 | |
| Source Width | | ft | 100 | Delineated LNAPL (100' if no plume is present) |
| Source Thickness | | ft | 30 | Alluvium Thickness from X-Sections |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | 0.1 x Longitudinal Dispersivity (QD User's Guide) |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | negligible QD User's Guide |
| Hydraulic Conductivty | k | ft/day | 0.283 | Estimated Barrier Wall Permeability |
| Hydraulic Gradient | | ft/ft | 0.091 | N-75/PZ-504 |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | steady-state |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | Chrysene | N-101 |
| Source Concentration (mg/L) | | mg/L | 0.1200 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 0.000 | Number Please!2011 |
| KOC | | | 490000 | Number Please!2011 |

| Output (Distance from Source Where Concentration Equals Respective Ground Water MSC) | | | | |
|---|---|---|---|---|
| **Contaminant** | **Starting Concentration (mg/L)** | **GW MSC[1] Non-Residential (mg/L)** | **Predicted Concentration (mg/L)** | **Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot)** |
| Sim 1 - Chrysene | 0.1200 | 0.002 | 0.002 | **8** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | Chrysene starting concentration = 0.12 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

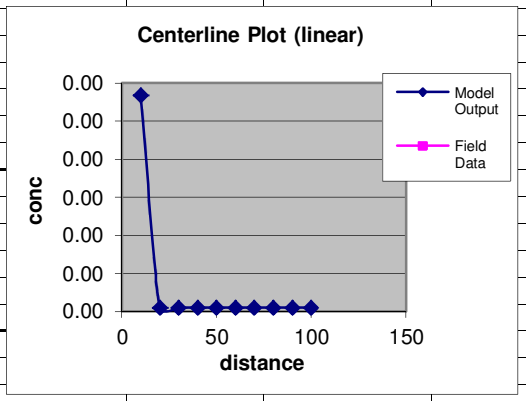
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00035616 | 100 | 30 | 1E+99 |

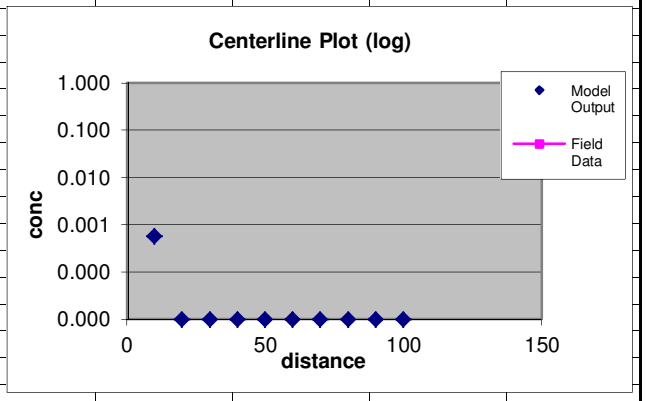
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^3$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.091 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 6.18267E-06 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 7.658021673 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 7.658021673 | 0 | 0 |
| at | 1E+99 | days = | 0.002 mg/l |




| AREAL MODEL | CALCULATION DOMAIN |
|---|---|
| Length (ft) | 100 |
| Width (ft) | 100 |

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 50 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| -50 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| -100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| Field Data: | Centerline C | Concentration |
|---|---|---|
| | Distance from Source | |

Table J.21 PZ-503 Chrysene

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

Project: Sunoco Philadelphia AOI 8 PZ-504

Date: 10/21/2011

Contaminant: PZ-503 Chrysene

Prepared by: TS

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) |
|---|---|---|---|---|---|---|---|
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | |
| 0.12 | 200 | 20 | 1.00E-04 | 3.56E-04 | 100 | 30 | 1.00E+99 |

| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.091 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 6.183E-06 |

Edge Criterion (mg/l) 0.00048

Higest modeled conc. 3.3E-08

SURFACE WATER LOADING GRID

Distance to Stream (ft) 28

Plume View Width (ft) 100

Plume View Depth (ft) 30

PENTOX NOT NEEDED

| | -50 | -40 | -30 | -20 | -10 | 0 | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.92E-08 | 2.36E-08 | 2.75E-08 | 3.063E-08 | 3.2576E-08 | 3.3242E-08 | 3.258E-08 | 3.063E-08 | 2.754E-08 | 2.36E-08 | 1.92E-08 |
| -3 | 1.92E-08 | 2.36E-08 | 2.75E-08 | 3.063E-08 | 3.2576E-08 | 3.3242E-08 | 3.258E-08 | 3.063E-08 | 2.754E-08 | 2.36E-08 | 1.92E-08 |
| -6 | 1.92E-08 | 2.36E-08 | 2.75E-08 | 3.063E-08 | 3.2576E-08 | 3.3242E-08 | 3.258E-08 | 3.063E-08 | 2.754E-08 | 2.36E-08 | 1.92E-08 |
| -9 | 1.92E-08 | 2.36E-08 | 2.75E-08 | 3.063E-08 | 3.2576E-08 | 3.3242E-08 | 3.258E-08 | 3.063E-08 | 2.754E-08 | 2.36E-08 | 1.92E-08 |
| -12 | 1.92E-08 | 2.36E-08 | 2.75E-08 | 3.063E-08 | 3.2576E-08 | 3.3242E-08 | 3.258E-08 | 3.063E-08 | 2.754E-08 | 2.36E-08 | 1.92E-08 |
| -15 | 1.92E-08 | 2.36E-08 | 2.75E-08 | 3.063E-08 | 3.2576E-08 | 3.3242E-08 | 3.258E-08 | 3.063E-08 | 2.754E-08 | 2.36E-08 | 1.92E-08 |
| -18 | 1.92E-08 | 2.36E-08 | 2.75E-08 | 3.063E-08 | 3.2576E-08 | 3.3242E-08 | 3.258E-08 | 3.063E-08 | 2.754E-08 | 2.36E-08 | 1.92E-08 |
| -21 | 1.92E-08 | 2.36E-08 | 2.75E-08 | 3.063E-08 | 3.2576E-08 | 3.3242E-08 | 3.258E-08 | 3.063E-08 | 2.754E-08 | 2.36E-08 | 1.92E-08 |
| -24 | 1.92E-08 | 2.36E-08 | 2.75E-08 | 3.063E-08 | 3.2576E-08 | 3.3242E-08 | 3.258E-08 | 3.063E-08 | 2.754E-08 | 2.36E-08 | 1.92E-08 |
| -27 | 1.92E-08 | 2.36E-08 | 2.75E-08 | 3.063E-08 | 3.2576E-08 | 3.3242E-08 | 3.258E-08 | 3.063E-08 | 2.754E-08 | 2.36E-08 | 1.92E-08 |
| -30 | 9.58E-09 | 1.18E-08 | 1.38E-08 | 1.531E-08 | 1.6288E-08 | 1.6621E-08 | 1.629E-08 | 1.531E-08 | 1.377E-08 | 1.18E-08 | 9.58E-09 |

**Average Groundwater Concentration** #DIV/0! mg/l

**Plume Flow** 0.00000 cfs 0 MGD

**Mass Loading to Stream** #DIV/0! mg/day

**Table J.22**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**PZ-505**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | AOI 8 SUNOCO Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **PZ-505** | Jul-08 |
| Sample Date | | | July-08 | |
| Source Width | | ft | 100 | Delineated LNAPL (100' if no plume is present) |
| Source Thickness | | ft | 30 | Alluvium Thickness from X-Sections |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | 0.1 x Longitudinal Dispersivity (QD User's Guide) |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | negligible QD User's Guide |
| Hydraulic Conductivty | k | ft/day | 0.283 | Estimated Barrier Wall Permeability |
| Hydraulic Gradient | | ft/ft | 0.0038 | N-55/PZ-505 |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | steady-state |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | Chrysene | PZ-505 |
| Source Concentration (mg/L) | | mg/L | 0.0410 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 0.000 | Number Please!2011 |
| KOC | | | 490000 | Number Please!2011 |

| Output (Distance from Source Where Concentration Equals Respective Ground Water MSC) | | | | |
|---|---|---|---|---|
| **Contaminant** | **Starting Concentration (mg/L)** | **GW MSC[1] Non-Residential (mg/L)** | **Predicted Concentration (mg/L)** | **Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot)** |
| Sim 1 - Chrysene | 0.0410 | 0.002 | 0.002 | **1** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | Chrysene starting concentration = 0.041 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

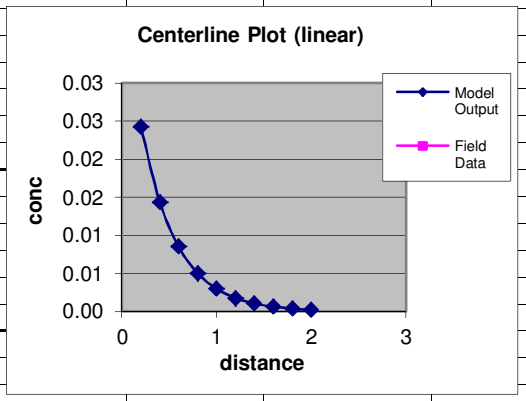
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00035616 | 100 | 30 | 1E+99 |

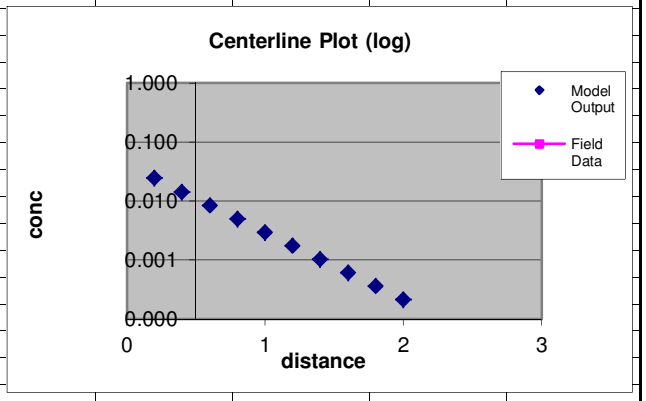
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^3$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.0038 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 2.58178E-07 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 1.151503841 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 1.151503841 | 0 | 0 |
| at | 1E+99 | days = | 0.002 mg/l |




| | AREAL MODEL | CALCULATION DOMAIN |
|---|---|---|
| | Length (ft) | 2 |
| | Width (ft) | 2 |

| | 0.2 | 0.4 | 0.6 | 0.8 | 1 | 1.2 | 1.4 | 1.6 | 1.8 | 2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0.024 | 0.014 | 0.008 | 0.005 | 0.003 | 0.002 | 0.001 | 0.001 | 0.000 | 0.000 |
| 1 | 0.024 | 0.014 | 0.008 | 0.005 | 0.003 | 0.002 | 0.001 | 0.001 | 0.000 | 0.000 |
| 0 | 0.024 | 0.014 | 0.008 | 0.005 | 0.003 | 0.002 | 0.001 | 0.001 | 0.000 | 0.000 |
| -1 | 0.024 | 0.014 | 0.008 | 0.005 | 0.003 | 0.002 | 0.001 | 0.001 | 0.000 | 0.000 |
| -2 | 0.024 | 0.014 | 0.008 | 0.005 | 0.003 | 0.002 | 0.001 | 0.001 | 0.000 | 0.000 |

| Field Data: | Centerline C | Concentration |
|---|---|---|
| | Distance from Source | |

Table J.23 PZ-505 Chrysene

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project: | Sunoco Philadelphia AOI 8 PZ-505 | | | | | | | | | | | | | | |
| Date: | 10/21/2011 | | | | | | | | | | | | | | |
| Contaminant: | PZ-505 Chrysene | | | Prepared by: | | TS | | | | | | | | | |
| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) | | | | | | | | |
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | | | | | | | | | |
| 0.041 | 200 | 20 | 1.00E-04 | 3.56E-04 | 100 | 30 | 1.00E+99 | | | | | | | | |
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) | | | | | | | | |
| 2.83E-01 | 0.0038 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 2.582E-07 | | | | | | | | |

| | | -50 | -40 | -30 | -20 | -10 | 0 | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Edge Criterion (mg/l) | 0.00048 | 0 | 2.72E-42 | 3.273E-42 | 3.77E-42 | 4.154E-42 | 4.4011E-42 | 4.4859E-42 | 4.401E-42 | 4.154E-42 | 3.766E-42 | 3.27E-42 | 2.72E-42 |
| Higest modeled conc. | 4.5E-42 | -3 | 2.72E-42 | 3.273E-42 | 3.77E-42 | 4.154E-42 | 4.4011E-42 | 4.4859E-42 | 4.401E-42 | 4.154E-42 | 3.766E-42 | 3.27E-42 | 2.72E-42 |
| | | -6 | 2.72E-42 | 3.273E-42 | 3.77E-42 | 4.154E-42 | 4.4011E-42 | 4.4859E-42 | 4.401E-42 | 4.154E-42 | 3.766E-42 | 3.27E-42 | 2.72E-42 |
| SURFACE WATER LOADING GRID | | -9 | 2.72E-42 | 3.273E-42 | 3.77E-42 | 4.154E-42 | 4.4011E-42 | 4.4859E-42 | 4.401E-42 | 4.154E-42 | 3.766E-42 | 3.27E-42 | 2.72E-42 |
| Distance to Stream (ft) | 35 | -12 | 2.72E-42 | 3.273E-42 | 3.77E-42 | 4.154E-42 | 4.4011E-42 | 4.4859E-42 | 4.401E-42 | 4.154E-42 | 3.766E-42 | 3.27E-42 | 2.72E-42 |
| Plume View Width (ft) | 100 | -15 | 2.72E-42 | 3.273E-42 | 3.77E-42 | 4.154E-42 | 4.4011E-42 | 4.4859E-42 | 4.401E-42 | 4.154E-42 | 3.766E-42 | 3.27E-42 | 2.72E-42 |
| Plume View Depth (ft) | 30 | -18 | 2.72E-42 | 3.273E-42 | 3.77E-42 | 4.154E-42 | 4.4011E-42 | 4.4859E-42 | 4.401E-42 | 4.154E-42 | 3.766E-42 | 3.27E-42 | 2.72E-42 |
| | | -21 | 2.72E-42 | 3.273E-42 | 3.77E-42 | 4.154E-42 | 4.4011E-42 | 4.4859E-42 | 4.401E-42 | 4.154E-42 | 3.766E-42 | 3.27E-42 | 2.72E-42 |
| | | -24 | 2.72E-42 | 3.273E-42 | 3.77E-42 | 4.154E-42 | 4.4011E-42 | 4.4859E-42 | 4.401E-42 | 4.154E-42 | 3.766E-42 | 3.27E-42 | 2.72E-42 |
| PENTOX NOT NEEDED | | -27 | 2.72E-42 | 3.273E-42 | 3.77E-42 | 4.154E-42 | 4.4011E-42 | 4.4859E-42 | 4.401E-42 | 4.154E-42 | 3.766E-42 | 3.27E-42 | 2.72E-42 |
| | | -30 | 1.36E-42 | 1.637E-42 | 1.88E-42 | 2.077E-42 | 2.2005E-42 | 2.2429E-42 | 2.201E-42 | 2.077E-42 | 1.883E-42 | 1.64E-42 | 1.36E-42 |

| | | | |
|---|---|---|---|
| Average Groundwater Concentration | #DIV/0! | mg/l | |
| Plume Flow | 0.00000 | cfs | 0 MGD |
| Mass Loading to Stream | #DIV/0! | mg/day | |

**Table J.24**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**PZ-506**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | AOI 8 SUNOCO Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **PZ-506** | Jul-08 |
| Sample Date | | | July-08 | |
| Source Width | | ft | 100 | Delineated LNAPL (100' if no plume is present) |
| Source Thickness | | ft | 70 | Alluvium Thickness from X-Sections |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | 0.1 x Longitudinal Dispersivity (QD User's Guide) |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | negligible QD User's Guide |
| Hydraulic Conductivty | k | ft/day | 0.283 | Estimated Barrier Wall Permeability |
| Hydraulic Gradient | | ft/ft | 0.00365 | N-54/PZ-506 |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | steady-state |
| Length of Grid Dimension | | ft | | |
| Width of Grid Dimension | | ft | | |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | Chrysene | PZ-506 |
| Source Concentration (mg/L) | | mg/L | 0.0080 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 3.562E-04 | Number Please!2011 |
| KOC | | | 490000 | Number Please!2011 |
| **Sim 2** | | | | |
| Contaminant | | | Benzene | PZ-506 Reporting Limit |
| Source Concentration (mg/L) | | mg/L | 0.0100 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 9.589E-04 | Number Please!2011 |
| KOC | | | 58 | Number Please!2011 |
| **Sim 3** | | | | |
| Contaminant | | | 1,2-dichloroethane | PZ-506 Reporting Limit |
| Source Concentration (mg/L) | | mg/L | 0.0100 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 1.918E-04 | Number Please!2011 |
| KOC | | | 38 | Number Please!2011 |

| Output (Distance from Source Where Concentration Equals Respective Ground Water MSC) | | | | |
|---|---|---|---|---|
| **Contaminant** | **Starting Concentration (mg/L)** | **GW MSC[1] Non-Residential (mg/L)** | **Predicted Concentration (mg/L)** | **Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot)** |
| Sim 1 - Chrysene | 0.0080 | 0.002 | 0.002 | **1** |
| Sim 2 - Benzene | 0.0100 | 0.005 | 0.005 | **11** |
| Sim 3 - 1,2-dichloroethane | 0.0100 | 0.005 | 0.005 | **26** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | Chrysene starting concentration = 0.008 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

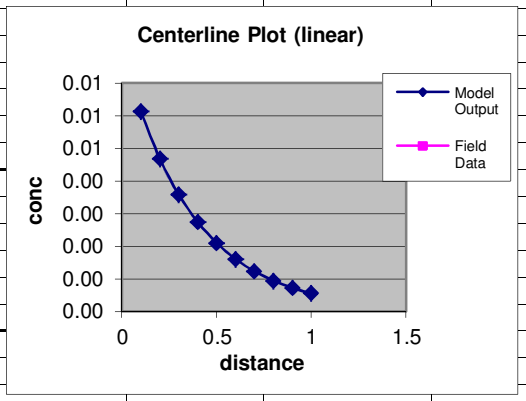
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00035616 | 100 | 70 | 1E+99 |

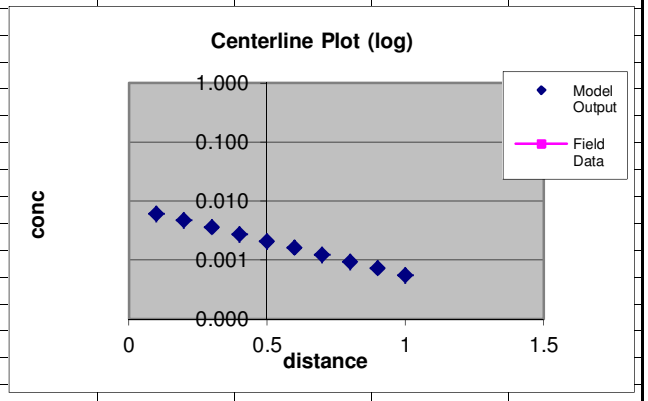
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^3$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.00365 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 2.47986E-07 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 0.517848215 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 0.517848215 | 0 | 0 |
| at | 1E+99 | days = | 0.002 mg/l |




| | AREAL MODEL | CALCULATION DOMAIN |
|---|---|---|
| | Length (ft) | 1 |
| | Width (ft) | 1 |

| | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.006 | 0.005 | 0.004 | 0.003 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 |
| 0.5 | 0.006 | 0.005 | 0.004 | 0.003 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 |
| 0 | 0.006 | 0.005 | 0.004 | 0.003 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 |
| -0.5 | 0.006 | 0.005 | 0.004 | 0.003 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 |
| -1 | 0.006 | 0.005 | 0.004 | 0.003 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Field Data: | Centerline C | Concentration | | | | | | | | |
| | Distance from Source | | | | | | | | | |

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | Benzene starting concentration = 0.01 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

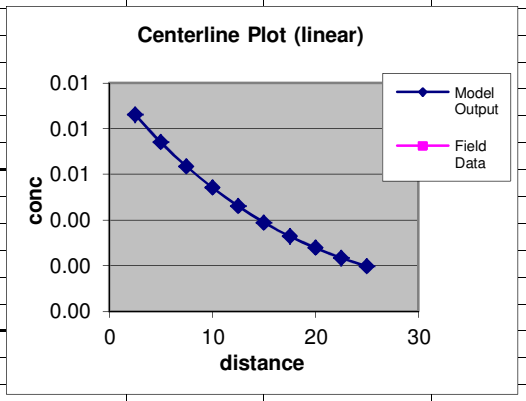
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.0009589 | 100 | 70 | 1E+99 |

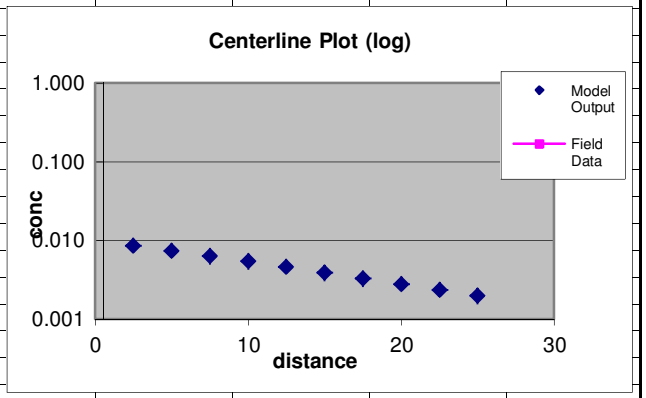
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^3$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.00365 | 0.35 | 1.7 | 58 | 5.00E-03 | 2.408571429 | 0.001225326 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 11.4258958 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 11.4258958 | 0 | 0 |
| at | 1E+99 | days = | 0.005 mg/l |




| | AREAL MODEL | CALCULATION DOMAIN |
|---|---|---|
| | Length (ft) | 25 |
| | Width (ft) | 25 |

| | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 | 17.5 | 20 | 22.5 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 0.009 | 0.007 | 0.006 | 0.005 | 0.004 | 0.003 | 0.003 | 0.002 | 0.002 | 0.002 |
| 12.5 | 0.009 | 0.007 | 0.006 | 0.005 | 0.004 | 0.004 | 0.003 | 0.003 | 0.002 | 0.002 |
| 0 | 0.009 | 0.007 | 0.006 | 0.005 | 0.005 | 0.004 | 0.003 | 0.003 | 0.002 | 0.002 |
| -12.5 | 0.009 | 0.007 | 0.006 | 0.005 | 0.004 | 0.004 | 0.003 | 0.003 | 0.002 | 0.002 |
| -25 | 0.009 | 0.007 | 0.006 | 0.005 | 0.004 | 0.003 | 0.003 | 0.002 | 0.002 | 0.002 |
| Field Data: | Centerline C | Concentration | | | | | | | | |
| | Distance from Source | | | | | | | | | |

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | 1,2-dichloroethane starting concentration = 0.01 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

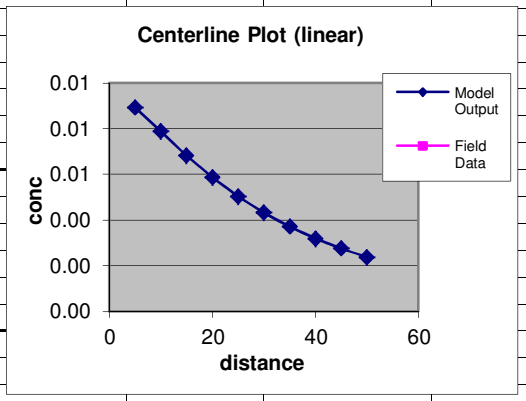
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00019178 | 100 | 70 | 1E+99 |

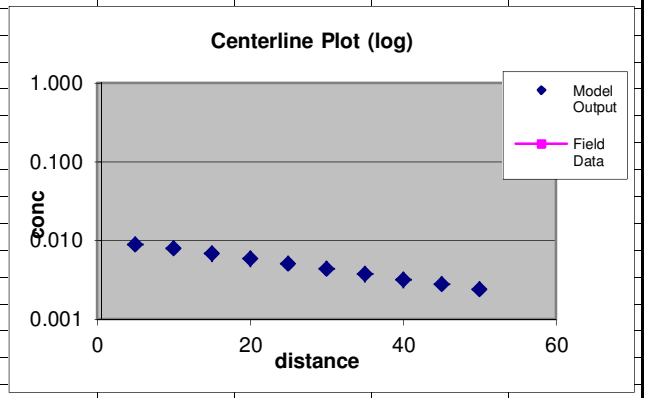
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^3$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.00365 | 0.35 | 1.7 | 38 | 5.00E-03 | 1.922857143 | 0.001534844 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 25.69922119 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 25.69922119 | 0 | 0 |
| at | 1E+99 | days = | 0.005 mg/l |




| | AREAL MODEL | CALCULATION DOMAIN |
|---|---|---|
| | Length (ft) | 50 |
| | Width (ft) | 50 |

| | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0.004 | 0.004 | 0.004 | 0.003 | 0.003 | 0.003 | 0.002 | 0.002 | 0.002 | 0.002 |
| 25 | 0.009 | 0.007 | 0.006 | 0.005 | 0.004 | 0.004 | 0.003 | 0.003 | 0.002 | 0.002 |
| 0 | 0.009 | 0.008 | 0.007 | 0.006 | 0.005 | 0.004 | 0.004 | 0.003 | 0.003 | 0.002 |
| -25 | 0.009 | 0.007 | 0.006 | 0.005 | 0.004 | 0.004 | 0.003 | 0.003 | 0.002 | 0.002 |
| -50 | 0.004 | 0.004 | 0.004 | 0.003 | 0.003 | 0.003 | 0.002 | 0.002 | 0.002 | 0.002 |

| Field Data: | Centerline C | Concentration |
|---|---|---|
| | Distance from Source | |

Table J.25 PZ-506 Chrysene

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project: | Sunoco Philadelphia AOI 8 PZ-506 | | | | | | | | | | | | | | |
| Date: | 10/21/2011 | | | | | | | | | | | | | | |
| Contaminant: | PZ-506 Chrysene | | | Prepared by: | | TS | | | | | | | | | |
| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) | | | | | | | | |
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | | | | | | | | | |
| 0.008 | 200 | 20 | 1.00E-04 | 3.56E-04 | 100 | 30 | 1.00E+99 | | | | | | | | |
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) | | | | | | | | |
| 2.83E-01 | 0.00365 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 2.48E-07 | | | | | | | | |

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

| | -50 | -40 | -30 | -20 | -10 | 0 | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Edge Criterion (mg/l) 0.00048 | 0 | 2.5E-154 | 2.73E-154 | 2.9E-154 | 3.02E-154 | 3.09E-154 | 3.115E-154 | 3.09E-154 | 3.02E-154 | 2.89E-154 | 2.7E-154 | 2.5E-154 |
| Higest modeled conc. 3E-154 | -3 | 2.5E-154 | 2.73E-154 | 2.9E-154 | 3.02E-154 | 3.09E-154 | 3.115E-154 | 3.09E-154 | 3.02E-154 | 2.89E-154 | 2.7E-154 | 2.5E-154 |
| | -6 | 2.5E-154 | 2.73E-154 | 2.9E-154 | 3.02E-154 | 3.09E-154 | 3.115E-154 | 3.09E-154 | 3.02E-154 | 2.89E-154 | 2.7E-154 | 2.5E-154 |
| SURFACE WATER LOADING GRID | -9 | 2.5E-154 | 2.73E-154 | 2.9E-154 | 3.02E-154 | 3.09E-154 | 3.115E-154 | 3.09E-154 | 3.02E-154 | 2.89E-154 | 2.7E-154 | 2.5E-154 |
| Distance to Stream (ft) 130 | -12 | 2.5E-154 | 2.73E-154 | 2.9E-154 | 3.02E-154 | 3.09E-154 | 3.115E-154 | 3.09E-154 | 3.02E-154 | 2.89E-154 | 2.7E-154 | 2.5E-154 |
| Plume View Width (ft) 100 | -15 | 2.5E-154 | 2.73E-154 | 2.9E-154 | 3.02E-154 | 3.09E-154 | 3.115E-154 | 3.09E-154 | 3.02E-154 | 2.89E-154 | 2.7E-154 | 2.5E-154 |
| Plume View Depth (ft) 30 | -18 | 2.5E-154 | 2.73E-154 | 2.9E-154 | 3.02E-154 | 3.09E-154 | 3.115E-154 | 3.09E-154 | 3.02E-154 | 2.89E-154 | 2.7E-154 | 2.5E-154 |
| | -21 | 2.5E-154 | 2.73E-154 | 2.9E-154 | 3.02E-154 | 3.09E-154 | 3.115E-154 | 3.09E-154 | 3.02E-154 | 2.89E-154 | 2.7E-154 | 2.5E-154 |
| | -24 | 2.5E-154 | 2.73E-154 | 2.9E-154 | 3.02E-154 | 3.09E-154 | 3.115E-154 | 3.09E-154 | 3.02E-154 | 2.89E-154 | 2.7E-154 | 2.5E-154 |
| PENTOX NOT NEEDED | -27 | 2.5E-154 | 2.73E-154 | 2.9E-154 | 3.02E-154 | 3.09E-154 | 3.115E-154 | 3.09E-154 | 3.02E-154 | 2.89E-154 | 2.7E-154 | 2.5E-154 |
| | -30 | 1.3E-154 | 1.37E-154 | 1.4E-154 | 1.51E-154 | 1.545E-154 | 1.558E-154 | 1.54E-154 | 1.51E-154 | 1.45E-154 | 1.4E-154 | 1.3E-154 |

**Average Groundwater Concentration** #DIV/0! mg/l

**Plume Flow** 0.00000 cfs 0 MGD

**Mass Loading to Stream** #DIV/0! mg/day

Table J.26 PZ-506 Benzene

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project: | Sunoco Philadelphia AOI 8 PZ-506 | | | | | | | | | | | | | | |
| Date: | 10/21/2011 | | | | | | | | | | | | | | |
| Contaminant: | PZ-506 Benzene RL | | | Prepared by: | | TS | | | | | | | | | |
| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) | | | | | | | | |
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | | | | | | | | | |
| 0.01 | 200 | 20 | 1.00E-04 | 9.59E-04 | 100 | 30 | 1.00E+99 | | | | | | | | |
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) | | | | | | | | |
| 2.83E-01 | 0.00365 | 0.35 | 1.7 | 58 | 5.00E-03 | 2.408571 | 0.0012253 | | | | | | | | |

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SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

| | | -50 | -40 | -30 | -20 | -10 | 0 | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Edge Criterion (mg/l) | 0.00048 | 0 | 1.69E-06 | 1.815E-06 | 1.92E-06 | 2.002E-06 | 2.052E-06 | 2.0689E-06 | 2.052E-06 | 2.002E-06 | 1.922E-06 | 1.82E-06 | 1.69E-06 |
| Higest modeled conc. | 2.1E-06 | -3 | 1.69E-06 | 1.815E-06 | 1.92E-06 | 2.002E-06 | 2.052E-06 | 2.0689E-06 | 2.052E-06 | 2.002E-06 | 1.922E-06 | 1.82E-06 | 1.69E-06 |
| | | -6 | 1.69E-06 | 1.815E-06 | 1.92E-06 | 2.002E-06 | 2.052E-06 | 2.0689E-06 | 2.052E-06 | 2.002E-06 | 1.922E-06 | 1.82E-06 | 1.69E-06 |
| SURFACE WATER LOADING GRID | | -9 | 1.69E-06 | 1.815E-06 | 1.92E-06 | 2.002E-06 | 2.052E-06 | 2.0689E-06 | 2.052E-06 | 2.002E-06 | 1.922E-06 | 1.82E-06 | 1.69E-06 |
| Distance to Stream (ft) | 130 | -12 | 1.69E-06 | 1.815E-06 | 1.92E-06 | 2.002E-06 | 2.052E-06 | 2.0689E-06 | 2.052E-06 | 2.002E-06 | 1.922E-06 | 1.82E-06 | 1.69E-06 |
| Plume View Width (ft) | 100 | -15 | 1.69E-06 | 1.815E-06 | 1.92E-06 | 2.002E-06 | 2.052E-06 | 2.0689E-06 | 2.052E-06 | 2.002E-06 | 1.922E-06 | 1.82E-06 | 1.69E-06 |
| Plume View Depth (ft) | 30 | -18 | 1.69E-06 | 1.815E-06 | 1.92E-06 | 2.002E-06 | 2.052E-06 | 2.0689E-06 | 2.052E-06 | 2.002E-06 | 1.922E-06 | 1.82E-06 | 1.69E-06 |
| | | -21 | 1.69E-06 | 1.815E-06 | 1.92E-06 | 2.002E-06 | 2.052E-06 | 2.0689E-06 | 2.052E-06 | 2.002E-06 | 1.922E-06 | 1.82E-06 | 1.69E-06 |
| | | -24 | 1.69E-06 | 1.815E-06 | 1.92E-06 | 2.002E-06 | 2.052E-06 | 2.0689E-06 | 2.052E-06 | 2.002E-06 | 1.922E-06 | 1.82E-06 | 1.69E-06 |
| PENTOX NOT NEEDED | | -27 | 1.69E-06 | 1.815E-06 | 1.92E-06 | 2.002E-06 | 2.052E-06 | 2.0689E-06 | 2.052E-06 | 2.002E-06 | 1.922E-06 | 1.82E-06 | 1.69E-06 |
| | | -30 | 8.43E-07 | 9.076E-07 | 9.61E-07 | 1.001E-06 | 1.026E-06 | 1.0344E-06 | 1.026E-06 | 1.001E-06 | 9.611E-07 | 9.08E-07 | 8.43E-07 |

| | | | |
|---|---|---|---|
| Average Groundwater Concentration | #DIV/0! | mg/l | |
| Plume Flow | 0.00000 | cfs | 0 MGD |
| Mass Loading to Stream | #DIV/0! | mg/day | |

Table J.27 PZ-506 Chrysene

| METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project: | Sunoco Philadelphia AOI 8 PZ-506 | | | | | | | | | | | | | | |
| Date: | 10/21/2011 | | | | | | | | | | | | | | |
| Contaminant: | PZ-506 Chrysene | | | Prepared by: | | TS | | | | | | | | | |
| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) | | | | | | | | |
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | | | | | | | | | |
| 0.008 | 200 | 20 | 1.00E-04 | 1.92E-04 | 100 | 30 | 1.00E+99 | | | | | | | | |
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) | | | | | | | | |
| 2.83E-01 | 0.00365 | 0.35 | 1.7 | 38 | 5.00E-03 | 1.922857 | 0.0015348 | | | | | | | | |
| | | | | -50 | -40 | -30 | -20 | -10 | 0 | 10 | 20 | 30 | 40 | 50 | |
| Edge Criterion (mg/l) | | 0.00048 | 0 | 0.000176 | 0.0001898 | 0.000201 | 0.0002094 | 0.00021459 | 0.00021635 | 0.0002146 | 0.0002094 | 0.000201 | 0.00019 | 0.000176 | |
| Higest modeled conc. | | 0.00022 | -3 | 0.000176 | 0.0001898 | 0.000201 | 0.0002094 | 0.00021459 | 0.00021635 | 0.0002146 | 0.0002094 | 0.000201 | 0.00019 | 0.000176 | |
| | | | -6 | 0.000176 | 0.0001898 | 0.000201 | 0.0002094 | 0.00021459 | 0.00021635 | 0.0002146 | 0.0002094 | 0.000201 | 0.00019 | 0.000176 | |
| SURFACE WATER LOADING GRID | | | -9 | 0.000176 | 0.0001898 | 0.000201 | 0.0002094 | 0.00021459 | 0.00021635 | 0.0002146 | 0.0002094 | 0.000201 | 0.00019 | 0.000176 | |
| Distance to Stream (ft) | | 130 | -12 | 0.000176 | 0.0001898 | 0.000201 | 0.0002094 | 0.00021459 | 0.00021635 | 0.0002146 | 0.0002094 | 0.000201 | 0.00019 | 0.000176 | |
| Plume View Width (ft) | | 100 | -15 | 0.000176 | 0.0001898 | 0.000201 | 0.0002094 | 0.00021459 | 0.00021635 | 0.0002146 | 0.0002094 | 0.000201 | 0.00019 | 0.000176 | |
| Plume View Depth (ft) | | 30 | -18 | 0.000176 | 0.0001898 | 0.000201 | 0.0002094 | 0.00021459 | 0.00021635 | 0.0002146 | 0.0002094 | 0.000201 | 0.00019 | 0.000176 | |
| | | | -21 | 0.000176 | 0.0001898 | 0.000201 | 0.0002094 | 0.00021459 | 0.00021635 | 0.0002146 | 0.0002094 | 0.000201 | 0.00019 | 0.000176 | |
| | | | -24 | 0.000176 | 0.0001898 | 0.000201 | 0.0002094 | 0.00021459 | 0.00021635 | 0.0002146 | 0.0002094 | 0.000201 | 0.00019 | 0.000176 | |
| PENTOX NOT NEEDED | | | -27 | 0.000176 | 0.0001898 | 0.000201 | 0.0002094 | 0.00021459 | 0.00021635 | 0.0002146 | 0.0002094 | 0.000201 | 0.00019 | 0.000176 | |
| | | | -30 | 8.82E-05 | 9.491E-05 | 0.000101 | 0.0001047 | 0.00010729 | 0.00010817 | 0.0001073 | 0.0001047 | 0.0001005 | 9.49E-05 | 8.82E-05 | |
| Average Groundwater Concentration | | | | | | | | #DIV/0! | mg/l | | | | | | |
| Plume Flow | | | | | | | | 0.00000 | cfs | 0 | MGD | | | | |
| Mass Loading to Stream | | | | | | | #DIV/0! | mg/day | | | | | | | |

PA DEPARTMENT
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A METHOD FOR ESTIMATING
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Modified to Include Retardation

**Table J.28**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**PZ-507**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | AOI 8 SUNOCO Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **PZ-507** | Jul-08 |
| Sample Date | | | July-08 | |
| Source Width | | ft | 100 | Delineated LNAPL (100' if no plume is present) |
| Source Thickness | | ft | 70 | Alluvium Thickness from X-Sections |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | 0.1 x Longitudinal Dispersivity (QD User's Guide) |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | negligible QD User's Guide |
| Hydraulic Conductivty | k | ft/day | 0.283 | Estimated Barrier Wall Permeability |
| Hydraulic Gradient | | ft/ft | 0.00676 | PZ-507/N-53 |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | steady-state |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | Chrysene | PZ-507 |
| Source Concentration (mg/L) | | mg/L | 0.1200 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 3.562E-04 | Number Please!2011 |
| KOC | | | 490000 | Number Please!2011 |

| Output (Distance from Source Where Concentration Equals Respective Ground Water MSC) | | | | |
|---|---|---|---|---|
| **Contaminant** | **Starting Concentration (mg/L)** | **GW MSC[1] Non-Residential (mg/L)** | **Predicted Concentration (mg/L)** | **Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot)** |
| Sim 1 - Chrysene | 0.1200 | 0.002 | 0.002 | **2** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | Chrysene starting concentration = 120 ug/l |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

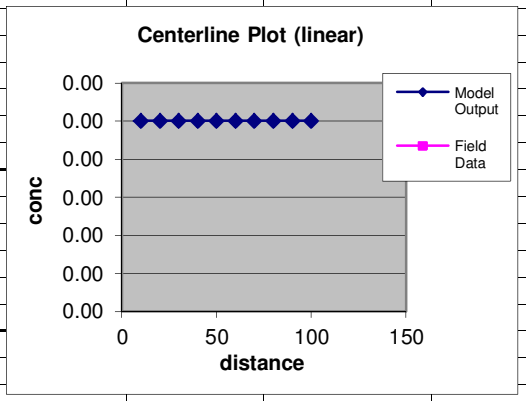
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00035616 | 100 | 70 | 1E+99 |

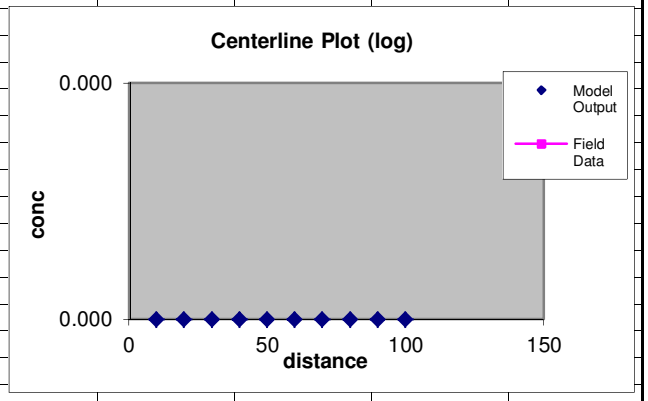
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.00676 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 4.59284E-07 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 2.082358396 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 2.082358396 | 0 | 0 |
| at | 1E+99 | days = | 0.002 mg/l |




| | AREAL MODEL | CALCULATION DOMAIN |
|---|---|---|
| | Length (ft) | 100 |
| | Width (ft) | 100 |

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 50 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| -50 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| -100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| Field Data: | Centerline C | Concentration |
|---|---|---|
| | Distance from Source | |

Table J.29 PZ-507 Chrysene

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

Project: Sunoco Philadelphia AOI 8 PZ-507

Date: 10/21/2011

Contaminant: PZ-507 Chrysene

Prepared by: TS

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) |
|---|---|---|---|---|---|---|---|
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | |
| 0.12 | 200 | 20 | 1.00E-04 | 3.56E-04 | 100 | 30 | 1.00E+99 |

| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.00676 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 4.593E-07 |

Edge Criterion (mg/l) 0.00048

Higest modeled conc. 5E-130

SURFACE WATER LOADING GRID

Distance to Stream (ft) 150

Plume View Width (ft) 100

Plume View Depth (ft) 30

PENTOX NOT NEEDED

| | -50 | -40 | -30 | -20 | -10 | 0 | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4E-130 | 4.24E-130 | 4.5E-130 | 4.63E-130 | 4.732E-130 | 4.766E-130 | 4.73E-130 | 4.63E-130 | 4.47E-130 | 4.2E-130 | 4E-130 |
| -3 | 4E-130 | 4.24E-130 | 4.5E-130 | 4.63E-130 | 4.732E-130 | 4.766E-130 | 4.73E-130 | 4.63E-130 | 4.47E-130 | 4.2E-130 | 4E-130 |
| -6 | 4E-130 | 4.24E-130 | 4.5E-130 | 4.63E-130 | 4.732E-130 | 4.766E-130 | 4.73E-130 | 4.63E-130 | 4.47E-130 | 4.2E-130 | 4E-130 |
| -9 | 4E-130 | 4.24E-130 | 4.5E-130 | 4.63E-130 | 4.732E-130 | 4.766E-130 | 4.73E-130 | 4.63E-130 | 4.47E-130 | 4.2E-130 | 4E-130 |
| -12 | 4E-130 | 4.24E-130 | 4.5E-130 | 4.63E-130 | 4.732E-130 | 4.766E-130 | 4.73E-130 | 4.63E-130 | 4.47E-130 | 4.2E-130 | 4E-130 |
| -15 | 4E-130 | 4.24E-130 | 4.5E-130 | 4.63E-130 | 4.732E-130 | 4.766E-130 | 4.73E-130 | 4.63E-130 | 4.47E-130 | 4.2E-130 | 4E-130 |
| -18 | 4E-130 | 4.24E-130 | 4.5E-130 | 4.63E-130 | 4.732E-130 | 4.766E-130 | 4.73E-130 | 4.63E-130 | 4.47E-130 | 4.2E-130 | 4E-130 |
| -21 | 4E-130 | 4.24E-130 | 4.5E-130 | 4.63E-130 | 4.732E-130 | 4.766E-130 | 4.73E-130 | 4.63E-130 | 4.47E-130 | 4.2E-130 | 4E-130 |
| -24 | 4E-130 | 4.24E-130 | 4.5E-130 | 4.63E-130 | 4.732E-130 | 4.766E-130 | 4.73E-130 | 4.63E-130 | 4.47E-130 | 4.2E-130 | 4E-130 |
| -27 | 4E-130 | 4.24E-130 | 4.5E-130 | 4.63E-130 | 4.732E-130 | 4.766E-130 | 4.73E-130 | 4.63E-130 | 4.47E-130 | 4.2E-130 | 4E-130 |
| -30 | 2E-130 | 2.12E-130 | 2.2E-130 | 2.32E-130 | 2.366E-130 | 2.383E-130 | 2.37E-130 | 2.32E-130 | 2.23E-130 | 2.1E-130 | 2E-130 |

**Average Groundwater Concentration** #DIV/0! mg/l

**Plume Flow** 0.00000 cfs 0 MGD

**Mass Loading to Stream** #DIV/0! mg/day

**Table J.30**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**RW-200**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | AOI 8 SUNOCO Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **RW-200** | Jul-08 |
| Sample Date | | | July-08 | |
| Source Width | | ft | 100 | Delineated LNAPL (100' if no plume is present) |
| Source Thickness | | ft | 70 | Alluvium Thickness from X-Sections |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | 0.1 x Longitudinal Dispersivity (QD User's Guide) |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | negligible QD User's Guide |
| Hydraulic Conductivty | k | ft/day | 4.64 | Alluvium (barrier wall not present) |
| Hydraulic Gradient | | ft/ft | 0.013 | RW-200/N-130 |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | steady-state |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | Chrysene | |
| Source Concentration (mg/L) | | mg/L | 0.0970 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 3.562E-04 | Number Please!2011 |
| KOC | | | 490000 | Number Please!2011 |
| **Sim 2** | | | | |
| Contaminant | | | Pyrene | PZ-506 RL |
| Source Concentration (mg/L) | | mg/L | 0.3000 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 1.918E-04 | Number Please!2011 |
| KOC | | | 68000 | Number Please!2011 |

| Output (Distance from Source Where Concentration Equals Respective Ground Water MSC) | | | | |
|---|---|---|---|---|
| **Contaminant** | **Starting Concentration (mg/L)** | **GW MSC[1] Non-Residential (mg/L)** | **Predicted Concentration (mg/L)** | **Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot)** |
| Sim 1 - Chrysene | 0.0970 | 0.002 | 0.002 | **11** |
| Sim 2 - Pyrene | 0.3000 | 0.130 | 0.130 | **9** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | Pyrene starting concentration = 0.3 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

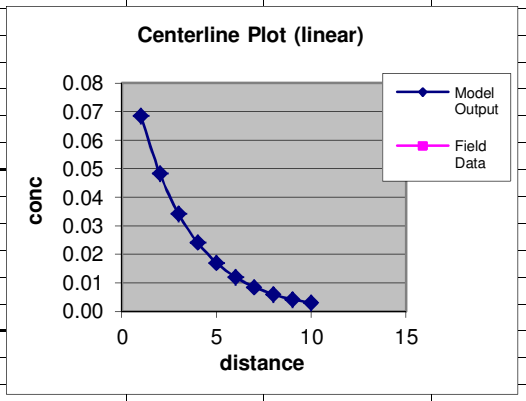
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00035616 | 100 | 70 | 1E+99 |

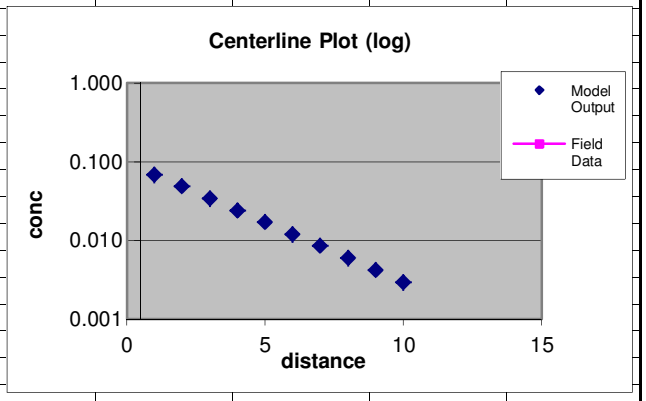
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^3$) | KOC | Frac. Org. Carb. | Retardation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 4.64E+00 | 0.013 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 1.44814E-05 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 11.09912397 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 11.09912397 | 0 | 0 |
| at | 1E+99 | days = | 0.002 mg/l |




| | AREAL MODEL | CALCULATION DOMAIN |
|---|---|---|
| | Length (ft) | 10 |
| | Width (ft) | 10 |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.068 | 0.048 | 0.034 | 0.024 | 0.017 | 0.012 | 0.008 | 0.006 | 0.004 | 0.003 |
| 5 | 0.068 | 0.048 | 0.034 | 0.024 | 0.017 | 0.012 | 0.008 | 0.006 | 0.004 | 0.003 |
| 0 | 0.068 | 0.048 | 0.034 | 0.024 | 0.017 | 0.012 | 0.008 | 0.006 | 0.004 | 0.003 |
| -5 | 0.068 | 0.048 | 0.034 | 0.024 | 0.017 | 0.012 | 0.008 | 0.006 | 0.004 | 0.003 |
| -10 | 0.068 | 0.048 | 0.034 | 0.024 | 0.017 | 0.012 | 0.008 | 0.006 | 0.004 | 0.003 |

| Field Data: | Centerline C | Concentration |
|---|---|---|
| | Distance from Source | |

Table J.30 RW-200 Chrysene Pyrene QD2 Model
SIM 1

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | Pyrene starting concentration = 0.3 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

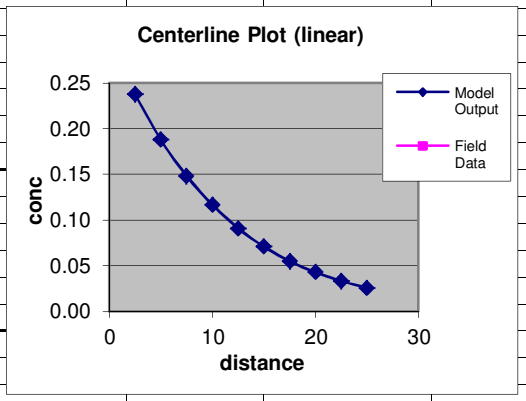
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.00019178 | 100 | 70 | 1E+99 |

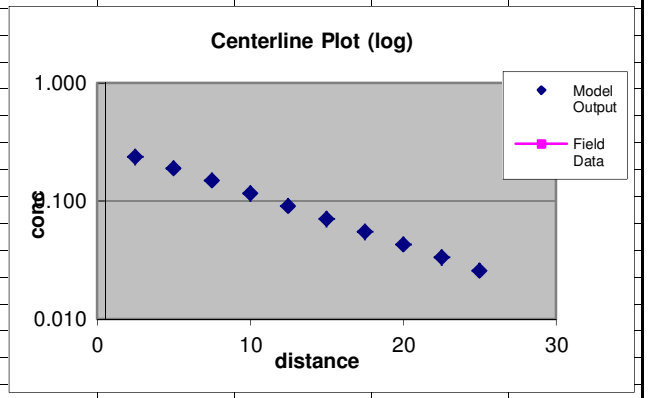
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^3$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 4.64E+00 | 0.013 | 0.35 | 1.7 | 68000 | 5.00E-03 | 1652.428571 | 0.000104297 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 8.867216568 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 8.867216568 | 0 | 0 |
| at | 1E+99 | days = | 0.130 mg/l |




| | AREAL MODEL | CALCULATION DOMAIN |
|---|---|---|
| | Length (ft) | 25 |
| | Width (ft) | 25 |

| | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 | 17.5 | 20 | 22.5 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 0.236 | 0.181 | 0.138 | 0.105 | 0.081 | 0.062 | 0.048 | 0.037 | 0.029 | 0.023 |
| 12.5 | 0.237 | 0.187 | 0.147 | 0.114 | 0.089 | 0.069 | 0.053 | 0.041 | 0.032 | 0.025 |
| 0 | 0.238 | 0.188 | 0.148 | 0.116 | 0.091 | 0.071 | 0.055 | 0.043 | 0.033 | 0.026 |
| -12.5 | 0.237 | 0.187 | 0.147 | 0.114 | 0.089 | 0.069 | 0.053 | 0.041 | 0.032 | 0.025 |
| -25 | 0.236 | 0.181 | 0.138 | 0.105 | 0.081 | 0.062 | 0.048 | 0.037 | 0.029 | 0.023 |

| Field Data: | Centerline C | Concentration |
|---|---|---|
| | Distance from Source | |

Table J.30 RW-200 Chrysene Pyrene QD2 Model
SIM 2

Table J.31 RW-200 Chrysene

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

Project: Sunoco Philadelphia AOI 8 RW-200

Date: 10/21/2011

Contaminant: RW-200 Chrysene

Prepared by: TS

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) |
|---|---|---|---|---|---|---|---|
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | |
| 0.097 | 200 | 20 | 1.00E-04 | 3.56E-04 | 100 | 30 | 1.00E+99 |

| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.013 | 0.35 | 1.7 | 490000 | 5.00E-03 | 11901 | 8.832E-07 |

Edge Criterion (mg/l) 0.00048

Higest modeled conc. 3E-125

SURFACE WATER LOADING GRID

Distance to Stream (ft) 200

Plume View Width (ft) 100

Plume View Depth (ft) 30

PENTOX NOT NEEDED

| | -50 | -40 | -30 | -20 | -10 | 0 | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2.9E-125 | 3.06E-125 | 3.2E-125 | 3.27E-125 | 3.328E-125 | 3.347E-125 | 3.33E-125 | 3.27E-125 | 3.18E-125 | 3.1E-125 | 2.9E-125 |
| -3 | 2.9E-125 | 3.06E-125 | 3.2E-125 | 3.27E-125 | 3.328E-125 | 3.347E-125 | 3.33E-125 | 3.27E-125 | 3.18E-125 | 3.1E-125 | 2.9E-125 |
| -6 | 2.9E-125 | 3.06E-125 | 3.2E-125 | 3.27E-125 | 3.328E-125 | 3.347E-125 | 3.33E-125 | 3.27E-125 | 3.18E-125 | 3.1E-125 | 2.9E-125 |
| -9 | 2.9E-125 | 3.06E-125 | 3.2E-125 | 3.27E-125 | 3.328E-125 | 3.347E-125 | 3.33E-125 | 3.27E-125 | 3.18E-125 | 3.1E-125 | 2.9E-125 |
| -12 | 2.9E-125 | 3.06E-125 | 3.2E-125 | 3.27E-125 | 3.328E-125 | 3.347E-125 | 3.33E-125 | 3.27E-125 | 3.18E-125 | 3.1E-125 | 2.9E-125 |
| -15 | 2.9E-125 | 3.06E-125 | 3.2E-125 | 3.27E-125 | 3.328E-125 | 3.347E-125 | 3.33E-125 | 3.27E-125 | 3.18E-125 | 3.1E-125 | 2.9E-125 |
| -18 | 2.9E-125 | 3.06E-125 | 3.2E-125 | 3.27E-125 | 3.328E-125 | 3.347E-125 | 3.33E-125 | 3.27E-125 | 3.18E-125 | 3.1E-125 | 2.9E-125 |
| -21 | 2.9E-125 | 3.06E-125 | 3.2E-125 | 3.27E-125 | 3.328E-125 | 3.347E-125 | 3.33E-125 | 3.27E-125 | 3.18E-125 | 3.1E-125 | 2.9E-125 |
| -24 | 2.9E-125 | 3.06E-125 | 3.2E-125 | 3.27E-125 | 3.328E-125 | 3.347E-125 | 3.33E-125 | 3.27E-125 | 3.18E-125 | 3.1E-125 | 2.9E-125 |
| -27 | 2.9E-125 | 3.06E-125 | 3.2E-125 | 3.27E-125 | 3.328E-125 | 3.347E-125 | 3.33E-125 | 3.27E-125 | 3.18E-125 | 3.1E-125 | 2.9E-125 |
| -30 | 1.5E-125 | 1.53E-125 | 1.6E-125 | 1.64E-125 | 1.664E-125 | 1.674E-125 | 1.66E-125 | 1.64E-125 | 1.59E-125 | 1.5E-125 | 1.5E-125 |

**Average Groundwater Concentration** #DIV/0! mg/l

**Plume Flow** 0.00000 cfs 0 MGD

**Mass Loading to Stream** #DIV/0! mg/day

Table J.32 RW-200 Pyrene

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project: | Sunoco Philadelphia AOI 8 RW-200 | | | | | | | | | | | | | | |
| Date: | 10/21/2011 | | | | | | | | | | | | | | |
| Contaminant: | RW-200 Chrysene | | | Prepared by: | | TS | | | | | | | | | |
| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) | | | | | | | | |
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | | | | | | | | | |
| 300 | 200 | 20 | 1.00E-04 | 1.92E-04 | 100 | 30 | 1.00E+99 | | | | | | | | |
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) | | | | | | | | |
| 4.64E+00 | 0.013 | 0.35 | 1.7 | 68000 | 5.00E-03 | 1652.429 | 0.0001043 | | | | | | | | |

| | -50 | -40 | -30 | -20 | -10 | 0 | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 8.49E-07 | 8.935E-07 | 9.29E-07 | 9.559E-07 | 9.7214E-07 | 9.7762E-07 | 9.721E-07 | 9.559E-07 | 9.294E-07 | 8.93E-07 | 8.49E-07 |
| -3 | 8.49E-07 | 8.935E-07 | 9.29E-07 | 9.559E-07 | 9.7214E-07 | 9.7762E-07 | 9.721E-07 | 9.559E-07 | 9.294E-07 | 8.93E-07 | 8.49E-07 |
| -6 | 8.49E-07 | 8.935E-07 | 9.29E-07 | 9.559E-07 | 9.7214E-07 | 9.7762E-07 | 9.721E-07 | 9.559E-07 | 9.294E-07 | 8.93E-07 | 8.49E-07 |
| -9 | 8.49E-07 | 8.935E-07 | 9.29E-07 | 9.559E-07 | 9.7214E-07 | 9.7762E-07 | 9.721E-07 | 9.559E-07 | 9.294E-07 | 8.93E-07 | 8.49E-07 |
| -12 | 8.49E-07 | 8.935E-07 | 9.29E-07 | 9.559E-07 | 9.7214E-07 | 9.7762E-07 | 9.721E-07 | 9.559E-07 | 9.294E-07 | 8.93E-07 | 8.49E-07 |
| -15 | 8.49E-07 | 8.935E-07 | 9.29E-07 | 9.559E-07 | 9.7214E-07 | 9.7762E-07 | 9.721E-07 | 9.559E-07 | 9.294E-07 | 8.93E-07 | 8.49E-07 |
| -18 | 8.49E-07 | 8.935E-07 | 9.29E-07 | 9.559E-07 | 9.7214E-07 | 9.7762E-07 | 9.721E-07 | 9.559E-07 | 9.294E-07 | 8.93E-07 | 8.49E-07 |
| -21 | 8.49E-07 | 8.935E-07 | 9.29E-07 | 9.559E-07 | 9.7214E-07 | 9.7762E-07 | 9.721E-07 | 9.559E-07 | 9.294E-07 | 8.93E-07 | 8.49E-07 |
| -24 | 8.49E-07 | 8.935E-07 | 9.29E-07 | 9.559E-07 | 9.7214E-07 | 9.7762E-07 | 9.721E-07 | 9.559E-07 | 9.294E-07 | 8.93E-07 | 8.49E-07 |
| -27 | 8.49E-07 | 8.935E-07 | 9.29E-07 | 9.559E-07 | 9.7214E-07 | 9.7762E-07 | 9.721E-07 | 9.559E-07 | 9.294E-07 | 8.93E-07 | 8.49E-07 |
| -30 | 4.25E-07 | 4.467E-07 | 4.65E-07 | 4.779E-07 | 4.8607E-07 | 4.8881E-07 | 4.861E-07 | 4.779E-07 | 4.647E-07 | 4.47E-07 | 4.25E-07 |

| | | | | |
|---|---|---|---|---|
| Edge Criterion (mg/l) | 130 | | | |
| Higest modeled conc. | 9.8E-07 | | | |
| SURFACE WATER LOADING GRID | | | | |
| Distance to Stream (ft) | 200 | | | |
| Plume View Width (ft) | 100 | | | |
| Plume View Depth (ft) | 30 | | | |
| PENTOX NOT NEEDED | | | | |
| Average Groundwater Concentration | | #DIV/0! | mg/l | |
| Plume Flow | | 0.00000 | cfs | 0 MGD |
| Mass Loading to Stream | | #DIV/0! | mg/day | |

**Table J.33**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**Zone 1**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | AOI 8 SUNOCO Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **Zone 1** | Jul-08 |
| Sample Date | | | July-08 | |
| Source Width | | ft | 500 | 2008 benzene isocontour map |
| Source Thickness | | ft | 30 | Alluvium Thickness from X-Sections |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | 0.1 x Longitudinal Dispersivity (QD User's Guide) |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | negligible QD User's Guide |
| Hydraulic Conductivty | k | ft/day | 0.283 | Estimated Barrier Wall Permeability |
| Hydraulic Gradient | | ft/ft | 0.00044 | N-59/N-73 |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | steady-state |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | Benzene | RW-500 |
| Source Concentration (mg/L) | | mg/L | 0.3000 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 0.001 | Number Please!2011 |
| KOC | | | 58 | Number Please!2011 |

| Output (Distance from Source Where Concentration Equals Respective Ground Water MSC) | | | | |
|---|---|---|---|---|
| **Contaminant** | **Starting Concentration (mg/L)** | **GW MSC[1] Non-Residential (mg/L)** | **Predicted Concentration (mg/L)** | **Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot)** |
| Sim 1 - Benzene | 0.3000 | 0.005 | 0.005 | **23** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | Benzene starting concentration = 0.3 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

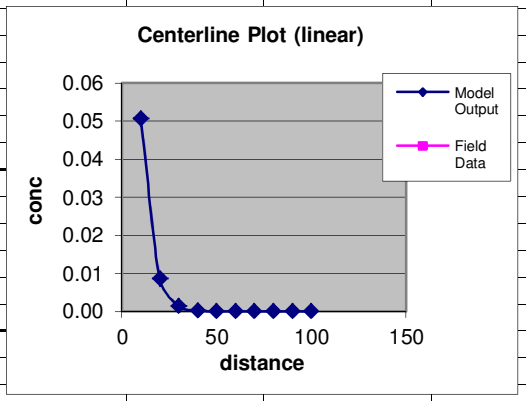
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| | | | >=.001 | day-1 | | | |
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.0009589 | 500 | 30 | 1E+99 |

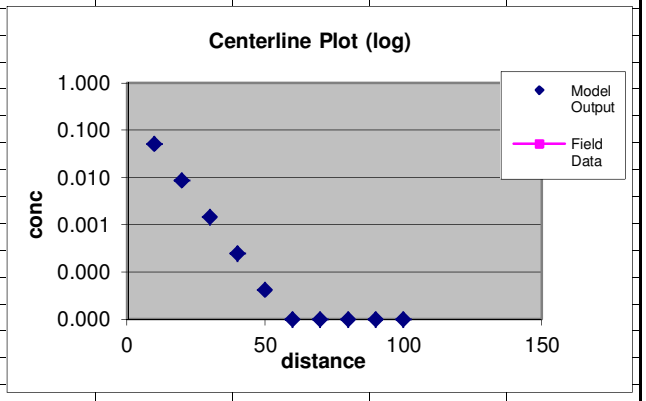
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^3$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.00044 | 0.35 | 1.7 | 58 | 5.00E-03 | 2.408571429 | 0.000147711 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 23.04496711 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 23.04496711 | 0 | 0 |
| at | 1E+99 | days = | 0.005 mg/l |




| AREAL MODEL | CALCULATION DOMAIN |
|---|---|
| Length (ft) | 100 |
| Width (ft) | 100 |

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 0.051 | 0.009 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 50 | 0.051 | 0.009 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0 | 0.051 | 0.009 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| -50 | 0.051 | 0.009 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| -100 | 0.051 | 0.009 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| Field Data: | Centerline C | Concentration |
|---|---|---|
| | Distance from Source | |

Table J.33 Zone 1 Benzene QD2 Model
SIM 1

Table J.34 Zone 1 Benzene

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

Project: SWLOAD5B

Date: 1/11/2012

Contaminant: Zone 1 Benzene

Prepared by: TS

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) |
|---|---|---|---|---|---|---|---|
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | |
| 0.3 | 200 | 20 | 1.00E-04 | 9.59E-04 | 500 | 30 | 1.00E+99 |

| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.00044 | 0.35 | 1.7 | 58 | 5.00E-03 | 2.408571 | 0.0001477 |

Edge Criterion (mg/l) 0.005

Higest modeled conc. 0.00207

SURFACE WATER LOADING GRID

Distance to Stream (ft) 28

Plume View Width (ft) 694

Plume View Depth (ft) 30

PENTOX NOT NEEDED

| | -347 | -277.6 | -208.2 | -138.8 | -69.4 | 0 | 69.4 | 138.8 | 208.2 | 277.6 | 347 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 3.89E-06 | 0.0004243 | 0.001853 | 0.002071 | 0.0020719 | 0.0020719 | 0.0020719 | 0.002071 | 0.0018526 | 0.000424 | 3.89E-06 |
| -3 | 3.89E-06 | 0.0004243 | 0.001853 | 0.002071 | 0.0020719 | 0.0020719 | 0.0020719 | 0.002071 | 0.0018526 | 0.000424 | 3.89E-06 |
| -6 | 3.89E-06 | 0.0004243 | 0.001853 | 0.002071 | 0.0020719 | 0.0020719 | 0.0020719 | 0.002071 | 0.0018526 | 0.000424 | 3.89E-06 |
| -9 | 3.89E-06 | 0.0004243 | 0.001853 | 0.002071 | 0.0020719 | 0.0020719 | 0.0020719 | 0.002071 | 0.0018526 | 0.000424 | 3.89E-06 |
| -12 | 3.89E-06 | 0.0004243 | 0.001853 | 0.002071 | 0.0020719 | 0.0020719 | 0.0020719 | 0.002071 | 0.0018526 | 0.000424 | 3.89E-06 |
| -15 | 3.89E-06 | 0.0004243 | 0.001853 | 0.002071 | 0.0020719 | 0.0020719 | 0.0020719 | 0.002071 | 0.0018526 | 0.000424 | 3.89E-06 |
| -18 | 3.89E-06 | 0.0004243 | 0.001853 | 0.002071 | 0.0020719 | 0.0020719 | 0.0020719 | 0.002071 | 0.0018526 | 0.000424 | 3.89E-06 |
| -21 | 3.89E-06 | 0.0004243 | 0.001853 | 0.002071 | 0.0020719 | 0.0020719 | 0.0020719 | 0.002071 | 0.0018526 | 0.000424 | 3.89E-06 |
| -24 | 3.89E-06 | 0.0004243 | 0.001853 | 0.002071 | 0.0020719 | 0.0020719 | 0.0020719 | 0.002071 | 0.0018526 | 0.000424 | 3.89E-06 |
| -27 | 3.89E-06 | 0.0004243 | 0.001853 | 0.002071 | 0.0020719 | 0.0020719 | 0.0020719 | 0.002071 | 0.0018526 | 0.000424 | 3.89E-06 |
| -30 | 1.94E-06 | 0.0002121 | 0.000926 | 0.0010355 | 0.00103595 | 0.00103595 | 0.001036 | 0.0010355 | 0.0009263 | 0.000212 | 1.94E-06 |

**Average Groundwater Concentration** 0.00192 mg/l

**Plume Flow** 0.00002 cfs 1.2E-05 MGD

**Mass Loading to Stream** 0.08 mg/day

**Table J.35**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**Zone 2**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | AOI 8 SUNOCO Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **Zone 2** | Jul-08 |
| Sample Date | | | July-08 | |
| Source Width | | ft | 200 | July 2011 benzene isocontour map |
| Source Thickness | | ft | 30 | Alluvium Thickness from X-Sections |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | 0.1 x Longitudinal Dispersivity (QD User's Guide) |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | negligible QD User's Guide |
| Hydraulic Conductivty | k | ft/day | 0.283 | Estimated Barrier Wall Permeability |
| Hydraulic Gradient | | ft/ft | 0.002 | N-61/N-135 |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | steady-state |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | Benzene | N-61 |
| Source Concentration (mg/L) | | mg/L | 8.7000 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 0.001 | Number Please!2011 |
| KOC | | | 58 | Number Please!2011 |

| Output (Distance from Source Where Concentration Equals Respective Ground Water MSC) | | | | |
|---|---|---|---|---|
| **Contaminant** | **Starting Concentration (mg/L)** | **GW MSC[1] Non-Residential (mg/L)** | **Predicted Concentration (mg/L)** | **Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot)** |
| Sim 1 - Benzene | 8.7000 | 0.005 | 0.005 | **90** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | Benzene starting concentration = 8.7 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

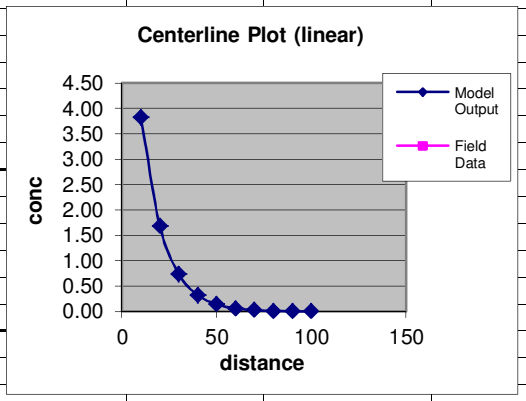
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 9 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.0009589 | 200 | 30 | 1E+99 |

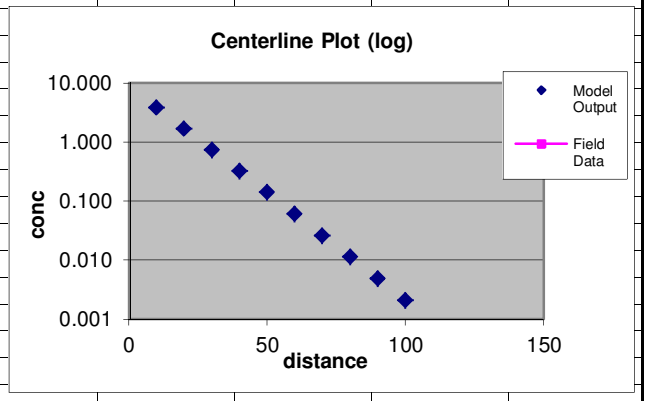
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^3$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.002 | 0.35 | 1.7 | 58 | 5.00E-03 | 2.408571429 | 0.000671412 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 89.73386223 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 89.73386223 | 0 | 0 |
| at | 1E+99 | days = | 0.005 |
| | | | mg/l |




| AREAL MODEL | CALCULATION DOMAIN |
|---|---|
| Length (ft) | 100 |
| Width (ft) | 100 |

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 1.915 | 0.843 | 0.371 | 0.163 | 0.072 | 0.032 | 0.014 | 0.006 | 0.003 | 0.001 |
| 50 | 3.806 | 1.621 | 0.687 | 0.292 | 0.125 | 0.054 | 0.023 | 0.010 | 0.004 | 0.002 |
| 0 | 3.830 | 1.686 | 0.739 | 0.323 | 0.140 | 0.061 | 0.026 | 0.011 | 0.005 | 0.002 |
| -50 | 3.806 | 1.621 | 0.687 | 0.292 | 0.125 | 0.054 | 0.023 | 0.010 | 0.004 | 0.002 |
| -100 | 1.915 | 0.843 | 0.371 | 0.163 | 0.072 | 0.032 | 0.014 | 0.006 | 0.003 | 0.001 |

| Field Data: | Centerline C | Concentration |
|---|---|---|
| | Distance from Source | |

Table J.35 Zone 2 Benzene QD2 Model
SIM 1

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project: | SWLOAD5B | | | | | | | | | | | | | | |
| Date: | 1/11/2012 | | | | | | | | | | | | | | |
| Contaminant: | Zone 2 Benzene | | | Prepared by: | | TS | | | | | | | | | |
| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) | | | | | | | | |
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | | | | | | | | | |
| 8.7 | 200 | 20 | 1.00E-04 | 9.59E-04 | 200 | 30 | 1.00E+99 | | | | | | | | |
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) | | | | | | | | |
| 2.83E-01 | 0.002 | 0.35 | 1.7 | 58 | 5.00E-03 | 2.408571 | 0.0006714 | | | | | | | | |
| | | | | -184 | -147.2 | -110.4 | -73.6 | -36.8 | 0 | 36.8 | 73.6 | 110.4 | 147.2 | 184 | |
| Edge Criterion (mg/l) | | 0.005 | 0 | 0.005026 | 0.0716487 | 0.356817 | 0.7491955 | 0.92355157 | 0.94719737 | 0.9235516 | 0.7491955 | 0.3568174 | 0.071649 | 0.005026 | |
| Higest modeled conc. | | 0.9472 | -3 | 0.005026 | 0.0716487 | 0.356817 | 0.7491955 | 0.92355157 | 0.94719737 | 0.9235516 | 0.7491955 | 0.3568174 | 0.071649 | 0.005026 | |
| | | | -6 | 0.005026 | 0.0716487 | 0.356817 | 0.7491955 | 0.92355157 | 0.94719737 | 0.9235516 | 0.7491955 | 0.3568174 | 0.071649 | 0.005026 | |
| SURFACE WATER LOADING GRID | | | -9 | 0.005026 | 0.0716487 | 0.356817 | 0.7491955 | 0.92355157 | 0.94719737 | 0.9235516 | 0.7491955 | 0.3568174 | 0.071649 | 0.005026 | |
| Distance to Stream (ft) | | 27 | -12 | 0.005026 | 0.0716487 | 0.356817 | 0.7491955 | 0.92355157 | 0.94719737 | 0.9235516 | 0.7491955 | 0.3568174 | 0.071649 | 0.005026 | |
| Plume View Width (ft) | | 368 | -15 | 0.005026 | 0.0716487 | 0.356817 | 0.7491955 | 0.92355157 | 0.94719737 | 0.9235516 | 0.7491955 | 0.3568174 | 0.071649 | 0.005026 | |
| Plume View Depth (ft) | | 30 | -18 | 0.005026 | 0.0716487 | 0.356817 | 0.7491955 | 0.92355157 | 0.94719737 | 0.9235516 | 0.7491955 | 0.3568174 | 0.071649 | 0.005026 | |
| | | | -21 | 0.005026 | 0.0716487 | 0.356817 | 0.7491955 | 0.92355157 | 0.94719737 | 0.9235516 | 0.7491955 | 0.3568174 | 0.071649 | 0.005026 | |
| | | | -24 | 0.005026 | 0.0716487 | 0.356817 | 0.7491955 | 0.92355157 | 0.94719737 | 0.9235516 | 0.7491955 | 0.3568174 | 0.071649 | 0.005026 | |
| PENTOX NEEDED | | | -27 | 0.005026 | 0.0716487 | 0.356817 | 0.7491955 | 0.92355157 | 0.94719737 | 0.9235516 | 0.7491955 | 0.3568174 | 0.071649 | 0.005026 | |
| | | | -30 | 0.002513 | 0.0358243 | 0.178409 | 0.3745977 | 0.46177578 | 0.47359868 | 0.4617758 | 0.3745977 | 0.1784087 | 0.035824 | 0.002513 | |
| | | | | | | | | | | | | | | | |
| | | | | Average Groundwater Concentration | | | | 0.44774 | mg/l | | | | | | |
| | | | | Plume Flow | | | | 0.00007 | cfs | 4.7E-05 MGD | | | | | |
| | | | | Mass Loading to Stream | | | 79.23 | mg/day | | | | | | | |

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

**Table J.37**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**Zone 3**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | AOI 8 SUNOCO Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **Zone 3** | Jul-08 |
| Sample Date | | | July-08 | |
| Source Width | | ft | 240 | July 2008 benzene isocontour map |
| Source Thickness | | ft | 30 | Alluvium Thickness from X-Sections |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | 0.1 x Longitudinal Dispersivity (QD User's Guide) |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | negligible QD User's Guide |
| Hydraulic Conductivty | k | ft/day | 0.283 | Estimated Barrier Wall Permeability |
| Hydraulic Gradient | | ft/ft | 0.00629 | N-133/PZ-504 |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | steady-state |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | Benzene | PZ-504 |
| Source Concentration (mg/L) | | mg/L | 2.4000 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 0.001 | Number Please!2011 |
| KOC | | | 58 | Number Please!2011 |

| Output (Distance from Source Where Concentration Equals Respective Ground Water MSC) | | | | |
|---|---|---|---|---|
| **Contaminant** | **Starting Concentration (mg/L)** | **GW MSC[1] Non-Residential (mg/L)** | **Predicted Concentration (mg/L)** | **Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot)** |
| Sim 1 - Benzene | 2.4000 | 0.005 | 0.005 | **134** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | Benzene starting concentration = 2.4 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

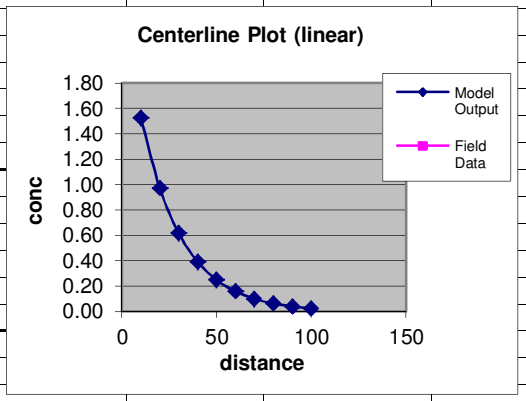
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 2 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.0009589 | 240 | 30 | 1E+99 |

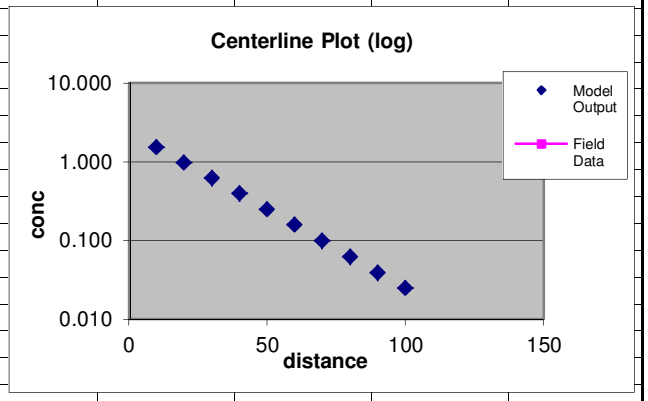
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.00629 | 0.35 | 1.7 | 58 | 5.00E-03 | 2.408571429 | 0.00211159 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 134.1830782 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 134.1830782 | 0 | 0 |
| at | 1E+99 | days = | 0.005 mg/l |




| AREAL MODEL | CALCULATION DOMAIN |
|---|---|
| Length (ft) | 100 |
| Width (ft) | 100 |

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 1.285 | 0.739 | 0.444 | 0.272 | 0.168 | 0.105 | 0.066 | 0.041 | 0.026 | 0.016 |
| 50 | 1.527 | 0.965 | 0.605 | 0.378 | 0.236 | 0.147 | 0.092 | 0.057 | 0.036 | 0.022 |
| 0 | 1.527 | 0.972 | 0.618 | 0.392 | 0.248 | 0.157 | 0.099 | 0.062 | 0.039 | 0.025 |
| -50 | 1.527 | 0.965 | 0.605 | 0.378 | 0.236 | 0.147 | 0.092 | 0.057 | 0.036 | 0.022 |
| -100 | 1.285 | 0.739 | 0.444 | 0.272 | 0.168 | 0.105 | 0.066 | 0.041 | 0.026 | 0.016 |

| Field Data: | Centerline C | Concentration |
|---|---|---|
| | Distance from Source | |

Table J.37 Zone 3 Benzene QD2 Model
SIM 1

Table J.38 Zone 3 Benzene

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

Project: SWLOAD5B
Date: 1/11/2012
Contaminant: Zone 3 Benzene
Prepared by: TS

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE
WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) |
|---|---|---|---|---|---|---|---|
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | |
| 2.4 | 200 | 20 | 1.00E-04 | 9.59E-04 | 240 | 30 | 1.00E+99 |

| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.00629 | 0.35 | 1.7 | 58 | 5.00E-03 | 2.408571 | 0.0021116 |

Edge Criterion (mg/l) 0.005
Higest modeled conc. 0.67639

SURFACE WATER LOADING GRID
Distance to Stream (ft) 28
Plume View Width (ft) 481
Plume View Depth (ft) 30

PENTOX NEEDED

| | -240.5 | -192.4 | -144.3 | -96.2 | -48.1 | 0 | 48.1 | 96.2 | 144.3 | 192.4 | 240.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.000107 | 0.0103229 | 0.158253 | 0.51525 | 0.66590056 | 0.67639077 | 0.6659006 | 0.51525 | 0.1582531 | 0.010323 | 0.000107 |
| -3 | 0.000107 | 0.0103229 | 0.158253 | 0.51525 | 0.66590056 | 0.67639077 | 0.6659006 | 0.51525 | 0.1582531 | 0.010323 | 0.000107 |
| -6 | 0.000107 | 0.0103229 | 0.158253 | 0.51525 | 0.66590056 | 0.67639077 | 0.6659006 | 0.51525 | 0.1582531 | 0.010323 | 0.000107 |
| -9 | 0.000107 | 0.0103229 | 0.158253 | 0.51525 | 0.66590056 | 0.67639077 | 0.6659006 | 0.51525 | 0.1582531 | 0.010323 | 0.000107 |
| -12 | 0.000107 | 0.0103229 | 0.158253 | 0.51525 | 0.66590056 | 0.67639077 | 0.6659006 | 0.51525 | 0.1582531 | 0.010323 | 0.000107 |
| -15 | 0.000107 | 0.0103229 | 0.158253 | 0.51525 | 0.66590056 | 0.67639077 | 0.6659006 | 0.51525 | 0.1582531 | 0.010323 | 0.000107 |
| -18 | 0.000107 | 0.0103229 | 0.158253 | 0.51525 | 0.66590056 | 0.67639077 | 0.6659006 | 0.51525 | 0.1582531 | 0.010323 | 0.000107 |
| -21 | 0.000107 | 0.0103229 | 0.158253 | 0.51525 | 0.66590056 | 0.67639077 | 0.6659006 | 0.51525 | 0.1582531 | 0.010323 | 0.000107 |
| -24 | 0.000107 | 0.0103229 | 0.158253 | 0.51525 | 0.66590056 | 0.67639077 | 0.6659006 | 0.51525 | 0.1582531 | 0.010323 | 0.000107 |
| -27 | 0.000107 | 0.0103229 | 0.158253 | 0.51525 | 0.66590056 | 0.67639077 | 0.6659006 | 0.51525 | 0.1582531 | 0.010323 | 0.000107 |
| -30 | 5.37E-05 | 0.0051614 | 0.079127 | 0.257625 | 0.33295028 | 0.33819538 | 0.3329503 | 0.257625 | 0.0791265 | 0.005161 | 5.37E-05 |

**Average Groundwater Concentration** 0.35804 mg/l

**Plume Flow** 0.00024 cfs 0.00015 MGD

**Mass Loading to Stream** 208.36 mg/day

**Table J.39**
**Quick Domenico**
**Fate and Transport Model Input and Output**
**Zone 4**
**Sunoco Philadehphia Refinery AOI 8**
**Philadelphia, Pennsylvania**

| | |
|---|---|
| Project | AOI 8 SUNOCO Philadelphia Refinery |
| Prepared by | TS |
| Date Prepared | 1/31/2012 |

| Generic Input Parameters | | | | Data Source |
|---|---|---|---|---|
| Source Identification (or Well ID) | | | **Zone 4** | Jul-08 |
| Sample Date | | | July-08 | |
| Source Width | | ft | 630 | July 2008 benzene isocontours |
| Source Thickness | | ft | 30 | Alluvium Thickness from X-Sections |
| Longitudinal Dispersivity | $A_x$ | ft | 200 | From CCR QD Simulations |
| Transverse Dispersivity | $A_y$ | ft | 20.0 | 0.1 x Longitudinal Dispersivity (QD User's Guide) |
| Vertical Dispersivity | $A_z$ | ft | 0.0001 | negligible QD User's Guide |
| Hydraulic Conductivty | k | ft/day | 0.283 | Estimated Barrier Wall Permeability |
| Hydraulic Gradient | | ft/ft | 0.0038 | PZ-505/N-55 |
| Porosity | | decimal fraction | 0.35 | Site soil analyses |
| Soil Bulk Density | $p_b$ | g/cm3 | 1.7 | ACT 2 TGM Default |
| Fraction of Organic Carbon | $f_{OC}$ | decimal fraction | 0.005 | ACT 2 TGM Default |
| Time | | days | 1.00E+99 | steady-state |

| Chemical Specific Input Parameters | | | | Data Source |
|---|---|---|---|---|
| **Sim 1** | | | | |
| Contaminant | | | Benzene | PZ-505 |
| Source Concentration (mg/L) | | mg/L | 0.1600 | July-08 |
| Lambda (per day) | | $day^{-1}$ | 0.001 | Number Please!2011 |
| KOC | | | 58 | Number Please!2011 |

**Output (Distance from Source Where Concentration Equals Respective Ground Water MSC)**

| Contaminant | Starting Concentration (mg/L) | GW MSC[1] Non-Residential (mg/L) | Predicted Concentration (mg/L) | Predicted Distance to Meet Non-Residential GW MSC (Rounded to the Nearest foot) |
|---|---|---|---|---|
| Sim 1 - Benzene | 0.1600 | 0.005 | 0.005 | **59** |

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Non-residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

**ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL**

| | | | |
|---|---|---|---|
| Project: | AOI 8 SUNOCO Philadelphia Refinery | | |
| Date: | 1/31/2012 | Prepared by: | TS |
| | | Contaminant: | Benzene starting concentration = 0.16 mg/L |

NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

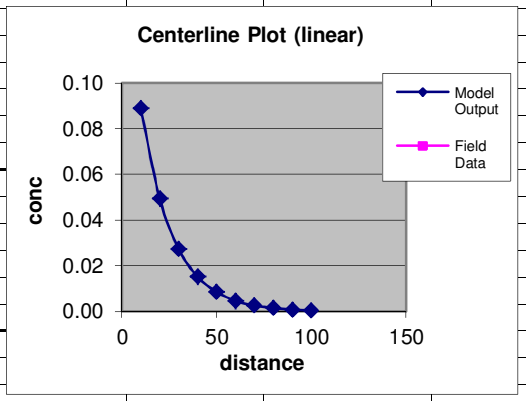
| SOURCE CONC (MG/L) | Ax (ft) | Ay (ft) | Az (ft) >=.001 | LAMBDA day-1 | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) (days) |
|---|---|---|---|---|---|---|---|
| 0 | 2.00E+02 | 2.00E+01 | 1.00E-04 | 0.0009589 | 630 | 30 | 1E+99 |

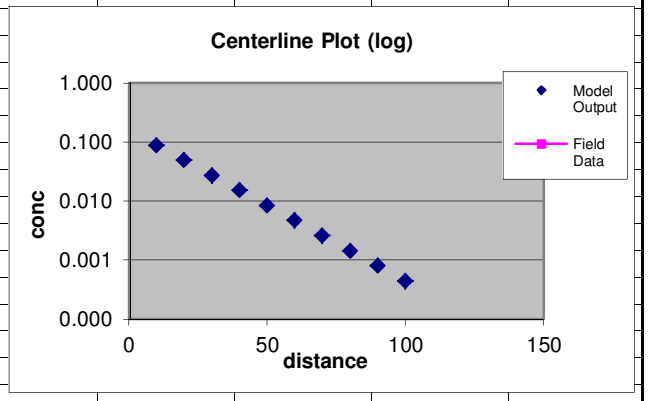
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^3$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) |
|---|---|---|---|---|---|---|---|
| 2.83E-01 | 0.0038 | 0.35 | 1.7 | 58 | 5.00E-03 | 2.408571429 | 0.001275682 |

**Point Concentration**

| x(ft) | y(ft) | z(ft) |
|---|---|---|
| 58.88794241 | 0 | 0 |

| | x(ft) | y(ft) | z(ft) |
|---|---|---|---|
| Conc. At | 58.88794241 | 0 | 0 |
| at | 1E+99 | days = | 0.005 mg/l |




| AREAL MODEL DOMAIN | |
|---|---|
| Length (ft) | 100 |
| Width (ft) | 100 |

| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 0.089 | 0.049 | 0.027 | 0.015 | 0.008 | 0.005 | 0.003 | 0.001 | 0.001 | 0.000 |
| 50 | 0.089 | 0.049 | 0.027 | 0.015 | 0.008 | 0.005 | 0.003 | 0.001 | 0.001 | 0.000 |
| 0 | 0.089 | 0.049 | 0.027 | 0.015 | 0.008 | 0.005 | 0.003 | 0.001 | 0.001 | 0.000 |
| -50 | 0.089 | 0.049 | 0.027 | 0.015 | 0.008 | 0.005 | 0.003 | 0.001 | 0.001 | 0.000 |
| -100 | 0.089 | 0.049 | 0.027 | 0.015 | 0.008 | 0.005 | 0.003 | 0.001 | 0.001 | 0.000 |

**Field Data:** Centerline C Concentration
Distance from Source

Table J.39 Zone 4 Benzene QD2 Model
SIM 1

**METHOD FOR ESTIMATNG FLOW, AVERAGE CONCENTRATION AND MASS LOADING TO SURFACE WATER FROM GROUNDWATER**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project: | SWLOAD5B | | | | | | | | | | | | | | |
| Date: | 1/11/2012 | | | | | | | | | | | | | | |
| Contaminant: | Zone 4 Benzene | | | Prepared by: | | TS | | | | | | | | | |
| SOURCE CONC (units) | Ax (ft) | Ay (ft) | Az (ft) | LAMBDA | SOURCE WIDTH (ft) | SOURCE THICKNESS (ft) | Time (days) | | | | | | | | |
| mg/l | >.0001 | >.0001 | >=.0001 | day-1 | | | | | | | | | | | |
| 0.16 | 200 | 20 | 1.00E-04 | 9.59E-04 | 630 | 30 | 1.00E+99 | | | | | | | | |
| Hydraulic Cond (ft/day) | Hydraulic Gradient (ft/ft) | Porosity (dec. frac.) | Soil Bulk Density ($g/cm^{3}$) | KOC | Frac. Org. Carb. | Retard-ation (R) | V (=K*i/n*R) (ft/day) | | | | | | | | |
| 2.83E-01 | 0.0038 | 0.35 | 1.7 | 58 | 5.00E-03 | 2.408571 | 0.0012757 | | | | | | | | |
| | | | | -257.5 | -206 | -154.5 | -103 | -51.5 | 0 | 51.5 | 103 | 154.5 | 206 | 257.5 | |
| Edge Criterion (mg/l) | | 0.005 | 0 | 0.027701 | 0.0290075 | 0.029027 | 0.0290274 | 0.02902739 | 0.02902739 | 0.0290274 | 0.0290274 | 0.0290274 | 0.029007 | 0.027701 | |
| Higest modeled conc. | | 0.02903 | -3 | 0.027701 | 0.0290075 | 0.029027 | 0.0290274 | 0.02902739 | 0.02902739 | 0.0290274 | 0.0290274 | 0.0290274 | 0.029007 | 0.027701 | |
| | | | -6 | 0.027701 | 0.0290075 | 0.029027 | 0.0290274 | 0.02902739 | 0.02902739 | 0.0290274 | 0.0290274 | 0.0290274 | 0.029007 | 0.027701 | |
| SURFACE WATER LOADING GRID | | | -9 | 0.027701 | 0.0290075 | 0.029027 | 0.0290274 | 0.02902739 | 0.02902739 | 0.0290274 | 0.0290274 | 0.0290274 | 0.029007 | 0.027701 | |
| Distance to Stream (ft) | | 29 | -12 | 0.027701 | 0.0290075 | 0.029027 | 0.0290274 | 0.02902739 | 0.02902739 | 0.0290274 | 0.0290274 | 0.0290274 | 0.029007 | 0.027701 | |
| Plume View Width (ft) | | 515 | -15 | 0.027701 | 0.0290075 | 0.029027 | 0.0290274 | 0.02902739 | 0.02902739 | 0.0290274 | 0.0290274 | 0.0290274 | 0.029007 | 0.027701 | |
| Plume View Depth (ft) | | 30 | -18 | 0.027701 | 0.0290075 | 0.029027 | 0.0290274 | 0.02902739 | 0.02902739 | 0.0290274 | 0.0290274 | 0.0290274 | 0.029007 | 0.027701 | |
| | | | -21 | 0.027701 | 0.0290075 | 0.029027 | 0.0290274 | 0.02902739 | 0.02902739 | 0.0290274 | 0.0290274 | 0.0290274 | 0.029007 | 0.027701 | |
| | | | -24 | 0.027701 | 0.0290075 | 0.029027 | 0.0290274 | 0.02902739 | 0.02902739 | 0.0290274 | 0.0290274 | 0.0290274 | 0.029007 | 0.027701 | |
| PENTOX NEEDED | | | -27 | 0.027701 | 0.0290075 | 0.029027 | 0.0290274 | 0.02902739 | 0.02902739 | 0.0290274 | 0.0290274 | 0.0290274 | 0.029007 | 0.027701 | |
| | | | -30 | 0.013851 | 0.0145037 | 0.014514 | 0.0145137 | 0.0145137 | 0.0145137 | 0.0145137 | 0.0145137 | 0.0145137 | 0.014504 | 0.013851 | |
| | | | | | | | | | | | | | | | |
| | | | | Average Groundwater Concentration | | | | 0.02747 | mg/l | | | | | | |
| | | | | Plume Flow | | | | 0.00019 | cfs | 0.00012 MGD | | | | | |
| | | | | Mass Loading to Stream | | | 12.93 | mg/day | | | | | | | |

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD5B.XLS
A METHOD FOR ESTIMATING
COMTAMINANT LOADING TO SURFACE WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

**Table J.41**
**Input Parameters for PENTOXSD Simulation**
**AOI 8**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Parameter | Unit | Zone 2 | Zone 3 | Zone 4 | N-58 | Source |
|---|---|---|---|---|---|---|
| River Mile Index (**at discharge point**) | mile | 3.92 | 4 | 4.08 | 4.2 | Estimated Using ArcGIS |
| River Stage Elevation (**at discharge point**) | ft | 1 | | | | Estimated from USGS Philadelphia Quadrangle Map |
| Drainage Area | $mi^2$ | 1906 | | | | Estimated Using USGS Penrose Avenue & Chestnut Street River Gauge Data |
| $Q_{7-10}$ Stream Flow | $ft^3/s$ | 10.1 | | | | Specified by PADEP as 10% of actual $Q_{7-10}$ Flow |
| $Q_h$ Stream Flow | $ft^3/s$ | 80.7 | | | | Specified by PADEP as 10% of actual $Q_h$ Flow |
| River Mile Index (**at confluence**) | mile | 0.001 | | | | Measured using ArcGIS |
| River Stage Elevation (**at confluence**) | ft | 0.5 | | | | Estimated from USGS Philadelphia quadrangle map |
| Drainage Area | $mi^2$ | 1910 | | | | USGS Penrose Avenue River Gauge Web Site |
| Diffuse Groundwater Flow [(1)] | million gallons per day | 0.00005 | 0.00015 | 0.00012 | 0.00012 | Calculated by SWLOAD |

NOTES:
All additional hydraulic parameters were calculated by PENTOXSD.

# Table J.42
# PENTOXSD Zone 2

## PENTOXSD

### Modeling Input Data

| Stream Code | RMI | Elevation (ft) | Drainage Area (sq mi) | Slope | PWS With (mgd) | Apply FC |
|---|---|---|---|---|---|---|
| 833 | 3.92 | 1.00 | 1906.00 | 0.00000 | 0.00 | ☑ |

**Stream Data**

| | LFY (cfsm) | Trib Flow (cfs) | Stream Flow (cfs) | WD Ratio | Rch Width (ft) | Rch Depth (ft) | Rch Velocity (fps) | Rch Trav Time (days) | Tributary Hard (mg/L) | Tributary pH | Stream Hard (mg/L) | Stream pH | Analysis Hard (mg/L) | Analysis pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q7-10 | 0.1 | 0 | 10.1 | 0 | 0 | 0 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 0 |
| Qh | | 0 | 80.7 | 0 | 0 | 0 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 0 |

**Discharge Data**

| Name | Permit Number | Existing Disc Flow (mgd) | Permitted Disc Flow (mgd) | Design Disc Flow (mgd) | Reserve Factor | AFC PMF | CFC PMF | THH PMF | CRL PMF | Disc Hard (mg/L) | Disc pH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AOI 8 Zone 2 | 2574601 | 4.7E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 |

**Parameter Data**

| Parameter Name | Disc Conc (µg/L) | Trib Conc (µg/L) | Disc Daily CV | Disc Hourly CV | Steam Conc (µg/L) | Stream CV | Fate Coef | FOS | Crit Mod | Max Disc Conc (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| BENZENE | 8700 | 0 | 0.5 | 0.5 | 0 | 0 | 0 | 0 | 1 | 0 |

| Stream Code | RMI | Elevation (ft) | Drainage Area (sq mi) | Slope | PWS With (mgd) | Apply FC |
|---|---|---|---|---|---|---|
| 833 | 0.00 | 0.50 | 1910.00 | 0.00000 | 0.00 | ☑ |

**Stream Data**

| | LFY (cfsm) | Trib Flow (cfs) | Stream Flow (cfs) | WD Ratio | Rch Width (ft) | Rch Depth (ft) | Rch Velocity (fps) | Rch Trav Time (days) | Tributary Hard (mg/L) | Tributary pH | Stream Hard (mg/L) | Stream pH | Analysis Hard (mg/L) | Analysis pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q7-10 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 0 |
| Qh | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 0 |

**Discharge Data**

| Name | Permit Number | Existing Disc Flow (mgd) | Permitted Disc Flow (mgd) | Design Disc Flow (mgd) | Reserve Factor | AFC PMF | CFC PMF | THH PMF | CRL PMF | Disc Hard (mg/L) | Disc pH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 |

**Parameter Data**

| Parameter Name | Disc Conc (µg/L) | Trib Conc (µg/L) | Disc Daily CV | Disc Hourly CV | Steam Conc (µg/L) | Stream CV | Fate Coef | FOS | Crit Mod | Max Disc Conc (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| BENZENE | 0 | 0 | 0.5 | 0.5 | 0 | 0 | 0 | 0 | 1 | 0 |

# Table J.42
# PENTOXSD Zone 2

## PENTOXSD Analysis Results

### Hydrodynamics

| SWP Basin | Stream Code: | Stream Name: |
|---|---|---|
| 03F | 833 | SCHUYLKILL RIVER |

| RMI | Stream Flow (cfs) | PWS With (cfs) | Net Stream Flow (cfs) | Disc Analysis Flow (cfs) | Reach Slope | Depth (ft) | Width (ft) | WD Ratio | Velocity (fps) | Reach Trav Time (days) | CMT (min) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Q7-10 Hydrodynamics** | | | | | | | | | | | |
| 3.920 | 10.1 | 0 | 10.1 | 0.00007 | 2.4E-05 | 1.10383 | 86.9429 | 78.7645 | 0.10524 | 2.27567 | 1000+ |
| 0.001 | 10.5 | 0 | 10.5 | NA | 0 | 0 | 0 | 0 | 0 | 0 | NA |
| **Qh Hydrodynamics** | | | | | | | | | | | |
| 3.920 | 80.7 | 0 | 80.7 | 0.00007 | 2.4E-05 | 2.75439 | 86.9429 | 31.5652 | 0.33699 | 0.71069 | 461.08 |
| 0.001 | 82.6362 | 0 | 82.6362 | NA | 0 | 0 | 0 | 0 | 0 | 0 | NA |

# Table J.42
# PENTOXSD Zone 2

## PENTOXSD Analysis Results

## Wasteload Allocations

| RMI | Name | Permit Number |
|---|---|---|
| **3.92** | **AOI 8 Zone 2** | **2574601** |

### AFC

**Q7-10:** **CCT (min)** 15 **PMF** 0.09 **Analysis pH** 7 **Analysis Hardness** 100

| Parameter | Stream Conc (µg/L) | Stream CV | Trib Conc (µg/L) | Fate Coef | WQC (µg/L) | WQ Obj (µg/L) | WLA (µg/L) |
|---|---|---|---|---|---|---|---|
| BENZENE | 0 | 0 | 0 | 0 | 640 | 640 | 8070000 |

### CFC

**Q7-10:** **CCT (min)** 720 **PMF** 0.629 **Analysis pH** 7 **Analysis Hardness** 100

| Parameter | Stream Conc. (µg/L) | Stream CV | Trib Conc. (µg/L) | Fate Coef | WQC (µg/L) | WQ Obj (µg/L) | WLA (µg/L) |
|---|---|---|---|---|---|---|---|
| BENZENE | 0 | 0 | 0 | 0 | 130 | 130 | 1.136E+07 |

### THH

**Q7-10:** **CCT (min)** 720 **PMF** NA **Analysis pH** NA **Analysis Hardness** NA

| Parameter | Stream Conc (µg/L) | Stream CV | Trib Conc (µg/L) | Fate Coef | WQC (µg/L) | WQ Obj (µg/L) | WLA (µg/L) |
|---|---|---|---|---|---|---|---|
| BENZENE | 0 | 0 | 0 | 0 | NA | NA | NA |

### CRL

**Qh:** **CCT (min)** 461.08 **PMF** 1

| Parameter | Stream Conc (µg/L) | Stream CV | Trib Conc (µg/L) | Fate Coef | WQC (µg/L) | WQ Obj (µg/L) | WLA (µg/L) |
|---|---|---|---|---|---|---|---|
| BENZENE | 0 | 0 | 0 | 0 | 1.2 | 1.2 | 1330000 |

# Table J.43
# PENTOXSD Zone 3

## PENTOXSD

### Modeling Input Data

| Stream Code | RMI | Elevation (ft) | Drainage Area (sq mi) | Slope | PWS With (mgd) | Apply FC |
|---|---|---|---|---|---|---|
| 833 | 4.00 | 1.00 | 1906.00 | 0.00000 | 0.00 | ☑ |

**Stream Data**

| | LFY | Trib Flow | Stream Flow | WD Ratio | Rch Width | Rch Depth | Rch Velocity | Rch Trav Time | Tributary Hard | Tributary pH | Stream Hard | Stream pH | Analysis Hard | Analysis pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (cfsm) | (cfs) | (cfs) | | (ft) | (ft) | (fps) | (days) | (mg/L) | | (mg/L) | | (mg/L) | |
| Q7-10 | 0.1 | | 10.1 | 0 | 0 | 0 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 0 |
| Qh | | 0 | 80.7 | 0 | 0 | 0 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 0 |

**Discharge Data**

| Name | Permit Number | Existing Disc Flow | Permitted Disc Flow | Design Disc Flow | Reserve Factor | AFC PMF | CFC PMF | THH PMF | CRL PMF | Disc Hard | Disc pH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (mgd) | (mgd) | (mgd) | | | | | | (mg/L) | |
| AOI 8 Zone 3 | 2574601 | 0.00015 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 |

**Parameter Data**

| Parameter Name | Disc Conc (µg/L) | Trib Conc (µg/L) | Disc Daily CV | Disc Hourly CV | Steam Conc (µg/L) | Stream CV | Fate Coef | FOS | Crit Mod | Max Disc Conc (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| BENZENE | 2400 | 0 | 0.5 | 0.5 | 0 | 0 | 0 | 0 | 1 | 0 |

| Stream Code | RMI | Elevation (ft) | Drainage Area (sq mi) | Slope | PWS With (mgd) | Apply FC |
|---|---|---|---|---|---|---|
| 833 | 0.00 | 0.50 | 1910.00 | 0.00000 | 0.00 | ☑ |

**Stream Data**

| | LFY | Trib Flow | Stream Flow | WD Ratio | Rch Width | Rch Depth | Rch Velocity | Rch Trav Time | Tributary Hard | Tributary pH | Stream Hard | Stream pH | Analysis Hard | Analysis pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (cfsm) | (cfs) | (cfs) | | (ft) | (ft) | (fps) | (days) | (mg/L) | | (mg/L) | | (mg/L) | |
| Q7-10 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 0 |
| Qh | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 0 |

**Discharge Data**

| Name | Permit Number | Existing Disc Flow | Permitted Disc Flow | Design Disc Flow | Reserve Factor | AFC PMF | CFC PMF | THH PMF | CRL PMF | Disc Hard | Disc pH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (mgd) | (mgd) | (mgd) | | | | | | (mg/L) | |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 |

**Parameter Data**

| Parameter Name | Disc Conc (µg/L) | Trib Conc (µg/L) | Disc Daily CV | Disc Hourly CV | Steam Conc (µg/L) | Stream CV | Fate Coef | FOS | Crit Mod | Max Disc Conc (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| BENZENE | 0 | 0 | 0.5 | 0.5 | 0 | 0 | 0 | 0 | 1 | 0 |

# Table J.43
# PENTOXSD Zone 3

## PENTOXSD Analysis Results

### Hydrodynamics

| SWP Basin | Stream Code: | Stream Name: |
|---|---|---|
| 03F | 833 | SCHUYLKILL RIVER |

| RMI | Stream Flow (cfs) | PWS With (cfs) | Net Stream Flow (cfs) | Disc Analysis Flow (cfs) | Reach Slope | Depth (ft) | Width (ft) | WD Ratio | Velocity (fps) | Reach Trav Time (days) | CMT (min) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Q7-10 Hydrodynamics** | | | | | | | | | | | |
| 4.000 | 10.1 | 0 | 10.1 | 0.00023 | 2E-05 | 1.1044 | 86.992 | 78.765 | 0.1051 | 2.3247 | 1000+ |
| 0.001 | 10.5 | 0 | 10.5 | NA | 0 | 0 | 0 | 0 | 0 | 0 | NA |
| **Qh Hydrodynamics** | | | | | | | | | | | |
| 4.000 | 80.7 | 0 | 80.7 | 0.00023 | 2E-05 | 2.7559 | 86.992 | 31.566 | 0.3366 | 0.7260 | 465.904 |
| 0.001 | 82.636 | 0 | 82.636 | NA | 0 | 0 | 0 | 0 | 0 | 0 | NA |

# Table J.43
# PENTOXSD Zone 3

## PENTOXSD Analysis Results

### Wasteload Allocations

| RMI | Name | Permit Number |
|---|---|---|
| **4.00** | **AOI 8 Zone 3** | **2574601** |

**AFC**

**Q7-10:** **CCT (min)** 15 **PMF** 0.09 **Analysis pH** 7 **Analysis Hardness** 100

| Parameter | Stream Conc (µg/L) | Stream CV | Trib Conc (µg/L) | Fate Coef | WQC (µg/L) | WQ Obj (µg/L) | WLA (µg/L) |
|---|---|---|---|---|---|---|---|
| BENZENE | 0 | 0 | 0 | 0 | 640 | 640 | 2510000 |

**CFC**

**Q7-10:** **CCT (min)** 720 **PMF** 0.626 **Analysis pH** 7 **Analysis Hardness** 100

| Parameter | Stream Conc. (µg/L) | Stream CV | Trib Conc. (µg/L) | Fate Coef | WQC (µg/L) | WQ Obj (µg/L) | WLA (µg/L) |
|---|---|---|---|---|---|---|---|
| BENZENE | 0 | 0 | 0 | 0 | 130 | 130 | 3540000 |

**THH**

**Q7-10:** **CCT (min)** 720 **PMF** NA **Analysis pH** NA **Analysis Hardness** NA

| Parameter | Stream Conc (µg/L) | Stream CV | Trib Conc (µg/L) | Fate Coef | WQC (µg/L) | WQ Obj (µg/L) | WLA (µg/L) |
|---|---|---|---|---|---|---|---|
| BENZENE | 0 | 0 | 0 | 0 | NA | NA | NA |

**CRL**

**Qh:** **CCT (min)** 465.904 **PMF** 1

| Parameter | Stream Conc (µg/L) | Stream CV | Trib Conc (µg/L) | Fate Coef | WQC (µg/L) | WQ Obj (µg/L) | WLA (µg/L) |
|---|---|---|---|---|---|---|---|
| BENZENE | 0 | 0 | 0 | 0 | 1.2 | 1.2 | 417325 |

# Table J.44
# PENTOXSD Zone 4

## PENTOXSD

### Modeling Input Data

| Stream Code | RMI | Elevation (ft) | Drainage Area (sq mi) | Slope | PWS With (mgd) | Apply FC |
|---|---|---|---|---|---|---|
| 833 | 4.08 | 1.00 | 1906.00 | 0.00000 | 0.00 | ☑ |

**Stream Data**

| | LFY (cfsm) | Trib Flow (cfs) | Stream Flow (cfs) | WD Ratio | Rch Width (ft) | Rch Depth (ft) | Rch Velocity (fps) | Rch Trav Time (days) | Tributary Hard (mg/L) | Tributary pH | Stream Hard (mg/L) | Stream pH | Analysis Hard (mg/L) | Analysis pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q7-10 | 0.1 | 0 | 10.1 | 0 | 0 | 0 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 0 |
| Qh | | 0 | 80.7 | 0 | 0 | 0 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 0 |

**Discharge Data**

| Name | Permit Number | Existing Disc Flow (mgd) | Permitted Disc Flow (mgd) | Design Disc Flow (mgd) | Reserve Factor | AFC PMF | CFC PMF | THH PMF | CRL PMF | Disc Hard (mg/L) | Disc pH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AOI 8 Zone 4 | 2574601 | 0.00012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 |

**Parameter Data**

| Parameter Name | Disc Conc (µg/L) | Trib Conc (µg/L) | Disc Daily CV | Disc Hourly CV | Steam Conc (µg/L) | Stream CV | Fate Coef | FOS | Crit Mod | Max Disc Conc (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| BENZENE | 160 | 0 | 0.5 | 0.5 | 0 | 0 | 0 | 0 | 1 | 0 |

| Stream Code | RMI | Elevation (ft) | Drainage Area (sq mi) | Slope | PWS With (mgd) | Apply FC |
|---|---|---|---|---|---|---|
| 833 | 0.00 | 0.50 | 1910.00 | 0.00000 | 0.00 | ☑ |

**Stream Data**

| | LFY (cfsm) | Trib Flow (cfs) | Stream Flow (cfs) | WD Ratio | Rch Width (ft) | Rch Depth (ft) | Rch Velocity (fps) | Rch Trav Time (days) | Tributary Hard (mg/L) | Tributary pH | Stream Hard (mg/L) | Stream pH | Analysis Hard (mg/L) | Analysis pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q7-10 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 0 |
| Qh | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 0 |

**Discharge Data**

| Name | Permit Number | Existing Disc Flow (mgd) | Permitted Disc Flow (mgd) | Design Disc Flow (mgd) | Reserve Factor | AFC PMF | CFC PMF | THH PMF | CRL PMF | Disc Hard (mg/L) | Disc pH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 |

**Parameter Data**

| Parameter Name | Disc Conc (µg/L) | Trib Conc (µg/L) | Disc Daily CV | Disc Hourly CV | Steam Conc (µg/L) | Stream CV | Fate Coef | FOS | Crit Mod | Max Disc Conc (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| BENZENE | 0 | 0 | 0.5 | 0.5 | 0 | 0 | 0 | 0 | 1 | 0 |

# Table J.44
# PENTOXSD Zone 4

## PENTOXSD Analysis Results

### Hydrodynamics

| SWP Basin | Stream Code: | Stream Name: |
|---|---|---|
| 03F | 833 | SCHUYLKILL RIVER |

| RMI | Stream Flow (cfs) | PWS With (cfs) | Net Stream Flow (cfs) | Disc Analysis Flow (cfs) | Reach Slope | Depth (ft) | Width (ft) | WD Ratio | Velocity (fps) | Reach Trav Time (days) | CMT (min) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Q7-10 Hydrodynamics** | | | | | | | | | | | |
| 4.080 | 10.1 | 0 | 10.1 | 0.00018 | 2.3E-05 | 1.10504 | 87.0396 | 78.7658 | 0.10501 | 2.37378 | 1000+ |
| 0.001 | 10.5 | 0 | 10.5 | NA | 0 | 0 | 0 | 0 | 0 | 0 | NA |
| **Qh Hydrodynamics** | | | | | | | | | | | |
| 4.080 | 80.7 | 0 | 80.7 | 0.00018 | 2.3E-05 | 2.75739 | 87.0396 | 31.5659 | 0.33625 | 0.74134 | 470.673 |
| 0.001 | 82.6362 | 0 | 82.6362 | NA | 0 | 0 | 0 | 0 | 0 | 0 | NA |

# Table J.44
# PENTOXSD Zone 4

## PENTOXSD Analysis Results

## Wasteload Allocations

| RMI | Name | Permit Number |
|---|---|---|
| **4.08** | **AOI 8 Zone 4** | **2574601** |

**AFC**

**Q7-10:** **CCT (min)** 15 **PMF** 0.089 **Analysis pH** 7 **Analysis Hardness** 100

| Parameter | Stream Conc (µg/L) | Stream CV | Trib Conc (µg/L) | Fate Coef | WQC (µg/L) | WQ Obj (µg/L) | WLA (µg/L) |
|---|---|---|---|---|---|---|---|
| BENZENE | 0 | 0 | 0 | 0 | 640 | 640 | 3130000 |

**CFC**

**Q7-10:** **CCT (min)** 720 **PMF** 0.622 **Analysis pH** 7 **Analysis Hardness** 100

| Parameter | Stream Conc. (µg/L) | Stream CV | Trib Conc. (µg/L) | Fate Coef | WQC (µg/L) | WQ Obj (µg/L) | WLA (µg/L) |
|---|---|---|---|---|---|---|---|
| BENZENE | 0 | 0 | 0 | 0 | 130 | 130 | 4400000 |

**THH**

**Q7-10:** **CCT (min)** 720 **PMF** NA **Analysis pH** NA **Analysis Hardness** NA

| Parameter | Stream Conc (µg/L) | Stream CV | Trib Conc (µg/L) | Fate Coef | WQC (µg/L) | WQ Obj (µg/L) | WLA (µg/L) |
|---|---|---|---|---|---|---|---|
| BENZENE | 0 | 0 | 0 | 0 | NA | NA | NA |

**CRL**

**Qh:** **CCT (min)** 470.673 **PMF** 1

| Parameter | Stream Conc (µg/L) | Stream CV | Trib Conc (µg/L) | Fate Coef | WQC (µg/L) | WQ Obj (µg/L) | WLA (µg/L) |
|---|---|---|---|---|---|---|---|
| BENZENE | 0 | 0 | 0 | 0 | 1.2 | 1.2 | 521656 |

# Table J.45
# PENTOXSD N-58

## PENTOXSD

### Modeling Input Data

| Stream Code | RMI | Elevation (ft) | Drainage Area (sq mi) | Slope | PWS With (mgd) | Apply FC |
|---|---|---|---|---|---|---|
| 833 | 4.20 | 1.00 | 1906.00 | 0.00000 | 0.00 | ☑ |

**Stream Data**

| | LFY (cfsm) | Trib Flow (cfs) | Stream Flow (cfs) | WD Ratio | Rch Width (ft) | Rch Depth (ft) | Rch Velocity (fps) | Rch Trav Time (days) | Tributary Hard (mg/L) | Tributary pH | Stream Hard (mg/L) | Stream pH | Analysis Hard (mg/L) | Analysis pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q7-10 | 0.1 | 10.1 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 0 |
| Qh | | 80.7 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 0 |

**Discharge Data**

| Name | Permit Number | Existing Disc Flow (mgd) | Permitted Disc Flow (mgd) | Design Disc Flow (mgd) | Reserve Factor | AFC PMF | CFC PMF | THH PMF | CRL PMF | Disc Hard (mg/L) | Disc pH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| N-58 | 2574601 | 0.00012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 |

**Parameter Data**

| Parameter Name | Disc Conc (µg/L) | Trib Conc (µg/L) | Disc Daily CV | Disc Hourly CV | Steam Conc (µg/L) | Stream CV | Fate Coef | FOS | Crit Mod | Max Disc Conc (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,2-DICHLOROETHANE | 10 | 0 | 0.5 | 0.5 | 0 | 0 | 0 | 0 | 1 | 0 |

| Stream Code | RMI | Elevation (ft) | Drainage Area (sq mi) | Slope | PWS With (mgd) | Apply FC |
|---|---|---|---|---|---|---|
| 833 | 0.00 | 0.50 | 1910.00 | 0.00000 | 0.00 | ☑ |

**Stream Data**

| | LFY (cfsm) | Trib Flow (cfs) | Stream Flow (cfs) | WD Ratio | Rch Width (ft) | Rch Depth (ft) | Rch Velocity (fps) | Rch Trav Time (days) | Tributary Hard (mg/L) | Tributary pH | Stream Hard (mg/L) | Stream pH | Analysis Hard (mg/L) | Analysis pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q7-10 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 0 |
| Qh | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 | 0 | 0 | 0 | 0 |

**Discharge Data**

| Name | Permit Number | Existing Disc Flow (mgd) | Permitted Disc Flow (mgd) | Design Disc Flow (mgd) | Reserve Factor | AFC PMF | CFC PMF | THH PMF | CRL PMF | Disc Hard (mg/L) | Disc pH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 7 |

**Parameter Data**

| Parameter Name | Disc Conc (µg/L) | Trib Conc (µg/L) | Disc Daily CV | Disc Hourly CV | Steam Conc (µg/L) | Stream CV | Fate Coef | FOS | Crit Mod | Max Disc Conc (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,2-DICHLOROETHANE | 0 | 0 | 0.5 | 0.5 | 0 | 0 | 0 | 0 | 1 | 0 |

# Table J.45
# PENTOXSD N-58

## PENTOXSD Analysis Results

### Hydrodynamics

| SWP Basin | Stream Code: | Stream Name: |
|---|---|---|
| 03F | 833 | SCHUYLKILL RIVER |

| RMI | Stream Flow (cfs) | PWS With (cfs) | Net Stream Flow (cfs) | Disc Analysis Flow (cfs) | Reach Slope | Depth (ft) | Width (ft) | WD Ratio | Velocity (fps) | Reach Trav Time (days) | CMT (min) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Q7-10 Hydrodynamics** | | | | | | | | | | | |
| 4.200 | 10.1 | 0 | 10.1 | 0.00018 | 2.3E-05 | 1.10592 | 87.1094 | 78.7666 | 0.10484 | 2.44751 | 1000+ |
| 0.001 | 10.5 | 0 | 10.5 | NA | 0 | 0 | 0 | 0 | 0 | 0 | NA |
| **Qh Hydrodynamics** | | | | | | | | | | | |
| 4.200 | 80.7 | 0 | 80.7 | 0.00018 | 2.3E-05 | 2.75958 | 87.1094 | 31.5662 | 0.33571 | 0.76436 | 477.745 |
| 0.001 | 82.6362 | 0 | 82.6362 | NA | 0 | 0 | 0 | 0 | 0 | 0 | NA |

Table J.45
PENTOXSD N-58

## PENTOXSD Analysis Results

### Wasteload Allocations

| RMI | Name | Permit Number |
|---|---|---|
| **4.20** | **N-58** | **2574601** |

**AFC**

**Q7-10:** **CCT (min)** 15 **PMF** 0.089 **Analysis pH** 7 **Analysis Hardness** 100

| Parameter | Stream Conc (µg/L) | Stream CV | Trib Conc (µg/L) | Fate Coef | WQC (µg/L) | WQ Obj (µg/L) | WLA (µg/L) |
|---|---|---|---|---|---|---|---|
| 1,2-DICHLOROETHANE | 0 | 0 | 0 | 0 | 15000 | 15000 | 7.285E+07 |

**CFC**

**Q7-10:** **CCT (min)** 720 **PMF** 0.618 **Analysis pH** 7 **Analysis Hardness** 100

| Parameter | Stream Conc. (µg/L) | Stream CV | Trib Conc. (µg/L) | Fate Coef | WQC (µg/L) | WQ Obj (µg/L) | WLA (µg/L) |
|---|---|---|---|---|---|---|---|
| 1,2-DICHLOROETHANE | 0 | 0 | 0 | 0 | 3100 | 3100 | 1.0429E+08 |

**THH**

**Q7-10:** **CCT (min)** 720 **PMF** NA **Analysis pH** NA **Analysis Hardness** NA

| Parameter | Stream Conc (µg/L) | Stream CV | Trib Conc (µg/L) | Fate Coef | WQC (µg/L) | WQ Obj (µg/L) | WLA (µg/L) |
|---|---|---|---|---|---|---|---|
| 1,2-DICHLOROETHANE | 0 | 0 | 0 | 0 | NA | NA | NA |

**CRL**

**Qh:** **CCT (min)** 477.745 **PMF** 1

| Parameter | Stream Conc (µg/L) | Stream CV | Trib Conc (µg/L) | Fate Coef | WQC (µg/L) | WQ Obj (µg/L) | WLA (µg/L) |
|---|---|---|---|---|---|---|---|
| 1,2-DICHLOROETHANE | 0 | 0 | 0 | 0 | 0.38 | 0.38 | 165191.1 |

# APPENDIX K
# DEVELOPMENT OF SITE-SPECIFIC STANDARDS
# AOI 8: SUNOCO PHILADELPHIA REFINERY
# PHILADELPHIA, PENNSYLVANIA

Based on the current and future intended non-residential site use, an exposure assessment was conducted for all compounds in surficial soil (0-2 feet) which exceeded the nonresidential direct contact statewide health standards in AOI 8. Potential human health exposures for the Refinery are evaluated for an industrial worker scenario.

Direct contact exposure pathways to surface soil, groundwater, and LNAPL is for the industrial scenario because of Sunoco's established excavation procedures, PPE requirements and soil handling procedures, as they are described in Appendix K of the 2004 Current Conditions Report (CCR). However, because direct contact to surface soils could occur outside of excavation activities, shallow soil samples were collected in AOI 8 to further evaluate this pathway under a non-residential (on-site worker) scenario.

Based on the recent characterization data collected, concentrations of benzene naphthalene, benzo(a)pyrene, and lead were detected above the non-residential soil MSCs in surficial soil (0-2 feet). In accordance with Section IV of the PADEP's Technical Guidance Manual (TGM) (dated June 8, 2002), the COCs listed above were further screened against the EPA Region III Risk-Based Concentrations (RBCs) (aka, EPA Regional Screening Levels) for industrial soil to potentially reduce the list of compounds carried through the risk assessment.

For all compounds that exceed both the non-residential statewide health standards and EPA Region III RBCs, site-specific standards were calculated using PADEP default intake parameters for an on-site worker and, where appropriate, a risk level of $10^{-4}$. For calculating a site-specific standard for on-site workers exposed to lead, Sunoco used the Society of Environmental Geochemistry and Health (SEGH) model used by PADEP to develop the non-residential MSC. The input parameters used to develop the site-specific standards for benzene and lead are provided in Tables K-1 through K-4.

The site-specific standards for the organic compounds (calculated in Tables K-1 through K-4) are as follows:

| Compound | Calculated Site-Specific Standard (mg/kg) |
|---|---|
| Benzene | 2,160 |
| Naphthalene | 56,780 |
| Benzo(a)pyrene | 109 |
| Lead | 1,708 |

The site-specific screening level for benzene was calculated for inhalation based on the calculation specified in 25 Pa. Code § 250.307(b), and for naphthalene and benzo(a)pyrene for ingestion based on the calculations specified in 25 Pa. Code § 250.306(b). These calculations used the PADEP's default parameters and an updated target risk level of 1E-4, in consideration of the site-specific conditions (PADEP's default target risk level is 1E-5).

As presented in Table K-1 through K-4, based on the revised target risk level, the derived site-specific standards for benzene, naphthalene and benzo(a)pyrene are calculated for an onsite worker and are consistent with the values used in the previous Act 2 reports submitted for the Refinery. Concentrations of benzene, naphthalene and benzo(a)pyrene detected in the surface soil samples collected in AOI 8 are below the site-specific standards and, therefore, risk to an on-site worker due to exposure is considered to be within the acceptable Act 2 range.

The site-specific screening level for lead was calculated for ingestion. As presented in 25 Pa. Code § 250.306(e), Appendix A, Table 7, the non-residential soil screening value for lead is based on the method presented in the report 'The Society for Environmental Geochemistry and Health (SEGH) Task Force Approach to the Assessment of Lead in Soil' (Wixson, 1991). The model used by the PADEP and developed by SEGH was also used to calculate the site specific criterion for the refinery. Based on the SEGH model and PADEP's default parameters, PADEP's non-residential direct contact MSC default value for lead in surface soil is 1,000 mg/kg. To develop a site-specific criteria for lead,

some of the parameters used by the PADEP were updated in consideration of site-specific conditions and updated lead data collected from recent studies. These parameters are discussed in the following paragraphs.

Target blood lead concentration (T) – The default target blood lead concentration used by the PADEP to develop the non-residential MSC is 20 ug/dL; however, the Center for Disease Control (CDC) recommends that worker blood lead levels be maintained below 25 ug/dL (NIOSH, 2008) to prevent adverse health effects for most workers from exposure to lead throughout a working lifetime. Based on conversations between representatives of Sunoco and EPA, the target lead blood level identified by the CDC is used in the site-specific calculation in Tables F-4 and F-5.

Geometric mean background blood lead concentration (B) – B is the background blood lead concentration in the target population from sources other than soil and dust. The PADEP's default value for B is 4 ug/dL and, as summarized in PADEPs reference document (Wixson, 1991), is based on data gathered in the United Kingdom from young children. The US Center for Disease Control and Prevention (CDC) in Atlanta, GA has monitored blood lead levels in US children and adults since 1976 and, based on the most recent results published by the National Center for Environmental Health of the CDC (NCEH, 2005), the mean blood lead concentration for an adult 20 years of age or older is 1.56 ug/dL. Based on the more recent study by the US CDC, the value used for B in the site specific calculation has been revised to 1.56 ug/dL.

## CONCLUSIONS

As presented in Table K-4, based on the revised parameters, the derived site-specific standard for lead in soil is 1,708 mg/kg for a refinery worker. Concentrations of lead detected in the surface soil samples collected in AOI 8 are below the site-specific standard and, therefore, risk to an on-site worker due to exposure to lead is considered to be within the acceptable Act 2 range.

In addition to calculating the site-specific standards for benzene, naphthalene,

**Table K-1**
**Derivation of Site-Specific Soil Value**
**for Benzene[1]**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Parameter | Abbreviation | Assumption | Units | Source |
|---|---|---|---|---|
| Transport Factor | TF | 13,100 | mg/kg / $mg/m^3$ | 25 Pa. Code § 250, Appendix A Table 5 |
| Absorption | Abs | 1 | unitless | 25 Pa. Code § 250.307(d) |
| Exposure Time | ET | 8 | hr/day | 25 Pa. Code § 250.307(d) |
| Exposure Frequency | EF | 180 | d/yr | 25 Pa. Code § 250.307(d) |
| Target Risk[2] | TR | 0.0001 | mg/kg | |
| Inhalation Cancer Slope Factor | $CSF_I$ | 0.027 | $mg/kg\text{-}day^{-1}$ | 25 Pa. Code § 250, Appendix A Table 5 |
| Averaging Time for Carcinogens | $AT_C$ | 70 | yr | 25 Pa. Code § 250.307(d) |
| Inhalation Factor | $IF_{ADJ}$ | 0.4 | unitless | 25 Pa. Code § 250.307(d) |

**Site-Specific, Non-Residential (Onsite Worker) Screening Value** **2,160** **mg/kg**

Notes:

1. The site specific screening value was calculated for inhalation based on the calculation specified in 25 Pa. Code 250.307(b)(1)

$$MSC\ (mg/kg) = \frac{TR \times AT_C \times 365\ days/year \times TF}{CSF_I \times Abs \times ET \times EF \times IF_{ADJ}}$$

2. The target risk level was modified from PADEP's default (1E-5) to 1E-4.

**Table K-2**
**Derivation of Site-Specific Soil Value**
**for Naphthalene[1]**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Parameter | Abbreviation | Assumption | Units | Source |
|---|---|---|---|---|
| Target Health Quotient | TR | 1 | | 25 Pa. Code § 250.306(d) |
| Oral Reference Dose | $RfD_o$ | 0.02 | $mg/kg\text{-}day^{-1}$ | 25 Pa. Code § 250, Appendix A Table 5 |
| Body Weight | BW | 70 | kg | 25 Pa. Code § 250.306(d) |
| Averaging Time | $AT_{DC}$ | 25 | yr | 25 Pa. Code § 250.306(d) |
| Absorption | Abs | 1 | unitless | 25 Pa. Code § 250.306(d) |
| Exposure Frequency | EF | 180 | d/yr | 25 Pa. Code § 250.306(d) |
| Exposure Duration | ED | 25 | yr | 25 Pa. Code § 250.306(d) |
| Conversion Factor | CF | 1.00E-06 | kg/day | 25 Pa. Code § 250.306(d) |
| Ingestion Rate | IngR | 50 | mg/day | 25 Pa. Code § 250.306(d) |

**Site-Specific, Non-Residential (Onsite Worker) Screening Value** **56,780** **mg/kg**

Notes:

1. The site specific screening value was calculated for ingestion based on the calculation specified in 25 Pa. Code 250.306(b)

$$MSC\ (mg/kg) = \frac{THQ \times RFDo \times BW \times AT_{DC} \times 365\ days/year}{Abs \times EF \times ED \times IngR \times CF}$$

**Table K-3**
**Derivation of Site-Specific Soil Value**
**for Benzo(a)pyrene[1]**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Parameter | Abbreviation | Assumption | Units | Source |
|---|---|---|---|---|
| Absorption | ABS | 1 | unitless | 25 Pa. Code § 250.306(d) |
| Exposure Frequency | EF | 180 | d/yr | 25 Pa. Code § 250.306(d) |
| Conversion Factor | CF | 1.00E-06 | kg/day | 25 Pa. Code § 250.306(d) |
| Target Risk[2] | TR | 1.00E-04 | mg/kg | |
| Oral Cancer Slope Factor | $CSF_o$ | 7.3 | $mg/kg\text{-}day^{-1}$ | 25 Pa. Code § 250, Appendix A Table 5 |
| Averaging Time for Carcinogens | $AT_c$ | 70 | yr | 25 Pa. Code § 250.306(d) |
| Ingestion Factor | IFadj | 17.9 | mg-yr/kg-day | 25 Pa. Code § 250.306(d) |

**Site-Specific, Non-Residential (Onsite Worker) Screening Value** **109** **mg/kg**

Notes:

1. The site specific screening value was calculated for ingestion based on the calculation specified in 25 Pa. Code 250.306(b)

$$MSC\ (mg/kg) = \frac{TR \times AT_C \times 365\ days/year}{CSF_O \times Abs \times EF \times IF_{ADJ} \times CF}$$

2. The target risk level was modified from PADEP's default (1E-5) to 1E-4.

**Table K-4**
**Derivation of Site-Specific Soil Value**
**for Lead[1]**
**AOI 8 Site Characterization/Remedial Investigation Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Parameter | Abbreviation | Assumption | Units | Source[2] |
|---|---|---|---|---|
| Blood lead target concentration | T | 25 | ug/dL | CDC - ABLES (NIOSH, 2008) |
| Geometric standard deviation of the blood lead distribution | G | 1.4 | unitless | 25 Pa. Code § 250, Appendix A Table 7 |
| Background blood lead concentration in the population from sources other than soil or dust | B | 1.56 | ug/dL | NCEH Pub. No. 05-0570 (NCEH, 2005) |
| Number of standard deviations corresponding to the degree of protection required for the population at risk | n | 1.645 | unitless | 25 Pa. Code § 250, Appendix A Table 7 |
| Response of the blood lead versus soil lead relationship | $\delta$ | 7.5 | ug/dL blood / ug/g soil | 25 Pa. Code § 250, Appendix A Table 7 |

**Site-Specific, Non-Residential (Onsite Worker) Screening Value** **1,708** **ug/g (mg/kg)**

Notes:

1. The site specific screening value for lead was calculated for ingestion based on the SEGH model as specified by 25 Pa. Code 250.306(e)

$$MSC\ (mg/kg) = \frac{[(T/G^{n}) - B] \times 1000}{\delta}$$

2. Sources for blood lead target level (T) based on conversation between James Oppenheim of Sunoco and Hon Lee of EPA in November 2010.

NIOSH (2008). Adult Blood Lead Epidemiology and Surveillance (ABLES). http://www.cdc.gov/niosh/topics/ABLES

NCEH (2005). Third National Report on Human Exposure to Environmental Chemicals. Centers for Disease Control and Prevention, National Center for Environmental Health, Division of Laboratory Sciences. Atlanta, Georgia. NCEH. Pub. No. 05-0570.

**Table K-5**
**Summary of Site Specific Cumulative Risk Evaluation**
**AOI 8 Site Characterization/Remedial Investigaiton Report**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| | | | | Benzene (71-43-2) | | Naphthalene (91-20-3) | | Benzo(a)pyrene (50-32-8) | | Lead (7439-92-1) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Location ID | Sample ID | Sample Interval | Sample Date | Reported Result (mg/kg) | Calculated Risk | Reported Result (mg/kg) | Calculated Hazard Quotient | Reported Result (mg/kg) | Calculated Risk | Reported Result (mg/kg) | Blood Lead Concentration[4] (ug/dL) |
| BH-08-01 | BH-08-01_1.0-2.0 | 1.0-2.0 | 6/17/2008 | ND | -- | ND | -- | ND | -- | 69.7 | 3.6 |
| BH-08-02 | BH-08-02_1.0-2.0 | 1.0-2.0 | 5/7/2008 | ND | -- | ND | -- | ND | -- | 138 | 4.5 |
| BH-08-03 | BH-08-03_1.0-2.0 | 1.0-2.0 | 5/7/2008 | 0.58 | 2.69E-08 | ND | -- | ND | -- | 291 | 6.5 |
| BH-08-04 | BH-08-04_1.0-2.0 | 1.0-2.0 | 5/8/2008 | 3.3 | 1.53E-07 | 12 | 0.00021 | ND | -- | 829 | 13.5 |
| BH-08-07 | BH-08-07_1.0-2.0 | 1.0-2.0 | 5/8/2008 | 1.4 | 6.51E-08 | 15 | 0.00026 | ND | -- | 519 | 9.5 |
| BH-08-08 | BH-08-08_1.0-2.0 | 1.0-2.0 | 5/7/2008 | 1.9 | 8.83E-08 | ND | -- | ND | -- | 637 | 11.0 |
| BH-08-09 | BH-08-09_1.0-2.0 | 1.0-2.0 | 5/7/2008 | 3.2 | 1.49E-07 | 5.9 | 0.00010 | ND | -- | 262 | 6.1 |
| BH-08-10 | BH-08-10_1.0-2.0 | 1.0-2.0 | 5/7/2008 | ND | -- | ND | -- | 2.6 | 2.39E-06 | 428 | 8.3 |
| BH-08-11 | BH-08-11_1.0-2.0 | 1.0-2.0 | 5/7/2008 | 0.31 | 1.44E-08 | ND | -- | ND | -- | 131 | 4.4 |
| BH-08-12 | BH-08-12_1.0-2.0 | 1.0-2.0 | 5/6/2008 | 3.1 | 1.44E-07 | 2.7 | 0.00005 | ND | -- | 1250 | 19.0 |
| BH-08-13 | BH-08-13_1.0-2.0 | 1.0-2.0 | 5/6/2008 | ND | -- | ND | -- | 1.3 | 1.20E-06 | 314 | 6.8 |
| BH-08-14 | BH-08-14_1.0-2.0 | 1.0-2.0 | 5/6/2008 | ND | -- | ND | -- | ND | -- | 78.8 | 3.7 |
| BH-08-15 | BH-08-15_1.0-2.0 | 1.0-2.0 | 5/6/2008 | ND | -- | ND | -- | ND | -- | 22.8 | 3.0 |
| BH-08-16 | BH-08-16_1.0-2.0 | 1.0-2.0 | 5/7/2008 | 3.1 | 1.44E-07 | 18 | 0.00032 | ND | -- | 1380 | 20.7 |
| BH-08-17 | BH-08-17_1.0-2.0 | 1.0-2.0 | 5/7/2008 | ND | -- | ND | -- | ND | -- | 102 | 4.0 |
| BH-08-18 | BH-08-18_1.0-2.0 | 1.0-2.0 | 5/7/2008 | ND | -- | ND | -- | ND | -- | 22.2 | 3.0 |
| BH-08-21 | BH-08-21_1.0-2.0 | 1.0-2.0 | 5/7/2008 | ND | -- | ND | -- | ND | -- | 540 | 9.8 |
| BH-08-22 | BH-08-22_1.0-2.0 | 1.0-2.0 | 5/7/2008 | ND | -- | ND | -- | ND | -- | 213 | 5.5 |
| BH-08-23 | BH-08-23_1.0-2.0 | 1.0-2.0 | 5/7/2008 | ND | -- | ND | -- | ND | -- | 374 | 7.6 |
| BH-08-24 | BH-08-24_1.0-2.0 | 1.0-2.0 | 5/7/2008 | ND | -- | ND | -- | ND | -- | 172 | 5.0 |
| BH-08-25 | BH-08-25_1.0-2.0 | 1.0-2.0 | 5/7/2008 | ND | -- | ND | -- | ND | -- | 223 | 5.6 |
| BH-08-26 | BH-08-26_1.0-2.0 | 1.0-2.0 | 5/8/2008 | 9 | 4.18E-07 | ND | -- | ND | -- | 261 | 6.1 |
| BH-08-27 | BH-08-27_1.0-2.0 | 1.0-2.0 | 5/6/2008 | ND | -- | ND | -- | 0.4 | 3.68E-07 | 89.7 | 3.9 |
| BH-08-28 | BH-08-28_1.0-2.0 | 1.0-2.0 | 5/6/2008 | ND | -- | ND | -- | ND | -- | 132 | 4.4 |
| BH-08-29 | BH-08-29_1.0-2.0 | 1.0-2.0 | 5/6/2008 | ND | -- | ND | -- | ND | -- | 96.4 | 4.0 |
| BH-08-31 | BH-08-31_1.0-2.0 | 1.0-2.0 | 5/6/2008 | ND | -- | ND | -- | 11 | 1.01E-05 | 1300 | 19.7 |
| BH-08-32 | BH-08-32_0.0-2.0 | 0-2.0 | 7/3/2008 | ND | -- | ND | -- | 0.9 | 8.29E-07 | 128 | 4.4 |
| BH-08-33 | BH-08-33_1.5-2.0 | 1.5-2.0 | 5/6/2008 | ND | -- | 0.36 | 0.00001 | 3.6 | 3.31E-06 | 172 | 5.0 |
| BH-08-34 | BH-08-34_1.5-2.0 | 1.5-2.0 | 5/6/2008 | ND | -- | ND | -- | 29 | 2.67E-05 | 354 | 7.3 |
| BH-08-35 | BH-08-35_1.0-2.0 | 1.0-2.0 | 5/6/2008 | ND | -- | ND | -- | ND | -- | 14.3 | 2.9 |
| N-98 | N-98_1.0-2.0 | 1.0-2.0 | 6/2/2008 | ND | -- | 1 | 0.00002 | ND | -- | 94.5 | 3.9 |
| N-99 | N-99_1.0-2.0 | 1.0-2.0 | 6/17/2008 | ND | -- | 53 | 0.00093 | 61 | 5.62E-05 | 146 | 4.6 |
| N-100 | N-100_0.0-2.0 | 0.0-2.0 | 6/11/2008 | ND | -- | ND | -- | ND | -- | 135 | 4.5 |
| N-101 | N-101_1.0-2.0 | 1.0-2.0 | 6/16/2008 | ND | -- | ND | -- | ND | -- | 78.1 | 3.7 |
| N-102 | N-102_1.0-2.0 | 1.0-2.0 | 6/5/2008 | ND | -- | ND | -- | 0.2 | 1.84E-07 | 24.7 | 3.0 |
| N-103 | N-103_1.0-2.0 | 1.0-2.0 | 6/6/2008 | ND | -- | ND | -- | ND | -- | 174 | 5.0 |
| N-104 | N-104_1.0-2.0 | 1.0-2.0 | 6/17/2008 | ND | -- | ND | -- | ND | -- | 164 | 4.9 |
| N-105 | N-105_1.0-2.0 | 1.0-2.0 | 6/17/2008 | ND | -- | ND | -- | ND | -- | 36.4 | 3.2 |
| N-106 | N-106_1.0-2.0 | 1.0-2.0 | 6/5/2008 | ND | -- | ND | -- | 0.19 | 1.75E-07 | 76.7 | 3.7 |
| N-107 | N-107_1.0-2.0 | 1.0-2.0 | 6/17/2008 | 0.74 | 3.44E-08 | ND | -- | ND | -- | 173 | 5.0 |
| N-108 | N-108_1.0-2.0 | 1.0-2.0 | 5/29/2008 | ND | -- | ND | -- | 5.4 | 4.97E-06 | 147 | 4.6 |
| N-109 | N-109_1.0-2.0 | 1.0-2.0 | 6/17/2008 | ND | -- | ND | -- | ND | -- | 294 | 6.5 |
| N-110 | N-110_1.0-2.0 | 1.0-2.0 | 5/14/2008 | ND | -- | ND | -- | ND | -- | 15 | 2.9 |
| N-111 | N-111_1.0-2.0 | 1.0-2.0 | 5/14/2008 | ND | -- | ND | -- | ND | -- | 117 | 4.2 |
| N-112 | N-112_1.0-2.0 | 1.0-2.0 | 5/8/2008 | ND | -- | ND | -- | ND | -- | 11.6 | 2.9 |
| N-113 | N-113_1.0-2.0 | 1.0-2.0 | 5/15/2008 | ND | -- | ND | -- | ND | -- | 77.9 | 3.7 |
| N-114 | N-114_1.0-2.0 | 1.0-2.0 | 5/8/2008 | 0.51 | 2.37E-08 | ND | -- | ND | -- | 139 | 4.5 |
| N-115 | N-115_0.0-2.0 | 0.0-2.0 | 5/28/2008 | ND | -- | ND | -- | 6.5 | 5.98E-06 | 1250 | 19.0 |
| N-116 | N-116_1.0-2.0 | 1.0-2.0 | 5/20/2008 | ND | -- | ND | -- | ND | -- | 340 | 7.1 |
| N-117 | N-117_1.0-2.0 | 1.0-2.0 | 6/4/2008 | ND | -- | ND | -- | 0.63 | 5.80E-07 | 219 | 5.6 |
| N-118 | N-118_1.0-2.0 | 1.0-2.0 | 5/23/2008 | ND | -- | ND | -- | ND | -- | 200 | 5.3 |
| N-119 | N-119_1.0-2.0 | 1.0-2.0 | 6/17/2008 | ND | -- | ND | -- | 0.43 | 3.96E-07 | 101 | 4.0 |
| N-120 | N-120_1.0-2.0 | 1.0-2.0 | 5/22/2008 | ND | -- | ND | -- | ND | -- | 181 | 5.1 |
| N-121 | N-121_1.0-2.0 | 1.0-2.0 | 6/9/2008 | ND | -- | ND | -- | ND | -- | 64 | 3.5 |
| N-122 | N-122_1.0-2.0 | 1.0-2.0 | 5/7/2008 | ND | -- | ND | -- | ND | -- | 207 | 5.4 |
| N-123 | N-123_1.0-2.0 | 1.0-2.0 | 5/20/2008 | ND | -- | ND | -- | 13 | 1.20E-05 | 254 | 6.0 |
| N-124 | N-124_1.0-2.0 | 1.0-2.0 | 5/21/2008 | ND | -- | ND | -- | ND | -- | 43.9 | 3.3 |
| N-125 | N-125_1.0-2.0 | 1.0-2.0 | 6/17/2008 | ND | -- | ND | -- | 1.5 | 1.38E-06 | 150 | 4.7 |
| N-126 | N-126_1.0-2.0 | 1.0-2.0 | 6/17/2008 | ND | -- | ND | -- | ND | -- | 912 | 14.6 |
| N-127 | N-127_1.0-2.0 | 1.0-2.0 | 5/22/2008 | ND | -- | ND | -- | ND | -- | 191 | 5.2 |
| N-128 | N-128_1.0-2.0 | 1.0-2.0 | 5/20/2008 | 1.9 | 8.83E-08 | 2.2 | 0.00004 | 6 | 5.52E-06 | 61.4 | 3.5 |
| N-129 | N-129_1.0-2.0 | 1.0-2.0 | 6/17/2008 | ND | -- | ND | -- | ND | -- | 31.3 | 3.1 |
| N-130 | N-130_0.0-2.0 | 0.0-2.0 | 5/16/2008 | ND | -- | ND | -- | ND | -- | 670 | 11.5 |
| N-131 | N-131_1.0-2.0 | 1.0-2.0 | 6/17/2008 | ND | -- | ND | -- | ND | -- | 88.8 | 3.9 |
| N-132 | N-132_1.0-2.0 | 1.0-2.0 | 5/13/2008 | ND | -- | ND | -- | ND | -- | 94.9 | 4.0 |
| N-133 | N-133_1.0-2.0 | 1.0-2.0 | 5/15/2008 | 3.7 | 1.72E-07 | ND | -- | ND | -- | 865 | 14.0 |
| N-134 | N-134_1.0-2.0 | 1.0-2.0 | 5/22/2008 | ND | -- | 4.7 | 0.00008 | 37 | 3.41E-05 | 74.6 | 3.7 |
| N-135 | N-135_1.0-2.0 | 1.0-2.0 | 5/15/2008 | ND | -- | 2.1 | 0.00004 | 1.5 | 1.38E-06 | 273 | 6.3 |
| N-136 | N-136_1.0-2.0 | 1.0-2.0 | 5/15/2008 | 0.7 | 3.25E-08 | ND | -- | ND | -- | 320 | 6.9 |
| | | | ***Cumulative Total:*** | ***1.55E-06*** | | ***2.06E-03*** | | ***1.68E-04*** | | | |

**Maximum Total Cumulative Risk for Carcinogens:** **1.69E-04** *> 1 in 10,000*
**Maximum Hazard Index for Non-Carcinogens:** **0.0021** *< 1*

**Notes:**
ND - Not Detected Above Lab Reporting Limit
(1) All soil samples collected and analyzed were unsaturated.
(2) all samples are located outside SWMU areas.
(3) Maximum Total Cumulative Risk is the combined risk of exposure to the detected concentrations of carcinogenic compounds benzene and BaP and should be less than 1 in 10,000.
(4) Calculated based on site specific parameters provided in Table F-4. The CDC (NIOSH, 2008) recommends that blood lead levels be maintained below 25 ug/dL.

# WORK PLAN FOR SITE CHARACTERIZATION
# AREA OF INTEREST 8

# SUNOCO PHILADELPHIA REFINERY
# PHILADELPHIA, PENNSYLVANIA


**Sunoco, Inc. (R&M)**
**3144 Passyunk Avenue**
**Philadelphia, Pennsylvania**

**May 16, 2008**
**2574601**

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## 1.0 INTRODUCTION

The Current Conditions Report and Comprehensive Remedial Plan (CCR) prepared by Sunoco Inc. (R&M) (Sunoco), dated June 30, 2004, proposed Phase II site characterization and corrective action activities for Sunoco's Philadelphia Refinery (Refinery), including preparation of Site Characterization Reports for individual Areas of Interest (AOIs). The CCR presented a prioritization of all eleven AOIs based on specific risk factors. To date, site characterization activities have been completed for four AOIs at the Refinery. These include AOI 1 (Belmont Terminal, #1 Tank Farm and #2 Tank Farm), AOI 4 (#4 Tank Farm), AOI 6 (Girard Point Chemicals Processing Area), and AOI 5 (Girard Point South Tank Field Area). Site characterization work plans and site characterization reports for these four AOIs were submitted to the Pennsylvania Department of Environment Protection (PADEP) and the United States Environmental Protection Agency (US EPA).

This site characterization work plan (work plan) has been prepared specifically for AOI 8, the next AOI to be characterized in accordance with the revised Phase II Corrective Action Schedule which is included as Appendix A.

AOI 8 is the northern most area of the Refinery and is known as the Point Breeze Process Area North Yard. AOI 8 is bound by the Philadelphia Gas Works (PGW) plant to the south, the Schuylkill River to the west, industrial properties to the north, and urban streets to the east (Figure 1). AOI 8 encompasses approximately 250 acres.

The North Yard was an active Refinery process area since the early twentieth century with significant process areas and above ground storage tanks (ASTs). The north yard also included the former lube, asphalt, soap, and wax plants. The majority of AOI 8 structures were demolished between 1975 and 1980. Subsequent to decommissioning of most of the process areas, a Land Treatment Unit ("LTU") was operated from 1986 through 2000. Currently, the only remaining active facilities in AOI 8 are the asphalt dock, the boiler house, a storm water separator, fuel oil storage, butane and propane storage area, and loading and unloading facilities. Much of AOI 8 is unoccupied and many of the ASTs have been demolished. The majority of the land surface in AOI 8 is not covered by impervious surfaces.

The existing monitoring well network in AOI 8 includes a total of 95 monitoring wells, 13 piezometers, and 20 recovery wells. Of the 20 recovery wells, nine are active. These nine active recovery wells are associated with three remedial systems; they include the the PGW Border Total Fluids Recovery System, the Jackson Street Sewer Total Fluids Recovery System,

and the North Yard Bulkhead / No. 3 Tank Farm Separator Total Fluids Recovery System. These remedial systems are discussed in detail in Section 1.3 of this Work Plan.

Ground water gauging of selected wells in AOI 8 occurs on a quarterly basis and is supplemented by a more comprehensive gauging event that is completed semi-annually. Sunoco samples select wells for constituents of concern (COCs) established in the CCR in AOI 8 on an annual basis. Quarterly, semi-annual and annual gauging and sampling activities, as well as the routine operation and maintenance data for the AOI 8 remedial systems, are reported to the PADEP and US EPA in Quarterly Reports.

### 1.1 Objectives

The objective of the proposed activities in this work plan is to characterize current environmental conditions at AOI 8 in accordance with the 2003 Consent Order and Agreement (CO&A) between Sunoco and the PADEP and the 2004 CCR. This work plan also includes activities to address any remaining issues pertaining to the characterization of the Resource, Conservation and Recovery Act (RCRA) Solid Waste Management Unit (SWMU) in AOI 8 known as SWMU 2 – Former Leaded Tank Bottoms Sludge Weathering Pad. This SWMU is discussed in detail in Section 1.2.1 of this work plan. The LTU was closed under a Consent Order and Agreement (CO&A) between PADEP and Sunoco and is currently undergoing post-closure monitoring activities. Therefore, no characterization work is proposed in the LTU.

Below is a list of the general site characterization activities proposed at AOI 8 and discussed in this work plan:

- Review of all available historical environmental reports relating to AOI 8;
- Evaluate performance of existing remediation systems;
- Advance shallow soil borings and collect shallow soil samples for laboratory analysis of Site compounds of concern (COCs);
- Install shallow groundwater monitoring wells;
- Survey all new wells and soil boring locations;
- Collect groundwater samples for laboratory analysis of Site COCs from all new and existing shallow and deep groundwater monitoring wells;
- Collect samples for characterization of light non-aqueous phase liquid (LNAPL) from select newly-installed monitoring wells;
- Complete LNAPL modeling to evaluate LNAPL specific volume and mobility;

- Evaluate potential vapor migration pathways using the PADEP's vapor intrusion guidance;
- Complete fate and transport modeling of dissolved COCs in site groundwater;
- Complete exposure and risk assessment activities, if necessary; and
- Prepare a Site Characterization Report detailing the results of the characterization activities.

The COCs for the proposed investigation activities include all constituents listed in Tables 5a and 5b of the CCR, and are included as Table 1 of this work plan. Data collected from the above activities will be evaluated as part of the AOI 8 site characterization process. This data will be presented in the Site Characterization Report for AOI 8 which is anticipated to be submitted to PADEP and US EPA by September 30, 2008 in accordance with the revised Phase II Corrective Action Schedule (Appendix A).

### 1.2 Overview of Investigative Framework and Remedial Approach for AOI 8

The current remediation program for the Refinery is performed under the 2003 CO&A between PADEP and Sunoco. In April 2004, the PADEP and US EPA signed an agreement entitled "One Cleanup Program Memorandum of Agreement (MOA or 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 US EPA to discuss the applicability of the Sunoco Philadelphia Refinery to the 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 meeting, Sunoco submitted a letter dated December 2, 2005 to US EPA and PADEP documenting the discussions at the meeting (Appendix B). As summarized in this letter, the major aspects of including the Philadelphia Refinery in the One-Cleanup Program include:

1. Submittal of a Notice of Intent to Remediate (NIR) under the PADEP Act 2 Program. Sunoco submitted a NIR for the Refinery, excluding the Belmont Terminal, to the PADEP on October 12, 2006. The NIR was accompanied by a cover letter which requested that the Refinery be included in the PA One-

Cleanup Program and that all remediation work will be completed under the 2003 CO&A. RCRA corrective action measures will be addressed concurrently with work performed under the CO&A and within the Act 2 program. The City of Philadelphia requested that a Public Involvement Plan be prepared in response to the NIR. Sunoco held a public involvement meeting in South Philadelphia on September 19, 2007.

2. Sunoco is currently in the process of revising the corrective action permit for the Philadelphia Refinery to embody the Pennsylvania One Cleanup Plan elements.

An overview of the RCRA corrective action program for the Point Breeze North Yard (AOI 8) portion of the Philadelphia Refinery is provided in the following section.

### *1.2.1 Overview of RCRA Corrective Action Program in AOI 8*

A number of RCRA investigations were completed in AOI 8 between 1986 and 1988 on behalf of Atlantic Refining and Marketing (Atlantic), the subsidiary of Sunoco, Inc. that owns the Point Breeze portion of the Philadelphia Refinery. Atlantic has leased the Point Breeze portion of the Philadelphia Refinery to Sunoco, Inc. (R&M), a subsidiary that operates the Philadelphia Refinery. These investigations included a Phase I Preliminary Review of SWMU's, a RCRA Facility Assessment, and a RCRA Verification Work Plan. On December 9, 1988, US EPA issued a Corrective Action and Waste Minimization Permit for the Point Breeze portion of the Refinery that identified six SWMUs. This permit required additional investigation of the SWMUs to determine if corrective action was needed. One of the SWMUs (SWMU 2 – Leaded Tank Bottoms Sludge Weathering Pad) is located in AOI 8; the remaining SWMUs are located in other AOIs at the Refinery. In 1991, a RCRA Facility Investigation (RFI) Work Plan was prepared by CH2MHill for the Refinery. The RFI Work Plan described SWMU 2 as a 50-foot by 100-foot area on which leaded gasoline storage tank bottoms sludge was placed and allowed to weather. SWMU 2 is shown in Figure 2. The startup date of the SWMU was not known, however, according to previous reports (A.T. Kearney, Inc, 1986 and NUS Corporation, 1988), the unit was reportedly constructed of naturally occurring soil and fill material and was closed in the mid-1960s. According to GES (GES, 1989), the area served as a leaded sludge weathering pad during two distinct time periods. Prior to 1959, leaded sludges were deposited in a pit at the location of the weathering pad. A

Refinery building occupied this area from 1959 to 1975. In 1975, the building was razed and the remaining concrete slab foundation was used to weather leaded tank bottoms sludge. The sludge weathering area was closed again in 1980 by transferring weathered sludges to a new sludge weathering unit. The concrete pad was reportedly swept clean of residual materials and covered with clean gravel (GES, 1989). The RFI Work Plan recommended that a geophysical survey be completed in the area to determine the orientation and location of the former sludge weathering pad. The RFI Work Plan also recommended that soil samples be collected from four test trenches to be excavated around the perimeter of the pad after the pad boundary is delineated by the geophysical survey.

The results of the RCRA Facility Investigation were presented in a report prepared by ENSR Consulting and Engineering dated September 1992 (RFI). The RFI was conducted in accordance with CH2MHill's 1991 RFI Work Plan. As part of the RFI, a geophysical survey was completed to delineate the extent of the concrete pad. The RFI documented that the dimensions of the former sludge weathering pad (SWMU 2) in AOI 8 was 50 by 400 feet, not 50 by 100 feet as described in the RFI Work Plan. Nine test trenches were then excavated around the perimeter of the pad on March 4 and 5, 1992. A total of 17 soil samples were collected from the trenches and submitted for laboratory analysis and the results are described in the RFI. No soil samples were collected from soil between zero and two feet beneath the ground surface around the perimeter of the pad. Concentrations of lead in two of the 17 soil samples collected at depths greater than two feet exceeded the current PADEP Medium Specific Concentration (MSC) of 450 mg/kg; all other samples exhibited lead concentrations below 450 mg/kg.

This Work Plan includes a plan to characterize soil at this SWMU in accordance with the objectives of the 2003 CO&A, the CCR and the PA One Cleanup Program. SWMU 2 is identified as the only SWMU in AOI 8 requiring further investigation. The approach to investigating SWMU 2 is described in detail in Section 1.2.2. If site characterization and or remediation are completed at SWMU 2 in accordance with the approach discussed herein, the RCRA obligations for this area in AOI 8 will be satisfied if the PADEP and US EPA have approved of the work completed as documented in the Site Characterization Report.

### *1.2.2 Overview of Proposed Approach for SWMU 2*

The proposed approach to address soils within SWMU 2 will support a RCRA final remedial measure, as well as support attainment of an Act 2 remediation standard, consistent with the One Cleanup Plan. The proposed approach is consistent with the approach used for other AOIs which have been previously characterized and contain leaded tank bottom SWMUs (i.e., AOI 5 and AOI 6).

Leaded Tank Bottom materials are distinguished by distinctive rust/red to black, metallic mostly oxidized scale materials. Leaded Tank Bottoms are also sometimes in a matrix of petroleum wax sludge. If materials are encountered in soil within the leaded tank bottom areas matching the physical description of the leaded tank bottoms, then Sunoco will collect samples for total lead. If the total lead results exceed 450 parts per million (ppm) (PADEP's non-residential soil MSC for lead), then the samples will be analyzed for lead via Toxicity Characteristic Leaching Procedure, EPA Test Method 1311. Delineated areas that have soils that physically resemble leaded tank bottoms, have concentrations of total lead exceeding 450 ppm, and are hazardous for lead, will retain the leaded tank bottom designation. If no soils are encountered that meet all three of these criteria, then the area will no longer be classified as a leaded tank bottom area. Sunoco will certify that these areas will no longer contain leaded tank bottoms materials, based on the procedures above, in the Site Characterization Report. The proposed soil sampling program for this portion of SWMU 2 is presented in detail in Section 2.1.

### *1.2.3 Overview of Proposed Approach in Non-RCRA Areas of AOI 8*

The proposed approach to address groundwater and soils in the remainder of AOI 8 is in accordance with the Act 2 program. Sampling will be focused to further characterize the volume and mobility of LNAPL and the extent of site COCs in soil and groundwater. Additional soil borings or well installations may also be completed throughout AOI 8 to ensure that site soils and groundwater are fully characterized in accordance with the Act 2 program.

### *1.2.4 Overview of the Land Farm Treatment Unit (LTU) in AOI 8*

The LTU is located in the northwestern portion of AOI 8 and encompasses approximately 20 acres. The LTU was closed under a Consent Order and Agreement (CO&A) between PADEP and Sunoco and is currently undergoing post-closure monitoring activities. Therefore, no characterization work is proposed in the LTU. A narrative describing the history and current status of the LTU will be provided in the Site Characterization Report to be prepared for AOI 8 following implementation of this work plan.

## 1.3 Overview of Existing Phase I Activities in AOI 8

Currently four active remediation systems operate in the North Yard. These systems are: the PGW Border Total Fluids Recovery System, the Jackson Street Sewer Total Fluids Recovery System, the North Yard Bulkhead / No. 3 Tank Farm Separator Total Fluids Recovery System, and the Jackson Street Sewer Water Curtain. These remediation systems are discussed below. Remediation system performance and monitoring data is summarized in quarterly reports that are provided to the PADEP and US EPA.

The PGW Border Total Fluids Recovery System is composed of recovery wells numbered RW-200 through RW-205 and an interceptor trench with a recovery sump (RW-206). The system was installed to address offsite migration of LNAPL. The system recovery network consists of total fluids recovery utilizing electric submersible pumps equipped with individual timers to control the on and off cycle of each pump. Total fluids are extracted from wells RW-201, RW-202, and RW-203. Total fluids produced by the 200 series pumps are routed to the North Yard 10,000-gallon holding tank where a flow meter measures incoming fluids produced by the three recovery wells. Groundwater is passed through the tank and routed to the Point Breeze Processing Area Wastewater Treatment Plant. Accumulated LNAPL is pumped out of the 10,000-gallon holding tank as needed by a vacuum truck.

The Jackson Street Sewer Total Fluids Recovery System network consists of total fluids (groundwater and LNAPL) recovery utilizing electric submersible pumps equipped with individual timers to control the pumping at each recovery well. The system was installed to address LNAPL migration to the Jackson Street Sewer and the Schuylkill River. The recovery network includes a total of three wells, RW-300, RW-301, and RW-302. Total fluids produced from the wells are routed to the North Yard 10,000-gallon

holding tank where a flow meter records the combined total fluids produced from the Jackson Street recovery well network. Recovered water is passed through the tank and routed to the Point Breeze Processing Area Wastewater Treatment Plant. Accumulated LNAPL is pumped out of the 10,000-gallon holding tank as needed by a vacuum truck.

The North Yard Bulkhead Total Fluids Recovery System consists of a 3,400-foot long interceptor trench with two recovery sumps (RW-500 and RW-501). The No. 3 Tank Farm Separator Total Fluids Recovery System consists of one recovery system RW-502 located in the center of the capped closed separator. This system was installed to address LNAPL migration to the Schuylkill River. RW-500, RW-501 and RW-502 utilize electric submersible pumps controlled by a timer to recover total fluids. The total fluids from the three recovery wells are pumped to the North Yard 10,000-gallon holding tank where a flow meter measures incoming fluids produced by the recovery wells. Groundwater is passed through the tank and routed to the Point Breeze Processing Area Wastewater Treatment Plant. Accumulated LNAPL is pumped out of the 10,000-gallon holding tank as needed by a vacuum truck.

In addition to the four remediation systems, a water curtain in Jackson Street Sewer was installed during 4th quarter 2003. The water curtain is designed to reduce hydrocarbon odors potentially migrating from Jackson Street sewer to the surrounding areas. The water curtain apparatus is located in the first manhole west of the interceptor chamber along 26$^{th}$ Street and consists of a single centrally located nozzle that emits a radial spray pattern. Recovered water is supplied to the water curtain apparatus from the North Yard fire water system. Heat trace was run along the water feed line allowing winter operation of the water curtain.

No additional Phase I corrective action activities are proposed in this work plan. The effectiveness of the existing AOI 8 remedial systems and the need to perform additional active remediation in AOI 8 will be evaluated following completion of the proposed site characterization activities.

### 1.4 Work Plan Support Activities

Several activities were performed to support the development of this work plan. These activities are summarized on the following page:

- Aquaterra Technologies, Inc. (Aquaterra) performed a round of groundwater monitoring and sampling in AOI 8 between February 4 and 8, 2008. All accessible wells in AOI 8 were gauged and select wells (40 total) were sampled for site COCs. The wells for sampling were selected to obtain a spatial representation of groundwater quality throughout AOI 8. The groundwater samples were submitted to Lancaster Laboratories of Lancaster, Pennsylvania (Act 2-certified) for analysis of site COCs. The results of these samples are presented in Tables 2a and 2b of this work plan. This data was obtained to enhance the Site Conceptual Model for AOI 8 and to refine site characterization activities proposed in this work plan;

- Aquaterra collected LNAPL from select wells which contained measurable (<0.01) LNAPL and submitted the samples to Torkelson Geochemistry, of Tulsa, Oklahoma for LNAPL characterization. This data was obtained to enhance the Site Conceptual Model for AOI 8 and to refine site characterization activities proposed in this work plan;

- Available historical aerial photographs with coverage of AOI 8 were obtained and reviewed to identify specific areas for characterization and to assist in determining previous industrial uses of AOI 8. Aerial photos were reviewed for the following years: 1928, 1930, 1943, 1959, 1965, 1970, 1973, 1975, 1980, 1985, 1986, 1990, 1992, 1995; and

- Historic reports and reports used in development of the CCR were reviewed to evaluate and refine site characterization activities proposed in this work plan. Key reports included:

    - *The Atlantic Lead Weathering Pad Final Closure Report, Sun Refining and Marketing Company, Atlantic Refining and Marketing Corporation, Philadelphia Refinery*, prepared by K.W. Brown & Associates, Inc., dated March 1991;

    - *RCRA Facility Investigation Work Plan, Philadelphia Refinery, Sun Refining and Marketing Company, Philadelphia Pennsylvania*, prepared by CH2MHILL, dated May 1991;

    - *Comprehensive Remedial Plan, Philadelphia Refinery, Sun Company (R&M),* prepared by ENSR Consulting and Engineering, dated September 1993;

- *Remedial Action Plan for the No. 3 Tank Farm Separator, Sun Company (R&M), Philadelphia Refinery*, prepared by ENSR Consulting and Engineering, dated October 1993;

- *Remedial Action Plan for the North Yard Bulkhead, Sun Company (R&M), Philadelphia Refinery*, prepared by ENSR Consulting and Engineering, dated October 1993;

- *Remedial Action Plan for the North Yard Southern Property Boundary, Sun Company (R&M), Philadelphia Refinery*, prepared by ENSR Consulting and Engineering, dated December 1993;

- *Consent Order and Agreement by and between the Commonwealth of Pennsylvania, Department of Environmental Protection, Atlantic Refining & Marketing Corporation and Sunoco Company, Inc. (R&M), dated August 1996, and amended December 2000 and July 2004;*

- *Corrective Measures Study Work Plan, Sun Company, Inc. (R&M), Philadelphia, Pennsylvania,* prepared by ENSR Consulting and Engineering, dated April 1997;

- *Landfarm Treatment Unit Closure Activation Report, Philadelphia Refinery Point Breeze Processing Area*, prepared by Blazosky Associates, Inc., dated November 2000;

- *Amended Closure Plan, Sunoco, Inc. Philadelphia Refinery, Point Breeze Processing Area, Land Treatment Unit,* prepared by Blazosky Associates, Inc., originally dated November 1988 and amended November 2002 and May 2004; and

- *Amended Post-Closure Plan, Sunoco, Inc. Philadelphia Refinery, Point Breeze Processing Area, Land Treatment Unit,* prepared by Blazosky Associates, Inc., originally dated November 1988 and amended June 2003 and May 2004.

## 2.0 PROPOSED SITE CHARACTERIZATION ACTIVITIES

Based on the identified data collection needs for AOI 8, the following site characterization tasks are proposed and included in this work plan:

**Task 1: Shallow Soil Borings and Sampling**
**Task 2 Installation of Shallow/Intermediate Groundwater Monitoring Wells and Deep Soil Borings**
**Task 3: Groundwater Monitoring and Sampling**
**Task 4: Collection and Characterization of LNAPL Samples**
**Task 5: Review of Available Aquifer Test Data**
**Task 6: Evaluation of the Potential Vapor Intrusion into Indoor Air Pathway**
**Task 7: Fate and Transport Analysis of Dissolved COCs in Groundwater**
**Task 8: Exposure and Risk Assessment**
**Task 9: Surveying**
**Task 10: Data Evaluation and Site Conceptual Model**
**Task 11: Reporting**

The individual site characterization tasks included in this work plan are discussed in detail in the following sections.

### 2.1 Shallow Soil Borings and Soil Sampling

To further characterize shallow soil conditions within AOI 8, a total of 37 shallow soil borings will be completed. The locations of the borings are shown on Figure 2. Twenty-four of the 37 soil boring locations were selected to characterize shallow soil at areas with possible historic environmental concerns, including former process and tank areas, and other areas identified from reviewing historic reports and aerial photographs. The remaining soil boring locations were selected in a random manner to spatially represent other areas of AOI 8. Each shallow soil boring will be advanced from zero to two feet beneath the ground surface and one soil sample will be collected from each boring for laboratory analysis of site COCs. One shallow soil sample will also be collected from zero to two feet beneath the ground surface at each proposed groundwater monitoring well location (see Section 2.2). Soil samples will only be collected from those areas that are not covered by impervious surfaces. Soil boring and sample collection procedures are outlined in Section C.3 of Appendix C and the

proposed soil boring locations are shown on Figure 2. A summary of the proposed soil sampling activities is included in Table 3.

SWMU 2 - Former Leaded Tank Bottoms Sludge Weathering Pad

Four soil borings will be advanced around the perimeter of the existing concrete pad and two soil samples will be advanced through the northern portion of the existing concrete pad (at the location of the former sludge pit beneath the pad) at SWMU 2 in accordance with Section 1.2.2 of this work plan. These soil borings will be advanced to a depth of six feet beneath the ground surface using a hand-auger or geoprobe. Soil samples will be collected from SWMU 2 in accordance with the procedures described in section C.3 of Appendix C. If necessary, soil samples will be submitted to Lancaster Laboratories for analysis of total lead, and for TCLP lead analysis in accordance with Section 1.2.2.

## 2.2 Task 2: Installation of Shallow/Intermediate Groundwater Monitoring Wells

Thirty-nine fill and alluvium (shallow) or Trenton gravel (intermediate) groundwater monitoring wells are proposed to be installed in AOI 8 as shown on Figure 2 and summarized on Table 3. At four well locations, the well borings will be advanced to the top of bedrock for characterization of geology. The well borings will be advanced using hollow stem auger drilling methods and screened within the shallow or intermediate zone. All wells will be installed so that the screened interval intercepts the groundwater table, allowing for appropriate measurement of apparent LNAPL thickness. Each well will be developed subsequent to completion. All well installation, well development, and waste handling activities will be performed in accordance with the procedures described in Appendix C of this work plan.

Fourteen deep (Lower Sand) groundwater monitoring wells exist in AOI 8. These wells include N-13, N-19, N-21, N-27, N-30, N-38D, N-4, N-43, N-46D, N-50D, N-69, N-79, N-83, and N-9. As part of AOI 8 characterization, the classification of these wells will be re-evaluated considering geology and well construction. Any changes to the classifications of these wells will be described in the Site Characterization Report for AOI 8. No additional deep groundwater monitoring wells are proposed to be installed in AOI 8 as part of this work plan.

## 2.3 Task 3: Groundwater Monitoring and Sampling

### *2.3.1 Groundwater Monitoring*

Upon completion of the monitoring well installations and development in AOI 8, a complete round of groundwater water elevation gauging will be performed from all accessible new and existing monitoring wells in AOI 8. All well gauging activities will be performed in accordance with the Liquid Level Gauging Procedures described in Appendix C of this work plan. Monitoring well gauging data collected during this event will be used to evaluate groundwater flow conditions and the occurrence and extent of apparent LNAPL in AOI 8.

### *2.3.2 Groundwater Sampling*

Following completion of the groundwater gauging activities in the AOI 8, a full round of groundwater sampling will be conducted from all accessible new and existing monitoring wells that do not contain measurable LNAPL. All groundwater samples will be submitted to Lancaster Laboratories for analysis of site COCs, as listed in Table 1. Groundwater sampling will be conducted in accordance with well sampling procedures described in Appendix C of this Work Plan. Groundwater samples will not be collected from wells containing LNAPL and may not be collected from active recovery wells.

## 2.4 Task 4: Collection and Characterization of LNAPL Samples

LNAPL characterization data exists for 22 wells in AOI 8. LNAPL from 11 wells (N-14, N-25, N-31, N-35, N-48, N-52, N-68, N-78, N-79, PZ-204 and PZ-502) was characterized in support of the CCR and LNAPL from 11 wells (N-42, N-47, N-51, N-75, N-76, N-82, N-91, N-503, RW-205, RW-300 and RW-305) was collected by Aquaterra and characterized in support of this Work Plan.

As part of implementation of this Work Plan, additional LNAPL samples will be collected from existing or newly installed monitoring wells that have measurable LNAPL thicknesses and are not located in the immediate vicinity of a well with known LNAPL type. All LNAPL sampling activities will be completed in accordance with the section C.4 in Appendix C of this Work Plan. The LNAPL samples will be submitted to Torkelson Geochemistry of Tulsa, Oklahoma for characterization. The results of the LNAPL characterization analysis will be used to separate LNAPL plumes by product type

and to assist in evaluating specific LNAPL volume and mobility. All LNAPL data for AOI 8 will be summarized in the Site Characterization Report.

### 2.5 Task 5: Review of Available Aquifer Test Data

Langan reviewed relevant historical documents prepared for AOI 8 to determine if specific aquifer data that may have been collected during previous environmental investigations was available. Based on the review, sufficient aquifer data exists, including data from numerous bail-down tests, slug tests, and step and constant rate pumping tests completed in AOI 8 by others. These data will be further evaluated and summarized as a part of the Site Characterization Report. Based on the sufficiency of this data, no further aquifer testing is proposed to be completed in AOI 8 as part of this Work Plan.

### 2.6 Task 6: Evaluation of the Potential Vapor Intrusion (VI) into Indoor Air Pathway

As presented in the CCR, there are three potential indoor air receptors in AOI 8. The boiler house building is located in the center of AOI 8 and is operated by Sunoco. As such, this building is covered under the Refinery's OSHA monitoring plan. The other two buildings are located in the southwest portion of AOI 8 and are currently used by the U.S. Coast Guard. These buildings are not covered under the Refinery's OSHA monitoring plan.

Sunoco will be sampling indoor air within the boiler house to evaluate the potential VI pathway. The results of the sampling will be compared to the OSHA permissible exposure limits. The results of this sampling will determine whether further investigation will be performed to assess the potential VI pathway at this building. The potential VI pathway at the two Coast Guard buildings will be evaluated in accordance with the PADEP's VI guidance. The results of the VI evaluations for all receptors will be summarized in the Site Characterization Report.

### 2.7 Task 7: Fate and Transport Analysis of Dissolved COCs in Groundwater

Fate and transport calculations will be completed for groundwater to evaluate potential migration pathways and potential impacts to receptors, as necessary. Fate and transport modeling will be conducted for the constituents listed in Table 1 using PADEP approved analytical models (QUICK_DOMENICO.XLS and FATBACK.XLS and PENTOXSD). To support the fate and transport analyses, Sunoco will provide all assumptions, data and information used in the analytical modeling. The parameters used in the analyses will either be site-specific data obtained during previous investigations, values collected as part of future site characterization activities, and/or default parameters provided in the Act 2 regulations or guidance manual.

### 2.8 Task 8: Exposure and Risk Assessment

In accordance with Title 25, Chapter 250, Subchapter F, a detailed exposure assessment will be performed for AOI 8 based on the completed site characterization activities. This exposure assessment will be based on an assumed non-residential current and future site use. If completed exposure pathways are identified, then risk assessment activities will be completed in accordance with Act 2.

### 2.9 Task 9: Surveying

Sunoco surveyed all existing wells in AOI 8 in November 2007 in support of this work plan. Following completion of proposed soil boring and groundwater monitoring well installation activities, the new boring and well locations will be surveyed to establish the location and elevation at each boring, and the elevations of the inner and outer casing and ground surface (for wells). The well elevations will be determined to the nearest 0.01 foot relative to mean sea level. All survey activities will be performed by a Pennsylvania-licensed surveyor and referenced to the NAVD 88 datum.

### 2.10 Task 10: Data Evaluation and Site Conceptual Model

Data collected from the site characterization activities will be compiled and evaluated in accordance with the objectives of the 2003 CO&A and the CCR. This data will also be used to modify and refine the Site Conceptual Model. Site characterization activities described in this work plan will provide the following information to be used in refining the Site Conceptual Model:

- Soil data collected between zero and two feet below the ground surface from select soil borings will further characterize the potential direct contact exposure pathway for soil;

- Soil data collected from within SWMU 2 will further characterize conditions in accordance with Section 1.2.2;

- Installation, monitoring and sampling of new groundwater monitoring wells will further characterize groundwater quality and flow in AOI 8;

- New and existing LNAPL data in AOI 8 will allow for more accurate LNAPL classification and distribution estimates, and will refine the LNAPL specific volume and mobility modeling predictions for these areas. This data may support the optimization of existing remedial systems in AOI 8 or the design of new remedial systems in AOI 8, if necessary;

- Fate and transport modeling of dissolved phase COCs in groundwater will further characterize the potential for migration of dissolved phase COCs in groundwater in AOI 8;

- Updated survey data will allow for accurate depiction and evaluation of data points; and

- Throughout the characterization process of AOI 8, additional information regarding the current and historic uses of these areas will be obtained from available sources. Information obtained will be used to generate more detailed Current and Historic Usage figures that may be included in the Site Characterization Report, if necessary.

Data collected during this characterization process will be used to augment the existing geographic information system (GIS) database for the Refinery. The GIS will be used to further evaluate characterization needs and to visually depict current and future site conditions.

### 2.11 Task 11: Reporting

Following completion of the activities listed above in Tasks 1 through 10, a Site Characterization Report will be prepared for AOI 8 documenting the results of all work plan-related activities. Copies of the report will be submitted to the PADEP and US EPA for review and approval. The report will include an executive summary, description of physical site characteristics, summary of field investigation and modeling activities, supporting maps, figures and data summary tables, an exposure assessment, refinement of the Site Conceptual Model based on field investigations, and conclusions and recommendations for future site characterization and/or remedial activities, if any.

All data gathered with respect to the deep aquifer, AOI 11, will be presented in the respective AOI reports; however, a formal characterization report for AOI 11 will be compiled at the conclusion of all other AOI characterization efforts.

## 3.0 IMPLEMENTATION SCHEDULE

Site characterization activities described in this work plan are anticipated to begin in May 2008. It is anticipated that all field activities will be completed by June 2008. The Site Characterization Report for AOI 8 will be submitted to the PADEP and US EPA by September 30, 2008. This schedule is consistent with the revised Phase II Corrective Action Activities Schedule, which is included as Appendix A.

During the Work Plan implementation, if any significant deviations are required from the proposed scope of work, the PADEP and US EPA will be notified prior to implementation of any changes to the work scope.

## 4.0 REFERENCES

RCRA Facility Investigation Work Plan, Philadelphia Refinery, Sun Refining and Marketing Company, Philadelphia Pennsylvania, CHM2HILL, May 1991;

The Atlantic Lead Weathering Pad Final Closure Report, Sun Refining and marketing Company, Atlantic Refining and marketing Corporation, Philadelphia Refinery, K.W. Brown & Associates, Inc., March 1991;

Comprehensive Remedial Plan, Philadelphia Refinery, Sun Company (R&M), September 1993, ENSR Consulting and Engineering;

Remedial Action Plan for the NO.3 Tank Farm Separator, Sun Company (R&M), Philadelphia Refinery, October 1993, ENSR Consulting and Engineering;

Remedial Action Plan for the North Yard Bulkhead, Sun Company (R&M), Philadelphia Refinery, October 1993, ENSR Consulting and Engineering;

Remedial Action Plan for the North Yard Southern Property Boundary, Sun Company (R&M), Philadelphia Refinery, December 1993, ENSR Consulting and Engineering;

Consent Order and Agreement by and between the Commonwealth of Pennsylvania, Department of Environmental Protection, Atlantic Refining & Marketing Corporation and Sunoco Company, Inc. (R&M), August 1996, and amended December 2000 and July 2004;

Corrective Measures Study Work Plan, Sun Company, Inc. (R&M), Philadelphia, PA, April 1997, ENSR Consulting and Engineering;

Landfarm Treatment Unit Closure Activation Report, Philadelphia Refinery Point Breeze Processing Area, November 2000, Blazosky Associates, Inc.;

Amended Closure Plan, Sunoco, Inc. Philadelphia Refinery, Point Breeze Processing Area, Land Treatment Unit, November 1988 and amended November 2002 and May 2004, Blazosky Associates, Inc; and

Amended Post-Closure Plan, Sunoco, Inc. Philadelphia Refinery, Point Breeze Processing Area, Land Treatment Unit, November 1988 and amended June 2003 and May 2004, Blazosky Associates, Inc.

# TABLES

**Table 1**
**Constituents of Concern for Groundwater**
**AOI 8 Work Plan for Site Characterization**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| METALS | CAS No. |
|---|---|
| Lead (dissolved) | 7439-92-1 |

| VOLATILE ORGANIC COMPOUNDS | CAS No. |
|---|---|
| 1,2-dichloroethane | 107-06-2 |
| Benzene | 71-43-2 |
| Cumene | 98-82-8 |
| Ethylbenzene | 100-41-4 |
| Ethylene dibromide | 106-93-4 |
| Methyl tertiary butyl ether | 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.

**Table 1 (continued)**
**Constituents of Concern for Soil**
**AOI 8 Work Plan for Site Characterization**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| METALS | CAS No. |
|---|---|
| Lead (total) | 7439-92-1 |

| VOLATILE ORGANIC COMPOUNDS | CAS No. |
|---|---|
| 1,2-dichloroethane | 107-06-2 |
| Benzene | 71-43-2 |
| Cumene | 98-82-8 |
| Ethylbenzene | 100-41-4 |
| Ethylene dibromide | 106-93-4 |
| Methyl tertiary butyl ether | 1634-04-4 |
| Toluene | 108-88-3 |
| Xylenes (total) | 1330-20-7 |

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

Notes:
1. Constituents are from Pennsylvania Corrective Action Process (CAP) Regulation Amendments effective December 1, 2001; provided in Chapter VI, Section E (pgs. 29-30) of PADEP Document, *Closure Requirements for Underground Storage Tank Systems,* effective April 1, 1998.

**Table 2a**
**Summary of**
**Fill / Alluvium Groundwater Analytical Results**
**AOI 8 Workplan**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**
**February 2008**

| | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Sample ID<br>Sample Date<br>Sample Matrix | Field Blank<br>2/8/2008<br>Groundwater | | | N-1<br>2/6/2008<br>Groundwater | | | N-10<br>2/6/2008<br>Groundwater | | | N-11<br>2/6/2008<br>Groundwater | | | N-12<br>2/7/2008<br>Groundwater | | | N-16<br>2/6/2008<br>Groundwater | | | N-17<br>2/6/2008<br>Groundwater | | | N-18<br>2/6/2008<br>Groundwater | | | N-20<br>2/7/2008<br>Groundwater | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **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** |
| Ethylbenzene | 100-41-4 | 700 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 2.00 | | 1.00 | 1.00 | U | 1.00 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.05 | ug/l | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | 0.03 | U | 0.03 | 0.03 | | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | 0.03 | U | 0.03 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 1.00 | U | 1.00 | 1.00 | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 1.00 | U | 1.00 |
| Toluene | 108-88-3 | 1000 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 11.00 | | 1.00 | 9.00 | | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 3.00 | | 1.00 | 1.00 | U | 1.00 |
| Xylene (Total) | 1330-20-7 | 10000 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 15.00 | | 1.00 | 12.00 | | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 2.00 | | 1.00 | 1.00 | U | 1.00 |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 20 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 1.00 | J | 1.00 | 1.00 | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 1.00 | U | 1.00 |
| Benzene | 71-43-2 | 5 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 10.00 | | 1.00 | 6.00 | | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 5.00 | | 1.00 | 1.00 | U | 1.00 |
| Cumene | 98-82-8 | 2300 | ug/l | ND | U | 2.00 | ND | U | 2.00 | 12.00 | | 2.00 | 45.00 | | 2.00 | 14.00 | | 2.00 | ND | U | 2.00 | ND | U | 2.00 | 75.00 | | 2.00 | 42.00 | | 2.00 |
| **Semi-Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | ND | U | 5.00 | ND | U | 5.00 | 13.00 | | 5.00 | 3.00 | J | 5.00 | 160.00 | | 50.00 | ND | U | 5.00 | 15.00 | | 5.00 | 9.00 | | 5.00 | 73.00 | | 50.00 |
| Chrysene | 218-01-9 | 1.9 | ug/l | ND | U | 5.00 | ND | U | 5.00 | 8.00 | | 5.00 | 1.00 | J | 5.00 | 74.00 | | 50.00 | ND | U | 5.00 | 2.00 | J | 5.00 | 6.00 | | 5.00 | 54.00 | | 50.00 |
| Phenanthrene | 85-01-8 | 1100 | ug/l | ND | U | 5.00 | ND | U | 5.00 | 6.00 | | 5.00 | 12.00 | | 5.00 | 690.00 | | 50.00 | ND | U | 5.00 | ND | U | 5.00 | 15.00 | | 5.00 | 50.00 | U | 50.00 |
| Fluorene | 86-73-7 | 1900 | ug/l | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | 8.00 | | 5.00 | 190.00 | | 50.00 | ND | U | 5.00 | ND | U | 5.00 | 10.00 | | 5.00 | 62.00 | | 50.00 |
| Naphthalene | 91-20-3 | 100 | ug/l | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | 5.00 | U | 5.00 | 50.00 | U | 50.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | 50.00 | U | 50.00 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 5 | mg/l | ND | U | 0.00100 | ND | U | 0.00100 | 0.00071 | | 0.00100 | 0.00100 | U | 0.00100 | 0.00100 | U | 0.00100 | ND | U | 0.00100 | ND | U | 0.00100 | 0.00011 | J | 0.00100 | 0.03820 | | 0.00100 |

| | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Sample ID<br>Sample Date<br>Sample Matrix | N-28<br>2/6/2008<br>Groundwater | | | N-29<br>2/7/2008<br>Groundwater | | | N-3<br>2/7/2008<br>Groundwater | | | N-32<br>2/7/2008<br>Groundwater | | | N-36<br>2/7/2008<br>Groundwater | | | N-37<br>2/7/2008<br>Groundwater | | | N-38<br>2/7/2008<br>Groundwater | | | N-40<br>2/8/2008<br>Groundwater | | | N-41<br>2/8/2008<br>Groundwater | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **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** |
| Ethylbenzene | 100-41-4 | 700 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.05 | ug/l | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Toluene | 108-88-3 | 1000 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Xylene (Total) | 1330-20-7 | 10000 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 1.00 | | 1.00 | ND | U | 1.00 |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 20 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 0.60 | J | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Benzene | 71-43-2 | 5 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Cumene | 98-82-8 | 2300 | ug/l | ND | U | 2.00 | ND | U | 2.00 | ND | U | 2.00 | ND | U | 2.00 | 2.00 | J | 2.00 | ND | U | 2.00 | 0.80 | J | 2.00 | 5.00 | | 2.00 | 7.00 | | 2.00 |
| **Semi-Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | 2.00 | J | 5.00 | ND | U | 50.00 | 170.00 | 170 | 50.00 | ND | U | 50.00 | 110.00 | | 5.00 | ND | U | 5.00 | 3.00 | J | 5.00 | 31.00 | | 5.00 | 250.00 | | 50.00 |
| Chrysene | 218-01-9 | 1.9 | ug/l | 1.00 | J | 5.00 | ND | U | 50.00 | 47.00 | | 50.00 | ND | U | 50.00 | 60.00 | | 9.00 | ND | U | 5.00 | 1.00 | J | 5.00 | 15.00 | | 5.00 | 150.00 | | 50.00 |
| Phenanthrene | 85-01-8 | 1100 | ug/l | ND | U | 5.00 | ND | U | 50.00 | ND | U | 50.00 | ND | U | 50.00 | 23.00 | | 5.00 | ND | U | 5.00 | ND | U | 5.00 | 39.00 | | 5.00 | 660.00 | | 50.00 |
| Fluorene | 86-73-7 | 1900 | ug/l | ND | U | 5.00 | ND | U | 50.00 | ND | U | 50.00 | ND | U | 50.00 | 20.00 | | 5.00 | ND | U | 5.00 | ND | U | 5.00 | 23.00 | | 5.00 | 280.00 | | 50.00 |
| Naphthalene | 91-20-3 | 100 | ug/l | ND | U | 5.00 | ND | U | 50.00 | ND | U | 50.00 | ND | U | 50.00 | 1.00 | J | 5.00 | ND | U | 5.00 | ND | U | 5.00 | 3.00 | J | 5.00 | 33.00 | J | 50.00 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 5 | mg/l | 0.00042 | | 0.00100 | 0.00005 | | 0.00100 | 0.00038 | | 0.00100 | ND | U | 0.00100 | 0.00015 | J | 0.00100 | ND | U | 0.00100 | ND | U | 0.00100 | 0.00100 | U | 0.00100 | 0.00011 | | 0.00100 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/l - Micrograms per liter
mg/l - Milligrams per liter
MSC - PADEP's Medium Specific Concentration for Impact to Groundwater
RL - Reporting limit (limit of quantitation)
ND - Not detected.

**Organic Qualifiers:**
Q - Qualifier
U - Analyte was analyzed but not detected.
J - Compound present. Reported value may not be accurate or precise.
UD - Compound analyzed at dilution, but not detected.
JD - Compound analyzed at dilution. Compound present, but reported value may not be accurate or precise.
D - Compound analyzed at dilution.

**Inorganic Qualifiers:**
U - Analyte was analyzed but not detected.
B - Compound present. Reported value may not be accurate or precise.

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

**Table 2a**
**Summary of**
**Fill / Alluvium Groundwater Analytical Results**
**AOI 8 Workplan**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**
**February 2008**

| | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Sample ID / Sample Date / Sample Matrix | N-24 2/7/2008 Groundwater | | | N-55 2/8/2008 Groundwater | | | N-56 2/8/2008 Groundwater | | | N-57 2/7/2008 Groundwater | | | N-58 2/7/2008 Groundwater | | | N-60 2/7/2008 Groundwater | | | N-61 2/7/2008 Groundwater | | | N-64 2/8/2008 Groundwater | | | N-65 2/6/2008 Groundwater | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **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** |
| Ethylbenzene | 100-41-4 | 700 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 2.00 | | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 15.00 | | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.05 | ug/l | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Toluene | 108-88-3 | 1000 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 0.80 | J | 1.00 | 0.80 | J | 1.00 | ND | U | 1.00 | 9.00 | | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Xylene (Total) | 1330-20-7 | 10000 | ug/l | 1.00 | | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 230.00 | | 1.00 | 140.00 | | 1.00 | ND | U | 1.00 | 52.00 | | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 20 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Benzene | 71-43-2 | 5 | ug/l | 0.80 | J | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 2.00 | | 1.00 | 2.00 | | 1.00 | 0.60 | J | 1.00 | 21000.00 | E | 100.00 | ND | U | 1.00 | ND | U | 1.00 |
| Cumene | 98-82-8 | 2300 | ug/l | 19.00 | | 2.00 | ND | U | 2.00 | 3.00 | | 2.00 | 4.00 | | 2.00 | 10.00 | | 2.00 | ND | U | 2.00 | 11.00 | | 2.00 | ND | U | 2.00 | ND | U | 2.00 |
| **Semi-Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | ND | U | 50.00 | ND | U | 5.00 | 19.00 | | 10.00 | 3.00 | J | 5.00 | 3.00 | J | 5.00 | 11.00 | | 5.00 | 6.00 | | 5.00 | ND | U | 5.00 | ND | U | 25.00 |
| Chrysene | 218-01-9 | 1.9 | ug/l | ND | U | 50.00 | ND | U | 5.00 | 18.00 | | 10.00 | 2.00 | J | 5.00 | 1.00 | J | 5.00 | 11.00 | | 5.00 | 2.00 | J | 5.00 | ND | U | 5.00 | ND | U | 25.00 |
| Phenanthrene | 85-01-8 | 1100 | ug/l | ND | U | 50.00 | ND | U | 5.00 | 7.00 | J | 10.00 | ND | U | 5.00 | ND | U | 5.00 | 2.00 | J | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 25.00 |
| Fluorene | 86-73-7 | 1900 | ug/l | ND | U | 50.00 | ND | U | 5.00 | 7.00 | J | 10.00 | ND | U | 5.00 | ND | U | 5.00 | 3.00 | J | 5.00 | 3.00 | J | 5.00 | 2.00 | J | 5.00 | ND | U | 25.00 |
| Naphthalene | 91-20-3 | 100 | ug/l | ND | U | 50.00 | ND | U | 5.00 | 2.00 | J | 10.00 | ND | U | 5.00 | ND | U | 5.00 | 2.00 | J | 5.00 | 1.00 | J | 5.00 | ND | U | 5.00 | ND | U | 25.00 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 5 | mg/l | 0.00029 | J | 0.00100 | 0.00040 | J | 0.00100 | ND | U | 0.00100 | ND | U | 0.00100 | ND | U | 0.00100 | ND | U | 0.00100 | ND | U | 0.00100 | ND | U | 0.00100 | 0.00006 | J | 0.00100 |

| | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Sample ID / Sample Date / Sample Matrix | N-66 2/8/2008 Groundwater | | | N-5 2/6/2008 Groundwater | | | N-67 2/8/2008 Groundwater | | | N-73 2/7/2008 Groundwater | | | N-74 2/7/2008 Groundwater | | | N-77 2/7/2008 Groundwater | | | N-8 2/7/2008 Groundwater | | | N-85 2/6/2008 Groundwater | | | N-9 2/7/2008 Groundwater | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **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** |
| Ethylbenzene | 100-41-4 | 700 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.05 | ug/l | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Toluene | 108-88-3 | 1000 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Xylene (Total) | 1330-20-7 | 10000 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 1.00 | | 1.00 | ND | U | 1.00 | 0.50 | J | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 20 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Benzene | 71-43-2 | 5 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | 25.00 | | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Cumene | 98-82-8 | 2300 | ug/l | ND | U | 2.00 | ND | U | 2.00 | ND | U | 2.00 | ND | U | 2.00 | ND | U | 2.00 | 11.00 | | 2.00 | ND | U | 2.00 | 2.00 | | 2.00 | ND | U | 2.00 |
| **Semi-Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | 15.00 | | 10.00 | 4.00 | J | 5.00 | ND | U | 5.00 | ND | U | 5.00 | 1.00 | J | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 |
| Chrysene | 218-01-9 | 1.9 | ug/l | 11.00 | | 10.00 | 3.00 | J | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 |
| Phenanthrene | 85-01-8 | 1100 | ug/l | 10.00 | | 10.00 | 2.00 | J | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 |
| Fluorene | 86-73-7 | 1900 | ug/l | 10.00 | | 10.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | 2.00 | J | 5.00 | 4.00 | J | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 |
| Naphthalene | 91-20-3 | 100 | ug/l | ND | U | 10.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 | ND | U | 5.00 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 5 | mg/l | ND | U | 0.00100 | 1.00000 | | 0.00500 | ND | U | 0.00100 | ND | U | 0.00100 | ND | U | 0.00100 | 0.00006 | J | 0.00100 | ND | U | 0.00100 | ND | U | 0.00100 | ND | U | 0.00100 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/l - Micrograms per liter
mg/l - Milligrams per liter
MSC - PADEP's Medium Specific Concentration for Impact to Groundwater
RL - Reporting limit (limit of quantitation)
ND - Not detected.

**Organic Qualifiers:**
Q - Qualifier
U - Analyte was analyzed but not detected.
J - Compound present. Reported value may not be accurate or precise.
UD - Compound analyzed at dilution, but not detected.
JD - Compound analyzed at dilution. Compound present, but reported value may not be accurate or precise.
D - Compound analyzed at dilution.

**Inorganic Qualifiers:**
U - Analyte was analyzed but not detected.
B - Compound present. Reported value may not be accurate or precise.

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

**Table 2a**
**Summary of**
**Fill / Alluvium Groundwater Analytical Results**
**AOI 8 Workplan**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**
**February 2008**

| | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Sample ID<br>Sample Date<br>Sample Matrix | N-90<br>2/8/2008<br>Groundwater | | | N-92<br>2/7/2008<br>Groundwater | | | N-94<br>2/6/2008<br>Groundwater | | | PZ-505<br>2/7/2008<br>Groundwater | | | PZ-506<br>2/8/2008<br>Groundwater | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organic Compounds** | | | **Unit** | **Result** | **Q** | **RL** | **Result** | **Q** | **RL** | **Result** | **Q** | **RL** | **Result** | **Q** | **RL** | **Result** | **Q** | **RL** |
| Ethylbenzene | 100-41-4 | 700 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.05 | ug/l | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 | ND | U | 0.03 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Toluene | 108-88-3 | 1000 | ug/l | 1.00 | | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Xylene (Total) | 1330-20-7 | 10000 | ug/l | 2.00 | | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 20 | ug/l | ND | U | 1.00 | ND | U | 1.00 | 0.60 | J | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Benzene | 71-43-2 | 5 | ug/l | 2.00 | | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 | ND | U | 1.00 |
| Cumene | 98-82-8 | 2300 | ug/l | 3.00 | | 2.00 | 0.50 | J | 2.00 | ND | U | 2.00 | 2.00 | J | 2.00 | ND | U | 2.00 |
| **Semi-Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | ND | U | 5.00 | 54.00 | | 10.00 | 2.00 | J | 5.00 | 21.00 | | 5.00 | 27.00 | | 5.00 |
| Chrysene | 218-01-9 | 1.9 | ug/l | ND | U | 5.00 | 19.00 | | 10.00 | 1.00 | J | 5.00 | 15.00 | | 5.00 | 20.00 | | 5.00 |
| Phenanthrene | 85-01-8 | 1100 | ug/l | ND | U | 5.00 | ND | U | 10.00 | ND | J | 5.00 | 2.00 | J | 5.00 | 9.00 | | 5.00 |
| Fluorene | 86-73-7 | 1900 | ug/l | ND | U | 5.00 | 28.00 | | 10.00 | ND | U | 5.00 | 3.00 | J | 5.00 | 5.00 | | 5.00 |
| Naphthalene | 91-20-3 | 100 | ug/l | ND | U | 5.00 | ND | U | 10.00 | ND | U | 5.00 | 2.00 | J | 5.00 | ND | U | 5.00 |
| **Metals** | | | | | | | | | | | | | | | | | | |
| Lead (Total) | 7439-92-1 | 5 | mg/l | ND | U | 0.00100 | ND | U | 0.00100 | ND | U | 0.00100 | 0.00031 | J | 0.00100 | 0.00008 | J | 0.00100 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/l - Micrograms per liter
mg/l - Milligrams per liter
MSC - PADEP's Medium Specific Concentration for Impact to Groundwater
RL - Reporting limit (limit of quantitation)
ND - Not detected.

**Organic Qualifiers:**
Q - Qualifier
U - Analyte was analyzed but not detected.
J - Compound present. Reported value may not be accurate or precise.
UD - Compound analyzed at dilution, but not detected.
JD - Compound analyzed at dilution. Compound present, but reported value may not be accurate or precise.
D - Compound analyzed at dilution.

**Inorganic Qualifiers:**
U - Analyte was analyzed but not detected.
B - Compound present. Reported value may not be accurate or precise.

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

**Table 2b**
**Summary of Lower Sand Groundwater Analytical Results**
**AOI 8 Workplan**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**
**February 2008**

| | CAS No | PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 | Sample ID<br>Sample Date<br>Sample Matrix | N-13<br>2/7/2008<br>Groundwater | | | N-19<br>2/6/2008<br>Groundwater | | | N-21<br>2/7/2008<br>Groundwater | | | N-27<br>2/6/2008<br>Groundwater | | | N-4<br>2/7/2008<br>Groundwater | | | N-38D<br>2/7/2008<br>Groundwater | | | N-50D<br>2/8/2008<br>Groundwater | | | N-69<br>2/6/2008<br>Groundwater | | | N-70<br>2/6/2008<br>Groundwater | | | N-83<br>2/6/2008<br>Groundwater | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **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** |
| Ethylbenzene | 100-41-4 | 700 | ug/l | ND | U | 1 | ND | U | 1 | ND | U | 1 | ND | U | 1 | 1 | | 1 | ND | U | 1 | ND | U | 1 | ND | U | 1 | 0.8 | J | 1 | ND | U | 1 |
| Ethylene dibromide (EDB) | 106-93-4 | 0.05 | ug/l | ND | U | 0.029 | ND | U | 0.029 | ND | U | 0.029 | ND | U | 0.029 | ND | U | 0.028 | ND | U | 0.029 | ND | U | 0.028 | ND | U | 0.029 | ND | U | 0.03 | ND | U | 0.029 |
| 1,2-Dichloroethane | 107-06-2 | 5 | ug/l | 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 |
| Toluene | 108-88-3 | 1000 | ug/l | 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 |
| Xylene (Total) | 1330-20-7 | 10000 | ug/l | ND | U | 1 | ND | U | 1 | 3 | | 1 | ND | U | 1 | 7 | | 1 | ND | U | 1 | ND | U | 1 | ND | U | 1 | 0.7 | J | 1 | ND | U | 1 |
| Methyl Tertiary Butyl Ether | 1634-04-4 | 20 | ug/l | 2 | | 1 | ND | U | 1 | ND | U | 1 | ND | U | 1 | 0.6 | J | 1 | ND | U | 1 | ND | U | 1 | ND | U | 1 | ND | U | 1 | ND | U | 1 |
| Benzene | 71-43-2 | 5 | ug/l | ND | U | 1 | ND | U | 1 | 2 | | 1 | ND | U | 1 | 71 | | 1 | ND | U | 1 | 4 | | 1 | ND | U | 1 | ND | U | 1 | ND | U | 1 |
| Cumene | 98-82-8 | 2300 | ug/l | ND | U | 2 | ND | U | 2 | 10 | | 2 | ND | U | 2 | 29 | | 2 | ND | U | 2 | ND | U | 2 | 5 | | 2 | 23 | | 2 | 0.8 | J | 2 |
| **Semi-Volatile Organic Compounds** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | 129-00-0 | 130 | ug/l | ND | U | 5 | ND | U | 5 | ND | U | 5 | ND | U | 5 | ND | U | 5 | ND | U | 5 | 13 | | 5 | ND | U | 5 | ND | U | 5 | 6 | | 5 |
| Chrysene | 218-01-9 | 1.9 | ug/l | ND | U | 5 | ND | U | 5 | ND | U | 5 | ND | U | 5 | ND | U | 5 | ND | U | 5 | 9 | | 5 | ND | U | 5 | ND | U | 5 | 3 | J | 5 |
| Phenanthrene | 85-01-8 | 1100 | ug/l | ND | U | 5 | ND | U | 5 | ND | U | 5 | ND | U | 5 | ND | U | 5 | ND | U | 5 | 3 | J | 5 | ND | U | 5 | ND | U | 5 | ND | U | 5 |
| Fluorene | 86-73-7 | 1900 | ug/l | 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 | 1 | J | 5 |
| Naphthalene | 91-20-3 | 100 | ug/l | 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 | mg/l | 0.00008 | J | 0.00100 | 0.00007 | J | 0.00100 | ND | U | 0.00100 | 0.00007 | J | 0.00100 | 0.00023 | J | 0.00100 | 0.00005 | J | 0.00100 | 0.00012 | J | 0.00100 | 0.00012 | J | 0.00100 | ND | U | 0.00100 | ND | U | 0.00100 |

**Notes:**
PADEP - Pennsylvania Department of Environmental Protection
ug/l - Micrograms per liter
mg/l - Milligrams per liter
MSC - PADEP's Medium Specific Concentration for Impact to Groundwater
RL - Reporting limit (limit of quantitation)
ND - Not detected.

**Organic Qualifiers:**
Q - Qualifier
U - Analyte was analyzed but not detected.
J - Compound present. Reported value may not be accurate or precise.
UD - Compound analyzed at dilution, but not detected.
JD - Compound analyzed at dilution. Compound present, but reported value may not be accurate or precise.
D - Compound analyzed at dilution.

**Inorganic Qualifiers:**
U - Analyte was analyzed but not detected.
B - Compound present. Reported value may not be accurate or precise.

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

**TABLE 3**
**Summary of Proposed Site Characterization Activities for AOI 8**
**AOI 8 Work Plan for Site Characterization**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Location ID | Existing | Proposed | Media | Collection of Soil Sample from 0-2 ft For Site COCs (Non-SWMU Location) | Observation for Leaded Tank Bottom Materials in Shallow Soil Borings[2] | Estimated Completion Depth for Proposed Monitoring Wells and Soil Borings | LNAPL Data Exists | COCs | Objective of Proposed Activity |
|---|---|---|---|---|---|---|---|---|---|
| N-1 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-10 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-11 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-12 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-13 | X | | Groundwater | | | | | 1 | Characterize Deep Groundwater in AOI 8 |
| N-14 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| N-15 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-16 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-17 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-18 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-19 | X | | Groundwater | | | | | 1 | Characterize Deep Groundwater in AOI 8 |
| N-20 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-21 | X | | Groundwater | | | | | 1 | Characterize Deep Groundwater in AOI 8 |
| N-22 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-23 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-24 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-25 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| N-26 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-27 | X | | Groundwater | | | | | 1 | Characterize Deep Groundwater in AOI 8 |
| N-28 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-29 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-3 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-30 | X | | Groundwater | | | | | 1 | Characterize Deep Groundwater in AOI 8 |
| N-31 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| N-32 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-34 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-35 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| N-36 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-37 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-38 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-38D | X | | Groundwater | | | | | 1 | Characterize Deep Groundwater in AOI 8 |
| N-4 | X | | Groundwater | | | | | 1 | Characterize Deep Groundwater in AOI 8 |
| N-40 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-41 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-42 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| N-43 | X | | Groundwater | | | | | 1 | Characterize Deep Groundwater in AOI 8 |
| N-44D | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-45 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-46D | X | | Groundwater | | | | | 1 | Characterize Deep Groundwater in AOI 8 |
| N-47 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| N-48 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| N-49 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-5 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-503 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| N-504 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-50D | X | | Groundwater | | | | | 1 | Characterize Deep Groundwater in AOI 8 |
| N-51 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| N-52 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| N-53 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-54 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-55 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-56 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-57 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-58 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-59 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-6 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-60 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-61 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |

**Notes:**
Final depth of well and screen placement to be determined by geologist based on field observation while completing the boring.
Field procedures will be performed in accordance with Appendix C of the Workplan.
ft bgs = feet below ground surface
COCs = Constituents of Concern
1 = Analysis of COCs listed in Table 1 of the Work Plan.
2 = Analysis for Total Lead in shallow soil only if leaded tank bottom materials are observed by the field geologist
SWMU = Solid Waste Management Unit
LNAPL = Light Non-Aqueous Phase Liquid

**TABLE 3**
**Summary of Proposed Site Characterization Activities for AOI 8**
**AOI 8 Work Plan for Site Characterization**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Location ID | Existing | Proposed | Media | Collection of Soil Sample from 0-2 ft For Site COCs (Non-SWMU Location) | Observation for Leaded Tank Bottom Materials in Shallow Soil Borings[2] | Estimated Completion Depth for Proposed Monitoring Wells and Soil Borings | LNAPL Data Exists | COCs | Objective of Proposed Activity |
|---|---|---|---|---|---|---|---|---|---|
| N-64 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-65 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-66 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-67 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-68 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| N-69 | X | | Groundwater | | | | | 1 | Characterize Deep Groundwater in AOI 8 |
| N-7 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-70 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-72 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-73 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-74 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-75 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| N-76 | X | | Groundwater | | | | X | 1 | Characterize Deep Groundwater in AOI 8 |
| N-77 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-77 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-78 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| N-79 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| N-8 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-81 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-82 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| N-83 | X | | Groundwater | | | | | 1 | Characterize Deep Groundwater in AOI 8 |
| N-84 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-85 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-86 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-87 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-88 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-89 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-9 | X | | Groundwater | | | | | 1 | Characterize Deep Groundwater in AOI 8 |
| N-90 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-91 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| N-92 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-93 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-94 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| N-95 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| PZ-201 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| PZ-202 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| PZ-203 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| PZ-204 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| PZ-300 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| PZ-500 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| PZ-501 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| PZ-502 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| PZ-503 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| PZ-504 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| PZ-505 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| PZ-506 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| PZ-507 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| RW-200 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| RW-201 | X | | NA | | | | | | No Samples - Active Recovery Well |
| RW-202 | X | | NA | | | | | | No Samples - Active Recovery Well |
| RW-203 | X | | NA | | | | | | No Samples - Active Recovery Well |
| RW-204 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| RW-205 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| RW-206 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| RW-300 | X | | NA | | | | X | | No Samples - Active Recovery Well |
| RW-301 | X | | NA | | | | | | No Samples - Active Recovery Well |
| RW-302 | X | | NA | | | | | | No Samples - Active Recovery Well |
| RW-303 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| RW-304 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| RW-305 | X | | Groundwater | | | | X | 1 | Characterize Groundwater in AOI 8 |
| RW-306 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| RW-307 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| RW-308 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| RW-309 | X | | Groundwater | | | | | 1 | Characterize Groundwater in AOI 8 |
| RW-500 | X | | NA | | | | | | No Samples - Active Recovery Well |
| RW-501 | X | | NA | | | | | | No Samples - Active Recovery Well |
| RW-502 | X | | NA | | | | | | No Samples - Active Recovery Well |
| N-98 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |

**Notes:**
Final depth of well and screen placement to be determined by geologist based on field observation while completing the boring.
Field procedures will be performed in accordance with Appendix C of the Workplan.
ft bgs = feet below ground surface
COCs = Constituents of Concern
1 = Analysis of COCs listed in Table 1 of the Work Plan.
2 = Analysis for Total Lead in shallow soil only if leaded tank bottom materials are observed by the field geologist
SWMU = Solid Waste Management Unit
LNAPL = Light Non-Aqueous Phase Liquid

**TABLE 3**
**Summary of Proposed Site Characterization Activities for AOI 8**
**AOI 8 Work Plan for Site Characterization**
**Sunoco Philadelphia Refinery**
**Philadelphia, Pennsylvania**

| Location ID | Existing | Proposed | Media | Collection of Soil Sample from 0-2 ft For Site COCs (Non-SWMU Location) | Observation for Leaded Tank Bottom Materials in Shallow Soil Borings[2] | Estimated Completion Depth for Proposed Monitoring Wells and Soil Borings | LNAPL Data Exists | COCs | Objective of Proposed Activity |
|---|---|---|---|---|---|---|---|---|---|
| N-99 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-100 | | X | Soil / Groundwater | X | | 85 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-101 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-102 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-103 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-104 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-105 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-106 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-107 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-108 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-109 | | X | Soil / Groundwater | X | | 85 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-110 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-111 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-112 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-113 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-114 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-115 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-116 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-117 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-118 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-119 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-120 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-121 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-122 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-123 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-124 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-125 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-126 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-127 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-128 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-129 | | X | Soil / Groundwater | X | | 85 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-130 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-131 | | X | Soil / Groundwater | X | | 85 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-132 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-133 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-134 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-135 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| N-136 | | X | Soil / Groundwater | X | | 25 ft bgs | | 1 | Characterize Soil and Groundwater in AOI 8 |
| BH-08-01 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-02 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-03 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-04 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-05 | | X | Soil | | X | 8 ft bgs | | 2 | Characterize Soil in AOI 8: SWMU 2 |
| BH-08-06 | | X | Soil | | X | 8 ft bgs | | 2 | Characterize Soil in AOI 8: SWMU 2 |
| BH-08-07 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-08 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-09 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-10 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-11 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-12 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-13 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-14 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-15 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-16 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-17 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-18 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-19 | | X | Soil | | X | 8 ft bgs | | 2 | Characterize Soil in AOI 8: SWMU 2 |
| BH-08-20 | | X | Soil | | X | 8 ft bgs | | 2 | Characterize Soil in AOI 8: SWMU 2 |
| BH-08-21 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-22 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-23 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-24 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-25 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-26 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-27 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-28 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-29 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-30 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-31 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-32 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-33 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-34 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-35 | | X | Soil | X | | 2 ft bgs | | 1 | Characterize Soil in AOI 8 |
| BH-08-36 | | X | Soil | | X | 8 ft bgs | | 2 | Characterize Soil in AOI 8: SWMU 2 |
| BH-08-37 | | X | Soil | | X | 8 ft bgs | | 2 | Characterize Soil in AOI 8: SWMU 2 |

**Notes:**
Final depth of well and screen placement to be determined by geologist based on field observation while completing the boring.
Field procedures will be performed in accordance with Appendix C of the Workplan.
ft bgs = feet below ground surface
COCs = Constituents of Concern
1 = Analysis of COCs listed in Table 1 of the Work Plan.
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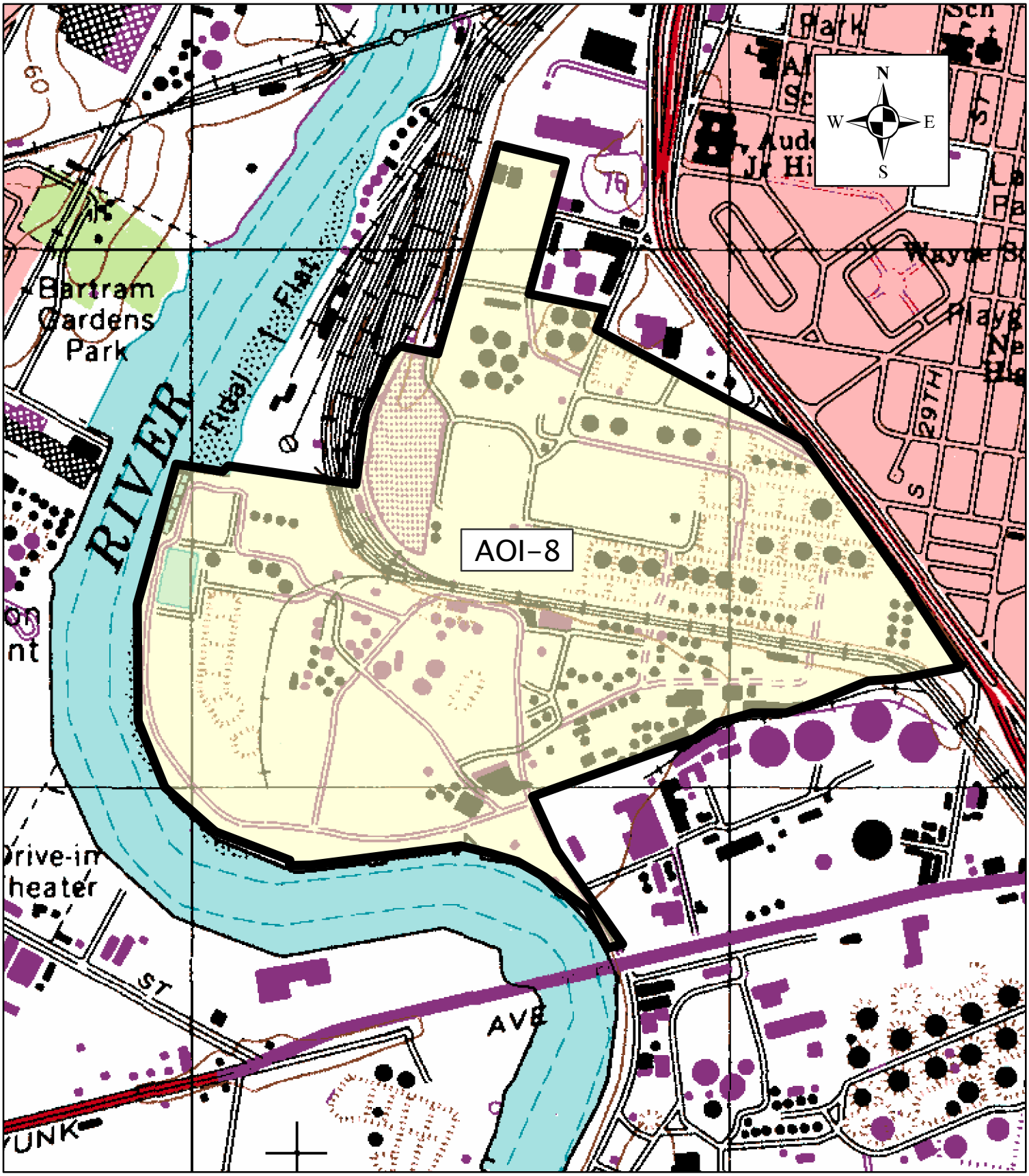
LNAPL = Light Non-Aqueous Phase Liquid

# 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 8
AOI 8 Work Plan for Site Characterization
Philadelphia Sunoco Philadelphia Refinery Pennsylvania

| Job Number | Scale: 1" = 800' | Date |
|---|---|---|
| 2574601 | 0 400 800 Feet | April 8, 2008 |

Q:\Data6\2574601\ArcGIS\MapDocuments\AOI 8 Workplan\Report Figures\Figure 1- AOI 8 Boundaries.mxd



## Legend

**Proposed Activities**

- Shallow Soil Boring Locations (0-2 feet)
- New Shallow/Intermediate Groundwater Monitoring Well Locations
- New Shallow/Intermediate Groundwater Monitoring Well Locations with Deep Soil Borings

**Existing Features**

- Existing Monitoring Point
- Existing Recovery Well
- Lead Weathering Pad Solid Waste Management Unit (SWMU 2)
- AOI Boundary

Figure 2: Summary of Proposed Site Characterization Activities for AOI 8
AOI 8 Work Plan for Site Characterization
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 230 460 Feet

SCALE: 1" = 230'
DATE: April 16, 2008
DRN. BY: JSC
CKD. BY: JH
JOB#: 3574601

Q:\Data\B\3574601\ArcGIS\MapDocuments\AOI 8 Work Plan\Figure 2_Proposed_Sample_Locations_04072008.mxd

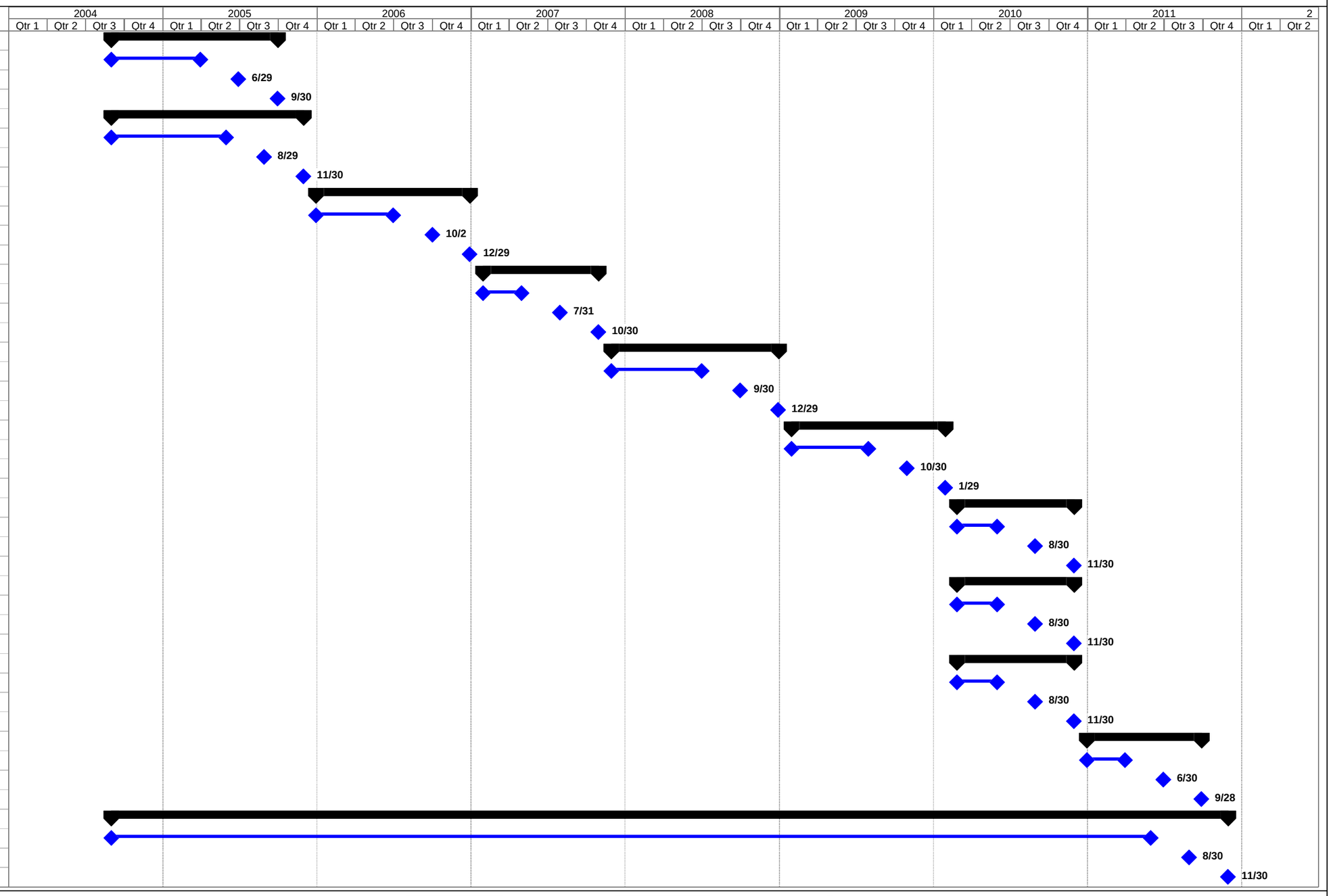
# APPENDIX A

# REVISED PHASE II CORRECTIVE ACTION ACTIVITIES SCHEDULE

## Figure 19

## Phase 2 Corrective Action Activities

| ID | Task Name |
|---|---|
| 1 | **AOI 1** |
| 2 | Characterization |
| 3 | Submittal of Site Characterization Report |
| 4 | PADEP Comments |
| 5 | **AOI 4** |
| 6 | Characterization |
| 7 | Submittal of Site Characterization Report |
| 8 | PADEP Comments |
| 9 | **AOI 6** |
| 10 | Characterization |
| 11 | Submittal of Site Characterization Report |
| 12 | PADEP Comments |
| 13 | **AOI 5** |
| 14 | Characterization |
| 15 | Submittal of Site Characterization Report |
| 16 | PADEP Comments |
| 17 | **AOI 8** |
| 18 | Characterization |
| 19 | Submittal of Site Characterization Report |
| 20 | PADEP Comments |
| 21 | **AOI 9** |
| 22 | Characterization |
| 23 | Submittal of Site Characterization Report |
| 24 | PADEP Comments |
| 25 | **AOI 3** |
| 26 | Characterization |
| 27 | Submittal of Site Characterization Report |
| 28 | PADEP Comments |
| 29 | **AOI 2** |
| 30 | Characterization |
| 31 | Submittal of Site Characterization Report |
| 32 | PADEP Comments |
| 33 | **AOI 7** |
| 34 | Characterization |
| 35 | Submittal of Site Characterization Report |
| 36 | PADEP Comments |
| 37 | **AOI 10** |
| 38 | Characterization |
| 39 | Submittal of Site Characterization Report |
| 40 | PADEP Comments |
| 41 | **AOI 11** |
| 42 | Characterization |
| 43 | Submittal of Site Characterization Report |
| 44 | PADEP Comments |




Project: Figure 19 Phase 2 Corrective
Date: Mon 10/9/06

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

# APPENDIX B

# PA-ONE CLEANUP PROGRAM
# MEETING LETTER

**Research and Development**

**Sunoco Inc.**
100 Green Street
PO Box 426
Marcus Hook PA 19061
610 859 1700

December 2, 2005

Mr. Paul Gotthold
Chief, Pennsylvania Operations Branch
U.S. Environmental Protection Agency
Region 3 Regional Office
1650 Arch Street
Philadelphia, PA 19103-2029

Mr. Dave Hess
Chief, Voluntary Cleanup and Standards Section
PADEP
Rachel Carson State Office Building
P.O. Box 8471
Harrisburg, PA 17105-8471

**SUBJECT: One Clean-up Program**
**Applicability for Sunoco Philadelphia Refinery**

Dear Gentlemen:

Thank you for taking the time to meet with us regarding the subject site. As we discussed, Sunoco, Inc. (R&M) ("Sunoco") is interested in the applicability of the One-Clean-Up Program to streamline the remediation program at our Philadelphia Refinery under the EPA RCRA program, the PADEP Act 2 program, and the existing PADEP Consent Order. It is our understanding that both of you and your respective agencies also see a benefit to merging the remediation obligations under the various programs under one consistent approach that has been in place and working for a number of years for our facility. We agreed that the One-Clean-Up program would work best if it covered the entire Philadelphia Refinery, including areas that are under separate corrective action permits, even though report submittals, field work, and remedial decision making is made on a area-by-area basis as defined in the Consent Order. Sunoco believes that this approach maintains the flexibility, and prioritization approach that is a hallmark of our existing remedial program, while gaining the benefits of having the entire facility dealt with under the overall One-Clean-Up plan.

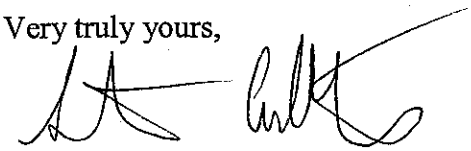
As a result of our discussions we identified the following approach:

a) Sunoco would submit a Notice of Intent to Remediate (NIR) under the PADEP Act 2 program. The NIR would specifically reference the Consent Order, including its Area of Interest approach.
b) EPA will provide copies of previous letters signifying approval with the Act 2 process from other sites that have been through the One-Cleanup program.
c) EPA will provide to Sunoco a copy of a recently completed Corrective Action permit for another facility.
d) Sunoco will work on a first draft of a proposed corrective action permit that would cover the Philadelphia Refinery.

Sunoco believes the meeting was fruitful and that the One-Clean-up program offers some significant advantages to move the facility's remedial programs towards clean-up. We look forward to working cooperatively together on this important program. We would appreciate confirmation from both of you that you agree with the above approach.

Thank you again for taking the opportunity to discuss these issues with us. I have attached the sign-in sheet from our meeting. Please call me at 610-859-1628 with any questions.

Very truly yours,



Steven Coladonato, PE
Remediation Services Manager
Sunoco, Inc. (R&M)

cc: S. O'Neil, PADEP
W. Payne, PADEP
D. Burke, PADEP
H. Lee, USEPA
J. Oppenheim, Sunoco, Inc.
E. Ciechon, Sunoco, Inc.
C. Costello, Langan
J. Hanna, Langan

4100-FM-SE0026 5/97

# COMMONWEALTH OF PENNSYLVANIA
# DEPARTMENT OF ENVIRONMENTAL PROTECTION
Southeast Regional Office
Lee Park, Suite 6010
555 North Lane, Conshohocken, PA 19428

Recycled Paper

at Langan's office
30 South 17th St
Philadelphia, PA

**Date:** Nov 22, 2005

**MEETING LOG**

**Subject:** Sunoco - Philly Refinery

**Programs Attending:** RD ___ AQC ___ RP ___ CRC ___ ECP ___ WQM ___ WSM ___ SWM ___ ERC ___ ADM ___

| NAME | TITLE | PROGRAM/COMPANY | PHONE # |
|---|---|---|---|
| Colleen Costello | | Langan | 2154397888 |
| DAVID BURKE | | PADEP | 484-250-5822 |
| DAVE HESS | | PADEP | 717-783-9480 |
| Jason Hanna | | Langan | 215-491-6500 |
| Steve Coladonato | | Sunoco | 610-859-1628 |
| Hon LEE | | EPA Reg 3 | 215-814-3419 |
| Paul Gotthold | | EPA Reg 3 | 215-814-3410 |
| WALTER PAYNE | | ~~PADEP~~ | ~~484-250-5791~~ |
| Jim Oppenheim | | SUNOCO | (610)299-5136 |
| ED CIECIYON | | SUNOCO | (215)977-6139 |
| Steve Oneil (by phone) | | PADEP | |

| NAME | TITLE | PROGRAM/COMPANY | PHONE # |
|---|---|---|---|

# APPENDIX C

# FIELD PROCEDURES

# APPENDIX C
# FIELD PROCEDURES
# AOI 8 WORK PLAN FOR SITE CHARACTERIZATION
# SUNOCO PHILADELPHIA REFINERY
# PHILADELPHIA, PENNSYLVANIA

## C.1. LIQUID LEVEL ACQUISITION

**Responsible Personnel:** Technicians and Geologists

**Training Qualifications:**

All field personnel involved in liquid level acquisition shall have, as a minimum, completed OSHA 40 HOUR HAZWOPER training and completed the 3-day minimum field training requirements as specified within the Corporate Health and Safety Plan. Prior to solo performance of liquid levels, all field personnel will have performed a minimum of three site visits under the direct supervision of experienced personnel.

**Health and Safety Requirements:**

**Personal Protective Equipment (PPE) Required**:

Level D attire including steel toe/steel shank boots. Based on previous site visits or current air monitoring results, Level C attire may be required. The PPE required to upgrade to Level C may include: nitrile gloves, disposable outerboots, Tyvek coveralls, and a respirator. Safety glasses or hard hats may also be required in certain areas.

**Site Controls:**

Safety cones and or caution tape should be used in high traffic areas. The "Buddy system" may also be employed in high traffic areas.

**Potential Hazards:**

Traffic, pinch and trip, chemical (airborne and physical contact) and biological. Additional hazards are mentioned in site-specific HASP.

**Materials and Equipment Necessary for Task Completion:**

Electronic oil/water interface probe or conductivity water line, decontamination supplies (Liquinox, deionized-distilled water, appropriate containers, scrub brush, and sorbent pads or paper towels), air monitoring instrument (optional, based on previous site visits).

**Methodology:**

The task involves the deployment of a liquid sensing probe into a well (in most cases), recording the reading, and decontaminating the probe. The recorded field readings can then be

utilized for one of several applications including: well sampling, water table gradient mapping, separate-phase hydrocarbon occurrence, thickness, and or gradient mapping, and various testing procedures.

The proper procedure for liquid level acquisition from a well is as follows:

1) The wells should be gauged in order of least to most contaminated based on existing sampling data or separate-phase hydrocarbon occurrence.
2) The gauging instrument is decontaminated prior to initial deployment and after each well to prevent cross contamination between wells.
3) Decontamination procedures include the following steps:

    a) Remove gross contaminants with sorbent pad or towel.
    b) Rinse/scrub equipment with water.
    c) Scrub equipment in Liquinox@/deionized-distilled water solution.
    d) Double rinse with deionized-distilled water.
    e) Air dry.

4) The well(s) to be gauged may need to be marked off with safety cones and or caution tape in order to protect personnel from auto traffic; the "Buddy system" may also be employed.
5) The manhole cover is then lifted off of the well head. A pry bar may be needed to prevent personal injury in the case of large manhole covers.
6) The probe is lowered into the well until the instrument signals contact with liquid.
7) The corresponding reading is recorded when the instrument signals either water or product. A clear bailer may be used to verify the existence or approximate amount and appearance of product.
8) The probe is then retracted from the well and decontaminated accordingly.
9) The well is then secured appropriately.
10) Note the start and stop time for gauging round in the field book.

## C.2. GROUNDWATER MONITORING PROCEDURES

**Responsible Personnel:** Technicians and Geologists

**Health and Safety Requirements**:

Site specific HASP must be completed and reviewed by field personnel. Ambient air monitoring will be performed quarterly at all treatment areas to determine the necessity of PPE upgrade. As a minimum, level "D" attire will be worn.

**Training Qualifications:**

All field personnel involved in groundwater monitoring shall have, as a minimum completed OSHA 40 HOUR HAZWOPER training and completed the 3 day minimum field training requirements. Prior to groundwater monitoring, all field personnel will have sampled a minimum of three sites under the direct supervision of experienced personnel. Field personnel

will also have experience in vapor monitoring techniques and sampling equipment decontamination.

**Materials and Equipment Necessary for Task Completion:**

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

- Current site map detailing well locations.
- Field data book for recording site data.
- Liquid level gauging device (graduated, optical interface probe).
- Keys and tools to provide well access.
- Appropriate sample containers and labels: volatile samples will be collected in laboratory provided 40 milliliter (ml) glass vials with plastic caps fitted with Teflon ® lined septa; all sample bottles will be laboratory sterilized and will contain the appropriate preservative, if applicable.
- Appropriate well purging apparatus as determined by volume of groundwater to be purged and compounds to be analyzed.
- Teflon ® (or equivalent) bottom-loading bailer to extract groundwater sample.
- Clean nylon or polypropylene bailer cord.
- Disposable nitrile sampling gloves.
- Decontamination supplies.
- Calibrated five-gallon bucket and watch or stopwatch to determine discharge rate during purging.
- Blank chain-of-custody forms.
- Cooler and ice for sample preservation.

**Methodology for Three Well Volume Sampling:**

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

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

Each monitoring well to be sampled will be gauged to obtain liquid level data immediately prior to initiation of the sampling process. Refer to Liquid Level Gauging SOP for appropriate well gauging procedures. Liquid level data will be recorded in a field book. Should free-phase petroleum product be detected by the gauging process and verified through inspection in a pre-cleaned acrylic bailer, groundwater sampling will not be conducted at that location.

The sampling procedure will be initiated by purging from the well a minimum of three well volumes, except in cases where the well is pumped dry, as referenced below. Well purging is performed to remove stagnant water and to draw representative water from the aquifer into the well for subsequent sampling and analysis for the established parameters. In extreme

cases where a well is pumped dry and/or shows little recharge capacity, the well will be evacuated once prior to sample procurement. Well volume calculations will be based on total well depth as determined during well installation and depth-to-water measurements obtained immediately prior to sampling.

Well purging is performed with various equipment including 1) a dedicated bailer for hand bailing low volumes of water, 2) a surface mounted electric centrifugal pump with dedicated polyethylene tubing, or 3) submersible pump (when the depth to water is greater than 20 feet) with dedicated polyethylene tubing. During pumping, the intake will be placed directly below the static water surface and slowly lowered during the purging process. This procedure may not prove necessary in low-yielding wells but is important in high-yielding, permeable strata where an intake initially placed deep in a well may draw laterally and have little influence in exchanging water from shallower depths within the well bore.

Flow rate during well purging will be approximated by the bucket and stop watch method. The duration of pumping required to remove three well volumes will be calculated directly from this flow rate. After purging, the well will be allowed to recover for a period of approximately two hours prior to sample collection. This action will permit a consistent groundwater flux into each well and allow for VOC stabilization prior to sample extraction. All fluids removed during purging will be treated on-site with activated carbon.

The sequence of obtaining site groundwater samples will be based upon available historical site data for existing wells and soil organic vapor analyzer (OVA) readings for newly installed wells. Site wells will be sampled in order from the lowest to highest concentration of water quality indicator parameters based upon the most recent available set of laboratory analyses to reduce the potential for sample cross-contamination. Groundwater samples will not be obtained for analysis from any well containing a measurable free product layer.

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

1) Establish a clean work area where sampling equipment will not come in contact with the ground or any potentially contaminated surfaces.
2) Use a laboratory, pre-cleaned Teflon@ sampling bailer for each well.
3) Don an unused, clean pair of nitrile gloves.
4) Attach an appropriate length of unused, clean nylon or polypropylene cord to the designated sampling bailer.
5) Select appropriate laboratory-sterilized sample containers.
6) Slowly lower sampling bailer into well until water surface is encountered; continue to lower the sampling bailer into the standing water column to one foot below the water surface.
7) Retrieve bailer at a steady rate to avoid excess agitation.
8) Visually inspect bailed sample to ensure that no free product or organic detritus has been collected.
9) Uncap first designated sample vial and fill from bailer as rapidly as possible but minimizing agitation; secure septum and lid.
10) Inspect sealed sample for entrapped air; if air is present within sample vial. Remove lid and repeat vial filling, sealing and inspection process until no air is present.

11) Repeat Steps 9 and 10 for the second designated vial; all volatile parameter samples will be collected in duplicate.
12) Complete and attach labels to sample containers noting sample collector, date, time, and location of sample; record same data in field book.
13) Place samples in ice-filled cooler in such a manner as to avoid breakage. Samples collected for VOC analysis will be maintained at a temperature of 4°C.

Discard gloves and bailer cord and move to next sample location.

**Methodology for Low-Flow Purging and Sampling:**

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

- Soil boring (lithologic) log and continuous soil sample PID;
- Well construction log showing the screened interval;
- Identification of the most permeable zone screened by the well;
- Approximate depth to static water;
- Proposed pump intake setting; and,
- Technical rationale for the pump intake setting, preferably across from the most impacted/contaminated subsurface interval.

**Equipment**

Adjustable rate, submersible, bladder pumps in conjunction with Teflon or Teflon-lined polyethylene tubing for purging and sampling will be used. The tubing diameter will be between 3/16-inch to ½-inch inner diameter and the length of the tubing extended outside the well will be minimized. Flow through cells will be used to evaluate parameters during sampling. Monitoring well information, equipment specifications, water level measurements, parameter readings, and other pertinent information will be recorded during monitoring well purging and sampling.

**Sampling Procedure**

The following protocol details the low-flow sampling procedure that will be used for sampling the monitoring wells.

1. PID Screening of Well. A PID measurement will be collected at the rim of the well immediately after the well cap will be removed and recorded on the sampling form.

2. Depth to Water Measurement. A depth to water measurement will be collected and recorded. To avoid disturbing accumulated sediment and to prevent the inadvertent mixing of stagnant water, measuring the total depth of the well will be done at the completion of sampling on an annual basis.

3. Low Stress Purging Startup. Water pumping will commence at a rate of 100 to 400 milliliters per minute (mL/min). This pumping should cause very little drawdown in the well (less than 0.2-0.3 feet) and the water level should stabilize. Water level measurements are made continuously and will be recorded in milliliters per minute on the sampling form.

4. Low Stress Purging and Sampling. The water level and pumping rate will be monitored and recorded every five minutes during purging, and any pumping rate adjustments will be recorded. During the early phase of purging, emphasis will be placed on minimizing and stabilizing pumping stress, and recording any necessary adjustments. Adjustments, when necessary, will be made in the first 15 minutes of purging. If necessary, pumping rates will be reduced to the minimum capabilities of the pump to avoid well dewatering. If the minimal drawdown exceeds 0.3 feet, but the water level stabilizes above the pump intake setting, purging will continue until indicator field parameters stabilized, as detailed in Step 5 below. If the water level drops below the pump intake setting at the absolute minimum purge rate, the pump will remain in place and the water level will be allowed to recover repeatedly until there will be sufficient water volume in the well to permit the collection of samples.

5. Indicator Field Parameters Monitoring. During well purging, indicator field parameters (DO, turbidity, pH, specific conductance, and redox potential) will be monitored every five minutes (or less frequently, if appropriate). Purging will be considered complete and sampling began when all the aforementioned indicator field parameters had stabilized. Stabilization will be achieved when three consecutive readings, taken at five (5) minute intervals (or less frequently, if appropriate), are within the following limits:

    - DO (±10 percent)
    - turbidity (±10 percent)
    - specific conductance (±3 percent)
    - pH (± 0.1 unit)
    - redox potential [Eh] ±10 mv)

Temperature and depth to water will be also monitored during purging. Should any of the parameter-reading components of the flow-through meter fail during sampling, the sampling team will attempt to locate a replacement flow-through meter. If none is available, the sampling team will measure that parameter with an individual criteria meter. Any other field observations relating to sample quality, such as odor, foaming, effervescence, and sheens, will also be recorded on the sampling form.

6. Collection of Ground Water Samples. Water samples for laboratory analyses will be collected before the groundwater had passed through the flow-through cell by either using a by-pass assembly or by temporarily disconnecting the flow-through cell. All sample containers will be filled by allowing the pump discharge to flow gently down the inside of

the container with minimal turbulence. During purging and sampling, the tubing remains filled with water in order to minimize possible changes in water chemistry upon contact with the atmosphere. Methods employed to ensure that the outlet tubing will be filled include (i) adjusting the tubing angle upward to completely fill the tubing and (ii) restricting the diameter of the tubing near the outlet of the tubing.

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

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

**Decontamination Requirements**:

Numerous practices are employed throughout the processes of site investigation and sampling to assure the integrity of the resulting data. Of particular significance to the procedures of groundwater measurement and sampling is the limitation, whenever possible, of materials inserted into a well bore and, even more importantly, of materials transferred from well to well.

Many items can be discarded between well sampling and/or gauging locations without significantly impacting project costs. Dedicated sampling equipment which can be discarded between well sampling locations without significantly impacting project costs, will be used whenever possible to preclude decontamination requirements. Sampling equipment included in this category are Teflon ® bailers, nitrile gloves, and bailer cord. However, other investigative and sampling equipment, including such items as liquid level probes, must be reused from well to well.

The danger in multi-well equipment applications lies in the potential of cross-contamination. While the threat of cross-contamination is always present, it can be minimized through the implementation of a consistent decontamination program during sensitive site measurement and data collection activities. The decontamination procedure is outlined below:

All site equipment used in a multi-well capacity will be decontaminated immediately prior to initial use and between each well. Standard site decontamination procedures for the optical interface probes between wells will be performed according to the following schedule:

- Initial rinse with clean tap water to remove excess residuals.
- Scrub equipment with sponge or clean, soft cloth in a distilled water/Liquinox@ (or equivalent) solution.
- Double rinse with deionized/distilled water.

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

## C.3. SOIL SAMPLING & WELL INSTALLATION

**Responsible Personnel:** Geologist

**Training Qualifications**: All field personnel supervising drilling activities shall have completed OSHA 40-Hour training, and three days of field training. Personnel supervising the well installation shall have observed drilling procedures for a minimum of three under the direct supervision of experienced personnel. Field personnel will have experience in operating the following field equipment: interface probe and photo-ionization detector (PID). Personnel should be able to describe soils encountered during drilling for generation of well logs.

**Health and Safety Requirements**:

A site specific HASP must be completed and reviewed by all field personnel. Prior to deploying a rig to the site, a utility call must be made (i.e. Pennsylvania One-Call) to allow mark-out of known subsurface utilities and associated laterals proximal to the site. Site plans, if available, should be reviewed to document and avoid the location of on-site utilities. No drilling should occur on retails sites within the exclusion zone. This zone is defined as the area between the pumps, the tank field and the station building. The area is excluded from drilling activities due to the likely occurrence of subsurface petroleum distribution lines. After review of all known mapped and marked utilities, a site reconnaissance will be performed to document the location of utility meters and storm sewer drains. In addition, the location of overhead utilities must be documented. After completing the subsurface and overhead utility review, the area to drill may be observed as clear or the location may be adjusted to a "clear" location.

Once the drilling location is established, the area must be marked with cones to alert area traffic of the work area. Other health and safety concerns include slip/trip hazards, working with heavy equipment and overhead work hazards. During drilling activities, a minimum of protective work gloves, steel toed boots, hard hats, and safety goggles must be worn.

A final health and safety requirement includes hand clearing the borehole, prior to advancing the borehole with the drill rig. To ensure the safety of workers, the borehole will be cleared by hand or air knife, to depth of 5 feet below ground surface. This will serve to clear the area of utilities, prior to drilling.

**Decontamination Requirements:**

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

**Methodology for Borings outside RCRA Areas in AOI 8:**

1) Borehole Advancement

During soil sampling or well installation activities, a borehole is advanced into the unconsolidated subsurface materials or bedrock via a drill rig (or similar). Various types of drilling methods could be deployed to advance the hole. A description of each drilling method is included below:

a) Hollow Stem Auger

A spiral tool form is used to move material from the subsurface to the surface. A bit at the bottom cuts into the subsurface material. Spiral augers on outside convey the material to the surface while spinning. The center of the auger is hollow like a straw when the inner drive rods and plug are removed. During drilling or formation cutting, the center is filled with rods connected to a plug at the bottom bit. Once the desired drilling depth is reached, the center plug and rods can be pulled out, leaving the hollow augers in place. The hollow augers hold the borehole to remain open for sediment sampling and well installation.

b) Air Rotary

A drill bit at the bottom of rods is used to cut into the subsurface material. Air injected into the drill rods escapes through small holes in the drill bit and conveys the drill cuttings to the surface.

c) Geoprobe®

The geoprobe® sampling allows collection of soil by directly pushing (through hydraulic hammering) a sampling device lined with a plastic macrocore into the soil column.

d) Hand Auger

A stainless steel or aluminum hand auger will be physically advanced to the desired soil sampling depth.

2) Soil Sampling

Soil samples will be obtained for lithologic logging and laboratory analysis for chemical contaminants with one of three different sampling devices: Split barrel spoon sampler, hand auger or Geoprobe® soil sampler. For either method, the sampling devices are lowered through

the hollow-stem augers or open borehole to allow sampling of the undisturbed sediments below the auger bit. Soil samples will be collected at intervals which appear to be visually impacted or from intervals which exhibit the highest deflections on the screening device (PID or similar).

a) Split barrel spoon sampler (split spoon)

The split spoon sampler will be driven into the soil column in accordance with ASTM Standard Method D1586 (Reference A6, Appendix E). Soil sampling by split barrel spoon will entail drilling a borehole with a hollow-stem auger to the desired sampling depth (standard five foot intervals). After augering to the desired depth, slowly and carefully lower the split barrel spoon sampler attached to the drill rod extension into the borehole. Drive the sampler into the soil by repeated blows from a 140 Lb. hammer with 30 inch travel. Record the blow counts required to drive the split spoon sampler each successive six inch interval. Remove sampler for borehole, split barrel open, remove soil sample utilizing a stainless steel knife to trim the top and edges of the sample and containerize sample in appropriate sample jar.

b) Geoprobe®

The geoprobe® liner is dedicated to each soil sampling interval. After retrieval of the sample, the liner may be sliced open and the soil sample can be logged and containerized in the appropriate sample jar. During shallow soil sampling from fine-grained sediments, the geoprobe® can advance the sampler directly into the ground, without the advance of an augered borehole.

c) Hand Auger

The hand auger allows for soil from the desired interval to be collected directly by removing the soil column that is contained in the auger portion of the device.

All soil samples collected for Site COC's will be collected using discrete soil sampling methods such as Geoprobe® macro cores or split spoons samplers.

**Methodology for Borings Around the Perimeter of Former Leaded Tank Bottoms Weathering Pad, SWMU 2, in AOI 8:**

1) Borehole Advancement

During soil sampling activities at SWMU 2, boreholes will be advanced in areas surrounding the perimeter of the existing concrete pad via a geoprobe® or hand auger. Actual leaded tank bottom materials are distinguished by distinctive rust/red to black, metallic mostly oxidized scale materials. Leaded tank bottoms are also sometimes in a matrix of petroleum wax sludge. Borings will be completed around the perimeter of SWMU 2 to a depth of two feet below ground surface. If materials encountered match the physical description stated above, they will be delineated through additional borings and sampling.

2) Soil Sampling

Soil samples will be obtained for lithologic logging and laboratory analysis for chemical contaminants with one of two different sampling devices: Geoprobe® soil sampler or hand auger. Soil samples will be collected at intervals which appear to be visually impacted or from intervals which exhibit the highest deflections on the screening device (PID or similar). If soil samples are collected in the SWMU area and exhibit total lead concentrations exceeding 450 mg/kg (Act 2 non-residential MSC for lead), then the samples will be submitted for hazardous characteristic analysis under RCRA.

3) Well Construction

After drilling to the desired depth or the desired interval, permanent monitoring wells can be installed to allow groundwater sampling. In general, wells are constructed with slotted screen, which allows groundwater to flow into the well at the desired monitored interval and well casing, which restricts groundwater flow into the well from undesired interval. In most cases the well materials are constructed of PVC. In conditions where the shallowest groundwater interval is monitored, a single case construction monitoring well is installed. In conditions where multiple water bearing units occur and deep groundwater conditions are selected for monitoring, a double cased well is installed.

a) Single Casing Construction

The construction details of a monitoring well are determined by soil type, depth to groundwater and relative fluctuation of groundwater level. After drilling to the desired depth, a monitoring well is constructed for installation into the evacuated borehole. The well consists of a bottom cap, a length of screen and length of well casing. To determine the length of screen used, seasonal groundwater table or tidal fluctuations should be considered to allow the water table to intercept the well screen throughout the year. The assembled well is then inserted into the borehole.

The annular space between the well screen and subsurface is filled with a sand pack, which consists of clean, sorted sand. The sand pack allows water flow into the well but acts as a filter to prevent subsurface sediments from silting in the well. The sand pack extends one to two feet above the top of well screen. Above the sand pack, a seal is installed in the annular space between the well casing and the subsurface. The seal is comprised of hydrated bentonite and prevents surface water from infiltrating the well screen. Above the well seal, the annular space is backfilled with drill cuttings or cement. A cap is placed on the top of the well to further prevent infiltration of the surface water. The top of the well is protected with either a stand-up pipe or a locking, flush mount box.

b) Double Casing Construction

In cases where multiple water bearing zones occur, a double case well is installed to allow monitoring of the deeper water bearing zones. Construction of a double cased well is similar to that of a single case well; however, to prevent groundwater infiltration from

shallower water bearing zones, a second casing is installed. This type of construction requires drilling two different diameter boreholes.

During drilling through the shallower groundwater zones, large diameter augers/bits are used to create a large diameter borehole. The borehole is advanced through the shallower water bearing area which will not be monitored. An outer casing is installed to seal the deeper monitoring well from infiltration from the shallow water bearing zones. After the outer casing is installed, the borehole is advanced deeper with smaller diameter auger/bit. The outside diameter of second augers fit within the inside diameter of the outer casing. The borehole is advanced to allow monitoring of the deeper water bearing zone. Once the desired depth is obtained, a monitoring well is installed within the outer casing, using similar methods as described in the single casing construction (3a, above). The outside casing prevents shallow groundwater infiltration into the well. The inside casing prevents surface water infiltration into the well.

4) Soil Cutting Handling

Cuttings generated from drilling will be containerized or stock-piled, undercover, until appropriate disposal is determined. In the case the soils are not impacted, the cuttings may remain on-site. Impacted soils will be removed using appropriate hazardous waste handling procedures and disposed of with an approved hazardous waste handler.

5) Well Development

After installation, monitoring wells are developed to remove residual sediments within the well and annular space. Water is pumped from the well a low flow rate (to minimize turbulence within the well and associated sand pack) until groundwater flowing from the well appears relatively free of sediments.

**Documentation:**

All site activities should be detailed in the site investigators fieldbook. The entry shall include the date, time, weather, address, and persons present on-site. In addition, data required to create well construction logs or boring logs (if no well is constructed) should be collected. This data includes soil type, relative moisture content, depth of water table, observed impact, soil screening measurements (if PID is used), blow counts (if split spoon samples are collected), sample recovery, depth of borehole, length of well screen, length of well casing(s), sand pack interval, well seal interval. The site investigator should identify the relative location and number.

## C.4. NON-AQUEOUS PHASE LIQUID (NAPL) SAMPLING PROCEDURES

**Responsible Personnel:** Technicians and Geologists

**Training Qualifications:**

All field personnel involved NAPL sampling, as a minimum completed OSHA 40 HOUR HAZWOPER training. Prior to NAPL sampling, all field personnel will have worked a minimum of three sites under the direct supervision of experienced personnel. Field personnel will also have experience in sampling and vapor monitoring techniques and sampling equipment decontamination.

**Materials and Equipment Necessary for Task Completion:**

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

- Current site map detailing well locations.
- Field data book for recording site data.
- Liquid level gauging device (graduated, optical interface probe).
- Keys and tools to provide well access.
- Appropriate sample containers and labels. NAPL samples will be collected in laboratory provided 40 milliliter (ml) glass vials with plastic caps fitted with Teflon ® lined septa; all sample bottles will be laboratory sterilized and will contain the appropriate preservative, if applicable. A minimum of 10 ml is required for laboratory analysis. In the case that sufficient volume is not obtained, a swabbing technique (described below) will be used.
- Sorbent pads (required for swabbing technique).
- Teflon ® (or equivalent) bottom-loading bailer to obtain NAPL sample.
- Clean nylon or polypropylene bailer cord.
- Decontamination supplies.
- H&S supplies (tyvek, nitrile gloves, safety goggles).
- Blank chain-of-custody forms.
- Cooler and ice for sample preservation.

**Health and Safety Requirements**:

Site specific HASP must be completed and reviewed by field personnel. As a minimum, modified Level "D" attire will be worn. Individuals performing NAPL sampling are required to wear safety goggles, tyvek suit, and nitrile sampling gloves.

**Decontamination Requirements**:

During NAPL sampling activities, dedicated sampling equipment (i.e. Teflon ® bailers, nitrile gloves, and bailer cord) are utilized; thereby, eliminating decontamination requirements. The interface probe, used to record the presence of NAPL and relative thickness prior to sampling, does require decontamination between sampling locations.

All site equipment used in a multi-well capacity will be decontaminated immediately prior to initial use and between each well. Standard site decontamination procedures for the optical interface probes between wells will be performed according to the following schedule:

- Initial rinse with clean tap water to remove excess residuals.
- Scrub equipment with sponge or clean, soft cloth in a distilled water/Liquinox@ (or equivalent) solution.
- Double rinse with deionized/distilled water.

**Methodology:**

Each monitoring well to be sampled will be gauged to obtain liquid level and relative NAPL thickness immediately prior to initiation of the sampling process. Refer to SOP No. 1 for appropriate well gauging procedures. Liquid level data will be recorded in a field book.

Sampling of the NAPL will occur via two different methods: 1) direct sample or 2) swabbing.

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

1) Establish a clean work area where sampling equipment will not come in contact with the ground or any potentially contaminated surfaces.
2) Use a laboratory, pre-cleaned Teflon@ sampling bailer for each well.
3) Don an unused, clean pair of nitrile gloves.
4) Attach an appropriate length of unused, clean nylon or polypropylene cord to the designated sampling bailer.
5) Select appropriate laboratory-sterilized sample containers.
6) Slowly lower sampling bailer into well until water surface is encountered; continue to lower the sampling bailer into the standing water column to one foot below the water surface.
7) Retrieve bailer at a steady rate to avoid excess agitation.
8) Visually inspect bailed sample to ensure for relative thickness of NAPL. If sufficient volume is present (>10 ml) place a direct sample of the NAPL into the laboratory vial. If less than 10 ml of NAPL is present, use a sorbent pad to absorb the NAPL from the surface of the groundwater sample. Place is swab sample into the laboratory vial.
9) Complete and attach labels to sample containers noting sample collector and date, time, and location of sample; record same data in field book.
10) Place samples in ice-filled cooler in such a manner as to avoid breakage. Samples collected for VOC analysis will be maintained at a temperature of 4°C.
11) Discard gloves and bailer cord and move to next sample location.

**Documentation:**

All site activities should be detailed in the site investigators fieldbook. The entry shall include the date, time, weather, address, persons present on-site, and the aforementioned parameters. Only relevant observations should be recorded. The nature of the work being performed is also appropriate.

## C.5. PUMPING TESTS

**Responsible Personnel:** Hydrogeologists, Engineers and Technicians.

**Training Qualifications**: All field personnel performing pumping tests shall have completed OSHA 40-Hour training, and three days of field training. Personnel directing the pumping test shall have assisted with a minimum of three tests under the direct supervision of experienced personnel. Field personnel will have experience in operating the following field equipment: interface probe, data logger, submersible pump, related piping and fittings, flow meter and portable generator.

**Health and Safety Requirements**:

A site specific HASP must be completed and reviewed by all field personnel. Caution must be exercised in set up of electrical equipment, particularly the placement of pumps in a well which could be impacted by floating product. Other health and safety concerns include slip/trip hazards, and area traffic.

**Decontamination Requirements:**

Pump, discharge lines, hand held probes and all pressure transducers must be cleaned with Alconox and distilled water prior to installation in wells at site, and again following removal. Any water sampling activities to be incorporated during the test must be prepared and used in accordance with the Groundwater Monitoring SOP.

**Methodology**:

1) Pre-test Considerations:

Some site specific information regarding the geology and hydrogeology of the subject site is needed to determine the most appropriate type of pumping test and to estimate the reliability of the test results. Lithologic logs of the subject site will indicate whether the zone of interest is an unconsolidated formation or a bedrock formation. They should also give a strong indication as to whether the zone of interest is a water table formation, a confined formation or a leaky-confined formation, and whether any preferential (vertical or horizontal) transmissivity may be expected. Logs and/or slug test data will also provide indications as to what test yield is sustainable, and provide a rough indication of the areal extent pumping will influence. Additional pre-test considerations include any obvious positive or negative hydraulic barriers, any tidal effects, and /or any influence from other wells pumping in the area.

Often times, budget considerations and/or time limitations will necessitate the use of a monitoring well as the test pumping well. While this is generally acceptable, the well must be screened deep enough to allow design drawdown to be achieved and friction losses (well loss) in the pumping well must be taken into consideration when the test data are analyzed. A minimum of three monitoring wells in the vicinity of the test pumping well are needed to evaluate formation response. Ideally, the wells should all be at varying distances from the test pumping well and screened across the same zone.

Pumping tests are broken into two general classifications: step tests and constant rate tests. Step tests involve pumping a well at progressively higher rates, at set intervals of one or two hours per step. They are often used to determine the yield a well will sustain during a constant rate test and to evaluate well loss (frictional head loss between the screen/gravel pack and the formation). Constant rate tests are used primarily to evaluate aquifer coefficients for design of groundwater treatment systems and/or water supply purposes. In high sensitivity sites, where budgets permit, the best method is to do a step test first, to evaluate well loss and long term sustainable yield, allow 24 hours of recovery and then initiate the constant rate test.

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

The approximate test flow rate needs to be determined in advance for proper pump and discharge design selection. If it is not appropriate to perform a step test, sustainable yield can be estimated from slug test data or a brief (<30 minutes) pumping episode the day before the actual test. Generally, it is best to pump the well at as high a rate as is feasible order to obtain the greatest formation response data from the test. However, if floating product is present at or near the pumping well, drawdown needs to be limited so as not to impact uncontaminated soils below the water table. In these instances drawdown should be limited to less than 5 feet. In water table formations, if there is no concern regarding floating product, drawdown should not exceed two-thirds of the wetted screen depth due to the effects of friction loss.

If the test discharge is contaminated, it must either 1) treated prior to discharge or 2) containerized for off-site disposal. If it is to be discharged directly on- site and allowed to re-infiltrate (verses discharged to a catch basin) it must be routed sufficiently far enough from the test area as to avoid any artificial recharge effects. All appropriate discharge permits must be obtained and complied with. If discharge water is to be treated on-site, proper contaminant loading calculations for the test flow rate, approximate contaminant loading and test duration must be done in advance to insure treatment is completely effective. Any on-site treatment should also have at least one discharge effluent sample lab analyzed to document treatment effectiveness.

2) Pumping Test Set Up:

Prior to starting the test, all well measuring points (i.e. top of casing) should be clearly marked and vertically surveyed to the nearest 0.01 feet. The horizontal distance and orientation of all wells should be surveyed to the nearest 0.1 feet, and illustrated on the site base map. If there are any surface water bodies in the vicinity, a staff gauge should be set up and surveyed in to evaluate possible influences.

The preferred pump to be used for a pumping test is a submersible centrifugal pump ("Grundfos", or equivalent), run off either existing site power or a portable generator. These pumps are not explosion proof, so a conductivity probe must be tied into the pump controls to alleviate any possibility of product coming into contact with the pump. If the test pump is designed to pump total fluids (e.g. air operated double diaphragm pump, jack pumps, etc.) discharge must either be containerized, or treatment must include an oil/water separator to handle any floating product. The submersible pump should be positioned just above the bottom of the well, using a handling line to support the pumps weight.

**NOTE:** extreme care must be taken that the power cord is neither bearing any of the pumps weight, nor damaged during installation due to the potential for sever electric shock.

Discharge piping from the pump should include a flow meter (preferably with totalizer), followed by a flow adjustment valve. The flow meter should be installed in a straight section of hard piping of sufficient length to avoid meter distortion caused by turbulence (typically about 10 pipe diameters on either side of the meter). In low flow pumping tests, flow rate can be calculated by measuring the exact time required to fill a known sized container.

Ideally, groundwater levels should be static prior to starting the test, so that pumping influences alone can be readily evaluated. Water levels in all monitoring wells and/or nearby surface waters should be gauged a minimum of two times during the 24 hours prior to starting test pumping; readings should not have varied by more than 0.10 feet. Any significant precipitation events within the previous several days will usually result in noticeable water level changes (barometric changes have significant influences in confined and semi-confined formations). If there are any major water level changes that cannot be accounted for prior to test pumping, additional investigation into possible area influences (e.g. local well pumping or construction de-watering) should be conducted.

Exact water level measurements (to the nearest 0.01 feet) and exact time denotations during the test are critical to achieving accurate test results. All personnel involved with taking measurements during the test should have watches with a second hand, and they should all be calibrated to the same time. Adequate liquid level measurements can be obtained using an interface probe ("ORS", "Solinst", etc.) for those wells with floating product. In wells clear of floating product, an electric water level detector ("Solinst", "Hazco", "M-Scope", etc.) or chalked steel tape will provide accurate measurements. All non-dedicated probes must be properly decontaminated after each level reading to prevent any possibility of cross contamination between wells.

Automatic water level recorders are typically used during pumping tests to augment hand measurements and to obtain reliable early time-drawdown data. A pressure transducer allows measure of changes in groundwater levels by measuring differences in pressure experienced by the transducer. The pressure transducers are manufactured by "In-Situ" and are available with many types of data loggers. Some data loggers are capable of connecting to several transducers (Hermits) while others collected data from one transducer (Trolls and Mini-Trolls). The measured depth data for each probe is digitally stored in the data logger as depth (in feet)

at a specific elapsed time. At the conclusion of the test, the data logger is brought back to the office, and the test data is down loaded into a computer for analysis.

The transducer is installed in each well to a depth several feet lower than the greatest drawdown depth anticipated. The transducer cable is secured at this depth with duct tape or cable ties attached to the well head, and the transducer is plugged into the data logger. The transducer must not be submerged deeper than the allowable operating pressure, which is noted on each transducer cable spool in PSI. Care must be taken that the transducer cable is not damaged from rough edges at the well head, and that no vehicles run over the cable. In addition, any wells with floating product require an inner PVC stilling well to be installed to prevent the transducer cable from being damaged from contact with product. The stilling well will also eliminate the need for any water level corrections for product thickness.

In terms of prioritization, transducers should be utilized in the wells closest to the pumping well and then pumping well. Wells further from the pumping well can be successfully monitored by hand, due to the reduced likelihood that early time drawdown will be critical. Despite having transducers in given wells, back up hand readings should be taken at least hourly during the first 8 hours of the test, and then at least every 3 hours, to verify the transducer levels.

After the transducers are installed in the wells, and connected to the data logger, hand measurements are taken at each well with a transducer. These levels are then entered into the data logger as initial reference points for comparison to the depths measured by the transducers. Readings from the transducers are not completely reliable until they have been emerged for at least 30 minutes, due to the effects of probe temperature equilibrium.

3) Running the Test:

Prior to starting the pumping test, the data logger must be completely formatted for that particular test, and the operator must be completely familiar with the start up sequence. If possible, the pump discharge control valve should be pre-set to the desired flow rate prior to turning on the pump. However, depending on the test pumps performance curves, minor flow rate adjustments are generally needed during the first hour or two of the test to correct for the additional head experienced by the pump due to increasing drawdown. In addition, movement of the discharge hose after the test has been started should be avoided, since any change in the elevation of the discharge will affect the pumping rate. All changes in flow rate should be recorded with the exact time noted.

A minimum of two field personnel are needed to run a pumping test, with additional personnel required for tests with high complexity. One person should be designated to turn on the pump, adjust the flow rate, check on discharge treatment, etc. The second person should be stationed at the data logger to turn it on at the exact moment the pump is turned on. The data logger will record liquid levels very rapidly during the first part of the test, dropping off logarithmically to what ever intervals are formatted (one measurement every 20 minutes is normal). When the data logger has been activated and is running, early time drawdown measurements should be taken by hand from any wells near the pumping well that do not have transducers.

Any hand monitored wells near the pumping well should be measured frequently during the first few hours of the test, with less frequent measurements during the remainder of the test. A rough rule of thumb is one measurement every half minute during the first 5 to 10 minutes, one every 3 to 5 minutes during the first hour, and one every 10 to 20 minutes for the second hour, and then each well hourly. After the test has been running for a few hours, the transducer level readings should be compared to the hand measurements for verification, or later correction.

It is essential that some data reduction be accomplished in the field, so that major water level trends are recognized during the test. At a minimum, drawdown trends from the pumping well and two of the nearest monitoring wells need to be semi-log plotted against time so that deviations indicative of boundary conditions can be discerned before pumping is ceased. This will allow decisions to be made about whether the test should go for longer than planned.

Generally, water quality samples are taken during a test for laboratory analysis of compounds of interest. These are generally taken after the first hour of pumping and just prior to pump shutdown. If the test is of more than 24 hours duration, it is advisable to get running samples during the middle of the test as well. All samples should be obtained following sampling SOP's.

At the conclusion of the test, water level recovery data should be taken. The recovery data should plot out to an approximate inverse mirror image of the drawdown curve, with feet of recovery measured from the theoretical drawdown that would have been observed if pumping had continued. Recovery data behaves as if there were a nearby well recharging the formation, following image well theory. It has the advantage that there are no variations in the curve produced by variations in pumping rate. In water table aquifers, however, the effects of formation de-watering can cause the recovery trends to be substantially different from drawdown trends. Consequently, recovery data should be used for comparison purposes only, but not relied upon as heavily as drawdown data.

1) Data Analysis:

The data produced by pumping tests are analyzed to estimate aquifer performance characteristics, such as transmissivity, conductivity and storage, which in turn are used to predict groundwater flow under various circumstances. One of the more useful analytical products is a determination of capture zone, which is widely utilized in aquifer contamination work. Capture zone (Keely & Tsang, 1983) calculations describe the radial area (down gradient and side gradient) that a pumping well will draw groundwater in from. In the case of a contamination site, this equals to that portion of the plume a given recovery well(s) will influence, at a given pumping rate(s). Aquifer coefficients determined from a pumping test can be applied to a capture zone analysis for the determination of the best recovery system for a given plume. When the recovery system is operational, capture zone calculations can then be used to evaluate the effectiveness of the system at addressing the contamination plume, what pumping rate is optimal for controlling the plume, and the need for any additional wells. It must be noted, however, that capture zone calculations are relatively simplistic, and far from absolute. Consequently, they should be used with considerable margin for safety, and employed with a large measure of common sense.

The mathematical solutions used in pumping test analysis include many assumptions typical "real world" formations violate in one or more way (e.g., "the formation is of uniform thickness and of infinite areal extent"). In addition, some of the values incorporated into typical pumping test solutions are not actually measured, but are educated estimates (e.g. porosity based on lithology, etc.). Consequently, even the most carefully designed and executed pumping tests have severe precision limitations, and the solutions should never be considered absolute. This is why groundwater flow evaluations are generally conceded to be "a mixture of science and art", and all solutions require a strong application of common sense and experience.

Many problems associated with pumping test data evaluation are due to not recognizing, and/or correcting for, deviations from the theoretical solution employed. Some of the more common errors occur due to: partial penetration effects, formation de-watering effects, casing storage effects, poor pumping well efficiency and/or the application of incorrect equations or units. Consequently, a thorough understanding of the underlying assumptions inherent to the solution employed is required before the validity of the results can be trusted. There are numerous references that describe pumping test analyses. Some of the more recommended references include: Driscoll's "Groundwater & Wells" (1986); Lohmans "Ground-water Hydraulics" USGS Professional Paper 708 (1979) and Fetter's "Applied Hydrogeology" (1980). In addition, the USGS published "Aquifer-test Design, Observation, and Data Analysis" in 1983 by Robert W. Stallman (Applications of Hydraulics, Book 3, Chapter B 1). This is an excellent, common sense, guide to pumping test set up, measurements and data analysis.

Two of the more common pumping test equations used and their applications are listed below:

1) Cooper-Jacob (1946); time-drawdown & distance-drawdown methods: Test data is plotted on semi-log paper, and the slope is used in the solution. Both solutions assume the formation is confined; however, this distinction lessens over time as drawdown becomes stabilized. Distance-drawdown has an added advantage in that it allows water level to respond from across the site to be used, which accounts for some lithologic variations.

2) Boulton (1963), modified by Neuman (1975): This solution is used for determining aquifer coefficients in water table formations, taking gravity drainage (delayed yield) effects into account. Time- drawdown data is plotted on log-log paper and two Theis type curves are matched to get early time-drawdown and late time drawdown, respectively. While this solution most closely matches typical floating product recovery work, it is difficult to apply and often subjective, due to the inherent nature of curve matching solutions.

It is usually appropriate to analyze pumping test data by more than one solution to get a range of aquifer performance values. These values can be averaged, or the most conservative value can be used, or the best fit based on experience can be presented. The computer program "Aqtesolv", produced by Geraghty & Miller, is a very useful tool for solving pumping test solutions. Data from an Insitu data logger can be imputed to the Aqtesolv, and curve matching solutions can be produced automatically, or with some adjustments.

## C.6. SLUG TESTS

**Responsible Personnel**: Hydrogeologists, Engineers, and Technicians

**Training Qualifications**:

All field personnel performing pumping tests shall have completed 40 HOUR OSHA training and 3 day field requirements. Personnel directing slug tests shall have assisted in at least 3 previous slug tests under the supervision of experienced personnel.

**Materials and Equipment Necessary for Task Completion**:

"Insitu " Hermit data logger, with one pressure transducer; interface tape or equivalent water level measuring device; "slug in" water displacement cylinder, or large bailer, 5 gallon pail, traffic cones and/or barricades, decontamination water and brush, alconox and decontamination pail.

**Health and Safety Requirements**:

A site specific HASP must be completed and reviewed by all field personnel. Caution must be exercised in test set up, particularly regarding vehicular traffic. Other concerns regard possible handling of free product, and slip/trip hazards.

**Decontamination Requirements:**

Any water level measuring probes, bailers and the water displacement cylinder must be cleaned with alconox and distilled water prior to use, and between uses at each well monitoring. Any groundwater and/or free product bailed must be disposed of in an approved manner, preferably in a properly installed, on-site holding tank.

**Methodology:**

Slug tests are utilized to obtain rough estimates of aquifer performance coefficients. They involve calculations based on the water level response of a well to the addition or subtraction of a known volume. They can be broken into two basic types of field exercises: slug-in tests and slug-out tests. As their names imply, slug-in tests involve the addition of water (volume) to the well, while slug-out tests involve the removal of water (volume). Water level response is monitored immediately following the displacement change, and for the next hour or so until the well has returned to approximately 90% of its original static level. Water level responses can be measured either rapidly by hand or with an "Insitu" Hermit data logger (or equivalent).

1) Field Procedures:

Exact well completion details are needed to perform slug test calculations. These include: total depth, total screened interval, depth to static water, casing diameter, screen diameter, gravel pack diameter and gravel pack interval. While these details should be documented on the well log, static water level and total depth should be field confirmed before the test. Where possible, several wells per site should be slug tested to obtain an average conductivity value for

a site, or to evaluate lithologic variables across a site. Addition data comparisons are accomplished by performing both slug-in and slug-out tests on the same well, where time permits.

Slug-In Tests: The slug-in method is best accomplished by lowering a cylinder of known volume into the well, and measuring the water level response over time. The displacement volume should be sufficient to cause a several foot initial change in the water level. In the case of a typical 4 inch diameter monitoring well, a simple displacement cylinder can be constructed using a 3 inch diameter PVC casing, capped at both ends and filled with clean sand. An over all length of 5 feet provides adequate displacement volume for a typical water table well having about 10 feet of standing water. A steel eye should be bolted into one cylinder cap for attachment of a disposable lowering rope (discard lowering rope between wells to prevent any cross contamination).

If a Hermit data logger is to be used for a slug-in test, the transducer should be set in the well at least one foot below where the bottom of the displacement cylinder will rest upon insertion, but not lying on the bottom (beware of silt clogging the transducer tip). Depth to water should be measured and compared to the transducer reading for correlation. When the Hermit has been properly imputed for the slug test, the hermit should be activated and the displacement cylinder should be rapidly, but carefully, lowered into the well to below the water surface. *NOTE: Take particular care that insertion of the displacement cylinder does not damage the transducer or cable.* When activated, the Hermit will be automatically recording time and water levels, starting at 6 readings per second, then decreasing exponentially over time. If water level changes are to be taken by hand, they must be carefully obtained at least every minute. When the well has recovered to about 90% of its original static level, the test may be concluded. If the test has proceeded for an hour and not recovered to at least 90% of the original static, additional data will be of marginal value and the test may be concluded.

2) Slug-out Tests:

Slug-out tests are performed in the same basic manner as slug-In tests, only by removing a known volume from the subject well. In wells that recharge rapidly during slug-in tests, a slug-out test can be performed by merely resetting the Hermit and extracting the displacement cylinder. The more conventional method of performing a slug-out test is to use a single long hand bailer to remove a known volume of water from the well. Typical bailers used for 4 inch diameter monitoring wells are either long steel bailers (similar to those often used by drillers to develop monitoring wells) or 2 Lexan sample bailers joined end to end to form one single long bailer. The bailer is lowered into the well prior to starting the Hermit, and the slight water level rise from the bailer is allowed to stabilize back to static. The Hermit is then activated, and the bailer is rapidly removed from the well, thereby creating the instantaneous. The test is run to 90% recovery, or one hour, like the slug-in test. If the bailed water is contaminated, it must be disposed of properly via either storage in an on site holding tank or on-site treatment with a portable carbon treatment container.

The validity of slug test values are highly field dependant. Some of the more common field oriented problems arise from:

a) Subject wells are not adequately developed prior to testing.
b) Formation slough occurred during drilling, so gravel pack volume is underestimated.
c) Water displacement is not instantaneous due to the bailer leaking during extraction.
d) The pressure transducer is jarred during water displacement.
e) Water level changes are too rapid to get accurate measurements.

3) Data Analysis:

Field data from slug tests can be analyzed by hand or using "Geraghty & Millers" Aqtesolv computer program. If the field data was taken with the Hermit, the data can be transferred to Aqtesolv for analysis, saving considerable time over hand analysis. There are four well recognized analytical methodologies general employed. These methods and their assumptions are listed below:

| Application | Hvorslev | Bouwer & Rice | Cooper | Nguygen-Pinder |
|---|---|---|---|---|
| Confined Fm. | **X** | **X** | **X** | **X** |
| Unconfined Fm. | **X** | **X** | | **X** |
| Screened across water level | | **X** | | |
| Accounts for partial penetration | **X** | **X** | | **X** |
| Specific storage >0 | | | **X** | **X** |
| Allows for anisotropy | **X** | | | |
| Assumes infinite borehole storage | **X** | **X** | **X** | **X** |

As illustrated on the chart above, slug tests performed in water table formations can be solved using either Hvorslev or Bouwer & Rice methods. The Bouwer & Rice method has the advantage of accounting for screening across the water table, while the Hvorslev method allows for anisotropy. Confined formation slug tests can be analyzed by any of the four methods, though the Cooper method is most often used. It is often beneficial to solve slug tests by more than one method to evaluate possible conductivity ranges.

It must be stressed that slug test data is very approximate and limited in its accuracy. It is generally conceded that conductivity' values derived from slug tests are usually within an order of magnitude of the real conductivity, and therefore are only approximations. Consequently, any judgments based on slug test values must be used with extreme caution and incorporate a large measure of common sense and experience.