SITE CHARACTERIZATION REPORT
AOI 1

SUNOCO, INC. (R&M)
PHILADELPLHIA REFINERY AND
BELMONT TERMINAL
PHILADELPHIA, PENNSYLVANIA

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1.0 INTRODUCTION

Sunoco Inc. (R&M) (Sunoco) and the Pennsylvania Department of Environmental Protection entered into a Consent Order & Agreement (CO&A) in December 2003 with respect to remedial activities associated with Sunoco's Philadelphia Refinery. In accordance with the CO&A, a Current Conditions Report and Comprehensive Remedial Plan (CCR), dated June 30, 2004, was prepared by Sunoco. The CCR proposed Phase II site characterization and corrective action activities for Sunoco's Philadelphia Refinery (Refinery), including preparation of Site Characterization Reports for eleven individual Areas of Interest (AOIs). The CCR presented a prioritization of all AOIs based on specific risk factors. Based on this prioritization, AOI 1 and AOI 4 were identified by Sunoco as the first areas of the Refinery to be investigated.

Sunoco prepared a Site Characterization Work Plan (Work Plan) for AOIs 1 and 4 in January 2005 which was approved by the Pennsylvania Department of Environmental Protection (PADEP) in March 2005. This Work Plan summarized proposed activities to be completed to characterize AOIs 1 and 4 in accordance with the objectives of the CCR. AOI 1 includes the No. 1 and No. 2 Tank Farms and the Belmont Terminal.

This Site Characterization Report (SCR) has been prepared exclusively for AOI 1, and documents the results of the activities that were performed for AOI 1 in accordance with the Work Plan. Site characterization activities discussed in the Work Plan for AOI 4 are currently ongoing, and the Site Characterization Report for AOI 4 is anticipated to be submitted to the Pennsylvania Department of Environmental Protection (PADEP) by September 30, 2005.

2.0 ENVIRONMENTAL SETTING

AOI 1 includes Belmont Terminal, No.1 Tank Farm, and No.2 Tank Farm and is shown in Figures 1 and 2. AOI 1 is bordered by Passyunk Avenue to the North, 26th Street to the East, Hartranft Street to the South, and Process area 869/employee parking area (AOI 2) to the West (Figure 2) and encompasses approximately 100 acres.

2.1 Current and Historic Use

Currently, AOI 1 is comprised of primarily light-end hydrocarbon Above Ground Tankage (No. 1 and 2 Tank Farms) and loading racks (the Belmont Terminal). The Belmont Terminal area is utilized for blending gasoline and additives as well as product distribution. There are numerous underground process lines in the terminal area of AOI 1. Appendix I of the CCR included a figure which described the current usage for the Point Breeze South Yard which includes AOI 1. For this report, this figure was updated to portray present conditions in AOI 1 and is included in Appendix A (Figure A1). A summary of updated features is provided below:

- Two biofilters were added to the map: one in Belmont Terminal and one along 26th Street;
- Belmont Terminal was labeled;
- The depiction of the footprint of the Credit Union building in Belmont Terminal was modified;
- Loading racks were located on the map;
- Two spheres next to RM90 and RM91 were labeled as butane spheres;
- Tank 34 was appropriately labeled;
- Additional propane bullets were labeled in the center of AOI 1; and
- Tanks previously labeled "removed" were taken off the Current Use figure and moved to the Historic Use figure.

No significant modifications were made to the Point Breeze South Yard Historic Use Figure that was provided in Appendix I of the CCR. The updated Current Use and Historic Use figures are provided in Appendix A.

2.2 Geology

The following paragraphs describe the geologic units observed during Site characterization activities in AOI 1 beginning with the deepest units to the most shallow units. Please note that several geologic descriptions are based on subsurface conditions observed at specific boring locations, and not all geologic conditions described in the following sections are representative of all of AOI 1.

Wissahickon Formation

Bedrock beneath AOI 1 is identified as the Wissahickon Schist. This formation beneath AOI 1 is a metamorphosed greenish-gray micaceous schist and quartzite. As observed in S-46D and S-80D, the competent bedrock of the Wissahickon Formation is overlain by weathered bedrock consisting of a micaceous clay which becomes increasingly sandy as the degree of weathering lessens and competent bedrock is encountered.

Lower Sand Unit of the PRM

The Wissahickon Formation is overlain by the Lower Sand, which is the lowest member of the Potomac-Raritan Magothy System. The Lower Sand beneath AOI 1 is a green, brown, orange and/or red fine gravel and course sand that grades upward into medium to fine sands and may contain a few layers of silt and clay. Throughout AOI 1, the Lower Sand is overlain by the Middle/Lower Clay, as observed in RW-1, S-80D, S-46D, and S-214 D.

Middle/Lower Clay

The Lower Sand is overlain by the Middle/Lower Clay Unit. The Middle/Lower Clay is characterized by very low permeability reddish-brown, brown or gray clays, and may be sandy in places (Paulachok, 1991). The Middle/Lower Clay was confirmed to be present within the two deep borings advanced in AOI 1.

Trenton Gravel

The Trenton Gravel overlies the Middle/Lower Clay and Lower Sand beneath AOI 1. During Site characterization activities, the Trenton Gravel was observed as a very heterogeneous unit comprised of a predominantly brown, reddish-brown, and gray sand and gravel, with minor amounts of clay.

Recent Fill/Alluvium

Overlying the Trenton Gravels Formation is recent fill/alluvium. The alluvium deposits generally consist of dark gray organic clayey mud or silt and fine sand. Fill type has historically varied across AOI 1 from asphalt to various gravels to cinder ash.

As part of the Site characterization activities, 30 Trenton Gravel monitoring wells and two Lower Sand monitoring wells were installed in AOI 1 (Figure 3). The Trenton Gravel wells were installed to depths of up to 35 feet below grade. The Lower Sand wells were advanced to a maximum depth of 95 feet below grade for geologic

characterization, however the well screens were set in the upper 15 feet of the Lower Sand unit at a maximum depth of up to 79 feet below grade. The data from these wells were combined with historical site information to generate an updated cross section (O-O') for AOI 1. The cross section location key for O-O' is provided as Figure 4 and the cross section is provided as Figure 5. Based on recent and historical activities, the following observations can be made concerning AOI 1:

- The Fill/Alluvium, Trenton Gravel, Middle/Lower Clay, and the Lower Sand all exist beneath AOI 1;
- The thickness of the Fill/Alluvium materials beneath AOI 1 ranges between 2-25 feet;
- The thickness of the Trenton Gravel beneath AOI 1 ranges between 10-30 feet;
- The thickness of the Middle/Lower Clay beneath AOI 1 is approximately 18 feet;
- The thickness of the Lower Sand beneath AOI 1 ranges between 20-25 feet;
- The thickness of the weathered bedrock (saprolitic schist) beneath AOI 1 along cross-section O-O' ranges between 10-17 feet; and
- Depth to competent bedrock (Wissahickon Schist) beneath AOI 1 is approximately 95 feet below the ground surface.

2.3 Hydrogeology

Groundwater flow in the Fill/Alluvium and Trenton Gravel (Intermediate) zone is generally towards the southeast in AOI 1, as shown in Figure 6. Groundwater flow in the Belmont Terminal and the northern portion of No. 1 Tank farm areas within the Fill/Alluvium and Trenton Gravel is influenced by the active fluids recovery systems in Belmont Terminal and along the 26th Street Border. Based on historical data, groundwater flow in the Lower Sand (Deep) in AOI 1 is towards the south-southeast .

Groundwater elevations in Lower Sand wells S-80D and S-46D were slightly lower than elevations observed in nearby Trenton Gravel wells, indicating a downward vertical gradient exists between the Trenton Gravel and the Lower Sand in this portion of AOI 1. This downward vertical gradient is consistent with the relationship between the hydraulic head in the Intermediate and Deep groundwater zones as determined at other well pairs throughout the refinery.

S-42I was previously classified as a Deep well (S-42D), but was re-classified as an Intermediate well as a result of this investigation. The available lithologic data from the

well boring is inconclusive as to whether the well is screened in the Lower Sand. Based on the lack of detailed deep lithological data in the area of this well, and since the well consistently exhibits higher hydraulic head elevations than nearby shallow wells, the well exhibits the characteristics of an Intermediate well and was therefore re-classified as such.

S-87I was previously classified as a Deep well, but was re-classified as an Intermediate well as a result of this investigation. Langan reviewed the S-87I boring log, boring logs in the vicinity of S-87I, and historic and current groundwater elevations for S-87I. In addition, based on the additional lithological data collected during the investigation, it has been determined that although a small sandy clay lens was observed from 40-41.5 feet below grade, S-87I is screened within the Trenton Gravel and not within the Middle/Lower clay. The sandy clay observed at 40-41.5 feet bgs at S-87I was determined to be part of the Trenton Gravel, and is not the Middle/Lower Clay as previously interpreted. Historic and current groundwater elevations also indicate that S-87 is screened in the Intermediate zone.

No aquifer testing was performed in AOI 1 since sufficient data was available from former aquifer tests (pumping tests, recovery tests, and slug tests) performed in AOI 1 by others (SECOR, 2003; USGS, 2001; URS, 2002; Chevron USA, Inc., 1992; USGS, 1988). The geometric mean of hydraulic conductivity values calculated using recovery data in Well RW-406 by SECOR in 2003 (SECOR, 2003) appears to be most representative of the Trenton Gravel. This value was calculated to be 24 feet/day.

2.4 Surface Water

No surface water features are located in AOI 1. The nearest surface water body to AOI 1 is the Schuylkill River which is located approximately 1,400 to 1,900 feet west of AOI 1. AOI 2 lies between the Schuylkill River and AOI 1.

3.0 SITE HISTORY AND BACKGROUND

The Sunoco Philadelphia Refinery is located on approximately 672 acres in southwest Philadelphia. 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 Atlantic Refining Company established 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 Point Breeze Processing Area portion of the Facility has been operating under a Consent Order and Agreement since 1993. The 2003 CO&A replaced the 1993 CO&A and includes the Girard Point Processing Area, the West Yard, and the Schuylkill River Tank Farm.

AOI 1 comprises the northeast portion of the Point Breeze Process Area South Yard and includes the Belmont Terminal (Figure 2). Results of a RCRA Facility Investigation (RFI) for the Point Breeze Process Area are summarized in a report by ENSR Consulting and Engineering (ENSR) dated September 1992. The primary purpose of the RFI was to examine potential contaminant releases to surrounding soils/sediments, surface water, and groundwater within three areas of the Point Breeze Processing Area. The investigation included the completion of soil borings and monitoring wells; sampling of groundwater and surface water sediments; sampling of waste materials, sampling of subsurface soils; geophysical surveys; bathymetric surveys, tidal surveys, and monthly water level monitoring.

Supplemental investigations have been performed in AOI 1 at areas which posed the highest potential for off-site migration and discharge to sensitive receptors. These areas include the Belmont Terminal, the northeast border of AOI 1 (along 26th Street), the 26th Street Sewer, and the Pollock Street/Packer Avenue Sewer. Results of these investigations have been summarized in the following reports:

- Secor International Inc. (Secor), *26th Street Border Progress Report*, dated January 1, 2003 through March 31, 2004;
- Secor International Inc. (Secor), *26th Street Border, Point Breeze Processing Area, Philadelphia Refinery, Philadelphia, Pennsylvania, Remedial Investigation Report*, dated January 31, 2003*;* and
- Aquaterra Technologies, Inc. (Aquaterra), *Pollock Street Sewer Investigation,* dated October 18, 2002.

In addition to the above reports, activities were performed to support the development of the AOI 1 Work Plan for Site Characterization. These activities included:

- Aquaterra Technologies (Aquaterra) performed one round of groundwater monitoring and sampling in AOI 1 between October 12 and 21, 2004. Groundwater samples were collected from all accessible AOI 1 wells, with the exception of recovery wells and wells which contained measurable (>0.01 feet) LNAPL. A total of 44 wells were sampled during this sampling event.
- The samples were submitted to Severn Trent Laboratories (STL) of Pensacola, Florida for analysis of Site COCs. The results of these samples were presented in Table 2 of the Work Plan.
- Semi-annual gauging of all wells and annual groundwater sampling of twenty perimeter monitoring wells was completed in accordance with the ongoing sitewide sampling program. Relevant data from these events was utilized in preparation of this report.

4.0 SELECTION OF COMPOUNDS OF CONCERN AND APPLICABLE STANDARDS

The compounds of concern (COCs) for soil and groundwater are listed in Table 1 of this report. These COCs are the same as those listed in the Work Plan and the CCR. The COCs for the soil gas samples are also listed in Table 1. The soil gas COCs are those COCs in soil and groundwater which are included in the compound list for United States Environmental Protection Agency (USEPA) Method TO-15, which include benzene, toluene, ethylbenzene, total xylenes, cumene, ethylene dibromide, 1,2-dichloroethane, and methyl tertiary-butyl ether (MTBE).

The following sections describe the applicable standards that were used in evaluating the Site characterization data.

Soil

Surface (0-2 feet) soil samples were collected at unpaved areas in accordance with the Work Plan and screened against the non-residential statewide health medium-specific concentrations (MSCs) for soil (0-2 feet). At two locations (BH-S207 and BH-S210), gravel was present between zero to two feet below the ground surface and soil samples were collected from immediately below this interval (three to four feet). Samples from these areas were compared to the non-residential statewide health MSCs for soil (2-15 feet). As summarized in the CCR,

where statewide health MSCs are exceeded, Sunoco will apply either the site specific pathway elimination option or calculated risk-based site-specific standards for soil samples that exceed the statewide health MSCs.

Groundwater

Groundwater sample results were screened against the non-residential, used-aquifer (TDS<2,500) statewide health groundwater MSCs. As summarized in the CCR, where statewide health MSCs are exceeded, Sunoco will apply either the site specific pathway elimination option or calculated risk-based site-specific standards for groundwater samples that exceed the statewide health MSCs.

Soil Gas

Soil gas samples were screened against the non-residential Indoor Air Quality MSCs provided in Table 3 of the PADEP's Vapor Guidance Manual (PADEP, 2003). Groundwater infiltrated four of the 11 soil gas points that were installed as part of the investigation. Groundwater results from these wells were screened against the non-residential USEPA-PA Default Values for Volatilization to Indoor Air provided in Table 2 of the PADEP's Vapor Guidance Manual.

5.0 SITE CHARACTERIZATION ACTIVITIES

The following sections summarize the Site characterization activities that were performed in AOI 1 in support of this report. All on-site activities were performed during April and May 2005 by Aquaterra.

5.1 Shallow Soil Borings and Sampling

A total of ten soil samples were collected at monitoring well boring locations shown on Figure 3 utilizing a stainless steel hand auger. Soil borings were advanced to a maximum depth of two feet below grade, with the exception of two locations (BH-S207 and BH-S210). At these locations gravel existed between zero and two feet below the ground surface, therefore soil samples were collected from three to four feet below grade.

Prior to advancement, the hand auger was decontaminated by washing in an alconox and distilled water solution and then rinsed using distilled water. Soil samples were collected in laboratory-prepared bottleware and immediately placed on ice. Soil samples

were submitted to Lancaster Laboratories, Inc. (LLI) of Lancaster, Pennsylvania for analysis of site COCs. A summary of the soil analytical results is provided as Table 2 and the results are discussed in Section 6.1. The laboratory analytical reports are provided as Appendix C.

5.2 Installation of Groundwater Monitoring Wells

Well installation activities were performed during March and April 2005. Intermediate wells were installed to monitor the Trenton Gravel unit and Deep wells were installed to monitor the Lower Sand unit. The well installation activities are discussed in detail in the following sections.

5.2.1 Trenton Gravel (Intermediate) Groundwater Monitoring Wells

Parratt Wolff, Inc of Syracuse, New York installed 30 Intermediate monitoring wells within the Trenton Gravel under the direct supervision of Aquaterra. All wells were installed and constructed in accordance with the Work Plan. Locations of these wells are shown on Figure 3. Prior to installation of the monitoring wells, a PA One Call was performed for marking out utilities. Monitoring well locations were cleared to a depth between six to ten feet below grade utilizing hydro excavation services provide by Environmental Industrial Services Corporation (EISCO) of Swedesboro, New Jersey. The Trenton Gravel wells were advanced utilizing 8.25-inch inside diameter hollow stem augers and split spoon samplers to record lithology. Split spoon samples were collected at five foot intervals throughout the borings, from 30 feet below grade to completion of the borehole. Monitoring wells were constructed to a maximum depth of 35 feet below grade with the screen interval of 15 feet set within the Trenton Gravel. Boring logs depicting monitoring well construction details and lithology are provided as Appendix B. Monitoring wells were constructed with a flush mount manhole cover or with three feet of PVC stickup steel casing for protection. Well construction details are provided in Table 3.

Augers were steam-cleaned between boreholes to eliminate cross contamination. Following construction of the wells, the wells were developed using a submersible pump until recovered water cleared or by pumping a minimum of three well volumes from the well.

5.2.2 Lower Sand (Deep) Groundwater Monitoring Wells

Parratt Wolff installed two Deep monitoring wells within the Lower Sand under the direct supervision of Aquaterra. These wells were screened to monitor the Lower Sand unit beneath the site. Locations of these wells are shown on Figure 3. Prior to installation of monitoring wells, a PA One Call was performed for marking out utilities. Monitoring well locations were cleared to a depth between six to ten feet below grade utilizing hydro excavation services provide by EISCO. The Lower Sand wells were installed using a combination of 8.25-inch inside diameter hollow stem augers and mud rotary techniques with split spoon samplers. Augers and continuous split spoons were advanced into the middle clay no more than ten feet. Once the augers were advanced into the middle clay, 4-inch steel casing was set into the borehole and grouted in place to prevent vertical migration of groundwater from shallower water-bearing zones. The grout was allowed to set for at least one week before initiating the remaining drilling activities.

Once grout had set, mud-rotary drilling techniques were used to advance the borehole to bedrock using a bentonite-based fluid to keep the borehole open. The mud-rotary roller bit was advanced to the bottom of the steel casing at which point continuous split spoon sampling was resumed. Continuous split spoon sampling was performed until the Lower Sand was encountered. Once it was determined that the Lower Sand was encountered, split spoon samples were collected at five foot intervals until competent bedrock was encountered. Monitoring wells were constructed using 2-inch diameter PVC 0.020 slot screens and 2-inch diameter PVC risers. The screened interval at each well was set in the upper 15 feet of the Lower Sand Unit. The annular space beneath the screened interval was sealed with bentonite chips.

Boring logs depicting monitoring well construction details and lithology are provided as Appendix B. Monitoring wells were constructed with a flush mount manhole cover or with three feet of PVC stickup steel casing for protection. Well construction details are provided in Table 3. Augers were steam-cleaned between boreholes to eliminate cross contamination. Following construction of the wells, the wells were developed using a submersible pump until recovered water cleared or by pumping a minimum of three well volumes from the well.

5.3 Groundwater Monitoring

On May 9 through May 11, 2005, Handex performed monitoring well gauging activities to collect liquid levels from monitoring wells within AOI-1 as part of the semi-annual refinery well gauging program. Monitoring wells were gauged for depth to water, and if applicable, depth to product in accordance with the Work Plan. All well gauging readings are summarized in Table 4.

The groundwater monitoring data for the fill/alluvium and Trenton Gravel wells in AOI 1 were used to generate formational groundwater elevation contour maps provided as Figure 6. Groundwater flow across AOI 1 is generally towards the south-southeast as indicated in Figure 6. Groundwater along the northeastern border of AOI 1 (26th Street) is actively recovered by a series of total fluid recovery wells (Table 3). These wells are pumped continuously between March and December. Groundwater recovery in this area is discussed in detail in Section 7.0 of this report.

The CCR identified two "deep" wells in AOI 1 (S-42D and S-87D). The construction of S-42D and S-87D was evaluated using geologic characterization data obtained from the newly installed deep wells and borings, and through re-evaluation of existing boring logs and hydraulic head measurements. Based on this evaluation, it has been determined that S-87D is not screened in the Lower Sand, but rather the Trenton Gravel and Middle Clay, and therefore was reclassified as a Trenton Gravel well and not a Lower Sand well. In addition, S-42D exhibits hydraulic head characteristics of an Intermediate well and is was therefore reclassified as a Trenton Gravel well and not a Lower Sand well. The nomenclature for S-87D and S-42D has been changed to S-87I and S-42I, respectively, in this report. Therefore, two Lower Sand wells (S-80D and S-46D) exist in AOI 1. Based on historical groundwater measurements in the Lower Sand in AOI 1, groundwater flow in the Lower Sand is generally towards the south-southeast.

5.4 Groundwater Sampling

Aquaterra performed groundwater sampling activities for AOI-1 between April 18 and 27, 2005. All groundwater sampling activities were completed in accordance with the Work Plan. Gauging data collected on April 14, 2005 by Aquaterra was used in calculating the amount of water to be purged prior to sampling the monitoring wells. Although monitoring well S-80 was gauged, it could not be adequately accessed for sampling due to internal damage. Three well volumes were purged from each well prior to sampling to remove stagnant water from the well and obtain a representative sample. Monitoring wells were sampled from least-to-most impacted based on historical groundwater analytical data. Well purging was performed by using either a submersible pump with disposable polyethylene tubing or by hand bailing using a disposable bailer. If a submersible pump was used for purging, the pump was decontaminated by rinsing in a distilled water and alconox solution and then rinsing in distilled water. Purge water was treated onsite using granular activated carbon. Well sampling data is presented in Appendix D.

Subsequent to purging, monitoring wells were allowed to recharge for no more than two hours prior to sampling. Samples were obtained by lowering a disposable bailer slowly into the 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 Lancaster Laboratories for analysis of site COCs. Once the sample was obtained, 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. A summary of groundwater analytical results is presented in Tables 5 and 6 and laboratory analytical reports are included as Appendix C.

5.5 LNAPL Sampling

Aquaterra collected light non-aqueous phase liquid (LNAPL) samples from a total of 31 monitoring wells, including 10 newly installed monitoring wells. LNAPL samples were collected using a direct sampling or swabbing method. For direct sampling (ability to collect >10mL of LNAPL), a bailer was lowered into the well until it was approximately one foot below the water surface. The bailer was then retrieved and the LNAPL sample was placed in an unpreserved vial. For the swabbing method (<10mL of LNAPL), the bailer was lowered into the well as previously described. Once the bailer

was retrieved, a piece of sorbent pad was used to absorb the LNAPL present in the bailer from the surface of the groundwater sample. T he swab was then placed into an unpreserved vial. The bailer, bailer cord, and nitrile gloves used for sampling each well were discarded after each sample was collected. Samples were packaged in certified hazardous material shipping boxes and sent via FedEx priority overnight to Torkelson Laboratories of Tulsa, Oklahoma for characterization (fingerprinting). LNAPL characterization data included product types, density, proportions of product, degree of weathering, and similarities to other samples. Table E1 in Appendix E summarizes the LNAPL characterization results for all samples collected in AOI 1 and previous results from wells in AOI 1.

Aquaterra collected two additional LNAPL samples and groundwater samples from monitoring wells S-198 (AOI 1) on April 27, 2005 and well S-34 (AOI 4) on May 3, 2005 to obtain site-specific LNAPL/soil saturation data for use with LNAPL modeling. Prior to collection of the LNAPL and groundwater samples, the wells were gauged to determine depth to product, water, and product thickness. Samples were collected using Teflon - lined polyethylene tubing and a peristaltic pump. The polyethylene tubing was lowered into the monitoring well and into the LNAPL layer. The peristaltic pump was set at a low flow rate during collection of the sample. A minimum of 200mL of LNAPL was collected in unpreserved laboratory-prepared bottleware. Once the LNAPL sample was collected, the polyethylene tubing was slowly lowered into the groundwater where no LNAPL was present. The polyethylene tubing was lowered no further than one foot below the bottom of the LNAPL/groundwater interface. A groundwater sample was then collected in unpreserved laboratory bottleware making sure no LNAPL was present in the sample.

Samples were then packaged in certified hazardous material shipping boxes and sent via FedEx priority overnight to PTS GeoLabs of Santa Fe Springs, California. The samples were analyzed via ASTM D445 and D1481 for fluid density of LNAPL and groundwater; surface tension of LNAPL and groundwater; viscosity of groundwater at 50°F, 60°F, and 100°F; and, viscosity of oil at 50°F, 60°F, and 100°F; interfacial tension of LNAPL to groundwater by ASTM D971, intrinsic permeability to both water by API RP 40/EPA 9100/ASTM D5084, LNAPL by API RP 40 and drainage capillary pressure by API RP 40/ASTMD425M/EPA 9100. The results of the analyses were used to support the LNAPL modeling for AOI 1 which is discussed in Appendix E.

Aquaterra collected one soil sample from a boring advanced adjacent to MW-42 to obtain additional site-specific LNAPL/soil saturation data for use with LNAPL modeling. Four continuous six-inch soil intervals were collected from the LNAPL-saturated area in this boring (22-24 feet beneath the ground surface) and were placed in brass soil rings with waxed end caps. The samples were then packaged in certified hazardous material shipping boxes and sent via FedEx priority overnight to PTS GeoLabs for photographing under white light and ultra-violet light; these photographs are included as Appendix J. The six-inch sample interval with most LNAPL fluorescence (23-23.5 feet) was the analyzed for the LNAPL parameters.

The samples were analyzed for pore space phase saturation (API RP 40) and porosity (API RP 40); grain size (ASTM D422 or D4464); Atterberg limits (ASTM D4318); total organic carbon by Walkly-Black; intrinsic permeability to both water (API RP 40/EPA9100/ASTM D5084) and LNAPL (API RP 40); and drainage capillary pressure (API RP 40/ASTM D425M/EPA 9100). The results of the analyses were used to support the LNAPL modeling discussed in Appendix E.

5.6 Soil Gas Points Installation and Sampling

Parratt Wolff, Inc. installed a total of 11 soil gas monitoring points in the Belmont Terminal area under the direct supervision of Aquaterra. The location of the soil gas points are shown on Figure 3. Eight soil gas points (SG-1 through SG-8) were installed adjacent to the north, east, and south exterior walls of the Credit Union building. One soil gas point (SG-9) was installed adjacent to the active office building and two soil gas points (SG-10 and SG-11) were installed adjacent to the former office building/maintenance building/supply storage building located within the Belmont Terminal.

Prior to drilling activities, a PA One Call was made for utility marking and locations were hand-cleared to a maximum depth of five feet below grade using a posthole digger and hand auger to minimize soil disturbance. Six and one quarter inch inside diameter augers and split spoon samplers were used to install the soil gas points and record lithology. Soil gas points were constructed to a maximum depth of 10 feet below grade due to the presence of a perched water-bearing zone encountered at approximately 11 feet below grade. Construction of the soil gas points consisted of five feet of two-inch diameter 0.020 slot PVC screen and five feet of two-inch diameter PVC riser. A sand pack was placed around the screened interval and four feet of bentonite was

placed along the riser to ensure an airtight seal. Boring logs depicting the soil gas monitoring point construction details and lithology are provided in Appendix B; this information is also summarized in Table 3.

During soil gas point installation, Aquaterra collected three soil samples from soil gas points SG-6, SG-9, and SG-10. The samples were submitted the PTS GeoLabs of Santa Fe Springs, California for the following analyses:

- permeability to air;
- total porosity;
- air filled porosity;
- grain and bulk density;
- moisture content; and
- total pore fluid saturation.

This soil data was collected to obtain site-specific soil information to support vapor intrusion modeling discussed in Appendix F. The results of these samples are also summarized in Appendix F.

On April 19, 2005, Aquaterra performed soil gas sampling in accordance with the USEPA SOP 2042 (2/16/04). A copy of the SOP was provided in Appendix A of the Work Plan. Prior to collecting soil-gas samples, wells were purged of three times the well volume of soil gas using a GilAir 3 Air sampling pump. The air-sampling pump was calibrated at a pump rate of 3 Liters per minute (Lpm) prior to sampling the soil gas points. Photo Ionization Detector readings were collected prior to sampling and after sampling. Appendix D includes a table which summarizes purging information and data collected during purging of the soil gas points. Please note that four soil gas points (SG-1, SG-3, SG-6, and SG-7) contained water in the well, therefore soil gas samples were not obtained from these wells. However, groundwater samples were collected from these wells on April 26, 2005 and submitted for laboratory analysis of site COCs. Results of the soil gas samples are discussed in Section 6.4 of this Report.

Soil-gas samples were collected using dedicated Teflon lined polyethylene tubing and summa canisters with control valves. Summa canisters were certified pre-cleaned and evacuated by Lancaster Laboratories, Inc. prior to sample collection. A standard volume of six liters was collected in the summa canisters set up by the laboratory for a

collection time of 20 minutes in duration. Samples were placed on ice and submitted to Lancaster Laboratories, Inc. for analysis of site COCs. Soil-gas sample results are summarized in Table 8 and laboratory analytical results are attached as Appendix C.

The groundwater samples collected from the soil gas points were collected following the same procedures described in Appendix A of the Work Plan for groundwater sampling from wells and are summarized in Table 9.

Vapor monitoring of the 26th Street Sewer and Pollock Street/Packer Avenue Sewers was performed by Aquaterra on June 6, 2005. The sewers were monitored for vacuum pressure and volatile organic compound (VOC) vapors. A vacuum pressure was observed in the 26th Street Sewer; no vacuum pressure was observed in the Pollock Street/Packer Avenue Sewers. No VOC concentrations were detected in either sewer using a photoionization detector (PID).

5.7 Evaluation of Mounding and Fire Water Line

On May 9, 2005, Aquaterra initiated an investigation into the apparent groundwater mounding at monitoring wells S-116 and S-126. The test was designed to determine if the cause of the elevated groundwater elevations at these wells was attributable to a potential leak in the nearby fire protection system (fire line). To determine if a leak was causing the elevated water levels, the fire line in this area was shut down for a period of two days while groundwater elevations in nearby wells were continually monitored.

Prior to shutting down the fire line, depth to water measurements were collected for monitoring wells S-116, S-126, and S-207. A mini-troll water pressure transducer was set in monitoring well S-116 to collect water level readings every 10 minutes; water levels in wells S-126 and S-207 were monitored manually. The shut down of the fire lines occurred between May 9 and 11, 2005, and water level gauging continued until May 13, 2005. A figure illustrating the study area and the manual and electronic gauging data recorded during the test are provided in Appendix G.

The water level data in the monitoring wells was plotted against time to identify trends. The results of this plot indicate that a leak in the fire line is likely present in this area and affecting groundwater based on the observations of an immediate drop in groundwater elevations at well S-116 following shutdown of the fire line, and an immediate increase

in groundwater elevations at S-116 following start-up of the fire line. This trend analysis and additional support information is provided in Appendix G.

5.8 Surveying Activities

Re-Survey of S-126, S-116 and S-44

On May 16, 2005, Langan surveyors re-surveyed the casing and ground surface elevations at wells S-116, S-126 and S-44 in AOI 1 to verify these elevations and to determine if incorrect survey data was causing the apparent groundwater mounding at S-116 and S-126 and the apparent groundwater depression at S-44. The results of the new survey were consistent with the former values, therefore apparent mounding and/or depressions at these locations are not attributable to survey inaccuracies.

Surveying of Newly Installed Monitoring Wells, Soil Gas Monitoring Points and Soil Boring Locations

Following completion of installation activities, the newly installed monitoring wells, soil gas monitoring points, and the 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. All well elevations were determined to the nearest 0.01 foot relative to mean sea level. All survey activities were performed by a Pennsylvania-licensed surveyor and tied to the NAVD 88 datum. The new survey data for these points is presented in Table 3.

6.0 SITE CHARACTERIZATION ANALYTICAL RESULTS

The following sections discuss the analytical results of the site characterization activities performed in AOI 1.

6.1 Soil Results

The results of the soil samples collected during this investigation are provided in Table 2 and are illustrated in Figure 7. All of the soil samples were collected between zero and four feet below the ground surface and no saturated soils were observed at these depths. The results of the soil samples were screened against the non-residential MSCs for soil. Based on the results, the concentration of benzene (4,200 ug/kg) in soil

sample BH-S206-032205-2-2.5 exceeded the MSC of 500 ug/kg for benzene. No other concentrations of COCs in soil exceeded the applicable MSCs.

6.2 Groundwater Results

Fill/Alluvium and Trenton Gravel Wells

The results of the groundwater samples collected from monitoring wells in the Fill/Alluvium and Trenton Gravel formations are provided in Table 5. The results were screened against the non-residential used aquifer (TDS>2,500) groundwater MSCs; exceedances of the MSCs are illustrated in Figures 9 and 10.

General comments regarding the results of the groundwater samples are summarized in the following:

- COCs which were detected in AOI 1 groundwater which exceed the non-residential MSCs include: benzene, toluene, ethylbenzene, total xylenes, ethylene dibromide, 1,2-dichloroethane, MTBE, chrysene, naphthalene, pyrene, and total lead;
- Cumene, fluorene, and phenanthrene were not detected in AOI 1 groundwater at concentrations exceeding the non-residential MSCs; and
- Elevated concentrations of benzene (exceeding 17,500 µg/L) were detected in eight groundwater wells in Belmont Terminal and AOI 1 (MW-36, MW-37, PZ-402, TW-3, TW-5, S-204, S-226, S-215). Sunoco further evaluated these elevated benzene concentrations in groundwater as follows:
  - Well construction summaries for these monitoring wells were reviewed to determine if the well screens were submerged when gauged. The results indicated that the groundwater elevations were within the screened intervals, which is appropriate for detection of LNAPL on groundwater.
  - Sunoco contacted Lancaster Laboratories regarding any observations of sheens on the groundwater samples upon receipt. The lab reported that no sheens were noted.
  - The wells with the elevated benzene concentrations were evaluated based on their proximity to nearby known LNAPL plumes. All wells, with the exception of S-204, are located in the immediate vicinity of areas where known LNAPL exists. The specific LNAPL types in the vicinity of the wells consist of gasoline, middle distillate, and mixtures of gasoline and middle distillate. The LNAPL type at S-215 is unknown.

- Since LNAPL was not observed in these wells at the time of sampling, and since the lab did not observe sheens on the samples, Sunoco evaluated the elevated benzene concentrations using the US Environmental Protection Agency's (EPA's) Temperature-Dependent Effective Solubility Calculator which as described below.

The EPA's calculator uses the following assumptions concerning Raoult's Law:

1. mixture properties are approximated based on the average properties of the fuel; and
2. unitary activity coefficients are used.

The governing equation for the temperature-dependant effective solubility calculator is:

$$\mathbf{C_w = x_o S}$$

where,

C_w = effective solubility

x_o = mole fraction (of chemical in fuel)

S = solubility

and,

Mole Fraction (x_o) = $MF_x\ MW_o / MW_x$

where,

MF_x = mass fraction of selected chemical in fuel

MW_o = average molecular weight of fuel

(est. 105 g/mole for gasoline)

(est. 230 g/mole for diesel fuel)

MW_X = molecular weight of selected chemical

The calculator includes example data sets for various gasoline and diesel fuels. Since LNAPL in the vicinity of the wells that exhibited the elevated benzene concentrations consists of gasoline, middle distillate and mixtures of gasoline and middle distillate, Sunoco performed one calculation using a reference gasoline type (89 Octane Gasoline with Low MTBE), and performed a separate calculation using a reference diesel fuel type (Diesel 2 TPH Working Group) to estimate the effective solubility of benzene in these fuel/groundwater mixtures. The groundwater temperature entered into the calculators was 12.5 degrees Celsius which is an average for Pennsylvania. All other

variables of the equation are provided from the reference fuel. The results of the calculators are presented below:

- For gasoline, the effective solubility of benzene was calculated to be 17.5 mg/L; and,
- For diesel fuel, the effective solubility of benzene was calculated to be 0.392 mg/L.

The calculated effective solubility values for benzene for both fuels (or a mixture of the fuels) are below the concentrations of benzene detected in the subject wells. Based on these results, the elevated concentrations of benzene detected in the subject wells is potentially due to the presence of LNAPL in the sample itself or in the immediate vicinity of these wells. These wells were re-gauged in October 2005 by SECOR as part of the Refinery's semi-annual groundwater gauging program. During this event, measurable LNAPL was observed in S-215 and S-226; no LNAPL was observed in the other wells. Sunoco intends to continue monitoring these wells as part of the ongoing semi-annual gauging program.

Lower Sand Wells

The results of the groundwater samples collected from monitoring wells in the Lower Sand are provided in Table 6. The results were screened against the non-residential used aquifer (TDS>2,500) groundwater MSCs; no COCs exceeded the MSCs in the groundwater samples.

6.3 LNAPL Characterization Results

LNAPL characterization results are presented in a summary table in Table E1 of Appendix E. This table includes previous LNAPL characterization data for AOI 1 which was gathered as part of the CCR, and new data collected during the AOI 1 Site characterization activities. The LNAPL types for all wells in AOI 1 and the apparent thickness of LNAPL measured during Handex's May 2005 gauging event are illustrated in Figure 10. To focus the LNAPL evaluation, Figure 10 and Table 7 summarize the major LNAPL types and mixtures of LNAPL types.

The new LNAPL characterization data, along with the additional soil, LNAPL and groundwater data collected at select locations as described in Section 5.5, were used to model LNAPL for determining specific volume and mobility, which are summarized on Table 7 and Figure 14. LNAPL modeling procedures are described in detail in

Appendix E. Major conclusions regarding the results of the LNAPL characterization and modeling are discussed below:

- Four different types or mixtures of LNAPL were identified in AOI 1. The LNAPL types include gasoline, middle distillate, light-end feedstocks and lube oil.
- Prior to characterization of AOI 1, historic data was used to illustrate the estimated apparent extent of LNAPL in Belmont Terminal. Figure 10 illustrates the apparent extent of LNAPL in AOI 1 utilizing the new characterization data. A strong correlation is observed between the elevated dissolved concentrations of petroleum compounds in groundwater and the LNAPL distribution in Belmont Terminal (Figure 8).
- LNAPL types or mixtures identified in the No.1 and No.2 Tank Farm areas include middle distillate, gasoline, light-end feedstocks and lube oil. A correlation is observed between the elevated dissolved concentrations of petroleum compounds in groundwater and the LNAPL distribution in most areas of No.1 and No.2 Tank Farms, with the exception of the southeast corner of No.2 Tank Farm where dissolved COCs are observed and LNAPL is not present (Figure 9).

6.4 Soil Gas Results

The results of the soil gas samples collected during this investigation are provided in Table 8. The analytical reports are provided in Appendix C. The results are discussed in relation to potential vapor receptors below:

Credit Union Building

The Credit Union building located adjacent to the Belmont Terminal was identified in the CCR as a non-residential receptor for potential vapor intrusion. Eight soil gas points (SG-1 through SG-8) were installed and sampled around the perimeter of this building as described in Section 5.6 and illustrated in Figure 3. Following their installation, perched water infiltrated four of the eight soil gas points. Therefore, soil gas samples were collected from dry monitoring points and groundwater samples were collected points with perched groundwater. T he soil gas samples were screened against the non-residential indoor air quality screening values provided in Table 3 of the PADEP's Vapor Guidance Manual (PADEP, 2003). The groundwater results were screened against the non-residential USEPA-PA Default Values for Volatilization to Indoor Air screening values provided in Table 2 of the PADEP's Vapor Guidance Manual.

The results of the soil gas samples are described below:

SG-2

- Benzene was detected at a concentration of 9 mg/m^3, exceeding benzene's non-residential Indoor Air Quality screening value of 1.1 mg/m^3.

SG-8

- Toluene was detected at a concentration of 200 mg/m^3, exceeding toluene's non-residential Indoor Air Quality screening value of 120 mg/m^3.

No other concentrations of COCs in soil gas samples collected in the vicinity of the Credit Union building exceeded the non-residential Indoor Air Quality screening values. Additionally, no concentrations of COCs in groundwater samples collected in the vicinity of the Credit Union building exceeded the non-residential USEPA-PA Default Screening Values for Volatilization to Indoor Air. Based on the results of soil gas samples collected from SG-2 and SG-8, and the presence of elevated dissolved phase petroleum COCs in groundwater in the vicinity of the Credit Union building (Figure 8), the source of petroleum compound vapors in these soil gas points is likely attributable to LNAPL or high dissolved concentrations of volatile compounds in LNAPL or shallow groundwater.

Current Office Building

The current office building in the Belmont Terminal was identified in the CCR as a non-residential receptor for potential vapor intrusion. One soil gas point (SG-9) was installed and sampled along the perimeter of this building as described in Section 5.6 and illustrated in Figure 3. No concentrations of COCs in the soil gas sample collected from SG-9 exceeded the non-residential Indoor Air Quality screening values.

Former Office Building/Maintenance Building/Supply Storage

The former office building/maintenance building/supply storage building in the Belmont Terminal was identified in the CCR as a non-residential receptor for potential vapor intrusion. This building is no longer used as an office building, but rather maintenance, supply and storage purposes. Two soil gas points (SG-10 and SG-11) were installed and sampled along the perimeter of this building as described in Section 5.6 and illustrated in Figure 3. The results of the soil gas samples are described on the following page:

SG-10

- Benzene was detected at a concentration of 22,000 mg/m^3, exceeding benzene's non-residential Indoor Air Quality screening value of 1.1 mg/m^3;
- 1,2-dichloroethane was detected at a concentration of 540 mg/m^3, exceeding 1,2-dichloroethane's non-residential Indoor Air Quality screening value of 0.31 mg/m^3;
- Toluene was detected at a concentration of 1,000 mg/m^3, exceeding toluene's non-residential Indoor Air Quality screening value of 120 mg/m^3; and
- Total xylenes were detected at a concentration of 65 mg/m^3, exceeding total xylenes' non-residential Indoor Air Quality screening value of 30 mg/m^3.

SG-11

- Benzene was detected at a concentration of 85,000 mg/m^3, exceeding benzene's non-residential Indoor Air Quality screening value of 1.1 mg/m^3;
- 1,2-dichloroethane was detected at a concentration of 2,200 mg/m^3, exceeding 1,2-dichloroethane's non-residential Indoor Air Quality screening value of 0.31 mg/m^3;
- Toluene was detected at a concentration of 2,600 mg/m^3, exceeding toluene's non-residential Indoor Air Quality screening value of 120 mg/m^3; and
- Total xylenes were detected at a concentration of 540 mg/m^3, exceeding total xylenes' non-residential Indoor Air Quality screening value of 30 mg/m^3.

No other concentrations of COCs in soil gas samples collected in the vicinity of the former office building/maintenance building/supply storage building exceeded the non-residential Indoor Air Quality screening values. Based on the results of soil gas samples collected from SG-10 and SG-11, and the presence of LNAPL in the vicinity of this facility (Figure 10), the source of petroleum compound vapors in these soil gas points is likely attributable to LNAPL or high dissolved concentrations of volatile compounds in LNAPL or shallow groundwater.

Since some COCs in soil gas samples SG-2, SG-8, SG-10 and SG-11 exceeded the non-residential Indoor Air Quality screening values, these concentrations were modeled using the Johnson and Ettinger (J&E) model to further characterize the potential vapor pathways at these locations. This modeling is discussed in Section 8.4 and Appendix F of this Report.

7.0 REMEDIAL SYSTEM UPDATE

7.1 Vapor Recovery and Treatment Systems

As shown in Figure 10, the Shunk Street Sewer traverses the Belmont Terminal area of AOI 1, the 26th Street Sewer parallels the eastern boundary of AOI 1, and a portion of the Pollock Street Sewer traverses the southern portion of AOI 1. Vapors from the 26th Street Sewer, Packer Avenue Sewer, and Shunk Street Sewer are currently processed by two Sewer Odor Control Systems (Packer Avenue Sewer, 26th Street Sewer and the Shunk Street Sewer Systems).

Monitoring of the Point Breeze Sewer Odor Control System with respect to the 26th Street Sewer and Pollock Street/Packer Avenue Sewers was performed by Aquaterra on June 6, 2005. The sewers were monitored for vacuum influence from the Odor Control System and VOC vapors by PID. Vacuum influence was observed in the 26th Street Sewer and the Packer Avenue Sewer; no vacuum influence was observed in the Pollock Street Sewer. No VOC concentrations were detected in any sewer.

Performance monitoring of the Sewer Odor Control Systems is performed on a monthly basis as part of the systems' routine operation and maintenance. Results of the performance monitoring are included in the Quarterly Reports which are prepared by Sunoco and submitted to PADEP and US EPA.

7.2 Total Fluids Recovery Systems

The current groundwater and LNAPL remediation program in AOI 1 consists of groundwater depression with separate LNAPL recovery from wells in Belmont Terminal, and total fluids pumping from the wells along 26th Street. Eight active recovery wells are located in Belmont Terminal; two wells (RW-6 and RW-7) in Belmont Terminal are inactive (Table 3).

The total fluid recovery system along the 26th Street border of AOI 1 was recently expanded in following manner:

- An additional 20 recovery wells were installed along 26th Street on the Sunoco property for perimeter control. These wells enhance the existing total fluids extraction system and became operational in May 2005.
- An additional six recovery wells will be installed across 26th Street on the CSX property

pending access from CSX. The startup of these wells is expected to occur in 2006. The startup will be documented in the Refinery's Quarterly Reports that are prepared by Sunoco and submitted to PADEP and US EPA.

The newly operational total fluids recovery wells along the 26th Street border and their approximate radii of influence and zone of capture are shown in Figure 12.

7.3 Proposed Oxygen Diffusion System

A groundwater oxygen diffusion test will be performed in the vicinity of S-50 to evaluate the effectiveness of oxygen diffusion as a barrier to dissolved hydrocarbon migration. A Work Plan for this test will be submitted to PADEP under separate cover by Sunoco in August 2005. This Work Plan will include a description of the sampling activities at S-43, S-50 and other nearby wells.

8.0 FATE AND TRANSPORT ANALYSIS

The following sections describe fate and transport modeling activities performed as part of AOI 1 Site characterization.

8.1 Soil

No fate and transport modeling was completed for the soil analytical results.

8.2 Groundwater

Fate and transport calculations were completed for groundwater in AOI 1 to support refinement of the Site Conceptual Model and the Exposure Assessment. Appendix H discusses the details of the fate and transport modeling activities in AOI 1. The results of the modeling are discussed below:

- Groundwater in the zone of capture of existing remedial systems in AOI 1 (Figure 13) was modeled using a four month (120 day) simulation period. This four month period is representative of the routine shutdown period of these systems (December through March of each year). Based on the results of four month simulations, that maximum simulated distance that a COC will migrate

offsite in shallow and intermediate groundwater is approximately 25 feet during the shutdown period (MTBE in Well S-182). This simulation is illustrated in Figure 13. To further evaluate the groundwater flow during this four month shutdown period, Sunoco performed additional groundwater transport modeling. This modeling is discussed in detail in Appendix H of this report.

- Groundwater not currently being captured by the existing remedial systems in AOI 1 was modeled using a 30 year simulation period. Based on the results of 30 year simulations, dissolved phase COCs have the potential to migrate offsite in the areas identified in Figure 13. The maximum offsite distance for this potential migration of dissolved COCs in fill/alluvium and Trenton Gravel wells outside of the zone of capture is approximately 950 feet (based on Benzene in Well S-226). The simulated off-site distances of groundwater from these wells are presented in Appendix H.
- No fate and transport modeling was completed for the Deep groundwater since no COCs were detected in AOI 1 deep wells at concentrations which exceed the non-residential groundwater MSCs.

8.3 LNAPL

As discussed in Section 5.5 of this report, additional LNAPL data was collected to further refine LNAPL type, occurrence, volume and mobility throughout AOI 1, and to support LNAPL modeling activities discussed in Appendix E.

For the LNAPL modeling at AOI 1, 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 and mobility. Site-specific LNAPL data were collected as described in Section 5.5 of this report and used as input parameters for modeling where applicable. These parameters, the RETC model, and the API model were utilized to estimate the specific volume and mobility of LNAPL at AOI 1 as discussed in Appendix E. The calculated LNAPL specific volume and seepage velocity for all wells included in the modeling is presented in Table 7. The results of this modeling refined the LNAPL volumes and mobilities that were presented in the CCR. These data indicated that LNAPL with the greatest mobility is located in areas where fluids are captured by existing remedial systems (Figures 13 and 15).

8.4 Soil Gas

As discussed in Section 6.4 of this report, some COCs in soil gas exceeded their respective non-residential Indoor Air Quality screening MSCs at soil gas monitoring points that were installed adjacent to the Credit Union building and the former office building/maintenance building/supply storage building in Belmont Terminal. To further evaluate the potential for vapor intrusion into indoor air at these receptors, the Johnson and Ettinger Model (J&E) was used to predict the indoor air concentrations at these receptors given site-specific values. The results of the modeling indicated that none of the detected concentrations will exceed the calculated site-specific levels. Appendix F discusses the details of the J&E modeling and derivation of the site-specific vapor concentrations.

9.0 SITE CONCEPTUAL MODEL

A preliminary site conceptual model (SCM) for the Refinery was presented in the CCR. Data collected from the Site characterization activities performed in AOI 1 were used to refine the SCM for this area. The SCM for AOI 1 is described below:

9.1 Description and Site Use

AOI 1 includes Belmont Terminal, No.1 Tank Farm, and No.2 Tank Farm (Figures1 and 2). AOI 1 is bordered by Passyunk Avenue to the North, 26th Street to the East, Hartranft Street to the South, and Process area 869/employee parking area (AOI 2) to the West (Figure 2) and encompasses approximately 100 acres. Currently, AOI 1 is comprised of primarily light-end hydrocarbon Above Ground Tankage (No. 1 and 2 Tank Farms) and loading racks (the Belmont Terminal). The Belmont Terminal area is utilized for blending gasoline and additives as well as product distribution.

9.2 Geology and Hydrogeology

The following summarizes the relevant information concerning geology and hydrogeology in AOI 1:

- The Fill/Alluvium, Trenton Gravel, Middle/Lower Clay, and the Lower Sand all exist beneath AOI 1;
- Groundwater flow in the Fill/Alluvium and Trenton Gravel zone is generally towards

the southeast in AOI 1 as shown in Figure 6; Groundwater flow in the Belmont Terminal and the northern portion of No. 1 Tank farm areas is influenced by the active fluids recovery systems in Belmont Terminal and along the 26th Street Border (Figure 12); and

- Groundwater flow in the Lower Sand (Deep) zone is towards the south-southeast as indicated by historical measurements.

9.3 Compounds of Concern

The following summarizes the relevant information concerning COCs in AOI 1:

- The COC for soil is benzene.
- The COCs for groundwater include benzene, toluene, ethylbenzene, total xylenes, ethylene dibromide, 1,2-dichloroethane, MTBE, chrysene, naphthalene, pyrene, and total lead.
- The COCs for soil gas include benzene, 1,2-dichloroethane, toluene, total xylenes.

9.4 LNAPL Distribution and LNAPL Mobility

The following summarizes the relevant information concerning LNAPL distribution in AOI 1:

- Four LNAPL types or mixtures have been identified in AOI 1 (Gasoline, Lube Oil, Middle Distillate, and Light-end Feedstocks). The apparent thickness and specific volumes of each LNAPL plume in AOI 1 are provided in Figure 10 and Table 7, respectively.
- LNAPL in AOI 1 with the greatest potential mobility (Figure 14) is located in areas where fluids are captured by existing remedial systems.

9.5 Fate and Transport of COCs

The following summarizes the relevant information concerning the results of the fate and transport of the dissolved phase COCs in groundwater in AOI 1:

- Dissolved phase COCs extend, or have the potential to extend off-site along 26th Street in the vicinity of wells S-44, S-43, S-51, S-98, S-99, S-194, S-193, and S-101 as illustrated in Figure 13.
- No fate and transport modeling was completed for the deep groundwater unit since

no COCs were detected in groundwater from deep wells at concentrations exceeding the non-residential MSCs.

9.6 Potential Migration Pathways and Site Receptors

The following summarizes the relevant information concerning the potential pathways and site receptors for AOI 1. These pathways and receptors are shown on Figure 11.

- Figure 16 of the CCR illustrated general areas of the Refinery that are covered with paved surfaces. Throughout the Site characterization activities for AOI 1, the paved surface coverage was refined to increase accuracy. The updated paved surface coverage in AOI 1 is provided as Figure A3 in Attachment A. A summary of the updated paved surface features is provided below:
  - A grass strip was identified between the northern fence and Frontage Road;
  - Paved areas were identified around the blender and north of Tanks 27, 28 and 29; and
  - The road surrounding the propane tanks was identified to be gravel.
- AOI 1 and the Belmont Terminal are located within a fenced area, with 24 hour guards to prevent unauthorized access. Direct contact to site soils is governed by on-site procedures and PPE requirements.
- No human health groundwater receptors exist for the Refinery; the only potential receptor for groundwater is discharge to surface water via the Pollock Street sewer and the Shunk Street sewer.
- The Refinery operates under OSHA regulations with periodic air monitoring. The only areas in AOI 1 which are not regulated by OSHA (Credit Union, Office Building and Former Office Building/Maintenance Building/Supply Storage Building) were evaluated for potential vapor intrusion into indoor air under a non-residential scenario.
- LNAPL and dissolved COCs in groundwater extend, or have the potential to extend off-site along 26th Street in the vicinity of wells S-89 and S-50.

10.0 HUMAN HEALTH EXPOSURE ASSESSMENT/RISK ASSESSMENT

Based on the current and future intended non-residential site use, an exposure assessment was conducted for all compounds which exceeded the non-residential statewide health standards. Potential human health exposures for the Refinery are for an industrial worker scenario. Potential human health receptors for AOI 1 include direct contact with soils, groundwater, LNAPL and potential indoor air vapor inhalation. Direct contact issues with soil, groundwater and LNAPL for the industrial scenario are addressed through Sunoco's established excavation procedures, PPE requirements and soil handling procedures described in Appendix K of the CCR. Since direct contact to surface soils could occur outside of excavation activities, shallow soil samples were collected at unpaved areas in AOI 1 for evaluation of this potential exposure pathway. Calculated risk-based standards were calculated for any identified potentially complete exposure pathway.

The following table serves to summarize potential pathways that can be reasonably expected under the current and intended future non-residential use for the site. The table lists potentially contaminated media, potential receptors for these media, and a summary of whether any potential pathways exist at the site from the media to these receptors. A more detailed evaluation of each of these pathways is presented in the following sections.

Potential for Complete Exposure Pathways

Contaminated Media	Residents	Workers	DayCare	Construction	Trespassers	Recreation	Food
Groundwater	Na	No(1)	Na	No	No	Na	Na
Air (indoor)	Na	No	Na	No	No	Na	Na
Soil <2 feet b.g.	Na	Yes	Na	No	No	Na	Na
Surface Water	Na	Na	Na	Na	Na	Na	Na
Sediment	Na	Na	Na	Na	Na	Na	Na
LNAPL	Na	No(1)	Na	No	Na	Na	Na

Notes:

(1) No complete groundwater or LNAPL pathways exist for workers that are not addressed through on-site procedures and PPE.

(2) No complete pathway for site soil > 2 feet deep due to on-site procedures and PPE.

Na - Not applicable

No - No potential complete exposure pathway

Yes – Potential complete exposure pathway

10.1 Surface Water /Sediment

No surface water/sediment are located in AOI 1. Groundwater in AOI 1 does not interface with surface water/sediment, therefore there are no potential surface water receptors and/or exposure pathways in AOI 1.

10.2 Groundwater

Benzene, toluene, ethylbenzene, total xylenes, ethylene dibromide, 1,2-dichloroethane, MTBE, chrysene, naphthalene, pyrene, and total lead have been detected in exceedance of the non-residential MSCs. Previous investigations (URS, 2002) verified that no wells within 1.5 miles of the Refinery are used for drinking water or agricultural use. There are no complete direct contact exposure pathways for groundwater within AOI 1 because of on-site procedures and required PPE. Based on fate and transport calculations, the plume has the potential to extend offsite from the southeastern portion of AOI 1. There is no potential direct contact exposure to impacted groundwater due to the depth of groundwater moving off-site, which is greater than 15 feet below grade. Sunoco evaluated the vapor intrusion pathway off-site in the southeastern portion of AOI 1 using the fate and transport simulations for wells in this area. Offsite simulated dissolved concentrations were screened against the residential USEPA-PA Default Screening Values for Volatilization to Indoor Air. Based on the results of this screening, there is no significant vapor pathway from the potential off-site groundwater plume within 100 feet of the closest potential off-site receptor, as shown on Figure 11.

10.3 Surficial Soils (0-2 Feet Below Grade)

10.3.1 Soil to Groundwater

One concentration of benzene (4,200 ug/kg) in soil sample BH-S206-032205-2-2.5 exceeded the PADEP non-residential soil-to-groundwater MSC. Since groundwater in this area is being addressed by a remedial system, this soil to groundwater pathway is being addressed through the groundwater pathway discussed in Section 10.2.

10.3.2 Direct Contact Exposure

One concentration of benzene (4,200 ug/kg) in soil sample BH-S206-032205-2-2.5 exceeded the PADEP non-residential direct contact MSC. Since this

represented a potentially complete exposure pathway, a calculated risk-based standard was calculated for this location. These calculations, which are summarized in Appendix I, support that the detected concentration is below the calculated risk-based standard for benzene.

10.4 Vapor Inhalation

Based on the results of the soil gas sampling, several compounds exceeded the non-residential screening criteria. Based on the J&E modeling, however, none of these pathways were determined to be above acceptable risk-based concentrations.

Potential off-site human health receptor considerations for AOI 1 include off-site migration of vapors. Vapors from the Packer Avenue, 26th Street Sewer and Shunk Street Sewer are currently treated by two Sewer Odor Control Systems (Packer Avenue/26th Street System and Shunk Street System), therefore there are no off-site human receptors to vapor from the sewers.

10.5 LNAPL

There are no complete direct contact exposure pathways for LNAPL within AOI 1 because of on-site procedures and required PPE. There are no complete direct contact pathways for LNAPL off-site due to the depth to potential LNAPL, which is greater than 15 feet below grade, and the operating remediation systems.

11.0 ECOLOGICAL ASSESSMENT

The majority of AOI 1 is paved or covered with gravel (Figure A3 in Appendix A) and the unpaved portions of AOI 1 are not likely to serve as a breeding area, migratory stopover, or primary habitat for wildlife. In 2002, a survey of endangered, threatened and special concern wildlife was conducted by reviewing maps provided at the Pennsylvania Department of Conservation and Natural Resources. No endangered, threatened and special concern wildlife were identified using these maps or during historical investigations. Based on this information, there are no ecological receptors of concern for AOI 1 and no related assessment was necessary.

12.0 CONCLUSIONS AND RECOMMENDATIONS

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

- Soil to groundwater issues are addressed through active remedial actions or lack of completed pathways. Direct contact issues are addressed through institutional controls, PPE and calculation of site specific risk levels.
- Groundwater and LNAPL in the majority of the AOI is effectively addressed by the ongoing remedial activities. Potential offsite impacts/exposure pathways have been identified in the southeastern portion of AOI 1 (S-43 and S-50) and the northwestern portion of the Belmont Terminal. Additional remedial activities are proposed in the vicinity of S-43 and S-50 that will address potential off site migration. Subsequent to remedial feasibility testing, a remedy will be proposed in August 2005 for control of potential off-site migration of dissolved phase COCs from the southeastern portion of AOI 1.
- A remediation plan will be developed to address the LNAPL plume in the northwest portion of the Belmont Terminal.
- Potential off site vapor migration is effectively addressed through two separate sewer odor control systems.
- Potential indoor air exposure pathways have been eliminated through soil gas sampling and demonstration of lack of complete pathways through use of the Johnson and Ettinger model.

13.0 REFERENCES

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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.

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SECOR, 2003, 26th Street Vicinity, Point Breeze Processing Area, Remedial Investigation Report, Philadelphia Refinery, Philadelphia, Pennsylvania.

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Paulachok, G.N., Geohydrology and Ground-Water Resources of Philadelphia, Pennsylvania, U.S.G.S Water-Supply Paper 2346, 1991.

US EPA On-Line Tools for Site Assessment Calculation, Temperature-Dependent Effective Solubility, http://www.epa.gov/athens/learn2model/part-two/onsite/es-temperature.htm.

TABLES

Table 1
Compounds of Concern
AOI 1 Site Chracterization 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.

Table 1 (continued)
Compounds of Concern
AOI 1 Site Characterization 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 1 (continued)
Compounds of Concern
AOI 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

SOIL GAS	
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

Notes:
1. Constituents are compounds listed in the soil and groundwater COC lists which are also included in the list for US EPA Method TO-15.

Table 1 (continued)
Compounds of Concern
AOI 1 Site Chracterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

GROUNDWATER		Aqueous Solubility (ug/L)
METALS	**CAS No.**	
Lead (dissolved)	7439-92-1	na
VOLATILE ORGANIC COMPOUNDS	**CAS No.**	
1,2-dichloroethane	107-06-2	
Benzene	71-43-2	1780500
Cumene	98-82-8	50000
Ethylbenzene	100-41-4	161000
Ethylene dibromide	106-93-4	4150000
Methyl tertiary butyl ether	1634-04-4	45000000
Toluene	108-88-3	532400
Xylenes (total)	1330-20-7	175000
SEMI-VOLATILE ORGANIC COMPOUNDS	**CAS No.**	
Chrysene	218-01-9	1.9
Fluorene	86-73-7	1900
Naphthalene	91-20-3	30000
Phenanthrene	85-01-8	1100
Pyrene	129-00-0	132

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
Summary of Soil Analytical Results
Sunoco Philadelphia Refinery - AOI 1
Philadelphia, Pennsylvania

	CAS No	PADEP Non-Residential Soil MSCs		Sample ID	BH-S198-030805-1.5-2			BH-S205-031005-1.5-2			BH-S206-032205-2-2.5			BH-S207-030805-3-3.5			BH-S208-030805-1.5-2			BH-S210-032505-3-3.5			BH-S211-031005-1.5-2			BH-S212-031005-1-1.5			BH-S213-031005-1.5-2			BH-S214-030905-1-1.5		
				Sample Date	3/8/2005			3/10/2005			3/22/2005			3/8/2005			3/8/2005			3/25/2005			3/10/2005			3/10/2005			3/10/2005			3/9/2005		
				Sample Matrix	Soil			Soil			Soil			Soil			Soil			Soil			Soil			Soil			Soil			Soil		
				Start Depth (ft)	1.5			1.5			2.0			3.0			1.5			3.0			1.5			1.0			1.5			1.0		
				End Depth (ft)	2.0			2.0			2.5			3.5			2.0			3.5			2.0			1.5			2.0			1.5		
		0 - 2' Dry	2 - 15' Dry	Unit	ug/kg			ug/kg			ug/kg			ug/kg			ug/kg			ug/kg			ug/kg			ug/kg			ug/kg			ug/kg		
Volatile Organic Compounds				Unit	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL
Ethylene dibromide (EDB)	106-93-4	5	5	ug/kg	ND	U	160	ND	U	3	ND	U	330	ND	U	3	ND	U	160	ND	U	5	ND	U	4	ND	U	3	ND	U	150	ND	U	3
1,2-Dichloroethane	107-06-2	500	500	ug/kg	ND	U	160	ND	U	3	ND	U	330	ND	U	3	ND	U	160	ND	U	5	ND	U	4	ND	U	3	ND	U	150	ND	U	3
Benzene	71-43-2	500	500	ug/kg	ND	U	160	ND	U	3	4200		330	ND	U	3	170		160	23		5	ND	U	4	ND	U	3	ND	U	150	ND	U	3
Ethylbenzene	100-41-4	70000	70000	ug/kg	ND	U	160	ND	U	3	1700		330	ND	U	3	270		160	ND	U	5	ND	U	4	ND	U	3	ND	U	150	ND	U	3
Cumene	98-82-8	1600000	1600000	ug/kg	ND	U	160	ND	U	3	24000		3300	ND	U	3	450		160	ND	U	5	ND	U	4	ND	U	3	ND	U	150	ND	U	3
Methyl Tertiary Butyl Ether	1634-04-4	2000	2000	ug/kg	ND	U	160	ND	U	3	ND	U	330	ND	U	3	ND	U	160	ND	U	5	ND	U	4	ND	U	3	ND	U	150	ND	U	3
Toluene	108-88-3	100000	100000	ug/kg	ND	U	160	ND	U	3	1800		330	ND	U	3	ND	U	160	ND	U	5	ND	U	4	ND	U	3	ND	U	150	ND	U	3
Xylene (Total)	1330-20-7	1000000	1000000	ug/kg	ND	U	160	ND	U	3	3500		330	ND	U	3	240		160	ND	U	5	ND	U	4	ND	U	3	ND	U	150	ND	U	3
Semi-Volatile Organic Compounds																																			
Chrysene	218-01-9	230000	230000	ug/kg	ND	U	390	ND	U	400	ND	U	8500	ND	U	420	ND	U	400	ND	U	400	ND	U	440	ND	U	380	ND	U	390	ND	U	400
Anthracene	120-12-7	350000	350000	ug/kg	ND	U	390	ND	U	400	ND	U	8500	ND	U	420	ND	U	400	ND	U	400	ND	U	440	ND	U	380	590		390	ND	U	400
Benzo(a)anthracene	56-55-3	110000	320000	ug/kg	ND	U	390	ND	U	400	ND	U	8500	ND	U	420	ND	U	400	ND	U	400	ND	U	440	ND	U	380	ND	U	390	ND	U	400
Benzo(a)pyrene	50-32-8	11000	46000	ug/kg	ND	U	390	ND	U	400	ND	U	8500	ND	U	420	ND	U	400	410		400	ND	U	440	ND	U	380	ND	U	390	ND	U	400
Benzo(b)fluoranthene	205-99-2	110000	170000	ug/kg	ND	U	390	ND	U	400	ND	U	8500	ND	U	420	ND	U	400	430		400	ND	U	440	ND	U	380	ND	U	390	ND	U	400
Benzo(g,h,i)perylene	191-24-2	180000	180000	ug/kg	ND	U	390	ND	U	400	ND	U	8500	ND	U	420	ND	U	400	ND	U	400	ND	U	440	ND	U	380	ND	U	390	ND	U	400
Fluorene	86-73-7	3800000	3800000	ug/kg	ND	U	390	ND	U	400	22000		8500	ND	U	420	ND	U	400	ND	U	400	ND	U	440	ND	U	380	720		390	ND	U	400
Naphthalene	91-20-3	25000	25000	ug/kg	ND	U	390	ND	U	400	ND	U	8500	ND	U	420	ND	U	400	ND	U	400	ND	U	440	ND	U	380	ND	U	390	ND	U	400
Phenanthrene	85-01-8	10000000	10000000	ug/kg	ND	U	390	ND	U	400	46000		8500	ND	U	420	ND	U	400	ND	U	400	ND	U	440	ND	U	380	1300		390	ND	U	400
Pyrene	129-00-0	2200000	2200000	ug/kg	ND	U	390	ND	U	400	ND	U	8500	ND	U	420	ND	U	400	420		400	ND	U	440	ND	U	380	ND	U	390	ND	U	400
Metals																																			
Lead (Total)	7439-92-1	450000	450000	ug/kg	176000		2270	8460		2380	184000		2480	41600		2390	28900		2400	37500		2400	45000		2560	212000		2300	127000		2300	18600		2390

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/kg - Microgram per kilogram
MSC - PADEP's Medium Specific Concentration for Soil
RL - Reporting Limit
(1) All Soil Samples Collected and Analyzed were Unsaturated
ND - Not Detected

Qualifiers:
Q - Qualifier
U - The Analyte Was Analyzed But Not Detected

Exceedance Summary:
10 - Reporting Limit Exceeds the PADEP Non-Residential Soil MSC
10 - Compound Exceeds the PADEP Non-Residential Soil MSC

Table 3
Well Summary
Current Conditions Report
Sunoco Philadelphia Refinery and Belmont Terminal

Well ID	Former Well ID[2]	AOI #	Well Type[3]	Well Classification (Shallow, Intermediate, Deep)	Soil Boring Log Available (Y/N)	Construction Detail Available (Y/N)	Date of Well Completion	Well Construction Details[1]								References
								Well Completion Depth (ft. bgs)	Well Diameter (in)	Casing Elevation (ft. msl) (NGVD 29)	Ground Surface Elevation[4] (ft.) (NAVD88)	Top of Screen Elevation (ft) (NAVD88)	Bottom of Screen Elevation (ft) (NAVD88)	Depth to Screen (ft. bgs)	Screen Length (ft.)	
AOI - 1 (Belmont Terminal/#1 Tank Farm/#2 Tank Farm)																
RW-21	MW-21	1	Recovery Well - Active	Shallow	--	--	--	--	--	--	--	--	--	--	--	Handex Boring log
RW-22	MW-22	1	Recovery Well -Active	Shallow	Y	Y	12/21/00	42.19	8	--	--	--	--	15.47	25.8	Handex Boring log
RW-23	MW-23	1	Recovery Well -Active	Intermediate	Y	Y	12/21/00	42.19	8	--	--	--	--	15.47	25.8	Handex Boring log
RW-24	MW-24	1	Recovery Well - Active	Intermediate	Y	Y	12/14/00	41.44	8	--	--	--	--	15.5	25.8	Handex Boring log
RW-25	MW-25	1	Recovery Well -Active	Intermediate	Y	Y	12/13/00	42.5	8	--	--	--	--	15.5	25.8	Handex Boring log
MW-26	--	1	Monitoring Well	Shallow	Y	Y	12/12/00	29.4	4	--	27.09	17.69	-2.31	9.4	20	Handex Boring log
MW-27	--	1	Monitoring Well	Shallow	Y	Y	12/12/00	29.5	4	--	29.05	19.55	-0.45	9.5	20	Handex Boring log
MW-28	--	1	Monitoring Well	Intermediate	Y	Y	12/13/00	30	4	--	29.26	19.26	-0.74	10	20	Handex Boring log
MW-29	--	1	Monitoring Well	Intermediate	Y	Y	12/11/00	30	4	--	29.5	19.5	-0.5	10	20	Handex Boring log
MW-31	--	1	Monitoring Well	Shallow	Y	Y	12/13/00	29.5	4	--	30.98	21.48	1.48	9.5	20	Handex Boring log
MW-32	--	1	Monitoring Well	Intermediate	Y	Y	12/12/00	29.9	4	--	29.59	19.59	-0.41	10	20	Handex Boring log
MW-33	--	1	Monitoring Well	Shallow	Y	Y	12/12/00	28.3	4	--	30.4	22.3	2.3	8.1	20	Handex Boring log
MW-34	--	1	Monitoring Well	Intermediate	Y	Y	12/15/00	40	4	--	27.99	7.99	-12.01	20	20	Handex Boring log
MW-35	--	1	Monitoring Well	Intermediate	Y	Y	3/31/05	35	4	--	30.84	10.84	-4.6	20	15	Aquaterra Boring log
MW-36	--	1	Monitoring Well	Intermediate	Y	Y	4/6/05	35	4	--	32.75	12.75	-2.25	20	15	Aquaterra Boring log
MW-37	--	1	Monitoring Well	Intermediate	Y	Y	4/8/05	35	4	--	32.55	12.55	-2.25	20	15	Aquaterra Boring log
MW-38	--	1	Monitoring Well	Intermediate	Y	Y	4/6/05	35	4	--	27.98	7.98	-7.02	20	15	Aquaterra Boring log
MW-39	--	1	Monitoring Well	Intermediate	Y	Y	4/5/08	35	4	--	27.94	7.94	-7.06	20	15	Aquaterra Boring log
MW-40	--	1	Monitoring Well	Intermediate	Y	Y	4/5/05	35	4	--	28.05	8.05	-6.95	20	15	Aquaterra Boring log
MW-41	--	1	Monitoring Well	Intermediate	Y	Y	3/30/05	35	4	--	27.66	7.66	-7.34	20	15	Aquaterra Boring log
MW-42	--	1	Monitoring Well	Intermediate	Y	Y	3/30/05	35	4	--	27.27	7.27	-7.73	20	15	Aquaterra Boring log
MW-43	--	1	Monitoring Well	Intermediate	Y	Y	4/19/08	35	4	--	30.98	10.98	-4.02	20	15	Aquaterra Boring log
MW-44	--	1	Monitoring Well	Intermediate	Y	Y	4/1/05	35	4	--	29.82	9.82	-5.18	20	15	Aquaterra Boring log
OW-12	--	1	Monitoring Well	Shallow	--	--	--	--	--	--	30.47	--	--	--	--	
OW-13	--	1	Monitoring Well	Shallow	--	--	--	--	--	--	32.39	--	--	--	--	
OW-14	--	1	Monitoring Well	Shallow	--	--	--	--	--	--	32.41	--	--	--	--	
OW-16	--	1	Monitoring Well	Shallow	--	--	--	--	--	--	31.64	--	--	--	--	
OW-17	--	1	Monitoring Well	Shallow	--	--	--	--	--	--	30.3	--	--	--	--	
OW-18	--	1	Monitoring Well	Intermediate	Y	Y	5/28/98	30	4	--	30.75	20.75	0.75	10	20	1998 Boring Log
OW-19	--	1	Monitoring Well	Intermediate	Y	Y	5/28/98	30	4	--	31.22	21.22	1.22	10	20	1998 Boring Log
OW-2	--	1	Monitoring Well	Shallow	--	--	--	--	--	--	32.16	--	--	--	--	1998 Boring Log
OW-20	--	1	Monitoring Well	Shallow	Y	Y	5/28/98	30	--	--	32.43	22.43	2.43	10	20	1998 Boring Log
PZ-400	--	1	Piezometer	--	--	--	--	--	--	--	30.2	--	--	--	--	Handex, 2004b
PZ-401	--	1	Piezometer	--	--	--	--	--	--	--	25.89	--	--	--	--	Handex, 2004b
PZ-402	--	1	Piezometer	--	--	--	--	--	--	--	25.38	--	--	--	--	Handex, 2004b
PZ-403	--	1	Piezometer	--	--	--	--	--	--	--	28.27	--	--	--	--	Handex, 2004b
PZ-404	--	1	Piezometer	--	--	--	--	--	--	--	28.02	--	--	--	--	Handex, 2004b
RW-1[5]	--	1	Recovery Well - Active	Intermediate	Y	Y	5/26/98	50	4	--	30.58	10.58	-19.42	20	30	1998 Boring Log
RW-15	--	1	Recovery Well -Active	--	--	--	--	--	--	--	30.86	--	--	--	--	--
RW-4[5]	--	1	Recovery Well - Active	Intermediate	Y	Y	5/27/98	50	4	--	31.37	11.37	-18.63	20	30	1998 Boring Log
RW-400	PH-14	1	Recovery Well -Active	Intermediate	Y	Y	5/26/94	39	6	--	27.45	5.45	-9.55	22	15	Secor, 2003
RW-401	--	1	Recovery Well - Inactive	--	--	--	9/9/93	50	6	--	24.51	9.51	-25.49	15	35	Secor, 2003
RW-402	PH-21	1	Recovery Well -Active	Intermediate	Y	Y	5/24/94	35	6	--	23.59	0.59	-9.41	23	10	Secor, 2003
RW-403	--	1	Recovery Well -Active	--	--	--	7/1/94	50	6	--	23.61	8.61	-26.39	15	35	Secor, 2003
RW-404	PH-13	1	Recovery Well -Active	Intermediate	Y	Y	8/25/94	34	6	--	23.19	1.19	-8.81	22	10	Secor, 2003
RW-405	PH-20	1	Recovery Well -Active	Intermediate	Y	Y	5/20/94	37.5	6	--	24	-1.5	-11.5	25.5	10	Secor, 2003
RW-406	--	1	Recovery Well -Active	Intermediate	Y	Y	11/20/00	36	8	--	28.59	12.59	-7.41	16	20	Secor, 2003
RW-6	--	1	Recovery Well - Inactive	--	--	--	--	--	--	--	5.29	--	--	--	--	-
RW-7[5]	--	1	Recovery Well - Inactive	Intermediate	Y	Y	5/28/98	50	4	--	29.07	9.07	-20.93	20	30	1998 Boring Log

NOTES:

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

Abandoned or damaged wells.

AOI - Area of Interest

ft. - feet

bgs - below ground surface

in. - inches

msl - elevation relative to mean sea level

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4. Elevation datum for wells within AOI 1 were obtained from J.M. Stewart Surveying, Inc., dated May 21, 2003, and Langan Survey Data May 2005. Survey is based on the Horizontal Datum: Pennsylvania State Plane Coordinates NAD 83 / South, Zone, Vertical Datum: NAVD 88
5. Well classifications for RW-1, RW-2, RW-4, and RW-7 to be verified

Table 3
Well Summary
Current Conditions Report
Sunoco Philadelphia Refinery and Belmont Terminal

Well ID	Former Well ID[2]	AOI #	Well Type[3]	Well Classification (Shallow, Intermediate, Deep)	Soil Boring Log Available (Y/N)	Construction Detail Available (Y/N)	Date of Well Completion	Well Construction Details[1]								References
								Well Completion Depth (ft. bgs)	Well Diameter (in)	Casing Elevation (ft. msl) (NGVD 29)	Ground Surface Elevation[4] (ft.) (NAVD88)	Top of Screen Elevation (ft) (NAVD88)	Bottom of Screen Elevation (ft) (NAVD88)	Depth to Screen (ft. bgs)	Screen Length (ft.)	
S-116	MW-A	1	Monitoring Well	Shallow	Y	Y	8/13/02	30	4	–	26.69	16.69	-3.31	10	20	Secor, 2003
S-117	MW-B	1	Monitoring Well	Shallow	Y	Y	8/13/02	28	4	–	18.6	10.6	-9.4	8	20	Secor, 2003
S-118	MW-C	1	Monitoring Well	Shallow	Y	Y	8/14/02	29.5	4	–	18.34	8.34	-11.16	10	19.5	Secor, 2003
S-125	MW-K	1	Monitoring Well	Shallow	Y	Y	8/26/02	30	4	–	23.84	13.84	-6.16	10	20	Secor, 2003
S-126	MW-L	1	Monitoring Well	Shallow	Y	Y	9/18/02	22	4	–	26.41	24.41	4.41	2	20	Secor, 2003
S-127	MW-M	1	Monitoring Well	Shallow	Y	Y	9/19/02	30	4	–	15.38	6.38	-13.62	9	20	Secor, 2003
S-160	–	1	Monitoring Well	Shallow	Y	Y	5/15/03	23	2	–	18.74	16.74	-3.26	2	20	Aquaterra Boring Log
S-161	–	1	Monitoring Well	Shallow	Y	Y	5/15/03	21	2	–	18.54	12.54	-2.46	6	15	Aquaterra Boring Log
S-162	–	1	Monitoring Well	Shallow	Y	Y	5/15/03	22	2	–	18.6	13.6	-3.4	5	17	Aquaterra Boring Log
S-164	–	1	Monitoring Well	Shallow	Y	Y	5/16/03	24	2	–	17.05	13.05	-6.95	4	20	Aquaterra Boring Log
S-177	–	1	Monitoring Well	Shallow	Y	Y	5/27/03	21	2	–	19.9	15.9	-1.1	4	17	Aquaterra Boring Log
S-178	–	1	Monitoring Well	Shallow	Y	Y	5/27/03	22	2	–	19.92	14.92	-2.08	5	17	Aquaterra Boring Log
S-179	–	1	Recovery Well - Active	–	–	Y	12/19/03	–	4	–	24.57	9.57	-10.43	15	20	Secor, 2004
S-180	–	1	Recovery Well - Active	–	–	Y	12/18/03	–	4	–	24.82	9.82	-10.18	15	20	Secor, 2004
S-181	–	1	Recovery Well - Active	–	–	Y	12/18/03	–	4	–	26.31	11.31	-8.69	15	20	Secor, 2004
S-182	–	1	Recovery Well - Active	–	–	Y	12/11/03	–	4	–	26.42	11.42	-8.58	15	20	Secor, 2004
S-183	–	1	Recovery Well - Active	–	–	Y	12/12/03	–	4	–	26.78	11.78	-8.22	15	20	Secor, 2004
S-184	–	1	Recovery Well - Active	–	–	Y	12/12/03	–	4	–	26.32	11.32	-8.68	15	20	Secor, 2004
S-185	–	1	Recovery Well - Active	–	–	Y	12/16/03	–	4	–	27.46	12.46	-7.54	15	20	Secor, 2004
S-186	–	1	Recovery Well - Active	–	–	Y	12/1/6/03	–	4	–	27.16	12.16	-7.84	15	20	Secor, 2004
S-187	–	1	Recovery Well - Active	–	–	Y	12/16/03	–	4	–	28.06	13.06	-6.94	15	20	Secor, 2004
S-188	–	1	Recovery Well - Active	–	–	Y	12/17/03	–	4	–	28.28	13.28	-6.72	15	20	Secor, 2004
S-189	–	1	Recovery Well - Active	–	–	Y	01/14/04	–	4	–	29.63	15.13	-4.87	14.5	20	Secor, 2004
S-190	–	1	Recovery Well - Active	–	–	Y	01/14/04	–	4	–	29.63	16.13	-3.87	13.5	20	Secor, 2004
S-191	–	1	Recovery Well - Active	–	–	Y	01/13/04	–	4	–	29.13	15.13	-4.87	14	20	Secor, 2004
S-192	–	1	Recovery Well - Active	–	–	Y	01/13/04	–	4	–	29.33	15.93	-4.07	13.4	20	Secor, 2004
S-197	–	1	Monitoring Well	–	–	Y	11/20/03	–	4	–	–	–	–	40	15	Secor, 2004
S-198	–	1	Monitoring Well	Intermediate	Y	Y	03/08/02	35	4	–	29.75	9.75	-5.25	20	15	Aquaterra Boring Log
S-199	–	1	Monitoring Well	Intermediate	Y	Y	03/10/05	34	4	–	29.83	9.83	-5.17	20	15	Aquaterra Boring Log
S-200	–	1	Monitoring Well	Intermediate	Y	Y	03/08/05	35	4	–	29.43	9.43	-5.57	20	15	Aquaterra Boring Log
S-201	–	1	Monitoring Well	Intermediate	Y	Y	03/17/05	35	4	–	27.93	7.93	-7.07	20	15	Aquaterra Boring Log
S-202	–	1	Monitoring Well	Intermediate	Y	Y	03/11/05	35	4	–	30.86	10.86	-4.14	20	15	Aquaterra Boring Log
S-203	–	1	Monitoring Well	Intermediate	Y	Y	03/22/05	32	4	–	29.45	12.45	-2.55	17	15	Aquaterra Boring Log
S-204	–	1	Monitoring Well	Intermediate	Y	Y	03/10/05	35	4	–	27.38	7.38	-7.62	20	15	Aquaterra Boring Log
S-205	–	1	Monitoring Well	Intermediate	Y	Y	03/09/05	30	4	–	24.39	14.39	-5.61	10	20	Aquaterra Boring Log
S-206	–	1	Monitoring Well	Intermediate	Y	Y	03/09/05	32	4	–	28.66	11.66	-3.34	17	15	Aquaterra Boring Log
S-207	–	1	Monitoring Well	Intermediate	Y	Y	03/08/05	30	4	–	24.49	14.49	-5.51	10	15	Aquaterra Boring Log
S-208	–	1	Monitoring Well	Intermediate	Y	Y	03/09/05	25	4	–	17.08	7.08	-7.92	10	15	Aquaterra Boring Log
S-209	–	1	Monitoring Well	Intermediate	Y	Y	03/10/05	35	4	–	23.91	3.91	-11.09	20	15	Aquaterra Boring Log
S-210	–	1	Monitoring Well	Intermediate	Y	Y	03/15/05	35	4	–	20.64	0.64	-14.66	20	15	Aquaterra Boring Log
S-211	–	1	Monitoring Well	Intermediate	Y	Y	03/24/05	27	4	–	12.57	0.57	-14.43	12	15	Aquaterra Boring Log
S-212	–	1	Monitoring Well	Intermediate	Y	Y	03/18/05	35	4	–	15.84	2.84	-9.16	13	12	Aquaterra Boring Log
S-213	–	1	Monitoring Well	Intermediate	Y	Y	03/24/05	27	4	–	12.11	0.11	-14.89	12	15	Aquaterra Boring Log
S-214	–	1	Monitoring Well	Intermediate	Y	Y	03/28/05	30	4	–	16.73	1.73	-13.27	15	15	Aquaterra Boring Log
S-215	–	1	Monitoring Well	Intermediate	Y	Y	03/11/005	35	4	–	31.57	11.57	-3.43	20	15	Aquaterra Boring Log
S-226	–	1	Monitoring Well	Intermediate	Y	Y	03/17/05	35	4	–	19.21	-0.79	-15.79	20	15	Aquaterra Boring Log
S-227	–	1	Monitoring Well	Intermediate	Y	Y	03/21/05	32	4	–	19.48	2.48	-12.52	17	15	Aquaterra Boring Log
S-228	–	1	Monitoring Well	Intermediate	Y	Y	03/21/05	33	4	–	19.21	1.21	-13.79	18	15	Aquaterra Boring Log
S-42I	AD-1	1	Monitoring Well	Intermediate	Y	Y	2/5/82	65	–	23.56	24.08	-31.52	-41.52	55.6	10	Sun, 1993

NOTES:

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

Abandoned or damaged wells.

AOI - Area of Interest

ft. - feet

bgs - below ground surface

in. - inches

msl - elevation relative to mean sea level

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Table 3
Well Summary
Current Conditions Report
Sunoco Philadelphia Refinery and Belmont Terminal

Well ID	Former Well ID[2]	AOI #	Well Type[3]	Well Classification (Shallow, Intermediate, Deep)	Soil Boring Log Available (Y/N)	Construction Detail Available (Y/N)	Date of Well Completion	Well Construction Details[1]								References
								Well Completion Depth (ft. bgs)	Well Diameter (in)	Casing Elevation (ft. msl) (NGVD 29)	Ground Surface Elevation[4] (ft.) (NAVD88)	Top of Screen Elevation (ft) (NAVD88)	Bottom of Screen Elevation (ft) (NAVD88)	Depth to Screen (ft. bgs)	Screen Length (ft.)	
S-43	S-79	1	Monitoring Well	Intermediate	Y	Y	8/5/88	34	4	–	23.46	9.46	-10.54	14	20	Sun, 1993
S-44	AS-2	1	Monitoring Well	Intermediate	Y	Y	1/29/82	41	–	–	22.21	1.21	-16.79	21	18	Sun, 1993
S-45	#69	1	Monitoring Well	Intermediate	Y	Y	7/29/87	37	2	24.73	21.93	6.93	-12.57	15	19.5	Sun, 1993
S-46	AB-15, AS-46	1	Monitoring Well	Intermediate	Y	Y	2/11/82	31	–	–	19.68	-6.82	-16.82	26.5	10	Sun, 1993
S-46D	–	1	Monitoring Well	Deep	Y	Y	3/18/05	69	2		13.63	-40.37	-55.37	54	15	Aquaterra Boring Log
S-47I	AD-3	1	Monitoring Well	Intermediate	Y	Y	2/11/82	40.5	–	–	18.72	-16.28	-21.28	35	5	Sun, 1993
S-49	#67	1	Monitoring Well	Intermediate	Y	Y	7/21/87	37	2	–	–	–	–	15	20	Sun, 1993
S-50	SM-57	1	Monitoring Well	Shallow	Y	N	8/1/85	27	–	–	21	–	–	–	–	Sun, 1993
S-51	#68	1	Monitoring Well	Shallow	Y	Y	7/22/87	40	2	–	25.38	12.38	-7.62	13	20	Sun, 1993
S-52	AS-3	1	Piezometer	Intermediate	Y	Y	2/2/82	44.5	3	24.05	23.7	-5.8	-20.8	29.5	15	Sun, 1993
S-74	#73	1	Monitoring Well	Shallow	Y	Y	7/27/87	37	2	–	27.99	12.99	-7.01	15	20	Sun, 1993
S-75	SM-36	1	Monitoring Well	Shallow	Y	N	3/19/85	31	–	–	28.01	–	–	–	–	Sun, 1993
S-76	66	1	Monitoring Well	Shallow	Y	Y	8/3/88	24	4	–	29.61	25.61	5.61	4	20	Sun, 1993
S-77	SM-3	1	Monitoring Well	Shallow	Y	–	8/3/88	24	4	–	33.71	29.71	9.71	4	20	Sun, 1993
S-77P	–	1	Monitoring Well	Shallow	–	–	–	–	–	–	35.07	–	–	–	–	Handex, 2004b
S-78	AS-11	1	Monitoring Well	Intermediate	Y	Y	8/4/88	24	4	–	29.56	25.56	5.56	4	20	Sun, 1993
S-79	SM-58	1	Monitoring Well	Intermediate	Y	–	8/5/88	34	4	–	27.87	13.87	-6.13	14	20	Sun, 1993
S-79P	–	1	Monitoring Well	Shallow	–	–	–	–	–	–	27.88	–	–	–	–	Handex, 2004b
S-80	#72	1	Monitoring Well	Shallow	Y	Y	7/27/87	36	2	–	29.94	14.94	-0.06	15	15	Sun, 1993
S-80D	–	1	Monitoring Well	Deep	Y	Y	3/31/05	79	2		30.09	-33.91	-48.91	64	15	Aquaterra Boring Log
S-81	#70	1	Monitoring Well	Shallow	Y	Y	7/23/87	37	2	–	25.78	10.78	-9.22	15	20	Sun, 1993
S-82	AS-5	1	Monitoring Well	Intermediate	Y	Y	2/5/82	30	–	–	24.6	8.6	-3.4	16	12	Sun, 1993
S-83	#74	1	Recovery Well - Active	Shallow	Y	Y	7/28/87	37	2	–	23.63	8.63	-6.37	15	15	Sun, 1993
S-84	PR-1	1	Monitoring Well	Intermediate	Y	Y	8/19/87	43.5	6	–	23.32	5.82	-9.68	17.5	15.5	Sun, 1993
S-84P	–	1	Monitoring Well	Shallow	–	–	–	–	–	–	23.26	–	–	–	–	Handex, 2004b
S-85	#71	1	Monitoring Well	Shallow	Y	Y	7/23/87	34	2	–	22.94	7.94	-7.06	15	15	Sun, 1993
S-86	AS-4	1	Monitoring Well	Intermediate	Y	Y	2/9/82	35	–	–	24.35	-0.25	-12.5	24.6	12.25	Sun, 1993
S-87I	AD-2	1	Monitoring Well	Intermediate	Y	Y	2/28/82	55	–	–	23.34	-17.86	-31.16	41.2	3.3	Sun, 1993
S-88	PR-2	1	Monitoring Well	Intermediate	Y	Y	8/20/87	44	6	–	23.64	6.64	-9.36	17	16	Sun, 1993
S-88A	–	1	Monitoring Well	Shallow	–	–	–	–	–	–	23.47	–	–	–	–	Handex, 2004b
S-89	#75	1	Monitoring Well	Intermediate	Y	Y	7/29/87	37	2	–	23.91	8.91	-11.09	15	20	Sun, 1993
S-90	–	1	Monitoring Well	–	Y	Y	7/1/93	50	6	27.81	–	–	–	15	35	GES, 1993
S-94	–	1	Monitoring Well	–	Y	Y	9/10/93	50	6	–	–	–	–	15	35	GES, 1993
S-95	–	1	Monitoring Well	Intermediate	Y	Y	4/4/94	30	4	–	21.61	6.61	-8.39	15	15	GES Boring Log
TW-10	–	1	Monitoring Well	Shallow	–	–	–	–	–	–	30.55	–	–	–	–	-
TW-11	–	1	Monitoring Well	Shallow	–	–	–	–	–	–	32.61	–	–	–	–	-
TW-3	–	1	Monitoring Well	Shallow	–	–	–	–	–	–	32.41	–	–	–	–	-
TW-5	–	1	Monitoring Well	Shallow	–	–	–	–	–	–	32.34	–	–	–	–	-
TW-8	–	1	Monitoring Well	Shallow	–	–	–	–	–	–	30.37	–	–	–	–	-
TW-9	–	1	Monitoring Well	Shallow	–	–	–	–	–	–	32.43	–	–	–	–	-
PH-68	–	1	Abandoned	–	–	–	–	–	–	–	–	–	–	–	–	USGS, 1989
PH-69	–	1	Abandoned	–	–	–	–	–	–	–	–	–	–	–	–	USGS, 1989
PH-70	–	1	Abandoned	–	–	–	–	–	–	–	–	–	–	–	–	USGS, 1989
PH-80	–	1	Abandoned	–	–	–	–	–	–	–	–	–	–	–	–	USGS, 1989
PH-81	–	1	Abandoned	–	–	–	–	–	–	–	–	–	–	–	–	USGS, 1989
AOI - 1 (26th Street Off Site Wells)																
S-98	–	1	Monitoring Well	Intermediate	Y	Y	12/6/93	35	4	–	27.19	12.19	-7.81	15	20	GES Boring Log
S-99	–	1	Monitoring Well	Intermediate	Y	Y	12/7/93	35	4	–	22.8	7.8	-12.2	15	20	GES Boring Log
S-100	–	1	Monitoring Well	Intermediate	Y	Y	12/13/93	35	4	–	25.09	10.09	-9.91	15	20	GES Boring Log
S-101	–	1	Monitoring Well	Intermediate	Y	Y	12/20/93	60	4	–	48.27	8.27	-11.73	40	20	Sun, 1993
S-193	–	1	Monitoring Well	–	–	Y	12/04/03	–	4	–	–	–	–	15	20	Secor, 2004
S-194	–	1	Monitoring Well	–	–	Y	12/04/03	–	4	–	–	–	–	15	15	Secor, 2004
S-195	–	1	Monitoring Well	–	–	Y	12/03/03	–	4	–	–	–	–	20	17	Secor, 2004
S-196	–	1	Monitoring Well	–	–	Y	12/01/03	–	4	–	–	–	–	40.7	15	Secor, 2004

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Table 4
Summary of AOI 1 Groundwater and LNAPL Elevations
Sunoco Philadelphia Refinery, AOI 1
Philadelphia, Pennsylvania

Monitoring Point ID	AOI	LNAPL Density (g/cc)		Notes	Depth to LNAPL[3] (ft)	Depth to Water[3] (ft)	LNAPL Thickness[3] (ft)	LNAPL Elevation[3] (ft amsl)	GW Elevation[3,4] (ft amsl)	Corrected GW Elevation (ft amsl)
		Density[1]	Source[2]							
AOI 1										
RW-400	AOI 1				NP	26.67	0	NA	1.52	1.52
RW-401	AOI 1	0.7930	S-100		20.47	20.56	0.09	4.3	4.21	4.28
RW-402	AOI 1			F	17.36	17.36	0	2.69	2.69	2.69
RW-403	AOI 1			F	20.39	20.39	0	3.71	3.71	3.71
RW-404	AOI 1			F	21.7	21.70	0	2.04	2.04	2.04
RW-405	AOI 1	0.8523	S-89		24.28	24.30	0.02	-0.17	-0.19	-0.17
RW-406	AOI 1				22.61	22.99	0.38	5.98	5.6	5.60
PZ-401	AOI 1				19.55	19.56	0.01	6.34	6.33	6.33
PZ-402	AOI 1				NP	19.55	0	NA	5.83	5.83
PZ-403	AOI 1				23.68	24.09	0.41	4.59	4.18	4.18
PZ-404	AOI 1				26.09	26.45	0.36	1.93	1.57	1.57
S-100	AOI 1	0.7930	S-100	F	22.77	22.77	0.00	4.18	4.18	4.18
S-101	AOI 1				NP	46.86	0	NA	2.26	2.26
S-116	AOI 1				NP	12.90	0	NA	13.46	13.46
S-117	AOI 1	0.8236	S-117		NP	16.75	0	NA	1.66	1.66
S-118	AOI 1				NP	17.19	0	NA	0.71	0.71
S-125	AOI 1				NP	21.90	0	NA	4.09	4.09
S-126	AOI 1			F	11.89	11.89	0	16.59	16.59	16.59
S-127	AOI 1				NP	16.01	0	NA	1.09	1.09
S-160	AOI 1	0.7436	S-160		16.88	17.08	0.2	1.66	1.46	1.61
S-161	AOI 1	0.7498	S-162		16.41	16.50	0.09	1.66	1.57	1.64
S-162	AOI 1	0.7498	S-162		16.69	16.91	0.22	1.55	1.33	1.49
S-172	AOI 1				NP	17.46	0	NA	1.47	1.47
S-173	AOI 1				NP	17.20	0	NA	1.45	1.45
S-179	AOI 1				NP	17.35	0	NA	7.15	7.15
S-180	AOI 1				NP	16.80	0	NA	8.02	8.02
S-184	AOI 1				NP	21.97	0	NA	4.26	4.26
S-186	AOI 1				NP	22.58	0	NA	4.58	4.58
S-187	AOI 1				23.45	23.46	0.01	4.61	4.6	4.60
S-188	AOI 1				NP	23.72	0	NA	4.56	4.56
S-189	AOI 1				24.89	24.95	0.06	4.74	4.68	4.68
S-190	AOI 1				24.85	24.96	0.11	NA	4.67	4.67
S-191	AOI 1				24.5	24.50	0	NA	4.63	4.63
S-192	AOI 1				25.18	25.18	0	4.15	4.15	4.15
S-193	AOI 1				NP	23.48	0	NA	NA	NA
S-194	AOI 1				NP	25.95	0	NA	NA	NA
S-195	AOI 1				NP	25.71	0	NA	NA	NA
S-196	AOI 1				NP	45.23	0	NA	NA	NA
S-198	AOI 1	0.7923	S-199		25	25.24	0.24	4.75	4.51	4.70
S-199	AOI 1	0.7923	S-199		25.03	25.85	0.82	4.8	3.98	4.63
S-200	AOI 1	0.8143	S-200		24.49	24.49	0	4.57	4.57	4.57
S-201	AOI 1	0.8030	S-201		23.12	23.78	0.66	4.81	4.15	4.68
S-202	AOI 1				NP	29.12	0	NA	5.11	5.11
S-203	AOI 1				NP	27.60	0	NA	4.23	4.23
S-204	AOI 1				NP	25.58	0	NA	4.71	4.71
S-205	AOI 1	0.8406	S-78		17.76	17.84	0.08	10.41	10.33	10.40
S-206	AOI 1				NP	26.83	0	NA	5.21	5.21
S-207	AOI 1				NP	19.42	0	NA	7.78	7.78
S-208	AOI 1	0.8236	S-117	F	18.81	18.81	0	2.05	2.05	2.05
S-209	AOI 1				NP	25.77	0	NA	1.13	1.13
S-210	AOI 1	0.7508	S-50		23.14	23.85	0.71	0.55	-0.16	0.37
S-211	AOI 1				NP	13.60	0	NA	1.59	1.59
S-212	AOI 1				NP	17.01	0	NA	1.36	1.36
S-213	AOI 1	0.7498	S-162		13.64	13.64	0	1.57	1.57	1.57
S-214	AOI 1				NP	18.80	0	NA	1.04	1.04
S-215	AOI 1				29.52	29.74	0.22	4.85	4.63	4.63
S-226	AOI 1				NP	21.58	0	NA	0.44	0.44
S-227	AOI 1				NP	22.31	0	NA	-0.52	-0.52
S-228	AOI 1				NP	21.62	0	NA	0.24	0.24
S-41	AOI 1				NP	25.22	0	NA	0.53	0.53
S-42I	AOI 1				NP	24.99	0	NA	0.73	0.73
S-43	AOI 1				NP	23.69	0	NA	-0.47	-0.47
S-44	AOI 1				NP	25.47	0	NA	-2.08	-2.08
S-45	AOI 1				NP	22.70	0	NA	-1.13	-1.13
S-46D	AOI 1				NP	21.14	0	NA	1.42	1.42
S-47D	AOI 1				NP	20.78	0	NA	1.43	1.43
S-50	AOI 1	0.7508	S-50		22.04	22.25	0.21	0.44	0.23	0.39

Notes:
1. Density values were determined from LNAPL samples collected by Aquaterra during February through March 2004, and April 2005, or from samples collected by SECOR in 1999-2000.
2. For wells with no direct LNAPL density measurements, the density value in the nearest well with LNAPL data was used.
3. Depth to Water and Depth to LNAPL provided by HANDEX, May 9-11, 2005.
4. All Groundwater elevations collected during the month of May 2005. Only wells accessible during gauging event are listed.

AOI = Area of Interest
g/cc = grams per cubic centimeter
LNAPL = Light Non-Aqueous Phase Liquid
amsl = above mean sea level
GW = Groundwater
F = Film or trace product
NA = Not applicable
NM = Not Measured
NP = No Product

Table 4
Groundwater and LNAPL Elevations
Sunoco Philadelphia Refinery, AOI 1
Philadelphia, Pennsylvania

Monitoring Point ID	AOI	Specific Gravity (g/cc)		Notes	Depth to LNAPL (ft)	Depth to Water[3] (ft)	LNAPL Thickness[3] (ft)	LNAPL Elevation[3] (ft amsl)	GW Elevation[3,4] (ft amsl)	Corrected GW Elevation (ft amsl)
		Density [1]	Source[2]							
AOI 1 (Continued)										
S-51	AOI 1				NP	22.82	0	NA	2.56	2.56
S-52	AOI 1				NP	22.79	0	NA	0.75	0.75
S-74	AOI 1				NP	25.40	0	NA	4.69	4.69
S-75	AOI 1	0.7948	S-81		26.54	26.63	0.09	4.69	4.69	4.76
S-76	AOI 1	0.7851	S-76		26.17	27.55	1.38	4.87	4.87	5.95
S-77	AOI 1	0.7677	S-77		12.4	13.02	0.62	21.05	20.43	20.91
S-77P	AOI 1				NP	28.54	0	NA	6.53	6.53
S-78	AOI 1	0.8406	S-78		25.89	25.92	0.03	5.04	5.01	5.04
S-79	AOI 1	0.8406	S-78		23.5	23.62	0.12	7.47	7.35	7.45
S-79P	AOI 1				NP	25.79	0	NA	4.63	4.63
S-80	AOI 1				NP	26.96	0	NA	5.17	5.17
S-80D	AOI 1				NP	30.07	0	NA	1.67	1.67
S-81	AOI 1	0.7948	S-81		20.91	21.44	0.53	4.57	4.04	4.46
S-82	AOI 1	0.7930	S-100		22.65	22.69	0.04	4.64	4.60	4.63
S-83	AOI 1	0.8066	S-100		18.84	19.01	0.17	4.49	4.32	4.46
S-84	AOI 1				NP	15.56	0	NA	7.43	7.43
S-84P	AOI 1				NP	14.92	0	NA	8.34	8.34
S-85	AOI 1			F	22.95	22.95	0	2.18	2.18	2.18
S-86	AOI 1			F	25.67	25.67	0	1.38	1.38	1.38
S-87I	AOI 1			F	24.73	24.73	0	1.14	1.14	1.14
S-88	AOI 1				NP	24.49	0	NA	-0.39	-0.39
S-88A	AOI 1			F	24.57	24.57	0	1.15	1.15	1.15
S-89	AOI 1	0.8523	S-89		26.17	26.26	0.09	-0.18	-0.27	-0.19
S-95	AOI 1				NP	22.03	0	NA	0.96	0.96
S-98	AOI 1				NP	24.50	0	NA	4.30	4.30
S-99	AOI 1				NP	25.01	0	NA	0.39	0.39
OW-2	AOI 1	0.8084	OW-2		26.64	26.91	0.27	5.03	4.76	4.98
OW-12	AOI 1	0.8050	OW-12		25.33	25.70	0.37	4.89	4.52	4.82
OW-13	AOI 1	0.8000	SECOR, 1999-2000		27.18	27.18	0.00	5.02	5.02	5.02
OW-14	AOI 1				NP	27.49	0	NA	4.72	4.72
OW-16	AOI 1	0.8050	OW-12		26.32	26.74	0.42	5.06	4.64	4.98
OW-17	AOI 1	0.8000	SECOR, 1999-2000		25.65	25.65	0.00	4.34	4.34	4.34
OW-18	AOI 1	0.8241	OW-18		26.85	26.93	0.08	3.99	3.91	3.98
OW-19	AOI 1	0.8000	SECOR, 1999-2000		26	26.00	0.00	5	5.00	5.00
OW-20	AOI 1				NP	26.65	0	NA	5.22	5.22
TW-3	AOI 1				NP	27.17	0	NA	4.94	4.94
TW-5	AOI 1				NP	26.45	0	NA	5.62	5.62
TW-8	AOI 1				NP	25.50	0	NA	4.64	4.64
TW-9	AOI 1				NP	28.47	0	NA	3.63	3.63
TW-10	AOI 1				NP	25.75	0	NA	4.47	4.47
TW-11	AOI 1				NP	27.75	0	NA	4.65	4.65
MW-26	AOI 1	0.8000	SECOR, 1999-2000		21.74	23.10	1.36	5.00	3.64	4.73
MW-27	AOI 1	0.7979	MW-27		23.92	24.35	0.43	4.73	4.30	4.64
MW-28	AOI 1	0.7918	MW-28		23.89	25.11	1.22	4.89	3.67	4.64
MW-29	AOI 1	0.7945	MW-29		23.9	26.19	2.29	5.05	2.76	4.58
MW-30	AOI 1				NP	27.23	0	NA	4.47	4.47
MW-31	AOI 1				NP	25.49	0	NA	5.07	5.07
MW-32	AOI 1				NP	24.61	0	NA	4.53	4.53
MW-33	AOI 1	0.8000	SECOR, 1999-2000		26.01	26.02	0.01	3.98	3.97	3.98
MW-34	AOI 1				32.03	32.03	0.00	-4.24	-4.24	-4.24
MW-35	AOI 1				NP	26.62	0	NA	4.03	4.03
MW-36	AOI 1				NP	27.62	0	NA	4.95	4.95
MW-37	AOI 1				NP	26.76	0	NA	5.16	5.16
MW-38	AOI 1				NP	22.94	0	NA	4.68	4.68
MW-39	AOI 1				NP	22.83	0	NA	4.72	4.72
MW-40	AOI 1				NP	23.19	0	NA	4.69	4.69
MW-41	AOI 1	0.8154	MW-41		22.5	23.06	0.56	4.85	4.29	4.75
MW-42	AOI 1				21.9	21.90	0.00	4.70	4.70	4.70
MW-43	AOI 1				NP	26.08	0	NA	4.53	4.53
MW-44	AOI 1	0.7802			25.37	25.47	0.10	3.93	3.83	3.91
RW-1	AOI 1				NP	24.93	0	NA	4.62	4.62
RW-4	AOI 1	0.8000	SECOR, 1999-2000		24.95	27.61	2.66	5.50	2.84	4.97
RW-6	AOI 1				NP	26.40	0	NA	4.66	4.66
RW-7	AOI 1				NP	23.37	0	NA	4.84	4.84
RW-15	AOI 1	0.8000	SECOR, 1999-2000		NP	26.41	0	NA	4.09	4.09
RW-21	AOI 1				23.97	24.25	0.28	NA	NA	NA
RW-22	AOI 1	0.8000	SECOR, 1999-2000		22.16	22.25	0.09	NA	NA	NA
RW-23	AOI 1	0.7590	RW-23		22.18	22.98	0.80	NA	NA	NA
RW-24	AOI 1	0.7667	RW-24		22.31	22.66	0.35	NA	NA	NA
RW-25	AOI 1	0.8000	SECOR, 1999-2000		NP	25.37	0	NA	NA	NA

Notes:
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3. Depth to Water and Depth to LNAPL provided by Handex, May 9-11 2005.
4. All Groundwater elevations collected during the month of May 2005. Only wells accessible during gauging event are listed.

AOI = Area of Interest
g/cc = grams per cubic centimeter
LNAPL = Light Non-Aqueous Phase Liquid
amsl = above mean sea level
GW = Groundwater
F = Film or trace product
NA = Not applicable
NM = Not Measured
NP = No Product

Table 5
Summary of Groundwater Analytical Results:
Fill/Alluvium and Trenton Gravel Wells
Sunoco Philadelphia Refinery - AOI 1
Philadelphia, Pennsylvania

	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	Sample ID / Sample Date / Sample Matrix / Unit	MW30-042705 4/27/2005 Groundwater ug/l			MW31-042605 4/26/2005 Groundwater ug/l			MW32-042605 4/26/2005 Groundwater ug/l			MW35-042705 4/27/2005 Groundwater ug/l			MW36-042505 4/25/2005 Groundwater ug/l			MW37-042605 4/26/2005 Groundwater ug/l			MW38-042605 4/26/2005 Groundwater ug/l			MW39-042605 4/26/2005 Groundwater ug/l			MW40-042605 4/26/2005 Groundwater ug/l		
Volatile Organic Compounds			**Unit**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**
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	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	5	ND	U	250	ND	U	250	ND	U	25	ND	U	5000	ND	U	10000	ND	U	5	ND	U	5	ND	U	25
Benzene	71-43-2	5	ug/l	960		50	2600		250	420		250	29		25	150000		5000	370000		10000	110		5	8		5	370		25
Ethylbenzene	100-41-4	700	ug/l	430		50	290		250	1100		250	970		25	ND	U	5000	12000		10000	ND	U	5	ND	U	5	150		25
Cumene	98-82-8	2300	ug/l	61		5	ND	U	250	ND	U	250	92		25	ND	U	5000	ND	U	10000	ND	U	5	ND	U	5	42		25
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	ND	U	5	ND	U	250	ND	U	250	ND	U	25	ND	U	5000	ND	U	10000	11		5	18		5	ND	U	25
Toluene	108-88-3	1000	ug/l	37		5	510		250	4600		250	30		25	ND	U	5000	31000		10000	ND	U	5	ND	U	5	ND	U	25
Xylene (Total)	1330-20-7	10000	ug/l	870		50	1000		250	6200		250	2600		250	ND	U	5000	41000		10000	ND	U	5	8		5	300		25
Semi-Volatile Organic Compounds																													
Chrysene	218-01-9	1.9	ug/l	ND	U	96	ND	U	100	ND	U	10	ND	U	97	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	96
Fluorene	86-73-7	1900	ug/l	ND	U	96	ND	U	100	ND	U	10	150		97	23		10	ND	U	10	24		10	51		10	110		96
Naphthalene	91-20-3	100	ug/l	3000		960	ND	U	100	120		20	5700		970	5800		990	25		10	ND	U	10	ND	U	10	150		96
Phenanthrene	85-01-8	1100	ug/l	ND	U	96	ND	U	100	ND	U	10	320		97	25		10	ND	U	10	ND	U	10	24		10	150		96
Pyrene	129-00-0	130	ug/l	ND	U	96	ND	U	100	ND	U	10	ND	U	97	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	96
Metals																													
Lead (Total)	7439-92-1	5	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - Micrograms Per Liter
MSC - PADEP's Medium Specific Concentration for Impact to Groundwater
RL - Reporting Limit
ND - Not Detected

Qualifiers:
Q - Qualifier
U - The Analyte Was Analyzed But Not Detected

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 5
Summary of Groundwater Analytical Results:
Fill/Alluvium and Trenton Gravel Wells
Sunoco Philadelphia Refinery - AOI 1
Philadelphia, Pennsylvania

	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	Sample ID / Sample Date / Sample Matrix / Unit	MW43-050205 5/2/2005 Groundwater ug/l			OW14-042505 4/25/2005 Groundwater ug/l			PZ402-042005 4/20/2005 Groundwater ug/l			S101-042205 4/22/2005 Groundwater ug/l			S117-042205 4/22/2005 Groundwater ug/l			S118-042205 4/22/2005 Groundwater ug/l			S127-042205 4/22/2005 Groundwater ug/l			S173-042205 4/22/2005 Groundwater ug/l			S193-042205 4/22/2005 Groundwater ug/l		
Volatile Organic Compounds			**Unit**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	0.041		0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	130	ND	U	5	ND	U	200	ND	U	5	ND	U	50	ND	U	50	ND	U	1000	ND	U	50	ND	U	5
Benzene	71-43-2	5	ug/l	5400		130	160		5	25000		1000	1400		100	8800		500	920		50	15000		1000	990		50	220		25
Ethylbenzene	100-41-4	700	ug/l	1000		130	ND	U	5	2200		200	22		5	550		50	180		50	ND	U	1000	480		50	27		5
Cumene	98-82-8	2300	ug/l	ND	U	130	ND	U	5	ND	U	200	26		5	ND	U	50	ND	U	50	ND	U	1000	320		50	16		5
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	ND	U	130	ND	U	5	2300		200	ND	U	5	100		50	170		50	1700		1000	140		50	ND	U	5
Toluene	108-88-3	1000	ug/l	ND	U	130	5		5	300		200	14		5	ND	U	50	52		50	ND	U	1000	ND	U	50	6		5
Xylene (Total)	1330-20-7	10000	ug/l	490		130	8		5	3700		200	89		5	52		50	460		50	1000		1000	1100		50	120		5
Semi-Volatile Organic Compounds																														
Chrysene	218-01-9	1.9	ug/l	ND	U	99	ND	U	10	ND	U	98	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Fluorene	86-73-7	1900	ug/l	99	U	99	ND	U	10	ND	U	98	10	U	10	ND	U	10	ND	U	10	ND	U	10	11		10	ND	U	10
Naphthalene	91-20-3	100	ug/l	7400		4900	10		10	980		98	41		10	360		50	33		10	240		49	47		10	ND	U	10
Phenanthrene	85-01-8	1100	ug/l	170		99	ND	U	10	120		98	ND	U	10	ND	U	10	ND	U	10	ND	U	10	18		10	ND	U	10
Pyrene	129-00-0	130	ug/l	ND	U	99	ND	U	10	ND	U	98	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Metals																														
Lead (Total)	7439-92-1	5	ug/l	ND	U	1	ND	U	10	12		1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - Micrograms Per Liter
MSC - PADEP's Medium Specific Concentration for Impact to Groundwater
RL - Reporting Limit
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Qualifiers:
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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 5
Summary of Groundwater Analytical Results:
Fill/Alluvium and Trenton Gravel Wells
Sunoco Philadelphia Refinery - AOI 1
Philadelphia, Pennsylvania

	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	Sample ID / Sample Date / Sample Matrix / Unit	S194-042205 4/22/2005 Groundwater ug/l			S196-042205 4/22/2005 Groundwater ug/l			S203-042005 4/20/2005 Groundwater ug/l			S209-042205 4/22/2005 Groundwater ug/l			S211-050205 5/2/2005 Groundwater ug/l			S212-050205 5/2/2005 Groundwater ug/l			S214-042005 4/20/2005 Groundwater ug/l			S226-042205 4/22/2005 Groundwater ug/l			S227-042005 4/20/2005 Groundwater ug/l		
Volatile Organic Compounds			**Unit**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**
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	0.029	ND	U	0.028	ND	U	0.029	ND	U	0.029	ND	U	0.029
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	5	ND	U	5	ND	U	100	ND	U	50	ND	U	10	ND	U	250	ND	U	5	ND	U	1000	ND	U	20
Benzene	71-43-2	5	ug/l	16		5	ND	U	5	940		100	7600		500	150		10	ND	U	250	580		25	91000		10000	750		20
Ethylbenzene	100-41-4	700	ug/l	11		5	ND	U	5	ND	U	100	460		50	28		10	360		250	190		5	1200		1000	1500		50
Cumene	98-82-8	2300	ug/l	11		5	ND	U	5	ND	U	100	170		50	62		10	ND	U	250	74		5	ND	U	1000	210		20
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	ND	U	5	ND	U	5	17000		500	77		50	37		10	ND	U	250	10		5	ND	U	1000	47		20
Toluene	108-88-3	1000	ug/l	ND	U	5	ND	U	5	ND	U	100	91		50	ND	U	10	ND	U	250	69		5	6100		1000	100		20
Xylene (Total)	1330-20-7	10000	ug/l	33		5	13		5	220		100	1800		50	85		10	1300		250	190		5	4700		1000	4300		50
Semi-Volatile Organic Compounds																														
Chrysene	218-01-9	1.9	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	99	ND	U	10	ND	U	10	ND	U	10
Fluorene	86-73-7	1900	ug/l	ND	U	10	ND	U	10	11		10	27		10	ND	U	10	ND	U	99	ND	U	10	13		10	ND	U	10
Naphthalene	91-20-3	100	ug/l	ND	U	10	ND	U	10	25		10	70		10	17		10	450		99	30		10	1200		490	100		10
Phenanthrene	85-01-8	1100	ug/l	ND	U	10	ND	U	10	10		10	42		10	ND	U	10	ND	U	99	ND	U	10	27		10	18		10
Pyrene	129-00-0	130	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	99	ND	U	10	ND	U	10	ND	U	10
Metals																														
Lead (Total)	7439-92-1	5	ug/l	ND	U	1	ND	U	1	4.4		1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - Micrograms Per Liter
MSC - PADEP's Medium Specific Concentration for Impact to Groundwater
RL - Reporting Limit
ND - Not Detected

Qualifiers:
Q - Qualifier
U - The Analyte Was Analyzed But Not Detected

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 5
Summary of Groundwater Analytical Results:
Fill/Alluvium and Trenton Gravel Wells
Sunoco Philadelphia Refinery - AOI 1
Philadelphia, Pennsylvania

	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	Sample ID / Sample Date / Sample Matrix / Unit	S41-042205 4/22/2005 Groundwater ug/l			S43-042105 4/21/2005 Groundwater ug/l			S44-042105 4/21/2005 Groundwater ug/l			S46-042105 4/21/2005 Groundwater ug/l			S47D-042105 4/21/2005 Groundwater ug/l			S74-042605 4/26/2005 Groundwater ug/l			S77P-042005 4/20/2005 Groundwater ug/l			S79P-042005 4/20/2005 Groundwater ug/l		
Volatile Organic Compounds			**Unit**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**
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	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029
1,2-Dichloroethane	107-06-2	5	ug/l	50	U	50	ND	U	5	ND	U	5	ND	U	50	ND	U	5	ND	U	5	ND	U	500	ND	U	20
Benzene	71-43-2	5	ug/l	65		50	940		50	2100		100	330		50	5		5	ND	U	5	17000		500	2400		100
Ethylbenzene	100-41-4	700	ug/l	ND	U	50	160		5	16		5	75		50	ND	U	5	ND	U	5	ND	U	500	ND	U	20
Cumene	98-82-8	2300	ug/l	ND	U	50	42		5	38		5	140		50	87		5	ND	U	5	ND	U	500	ND	U	20
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	530		50	10		5	34		5	170		50	92		5	ND	U	5	10000		500	180		20
Toluene	108-88-3	1000	ug/l	ND	U	50	41		5	52		5	ND	U	50	ND	U	5	ND	U	5	ND	U	500	ND	U	20
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	50	98		5	44		5	ND		50	ND	U	5	ND	U	5	ND	U	500	29		20
Semi-Volatile Organic Compounds																												
Chrysene	218-01-9	1.9	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Fluorene	86-73-7	1900	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	15		10	ND	U	10
Naphthalene	91-20-3	100	ug/l	ND	U	10	28		10	ND	U	10	13		10	ND	U	10	ND	U	10	110		10	ND	U	10
Phenanthrene	85-01-8	1100	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	23		10	ND	U	10
Pyrene	129-00-0	130	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Metals																												
Lead (Total)	7439-92-1	5	ug/l	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	1	ND	U	10	3		1	1.7		1

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - Micrograms Per Liter
MSC - PADEP's Medium Specific Concentration for Impact to Groundwater
RL - Reporting Limit
ND - Not Detected

Qualifiers:
Q - Qualifier
U - The Analyte Was Analyzed But Not Detected

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 5
Summary of Groundwater Analytical Results:
Fill/Alluvium and Trenton Gravel Wells
Sunoco Philadelphia Refinery - AOI 1
Philadelphia, Pennsylvania

	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	Sample ID / Sample Date / Sample Matrix / Unit	S88-042105 4/21/2005 Groundwater ug/l			S98-042205 4/22/2005 Groundwater ug/l			S99-042205 4/22/2005 Groundwater ug/l			TW10-042705 4/27/2005 Groundwater ug/l			TW11-042505 4/25/2005 Groundwater ug/l			TW3-042505 4/25/2005 Groundwater ug/l			TW5-042505 4/25/2005 Groundwater ug/l			TW8-042505 4/25/2005 Groundwater ug/l			TW9-042505 4/25/2005 Groundwater ug/l		
Volatile Organic Compounds			**Unit**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.029	ND	U	0.029	ND	U	0.029	0.089		0.029	ND	U	0.029	0.058		0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	5	ND	U	25	ND	U	5	ND	U	500	ND	U	5	ND	U	500	ND	U	5000	ND	U	250	ND	U	25
Benzene	71-43-2	5	ug/l	28		5	580		25	200		5	9200		500	ND	U	5	63000		2500	450000		25000	480		250	360		25
Ethylbenzene	100-41-4	700	ug/l	ND	U	5	140		25	6		5	3200		500	ND	U	5	2700		500	ND	U	5000	2100		250	25	U	25
Cumene	98-82-8	2300	ug/l	12		5	37		25	81		5	ND	U	500	ND	U	5	ND	U	500	ND	U	5000	280		250	ND	U	25
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	590		50	ND	U	25	17		5	84000		5000	ND	U	5	56000		2500	ND	U	5000	ND	U	250	ND	U	25
Toluene	108-88-3	1000	ug/l	5		5	ND	U	25	23		5	24000		5000	ND	U	5	29000		2500	8500		5000	ND	U	250	ND	U	25
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	5	1000		25	19		5	20000		500	ND	U	5	17000		500	ND	U	5000	2800		250	ND	U	25
Semi-Volatile Organic Compounds																														
Chrysene	218-01-9	1.9	ug/l	18		10	ND	U	10	ND	U	10	180		98	ND	U	11	16		10	ND	U	10	200		99	ND	U	11
Fluorene	86-73-7	1900	ug/l	ND	U	10	ND	U	10	ND	U	10	470		98	ND	U	11	55		10	ND	U	10	620		99	ND	U	11
Naphthalene	91-20-3	100	ug/l	ND	U	10	110		19	ND	U	10	12000		4900	ND	U	11	1500		490	17		10	22000		2500	ND	U	11
Phenanthrene	85-01-8	1100	ug/l	ND	U	10	ND	U	10	ND	U	10	1100		98	ND	U	11	110		10	ND	U	10	ND	U	2500	ND	U	11
Pyrene	129-00-0	130	ug/l	17		10	ND	U	10	ND	U	10	430		98	ND	U	11	44		10	ND	U	10	500		99	ND	U	11
Metals																														
Lead (Total)	7439-92-1	5	ug/l	1.5		1	3.9		1	1.5		1	10.1		10	ND	U	10	14.2		10	ND	U	10	ND	U	10	ND	U	1

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - Micrograms Per Liter
MSC - PADEP's Medium Specific Concentration for Impact to Groundwater
RL - Reporting Limit
ND - Not Detected

Qualifiers:
Q - Qualifier
U - The Analyte Was Analyzed But Not Detected

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 5
Summary of Groundwater Analytical Results:
Fill/Alluvium and Trenton Gravel Wells
Sunoco Philadelphia Refinery - AOI 1
Philadelphia, Pennsylvania

	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	Sample ID / Sample Date / Sample Matrix / Unit	S116-041805 4/18/2005 Groundwater ug/l			S125-041905 4/19/2005 Groundwater ug/l			S179-041905 4/19/2005 Groundwater ug/l			S180-041905 4/19/2005 Groundwater ug/l			S181-041905 4/19/2005 Groundwater ug/l			S182-041805 4/18/2005 Groundwater ug/l			S183-041805 4/18/2005 Groundwater ug/l			S184-041805 4/18/2005 Groundwater ug/l		
Volatile Organic Compounds			**Unit**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**
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	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	5	ND	U	50	ND	U	5	ND	U	5	ND	U	50	ND	U	100	ND	U	130	ND		25
Benzene	71-43-2	5	ug/l	ND	U	5	17000		500	ND	U	5	ND	U	5	460		50	12000		500	14000		1000	650		25
Ethylbenzene	100-41-4	700	ug/l	ND	U	5	250		50	ND	U	5	ND	U	5	ND	U	50	140		100	ND	U	130	ND	U	25
Cumene	98-82-8	2300	ug/l	ND	U	5	61		50	110		5	ND	U	5	ND	U	50	120		100	ND	U	130	57		25
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	ND	U	5	11000		500	ND	U	5	ND	U	5	240		50	340		100	140		130	ND	U	25
Toluene	108-88-3	1000	ug/l	ND	U	5	180		50	ND	U	5	ND	U	5	ND	U	50	150		100	130		130	ND	U	25
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	5	920		50	ND	U	5	ND	U	5	95		50	320		100	290		130	46		25
Semi-Volatile Organic Compounds																											
Chrysene	218-01-9	1.9	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Fluorene	86-73-7	1900	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Naphthalene	91-20-3	100	ug/l	ND	U	10	160		48	ND	U	10	ND	U	10	ND	U	10	240		97	540		97	24		10
Phenanthrene	85-01-8	1100	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Pyrene	129-00-0	130	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Metals																											
Lead (Total)	7439-92-1	5	ug/l	ND	U	1	6.8		1	ND	U	1	ND	U	1	1.4		1	11		1	9.9		1	5.4		1

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - Micrograms Per Liter
MSC - PADEP's Medium Specific Concentration for Impact to Groundwater
RL - Reporting Limit
ND - Not Detected

Qualifiers:
Q - Qualifier
U - The Analyte Was Analyzed But Not Detected

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 5
Summary of Groundwater Analytical Results:
Fill/Alluvium and Trenton Gravel Wells
Sunoco Philadelphia Refinery - AOI 1
Philadelphia, Pennsylvania

	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	Sample ID / Sample Date / Sample Matrix / Unit	S185-041805 4/18/2005 Groundwater ug/l			S186-041805 4/18/2005 Groundwater ug/l			S187-041805 4/18/2005 Groundwater ug/l			S188-041805 4/18/2005 Groundwater ug/l			S202-041905 4/19/2005 Groundwater ug/l			S204-041905 4/19/2005 Groundwater ug/l			S206-041905 4/19/2005 Groundwater ug/l			S207-041905 4/19/2005 Groundwater ug/l		
Volatile Organic Compounds			Unit	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL	Result	Q	RL
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.029	ND	U	0.029	ND	U	0.029	0.038		0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	50	ND	U	10	ND	U	20	ND	U	5	ND	U	100	ND	U	10000	ND	U	25	ND	U	5
Benzene	71-43-2	5	ug/l	850		50	47		10	130		20	1200		50	1400		100	26000		10000	52		25	ND	U	5
Ethylbenzene	100-41-4	700	ug/l	68		50	ND	U	10	ND	U	20	97		5	350		100	ND	U	10000	ND	U	25	ND	U	5
Cumene	98-82-8	2300	ug/l	50		50	49		10	42		20	110		5	ND	U	100	ND	U	10000	29		25	25		5
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	ND	U	50	ND	U	10	ND	U	20	ND	U	5	130		100	370000		10000	76		25	10		5
Toluene	108-88-3	1000	ug/l	ND	U	50	ND	U	10	ND	U	20	15		5	1600		100	ND	U	10000	ND	U	25	ND	U	5
Xylene (Total)	1330-20-7	10000	ug/l	130		50	ND	U	10	30		20	210		5	1700		100	ND	U	10000	ND	U	25	ND	U	5
Semi-Volatile Organic Compounds																											
Chrysene	218-01-9	1.9	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Fluorene	86-73-7	1900	ug/l	10	U	10	ND	U	10	ND	U	10	10		10	ND	U	10	11		10	ND	U	10	ND	U	10
Naphthalene	91-20-3	100	ug/l	560		97	ND	U	10	ND	U	10	66		10	94		10	290		96	ND	U	10	ND	U	10
Phenanthrene	85-01-8	1100	ug/l	ND	U	10	ND	U	10	ND	U	10	12		10	ND	U	10	21		10	ND	U	10	ND	U	10
Pyrene	129-00-0	130	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Metals																											
Lead (Total)	7439-92-1	5	ug/l	6.3		1	2.1		1	4.4		1	6.3		1	4.9		1	6.4		1	ND	U	1	ND	U	1

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - Micrograms Per Liter
MSC - PADEP's Medium Specific Concentration for Impact to Groundwater
RL - Reporting Limit
ND - Not Detected

Qualifiers:
Q - Qualifier
U - The Analyte Was Analyzed But Not Detected

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 5
Summary of Groundwater Analytical Results:
Fill/Alluvium and Trenton Gravel Wells
Sunoco Philadelphia Refinery - AOI 1
Philadelphia, Pennsylvania

	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	Sample ID / Sample Date / Sample Matrix / Unit	S215-041905 4/19/2005 Groundwater ug/l			S51-041905 4/19/2005 Groundwater ug/l			S-52-041905 4/19/2005 Groundwater ug/l			S84-041905 4/19/2005 Groundwater ug/l			S84P-041905 4/19/2005 Groundwater ug/l		
Volatile Organic Compounds			**Unit**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029	ND	U	0.029
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	2500	ND	U	100	ND	U	50	ND	U	20	ND	U	20
Benzene	71-43-2	5	ug/l	29000		2500	590		100	230		50	72		20	72		20
Ethylbenzene	100-41-4	700	ug/l	3300		2500	ND	U	100	ND	U	50	140		20	140		20
Cumene	98-82-8	2300	ug/l	ND	U	2500	ND	U	100	ND	U	50	160		20	160		20
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	51000		2500	1900		100	1200		50	ND	U	20	ND	U	20
Toluene	108-88-3	1000	ug/l	29000		2500	ND	U	100	ND	U	50	ND	U	20	ND	U	20
Xylene (Total)	1330-20-7	10000	ug/l	19000		2500	190		100	ND	U	50	4800		100	4800		100
Semi-Volatile Organic Compounds																		
Chrysene	218-01-9	1.9	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Fluorene	86-73-7	1900	ug/l	53		10	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Naphthalene	91-20-3	100	ug/l	2200		500	15		10	ND	U	10	420		98	420		98
Phenanthrene	85-01-8	1100	ug/l	87		10	10		10	ND	U	10	ND	U	10	ND	U	10
Pyrene	129-00-0	130	ug/l	13		10	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Metals																		
Lead (Total)	7439-92-1	5	ug/l	44.7		1	ND	U	1	ND	U	1	ND	U	1	ND	U	1

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - Micrograms Per Liter
MSC - PADEP's Medium Specific Concentration for Impact to Groundwater
RL - Reporting Limit
ND - Not Detected

Qualifiers:
Q - Qualifier
U - The Analyte Was Analyzed But Not Detected

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 6
Summary of Groundwater Analytical Results:
Lower Sand Wells
Sunoco Philadelphia Refinery - AOI 1
Philadelphia, Pennsylvania

	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500	Sample ID Sample Date Sample Matrix Unit	S46D-041805 4/18/2005 Groundwater ug/l			S42D-041505 4/15/2005 Groundwater ug/l			S80D-041505 4/15/2005 Groundwater ug/l		
Volatile Organic Compounds			**Unit**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**
Ethylene dibromide (EDB)	106-93-4	0.05	ug/l	ND	U	0.029	ND	U	0.028	ND	U	0.028
1,2-Dichloroethane	107-06-2	5	ug/l	ND	U	5	ND	U	5	ND	U	5
Benzene	71-43-2	5	ug/l	ND	U	5	ND	U	5	ND	U	5
Ethylbenzene	100-41-4	700	ug/l	ND	U	5	ND	U	5	ND	U	5
Cumene	98-82-8	2300	ug/l	ND	U	5	ND	U	5	ND	U	5
Methyl Tertiary Butyl Ether	1634-04-4	20	ug/l	ND	U	5	ND	U	5	ND	U	5
Toluene	108-88-3	1000	ug/l	ND	U	5	ND	U	5	ND	U	5
Xylene (Total)	1330-20-7	10000	ug/l	ND	U	5	ND	U	5	ND	U	5
Semi-Volatile Organic Compounds												
Chrysene	218-01-9	1.9	ug/l	ND	U	10	ND	U	10	ND	U	11
Fluorene	86-73-7	1900	ug/l	ND	U	10	ND	U	10	ND	U	11
Naphthalene	91-20-3	100	ug/l	ND	U	10	ND	U	10	ND	U	11
Phenanthrene	85-01-8	1100	ug/l	ND	U	10	ND	U	10	ND	U	11
Pyrene	129-00-0	130	ug/l	ND	U	10	ND	U	10	ND	U	11
Metals												
Lead (Total)	7439-92-1	5	ug/l	ND	U	1	ND	U	0.001	ND	U	0.001

Notes:
PADEP - Pennsylvania Department of Environmental Protection
ug/l - Micrograms Per Liter
MSC - PADEP's Medium Specific Concentration for Impact to Groundwater
RL - Reporting Limit
ND - Not Detected

Qualifiers:
Q - Qualifier
U - The Analyte Was Analyzed But Not Detected

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 7
API Calculated LNAPL Specific Volume and Calculated Seepage Velocity Summary
AOI 1: Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Well ID	Apparent LNAPL Thickness [1] (ft)	API Model Calculated LNAPL Specific Volume (ft)	Calculated LNAPL Seepage Velocity (cm/sec)[3]
S-76	1.38	5.54E-02	2.664E-07
S-82	0.04	2.03E-07	6.876E-13
RW-401	0.09	8.24E-11	5.122E-20
PZ-401	0.01	4.36E-07	1.709E-14
RW-406	0.38	4.38E-04	2.613E-10
OW-18	0.08	6.37E-06	1.506E-10
OW-2	0.27	5.89E-04	1.586E-08
RW-22	0.09	4.99E-06	8.513E-11
RW-23	0.8	3.12E-02	1.109E-06
RW-24	0.35	2.70E-03	8.930E-08
S-81	0.53	1.65E-03	4.038E-08
S-75	0.09	4.81E-06	1.757E-10
RW-4	2.66	1.54E-01	3.468E-06
RW-21	0.28	6.46E-04	3.895E-09
S-187	0.01	8.03E-09	5.572E-14
S-189	0.06	1.64E-06	5.821E-11
S-190	0.11	1.89E-06	1.115E-12
MW-27	0.43	5.54E-03	2.923E-07
MW-28	1.22	8.90E-02	4.462E-06
MW-29	2.29	2.92E-01	1.114E-05
MW-34	0.01	9.15E-10	1.300E-17
MW-41	0.56	7.92E-03	1.060E-07
MW-42	0.01	8.94E-11	2.718E-18
MW-44	0.1	3.44E-06	3.015E-12
OW-12	0.37	3.12E-03	1.574E-07
OW-13	0.01	1.08E-08	1.692E-13
S-100	0.01	6.19E-10	6.988E-18
S-198	0.24	4.73E-04	2.160E-09
S-199	0.82	5.28E-02	1.505E-06
S-200	0.01	3.26E-10	2.478E-18
S-201	0.66	2.03E-02	4.112E-07
S-205	0.08	9.58E-07	4.017E-13
S-213	0.01	4.11E-10	3.612E-18
S-83	0.17	1.84E-05	2.746E-11
S-89	0.09	3.92E-06	1.684E-10
MW-26	1.36	4.38E-02	1.783E-06
PZ-403	0.41	5.06E-04	1.652E-08
PZ-404	0.36	3.39E-04	1.130E-08
OW-16	0.42	4.55E-03	2.338E-07
RW-405	0.02	6.29E-08	2.256E-12
S-160	0.2	8.93E-06	2.099E-10
S-161	0.09	8.90E-07	1.943E-11
S-162	0.22	1.12E-05	2.562E-10
S-50	0.21	9.70E-06	2.215E-10
S-77	0.62	7.56E-04	1.559E-08
S-210	0.71	3.95E-04	4.985E-10
MW-33	0.01	2.53E-08	9.341E-14
S-208	0.01	6.61E-11	3.256E-20
S-78	0.03	1.50E-07	5.870E-13
S-79	0.12	5.86E-06	2.766E-11
OW-17	0.01	6.30E-09	8.664E-15
S-126	0.01	1.76E-12	3.670E-24

Notes:

1. Groundwater/LNAPL gauging event performed by Handex in May 2005.
2. The Specific Volume and Seepage Velocity values were calculated using API model.
3. A groundwater gradient of 0.0035 was used in the calculation of these values.

Table 8
Summary Of Soil Gas Sampling Results
Sunoco Philadelphia Refinery, AOI 1
Philadelphia, Pennsylvania

	CAS Number	PADEP Indoor Air Criteria Non-Residential MSC x100	Sample ID Sample Date Sample Matrix Units	SG-5 4/19/2005 Soil Gas mg/m^3			SG-4 4/19/2005 Soil Gas mg/m^3			SG-2 4/19/2005 Soil Gas mg/m^3			SG-8 4/19/2005 Soil Gas mg/m^3			SG-9 4/19/2005 Soil Gas mg/m^3			SG-10 4/19/2005 Soil Gas mg/m^3			SG-11 4/19/2005 Soil Gas mg/m^3		
Volatile Organic Compounds				Result	Q	MDL	Result	Q	MDL	Result	Q	MDL	Result	Q	MDL	Result	Q	MDL	Result	Q	MDL	Result	Q	MDL
Napthalene	91-20-3	0.88	mg/m^3	ND		0.017	ND		0.017	ND		0.017	ND		0.02	ND		0.017	ND		0	ND		0.017
Methyl Tertiary Butyl Ether	1634-04-4	31	mg/m^3	ND		0.7	ND		0.35	ND		0.35	ND		140	ND		0.07	ND		35	ND		70
1,2-Dichloroethane	107-06-2	0.31	mg/m^3	ND		0.8	ND		0.4	ND		0.4	ND		160	ND		0.08	540		40	2200		80
Benzene	71-43-2	1.1	mg/m^3	0.7	J	0.6	0.68	J	0.3	9		0.3	ND		130	0.69		0.06	22000		30	85000		120
Toluene	108-88-3	120	mg/m^3	2	J	0.8	2		0.4	0.9	J	0.4	200	J	150	0.68		0.08	1000		40	2600		80
Etylene Dibromide	106-93-4	0.037	mg/m^3	ND		2	ND		0.75	ND		0.75	ND		300	ND		0.15	ND		75	ND		150
Ethylbenzene	100-41-4	7.3	mg/m^3	1	J	0.9	ND		0.45	ND		0.45	ND		170	ND		0.09	ND		45	150	J	90
Xylenes (Total)	1330-20-7	30	mg/m^3	3	J	0.9	1	J	0.45	0.8	J	0.45	ND		170	0.12	J	0.09	65	J	45	540	J	90
Cumene	98-82-8	110	mg/m^3	ND		1	ND		0.5	ND		0.5	ND		200	ND		0.1	ND		50	ND		100

Notes:
PADEP - Pennsylvania Department of Environmental Protection
mg/m^3 - Milligrams Per Cubic Meter
MSC - Medium Specific Concentration for Impact to Soil Gas
RL - Reporting Limit
MDL - Method Detection Limit
ND - Not Detected

Qualifiers:
Q - Qualifier
J - Estimated Value, The Analyte Was Detected Below the MDL
U - The Analyte Was Analyzed But Not Detected

Exceedance Summary:
10 - Reporting Limit Exceeds the PADEP Non-Residential Soil Gas MSCs
10 - Compound Exceeds the PADEP Non-Residential Soil Gas MSCs

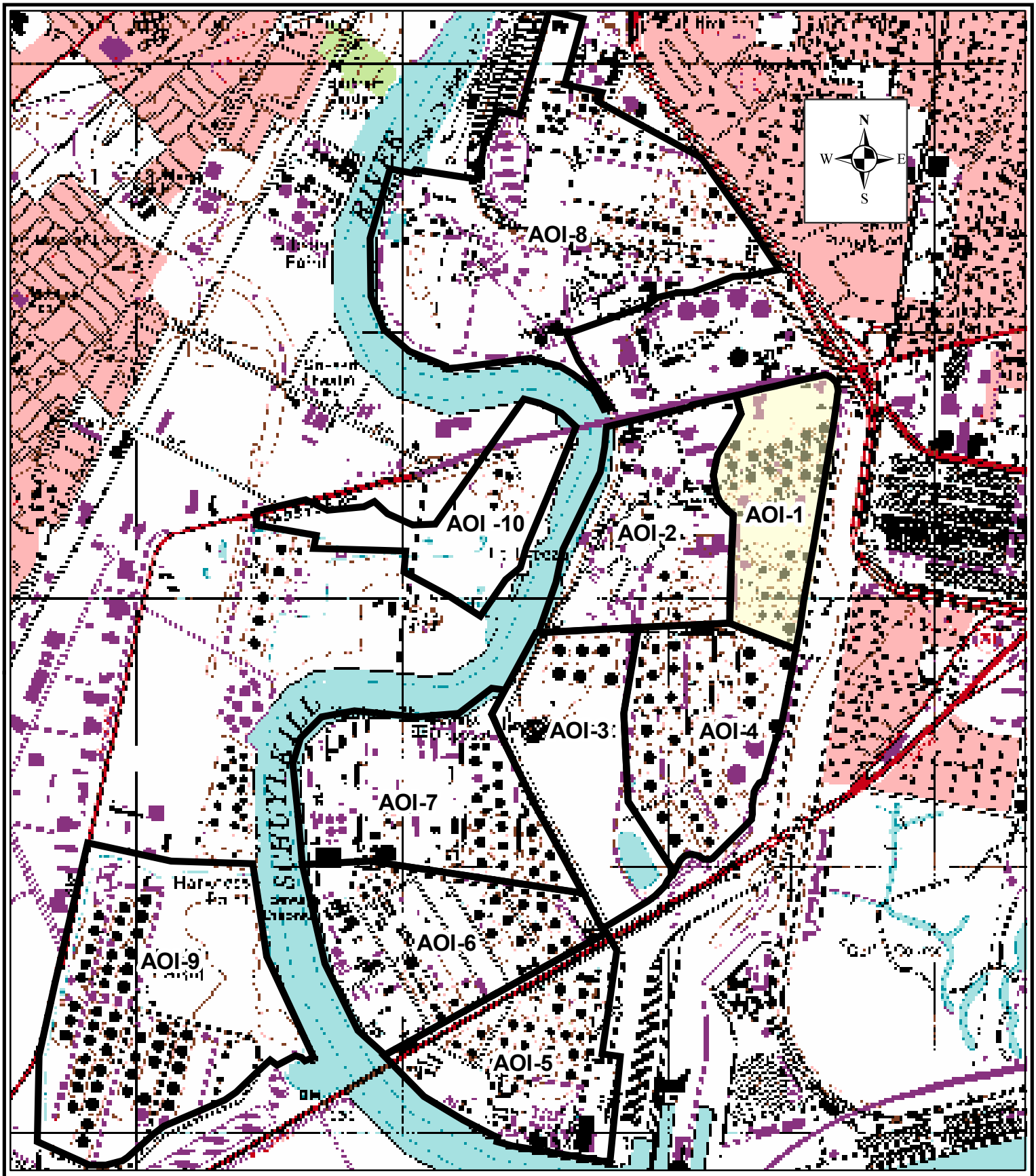
Table 9
Summary of Groundwater Sample Results from Soil Gas Points
Sunoco Philadelphia Refinery - AOI 1
Philadelphia, Pennsylvania

	CAS Number	USEPA-PA Defaults Nonresidential Volatilization to Indoor Air Screen (1)	Sample ID / Sample Date / Sample Matrix / Units	SG1-GW-042605 / 4/26/2005 / Groundwater / ug/l			SG3-GW-042605 / 4/26/2005 / Groundwater / ug/l			SG6-GW-0426050 / 4/26/2005 / Groundwater / ug/l			SG7-GW-042605 / 4/26/2005 / Groundwater / ug/l		
Volatile Organic Compounds				**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**	**Result**	**Q**	**RL**
Ethylene Dibromide	106-93-4	1000	ug/l	ND	U	0.03	ND	U	0.029	ND	U	0.029	ND	U	0.029
1,2-Dichloroethane	107-06-2	4600	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Benzene	71-43-2	5900	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Ethylbenzene	100-41-4	**45000**	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Cumene	98-82-8	NS	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Methyl Tertiary Butyl Ether	1634-04-4	640000	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Toluene	108-88-3	NOC	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Xylene (Total)	1330-20-7	NOC	ug/l	ND	U	5	ND	U	5	ND	U	5	ND	U	5
Semi-Volatile Organic Compounds															
Chrysene	218-01-9	NS	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Fluorene	86-73-7	NOC	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Naphthalene	91-20-3	NOC	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Phenanthrene	85-01-8	NOC	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10
Pyrene	129-00-0	NS	ug/l	ND	U	10	ND	U	10	ND	U	10	ND	U	10

Notes:
NS - No Standard
NOC - Not of Concern
1 - PA Defaults Using USEPA J&E Version 2.3; 03/01, Nonresidential Receptor, RL = 10-5, HQ=1
4500 - Bold Face Values Indicate Compound of Potential Indoor Air Concern
391 Actual Dectection Above USEPA Defaults Nonresidential Volatilization to Indoor Air
RL- Reporting Limit
ND - Not Detected

Qualifiers:
Q - Qualifier
U - The Analyte Was Analyzed But Not Detected

FIGURES



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

SUNOCO

Sunoco, Inc. (R&M)

Philadelphia Refinery

3144 Passyunk Avenue
Philadelphia, PA. 19145

Figure 1: Site Boundary with AOI 1 Highlighted
AOI 1 Site Characterization Report
Philadelphia Sunoco Philadelphia Refinery Pennsylvania

Job Number	Scale: 1" = 1600'	Date
2574601	0 800 1,600 Feet	June 21, 2005

Q:\Data6\2574601\ArcGIS\MapDocuments\AOI 1 Site Characterization Report\Figure 1- AOI 1 Boundary.mxd

Legend

AOI-1: No.1 Tank Farm, No.2 Tank Farm, and Belmont Terminal Boundaries

N
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Figure 2: Site Plan
AOI 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 125 250 Feet

SCALE: 1" = 125'
DATE: June 20, 2005
DRN. BY: JSC
CKD. BY: JH
JOB#: 2574601

O:\Date\2574601\ArcGIS\MapDocuments\AOI 1 Site Characterization Report\Figure 2- Site Plan.mxd

Legend

- S-116 — Wells Investigated for Groundwater Mounding
- SG-1 — Soil Gas Monitoring Point
- BH-206-1.0-1.5 — Soil Samples Locations
- AOI Boundaries
- S-42D — New Lower Sand Monitoring Well
- S-206 — New Trenton Gravel Monitoring Well
- S-206 BH-206-1.0-1.5 — New Trenton Gravel Well With Soil Samples
- S-76 — All Existing Monitoring Points

N W E S

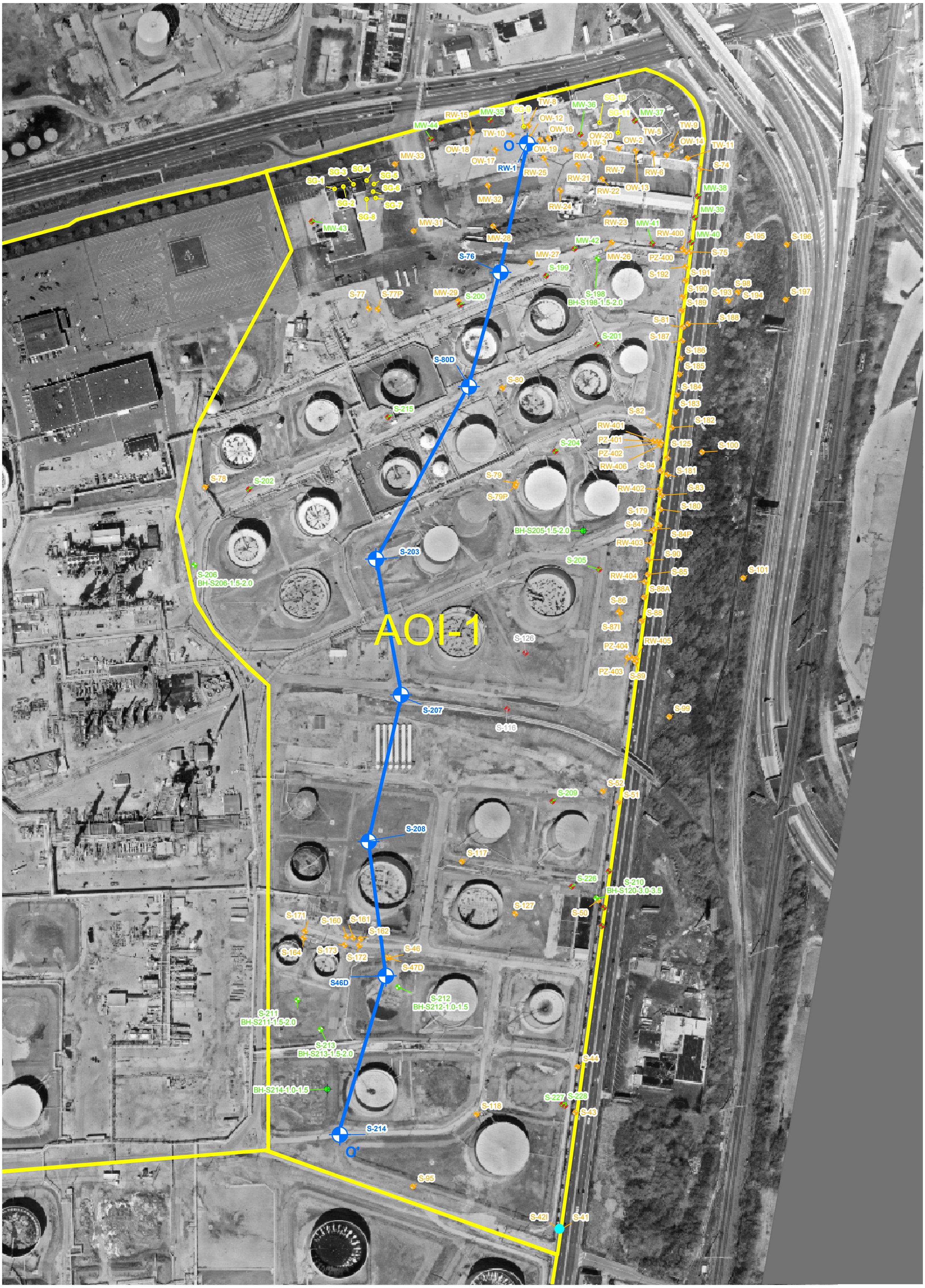
Figure 3: Completed Activities
AOI 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 125 250 Feet

SCALE: 1" = 125'
DATE: June 20, 2005
DRN. BY: JSC
CKD. BY: JH
JOB#: 2574601

Q:\Data\2574601\Arc\GIS\MapDocuments\AOI 1 Site Characterization Report\Figure 3- Completed Activities.mxd



Legend

- Cross Section O - O'
- S-208 — Monitoring Well Used In Cross Section
- S-116 — Wells Investigated for Groundwater Mounding
- SG-1 — Soil Gas Monitoring Point
- BH-206-1.0-1.5 — Soil Samples Locations
- AOI Boundaries
- S-42D — New Lower Sand Monitoring Well
- S-206 — New Trenton Gravel Monitoring Well
- S-206 BH-206-1.0-1.5 — New Trenton Gravel Well With Soil Samples
- S-76 — All Existing Monitoring Points

N W E S

Figure 4: Cross Section Location Map
AOI 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

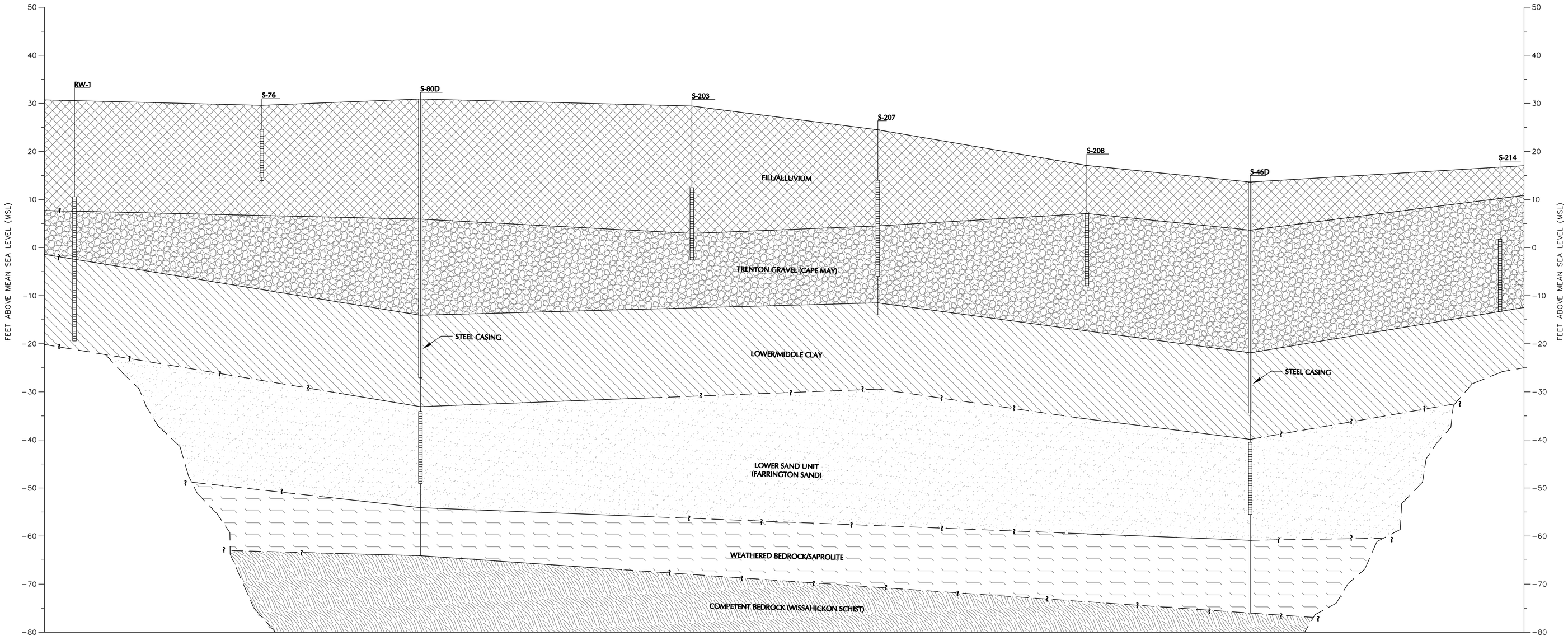
0 125 250 Feet

SCALE: 1" = 125'
DATE: August 18, 2005
DRN. BY: JSC
CKD. BY: JH
JOB#: 2574601

O:\Date\2574601\ArcGIS\Mxd\Documents\AOI 1 Site Characterization Report\Figure 4 - Cross Section Location Map.mxd

O
NORTH

O'
SOUTH



LEGEND

- FILL
- ALLUVIUM
- SAND AND GRAVEL
- CLAY/SILT
- SAND
- WEATHERED BEDROCK
- BEDROCK
- WELL SCREEN

10 0 2 4 10
VERTICAL SCALE IN FEET

100 0 50 100
HORIZONTAL SCALE IN FEET

SUNOCO

Project
SUNOCO, INC. (R & M)
PHILADELPHIA
PHILADELPHIA COUNTY PENNSYLVANIA

Drawing Title
GEOLOGIC CROSS SECTION O-O'
SUNOCO PHILADELPHIA REFINERY AND BELMONT TERMINAL

Project No.	2574601
Date	1 JUNE 2005
Scale	AS SHOWN
Drn. By	DMM/RJA
Last Revised	8 JUNE 2005
Drawing No.	5
	1 Of 1

Filename: Q:\Data6\2574601\Cadd Data - 2574601\Dwg\Environmental\Figure 5_Geologic Cross Section O-O'.dwg Date: 6/21/2005 Time: 12:41 User: dwebster Style Table: Langan.stb Layout: E Size Sheet (Bottom)

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AOI-1

OI-2

Legend

- AOI Boundaries
- Groundwater Elevation Contour
- Groundwater Depression Contour
- Inferred Groundwater Contour
- Trenton Gravel Wells and Groundwater Elevations (ft amsl)
- Trenton Gravel Recovery Wells and Groundwater Elevations (ft amsl)
- Fill / Alluvium Wells and Groundwater Elevations (ft amsl)
- Fill / Alluvium Recovery Wells and Groundwater Elevations (ft amsl)
- Recovery Wells
- 26th Street Area Off-Site Wells
- Other Existing Wells
- Other Existing Recovery Wells

Notes:
1. All Groundwater elevations collected by Handex during May 2005. Only wells accessible during gauging event are listed.

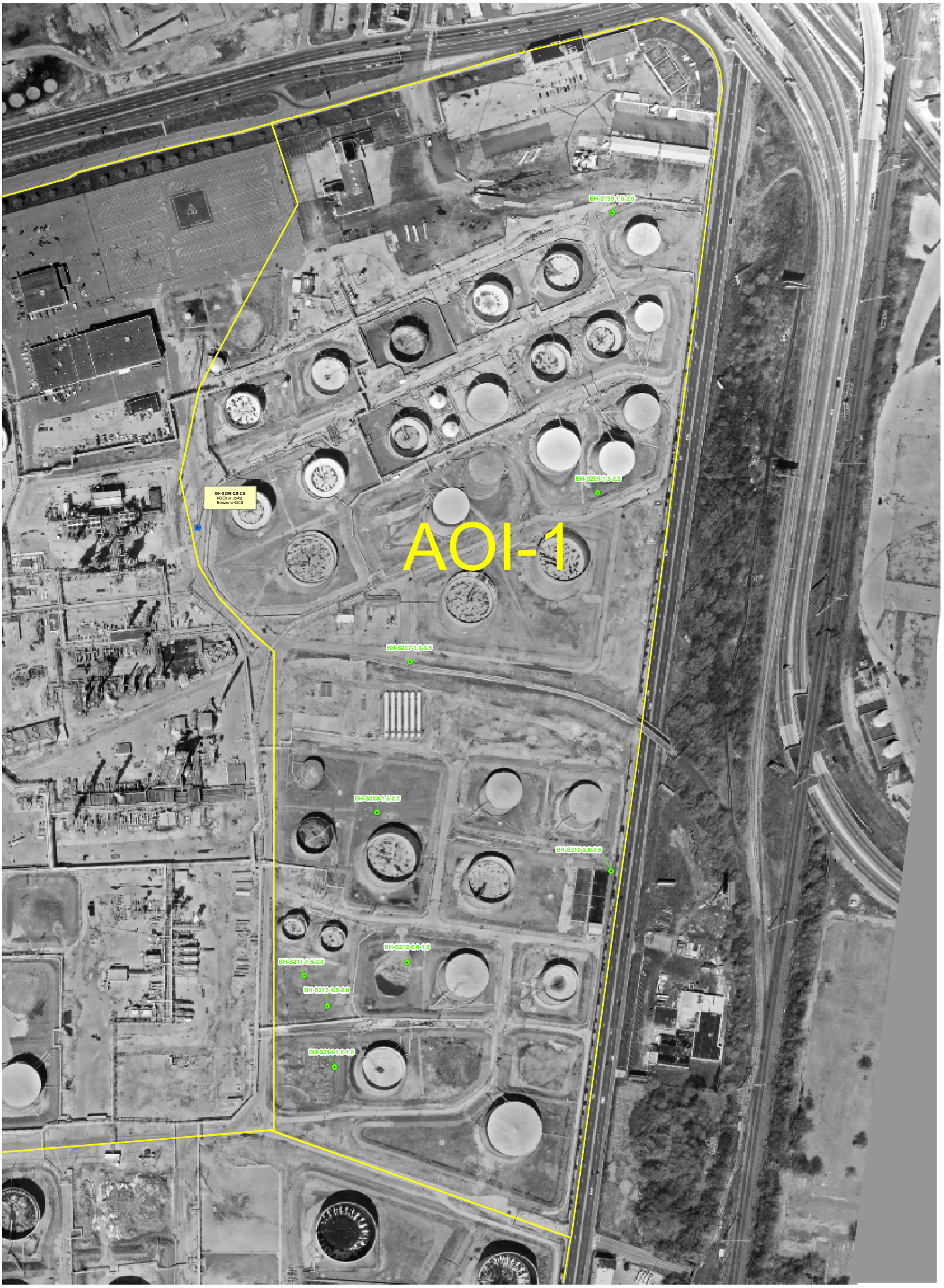
Figure 6: Fill / Alluvium and Trenton Gravel Groundwater Elevations
AOI 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 125 250 Feet

SCALE: 1" = 125'
DATE: June 20, 2005
DRN. BY: JSC
CKD. BY: JH
JOB#: 2574601

O:\Data\2574601\Arc\GIS\MapDocs\mxds\AOI 1 Site Characterization Report\Figure 7 - Fill_Alluvium and Trenton Gravel Groundwater Elevations.mxd



N
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Legend

- Shallow Soil Sampling Location With no Exceedances
- Shallow Soil Sampling Location With Exceedances
- AOI Boundary

Compounds of Concern for Site Soil and Associated MSC'S

	CAS No	PADEP Non-Residential Soil MSC (ug/kg)	
		0 - 2' Dry	2 - 15' Dry
Volatile Organic Compounds			
Ethylene dibromide (EDB)	106-93-4	5	5
1,2-Dichloroethane	107-06-2	500	500
Benzene	71-43-2	500	500
Ethylbenzene	100-41-4	70000	70000
Cumene	98-82-8	1600000	1600000
Methyl Tertiary Butyl Ether	1634-04-4	2000	2000
Toluene	108-88-3	100000	100000
Xylene (Total)	1330-20-7	1000000	1000000
Semi-Volatile Organic Compounds			
Chrysene	218-01-9	230000	230000
Anthracene	120-12-7	350000	350000
Benzo(a)anthracene	56-55-3	110000	320000
Benzo(a)pyrene	50-32-8	11000	46000
Benzo(b)fluoranthene	205-99-2	110000	170000
Benzo(g,h,i)perylene	191-24-2	180000	180000
Fluorene	86-73-7	3800000	3800000
Naphthalene	91-20-3	25000	25000
Phenanthrene	85-01-8	10000000	10000000
Pyrene	129-00-0	2200000	2200000
Metals			
Lead (Total)	7439-92-1	450000	450000

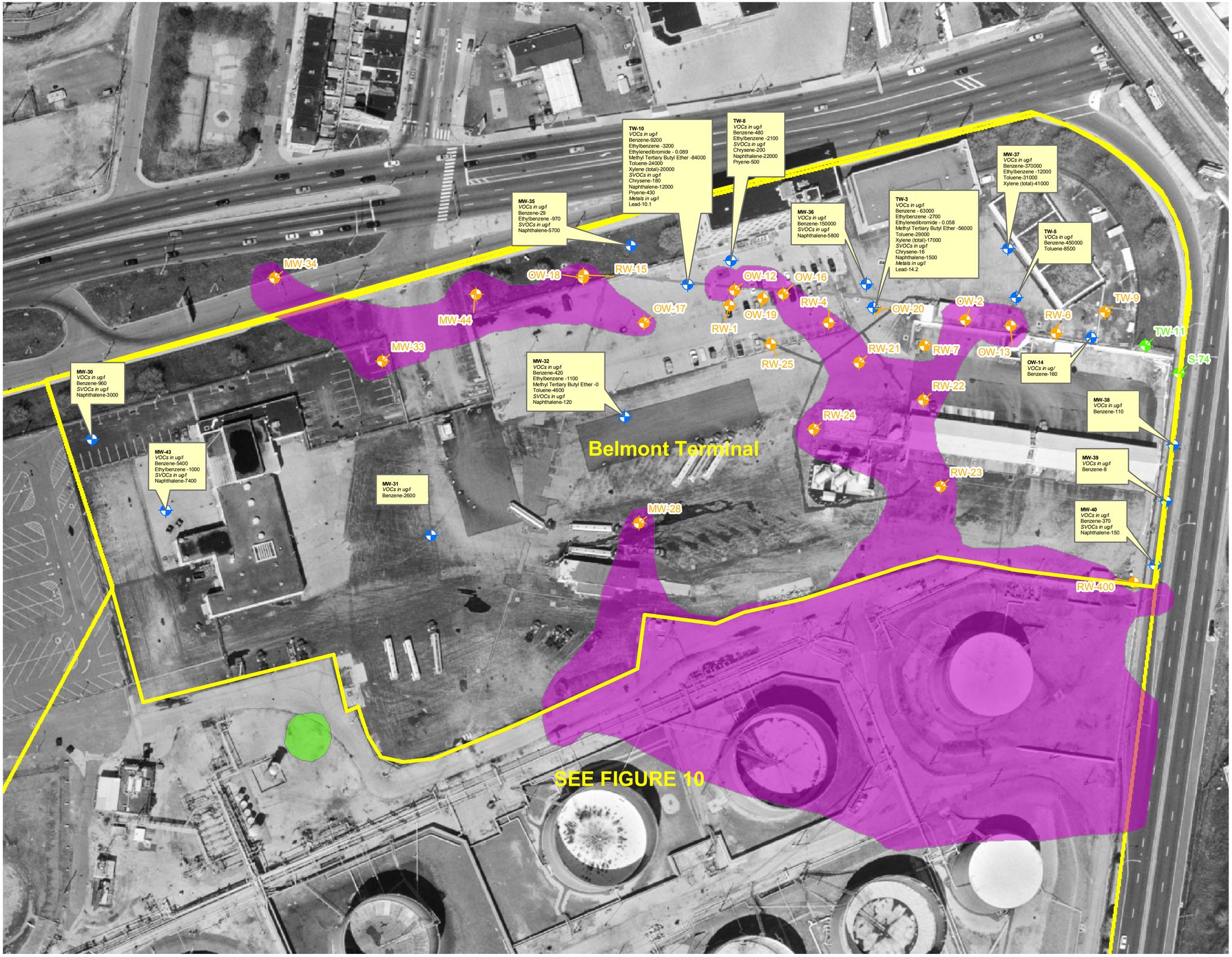
Figure 7: Summary of Soil Sample Exceedances
AOI 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 125 250 Feet

SCALE: 1" = 125'
DATE: May 30, 2005
DRN. BY: JSC
CKD. BY: JH
JOB#: 2574601

O:\Data\2574601\ArcGIS\MapDocuments\AOI 1 Site Characterization Report\Figure 7 - Summary of Soil Sample Exceedances.mxd



N
W E
S

Legend

- Groundwater Monitoring Location Not Sampled (Active Recovery Well or LNAPL Present)
- Groundwater Monitoring Location With Exceedance Of PADEP MSC
- Groundwater Monitoring Location With No Exceedance Of PADEP MSC
- AOI 1 and Belmont Terminal Boundaries

LNAPL Plume Type

- Gasoline / Middle Distillate Mix
- Lube Oil
- Light End Feed Stock
- Middle Distillate / Light End Feed Stock
- Unknown - Insufficient Quantity for Analysis

Compounds of Concern For Site Groundwater and Associated MSC's

	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 (ug/l)
Volatile Organic Compounds		
Ethylene dibromide (EDB)	106-93-4	0.05
1,2-Dichloroethane	107-06-2	5
Benzene	71-43-2	5
Ethylbenzene	100-41-4	700
Cumene	98-82-8	2300
Methyl Tertiary Butyl Ether	1634-04-4	20
Toluene	108-88-3	1000
Xylene (Total)	1330-20-7	10000
Semi-Volatile Organic Compounds		
Chrysene	218-01-9	1.9
Fluorene	86-73-7	1900
Naphthalene	91-20-3	100
Phenanthrene	85-01-8	1100
Pyrene	129-00-0	130
Metals		
Lead (Total)	7439-92-1	5

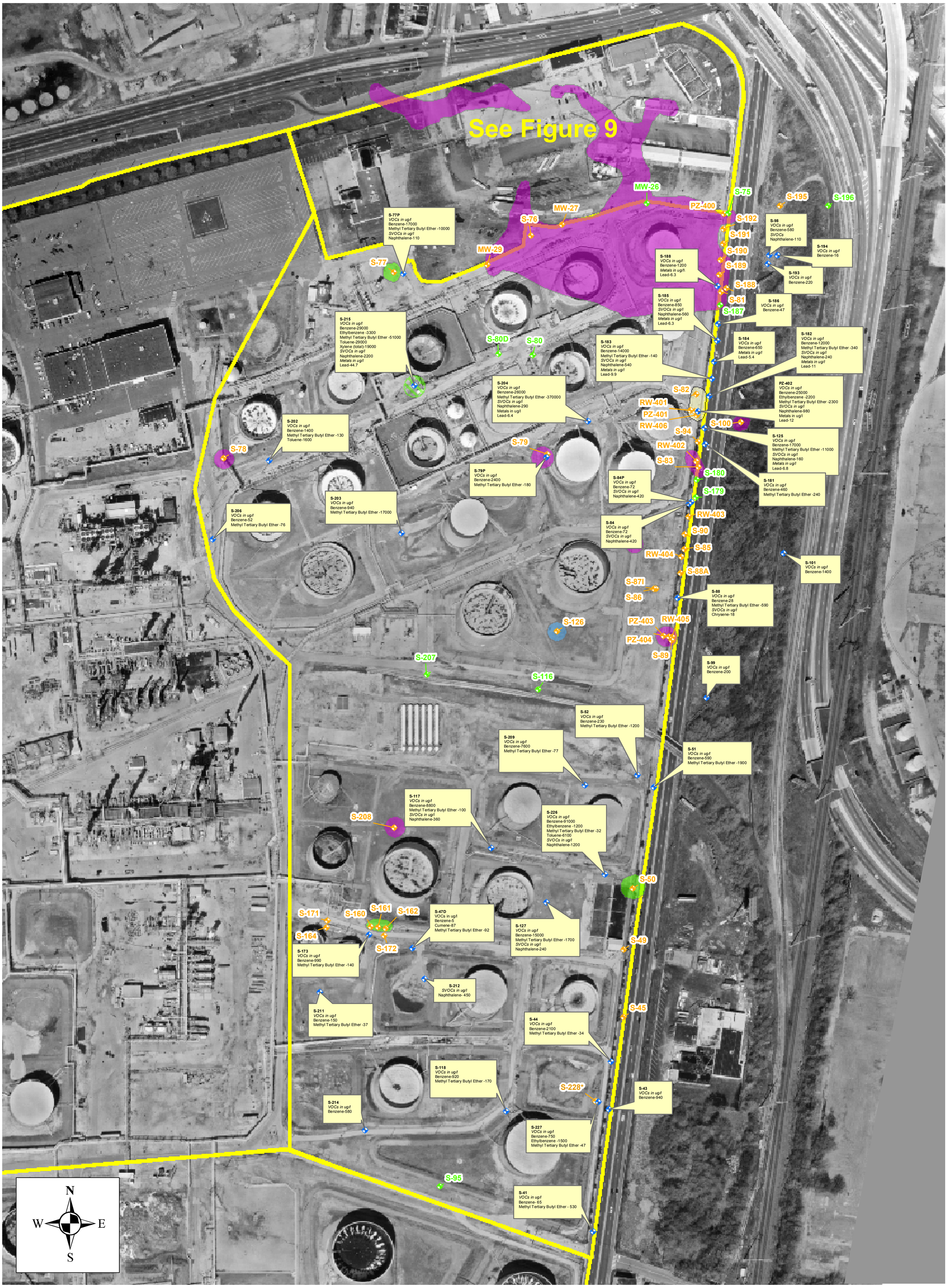
Figure 8: Summary of Groundwater Sample Exceedances and Apparent LNAPL Extent: Fill / Alluvium and Trenton Gravel Wells in Belmont Terminal
AOI 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 50 100 Feet

SCALE: 1" = 50'
DATE: May 20, 2005
DRN. BY: JSC
CKD. BY: JH
JOB#: 2574501

G:\Projects\Philly Refinery\Belmont\Belmont Terminal\Site Characterization Report\Figure 8 - Summary of Groundwater Sample Exceedances And Apparent LNAPL Extent.mxd



Legend

- Groundwater Sampling Location With No Exceedance Of PADEP MSC
- Groundwater Sampling Location With Exceedance Of PADEP MSC
- Groundwater Sampling Location Not Sampled (Active Recovery Well Or LNAPL Present)
- AOI 1 and Belmont Terminal Boundaries
- Gasoline / Middle Distillate
- Light End Feed Stock
- Lube Oil
- Middle Distillate / Light End Feed Stock
- Unknown

*** Sample not collected at location S-228 because of it's proximity to S-227.**

Compounds of Concern for Site Groundwater and Associated MSC's

	CAS No	PADEP Non-Residential Used Aquifer MSC for Groundwater TDS<2,500 (ug/l)
Volatile Organic Compounds		
Ethylene dibromide (EDB)	106-93-4	0.05
1,2-Dichloroethane	107-06-2	5
Benzene	71-43-2	5
Ethylbenzene	100-41-4	700
Cumene	98-82-8	2300
Methyl Tertiary Butyl Ether	1634-04-4	20
Toluene	108-88-3	1000
Xylene (Total)	1330-20-7	10000
Semi-Volatile Organic Compounds		
Chrysene	218-01-9	1.9
Fluorene	86-73-7	1900
Naphthalene	91-20-3	100
Phenanthrene	85-01-8	1100
Pyrene	129-00-0	130
Metals		
Lead (Total)	7439-92-1	5

Figure 9: Summary of Groundwater Sample Exceedances and Apparent LNAPL Extent:Fill / Alluvium and Trenton Gravel Wells in No. 1 and No. 2 Tank Farms
AOI 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 125 250 Feet

SCALE: 1" = 125'
DATE: May 30, 2005
DRN. BY: JSC
CKD. BY: JH
JOB#: 2574601

G:\Data\257460.1\ArcGIS\MapDocuments\AOI 1 Site Characterization Report\Summary of Groundwater Sample Exceedances Figure 9 Fill _Alluvium and Trenton Gravel Wells in No. 1 and No. 2 Tank Farms.mxd

MW-34 0.01
MW-44 0.01
OW-18 0.08
OW-12 0.37
OW-16 0.42
RW-4 2.66
RW-21 0.28
OW-2 0.27
OW-13 0.01
OW-17 0.01
MW-33 0.01
RW-24 0.35
RW-22 0.09
RW-23 0.8
MW-28 1.22
MW-42 0.01
MW-26 1.36
MW-41 0.56
MW-27 0.43
S-75 0.09
S-198 0.24
S-77 0.62
MW-29 2.29
S-76 1.38
S-199 0.82
S-190 0.11
S-200 0.01
S-189 0.06
S-201 0.66
S-81 0.53
S-187 0.01
S-82 0.04
RW-401 0.09
PZ-401 0.01
RW-406 0.38
S-100 0.01
S-215 0.22
S-78 0.03
S-79 0.12
S-83 0.17
S-205 0.08
AOI-1
S-126 0.01
PZ-404 0.36
PZ-403 0.41
RW-405 0.02
S-89 0.09
S-208 0.01
S-210 0.71
S-50 0.21
S-160 0.2
S-162 0.22
S-161 0.09
S-213 0.01

Legend

Monitoring Points with LNAPL

- Shallow
- Piezometer
- Intermediate
- Intermediate RW
- Deep well
- Recovery Well

Wells With Specific LNAPL Types

- Gasoline
- Light End Feed Stock
- Lube Oil
- Middle Distillate / Gasoline
- Middle Distillate / Light End Feed Stock
- Unknown

LNAPL Plume Type

- Gasoline / Middle Distillate
- Light End Feed Stock
- Lube Oil
- Middle Distillate / Light End Feed Stock
- Unknown

AOIs

Monitoring Points With No LNAPL

Notes:
1. All LNAPL thickness measured May 2005 by Handex.
2. All LNAPL thickness measured to the nearest .01 feet.
3. LNAPL types based on samples collected in 2004 and 2005 by Aquaterra and analyzed by Torkelson Geochemistry.

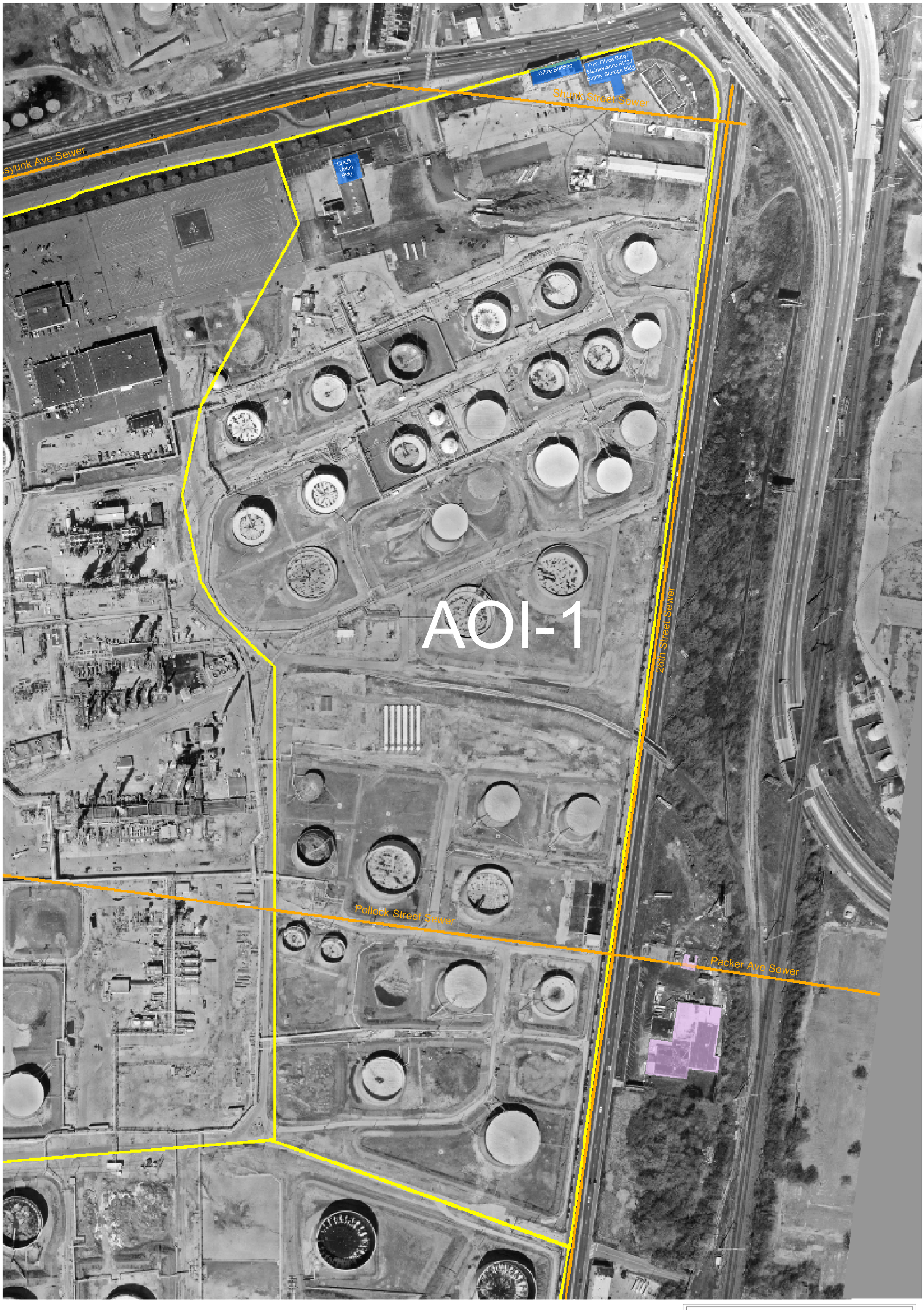
Figure 10: Apparent LNAPL Thickness
AOI 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 125 250 Feet

SCALE: 1" = 125'
DATE: June 1, 2005
DRN. BY: JSC
CKD. BY: JH
JOB#: 2574601

G:\Data\2574601\ArcGIS\MapDocuments\AOI 1 Site Characterization Report\Figure 10 - Apparent LNAPL Thickness.mxd



N
W E
S

Legend

- AOI Boundaries
- Non-Residential Receptors
- Off-Site Non-Residential Receptors
- Potential Migration Pathways

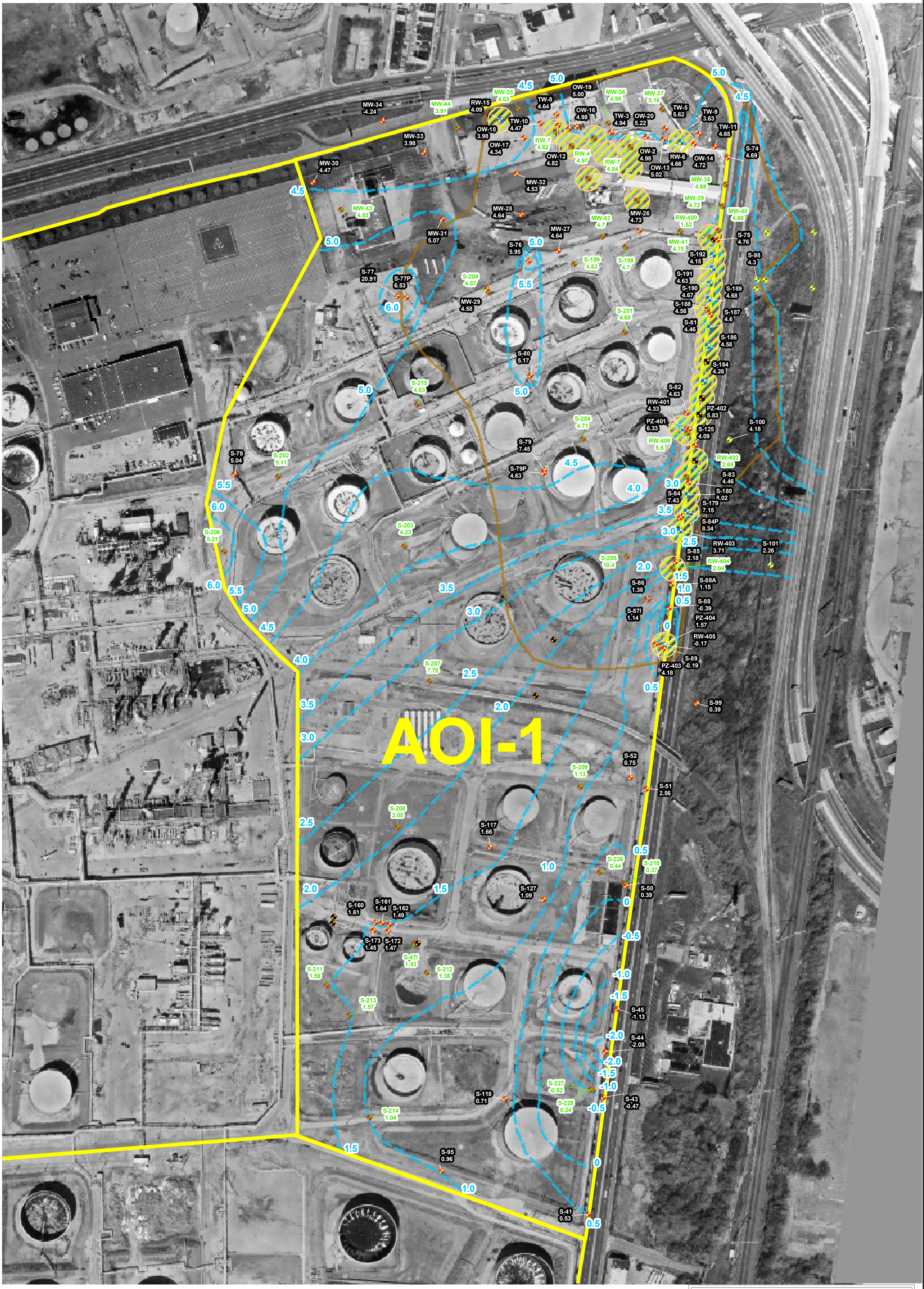
Figure 11: Potential Migration Pathways and Receptors
AOI 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 125 250 Feet

SCALE: 1" = 125'
DATE: June 13, 2005
DRN. BY: JSC
CKD. BY: JH
JOB#: 2574601

O:\Data\2574601\MxdGIS\MxdDocuments\AOI 1 Site Characterization Report\Figure 11 - Potential Migration Pathway Receptors.mxd



N
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Legend

- AOI Boundaries
- Total Fluids Recovery Well Approximate Radius of Influence
- Estimated Zone of Fluids Capture
- Groundwater Depression Contour
- Inferred Groundwater Elevation Contour
- S-34 7.87 — Trenton Gravel Wells and Groundwater Elevations (ft amsl)
- S-34 7.87 — Trenton Gravel Recovery Wells and Groundwater Elevations (ft amsl)
- S-75 4.27 — Fill / Alluvium Wells and Groundwater Elevations (ft amsl)
- S-75 4.27 — Fill / Alluvium Recovery Wells and Groundwater Elevations (ft amsl)
- Recovery Wells
- S-100 — 26th Street Area Off-Site Wells
- Other Existing Wells
- Other Existing Recovery Wells

Notes:
1. All Groundwater elevations collected by Handex during May 2005. Only wells accessible during gauging event are listed.

Figure 12: Total Fluids Recovery Systems and Estimated Zone of Capture
AOI 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 125 250 Feet

SCALE: 1" = 125'
DATE: August 18, 2005
DRN. BY: JSC
CKD. BY: JH
JOB#: 2574601

O:\Data\2574601\ArcGIS\MapDocuments\AOI 1 Site Characterization Report\Figure 12 - Total Fluids Recovery Systems and Estimated Zone of Capture.mxd

AOI-1

Legend

Conservative Tracer Concentration Scale
1,000.0 mg/L
0.001 mg/L

- AOI Boundaries
- Total Fluids Recovery Well Approximate Radius of Influence
- Estimated Zone of Fluids Capture
- Groundwater Elevation Contour
- Groundwater Depression Contour
- Inferred Groundwater Contour

- S-34 7.87 — Trenton Gravel Wells and Groundwater Elevations (ft amsl)
- S-34 7.87 — Trenton Gravel Recovery Wells and Groundwater Elevations (ft amsl)
- S-75 4.27 — Fill / Alluvium Wells and Groundwater Elevations (ft amsl)
- S-75 4.27 — Fill / Alluvium Recovery Wells and Groundwater Elevations (ft amsl)

- Recovery Wells
- S-100 — 26th Street Area Off-Site Wells
- Other Existing Wells
- Other Existing Recovery Wells

Notes:
1. All Groundwater elevations collected by Handex during May 2005. Only wells accessible during gauging event are listed.
2. The approximated extent of dissolved groundwater concentrations is based on Quick Domenico results for monitoring and recovery wells S-226, S-51, S-99, S-88, S-84, S-181, S-125, PZ-402, S-182, S-183, S-184, S-186, S-187, S-193, S-194, and MW-38.

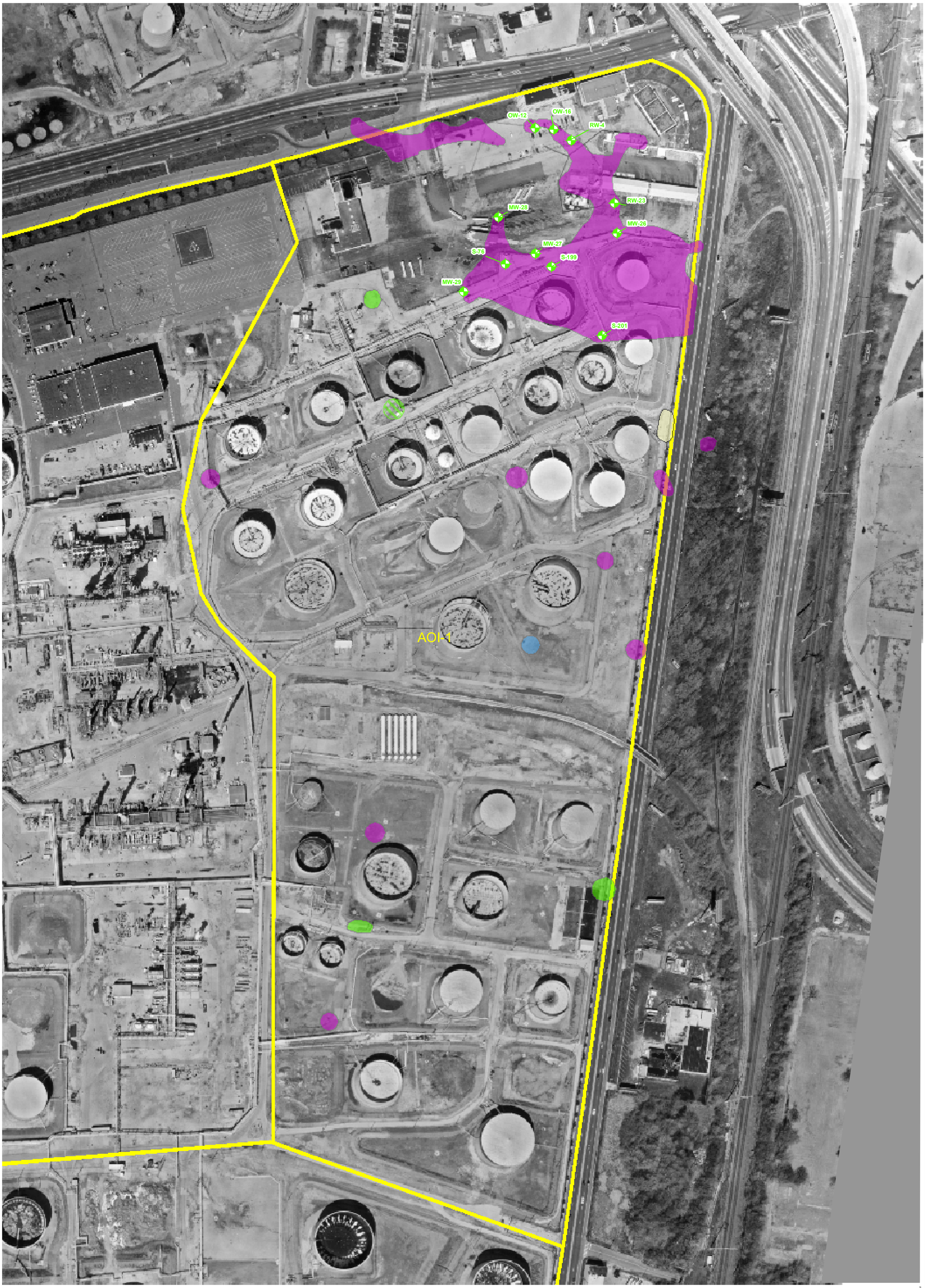
Figure 13: Fate and Transport Results Summary: Fill / Alluvium and Trenton Gravel Wells
AOI 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 125 250 Feet

SCALE: 1" = 125'
DATE: November 8, 2005
DRN. BY: JSC
CKD. BY: JH
JOB#: 2574601

O:\Dwg\2574601\Arc\GIS\MapDocuments\AOI 1 Site Characterization Report\Figure 13 - Fate and Transport Results\revised11805.mxd



N
W E
S

Legend

- Wells With Greatest Calculated LNAPL Mobility Values
- AOIs

LNAPL Plume Type

- Gasoline / Middle Distillate
- Light End Feed Stock
- Lube Oil
- Middle Distillate / Light End Feed Stock
- Unknown

Figure 14: Wells With Greatest Calculated LNAPL Mobility Values
AOI 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 125 250 Feet

SCALE: 1" = 125'
DATE: June 1, 2005
DRN. BY: JSC
CKD. BY: JH
JOB#: 2574601

O:\Data\2574601\ArcGISMapDocuments\AOI 1 Site Characterization Report\Figure 14 - Wells With Greatest Calculated LNAPL Mobility Values.mxd

APPENDIX A

CURRENT AND HISTORIC USE FIGURES IN AOI 1 AND PAVED SURFACES IN AOI 1

Office
Former Office Building/
Maintenance Building/
Supply Storage
Biofilter
Credit
Union
Belmont Terminal
Loading
Racks
Garage
Blender
26
27
28
85
39
38
29
30
RM-90
37
42
36
RM-91
43
83
35
44
34
84
40
129
128
AOI-1
182
119
121
181
178
179
Pump House
#16
Biofilter
125
126
172
176
162
190

N
W E
S

Legend

Tanks Contents

886 Intermediate Fuels

886 Light Fuels and Chemicals

AOI Boundaries

Current Use Areas

Figure A1: Current Use
AOI 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 125 250 Feet

SCALE: 1" = 125'
DATE: May 24, 2005
DRN. BY: JSC
CKD. BY: JH
JOB#: 2574601

G:\Data\2574601\ArcGIS\MapDocuments\AOI 1 Site Characterization Report\Figure A1 - Current Use.mxd

Batch Stills and Processed Solvent Materials
Naphtha Plant
Pipe Stills
Heavy Oils
Cogen Plant
Solvent Tanks
Pump House #14
Pipe Stills
AOI-1
AOI-2
AOI-3
AOI-4
Former Ballfields
Former Tank Car Cleaning Area
10
7300
7308
7300
7305
7307
7310
7311
15V-102
15V-101
RM-90
RM-91
ST-2
ST-3

Legend

882 Historic Tankage

AOI Boundaries

Historic Use Area

N
W E
S

Notes:
1. Historic usage derived from available historic documentation.

Figure A2: Point Breeze South Yard
Historic Use
Sunoco Philadelphia Refinery
and Belmont Terminal
Philadelphia, Pennsylvania

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

0 250 500 Feet

SCALE: 1" = 250'
DATE: June 28, 2004
DRN. BY: JSC
CKD. BY: CC
JOB#: 2574601

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AOI-1

N

W E

S

Legend

Paved Surfaces, Tanks, and Buildings

Paved Surfaces

AOI Boundary

Notes:
1. Paved surfaces estimated based on on-site observation.

Figure A3: Paved Surfaces, Tanks, and Buildings in AOI 1
AOI 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 125 250 Feet

SCALE: 1" = 120'
DATE: June 20, 2005
DRN. BY: JSC
CKD. BY: JH
JOB#: 2574601

G:\Out#\2574601\Arc\GIS\MapDocuments\AOI 1 Site Characterization Report\Figure 2A - Paved Surfaces in AOI1.mxd

APPENDIX B

SOIL BORING LOGS/MONITORING WELL CONSTRUCTION SUMMARIES

BELMONT TERMINAL BORING LOGS AND WELL CONSTRUCTION SUMMARY

Aquaterra Technologies, Inc.
Subsurface Log: MW-35

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: MW-35
Casing Elevation: N/A
Screen Diameter: 4 inch **Length:** 15'
Casing Diameter: 4 inch **Length:** 20'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 31-Mar-05
Borehole Dia: 8.25"
Water Level (Init): 30'
Rig Type: HSA Rig

Construction Details

Total Well Depth: 35' bgs
Screen Interval: 20'-35'
Sand Pack Interval: 18'-35'
Completion Details: 10" Flushmount

Backfill: 0'-15'
Cement/Grout Interval: NA
Bentonite Interval: 16'-18'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Hydroexcavate to 8' BGS	
5				Advance augers to 10' BGS and begin split spoons every 5'	
10	10-12	2.9	2	Gray-brown banded silt, compact, very moist	
15	15-17	0	2	Same as above to 16' BGS, changing to a red-brown gravel and sand, some rocks present, slighlty moist.	
20	20-22	0	2	Red-brown gravel and sand, slight moisture	
25	25-27	5.8	2	Red-brown gravel very coarse sand and gravel, slightly moist.	
30	30-32	1047	2	Black stained sand and gravel, wet. Sheen present on spoon.	
35				Well set at 35' and completed with a flushmount manhole cover	

Aquaterra Technologies, Inc.
Subsurface Log: MW-36

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: MW-36
Casing Elevation: N/A
Screen Diameter: 4 inch **Length:** 15'
Casing Diameter: 4 inch **Length:** 20'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 6-Apr-05
Borehole Dia: 8.25"
Water Level (Init): 30'
Rig Type: HSA Rig

Construction Details

Total Well Depth: 35' bgs
Screen Interval: 20'-35'
Sand Pack Interval: 18'-35'
Completion Details: 10" Flushmount

Backfill: 0'-15'
Cement/Grout Interval: NA
Bentonite Interval: 16'-18'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Hydroexcavate to 8' BGS	
5				Advance augers to 10' BGS and begin split spoons every 5'	
10	10-12	1847	2	Green-black stained clay and silt, slightly moist.	
15	15-17	2140	2	Green silty clay, slightly moist to 16' BGS. Changing to a tan clay, highly plastic. Slightly moist.	
20	20-22	1709	2	Same as above to 21' BGS, changing to a red-brown gravel and sand, moist.	
25	25-27	2790 2473	2	Red-brown gravel and sand to 26' BGS. Changing to a Brown silt with some clay, slightly moist.	
30	30-32	1091	2	Black stained sand and gravel, wet.	
35				Well set at 35' and completed with a flushmount manhole cover	

Aquaterra Technologies, Inc.
Subsurface Log: MW-37

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: MW-37
Casing Elevation: N/A
Screen Diameter: 4 inch **Length:** 15'
Casing Diameter: 4 inch **Length:** 20'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 7-Apr-05
Borehole Dia: 8.25"
Water Level (Init): NA
Rig Type: HSA Rig

Construction Details

Total Well Depth: 35' bgs
Screen Interval: 20'-35'
Sand Pack Interval: 18'-35'
Completion Details: 10" Flushmount

Backfill: 0'-15'
Cement/Grout Interval: NA
Bentonite Interval: 16'-18'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Hydroexcavate to 8' BGS	
5					
				Advance augers to 10' BGS and begin split spoons every 5'	
10	10-12	NA	2	Black fill material, wet from rain	
15	15-17	NA	2	Brown sandy silt with rock fragments, gravel and brick material, moist.	
20	20-22	NA	2	Tan/red/brown sandy silt with some gravel present. Slightly moist.	
25	25-27	NA	0	No Recovery	
30	30-32	NA	0.25	Brown-red gravel and sandy silt, moist.	
35				Well set at 35' and completed with a flushmount manhole cover	

PID not working, therefore no measurements were collected

Aquaterra Technologies, Inc.
Subsurface Log: MW-38

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: MW-38
Casing Elevation: N/A
Screen Diameter: 4 inch **Length:** 15'
Casing Diameter: 4 inch **Length:** 20'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 6-Apr-05
Borehole Dia: 8.25"
Water Level (Init): 22-24'
Rig Type: HSA Rig

Construction Details

Total Well Depth: 35' bgs
Screen Interval: 20'-35'
Sand Pack Interval: 18'-35'
Completion Details: 10" Flushmount

Backfill: 0'-15'
Cement/Grout Interval: NA
Bentonite Interval: 16'-18'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Hydroexcavate to 8' BGS	
				Advance augers to 8' BGS and begin continuous split spoons every	
5					
	8-10'	10.9	0.25	Red-brown gravel and sand, slightly moist	
10	10-12	41.6	0.1	Same as above	
	12-14'	84.8	0.25	Same as above	
	14-16'	29.1	2	Same as above to 15' BGS. Changing to a	
15		245.6		Gray silt with some sand, slightly moist	
	16-18'	287	2	Red-brown sand and gravel, slightly moist. Clay lense from 16.5-17' BGS	
				Color banding from red-brown to tan to gray	
	18-20'	70.4	2	Red-brown sand and some gravel, slightly moist	
20	20-22	69.7	2	Same as above, gravel content increased with depth.	
	22-24'	9	2	Sand and gravel, wet.	
	24-26'	62.2	2	Coarse sand with small gravel, wet.	
25					
	26-28'	32.2	2	Sand and gravel, wet	
	28-30'	42.2	2	Brown-gray sand and gravel, wet.	
30	30-32	45.5	2	Same as above	
	32-34'	NA	2	No Recovery	
35				Well set at 35' and completed with a flushmount manhole cover	

Aquaterra Technologies, Inc.
Subsurface Log: MW-39

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: MW-39
Casing Elevation: N/A
Screen Diameter: 4 inch **Length:** 15'
Casing Diameter: 4 inch **Length:** 20'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 5-Apr-05
Borehole Dia: 8.25"
Water Level (Init): 25-27'
Rig Type: HSA Rig

Construction Details

Total Well Depth: 35' bgs
Screen Interval: 20'-35'
Sand Pack Interval: 18'-35'
Completion Details: 10" Flushmount

Backfill: 0'-15'
Cement/Grout Interval: NA
Bentonite Interval: 16'-18'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Hydroexcavate to 8' BGS	
5				Advance augers to 10' BGS and begin split spoons every 5'	
10	10-12	186.2	2	Red-brown gravel and sand, moist	
15	15-17	NA	0	No Recovery, rock fragment in shoe of spoon.	
20	20-22	373 337	2	Red brown sand and gravel, slightly moist. Change at 21.5' BGS to a red-brown silty clay, slightly moist	
25	25-27	264	2	Tan-poorly sorted gravel and sand, wet, sheen on sample.	
30	30-32	114	2	Red-brown poorly sorted gravel and sand, wet	
35				Well set at 35' and completed with a flushmount manhole cover	

Aquaterra Technologies, Inc.
Subsurface Log: MW-40

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: MW-40
Casing Elevation: N/A
Screen Diameter: 4 inch **Length:** 15'
Casing Diameter: 4 inch **Length:** 20'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 5-Apr-05
Borehole Dia: 8.25"
Water Level (Init): 25-27'
Rig Type: HSA Rig

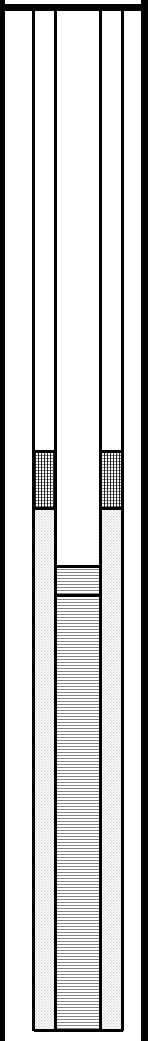
Construction Details

Total Well Depth: 35' bgs
Screen Interval: 20'-35'
Sand Pack Interval: 18'-35'
Completion Details: 10" Flushmount

Backfill: 0'-15'
Cement/Grout Interval: NA
Bentonite Interval: 16'-18'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Hydroexcavate to 8' BGS	
5					
				Advance augers to 10' BGS and begin split spoons every 5'	
10	10-12	191	2	Red-brown-black sand and gravel, slightly moist	
15	15-17	90	2	Brown-gray silt with sand and gravel, slightly moist.	
20	20-22	NA	2	No Recovery	
25	25-27	92.3	2	Brown wet poorly sorted gravel and sand	
30	30-32	296	2	Brown-black sand and gravel, wet.	
35				Well set at 35' and completed with a flushmount manhole cover	



Aquaterra Technologies, Inc.
Subsurface Log: MW-41

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: MW-41
Casing Elevation: N/A
Screen Diameter: 4 inch **Length:** 15'
Casing Diameter: 4 inch **Length:** 20'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 30-Mar-05
Borehole Dia: 8.25"
Water Level (Init): 25-27'
Rig Type: HSA Rig

Construction Details

Total Well Depth: 35' bgs
Screen Interval: 20'-35'
Sand Pack Interval: 18'-35'
Completion Details: 10" Flushmount

Backfill: 0'-15'
Cement/Grout Interval: NA
Bentonite Interval: 16'-18'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Hydroexcavate to 8' BGS	
5				Advance augers to 10' BGS and begin split spoons every 5'	
10	10-12	537	2	Brown sand from 10-11' BGS changing to a red-brown gravel and sand matrix, moist.	
15	15-17	502	0.25	Brown gravel and sand, slightly moist. Rock fragment in shoe of spoon	
20	20-22	686	1	Brown gravel and sand, slighlty moist	
25	25-27	533	2	Coarse sand and poorly sorted gravel, red-brown in color. Wet.	
30	30-32	639	2	Same as above, black staining present	
35				Well set at 35' and completed with a flushmount manhole cover	

Aquaterra Technologies, Inc.
Subsurface Log: MW-42

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: MW-42
Casing Elevation: N/A
Screen Diameter: 4 inch **Length:** 15'
Casing Diameter: 4 inch **Length:** 20'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 30-Mar-05
Borehole Dia: 8.25"
Water Level (Init): 20-22'
Rig Type: HSA Rig

Construction Details

Total Well Depth: 35' bgs
Screen Interval: 20'-35'
Sand Pack Interval: 18'-35'
Completion Details: 10" Flushmount

Backfill: 0'-15'
Cement/Grout Interval: NA
Bentonite Interval: 16'-18'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0	0-2			Hydroexcavate to 8' BGS on 3/29/05 Asphalt and subangular base stone	
	2-4	277		Gray clay layer from 2-2.5' BGS changing to a small angular gravel matrix with water entering borehole	
	4-6	NM		Gray clay with gravel and rock fragments.	
5					
	6-8	NM		Same. After soft dig was completed, the excavation filled up with water to 3' BGS	
	8-10	NM		Advance augers to 10' BGS and begin split spoons	
10	10-12	583 461	2	Brown orange clay, highly plastic, moist changing to a dark brown/red clay with gravel and sand, moist.	
	12-14	612	2	Dark brown orange clay with gravel and sand, slight moisture	
	14-16	624	0.5	Dark brown clay, highly plastic, moist. (wet black sand in spoon at the top, fall in material)	
15					
	16-18	609 629	2	Reddish brown-gray compact clay, slight moisture with a sand lense in the top of the spoon changing to a red-brown gravel and sand, moist	
	18-20	528	0.5	Red brown compact clay with some gravel and sand at 20' BGS. Slight moisture	
20	20-22	534	0.25	Sand layer in top 1' changing to a red brown compact clay, slight moisture	
	22-24	569	0.25	Red brown compact clay, slightly moist Soil sample collected for GeoTechnical analysis	
	24-26	679	2	Red-gray-brown compact clay in top 1' changing to a red-brown gravel	
25		345		and sand matrix, very moist	
	26-28	770 926	2	Red-brown gravel and sand matrix, very moist	
	28-30	615	2	Black stained gravel and sand very moist	
30	30-32	437	2"	Recovery in shoe of spoon only. Wet gravel and sand.	
	32-34	507	2	Wet gravel and sand matrix.	
35				Well set at 35' and completed with a flushmount manhole cover	

Aquaterra Technologies, Inc.
Subsurface Log: MW-43

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: MW-43
Casing Elevation: N/A
Screen Diameter: 4 inch **Length:** 15'
Casing Diameter: 4 inch **Length:** 20'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: M. Brad Spancake
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 19-Apr-05
Borehole Dia: 8.25"
Water Level (Init): 27'
Rig Type: HSA Rig

Construction Details

Total Well Depth: 35' bgs
Screen Interval: 20'-35'
Sand Pack Interval: 18'-35'
Completion Details: 10" Flushmount
Backfill: 0'-15'
Cement/Grout Interval: NA
Bentonite Interval: 16'-18'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Hydroexcavate to 8' BGS	
5				Advance augers to 10' BGS and begin split spoons every 5'	
10	10-12	325	1.25	Moist greenish gray silty clay, some small gravel in top 3" Blowcount: 1-1-3-3	
15	15-17	46	1.5	Same as above to 15.5' BGS. Changing to a wet gray medium sand to 16.25' BGS. Changing to a moist to slightly moist reddish brown clay. Blowcount: 1-1-2-2	
20	20-22	36	1	Brownish orange silty coarse sand with poorly sorted gravel. Large rock fragment in shoe of spoon. Dry. Blowcount: 8-6-10-19	
25	25-27	145	1	Reddish brown coarse sand and gravel, slightly moist. Gravel is small. Black staining present in bottom 2" of spoon. Material is wet. Blowcount: 15-15-12-12	
30	30-32	298	1.75	Coarse brown sand in top 1' of spoon. Changing to a heavily black stained coarse sand. Blowcount: 8-14-14-15	
35	35-37	6.3	2	Tanish brown moist clay to 36.5' BGS. Changing to a moist gray fine sand for 3". Changing to a dark gray clay silt.	

Well set at 35' and completed with a flushmount manhole cover

Aquaterra Technologies, Inc.
Subsurface Log: MW-44

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: MW-44
Casing Elevation: N/A
Screen Diameter: 4 inch **Length:** 15'
Casing Diameter: 4 inch **Length:** 20'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 1-Apr-05
Borehole Dia: 8.25"
Water Level (Init): 27'
Rig Type: HSA Rig

Construction Details

Total Well Depth: 35' bgs
Screen Interval: 20'-35'
Sand Pack Interval: 18'-35'
Completion Details: 10" Flushmount
Backfill: 0'-15'
Cement/Grout Interval: NA
Bentonite Interval: 16'-18'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Hydroexcavate to 8' BGS	
5				Advance augers to 10' BGS and begin split spoons every 5'	
10	10-12	579 21.6	2	Gray-green stained silt and some gravel, moist. Changing at 11' BGS to a red-orange compact silt, slight moisture.	
15	15-17	18.8	2	Red-brown-orange sand and gravel, slightly moist	
20	20-22	382	2	Red-brown silt, very moist	
25	25-27	522	2	Red-brown gravel and sand, moist. Black staining present at 27' BGS.	
30	30-32	574	2	Black stained sand and gravel, wet	
35				Well set at 35' and completed with a flushmount manhole cover	

SOIL GAS MONITORING POINT LOGS AND CONSTRUCTION SUMMARY

Aquaterra Technologies, Inc.
Subsurface Log: SG-1

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: SG-1
Casing Elevation: N/A
Screen Diameter: 2 inch **Length:** 5'
Casing Diameter: 2 inch **Length:** 5'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 12-Apr-05
Borehole Dia: 6.25"
Water Level (Init): 11'
Rig Type: HSA Rig

Construction Details

Total Well Depth: 10' bgs
Screen Interval: 5'-10'
Sand Pack Interval: 4'-10'
Completion Details: 8" Flushmount

Backfill: NA
Cement/Grout Interval: NA
Bentonite Interval: 1'-4'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0		NA		Hand clear to 5' BGS.	
5	5-7	150	2	Gray, black stained silt	
	7-9	138	2	Gray, slightly stained silt with some sand, moist	
10	9-11	74.8	2	Gray silt with some fine sand, moist.	
	11-13	8.9	2	Same. Sand at 12' BGS.	
				Set well at 10' BGS	

Aquaterra Technologies, Inc.
Subsurface Log: SG-2

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: SG-2
Casing Elevation: N/A
Screen Diameter: 2 inch **Length:** 5'
Casing Diameter: 2 inch **Length:** 5'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 13-Apr-05
Borehole Dia: 6.25"
Water Level (Init): 11'
Rig Type: HSA Rig

Construction Details

Total Well Depth: 10' bgs
Screen Interval: 5'-10'
Sand Pack Interval: 4'-10'
Completion Details: 8" Flushmount

Backfill: NA
Cement/Grout Interval: NA
Bentonite Interval: 1'-4'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0		NA		Hand clear to 5' BGS.	
5	5-7	199	2	Brown sandy silt, fine grained. Slightly moist	
	7-9	245	2	Gray-brown-green sandy silt, fine grained. Slightly moist with staining present	
10	9-11	2.6	2	Soft gray silt, slight moisture	
	11-13	2.5	2	Same, wet. Turning brown in color	
				Set well at 10' BGS	

Aquaterra Technologies, Inc.
Subsurface Log: SG-1

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: SG-1
Casing Elevation: N/A
Screen Diameter: 2 inch **Length:** 5'
Casing Diameter: 2 inch **Length:** 5'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 14-Apr-05
Borehole Dia: 6.25"
Water Level (Init): NA
Rig Type: HSA Rig

Construction Details

Total Well Depth: 5' bgs
Screen Interval: 3'-5'
Sand Pack Interval: 2.5'-3'
Completion Details: 8" Flushmount

Backfill: NA
Cement/Grout Interval: NA
Bentonite Interval: 1'-2.5'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0		NA		Hand clear to 5' BGS.	
5	5-7		2	Sandy gray silt. Spoon wet on outside	
	7-9		2	Same as above, wet. 3' of water in borehole	
9	9-11		2	Set well at 5' BGS	

Aquaterra Technologies, Inc.
Subsurface Log: SG-4

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: SG-4
Casing Elevation: N/A
Screen Diameter: 2 inch **Length:** 5'
Casing Diameter: 2 inch **Length:** 5'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 12-Apr-05
Borehole Dia: 6.25"
Water Level (Init): NA
Rig Type: HSA Rig

Construction Details

Total Well Depth: 10' bgs
Screen Interval: 5'-10'
Sand Pack Interval: 4'-10'
Completion Details: 8" Flushmount

Backfill: NA
Cement/Grout Interval: NA
Bentonite Interval: 1'-4'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0		NA		Hand clear to 5' BGS.	
5	5-7	8.3	2	Green-gray silt, slightly moist. Some fine grained sand	
	7-9	5.4	2	Same, moist.	
10	9-11	5.3	2	Same	
	11-13	1.6	2	Same. Wet sand at 12.5' BGS	
				Set well at 10' BGS	

Aquaterra Technologies, Inc.
Subsurface Log: SG-5

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: SG-5
Casing Elevation: N/A
Screen Diameter: 2 inch **Length:** 5'
Casing Diameter: 2 inch **Length:** 5'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 12-Apr-05
Borehole Dia: 6.25"
Water Level (Init): NA
Rig Type: HSA Rig

Construction Details

Total Well Depth: 10' bgs
Screen Interval: 5'-10'
Sand Pack Interval: 4'-10'
Completion Details: 8" Flushmount

Backfill: NA
Cement/Grout Interval: NA
Bentonite Interval: 1'-4'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0		NA		Hand clear to 5' BGS.	
5	5-7	70.9	2	Green-gray silt, slightly moist. Fine grained sand present	
	7-9	61.3	2	Same as above, staining present	
	9-11	28.2	2	Same as above to 10' BGS. Changing to a green gray wet sand	
10		58.6			
	11-13	34.2	2	Wet green-gray sand to 12' BGS, changing to a gray brown marbled compact	
		83.5		clay, slightly moist	
				Set well at 10' BGS	

Aquaterra Technologies, Inc.
Subsurface Log: SG-6

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: SG-6
Casing Elevation: N/A
Screen Diameter: 2 inch **Length:** 5'
Casing Diameter: 2 inch **Length:** 5'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:

Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 12-Apr-05
Borehole Dia: 6.25"
Water Level (Init): NA

Rig Type: HSA Rig

Construction Details

Total Well Depth: 10' bgs
Screen Interval: 5'-10'
Sand Pack Interval: 4'-10'
Completion Details: 8" Flushmount

Backfill: NA
Cement/Grout Interval: NA
Bentonite Interval: 1'-4'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0		NA		Hand clear to 5' BGS.	
5	5-7	1.5	2	Green-gray-brown silt and fine sand, moist	
	7-9	1.7	2	Same as above	
10	9-11	132	2	Same as above, some clay content. Sand lense at 9.5-9.75' BGS	
	11-13	7.4	2	Wet, gray sand to 12.75' BGS. Changing to a compact clay.	
				Set well at 10' BGS	

Aquaterra Technologies, Inc.
Subsurface Log: SG-7

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: SG-7
Casing Elevation: N/A
Screen Diameter: 2 inch **Length:** 5'
Casing Diameter: 2 inch **Length:** 5'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 12-Apr-05
Borehole Dia: 6.25"
Water Level (Init): NA
Rig Type: HSA Rig

Construction Details

Total Well Depth: 10' bgs
Screen Interval: 5'-10'
Sand Pack Interval: 4'-10'
Completion Details: 8" Flushmount

Backfill: NA
Cement/Grout Interval: NA
Bentonite Interval: 1'-4'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0		NA		Hand clear to 5' BGS.	
5	5-7	24.2	2	Gray-brown silt, moist	
	7-9	52.6	2	Same as above	
10	9-11	24	2	Same as above, sand lense from 10.25-10.75' BGS	
	11-13	28.3	2	Gray-green sand, wet	
				Set well at 10' BGS	

Aquaterra Technologies, Inc.
Subsurface Log: SG-8

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: SG-8
Casing Elevation: N/A
Screen Diameter: 2 inch **Length:** 5'
Casing Diameter: 2 inch **Length:** 5'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 12-Apr-05
Borehole Dia: 6.25"
Water Level (Init): NA
Rig Type: HSA Rig

Construction Details

Total Well Depth: 10' bgs
Screen Interval: 5'-10'
Sand Pack Interval: 4'-10'
Completion Details: 8" Flushmount

Backfill: NA
Cement/Grout Interval: NA
Bentonite Interval: 1'-4'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0		NA		Hand clear to 5' BGS.	
5	5-7		2	Slightly moist brown silt to 6' BGS. Changing to a Green-black stained silt, slightly moist.	
	7-9		2	Greenish-brown silt, slightly moist	
10	9-11		2	Brown-green silt with clay, slightly moist	
	11-13		2	Green sand with small amount of gravel, moist. Clay at 12.75' BGS Auger cuttings are wet. Set well at 10' BGS	

Aquaterra Technologies, Inc.
Subsurface Log: SG-9

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: SG-9
Casing Elevation: N/A
Screen Diameter: 2 inch **Length:** 3'
Casing Diameter: 2 inch **Length:** 5'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 15-Apr-05
Borehole Dia: 6.25"
Water Level (Init): NA
Rig Type: HSA Rig

Construction Details

Total Well Depth: 8" bgs
Screen Interval: 5'-8'
Sand Pack Interval: 4'-8'
Completion Details: 8" Flushmount

Backfill: NA
Cement/Grout Interval: NA
Bentonite Interval: 1'-4'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0		NA		Hand clear to 5' BGS. Advance augers to 6' BGS and collect sample tube for geotechnical analysis.	
6	6-8	NA	2	Sample submitted to PTS GeoLabs for geotechnical analysis	
8				Well set at 8' BGS	

Aquaterra Technologies, Inc.
Subsurface Log: SG-10

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: SG-10
Casing Elevation: N/A
Screen Diameter: 2 inch **Length:** 5'
Casing Diameter: 2 inch **Length:** 5'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 15-Apr-05
Borehole Dia: 6.25"
Water Level (Init): NA
Rig Type: HSA Rig

Construction Details

Total Well Depth: 8' bgs
Screen Interval: 5'-8'
Sand Pack Interval: 4'-8'
Completion Details: 8" Flushmount

Backfill: NA
Cement/Grout Interval: NA
Bentonite Interval: 1'-4'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0		NA		Hand clear to 5' BGS.	
				Advance augers to 6' BGS and collect sample for geotechnical analysis	
5					
	6-8	NA	0	Attempted to collect soil sample for geotechnical analysis, no recovery Advance augers to 8' BGS and attempt again	
	8-10	NA	1'	Sample collected and submitted to PTS GeoLabs for geotechnical analysis.	
10	10-12'	NA	1'	Saturated sample.	
				Set well at 8' BGS	

Aquaterra Technologies, Inc.
Subsurface Log: SG-11

Project Name: Sunoco Belmont Terminal
Location: 2700 W. Passyunk Ave
Philadelphia, PA
Boring Number: SG-11
Casing Elevation: N/A
Screen Diameter: 2 inch **Length:** 5'
Casing Diameter: 2 inch **Length:** 5'
Drilling Method: Hollow Stem Auger

Owner: Sunoco, Inc. (R&M)
Permit No.:
Log By: Brandee Blasi
Driller: Parrat Wolff
Slot Size: 0.020
Type: PVC
Sample Method: Split Spoon

Date: 13-Apr-05
Borehole Dia: 6.25"
Water Level (Init): NA
Rig Type: HSA Rig

Construction Details

Total Well Depth: 10' bgs
Screen Interval: 5'-10'
Sand Pack Interval: 4'-10'
Completion Details: 8" Flushmount

Backfill: NA
Cement/Grout Interval: NA
Bentonite Interval: 1'-4'
Sand Pack Type: No. 2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0		NA		Hand clear to 5' BGS.	
5	5-7	1300	2	Some clay with rock fragments	
	7-9	1026	2	Fill material	
	9	NA	2	Perched water in borehole, rollerbit was saturated.	

NO. 1 AND NO. 2 TANK FARMS BORING LOGS AND WELL CONSTRUCTION SUMMARY

Aquaterra Technologies, Inc.
Subsurface Log: S-198

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-198 **Log By:** M.B. Spancake **Date:** 3/8, 11,15/05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.020 **Water Level (Init):**
Casing Diameter: 4 inch **Length:** 20.5 **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 35' bgs **Backfill:** 0'-15'
Screen Interval: 20'-35' **Cement/Grout Interval:**
Sand Pack Interval: 18'-35' **Bentonite Interval:** 15'-18'
Completion Details: 1.5' stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0	1.5-2			Gray clay matrix and rock fragments.	
	2-7			Soft dig to 7' BGS. Advance augers to 10' BGS and begin split spoons every 5'	
5					
10	10-12	NA	NA	Gray moist to wet sandy clay.	
15	15-17	595	NA	Gray sandy gravel, moist, slight clay content.	
20	20-22	363	NA	Gray sandy clay, slightly moist.	
25	25-27	NA	1.5	Coarse sand and gravel matrix, moist to wet towards bottom.	
30	30-32	1019	NA	Poorly sorted sandy gravel. Sand is coarse and medium gray in color.	
35				Well set at 35' and completed with a 3' stick-up.	

1.5-2 Sample interval submitted for laboratory analysis

Aquaterra Technologies, Inc.
Subsurface Log: S-199

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-199 **Log By:** M.B. Spancake **Date:** 10-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.020 **Water Level (Init):** 25'
Casing Diameter: 4 inch **Length:** 21' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 35' bgs **Backfill:** 0'-15'
Screen Interval: 20'-35' **Cement/Grout Interval:**
Sand Pack Interval: 18'-35' **Bentonite Interval:** 15'-18'
Completion Details: 1' stickup **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 7' BGS. Advance augers to 10' below ground surface and begin split spoons every 5 feet.	
5					
10	10-12	42	2	Gray fine clayey sand, wet, changing to brown and gray clay towards bottom.	
15	15-17	272	2	Brown gray clay in top 6" changing to a coarse sandy gravel. Gravel is small.	
20	20-22	657	1.5	Same as above changing to a brown silt, some clay. Rock fragment in bottom of spoon.	
25	25-27	672	1	Wet poorly sorted sandy coarse gravel. Reddish brown in color.	
30	30-32	627	1.75	Same as above.	
35				Lost 1' to cave in. Well set at 34'.	

1.5-2 Sample interval submitted for laboratory analysis

Aquaterra Technologies, Inc.
Subsurface Log: S-200

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-200 **Log By:** M.B. Spancake **Date:** 16-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.020 **Water Level (Init):** 25'
Casing Diameter: 4 inch **Length:** 20' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 35' bgs **Backfill:** 0'-15'
Screen Interval: 20'-35' **Cement/Grout Interval:**
Sand Pack Interval: 18'-35' **Bentonite Interval:** 15'-18'
Completion Details: Flushmount manhole **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 10' below ground surface and begin split spoons every 5 feet.	
5					
10	10-12	961	1.5	Black stained medium and coarse sandy gravel, wet. Changing to a brown clayey silt.	
15	15-17	NA	0	No recovery. Rock fragment and some gravel in shoe of spoon.	
20	20-22	869	1	Brown and reddish coarse sandy gravel, poorly sorted	
25	25-27	835	1.5	Moist to wet medium sand and poorly sorted gravel with brown silt and rock fragments.	
30	30-32	627	1.75	Wet poorly sorted coarse sandy gravel, brown in color. A Advance augers to 35' BGS and set well	
35				Well set at 35'.	

Aquaterra Technologies, Inc.
Subsurface Log: S-201

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-201 **Log By:** M.B. Spancake **Date:** 17-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.020 **Water Level (Init):** 25'
Casing Diameter: 4 inch **Length:** 20' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 35' bgs **Backfill:** 0'-15'
Screen Interval: 20'-35' **Cement/Grout Interval:**
Sand Pack Interval: 18'-35' **Bentonite Interval:** 15'-18'
Completion Details: Flushmount manhole **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 10' below ground surface and begin split spoons every 5 feet.	
5					
10	10-12	34	0.5	Wet gravel in a gray silt matrix, some clay content in the top of spoon.	
15	15-17	246	1.5	Moist poorly sorted gravel and coarse sand, brownish red in color.	
20	20-22	83	1	Brown clayey silt, some small gravel. Slightly moist.	
25	25-27	433	1.25	Wet brown coarse sandy gravel, poorly sorted.	
30	30-32	617	0.75	Same as above, some black staining towards bottom of spoon. Advance augers to 35' BGS and set well	
35				Well set at 35'.	

Aquaterra Technologies, Inc.
Subsurface Log: S-202

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-202 **Log By:** M.B. Spancake **Date:** 3/10 & 11/05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.020 **Water Level (Init):** 28'
Casing Diameter: 4 inch **Length:** 23' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 35' bgs **Backfill:** 0-15'
Screen Interval: 20'-35" **Cement/Grout Interval:**
Sand Pack Interval: 18'-35" **Bentonite Interval:** 15'-18'
Completion Details: 3-foot Stickup **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 10' below ground surface and begin continuous split spoons	
5					
10	10-12	144	2	Brown and gray clay changing to a gray fine sandy clay, slightly moist.	
	12-14'	NM	NS	Not sampled	
	14-16'	847	1	Gray sandy clay changing to a fine gray sand, wet.	
15					
	16-18'	704	2	Wet gray sand and small gravel changing to a moist gray clay at 17' BGS	
	18-20'	6	2	Moist gray sandy clay changing to a tan and gray clay at 18.5' BGS. Changing to a brown clay at 19' BGS with some small gravel	
20	20-22	27	1.25	Moist brown clay changing to a poorly sorted sandy gravel, some red sandstone rock fragments present.	
	22-24	38	1	Poorly sorted sandy gravel, reddish brown in color, slightly moist.	
	24-26	371	1	Same as above.	
25					
	26-28	810	1	Moist to wet grayish red sand, poorly sorted gravel.	
	28-30	652	1	Wet poorly sorted reddish gray sand and small gravel.	
30	30-32	754	0.5	Same as above	
	32-34	759	1.5	Wet poorly sorted sandy gravel, reddish gray in color.	
35				Advance augers to 35' BGS Well set at 35' BGS.	

Aquaterra Technologies, Inc.
Subsurface Log: S-203

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-203 **Log By:** M.B. Spancake **Date:** 22-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.020 **Water Level (Init):** 25'
Casing Diameter: 4 inch **Length:** 20' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 32' bgs **Backfill:** 0'-12'
Screen Interval: 17'-32' **Cement/Grout Interval:**
Sand Pack Interval: 15'-32' **Bentonite Interval:** 12'-15'
Completion Details: 3' Stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 8' BGS Advance augers to 10' BGS and collect spoons every 5'	
5					
10	10-12	NA	2	Gray clayey silt changing to a moist to wet gray fine sand	
15	15-17	NA	2	Moist gray silt changing to a gray and tan clay	
20	20-22	NA	1.25	Dark grayish brown silt with slight clay content	
25	25-27	NA	1	Orangish brown silt, slight clay changing to a wet gray sandy gravel. Advance augers to 32' BGS and set well	
30	30-32	NA	NA	Same as above. Set well at 32' BGS.	

Note: PID malfunctioned therefore no readings were collected.

Aquaterra Technologies, Inc.
Subsurface Log: S-204

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-204 **Log By:** M.B. Spancake **Date:** 10-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.020 **Water Level (Init):** 26'
Casing Diameter: 4 inch **Length:** 23' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 35' bgs **Backfill:** 0'-16'
Screen Interval: 20'-35' **Cement/Grout Interval:**
Sand Pack Interval: 18'-35' **Bentonite Interval:** 16'-18'
Completion Details: 3' Stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 10' below ground surface and begin split spoons every 5 feet.	
5					
10	10-12	47	1.5	Gray sandy clay with a thin layer of fine gray sand, moist. Changing to a brown silty clay.	
15	15-17	12	1.25	Tan clay with slight orange mottling, slightly moist.	
20	20-22	2	2	Tan clay in top 9" changing to a dark gray clay	
25	25-27	953	1.25	Gray and tan clay in top 4" changing to a poorly sorted coarse sandy gravel, wet. Some pebble and brown silt.	
30	30-32	250	1	Wet coarse sandy gravel, gravel is larger and rock fragments present. Red sandstone fragment in bottom of spoon. Advance augers to 35' BGS.	
35				Well set at 35'.	

Aquaterra Technologies, Inc.
Subsurface Log: S-205

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-205 **Log By:** M.B. Spancake **Date:** 9-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 20' **Slot Size:** 0.020 **Water Level (Init):** 15'
Casing Diameter: 4 inch **Length:** 10' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 30' bgs **Backfill:** 0'-5'
Screen Interval: 10'-30' **Cement/Grout Interval:**
Sand Pack Interval: 8'-30' **Bentonite Interval:** 5'-8'
Completion Details: 3' Stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 8' BGS Advance augers to 10' BGS and collect spoons every 5'	
5					
10	10-12	24	0.25	Fine black stained sand, wood fragments and gravel, slightly moist	
15	15-17	287	0.75	Fine sand and brown silt with black staining, moist to wet.	
20	20-22	81	1.75	Brown coarse sand, wet. Brick fragments in top of spoon. Heavy staining. Changing to a gray clay at 21' BGS.	
25	25-27	240	0.75	Wet gray sandy gravel, some brown silt. Advance augers to 30' BGS and set well	
30		NA	NA	Set well at 30' BGS	

Aquaterra Technologies, Inc.
Subsurface Log: S-206

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-206 **Log By:** M.B. Spancake **Date:** 9-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.020 **Water Level (Init):** 25'
Casing Diameter: 4 inch **Length:** 20' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 32' bgs **Backfill:** 0'-12'
Screen Interval: 17'-32' **Cement/Grout Interval:**
Sand Pack Interval: 15'-32' **Bentonite Interval:** 12'-15'
Completion Details: 3' Stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 8' BGS Advance augers to 15' BGS and collect spoons every 5' Augers were advanced to 15' due to time constraints.	
5					
10	10-12	NA	NA		
15	15-17	40	2	Gray sandy clay in top 6", moist. Changing to a light gray and tan clay matrix, slight moisture.	
20	20-22	8	2	Same as above changing to a dark brown clayey silt matrix. Augers starting "jumping" indicating gravel.	
25	25-27	741	1.25	Wet gray coarse sandy gravel, poorly sorted. Advance augers to 32' BGS and set well	
30	30-32	NA	NA	Same as above. Set well at 32' BGS.	

Aquaterra Technologies, Inc.
Subsurface Log: S-207

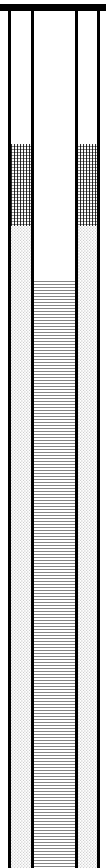
Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-207 **Log By:** M.B. Spancake **Date:** 8-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.020 **Water Level (Init):** 24'
Casing Diameter: 4 inch **Length:** 18' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 30' bgs **Backfill:** 0-5'
Screen Interval: 10'-30' **Cement/Grout Interval:**
Sand Pack Interval: 8'-30' **Bentonite Interval:** 5'-8'
Completion Details: 3-foot Stickup **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 10' below ground surface and begin continuous split spoons	
5					
10	10-12	21	1.25	Gray stained fine sand, slight clay content. Moist	
	12-14'	33	1	Gray stained fine sand, moist. More clay content towards bottom.	
	14-16'	0	0.25	Gray sand and gravel, rock fragments. Moist to wet.	
15	16-18'	0	2	Gray sand in top 6" changing to a tan clay. Moist.	
	18-20'	0	1	Compact, dense tan clay. Slight moisture.	
20	20-22	0	1	Gray coarse sand and gravel, slight moisture.	
	22-24	0	1	Same, red dense clay in bottom of spoon. Dry	
	24-26	0	1	Brownish gray sandy gravel, some pebble. Moist to wet	
25	26-28	0	1	Same as above.	
	28-30	0	1	Same as above	
30	30-32	0	2	Brown silty sand and gravel, wet.	
	32-34	0	2	Same as above, gray sand in bottom 6"	
	34-36	0	1	Wet gray sand matrix changing to a moist gray sandy clay	
35	36-38	0	1.5	Gray clay with orange banding, some fine sand changing to a silt and clay matrix.	

Aquaterra Technologies, Inc.
Subsurface Log: S-208

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-208 **Log By:** M.B. Spancake **Date:** 9-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 12' **Slot Size:** 0.020 **Water Level (Init):** 20'
Casing Diameter: 4 inch **Length:** 15' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 25' bgs **Backfill:** 0-5'
Screen Interval: 10'-25' **Cement/Grout Interval:**
Sand Pack Interval: 8'-25' **Bentonite Interval:** 5'-8'
Completion Details: 3' Stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 10' below ground surface and begin split spoons every 5 feet.	
5					
10	10-12	32	1.25'	Medium sand and gravel in a brown silt matrix	
15	15-17	228	1	Same as above, slight moisture	
20	20-22	387	1.5	Wet gray sand and small gravel	
	23-25	97	1	Wet coarse tan sand and brown silt with small gravel and pebble. Rock fragment in bottom of spoon.	
25				Set well at 25' BGS	

Aquaterra Technologies, Inc.
Subsurface Log: S-209

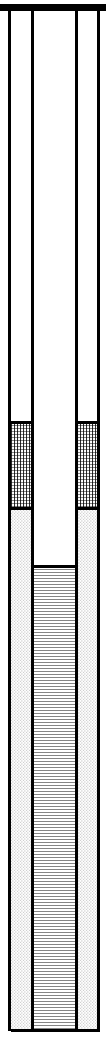
Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-209 **Log By:** M.B. Spancake **Date:** 10-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.020 **Water Level (Init):** 25'
Casing Diameter: 4 inch **Length:** 23' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 35' bgs **Backfill:** 0'-15'
Screen Interval: 20'-35' **Cement/Grout Interval:**
Sand Pack Interval: 18'-35' **Bentonite Interval:** 15'-18'
Completion Details: 3' Stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 10' below ground surface and begin split spoons every 5 feet.	
5					
10	10-12	5	0.5	Brown silt and medium sand with small gravel and rock fragments	
15	15-17	7	0.75	Coarse sand and brown silt with gravel, red sandstone fragment in bottom of spoon	
20	20-22	82	1.25	Moist brown medium sand and silt with some small gravel. Some gray clay in top of spoon	
25	25-27	180	1	Wet coarse sandy gravel and pebble, some brown silt.	
30	30-32	131	1.5	Wet poorly sorted coarse sandy gravel with small pebble Advance augers to 35' BGS and set well	
35				Well set at 35'.	

Aquaterra Technologies, Inc.
Subsurface Log: S-210

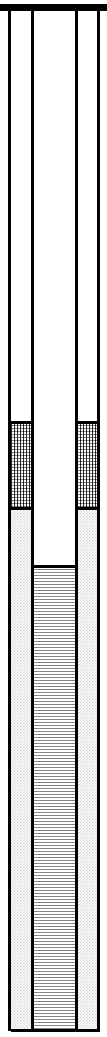
Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-210 **Log By:** M.B. Spancake **Date:** 17-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.020 **Water Level (Init):** 25'
Casing Diameter: 4 inch **Length:** 23' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 35' bgs **Backfill:** 0'-15'
Screen Interval: 20'-35' **Cement/Grout Interval:**
Sand Pack Interval: 18'-35' **Bentonite Interval:** 15'-18'
Completion Details: 3' Stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 10' below ground surface and begin split spoons every 5 feet.	
5					
10	10-12	0	0.75	Moist gray silty clay	
15	15-17	0	2	Gray and brown fine to medium sand with slight clay content, moist. Rock fragment in bottom of spoon.	
20	20-22	884	1.75	Gray and brown fine sandy clay changing to a black stained coarse sandy gravel, moist.	
25	25-27	629	1	Wet brownish gray coarse sandy gravel.	
30	30-32	641	2	Wet poorly sorted coarse sandy gravel and pebble. Advance augers to 35' BGS and set well	
35				Well set at 35'.	

Aquaterra Technologies, Inc.
Subsurface Log: S-211

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

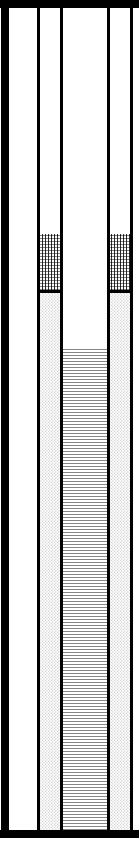
Boring Number: S-211 **Log By:** M.B. Spancake **Date:** 24-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 12' **Slot Size:** 0.020 **Water Level (Init):** 17'
Casing Diameter: 4 inch **Length:** 18' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 27' bgs **Backfill:** 0-8'
Screen Interval: 12'-27' **Cement/Grout Interval:**
Sand Pack Interval: 10'-27' **Bentonite Interval:** 7'-10'
Completion Details: 3' Stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 10' below ground surface and begin split spoons every 5 feet.	
5					
10	10-12	238	0.5	Brown coarse sand, poorly sorted gravel and rock fragments	
15	15-17	550	1.25	Same as above, moist to wet at 17' BGS	
20	20-22	227	1	Large rock fragments in a coarse gray sand and small gravel matrix.	
25	25-27	115	0.5	Same as above, some brown silt present. Set well at 27' BGS	



Aquaterra Technologies, Inc.
Subsurface Log: S-212

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

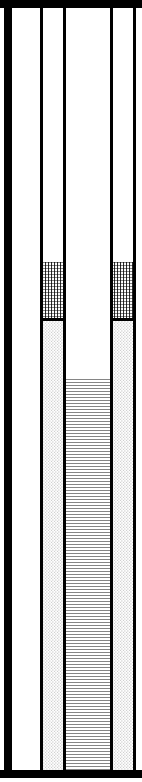
Boring Number: S-212 **Log By:** M.B. Spancake **Date:** 18-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 12' **Slot Size:** 0.020 **Water Level (Init):** 20'
Casing Diameter: 4 inch **Length:** 15' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 25' bgs **Backfill:** 0-8'
Screen Interval: 13-25' **Cement/Grout Interval:**
Sand Pack Interval: 11-25' **Bentonite Interval:** 8'-11'
Completion Details: 2' Stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 10' below ground surface and begin split spoons every 5 feet.	
5					
10	10-12	77	1.5	Coarse sandy gravel matrix, reddish brown in color, dry.	
15	15-17	90	1	Reddish brown coarse sandy gravel, becoming moist towards bottom	
20	20-22	155	1.5	Wet coarse sandy gravel, reddish brown in color Advance augers to 25' BGS and set well	
25					



Aquaterra Technologies, Inc.
Subsurface Log: S-213

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

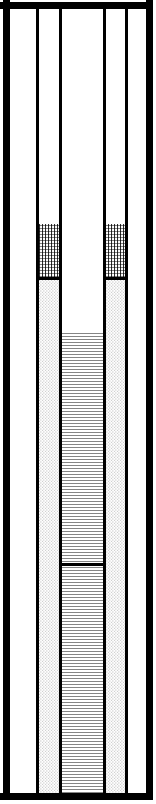
Boring Number: S-213 **Log By:** M.B. Spancake **Date:** 24-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 12' **Slot Size:** 0.020 **Water Level (Init):** 17'
Casing Diameter: 4 inch **Length:** 18' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 27' bgs **Backfill:** 0-8'
Screen Interval: 12'-27' **Cement/Grout Interval:**
Sand Pack Interval: 10'-27' **Bentonite Interval:** 7'-10'
Completion Details: 3' Stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 10' below ground surface and begin split spoons every 5 feet.	
5				Lithology not recorded. See boring log for S-211 for lithology information	
10	10-12				
15	15-17				
20	20-22				
25	25-27			Set well at 27' BGS with 3' Stick up	



Aquaterra Technologies, Inc.
Subsurface Log: S-214

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-214 **Log By:** M.B. Spancake **Date:** 28-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.020 **Water Level (Init):** 17'
Casing Diameter: 4 inch **Length:** 18' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 30' bgs **Backfill:** 0'-10'
Screen Interval: 15'-30' **Cement/Grout Interval:**
Sand Pack Interval: 13'-30' **Bentonite Interval:** 10'-13'
Completion Details: 3' Stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 8' BGS Advance augers to 15' BGS and collect spoons every 5' Augers were advanced to 15' due to time constraints.	
5					
10	10-12	NA	1.25	Reddish brown coarse sand and poorly sorted gravel, moist.	
15	15-17	NA	1.5	Same as above, becoming wet at 17' BGS	
20	20-22	NA	0.75	Same as above, wet.	
25	25-27	NA	1	Same as above, slight clay content towards the bottom of spoon. Wet	
30	30-32	NA	1.75	Gray silty clay with some small gravel and coarse sand Set well at 30' BGS with 3' Stick-up	

Note: PID malfunctioned therefore no readings were collected.

Aquaterra Technologies, Inc.
Subsurface Log: S-215

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

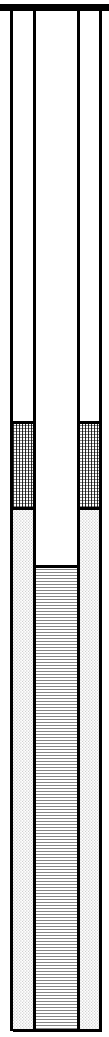
Boring Number: S-215 **Log By:** M.B. Spancake **Date:** 11-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.020 **Water Level (Init):** 25'
Casing Diameter: 4 inch **Length:** 23' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 35' bgs **Backfill:** 0'-15'
Screen Interval: 20'-35' **Cement/Grout Interval:**
Sand Pack Interval: 18'-35' **Bentonite Interval:** 15'-18'
Completion Details: 3' Stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 10' below ground surface and begin split spoons every 5 feet.	
5					
10	10-12	433	2	Brown and gray clayey silt changing to a fine gray sand with brown banding	
15	15-17	53	1.5	Brown moist clay and some small gravel changing to a gray sandy clay with small gravel.	
20	20-22	67	1	Poorly sorted coarse sandy gravel, reddish brown in color.	
25	25-27	1125	1.25	Reddish brown medium and coarse sand, some poorly sorted gravel. Moist to wet towards bottom of spoon.	
30	30-32	NM	2"	Gray and brown clay with medium sand and some small gravel. Rock fragment in shoe of spoon, wet.	
35				Well set at 35'.	



Aquaterra Technologies, Inc.
Subsurface Log: S-226

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

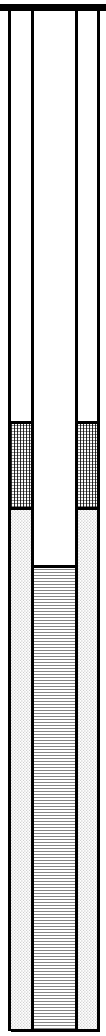
Boring Number: S-226 **Log By:** M.B. Spancake **Date:** 17-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.020 **Water Level (Init):** 25'
Casing Diameter: 4 inch **Length:** 23' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 35' bgs **Backfill:** 0'-15'
Screen Interval: 20'-35' **Cement/Grout Interval:**
Sand Pack Interval: 18'-35' **Bentonite Interval:** 15'-18'
Completion Details: 3' Stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 35' below ground surface and set well	
				No lithology recorded due to proximity of well S-210.	
5				See S-210 well log for litholgy details.	
10	10-12				
15	15-17				
20	20-22				
25	25-27				
30	30-32				
35				Well set at 35'.	



Aquaterra Technologies, Inc.
Subsurface Log: S-227

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-227 **Log By:** M.B. Spancake **Date:** 21-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.020 **Water Level (Init):** 25'
Casing Diameter: 4 inch **Length:** 20' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 32' bgs **Backfill:** 0'-12'
Screen Interval: 17'-32' **Cement/Grout Interval:**
Sand Pack Interval: 15'-32' **Bentonite Interval:** 12'-15'
Completion Details: 3' Stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 10' BGS and collect spoons every 5'	
5					
10	10-12	102 7.6	0.75	Moist brownish tan medium sand in top 3" changing to a brown silty clay	
15	15-17	0	1.5	Dry coarse sandy poorly sorted gravel, reddish brown in color.	
20	20-22	4	1.25	Same as above, moist to wet at bottom of spoon.	
25	25-27	734	1.5	Wet gray medium and coarse sand, pebble fragments and some small gravel.	
30	30-32	744	1.25	Same as above. Set well at 32' BGS.	

Aquaterra Technologies, Inc.
Subsurface Log: S-228

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-228 **Log By:** M.B. Spancake **Date:** 21-Mar-05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 4 inch **Length:** 15' **Slot Size:** 0.020 **Water Level (Init):** NA
Casing Diameter: 4 inch **Length:** 21' **Type:** PVC
Drilling Method: Hollow Stem Auger **Sample Method:** Split Spoon **Rig Type:** HSA Rig

Construction Details

Total Well Depth: 33' BGS **Backfill:** 0'-13'
Screen Interval: 18'-33' **Cement/Grout Interval:**
Sand Pack Interval: 16'-33' **Bentonite Interval:** 13'-16'
Completion Details: 3' Stick up **Sand Pack Type:** #2

= Backfill
= Cement/Grout
= Bentonite
= Sand

Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Soft dig to 10' BGS Advance augers to 33' BGS and set well. No lithology recorded due to proximity of S-227	
5					
10	10-12				
15	15-17				
20	20-22				
25	25-27				
30	30-32			Set well at 33' BGS	

Aquaterra Technologies, Inc.
Subsurface Log: S-80D

Project Name: Sunoco Philadelphia Refinery AOI - 1
Location: Philadelphia, PA
Owner: Sunoco, Inc. (R&M)
Permit No.:

Boring Number: S-80D
Casing Elevation: N/A
Screen Diameter: 2" **Length:** 15'
Casing Diameter: 2" **Length:** 66'
Drilling Method: Hollow Stem Auger/ Mud Rotary
Log By: M.B. Spancake
Driller: Parrat Wolff
Slot Size: 0.02
Type: PVC
Sample Method: Split Spoon
Date: 3/15-31/05
Borehole Dia: 8.25'
Water Level (Init): 70'
Rig Type: HSA Rig/Mud Rotary

Construction Details

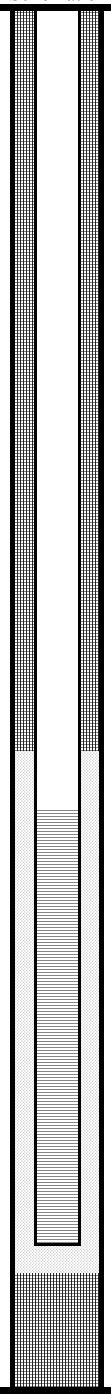
Total Well Depth: 79' BGS
Screen Interval: 64'-79'
Sand Pack Interval: 62'-79'
Completion Details: Completed with 2' Steel stick-up
Outer Steel Casing Interval: 0'-58'
Bentonite Interval: 0-62'
Cement/Grout Interval:
Sand Pack Type: 62'-79'

= Backfill
= Cement/Grout
= Bentonite
= Sand

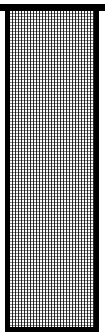
Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Vacuum Utility Clearance to 9' below ground surface (bgs). Advance augers to 10' BGS and begin split spoons	
5					
10	10-12	21	2	Wet gray sandy clay changing to a wet gray medium sand	
	12-14	43	2	Wet gray and brown fine to medium sand, some small gravel	
	14-16	NM	0	No recovery	
15					
	16-18	102	1.5	Coarse sand and gravel, some gray clayey silt	
	18-20	48	1	Coarse sand and pebble fragments, reddish brown in color, slight moisture	
20	20-22	660	1	Poorly sorted coarse sandy gravel, quartz fragments and small pebble Moist	
	22-24	1485	1.75	Sams as above, changing to a reddish gray medium sand and smaller gravel toward bottom	
	24-26	959	1.5	Same as above, changing to a brownish gray clayey silt	
25					
	26-28	1435	1.75	Reddish brown clayey silt and fine sand, moist to wet	
	28-30	1511	2	Wet brown poorly sorted sandy gravel and silt, black staining present towards bottom of spoon.	
30	30-32	967	1.25	Wet poorly sorted coarse sandy gravel, gray in color.	
	32-34	697	1.25	Coarse sandy gravel, poorly sorted and wet. Gravel is small. Rock fragment in bottom of spoon.	
	34-36	44	2	Wet poorly sorted gravel with fine and medium sand. Some brown silt	
35					
	36-38	87	2	Same as above, changing to a gray and brown moist silt in bottom 3"	

Aquaterra Technologies, Inc.
Subsurface Log: S-80D (Continued)

Depth (ft)					Well Schematic
	38-40	11	1	Fine gray and brown sand, slight moisture	
40	40-42	4.5	1.5	Moist brownish gray silty clay changing to a moist light brown clay	
	42-44	19	2	Wet gray medium sandy gravel - Note: could be cave-in from above	
	44-46	9	2	Wet gray medium sand and silt, slight clay content towards bottom	
45	46-48	5	2	Same as above, changing to a reddish brown silty clay at 47' BGS	
	48-50	NM	0	No recovery	
50	50-52	0	1	Reddish brown clay, moist	
	52-54	0	1.25	Same as above.	
	54-56	0	1.5	Same as above.	
55	56-58	0	1	Same as above.	
	58-60	NM	NS	Set 4" steel casing at 58' BGS. Continue drilling with mud rotary on 3/29/2005	
60	60-62	NM	NS	Advanced Mud rotary to 62' BGS	
	62-64	0	NM	Reddish brown moist clay becoming sandy towards bottom Blow Count: 4-4-4-4	
	64-66	0	NM	Moist reddish brown coarse sand, slight clay content Blow Count: 9-11-10-11	
65	66-68	0	NM	Moist to wet coarse sand reddish brown in color. Some small gravel Blow Count: 10-10-9-10	
	68-70	0	NM	Moist reddish brown coarse sand Blow Count: 11-9-18-18	
70	70-72	0	0.5	Reddish brown coarse sand and some small gravel, wet Blowcount: 17-21-18-19	
75	75-77	0	0.5	Same as above, gravel lense at 76' BGS with very coarse sand. Blowcount: 20-20-16-20	
80	80-82	0	0.5	Brown coarse sand and some small gravel, wet. Blowcount: 38-15-22-16	



Aquaterra Technologies, Inc.
Subsurface Log: S-80D (Continued)

Depth (ft)					Well Schematic
85	85-87	0	2"	Dark greenish gray silt, some pebble. Silt had some dark brown layering Blowcount: 27-25-40-31 Rollerbit starting slight refusal at 87' BGS. Slow advancement	
90	90-92	0	2'	Small gravel (white, tan, red, green and gray) with very coarse sand. Blowcount: 19-17-15-50/4"	
	92-94	0	0.75	Dark greenish gray tight silt, slight clay content, some medium sand Blowcount: 21-30-28-20	
95				Rollerbit started "jumping" at 95' BGS, only advance 1" in 45 minutes End boring	

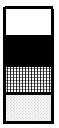
Aquaterra Technologies, Inc.
Subsurface Log: S-46D

Project Name: Sunoco Philadelphia Refinery AOI - 1 **Owner:** Sunoco, Inc. (R&M)
Location: Philadelphia, PA **Permit No.:**

Boring Number: S-46D **Log By:** M.B. Spancake **Date:** 3/17-18/05
Casing Elevation: N/A **Driller:** Parrat Wolff **Borehole Dia:** 8.25'
Screen Diameter: 2" **Length:** 15' **Slot Size:** **Water Level (Init):** 58'
Casing Diameter: 2" **Length:** 56' **Type:** PVC
Drilling Method: Hollow Stem Auger/ Mud Rotary **Sample Method:** Split Spoon **Rig Type:** HAS/Mud rotary

Construction Details

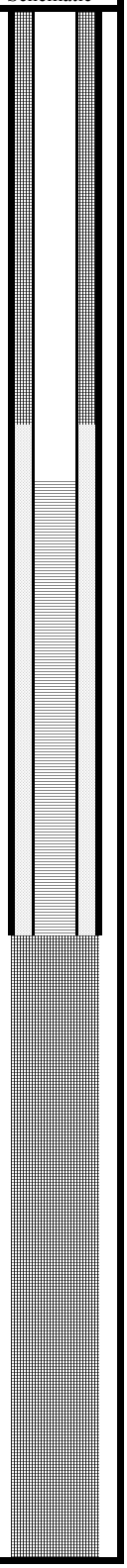
Total Well Depth: 69' BGS **Outer Steel Casing Interval:** 0'-48'
Screen Interval: 54'-69' **Bentonite Interval:** 0'-52'
Sand Pack Interval: 52'-69' **Cement/Grout Interval:**
Completion Details: Completed with 2' Steel stick-up **Sand Pack Type:** # 2



Depth (ft)	Sample Depth (ft)	OVM (ppm)	Amount of Recovery (ft)	Lithology	Well Schematic
0				Vacuum Utility Clearance to 9' below ground surface (bgs).	
5					
10	10-12	45	1	Brown coarse sandy gravel, moist, poorly sorted.	
	12-14	28	0.75	Same as above. Rock fragment in bottom of spoon. Slightly more moisture.	
	14-16	823	1	Wet, poorly sorted, coarse sandy gravel. Brownish-red in color.	
15	16-18	829	1	Same as above.	
	18-20	817	1.5	Same as above.	
20	20-22	267	0.75	Same as above, gravel is slightly larger.	
	22-24	744	1.75	Same as above, gravel is smaller and less abundant, more coarse sandy gravel matrix.	
	24-26	760	1	Brownish red, coarse, sandy gravel, wet.	
25	26-28	20	2	Same as above, more gravel and pebbles.	
	28-30	0	2	Same as above, changing to a wet, gray, fine sand at 28.5'. Slight clay content from 28.5'-29' bgs.	
30	30-32	13	NM	Same as above, changing to a coarse sand and very small gravel.	
	32-34	9	2	Coarse sandy gravel turning to a fine sandy gray clay towards bottom.	
	34-36	122	1	Fine brown silty sand, wet.	
35	36-38	11	1.25	Gray clayey silt, slight moisture to dry.	

Aquaterra Technologies, Inc.
Subsurface Log: S-46D (Continued)

Depth (ft)					Well Schematic
	38-40	2	0.75	Same as above, more clay content.	
40	40-42	0	1.5	Same as above.	
	42-44	0	2	Gray clayey silt.	
45	44-46	0	1.5	Gray fine sandy silt, slight clay.	
	46-48	0	1.5	Same as above.	
	48-50	0	1.25	Same as above.	
50	50-52	0	1.75	Same as above.	
	52-54	NM	1.5	Same as above. Changing to a green coarse sand. Large quartz fragment sand and in bottom and serpentine fragment.	
55	54-56	0	0.5	Note: The spoon advanced only 0.75 feet. Coarse brown orange coarse pebble matrix. Moist.	
	56-58	0	1	Same as above. No gravel or pebble present in bottom of spoon.	
	58-60	0	1	Same as above. Changed to medium sand at bottom of shoe. Moist to wet.	
60	60-62				
65	65-67	0	1.5	Medium brown orange sand and pebble. Wet. Changing to a medium greenish gray wet sand.	
70	70-72	0	1	White medium and fine sand matrix with large pebble fragments. Wet End augers. Remove augers from borehole and fill with grout. Will move well location 15' east. Advanced augers to 48' BGS and set 4"-steel casing. Begin with mud rotary drilling on 4/5/05. Advance mud rotary to 75' BGS and collect spoon.	
75	75-77	0	1.75	White and light gray saprolitic mica schist. Some dark gray banding is present. Blow count = 5-23-36-46	
80	80-82	0	1.25	Light gray highly weathered mica schist with darker banding. Slight green coloration. Blow count = 14-27-42-46	
85	85-87	0	2	Greenish gray saprolitic mica shist in top 1.5'. Changing to a dark grayish green weathered mica schist. Blow count = 27-43-50-50.	
90	90-92	0		Greenish gray and tan weathered mica schist, very dense and compact. Blow count = 47-52-50/0.3	



APPENDIX C

SOIL, SOIL GAS, AND GROUNDWATER ANALYTICAL REPORTS

BELMONT TERMINAL

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:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 940418. Samples arrived at the laboratory on Thursday, April 21, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description	Lancaster Labs Number
SG-5 Grab Summa Canister #296	4508334
SG-5 Grab Sorbent Tube Sample	4508335
SG-4 Grab Summa Canister #0144	4508336
SG-4 Grab Sorbent Tube Sample	4508337
SG-2 Grab Summa Canister #0016	4508338
SG-2 Grab Sorbent Tube Sample	4508339
SG-8 Grab Summa Canister #012	4508340
SG-8 Grab Sorbent Tube Sample	4508341
SG-9 Grab Summa Canister #313	4508342
SG-9 Grab Sorbent Tube Sample	4508343
SG-10 Grab Summa Canister #408	4508344
SG-10 Grab Sorbent Tube Sample	4508345
SG-11 Grab Summa Canister #0175	4508346
SG-11 Grab Sorbent Tube Sample	4508347

ELECTRONIC COPY TO	SUN: Aquaterra Tech.	Attn: Brad Spancake
1 COPY TO	LL	Attn: Angela Miller
ELECTRONIC COPY TO	Langan	Attn: Dennis Webster
1 COPY TO	Langan	Attn: Jason Hanna

Lancaster Laboratories

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Analysis Report

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,

Michele A. Jarosick
Senior Chemist, Coordinator

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. AQ 4508334

SG-5 Grab Summa Canister #296
SUN: Philadelphia Refinery (Belmont Terminal)

Collected:04/19/2005 11:05 by BB

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/09/2005 at 13:25
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

CAT No.	Analysis Name	CAS Number	As Received Result		As Received Method Detection Limit*	As Received Limit of Quantitation	Units	Dilution Factor
05298	TO 15 VOA Ext. List							
07225	Methyl t-Butyl Ether	1634-04-4	N.D.		0.70	3.5	mg/m3	1000
07237	1,2-Dichloroethane	107-06-2	N.D.		0.80	4.0	mg/m3	1000
07238	Benzene	71-43-2	0.70	J	0.60	3.0	mg/m3	1000
07250	Toluene	108-88-3	2.0	J	0.80	4.0	mg/m3	1000
07258	1,2-Dibromoethane	106-93-4	N.D.		2.0	10.	mg/m3	1000
07261	Ethylbenzene	100-41-4	1.0	J	0.90	4.5	mg/m3	1000
07262	m/p-Xylene	1330-20-7	3.0	J	0.90	4.5	mg/m3	1000
07263	o-Xylene	95-47-6	N.D.		0.90	4.5	mg/m3	1000
07266	Cumene	98-82-8	N.D.		1.0	5.0	mg/m3	1000

The limits of quantitation were raised due to high levels of non-target compounds.

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
05298	TO 15 VOA Ext. List	EPA Method TO-15	1	05/02/2005 12:21	George M Main	1000

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. AQ 4508335

SG-5 Grab Sorbent Tube Sample
SUN: Philadelphia Refinery (Belmont Terminal)

Collected:04/19/2005 11:29 by BB

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/09/2005 at 13:25
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

SG--5

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit*	As Received Limit of Quantitation	Units	Dilution Factor
09002	Napthalene in Air	n.a.	N.D.	0.017	0.17	mg/m3	1
07804	PAHs in Soil by GC/MS						
03761	Naphthalene	91-20-3	N.D.	1.	10.	ug	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
09002	Napthalene in Air	TO-13 mod.	1	05/09/2005 13:18	Rachel R Cochis	1
07804	PAHs in Soil by GC/MS	Modified TO-13	1	04/28/2005 12:18	Brian K Graham	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. AQ 4508336

SG-4 Grab Summa Canister #0144
SUN: Philadelphia Refinery (Belmont Terminal)

Collected:04/19/2005 11:36 by BB

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/09/2005 at 13:25
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

CAT No.	Analysis Name	CAS Number	As Received Result		As Received Method Detection Limit*	As Received Limit of Quantitation	Units	Dilution Factor
05298	TO 15 VOA Ext. List							
07225	Methyl t-Butyl Ether	1634-04-4	N.D.		0.35	1.8	mg/m3	500
07237	1,2-Dichloroethane	107-06-2	N.D.		0.40	2.0	mg/m3	500
07238	Benzene	71-43-2	0.68	J	0.30	1.5	mg/m3	500
07250	Toluene	108-88-3	2.0		0.40	2.0	mg/m3	500
07258	1,2-Dibromoethane	106-93-4	N.D.		0.75	3.8	mg/m3	500
07261	Ethylbenzene	100-41-4	N.D.		0.45	2.3	mg/m3	500
07262	m/p-Xylene	1330-20-7	1.0	J	0.45	2.3	mg/m3	500
07263	o-Xylene	95-47-6	N.D.		0.45	2.3	mg/m3	500
07266	Cumene	98-82-8	N.D.		0.50	2.5	mg/m3	500

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
05298	TO 15 VOA Ext. List	EPA Method TO-15	1	05/02/2005 13:33	George M Main	500

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. AQ 4508337

SG-4 Grab Sorbent Tube Sample
SUN: Philadelphia Refinery (Belmont Terminal)

Collected:04/19/2005 12:13 by BB

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/09/2005 at 13:25
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

SG--4

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit*	As Received Limit of Quantitation	Units	Dilution Factor
09002	Napthalene in Air	n.a.	N.D.	0.017	0.17	mg/m3	1
07804	PAHs in Soil by GC/MS						
03761	Naphthalene	91-20-3	N.D.	1.	10.	ug	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
09002	Napthalene in Air	TO-13 mod.	1	05/09/2005 13:18	Rachel R Cochis	1
07804	PAHs in Soil by GC/MS	Modified TO-13	1	04/28/2005 13:06	Brian K Graham	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. AQ 4508338

SG-2 Grab Summa Canister #0016
SUN: Philadelphia Refinery (Belmont Terminal)

Collected:04/19/2005 12:16 by BB

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/09/2005 at 13:25
Discard: 06/09/2005

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CAT No.	Analysis Name	CAS Number	As Received Result		As Received Method Detection Limit*	As Received Limit of Quantitation	Units	Dilution Factor
05298	TO 15 VOA Ext. List							
07225	Methyl t-Butyl Ether	1634-04-4	N.D.		0.35	1.8	mg/m3	500
07237	1,2-Dichloroethane	107-06-2	N.D.		0.40	20.	mg/m3	500
07238	Benzene	71-43-2	9.0		0.30	1.5	mg/m3	500
07250	Toluene	108-88-3	0.90	J	0.40	2.0	mg/m3	500
07258	1,2-Dibromoethane	106-93-4	N.D.		0.75	3.8	mg/m3	500
07261	Ethylbenzene	100-41-4	N.D.		0.45	2.2	mg/m3	500
07262	m/p-Xylene	1330-20-7	0.80	J	0.45	2.2	mg/m3	500
07263	o-Xylene	95-47-6	N.D.		0.45	2.2	mg/m3	500
07266	Cumene	98-82-8	N.D.		0.50	2.5	mg/m3	500

The limits of quantitation were raised due to high levels of non-target compounds.

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
05298	TO 15 VOA Ext. List	EPA Method TO-15	1	05/02/2005 14:46	George M Main	500

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. AQ 4508339

SG-2 Grab Sorbent Tube Sample
SUN: Philadelphia Refinery (Belmont Terminal)

Collected:04/19/2005 12:40 by BB

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/09/2005 at 13:25
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

SG--2

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit*	As Received Limit of Quantitation	Units	Dilution Factor
09002	Napthalene in Air	n.a.	N.D.	0.017	0.17	mg/m3	1
07804	PAHs in Soil by GC/MS						
03761	Naphthalene	91-20-3	N.D.	1.	10.	ug	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
09002	Napthalene in Air	TO-13 mod.	1	05/09/2005 13:18	Rachel R Cochis	1
07804	PAHs in Soil by GC/MS	Modified TO-13	1	04/28/2005 13:53	Brian K Graham	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. AQ 4508340

SG-8 Grab Summa Canister #012
SUN: Philadelphia Refinery (Belmont Terminal)

Collected:04/19/2005 13:11 by BB

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/09/2005 at 13:25
Discard: 06/09/2005

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Doylestown PA 18901

CAT No.	Analysis Name	CAS Number	As Received Result		As Received Method Detection Limit*	As Received Limit of Quantitation	Units	Dilution Factor
05298	TO 15 VOA Ext. List							
07225	Methyl t-Butyl Ether	1634-04-4	N.D.		140.	700.	mg/m3	200000
07237	1,2-Dichloroethane	107-06-2	N.D.		160.	800.	mg/m3	200000
07238	Benzene	71-43-2	N.D.		130.	650.	mg/m3	200000
07250	Toluene	108-88-3	200.	J	150.	750.	mg/m3	200000
07258	1,2-Dibromoethane	106-93-4	N.D.		300.	1,500.	mg/m3	200000
07261	Ethylbenzene	100-41-4	N.D.		170.	850.	mg/m3	200000
07262	m/p-Xylene	1330-20-7	N.D.		170.	850.	mg/m3	200000
07263	o-Xylene	95-47-6	N.D.		170.	850.	mg/m3	200000
07266	Cumene	98-82-8	N.D.		200.	1,000.	mg/m3	200000

The limits of quantitation were raised due to high levels of non-target compounds.

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
05298	TO 15 VOA Ext. List	EPA Method TO-15	1	05/02/2005 15:22	George M Main	200000

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. AQ 4508341

SG-8 Grab Sorbent Tube Sample
SUN: Philadelphia Refinery (Belmont Terminal)

Collected:04/19/2005 13:54 by BB

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/09/2005 at 13:25
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

SG--8

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit*	As Received Limit of Quantitation	Units	Dilution Factor
09002	Napthalene in Air	n.a.	N.D.	0.017	0.17	mg/m3	1
07804	PAHs in Soil by GC/MS						
03761	Naphthalene	91-20-3	N.D.	1.	10.	ug	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
09002	Napthalene in Air	TO-13 mod.	1	05/09/2005 13:18	Rachel R Cochis	1
07804	PAHs in Soil by GC/MS	Modified TO-13	1	04/28/2005 14:40	Brian K Graham	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. AQ 4508342

SG-9 Grab Summa Canister #313
SUN: Philadelphia Refinery (Belmont Terminal)

Collected:04/19/2005 14:36 by BB

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/09/2005 at 13:25
Discard: 06/09/2005

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500 Hyde Park
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CAT No.	Analysis Name	CAS Number	As Received Result		As Received Method Detection Limit*	As Received Limit of Quantitation	Units	Dilution Factor
05298	TO 15 VOA Ext. List							
07225	Methyl t-Butyl Ether	1634-04-4	N.D.		0.070	0.35	mg/m3	100
07237	1,2-Dichloroethane	107-06-2	N.D.		0.080	0.40	mg/m3	100
07238	Benzene	71-43-2	0.69		0.060	0.30	mg/m3	100
07250	Toluene	108-88-3	0.68		0.080	0.40	mg/m3	100
07258	1,2-Dibromoethane	106-93-4	N.D.		0.15	0.75	mg/m3	100
07261	Ethylbenzene	100-41-4	N.D.		0.090	0.45	mg/m3	100
07262	m/p-Xylene	1330-20-7	0.12	J	0.090	0.45	mg/m3	100
07263	o-Xylene	95-47-6	N.D.		0.090	0.45	mg/m3	100
07266	Cumene	98-82-8	N.D.		0.10	0.50	mg/m3	100

The limits of quantitation were raised due to high levels of non-target compounds.

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
05298	TO 15 VOA Ext. List	EPA Method TO-15	1	05/02/2005 17:11	George M Main	100

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. AQ 4508343

SG-9 Grab Sorbent Tube Sample
SUN: Philadelphia Refinery (Belmont Terminal)

Collected:04/19/2005 15:03 by BB

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/09/2005 at 13:25
Discard: 06/09/2005

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500 Hyde Park
Doylestown PA 18901

SG--9

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit*	As Received Limit of Quantitation	Units	Dilution Factor
09002	Napthalene in Air	n.a.	N.D.	0.017	0.17	mg/m3	1
07804	PAHs in Soil by GC/MS						
03761	Naphthalene	91-20-3	N.D.	1.	10.	ug	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
09002	Napthalene in Air	TO-13 mod.	1	05/09/2005 13:18	Rachel R Cochis	1
07804	PAHs in Soil by GC/MS	Modified TO-13	1	04/28/2005 15:27	Brian K Graham	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. AQ 4508344

SG-10 Grab Summa Canister #408
SUN: Philadelphia Refinery (Belmont Terminal)

Collected:04/19/2005 14:48 by BB

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/09/2005 at 13:25
Discard: 06/09/2005

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Doylestown PA 18901

CAT No.	Analysis Name	CAS Number	As Received Result		As Received Method Detection Limit*	As Received Limit of Quantitation	Units	Dilution Factor
05298	TO 15 VOA Ext. List							
07225	Methyl t-Butyl Ether	1634-04-4	N.D.		35.	180.	mg/m3	50000
07237	1,2-Dichloroethane	107-06-2	540.		40.	200.	mg/m3	50000
07238	Benzene	71-43-2	22,000.		30.	150.	mg/m3	500000
07250	Toluene	108-88-3	1,000.		40.	200.	mg/m3	50000
07258	1,2-Dibromoethane	106-93-4	N.D.		75.	380.	mg/m3	50000
07261	Ethylbenzene	100-41-4	N.D.		45.	220.	mg/m3	50000
07262	m/p-Xylene	1330-20-7	65.	J	45.	220.	mg/m3	50000
07263	o-Xylene	95-47-6	N.D.		45.	220.	mg/m3	50000
07266	Cumene	98-82-8	N.D.		50.	250.	mg/m3	50000

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
05298	TO 15 VOA Ext. List	EPA Method TO-15	1	05/02/2005 17:47	George M Main	500000
05298	TO 15 VOA Ext. List	EPA Method TO-15	1	05/02/2005 18:23	George M Main	50000

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. AQ 4508345

SG-10 Grab Sorbent Tube Sample
SUN: Philadelphia Refinery (Belmont Terminal)

Collected:04/19/2005 15:31 by BB

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/09/2005 at 13:25
Discard: 06/09/2005

Langan
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Doylestown PA 18901

SG-10

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit*	As Received Limit of Quantitation	Units	Dilution Factor
09002	Napthalene in Air	n.a.	N.D.	0.017	0.17	mg/m3	1
07804	PAHs in Soil by GC/MS						
03761	Naphthalene	91-20-3	N.D.	1.	10.	ug	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
09002	Napthalene in Air	TO-13 mod.	1	05/09/2005 13:18	Rachel R Cochis	1
07804	PAHs in Soil by GC/MS	Modified TO-13	1	04/28/2005 16:14	Brian K Graham	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. AQ 4508346

SG-11 Grab Summa Canister #0175
SUN: Philadelphia Refinery (Belmont Terminal)

Collected:04/19/2005 16:07 by BB

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/09/2005 at 13:25
Discard: 06/09/2005

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500 Hyde Park
Doylestown PA 18901

CAT No.	Analysis Name	CAS Number	As Received Result		As Received Method Detection Limit*	As Received Limit of Quantitation	Units	Dilution Factor
05298	TO 15 VOA Ext. List							
07225	Methyl t-Butyl Ether	1634-04-4	N.D.		70.	350.	mg/m3	100000
07237	1,2-Dichloroethane	107-06-2	2,200.		80.	400.	mg/m3	100000
07238	Benzene	71-43-2	85,000.		120.	600.	mg/m3	2000000
07250	Toluene	108-88-3	2,600.		80.	400.	mg/m3	100000
07258	1,2-Dibromoethane	106-93-4	N.D.		150.	750.	mg/m3	100000
07261	Ethylbenzene	100-41-4	150.	J	90.	450.	mg/m3	100000
07262	m/p-Xylene	1330-20-7	410.	J	90.	450.	mg/m3	100000
07263	o-Xylene	95-47-6	130.	J	90.	450.	mg/m3	100000
07266	Cumene	98-82-8	N.D.		100.	500.	mg/m3	100000

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
05298	TO 15 VOA Ext. List	EPA Method TO-15	1	05/02/2005 19:35	George M Main	100000
05298	TO 15 VOA Ext. List	EPA Method TO-15	1	05/03/2005 00:20	George M Main	2000000

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. AQ 4508347

SG-11 Grab Sorbent Tube Sample
SUN: Philadelphia Refinery (Belmont Terminal)

Collected:04/19/2005 16:29 by BB

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/09/2005 at 13:25
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

SG-11

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit*	As Received Limit of Quantitation	Units	Dilution Factor
09002	Napthalene in Air	n.a.	N.D.	0.017	0.17	mg/m3	1
07804	PAHs in Soil by GC/MS						
03761	Naphthalene	91-20-3	N.D.	1.	10.	ug	1

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
09002	Napthalene in Air	TO-13 mod.	1	05/09/2005 13:18	Rachel R Cochis	1
07804	PAHs in Soil by GC/MS	Modified TO-13	1	04/28/2005 18:09	Brian K Graham	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Quality Control Summary

Client Name: Langan Group Number: 940418
Reported: 05/09/05 at 01:25 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 MDL**	Blank LOQ	Report Units	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Max
Batch number: 05116SLC026	Sample number(s): 4508335,4508337,4508339,4508341,4508343,4508345,4508347								
Naphthalene	N.D.	1,000.	10,000.	ug/kg	91		70-103		
Batch number: C051221AA	Sample number(s): 4508334,4508336,4508338,4508340,4508342,4508344,4508346								
Methyl t-Butyl Ether	N.D.	0.20	1.0	ppb(v)					
1,2-Dichloroethane	N.D.	0.20	1.0	ppb(v)					
Benzene	N.D.	0.20	1.0	ppb(v)	122		56-146		
Toluene	N.D.	0.20	1.0	ppb(v)					
1,2-Dibromoethane	N.D.	0.20	1.0	ppb(v)					
Ethylbenzene	N.D.	0.20	1.0	ppb(v)	119		65-127		
m/p-Xylene	N.D.	0.20	1.0	ppb(v)					
o-Xylene	N.D.	0.20	1.0	ppb(v)					
Cumene	N.D.	0.20	1.0	ppb(v)					

Surrogate Quality Control

Analysis Name: PAHs in Soil by GC/MS
Batch number: 05116SLC026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4508335	87	86	98
4508337	83	81	96
4508339	76	77	93
4508341	57	56	67
4508343	76	79	90
4508345	80	79	98
4508347	80	81	92
Blank	96	100	110
LCS	95	100	121
Limits:	47-128	55-123	53-140

*- 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 background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. # 10132 Group# 940418 Sample # 4508334-41

COC # 0082213

Please print. Instructions on reverse side correspond with circled numbers. cooler temp 3.4°C

(1)
Client: Aquaterra Acct. #:
Project Name/#: Phila Refinery (Belmont Terminal) PWSID #:
Project Manager: KM P.O.#:
Sampler: BB Quote #:
Name of state where samples were collected: Pa

For Lab Use Only
FSC:
SCR #: 1202446

(6) Preservation Codes H=HCl N=HNO3 T=Thiosulfate B=NaOH A=Ascorbic Acid S=H2SO4 O=Other

(2) Sample Identification	Date Collected	Time Collected	(3) Grab	Composite	(4) Matrix: Soil	Solid	Waste	Water	Oil	Total # of Containers	(5) Analyses Requested: TO-15	TO-15 (Naphthalene)	Remarks
SG-5	4/19/05	1105	X						X	1	X		Summa # 286
SG-5		1129								1		X	
SG-4		1136								1	X		Summa # 0144
SG-4		1213								1		X	
SG-2		1216								1	X		Summa # 0016
SG-2		1240								1		X	
SG-8		1311								1	X		Summa # 012
SG-8		1354								1		X	
SG-9		1436								1	X		Summa # 313
SG-9		1503								1		X	

1 of 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)
QC Summary Type VI (Raw Data)
Type I (Tier I) GLP
Type II (Tier II) Other
Type III (NJ Red. Del.)
Type IV (CLP)

SDG Complete? Yes No

Site-specific QC required? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes No

(9)

Relinquished by:	Date	Time	Received by:	Date	Time
K. Mott	4-15-05	1240	Maureen M Fallen	4/18/05	8:07
Maureen M Fallen	4/18/05	11:00			
	4/19/05		Fridge		Same
AT FRIDGE			D. Lefever	4/21/05	1417
D. Lefever 4/21/05		1635	Jessica B	4/21/05	1635

Analysis Request / Environmental Services Chain of Custody

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Where quality is a science.

For Lancaster Laboratories use only
Acct. # 10132 Group# 940418 Sample # 4508334-41

COC # 0073913

Please print. Instructions on reverse side correspond with circled numbers. Cooler temp 3.4°C

(1)
Client: AQuaterra Acct. #:
Project Name/#: Phila Refinery (Belmont Terminal) PWSID #:
Project Manager: KM P.O.#:
Sampler: BB Quote #:
Name of state where samples were collected: PA

(4) Matrix: Soil | Water | Other (Check if Potable / NPDES Applicable)

(5) Analyses Requested

For Lab Use Only
FSC:
SCR #:

(6) Temperature of samples upon receipt (if requested)

2 of 2

(2) Sample Identification	Date Collected	Time Collected	(3) Grab	Composite	Soil	Water	Other	Total # of Containers	TO-15	TO-13 (with Naphthalene)	Remarks
SG-10	4/20/05	1448						1	X		Summa #408
SG-10		1531						1		X	
SG-11		1607						1	X		Summa #0175
SG-11		1629						1		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)
QC Summary | Type VI (Raw Data) | SDG Complete? (Yes / No)
Type I (Tier I) | GLP | Site-specific QC required? Yes / No
Type II (Tier II) | Other | (If yes, indicate QC sample and submit triplicate volume.)
Type III (NJ Red. Del.) | Internal Chain of Custody required? Yes / No
Type IV (CLP)

(9)

Relinquished by:	Date	Time	Received by:	Date	Time
[signature] BB	4/20/05		AQuaterra	Same	
AT PRIDGE			[signature]	4/21/05	1417
[signature]	4/21/05	1635			
			Jessica [signature]	4/21/05	1635

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

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
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< 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

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

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. All other results are reported on an as-received basis.

U.S. EPA CLP 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 quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
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 sample 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.

Measurement uncertainty values, as applicable, are available upon request.

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:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 941001. Samples arrived at the laboratory on Tuesday, April 26, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description	Lancaster Labs Number
OW14-042505 Grab Water Sample	4511551
TW3-042505 Grab Water Sample	4511552
TW5-042505 Grab Water Sample	4511553
TW8-042505 Grab Water Sample	4511554
TW11-042505 Grab Water Sample	4511555
MW36-042505 Grab Water Sample	4511556
TW9-042505 Grab Water Sample	4511557

ELECTRONIC COPY TO	SUN: Aquaterra Tech.	Attn: Brad Spancake
1 COPY TO	LL	Attn: Angela Miller
1 COPY TO	Langan	Attn: Jason Hanna
ELECTRONIC COPY TO	Langan	Attn: Dennis Webster

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Analysis Report

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,

Michele J. Smith

Michele J. Smith
Group Leader

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4511551

OW14-042505 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/25/2005 14:20 by MH

Account Number: 10132

Submitted: 04/26/2005 18:15
Reported: 05/23/2005 at 13:17
Discard: 06/23/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM14

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	< 0.0100	0.0100	0.0021	mg/l	10
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	10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	160.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	8.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/03/2005 22:36	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 18:46	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 00:09	Jolene M Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/01/2005 22:24	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/01/2005 22:24	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4511551

OW14-042505 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/25/2005 14:20 by MH

Account Number: 10132

Submitted: 04/26/2005 18:15
Reported: 05/23/2005 at 13:17
Discard: 06/23/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM14

07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4511552

TW3-042505 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/25/2005 13:20 by MH

Account Number: 10132

Submitted: 04/26/2005 18:15
Reported: 05/23/2005 at 13:17
Discard: 06/23/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM03

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	0.0142	0.0100	0.0021	mg/l	10
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	0.058	0.029	0.0097	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	1,500.	490.	49.	ug/l	50
03956	Fluorene	86-73-7	55.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	110.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	44.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	16.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	56,000.	2,500.	250.	ug/l	500
05401	Benzene	71-43-2	63,000.	2,500.	250.	ug/l	500
05402	1,2-Dichloroethane	107-06-2	< 500.	500.	100.	ug/l	100
05407	Toluene	108-88-3	29,000.	2,500.	350.	ug/l	500
05415	Ethylbenzene	100-41-4	2,700.	500.	80.	ug/l	100
05420	Isopropylbenzene	98-82-8	< 500.	500.	100.	ug/l	100
06310	Xylene (Total)	1330-20-7	17,000.	500.	80.	ug/l	100

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/03/2005 22:38	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 19:16	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 01:03	Jolene M Graham	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4511552

TW3-042505 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/25/2005 13:20 by MH

Account Number: 10132

Submitted: 04/26/2005 18:15
Reported: 05/23/2005 at 13:17
Discard: 06/23/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM03

07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 11:08	Joseph M Gambler	50
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 20:30	Shawn J Rice	100
02302	UST-Waters by 8260B	SW-846 8260B	1	05/01/2005 22:51	Jason M Long	500
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 20:30	Shawn J Rice	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	05/01/2005 22:51	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4511553

TW5-042505 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/25/2005 13:55 by MH

Account Number: 10132

Submitted: 04/26/2005 18:15
Reported: 05/23/2005 at 13:17
Discard: 06/23/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM05

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	< 0.0100	0.0100	0.0021	mg/l	10
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	17.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5,000.	5,000.	500.	ug/l	1000
05401	Benzene	71-43-2	450,000.	25,000.	2,500.	ug/l	5000
05402	1,2-Dichloroethane	107-06-2	< 5,000.	5,000.	1,000.	ug/l	1000
05407	Toluene	108-88-3	8,500.	5,000.	700.	ug/l	1000
05415	Ethylbenzene	100-41-4	< 5,000.	5,000.	800.	ug/l	1000
05420	Isopropylbenzene	98-82-8	< 5,000.	5,000.	1,000.	ug/l	1000
06310	Xylene (Total)	1330-20-7	< 5,000.	5,000.	800.	ug/l	1000

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/03/2005 22:22	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 19:45	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 01:57	Jolene M Graham	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4511553

TW5-042505 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/25/2005 13:55 by MH

Account Number: 10132

Submitted: 04/26/2005 18:15
Reported: 05/23/2005 at 13:17
Discard: 06/23/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM05

02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 20:56	Shawn J Rice	1000
02302	UST-Waters by 8260B	SW-846 8260B	1	05/01/2005 23:17	Jason M Long	5000
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 20:56	Shawn J Rice	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	05/01/2005 23:17	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4511554

TW8-042505 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/25/2005 12:00 by MH

Account Number: 10132

Submitted: 04/26/2005 18:15
Reported: 05/23/2005 at 13:17
Discard: 06/23/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM08

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	< 0.0100	0.0100	0.0021	mg/l	10
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	22,000.	2,500.	250.	ug/l	250
03956	Fluorene	86-73-7	620.	99.	10.	ug/l	10
03963	Phenanthrene	85-01-8	< 2,500.	2,500.	250.	ug/l	250
03967	Pyrene	129-00-0	500.	99.	10.	ug/l	10
03971	Chrysene	218-01-9	200.	99.	10.	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	< 250.	250.	25.	ug/l	50
05401	Benzene	71-43-2	480.	250.	25.	ug/l	50
05402	1,2-Dichloroethane	107-06-2	< 250.	250.	50.	ug/l	50
05407	Toluene	108-88-3	< 250.	250.	35.	ug/l	50
05415	Ethylbenzene	100-41-4	2,100.	250.	40.	ug/l	50
05420	Isopropylbenzene	98-82-8	280.	250.	50.	ug/l	50
06310	Xylene (Total)	1330-20-7	2,800.	250.	40.	ug/l	50
	The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.						

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4511554

TW8-042505 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/25/2005 12:00 by MH

Account Number: 10132

Submitted: 04/26/2005 18:15
Reported: 05/23/2005 at 13:17
Discard: 06/23/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM08

06035	Lead	SW-846 6020	1	05/03/2005 22:45	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 20:45	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 12:01	Joseph M Gambler	10
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 15:34	Joseph M Gambler	250
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 21:23	Shawn J Rice	50
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 21:23	Shawn J Rice	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4511555

TW11-042505 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/25/2005 14:50 by MH

Account Number: 10132

Submitted: 04/26/2005 18:15
Reported: 05/23/2005 at 13:17
Discard: 06/23/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM11

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	< 0.0100	0.0100	0.0021	mg/l	10
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	< 11.	11.	1.	ug/l	1
03956	Fluorene	86-73-7	< 11.	11.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 11.	11.	1.	ug/l	1
03967	Pyrene	129-00-0	< 11.	11.	1.	ug/l	1
03971	Chrysene	218-01-9	< 11.	11.	1.	ug/l	1
	Due to insufficient sample, 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.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/03/2005 22:47	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 21:15	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 03:45	Jolene M Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/04/2005 21:32	Dawn M Harle	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4511555

TW11-042505 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/25/2005 14:50 by MH

Account Number: 10132

Submitted: 04/26/2005 18:15
Reported: 05/23/2005 at 13:17
Discard: 06/23/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM11

01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/04/2005 21:32	Dawn M Harle	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4511556

MW36-042505 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/25/2005 12:45 by MH

Account Number: 10132

Submitted: 04/26/2005 18:15
Reported: 05/23/2005 at 13:17
Discard: 06/23/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM36

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	< 0.0100	0.0100	0.0021	mg/l	10
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	5,800.	990.	99.	ug/l	100
03956	Fluorene	86-73-7	23.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	25.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
	Surrogate recoveries were outside of QC limits for the GC/MS semivolatile compounds. The analysis was repeated outside of the required hold time and surrogate recoveries met requirements. The data reported is from the initial extraction of the sample.						
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5,000.	5,000.	500.	ug/l	1000
05401	Benzene	71-43-2	150,000.	5,000.	500.	ug/l	1000
05402	1,2-Dichloroethane	107-06-2	< 5,000.	5,000.	1,000.	ug/l	1000
05407	Toluene	108-88-3	< 5,000.	5,000.	700.	ug/l	1000
05415	Ethylbenzene	100-41-4	< 5,000.	5,000.	800.	ug/l	1000
05420	Isopropylbenzene	98-82-8	< 5,000.	5,000.	1,000.	ug/l	1000
06310	Xylene (Total)	1330-20-7	< 5,000.	5,000.	800.	ug/l	1000
	Due to the level of benzene, the reporting limits for all GC/MS volatile compounds were raised.						

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4511556

MW36-042505 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/25/2005 12:45 by MH

Account Number: 10132

Submitted: 04/26/2005 18:15
Reported: 05/23/2005 at 13:17
Discard: 06/23/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM36

06035	Lead	SW-846 6020	1	05/03/2005 22:49	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 21:44	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 04:39	Jolene M Graham	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 12:55	Joseph M Gambler	100
02302	UST-Waters by 8260B	SW-846 8260B	1	05/02/2005 00:36	Jason M Long	1000
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/02/2005 00:36	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4511557

TW9-042505 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/25/2005 15:15 by MH

Account Number: 10132

Submitted: 04/26/2005 18:15
Reported: 05/23/2005 at 13:17
Discard: 06/23/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM09

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
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	< 11.	11.	1.	ug/l	1
03956	Fluorene	86-73-7	< 11.	11.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 11.	11.	1.	ug/l	1
03967	Pyrene	129-00-0	< 11.	11.	1.	ug/l	1
03971	Chrysene	218-01-9	< 11.	11.	1.	ug/l	1
	Due to insufficient sample, the reporting limits for the GC/MS semivolatile compounds were raised.						
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 25.	25.	3.	ug/l	5
05401	Benzene	71-43-2	360.	25.	3.	ug/l	5
05402	1,2-Dichloroethane	107-06-2	< 25.	25.	5.	ug/l	5
05407	Toluene	108-88-3	< 25.	25.	4.	ug/l	5
05415	Ethylbenzene	100-41-4	< 25.	25.	4.	ug/l	5
05420	Isopropylbenzene	98-82-8	< 25.	25.	5.	ug/l	5
06310	Xylene (Total)	1330-20-7	< 25.	25.	4.	ug/l	5
	Due to the level of benzene, the reporting limits for all GC/MS volatile compounds were raised.						

Commonwealth of Pennsylvania Lab Certification No. 36-037
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 22:14	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 05:33	Jolene M Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/02/2005 01:03	Jason M Long	5
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/02/2005 01:03	Jason M Long	n.a.

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4511557

TW9-042505 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/25/2005 15:15 by MH

Account Number: 10132

Submitted: 04/26/2005 18:15
Reported: 05/23/2005 at 13:17
Discard: 06/23/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM09

07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	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: Langan Group Number: 941001
Reported: 05/23/05 at 01:17 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: 051170000A	Sample number(s): 4511551-4511557								
Ethylene dibromide	< 0.030	0.030	0.010	ug/l	96	96	60-140	0	20
Batch number: 05118WAC026	Sample number(s): 4511551-4511557								
Naphthalene	< 10.	10.	1.	ug/l	78	81	58-108	3	30
Fluorene	< 10.	10.	1.	ug/l	89	89	61-116	0	30
Phenanthrene	< 10.	10.	1.	ug/l	96	96	68-111	1	30
Pyrene	< 10.	10.	1.	ug/l	98	99	68-114	1	30
Chrysene	< 10.	10.	1.	ug/l	96	97	70-111	1	30
Batch number: 051216050001A	Sample number(s): 4511551-4511556								
Lead	< 0.0010	0.0010	0.00021	mg/l	105		80-120		
Batch number: P051192AA	Sample number(s): 4511552-4511554								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	87		77-127		
Benzene	< 5.	5.	0.5	ug/l	95		85-117		
1,2-Dichloroethane	< 5.	5.	1.	ug/l	85		77-132		
Toluene	< 5.	5.	0.7	ug/l	100		85-115		
Ethylbenzene	< 5.	5.	0.8	ug/l	98		82-119		
Isopropylbenzene	< 5.	5.	1.	ug/l	97		80-120		
Xylene (Total)	< 5.	5.	0.8	ug/l	99		83-113		
Batch number: P051211AA	Sample number(s): 4511551-4511553,4511556-4511557								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	81		77-127		
Benzene	< 5.	5.	0.5	ug/l	100		85-117		
1,2-Dichloroethane	< 5.	5.	1.	ug/l	89		77-132		
Toluene	< 5.	5.	0.7	ug/l	105		85-115		
Ethylbenzene	< 5.	5.	0.8	ug/l	99		82-119		
Isopropylbenzene	< 5.	5.	1.	ug/l	95		80-120		
Xylene (Total)	< 5.	5.	0.8	ug/l	100		83-113		
Batch number: P051241AA	Sample number(s): 4511555								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	93		77-127		
Benzene	< 5.	5.	0.5	ug/l	97		85-117		
1,2-Dichloroethane	< 5.	5.	1.	ug/l	88		77-132		
Toluene	< 5.	5.	0.7	ug/l	101		85-115		
Ethylbenzene	< 5.	5.	0.8	ug/l	97		82-119		
Isopropylbenzene	< 5.	5.	1.	ug/l	97		80-120		
Xylene (Total)	< 5.	5.	0.8	ug/l	99		83-113		

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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 941001
Reported: 05/23/05 at 01:17 PM

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: 051170000A	Sample number(s): 4511551-4511557								
Ethylene dibromide	78		65-135			< 0.029	< 0.029	0 (1)	30
Batch number: 051216050001A	Sample number(s): 4511551-4511556								
Lead	120	100	75-125	18	20	< 0.0010	< 0.0010	9 (1)	20
Batch number: P051192AA	Sample number(s): 4511552-4511554								
Methyl Tertiary Butyl Ether	88	89	69-134	1	30				
Benzene	99	99	83-128	0	30				
1,2-Dichloroethane	85	85	73-136	1	30				
Toluene	98	99	83-127	1	30				
Ethylbenzene	92	91	82-129	2	30				
Isopropylbenzene	92	92	81-130	1	30				
Xylene (Total)	90	90	82-130	0	30				
Batch number: P051211AA	Sample number(s): 4511551-4511553,4511556-4511557								
Methyl Tertiary Butyl Ether	86	88	69-134	1	30				
Benzene	127	117	83-128	4	30				
1,2-Dichloroethane	94	95	73-136	1	30				
Toluene	118	114	83-127	3	30				
Ethylbenzene	117	112	82-129	3	30				
Isopropylbenzene	110	109	81-130	1	30				
Xylene (Total)	131*	117	82-130	5	30				
Batch number: P051241AA	Sample number(s): 4511555								
Methyl Tertiary Butyl Ether	90	90	69-134	1	30				
Benzene	102	101	83-128	1	30				
1,2-Dichloroethane	81	86	73-136	6	30				
Toluene	105	105	83-127	0	30				
Ethylbenzene	104	102	82-129	2	30				
Isopropylbenzene	103	102	81-130	1	30				
Xylene (Total)	104	102	82-130	2	30				

Surrogate Quality Control

Analysis Name: EDB in Wastewater
Batch number: 051170000A

	1,1,2,2-Tetrachloroethane
4511551	115
4511552	66
4511553	97
4511554	101
4511555	106
4511556	105
4511557	108
Blank	106
DUP	104
LCS	104
LCSD	110
MS	107

*- 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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 941001
Reported: 05/23/05 at 01:17 PM

Surrogate Quality Control

Limits: 52-120

Analysis Name: PAHs in Water by GC/MS
Batch number: 05118WAC026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4511551	92	90	121
4511552	97	68	108
4511553	96	87	122
4511554	107	97	113
4511555	94	86	111
4511556	125*	85	121
4511557	94	89	111
Blank	86	76	119
LCS	94	90	124
LCSD	96	92	124
Limits:	51-123	64-112	53-135

Analysis Name: UST-Waters by 8260B
Batch number: P051192AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4511552	92	90	104	103
4511553	91	89	103	102
4511554	93	91	104	103
Blank	93	93	105	103
LCS	92	92	105	105
MS	93	93	104	105
MSD	93	91	103	103
Limits:	81-120	82-112	85-112	83-113

Analysis Name: UST-Waters by 8260B
Batch number: P051211AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4511551	88	87	99	99
4511556	88	84	99	95
4511557	89	87	100	93
Blank	90	87	99	93
LCS	90	86	98	95
MS	89	86	99	97
MSD	89	89	99	97
Limits:	81-120	82-112	85-112	83-113

Analysis Name: UST-Waters by 8260B
Batch number: P051241AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4511555	93	93	103	103
Blank	92	93	102	103
LCS	93	92	103	103
MS	94	90	103	104
MSD	93	90	102	103

*- 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 background result was more than four times the spike added.

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Quality Control Summary

Client Name: Langan Group Number: 941001
Reported: 05/23/05 at 01:17 PM

Surrogate Quality Control

Limits:	81-120	82-112	85-112	83-113

*- 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 background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. # 10132 Group# 941001 Sample # 4511551-57

COC # 0082104

Please print. Instructions on reverse side correspond with circled numbers.

Cooler temp 1.9-3.7°C

(1) Client: Sun / Aquaterra Acct. #:
Project Name/#: Sun - Belmont Terminal AOI-1 PWSID #:
Project Manager: K. Martin / J. Hanna (Langan) P.O.#:
Sampler: MH Quote #:
Name of state where samples were collected: PA

(2) Sample Identification	Date Collected	Time Collected	(3) Grab	Composite	Matrix: Soil	Drinking Water	Groundwater	Wastewater	Other	Total # of Containers	8260B BTEX, MTBE, cumene, EDB	8011 EDB	6020 Dissolved Pb	8270C Fluorene, Phenanthrene, Pyrene, Chrysene, Naphthalene	Remarks
OW14-042505	4-25-05	1420	X				X			8					Dissolved Pb samples are unfiltered/unpreserved
TW3-042505		1320	X				X			8					
TW5-042505		1355	X				X			8					
TW8-042505		1200	X				X			8					
TW11-042505		1450	X				X			8					
MW36-042505		1245	X				X			8					
TW9-042505		1515	X				X			7	++		+	+	

For Lab Use Only
FSC:
SCR #: 120259

(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)
QC Summary Type VI (Raw Data)
Type I (Tier I) GLP
Type II (Tier II) Other
Type III (NJ Red. Del.)
Type IV (CLP)

SDG Complete? Yes No
Site-specific QC required? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes No

Relinquished by:	Date	Time	Received by:	Date	Time
	4/25	17:2		4-25	5:15
Fridge	4-25-05	5:15	Aquaterra Fridge	4-25-05	5:15
	4/26/05	1120		4/26/05	11:20
	4/26/05	18:15			
				4/26/05	1815

(9)

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

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
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< 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

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

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. All other results are reported on an as-received basis.

U.S. EPA CLP 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 quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
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 sample 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.

Measurement uncertainty values, as applicable, are available upon request.

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:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 941186. Samples arrived at the laboratory on Wednesday, April 27, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description	Lancaster Labs Number
S74-042605 Grab Water Sample	4512415
MW38-042605 Grab Water Sample	4512416
MW39-042605 Grab Water Sample	4512417
SG1-GW-042605 Grab Water Sample	4512418
SG3-GW-042605 Grab Water Sample	4512419
SG7-GW-042605 Grab Water Sample	4512420
SG6-GW-042605 Grab Water Sample	4512421
MW40-042605 Grab Water Sample	4512422
MW32-042605 Grab Water Sample	4512423
MW31-042605 Grab Water Sample	4512424
MW37-042605 Grab Water Sample	4512425

ELECTRONIC COPY TO	SUN: Aquaterra Tech.	Attn: Brad Spancake
1 COPY TO	LL	Attn: Angela Miller
1 COPY TO	Langan	Attn: Jason Hanna
ELECTRONIC COPY TO	Langan	Attn: Dennis Webster

Lancaster Laboratories

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Analysis Report

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,

Michele A. Jarosick
Senior Chemist, Coordinator

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4512415

S74-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 08:30 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM74

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	< 0.0100	0.0100	0.0021	mg/l	10
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	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/03/2005 22:52	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 10:24	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/03/2005 12:33	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 01:05	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 01:05	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4512415

S74-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 08:30 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM74

07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512416

MW38-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 09:00 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM38

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	< 0.0100	0.0100	0.0021	mg/l	10
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.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	24.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	11.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	110.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/03/2005 22:54	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 11:53	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/03/2005 13:28	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 01:24	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 01:24	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4512416

MW38-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 09:00 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

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500 Hyde Park
Doylestown PA 18901

BLM38

07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512417

MW39-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 09:25 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

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500 Hyde Park
Doylestown PA 18901

BLM39

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	< 0.0100	0.0100	0.0021	mg/l	10
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	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	51.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	24.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	18.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	8.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	8.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/03/2005 22:56	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 12:53	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/03/2005 14:22	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 01:44	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 01:44	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512417

MW39-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 09:25 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

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500 Hyde Park
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BLM39

07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512418

SG1-GW-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 12:50 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

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500 Hyde Park
Doylestown PA 18901

BLMS1

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	< 0.0100	0.0100	0.0021	mg/l	10
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	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/03/2005 22:58	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 13:23	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/03/2005 15:16	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 02:04	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 02:04	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4512418

SG1-GW-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 12:50 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

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500 Hyde Park
Doylestown PA 18901

BLMS1

07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512419

SG3-GW-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 12:50 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

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500 Hyde Park
Doylestown PA 18901

BLMS3

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	< 0.0100	0.0100	0.0021	mg/l	10
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	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/03/2005 23:01	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 13:53	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/03/2005 16:10	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 02:24	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 02:24	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512419

SG3-GW-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 12:50 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLMS3

07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4512420

SG7-GW-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 13:15 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLMS7

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	< 0.0100	0.0100	0.0021	mg/l	10
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	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/03/2005 23:03	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 14:22	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/03/2005 17:04	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 02:43	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 02:43	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512420

SG7-GW-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 13:15 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLMS7

07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512421

SG6-GW-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 13:20 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

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500 Hyde Park
Doylestown PA 18901

BLMS6

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	< 0.0100	0.0100	0.0021	mg/l	10
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.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/03/2005 23:05	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 14:52	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/03/2005 17:59	Joseph M Gambler	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 03:03	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 03:03	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512421

SG6-GW-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 13:20 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLMS6

07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512422

MW40-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 14:20 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

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500 Hyde Park
Doylestown PA 18901

BLM40

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	< 0.0100	0.0100	0.0021	mg/l	10
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	150.	96.	10.	ug/l	10
03956	Fluorene	86-73-7	110.	96.	10.	ug/l	10
03963	Phenanthrene	85-01-8	150.	96.	10.	ug/l	10
03967	Pyrene	129-00-0	< 96.	96.	10.	ug/l	10
03971	Chrysene	218-01-9	< 96.	96.	10.	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	< 25.	25.	3.	ug/l	5
05401	Benzene	71-43-2	370.	25.	3.	ug/l	5
05402	1,2-Dichloroethane	107-06-2	< 25.	25.	5.	ug/l	5
05407	Toluene	108-88-3	< 25.	25.	4.	ug/l	5
05415	Ethylbenzene	100-41-4	150.	25.	4.	ug/l	5
05420	Isopropylbenzene	98-82-8	42.	25.	5.	ug/l	5
06310	Xylene (Total)	1330-20-7	300.	25.	4.	ug/l	5
	Due to the level of benzene, the reporting limits for all GC/MS volatile compounds were raised.						

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/03/2005 23:12	David K Beck	10

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512422

MW40-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 14:20 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

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07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 15:23	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 09:22	Joseph M Gambler	10
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 03:23	Jason M Long	5
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 03:23	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512423

MW32-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 14:30 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

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Doylestown PA 18901

BLM32

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	< 0.0100	0.0100	0.0021	mg/l	10
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	120.	20.	2.	ug/l	2
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 250.	250.	25.	ug/l	50
05401	Benzene	71-43-2	420.	250.	25.	ug/l	50
05402	1,2-Dichloroethane	107-06-2	< 250.	250.	50.	ug/l	50
05407	Toluene	108-88-3	4,600.	250.	35.	ug/l	50
05415	Ethylbenzene	100-41-4	1,100.	250.	40.	ug/l	50
05420	Isopropylbenzene	98-82-8	< 250.	250.	50.	ug/l	50
06310	Xylene (Total)	1330-20-7	6,200.	250.	40.	ug/l	50

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/03/2005 23:14	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 15:52	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/03/2005 21:27	Jolene M Graham	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512423

MW32-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 14:30 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

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BLM32

07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 10:15	Joseph M Gambler	2
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 03:42	Jason M Long	50
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 03:42	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512424

MW31-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 14:45 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

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BLM31

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	< 0.0100	0.0100	0.0021	mg/l	10
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	< 100.	100.	10.	ug/l	1
03956	Fluorene	86-73-7	< 100.	100.	10.	ug/l	1
03963	Phenanthrene	85-01-8	< 100.	100.	10.	ug/l	1
03967	Pyrene	129-00-0	< 100.	100.	10.	ug/l	1
03971	Chrysene	218-01-9	< 100.	100.	10.	ug/l	1
	Due to insufficient sample, the reporting limits for the GC/MS semivolatile compounds were raised.						
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 250.	250.	25.	ug/l	50
05401	Benzene	71-43-2	2,600.	250.	25.	ug/l	50
05402	1,2-Dichloroethane	107-06-2	< 250.	250.	50.	ug/l	50
05407	Toluene	108-88-3	510.	250.	35.	ug/l	50
05415	Ethylbenzene	100-41-4	290.	250.	40.	ug/l	50
05420	Isopropylbenzene	98-82-8	< 250.	250.	50.	ug/l	50
06310	Xylene (Total)	1330-20-7	1,000.	250.	40.	ug/l	50
	The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.						

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/03/2005 23:17	David K Beck	10

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512424

MW31-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 14:45 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

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07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 16:22	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/03/2005 22:21	Jolene M Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 04:02	Jason M Long	50
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 04:02	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512425

MW37-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 15:10 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

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BLM37

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	< 0.0100	0.0100	0.0021	mg/l	10
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	25.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 10,000.	10,000.	1,000.	ug/l	2000
05401	Benzene	71-43-2	370,000.	10,000.	1,000.	ug/l	2000
05402	1,2-Dichloroethane	107-06-2	< 10,000.	10,000.	2,000.	ug/l	2000
05407	Toluene	108-88-3	31,000.	10,000.	1,400.	ug/l	2000
05415	Ethylbenzene	100-41-4	12,000.	10,000.	1,600.	ug/l	2000
05420	Isopropylbenzene	98-82-8	< 10,000.	10,000.	2,000.	ug/l	2000
06310	Xylene (Total)	1330-20-7	41,000.	10,000.	1,600.	ug/l	2000

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/03/2005 23:19	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 17:22	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/03/2005 23:15	Jolene M Graham	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4512425

MW37-042605 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/26/2005 15:10 by MBS

Account Number: 10132

Submitted: 04/27/2005 14:30
Reported: 05/05/2005 at 14:32
Discard: 06/05/2005

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Doylestown PA 18901

BLM37

02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 04:22	Jason M Long	2000
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 04:22	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/29/2005 07:00	Mark P Mastropietro	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Quality Control Summary

Client Name: Langan Group Number: 941186
Reported: 05/05/05 at 02:32 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: 05118WAC026	Sample number(s): 4512415-4512425								
Naphthalene	< 10.	10.	1.	ug/l	78	81	58-108	3	30
Fluorene	< 10.	10.	1.	ug/l	89	89	61-116	0	30
Phenanthrene	< 10.	10.	1.	ug/l	96	96	68-111	1	30
Pyrene	< 10.	10.	1.	ug/l	98	99	68-114	1	30
Chrysene	< 10.	10.	1.	ug/l	96	97	70-111	1	30
Batch number: 051200009A	Sample number(s): 4512415-4512425								
Ethylene dibromide	< 0.030	0.030	0.010	ug/l	92	92	60-140	0	20
Batch number: 051216050001A	Sample number(s): 4512415-4512425								
Lead	< 0.0010	0.0010	0.00021	mg/l	105		80-120		
Batch number: P051183AA	Sample number(s): 4512415-4512425								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	88		77-127		
Benzene	< 5.	5.	0.5	ug/l	98		85-117		
1,2-Dichloroethane	< 5.	5.	1.	ug/l	87		77-132		
Toluene	< 5.	5.	0.7	ug/l	102		85-115		
Ethylbenzene	< 5.	5.	0.8	ug/l	101		82-119		
Isopropylbenzene	< 5.	5.	1.	ug/l	103		80-120		
Xylene (Total)	< 5.	5.	0.8	ug/l	104		83-113		

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: 051200009A	Sample number(s): 4512415-4512425								
Ethylene dibromide	87		65-135			< 0.029	< 0.029	0 (1)	30
Batch number: 051216050001A	Sample number(s): 4512415-4512425								
Lead	120	100	75-125	18	20	< 0.0010	< 0.0010	9 (1)	20
Batch number: P051183AA	Sample number(s): 4512415-4512425								
Methyl Tertiary Butyl Ether	90	93	69-134	3	30				
Benzene	104	106	83-128	1	30				
1,2-Dichloroethane	87	90	73-136	3	30				
Toluene	107	111	83-127	3	30				
Ethylbenzene	103	106	82-129	3	30				
Isopropylbenzene	103	108	81-130	4	30				
Xylene (Total)	101	105	82-130	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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 941186
Reported: 05/05/05 at 02:32 PM

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max

Surrogate Quality Control

Analysis Name: PAHs in Water by GC/MS
Batch number: 05118WAC026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4512415	90	86	120
4512416	99	98	119
4512417	100	95	113
4512418	83	81	93
4512419	92	88	120
4512420	93	90	121
4512421	105	102	133
4512422	115	92	113
4512423	95	87	114
4512424	100	89	117
4512425	96	85	122
Blank	86	76	119
LCS	94	90	124
LCSD	96	92	124
Limits:	51-123	64-112	53-135

Analysis Name: EDB in Wastewater
Batch number: 051200009A

	1,1,2,2-Tetrachloroethane
4512415	89
4512416	93
4512417	112
4512418	103
4512419	102
4512420	102
4512421	88
4512422	104
4512423	77
4512424	96
4512425	93
Blank	101
DUP	92
LCS	93
LCSD	95
MS	117
Limits:	52-120

Analysis Name: UST-Waters by 8260B
Batch number: P051183AA

	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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 941186
Reported: 05/05/05 at 02:32 PM

Surrogate Quality Control

4512415	95	91	100	100
4512416	93	89	100	101
4512417	94	90	99	104
4512418	93	91	100	102
4512419	95	91	100	100
4512420	95	90	102	102
4512421	93	90	99	100
4512422	94	89	102	106
4512423	92	88	101	102
4512424	94	90	101	102
4512425	93	88	100	101
Blank	94	91	101	100
LCS	95	89	102	101
MS	93	88	101	102
MSD	94	89	101	101
Limits:	81-120	82-112	85-112	83-113

*- 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 background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. # 10132 Group# 941186 Sample # 4512415-25

COC # 0080649

Please print. Instructions on reverse side correspond with circled numbers.

Cooler temp 1.4-2.7°C

(1) Client: Sun Aquaterra Acct. #:
Project Name/#: Sun-Belmont Terminal (AAI-1) PWSID #:
Project Manager: K. Martin / J. Hanna (Langan) P.O.#:
Sampler: 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: 8260B BTEX, MTBE, Cumene, EDC	8011 EDB	6020 Dissolved Pb	8270C Fluoren, Phenanthrene, Naphthalene	Remarks
S74-042605	4/26/05	0830	X			X		8					
MW38-042605		0900	X			X		8					
MW39-042605		0925	X			X		8					
SG1-GW-042605		1250	X			X		8					
SG3-GW-042605		1250	X			X		8					
SG7-GW-042605		1315	X			X		8					
SG6-GW-042605		1320	X			X		8					
MW40-042605		1420	X			X		8					
MW32-042605		1430	X			X		8					
MW31-042605		1445	X			X		8					

(6) Preservation of Containers (see reverse)

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: 5 Day TAT
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
QC Summary Type VI (Raw Data)
Type I (Tier I) GLP
Type II (Tier II) Other
Type III (NJ Red. Del.)
Type IV (CLP)

SDG Complete? Yes No

Site-specific QC required? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes No

Relinquished by:	Date	Time	Received by:	Date	Time
M. Bradley	4/26/05	1700	Aquaterra Fridge	4/26/05	1700
AT FRIDGE	4/27/05	0800	Kurt Heberlein	4/27/05	0800
Lisa Hedman	4/27/05	0950	Marvin McCallister	4/27/05	0950
Marvin McCallister	4/27/05	1430			
			Jessica Bu	4/27/05	1430

(9)

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. # 10132 Group# 941186 Sample # 4512415-25

COC # 0080774

Please print. Instructions on reverse side correspond with circled numbers. cooler temp 1.4-2.7°C

(1)
Client: Sun-Aquaterra Acct. #:
Project Name/#: Sun-Belmont Terminal (AOI-1) PWSID #:
Project Manager: K. Martin / J. Hanna (Langan) P.O.#:
Sampler: M. Brad Spancake / Mike Hinder Quote #:
Name of state where samples were collected: PA

(2) Sample Identification	Date Collected	Time Collected	(3) Grab	Composite	(4) Matrix: Soil	Water	Other	# of containers	(5) Analyses Requested: 8260B BTEX, MTBE, Cumene, EDC, EDB 8011 EDB 6020 Dissolved Pb 8270 Fluorene, Pyrene, Benzo(a)anthracene, Chrysene, Naphthalene	Remarks
MW37-042605	4/26/05	1510	X			X		8	X	* please lab filter & preserved diss. Pb.

For Lab Use Only
FSC:
SCR #:

(6) Preservation (1) HCl, (2) HNO3, (3) H2SO4, (4) NaOH, (5) Ascorbic Acid, (6) Zinc Acetate, (7) Other

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: 5 DAY TAT
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
QC Summary Type VI (Raw Data)
Type I (Tier I) GLP
Type II (Tier II) Other
Type III (NJ Red. Del.)
Type IV (CLP)

SDG Complete? Yes (No*)
Site-specific QC required? Yes (No)
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes (No)

Relinquished by:	Date	Time	Received by:	Date	Time
M. Brad Spancake	4/26/05	1500	Aquaterra Fridge	4/26/05	1500
AT FRIDGE	4/27/05	0950	Rick Holden	4/27/05	0952
Rick Holden	4/27/05	0950	Marvin McCallister	4/27/05	9:50
Marvin McCallister	4/27/05	14:30			
			Jessica Bruno	4/27/05	1430

(9)

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.

2102 Rev. 10/27/02

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

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
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< 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

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

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. All other results are reported on an as-received basis.

U.S. EPA CLP 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 quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
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 sample 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.

Measurement uncertainty values, as applicable, are available upon request.

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:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 941392. Samples arrived at the laboratory on Thursday, April 28, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description	Lancaster Labs Number
TW10-042705 Grab Water Sample	4513504
MW35-042705 Grab Water Sample	4513505
MW30-042705 Grab Water Sample	4513506

ELECTRONIC COPY TO	SUN: Aquaterra Tech.	Attn: Brad Spancake
1 COPY TO	LL	Attn: Angela Miller
1 COPY TO	Langan	Attn: Jason Hanna
ELECTRONIC COPY TO	Langan	Attn: Dennis Webster

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Analysis Report

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,

Michele A. Jarosick
Senior Chemist, Coordinator

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4513504

TW10-042705 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/27/2005 07:40 by MBS

Account Number: 10132

Submitted: 04/28/2005 16:40
Reported: 05/05/2005 at 16:58
Discard: 06/05/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM10

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	0.0101	0.0100	0.0021	mg/l	10
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	0.089	0.029	0.0098	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	12,000.	4,900.	490.	ug/l	500
03956	Fluorene	86-73-7	470.	98.	10.	ug/l	10
03963	Phenanthrene	85-01-8	1,100.	98.	10.	ug/l	10
03967	Pyrene	129-00-0	430.	98.	10.	ug/l	10
03971	Chrysene	218-01-9	180.	98.	10.	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	84,000.	5,000.	500.	ug/l	1000
05401	Benzene	71-43-2	9,200.	500.	50.	ug/l	100
05402	1,2-Dichloroethane	107-06-2	< 500.	500.	100.	ug/l	100
05407	Toluene	108-88-3	24,000.	5,000.	700.	ug/l	1000
05415	Ethylbenzene	100-41-4	3,200.	500.	80.	ug/l	100
05420	Isopropylbenzene	98-82-8	< 500.	500.	100.	ug/l	100
06310	Xylene (Total)	1330-20-7	20,000.	500.	80.	ug/l	100
	The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.						

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4513504

TW10-042705 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/27/2005 07:40 by MBS

Account Number: 10132

Submitted: 04/28/2005 16:40
Reported: 05/05/2005 at 16:58
Discard: 06/05/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM10

06035	Lead	SW-846 6020	1	05/03/2005 23:21	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 17:52	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 15:31	Brian K Graham	10
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 17:48	Brian K Graham	500
02302	UST-Waters by 8260B	SW-846 8260B	1	05/03/2005 17:06	Shawn J Rice	1000
02302	UST-Waters by 8260B	SW-846 8260B	1	05/03/2005 17:33	Shawn J Rice	100
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/03/2005 17:33	Shawn J Rice	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	05/03/2005 17:06	Shawn J Rice	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/30/2005 06:00	Zachary S Dennis	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4513505

MW35-042705 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/27/2005 10:45 by MBS

Account Number: 10132

Submitted: 04/28/2005 16:40
Reported: 05/05/2005 at 16:58
Discard: 06/05/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM35

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	< 0.0100	0.0100	0.0021	mg/l	10
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	5,700.	970.	97.	ug/l	100
03956	Fluorene	86-73-7	150.	97.	10.	ug/l	10
03963	Phenanthrene	85-01-8	320.	97.	10.	ug/l	10
03967	Pyrene	129-00-0	< 97.	97.	10.	ug/l	10
03971	Chrysene	218-01-9	< 97.	97.	10.	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	< 25.	25.	3.	ug/l	5
05401	Benzene	71-43-2	29.	25.	3.	ug/l	5
05402	1,2-Dichloroethane	107-06-2	< 25.	25.	5.	ug/l	5
05407	Toluene	108-88-3	30.	25.	4.	ug/l	5
05415	Ethylbenzene	100-41-4	970.	25.	4.	ug/l	5
05420	Isopropylbenzene	98-82-8	92.	25.	5.	ug/l	5
06310	Xylene (Total)	1330-20-7	2,600.	250.	40.	ug/l	50
	The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.						

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4513505

MW35-042705 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/27/2005 10:45 by MBS

Account Number: 10132

Submitted: 04/28/2005 16:40
Reported: 05/05/2005 at 16:58
Discard: 06/05/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM35

06035	Lead	SW-846 6020	1	05/03/2005 23:24	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 18:21	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 16:17	Brian K Graham	10
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 18:34	Brian K Graham	100
02302	UST-Waters by 8260B	SW-846 8260B	1	05/03/2005 17:59	Shawn J Rice	5
02302	UST-Waters by 8260B	SW-846 8260B	1	05/03/2005 18:26	Shawn J Rice	50
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/03/2005 17:59	Shawn J Rice	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	05/03/2005 18:26	Shawn J Rice	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/30/2005 06:00	Zachary S Dennis	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4513506

MW30-042705 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/27/2005 11:20 by MBS

Account Number: 10132

Submitted: 04/28/2005 16:40
Reported: 05/05/2005 at 16:58
Discard: 06/05/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM30

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	< 0.0100	0.0100	0.0021	mg/l	10
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	3,000.	960.	96.	ug/l	100
03956	Fluorene	86-73-7	< 96.	96.	10.	ug/l	10
03963	Phenanthrene	85-01-8	< 96.	96.	10.	ug/l	10
03967	Pyrene	129-00-0	< 96.	96.	10.	ug/l	10
03971	Chrysene	218-01-9	< 96.	96.	10.	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	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	960.	50.	5.	ug/l	10
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	37.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	430.	50.	8.	ug/l	10
05420	Isopropylbenzene	98-82-8	61.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	870.	50.	8.	ug/l	10

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/03/2005 23:26	David K Beck	10
07879	EDB in Wastewater	SW-846 8011	1	05/03/2005 18:51	Richard A Shober	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/04/2005 17:03	Brian K Graham	10

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4513506

MW30-042705 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:04/27/2005 11:20 by MBS

Account Number: 10132

Submitted: 04/28/2005 16:40
Reported: 05/05/2005 at 16:58
Discard: 06/05/2005

Langan
500 Hyde Park
Doylestown PA 18901

BLM30

07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/05/2005 05:25	Brian K Graham	100
02302	UST-Waters by 8260B	SW-846 8260B	1	05/03/2005 18:52	Shawn J Rice	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/03/2005 19:19	Shawn J Rice	10
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/03/2005 18:52	Shawn J Rice	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	05/03/2005 19:19	Shawn J Rice	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/01/2005 07:25	Suzette L Lehman	1
07786	EDB Extraction	SW-846 8011	1	05/02/2005 08:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/30/2005 06:00	Zachary S Dennis	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: Langan Group Number: 941392
Reported: 05/05/05 at 04:58 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: 05119WAF026	Sample number(s): 4513504-4513506								
Naphthalene	< 10.	10.	1.	ug/l	79	79	58-108	0	30
Fluorene	< 10.	10.	1.	ug/l	91	94	61-116	3	30
Phenanthrene	< 10.	10.	1.	ug/l	92	88	68-111	4	30
Pyrene	< 10.	10.	1.	ug/l	87	90	68-114	3	30
Chrysene	< 10.	10.	1.	ug/l	91	94	70-111	4	30
Batch number: 051200009A	Sample number(s): 4513504-4513506								
Ethylene dibromide	< 0.030	0.030	0.010	ug/l	92	92	60-140	0	20
Batch number: 051216050001A	Sample number(s): 4513504-4513506								
Lead	< 0.0010	0.0010	0.00021	mg/l	105		80-120		
Batch number: P051231AA	Sample number(s): 4513504-4513506								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	83	83	77-127	0	30
Benzene	< 5.	5.	0.5	ug/l	99	102	85-117	2	30
1,2-Dichloroethane	< 5.	5.	1.	ug/l	87	90	77-132	3	30
Toluene	< 5.	5.	0.7	ug/l	101	108	85-115	6	30
Ethylbenzene	< 5.	5.	0.8	ug/l	98	102	82-119	4	30
Isopropylbenzene	< 5.	5.	1.	ug/l	94	99	80-120	5	30
Xylene (Total)	< 5.	5.	0.8	ug/l	98	103	83-113	5	30

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: 051200009A	Sample number(s): 4513504-4513506								
Ethylene dibromide	87		65-135			< 0.029	< 0.029	0 (1)	30
Batch number: 051216050001A	Sample number(s): 4513504-4513506								
Lead	120	100	75-125	18	20	< 0.0010	< 0.0010	9 (1)	20
Batch number: P051231AA	Sample number(s): 4513504-4513506								
Methyl Tertiary Butyl Ether	82		69-134						
Benzene	105		83-128						
1,2-Dichloroethane	91		73-136						
Toluene	109		83-127						
Ethylbenzene	105		82-129						
Isopropylbenzene	104		81-130						
Xylene (Total)	106		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 background result was more than four times the spike added.

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Analysis Report

Quality Control Summary

Client Name: Langan Group Number: 941392
Reported: 05/05/05 at 04:58 PM

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max

Surrogate Quality Control

Analysis Name: PAHs in Water by GC/MS
Batch number: 05119WAF026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4513504	83	86	94
4513505	93	93	100
4513506	88	83	103
Blank	91	88	110
LCS	87	88	110
LCSD	93	93	110
Limits:	51-123	64-112	53-135

Analysis Name: EDB in Wastewater
Batch number: 051200009A

	1,1,2,2-Tetrachloroethane
4513504	92
4513505	91
4513506	105
Blank	101
DUP	92
LCS	93
LCSD	95
MS	117
Limits:	52-120

Analysis Name: UST-Waters by 8260B
Batch number: P051231AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4513504	89	91	99	96
4513505	89	88	98	101
4513506	89	84	98	105
Blank	89	87	100	95
LCS	89	86	98	95
LCSD	88	85	99	96
MS	90	88	99	96
Limits:	81-120	82-112	85-112	83-113

*- 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 background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. # 10132 Group# 941392 Sample # 4513504-06

COC # 0080453

Please print. Instructions on reverse side correspond with circled numbers. Cooler temp 1.4-1.9°C

(1)
Client: Sun Aquaterra Acct. #:
Project Name/#: Sun-Belmont Term. AOI-1 PWSID #:
Project Manager: K Martin | J. Hanna (Langan) P.O.#:
Sampler: M. Brad Spancake Quote #:
Name of state where samples were collected: PA

(2) (3) (4) (5) (6)

Sample Identification	Date Collected	Time Collected	(3) Grab	(3) Composite	(4) Matrix: Soil	(4) Matrix: Water	(4) Matrix: Other	(4) Total # of Containers	(5) Analyses Requested: 8260B BTEX, MTBE, cumene, EDC	8011 EDB	6020 Dissolved Pb	8270 Fluorene, Phenanthrene, Naphthalene, Chrysene	Remarks
TW10-042705	4/27/05	0740	X			X		8					Dissolved Pb Samples are unfiltered/unpreserved
MW35-042705	↓	1045	X			X		8					
MW30-042705	↓	1120	X			X		8					

For Lab Use Only
FSC:
SCR #:

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: 5 DAY TAT
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
QC Summary, Type I (Tier I), Type II (Tier II), Type III (NJ Red. Del.), Type IV (CLP), Type VI (Raw Data), GLP, Other
SDG Complete? Yes No
Site-specific QC required? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes No

(9)

Relinquished by:	Date	Time	Received by:	Date	Time
M. Brad Spancake	4/28/05	1700	Aquaterra Jmy	4/28/05	1700
AT FEDEX	4/28/05	1025	Kathleen Stone	4/28/05	1025
Kathleen Stone	4/28/05	1025	Marvin McCallum	4/28/05	10:25
Marvin McCallum	4/28/05	16:40			
			Jessica Bomberger	4/28/05	1640

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2425 New Holland Pike • Lancaster, PA 17601

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
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< 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

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

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. All other results are reported on an as-received basis.

U.S. EPA CLP 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 quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
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 sample 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.

Measurement uncertainty values, as applicable, are available upon request.

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:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 941915. Samples arrived at the laboratory on Tuesday, May 03, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description	Lancaster Labs Number
MW43-050205 Grab Water Sample	4516623

ELECTRONIC COPY TO	SUN: Aquaterra Tech.	Attn: Brad Spancake
1 COPY TO	LL	Attn: Angela Miller
1 COPY TO	Langan	Attn: Jason Hanna
ELECTRONIC COPY TO	Langan	Attn: Dennis Webster

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Analysis Report

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,

Michele A. Jarosick
Senior Chemist, Coordinator

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4516623

MW43-050205 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:05/02/2005 11:50 by MBS

Account Number: 10132

Submitted: 05/03/2005 16:35
Reported: 05/10/2005 at 15:18
Discard: 06/10/2005

Langan
500 Hyde Park
Doylestown PA 18901

MW-43

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	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	0.041	0.029	0.0095	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	7,400.	4,900.	490.	ug/l	500
03956	Fluorene	86-73-7	< 99.	99.	10.	ug/l	10
03963	Phenanthrene	85-01-8	170.	99.	10.	ug/l	10
03967	Pyrene	129-00-0	< 99.	99.	10.	ug/l	10
03971	Chrysene	218-01-9	< 99.	99.	10.	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	< 130.	130.	13.	ug/l	25
05401	Benzene	71-43-2	5,400.	130.	13.	ug/l	25
05402	1,2-Dichloroethane	107-06-2	< 130.	130.	25.	ug/l	25
05407	Toluene	108-88-3	< 130.	130.	18.	ug/l	25
05415	Ethylbenzene	100-41-4	1,000.	130.	20.	ug/l	25
05420	Isopropylbenzene	98-82-8	< 130.	130.	25.	ug/l	25
06310	Xylene (Total)	1330-20-7	490.	130.	20.	ug/l	25
	The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.						

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4516623

MW43-050205 Grab Water Sample
SUN: Belmont Terminal AOI-1

Collected:05/02/2005 11:50 by MBS

Account Number: 10132

Submitted: 05/03/2005 16:35
Reported: 05/10/2005 at 15:18
Discard: 06/10/2005

Langan
500 Hyde Park
Doylestown PA 18901

MW-43

06035	Lead	SW-846 6020	1	05/06/2005 23:11	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/06/2005 03:58	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/09/2005 09:09	Joseph M Gambler	10
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/09/2005 10:07	Joseph M Gambler	500
02302	UST-Waters by 8260B	SW-846 8260B	1	05/06/2005 04:45	Andrea D Moore	25
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/06/2005 04:45	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/05/2005 15:54	Megersa Deyessa	1
07786	EDB Extraction	SW-846 8011	1	05/05/2005 10:00	Joseph S Feister	1
07807	BNA Water Extraction	SW-846 3510C	1	05/04/2005 17:00	Olivia I Santiago	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: Langan Group Number: 941915
Reported: 05/10/05 at 03:18 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: 051240024A	Sample number(s): 4516623								
Ethylene dibromide	< 0.030	0.030	0.010	ug/l	100	100	60-140	0	20
Batch number: 05124WAC026	Sample number(s): 4516623								
Naphthalene	< 10.	10.	1.	ug/l	88	87	58-108	1	30
Fluorene	< 10.	10.	1.	ug/l	100	95	61-116	4	30
Phenanthrene	< 10.	10.	1.	ug/l	97	99	68-111	2	30
Pyrene	< 10.	10.	1.	ug/l	88	90	68-114	2	30
Chrysene	< 10.	10.	1.	ug/l	91	94	70-111	3	30
Batch number: 051256050001A	Sample number(s): 4516623								
Lead	< 0.0010	0.0010	0.00021	mg/l	100		80-120		
Batch number: T051252AA	Sample number(s): 4516623								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	99		77-127		
Benzene	< 5.	5.	0.5	ug/l	109		85-117		
1,2-Dichloroethane	< 5.	5.	1.	ug/l	117		77-132		
Toluene	< 5.	5.	0.7	ug/l	104		85-115		
Ethylbenzene	< 5.	5.	0.8	ug/l	97		82-119		
Isopropylbenzene	< 5.	5.	1.	ug/l	97		80-120		
Xylene (Total)	< 5.	5.	0.8	ug/l	98		83-113		

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: 051240024A	Sample number(s): 4516623								
Ethylene dibromide	84		65-135			< 0.028	< 0.029	0 (1)	30
Batch number: 051256050001A	Sample number(s): 4516623								
Lead	100	101	75-125	1	20	< 0.0010	< 0.0010	25* (1)	20
Batch number: T051252AA	Sample number(s): 4516623								
Methyl Tertiary Butyl Ether	104	107	69-134	4	30				
Benzene	115	115	83-128	0	30				
1,2-Dichloroethane	123	124	73-136	1	30				
Toluene	108	110	83-127	2	30				
Ethylbenzene	100	102	82-129	2	30				
Isopropylbenzene	98	102	81-130	5	30				
Xylene (Total)	100	100	82-130	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 background result was more than four times the spike added.

Lancaster Laboratories

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Analysis Report

Quality Control Summary

Client Name: Langan Group Number: 941915
Reported: 05/10/05 at 03:18 PM

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max

Surrogate Quality Control

Analysis Name: EDB in Wastewater
Batch number: 051240024A

	1,1,2,2-Tetrachloroethane
4516623	106
Blank	102
DUP	75
LCS	104
LCSD	103
MS	96
Limits:	52-120

Analysis Name: PAHs in Water by GC/MS
Batch number: 05124WAC026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4516623	75	81	88
Blank	77	86	94
LCS	77	86	98
LCSD	76	86	102
Limits:	51-123	64-112	53-135

Analysis Name: UST-Waters by 8260B
Batch number: T051252AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4516623	92	88	94	100
Blank	98	88	92	98
LCS	95	86	92	100
MS	96	86	91	99
MSD	97	87	94	100
Limits:	81-120	82-112	85-112	83-113

*- 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 background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody

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For Lancaster Laboratories use only
Acct. # 10132 Group# 941915 Sample # 45166023

COC # 0084323

Please print. Instructions on reverse side correspond with circled numbers. cooler temp 1.1-1.6°C

(1)
Client: Sun-Aquaterra/Langan Acct. #:
Project Name/#: Sun-Belmont Terminal - AOI-1 PWSID #:
Project Manager: K. Martin / J. Hanna (Langan) P.O.#:
Sampler: M. Brad Spangler Quote #:
Name of state where samples were collected: PA

(2) Sample Identification	Date Collected	Time Collected	(3) Grab	Composite	(4) Matrix: Soil	Water	Oil	# of containers	(5) Analyses Requested: 8260 BTEX, MTBE, Cumene, EDC	8011 EDB	6020 Dissolved Pb	8270 Fluorene, Phenanthrene, Pyrene, Chrysene, Naphthalene	Remarks
MW43-050205	5/2/05	1150	X			X		8					Dissolved Pb sample is unfiltered/unpreserved

For Lab Use Only
FSC:
SCR #:

(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: 5DAY TAT
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
QC Summary Type VI (Raw Data)
Type I (Tier I) GLP
Type II (Tier II) Other
Type III (NJ Red. Del.)
Type IV (CLP)

SDG Complete? (Yes) No
Site-specific QC required? Yes (No)
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes (No)

(9)

Relinquished by:	Date	Time	Received by:	Date	Time
M. Brad Spangler	5/2/05	1700	Aquaterra Fridge	5/2/05	1700
M Applegate	5/3/05	1105	Marvin McFadden	5/3/05	11:00
Marvin McFadden	5/3/05	1635			
			Jessica Barr	5/3/05	1635

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

Explanation of Symbols and Abbreviations

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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
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< 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

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

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. All other results are reported on an as-received basis.

U.S. EPA CLP Data Qualifiers:

Organic Qualifiers

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X,Y,Z	Defined in case narrative

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N	Spike sample 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
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Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAC unless otherwise noted under the individual analysis.

Measurement uncertainty values, as applicable, are available upon request.

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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NO. 1 AND NO. 2 TANK FARMS

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Analysis Report

ANALYTICAL RESULTS

Prepared for:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 934918. Samples arrived at the laboratory on Thursday, March 10, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description	Lancaster Labs Number
BH-S208-030805-1.5-2 Grab Soil Sample	4479505
BH-S207-030805-3-3.5 Grab Soil Sample	4479506
BH-S198-030805-1.5-2 Grab Soil Sample	4479507
BH-S214-030905-1-1.5 Grab Soil Sample	4479508

1 COPY TO	LL	Attn: Angela Miller
ELECTRONIC COPY TO	SUN: Aquaterra Tech.	Attn: Brad Spancake
1 COPY TO	Langan	Attn: Jason Hanna
ELECTRONIC COPY TO	Langan	Attn: Dennis Webster

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Analysis Report

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,

Michele A. Jarosick
Senior Chemist, Coordinator

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. SW 4479505

BH-S208-030805-1.5-2 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/08/2005 08:10 by MBS

Account Number: 10132

Submitted: 03/10/2005 18:55
Reported: 03/24/2005 at 12:27
Discard: 04/24/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-208

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	28.9	2.40	1.12	mg/kg	1
00111	Moisture	n.a.	16.7	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	< 400.	400.	40.	ug/kg	1
03761	Naphthalene	91-20-3	< 400.	400.	40.	ug/kg	1
03768	Fluorene	86-73-7	< 400.	400.	40.	ug/kg	1
03775	Phenanthrene	85-01-8	< 400.	400.	40.	ug/kg	1
03776	Anthracene	120-12-7	< 400.	400.	40.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 400.	400.	40.	ug/kg	1
03782	Chrysene	218-01-9	< 400.	400.	40.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	< 400.	400.	40.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	< 400.	400.	40.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 400.	400.	40.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 160.	160.	16.	ug/kg	26.6
05460	Benzene	71-43-2	170.	160.	16.	ug/kg	26.6
05461	1,2-Dichloroethane	107-06-2	< 160.	160.	32.	ug/kg	26.6
05466	Toluene	108-88-3	< 160.	160.	32.	ug/kg	26.6
05471	1,2-Dibromoethane	106-93-4	< 160.	160.	32.	ug/kg	26.6
05474	Ethylbenzene	100-41-4	270.	160.	32.	ug/kg	26.6
05479	Isopropylbenzene	98-82-8	450.	160.	32.	ug/kg	26.6
06301	Xylene (Total)	1330-20-7	240.	160.	32.	ug/kg	26.6
	The GC/MS volatile analysis was performed according to the high level soil method due to the level of non-target compounds. Therefore, the reporting limits were raised.						

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. SW 4479505

BH-S208-030805-1.5-2 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/08/2005 08:10 by MBS

Account Number: 10132

Submitted: 03/10/2005 18:55
Reported: 03/24/2005 at 12:27
Discard: 04/24/2005

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Doylestown PA 18901

S-208

06955	Lead	SW-846 6010B	1	03/14/2005 20:46	Donna R Sackett	1
00111	Moisture	EPA 160.3 modified	1	03/15/2005 14:41	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	03/22/2005 12:24	Joseph M Gambler	1
02308	UST-Soils by 8260B	SW-846 8260B	1	03/14/2005 06:28	Stephanie A Selis	26.6
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	1	03/11/2005 09:54	Stephanie A Sanchez	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	2	03/11/2005 09:54	Stephanie A Sanchez	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	03/14/2005 06:53	Denise Y Black	1
06171	GC/MS - Field Preserved MeOH	SW-846 5035	1	03/11/2005 09:55	Stephanie A Sanchez	1
07806	BNA Soil Extraction	SW-846 3550B	3	03/18/2005 19:00	Elia R Botrous	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. SW 4479506

BH-S207-030805-3-3.5 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/08/2005 09:00 by MBS

Account Number: 10132

Submitted: 03/10/2005 18:55
Reported: 03/24/2005 at 12:27
Discard: 04/24/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-207

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	41.6	2.39	1.11	mg/kg	1
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	< 420.	420.	42.	ug/kg	1
03761	Naphthalene	91-20-3	< 420.	420.	42.	ug/kg	1
03768	Fluorene	86-73-7	< 420.	420.	42.	ug/kg	1
03775	Phenanthrene	85-01-8	< 420.	420.	42.	ug/kg	1
03776	Anthracene	120-12-7	< 420.	420.	42.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 420.	420.	42.	ug/kg	1
03782	Chrysene	218-01-9	< 420.	420.	42.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	< 420.	420.	42.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	< 420.	420.	42.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 420.	420.	42.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 3.	3.	0.3	ug/kg	0.52
05460	Benzene	71-43-2	< 3.	3.	0.3	ug/kg	0.52
05461	1,2-Dichloroethane	107-06-2	< 3.	3.	0.7	ug/kg	0.52
05466	Toluene	108-88-3	< 3.	3.	0.7	ug/kg	0.52
05471	1,2-Dibromoethane	106-93-4	< 3.	3.	0.7	ug/kg	0.52
05474	Ethylbenzene	100-41-4	< 3.	3.	0.7	ug/kg	0.52
05479	Isopropylbenzene	98-82-8	< 3.	3.	0.7	ug/kg	0.52
06301	Xylene (Total)	1330-20-7	< 3.	3.	0.7	ug/kg	0.52

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06955	Lead	SW-846 6010B	1	03/14/2005 20:50	Donna R Sackett	1
00111	Moisture	EPA 160.3 modified	1	03/15/2005 14:41	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	03/22/2005 13:33	Joseph M Gambler	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. SW 4479506

BH-S207-030805-3-3.5 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/08/2005 09:00 by MBS

Account Number: 10132

Submitted: 03/10/2005 18:55
Reported: 03/24/2005 at 12:27
Discard: 04/24/2005

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500 Hyde Park
Doylestown PA 18901

S-207

02308	UST-Soils by 8260B	SW-846 8260B	1	03/14/2005 06:04	Anastasia Papadoplos	0.52
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	1	03/11/2005 09:56	Stephanie A Sanchez	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	2	03/11/2005 09:56	Stephanie A Sanchez	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	03/14/2005 06:53	Denise Y Black	1
06171	GC/MS - Field Preserved MeOH	SW-846 5035	1	03/11/2005 09:57	Stephanie A Sanchez	1
07806	BNA Soil Extraction	SW-846 3550B	2	03/18/2005 19:00	Elia R Botrous	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. SW 4479507

BH-S198-030805-1.5-2 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/08/2005 10:20 by MBS

Account Number: 10132

Submitted: 03/10/2005 18:55
Reported: 03/24/2005 at 12:27
Discard: 04/24/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-198

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	176.	2.27	1.06	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.	390.	39.	ug/kg	1
03761	Naphthalene	91-20-3	< 390.	390.	39.	ug/kg	1
03768	Fluorene	86-73-7	< 390.	390.	39.	ug/kg	1
03775	Phenanthrene	85-01-8	< 390.	390.	39.	ug/kg	1
03776	Anthracene	120-12-7	< 390.	390.	39.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 390.	390.	39.	ug/kg	1
03782	Chrysene	218-01-9	< 390.	390.	39.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	< 390.	390.	39.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	< 390.	390.	39.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 390.	390.	39.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 160.	160.	16.	ug/kg	28.18
05460	Benzene	71-43-2	< 160.	160.	16.	ug/kg	28.18
05461	1,2-Dichloroethane	107-06-2	< 160.	160.	33.	ug/kg	28.18
05466	Toluene	108-88-3	< 160.	160.	33.	ug/kg	28.18
05471	1,2-Dibromoethane	106-93-4	< 160.	160.	33.	ug/kg	28.18
05474	Ethylbenzene	100-41-4	< 160.	160.	33.	ug/kg	28.18
05479	Isopropylbenzene	98-82-8	< 160.	160.	33.	ug/kg	28.18
06301	Xylene (Total)	1330-20-7	< 160.	160.	33.	ug/kg	28.18
	The GC/MS volatile analysis was performed according to the high level soil method due to the level of non-target compounds. Therefore, the reporting limits were raised.						

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. SW 4479507

BH-S198-030805-1.5-2 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/08/2005 10:20 by MBS

Account Number: 10132

Submitted: 03/10/2005 18:55
Reported: 03/24/2005 at 12:27
Discard: 04/24/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-198

06955	Lead	SW-846 6010B	1	03/14/2005 20:54	Donna R Sackett	1
00111	Moisture	EPA 160.3 modified	1	03/15/2005 14:41	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	03/22/2005 14:41	Joseph M Gambler	1
02308	UST-Soils by 8260B	SW-846 8260B	1	03/14/2005 06:51	Stephanie A Selis	28.18
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	1	03/11/2005 09:58	Stephanie A Sanchez	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	2	03/11/2005 09:58	Stephanie A Sanchez	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	03/14/2005 06:53	Denise Y Black	1
06171	GC/MS - Field Preserved MeOH	SW-846 5035	1	03/11/2005 09:59	Stephanie A Sanchez	1
07806	BNA Soil Extraction	SW-846 3550B	3	03/18/2005 19:00	Elia R Botrous	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. SW 4479508

BH-S214-030905-1-1.5 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/09/2005 10:00 by MBS

Account Number: 10132

Submitted: 03/10/2005 18:55
Reported: 03/24/2005 at 12:27
Discard: 04/24/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-214

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	18.6	2.39	1.11	mg/kg	1
00111	Moisture	n.a.	16.4	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	< 400.	400.	40.	ug/kg	1
03761	Naphthalene	91-20-3	< 400.	400.	40.	ug/kg	1
03768	Fluorene	86-73-7	< 400.	400.	40.	ug/kg	1
03775	Phenanthrene	85-01-8	< 400.	400.	40.	ug/kg	1
03776	Anthracene	120-12-7	< 400.	400.	40.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 400.	400.	40.	ug/kg	1
03782	Chrysene	218-01-9	< 400.	400.	40.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	< 400.	400.	40.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	< 400.	400.	40.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 400.	400.	40.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 3.	3.	0.3	ug/kg	0.55
05460	Benzene	71-43-2	< 3.	3.	0.3	ug/kg	0.55
05461	1,2-Dichloroethane	107-06-2	< 3.	3.	0.7	ug/kg	0.55
05466	Toluene	108-88-3	< 3.	3.	0.7	ug/kg	0.55
05471	1,2-Dibromoethane	106-93-4	< 3.	3.	0.7	ug/kg	0.55
05474	Ethylbenzene	100-41-4	< 3.	3.	0.7	ug/kg	0.55
05479	Isopropylbenzene	98-82-8	< 3.	3.	0.7	ug/kg	0.55
06301	Xylene (Total)	1330-20-7	< 3.	3.	0.7	ug/kg	0.55

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06955	Lead	SW-846 6010B	1	03/14/2005 21:07	Donna R Sackett	1
00111	Moisture	EPA 160.3 modified	1	03/15/2005 14:41	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	03/22/2005 15:50	Joseph M Gambler	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. SW 4479508

BH-S214-030905-1-1.5 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/09/2005 10:00 by MBS

Account Number: 10132

Submitted: 03/10/2005 18:55
Reported: 03/24/2005 at 12:27
Discard: 04/24/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-214

02308	UST-Soils by 8260B	SW-846 8260B	1	03/14/2005 06:27	Anastasia Papadoplos	0.55
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	1	03/11/2005 10:00	Stephanie A Sanchez	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	2	03/11/2005 10:00	Stephanie A Sanchez	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	03/14/2005 06:53	Denise Y Black	1
06171	GC/MS - Field Preserved MeOH	SW-846 5035	1	03/11/2005 10:01	Stephanie A Sanchez	1
07806	BNA Soil Extraction	SW-846 3550B	3	03/18/2005 19:00	Elia R Botrous	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Quality Control Summary

Client Name: Langan Group Number: 934918
Reported: 03/24/05 at 12:27 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: 050735708001	Sample number(s): 4479505-4479508								
Lead	< 2.00	2.00	0.930	mg/kg	97		86-109		
Batch number: 05074820002B	Sample number(s): 4479505-4479508								
Moisture					100		99-101		
Batch number: 05077SLA026	Sample number(s): 4479505-4479508								
Pyrene	< 330.	330.	33.	ug/kg	98		67-116		
Naphthalene	< 330.	330.	33.	ug/kg	89		70-103		
Fluorene	< 330.	330.	33.	ug/kg	95		66-115		
Phenanthrene	< 330.	330.	33.	ug/kg	94		70-107		
Anthracene	< 330.	330.	33.	ug/kg	93		69-109		
Benzo(a)anthracene	< 330.	330.	33.	ug/kg	96		73-111		
Chrysene	< 330.	330.	33.	ug/kg	94		72-110		
Benzo(b)fluoranthene	< 330.	330.	33.	ug/kg	87		68-116		
Benzo(a)pyrene	< 330.	330.	33.	ug/kg	96		72-117		
Benzo(g,h,i)perylene	< 330.	330.	33.	ug/kg	89		66-120		
Batch number: Q050701AB	Sample number(s): 4479505,4479507								
Methyl Tertiary Butyl Ether	< 250.	250.	25.	ug/kg	108		75-125		
Benzene	< 250.	250.	25.	ug/kg	113		77-119		
1,2-Dichloroethane	< 250.	250.	50.	ug/kg	111		76-126		
Toluene	< 250.	250.	50.	ug/kg	112		81-116		
1,2-Dibromoethane	< 250.	250.	50.	ug/kg	112		77-114		
Ethylbenzene	< 250.	250.	50.	ug/kg	110		82-115		
Isopropylbenzene	< 250.	250.	50.	ug/kg	110		79-117		
Xylene (Total)	< 250.	250.	50.	ug/kg	112		82-117		
Batch number: X050691AB	Sample number(s): 4479506,4479508								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/kg	96	90	75-125	6	30
Benzene	< 5.	5.	0.5	ug/kg	104	101	77-119	2	30
1,2-Dichloroethane	< 5.	5.	1.	ug/kg	94	92	76-126	2	30
Toluene	< 5.	5.	1.	ug/kg	100	98	81-116	2	30
1,2-Dibromoethane	< 5.	5.	1.	ug/kg	93	87	77-114	7	30
Ethylbenzene	< 5.	5.	1.	ug/kg	99	97	82-115	2	30
Isopropylbenzene	< 5.	5.	1.	ug/kg	100	97	79-117	3	30
Xylene (Total)	< 5.	5.	1.	ug/kg	99	96	82-117	3	30

Sample Matrix Quality Control

MS	MSD	MS/MSD	RPD	BKG	DUP	DUP	Dup RPD

*- 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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 934918
Reported: 03/24/05 at 12:27 PM

Analysis Name	%REC	%REC	Limits	RPD	MAX	Conc	Conc	RPD	Max
Batch number: 050735708001	Sample number(s): 4479505-4479508								
Lead	98	96	75-125	1	20	4.83	5.48	13 (1)	20
Batch number: 05074820002B	Sample number(s): 4479505-4479508								
Moisture						16.9	17.3	2	15
Batch number: 05077SLA026	Sample number(s): 4479505-4479508								
Pyrene	96	97	40-145	1	30				
Naphthalene	87	92	38-132	5	30				
Fluorene	92	95	39-137	3	30				
Phenanthrene	92	92	42-137	1	30				
Anthracene	90	85	47-135	6	30				
Benzo(a)anthracene	93	94	42-137	1	30				
Chrysene	90	92	39-140	2	30				
Benzo(b)fluoranthene	84	90	42-141	7	30				
Benzo(a)pyrene	93	83	38-142	11	30				
Benzo(g,h,i)perylene	85	93	32-150	9	30				
Batch number: Q050701AB	Sample number(s): 4479505,4479507								
Methyl Tertiary Butyl Ether	114	115	49-140	9	30				
Benzene	120	120	67-123	8	30				
1,2-Dichloroethane	115	116	62-130	9	30				
Toluene	119	119	55-125	8	30				
1,2-Dibromoethane	114	114	62-116	8	30				
Ethylbenzene	119	120	50-127	9	30				
Isopropylbenzene	120	121	48-124	9	30				
Xylene (Total)	120	119	54-123	8	30				
Batch number: X050691AB	Sample number(s): 4479506,4479508								
Methyl Tertiary Butyl Ether	89		49-140						
Benzene	89		67-123						
1,2-Dichloroethane	82		62-130						
Toluene	88		55-125						
1,2-Dibromoethane	82		62-116						
Ethylbenzene	55		50-127						
Isopropylbenzene	77		48-124						
Xylene (Total)	90		54-123						

Surrogate Quality Control

Analysis Name: PAHs in Soil by GC/MS
Batch number: 05077SLA026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4479505	108	78	112
4479506	83	83	112
4479507	89	84	115
4479508	87	88	116
Blank	79	83	115
LCS	77	84	114
MS	75	81	109
MSD	74	82	110
Limits:	47-128	55-123	49-133

*- 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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 934918
Reported: 03/24/05 at 12:27 PM

Surrogate Quality Control

Analysis Name: UST-Soils by 8260B
Batch number: Q050701AB

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4479505	73	73	79	78
4479507	73	73	71	72
Blank	103	104	99	90
LCS	98	97	99	91
MS	77	78	76	73
MSD	77	77	76	73
Limits:	70-129	70-121	70-130	70-128

Analysis Name: UST-Soils by 8260B
Batch number: X050691AB

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4479506	95	93	92	90
4479508	92	93	92	89
Blank	93	92	93	89
LCS	94	90	96	90
LCSD	93	88	96	89
MS	92	89	103	84
Limits:	70-129	70-121	70-130	70-128

*- 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 background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only

Acct. # 10132 Group# 934918 Sample # 4479505-8

COC # 0084314

Please print. Instructions on reverse side correspond with circled numbers.

(1)

Client: Sun - Aquaterra Acct. #:

Project Name/#: Sun Philadelphia Refinery AOF-1 PWSID #:

Project Manager: Kevin Martin / Jason Hanna P.O.#:

Sampler: M. Brad Spancake 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: 8260 BTEX, MTBE, Cumene, Naphthalene	8270 EDB, EDC	Anthracene, Benzo(a)anthracene	Benzo(a)pyrene, Benzo(b)fluoranthene	Benzo(g,h,i)perylene, Benzo(k)fluoranthene	Chrysene, Fluorene	Naphthalene, Phenanthrene	Pyrene	Total Lead	% Moist	Remarks
BH-S208-030805-1.5-2	3/8/05	0810	X		X			4											2.4°C
BH-S207-030805-3-3.5	3/8/05	0900	X		X			4											3/10/05
BH-S198-030805-1.5-2	3/8/05	1020	X		X			4											MS
BH-S214-030905-1-1.5	3/9/05	1000	X		X			4											

For Lab Use Only
FSC:
SCR #: 1200988

(6) Preservation of Samples

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.) 10 business Days
Date results are needed:
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address: jhanna@Langan.com bs@aquaterra-tech.com

(8) **Data Package Options** (please circle if required)

QC Summary — Type VI (Raw Data)
Type I (Tier I) — GLP
Type II (Tier II) — Other
Type III (NJ Red. Del.)
Type IV (CLP)

SDG Complete? Yes No

Site-specific QC required? Yes (No)
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes (No)

(9)

Relinquished by:	Date	Time	Received by:	Date	Time
	3/4/05	16:50	Marvin McCallister	3/7/05	7:30
Marvin McCallister	3/7/05	TR 20		3/7/05	12:20
	3/9/05	1530	AT Fike	3/9/05	1530
	3/10/05	1100	Marvin McCallister	3/10/05	1100
Marvin McCallister	3/10/05	18:55	Jessica	3/10/05	1855

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

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
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< 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

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

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. All other results are reported on an as-received basis.

U.S. EPA CLP 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 quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
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 sample 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.

Measurement uncertainty values, as applicable, are available upon request.

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:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 935093. Samples arrived at the laboratory on Friday, March 11, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description	Lancaster Labs Number
BH-S205-031005-1.5-2 Grab Soil Sample	4480726
BH-S212-031005-1-1.5 Grab Soil Sample	4480727
BH-S213-031005-1.5-2 Grab Soil Sample	4480728
BH-S211-031005-1.5-2 Grab Soil Sample	4480729

1 COPY TO	LL	Attn: Angela Miller
ELECTRONIC COPY TO	SUN: Aquaterra Tech.	Attn: Brad Spancake
1 COPY TO	Langan	Attn: Jason Hanna
ELECTRONIC COPY TO	Langan	Attn: Dennis Webster

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Analysis Report

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,

Michele A. Jarosick
Senior Chemist, Coordinator

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. SW 4480726

BH-S205-031005-1.5-2 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/10/2005 10:20 by MBS

Account Number: 10132

Submitted: 03/11/2005 17:50
Reported: 03/24/2005 at 12:27
Discard: 04/24/2005

Langan
500 Hyde Park
Doylestown PA 18901

S205-

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	8.46	2.38	1.10	mg/kg	1
00111	Moisture	n.a.	15.8	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	< 400.	400.	40.	ug/kg	1
03761	Naphthalene	91-20-3	< 400.	400.	40.	ug/kg	1
03768	Fluorene	86-73-7	< 400.	400.	40.	ug/kg	1
03775	Phenanthrene	85-01-8	< 400.	400.	40.	ug/kg	1
03776	Anthracene	120-12-7	< 400.	400.	40.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 400.	400.	40.	ug/kg	1
03782	Chrysene	218-01-9	< 400.	400.	40.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	< 400.	400.	40.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	< 400.	400.	40.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 400.	400.	40.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 3.	3.	0.3	ug/kg	0.51
05460	Benzene	71-43-2	< 3.	3.	0.3	ug/kg	0.51
05461	1,2-Dichloroethane	107-06-2	< 3.	3.	0.6	ug/kg	0.51
05466	Toluene	108-88-3	< 3.	3.	0.6	ug/kg	0.51
05471	1,2-Dibromoethane	106-93-4	< 3.	3.	0.6	ug/kg	0.51
05474	Ethylbenzene	100-41-4	< 3.	3.	0.6	ug/kg	0.51
05479	Isopropylbenzene	98-82-8	< 3.	3.	0.6	ug/kg	0.51
06301	Xylene (Total)	1330-20-7	< 3.	3.	0.6	ug/kg	0.51

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06955	Lead	SW-846 6010B	1	03/15/2005 18:39	John P Hook	1
00111	Moisture	EPA 160.3 modified	1	03/16/2005 13:43	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	03/22/2005 16:59	Joseph M Gambler	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. SW 4480726

BH-S205-031005-1.5-2 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/10/2005 10:20 by MBS

Account Number: 10132

Submitted: 03/11/2005 17:50
Reported: 03/24/2005 at 12:27
Discard: 04/24/2005

Langan
500 Hyde Park
Doylestown PA 18901

S205-

02308	UST-Soils by 8260B	SW-846 8260B	1	03/15/2005 23:30	Kenneth L Boley Jr	0.51
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	1	03/13/2005 16:50	Medina A Long	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	2	03/13/2005 17:14	Medina A Long	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	3	03/13/2005 17:15	Medina A Long	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	03/15/2005 07:00	Denise Y Black	1
07806	BNA Soil Extraction	SW-846 3550B	3	03/18/2005 19:00	Elia R Botrous	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. SW 4480727

BH-S212-031005-1-1.5 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/10/2005 13:40 by MBS

Account Number: 10132

Submitted: 03/11/2005 17:50
Reported: 03/24/2005 at 12:27
Discard: 04/24/2005

Langan
500 Hyde Park
Doylestown PA 18901

S212-

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	212.	2.30	1.07	mg/kg	1
00111	Moisture	n.a.	13.1	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	< 380.	380.	38.	ug/kg	1
03761	Naphthalene	91-20-3	< 380.	380.	38.	ug/kg	1
03768	Fluorene	86-73-7	< 380.	380.	38.	ug/kg	1
03775	Phenanthrene	85-01-8	< 380.	380.	38.	ug/kg	1
03776	Anthracene	120-12-7	< 380.	380.	38.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 380.	380.	38.	ug/kg	1
03782	Chrysene	218-01-9	< 380.	380.	38.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	< 380.	380.	38.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	< 380.	380.	38.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 380.	380.	38.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 3.	3.	0.3	ug/kg	0.57
05460	Benzene	71-43-2	< 3.	3.	0.3	ug/kg	0.57
05461	1,2-Dichloroethane	107-06-2	< 3.	3.	0.7	ug/kg	0.57
05466	Toluene	108-88-3	< 3.	3.	0.7	ug/kg	0.57
05471	1,2-Dibromoethane	106-93-4	< 3.	3.	0.7	ug/kg	0.57
05474	Ethylbenzene	100-41-4	< 3.	3.	0.7	ug/kg	0.57
05479	Isopropylbenzene	98-82-8	< 3.	3.	0.7	ug/kg	0.57
06301	Xylene (Total)	1330-20-7	< 3.	3.	0.7	ug/kg	0.57

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06955	Lead	SW-846 6010B	1	03/15/2005 18:43	John P Hook	1
00111	Moisture	EPA 160.3 modified	1	03/16/2005 13:43	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	03/22/2005 18:07	Joseph M Gambler	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. SW 4480727

BH-S212-031005-1-1.5 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/10/2005 13:40 by MBS

Account Number: 10132

Submitted: 03/11/2005 17:50
Reported: 03/24/2005 at 12:27
Discard: 04/24/2005

Langan
500 Hyde Park
Doylestown PA 18901

S212-

02308	UST-Soils by 8260B	SW-846 8260B	1	03/15/2005 23:52	Kenneth L Boley Jr	0.57
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	1	03/13/2005 16:51	Medina A Long	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	2	03/13/2005 17:16	Medina A Long	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	3	03/13/2005 17:17	Medina A Long	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	03/15/2005 07:00	Denise Y Black	1
07806	BNA Soil Extraction	SW-846 3550B	3	03/18/2005 19:00	Elia R Botrous	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. SW 4480728

BH-S213-031005-1.5-2 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/10/2005 15:10 by MBS

Account Number: 10132

Submitted: 03/11/2005 17:50
Reported: 03/24/2005 at 12:27
Discard: 04/24/2005

Langan
500 Hyde Park
Doylestown PA 18901

S213-

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	127.	2.30	1.07	mg/kg	1
00111	Moisture	n.a.	15.5	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	< 390.	390.	39.	ug/kg	1
03761	Naphthalene	91-20-3	< 390.	390.	39.	ug/kg	1
03768	Fluorene	86-73-7	720.	390.	39.	ug/kg	1
03775	Phenanthrene	85-01-8	1,300.	390.	39.	ug/kg	1
03776	Anthracene	120-12-7	590.	390.	39.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 390.	390.	39.	ug/kg	1
03782	Chrysene	218-01-9	< 390.	390.	39.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	< 390.	390.	39.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	< 390.	390.	39.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 390.	390.	39.	ug/kg	1
	The GC/MS semivolatile internal standard peak areas were outside of the QC limits for both the initial injection and the re-injection. The values here are from the initial injection of the sample.						
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 150.	150.	15.	ug/kg	25.72
05460	Benzene	71-43-2	< 150.	150.	15.	ug/kg	25.72
05461	1,2-Dichloroethane	107-06-2	< 150.	150.	30.	ug/kg	25.72
05466	Toluene	108-88-3	< 150.	150.	30.	ug/kg	25.72
05471	1,2-Dibromoethane	106-93-4	< 150.	150.	30.	ug/kg	25.72
05474	Ethylbenzene	100-41-4	< 150.	150.	30.	ug/kg	25.72
05479	Isopropylbenzene	98-82-8	< 150.	150.	30.	ug/kg	25.72
06301	Xylene (Total)	1330-20-7	< 150.	150.	30.	ug/kg	25.72
	The GC/MS volatile analysis was performed according to the high level soil method due to the level of non-target compounds. Therefore, the reporting limits were raised.						

Commonwealth of Pennsylvania Lab Certification No. 36-037

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. SW 4480728

BH-S213-031005-1.5-2 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/10/2005 15:10 by MBS

Account Number: 10132

Submitted: 03/11/2005 17:50
Reported: 03/24/2005 at 12:27
Discard: 04/24/2005

Langan
500 Hyde Park
Doylestown PA 18901

S213-

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06955	Lead	SW-846 6010B	1	03/15/2005 18:57	John P Hook	1
00111	Moisture	EPA 160.3 modified	1	03/16/2005 13:43	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	03/22/2005 22:13	Jolene M Graham	1
02308	UST-Soils by 8260B	SW-846 8260B	1	03/15/2005 16:20	Parker D Lindstrom	25.72
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	1	03/13/2005 16:52	Medina A Long	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	2	03/13/2005 17:18	Medina A Long	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	3	03/13/2005 17:19	Medina A Long	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	03/15/2005 07:00	Denise Y Black	1
07806	BNA Soil Extraction	SW-846 3550B	3	03/18/2005 19:00	Elia R Botrous	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. SW 4480729

BH-S211-031005-1.5-2 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/10/2005 15:45 by MBS

Account Number: 10132

Submitted: 03/11/2005 17:50
Reported: 03/24/2005 at 12:27
Discard: 04/24/2005

Langan
500 Hyde Park
Doylestown PA 18901

S211-

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	45.0	2.56	1.19	mg/kg	1
00111	Moisture	n.a.	24.1	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	< 440.	440.	44.	ug/kg	1
03761	Naphthalene	91-20-3	< 440.	440.	44.	ug/kg	1
03768	Fluorene	86-73-7	< 440.	440.	44.	ug/kg	1
03775	Phenanthrene	85-01-8	< 440.	440.	44.	ug/kg	1
03776	Anthracene	120-12-7	< 440.	440.	44.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 440.	440.	44.	ug/kg	1
03782	Chrysene	218-01-9	< 440.	440.	44.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	< 440.	440.	44.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	< 440.	440.	44.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 440.	440.	44.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 4.	4.	0.4	ug/kg	0.55
05460	Benzene	71-43-2	< 4.	4.	0.4	ug/kg	0.55
05461	1,2-Dichloroethane	107-06-2	< 4.	4.	0.7	ug/kg	0.55
05466	Toluene	108-88-3	< 4.	4.	0.7	ug/kg	0.55
05471	1,2-Dibromoethane	106-93-4	< 4.	4.	0.7	ug/kg	0.55
05474	Ethylbenzene	100-41-4	< 4.	4.	0.7	ug/kg	0.55
05479	Isopropylbenzene	98-82-8	< 4.	4.	0.7	ug/kg	0.55
06301	Xylene (Total)	1330-20-7	< 4.	4.	0.7	ug/kg	0.55

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06955	Lead	SW-846 6010B	1	03/15/2005 19:02	John P Hook	1
00111	Moisture	EPA 160.3 modified	1	03/16/2005 13:43	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	03/22/2005 23:19	Jolene M Graham	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. SW 4480729

BH-S211-031005-1.5-2 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/10/2005 15:45 by MBS

Account Number: 10132

Submitted: 03/11/2005 17:50
Reported: 03/24/2005 at 12:27
Discard: 04/24/2005

Langan
500 Hyde Park
Doylestown PA 18901

S211-

02308	UST-Soils by 8260B	SW-846 8260B	1	03/16/2005 00:14	Kenneth L Boley Jr	0.55
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	1	03/13/2005 16:49	Medina A Long	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	2	03/13/2005 17:20	Medina A Long	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	3	03/13/2005 17:21	Medina A Long	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	03/15/2005 07:00	Denise Y Black	1
07806	BNA Soil Extraction	SW-846 3550B	3	03/18/2005 19:00	Elia R Botrous	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Quality Control Summary

Client Name: Langan Group Number: 935093
Reported: 03/24/05 at 12:27 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: 050745708001	Sample number(s): 4480726-4480729								
Lead	< 2.00	2.00	0.930	mg/kg	96		86-109		
Batch number: 05075820001B	Sample number(s): 4480726-4480729								
Moisture					100		99-101		
Batch number: 05077SLA026	Sample number(s): 4480726-4480729								
Pyrene	< 330.	330.	33.	ug/kg	98		67-116		
Naphthalene	< 330.	330.	33.	ug/kg	89		70-103		
Fluorene	< 330.	330.	33.	ug/kg	95		66-115		
Phenanthrene	< 330.	330.	33.	ug/kg	94		70-107		
Anthracene	< 330.	330.	33.	ug/kg	93		69-109		
Benzo(a)anthracene	< 330.	330.	33.	ug/kg	96		73-111		
Chrysene	< 330.	330.	33.	ug/kg	94		72-110		
Benzo(b)fluoranthene	< 330.	330.	33.	ug/kg	87		68-116		
Benzo(a)pyrene	< 330.	330.	33.	ug/kg	96		72-117		
Benzo(g,h,i)perylene	< 330.	330.	33.	ug/kg	89		66-120		
Batch number: Q050661AB	Sample number(s): 4480728								
Methyl Tertiary Butyl Ether	< 250.	250.	25.	ug/kg	108		75-125		
Benzene	< 250.	250.	25.	ug/kg	110		77-119		
1,2-Dichloroethane	< 250.	250.	50.	ug/kg	111		76-126		
Toluene	< 250.	250.	50.	ug/kg	111		81-116		
1,2-Dibromoethane	< 250.	250.	50.	ug/kg	112		77-114		
Ethylbenzene	< 250.	250.	50.	ug/kg	109		82-115		
Isopropylbenzene	< 250.	250.	50.	ug/kg	110		79-117		
Xylene (Total)	< 250.	250.	50.	ug/kg	111		82-117		
Batch number: X050742AA	Sample number(s): 4480726-4480727,4480729								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/kg	98	97	75-125	1	30
Benzene	< 5.	5.	0.5	ug/kg	105	103	77-119	2	30
1,2-Dichloroethane	< 5.	5.	1.	ug/kg	99	98	76-126	1	30
Toluene	< 5.	5.	1.	ug/kg	100	98	81-116	2	30
1,2-Dibromoethane	< 5.	5.	1.	ug/kg	92	91	77-114	1	30
Ethylbenzene	< 5.	5.	1.	ug/kg	98	96	82-115	2	30
Isopropylbenzene	< 5.	5.	1.	ug/kg	98	96	79-117	2	30
Xylene (Total)	< 5.	5.	1.	ug/kg	97	95	82-117	2	30

Sample Matrix Quality Control

MS	MSD	MS/MSD	RPD	BKG	DUP	DUP	Dup RPD

*- 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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 935093
Reported: 03/24/05 at 12:27 PM

Analysis Name	%REC	%REC	Limits	RPD	MAX	Conc	Conc	RPD	Max
Batch number: 050745708001	Sample number(s): 4480726-4480729								
Lead	85	79	75-125	6	20	14.1	15.1	7	20
Batch number: 05075820001B	Sample number(s): 4480726-4480729								
Moisture						12.0	12.5	4	15
Batch number: 05077SLA026	Sample number(s): 4480726-4480729								
Pyrene	96	97	40-145	1	30				
Naphthalene	87	92	38-132	5	30				
Fluorene	92	95	39-137	3	30				
Phenanthrene	92	92	42-137	1	30				
Anthracene	90	85	47-135	6	30				
Benzo(a)anthracene	93	94	42-137	1	30				
Chrysene	90	92	39-140	2	30				
Benzo(b)fluoranthene	84	90	42-141	7	30				
Benzo(a)pyrene	93	83	38-142	11	30				
Benzo(g,h,i)perylene	85	93	32-150	9	30				
Batch number: Q050661AB	Sample number(s): 4480728								
Methyl Tertiary Butyl Ether	100	98	49-140	3	30				
Benzene	100	102	67-123	1	30				
1,2-Dichloroethane	100	101	62-130	0	30				
Toluene	100	101	55-125	0	30				
1,2-Dibromoethane	101	101	62-116	1	30				
Ethylbenzene	99	100	50-127	0	30				
Isopropylbenzene	99	101	48-124	0	30				
Xylene (Total)	100	102	54-123	1	30				
Batch number: X050742AA	Sample number(s): 4480726-4480727,4480729								
Methyl Tertiary Butyl Ether	91		49-140						
Benzene	100		67-123						
1,2-Dichloroethane	90		62-130						
Toluene	92		55-125						
1,2-Dibromoethane	81		62-116						
Ethylbenzene	86		50-127						
Isopropylbenzene	81		48-124						
Xylene (Total)	84		54-123						

Surrogate Quality Control

Analysis Name: PAHs in Soil by GC/MS
Batch number: 05077SLA026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4480726	82	84	111
4480727	86	88	114
4480728	113	103	122
4480729	80	82	110
Blank	79	83	115
LCS	77	84	114
MS	75	81	109
MSD	74	82	110
Limits:	47-128	55-123	49-133

*- 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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 935093
Reported: 03/24/05 at 12:27 PM

Surrogate Quality Control

Analysis Name: UST-Soils by 8260B
Batch number: Q050661AB

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4480728	73	73	70	75
Blank	103	101	97	88
LCS	96	101	97	92
MS	96	96	97	92
MSD	95	97	96	91
Limits:	70-129	70-121	70-130	70-128

Analysis Name: UST-Soils by 8260B
Batch number: X050742AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4480726	94	96	91	90
4480727	95	94	93	89
4480729	95	93	92	91
Blank	94	91	92	89
LCS	94	90	94	91
LCSD	94	90	94	93
MS	93	93	93	92
Limits:	70-129	70-121	70-130	70-128

*- 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 background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. # 10132 Group# 935093 Sample # 4480726-29

COC # 0084313

Please print. Instructions on reverse side correspond with circled numbers.

(1)
Client: Sun - Aquaterra Acct. #:
Project Name/#: Sun - Philadelphia Refinery AOI 3 PWSID #:
Project Manager: Kevin Martin / Jason Hanna (Langan) P.O.#:
Sampler: M. Brad Spancake 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
BH-S205-031005-1.5-2	3/10/05	1020	X		X			4
BH-S212-031005-1-1.5	3/10/05	1340	X		X			4
BH-S213-031005-1.5-2	3/10/05	1510	X		X			4
BH-S211-031005-1.5-2	3/10/05	1545	X		X			4

(5) Analyses Requested: 8260 BTEX, MBE (Cumene, EDC, EDB, Total Lead); 8270 Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Chrysene, Naphthalene, Fluorene, Phenanthrene, Pyrene, % Moist

For Lab Use Only
FSC:
SCR #:

(6) Remarks
Vials 3121, 3120, 1503
Vials 3111, 3116, 1588
Vials 3117, 3122, 1587
Vials 3106, 3107, 1586
temp 3.0 °C
IB 3/11/05

(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)
QC Summary, Type I (Tier I), Type II (Tier II), Type III (NJ Red. Del.), Type IV (CLP), Type VI (Raw Data), GLP, Other
SDG Complete? Yes No
Site-specific QC required? Yes (No)
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes (No)

Relinquished by:	Date	Time	Received by:	Date	Time
M. Brad Spancake	3/10/05	1830	AT Fridge	3/10/05	1830
AT FRIDGE	3/11/05	1452	Lon Udvari	3/11/05	1452
Lon Udvari	3/11/05	1452	P. Lefevre	3/11/05	1452
P. Lefevre	3/11/05	1750			
			Jessica Bon	3/11/05	1752

(9)

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

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
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< 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

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

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. All other results are reported on an as-received basis.

U.S. EPA CLP 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 quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
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 sample 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.

Measurement uncertainty values, as applicable, are available upon request.

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:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 937119. Samples arrived at the laboratory on Monday, March 28, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description	Lancaster Labs Number
BH-S206-032205-2-2.5 Grab Soil Sample	4491367
BH-S210-032505-3-3.5 Grab Soil Sample	4491368

1 COPY TO	Langan	Attn: Jason Hanna
ELECTRONIC	SUN: Aquaterra Tech.	Attn: Brad Spancake
COPY TO		
1 COPY TO	LL	Attn: Angela Miller
ELECTRONIC	Langan	Attn: Dennis Webster
COPY TO		

Lancaster Laboratories

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Analysis Report

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,

Michele A. Jarosick
Senior Chemist, Coordinator

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. SW 4491367

BH-S206-032205-2-2.5 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/22/2005 11:45 by MBS

Account Number: 10132

Submitted: 03/28/2005 17:30
Reported: 04/10/2005 at 12:17
Discard: 05/11/2005

Langan
500 Hyde Park
Doylestown PA 18901

S206-

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	184.	2.48	1.15	mg/kg	1
00111	Moisture	n.a.	21.7	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.	8,500.	850.	ug/kg	10
03761	Naphthalene	91-20-3	< 8,500.	8,500.	850.	ug/kg	10
03768	Fluorene	86-73-7	22,000.	8,500.	850.	ug/kg	10
03775	Phenanthrene	85-01-8	46,000.	8,500.	850.	ug/kg	10
03776	Anthracene	120-12-7	< 8,500.	8,500.	850.	ug/kg	10
03781	Benzo(a)anthracene	56-55-3	< 8,500.	8,500.	850.	ug/kg	10
03782	Chrysene	218-01-9	< 8,500.	8,500.	850.	ug/kg	10
03786	Benzo(b)fluoranthene	205-99-2	< 8,500.	8,500.	850.	ug/kg	10
03788	Benzo(a)pyrene	50-32-8	< 8,500.	8,500.	850.	ug/kg	10
03791	Benzo(g,h,i)perylene	191-24-2	< 8,500.	8,500.	850.	ug/kg	10
	Due to sample matrix interferences observed during the extraction, the normal reporting limits could not be obtained. 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. Surrogate recoveries were outside of QC limits for the GC/MS semivolatile compounds due to the dilution needed to perform the analysis.						
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 330.	330.	33.	ug/kg	52.3
05460	Benzene	71-43-2	4,200.	330.	33.	ug/kg	52.3
05461	1,2-Dichloroethane	107-06-2	< 330.	330.	67.	ug/kg	52.3
05466	Toluene	108-88-3	1,800.	330.	67.	ug/kg	52.3
05471	1,2-Dibromoethane	106-93-4	< 330.	330.	67.	ug/kg	52.3
05474	Ethylbenzene	100-41-4	1,700.	330.	67.	ug/kg	52.3
05479	Isopropylbenzene	98-82-8	24,000.	3,300.	670.	ug/kg	523.01
06301	Xylene (Total)	1330-20-7	3,500.	330.	67.	ug/kg	52.3
	The GC/MS volatile analysis was performed according to the high level soil method due to the level of target and non-target compounds. Therefore, the						

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. SW 4491367

BH-S206-032205-2-2.5 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/22/2005 11:45 by MBS

Account Number: 10132

Submitted: 03/28/2005 17:30
Reported: 04/10/2005 at 12:17
Discard: 05/11/2005

Langan
500 Hyde Park
Doylestown PA 18901

S206-

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor

reporting limits were raised.

Surrogate recoveries were outside of QC limits for the GC/MS volatile fraction. The analysis was repeated and out of specification surrogate recoveries were again observed indicating a matrix effect.

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06955	Lead	SW-846 6010B	1	03/31/2005 21:47	John P Hook	1
00111	Moisture	EPA 160.3 modified	1	04/01/2005 17:27	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	03/31/2005 07:58	Brian K Graham	10
02308	UST-Soils by 8260B	SW-846 8260B	1	04/04/2005 14:26	Parker D Lindstrom	52.3
02308	UST-Soils by 8260B	SW-846 8260B	1	04/05/2005 03:49	Seth J Good	523.01
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	1	03/30/2005 14:14	Nadine Fegley	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	2	03/30/2005 14:15	Nadine Fegley	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	03/31/2005 07:33	Denise Y Black	1
06171	GC/MS - Field Preserved MeOH	SW-846 5035	1	03/30/2005 13:51	Nadine Fegley	1
07806	BNA Soil Extraction	SW-846 3550B	1	03/30/2005 15:15	Ashley B Zook	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. SW 4491368

BH-S210-032505-3-3.5 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/25/2005 13:00 by MBS

Account Number: 10132

Submitted: 03/28/2005 17:30
Reported: 04/10/2005 at 12:17
Discard: 05/11/2005

Langan
500 Hyde Park
Doylestown PA 18901

S210-

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Limit of Quantitation*	Dry Method Detection Limit	Units	Dilution Factor
06955	Lead	7439-92-1	37.5	2.40	1.11	mg/kg	1
00111	Moisture	n.a.	17.4	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	420.	400.	40.	ug/kg	1
03761	Naphthalene	91-20-3	< 400.	400.	40.	ug/kg	1
03768	Fluorene	86-73-7	< 400.	400.	40.	ug/kg	1
03775	Phenanthrene	85-01-8	< 400.	400.	40.	ug/kg	1
03776	Anthracene	120-12-7	< 400.	400.	40.	ug/kg	1
03781	Benzo(a)anthracene	56-55-3	< 400.	400.	40.	ug/kg	1
03782	Chrysene	218-01-9	< 400.	400.	40.	ug/kg	1
03786	Benzo(b)fluoranthene	205-99-2	430.	400.	40.	ug/kg	1
03788	Benzo(a)pyrene	50-32-8	410.	400.	40.	ug/kg	1
03791	Benzo(g,h,i)perylene	191-24-2	< 400.	400.	40.	ug/kg	1
02308	UST-Soils by 8260B						
02016	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/kg	0.81
05460	Benzene	71-43-2	23.	5.	0.5	ug/kg	0.81
05461	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/kg	0.81
05466	Toluene	108-88-3	< 5.	5.	1.	ug/kg	0.81
05471	1,2-Dibromoethane	106-93-4	< 5.	5.	1.	ug/kg	0.81
05474	Ethylbenzene	100-41-4	< 5.	5.	1.	ug/kg	0.81
05479	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/kg	0.81
06301	Xylene (Total)	1330-20-7	< 5.	5.	1.	ug/kg	0.81

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06955	Lead	SW-846 6010B	1	03/31/2005 21:50	John P Hook	1
00111	Moisture	EPA 160.3 modified	1	04/01/2005 17:27	Scott W Freisher	1
07804	PAHs in Soil by GC/MS	SW-846 8270C	1	03/31/2005 00:55	Linda M Hartenstine	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. SW 4491368

BH-S210-032505-3-3.5 Grab Soil Sample
SUN: Philadelphia Refinery AOI-1

Collected:03/25/2005 13:00 by MBS

Account Number: 10132

Submitted: 03/28/2005 17:30
Reported: 04/10/2005 at 12:17
Discard: 05/11/2005

Langan
500 Hyde Park
Doylestown PA 18901

S210-

02308	UST-Soils by 8260B	SW-846 8260B	1	04/04/2005 14:28	Kenneth L Boley Jr	0.81
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	1	03/30/2005 14:17	Nadine Fegley	1
02392	GC/MS - Field Preserved NaHSO4	SW-846 5035	2	03/30/2005 14:18	Nadine Fegley	1
05708	SW SW846 ICP Digest	SW-846 3050B	1	03/31/2005 07:33	Denise Y Black	1
06171	GC/MS - Field Preserved MeOH	SW-846 5035	1	03/30/2005 14:01	Nadine Fegley	1
07806	BNA Soil Extraction	SW-846 3550B	1	03/30/2005 15:15	Ashley B Zook	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Quality Control Summary

Client Name: Langan Group Number: 937119
Reported: 04/10/05 at 12:17 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: 05089SLD026	Sample number(s): 4491367-4491368								
Pyrene	< 330.	330.	33.	ug/kg	89		67-116		
Naphthalene	< 330.	330.	33.	ug/kg	88		70-103		
Fluorene	< 330.	330.	33.	ug/kg	88		66-115		
Phenanthrene	< 330.	330.	33.	ug/kg	92		70-107		
Anthracene	< 330.	330.	33.	ug/kg	88		69-109		
Benzo(a)anthracene	< 330.	330.	33.	ug/kg	94		73-111		
Chrysene	< 330.	330.	33.	ug/kg	95		72-110		
Benzo(b)fluoranthene	< 330.	330.	33.	ug/kg	104		68-116		
Benzo(a)pyrene	< 330.	330.	33.	ug/kg	111		72-117		
Benzo(g,h,i)perylene	< 330.	330.	33.	ug/kg	104		66-120		
Batch number: 050905708002	Sample number(s): 4491367-4491368								
Lead	< 2.00	2.00	0.930	mg/kg	95		86-109		
Batch number: 05091820002B	Sample number(s): 4491367-4491368								
Moisture					100		99-101		
Batch number: Q050911AB	Sample number(s): 4491367								
Methyl Tertiary Butyl Ether	< 250.	250.	25.	ug/kg	76	77	75-125	2	30
Benzene	< 250.	250.	25.	ug/kg	95	95	77-119	0	30
1,2-Dichloroethane	< 250.	250.	50.	ug/kg	94	94	76-126	0	30
Toluene	< 250.	250.	50.	ug/kg	98	99	81-116	0	30
1,2-Dibromoethane	< 250.	250.	50.	ug/kg	99	97	77-114	2	30
Ethylbenzene	< 250.	250.	50.	ug/kg	99	99	82-115	0	30
Xylene (Total)	< 250.	250.	50.	ug/kg	101	101	82-117	0	30
Batch number: Q050911AC	Sample number(s): 4491367								
Isopropylbenzene	< 250.	250.	50.	ug/kg	99	99	79-117	0	30
Batch number: X050941AA	Sample number(s): 4491368								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/kg	115		75-125		
Benzene	< 5.	5.	0.5	ug/kg	110		77-119		
1,2-Dichloroethane	< 5.	5.	1.	ug/kg	113		76-126		
Toluene	< 5.	5.	1.	ug/kg	107		81-116		
1,2-Dibromoethane	< 5.	5.	1.	ug/kg	102		77-114		
Ethylbenzene	< 5.	5.	1.	ug/kg	106		82-115		
Isopropylbenzene	< 5.	5.	1.	ug/kg	105		79-117		
Xylene (Total)	< 5.	5.	1.	ug/kg	104		82-117		

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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 937119
Reported: 04/10/05 at 12:17 PM

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: 05089SLD026	Sample number(s): 4491367-4491368								
Pyrene	78	81	40-145	3	30				
Naphthalene	83	90	38-132	8	30				
Fluorene	89	91	39-137	3	30				
Phenanthrene	87	88	42-137	1	30				
Anthracene	88	91	47-135	4	30				
Benzo(a)anthracene	88	93	42-137	5	30				
Chrysene	83	86	39-140	4	30				
Benzo(b)fluoranthene	93	102	42-141	8	30				
Benzo(a)pyrene	103	116	38-142	11	30				
Benzo(g,h,i)perylene	103	113	32-150	9	30				
Batch number: 050905708002	Sample number(s): 4491367-4491368								
Lead	87	67*	75-125	7	20	103.	102.	1	20
Batch number: 05091820002B	Sample number(s): 4491367-4491368								
Moisture						19.6	19.8	1	15
Batch number: X050941AA	Sample number(s): 4491368								
Methyl Tertiary Butyl Ether	77	122	49-140	43*	30				
Benzene	(2)	(2)	67-123	39*	30				
1,2-Dichloroethane	83	125	62-130	39*	30				
Toluene	(2)	(2)	55-125	41*	30				
1,2-Dibromoethane	82	121*	62-116	37*	30				
Ethylbenzene	(2)	(2)	50-127	40*	30				
Isopropylbenzene	(2)	(2)	48-124	27	30				
Xylene (Total)	(2)	(2)	54-123	40*	30				

Surrogate Quality Control

Analysis Name: PAHs in Soil by GC/MS
Batch number: 05089SLD026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4491367	246*	93	96
4491368	87	91	94
Blank	86	92	95
LCS	89	95	91
MS	85	95	88
MSD	90	98	92
Limits:	47-128	55-123	49-133

Analysis Name: UST-Soils by 8260B
Batch number: Q050911AB

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4491367	76	77	62*	74
Blank	84	86	83	77
LCS	82	83	87	87
LCSD	84	84	88	87

*- 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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 937119
Reported: 04/10/05 at 12:17 PM

Surrogate Quality Control

Limits:	70-129	70-121	70-130	70-128

Analysis Name: 8260 Master Scan (soil)
Batch number: Q050911AC

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
Blank	84	83	82	79
LCS	82	83	87	87
LCSD	84	84	88	87
Limits:	70-129	70-121	70-130	70-128

Analysis Name: UST-Soils by 8260B
Batch number: X050941AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4491368	92	87	91	90
Blank	91	85	91	90
LCS	91	88	91	89
MS	90	84	155*	249*
MSD	93	86	172*	244*
Limits:	70-129	70-121	70-130	70-128

*- 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 background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. # 10132 Group# 937119 Sample # 4491367-68

COC # 0086561

Please print. Instructions on reverse side correspond with circled numbers.

(1)
Client: Sun-Aquaterra Acct. #:
Project Name/#: Sun-Philadelphia Refinery ACT-1 PWSID #:
Project Manager: Kevin Martin / Jason Hanna P.O.#:
Sampler: M. Brad Spancake 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
BH-S206-032205-2-2.5	3/22/05	1145	X		X			4
BH-S210-032505-3-3.5	3/25/05	1300	X		X			4

(4) Preservation: Type of Container / Preservative; Soil/Solid: Groundwater / Wastewater / Drinking Water; Liquid: Air / Other

(5) Analyses Requested: 8260 PAHs, EDC, EDB; Total Lead; 8270 Anthracene, Benz(a)Anthracene, Benzo(ghi)perylene, Benzo(a)Pyrene, Benzo(b)Fluoranthene, Chrysene, Fluorene, Naphthalene, Phenanthrene, Pyrene, % Moist

For Lab Use Only
FSC:
SCR #: 12.01395

(6) Remarks
Vials 3108, 3112, 1589
Vials 3113, 3118, 1584
3.0-4.3°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: bs@aquaterra-tech.com / jhanna@Langan.com

(8) **Data Package Options** (please circle if required)
QC Summary
Type I (Tier I)
Type II (Tier II)
Type III (NJ Red. Del.)
Type IV (CLP)
Type VI (Raw Data)
GLP
Other
SDG Complete? Yes No
Site-specific QC required? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes No

Relinquished by:	Date	Time	Received by:	Date	Time
	3/17/05	16:30	Marvin McCallum	3/18/05	7:30
Marvin McCallum	3/25/05	9:45	M. Breed		
M. Brad Spancake	3/25/05	1600	AT FLG	3/25/05	1600
			Marvin McCallum	3/26/05	10:20
Marvin McCallum	3/28/05	1530	Jessica	3/28/05	1730

(9)

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.

2102 Rev. 10/27/02

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

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
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< 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

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

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. All other results are reported on an as-received basis.

U.S. EPA CLP 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 quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
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 sample 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.

Measurement uncertainty values, as applicable, are available upon request.

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:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 939896. Samples arrived at the laboratory on Monday, April 18, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description	Lancaster Labs Number
S80D-041505 Grab Water Sample	4505845
S42D-041505 Grab Water Sample	4505846
S95D-041505 Grab Water Sample	4505847

ELECTRONIC COPY TO	SUN: Aquaterra Tech.	Attn: Brad Spancake
1 COPY TO	Langan	Attn: Jason Hanna
1 COPY TO	LL	Attn: Angela Miller
ELECTRONIC COPY TO	Langan	Attn: Dennis Webster

Lancaster Laboratories

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Analysis Report

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,

Rachel R. Cochis
Senior Chemist, Coordinator

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. WW 4505845

S80D-041505 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/15/2005 13:00 by MBS

Account Number: 10132

Submitted: 04/18/2005 17:50
Reported: 04/29/2005 at 08:46
Discard: 05/30/2005

Langan
500 Hyde Park
Doylestown PA 18901

S80D-

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	0.00018	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	< 11.	11.	1.	ug/l	1
03956	Fluorene	86-73-7	< 11.	11.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 11.	11.	1.	ug/l	1
03967	Pyrene	129-00-0	< 11.	11.	1.	ug/l	1
03971	Chrysene	218-01-9	< 11.	11.	1.	ug/l	1
	Due to insufficient sample, 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.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 22:55	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/22/2005 09:43	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/20/2005 13:04	Timothy J Trees	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/20/2005 05:06	Seth J Good	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4505845

S80D-041505 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/15/2005 13:00 by MBS

Account Number: 10132

Submitted: 04/18/2005 17:50
Reported: 04/29/2005 at 08:46
Discard: 05/30/2005

Langan
500 Hyde Park
Doylestown PA 18901

S80D-

01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/20/2005 05:06	Seth J Good	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/21/2005 07:45	Darin P Wagner	1
07807	BNA Water Extraction	SW-846 3510C	1	04/19/2005 18:00	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4505846

S42D-041505 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/15/2005 14:30 by MBS

Account Number: 10132

Submitted: 04/18/2005 17:50
Reported: 04/29/2005 at 08:46
Discard: 05/30/2005

Langan
500 Hyde Park
Doylestown PA 18901

S42D-

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	0.00018	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	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:09	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/22/2005 10:13	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/20/2005 13:24	Timothy J Trees	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/20/2005 05:31	Seth J Good	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/20/2005 05:31	Seth J Good	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/21/2005 07:45	Darin P Wagner	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4505846

S42D-041505 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/15/2005 14:30 by MBS

Account Number: 10132

Submitted: 04/18/2005 17:50
Reported: 04/29/2005 at 08:46
Discard: 05/30/2005

Langan
500 Hyde Park
Doylestown PA 18901

S42D-

07807	BNA Water Extraction	SW-846 3510C	1	04/19/2005 18:00	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4505847

S95D-041505 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/15/2005 15:00 by MBS

Account Number: 10132

Submitted: 04/18/2005 17:50
Reported: 04/29/2005 at 08:46
Discard: 05/30/2005

Langan
500 Hyde Park
Doylestown PA 18901

S95D-

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	0.00018	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.028	0.028	0.0094	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	8.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	26.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:11	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/22/2005 11:12	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/20/2005 13:45	Timothy J Trees	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/20/2005 05:55	Seth J Good	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/20/2005 05:55	Seth J Good	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/21/2005 07:45	Darin P Wagner	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4505847

S95D-041505 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/15/2005 15:00 by MBS

Account Number: 10132

Submitted: 04/18/2005 17:50
Reported: 04/29/2005 at 08:46
Discard: 05/30/2005

Langan
500 Hyde Park
Doylestown PA 18901

S95D-

07807	BNA Water Extraction	SW-846 3510C	1	04/19/2005 18:00	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Quality Control Summary

Client Name: Langan Group Number: 939896
Reported: 04/29/05 at 08:46 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: 05109WAD026	Sample number(s): 4505845-4505847								
Naphthalene	< 10.	10.	1.	ug/l	93	94	58-108	1	30
Fluorene	< 10.	10.	1.	ug/l	96	93	61-116	3	30
Phenanthrene	< 10.	10.	1.	ug/l	100	99	68-111	1	30
Pyrene	< 10.	10.	1.	ug/l	87	90	68-114	4	30
Chrysene	< 10.	10.	1.	ug/l	94	98	70-111	4	30
Batch number: 051100017A	Sample number(s): 4505845-4505847								
Ethylene dibromide	< 0.030	0.030	0.010	ug/l	92	96	60-140	4	20
Batch number: 051186050001A	Sample number(s): 4505845-4505847								
Lead	< 0.0010	0.0010	0.00018	mg/l	99		80-120		
Batch number: T051092AA	Sample number(s): 4505845-4505847								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	102	106	77-127	4	30
Benzene	< 5.	5.	0.5	ug/l	104	108	85-117	5	30
1,2-Dichloroethane	< 5.	5.	1.	ug/l	117	122	77-132	4	30
Toluene	< 5.	5.	0.7	ug/l	101	105	85-115	4	30
Ethylbenzene	< 5.	5.	0.8	ug/l	92	96	82-119	4	30
Isopropylbenzene	< 5.	5.	1.	ug/l	92	98	80-120	6	30
Xylene (Total)	< 5.	5.	0.8	ug/l	92	97	83-113	5	30

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: 051100017A	Sample number(s): 4505845-4505847								
Ethylene dibromide	100		65-135			< 0.028	< 0.028	0 (1)	30
Batch number: 051186050001A	Sample number(s): 4505845-4505847								
Lead	97	97	75-125	0	20	< 0.0010	< 0.0010	12 (1)	20
Batch number: T051092AA	Sample number(s): 4505845-4505847								
Methyl Tertiary Butyl Ether	113		69-134						
Benzene	119		83-128						
1,2-Dichloroethane	128		73-136						
Toluene	113		83-127						
Ethylbenzene	102		82-129						
Isopropylbenzene	103		81-130						
Xylene (Total)	103		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 background result was more than four times the spike added.

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Analysis Report

Quality Control Summary

Client Name: Langan Group Number: 939896
Reported: 04/29/05 at 08:46 AM

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max

Surrogate Quality Control

Analysis Name: PAHs in Water by GC/MS
Batch number: 05109WAD026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4505845	96	93	118
4505846	101	99	120
4505847	94	95	120
Blank	101	99	123
LCS	100	100	120
LCSD	102	96	124
Limits:	51-123	64-112	48-125

Analysis Name: EDB in Wastewater
Batch number: 051100017A

	1,1,2,2-Tetrachloroethane
4505845	116
4505846	116
4505847	118
Blank	109
DUP	117
LCS	106
LCSD	105
MS	98
Limits:	52-120

Analysis Name: UST-Waters by 8260B
Batch number: T051092AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4505845	102	90	91	101
4505846	101	90	93	98
4505847	100	88	93	104
Blank	99	89	90	102
LCS	95	90	94	102
LCSD	97	90	94	102
MS	99	90	94	104
Limits:	81-120	82-112	85-112	83-113

*- 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 background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. # 10132 Group# 939896 Sample # 4505845-7

COC # 0082439

Please print. Instructions on reverse side correspond with circled numbers.

(1)
Client: Sun Aquaterra Acct. #:
Project Name/#: Sun-Philadelphia Refinery AOI-1 PWSID #:
Project Manager: Kevin Martin / Jason Hanna (Langan) P.O.#:
Sampler: M. Brad Spancake Quote #:
Name of state where samples were collected: PA

(2) Sample Identification | Date Collected | Time Collected | (3) Matrix: Drinking Water, Groundwater, Wastewater, Soil, Other | (4) Total # of Containers | (5) Analyses Requested: 8260B BTEX, MTBE, Cumene; Dissolved Pb; 8270C Chrysene, Naphthalene, Fluoranthene, Pyrene; 8011 EDB | Remarks

Sample Identification	Date Collected	Time Collected	Drinking Water	Groundwater	Wastewater	Soil	Other	Total # of Containers	8260B BTEX, MTBE, Cumene	Dissolved Pb	8270C Chrysene, Naphthalene, Fluoranthene, Pyrene	8011 EDB	Remarks
S80D-041505	4/15/05	1300	X			X		6				X	Dissolved Pb samples need filtering/preservation
S42D-041505	4/15/05	1430	X			X		6				X	
S95D-041505	4/15/05	1500	X			X		6				X	3.3°C

For Lab Use Only
FSC:
SCR #: 1202270

(6) Preservation: Unpreserved, HCl, HNO3, H2SO4, NaOH, Other

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: 4/29/05
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
QC Summary
Type I (Tier I)
Type II (Tier II)
Type III (NJ Red. Del.)
Type IV (CLP)
Type VI (Raw Data)
GLP
Other
SDG Complete? Yes (No)
Site-specific QC required? Yes (No)
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes (No)

(9)

Relinquished by:	Date	Time	Received by:	Date	Time
	4/12/05	15:50	Aquaterra		
M. Brad Spancake	4/15/05	1600	AT Fridge	4/15/05	1600
AT Fridge	4/18/05	1105		4/18/05	1105
	4/18/05	1105	Marvin McCallum	4/18/05	11:05
Marvin McCallum	4/18/05	17:50	Jessica Bu	4/18/05	1750

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

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
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< 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

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

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. All other results are reported on an as-received basis.

U.S. EPA CLP 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 quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
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 sample 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.

Measurement uncertainty values, as applicable, are available upon request.

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:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 940043. Samples arrived at the laboratory on Tuesday, April 19, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description	Lancaster Labs Number
S188-041805 Grab Water Sample	4506528
S187-041805 Grab Water Sample	4506529
S116-041805 Grab Water Sample	4506530
S186-041805 Grab Water Sample	4506531
S46D-041805 Grab Water Sample	4506532
S185-041805 Grab Water Sample	4506533
S184-041805 Grab Water Sample	4506534
S183-041805 Grab Water Sample	4506535
S182-041805 Grab Water Sample	4506536

1 COPY TO	LL	Attn: Angela Miller
ELECTRONIC COPY TO	SUN: Aquaterra Tech.	Attn: Brad Spancake
ELECTRONIC COPY TO	Langan	Attn: Dennis Webster
1 COPY TO	Langan	Attn: Jason Hanna

Lancaster Laboratories

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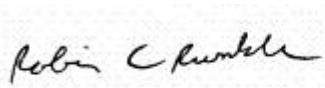
Analysis Report

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,



Robin C. Runkle
Senior Chemist

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4506528

S188-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 10:40 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:01
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-188

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	0.0063	0.0010	0.00018	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	0.038	0.029	0.0096	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	66.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	12.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	1,200.	50.	5.	ug/l	10
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	15.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	97.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	110.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	210.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:18	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 12:58	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/22/2005 15:03	Brian K Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 04:55	Seth J Good	10
02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 08:35	Andrea D Moore	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/21/2005 08:35	Andrea D Moore	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/21/2005 04:55	Seth J Good	n.a.

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4506528

S188-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 10:40 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:01
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-188

06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4506529

S187-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 11:05 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:01
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-187

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	0.0044	0.0010	0.00018	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.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 20.	20.	2.	ug/l	4
05401	Benzene	71-43-2	130.	20.	2.	ug/l	4
05402	1,2-Dichloroethane	107-06-2	< 20.	20.	4.	ug/l	4
05407	Toluene	108-88-3	< 20.	20.	3.	ug/l	4
05415	Ethylbenzene	100-41-4	< 20.	20.	3.	ug/l	4
05420	Isopropylbenzene	98-82-8	42.	20.	4.	ug/l	4
06310	Xylene (Total)	1330-20-7	30.	20.	3.	ug/l	4

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:21	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 13:28	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/22/2005 15:52	Brian K Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 05:20	Seth J Good	4
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/21/2005 05:20	Seth J Good	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4506529

S187-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 11:05 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:01
Discard: 06/09/2005

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500 Hyde Park
Doylestown PA 18901

S-187

07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4506530

S116-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 12:15 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:01
Discard: 06/09/2005

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Doylestown PA 18901

S-116

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	0.00018	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.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:23	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 14:28	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/22/2005 16:40	Brian K Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 05:44	Seth J Good	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/21/2005 05:44	Seth J Good	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4506530

S116-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 12:15 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:01
Discard: 06/09/2005

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500 Hyde Park
Doylestown PA 18901

S-116

07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4506531

S186-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 12:20 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:01
Discard: 06/09/2005

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Doylestown PA 18901

S-186

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	0.0021	0.0010	0.00018	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	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 10.	10.	1.	ug/l	2
05401	Benzene	71-43-2	47.	10.	1.	ug/l	2
05402	1,2-Dichloroethane	107-06-2	< 10.	10.	2.	ug/l	2
05407	Toluene	108-88-3	< 10.	10.	1.	ug/l	2
05415	Ethylbenzene	100-41-4	< 10.	10.	2.	ug/l	2
05420	Isopropylbenzene	98-82-8	49.	10.	2.	ug/l	2
06310	Xylene (Total)	1330-20-7	< 10.	10.	2.	ug/l	2

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:25	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 14:58	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/22/2005 18:38	Brian K Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 06:08	Seth J Good	2
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/21/2005 06:08	Seth J Good	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4506531

S186-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 12:20 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:01
Discard: 06/09/2005

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500 Hyde Park
Doylestown PA 18901

S-186

07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4506532

S46D-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 12:40 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:01
Discard: 06/09/2005

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S-46D

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	0.00018	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.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:28	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 15:27	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/22/2005 19:27	Brian K Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 07:46	Andrea D Moore	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/21/2005 07:46	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4506532

S46D-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 12:40 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:01
Discard: 06/09/2005

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500 Hyde Park
Doylestown PA 18901

S-46D

07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4506533

S185-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 12:40 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:01
Discard: 06/09/2005

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500 Hyde Park
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S-185

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	0.0063	0.0010	0.00018	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	560.	97.	10.	ug/l	10
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 50.	50.	5.	ug/l	10
05401	Benzene	71-43-2	850.	50.	5.	ug/l	10
05402	1,2-Dichloroethane	107-06-2	< 50.	50.	10.	ug/l	10
05407	Toluene	108-88-3	< 50.	50.	7.	ug/l	10
05415	Ethylbenzene	100-41-4	68.	50.	8.	ug/l	10
05420	Isopropylbenzene	98-82-8	50.	50.	10.	ug/l	10
06310	Xylene (Total)	1330-20-7	130.	50.	8.	ug/l	10

Due to the level of benzene, the reporting limits for all GC/MS volatile compounds were raised.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:30	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 15:57	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/22/2005 20:16	Brian K Graham	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/23/2005 10:24	Brian K Graham	10

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4506533

S185-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 12:40 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:01
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-185

02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 08:11	Andrea D Moore	10
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/21/2005 08:11	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4506534

S184-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 13:00 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:01
Discard: 06/09/2005

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500 Hyde Park
Doylestown PA 18901

S-184

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	0.0054	0.0010	0.00018	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	24.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 25.	25.	3.	ug/l	5
05401	Benzene	71-43-2	650.	25.	3.	ug/l	5
05402	1,2-Dichloroethane	107-06-2	< 25.	25.	5.	ug/l	5
05407	Toluene	108-88-3	< 25.	25.	4.	ug/l	5
05415	Ethylbenzene	100-41-4	< 25.	25.	4.	ug/l	5
05420	Isopropylbenzene	98-82-8	57.	25.	5.	ug/l	5
06310	Xylene (Total)	1330-20-7	46.	25.	4.	ug/l	5

Due to the level of benzene, the reporting limits for all GC/MS volatile compounds were raised.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:32	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 16:27	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/22/2005 21:05	Brian K Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 13:31	Andrea D Moore	5

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4506534

S184-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 13:00 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:01
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-184

01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/21/2005 13:31	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	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. WW 4506535

S183-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 13:30 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:01
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-183

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	0.0099	0.0010	0.00018	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	540.	97.	10.	ug/l	10
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	140.	130.	13.	ug/l	25
05401	Benzene	71-43-2	14,000.	1,000.	100.	ug/l	200
05402	1,2-Dichloroethane	107-06-2	< 130.	130.	25.	ug/l	25
05407	Toluene	108-88-3	130.	130.	18.	ug/l	25
05415	Ethylbenzene	100-41-4	< 130.	130.	20.	ug/l	25
05420	Isopropylbenzene	98-82-8	< 130.	130.	25.	ug/l	25
06310	Xylene (Total)	1330-20-7	290.	130.	20.	ug/l	25

Due to the level of benzene, the reporting limits for all GC/MS volatile compounds were raised.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:35	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 16:57	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/22/2005 21:53	Brian K Graham	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/23/2005 11:13	Brian K Graham	10

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4506535

S183-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 13:30 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:01
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-183

02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 09:00	Andrea D Moore	25
02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 09:24	Andrea D Moore	200
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/21/2005 09:00	Andrea D Moore	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/21/2005 09:24	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4506536

S182-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 13:45 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:02
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-182

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	0.0110	0.0010	0.00018	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	240.	97.	10.	ug/l	10
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	340.	100.	10.	ug/l	20
05401	Benzene	71-43-2	12,000.	500.	50.	ug/l	100
05402	1,2-Dichloroethane	107-06-2	< 100.	100.	20.	ug/l	20
05407	Toluene	108-88-3	150.	100.	14.	ug/l	20
05415	Ethylbenzene	100-41-4	140.	100.	16.	ug/l	20
05420	Isopropylbenzene	98-82-8	120.	100.	20.	ug/l	20
06310	Xylene (Total)	1330-20-7	320.	100.	16.	ug/l	20

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:37	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 17:27	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/22/2005 22:42	Brian K Graham	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4506536

S182-041805 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/18/2005 13:45 by MBS

Account Number: 10132

Submitted: 04/19/2005 18:10
Reported: 05/09/2005 at 14:02
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-182

07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/23/2005 12:02	Brian K Graham	10
02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 09:49	Andrea D Moore	20
02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 10:13	Andrea D Moore	100
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/21/2005 09:49	Andrea D Moore	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/21/2005 10:13	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	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: Langan Group Number: 940043
Reported: 05/09/05 at 02:02 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: 051110012A	Sample number(s): 4506528-4506536								
Ethylene dibromide	< 0.030	0.030	0.010	ug/l	92	92	60-140	0	20
Batch number: 05111WAE026	Sample number(s): 4506528-4506536								
Naphthalene	< 10.	10.	1.	ug/l	85	91	58-108	6	30
Fluorene	< 10.	10.	1.	ug/l	89	91	61-116	1	30
Phenanthrene	< 10.	10.	1.	ug/l	92	94	68-111	2	30
Pyrene	< 10.	10.	1.	ug/l	88	94	68-114	7	30
Chrysene	< 10.	10.	1.	ug/l	87	94	70-111	8	30
Batch number: 051186050001A	Sample number(s): 4506528-4506536								
Lead	< 0.0010	0.0010	0.00018	mg/l	99		80-120		
Batch number: T051101AB	Sample number(s): 4506528-4506531								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	96	96	77-127	0	30
Benzene	< 5.	5.	0.5	ug/l	100	102	85-117	2	30
1,2-Dichloroethane	< 5.	5.	1.	ug/l	100	102	77-132	2	30
Toluene	< 5.	5.	0.7	ug/l	99	103	85-115	4	30
Ethylbenzene	< 5.	5.	0.8	ug/l	95	100	82-119	5	30
Isopropylbenzene	< 5.	5.	1.	ug/l	97	102	80-120	5	30
Xylene (Total)	< 5.	5.	0.8	ug/l	96	99	83-113	3	30
Batch number: T051111AA	Sample number(s): 4506532-4506536								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	101	100	77-127	1	30
Benzene	< 5.	5.	0.5	ug/l	105	106	85-117	1	30
1,2-Dichloroethane	< 5.	5.	1.	ug/l	111	107	77-132	3	30
Toluene	< 5.	5.	0.7	ug/l	104	104	85-115	1	30
Ethylbenzene	< 5.	5.	0.8	ug/l	100	98	82-119	2	30
Isopropylbenzene	< 5.	5.	1.	ug/l	99	98	80-120	2	30
Xylene (Total)	< 5.	5.	0.8	ug/l	98	98	83-113	1	30

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: 051110012A	Sample number(s): 4506528-4506536								
Ethylene dibromide	96		65-135			< 0.029	< 0.029	0 (1)	30
Batch number: 051186050001A	Sample number(s): 4506528-4506536								
Lead	97	97	75-125	0	20	< 0.0010	< 0.0010	12 (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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 940043
Reported: 05/09/05 at 02:02 PM

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: T051101AB	Sample number(s): 4506528-4506531								
Methyl Tertiary Butyl Ether	99		69-134						
Benzene	109		83-128						
1,2-Dichloroethane	114		73-136						
Toluene	107		83-127						
Ethylbenzene	97		82-129						
Isopropylbenzene	96		81-130						
Xylene (Total)	97		82-130						
Batch number: T051111AA	Sample number(s): 4506532-4506536								
Methyl Tertiary Butyl Ether	101		69-134						
Benzene	113		83-128						
1,2-Dichloroethane	110		73-136						
Toluene	110		83-127						
Ethylbenzene	105		82-129						
Isopropylbenzene	105		81-130						
Xylene (Total)	104		82-130						

Surrogate Quality Control

Analysis Name: EDB in Wastewater
Batch number: 051110012A

	1,1,2,2-Tetrachloroethane
4506528	90
4506529	80
4506530	96
4506531	82
4506532	109
4506533	97
4506534	93
4506535	90
4506536	104
Blank	103
DUP	82
LCS	100
LCSD	100
MS	101
Limits:	52-120

Analysis Name: PAHs in Water by GC/MS
Batch number: 05111WAE026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4506528	86	87	103
4506529	91	94	114
4506530	79	80	95
4506531	94	89	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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 940043
Reported: 05/09/05 at 02:02 PM

Surrogate Quality Control

4506532	89	83	107
4506533	85	87	108
4506534	92	91	109
4506535	99	94	115
4506536	85	75	101
Blank	89	92	109
LCS	87	91	110
LCSD	93	91	111
Limits:	51-123	64-112	48-125

Analysis Name: UST-Waters by 8260B
Batch number: T051101AB

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4506528	94	90	96	104
4506529	100	89	94	102
4506530	98	86	92	98
4506531	99	90	96	106
Blank	100	89	93	100
LCS	93	93	95	99
LCSD	91	91	97	101
MS	94	88	95	103
Limits:	81-120	82-112	85-112	83-113

Analysis Name: UST-Waters by 8260B
Batch number: T051111AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4506532	93	88	94	98
4506533	97	90	95	101
4506534	98	90	93	102
4506535	90	89	95	99
4506536	95	93	95	100
Blank	100	89	93	100
LCS	93	92	95	101
LCSD	93	91	95	99
MS	93	89	95	102
Limits:	81-120	82-112	85-112	83-113

*- 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 background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

Acct. # 10132 | For Lancaster Laboratories use only Group# 940043 Sample # 4506528-36

COC # 0082438

Please print. Instructions on reverse side correspond with circled numbers. Cooler temp 2.4-3.1°C

(1) Client: Sun-Aquaterra Acct. #:
Project Name/#: Sun-Philadelphia Refinery AOI-1 PWSID #:
Project Manager: K. Martin / J. Hanna (Langan) P.O.#:
Sampler: M. Brad Spancake / Mike Hinderliter Quote #:
Name of state where samples were collected: PA

(4) Matrix: Drinking Water, Groundwater, Wastewater, Soil, Other

(5) Analyses Requested: 8260B BTEX, MTBE, Chlorinated Solvents, EDC; 8011 EDB; Dissolved Pb; 8270 Fluorene, Phenanthrene, Pyrene, Chrysene, Naphthalene

For Lab Use Only
FSC:
SCR #:

(6) Preservation Codes (H=HCl, N=HNO3, T=Thiosulfate, B=NaOH, S=H2SO4, O=Other)

(2) Sample Identification	Date Collected	Time Collected	(3) Grab	Composite	Matrix: Soil	Matrix: Other	Total # of Containers	Remarks
S188-041805	4-18-05	10:40	X			X	8	Dissolved Pb samples are unfiltered/unpreserved
S187-041805	4-18-05	1105	X			X	8	
S116-041805	4-18-05	1215	X			X	8	
S186-041805	4-18-05	1220	X			X	8	
S160-041805	4-18-05	1240	X			X	8	
S185-041805	4-18-05	1240	X			X	8	
S184041805	4-18-05	1300	X			X	8	
S183-041805	4-18-05	1330	X			X	8	
S182-041805	4-1805	1345	X			X	8	

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and ~~surcharge~~.)
Date results are needed: 4/29/05
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address: jhanna@Langan.com, bs@aquaterratech.com

(8) **Data Package Options** (please circle if required)
QC Summary
Type I (Tier I)
Type II (Tier II)
Type III (NJ Red. Del.)
Type IV (CLP)
Type VI (Raw Data)
GLP
Other
SDG Complete? Yes (No)
Site-specific QC required? Yes (No)
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes (No)

Relinquished by:	Date	Time	Received by:	Date	Time
M. Brad	4/18/05	1600	Aquaterra Envelope	4/18/05	1600
AT FRIDGE	4/19/05	1140	Dan Hildebrand	4/19/05	1140
Dan Hildebrand	4/19/05	1110	Marvin McCallister	4/19/05	11:40
Marvin McCallister	4/19/05	18:10			
			Jessica	4/19/05	1810

(9)

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

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
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< 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

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

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. All other results are reported on an as-received basis.

U.S. EPA CLP 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 quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
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 sample 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.

Measurement uncertainty values, as applicable, are available upon request.

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:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 940192. Samples arrived at the laboratory on Wednesday, April 20, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description	Lancaster Labs Number
S181-041905 Grab Water Sample	4507358
S202-041905 Grab Water Sample	4507359
S204-041905 Grab Water Sample	4507360
S206-041905 Grab Water Sample	4507361
S207-041905 Grab Water Sample	4507362
S-52-041905 Grab Water Sample	4507363
S51-041905 Grab Water Sample	4507364
S215-041905 Grab Water Sample	4507365
S180-041905 Grab Water Sample	4507366
S84-041905 Grab Water Sample	4507367
S179-041905 Grab Water Sample	4507368
S125-041905 Grab Water Sample	4507369

1 COPY TO	LL	Attn: Angela Miller
ELECTRONIC COPY TO	SUN: Aquaterra Tech.	Attn: Brad Spancake
ELECTRONIC COPY TO	Langan	Attn: Dennis Webster
1 COPY TO	Langan	Attn: Jason Hanna

Lancaster Laboratories

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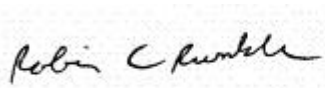
Analysis Report

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,



Robin C. Runkle
Senior Chemist

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Analysis Report

Lancaster Laboratories Sample No. WW 4507358

S181-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 12:40 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:01
Discard: 05/30/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-181

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	0.0014	0.0010	0.00018	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	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	240.	50.	5.	ug/l	10
05401	Benzene	71-43-2	460.	50.	5.	ug/l	10
05402	1,2-Dichloroethane	107-06-2	< 50.	50.	10.	ug/l	10
05407	Toluene	108-88-3	< 50.	50.	7.	ug/l	10
05415	Ethylbenzene	100-41-4	< 50.	50.	8.	ug/l	10
05420	Isopropylbenzene	98-82-8	< 50.	50.	10.	ug/l	10
06310	Xylene (Total)	1330-20-7	95.	50.	8.	ug/l	10

Due to the benzene, the reporting limits for all GC/MS volatile compounds were raised.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:39	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 17:57	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/22/2005 23:31	Brian K Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 21:57	Emiley A King	10

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507358

S181-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 12:40 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:01
Discard: 05/30/2005

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500 Hyde Park
Doylestown PA 18901

S-181

01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/21/2005 21:57	Emiley A King	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507359

S202-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 14:15 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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500 Hyde Park
Doylestown PA 18901

S-202

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	0.0049	0.0010	0.00018	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	94.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	130.	100.	10.	ug/l	20
05401	Benzene	71-43-2	1,400.	100.	10.	ug/l	20
05402	1,2-Dichloroethane	107-06-2	< 100.	100.	20.	ug/l	20
05407	Toluene	108-88-3	1,600.	100.	14.	ug/l	20
05415	Ethylbenzene	100-41-4	350.	100.	16.	ug/l	20
05420	Isopropylbenzene	98-82-8	< 100.	100.	20.	ug/l	20
06310	Xylene (Total)	1330-20-7	1,700.	100.	16.	ug/l	20

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:46	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 18:57	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/23/2005 00:20	Brian K Graham	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507359

S202-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 14:15 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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500 Hyde Park
Doylestown PA 18901

S-202

02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 22:22	Emiley A King	20
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/21/2005 22:22	Emiley A King	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507360

S204-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 13:15 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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500 Hyde Park
Doylestown PA 18901

S-204

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	0.0064	0.0010	0.00018	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	290.	96.	10.	ug/l	10
03956	Fluorene	86-73-7	11.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	21.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	370,000.	10,000.	1,000.	ug/l	2000
05401	Benzene	71-43-2	26,000.	10,000.	1,000.	ug/l	2000
05402	1,2-Dichloroethane	107-06-2	< 10,000.	10,000.	2,000.	ug/l	2000
05407	Toluene	108-88-3	< 10,000.	10,000.	1,400.	ug/l	2000
05415	Ethylbenzene	100-41-4	< 10,000.	10,000.	1,600.	ug/l	2000
05420	Isopropylbenzene	98-82-8	< 10,000.	10,000.	2,000.	ug/l	2000
06310	Xylene (Total)	1330-20-7	< 10,000.	10,000.	1,600.	ug/l	2000

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:49	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 20:27	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/23/2005 01:08	Brian K Graham	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507360

S204-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 13:15 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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Doylestown PA 18901

S-204

07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/23/2005 12:51	Brian K Graham	10
02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 22:46	Emiley A King	2000
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/21/2005 22:46	Emiley A King	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507361

S206-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 13:55 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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500 Hyde Park
Doylestown PA 18901

S-206

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	0.00018	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.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	76.	25.	3.	ug/l	5
05401	Benzene	71-43-2	52.	25.	3.	ug/l	5
05402	1,2-Dichloroethane	107-06-2	< 25.	25.	5.	ug/l	5
05407	Toluene	108-88-3	< 25.	25.	4.	ug/l	5
05415	Ethylbenzene	100-41-4	< 25.	25.	4.	ug/l	5
05420	Isopropylbenzene	98-82-8	29.	25.	5.	ug/l	5
06310	Xylene (Total)	1330-20-7	< 25.	25.	4.	ug/l	5

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:51	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 20:57	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/23/2005 01:57	Brian K Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 23:11	Emiley A King	5
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/21/2005 23:11	Emiley A King	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4507361

S206-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 13:55 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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500 Hyde Park
Doylestown PA 18901

S-206

07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507362

S207-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 13:35 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-207

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	0.00018	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.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	10.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	25.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:54	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 21:27	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/23/2005 02:46	Brian K Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 23:35	Emiley A King	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/21/2005 23:35	Emiley A King	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507362

S207-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 13:35 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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500 Hyde Park
Doylestown PA 18901

S-207

07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507363

S-52-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 14:45 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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500 Hyde Park
Doylestown PA 18901

S--52

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	0.00018	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.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	1,200.	50.	5.	ug/l	10
05401	Benzene	71-43-2	230.	50.	5.	ug/l	10
05402	1,2-Dichloroethane	107-06-2	< 50.	50.	10.	ug/l	10
05407	Toluene	108-88-3	< 50.	50.	7.	ug/l	10
05415	Ethylbenzene	100-41-4	< 50.	50.	8.	ug/l	10
05420	Isopropylbenzene	98-82-8	< 50.	50.	10.	ug/l	10
06310	Xylene (Total)	1330-20-7	< 50.	50.	8.	ug/l	10

Due to the level of methyl tertiary butyl ether, the reporting limits for all GC/MS volatile compounds were raised.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:56	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 21:57	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/23/2005 03:34	Brian K Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/21/2005 23:59	Emiley A King	10

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4507363

S-52-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 14:45 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

Langan
500 Hyde Park
Doylestown PA 18901

S--52

01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/21/2005 23:59	Emiley A King	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4507364

S51-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 15:00 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

Langan
500 Hyde Park
Doylestown PA 18901

S--51

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	0.00018	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	15.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	1,900.	100.	10.	ug/l	20
05401	Benzene	71-43-2	590.	100.	10.	ug/l	20
05402	1,2-Dichloroethane	107-06-2	< 100.	100.	20.	ug/l	20
05407	Toluene	108-88-3	< 100.	100.	14.	ug/l	20
05415	Ethylbenzene	100-41-4	< 100.	100.	16.	ug/l	20
05420	Isopropylbenzene	98-82-8	< 100.	100.	20.	ug/l	20
06310	Xylene (Total)	1330-20-7	190.	100.	16.	ug/l	20

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	3	04/28/2005 23:58	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 22:27	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/27/2005 23:33	Linda M Hartenstine	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507364

S51-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 15:00 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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Doylestown PA 18901

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02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 00:24	Emiley A King	20
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/22/2005 00:24	Emiley A King	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	2	04/26/2005 11:45	Andrew G Newton	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507365

S215-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 15:15 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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S215-

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	0.0447	0.0010	0.00018	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	2,200.	500.	50.	ug/l	50
03956	Fluorene	86-73-7	53.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	87.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	13.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	51,000.	2,500.	250.	ug/l	500
05401	Benzene	71-43-2	29,000.	2,500.	250.	ug/l	500
05402	1,2-Dichloroethane	107-06-2	< 2,500.	2,500.	500.	ug/l	500
05407	Toluene	108-88-3	29,000.	2,500.	350.	ug/l	500
05415	Ethylbenzene	100-41-4	3,300.	2,500.	400.	ug/l	500
05420	Isopropylbenzene	98-82-8	< 2,500.	2,500.	500.	ug/l	500
06310	Xylene (Total)	1330-20-7	19,000.	2,500.	400.	ug/l	500

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	3	04/29/2005 00:01	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 22:57	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/23/2005 05:12	Brian K Graham	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507365

S215-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 15:15 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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Doylestown PA 18901

S215-

07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/23/2005 13:40	Brian K Graham	50
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 00:48	Emiley A King	500
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/22/2005 00:48	Emiley A King	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 10:25	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507366

S180-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 15:45 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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Doylestown PA 18901

S-180

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	0.00022	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	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	3	04/28/2005 23:45	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 23:27	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/23/2005 09:35	Brian K Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 01:14	Emiley A King	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/22/2005 01:14	Emiley A King	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 11:05	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4507366

S180-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 15:45 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507367

S84-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 15:30 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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Doylestown PA 18901

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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	0.00022	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	420.	98.	10.	ug/l	10
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 20.	20.	2.	ug/l	4
05401	Benzene	71-43-2	72.	20.	2.	ug/l	4
05402	1,2-Dichloroethane	107-06-2	< 20.	20.	4.	ug/l	4
05407	Toluene	108-88-3	< 20.	20.	3.	ug/l	4
05415	Ethylbenzene	100-41-4	140.	20.	3.	ug/l	4
05420	Isopropylbenzene	98-82-8	160.	20.	4.	ug/l	4
06310	Xylene (Total)	1330-20-7	4,800.	100.	16.	ug/l	20

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	3	04/28/2005 23:48	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 23:57	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/23/2005 21:42	Linda M Hartenstine	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507367

S84-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 15:30 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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Doylestown PA 18901

S--84

07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/24/2005 15:29	Jolene M Graham	10
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 01:39	Emiley A King	20
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 04:58	Seth J Good	4
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/22/2005 04:58	Seth J Good	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/22/2005 01:39	Emiley A King	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 11:05	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507368

S179-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 15:50 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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500 Hyde Park
Doylestown PA 18901

S-179

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	0.00022	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	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	110.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	3	04/28/2005 23:55	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/27/2005 00:27	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/23/2005 19:48	Linda M Hartenstine	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 02:03	Emiley A King	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/22/2005 02:03	Emiley A King	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 11:05	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4507368

S179-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 15:50 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507369

S125-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 15:30 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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500 Hyde Park
Doylestown PA 18901

S-125

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	0.0068	0.0010	0.00022	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	160.	48.	5.	ug/l	5
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	11,000.	500.	50.	ug/l	100
05401	Benzene	71-43-2	17,000.	500.	50.	ug/l	100
05402	1,2-Dichloroethane	107-06-2	< 50.	50.	10.	ug/l	10
05407	Toluene	108-88-3	180.	50.	7.	ug/l	10
05415	Ethylbenzene	100-41-4	250.	50.	8.	ug/l	10
05420	Isopropylbenzene	98-82-8	61.	50.	10.	ug/l	10
06310	Xylene (Total)	1330-20-7	920.	50.	8.	ug/l	10

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:57	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/27/2005 04:56	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/23/2005 20:45	Linda M Hartenstine	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4507369

S125-041905 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/19/2005 15:30 by MH

Account Number: 10132

Submitted: 04/20/2005 14:15
Reported: 04/29/2005 at 13:02
Discard: 05/30/2005

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Doylestown PA 18901

S-125

07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/24/2005 14:33	Jolene M Graham	5
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 05:06	Dawn M Harle	10
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 09:38	Dawn M Harle	100
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/22/2005 05:06	Dawn M Harle	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/22/2005 09:38	Dawn M Harle	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 11:05	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/22/2005 11:45	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/21/2005 17:45	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Quality Control Summary

Client Name: Langan Group Number: 940192
Reported: 04/29/05 at 01:02 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: 051110012A	Sample number(s): 4507358-4507368								
Ethylene dibromide	< 0.030	0.030	0.010	ug/l	92	92	60-140	0	20
Batch number: 051110013A	Sample number(s): 4507369								
Ethylene dibromide	< 0.030	0.030	0.010	ug/l	104	104	60-140	0	20
Batch number: 05111WAE026	Sample number(s): 4507358-4507363,4507365-4507366								
Naphthalene	< 10.	10.	1.	ug/l	85	91	58-108	6	30
Fluorene	< 10.	10.	1.	ug/l	89	91	61-116	1	30
Phenanthrene	< 10.	10.	1.	ug/l	92	94	68-111	2	30
Pyrene	< 10.	10.	1.	ug/l	88	94	68-114	7	30
Chrysene	< 10.	10.	1.	ug/l	87	94	70-111	8	30
Batch number: 05111WAF026	Sample number(s): 4507367-4507369								
Naphthalene	< 10.	10.	1.	ug/l	86	86	58-108	0	30
Fluorene	< 10.	10.	1.	ug/l	93	90	61-116	3	30
Phenanthrene	< 10.	10.	1.	ug/l	89	92	68-111	3	30
Pyrene	< 10.	10.	1.	ug/l	81	85	68-114	5	30
Chrysene	< 10.	10.	1.	ug/l	85	90	70-111	5	30
Batch number: 05115WAF026	Sample number(s): 4507364								
Naphthalene	< 10.	10.	1.	ug/l	69	77	58-108	11	30
Fluorene	< 10.	10.	1.	ug/l	87	89	61-116	2	30
Phenanthrene	< 10.	10.	1.	ug/l	92	96	68-111	4	30
Pyrene	< 10.	10.	1.	ug/l	95	94	68-114	2	30
Chrysene	< 10.	10.	1.	ug/l	96	96	70-111	0	30
Batch number: 051186050001A	Sample number(s): 4507358-4507365								
Lead	< 0.0010	0.0010	0.00018	mg/l	99		80-120		
Batch number: 051186050002A	Sample number(s): 4507366-4507369								
Lead	< 0.0010	0.0010	0.00022	mg/l	101		80-120		
Batch number: T051112AA	Sample number(s): 4507358-4507368								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	105	103	77-127	3	30
Benzene	< 5.	5.	0.5	ug/l	110	104	85-117	6	30
1,2-Dichloroethane	< 5.	5.	1.	ug/l	114	111	77-132	2	30
Toluene	< 5.	5.	0.7	ug/l	105	100	85-115	4	30
Ethylbenzene	< 5.	5.	0.8	ug/l	97	95	82-119	3	30
Isopropylbenzene	< 5.	5.	1.	ug/l	99	95	80-120	4	30
Xylene (Total)	< 5.	5.	0.8	ug/l	99	94	83-113	5	30
Batch number: T051121AA	Sample number(s): 4507367								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	102	101	77-127	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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 940192
Reported: 04/29/05 at 01:02 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
Benzene	< 5.	5.	0.5	ug/l	105	103	85-117	1	30
1,2-Dichloroethane	< 5.	5.	1.	ug/l	110	107	77-132	2	30
Toluene	< 5.	5.	0.7	ug/l	102	101	85-115	1	30
Ethylbenzene	< 5.	5.	0.8	ug/l	97	96	82-119	1	30
Isopropylbenzene	< 5.	5.	1.	ug/l	96	96	80-120	0	30
Batch number: Y051111AB	Sample number(s): 4507369								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	115		77-127		
Benzene	< 5.	5.	0.5	ug/l	116		85-117		
1,2-Dichloroethane	< 5.	5.	1.	ug/l	105		77-132		
Toluene	< 5.	5.	0.7	ug/l	110		85-115		
Ethylbenzene	< 5.	5.	0.8	ug/l	108		82-119		
Isopropylbenzene	< 5.	5.	1.	ug/l	107		80-120		
Xylene (Total)	< 5.	5.	0.8	ug/l	107		83-113		

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: 051110012A	Sample number(s): 4507358-4507368								
Ethylene dibromide	96		65-135			< 0.029	< 0.029	0 (1)	30
Batch number: 051110013A	Sample number(s): 4507369								
Ethylene dibromide	104		65-135			< 0.029	< 0.029	0 (1)	30
Batch number: 051186050001A	Sample number(s): 4507358-4507365								
Lead	97	97	75-125	0	20	< 0.0010	< 0.0010	12 (1)	20
Batch number: 051186050002A	Sample number(s): 4507366-4507369								
Lead	108	105	75-125	2	20	< 0.0010	< 0.0010	5 (1)	20
Batch number: T051112AA	Sample number(s): 4507358-4507368								
Methyl Tertiary Butyl Ether	102		69-134						
Benzene	110		83-128						
1,2-Dichloroethane	119		73-136						
Toluene	111		83-127						
Ethylbenzene	99		82-129						
Isopropylbenzene	100		81-130						
Xylene (Total)	100		82-130						
Batch number: T051121AA	Sample number(s): 4507367								
Methyl Tertiary Butyl Ether	101		69-134						
Benzene	110		83-128						
1,2-Dichloroethane	109		73-136						
Toluene	109		83-127						
Ethylbenzene	104		82-129						
Isopropylbenzene	104		81-130						
Batch number: Y051111AB	Sample number(s): 4507369								
Methyl Tertiary Butyl Ether	102	130	69-134	24	30				
Benzene	109	138*	83-128	23	30				

*- Outside of specification
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(1) The result for one or both determinations was less than five times the LOQ.
(2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 940192
Reported: 04/29/05 at 01:02 PM

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
1,2-Dichloroethane	96	121	73-136	23	30				
Toluene	105	130*	83-127	22	30				
Ethylbenzene	102	128	82-129	23	30				
Isopropylbenzene	102	130	81-130	24	30				
Xylene (Total)	101	127	82-130	23	30				

Surrogate Quality Control

Analysis Name: EDB in Wastewater
Batch number: 051110012A

	1,1,2,2-Tetrachloroethane
4507358	100
4507359	79
4507360	80
4507361	90
4507362	113
4507363	108
4507364	79
4507365	66
4507366	101
4507367	80
4507368	109
Blank	103
DUP	82
LCS	100
LCSD	100
MS	101
Limits:	52-120

Analysis Name: EDB in Wastewater
Batch number: 051110013A

	1,1,2,2-Tetrachloroethane
4507369	100
Blank	116
DUP	94
LCS	112
LCSD	113
MS	121*
Limits:	52-120

Analysis Name: PAHs in Water by GC/MS
Batch number: 05111WAE026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4507358	90	89	114

*- Outside of specification
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(2) The background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 940192
Reported: 04/29/05 at 01:02 PM

Surrogate Quality Control

4507359	94	87	113
4507360	96	86	109
4507361	99	82	116
4507362	97	94	112
4507363	92	92	111
4507365	51	88	112
4507366	96	92	110
Blank	89	92	109
LCS	87	91	110
LCSD	93	91	111
Limits:	51-123	64-112	48-125

Analysis Name: PAHs in Water by GC/MS
Batch number: 05111WAF026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4507367	93	96	120
4507368	93	93	110
4507369	93	95	115
Blank	87	97	109
LCS	90	93	108
LCSD	89	96	105
Limits:	51-123	64-112	48-125

Analysis Name: PAHs in Water by GC/MS
Batch number: 05115WAF026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4507364	89	83	114
Blank	91	82	124
LCS	86	83	120
LCSD	91	85	118
Limits:	51-123	64-112	53-135

Analysis Name: UST-Waters by 8260B
Batch number: T051112AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4507358	100	89	92	100
4507359	99	89	92	102
4507360	104	92	92	100
4507361	100	91	92	100
4507362	101	90	96	107
4507363	98	87	92	98
4507364	97	88	93	99
4507365	96	88	93	99
4507366	98	90	92	100
4507368	97	87	94	105
Blank	96	88	94	100
LCS	97	94	96	103
LCSD	93	90	94	101
MS	97	91	95	105
Limits:	81-120	82-112	85-112	83-113

*- 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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 940192
Reported: 04/29/05 at 01:02 PM

Surrogate Quality Control

Analysis Name: UST-Waters by 8260B
Batch number: T051121AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4507367	96	91	95	103
Blank	94	90	93	98
LCS	96	89	95	100
LCSD	94	91	94	101
MS	91	89	94	100
Limits:	81-120	82-112	85-112	83-113

Analysis Name: UST-Waters by 8260B
Batch number: Y051111AB

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4507369	91	93	93	92
Blank	90	92	95	91
LCS	92	97	93	91
MS	91	96	94	93
MSD	92	93	93	92
Limits:	81-120	82-112	85-112	83-113

*- 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 background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
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For Lancaster Laboratories use only
Acct. # 10132 Group# 940192 Sample # 4507358-69

COC # 0081263

Please print. Instructions on reverse side correspond with circled numbers. Cooler temp 3.9-4.8°C

(1) Client: Aquaterra / Sun Acct. #:
Project Name/#: Sun - Philly Refinery AOF-1 PWSID #:
Project Manager: Kevin Martin/Jason Hamm P.O.#:
Sampler: MH + MBS Quote #:
Name of state where samples were collected: PA

(4) Matrix: Soil, Water, Other

(5) Analyses Requested: 8260B BTEX, MTBE, Cumene; EDC; 8011 EDB; 6020 Dissolved Pb; 8270C Fluorene, Phenanthrene, Naphthalene, Chrysene

For Lab Use Only
FSC:
SCR #:

(6) Remarks

(2) Sample Identification	Date Collected	Time Collected	(3) # of Containers	Grab	Composite	Soil	Water	Other	Preservation Codes
S181-041905	4-19-05	1240	X				X		8
S202-041905		1415	X				X		8
S204-041905		1315	X				X		8
S206-041905		1355	X				X		8
S207-041905		1335	X				X		8
S-52-041905		1445	X				X		8
351-041905		1500	X				X		8
S215-041905		1515	X				X		8
S180-041905		1545	X				X		8
S84-041905		1530	X				X		8

(7) **Turnaround Time Requested** (TAT) (please circle): (Normal) Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: 4/29/05
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
QC Summary, Type I (Tier I), Type II (Tier II), Type III (NJ Red. Del.), Type IV (CLP), Type VI (Raw Data), GLP, Other

SDG Complete? Yes (No)

Site-specific QC required? Yes (No)
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes (No)

Relinquished by:	Date	Time	Received by:	Date	Time
M. Bryson	4/20/05	1715	Aquaterra Fridge	4/19/05	1715
[illegible]	4/20/05	1115	P. Lefever	4/20/05	1115
P. Lefever	4/20/05	1415			
			Jessica B	4/20/05	1415

(9)

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.

2102 Rev. 10/27/02

Analysis Request / Environmental Services Chain of Custody

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For Lancaster Laboratories use only
Acct. # 10132 Group# 940192 Sample # 4507358-69

COC # 0086231

Please print. Instructions on reverse side correspond with circled numbers.

Cooler temp 3.9-4.8°C

(1) Client: Sun-Aquaterve Acct. #:
Project Name/#: Sun-Philadelphia Refinery AOI-1 PWSID #:
Project Manager: K. Martin / J. Hanna P.O.#:
Sampler: M. Brad Sparks 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: 8260B BTEX, MTBE, Cumene, EDC	8011 EDB	1020 Dissolved Pb	8270C Fluorene, Phenanthrene, Naphthalene	Chrysene, Pyrene, Naphthalene	Remarks	(6) Sample Specific Reporting Limits
S179-041905	4/19/05	1550	X					8							
S125-041905	4/19/05	1530	X			X		8	X	X	X	X	X		

For Lab Use Only
FSC:
SCR #:

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: 4/29/05
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
QC Summary Type VI (Raw Data)
Type I (Tier I) GLP
Type II (Tier II) Other
Type III (NJ Red. Del.)
Type IV (CLP)

SDG Complete? Yes (No)
Site-specific QC required? Yes (No)
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes (No)

Relinquished by:	Date	Time	Received by:	Date	Time
M. Brad Sparks	4/19/05	1715	Aquaterve Fridge	4/19/05	1715
AT FEDEX	4/20/05	1115	Ron Helmer	4/20/05	1115
Ron Helmer	4/20/05	1115	J. Lefever	4/20/05	1115
J. Lefever 4/20/05	4/20/05	1415			
			Jessica Bu	4/20/05	1415

(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 Rev. 10/27/02

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2425 New Holland Pike • Lancaster, PA 17601

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
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< 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

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

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. All other results are reported on an as-received basis.

U.S. EPA CLP 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 quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
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 sample 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.

Measurement uncertainty values, as applicable, are available upon request.

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:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 940417. Samples arrived at the laboratory on Thursday, April 21, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description	Lancaster Labs Number
S203-042005 Grab Water Sample	4508328
S214-042005 Grab Water Sample	4508329
S227-042005 Grab Water Sample	4508330
PZ402-042005 Grab Water Sample	4508331
S79P-042005 Grab Water Sample	4508332
S77P-042005 Grab Water Sample	4508333

ELECTRONIC COPY TO	Langan	Attn: Dennis Webster
1 COPY TO	Langan	Attn: Jason Hanna
ELECTRONIC COPY TO	SUN: Aquaterra Tech.	Attn: Brad Spancake
1 COPY TO	LL	Attn: Angela Miller

Lancaster Laboratories

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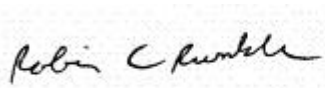
Analysis Report

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,



Robin C. Runkle
Senior Chemist

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4508328

S203-042005 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/20/2005 14:45 by MH

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/17/2005 at 09:14
Discard: 06/17/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-203

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	0.0044	0.0010	0.00022	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	25.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	11.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	17,000.	500.	50.	ug/l	100
05401	Benzene	71-43-2	940.	100.	10.	ug/l	20
05402	1,2-Dichloroethane	107-06-2	< 100.	100.	20.	ug/l	20
05407	Toluene	108-88-3	< 100.	100.	14.	ug/l	20
05415	Ethylbenzene	100-41-4	< 100.	100.	16.	ug/l	20
05420	Isopropylbenzene	98-82-8	< 100.	100.	20.	ug/l	20
06310	Xylene (Total)	1330-20-7	220.	100.	16.	ug/l	20

Due to the level of methyl tertiary butyl ether, the reporting limits for all GC/MS volatile compounds were raised.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/28/2005 23:59	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 04:32	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/12/2005 09:22	Brian K Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 11:03	Andrea D Moore	20
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 11:27	Andrea D Moore	100

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4508328

S203-042005 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/20/2005 14:45 by MH

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/17/2005 at 09:14
Discard: 06/17/2005

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500 Hyde Park
Doylestown PA 18901

S-203

01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/22/2005 11:03	Andrea D Moore	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/22/2005 11:27	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 11:05	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/25/2005 12:30	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	2	05/11/2005 17:50	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. WW 4508329

S214-042005 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/20/2005 15:10 by MH

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/17/2005 at 09:14
Discard: 06/17/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-214

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	0.00022	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	30.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	10.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	580.	25.	3.	ug/l	5
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	69.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	190.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	74.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	190.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/29/2005 00:01	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 05:01	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/09/2005 23:29	Jolene M Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 11:51	Andrea D Moore	5
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 14:18	Andrea D Moore	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/22/2005 14:18	Andrea D Moore	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/22/2005 11:51	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 11:05	Denise K Conners	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4508329

S214-042005 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/20/2005 15:10 by MH

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/17/2005 at 09:14
Discard: 06/17/2005

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500 Hyde Park
Doylestown PA 18901

S-214

07786	EDB Extraction	SW-846 8011	1	04/25/2005 12:30	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	05/08/2005 10:00	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. WW 4508330

S227-042005 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/20/2005 15:30 by MH

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/17/2005 at 09:14
Discard: 06/17/2005

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500 Hyde Park
Doylestown PA 18901

S-227

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	0.00022	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	100.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	18.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	47.	20.	2.	ug/l	4
05401	Benzene	71-43-2	750.	20.	2.	ug/l	4
05402	1,2-Dichloroethane	107-06-2	< 20.	20.	4.	ug/l	4
05407	Toluene	108-88-3	100.	20.	3.	ug/l	4
05415	Ethylbenzene	100-41-4	1,500.	50.	8.	ug/l	10
05420	Isopropylbenzene	98-82-8	210.	20.	4.	ug/l	4
06310	Xylene (Total)	1330-20-7	4,300.	50.	8.	ug/l	10

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/29/2005 00:04	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 05:31	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/10/2005 00:21	Jolene M Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 12:16	Andrea D Moore	10

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4508330

S227-042005 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/20/2005 15:30 by MH

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/17/2005 at 09:14
Discard: 06/17/2005

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S-227

02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 21:16	Emiley A King	4
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/22/2005 21:16	Emiley A King	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/22/2005 12:16	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 11:05	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/25/2005 12:30	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	05/08/2005 10:00	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. WW 4508331

PZ402-042005 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/20/2005 13:30 by MH

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/17/2005 at 09:14
Discard: 06/17/2005

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500 Hyde Park
Doylestown PA 18901

PZ402

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	0.0120	0.0010	0.00022	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	980.	98.	10.	ug/l	10
03956	Fluorene	86-73-7	< 98.	98.	10.	ug/l	10
03963	Phenanthrene	85-01-8	120.	98.	10.	ug/l	10
03967	Pyrene	129-00-0	< 98.	98.	10.	ug/l	10
03971	Chrysene	218-01-9	< 98.	98.	10.	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.

Surrogate recoveries were outside of QC limits for the GC/MS semivolatile compounds due to the dilution needed to perform the analysis.

02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	2,300.	200.	20.	ug/l	40
05401	Benzene	71-43-2	25,000.	1,000.	100.	ug/l	200
05402	1,2-Dichloroethane	107-06-2	< 200.	200.	40.	ug/l	40
05407	Toluene	108-88-3	300.	200.	28.	ug/l	40
05415	Ethylbenzene	100-41-4	2,200.	200.	32.	ug/l	40
05420	Isopropylbenzene	98-82-8	< 200.	200.	40.	ug/l	40
06310	Xylene (Total)	1330-20-7	3,700.	200.	32.	ug/l	40

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4508331

PZ402-042005 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/20/2005 13:30 by MH

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/17/2005 at 09:14
Discard: 06/17/2005

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PZ402

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/29/2005 00:06	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 06:01	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/10/2005 09:28	Joseph M Gambler	10
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 12:40	Andrea D Moore	40
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 13:05	Andrea D Moore	200
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/22/2005 12:40	Andrea D Moore	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/22/2005 13:05	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 11:05	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/25/2005 12:30	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	05/08/2005 10:00	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. WW 4508332

S79P-042005 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/20/2005 14:05 by MH

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/17/2005 at 09:14
Discard: 06/17/2005

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500 Hyde Park
Doylestown PA 18901

S-79P

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	0.00022	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.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	180.	20.	2.	ug/l	4
05401	Benzene	71-43-2	2,400.	100.	10.	ug/l	20
05402	1,2-Dichloroethane	107-06-2	< 20.	20.	4.	ug/l	4
05407	Toluene	108-88-3	< 20.	20.	3.	ug/l	4
05415	Ethylbenzene	100-41-4	< 20.	20.	3.	ug/l	4
05420	Isopropylbenzene	98-82-8	< 20.	20.	4.	ug/l	4
06310	Xylene (Total)	1330-20-7	29.	20.	3.	ug/l	4

Due to the level of benzene, the reporting limits for all GC/MS volatile compounds were raised.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/29/2005 00:08	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 06:31	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/10/2005 02:05	Jolene M Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 13:29	Andrea D Moore	20
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 13:53	Andrea D Moore	4

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4508332

S79P-042005 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/20/2005 14:05 by MH

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/17/2005 at 09:14
Discard: 06/17/2005

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500 Hyde Park
Doylestown PA 18901

S-79P

01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/22/2005 13:53	Andrea D Moore	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/22/2005 13:29	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 11:05	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/25/2005 12:30	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	05/08/2005 10:00	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. WW 4508333

S77P-042005 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/20/2005 15:45 by MH

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/17/2005 at 09:14
Discard: 06/17/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-77P

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	0.0030	0.0010	0.00022	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	110.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	15.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	23.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	10,000.	500.	50.	ug/l	100
05401	Benzene	71-43-2	17,000.	500.	50.	ug/l	100
05402	1,2-Dichloroethane	107-06-2	< 500.	500.	100.	ug/l	100
05407	Toluene	108-88-3	< 500.	500.	70.	ug/l	100
05415	Ethylbenzene	100-41-4	< 500.	500.	80.	ug/l	100
05420	Isopropylbenzene	98-82-8	< 500.	500.	100.	ug/l	100
06310	Xylene (Total)	1330-20-7	< 500.	500.	80.	ug/l	100

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	2	04/29/2005 00:11	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/26/2005 07:01	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/10/2005 02:57	Jolene M Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/22/2005 17:11	Emiley A King	100

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4508333

S77P-042005 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/20/2005 15:45 by MH

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/17/2005 at 09:14
Discard: 06/17/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-77P

01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/22/2005 17:11	Emiley A King	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/28/2005 11:05	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/25/2005 12:30	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	05/08/2005 10:00	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: Langan Group Number: 940417
Reported: 05/17/05 at 09:14 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: 051130007A	Sample number(s): 4508328-4508333								
Ethylene dibromide	< 0.030	0.030	0.010	ug/l	96	92	60-140	4	20
Batch number: 051186050002A	Sample number(s): 4508328-4508333								
Lead	< 0.0010	0.0010	0.00022	mg/l	101		80-120		
Batch number: 05126WAH026	Sample number(s): 4508329-4508333								
Naphthalene	< 10.	10.	1.	ug/l	80	83	58-108	3	30
Fluorene	< 10.	10.	1.	ug/l	87	91	61-116	4	30
Phenanthrene	< 10.	10.	1.	ug/l	96	97	68-111	1	30
Pyrene	< 10.	10.	1.	ug/l	98	98	68-114	0	30
Chrysene	< 10.	10.	1.	ug/l	93	93	70-111	0	30
Batch number: 05131WAD026	Sample number(s): 4508328								
Naphthalene	< 10.	10.	1.	ug/l	81	78	58-108	4	30
Fluorene	< 10.	10.	1.	ug/l	89	87	61-116	2	30
Phenanthrene	< 10.	10.	1.	ug/l	88	88	68-111	0	30
Pyrene	< 10.	10.	1.	ug/l	91	91	68-114	0	30
Chrysene	< 10.	10.	1.	ug/l	89	85	70-111	5	30
Batch number: T051121AA	Sample number(s): 4508328-4508332								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	102	101	77-127	0	30
Benzene	< 5.	5.	0.5	ug/l	105	103	85-117	1	30
1,2-Dichloroethane	< 5.	5.	1.	ug/l	110	107	77-132	2	30
Toluene	< 5.	5.	0.7	ug/l	102	101	85-115	1	30
Ethylbenzene	< 5.	5.	0.8	ug/l	97	96	82-119	1	30
Isopropylbenzene	< 5.	5.	1.	ug/l	96	96	80-120	0	30
Xylene (Total)	< 5.	5.	0.8	ug/l	96	96	83-113	1	30
Batch number: T051122AA	Sample number(s): 4508330,4508333								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	96	102	77-127	6	30
Benzene	< 5.	5.	0.5	ug/l	102	104	85-117	1	30
1,2-Dichloroethane	< 5.	5.	1.	ug/l	104	106	77-132	1	30
Toluene	< 5.	5.	0.7	ug/l	101	105	85-115	3	30
Ethylbenzene	< 5.	5.	0.8	ug/l	97	99	82-119	2	30
Isopropylbenzene	< 5.	5.	1.	ug/l	95	101	80-120	6	30
Xylene (Total)	< 5.	5.	0.8	ug/l	97	98	83-113	1	30

Sample Matrix Quality Control

MS	MSD	MS/MSD	RPD	BKG	DUP	DUP	Dup RPD

*- 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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 940417
Reported: 05/17/05 at 09:14 AM

Analysis Name	%REC	%REC	Limits	RPD	MAX	Conc	Conc	RPD	Max
Batch number: 051130007A	Sample number(s): 4508328-4508333								
Ethylene dibromide	104		65-135			< 0.028	< 0.028	0 (1)	30
Batch number: 051186050002A	Sample number(s): 4508328-4508333								
Lead	108	105	75-125	2	20	< 0.0010	< 0.0010	5 (1)	20
Batch number: T051121AA	Sample number(s): 4508328-4508332								
Methyl Tertiary Butyl Ether	101		69-134						
Benzene	110		83-128						
1,2-Dichloroethane	109		73-136						
Toluene	109		83-127						
Ethylbenzene	104		82-129						
Isopropylbenzene	104		81-130						
Xylene (Total)	103		82-130						
Batch number: T051122AA	Sample number(s): 4508330,4508333								
Methyl Tertiary Butyl Ether	92		69-134						
Benzene	103		83-128						
1,2-Dichloroethane	100		73-136						
Toluene	103		83-127						
Ethylbenzene	100		82-129						
Isopropylbenzene	101		81-130						
Xylene (Total)	99		82-130						

Surrogate Quality Control

Analysis Name: EDB in Wastewater
Batch number: 051130007A

	1,1,2,2-Tetrachloroethane
4508328	100
4508329	87
4508330	98
4508331	90
4508332	108
4508333	97
Blank	98
DUP	102
LCS	100
LCSD	99
MS	100
Limits:	52-120

Analysis Name: PAHs in Water by GC/MS
Batch number: 05126WAH026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4508329	94	90	113
4508330	108	93	113
4508331	156*	96	85
4508332	96	85	98
4508333	90	85	58

*- 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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 940417
Reported: 05/17/05 at 09:14 AM

Surrogate Quality Control

Blank	95	83	114	
LCS	92	87	114	
LCSD	93	88	116	
Limits:	51-123	64-112	53-135	

Analysis Name: PAHs in Water by GC/MS
Batch number: 05131WAD026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14	
4508328	80	75	104	
Blank	83	82	105	
LCS	82	89	107	
LCSD	79	82	106	
Limits:	51-123	64-112	53-135	

Analysis Name: UST-Waters by 8260B
Batch number: T051121AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4508328	101	91	92	101
4508329	94	89	96	106
4508331	94	89	96	102
4508332	95	87	93	100
Blank	94	90	93	98
LCS	96	89	95	100
LCSD	94	91	94	101
MS	91	89	94	100
Limits:	81-120	82-112	85-112	83-113

Analysis Name: UST-Waters by 8260B
Batch number: T051122AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4508330	95	90	96	104
4508333	92	91	93	99
Blank	90	89	96	101
LCS	94	92	95	101
LCSD	92	93	95	100
MS	91	89	95	102
Limits:	81-120	82-112	85-112	83-113

*- 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 background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

Acct. # 10132 Group # 940417 Sample # 4508328-33
940452 4508480

For Lancaster Laboratories use only

COC # 0081264

Please print. Instructions on reverse side correspond with circled numbers. cooler temp 3.4°C

(1) Client: Sun Aquaterra Acct. #:
Project Name/#: Sun-Philadelphia Refinery AOC-1 PWSID #:
Project Manager: K. Martin / J. Hanna P.O.#:
Sampler: MH & MBS Quote #:
Name of state where samples were collected: PA

(2) Sample Identification	Date Collected	Time Collected	(3) Grab	Composite	(4) Matrix: Soil	Water	Other	# of Containers	(5) Analyses Requested: 8260B BTEX, MTBE, Cumene; EDC; 8011 EDB; 6020 Dissolved Pb; 8270C Fluorene, Phenanthrene, Pyrene, Chrysene, Naphthalene	Remarks
S203-042005	4-20-05	1445	X			X		8		Dissolved Pb samples are unfiltered/unpreserved
S214-042005		1510	X			X		8		
S227-042005		1530	X			X		8		
PZ402-042005		1330	X			X		8		
S79P-042005		1405	X			X		8		
S77P-042005		1545	X			X		8		

For Lab Use Only
FSC:
SCR #: 1202447

(6) Preservation (please specify above)

(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)
QC Summary Type VI (Raw Data)
Type I (Tier I) GLP
Type II (Tier II) Other
Type III (NJ Red. Del.)
Type IV (CLP)

SDG Complete? Yes (No)
Site-specific QC required? Yes (No)
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes (No)

(9)

Relinquished by:	Date	Time	Received by:	Date	Time
	4/15/05	13:15	Marvin M Lollar	4/18/05	8:00
Marvin M Lollar	4/18/05	11:00	Aquaterra	4/18/05	1100
M Brad	4/20/05	1700	Aquaterra Fridge	4/20/05	1700
M Markegard			P. Lefever	4/21/05	1417
P. Lefever	4/21/05	1635	Jessica Bu	4/21/05	1635

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. # 10132 Group# 940417 Sample # 4508328-450833 **COC #** 0081320

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: Sun-Aquaterra/Langan Acct. #:
Project Name/#: Sun-Philadelphia Refinery AOI-1 PWSID #:
Project Manager: K. Martin / J. Manna P.O.#:
Sampler: M. Brad Spancake Quote #:
Name of state where samples were collected: PA

(2) Sample Identification	Date Collected	Time Collected	(3) # of containers: Grab	Composite	(4) Matrix: Soil	Water	Other	Total # of containers
S214-050505	5/5/05	1230	X		X			2
MS S77P-050505		1245	X		X			2
PZ402-050505		1300	X		X			2
S79P-050505		1315	X		X			2
S203-050505		1330	X		X			2
S227-050505		1345	X		X			2

(5) Analyses Requested: 8270 Fluorene, Phenanthrene, Chrysene, Pyrene, Naphthalene

For Lab Use Only
FSC:
SCR #: 1202668

(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)
QC Summary
Type I (Tier I)
Type II (Tier II)
Type III (NJ Red. Del.)
Type IV (CLP)
Type VI (Raw Data)
GLP
Other
SDG Complete? (Yes) No
Site-specific QC required? Yes (No)
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes (No)

(9)

Relinquished by:	Date	Time	Received by:	Date	Time
	4-30-05	1645	Aquaterra	4/30/05	1645
M. Brad Spancake	5/5/05	1746	Aquaterra Fridge	5/5/05	1746
	5/6/05	11:00		5/6/05	11:00
	5/6/05	18:05			
				5/6/05	1305

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

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
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< 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

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

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. All other results are reported on an as-received basis.

U.S. EPA CLP 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 quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
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 sample 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.

Measurement uncertainty values, as applicable, are available upon request.

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:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 940452. Samples arrived at the laboratory on Thursday, April 21, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description	Lancaster Labs Number
Trip_Blank Water Sample	4508480

1 COPY TO	LL	Attn: Angela Miller
ELECTRONIC COPY TO	SUN: Aquaterra Tech.	Attn: Brad Spancake
ELECTRONIC COPY TO	Langan	Attn: Jason Hanna
ELECTRONIC COPY TO	Langan	Attn: Dennis Webster

Lancaster Laboratories

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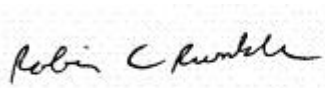
Analysis Report

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,



Robin C. Runkle
Senior Chemist

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4508480

Trip_Blank Water Sample
SUN: Philadelphia Refinery AOI-1

Collected: n.a.

Account Number: 10132

Submitted: 04/21/2005 16:35
Reported: 05/06/2005 at 10:48
Discard: 06/06/2005

Langan
500 Hyde Park
Doylestown PA 18901

PHLTB

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Limit of Quantitation*	As Received Method Detection Limit	Units	Dilution Factor
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

The sample for the GC/MS volatile analysis was received with headspace.

Commonwealth of Pennsylvania Lab Certification No. 36-037

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
02302	UST-Waters by 8260B	SW-846 8260B	1	04/23/2005 00:30	Andrea D Moore	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/23/2005 00:30	Andrea D Moore	n.a.

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Quality Control Summary

Client Name: Langan Group Number: 940452
Reported: 05/06/05 at 10:48 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: T051122AA	Sample number(s): 4508480								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	96	102	77-127	6	30
Benzene	< 5.	5.	0.5	ug/l	102	104	85-117	1	30
1,2-Dichloroethane	< 5.	5.	1.	ug/l	104	106	77-132	1	30
Toluene	< 5.	5.	0.7	ug/l	101	105	85-115	3	30
Ethylbenzene	< 5.	5.	0.8	ug/l	97	99	82-119	2	30
Isopropylbenzene	< 5.	5.	1.	ug/l	95	101	80-120	6	30
Xylene (Total)	< 5.	5.	0.8	ug/l	97	98	83-113	1	30

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: T051122AA	Sample number(s): 4508480								
Methyl Tertiary Butyl Ether	92		69-134						
Benzene	103		83-128						
1,2-Dichloroethane	100		73-136						
Toluene	103		83-127						
Ethylbenzene	100		82-129						
Isopropylbenzene	101		81-130						
Xylene (Total)	99		82-130						

Surrogate Quality Control

Analysis Name: UST-Waters by 8260B
Batch number: T051122AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4508480	94	91	95	99
Blank	90	89	96	101
LCS	94	92	95	101
LCSD	92	93	95	100
MS	91	89	95	102
Limits:	81-120	82-112	85-112	83-113

*- 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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 940452
Reported: 05/06/05 at 10:48 AM

*- 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 background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody

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For Lancaster Laboratories use only
Acct. # 10132 Group# 940417 Sample # 4508328-33
940452 4508480

COC # 0081264

Please print. Instructions ~~on reverse side correspond with circled numbers.~~ cooler temp 3.4°C

(1) Client: Sun Aquaterra Acct. #:
Project Name/#: Sun Philadelphia Refinery AOC-1 PWSID #:
Project Manager: K Martin / J. Hanna P.O.#:
Sampler: MH & MBS Quote #:
Name of state where samples were collected: PA

(3)

(4)

(5)

| (2) | | |

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

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
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< 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

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

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. All other results are reported on an as-received basis.

U.S. EPA CLP 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 quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
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 sample 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.

Measurement uncertainty values, as applicable, are available upon request.

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:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 940597. Samples arrived at the laboratory on Friday, April 22, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description	Lancaster Labs Number
S88-042105 Grab Water Sample	4509406
S43-042105 Grab Water Sample	4509407
S44-042105 Grab Water Sample	4509408
S46-042105 Grab Water Sample	4509409
S47D-042105 Grab Water Sample	4509410

ELECTRONIC COPY TO	SUN: Aquaterra Tech.	Attn: Brad Spancake
1 COPY TO	LL	Attn: Angela Miller
ELECTRONIC COPY TO	Langan	Attn: Dennis Webster
1 COPY TO	Langan	Attn: Jason Hanna

Lancaster Laboratories

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Analysis Report

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,

Michele A. Jarosick
Senior Chemist, Coordinator

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4509406

S88-042105 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/21/2005 13:00 by MH

Account Number: 10132

Submitted: 04/22/2005 14:25
Reported: 05/06/2005 at 09:32
Discard: 06/06/2005

Langan
500 Hyde Park
Doylestown PA 18901

S--88

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	0.0015	0.0010	0.00021	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	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	17.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	18.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	590.	50.	5.	ug/l	10
05401	Benzene	71-43-2	28.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	12.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/05/2005 22:07	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/27/2005 13:26	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/28/2005 02:39	Linda M Hartenstine	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/26/2005 17:16	Shawn J Rice	10
02302	UST-Waters by 8260B	SW-846 8260B	1	04/27/2005 12:06	Shawn J Rice	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/27/2005 12:06	Shawn J Rice	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/26/2005 17:16	Shawn J Rice	n.a.

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4509406

S88-042105 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/21/2005 13:00 by MH

Account Number: 10132

Submitted: 04/22/2005 14:25
Reported: 05/06/2005 at 09:32
Discard: 06/06/2005

Langan
500 Hyde Park
Doylestown PA 18901

S--88

06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 15:14	Megersa Deyessa	1
07786	EDB Extraction	SW-846 8011	1	04/25/2005 12:30	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/26/2005 11:45	Andrew G Newton	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4509407

S43-042105 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/21/2005 12:40 by MH

Account Number: 10132

Submitted: 04/22/2005 14:25
Reported: 05/06/2005 at 09:32
Discard: 06/06/2005

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500 Hyde Park
Doylestown PA 18901

S--43

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	0.00021	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	28.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	10.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	940.	50.	5.	ug/l	10
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	41.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	160.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	42.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	98.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/05/2005 22:10	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/27/2005 13:56	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/28/2005 02:59	Linda M Hartenstine	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/26/2005 17:38	Shawn J Rice	10
02302	UST-Waters by 8260B	SW-846 8260B	1	04/27/2005 12:32	Shawn J Rice	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/27/2005 12:32	Shawn J Rice	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/26/2005 17:38	Shawn J Rice	n.a.

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4509407

S43-042105 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/21/2005 12:40 by MH

Account Number: 10132

Submitted: 04/22/2005 14:25
Reported: 05/06/2005 at 09:32
Discard: 06/06/2005

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500 Hyde Park
Doylestown PA 18901

S--43

06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 15:14	Megersa Deyessa	1
07786	EDB Extraction	SW-846 8011	1	04/25/2005 12:30	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/26/2005 11:45	Andrew G Newton	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4509408

S44-042105 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/21/2005 12:20 by MH

Account Number: 10132

Submitted: 04/22/2005 14:25
Reported: 05/06/2005 at 09:32
Discard: 06/06/2005

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500 Hyde Park
Doylestown PA 18901

S--44

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	0.00021	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.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	34.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	2,100.	100.	10.	ug/l	20
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	52.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	16.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	38.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	44.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/05/2005 22:20	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/27/2005 14:26	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/28/2005 03:20	Linda M Hartenstine	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/26/2005 18:00	Shawn J Rice	20
02302	UST-Waters by 8260B	SW-846 8260B	1	04/27/2005 12:59	Shawn J Rice	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/27/2005 12:59	Shawn J Rice	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/26/2005 18:00	Shawn J Rice	n.a.

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4509408

S44-042105 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/21/2005 12:20 by MH

Account Number: 10132

Submitted: 04/22/2005 14:25
Reported: 05/06/2005 at 09:32
Discard: 06/06/2005

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500 Hyde Park
Doylestown PA 18901

S--44

06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 15:14	Megersa Deyessa	1
07786	EDB Extraction	SW-846 8011	1	04/25/2005 12:30	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/26/2005 11:45	Andrew G Newton	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4509409

S46-042105 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/21/2005 11:35 by MH

Account Number: 10132

Submitted: 04/22/2005 14:25
Reported: 05/06/2005 at 09:32
Discard: 06/06/2005

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500 Hyde Park
Doylestown PA 18901

S--46

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	0.00021	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	13.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	170.	50.	5.	ug/l	10
05401	Benzene	71-43-2	330.	50.	5.	ug/l	10
05402	1,2-Dichloroethane	107-06-2	< 50.	50.	10.	ug/l	10
05407	Toluene	108-88-3	< 50.	50.	7.	ug/l	10
05415	Ethylbenzene	100-41-4	75.	50.	8.	ug/l	10
05420	Isopropylbenzene	98-82-8	140.	50.	10.	ug/l	10
06310	Xylene (Total)	1330-20-7	64.	50.	8.	ug/l	10

Due to the level of benzene, the reporting limits for all GC/MS volatile compounds were raised.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/05/2005 22:24	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/27/2005 14:56	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/28/2005 03:41	Linda M Hartenstine	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/26/2005 18:22	Shawn J Rice	10

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4509409

S46-042105 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/21/2005 11:35 by MH

Account Number: 10132

Submitted: 04/22/2005 14:25
Reported: 05/06/2005 at 09:32
Discard: 06/06/2005

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500 Hyde Park
Doylestown PA 18901

S--46

01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/26/2005 18:22	Shawn J Rice	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 15:14	Megersa Deyessa	1
07786	EDB Extraction	SW-846 8011	1	04/25/2005 12:30	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/26/2005 11:45	Andrew G Newton	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4509410

S47D-042105 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/21/2005 11:55 by MH

Account Number: 10132

Submitted: 04/22/2005 14:25
Reported: 05/06/2005 at 09:32
Discard: 06/06/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-47D

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	0.00021	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	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	92.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	87.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	< 5.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/05/2005 22:27	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/27/2005 15:26	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/28/2005 04:01	Linda M Hartenstine	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/27/2005 13:25	Shawn J Rice	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/27/2005 13:25	Shawn J Rice	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 15:14	Megersa Deyessa	1
07786	EDB Extraction	SW-846 8011	1	04/25/2005 12:30	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4509410

S47D-042105 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/21/2005 11:55 by MH

Account Number: 10132

Submitted: 04/22/2005 14:25
Reported: 05/06/2005 at 09:32
Discard: 06/06/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-47D

07807	BNA Water Extraction	SW-846 3510C	1	04/26/2005 11:45	Andrew G Newton	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Quality Control Summary

Client Name: Langan Group Number: 940597
Reported: 05/06/05 at 09:32 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: 051130008A	Sample number(s): 4509406-4509410								
Ethylene dibromide	< 0.030	0.030	0.010	ug/l	108	104	60-140	4	20
Batch number: 05115WAG026	Sample number(s): 4509406-4509410								
Naphthalene	< 10.	10.	1.	ug/l	86		58-108		
Fluorene	< 10.	10.	1.	ug/l	93		61-116		
Phenanthrene	< 10.	10.	1.	ug/l	96		68-111		
Pyrene	< 10.	10.	1.	ug/l	97		68-114		
Chrysene	< 10.	10.	1.	ug/l	96		70-111		
Batch number: 051196050004A	Sample number(s): 4509406-4509410								
Lead	< 0.0010	0.0010	0.00021	mg/l	102		80-120		
Batch number: P051161AA	Sample number(s): 4509406-4509409								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	86		77-127		
Benzene	< 5.	5.	0.5	ug/l	99		85-117		
1,2-Dichloroethane	< 5.	5.	1.	ug/l	92		77-132		
Toluene	< 5.	5.	0.7	ug/l	102		85-115		
Ethylbenzene	< 5.	5.	0.8	ug/l	98		82-119		
Isopropylbenzene	< 5.	5.	1.	ug/l	95		80-120		
Xylene (Total)	< 5.	5.	0.8	ug/l	99		83-113		
Batch number: P051171AA	Sample number(s): 4509406-4509408,4509410								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	81		77-127		
Benzene	< 5.	5.	0.5	ug/l	101		85-117		
1,2-Dichloroethane	< 5.	5.	1.	ug/l	90		77-132		
Toluene	< 5.	5.	0.7	ug/l	100		85-115		
Ethylbenzene	< 5.	5.	0.8	ug/l	96		82-119		
Isopropylbenzene	< 5.	5.	1.	ug/l	95		80-120		
Xylene (Total)	< 5.	5.	0.8	ug/l	99		83-113		

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: 051130008A	Sample number(s): 4509406-4509410								
Ethylene dibromide	96		65-135			< 0.028	< 0.028	0 (1)	30
Batch number: 05115WAG026	Sample number(s): 4509406-4509410								
Naphthalene	85	88	71-101	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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 940597
Reported: 05/06/05 at 09:32 AM

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Fluorene	87	90	52-121	4	30				
Phenanthrene	93	93	56-125	1	30				
Pyrene	95	97	63-117	2	30				
Chrysene	93	95	71-111	2	30				
Batch number: 051196050004A	Sample number(s): 4509406-4509410								
Lead	103	100	75-125	2	20	0.0129	0.0139	8	20
Batch number: P051161AA	Sample number(s): 4509406-4509409								
Methyl Tertiary Butyl Ether	88	93	69-134	5	30				
Benzene	106	107	83-128	0	30				
1,2-Dichloroethane	93	92	73-136	0	30				
Toluene	106	109	83-127	2	30				
Ethylbenzene	100	103	82-129	3	30				
Isopropylbenzene	99	102	81-130	3	30				
Xylene (Total)	102	104	82-130	2	30				
Batch number: P051171AA	Sample number(s): 4509406-4509408,4509410								
Methyl Tertiary Butyl Ether	84	82	69-134	2	30				
Benzene	98	100	83-128	2	30				
1,2-Dichloroethane	91	90	73-136	0	30				
Toluene	100	99	83-127	1	30				
Ethylbenzene	96	95	82-129	2	30				
Isopropylbenzene	94	94	81-130	0	30				
Xylene (Total)	98	97	82-130	1	30				

Surrogate Quality Control

Analysis Name: EDB in Wastewater
Batch number: 051130008A

	1,1,2,2-Tetrachloroethane
4509406	95
4509407	108
4509408	96
4509409	99
4509410	104
Blank	107
DUP	89
LCS	109
LCSD	110
MS	101
Limits:	52-120

Analysis Name: PAHs in Water by GC/MS
Batch number: 05115WAG026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4509406	115	83	92

*- 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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 940597
Reported: 05/06/05 at 09:32 AM

Surrogate Quality Control

4509407	86	83	115
4509408	91	89	121
4509409	89	89	118
4509410	89	86	113
Blank	90	86	124
LCS	93	91	122
MS	89	82	109
MSD	94	88	116
Limits:	51-123	64-112	53-135

Analysis Name: UST-Waters by 8260B
Batch number: P051161AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4509409	93	85	96	94
Blank	93	86	96	91
LCS	93	85	96	95
MS	92	87	96	94
MSD	92	87	96	95
Limits:	81-120	82-112	85-112	83-113

Analysis Name: UST-Waters by 8260B
Batch number: P051171AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4509406	95	86	98	99
4509407	92	85	95	97
4509408	91	87	94	101
4509410	94	87	94	98
Blank	93	87	97	92
LCS	94	88	96	95
MS	93	86	95	95
MSD	94	87	95	94
Limits:	81-120	82-112	85-112	83-113

*- 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 background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. # 10132 Group# 940597 Sample # 4509406-10

COC # 0082105

Please print. Instructions on reverse side correspond with circled numbers. cooler temp 1.9-3.3°C

(1) Client: Sun Aquatarre Acct. #:
Project Name/#: Sun Philadelphia Refinery Act-1 PWSID #:
Project Manager: K Martin / J. Hanna (Langan) P.O.#:
Sampler: MH & MBS 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: 8260B BTEX, MTBE, Cumene, EDC / 8011 EDB / 6020 Dissolved Pb / 8270C Fluorene, Phenanthrene, Pyrene, Chrysene, Naphthalene	Remarks
S88-042105	4-21-05	1300	X			X		8		
S43-042105		1240	X			X		8		
S44-042105		1220	X			X		8		
S46-042105		1135	X			X		8		
S47D-042105		1155	X			X		8		
~~S77P-042005~~		~~1545~~								

For Lab Use Only
FSC:
SCR #:

(6) Preservation of Containers

(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)
QC Summary | Type VI (Raw Data) | GLP | Other
Type I (Tier I)
Type II (Tier II)
Type III (NJ Red. Del.)
Type IV (CLP)
Site-specific QC required? Yes (No)
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes (No)
SDG Complete? Yes (No)

(9)

Relinquished by:	Date	Time	Received by:	Date	Time
M. Brady	4/22/05	1600	Aquatarre Fridge	4/22/05	1600
AT FRIDGE	4/22/05	1000	Lori Hildreth	4/22/05	1000
Lori Hildreth	4/22/05	1500	Jay Charles	4/22/05	1500
Jay Charles	4/22/05	1425			
			Jessica Bruno	4/22/05	1425

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

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
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< 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

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

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. All other results are reported on an as-received basis.

U.S. EPA CLP 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 quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
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 sample 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.

Measurement uncertainty values, as applicable, are available upon request.

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:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 940811. Samples arrived at the laboratory on Monday, April 25, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description	Lancaster Labs Number
S41-042205 Grab Water Sample	4510582
S117-042205 Grab Water Sample	4510583
S118-042205 Grab Water Sample	4510584
S127-042205 Grab Water Sample	4510585
S209-042205 Grab Water Sample	4510586
S226-042205 Grab Water Sample	4510587
S173-042205 Grab Water Sample	4510588
S99-042205 Grab Water Sample	4510589
S98-042205 Grab Water Sample	4510590
S193-042205 Grab Water Sample	4510591
S194-042205 Grab Water Sample	4510592
S196-042205 Grab Water Sample	4510593
S101-042205 Grab Water Sample	4510594

1 COPY TO	Langan	Attn: Jason Hanna
ELECTRONIC COPY TO	SUN: Aquaterra Tech.	Attn: Brad Spancake
ELECTRONIC COPY TO	Langan	Attn: Dennis Webster
1 COPY TO	LL	Attn: Angela Miller

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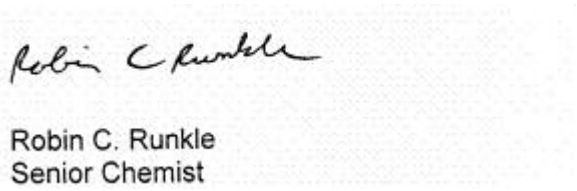
Analysis Report

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,



Robin C. Runkle
Senior Chemist

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4510582

S41-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 10:50 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:19
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

PR-41

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	0.00018	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.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	530.	50.	5.	ug/l	10
05401	Benzene	71-43-2	65.	50.	5.	ug/l	10
05402	1,2-Dichloroethane	107-06-2	< 50.	50.	10.	ug/l	10
05407	Toluene	108-88-3	< 50.	50.	7.	ug/l	10
05415	Ethylbenzene	100-41-4	< 50.	50.	8.	ug/l	10
05420	Isopropylbenzene	98-82-8	< 50.	50.	10.	ug/l	10
06310	Xylene (Total)	1330-20-7	< 50.	50.	8.	ug/l	10

Due to the level of methyl tertiary butyl ether, the reporting limits for all GC/MS volatile compounds were raised.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	04/30/2005 01:23	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 10:19	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/29/2005 09:37	Mark A Clark	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/28/2005 11:50	Shawn J Rice	10

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510582

S41-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 10:50 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:19
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

PR-41

01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/28/2005 11:50	Shawn J Rice	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 13:13	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/28/2005 09:15	Darin P Wagner	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510583

S117-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 12:45 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:19
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

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	0.00018	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	360.	50.	5.	ug/l	5
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	100.	50.	5.	ug/l	10
05401	Benzene	71-43-2	8,800.	500.	50.	ug/l	100
05402	1,2-Dichloroethane	107-06-2	< 50.	50.	10.	ug/l	10
05407	Toluene	108-88-3	< 50.	50.	7.	ug/l	10
05415	Ethylbenzene	100-41-4	550.	50.	8.	ug/l	10
05420	Isopropylbenzene	98-82-8	< 50.	50.	10.	ug/l	10
06310	Xylene (Total)	1330-20-7	52.	50.	8.	ug/l	10

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	04/30/2005 01:25	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 10:49	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/30/2005 11:45	Mark A Clark	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510583

S117-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 12:45 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:19
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

PR117

07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/30/2005 13:31	Mark A Clark	5
02302	UST-Waters by 8260B	SW-846 8260B	1	04/28/2005 12:17	Shawn J Rice	100
02302	UST-Waters by 8260B	SW-846 8260B	1	04/28/2005 23:26	Jason M Long	10
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/28/2005 23:26	Jason M Long	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/28/2005 12:17	Shawn J Rice	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 13:13	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/28/2005 09:15	Darin P Wagner	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510584

S118-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 11:10 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:19
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

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	0.00018	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	33.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	170.	50.	5.	ug/l	10
05401	Benzene	71-43-2	920.	50.	5.	ug/l	10
05402	1,2-Dichloroethane	107-06-2	< 50.	50.	10.	ug/l	10
05407	Toluene	108-88-3	52.	50.	7.	ug/l	10
05415	Ethylbenzene	100-41-4	180.	50.	8.	ug/l	10
05420	Isopropylbenzene	98-82-8	< 50.	50.	10.	ug/l	10
06310	Xylene (Total)	1330-20-7	460.	50.	8.	ug/l	10

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	04/30/2005 01:32	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 11:19	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/29/2005 10:19	Mark A Clark	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510584

S118-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 11:10 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:19
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

PR118

02302	UST-Waters by 8260B	SW-846 8260B	1	04/28/2005 12:43	Shawn J Rice	10
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/28/2005 12:43	Shawn J Rice	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 13:13	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/28/2005 09:15	Darin P Wagner	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4510585

S127-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 12:30 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:19
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

PR127

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	0.00018	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	240.	49.	5.	ug/l	5
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	1,700.	1,000.	100.	ug/l	200
05401	Benzene	71-43-2	15,000.	1,000.	100.	ug/l	200
05402	1,2-Dichloroethane	107-06-2	< 1,000.	1,000.	200.	ug/l	200
05407	Toluene	108-88-3	< 1,000.	1,000.	140.	ug/l	200
05415	Ethylbenzene	100-41-4	< 1,000.	1,000.	160.	ug/l	200
05420	Isopropylbenzene	98-82-8	< 1,000.	1,000.	200.	ug/l	200
06310	Xylene (Total)	1330-20-7	1,000.	1,000.	160.	ug/l	200

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	04/30/2005 01:34	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 11:49	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/29/2005 12:24	Mark A Clark	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510585

S127-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 12:30 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:19
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

PR127

07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/30/2005 13:52	Mark A Clark	5
02302	UST-Waters by 8260B	SW-846 8260B	1	04/28/2005 13:10	Shawn J Rice	200
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/28/2005 13:10	Shawn J Rice	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 13:13	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/28/2005 09:15	Darin P Wagner	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510586

S209-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 11:35 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:19
Discard: 06/09/2005

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500 Hyde Park
Doylestown PA 18901

PR209

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	0.00018	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.029	0.029	0.010	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	70.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	27.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	42.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1

The GC/MS semivolatile surrogate recoveries were outside of QC limits. The analysis was repeated and surrogate recoveries were again outside of QC limits, indicating a matrix effect.

The GC/MS semivolatile internal standard peak areas were outside of the QC limits for both the initial injection and the re-injection. The values here are from the initial injection of the sample.

02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	77.	50.	5.	ug/l	10
05401	Benzene	71-43-2	7,600.	500.	50.	ug/l	100
05402	1,2-Dichloroethane	107-06-2	< 50.	50.	10.	ug/l	10
05407	Toluene	108-88-3	91.	50.	7.	ug/l	10
05415	Ethylbenzene	100-41-4	460.	50.	8.	ug/l	10
05420	Isopropylbenzene	98-82-8	170.	50.	10.	ug/l	10
06310	Xylene (Total)	1330-20-7	1,800.	50.	8.	ug/l	10

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510586

S209-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 11:35 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:19
Discard: 06/09/2005

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Doylestown PA 18901

PR209

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	04/30/2005 01:37	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 12:18	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/29/2005 12:44	Mark A Clark	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/28/2005 23:46	Jason M Long	10
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 00:05	Jason M Long	100
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/28/2005 23:46	Jason M Long	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/29/2005 00:05	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 13:13	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/28/2005 09:15	Darin P Wagner	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510587

S226-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 12:00 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:20
Discard: 06/09/2005

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500 Hyde Park
Doylestown PA 18901

PR226

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	0.00018	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	1,200.	490.	49.	ug/l	50
03956	Fluorene	86-73-7	13.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	27.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1

The GC/MS semivolatile surrogate recoveries were outside of QC limits. The analysis was repeated and surrogate recoveries were again outside of QC limits, indicating a matrix effect.

The GC/MS semivolatile internal standard peak areas were outside of the QC limits for both the initial injection and the re-injection. The values here are from the initial injection of the sample.

02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 1,000.	1,000.	100.	ug/l	200
05401	Benzene	71-43-2	91,000.	10,000.	1,000.	ug/l	2000
05402	1,2-Dichloroethane	107-06-2	< 1,000.	1,000.	200.	ug/l	200
05407	Toluene	108-88-3	6,100.	1,000.	140.	ug/l	200
05415	Ethylbenzene	100-41-4	1,200.	1,000.	160.	ug/l	200
05420	Isopropylbenzene	98-82-8	< 1,000.	1,000.	200.	ug/l	200
06310	Xylene (Total)	1330-20-7	4,700.	1,000.	160.	ug/l	200

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510587

S226-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 12:00 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:20
Discard: 06/09/2005

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Doylestown PA 18901

PR226

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	04/30/2005 01:39	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 12:48	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/29/2005 13:05	Mark A Clark	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/30/2005 14:13	Mark A Clark	50
02302	UST-Waters by 8260B	SW-846 8260B	1	04/28/2005 14:02	Shawn J Rice	2000
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 00:25	Jason M Long	200
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 00:25	Jason M Long	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/28/2005 14:02	Shawn J Rice	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 13:13	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/28/2005 09:15	Darin P Wagner	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510588

S173-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 13:15 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:20
Discard: 06/09/2005

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Doylestown PA 18901

PR173

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	0.00018	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	47.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	11.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	18.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1

Surrogate recoveries were outside of QC limits for the GC/MS semivolatile compounds. The analysis was repeated outside of the required hold time and surrogate recoveries met requirements. The data reported is from the initial extraction of the sample.

02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	140.	50.	5.	ug/l	10
05401	Benzene	71-43-2	990.	50.	5.	ug/l	10
05402	1,2-Dichloroethane	107-06-2	< 50.	50.	10.	ug/l	10
05407	Toluene	108-88-3	< 50.	50.	7.	ug/l	10
05415	Ethylbenzene	100-41-4	480.	50.	8.	ug/l	10
05420	Isopropylbenzene	98-82-8	320.	50.	10.	ug/l	10
06310	Xylene (Total)	1330-20-7	1,100.	50.	8.	ug/l	10

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510588

S173-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 13:15 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:20
Discard: 06/09/2005

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PR173

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	04/30/2005 01:41	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 13:18	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/30/2005 12:49	Mark A Clark	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 00:45	Jason M Long	10
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 00:45	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 13:13	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/28/2005 09:15	Darin P Wagner	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510589

S99-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 10:00 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:20
Discard: 06/09/2005

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Doylestown PA 18901

PR-99

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	0.0015	0.0010	0.00018	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	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	17.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	200.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	23.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	6.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	81.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	19.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	04/30/2005 01:44	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 13:48	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/30/2005 13:10	Mark A Clark	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 04:41	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 04:41	Jason M Long	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 13:13	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510589

S99-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 10:00 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:20
Discard: 06/09/2005

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PR-99

07807	BNA Water Extraction	SW-846 3510C	1	04/28/2005 09:15	Darin P Wagner	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510590

S98-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 10:50 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:20
Discard: 06/09/2005

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500 Hyde Park
Doylestown PA 18901

PR-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	0.0039	0.0010	0.00018	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	110.	19.	2.	ug/l	2
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 25.	25.	3.	ug/l	5
05401	Benzene	71-43-2	580.	25.	3.	ug/l	5
05402	1,2-Dichloroethane	107-06-2	< 25.	25.	5.	ug/l	5
05407	Toluene	108-88-3	< 25.	25.	4.	ug/l	5
05415	Ethylbenzene	100-41-4	140.	25.	4.	ug/l	5
05420	Isopropylbenzene	98-82-8	37.	25.	5.	ug/l	5
06310	Xylene (Total)	1330-20-7	1,000.	25.	4.	ug/l	5

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	04/30/2005 01:46	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 14:18	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/29/2005 14:08	Mark A Clark	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4510590

S98-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 10:50 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:20
Discard: 06/09/2005

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500 Hyde Park
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PR-98

07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/30/2005 14:34	Mark A Clark	2
02302	UST-Waters by 8260B	SW-846 8260B	1	04/28/2005 15:22	Shawn J Rice	5
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/28/2005 15:22	Shawn J Rice	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 13:13	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/28/2005 09:15	Darin P Wagner	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510591

S193-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 11:20 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:20
Discard: 06/09/2005

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500 Hyde Park
Doylestown PA 18901

PR193

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	0.00018	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	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	220.	25.	3.	ug/l	5
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	6.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	27.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	16.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	120.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	04/30/2005 01:48	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 15:18	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/29/2005 14:29	Mark A Clark	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/28/2005 15:48	Shawn J Rice	5
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 05:01	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 05:01	Jason M Long	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/28/2005 15:48	Shawn J Rice	n.a.

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4510591

S193-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 11:20 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:20
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

PR193

06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 13:13	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/28/2005 09:15	Darin P Wagner	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4510592

S194-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 11:35 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:20
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

PR194

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	0.00018	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	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	16.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	11.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	11.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	33.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	04/30/2005 01:51	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 15:48	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/29/2005 14:49	Mark A Clark	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/28/2005 16:15	Shawn J Rice	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/28/2005 16:15	Shawn J Rice	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 13:13	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4510592

S194-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 11:35 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:20
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

PR194

07807	BNA Water Extraction	SW-846 3510C	1	04/28/2005 09:15	Darin P Wagner	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510593

S196-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 12:40 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:20
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

PR196

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	0.00018	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	< 10.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	< 5.	5.	0.5	ug/l	1
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	< 5.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	< 5.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	< 5.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	13.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	04/30/2005 01:53	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 16:17	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/29/2005 15:10	Mark A Clark	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/28/2005 16:41	Shawn J Rice	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/28/2005 16:41	Shawn J Rice	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 13:13	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4510593

S196-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 12:40 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:20
Discard: 06/09/2005

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500 Hyde Park
Doylestown PA 18901

PR196

07807	BNA Water Extraction	SW-846 3510C	1	04/28/2005 09:15	Darin P Wagner	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510594

S101-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 13:20 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:20
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

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	0.00018	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	41.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 5.	5.	0.5	ug/l	1
05401	Benzene	71-43-2	1,400.	100.	10.	ug/l	20
05402	1,2-Dichloroethane	107-06-2	< 5.	5.	1.	ug/l	1
05407	Toluene	108-88-3	14.	5.	0.7	ug/l	1
05415	Ethylbenzene	100-41-4	22.	5.	0.8	ug/l	1
05420	Isopropylbenzene	98-82-8	26.	5.	1.	ug/l	1
06310	Xylene (Total)	1330-20-7	89.	5.	0.8	ug/l	1

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	04/30/2005 02:00	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	04/28/2005 16:47	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	04/29/2005 15:31	Mark A Clark	1
02302	UST-Waters by 8260B	SW-846 8260B	1	04/28/2005 17:08	Shawn J Rice	20
02302	UST-Waters by 8260B	SW-846 8260B	1	04/29/2005 06:59	Jason M Long	1
01163	GC/MS VOA Water Prep	SW-846 5030B	1	04/29/2005 06:59	Jason M Long	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	2	04/28/2005 17:08	Shawn J Rice	n.a.

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4510594

S101-042205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:04/22/2005 13:20 by MBS

Account Number: 10132

Submitted: 04/25/2005 15:00
Reported: 05/09/2005 at 10:20
Discard: 06/09/2005

Langan
500 Hyde Park
Doylestown PA 18901

PR101

06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	04/29/2005 13:13	Denise K Conners	1
07786	EDB Extraction	SW-846 8011	1	04/27/2005 11:00	Deborah M Zimmerman	1
07807	BNA Water Extraction	SW-846 3510C	1	04/28/2005 09:15	Darin P Wagner	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: Langan Group Number: 940811
Reported: 05/09/05 at 10:20 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: 051160020A	Sample number(s): 4510582-4510594								
Ethylene dibromide	< 0.030	0.030	0.010	ug/l	92	92	60-140	0	20
Batch number: 05117WAG026	Sample number(s): 4510582-4510594								
Naphthalene	< 10.	10.	1.	ug/l	87	84	58-108	3	30
Fluorene	< 10.	10.	1.	ug/l	91	88	61-116	3	30
Phenanthrene	< 10.	10.	1.	ug/l	99	95	68-111	4	30
Pyrene	< 10.	10.	1.	ug/l	86	81	68-114	6	30
Chrysene	< 10.	10.	1.	ug/l	99	94	70-111	5	30
Batch number: 051196050001A	Sample number(s): 4510582-4510594								
Lead	< 0.0010	0.0010	0.00018	mg/l	99		80-120		
Batch number: P051181AA	Sample number(s): 4510582-4510585,4510587,4510590-4510594								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	83		77-127		
Benzene	< 5.	5.	0.5	ug/l	102		85-117		
1,2-Dichloroethane	< 5.	5.	1.	ug/l	92		77-132		
Toluene	< 5.	5.	0.7	ug/l	101		85-115		
Ethylbenzene	< 5.	5.	0.8	ug/l	97		82-119		
Isopropylbenzene	< 5.	5.	1.	ug/l	95		80-120		
Xylene (Total)	< 5.	5.	0.8	ug/l	100		83-113		
Batch number: P051183AA	Sample number(s): 4510583,4510586-4510589,4510591,4510594								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	88		77-127		
Benzene	< 5.	5.	0.5	ug/l	98		85-117		
1,2-Dichloroethane	< 5.	5.	1.	ug/l	87		77-132		
Toluene	< 5.	5.	0.7	ug/l	102		85-115		
Ethylbenzene	< 5.	5.	0.8	ug/l	101		82-119		
Isopropylbenzene	< 5.	5.	1.	ug/l	103		80-120		
Xylene (Total)	< 5.	5.	0.8	ug/l	104		83-113		

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: 051160020A	Sample number(s): 4510582-4510594								
Ethylene dibromide	96		65-135			< 0.030	< 0.029	0 (1)	30
Batch number: 051196050001A	Sample number(s): 4510582-4510594								
Lead	94	95	75-125	1	20	< 0.0010	< 0.0010	51* (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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 940811
Reported: 05/09/05 at 10:20 AM

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: P051181AA	Sample number(s): 4510582-4510585,4510587,4510590-4510594								
Methyl Tertiary Butyl Ether	88	93	69-134	6	30				
Benzene	111	110	83-128	1	30				
1,2-Dichloroethane	95	95	73-136	0	30				
Toluene	110	110	83-127	0	30				
Ethylbenzene	105	106	82-129	1	30				
Isopropylbenzene	105	105	81-130	0	30				
Xylene (Total)	106	107	82-130	1	30				
Batch number: P051183AA	Sample number(s): 4510583,4510586-4510589,4510591,4510594								
Methyl Tertiary Butyl Ether	90	93	69-134	3	30				
Benzene	104	106	83-128	1	30				
1,2-Dichloroethane	87	90	73-136	3	30				
Toluene	107	111	83-127	3	30				
Ethylbenzene	103	106	82-129	3	30				
Isopropylbenzene	103	108	81-130	4	30				
Xylene (Total)	101	105	82-130	4	30				

Surrogate Quality Control

Analysis Name: EDB in Wastewater
Batch number: 051160020A

	1,1,2,2-Tetrachloroethane
4510582	84
4510583	112
4510584	86
4510585	101
4510586	83
4510587	100
4510588	114
4510589	117
4510590	109
4510591	102
4510592	116
4510593	115
4510594	79
Blank	98
DUP	98
LCS	101
LCSD	97
MS	99
Limits:	52-120

Analysis Name: PAHs in Water by GC/MS
Batch number: 05117WAG026

	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 background result was more than four times the spike added.

Quality Control Summary

Client Name: Langan Group Number: 940811
Reported: 05/09/05 at 10:20 AM

Surrogate Quality Control

4510582	88	85	117
4510583	98	87	118
4510584	89	87	111
4510585	100	92	103
4510586	257*	79	66
4510587	239*	61*	106
4510588	196*	83	106
4510589	96	91	132
4510590	92	87	121
4510591	90	88	99
4510592	89	85	104
4510593	92	89	120
4510594	91	86	117
Blank	90	87	116
LCS	91	88	113
LCSD	91	90	110
Limits:	51-123	64-112	53-135

Analysis Name: UST-Waters by 8260B
Batch number: P051181AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4510582	93	84	96	93
4510584	91	84	95	93
4510585	92	85	94	92
4510590	93	86	96	97
4510592	92	86	94	98
4510593	92	84	96	98
Blank	93	87	95	92
LCS	93	87	95	96
MS	90	86	95	96
MSD	93	82	95	97
Limits:	81-120	82-112	85-112	83-113

Analysis Name: UST-Waters by 8260B
Batch number: P051183AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4510583	93	88	100	102
4510586	92	88	101	105
4510587	93	89	102	100
4510588	94	89	100	101
4510589	93	94	100	103
4510591	94	91	100	107
4510594	91	87	101	104
Blank	94	91	101	100
LCS	95	89	102	101
MS	93	88	101	102
MSD	94	89	101	101
Limits:	81-120	82-112	85-112	83-113

*- 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 background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. # 10182 Group# 940811 Sample # 4510582-94

COC # 0086349

Please print. Instructions on reverse side correspond with circled numbers.

(1)
Client: Sun-Aquaterra Acct. #:
Project Name/#: Sun-Philadelphia Refinery AOI-) PWSID #:
Project Manager: K. Martin / J. Hanna (Langan) P.O.#:
Sampler: MH (+ M. Brad Spangler) Quote #:
Name of state where samples were collected: PA

(2) Sample Identification | Date Collected | Time Collected | (3) # of Containers | Matrix: Soil | Water | (4) Preservation: Type of Container | (5) Analyses Requested: 8260 BTEX, MTBE, Cumene, EDC | 8011 EDB | 6020 Dissolved Pb | 8270C Fluoranthene, Pyrene, Chrysene, Naphthalene | Remarks

Sample Identification	Date Collected	Time Collected	# of Containers	Soil	Water	Preservation: Type of Container	Remarks
S41-042205	4-22-05	10:50	X		X	8	Dissolved Pb samples are unfiltered/unpreserved
S117-042205		12:45	X		X	8	
S118-042205		11:10	X		X	8	
S127-042205		12:30	X		X	8	
S209-042205		11:35	X		X	8	
S226-042205		12:00	X		X	8	
S173-042205		1315	X		X	8	

For Lab Use Only
FSC:
SCR #: 120434

(7) **Turnaround Time Requested** (TAT) (please circle): (Normal) Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: 5/2/05
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
QC Summary | Type VI (Raw Data) | SDG Complete? Yes (No)
Type I (Tier I) | GLP
Type II (Tier II) | Other
Type III (NJ Red. Del.)
Type IV (CLP)
Site-specific QC required? Yes (No)
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes (No)

(9)

Relinquished by:	Date	Time	Received by:	Date	Time
	3-17-05	1640	Aquaterra	3/17/05	1640
M. Brad Spangler	4/22/05	1600	Aquaterra Fridge	4/22/05	1600
M. Brad Spangler	4/25/05	1110	P. Lefever	4/25/05	1110
P. Lefever	4/25/05	1500			
			Jessica Bom	4/25/05	1500

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. # 10132 Group# 940811 Sample # 4510582-94

COC # 0080648

Please print. Instructions on reverse side correspond with circled numbers.

(1) Client: Sun-Aquaterra Acct. #:
Project Name/#: Sun-Philadelphic Refinery AOI-1 PWSID #:
Project Manager: K. Martin / J. Hanna (Langan) P.O.#:
Sampler: M. Brad Spancake Quote #:
Name of state where samples were collected: PA

(2) Sample Identification	Date Collected	Time Collected	(3) # of Containers	Matrix: Water	(4) Total # of Containers	(5) Analyses Requested: BTEX, MTBE, Current EDX, EDB, 6020 Dissolved Pb, 8270 Fluoranthene, Pyrene, Acenaphthene, Naphthalene	Remarks
S99-042205	4/22/05	1000	X	X	8		Dissolved Pb Samples are unfiltered/Unpreserved
S98-042205	4/22/05	1050	X	X	8		
S193-042205	4/22/05	1120	X	X	8		
S194-042205	4/22/05	1135	X	X	8		
S196-042205	4/22/05	1240	X	X	8		
S101-042205	4/22/05	1320	X	X	8		

NPDES Applicable

For Lab Use Only
FSC:
SCR #: 1202594

(7) **Turnaround Time Requested** (TAT) (please circle): (Normal) Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: 4/25/05
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
QC Summary
Type I (Tier I)
Type II (Tier II)
Type III (NJ Red. Del.)
Type IV (CLP)
Type VI (Raw Data)
GLP
Other

SDG Complete? Yes (No)

Site-specific QC required? Yes (No)
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes (No)

Relinquished by:	Date	Time	Received by:	Date	Time
	4/19/05	16:40	M. Brad	4/19/05	16:40
M. Brad	4/22/05	1600	Aquaterra Fridge	4/22/05	1600
M. Brad	4/25/05	1110	P. Lefever	4/25/05	1110
P. Lefever 4/25/05		1500			
			Jessica B	4/26/05	1500

(9)

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.

2102 Rev. 10/27/02

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

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
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< 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

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

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. All other results are reported on an as-received basis.

U.S. EPA CLP 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 quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
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 sample 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.

Measurement uncertainty values, as applicable, are available upon request.

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:

Langan
500 Hyde Park
Doylestown PA 18901

215-348-7101

Prepared by:

Lancaster Laboratories
2425 New Holland Pike
Lancaster, PA 17605-2425

SAMPLE GROUP

The sample group for this submittal is 941913. Samples arrived at the laboratory on Tuesday, May 03, 2005. The PO# for this group is SUNOCO PHILLY REFINER.

Client Description	Lancaster Labs Number
S211-050205 Grab Water Sample	4516617
S212-050205 Grab Water Sample	4516618
S43-050205 Grab Water Sample	4516619

ELECTRONIC COPY TO	SUN: Aquaterra Tech.	Attn: Brad Spancake
1 COPY TO	LL	Attn: Angela Miller
1 COPY TO	Langan	Attn: Jason Hanna
ELECTRONIC COPY TO	Langan	Attn: Dennis Webster

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Analysis Report

Questions? Contact your Client Services Representative
Angela M Miller at (717) 656-2300.

Respectfully Submitted,

Michele A. Jarosick
Senior Chemist, Coordinator

Lancaster Laboratories

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Analysis Report

Lancaster Laboratories Sample No. WW 4516617

S211-050205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:05/02/2005 12:10 by MBS

Account Number: 10132

Submitted: 05/03/2005 16:35
Reported: 05/10/2005 at 15:13
Discard: 06/10/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-211

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	0.00021	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	17.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	37.	10.	1.	ug/l	2
05401	Benzene	71-43-2	150.	10.	1.	ug/l	2
05402	1,2-Dichloroethane	107-06-2	< 10.	10.	2.	ug/l	2
05407	Toluene	108-88-3	< 10.	10.	1.	ug/l	2
05415	Ethylbenzene	100-41-4	28.	10.	2.	ug/l	2
05420	Isopropylbenzene	98-82-8	62.	10.	2.	ug/l	2
06310	Xylene (Total)	1330-20-7	85.	10.	2.	ug/l	2

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/06/2005 22:53	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/05/2005 23:29	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/06/2005 14:53	Joseph M Gambler	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4516617

S211-050205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:05/02/2005 12:10 by MBS

Account Number: 10132

Submitted: 05/03/2005 16:35
Reported: 05/10/2005 at 15:13
Discard: 06/10/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-211

02302	UST-Waters by 8260B	SW-846 8260B	1	05/06/2005 02:19	Andrea D Moore	2
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/06/2005 02:19	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/05/2005 15:54	Megersa Deyessa	1
07786	EDB Extraction	SW-846 8011	1	05/05/2005 10:00	Joseph S Feister	1
07807	BNA Water Extraction	SW-846 3510C	1	05/04/2005 17:00	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4516618

S212-050205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:05/02/2005 12:30 by MBS

Account Number: 10132

Submitted: 05/03/2005 16:35
Reported: 05/10/2005 at 15:13
Discard: 06/10/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-212

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	0.00021	mg/l	1
07879	EDB in Wastewater						
01087	Ethylene dibromide	106-93-4	< 0.028	0.028	0.0094	ug/l	1
07805	PAHs in Water by GC/MS						
03947	Naphthalene	91-20-3	450.	99.	10.	ug/l	10
03956	Fluorene	86-73-7	< 99.	99.	10.	ug/l	10
03963	Phenanthrene	85-01-8	< 99.	99.	10.	ug/l	10
03967	Pyrene	129-00-0	< 99.	99.	10.	ug/l	10
03971	Chrysene	218-01-9	< 99.	99.	10.	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.

Surrogate recoveries were outside of QC limits for the GC/MS semivolatile compounds due to the dilution needed to perform the analysis.

02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 250.	250.	25.	ug/l	50
05401	Benzene	71-43-2	< 250.	250.	25.	ug/l	50
05402	1,2-Dichloroethane	107-06-2	< 250.	250.	50.	ug/l	50
05407	Toluene	108-88-3	< 250.	250.	35.	ug/l	50
05415	Ethylbenzene	100-41-4	360.	250.	40.	ug/l	50
05420	Isopropylbenzene	98-82-8	< 250.	250.	50.	ug/l	50
06310	Xylene (Total)	1330-20-7	1,300.	250.	40.	ug/l	50

The reporting limits for the GC/MS volatile compounds were raised because sample dilution was necessary to bring target compounds into the calibration range of the system.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

*=This limit was used in the evaluation of the final result

Lancaster Laboratories Sample No. WW 4516618

S212-050205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:05/02/2005 12:30 by MBS

Account Number: 10132

Submitted: 05/03/2005 16:35
Reported: 05/10/2005 at 15:13
Discard: 06/10/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-212

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/06/2005 22:55	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/06/2005 00:29	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/09/2005 08:10	Joseph M Gambler	10
02302	UST-Waters by 8260B	SW-846 8260B	1	05/06/2005 02:43	Andrea D Moore	50
01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/06/2005 02:43	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/05/2005 15:54	Megersa Deyessa	1
07786	EDB Extraction	SW-846 8011	1	05/05/2005 10:00	Joseph S Feister	1
07807	BNA Water Extraction	SW-846 3510C	1	05/04/2005 17:00	Olivia I Santiago	1

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4516619

S43-050205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:05/02/2005 12:45 by MBS

Account Number: 10132

Submitted: 05/03/2005 16:35
Reported: 05/10/2005 at 15:13
Discard: 06/10/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-043

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	0.00021	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	35.	10.	1.	ug/l	1
03956	Fluorene	86-73-7	< 10.	10.	1.	ug/l	1
03963	Phenanthrene	85-01-8	< 10.	10.	1.	ug/l	1
03967	Pyrene	129-00-0	< 10.	10.	1.	ug/l	1
03971	Chrysene	218-01-9	< 10.	10.	1.	ug/l	1
02302	UST-Waters by 8260B						
02010	Methyl Tertiary Butyl Ether	1634-04-4	< 20.	20.	2.	ug/l	4
05401	Benzene	71-43-2	820.	20.	2.	ug/l	4
05402	1,2-Dichloroethane	107-06-2	< 20.	20.	4.	ug/l	4
05407	Toluene	108-88-3	35.	20.	3.	ug/l	4
05415	Ethylbenzene	100-41-4	160.	20.	3.	ug/l	4
05420	Isopropylbenzene	98-82-8	36.	20.	4.	ug/l	4
06310	Xylene (Total)	1330-20-7	100.	20.	3.	ug/l	4

Due to the level of benzene, the reporting limits for all GC/MS volatile compounds were raised.

Commonwealth of Pennsylvania Lab Certification No. 36-037
This sample was filtered in the lab for dissolved metals.
Trip blank vials were not received by the laboratory for this sample group.

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
06035	Lead	SW-846 6020	1	05/06/2005 23:02	David K Beck	1
07879	EDB in Wastewater	SW-846 8011	1	05/06/2005 01:29	James H Place	1
07805	PAHs in Water by GC/MS	SW-846 8270C	1	05/06/2005 19:09	Jolene M Graham	1
02302	UST-Waters by 8260B	SW-846 8260B	1	05/06/2005 03:08	Andrea D Moore	4

*=This limit was used in the evaluation of the final result

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Analysis Report

Lancaster Laboratories Sample No. WW 4516619

S43-050205 Grab Water Sample
SUN: Philadelphia Refinery AOI-1

Collected:05/02/2005 12:45 by MBS

Account Number: 10132

Submitted: 05/03/2005 16:35
Reported: 05/10/2005 at 15:13
Discard: 06/10/2005

Langan
500 Hyde Park
Doylestown PA 18901

S-043

01163	GC/MS VOA Water Prep	SW-846 5030B	1	05/06/2005 03:08	Andrea D Moore	n.a.
06050	ICP/MS SW-846 Water	SW-846 3010A Mod.	1	05/05/2005 15:54	Megersa Deyessa	1
07786	EDB Extraction	SW-846 8011	1	05/05/2005 10:00	Joseph S Feister	1
07807	BNA Water Extraction	SW-846 3510C	1	05/04/2005 17:00	Olivia I Santiago	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: Langan Group Number: 941913
Reported: 05/10/05 at 03:13 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: 051240024A	Sample number(s): 4516617-4516619								
Ethylene dibromide	< 0.030	0.030	0.010	ug/l	100	100	60-140	0	20
Batch number: 05124WAC026	Sample number(s): 4516617-4516619								
Naphthalene	< 10.	10.	1.	ug/l	88	87	58-108	1	30
Fluorene	< 10.	10.	1.	ug/l	100	95	61-116	4	30
Phenanthrene	< 10.	10.	1.	ug/l	97	99	68-111	2	30
Pyrene	< 10.	10.	1.	ug/l	88	90	68-114	2	30
Chrysene	< 10.	10.	1.	ug/l	91	94	70-111	3	30
Batch number: 051256050001A	Sample number(s): 4516617-4516619								
Lead	< 0.0010	0.0010	0.00021	mg/l	100		80-120		
Batch number: T051252AA	Sample number(s): 4516617-4516619								
Methyl Tertiary Butyl Ether	< 5.	5.	0.5	ug/l	99		77-127		
Benzene	< 5.	5.	0.5	ug/l	109		85-117		
1,2-Dichloroethane	< 5.	5.	1.	ug/l	117		77-132		
Toluene	< 5.	5.	0.7	ug/l	104		85-115		
Ethylbenzene	< 5.	5.	0.8	ug/l	97		82-119		
Isopropylbenzene	< 5.	5.	1.	ug/l	97		80-120		
Xylene (Total)	< 5.	5.	0.8	ug/l	98		83-113		

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max
Batch number: 051240024A	Sample number(s): 4516617-4516619								
Ethylene dibromide	84		65-135			< 0.028	< 0.029	0 (1)	30
Batch number: 051256050001A	Sample number(s): 4516617-4516619								
Lead	100	101	75-125	1	20	< 0.0010	< 0.0010	25* (1)	20
Batch number: T051252AA	Sample number(s): 4516617-4516619								
Methyl Tertiary Butyl Ether	104	107	69-134	4	30				
Benzene	115	115	83-128	0	30				
1,2-Dichloroethane	123	124	73-136	1	30				
Toluene	108	110	83-127	2	30				
Ethylbenzene	100	102	82-129	2	30				
Isopropylbenzene	98	102	81-130	5	30				
Xylene (Total)	100	100	82-130	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 background result was more than four times the spike added.

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Analysis Report

Quality Control Summary

Client Name: Langan Group Number: 941913
Reported: 05/10/05 at 03:13 PM

Sample Matrix Quality Control

Analysis Name	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD MAX	BKG Conc	DUP Conc	DUP RPD	Dup RPD Max

Surrogate Quality Control

Analysis Name: EDB in Wastewater
Batch number: 051240024A

	1,1,2,2-Tetrachloroethane
4516617	113
4516618	115
4516619	108
Blank	102
DUP	75
LCS	104
LCSD	103
MS	96
Limits:	52-120

Analysis Name: PAHs in Water by GC/MS
Batch number: 05124WAC026

	Nitrobenzene-d5	2-Fluorobiphenyl	Terphenyl-d14
4516617	73	84	92
4516618	166*	85	95
4516619	73	84	92
Blank	77	86	94
LCS	77	86	98
LCSD	76	86	102
Limits:	51-123	64-112	53-135

Analysis Name: UST-Waters by 8260B
Batch number: T051252AA

	Dibromofluoromethane	1,2-Dichloroethane-d4	Toluene-d8	4-Bromofluorobenzene
4516617	97	89	92	101
4516618	95	87	94	101
4516619	93	87	94	100
Blank	98	88	92	98
LCS	95	86	92	100
MS	96	86	91	99
MSD	97	87	94	100
Limits:	81-120	82-112	85-112	83-113

*- 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 background result was more than four times the spike added.

Analysis Request / Environmental Services Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. # 10132 Group# 941913 Sample # 4516617-19

COC # 0084324

Please print. Instructions on reverse side correspond with circled numbers. Cooler temp 1.1-1.6°C

(1) Client: Sun Aquatorra / Langan Acct. #:
Project Name/#: Sun Philadelphia Refinery ACI-1 PWSID #:
Project Manager: K. Martin / J. Hanna (Langan) P.O.#:
Sampler: M. Brad Spancake Quote #:
Name of state where samples were collected: PA

(2) Sample Identification	Date Collected	Time Collected	(3) Grab	Composite	(4) Matrix: Soil	Water	Other	# of Containers	(5) Analyses Requested: 8260 BTEX, MTBE, Cumene, EDC	8011 EDB	6020 Dissolved Pb	8270 Fluorene, Phenanthrene, Acenaphthene, Naphthalene	For Lab Use Only FSC: SCR #	(6) Preservation Codes
S211-050205	5/2/05	1210	X			X		8						
S212-050205	5/2/05	1230	X			X		8						
	5/2/05	1245	X			X		8						

Remarks:
Dissolved Pb samples are unfiltered/unpreserved

analyze sample S13-050205 per Brad Spancake. AM 5/4/05

(7) **Turnaround Time Requested** (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: 5 DAY TAT
Rush results requested by (please circle): Phone Fax E-mail
Phone #: Fax #:
E-mail address:

(8) **Data Package Options** (please circle if required)
QC Summary Type VI (Raw Data)
Type I (Tier I) GLP
Type II (Tier II) Other
Type III (NJ Red. Del.)
Type IV (CLP)

SDG Complete? Yes No
Site-specific QC required? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes No

Relinquished by:	Date	Time	Received by:	Date	Time
M. Brad Spancake	5/2/05	1700	Aquatorra Fedex	5/2/05	1700
M Modugno	5-3-05	1100	Marvin McFadden	5/3/05	11:02
Marvin McFadden	5/3/05	16:35			

(9)

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

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
meq	milliequivalents	**lb.**	pound(s)
g	gram(s)	**kg**	kilogram(s)
ug	microgram(s)	**mg**	milligram(s)
ml	milliliter(s)	**l**	liter(s)
m3	cubic meter(s)	**ul**	microliter(s)

< 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

J estimated value – The result is ≥ the Method Detection Limit (MDL) and < the Limit of Quantitation (LOQ).

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. All other results are reported on an as-received basis.

U.S. EPA CLP 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 quantitated on a diluted sample
E	Concentration exceeds the calibration range of the instrument
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 sample 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.

Measurement uncertainty values, as applicable, are available upon request.

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 D

FIELD SAMPLING REPORTS

APPENDIX D. Groundwater Sampling Summary
AOI-1
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

	WELL IDENTIFICATION	SAMPLE DATE	DEPTH TO WATER (feet)	DEPTH TO BOTTOM (feet)	WATER COLUMN (feet)	CONVERSION FACTOR	GALLONS IN WELL	PURGE VOLUME (Gallons)
AOI 1 - No.1 and No.2 Tank Farms	PZ-402*	20-Apr-05	19.25	35	15.75	0.16	2.5	8
	S-101	22-Apr-05	46.73	60	13.27	0.65	8.6	26
	S-116	18-Apr-05	12.36	30	17.64	0.65	11.5	34
	S-117	22-Apr-05	16.80	28	11.20	0.65	7.3	22
	S-118	22-Apr-05	17.34	29.5	12.16	0.65	7.9	24
	S-125	19-Apr-05	21.42	30	8.58	0.65	5.6	17
	S-127	22-Apr-05	16.85	30	13.15	0.65	8.5	26 (Purged 20 gallons, went dry)
	S-173	22-Apr-05	17.14	25	7.86	0.16	1.3	4
	S-179	19-Apr-05	16.63	35	18.37	0.65	11.9	36
	S-180	19-Apr-05	14.90	35	20.10	0.65	13.1	39
	S-181	19-Apr-05	21.71	35	13.29	0.65	8.6	26
	S-182	18-Apr-05	22.00	35	13.00	0.65	8.5	25
	S-183	18-Apr-05	22.82	35	12.18	0.65	7.9	24
	S-184	18-Apr-05	22.02	35	12.98	0.65	8.4	25
	S-185	18-Apr-05	23.20	35	11.80	0.65	7.7	23
	S-186	18-Apr-05	22.59	35	12.41	0.65	8.1	24
	S-187	18-Apr-05	23.46	35	11.54	0.65	7.5	23
	S-188	18-Apr-05	23.72	35	11.28	0.65	7.3	22
	S-193	22-Apr-05	23.48	35	11.52	0.65	7.5	22
	S-194	22-Apr-05	25.84	30	4.16	0.65	2.7	8
	S-196	22-Apr-05	45.27	58	12.73	0.65	8.3	25
	S-202	19-Apr-05	22.29	38	15.71	0.65	10.2	31
	S-203*	20-Apr-05	28.03	35	6.97	0.65	4.5	14
	S-204	19-Apr-05	25.72	38	12.28	0.65	8.0	24
	S-206	19-Apr-05	26.94	35	8.06	0.65	5.2	16

APPENDIX D. Groundwater Sampling Summary
AOI-1
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

WELL IDENTIFICATION		SAMPLE DATE	DEPTH TO WATER (feet)	DEPTH TO BOTTOM (feet)	WATER COLUMN (feet)	CONVERSION FACTOR	GALLONS IN WELL	PURGE VOLUME (Gallons)
AOI 1 - No.1 and No.2 Tank Farms	S-207	19-Apr-05	23.57	33	9.43	0.65	6.1	18
	S-209	22-Apr-05	26.04	38	11.96	0.65	7.8	23
	S-211	02-May-05	13.55	30	16.45	0.65	10.7	32
	S-212	02-May-05	16.99	28	11.01	0.65	7.2	21
	S-214*	20-Apr-05	18.99	33	14.01	0.65	9.1	27
	S-215	19-Apr-05	29.77	38	8.23	0.65	5.3	16
	S-226	22-Apr-05	21.54	38	16.46	0.65	10.7	32
	S-227*	20-Apr-05	22.49	35	12.51	0.65	8.1	24
	S-41	22-Apr-05	25.90	35	9.10	0.65	5.9	18
	S-42D	15-Apr-05	25.42	65	39.58	0.65	25.7	77
	S-43	02-May-05	23.93	34	10.07	0.65	6.5	20
	S-44	21-Apr-05	26.37	41	14.63	0.65	9.5	29 (Purged 15 gallons, went dry)
	S-46	21-Apr-05	21.57	31	9.43	0.65	6.1	18
	S-46D	18-Apr-05	14.89	71	56.11	0.16	9.0	27
	S-47D	21-Apr-05	21.16	40.5	19.34	0.65	12.6	38
	S-51	19-Apr-05	22.98	40	17.02	0.16	2.7	8
	S-52	19-Apr-05	22.93	44.5	21.57	0.37	8.0	24
	S-77P*	20-Apr-05	28.61	35	6.39	0.16	1.0	3
	S-79P*	20-Apr-05	25.90	35	9.10	0.16	1.5	4
	S-80D	15-Apr-05	30.15	81	50.85	0.16	8.1	24
	S-84P	19-Apr-05	13.86	35	21.14	0.16	3.4	10
	S-88	21-Apr-05	24.87	44	19.13	0.65	12.4	37 (Purged 25 gallons, went dry)
	S-95	15-Apr-05	22.64	30	7.36	0.65	4.8	14
	S-98	22-Apr-05	24.50	35	10.50	0.65	6.8	20
	S-99	22-Apr-05	25.07	35	9.93	0.65	6.5	19

APPENDIX D. Groundwater Sampling Summary
AOI-1
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

WELL IDENTIFICATION		SAMPLE DATE	DEPTH TO WATER (feet)	DEPTH TO BOTTOM (feet)	WATER COLUMN (feet)	CONVERSION FACTOR	GALLONS IN WELL	PURGE VOLUME (Gallons)
AOI 1 - BELMONT TERMINAL	MW-30	27-Apr-05	27.29	35	7.71	0.65	5.0	15
	MW-31	26-Apr-05	25.64	30	4.36	0.65	2.8	9
	MW-32	26-Apr-05	24.71	30	5.29	0.65	3.4	10
	MW-35	27-Apr-05	26.63	35	8.37	0.65	5.4	16
	MW-36	25-Apr-05	27.57	35	7.43	0.65	4.8	14
	MW-37	26-Apr-05	26.70	35	8.30	0.65	5.4	16
	MW-38	26-Apr-05	22.88	35	12.12	0.65	7.9	24
	MW-39	26-Apr-05	22.73	35	12.27	0.65	8.0	24 (Purged 17 gallons, went dry)
	MW-40	26-Apr-05	23.05	35	11.95	0.65	7.8	23
	MW-43	02-May-05	26.11	35	8.89	0.65	5.8	17
	OW-14	25-Apr-05	27.47	43	15.53	0.65	10.1	30
	S-74	26-Apr-05	25.35	36	10.65	0.16	1.7	5
	TW-3	25-Apr-05	26.54	32	5.46	0.16	0.9	3
	TW-5	25-Apr-05	26.18	32	5.82	0.16	0.9	3 (Purged 2 gallons, went dry)
	TW-8	25-Apr-05	25.49	31.5	6.01	0.16	1.0	3
	TW-9	25-Apr-05	27.18	29	1.82	0.16	0.3	1 (purged 0.5 gallons, went dry)
	TW-10	27-Apr-05	25.70	31.5	5.80	0.16	0.9	3
	TW-11	25-Apr-05	27.53	30.5	2.97	0.16	0.5	1
	SG-1	26-Apr-05	6.51	10	3.49	0.16	0.6	No purge, collected sample
	SG-3	26-Apr-05	4.44	5	0.56	0.16	0.1	No purge, collected sample
	SG-6	26-Apr-05	6.23	10	3.77	0.16	0.6	No purge, collected sample
	SG-7	26-Apr-05	5.89	10	4.11	0.16	0.7	No purge, collected sample

* = PAH's were re-sampled on 5 May 2005 due to laboratory error.

APPENDIX D. Soil Gas Sampling Summary
AOI-1
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

WELL IDENTIFICATION	SAMPLE DATE	DEPTH TO BOTTOM (feet)	CONVERSION FACTOR	LITERS OF SOIL GAS IN WELL	PURGE VOLUME (Liters of Soil Gas)	PID Reading at Start (ppmV)	PID Reading at End (ppmV)
SG-2	19-Apr-05	10	0.166	6.3	19	10.4	38.6
SG-4	19-Apr-05	10	0.166	6.3	19	30.6	66.6
SG-5	19-Apr-05	10	0.166	6.3	19	13.5	36.9
SG-8	19-Apr-05	10	0.166	6.3	19	37.9	45.7
SG-9	19-Apr-05	8	0.166	5.0	15	121	46.9
SG-10	19-Apr-05	8	0.166	5.0	15	1821	1749
SG-11	19-Apr-05	10	0.166	6.3	19	1967	1524

APPENDIX E

LNAPL SAMPLING ANALYTICAL DATA AND MODELING PROCEDURES

APPENDIX E
LNAPL SAMPLING ANALYTICAL DATA AND MODELING PROCEDURES
AOI 1: SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

E.0 LNAPL DISTRIBUTION AND MOBILITY ASSESSEMNT

LNAPL distribution and mobility characterization field activities discussed in this appendix and the Site Characterization Report were performed by Aquaterra during April 2005. The gauging of groundwater elevations and LNAPL thicknesses was performed by Handex during May 9 - 11, 2005.

E.1 LNAPL CHARACTERIZATION RESULTS

LNAPL characterization was performed on samples collected from 28 monitoring well locations in AOI 1 during April 2005. The characterization analyses were performed by Torkelson Geochemistry of Texas. Characterization results from nine samples previously collected in AOI 1 to support LNAPL volume and mobility calculations in the 2004 Current Conditions Report were incorporated into the LNAPL modeling completed for the AOI 1 LNAPL modeling activities summarized in this appendix. The characterization data is summarized in Table E1. Chromatographic results indicate that LNAPL types detected in AOI 1 include gasoline, heavy virgin naphtha, middle distillate, a mix of coker naphtha and middle distillate, lube oil, a mix of Stoddard solvent and middle distillate and a mix of gasoline and middle distillate. The chromatograms can be found in Figure E1. Since the majority of the samples were mixtures of these identified components, the LNAPL types were placed into four general categories (Lube Oil, gasoline/middle distillate, gasoline, and light end feed stock) in Figure 11 and Table E1. The most prevalent LNAPL type in a mixture, however, was used in the LNAPL modeling.

E.2 ANALYTICAL PROGRAM AND LNAPL MODELING PROCEDURE

Soil samples from S-34 and MW-42 were collected in April 2005 for physical properties analysis including:

- Bulk density,
- Grain density,
- Moisture content,
- Porosity,
- Soil type,
- Air/water capillary pressure,
- Atterberg limits,
- Saturated hydraulic conductivity,
- Specific permeability,
- Intrinsic permeability,
- Pore fluid saturation percentage, and
- Particle size distribution).

Groundwater and LNAPL samples from S-34, MW-42, and S-198 were collected for physical properties analysis including:

- Interfacial/surface tension,
- Viscosity,
- Specific gravity, and
- Density.

Soil samples from S-34 and MW-42 were sent for pore saturation pressure curve analysis after identifying the areas in each core which contained the highest LNAPL saturation based on LNAPL fluorescence under ultra-violet lighting. Pore saturation pressure curve analysis consists of measuring change in pore-water saturation as it is displaced by air under increasing pressure**.** The resulting data was then entered into the Retention Curve model RETC. The RETC model is used to fit van Genuchten parameters to saturation and pressure data. The results from RETC are site-specific estimates of the van Genuchten parameters N and α, residual water saturation,

and maximum pore saturation and are presented in Figure E2. For comparison, the results of the modeling using the site-specific RETC results were compared to results using the API Database values for wells S-34 and MW-42. It was determined that the API database values were conservative in representing site conditions. Therefore, monitoring well locations with LNAPL present that have not been analyzed for soil properties were assigned van Genuchten parameters N and α, residual water saturation, and maximum pore saturation values from the API database based on soil type as inferred from boring logs.

The results of the RETC model were then entered, along with the physical properties of LNAPL and groundwater, into the API model as summarized in Table E2. Any location with LNAPL that has not been analyzed for fluid properties has been assigned values from the API database based upon LNAPL type present or by proximity to other locations with LNAPL data. The site-specific data, when compared to API database values, were found to be conservative in representing site conditions. The API model was then used to calculate the specific volume of LNAPL in the formation surrounding each well. These values are summarized in Table E3.

The API model also calculates relative permeability of LNAPL. Using site-specific viscosity values or surrogate values from the API or Environment Canada databases, the seepage velocity of LNAPL was then computed and the values are summarized in Table E3. The seepage velocity at which LNAPL flows is a strong indication of the mobility and recoverability of LNAPL from the subsurface.

E.3 APPARENT LNAPL THICKNESS

The apparent LNAPL thickness is the measured thickness of LNAPL at each monitoring well location. The maximum detected LNAPL thickness on site during the week of May 9 – 11, 2005 was observed in RW-4 at 2.66 feet. RW-4 is located in the northern portion of AOI 1 in the Belmont Terminal. Monitoring well MW-29 is also located in the Belmont Terminal Area and was observed to have an apparent LNAPL thickness of 2.29 feet. Four locations had LNAPL thicknesses greater than one foot but less than two feet. S-76, located 125 feet northeast of MW-29, had a LNAPL thickness of 1.38 feet. MW-28, located 200 feet northeast of MW-29, had a LNAPL thickness of 1.22 feet. MW-26, located approximately 260 feet northeast of

MW-29, had a LNAPL thickness of 1.36 feet. Additional LNAPL thicknesses greater than a half foot, but less than one foot, have been detected at wells RW-23, S-77, S-81, S-199, S-201, S-210, and MW-41. Monitoring well S-210 is located in the southern portion of AOI 1; the remainder are located in the northern portion of AOI 1. Thirty-nine other monitoring wells in AOI 1 contained detectable amounts of LNAPL that ranged from less than one-half foot thick to a sheen (represented as 0.01 feet thick for API modeling purposes).

E.4 LNAPL SPECIFIC VOLUME

The specific volume is the amount of LNAPL in the surrounding formation, after taking into account soil and LNAPL properties (Table E1). The maximum calculated LNAPL specific volume in AOI 1 is found at MW-29 at 0.29 feet. One additional monitoring well, RW-4, has a calculated specific volume greater than one tenth of a foot. The remaining 50 locations with detectable LNAPL have specific volumes calculated to be less than one tenth of a foot in thickness.

E.5 LNAPL MOBILITY

A LNAPL seepage velocity was calculated for each monitoring well having a measurable thickness of LNAPL (Table 4). A hydraulic gradient of 0.0035 feet/feet was used; this gradient is the same as that used in the current fate and transport calculations. Calculated seepage velocities range from a minimum of 3.67 E 10^{-24} feet/day at S-126 to a maximum of 1.11 E 10^{-5} feet/day at MW-29. LNAPL was considered to be mobile if its seepage velocity exceeds 1 E 10^{-7} cm/sec. The highest LNAPL seepage velocities are located near the Belmont Terminal or in close proximity to recovery wells along the eastern property boundary as shown in Figure 15.

TABLES

TABLE E1
LNAPL CHARACTERIZATION RESULTS SUMMARY
AOI 1: SUNOCO PHILADELPHIA REFINERY

Characterization Results Compiled for Current Conditions Report Interpretation of Product Type(s), Proportions and Weathering					
Well ID	**Density (gm/ml @ 60F)**	**LNAPL Type(s)**	**Torkleson LNAPL Type(s)**	**Proportions**	**Weathering**
*S-75	0.800	Middle Distillate / Gasoline	Gasoline Distallate	NA NA	Moderate High
*RW-1	0.762	Gasoline	Gasoline	NA	Unweathered
*RW-4	0.759	Gasoline	Gasoline	NA	Unweathered
*RW-7	0.777	Gasoline	Gasoline	NA	Unweathered
*RW-15	0.775	Gasoline	Gasoline	NA	Unweathered
S-100	0.793	Middle Distillate / Gasoline	Gasolne Middle Distillate	50 50	Moderate Moderate
S-117	0.8236	Light End Feed Stock	Gasoline Kerosene (Jet Fuel)	20 80	Extreme Extreme
S-162	0.7498	Light End Feed Stock	Estimated as Crude Heavy Virgin Naphtha	2 98	Severe Severe
S-50	0.7508	Light End Feed Stock	Heavy Virgin Naphtha Middle Distillate	98 2	Moderate Severe
S-76	0.7851	Middle Distillate / Light End Feed Stock	Coker Naphtha Middle Distillate	60 40	Severe High
S-78	QNS	Middle Distillate / Gasoline	Estimated as Gasoline Middle Distillate	2 98	Extreme Extreme
S-79	0.8406	Middle Distillate / Gasoline	Estimated as Gasoline Middle Distillate	2 98	Extreme Extreme
S-81	0.7948	Middle Distillate / Gasoline	Gasoline Middle Distillate	90 10	High Extreme
S-82	QNS	Middle Distillate / Light End Feed Stock	Coker Naphtha Middle Distillate	50 50	High Extreme
S-89	0.8523	Middle Distillate / Gasoline	Gasoline Lube Oil Middle Distillate	25 5 70	Extreme Extreme Extreme
Characterization Results Compiled for AOI 1 Site Characterization **Interpretation of Product Type(s), Proportions and Weathering**					
Well ID	**Density (gm/ml @ 60F)**	**LNAPL Type(s)**	**Torkleson LNAPL Type(s)**	**Proportions**	**Weathering**
MW-27	0.7979	Middle Distillate / Gasoline	Gasoline Middle Distillate	45 55	Slight Slight
MW-28	0.7918	Middle Distillate / Gasoline	Gasoline Middle Distillate	65 35	Moderate Slight
MW-29	0.7945	Middle Distillate / Gasoline	Gasoline and Heavy Virgin Naphtha Middle Distillate	50 50	Slight Slight
MW-33	QNS	Middle Distillate / Gasoline	Unknown Light Ends Middle Distillate	20 80	Undetermined Severe
MW-34	QNS	Middle Distillate / Gasoline	Gasoline Middle Distillate	75 25	Moderate Moderate
MW-41	0.8154	Middle Distillate / Gasoline	Gasoline Middle Distillate	35 65	Moderate Extreme
MW-42	QNS	Middle Distillate / Gasoline	Gasoline Middle Distillate Polynuclear Aromatics	45 50 5	Moderate Severe Undetermined
MW-44	0.7802	Middle Distillate / Gasoline	Gasoline Middle Distillate	70 30	Slight Moderate
OW-2	0.8084	Middle Distillate / Gasoline	Gasoline Middle Distillate	90 10	High High
OW-12	0.805	Middle Distillate / Gasoline	Gasoline Middle Distillate	75 25	Moderate High
OW-13	QNS	Middle Distillate / Gasoline	Gasoline Middle Distillate	65 35	Moderate Moderate-High
OW-17	QNS	Middle Distillate / Gasoline	Unknown Light Ends Stoddard Solvent Unknown Mid Range Material	5 30 65	Undetermined Undetermined Undetermined
OW-18	0.8241	Middle Distillate / Gasoline	Gasoline Middle Distillate	90 10	Moderate-High Moderate
RW-22	QNS	Middle Distillate / Gasoline	Premium Gasoline Middle Distillate	95 5	Slight Extreme
RW-23	0.759	Middle Distillate / Gasoline	Premium Gasoline Middle Distillate	95 5	Slight High
RW-24	0.7667	Middle Distillate / Gasoline	Premium Gasoline Middle Distillate	95 5	Slight Extreme
S-77	0.7677	Light End Feed Stock	Estimated as Heavy Virgin Naphtha Middle Distillate	95 5	High Severe
S-83	0.8066	Middle Distillate / Gasoline	Gasoline Middle Distillate	50 50	Moderate-High Severe
S-126	QNS	Lube Oil	Unknown Light Material Middle Distillate Lubricating Oil	2 10 88	Undetermined Severe Estimated Severe
S-160	0.7436	Light End Feed Stock	Heavy Virgin Naphtha Estimated as Middle Distillate	98 2	Moderate Severe
S-161	QNS	Light End Feed Stock	Heavy Virgin Naphtha Estimated as Middle Distillate	98 2	Moderate Severe
S-198	QNS	Middle Distillate / Gasoline	Gasoline Middle Distillate	70 30	Moderate Moderate
S-199	0.7923	Middle Distillate / Gasoline	Gasoline Middle Distillate	55 45	Slight Slight
S-200	0.8143	Middle Distillate / Gasoline	Gasoline Middle Distillate	60 40	Slight Moderate
S-201	0.803	Middle Distillate / Gasoline	Gasoline Middle Distillate	40 60	Slight Slight
S-205	QNS	Middle Distillate / Gasoline	Gasoline Middle Distillate	70 30	High Extreme
S-208	QNS	Middle Distillate / Gasoline	Gasoline Middle Distillate	10 90	High Severe
S-213	QNS	Middle Distillate / Gasoline	Gasoline Middle Distillate	40 60	Severe Extreme

Notes:

*LNAPL Characterization Data Provided by SECOR from 1999 and 2000 Sampling Activities

1. Characterization Data Provided by Torkelson Geochemistry of Tulsa, OK
2. QNS = Quantity Not Sufficient for Density Determination
3. LNAPL was not present in S-117 during the AOI 1Site Characterization Field Activities. LNAPL was detected in S-117 and sampled as a part of the Current Conditions Report (February 2004)
4. NA = Not Applicable

Table E2
Input Data For American Petroleum Institute's van Genuchten - Mualem Model of LNAPL Distribution and Relative Permeability
AOI 1 Site Charaterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Monitoring Point	LNAPL Density (g/ml @ 60°F)	LNAPL	API Database						API or Environment Canada Database		
ID	Density[1]	Thickness[3] (ft)	Porosity Well ID (unitless)	USCS Soil Type Surrounding Well Screen[2]	van Genuchten "N" (unitless)	van Genuchten "a" (ft^{-1})	Irreducible Water Saturation[3] (unitless)	LNAPL Type or Source of Surrogate LNAPL Type (Torkelson Geochemistry)	Air/Water Surface Tension[4] (dynes/cm)	Air/LNAPL Surface Tension (dynes/cm)	LNAPL/Water Surface Tension (dynes/cm)
S-76	0.7851	1.38	0.428	SM	2.16	0.8382	0.31	Coker Naphtha/Middle Distillate Mix	65	26.9	22.3
S-82	0.8410	0.04	0.426	SP	1.98	0.4115	0.321	Coker Naphtha/Middle Distillate Mix	65	26.9	22.3
RW-401	0.7930	0.09	0.443	SW	3.26	0.8748	0.114	S-82	65	26.9	22.3
PZ-401	0.7930	0.01	0.443	SW	3.26	0.8748	0.114	S-82	65	26.9	22.3
RW-406	0.7930	0.38	0.443	SW	3.26	0.8748	0.114	S-82	65	26.9	22.3
OW-18	0.8241	0.08	0.428	SM	2.16	0.8382	0.31	Gasoline	62.51	24.21	17.21
OW-2	0.8084	0.27	0.428	SM	2.16	0.8382	0.31	Gasoline	62.51	24.21	17.21
RW-22	0.8650	0.09	0.428	SM	2.16	0.8382	0.31	Gasoline	62.51	24.21	17.21
RW-23	0.7590	0.80	0.428	SM	2.16	0.8382	0.31	Gasoline	62.51	24.21	17.21
RW-24	0.7667	0.35	0.428	SM	2.16	0.8382	0.31	Gasoline	62.51	24.21	17.21
S-81	0.7948	0.53	0.426	SP	1.98	0.4115	0.321	Gasoline	62.51	24.21	17.21
S-75	0.7948	0.09	0.426	SP	1.98	0.4115	0.321	S-81	62.51	24.21	17.21
RW-4	0.8650	2.66	0.428	SM	2.16	0.8382	0.31	RW-24	62.51	24.21	17.21
RW-21	0.7667	0.28	0.443	SW	3.26	0.8748	0.114	RW-24	62.51	24.21	17.21
S-187	0.7948	0.01	0.426	SP	1.98	0.4115	0.321	S-81	62.51	24.21	17.21
S-189	0.7948	0.06	0.426	SP	1.98	0.4115	0.321	S-81	62.51	24.21	17.21
S-190	0.7948	0.11	0.443	SW	3.26	0.8748	0.114	S-81	62.51	24.21	17.21
MW-27	0.7979	0.43	0.428	SM	2.16	0.8382	0.31	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
MW-28	0.7918	1.22	0.428	SM	2.16	0.8382	0.31	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
MW-29	0.7945	2.29	0.428	SM	2.16	0.8382	0.31	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
MW-34*	0.7802	0.01	0.443	SW	3.26	0.8748	0.114	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
MW-41	0.8154	0.56	0.443	SW	3.26	0.8748	0.114	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
MW-42*	0.7923	0.01	0.443	SW	3.26	0.8748	0.114	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
MW-44	0.7802	0.10	0.443	SW	3.26	0.8748	0.114	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
OW-12	0.8050	0.37	0.428	SM	2.16	0.8382	0.31	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
OW-13*	0.8650	0.01	0.428	SM	2.16	0.8382	0.31	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
S-100*	0.7930	0.01	0.443	SW	3.26	0.8748	0.114	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
S-198	0.7923	0.24	0.443	SW	3.26	0.8748	0.114	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
S-199	0.7923	0.82	0.443	SW	3.26	0.8748	0.114	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
S-200*	0.8143	0.01	0.443	SW	3.26	0.8748	0.114	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
S-201	0.8030	0.66	0.443	SW	3.26	0.8748	0.114	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
S-205	0.8066	0.08	0.443	SW	3.26	0.8748	0.114	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
S-213*	0.8066	0.01	0.443	SW	3.26	0.8748	0.114	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
S-83	0.8066	0.17	0.443	SW	3.26	0.8748	0.114	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
S-89	0.8523	0.09	0.426	SP	1.98	0.4115	0.321	Gasoline/Middle Distillate Mix	65.7	23.3	14.4
MW-26	0.8650	1.36	0.428	SM	2.16	0.8382	0.31	S-198	65.7	23.3	14.4
PZ-403	0.8520	0.41	0.426	SP	1.98	0.4115	0.321	S-89	65.7	23.3	14.4
PZ-404	0.8520	0.36	0.426	SP	1.98	0.4115	0.321	S-89	65.7	23.3	14.4
OW-16	0.8050	0.42	0.428	SM	2.16	0.8382	0.31	OW-12	65.7	23.3	14.4
RW-405	0.8523	0.02	0.426	SP	1.98	0.4115	0.321	S-89	65.7	23.3	14.4
S-160	0.7436	0.2	0.426	SP	1.98	0.4115	0.321	Heavy Virgin Naphtha	65	21	50
S-161	0.7498	0.09	0.426	SP	1.98	0.4115	0.321	Heavy Virgin Naphtha	65	21	50
S-162	0.7498	0.22	0.426	SP	1.98	0.4115	0.321	Heavy Virgin Naphtha	65	21	50
S-50	0.7508	0.21	0.426	SP	1.98	0.4115	0.321	Heavy Virgin Naphtha	65	21	50
S-77	0.7677	0.62	0.428	SM	2.16	0.8382	0.313	Heavy Virgin Naphtha	65	21	50
S-210	0.7508	0.71	0.443	SW	3.26	0.8748	0.114	S-50	65	21	50
MW-33	0.8000	0.01	0.428	SM	2.16	0.8382	0.31	Middle Distillate	57.7	28.6	16.6
S-208*	0.8406	0.01	0.443	SW	3.26	0.8748	0.114	Middle Distillate	57.7	28.6	16.6
S-78	0.8406	0.03	0.426	SP	1.98	0.4115	0.321	Middle Distillate	57.7	28.6	16.6
S-79	0.8406	0.12	0.426	SP	1.98	0.4115	0.321	Middle Distillate	57.7	28.6	16.6
OW-17*	0.8650	0.01	0.428	SM	2.16	0.8382	0.31	Middle Distillate/Stoddard Solvent Mix	57.7	28.6	16.6
S-126	0.9016	0.01	0.443	SW	3.26	0.8748	0.114	Lube Oil	65	31.6	27.1

Notes:

1. Density values were determined from LNAPL samples taken by Aquaterra on February 27th , March 1st, 2004, and April 2005, or from samples collected by SECOR in 1999-2000.
2. For wells with no direct LNAPL density measurements, the density value in the nearest well with a direct density was used.
3. Depth to Water and Depth to LNAPL provided by Handex, May 9-11, 2005.
4. All Groundwater elevations collected during the month of April 2005. Only wells accessible during gauging event are listed.

* Sufficeint quantity of LNAPL obtained for fingerprinting, but insufficient for LNAPL thickness measurement, therefore a value of 0.01 ft was assigned.

AOI = Area of Interest
g/ml = grams per milliliter
LNAPL = Light Non-Aqueous Phase Liquid
amsl = above mean sea level

USCS Soil Descriptions (API Database)

SW = Gravelly Sand
SM = Silty Sand
SP = Sand

Interfacial/Surface Tension Data Source

- Coker naphtha/middle distillate mix from Env Canada Database
- Gasoline from API Database
- Gasoline/middle distiallate mix from S-198 (PTS Geolab Data, 2005)
- Heavy virgin naphtha from Env Canada Database
- Middle distillate from S-34 (PTS Geoloab Data, 2005)
- Middle distillate/Stoddard Solvent mix as middle distillate from S-34 (PTS Geolab Data, 2005)
- Lube oil from Env Canada Database

Table E3
LNAPL Seepage Velocity Parameter Input Table
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Sunoco Philadelphia Refinery
Philadephia, Pennsylvania

Well Number	LNAPL Type or Source of Surrogate LNAPL Type	Effective Porosity of Soil	Groundwater Density @ 70F (kg/m^3)	Groundwater Kinematic Viscosity @70F (centistokes)	Groundwater Kinematic Viscosity @70F (m^2/sec)	Groundwater Dynamic Viscosity @70F (N·s/m^2)	Soil Permeability (m^2)	Kro	Groundwater Gradient	Kinematic Viscosity of SPL (centistokes)	Kinematic Viscosity of SPL (m^2/sec)	Dynamic Viscosity of SPL (N·s/m^2)	SPL Density (kg/m3)	NAPL K @ 100% Saturation (m/day)	Corrected NAPL K (m/day)	NAPL Specific Discharge (m/day)	Final NAPL Seepage Velocity (ft/d)
	Torkelson Geochemistry	PTS	Literature Value	PTS	Calculated	Calculated	PTS	API Model	Groundwater Contour Map	PTS	Calculated	Calculated	PTS	Calculated	Calculated	Calculated	Calculated
S-76	Coker Naphtha/Middle Distillate Mix	0.428	1000	1.000	1.000E-06	0.001	3.20E-12	4.65E-02	0.0035	4.4800	4.480E-06	3.52E-03	785.100	0.605	2.815E-02	9.85E-05	7.55E-04
S-82	Coker Naphtha/Middle Distillate Mix	0.426	1000	1.000	1.000E-06	0.001	3.34E-12	1.14E-07	0.0035	4.4800	4.480E-06	3.77E-03	841.000	0.632	7.231E-08	2.53E-10	1.95E-09
RW-401	S-82	0.443	1000	1.000	1.000E-06	0.001	6.02E-12	4.92E-15	0.0035	4.4800	4.480E-06	3.55E-03	793.000	1.139	5.601E-15	1.96E-17	1.45E-16
PZ-401	S-82	0.443	1000	1.000	1.000E-06	0.001	6.02E-12	1.64E-09	0.0035	4.4800	4.480E-06	3.55E-03	793.000	1.139	1.869E-09	6.54E-12	4.85E-11
RW-406	S-82	0.443	1000	1.000	1.000E-06	0.001	6.02E-12	2.51E-05	0.0035	4.4800	4.480E-06	3.55E-03	793.000	1.139	2.857E-05	1.00E-07	7.41E-07
OW-18	Gasoline	0.428	1000	1.000	1.000E-06	0.001	3.20E-12	4.54E-06	0.0035	0.7733	7.733E-07	6.37E-04	824.100	3.507	1.591E-05	5.57E-08	4.27E-07
OW-2	Gasoline	0.428	1000	1.000	1.000E-06	0.001	3.20E-12	4.78E-04	0.0035	0.7733	7.733E-07	6.25E-04	808.400	3.507	1.676E-03	5.87E-06	4.50E-05
RW-22	Gasoline	0.428	1000	1.000	1.000E-06	0.001	3.20E-12	2.56E-06	0.0035	0.7733	7.733E-07	6.69E-04	865.000	3.507	8.994E-06	3.15E-08	2.41E-07
RW-23	Gasoline	0.428	1000	1.000	1.000E-06	0.001	3.20E-12	3.34E-02	0.0035	0.7733	7.733E-07	5.87E-04	759.000	3.507	1.171E-01	4.10E-04	3.14E-03
RW-24	Gasoline	0.428	1000	1.000	1.000E-06	0.001	3.20E-12	2.69E-03	0.0035	0.7733	7.733E-07	5.93E-04	766.700	3.507	9.435E-03	3.30E-05	2.53E-04
S-81	Gasoline	0.426	1000	1.000	1.000E-06	0.001	3.34E-12	1.16E-03	0.0035	0.7733	7.733E-07	6.15E-04	794.800	3.661	4.247E-03	1.49E-05	1.14E-04
S-75	S-81	0.426	1000	1.000	1.000E-06	0.001	3.34E-12	5.05E-06	0.0035	0.7730	7.730E-07	6.14E-04	794.800	3.662	1.848E-05	6.47E-08	4.98E-07
RW-4	RW-24	0.426	1000	1.000	1.000E-06	0.001	3.34E-12	9.96E-02	0.0035	0.7733	7.733E-07	6.69E-04	865.000	3.661	3.647E-01	1.28E-03	9.83E-03
RW-21	RW-24	0.443	1000	1.000	1.000E-06	0.001	6.02E-12	6.46E-05	0.0035	0.7733	7.733E-07	5.93E-04	766.700	6.598	4.260E-04	1.49E-06	1.10E-05
S-187	S-81	0.426	1000	1.000	1.000E-06	0.001	3.34E-12	1.60E-09	0.0035	0.7733	7.733E-07	6.15E-04	794.800	3.661	5.860E-09	2.05E-11	1.58E-10
S-189	S-81	0.426	1000	1.000	1.000E-06	0.001	3.34E-12	1.67E-06	0.0035	0.7733	7.733E-07	6.15E-04	794.800	3.661	6.122E-06	2.14E-08	1.65E-07
S-190	S-81	0.443	1000	1.000	1.000E-06	0.001	6.02E-12	1.85E-08	0.0035	0.7733	7.733E-07	6.15E-04	794.800	6.598	1.219E-07	4.27E-10	3.16E-09
MW-27	Gasoline/Middle Distillate Mix	0.428	998.3	1.070	1.070E-06	0.001	6.02E-12	6.36E-03	0.0035	1.0500	1.050E-06	8.38E-04	797.900	4.859	3.088E-02	1.08E-04	8.29E-04
MW-28	Gasoline/Middle Distillate Mix	0.428	998.3	1.070	1.070E-06	0.001	6.02E-12	9.70E-02	0.0035	1.0500	1.050E-06	8.31E-04	791.800	4.859	4.714E-01	1.65E-03	1.26E-02
MW-29	Gasoline/Middle Distillate Mix	0.428	998.3	1.070	1.070E-06	0.001	6.02E-12	2.42E-01	0.0035	1.0500	1.050E-06	8.34E-04	794.500	4.859	1.176E+00	4.12E-03	3.16E-02
MW-34	Gasoline/Middle Distillate Mix	0.443	998.3	1.070	1.070E-06	0.001	6.02E-12	2.92E-13	0.0035	1.0500	1.050E-06	8.19E-04	780.200	4.859	1.421E-12	4.97E-15	3.68E-14
MW-41	Gasoline/Middle Distillate Mix	0.443	998.3	1.070	1.070E-06	0.001	6.02E-12	2.39E-03	0.0035	1.0500	1.050E-06	8.56E-04	815.400	4.859	1.160E-02	4.06E-05	3.01E-04
MW-42	Gasoline/Middle Distillate Mix	0.443	998.3	1.070	1.070E-06	0.001	6.02E-12	6.12E-14	0.0035	1.0500	1.050E-06	8.32E-04	792.300	4.859	2.972E-13	1.04E-15	7.70E-15
MW-44	Gasoline/Middle Distillate Mix	0.443	998.3	1.070	1.070E-06	0.001	6.02E-12	6.78E-08	0.0035	1.0500	1.050E-06	8.19E-04	780.200	4.859	3.297E-07	1.15E-09	8.55E-09
OW-12	Gasoline/Middle Distillate Mix	0.428	998.3	1.070	1.070E-06	0.001	6.02E-12	3.42E-03	0.0035	1.0500	1.050E-06	8.45E-04	805.000	4.859	1.663E-02	5.82E-05	4.46E-04
OW-13	Gasoline/Middle Distillate Mix	0.428	998.3	1.070	1.070E-06	0.001	6.02E-12	3.68E-09	0.0035	1.0500	1.050E-06	9.08E-04	865.000	4.859	1.787E-08	6.26E-11	4.80E-10
S-100	Gasoline/Middle Distillate Mix	0.443	998.3	1.070	1.070E-06	0.001	6.02E-12	1.57E-13	0.0035	1.0500	1.050E-06	8.33E-04	793.000	4.859	7.642E-13	2.67E-15	1.98E-14
S-198	Gasoline/Middle Distillate Mix	0.443	998.3	1.070	1.070E-06	0.001	6.02E-12	4.86E-05	0.0035	1.0500	1.050E-06	8.32E-04	792.300	4.859	2.362E-04	8.27E-07	6.12E-06
S-199	Gasoline/Middle Distillate Mix	0.443	998.3	1.070	1.070E-06	0.001	6.02E-12	3.39E-02	0.0035	1.0500	1.050E-06	8.32E-04	792.300	4.859	1.646E-01	5.76E-04	4.27E-03
S-200	Gasoline/Middle Distillate Mix	0.443	998.3	1.070	1.070E-06	0.001	6.02E-12	5.58E-14	0.0035	1.0500	1.050E-06	8.55E-04	814.300	4.859	2.710E-13	9.48E-16	7.02E-15
S-201	Gasoline/Middle Distillate Mix	0.443	998.3	1.070	1.070E-06	0.001	6.02E-12	9.25E-03	0.0035	1.0500	1.050E-06	8.43E-04	803.000	4.859	4.497E-02	1.57E-04	1.17E-03
S-205	Gasoline/Middle Distillate Mix	0.443	998.3	1.070	1.070E-06	0.001	6.02E-12	9.04E-09	0.0035	1.0500	1.050E-06	8.47E-04	806.600	4.859	4.393E-08	1.54E-10	1.14E-09
S-213	Gasoline/Middle Distillate Mix	0.443	998.3	1.070	1.070E-06	0.001	6.02E-12	8.13E-14	0.0035	1.0500	1.050E-06	8.47E-04	806.600	4.859	3.950E-13	1.38E-15	1.02E-14
S-83	Gasoline/Middle Distillate Mix	0.443	998.3	1.070	1.070E-06	0.001	6.02E-12	6.18E-07	0.0035	1.0500	1.050E-06	8.47E-04	806.600	4.859	3.003E-06	1.05E-08	7.78E-08
S-89	Gasoline/Middle Distillate Mix	0.426	998.3	1.070	1.070E-06	0.001	6.02E-12	3.64E-06	0.0035	1.0500	1.050E-06	8.95E-04	852.300	4.859	1.771E-05	6.20E-08	4.77E-07
MW-26	S-198	0.428	998.3	1.070	1.070E-06	0.001	6.02E-12	3.88E-02	0.0035	1.0500	1.050E-06	9.08E-04	865.000	4.859	1.884E-01	6.60E-04	5.06E-03
PZ-403	S-89	0.426	998.3	1.070	1.070E-06	0.001	6.02E-12	3.58E-04	0.0035	1.0500	1.050E-06	8.95E-04	852.000	4.859	1.738E-03	6.08E-06	4.68E-05
PZ-404	S-89	0.426	998.3	1.070	1.070E-06	0.001	6.02E-12	2.45E-04	0.0035	1.0500	1.050E-06	8.95E-04	852.000	4.859	1.188E-03	4.16E-06	3.20E-05
OW-16	OW-12	0.428	998.3	1.070	1.070E-06	0.001	6.02E-12	5.08E-03	0.0035	1.0500	1.050E-06	8.45E-04	805.000	4.859	2.470E-02	8.65E-05	6.63E-04
RW-405	S-89	0.426	998.3	1.070	1.070E-06	0.001	6.02E-12	4.88E-08	0.0035	1.0500	1.050E-06	8.95E-04	852.300	4.859	2.372E-07	8.30E-10	6.39E-09
S-160	Heavy Virgin Naphtha	0.426	1000	1.000	1.000E-06	0.001	6.02E-12	4.14E-06	0.0035	0.9580	9.580E-07	7.12E-04	743.600	5.326	2.207E-05	7.73E-08	5.95E-07
S-161	Heavy Virgin Naphtha	0.426	1000	1.000	1.000E-06	0.001	6.02E-12	3.84E-07	0.0035	0.9580	9.580E-07	7.18E-04	749.800	5.326	2.043E-06	7.15E-09	5.51E-08
S-162	Heavy Virgin Naphtha	0.426	1000	1.000	1.000E-06	0.001	6.02E-12	5.06E-06	0.0035	0.9580	9.580E-07	7.18E-04	749.800	5.326	2.694E-05	9.43E-08	7.26E-07
S-50	Heavy Virgin Naphtha	0.426	1000	1.000	1.000E-06	0.001	6.02E-12	4.37E-06	0.0035	0.9580	9.580E-07	7.19E-04	750.800	5.326	2.330E-05	8.15E-08	6.28E-07
S-77	Heavy Virgin Naphtha	0.428	1000	1.000	1.000E-06	0.001	6.02E-12	3.09E-04	0.0035	0.9580	9.580E-07	7.35E-04	767.700	5.326	1.647E-03	5.76E-06	4.42E-05
S-210	S-50	0.443	1000	1.000	1.000E-06	0.001	6.02E-12	1.02E-05	0.0035	0.9580	9.580E-07	7.19E-04	750.800	5.326	5.451E-05	1.91E-07	1.41E-06
MW-33	Middle Distillate	0.428	999.4	0.997	9.970E-07	0.001	6.02E-12	8.67E-09	0.0035	4.4800	4.480E-06	3.58E-03	800.000	1.139	9.870E-09	3.45E-11	2.65E-10
S-208	Middle Distillate	0.443	999.4	0.997	9.970E-07	0.001	6.02E-12	3.13E-15	0.0035	4.4800	4.480E-06	3.77E-03	840.600	1.139	3.560E-15	1.25E-17	9.23E-17
S-78	Middle Distillate	0.426	999.4	0.997	9.970E-07	0.001	3.34E-12	9.77E-08	0.0035	4.4800	4.480E-06	3.77E-03	840.600	0.632	6.173E-08	2.16E-10	1.66E-09
S-79	Middle Distillate	0.426	999.4	0.997	9.970E-07	0.001	3.34E-12	4.60E-06	0.0035	4.4800	4.480E-06	3.77E-03	840.600	0.632	2.908E-06	1.02E-08	7.84E-08
OW-17	Middle Distillate/Stoddard Solvent Mix	0.428	999.4	0.997	9.970E-07	0.001	3.20E-12	1.51E-09	0.0035	4.4800	4.480E-06	3.88E-03	865.000	0.605	9.154E-10	3.20E-12	2.46E-11
S-126	Lube Oil	0.443	1000	1.000	1.000E-06	0.001	6.02E-12	5.74E-18	0.0035	73.0000	7.300E-05	6.58E-02	901.600	0.070	4.013E-19	1.40E-21	1.04E-20

NOTES:
(1) arithmetic average of all values report by PTS from Shelby-tube sample analysis.
kg/m^3 = kilogram per cubic meter
m^2/sec = square meters per second
N·s/m^2 = Newton-seconds per square meter
m = meter
m/d = meter per day
ft/d = feet per day

FIGURES

Analysis Request/ Environmental Services Chain of Custody

Acct. #: _____ Sample #: _____

Client: Langan Engineering Acct. #:

Project Name/#: Sun - Philadelphia Refinery/~~Belmont Terminal~~ PWSID #:

Project Manager: K. Martin (Aquaterra) J. Hanna (Langan Eng) P.O; #:

Sampler: M. Brad Spancake Quote #:

Name of State where samples were collected: PA

Sample Identification	Date Collected	Time Collected	Grab	Composite	Matrix: Soil	Matrix: Water (Potable / NPDES)	Matrix: Other	Total # of Containers	Analyses Requested: GC Fingerprint	Remarks	Temperature of samples upon receipt (if applicable)
S198-LNAPL-042005	4/20/05	1035	X				X	1	X		
S199-LNAPL-042005		1045	X				X	1	X		
S200-LNAPL-042005		1100	X				X	1	X		
S77-LNAPL-042005		1110	X				X	1	X		
S201-LNAPL-042005		1130	X				X	1	X		
S83-LNAPL-042005		1140	X				X	1	X		
S126-LNAPL-042005		1325	X				X	1	X		
S205-LNAPL-042005		1340	X				X	1	X		
S208-LNAPL-042005		1350	X				X	1	X		
S213-LNAPL-042005		1400	X				X	1	X		

For Lab Use Only: FSC: SCR:

Turnaround Time Requested (TAT) (please Ccircle): (Normal) Rush

(Rush TAT is subject to Lancaster Laboratories approval and surcharge.

Date results are needed: _____

Rush results requested by (please circle): Phone Fax

Phone #: _____ Fax #: _____

SDG Complete? Yes No

State-specific QC required? Yes No

(If yes, indicated QC sample and submit triplecate volume)

Internal Chain-of-Custody required? Yes No

Relinquished by:	Date	Time	Received by:	Date	Time
M. Brad Spancake	4/21/05		Bruce Tinkelman	42205	1000

Analysis Request/ Environmental Services Chain of Custody

Acct. #: _____ Sample #: _____

Client: Langan Engineering Acct. #:

Project Name/#: Sun - Philadelphia Refinery/~~Belmont Terminal~~ HR3 PWSID #:

Project Manager: K. Martin (Aquaterra) J. Hanna (Langan Eng) P.O; #:

Sampler: M. Brad Spancake Quote #:

Name of State where samples were collected: PA

Sample Identification	Date Collected	Time Collected	Grab	Composite	Matrix: Soil	Matrix: Water	Matrix: Other	Total # of Containers	Analyses Requested: GC fingerprint	Remarks
S160-LNAPL-042005	4/20/05	1410	X				X	1	X	
S161-LNAPL-042005	4/20/05	1420	X				X	1	X	
S35-LNAPL-042105	4/21/05	1110	X				X	1	X	
S57-LNAPL-042105	4/21/05	1150	X				X	1	X	
S37-LNAPL-042105	4/21/05	1200	X				X	1	X	
			X				X	1		
			X				X	1		
			X				X	1		
			X				X	1		
			X				X	1		

Matrix: Potable ___ NPDES ___

For Lab Use Only: FSC: SCR:

Temperature of samples upon receipt (if applicable)

Turnaround Time Requested (TAT) (please Ccircle): Normal Rush

(Rush TAT is subject to Lancaster Laboratories approval and surcharge.

Date results are needed: _____

Rush results requested by (please circle): Phone Fax

Phone #: _____ Fax #: _____

SDG Complete? Yes No

State-specific QC required? Yes No

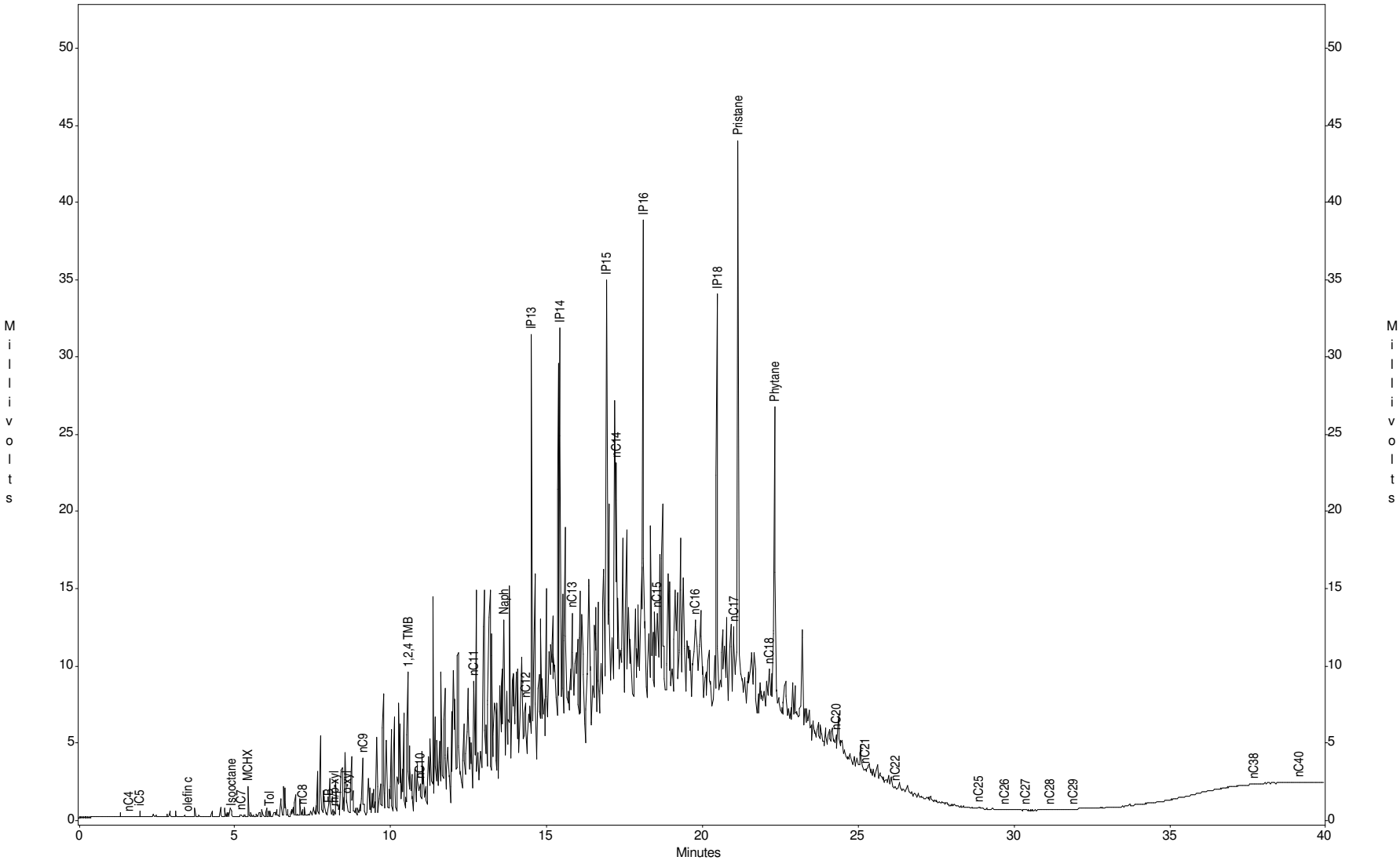
(If yes, indicated QC sample and submit triplecate volume)

Internal Chain-of-Custody required? Yes No

Relinquished by:	Date	Time	Received by:	Date	Time
			Bruce Tarbell	4-22-05	1000
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:	Date	Time

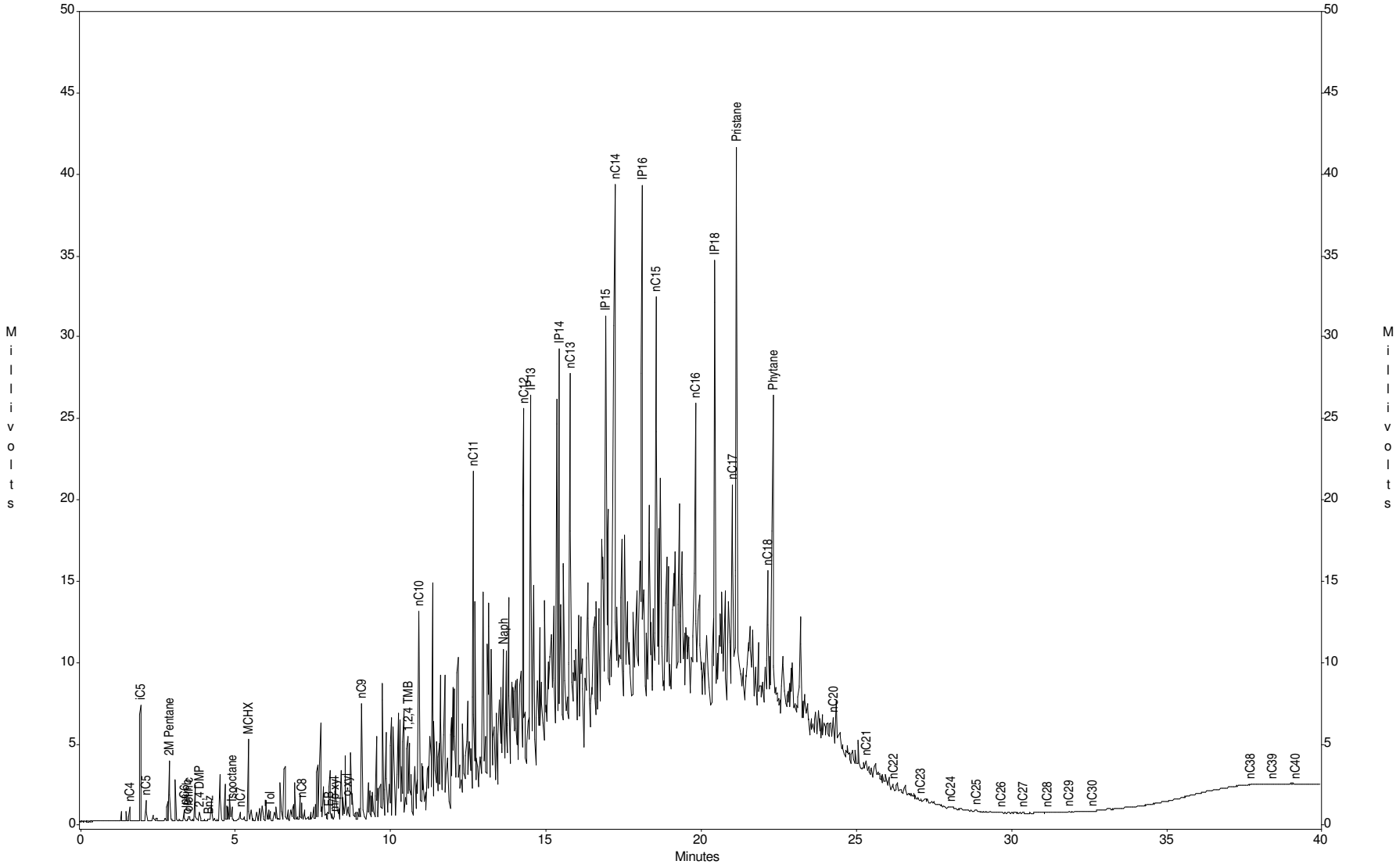
Sun - Philadelphia Refinery
Sample ID : S35-LNAPL-042105
Acquired : Apr 26, 2005 10:07:40

c:\ezchrom\chrom\05054\s35 -- Channel A

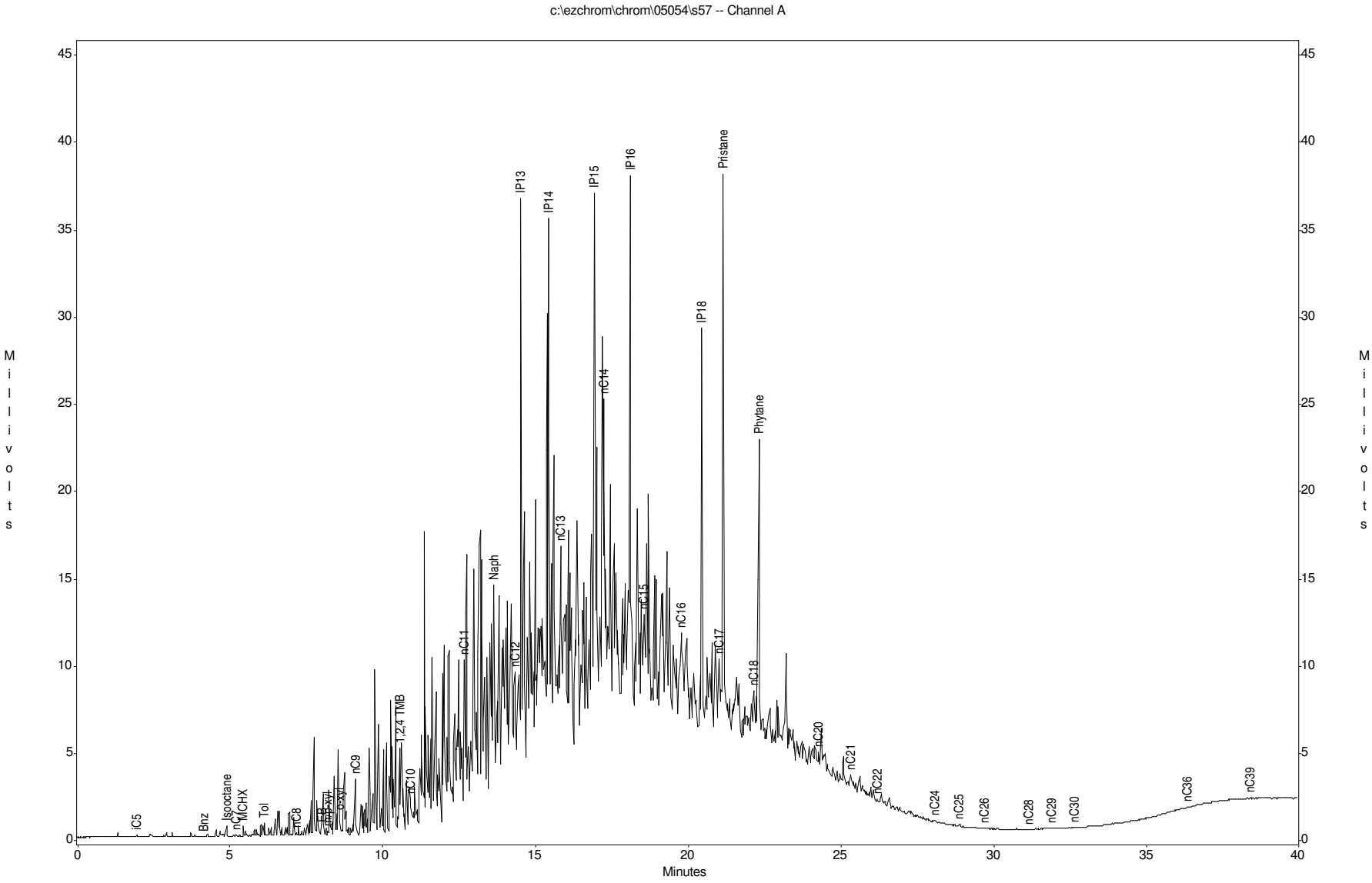


Sun - Philadelphia Refinery
Sample ID : S37-LNAPL-042105
Acquired : Apr 25, 2005 18:27:23

c:\ezchrom\chrom\05054\s37 -- Channel A

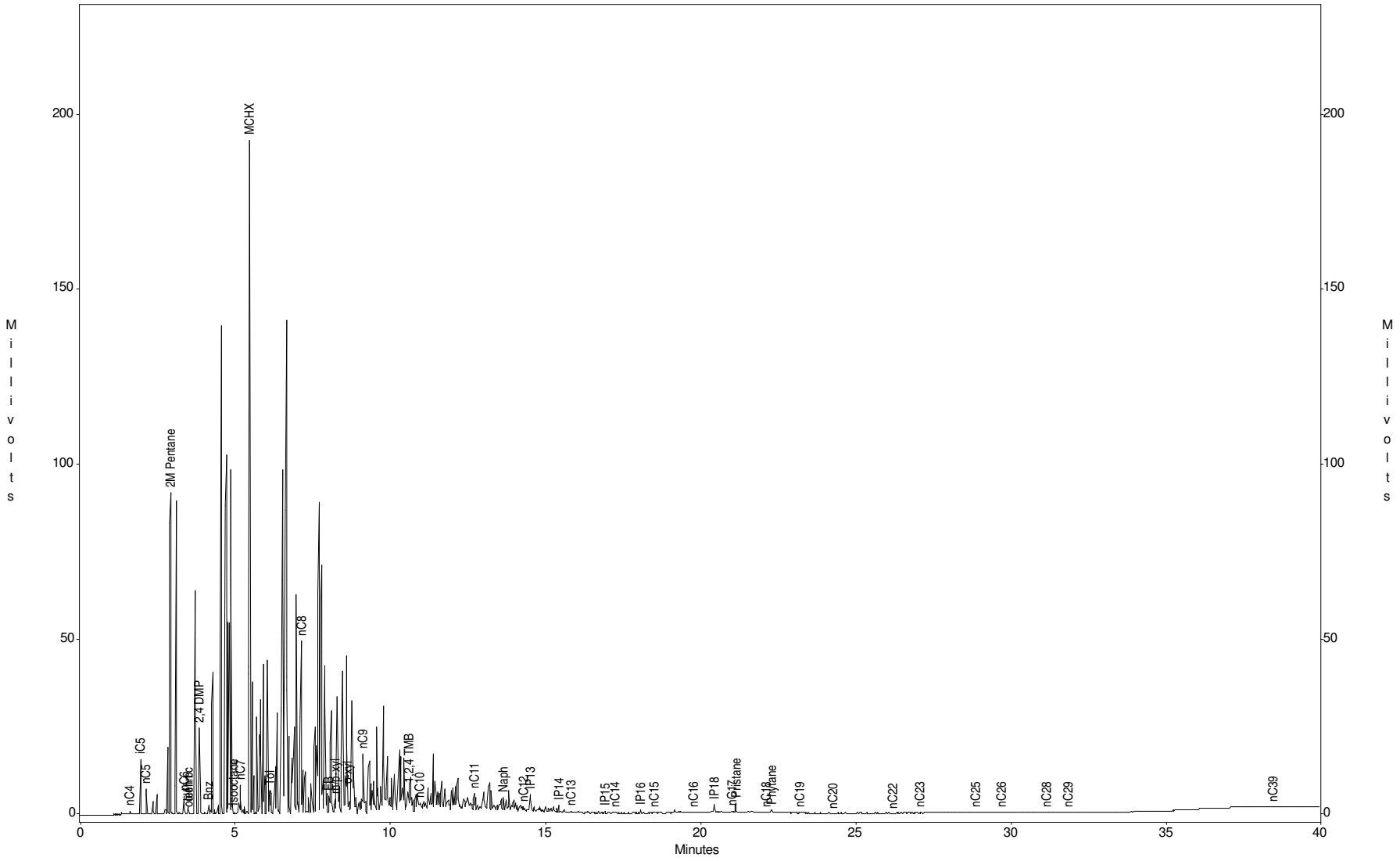


Sun - Philadelphia Refinery
Sample ID : S57-LNAPL-042105
Acquired : Apr 25, 2005 13:27:24



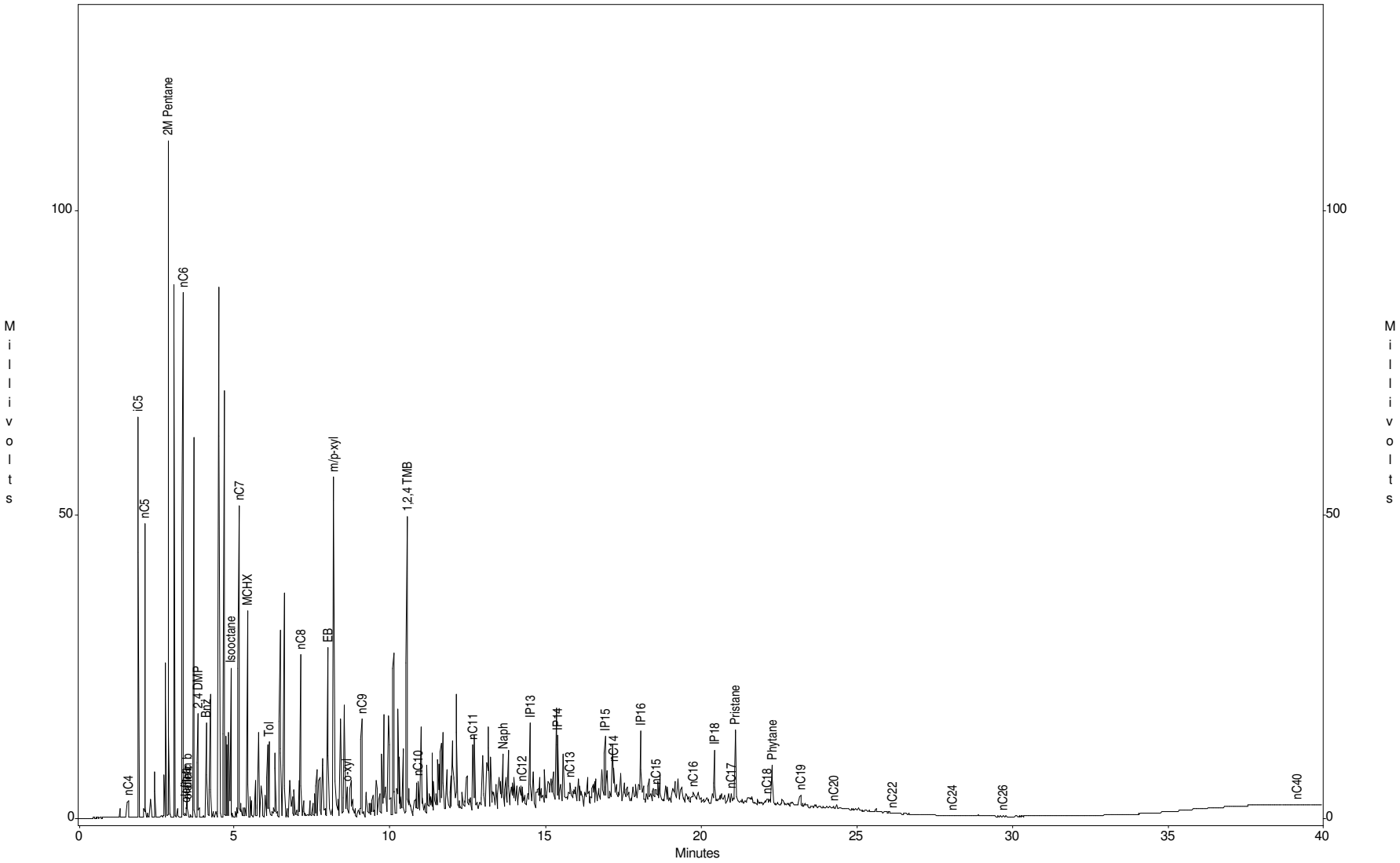
Sun - Philadelphia Refinery
Sample ID : S77-LNAPL-042005
Acquired : Apr 26, 2005 09:19:05

c:\ezchrom\chrom\05054\s77 -- Channel A

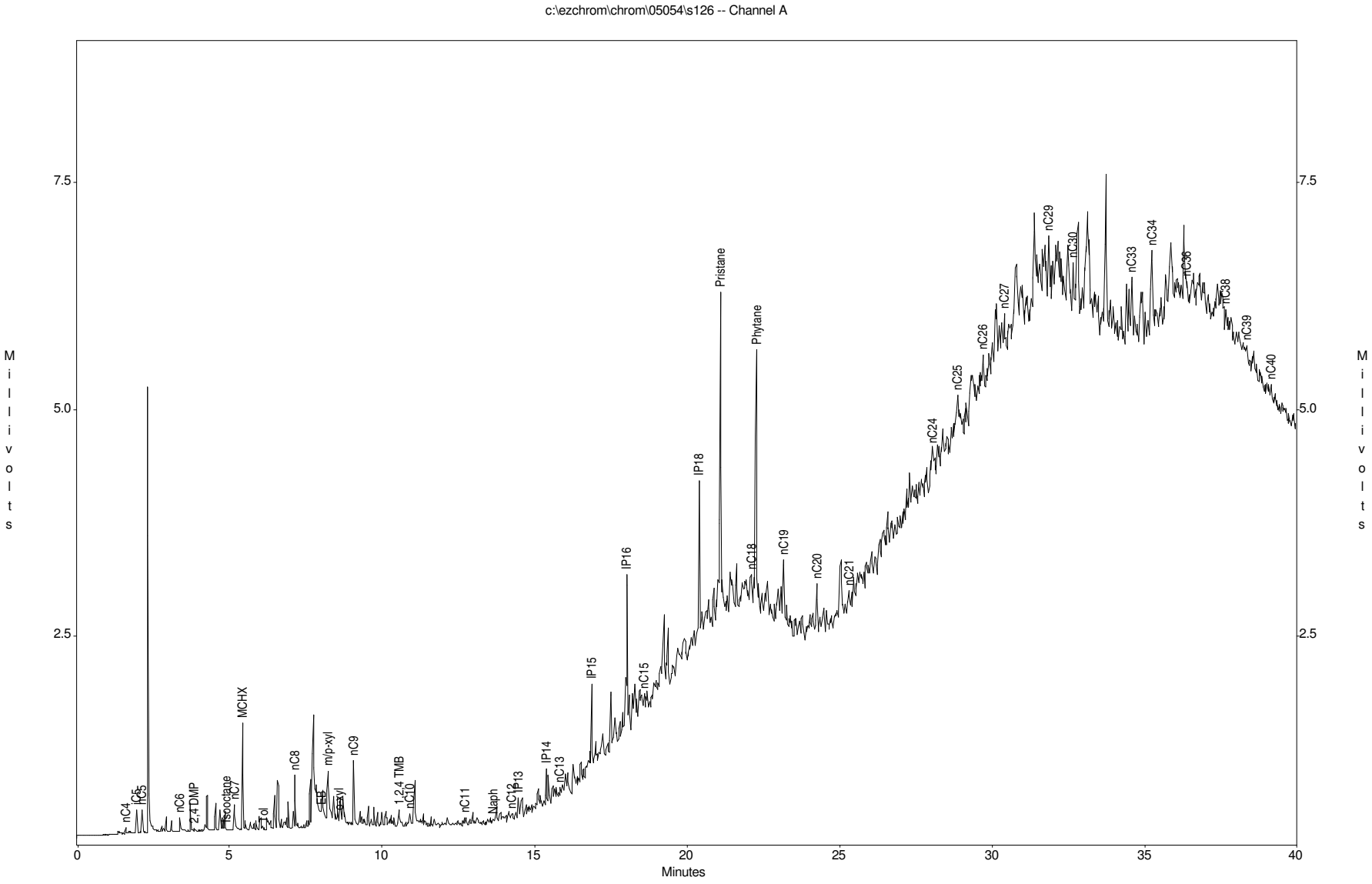


Sun - Philadelphia Refinery
Sample ID : S83-LNAPL-042005
Acquired : Apr 25, 2005 15:59:15

c:\ezchrom\chrom\05054\s83 -- Channel A

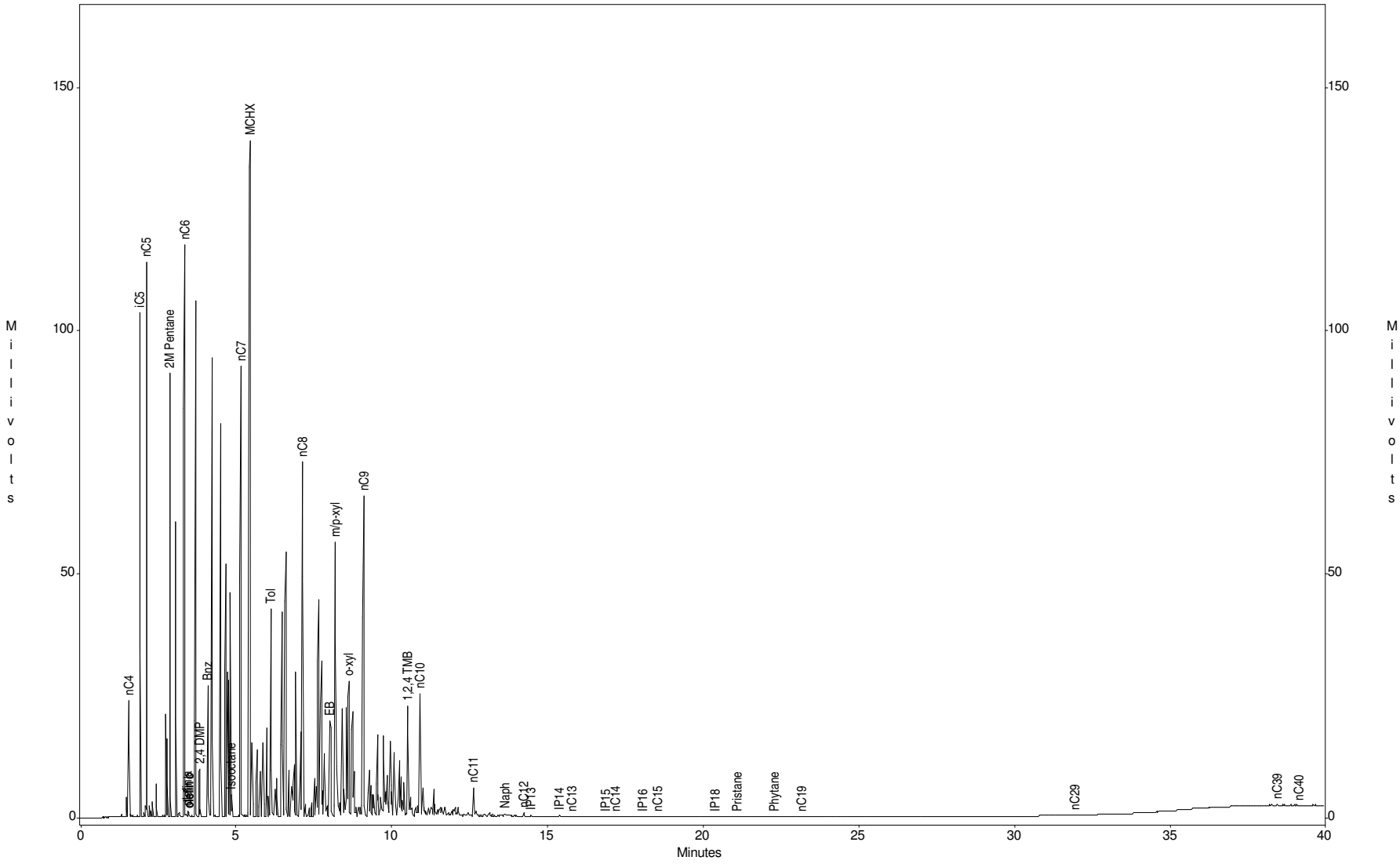


Sun - Philadelphia Refinery
Sample ID : S126-LNAPL-042005
Acquired : Apr 26, 2005 11:46:25



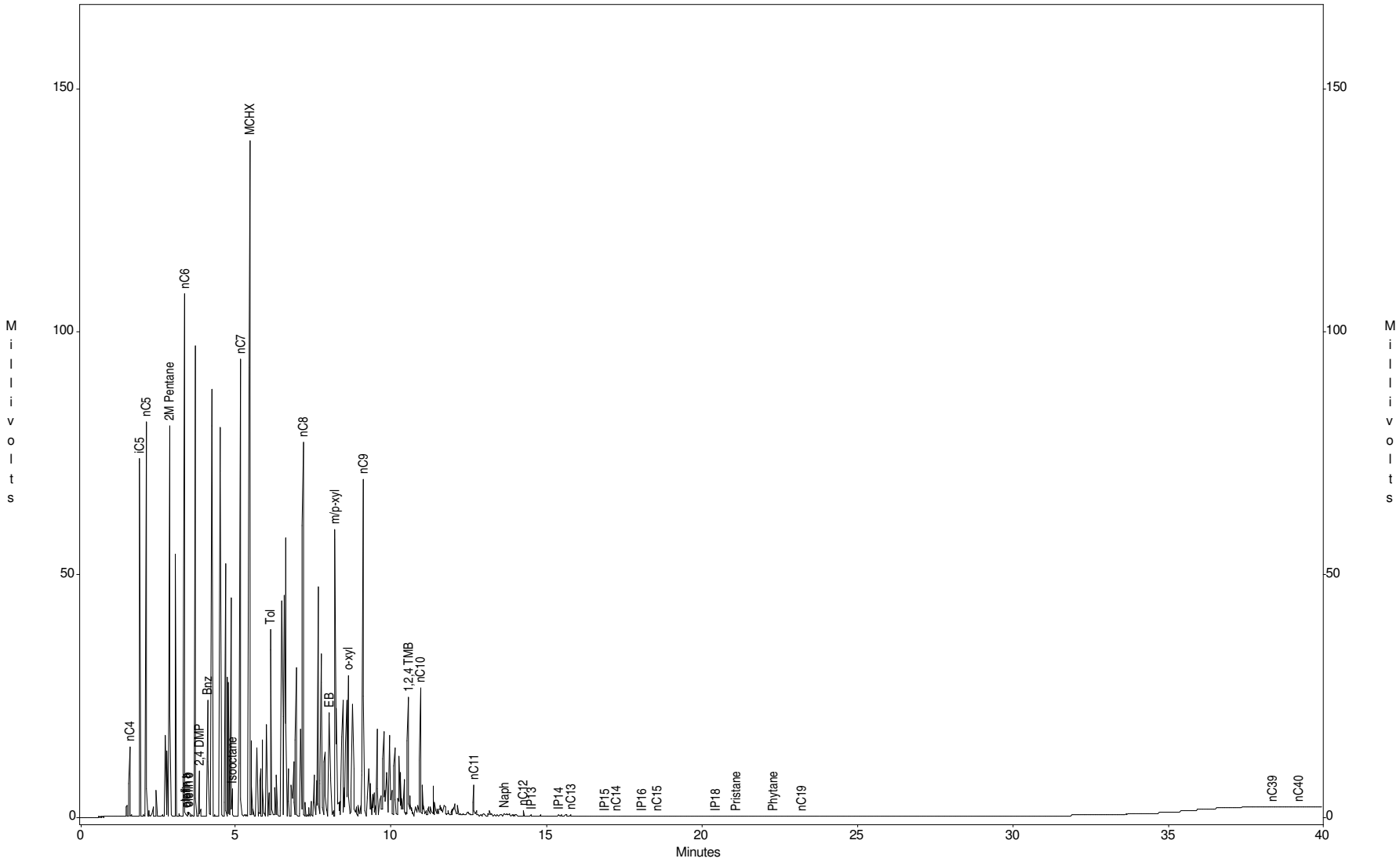
Sun - Philadelphia Refinery
Sample ID : S160-LNAPL-042005
Acquired : Apr 26, 2005 12:42:54

c:\ezchrom\chrom\05054\s160 -- Channel A



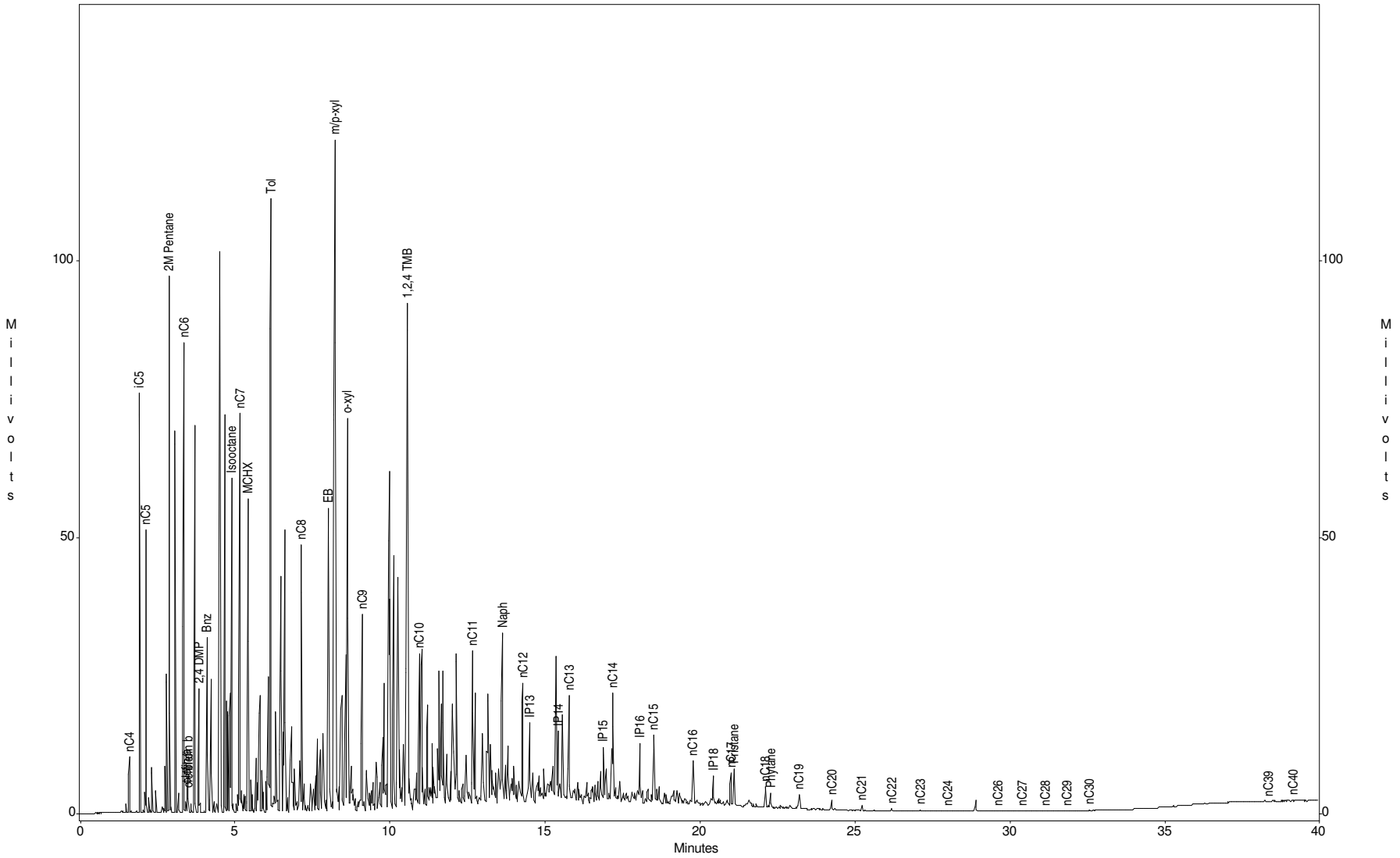
Sun - Philadelphia Refinery
Sample ID : S161-LNAPL-042005
Acquired : Apr 26, 2005 10:58:03

c:\ezchrom\chrom\05054\s161 -- Channel A



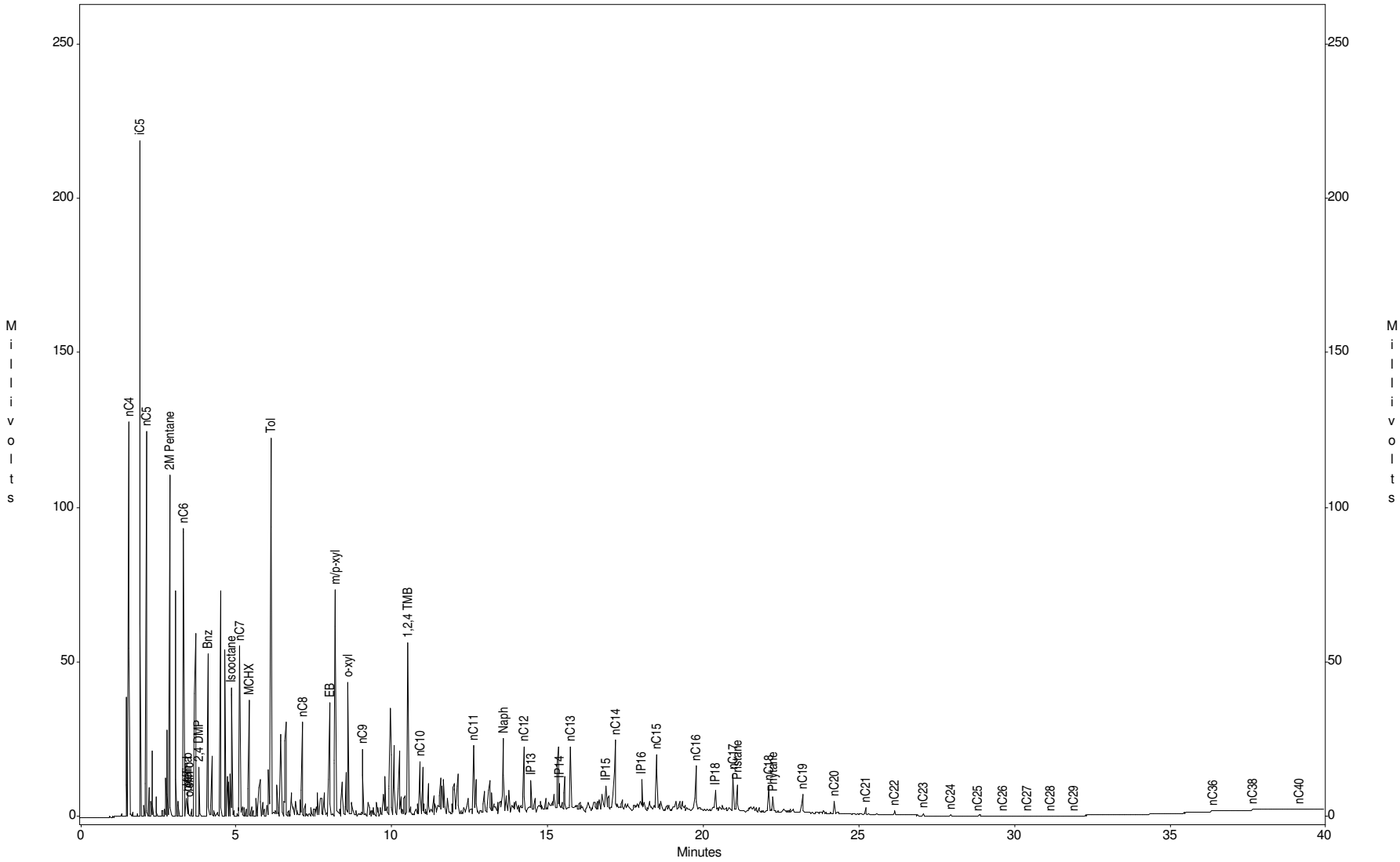
Sun - Philadelphia Refinery
Sample ID : S198-LNAPL-042005
Acquired : Apr 25, 2005 15:11:04

c:\ezchrom\chrom\05054\s198 -- Channel A



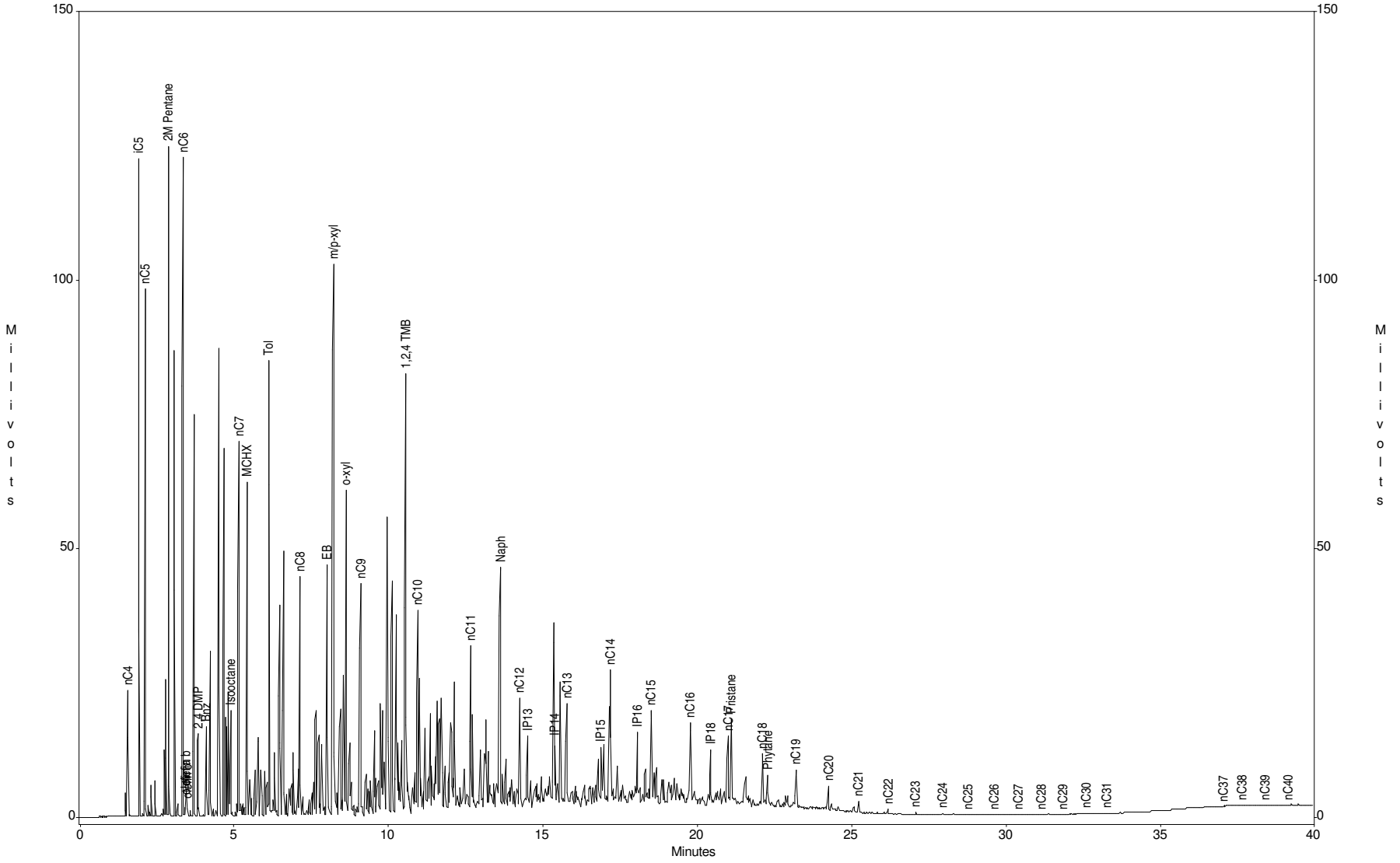
Sun - Philadelphia Refinery
Sample ID : S199-LNAPL-042005
Acquired : Apr 26, 2005 14:20:57

c:\ezchrom\chrom\05054\s199 -- Channel A



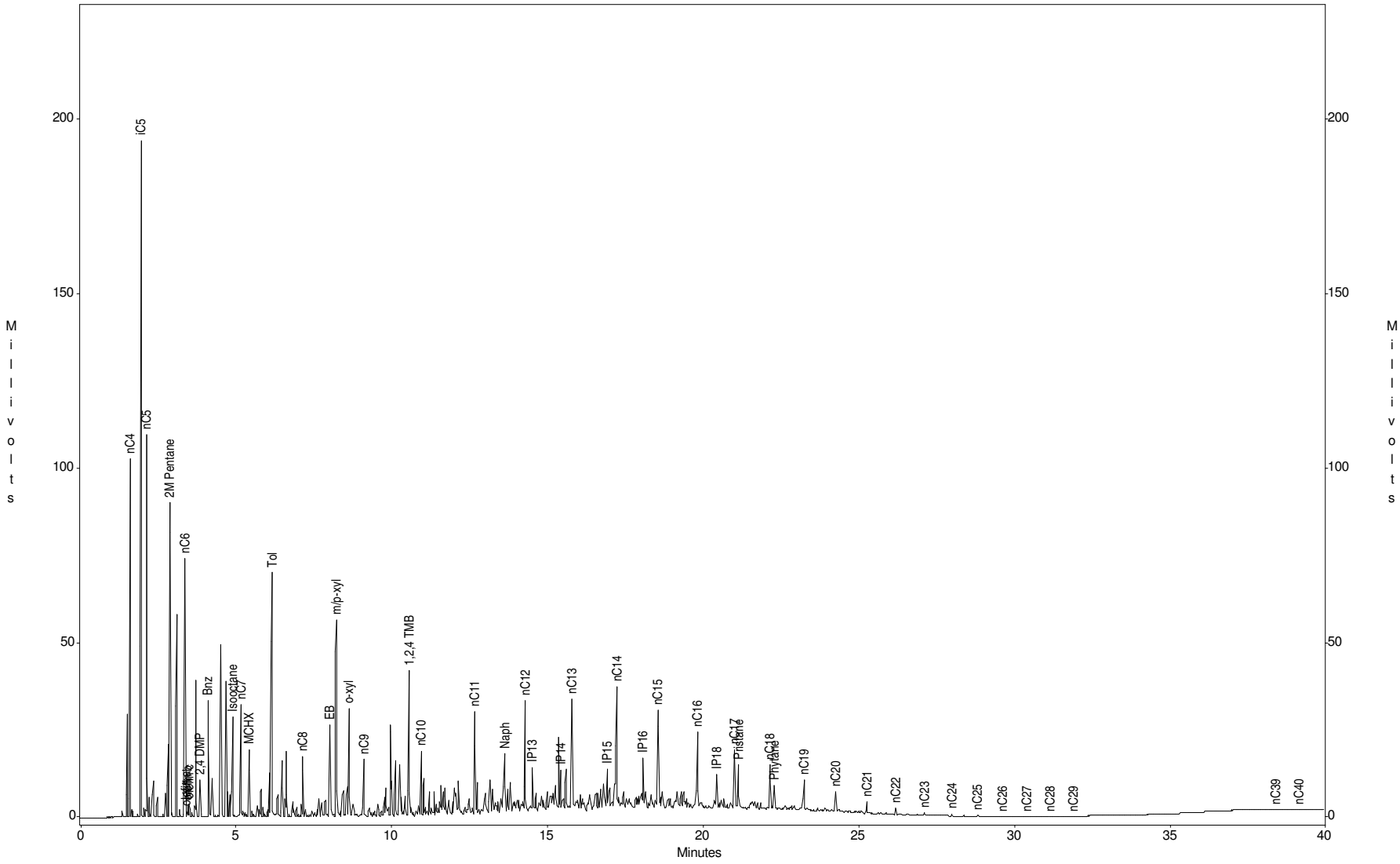
Sun - Philadelphia Refinery
Sample ID : S200-LNAPL-042005
Acquired : Apr 25, 2005 12:38:28

c:\ezchrom\chrom\05054\s200 -- Channel A



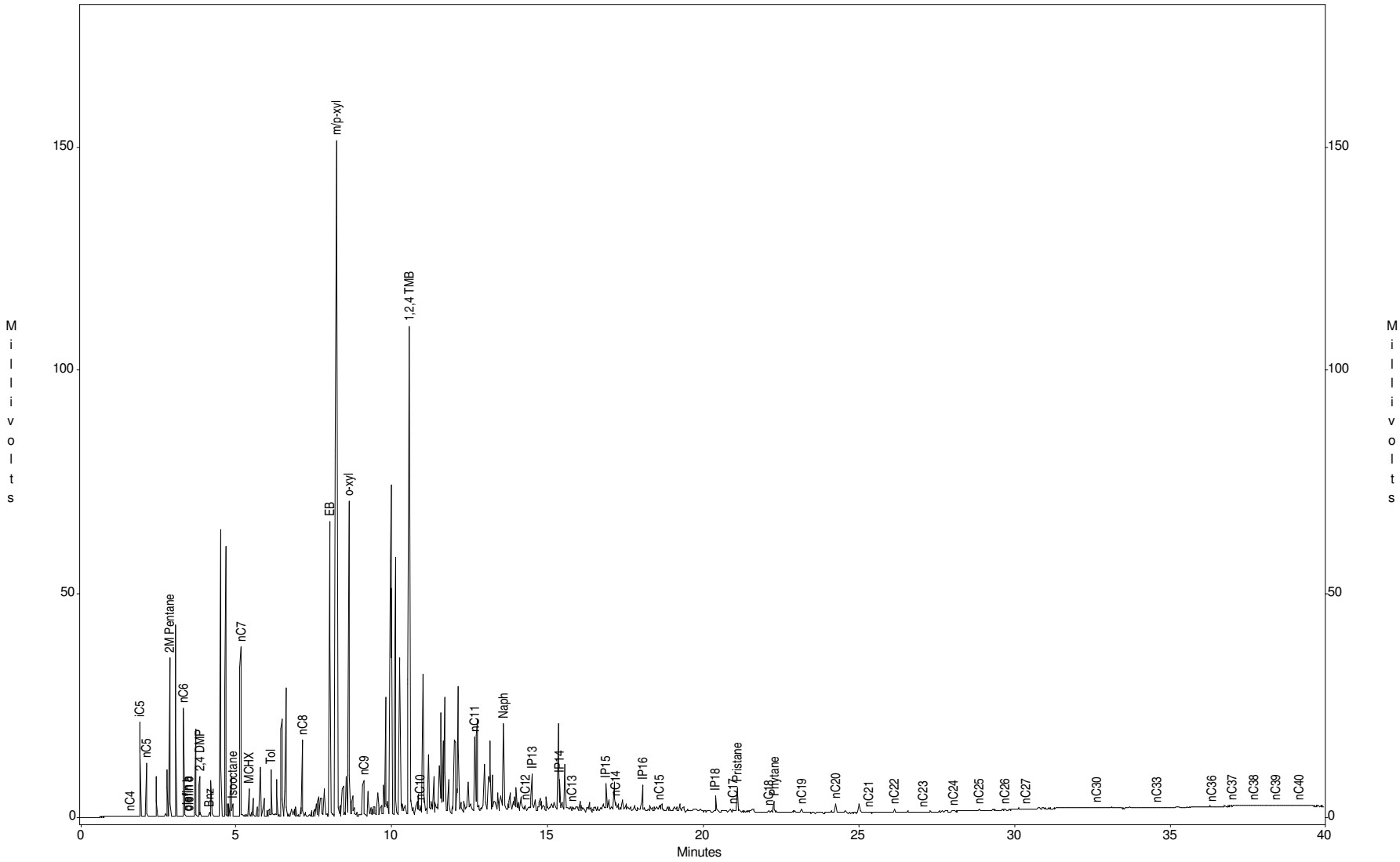
Sun - Philadelphia Refinery
Sample ID : S201-LNAPL-042005
Acquired : Apr 26, 2005 15:10:11

c:\ezchrom\chrom\05054\s201 -- Channel A



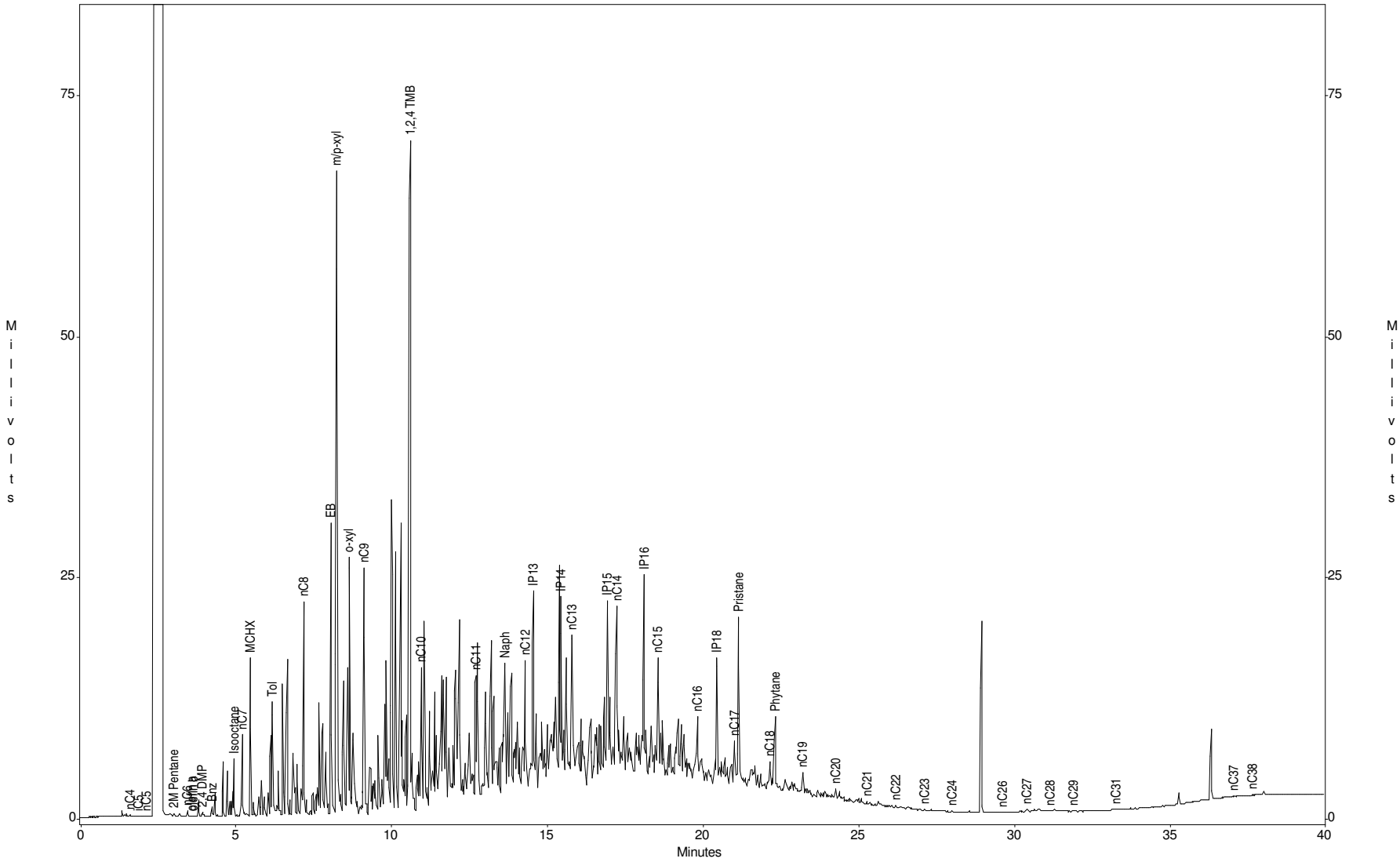
Sun - Philadelphia Refinery
Sample ID : S205-LNAPL-042005
Acquired : Apr 25, 2005 17:38:08

c:\ezchrom\chrom\05054\s205.2 -- Channel A



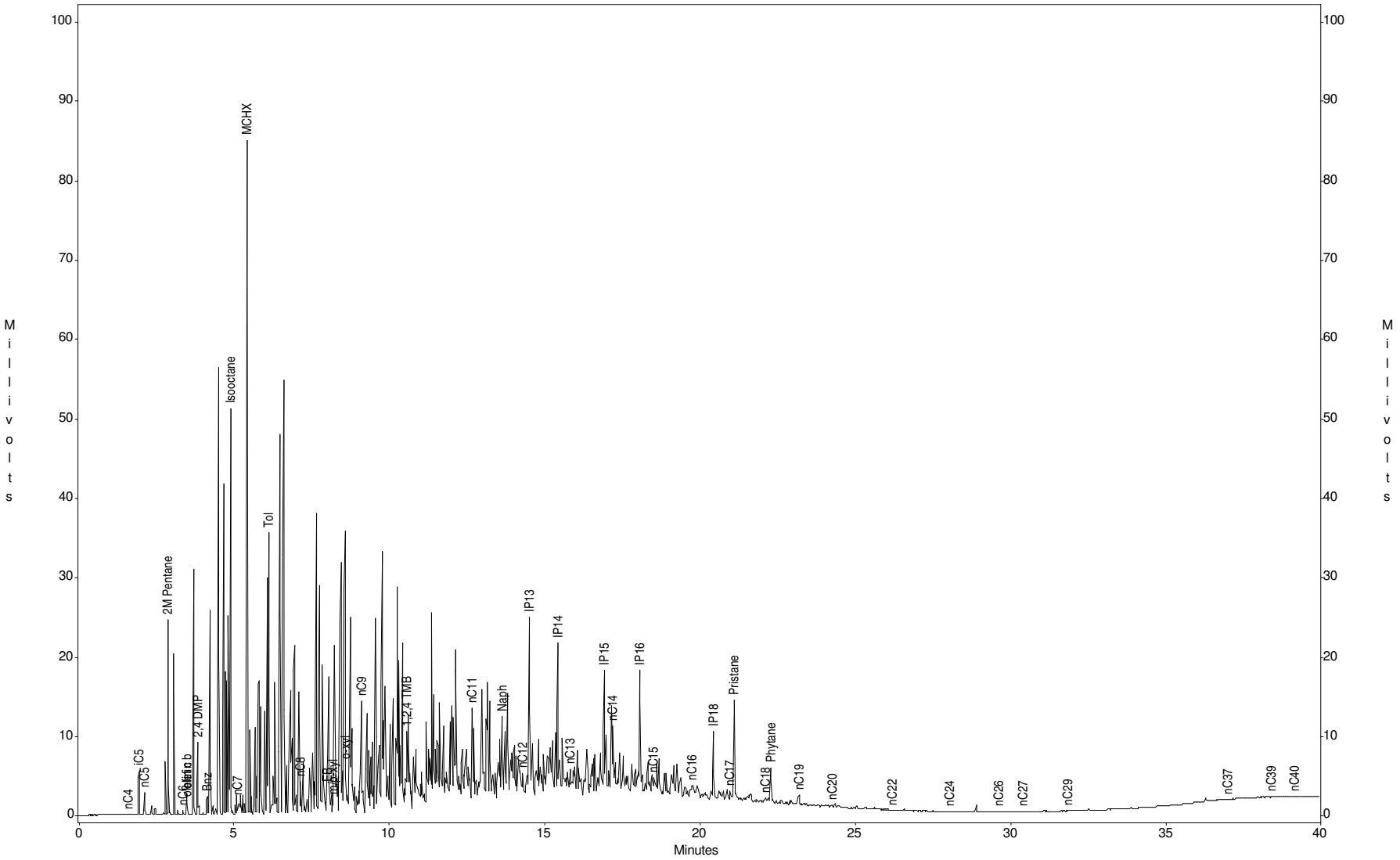
Sun - Philadelphia Refinery
Sample ID : S208-LNAPL-042005
Acquired : Apr 26, 2005 16:47:57

c:\ezchrom\chrom\05054\s208.s -- Channel A



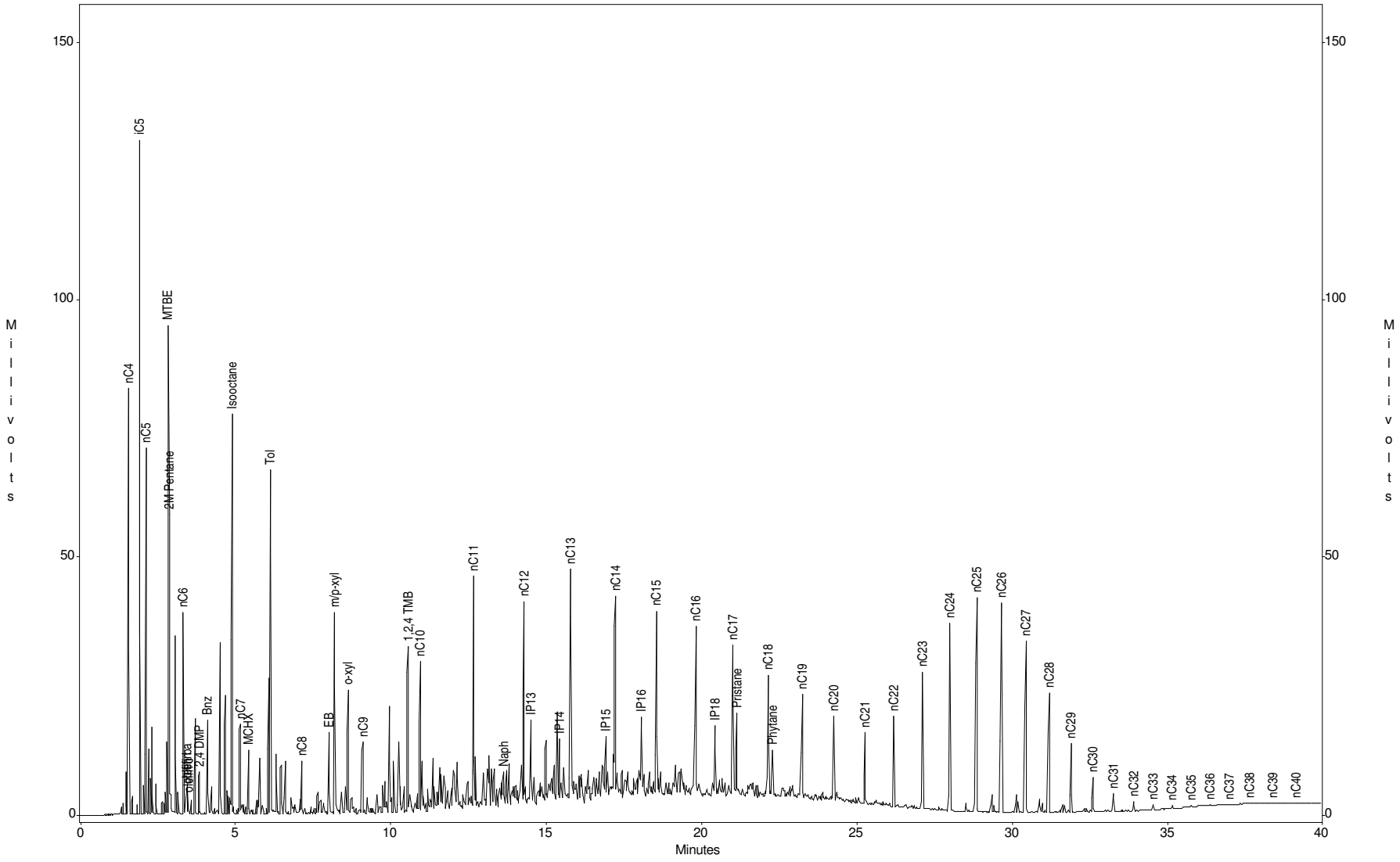
Sun - Philadelphia Refinery
Sample ID : S213-LNAPL-042005
Acquired : Apr 25, 2005 14:19:36

c:\ezchrom\chrom\05054\s213 -- Channel A



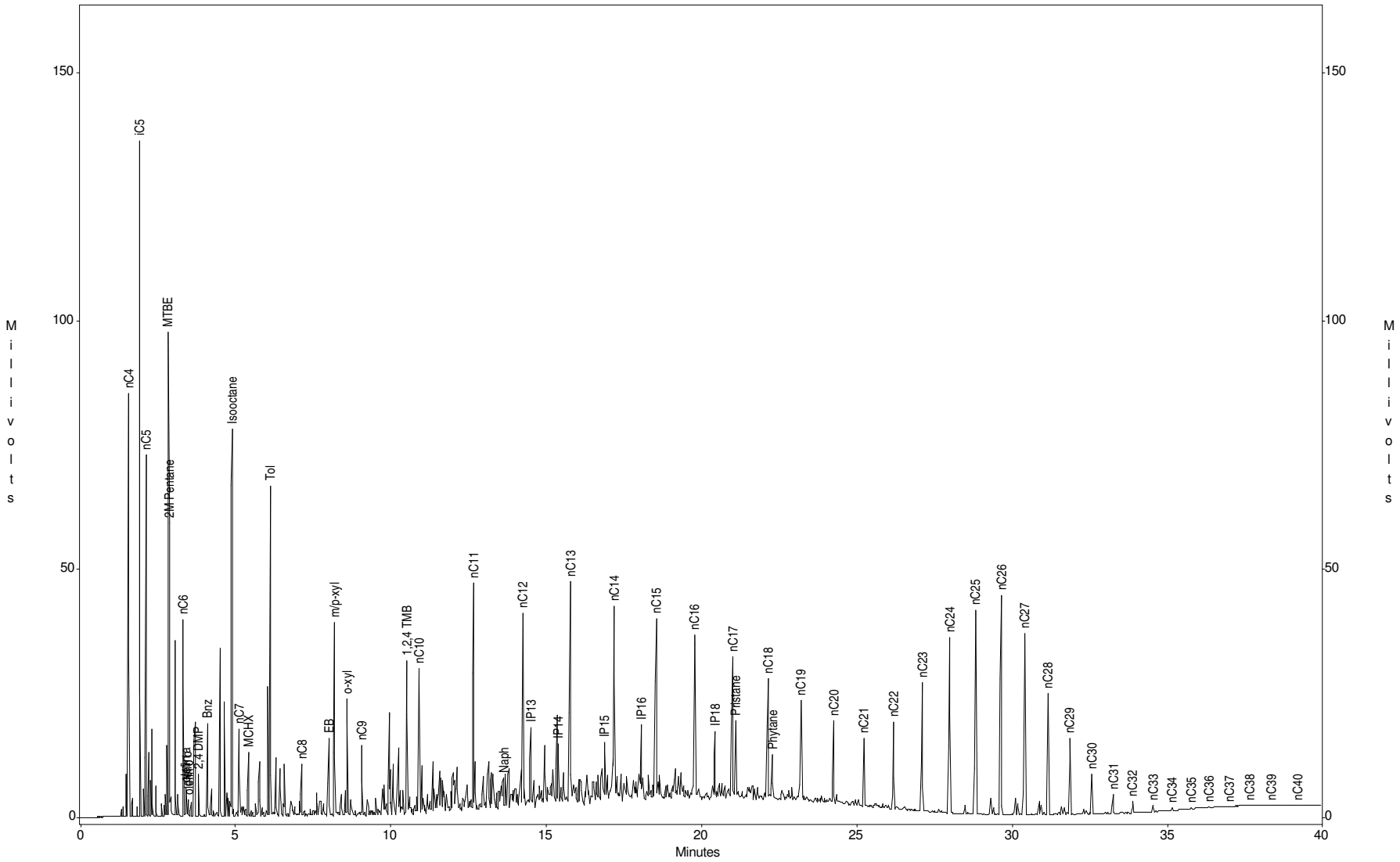
Sun - Philadelphia Refinery
Sample ID : Gas/Dies/Wax std
Acquired : Apr 25, 2005 11:00:43

c:\ezchrom\chrom\05054\gadiwax2 -- Channel A



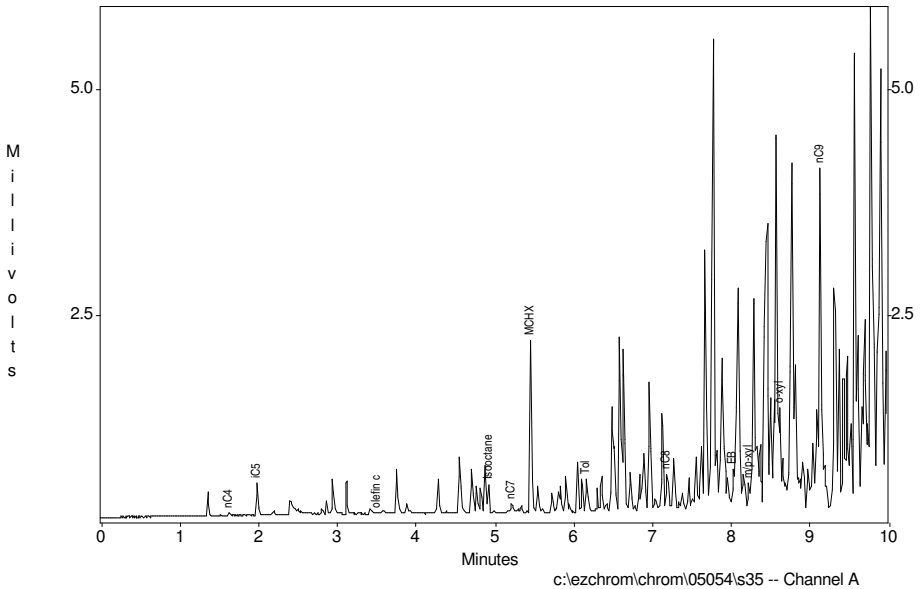
Sun - Philadelphia Refinery
Sample ID : Gas/Dies/Wax std
Acquired : Apr 26, 2005 13:31:55

c:\ezchrom\chrom\05054\gadiwax.2 -- Channel A

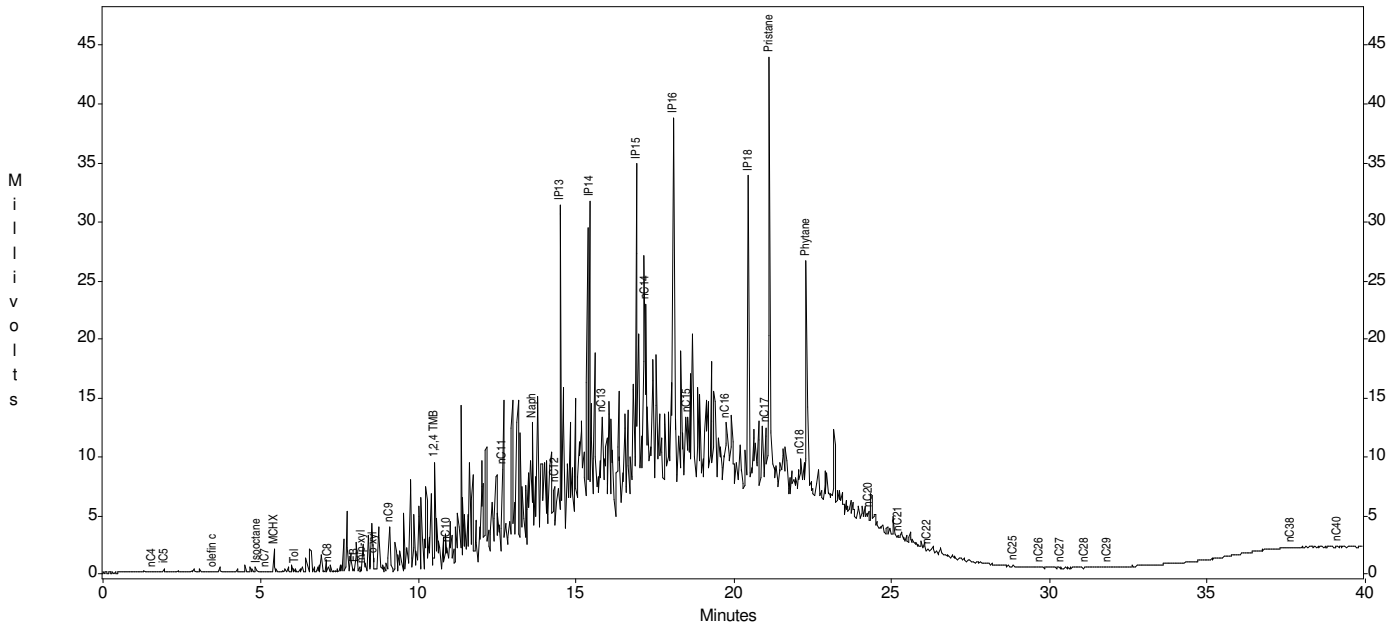


Sun - Philadelphia Refinery
Sample ID : S35-LNAPL-042105
Acquired : Apr 26, 2005 10:07:40

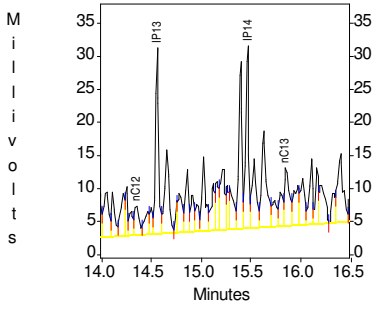
c:\ezchrom\chrom\05054\s35 -- Channel A



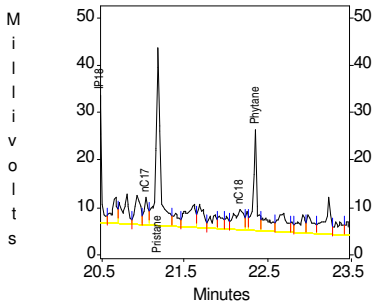
c:\ezchrom\chrom\05054\s35 -- Channel A



c:\ezchrom\chrom\05054\s35 -- Channel A



c:\ezchrom\chrom\05054\s35 -- Channel A

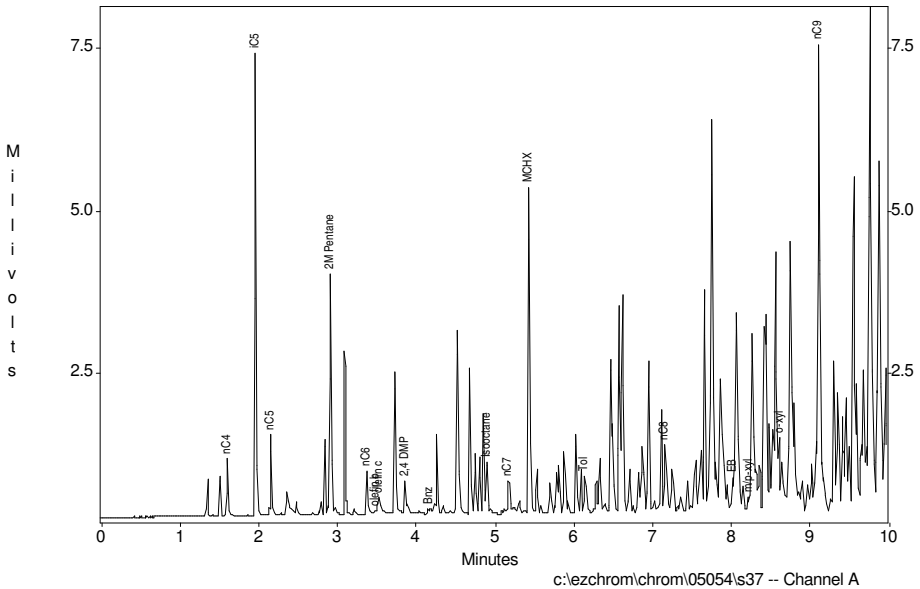


Channel A Results

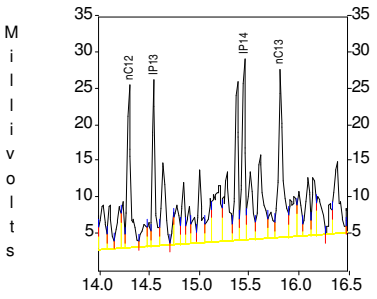
Peak	Area	Height
nC4	41	34
iC5	406	360
nC5	0	0
MTBE	0	0
2M Pentane	0	0
nC6	0	0
olefin a	0	0
olefin b	0	0
olefin c	18	11
2,4 DMP	0	0
Bnz	0	0
Isooctane	466	322
nC7	284	96
MCHX	2769	1919
Tol	626	361
nC8	866	397
EB	729	459
m/p-xyl	484	292
o-xyl	1585	1120
nC9	9779	3771
1,2,4 TMB	22309	9072
nC10	6760	1645
nC11	15135	7186
Naph	26883	10245
nC12	15285	4283
IP13	54748	27961
IP14	50997	27544
nC13	29918	8784
IP15	54293	29055
nC14	39758	16795
IP16	80530	31411
nC15	20820	5379
nC16	38935	5163
IP18	65014	26798
nC17	15677	5743
Pristane	130209	37401
nC18	31460	4108
Phytane	62087	21228
nC19	0	0
nC20	5066	1762
nC21	2131	463
nC22	627	183
nC23	0	0
nC24	0	0
nC25	652	97
nC26	154	57
nC27	118	21
nC28	84	23
nC29	324	21
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	76	17
nC39	0	0
nC40	128	36

Sun - Philadelphia Refinery
Sample ID : S37-LNAPL-042105
Acquired : Apr 25, 2005 18:27:23

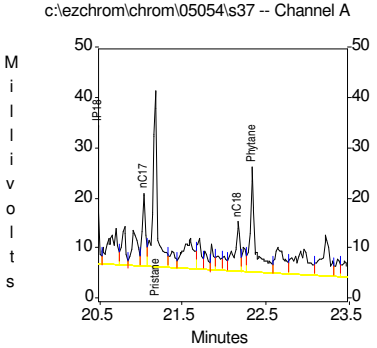
c:\ezchrom\chrom\05054\s37 -- Channel A



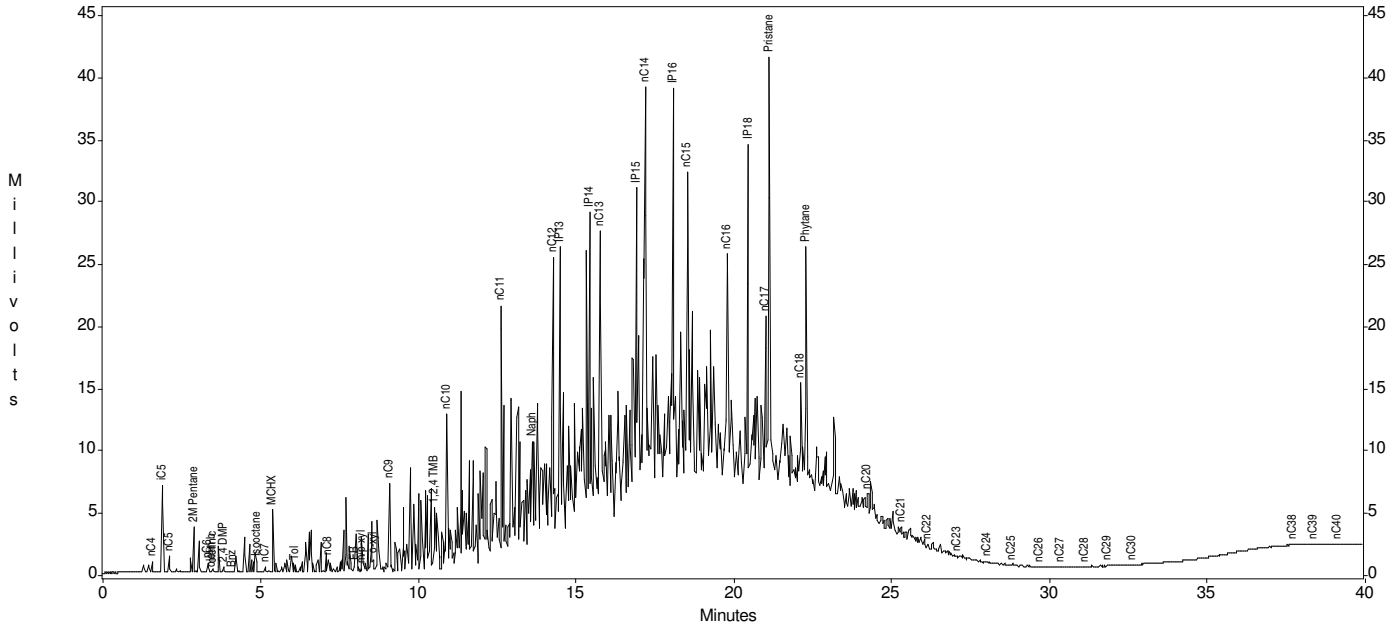
c:\ezchrom\chrom\05054\s37 -- Channel A



c:\ezchrom\chrom\05054\s37 -- Channel A



c:\ezchrom\chrom\05054\s37 -- Channel A

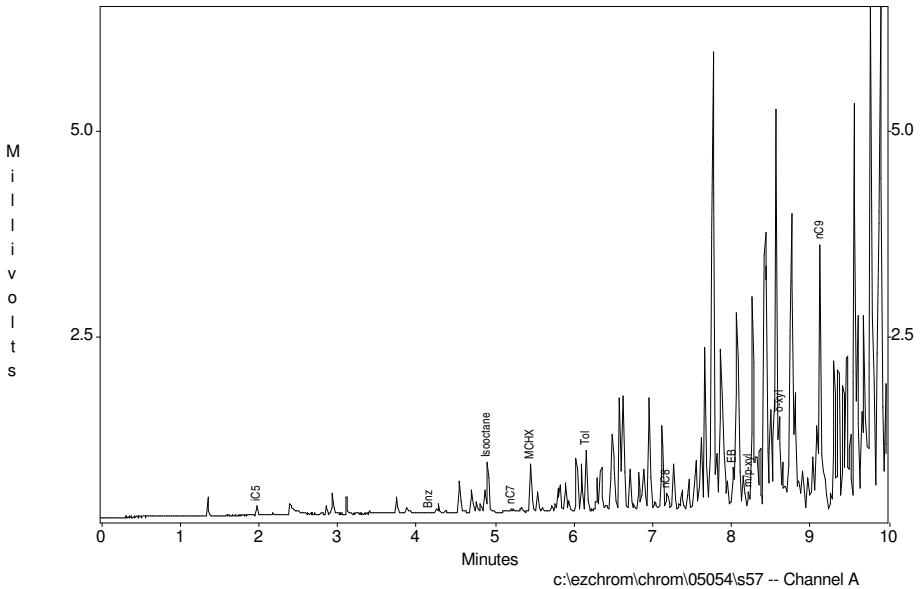


Channel A Results

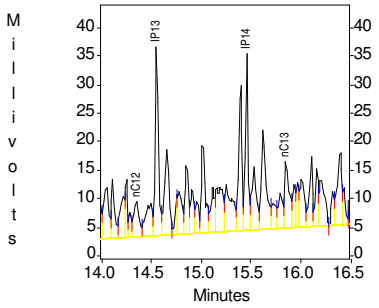
Peak	Area	Height
nC4	696	862
iC5	5974	7102
nC5	1458	1229
MTBE	0	0
2M Pentane	3971	3676
nC6	960	666
olefin a	0	0
olefin b	81	54
olefin c	268	247
2,4 DMP	651	511
Bnz	311	84
Isooctane	1040	792
nC7	995	490
MCHX	6694	4997
Tol	971	557
nC8	1810	1033
EB	824	511
m/p-xyl	325	214
o-xyl	1594	1136
nC9	14633	7149
1,2,4 TMB	15276	4858
nC10	21903	12425
nC11	38135	20066
Naph	19522	8247
nC12	50142	22469
IP13	47283	23108
IP14	45359	25177
nC13	71744	23324
IP15	47838	25543
nC14	73977	33261
IP16	73456	31971
nC15	58566	24531
nC16	64308	18143
IP18	65398	27484
nC17	36514	14196
Pristane	128561	35040
nC18	44957	9884
Phytane	88650	20881
nC19	0	0
nC20	7475	2775
nC21	6968	1053
nC22	1135	364
nC23	240	123
nC24	929	100
nC25	777	104
nC26	144	46
nC27	94	23
nC28	91	30
nC29	409	27
nC30	78	19
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	94	20
nC39	14	8
nC40	11	8

Sun - Philadelphia Refinery
Sample ID : S57-LNAPL-042105
Acquired : Apr 25, 2005 13:27:24

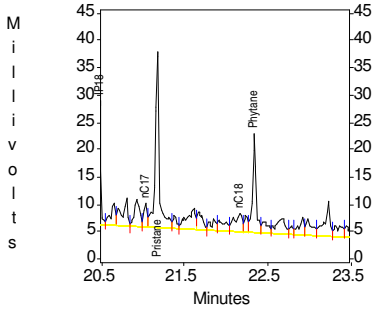
c:\ezchrom\chrom\05054\s57 -- Channel A



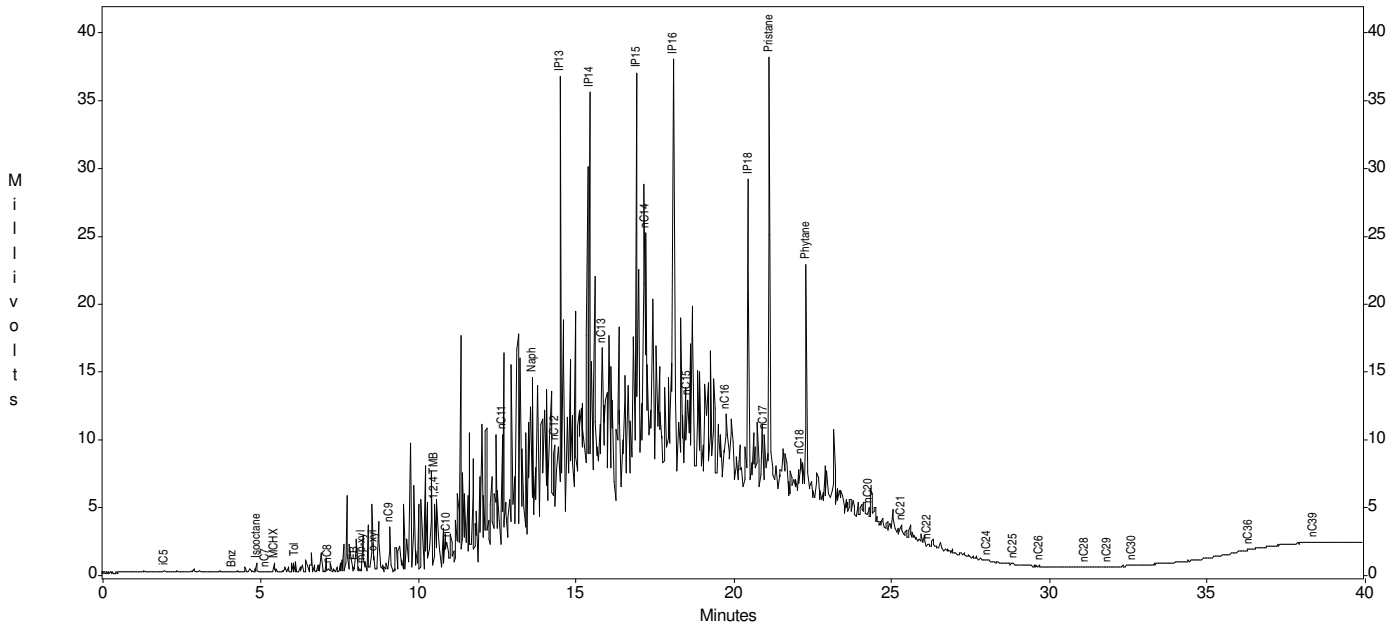
c:\ezchrom\chrom\05054\s57 -- Channel A



c:\ezchrom\chrom\05054\s57 -- Channel A



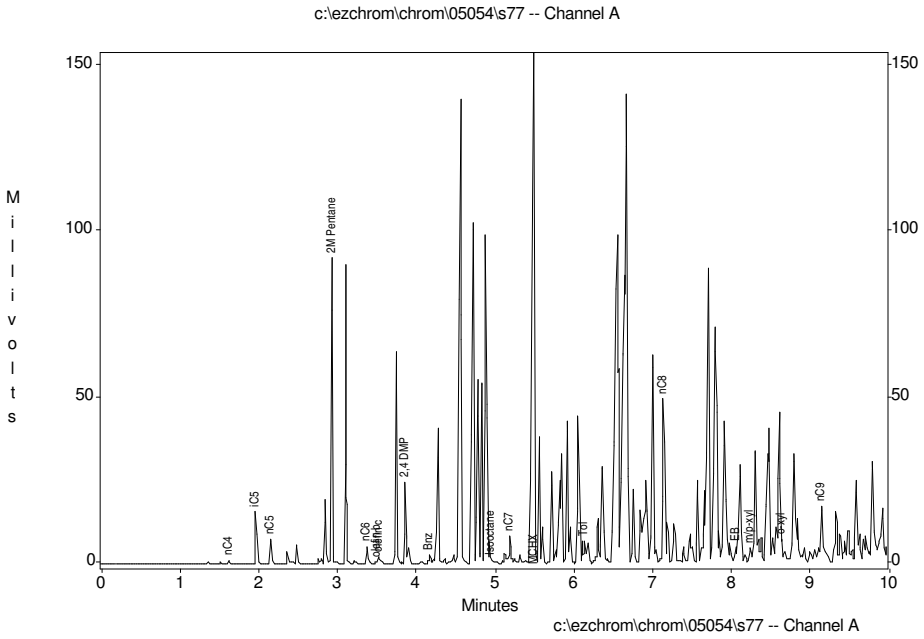
c:\ezchrom\chrom\05054\s57 -- Channel A

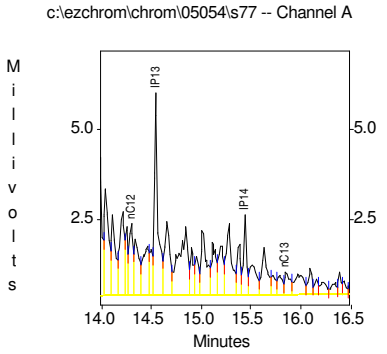


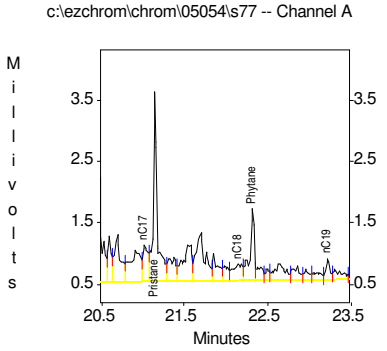
Channel A Results

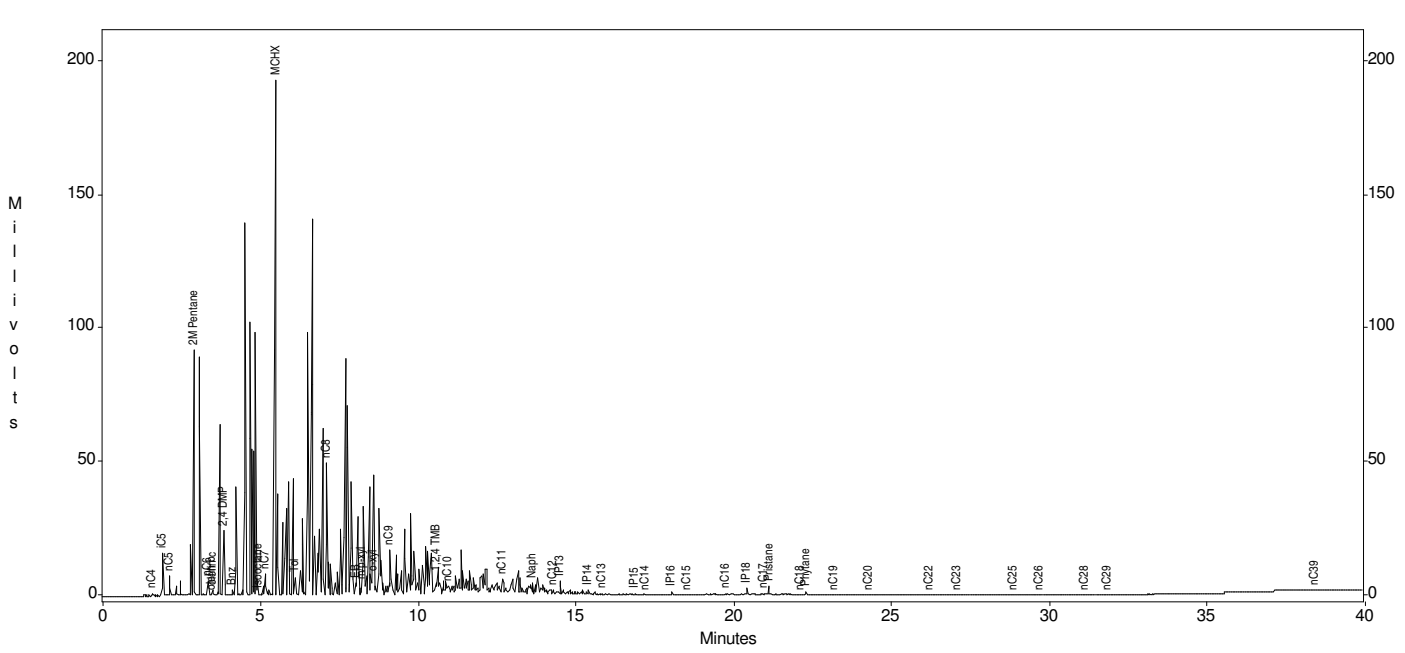
Peak	Area	Height
nC4	0	0
iC5	122	107
nC5	0	0
MTBE	0	0
2M Pentane	0	0
nC6	0	0
olefin a	0	0
olefin b	0	0
olefin c	0	0
2,4 DMP	0	0
Bnz	16	8
Isooctane	883	623
nC7	103	25
MCHX	927	580
Tol	1124	752
nC8	501	215
EB	861	517
m/p-xyl	351	218
o-xyl	1618	1141
nC9	8667	3248
1,2,4 TMB	12775	4769
nC10	6265	1719
nC11	18000	8477
Naph	28717	11767
nC12	21884	6134
IP13	68810	33052
IP14	57673	30993
nC13	39734	11800
IP15	58968	30891
nC14	43998	18867
IP16	100213	30750
nC15	20690	5153
nC16	36083	4848
IP18	54395	22906
nC17	12130	4448
Pristane	106010	32285
nC18	23752	3403
Phytane	50764	17975
nC19	0	0
nC20	4373	1476
nC21	6350	942
nC22	930	201
nC23	0	0
nC24	936	135
nC25	765	105
nC26	167	48
nC27	0	0
nC28	77	26
nC29	212	17
nC30	66	18
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	77	29
nC37	0	0
nC38	0	0
nC39	31	14
nC40	0	0

Sun - Philadelphia Refinery
Sample ID : S77-LNAPL-042005
Acquired : Apr 26, 2005 09:19:05







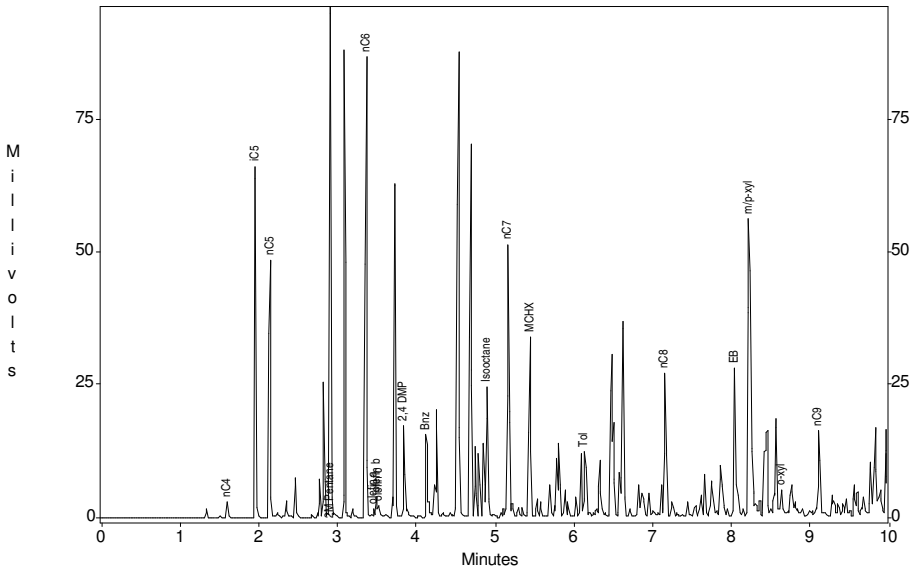


Channel A Results

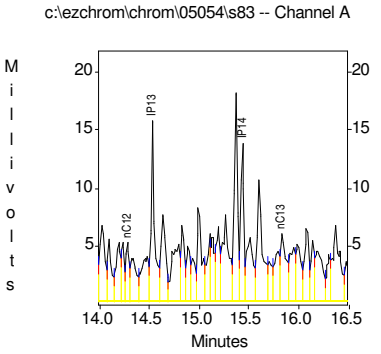
Peak	Area	Height
nC4	745	844
iC5	13689	15662
nC5	7651	7314
MTBE	0	0
2M Pentane	91837	91850
nC6	6466	5229
olefin a	0	0
olefin b	484	462
olefin c	2620	2034
2,4 DMP	27698	24597
Bnz	3899	2383
Isooctane	943	986
nC7	13129	8196
MCHX	295413	192682
Tol	8617	6738
nC8	74654	49515
EB	8110	5042
m/p-xyl	8029	4457
o-xyl	8655	7248
nC9	51732	17271
1,2,4 TMB	24982	7530
nC10	11074	3189
nC11	15690	5922
Naph	10905	4571
nC12	4414	1969
IP13	14023	5603
IP14	4145	2198
nC13	2453	604
IP15	2007	937
nC14	793	351
IP16	3087	1278
nC15	1064	246
nC16	5553	462
IP18	11604	2649
nC17	2320	608
Pristane	10665	3093
nC18	2095	267
Phytane	4157	1173
nC19	1147	352
nC20	436	67
nC21	0	0
nC22	116	35
nC23	106	24
nC24	0	0
nC25	587	86
nC26	379	65
nC27	0	0
nC28	102	26
nC29	70	18
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	110	31
nC40	0	0

Sun - Philadelphia Refinery
Sample ID : S83-LNAPL-042005
Acquired : Apr 25, 2005 15:59:15

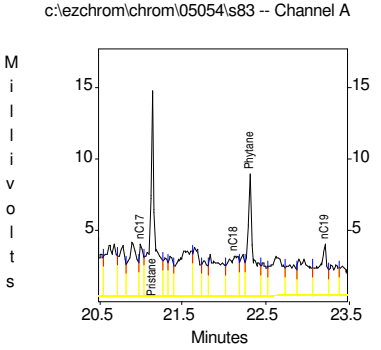
c:\ezchrom\chrom\05054\s83 -- Channel A



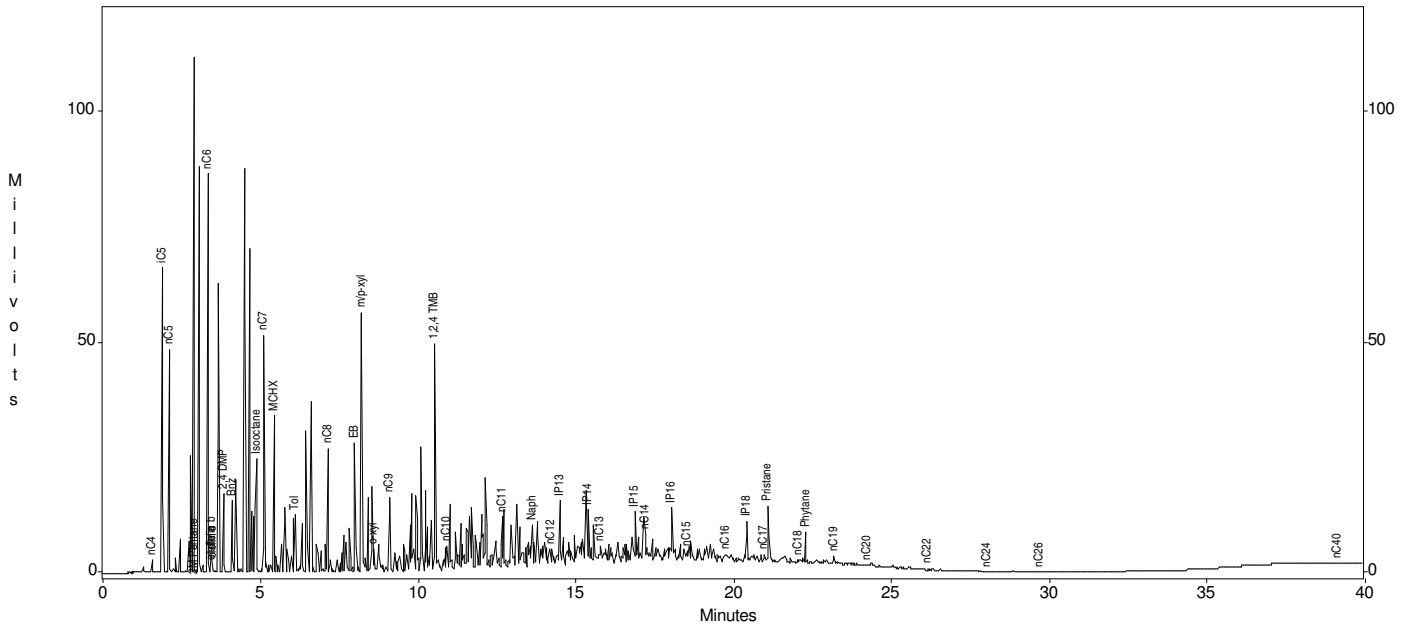
c:\ezchrom\chrom\05054\s83 -- Channel A



c:\ezchrom\chrom\05054\s83 -- Channel A



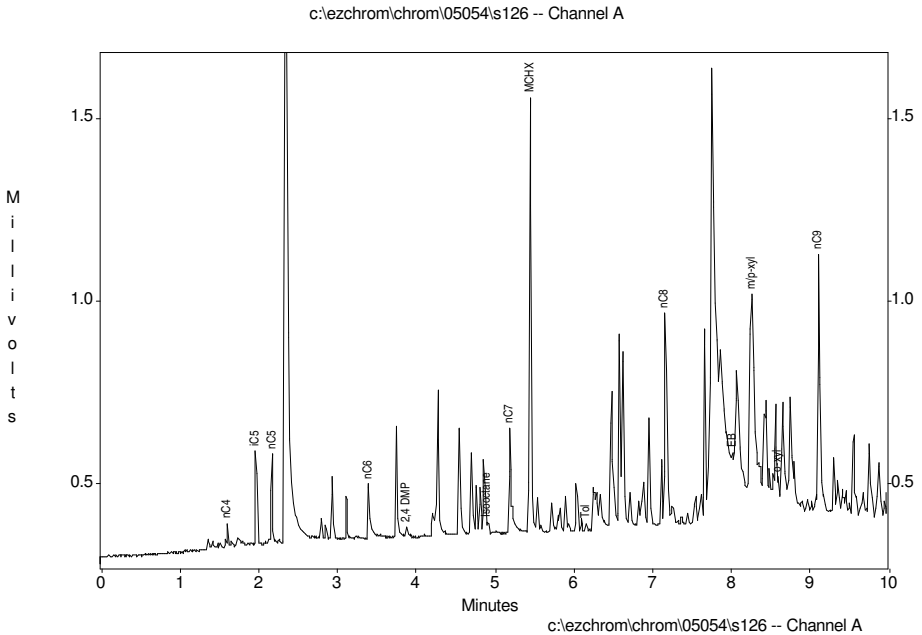
c:\ezchrom\chrom\05054\s83 -- Channel A

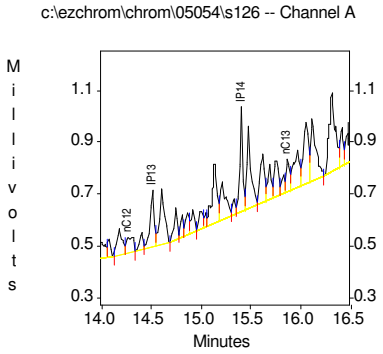


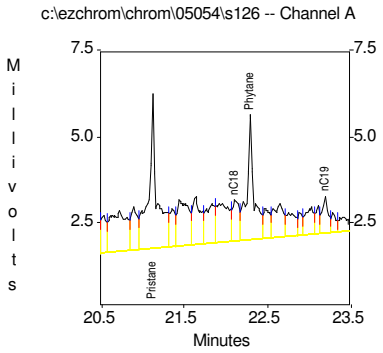
Channel A Results

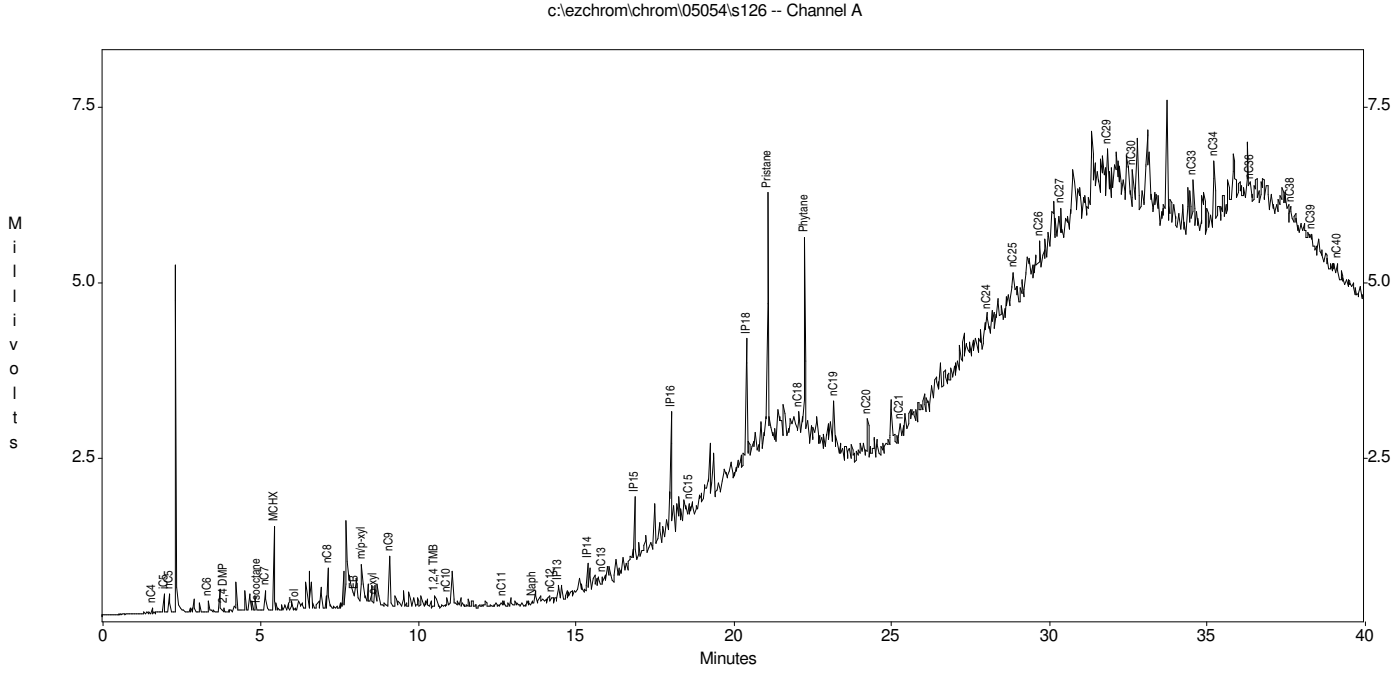
Peak	Area	Height
nC4	2066	2854
iC5	50374	65890
nC5	40293	48420
MTBE	0	0
2M Pentane	107642	111457
nC6	90152	86494
olefin a	1667	1600
olefin b	4285	3836
olefin c	3676	2184
2,4 DMP	18936	17273
Bnz	23057	15537
Isooctane	28806	24518
nC7	67125	51384
MCHX	44103	33989
Tol	17135	12474
nC8	35807	26899
EB	50895	27882
m/p-xyl	140132	56086
o-xyl	9989	4963
nC9	27834	16313
1,2,4 TMB	95389	49607
nC10	12208	5858
nC11	26959	12025
Naph	26773	10298
nC12	10404	4951
IP13	37806	15492
IP14	25358	13482
nC13	21475	5724
IP15	26086	13307
nC14	23563	8254
IP16	31742	14153
nC15	20552	4545
nC16	43438	3967
IP18	56442	10970
nC17	11306	3697
Pristane	64122	14441
nC18	25754	2801
Phytane	39174	8532
nC19	26953	3600
nC20	9039	1648
nC21	0	0
nC22	3337	581
nC23	0	0
nC24	1950	171
nC25	0	0
nC26	147	18
nC27	0	0
nC28	0	0
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	0	0
nC40	61	14

Sun - Philadelphia Refinery
Sample ID : S126-LNAPL-042005
Acquired : Apr 26, 2005 11:46:25







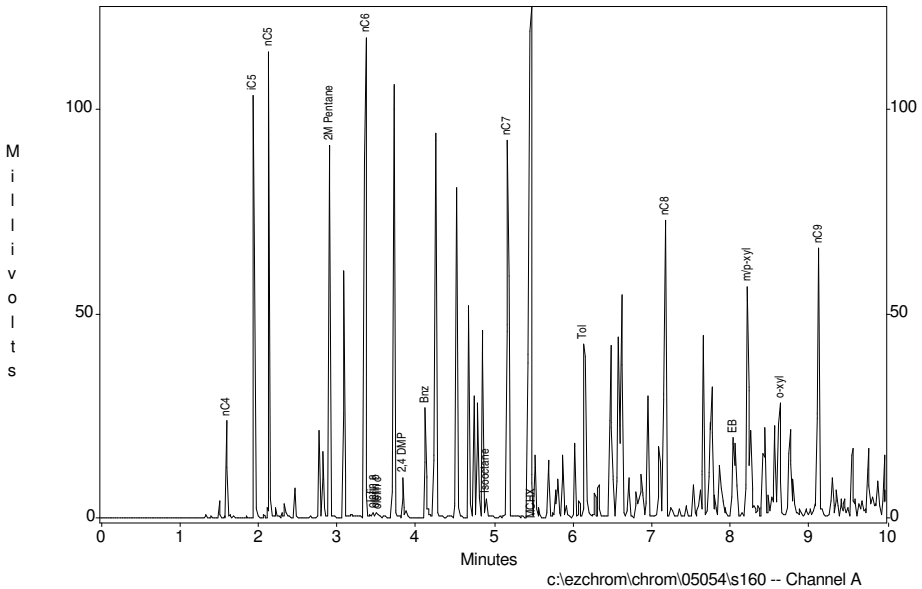


Channel A Results

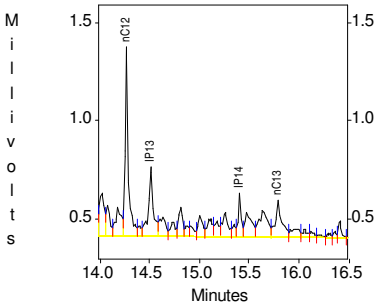
Peak	Area	Height
nC4	55	64
iC5	224	255
nC5	248	241
MTBE	0	0
2M Pentane	0	0
nC6	314	148
olefin a	0	0
olefin b	0	0
olefin c	0	0
2,4 DMP	57	28
Bnz	0	0
Isooctane	41	29
nC7	664	284
MCHX	1696	1184
Tol	44	23
nC8	1076	590
EB	369	206
m/p-xyl	2912	638
o-xyl	229	139
nC9	1823	744
1,2,4 TMB	805	189
nC10	503	150
nC11	201	92
Naph	122	47
nC12	308	64
IP13	585	220
IP14	811	407
nC13	314	130
IP15	2429	1062
nC14	0	0
IP16	7943	2021
nC15	2373	598
nC16	0	0
IP18	13607	2558
nC17	0	0
Pristane	32400	4496
nC18	6948	1171
Phytane	20520	3600
nC19	4828	1090
nC20	1972	600
nC21	798	230
nC22	0	0
nC23	0	0
nC24	3887	427
nC25	8620	587
nC26	5793	579
nC27	3081	676
nC28	0	0
nC29	2833	753
nC30	1569	512
nC31	0	0
nC32	0	0
nC33	1447	589
nC34	3994	877
nC35	0	0
nC36	179	121
nC37	0	0
nC38	632	198
nC39	339	102
nC40	374	147

Sun - Philadelphia Refinery
Sample ID : S160-LNAPL-042005
Acquired : Apr 26, 2005 12:42:54

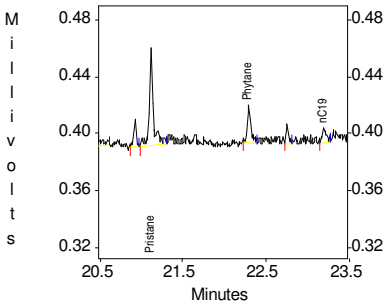
c:\ezchrom\chrom\05054\s160 -- Channel A



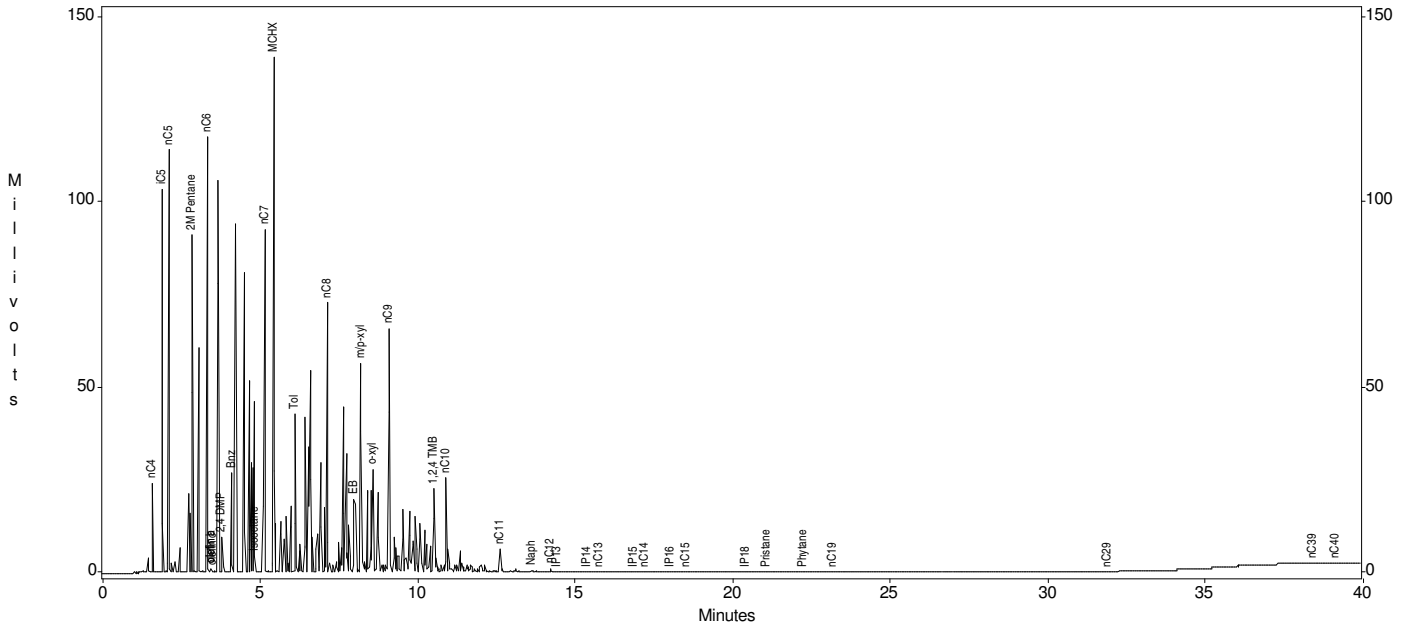
c:\ezchrom\chrom\05054\s160 -- Channel A



c:\ezchrom\chrom\05054\s160 -- Channel A



c:\ezchrom\chrom\05054\s160 -- Channel A

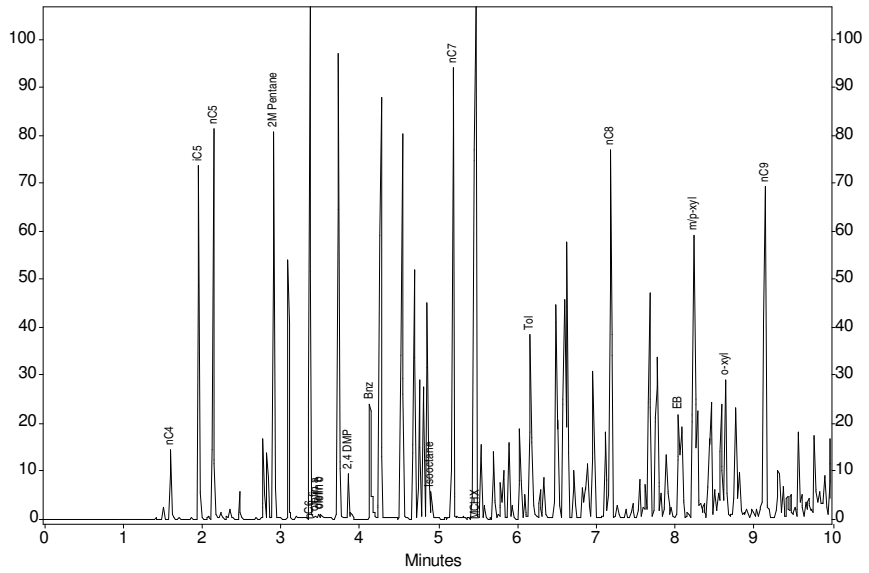


Channel A Results

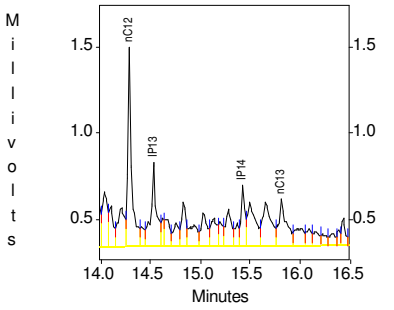
Peak	Area	Height
nC4	17505	23967
iC5	83014	103747
nC5	94147	114170
MTBE	0	0
2M Pentane	88607	91232
nC6	131411	117762
olefin a	1453	1132
olefin b	1311	1029
olefin c	1231	736
2,4 DMP	10702	9792
Bnz	37030	26891
Isooctane	6020	4629
nC7	135672	92543
MCHX	247161	139058
Tol	57997	42316
nC8	115677	72908
EB	36725	19658
m/p-xyl	120755	56499
o-xyl	48502	27868
nC9	130150	65886
1,2,4 TMB	42571	22635
nC10	39030	25359
nC11	10567	6046
Naph	1503	535
nC12	2110	968
IP13	1120	354
IP14	456	228
nC13	819	190
IP15	217	116
nC14	168	49
IP16	289	99
nC15	151	23
nC16	0	0
IP18	111	37
nC17	0	0
Pristane	221	69
nC18	0	0
Phytane	69	25
nC19	38	11
nC20	0	0
nC21	0	0
nC22	0	0
nC23	0	0
nC24	0	0
nC25	0	0
nC26	0	0
nC27	0	0
nC28	0	0
nC29	190	25
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	143	33
nC40	24	18

Sun - Philadelphia Refinery
Sample ID : S161-LNAPL-042005
Acquired : Apr 26, 2005 10:58:03

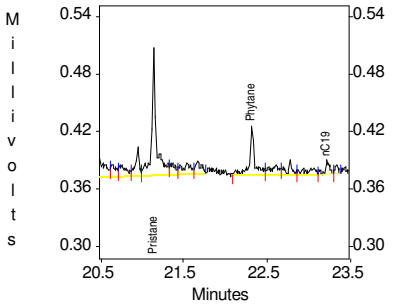
c:\ezchrom\chrom\05054\s161 -- Channel A



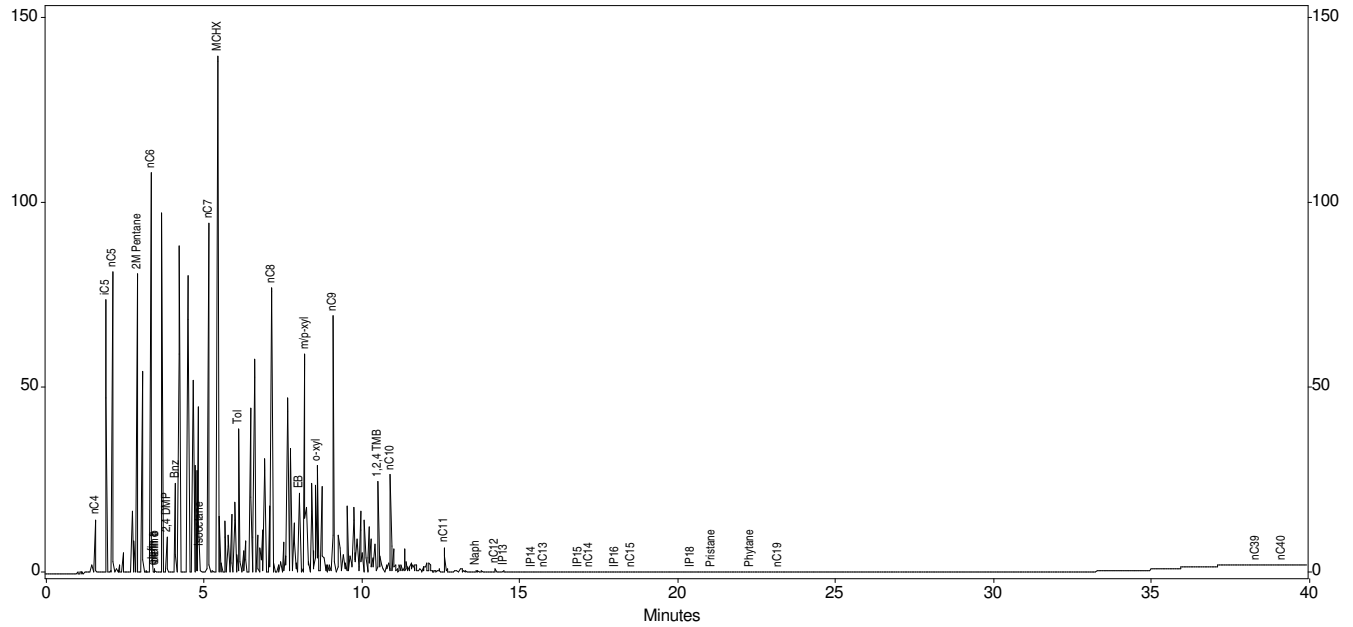
c:\ezchrom\chrom\05054\s161 -- Channel A



c:\ezchrom\chrom\05054\s161 -- Channel A



c:\ezchrom\chrom\05054\s161 -- Channel A

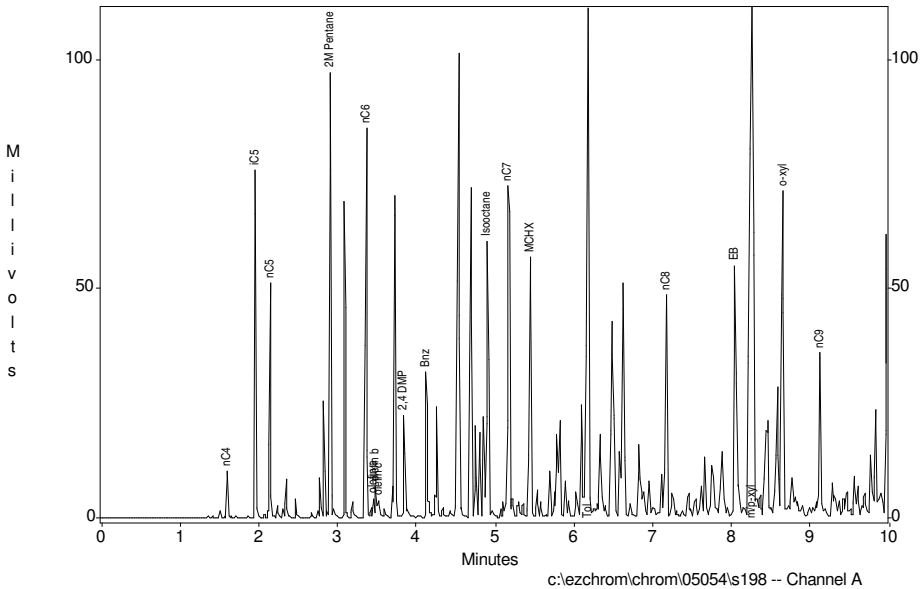


Channel A Results

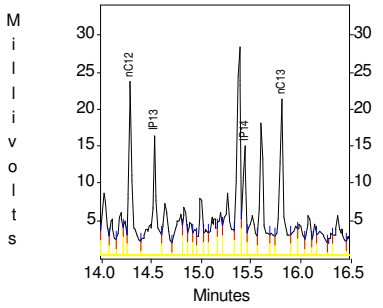
Peak	Area	Height
nC4	10594	14390
iC5	58797	73717
nC5	70252	81340
MTBE	0	0
2M Pentane	77472	80619
nC6	119053	107947
olefin a	888	592
olefin b	1274	946
olefin c	1181	922
2,4 DMP	10474	9443
Bnz	34391	24024
Isooctane	7607	5712
nC7	139225	94243
MCHX	248410	139452
Tol	57001	38639
nC8	124388	77219
EB	40561	21603
m/p-xyl	130505	59076
o-xyl	51681	29167
nC9	139055	69551
1,2,4 TMB	46970	24607
nC10	42072	26548
nC11	12049	6640
Naph	2042	685
nC12	2854	1154
IP13	1850	486
IP14	797	353
nC13	1372	268
IP15	581	215
nC14	1088	136
IP16	746	183
nC15	513	58
nC16	0	0
IP18	281	72
nC17	0	0
Pristane	490	133
nC18	0	0
Phytane	229	51
nC19	60	13
nC20	0	0
nC21	0	0
nC22	0	0
nC23	0	0
nC24	0	0
nC25	0	0
nC26	0	0
nC27	0	0
nC28	0	0
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	21	15
nC40	37	17

Sun - Philadelphia Refinery
Sample ID : S198-LNAPL-042005
Acquired : Apr 25, 2005 15:11:04

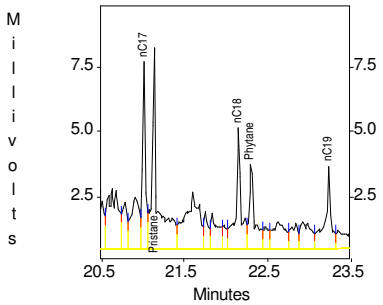
c:\ezchrom\chrom\05054\s198 -- Channel A



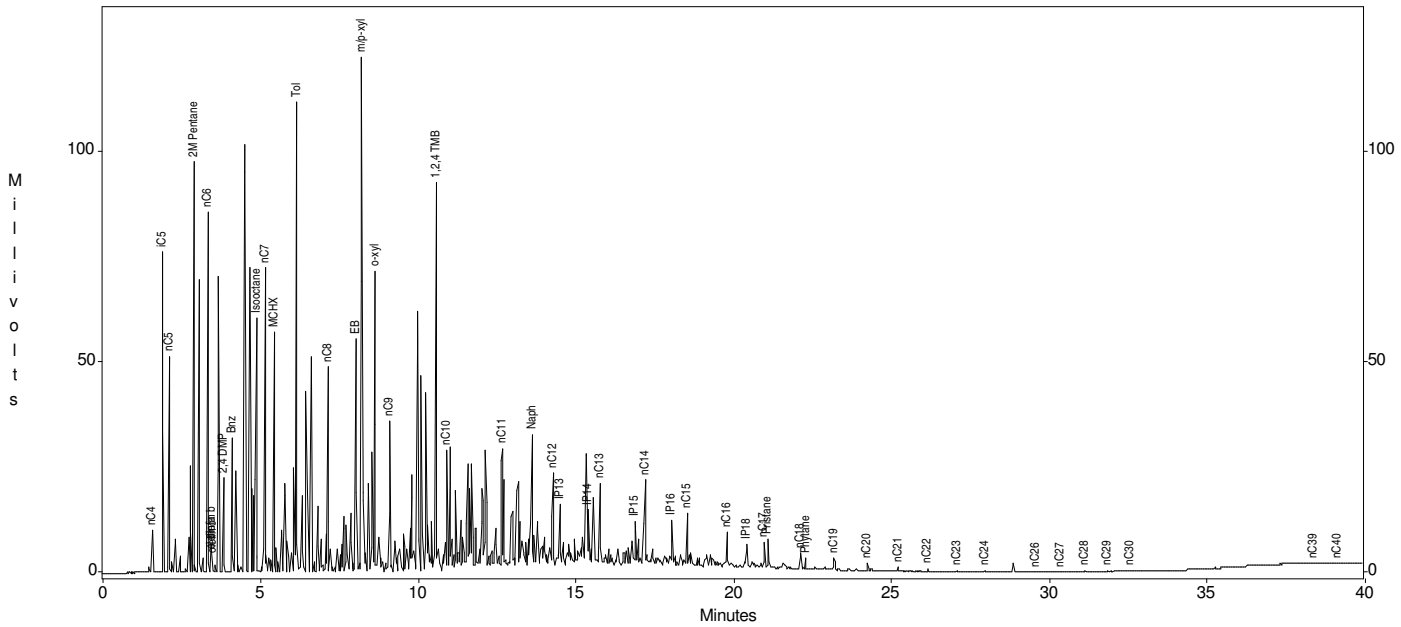
c:\ezchrom\chrom\05054\s198 -- Channel A



c:\ezchrom\chrom\05054\s198 -- Channel A



c:\ezchrom\chrom\05054\s198 -- Channel A

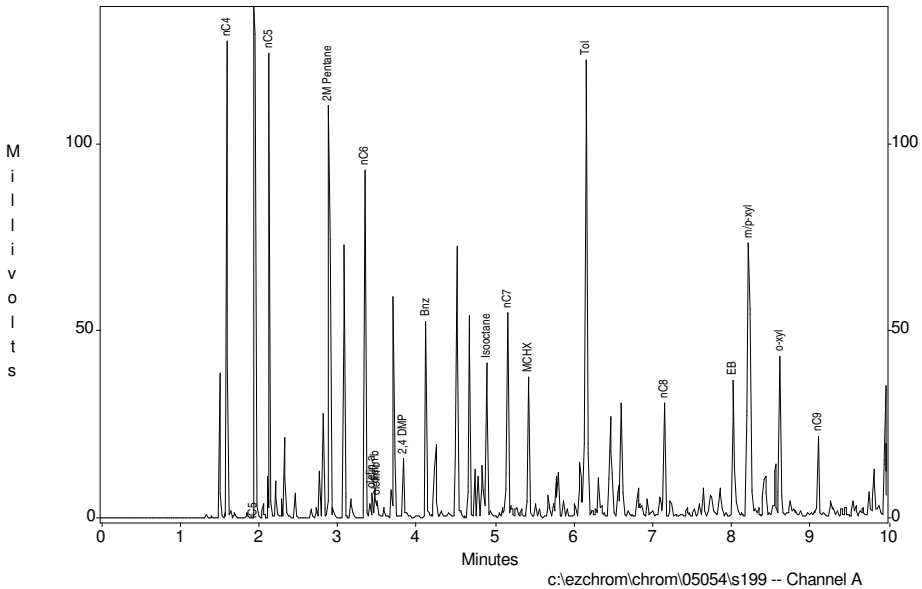


Channel A Results

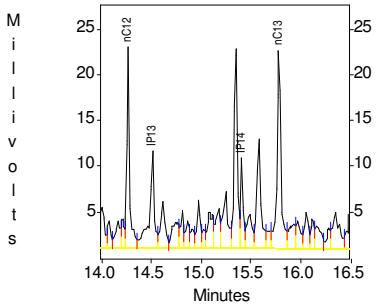
Peak	Area	Height
nC4	6805	10193
iC5	56062	76092
nC5	41370	51174
MTBE	0	0
2M Pentane	94987	97341
nC6	88612	85212
olefin a	4768	4149
olefin b	7273	6670
olefin c	5630	3602
2,4 DMP	24785	22357
Bnz	43426	31804
Isooctane	77664	60425
nC7	103956	72263
MCHX	76887	56499
Tol	185088	111104
nC8	70463	48501
EB	105627	55069
m/p-xyl	386115	121810
o-xyl	135212	71315
nC9	63724	35758
1,2,4 TMB	228975	92309
nC10	47999	28685
nC11	69618	29135
Naph	92168	32466
nC12	55621	23365
IP13	60906	16191
IP14	27028	14790
nC13	59351	21028
IP15	23022	11823
nC14	46462	21673
IP16	27950	12557
nC15	43063	13846
nC16	37188	9376
IP18	35271	6482
nC17	16510	7152
Pristane	39417	7725
nC18	19805	4642
Phytane	14102	3240
nC19	15548	3172
nC20	6030	2032
nC21	2868	1132
nC22	1681	622
nC23	802	316
nC24	377	172
nC25	0	0
nC26	340	94
nC27	405	102
nC28	407	90
nC29	213	46
nC30	197	29
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	47	15
nC40	18	11

Sun - Philadelphia Refinery
Sample ID : S199-LNAPL-042005
Acquired : Apr 26, 2005 14:20:57

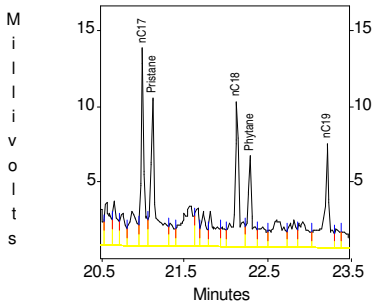
c:\ezchrom\chrom\05054\s199 -- Channel A



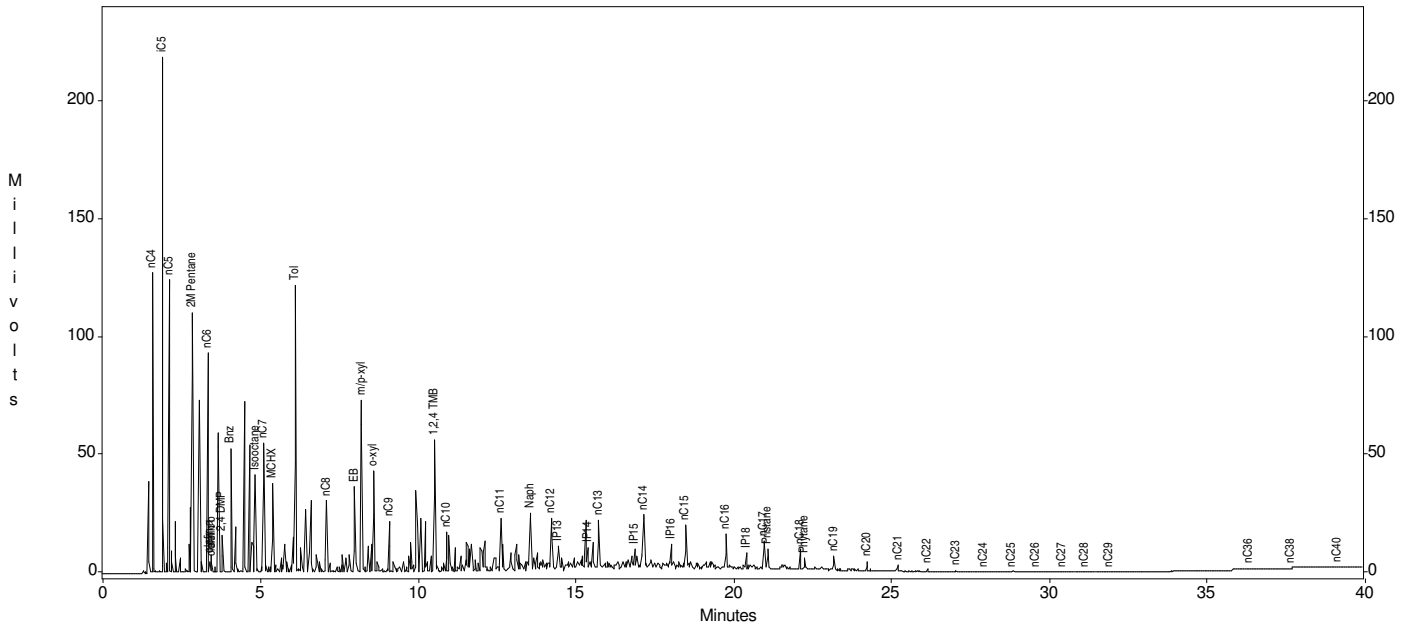
c:\ezchrom\chrom\05054\s199 -- Channel A



c:\ezchrom\chrom\05054\s199 -- Channel A



c:\ezchrom\chrom\05054\s199 -- Channel A

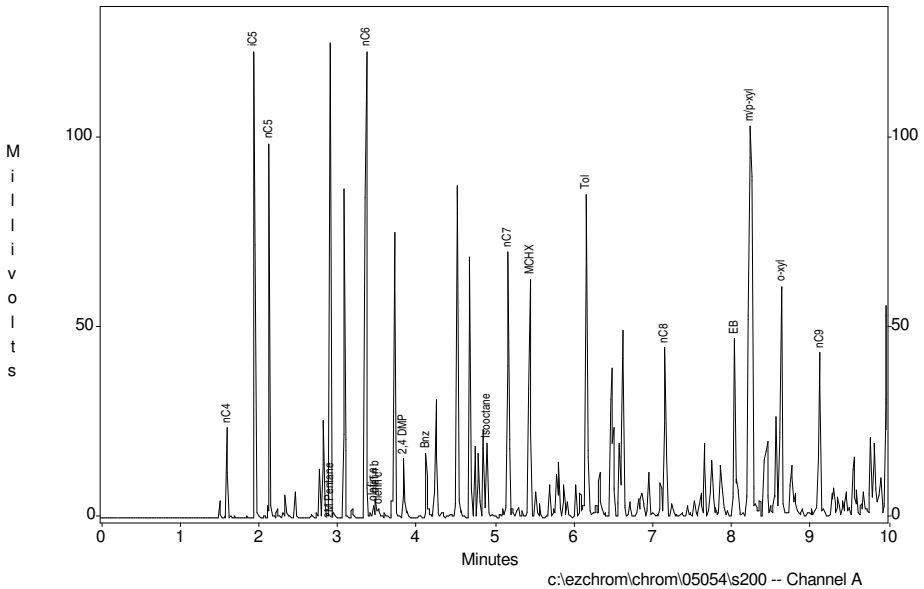


Channel A Results

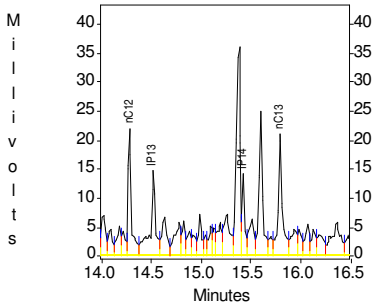
Peak	Area	Height
nC4	90952	127676
iC5	174049	218801
nC5	105932	124673
MTBE	0	0
2M Pentane	111384	110654
nC6	100959	93398
olefin a	7664	6471
olefin b	8672	7759
olefin c	6643	4393
2,4 DMP	19267	15861
Bnz	67979	52520
Isooctane	50589	41492
nC7	76748	55080
MCHX	50195	37642
Tol	218179	122448
nC8	41461	30343
EB	61977	36401
m/p-xyl	200649	73193
o-xyl	72197	43297
nC9	35760	21523
1,2,4 TMB	108568	56012
nC10	26484	17172
nC11	45669	21932
Naph	65046	24279
nC12	48352	21951
IP13	35607	10592
IP14	18471	9848
nC13	57127	21692
IP15	19234	9096
nC14	52138	24282
IP16	25743	11150
nC15	65275	19244
nC16	50196	15849
IP18	38985	7814
nC17	32388	13022
Pristane	38462	9661
nC18	33914	9513
Phytane	19600	5918
nC19	28849	6862
nC20	11066	4407
nC21	6730	2562
nC22	3572	1436
nC23	1769	669
nC24	666	329
nC25	320	167
nC26	274	108
nC27	217	63
nC28	148	46
nC29	148	26
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	111	36
nC37	0	0
nC38	71	25
nC39	0	0
nC40	42	14

Sun - Philadelphia Refinery
Sample ID : S200-LNAPL-042005
Acquired : Apr 25, 2005 12:38:28

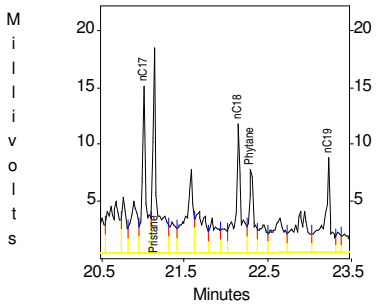
c:\ezchrom\chrom\05054\s200 -- Channel A



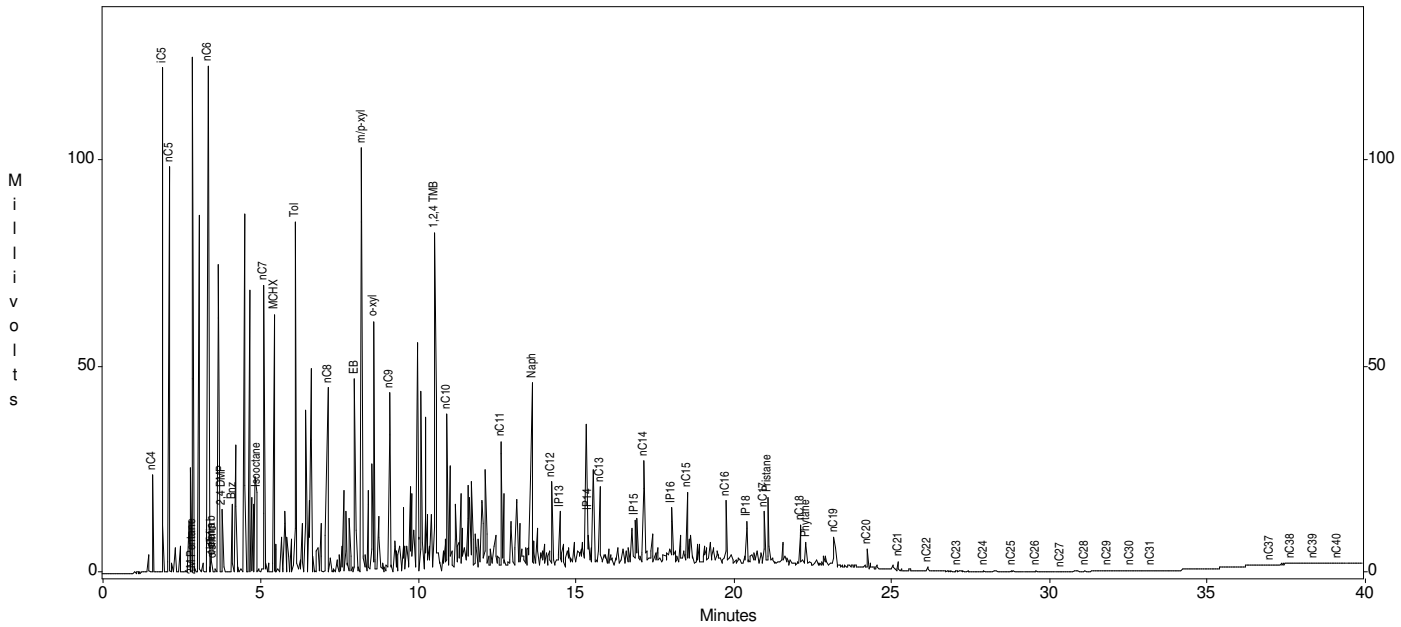
c:\ezchrom\chrom\05054\s200 -- Channel A



c:\ezchrom\chrom\05054\s200 -- Channel A



c:\ezchrom\chrom\05054\s200 -- Channel A

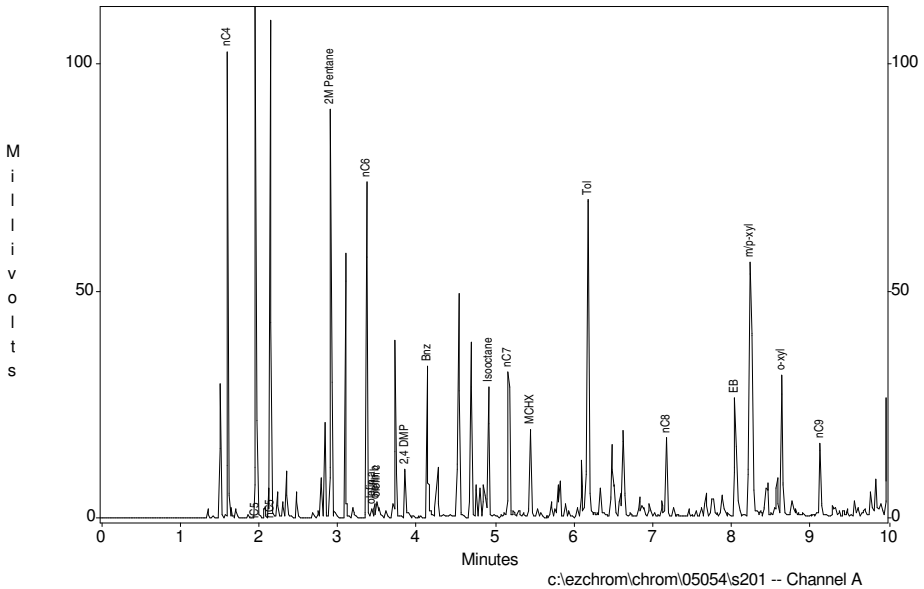


Channel A Results

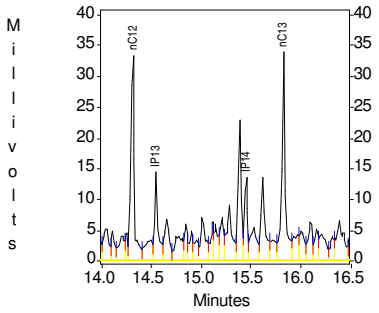
Peak	Area	Height
nC4	16094	23632
iC5	91867	122447
nC5	77629	98267
MTBE	0	0
2M Pentane	121485	124853
nC6	136260	122849
olefin a	3729	3198
olefin b	5525	4796
olefin c	3834	2320
2,4 DMP	17005	15364
Bnz	24234	16753
Isooctane	23458	19688
nC7	96123	69846
MCHX	85197	62395
Tol	128873	84891
nC8	61885	44711
EB	76024	46895
m/p-xyl	317056	102873
o-xyl	107360	60808
nC9	76170	43414
1,2,4 TMB	196559	82409
nC10	66263	38390
nC11	68489	31827
Naph	114598	46216
nC12	50728	21971
IP13	54349	14767
IP14	23915	13977
nC13	58441	20836
IP15	25198	12872
nC14	59443	27047
IP16	36665	15429
nC15	63031	19457
nC16	65512	17290
IP18	61249	12308
nC17	43221	14781
Pristane	69846	18152
nC18	49528	11390
Phytane	28371	7322
nC19	44870	8358
nC20	13731	5358
nC21	11620	2633
nC22	3027	1188
nC23	1747	517
nC24	626	249
nC25	418	134
nC26	581	107
nC27	216	58
nC28	235	51
nC29	80	32
nC30	230	34
nC31	255	25
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	1371	20
nC38	247	40
nC39	31	16
nC40	50	14

Sun - Philadelphia Refinery
Sample ID : S201-LNAPL-042005
Acquired : Apr 26, 2005 15:10:11

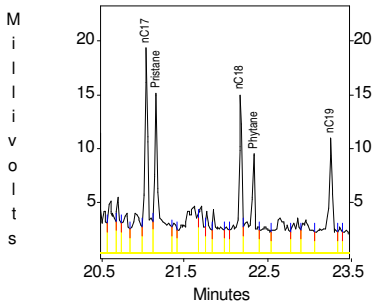
c:\ezchrom\chrom\05054\s201 -- Channel A



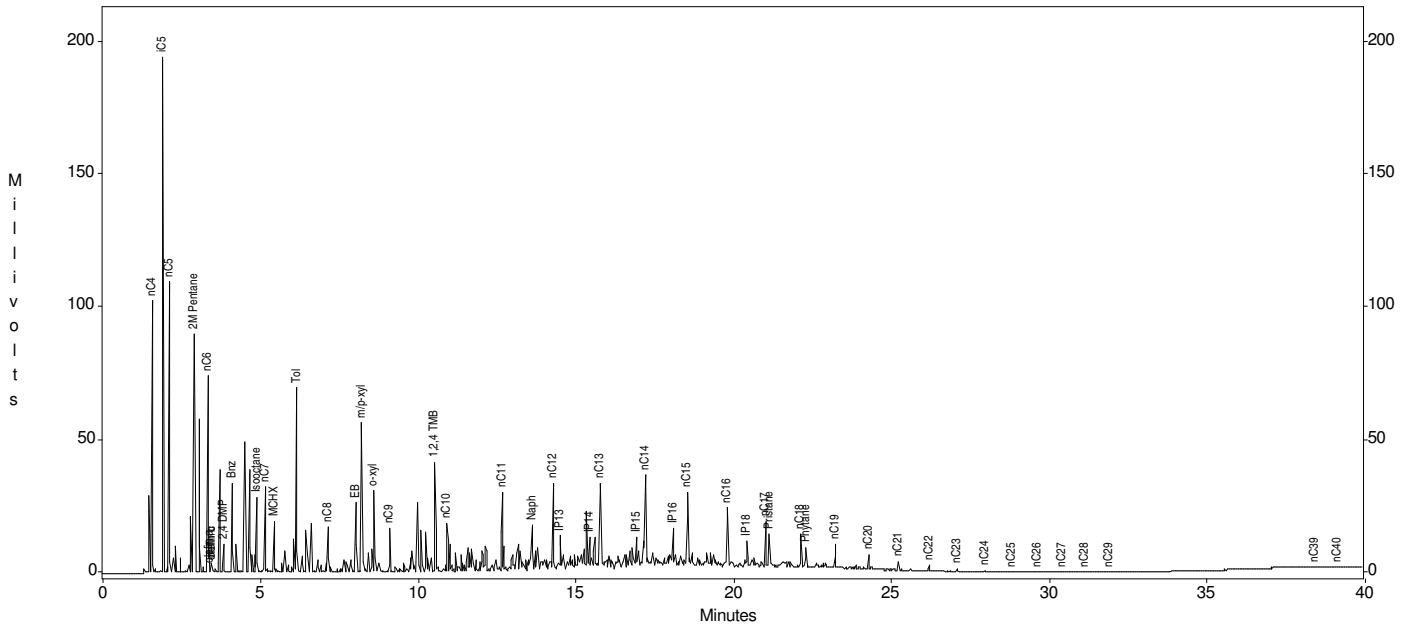
c:\ezchrom\chrom\05054\s201 -- Channel A



c:\ezchrom\chrom\05054\s201 -- Channel A



c:\ezchrom\chrom\05054\s201 -- Channel A

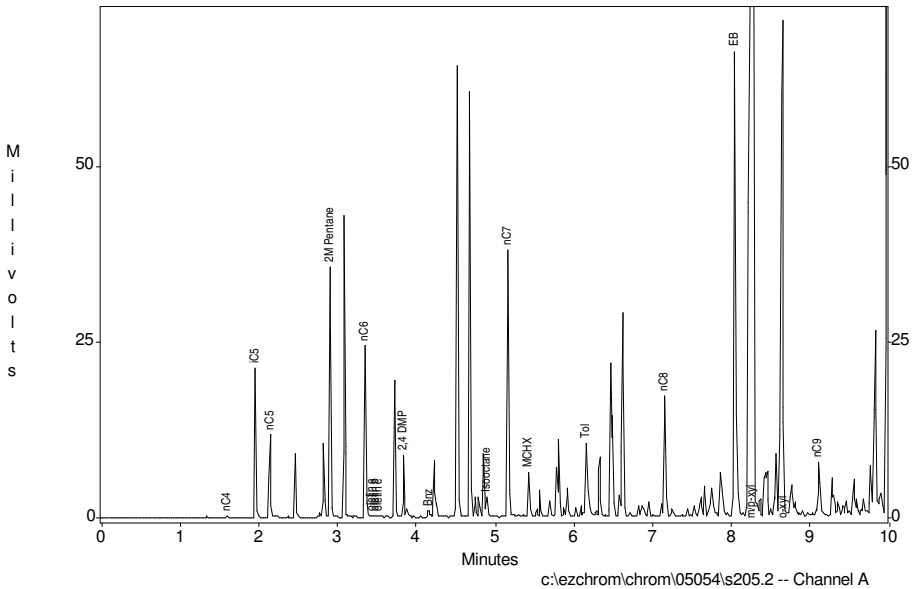


Channel A Results

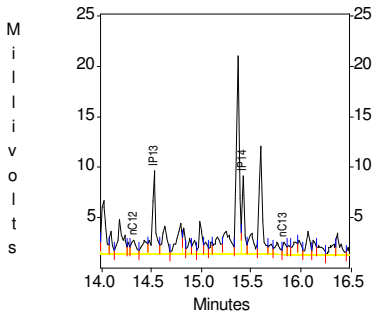
Peak	Area	Height
nC4	68792	102692
iC5	143867	193951
nC5	87884	109676
MTBE	0	0
2M Pentane	85546	90001
nC6	75128	74038
olefin a	2111	1846
olefin b	3942	3141
olefin c	4020	3521
2,4 DMP	11817	10555
Bnz	44718	33420
Isooctane	34262	28657
nC7	41504	32134
MCHX	25788	19423
Tol	105969	69952
nC8	22589	17270
EB	43298	26367
m/p-xyl	140769	56192
o-xyl	49082	31075
nC9	25181	16387
1,2,4 TMB	74115	41736
nC10	28657	18756
nC11	56326	30255
Naph	61462	17868
nC12	71983	33352
IP13	33811	14260
IP14	24419	13340
nC13	83454	33833
IP15	26663	13533
nC14	76434	37111
IP16	44752	16669
nC15	87372	30605
nC16	80114	24201
IP18	63981	12207
nC17	51179	19052
Pristane	63474	14796
nC18	46824	14724
Phytane	42353	9107
nC19	49739	10672
nC20	18390	6889
nC21	11344	4196
nC22	6343	2441
nC23	4992	1246
nC24	1626	590
nC25	1236	253
nC26	509	139
nC27	180	65
nC28	140	41
nC29	182	20
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	22	14
nC40	189	31

Sun - Philadelphia Refinery
Sample ID : S205-LNAPL-042005
Acquired : Apr 25, 2005 17:38:08

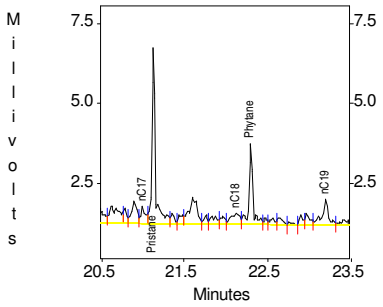
c:\ezchrom\chrom\05054\s205.2 -- Channel A



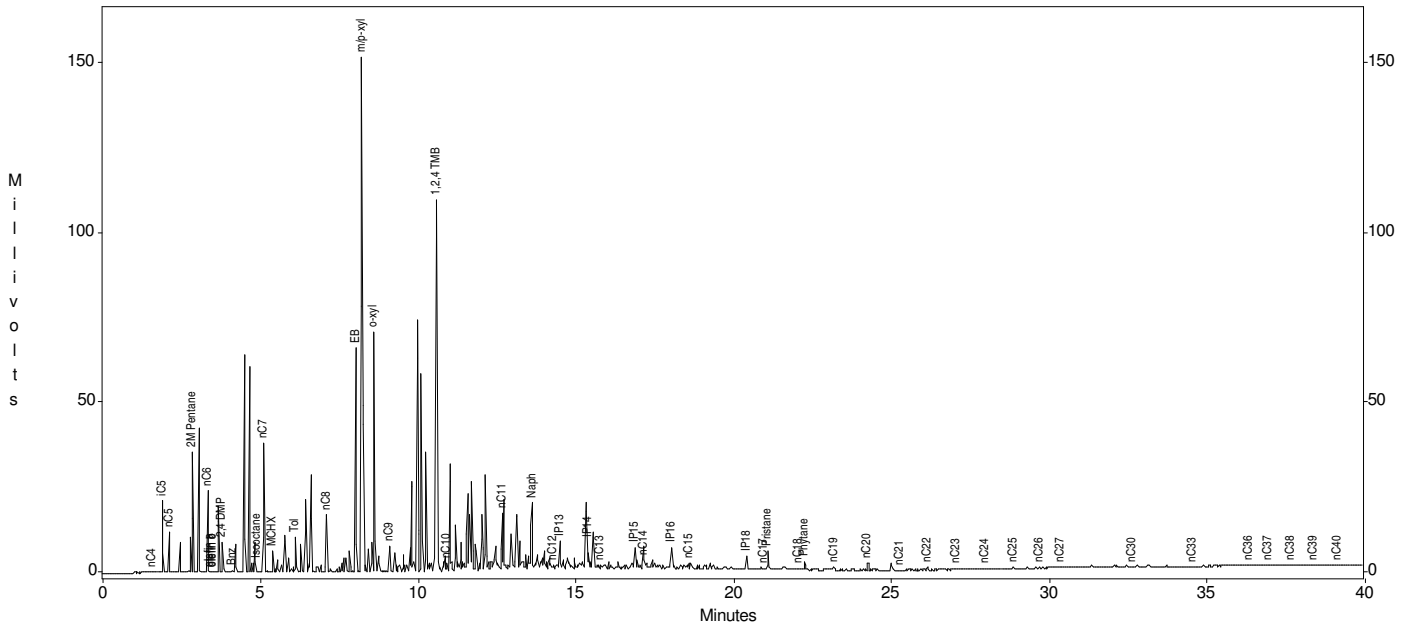
c:\ezchrom\chrom\05054\s205.2 -- Channel A



c:\ezchrom\chrom\05054\s205.2 -- Channel A



c:\ezchrom\chrom\05054\s205.2 -- Channel A

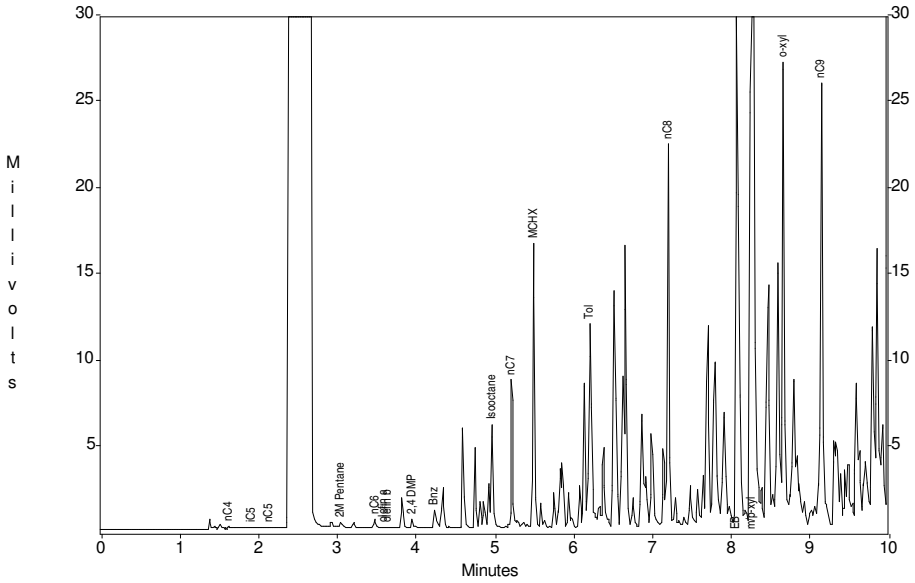


Channel A Results

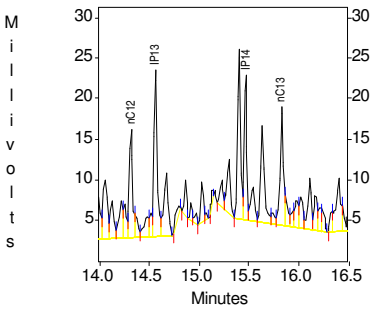
Peak	Area	Height
nC4	204	253
iC5	16906	21225
nC5	11104	11895
MTBE	0	0
2M Pentane	34500	35496
nC6	25682	24268
olefin a	153	100
olefin b	170	115
olefin c	299	240
2,4 DMP	9544	8853
Bnz	1711	901
Isooctane	4048	2865
nC7	45624	38063
MCHX	8580	6248
Tol	19741	10392
nC8	22260	17140
EB	109573	65993
m/p-xyl	496002	151358
o-xyl	125750	70567
nC9	16041	7812
1,2,4 TMB	284981	109548
nC10	6043	2257
nC11	28798	16591
Naph	44906	19685
nC12	4503	1445
IP13	20152	8378
IP14	12613	7765
nC13	3056	1260
IP15	11100	6527
nC14	6947	2561
IP16	17804	6161
nC15	3758	1681
nC16	0	0
IP18	11724	3711
nC17	1953	589
Pristane	16037	5499
nC18	2607	396
Phytane	7675	2560
nC19	4351	853
nC20	5036	2140
nC21	780	112
nC22	1751	697
nC23	279	61
nC24	1439	248
nC25	2842	298
nC26	829	218
nC27	825	165
nC28	0	0
nC29	0	0
nC30	378	108
nC31	0	0
nC32	0	0
nC33	371	116
nC34	0	0
nC35	0	0
nC36	21	21
nC37	28	11
nC38	137	24
nC39	34	8
nC40	48	22

Sun - Philadelphia Refinery
Sample ID : S208-LNAPL-042005
Acquired : Apr 26, 2005 16:47:57

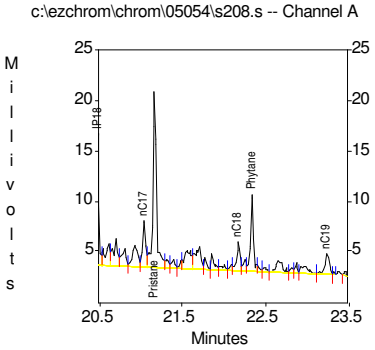
c:\ezchrom\chrom\05054\s208.s -- Channel A



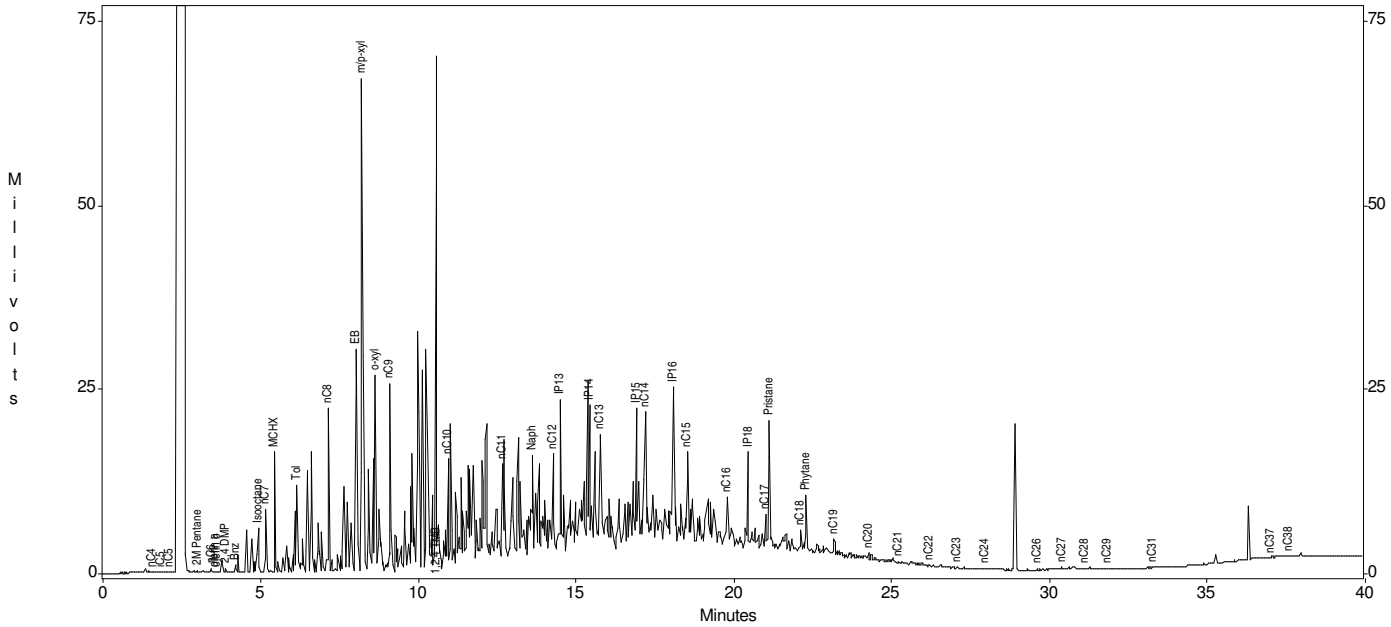
c:\ezchrom\chrom\05054\s208.s -- Channel A



c:\ezchrom\chrom\05054\s208.s -- Channel A



c:\ezchrom\chrom\05054\s208.s -- Channel A

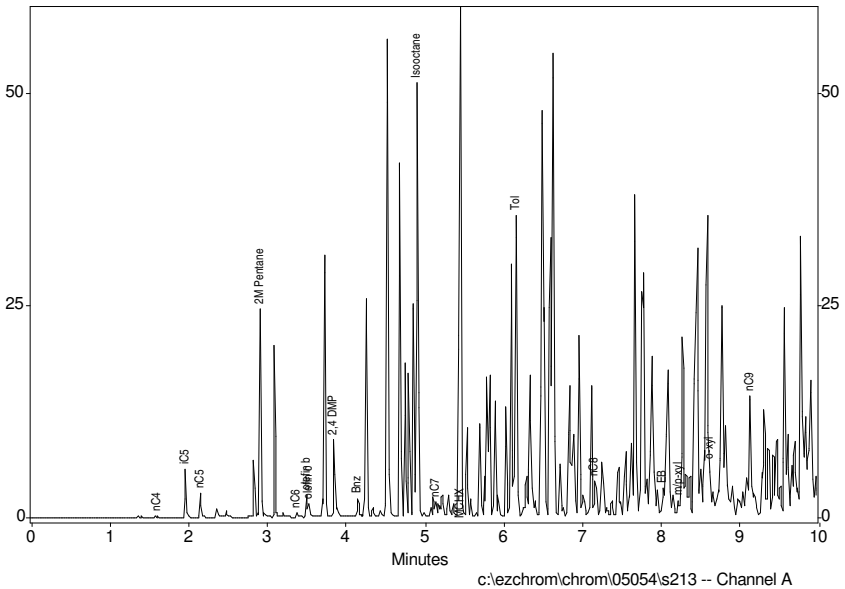


Channel A Results

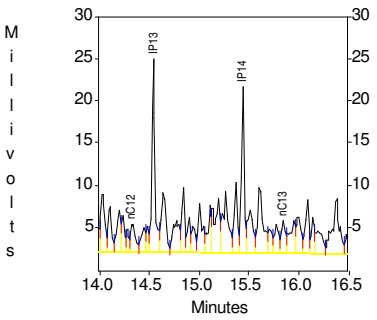
Peak	Area	Height
nC4	174	119
iC5	20	10
nC5	30	14
MTBE	0	0
2M Pentane	522	227
nC6	914	490
olefin a	34	22
olefin b	131	43
olefin c	0	0
2,4 DMP	757	483
Bnz	2122	1034
Isooctane	9321	5918
nC7	13670	8542
MCHX	25149	16442
Tol	23584	11792
nC8	36187	22166
EB	54597	30320
m/p-xyl	193165	66902
o-xyl	52529	26770
nC9	47366	25594
1,2,4 TMB	157499	69554
nC10	28645	14798
nC11	39542	12935
Naph	45490	13611
nC12	28900	13467
IP13	46827	20611
IP14	30669	17915
nC13	33488	14700
IP15	34292	18450
nC14	44519	17659
IP16	47906	20613
nC15	22023	11159
nC16	22629	6481
IP18	32847	13050
nC17	11022	4633
Pristane	49324	17595
nC18	8214	2891
Phytane	18197	7653
nC19	8044	2056
nC20	2505	1038
nC21	1048	359
nC22	668	275
nC23	643	154
nC24	256	132
nC25	0	0
nC26	218	98
nC27	1501	315
nC28	1315	183
nC29	129	34
nC30	0	0
nC31	361	35
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	122	31
nC38	318	21
nC39	0	0
nC40	0	0

Sun - Philadelphia Refinery
Sample ID : S213-LNAPL-042005
Acquired : Apr 25, 2005 14:19:36

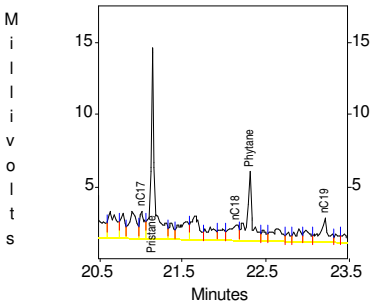
c:\ezchrom\chrom\05054\s213 -- Channel A



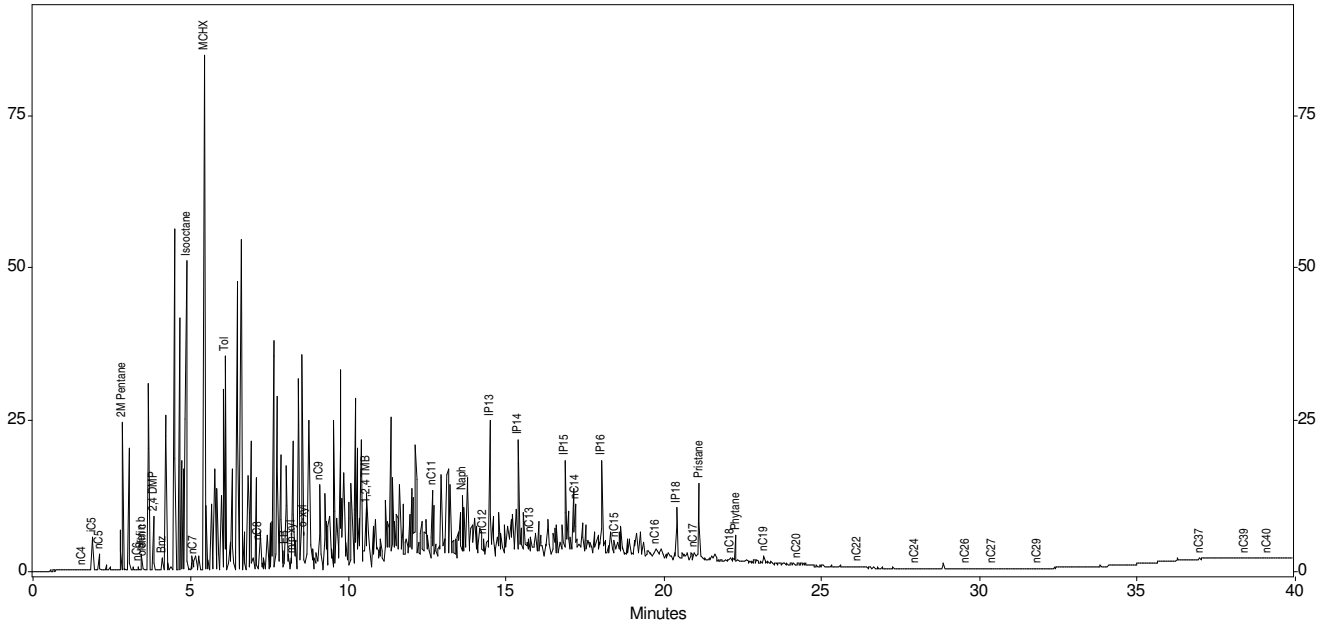
c:\ezchrom\chrom\05054\s213 -- Channel A



c:\ezchrom\chrom\05054\s213 -- Channel A



c:\ezchrom\chrom\05054\s213 -- Channel A

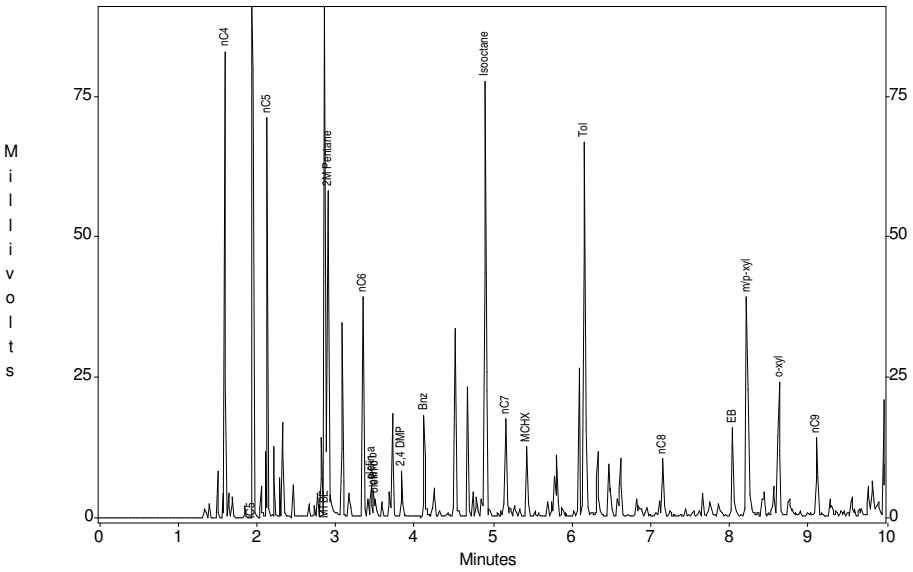


Channel A Results

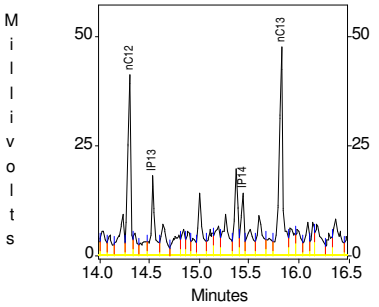
Peak	Area	Height
nC4	94	106
iC5	4592	5561
nC5	2791	2721
MTBE	0	0
2M Pentane	24136	24521
nC6	866	570
olefin a	0	0
olefin b	2886	2570
olefin c	2582	1541
2,4 DMP	10333	9088
Bnz	3686	2190
Isooctane	63352	51067
nC7	2321	1640
MCHX	125047	84842
Tol	47929	35344
nC8	6218	4005
EB	5604	3322
m/p-xyl	3034	1795
o-xyl	7513	6101
nC9	32049	13986
1,2,4 TMB	28623	9748
nC10	0	0
nC11	21032	11341
Naph	21025	10434
nC12	11633	3350
IP13	47928	23076
IP14	35852	19873
nC13	10652	3995
IP15	31192	16605
nC14	24150	9564
IP16	50710	16679
nC15	19279	3257
nC16	24288	2354
IP18	36379	9287
nC17	7271	1876
Pristane	43616	13342
nC18	8340	1081
Phytane	19781	4826
nC19	10329	1609
nC20	2502	451
nC21	0	0
nC22	274	59
nC23	0	0
nC24	499	52
nC25	0	0
nC26	216	71
nC27	234	58
nC28	0	0
nC29	455	51
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	103	28
nC38	0	0
nC39	71	31
nC40	112	29

Sun - Philadelphia Refinery
Sample ID : Gas/Dies/Wax std
Acquired : Apr 25, 2005 11:00:43

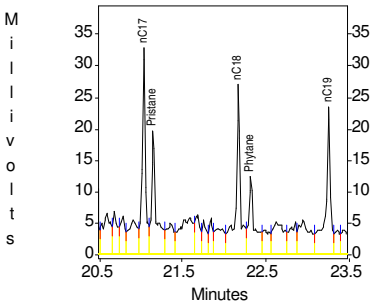
c:\ezchrom\chrom\05054\gadiwax2 -- Channel A



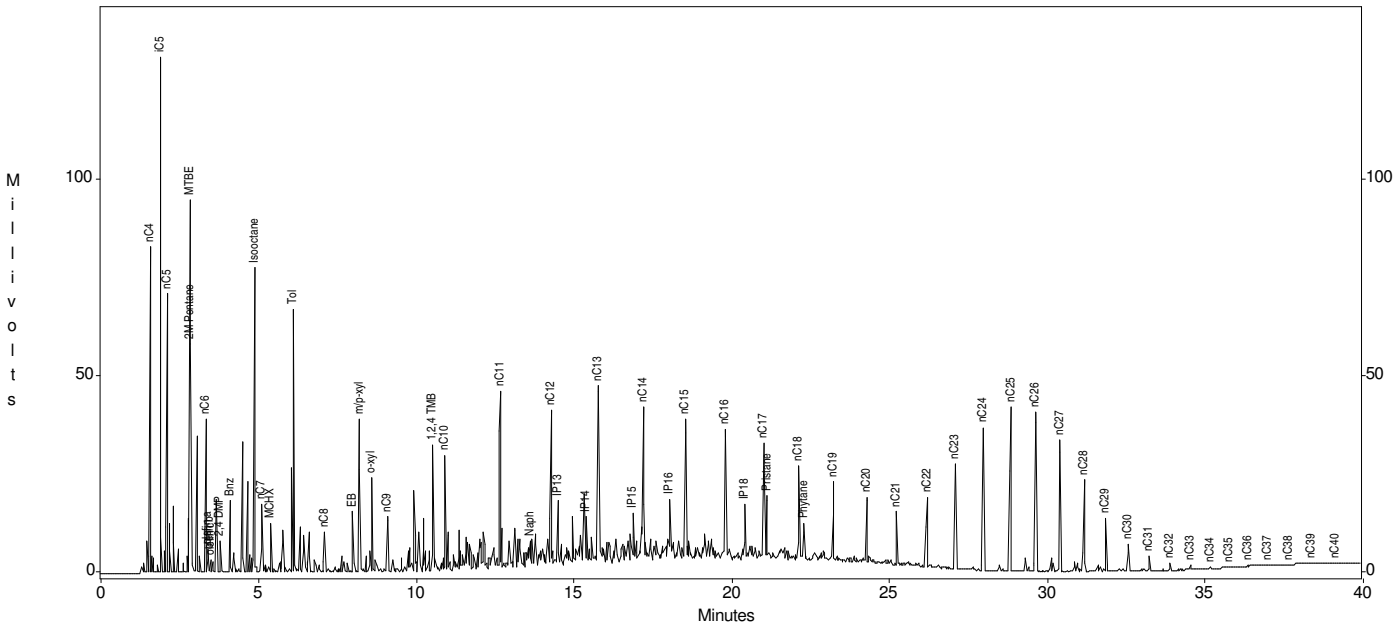
c:\ezchrom\chrom\05054\gadiwax2 -- Channel A



c:\ezchrom\chrom\05054\gadiwax2 -- Channel A



c:\ezchrom\chrom\05054\gadiwax2 -- Channel A

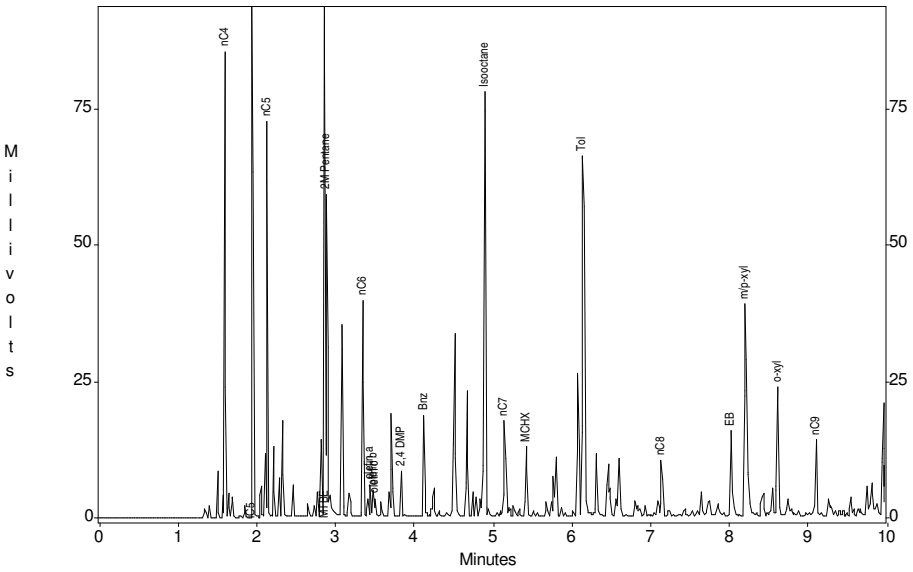


Channel A Results

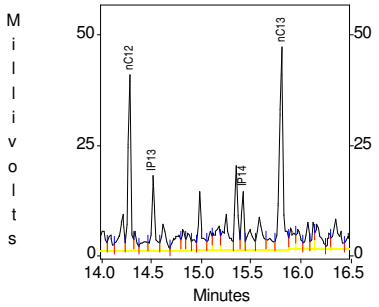
Peak	Area	Height
nC4	52712	82761
iC5	94084	131011
nC5	54568	71060
MTBE	82655	95046
2M Pentane	58774	58171
nC6	38824	39111
olefin a	6742	5840
olefin b	5214	4757
olefin c	4416	3160
2,4 DMP	8961	8315
Bnz	25452	18232
Isooctane	104367	77711
nC7	22494	17473
MCHX	17140	12448
Tol	97052	66784
nC8	13511	10241
EB	26743	15774
m/p-xyl	86073	39006
o-xyl	37782	23980
nC9	21437	14073
1,2,4 TMB	58401	32456
nC10	46420	29528
nC11	84142	46151
Naph	26657	8023
nC12	78431	41082
IP13	46228	18036
IP14	27609	14349
nC13	118993	47537
IP15	58525	15083
nC14	94325	42255
IP16	42113	18718
nC15	108937	39145
nC16	122429	36447
IP18	48206	17030
nC17	87727	32674
Pristane	76104	19285
nC18	101016	26820
Phytane	55545	12309
nC19	89924	23110
nC20	47803	18726
nC21	54916	15553
nC22	40896	18918
nC23	59034	27401
nC24	91857	36738
nC25	105012	41788
nC26	105659	40667
nC27	79570	33417
nC28	49673	23146
nC29	28543	13552
nC30	14195	6831
nC31	7309	3492
nC32	3575	1865
nC33	1869	963
nC34	1049	552
nC35	543	284
nC36	341	147
nC37	677	86
nC38	248	53
nC39	134	36
nC40	140	35

Sun - Philadelphia Refinery
Sample ID : Gas/Dies/Wax std
Acquired : Apr 26, 2005 13:31:55

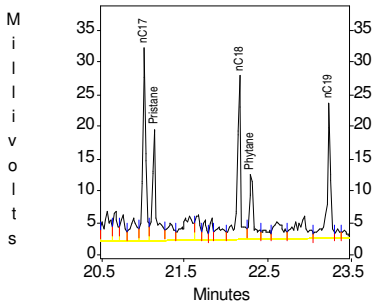
c:\ezchrom\chrom\05054\gadiwax.2 -- Channel A



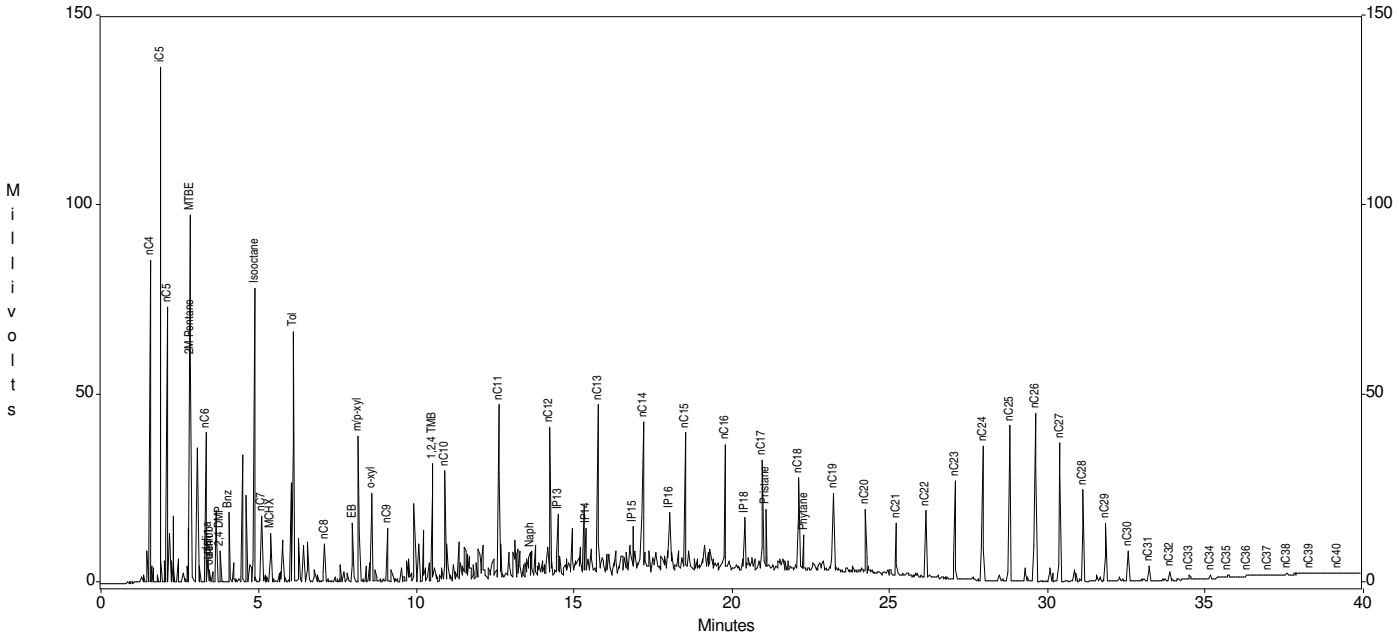
c:\ezchrom\chrom\05054\gadiwax.2 -- Channel A



c:\ezchrom\chrom\05054\gadiwax.2 -- Channel A



c:\ezchrom\chrom\05054\gadiwax.2 -- Channel A



Channel A Results

Peak	Area	Height
nC4	53084	85426
iC5	95817	136245
nC5	55893	72926
MTBE	85734	97515
2M Pentane	59383	59281
nC6	39608	39784
olefin a	6897	5973
olefin b	5292	4883
olefin c	4618	3278
2,4 DMP	9213	8629
Bnz	26172	18623
Isooctane	105503	78057
nC7	22798	17641
MCHX	17693	12823
Tol	96494	66386
nC8	13752	10396
EB	26529	15612
m/p-xyl	84051	38909
o-xyl	36817	23669
nC9	21189	14199
1,2,4 TMB	54943	31131
nC10	44584	29262
nC11	79918	46298
Naph	22170	6892
nC12	73338	39882
IP13	38492	16965
IP14	23623	13275
nC13	106713	45994
IP15	47725	13441
nC14	87170	40892
IP16	36490	16857
nC15	93901	38074
nC16	100974	34524
IP18	37357	15030
nC17	72725	29974
Pristane	52776	17091
nC18	68286	25333
Phytane	30874	9955
nC19	56538	20896
nC20	29938	16591
nC21	28896	13911
nC22	33440	17715
nC23	54953	25864
nC24	86914	35299
nC25	106002	41117
nC26	111313	44296
nC27	86445	36681
nC28	55291	24341
nC29	32329	15374
nC30	16254	8048
nC31	8376	3932
nC32	4202	2234
nC33	2232	1172
nC34	1267	636
nC35	733	343
nC36	453	184
nC37	252	104
nC38	254	66
nC39	98	35
nC40	32	20

Analysis Request/ Environmental Services Chain of Custody

Acct. #: _____ Sample #: _____

Client: LANGAN / AQUATERRA	Acct. #:		
Project Name/#: SUN - BELMONT TERMINAL	PWSID #:		
Project Manager: K. Martin / T. Hanna	P.O. #:		
Sampler: M. BRAD SPANGLE	Quote #:		
Name of State where samples were collected:	PA		

Sample Identification	Date Collected	Time Collected	Grab	Composite	Matrix: Soil	Matrix: Water (Potable / NPDES)	Matrix: Other	Total # of Containers	8260 Fingerprint										Remarks	Temperature of samples upon receipt (if applicable)
MW33-LNAPL-042605	4/26/05	1335	X				X	1	X										Swab	
MW44-LNAPL-042605		1345	X				X	1	X											
MW34-LNAPL-042605		1350	X				X	1	X										Swab	
OW18-LNAPL-042605		1400	X				X	1	X											
RW22-LNAPL-042605		1525	X				X	1	X										Swab	
RW24-LNAPL-042605		1530	X				X	1	X											
RW23-LNAPL-042605		1540	X				X	1	X											
OW2-LNAPL-042605		1550	X				X	1	X											
OW12-LNAPL-042705	4/27/05	0820						1	X											
OW17-LNAPL-042705	4/27/05	0830						1	X										Swab	

Turnaround Time Requested (TAT) (please Ccircle): (Normal) Rush 5 DAY TAT

(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)

Date results are needed: _____

Rush results requested by (please circle): Phone Fax

Phone #: _____ Fax #: _____

SDG Complete? (Yes) No

State-specific QC required? Yes (No)

(If yes, indicated QC sample and submit triplecate volume)

Internal Chain-of-Custody required? Yes (No)

Relinquished by:	Date	Time	Received by:	Date	Time
M. Brad Spangle	4/28/05		FED EX		
Relinquished by:	Date	Time	Received by:	Date	Time
			[signature]	4/29/05	1000
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

For Lab Use Only

FSC:

SCR:

Analysis Request/ Environmental Services Chain of Custody

Acct. #: _____ Sample #: _____

Client: AQUATERRA/LANCAN | Acct. #:
Project Name/#: Sun-Belmont Terminal ACI-1 | PWSID #:
Project Manager: K. Martin / T. Hauska | P.O; #:
Sampler: M. Brad Spencake | Quote #:
Name of State where samples were collected: PA

Sample Identification	Date Collected	Time Collected	Grab	Composite	Matrix: Soil	Matrix: Water (Potable / NPDES)	Matrix: Other	Total # of Containers	Analyses Requested	For Lab Use Only: Remarks / Temperature of samples upon receipt (if applicable)
MW28-LNAPL-042705	4/27/05	0900	X				X	1		
MW29-LNAPL-042705		0915	X				X	1		
MW27-LNAPL-042705		0830	X				X	1		
MW41-LNAPL-042705		0945	X				X	1		
OW13-LNAPL-042705		1000	X				X	1		Swab
MW42-LNAPL-042705		1100	X				X	1		Swab

For Lab Use Only: FSC: SCR:

Turnaround Time Requested (TAT) (please Circle): Normal Rush 5 DAY TAT
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: _____
Rush results requested by (please circle): Phone Fax
Phone #: _____ Fax #: _____

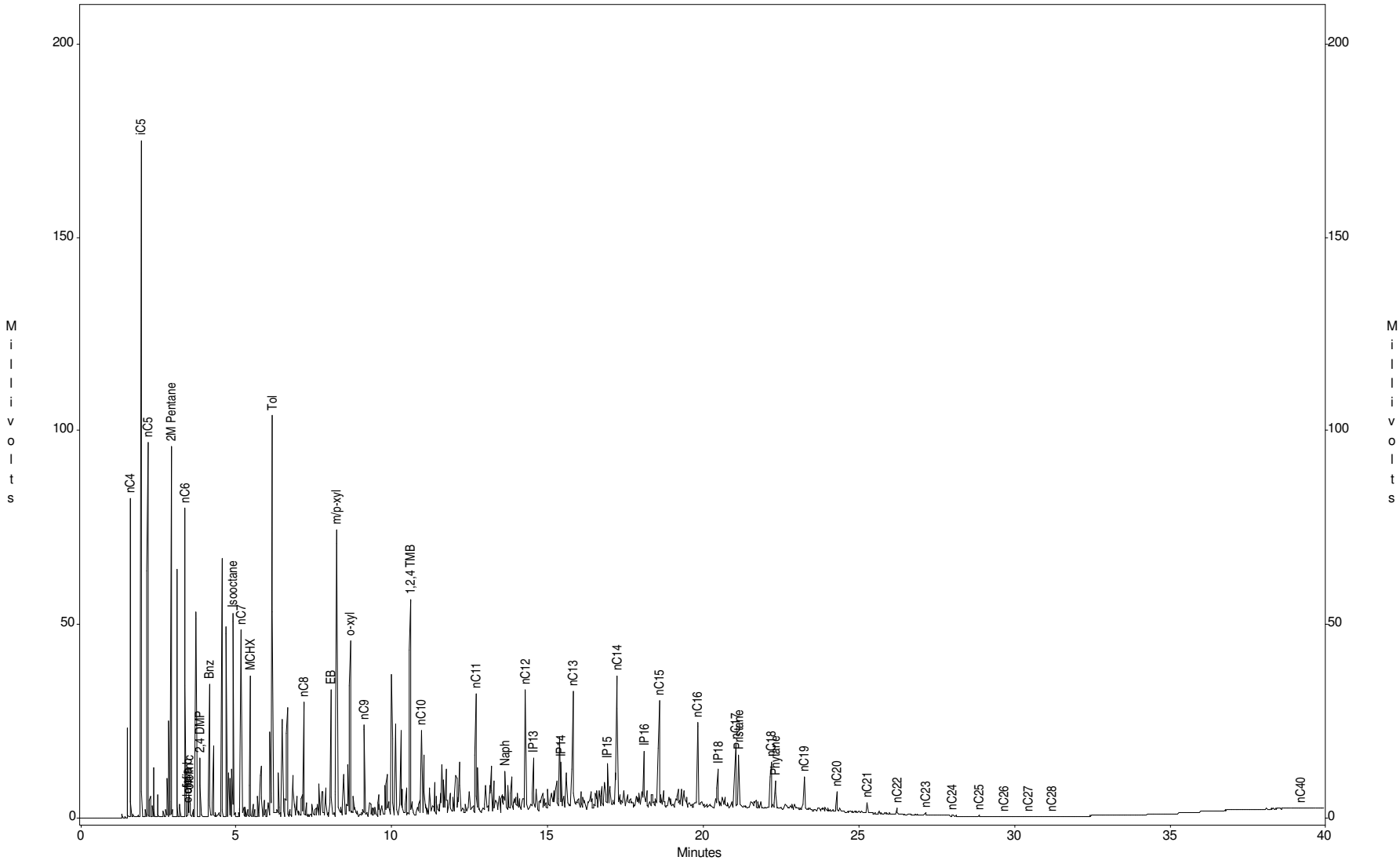
SDG Complete? Yes No

State-specific QC required? Yes No
(If yes, indicated QC sample and submit triplecate volume)
Internal Chain-of-Custody required? Yes No

Relinquished by:	Date	Time	Received by:	Date	Time
M. Brad Spencake	4/28/05		FEDEX	4/28/05	
Relinquished by:	Date	Time	Received by:	Date	Time
			[signature]	4/29/05	1000
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

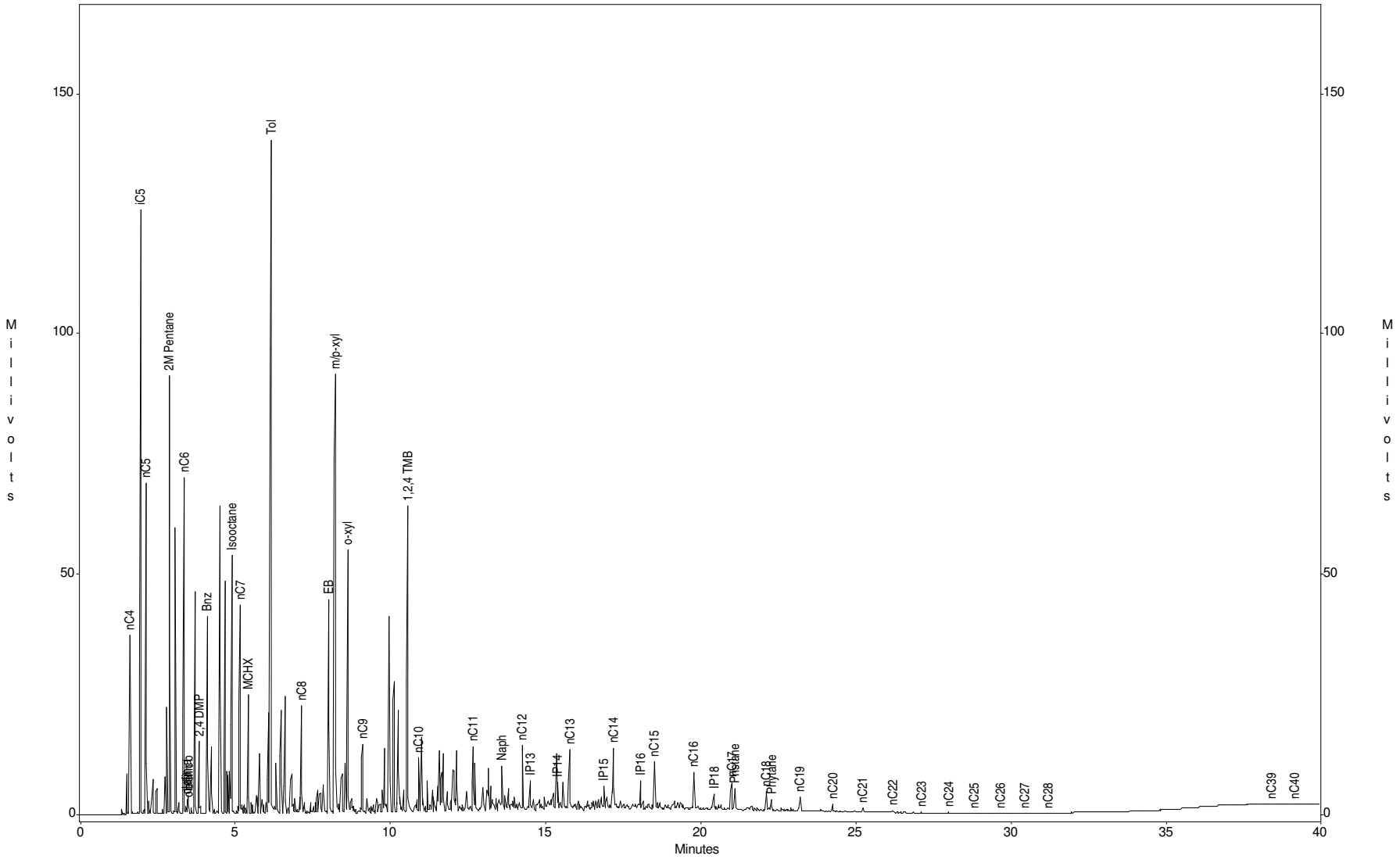
Sun - Belmont Terminal (AOI-1)
Sample ID : MW27-LNAPL-042705
Acquired : May 03, 2005 08:20:19

c:\ezchrom\chrom\05057\mw27 -- Channel A



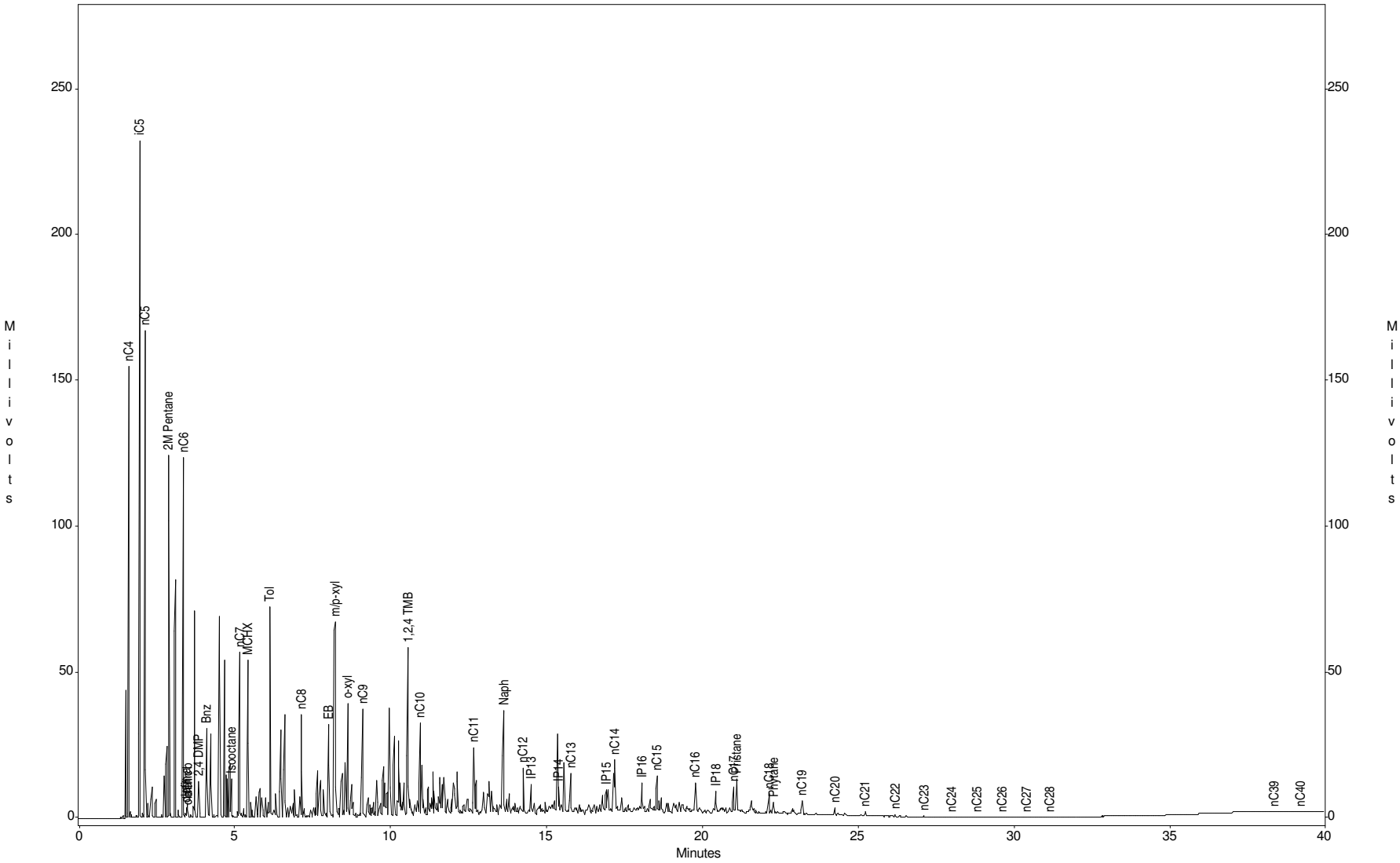
Sun - Belmont Terminal (AOI-1)
Sample ID : MW28-LNAPL-042705
Acquired : May 03, 2005 14:16:59

c:\ezchrom\chrom\05057\mw28 -- Channel A



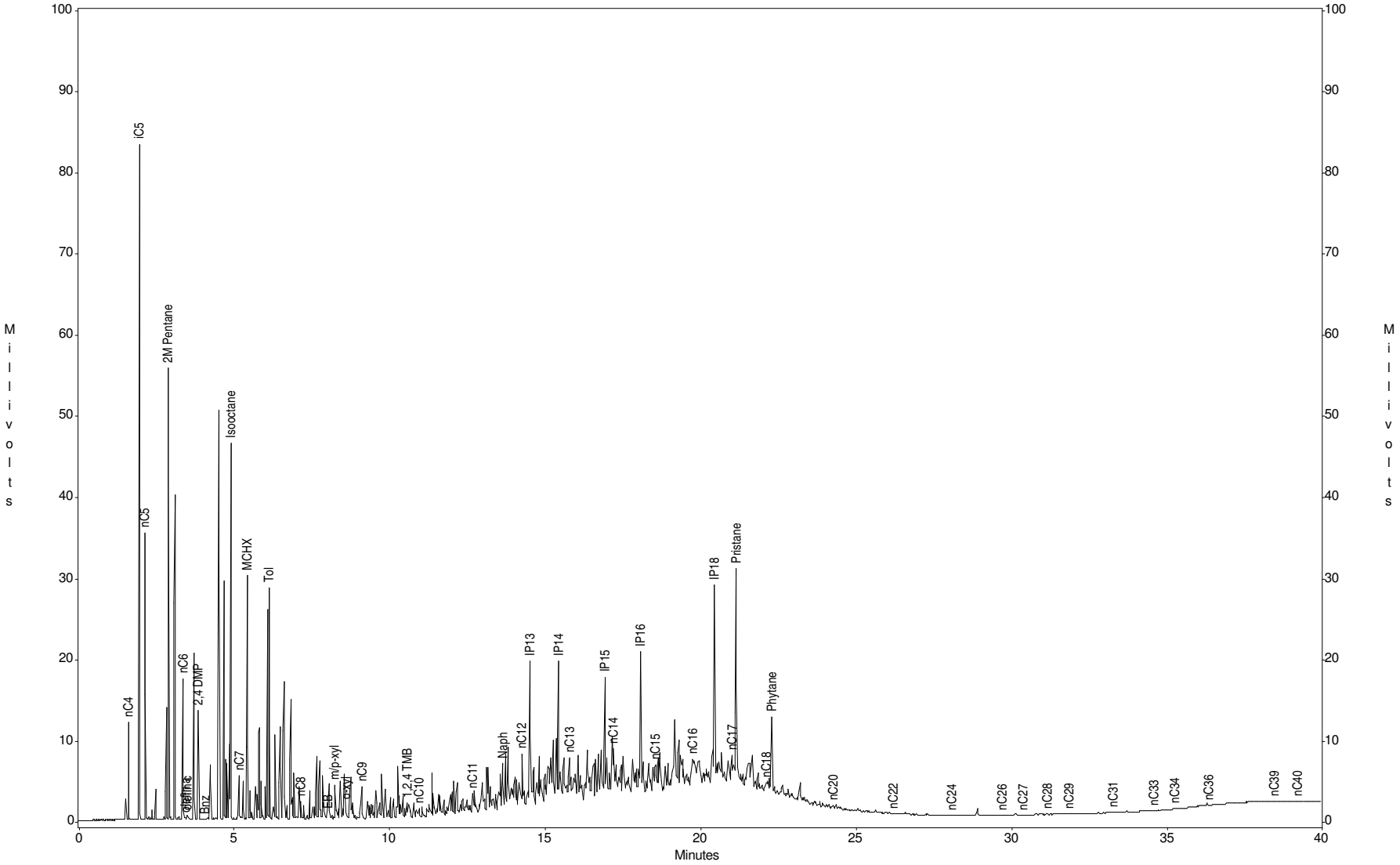
Sun - Belmont Terminal (AOI-1)
Sample ID : MW29-LNAPL-042705
Acquired : May 03, 2005 12:27:23

c:\ezchrom\chrom\05057\mw29 -- Channel A



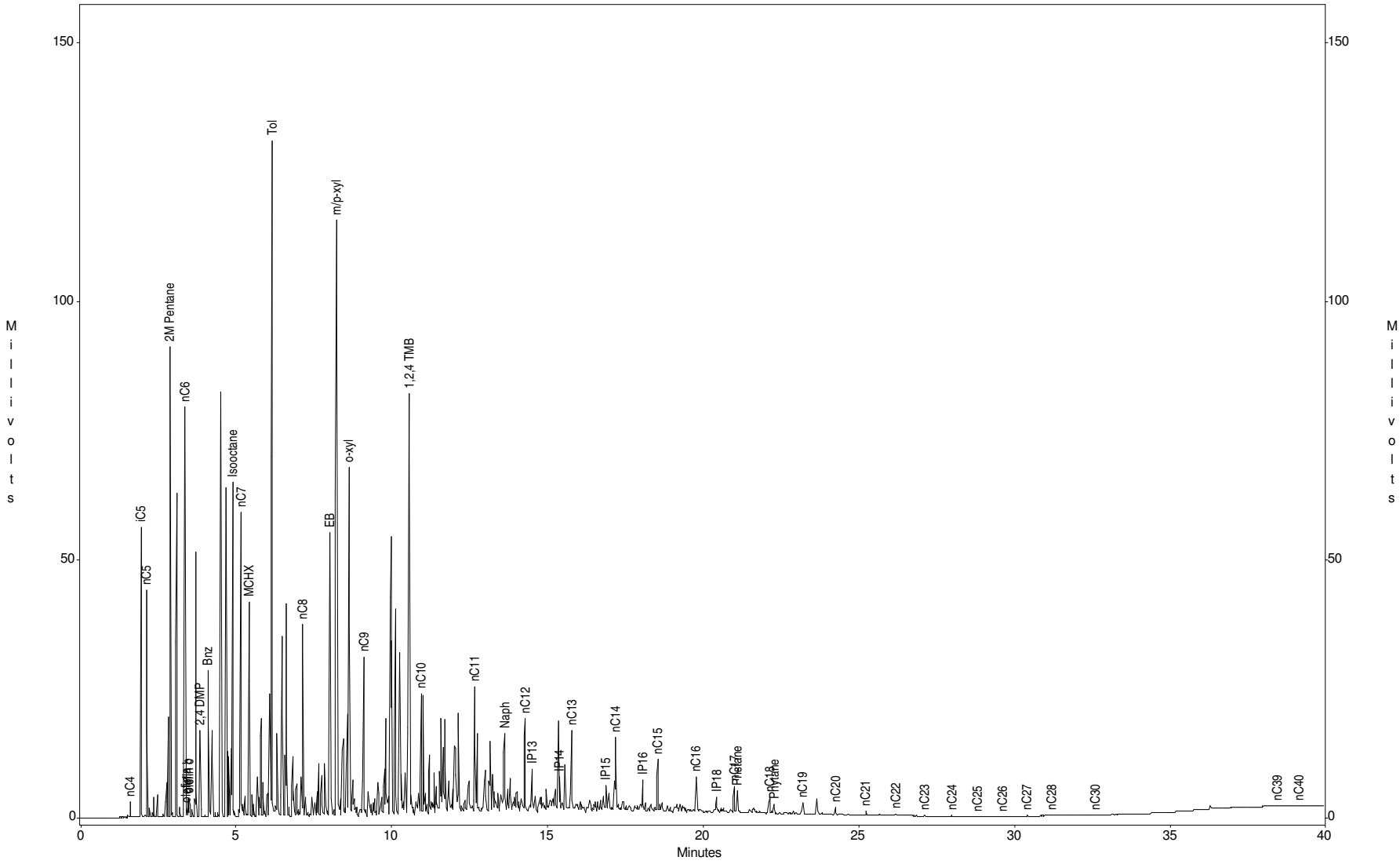
Sun - Belmont Terminal (AOI-1)
Sample ID : MW33-LNAPL-042605
Acquired : May 04, 2005 11:48:19

c:\ezchrom\chrom\05057\mw33 -- Channel A



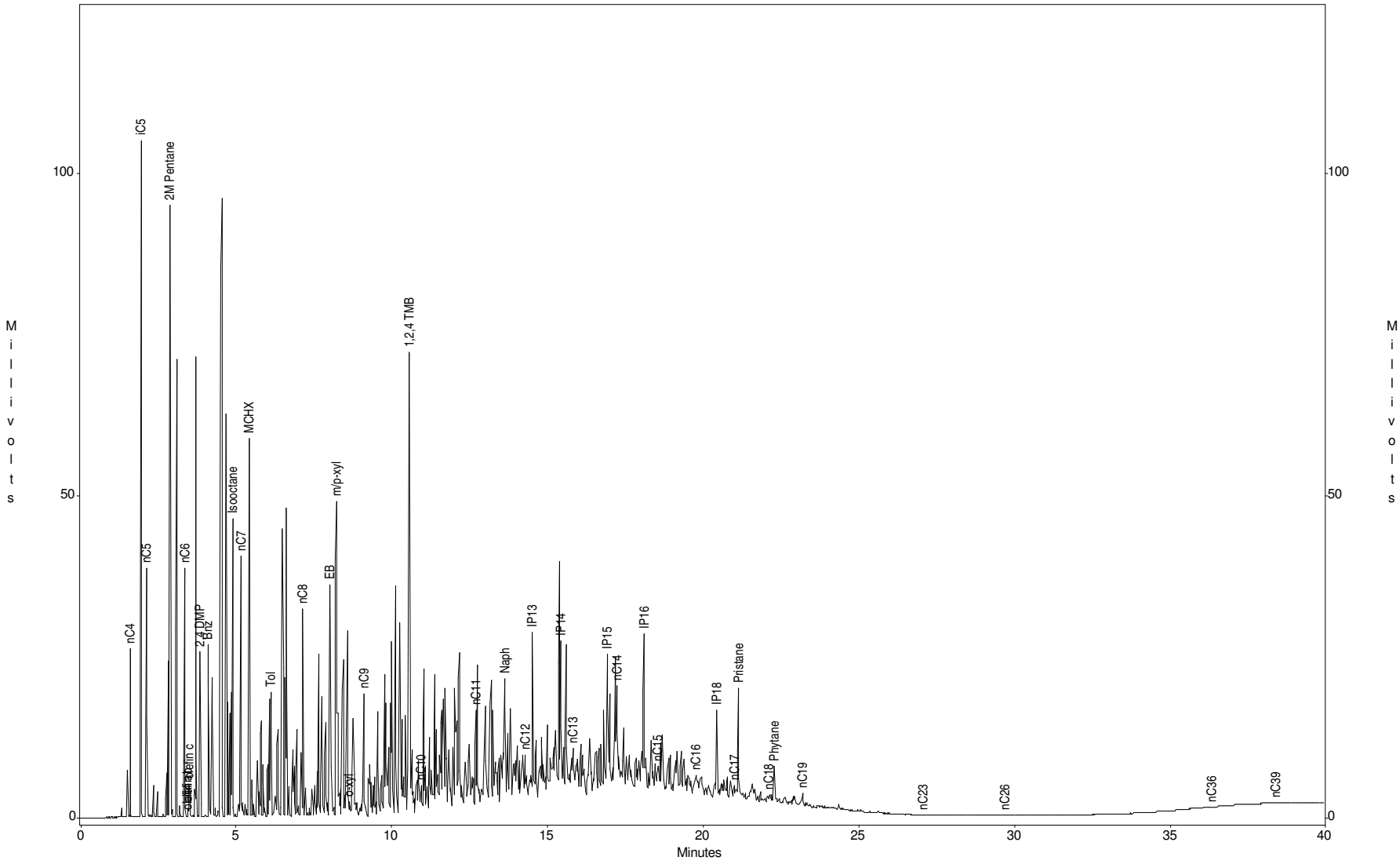
Sun - Belmont Terminal (AOI-1)
Sample ID : MW34-LNAPL-042605
Acquired : May 04, 2005 10:58:59

c:\ezchrom\chrom\05057\mw34 -- Channel A



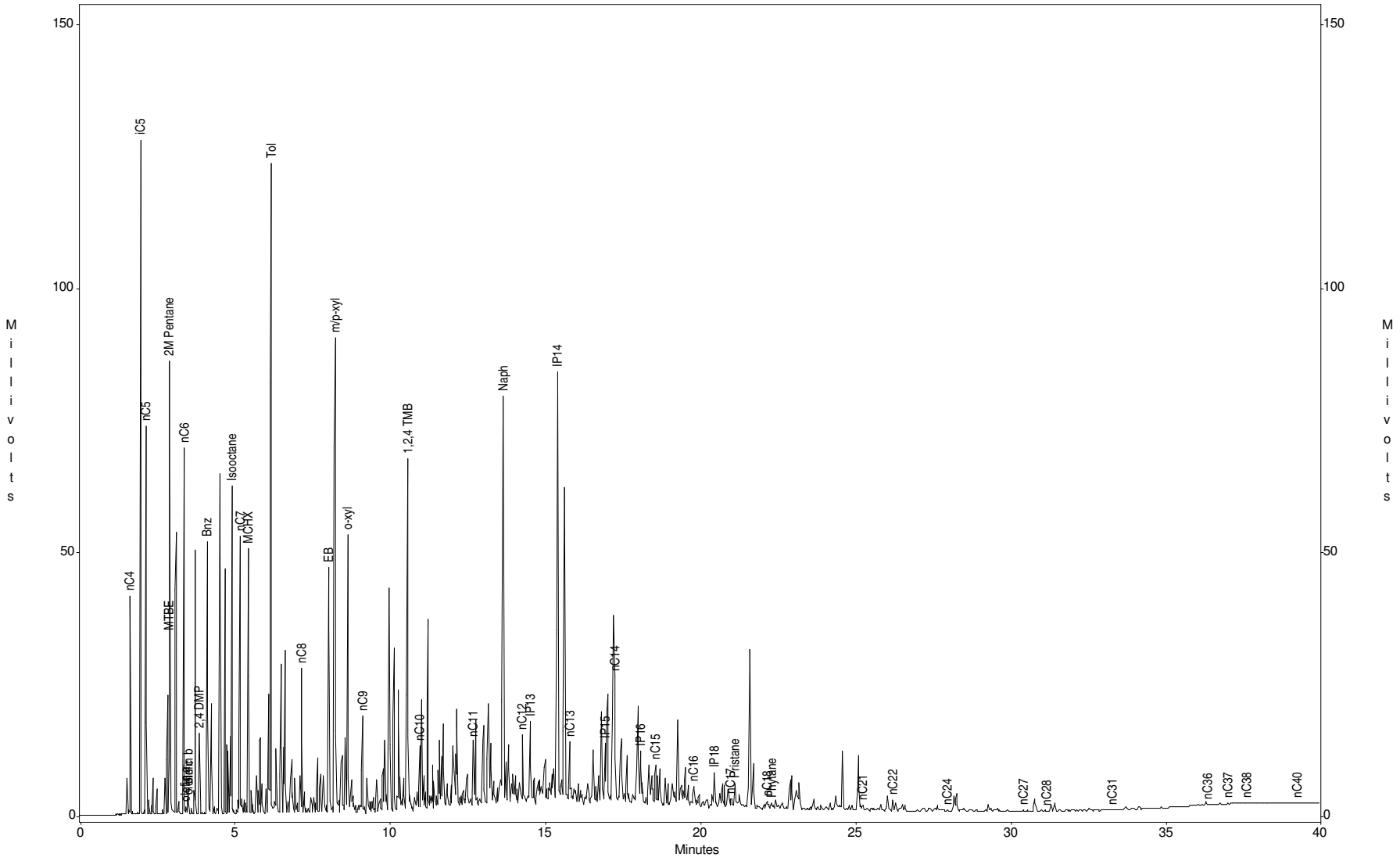
Sun - Belmont Terminal (AOI-1)
Sample ID : MW41-LNAPL-042705
Acquired : May 03, 2005 10:49:05

c:\ezchrom\chrom\05057\mw41 -- Channel A



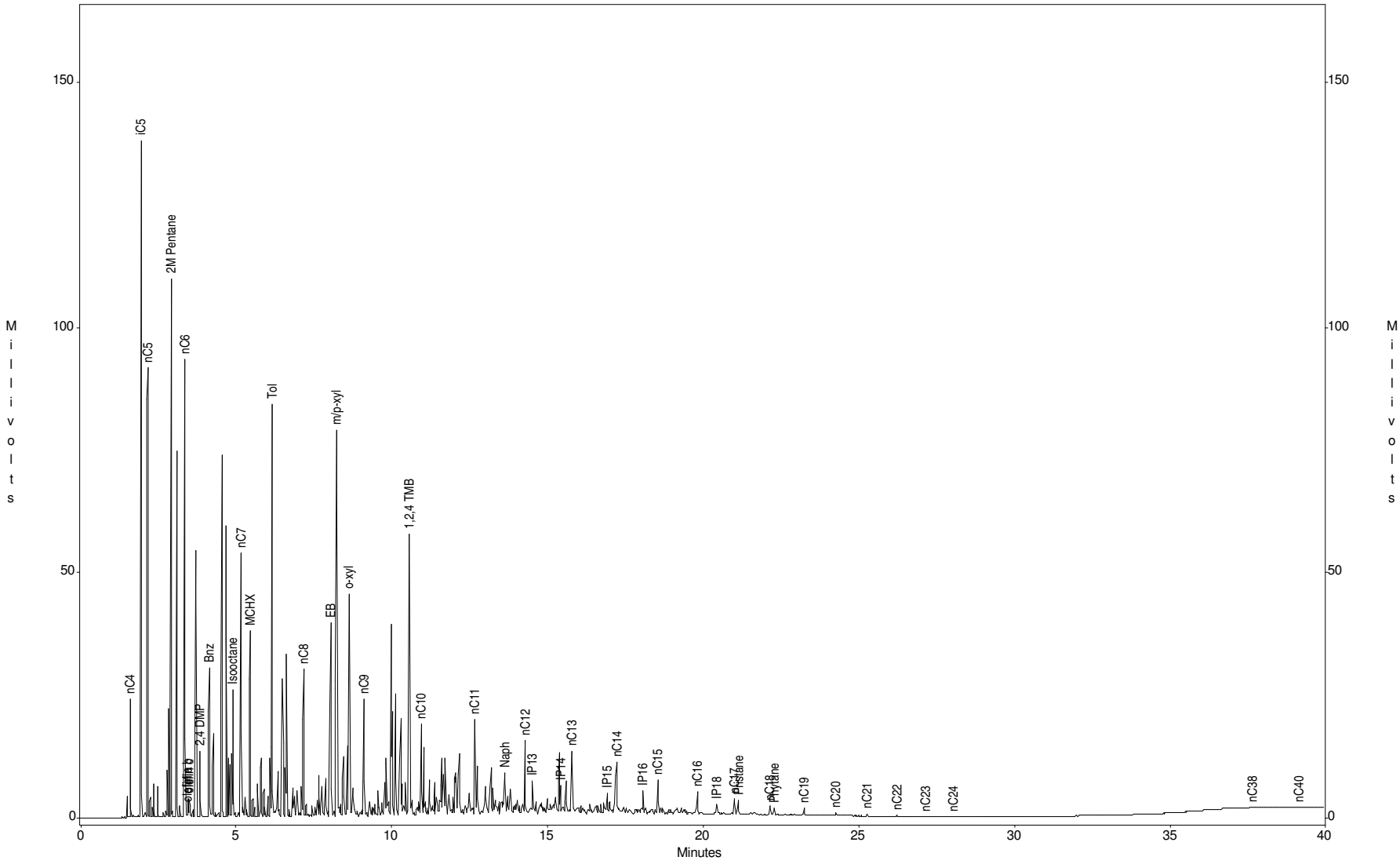
Sun - Belmont Terminal (AOI-1)
Sample ID : MW42-LNAPL-042705
Acquired : May 04, 2005 13:29:40

c:\ezchrom\chrom\05057\mw42 -- Channel A



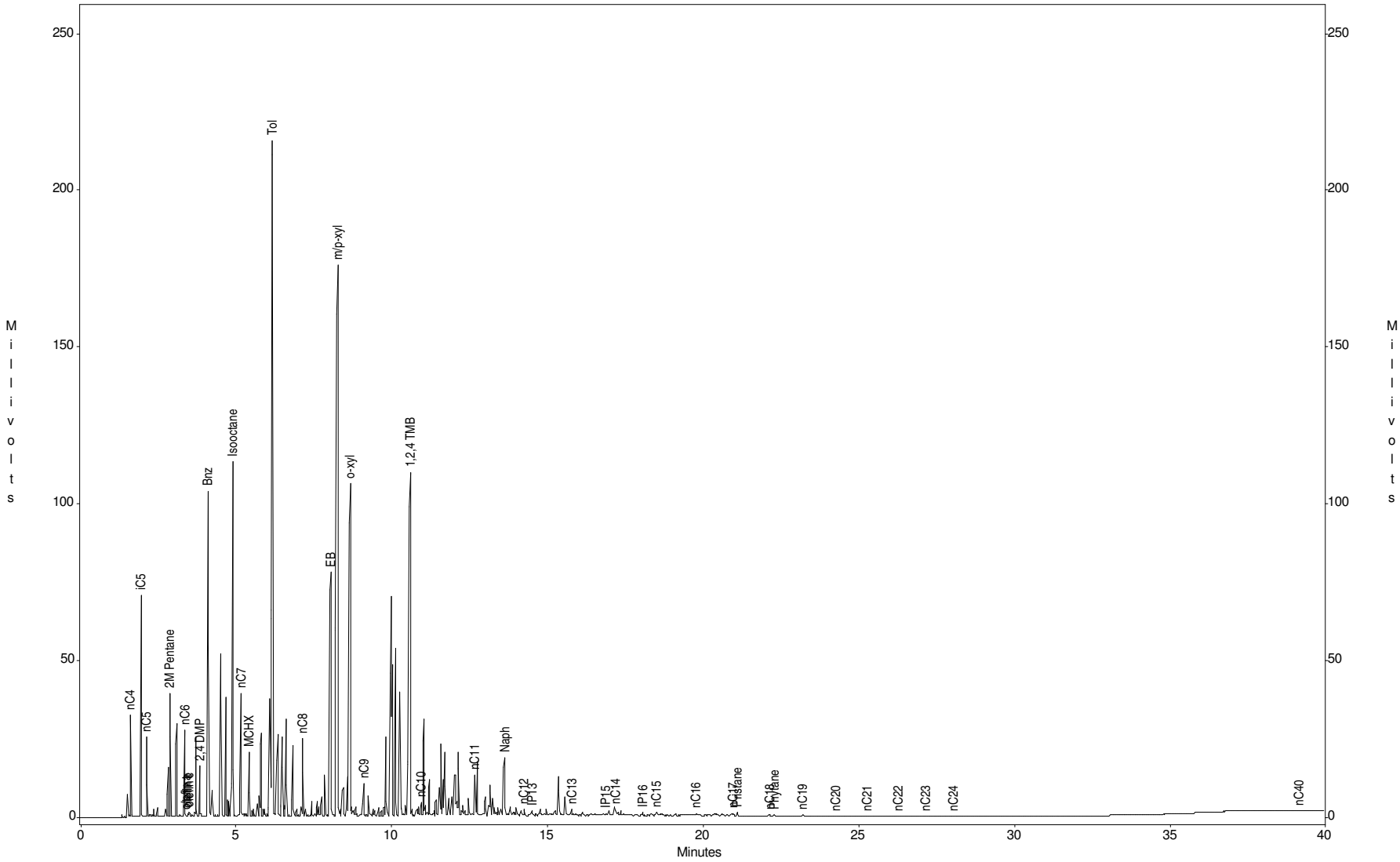
Sun - Belmont Terminal (AOI-1)
Sample ID : MW44-LNAPL-042605
Acquired : May 04, 2005 08:22:55

c:\ezchrom\chrom\05057\mw44 -- Channel A



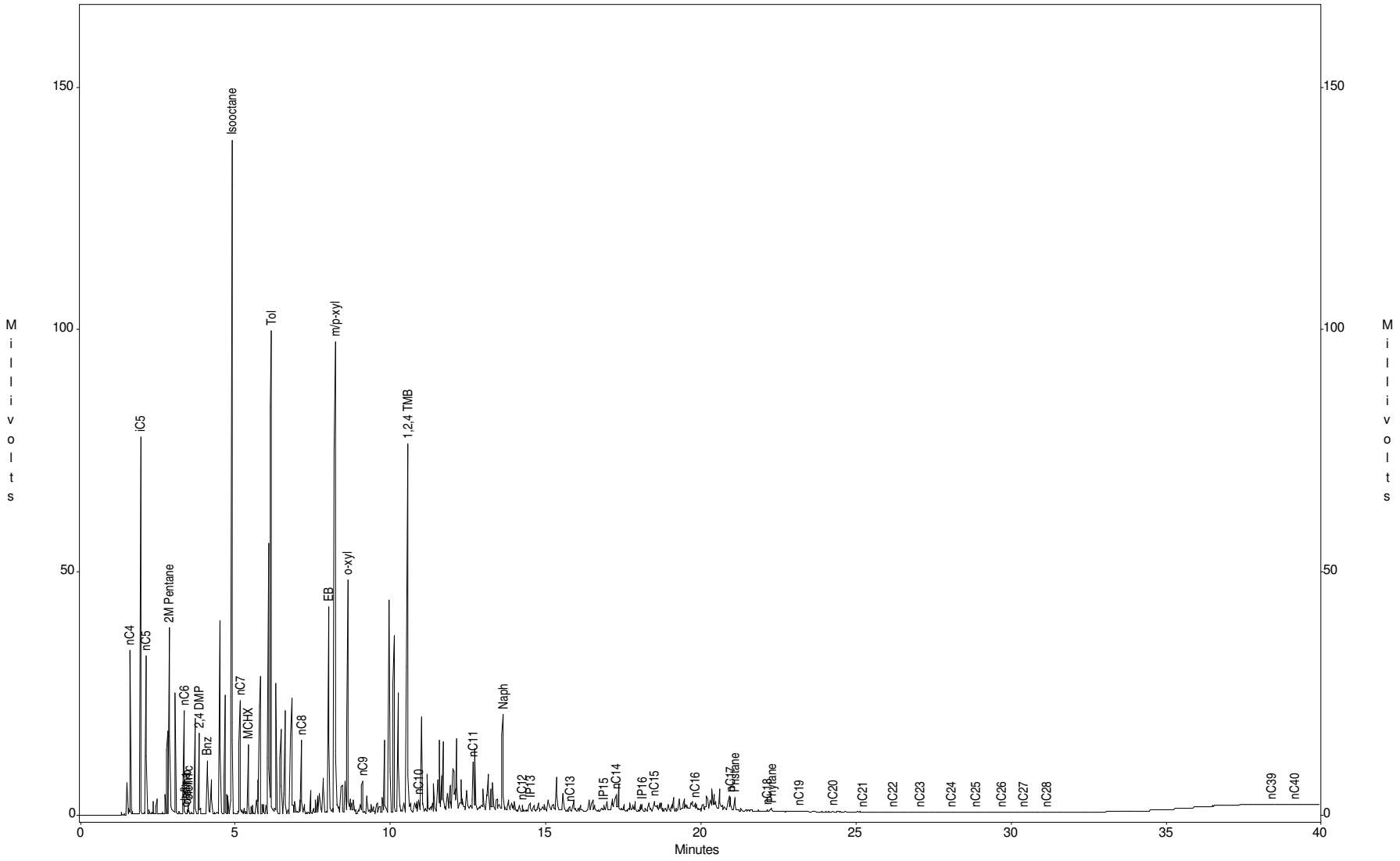
Sun - Belmont Terminal (AOI-1)
Sample ID : OW2-LNAPL-042605
Acquired : May 03, 2005 11:38:40

c:\ezchrom\chrom\05057\ow2 -- Channel A



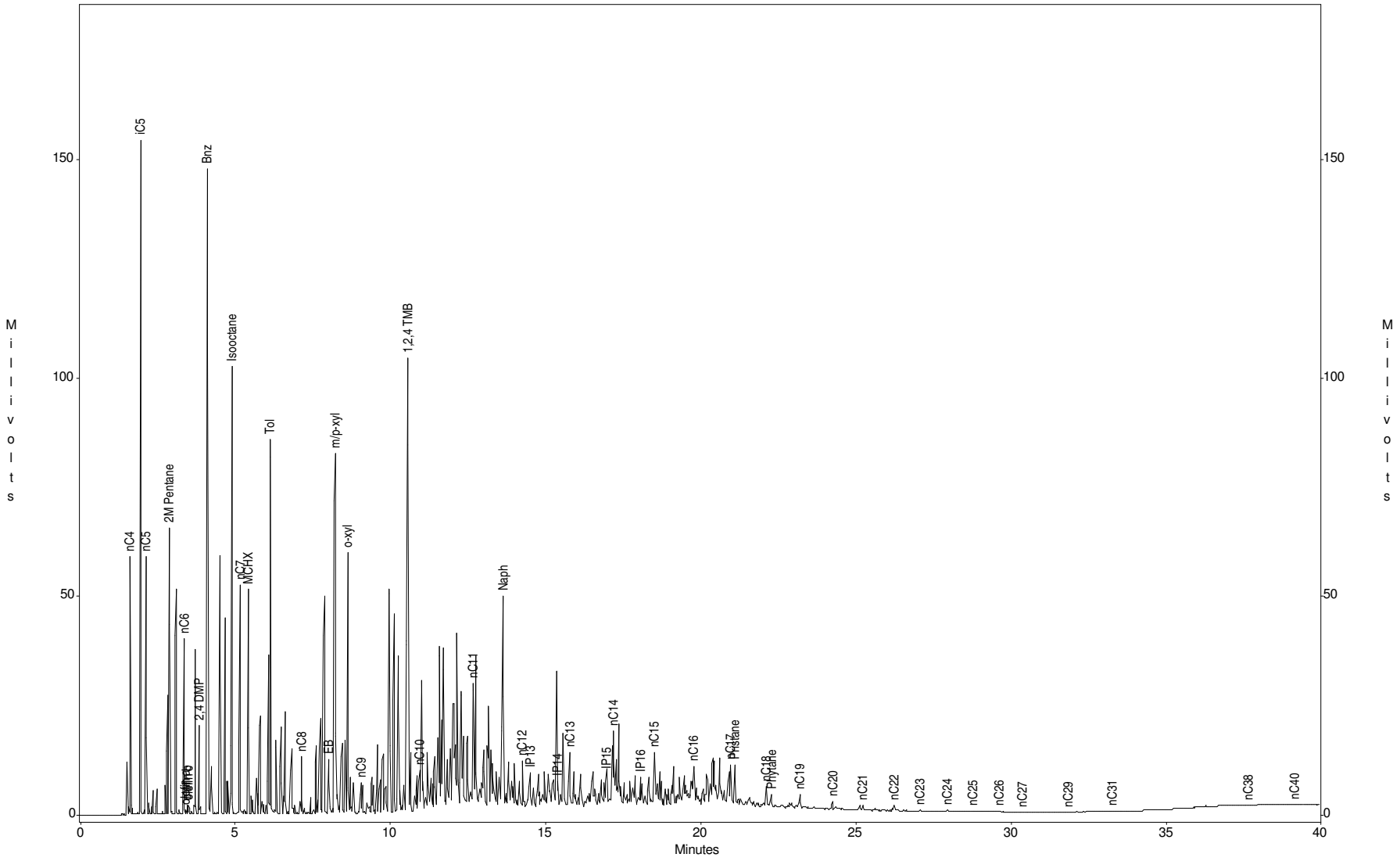
Sun - Belmont Terminal (AOI-1)
Sample ID : OW12-LNAPL-042705
Acquired : May 03, 2005 17:34:58

c:\ezchrom\chrom\05057\ow12.2 -- Channel A



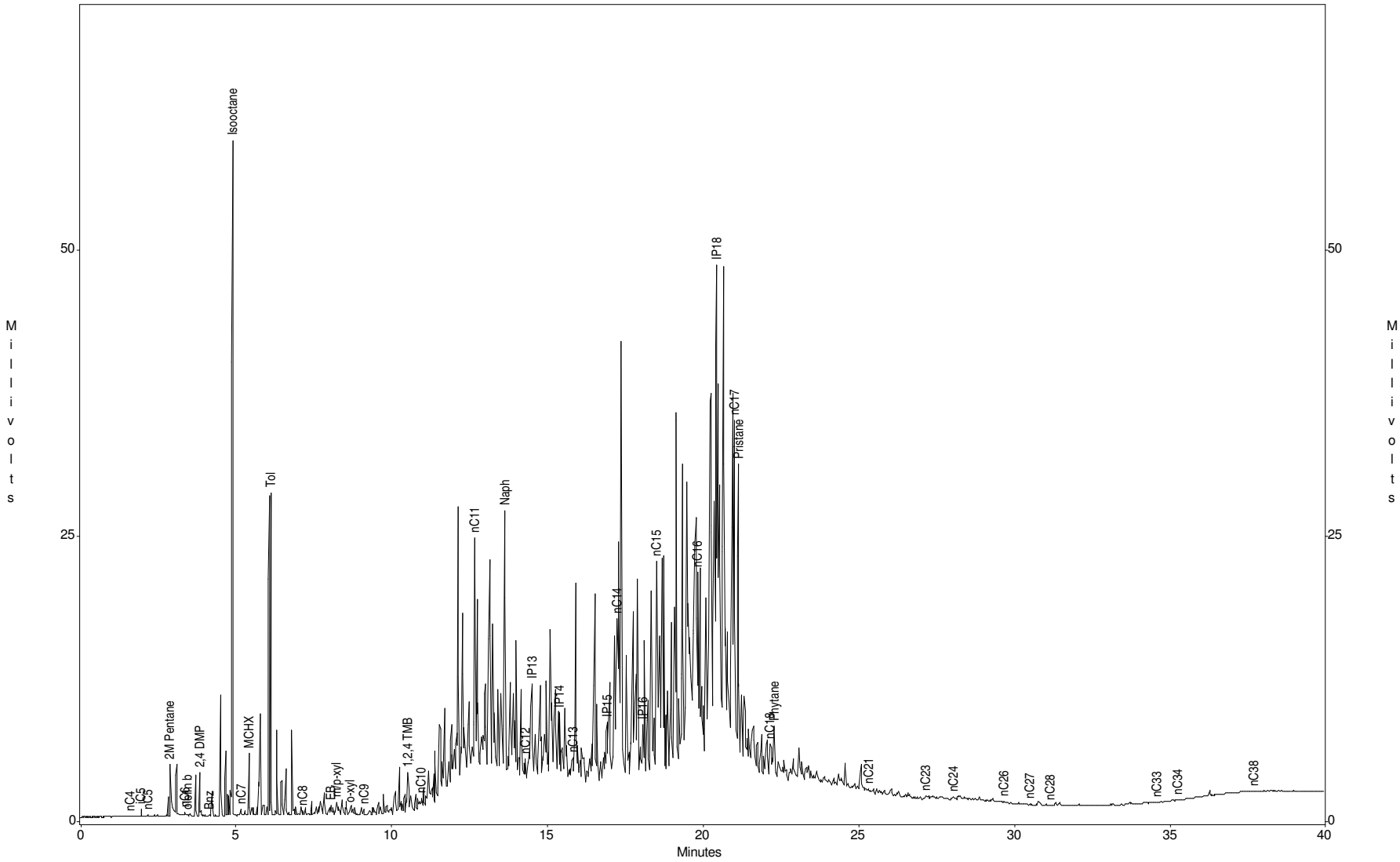
Sun - Belmont Terminal (AOI-1)
Sample ID : OW13-LNAPL-042705
Acquired : May 04, 2005 14:19:18

c:\ezchrom\chrom\05057\ow13 -- Channel A



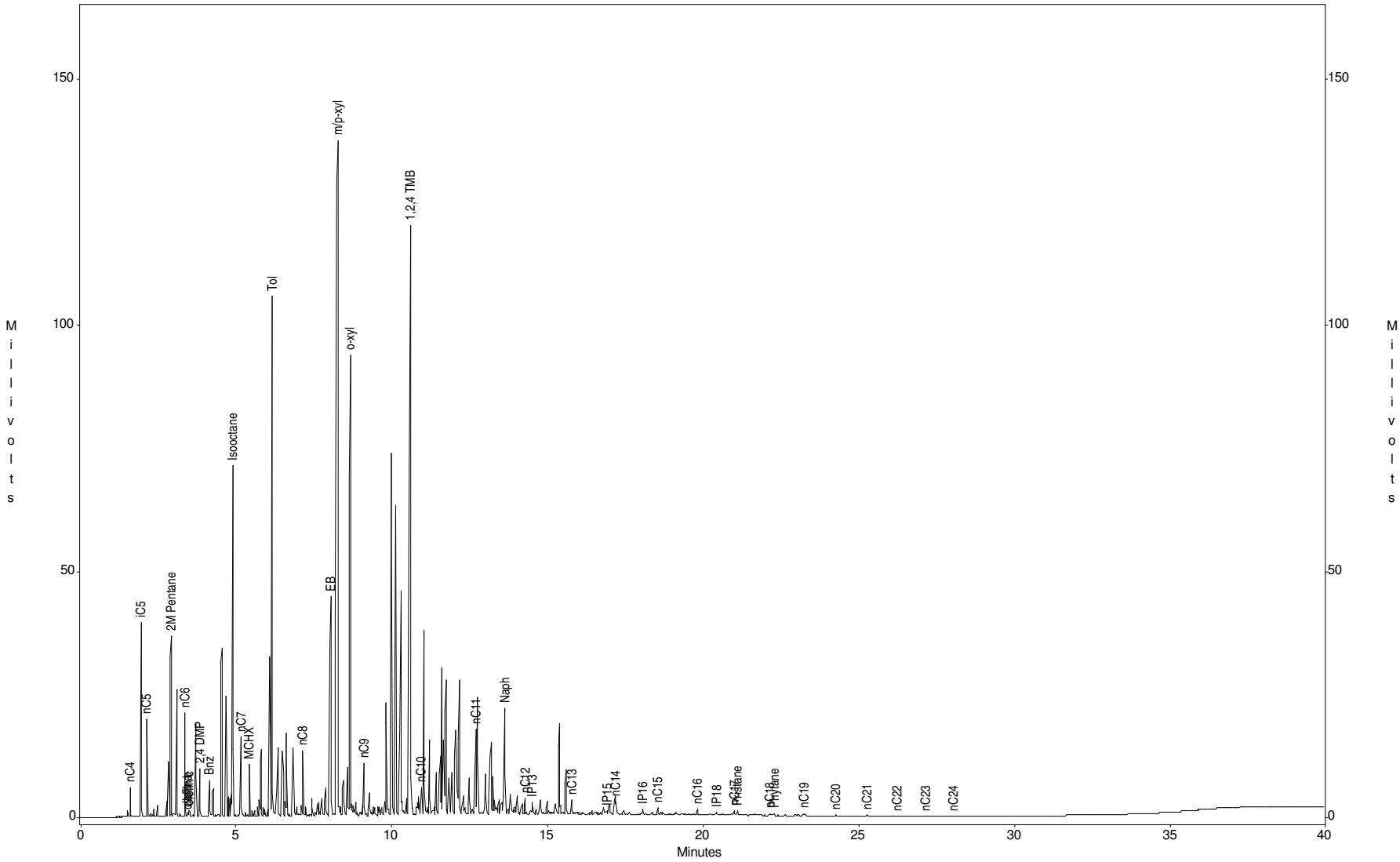
Sun - Belmont Terminal (AOI-1)
Sample ID : OW17-LNAPL-042705
Acquired : May 04, 2005 15:08:13

c:\ezchrom\chrom\05057\ow17 -- Channel A



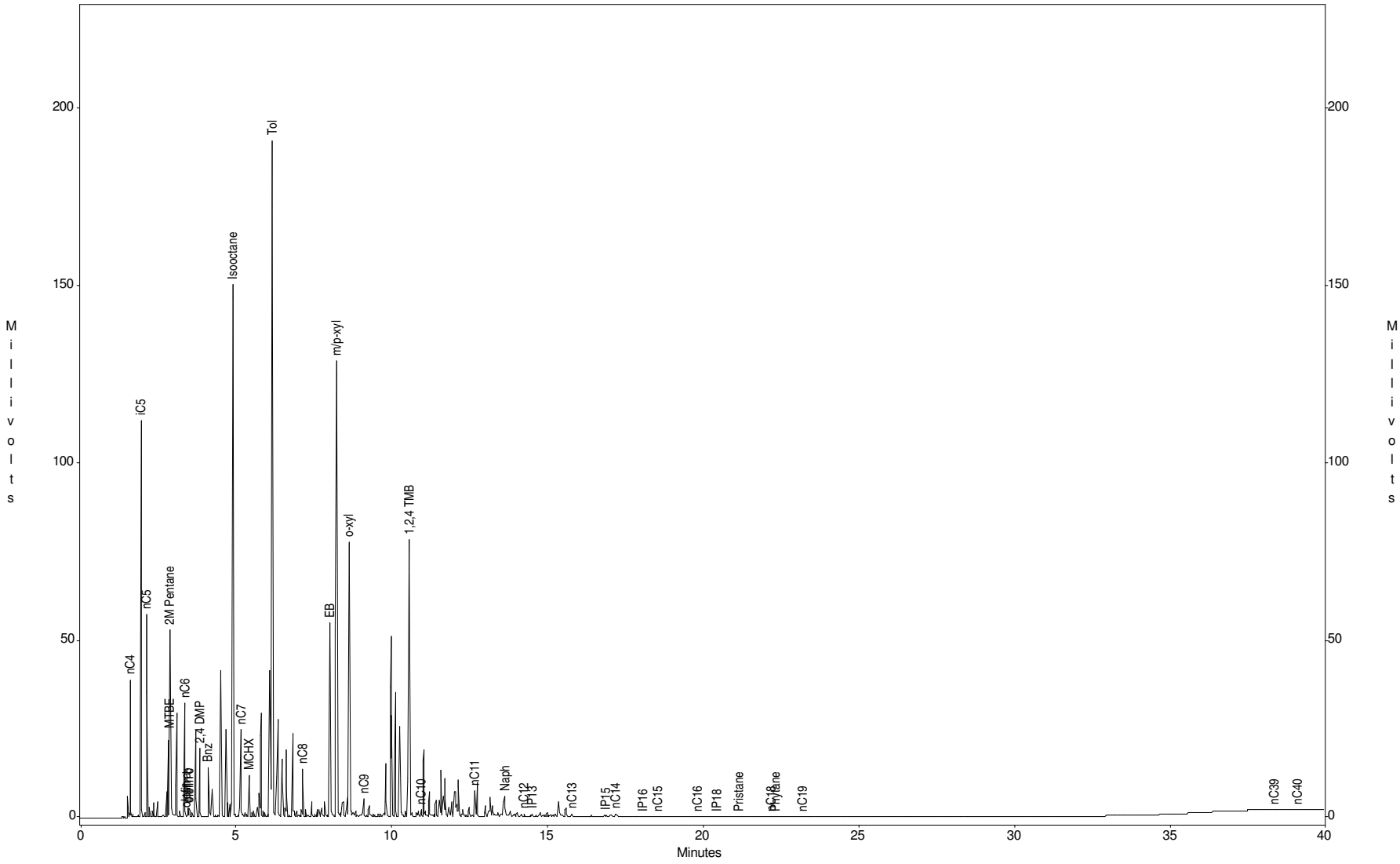
Sun - Belmont Terminal (AOI-1)
Sample ID : OW18-LNAPL-042605
Acquired : May 03, 2005 09:58:53

c:\ezchrom\chrom\05057\ow18.2 -- Channel A



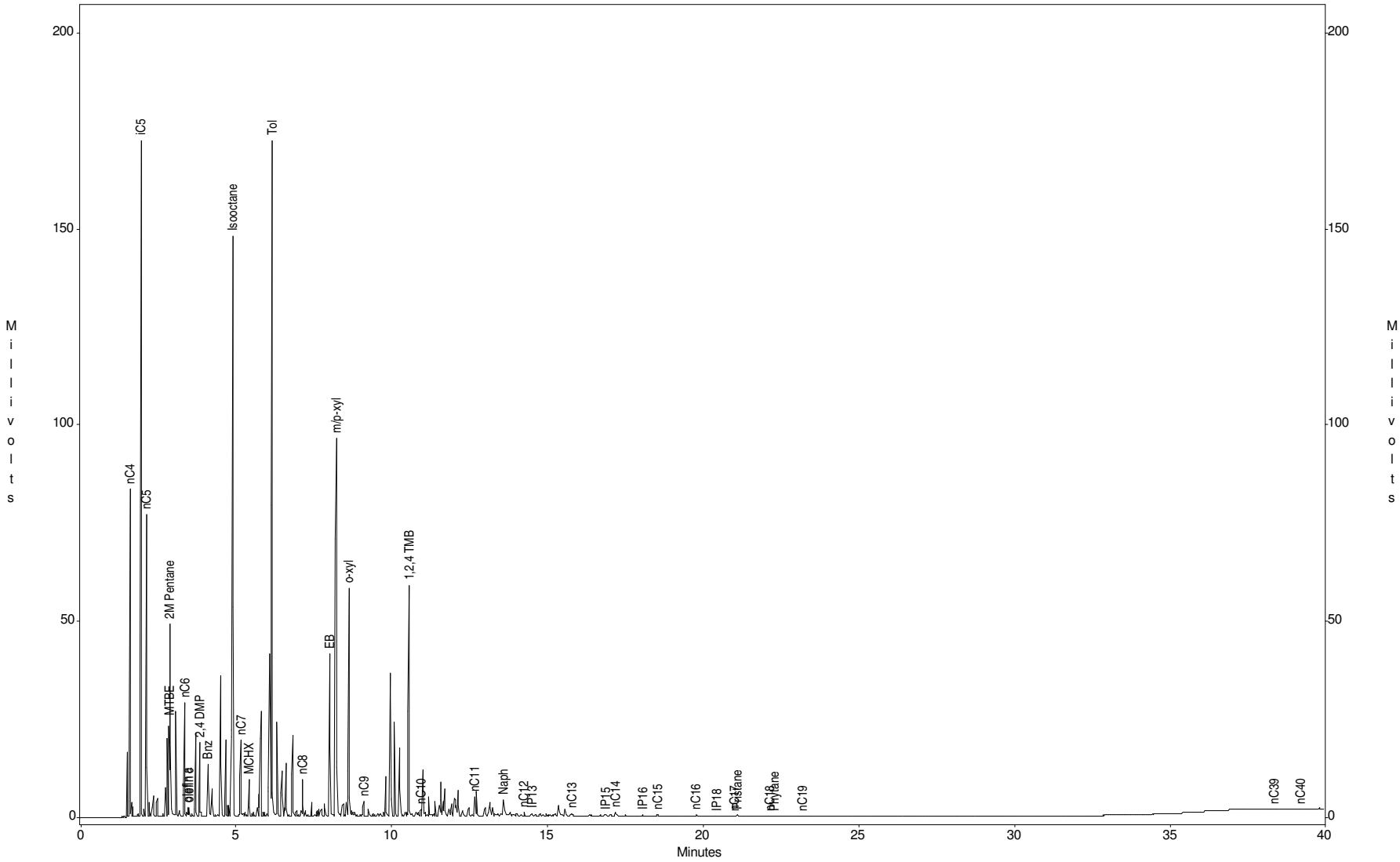
Sun - Belmont Terminal (AOI-1)
Sample ID : RW22-LNAPL-042605
Acquired : May 04, 2005 10:09:46

c:\ezchrom\chrom\05057\rw22 -- Channel A



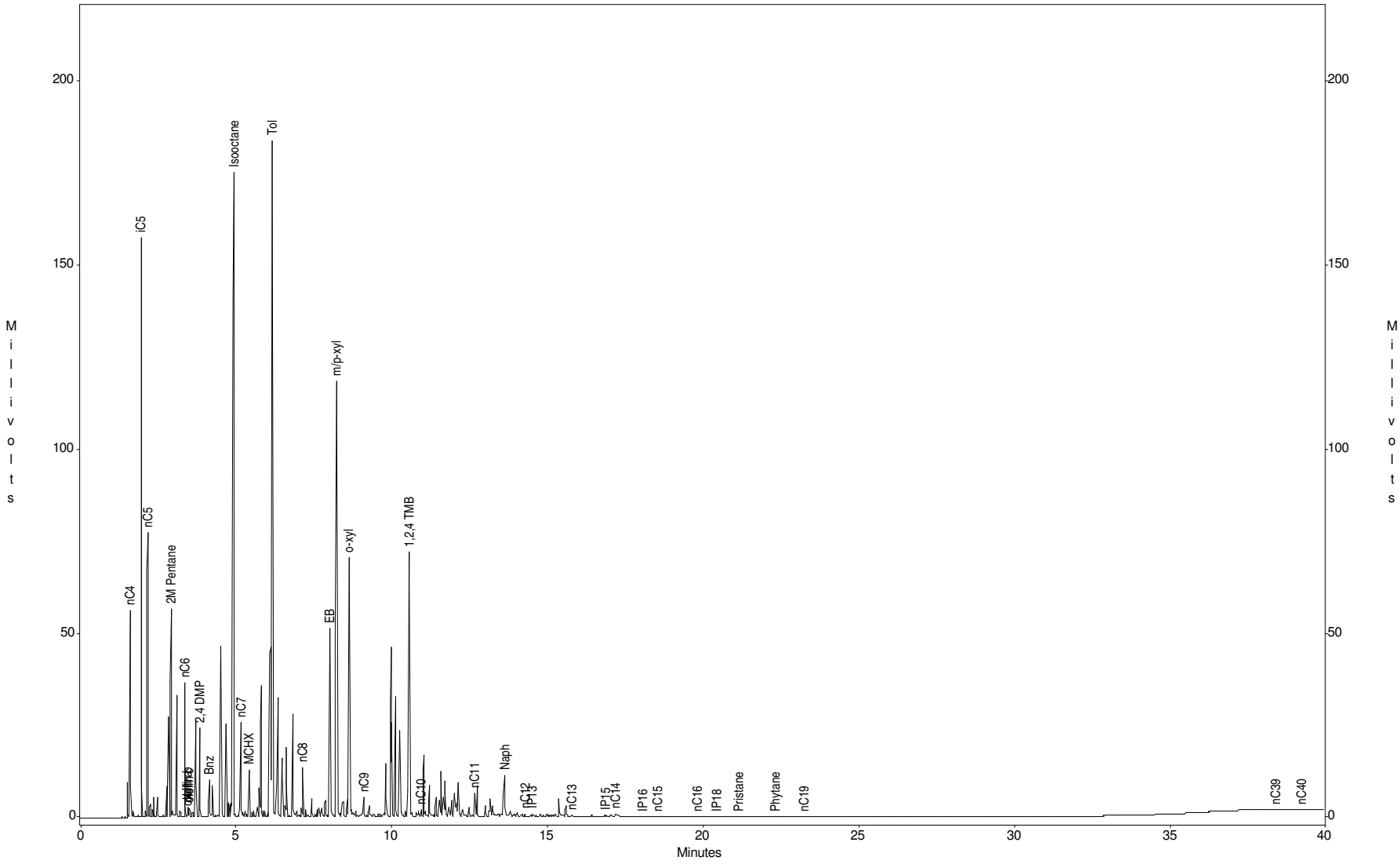
Sun - Belmont Terminal (AOI-1)
Sample ID : RW23-LNAPL-042605
Acquired : May 03, 2005 15:55:29

c:\ezchrom\chrom\05057\rw23.2 -- Channel A



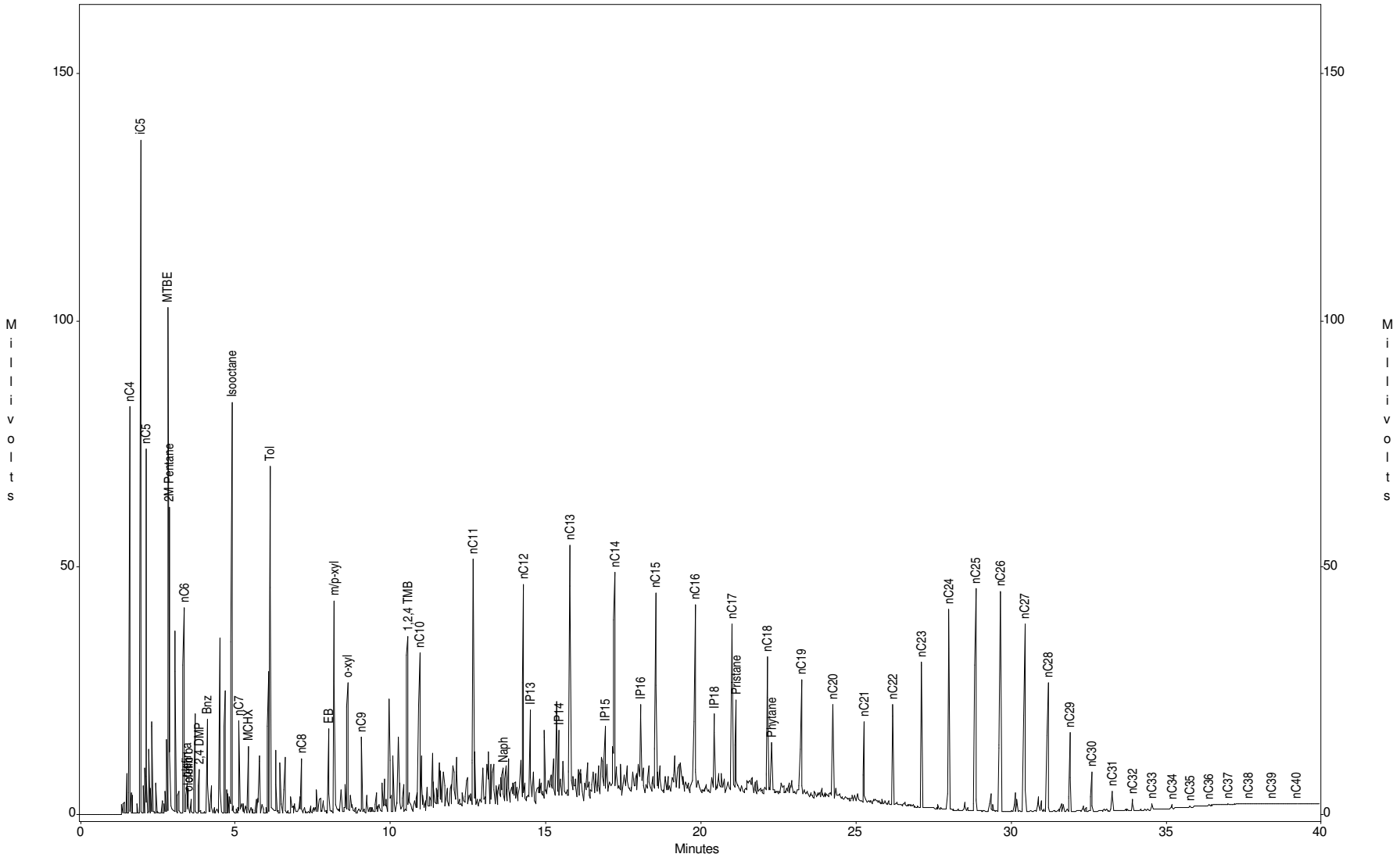
Sun - Belmont Terminal (AOI-1)
Sample ID : RW24-LNAPL-042605
Acquired : May 04, 2005 09:20:56

c:\ezchrom\chrom\05057\rw24 -- Channel A



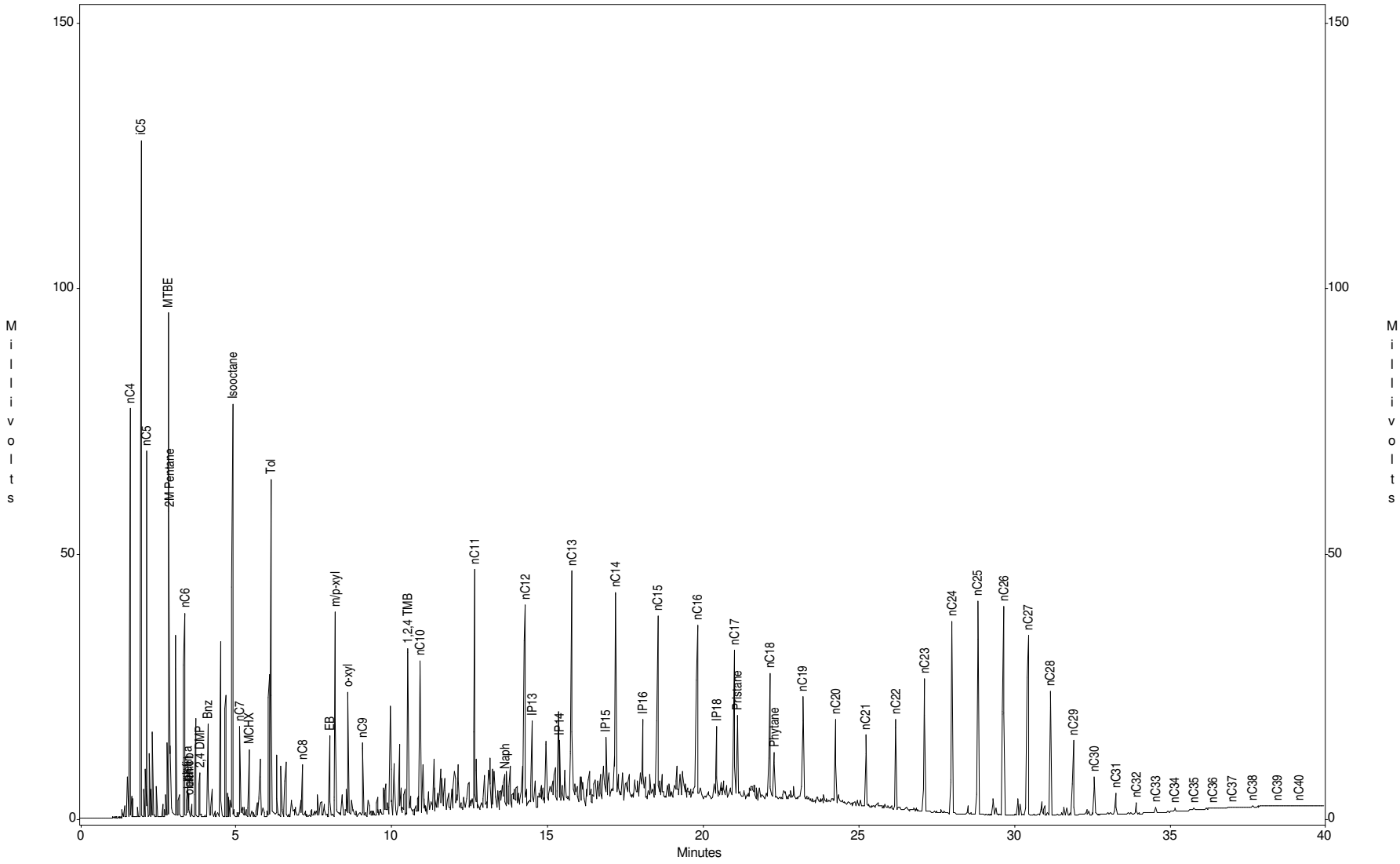
Sun - Belmont Terminal (AOI-1)
Sample ID : Gas/Dies/Wax std
Acquired : May 03, 2005 13:24:28

c:\ezchrom\chrom\05057\gadiwax2 -- Channel A



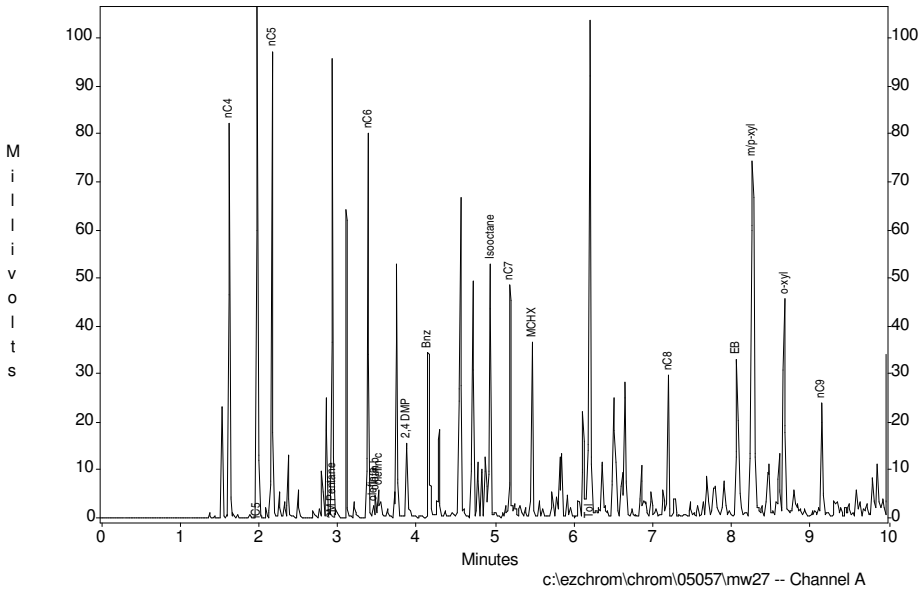
Sun - Belmont Terminal (AOI-1)
Sample ID : Gas/Dies/Wax std
Acquired : May 04, 2005 16:01:10

c:\ezchrom\chrom\05057\gadiwax2.2 -- Channel A

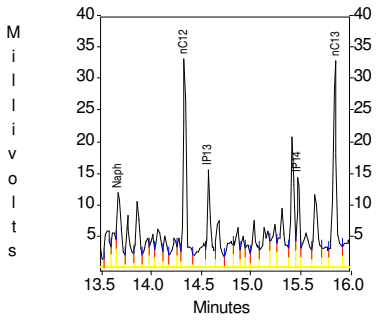


Sun - Belmont Terminal (AOI-1)
Sample ID : MW27-LNAPL-042705
Acquired : May 03, 2005 08:20:19

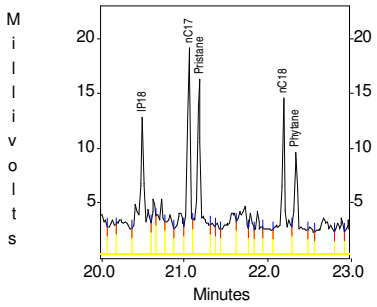
c:\ezchrom\chrom\05057\mw27 -- Channel A



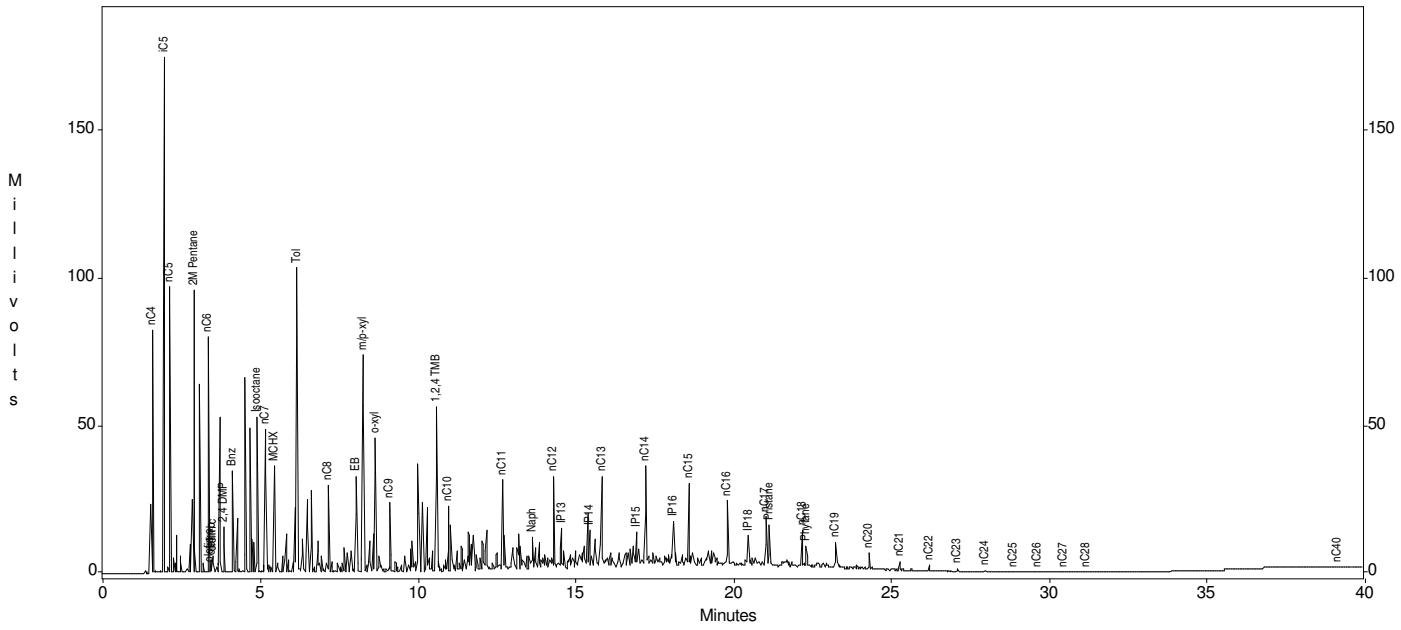
c:\ezchrom\chrom\05057\mw27 -- Channel A



c:\ezchrom\chrom\05057\mw27 -- Channel A



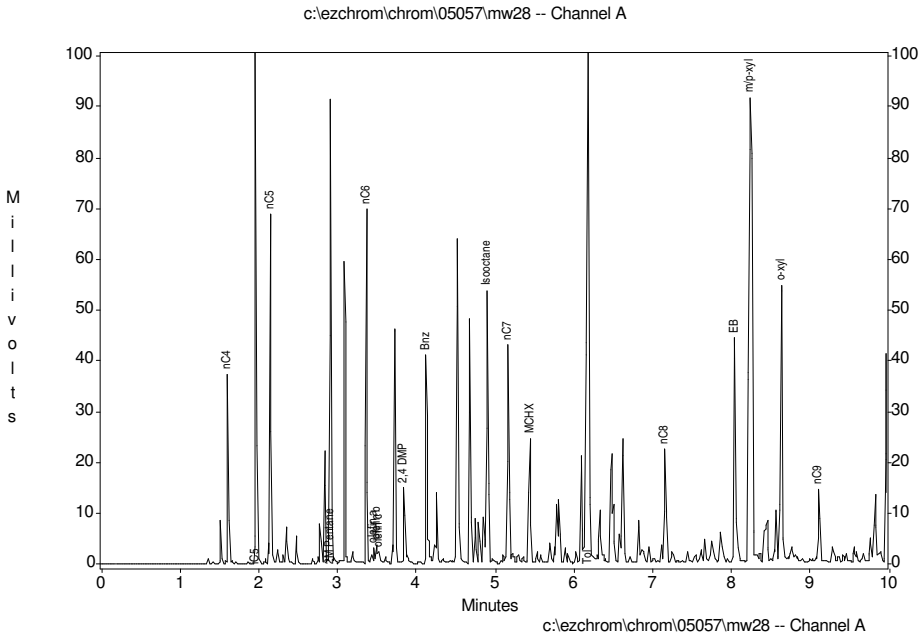
c:\ezchrom\chrom\05057\mw27 -- Channel A

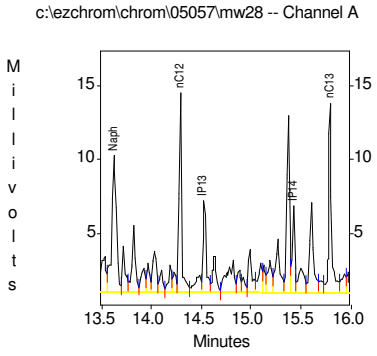


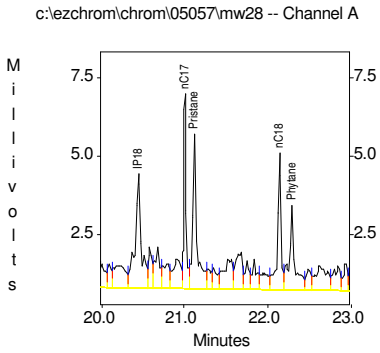
Channel A Results

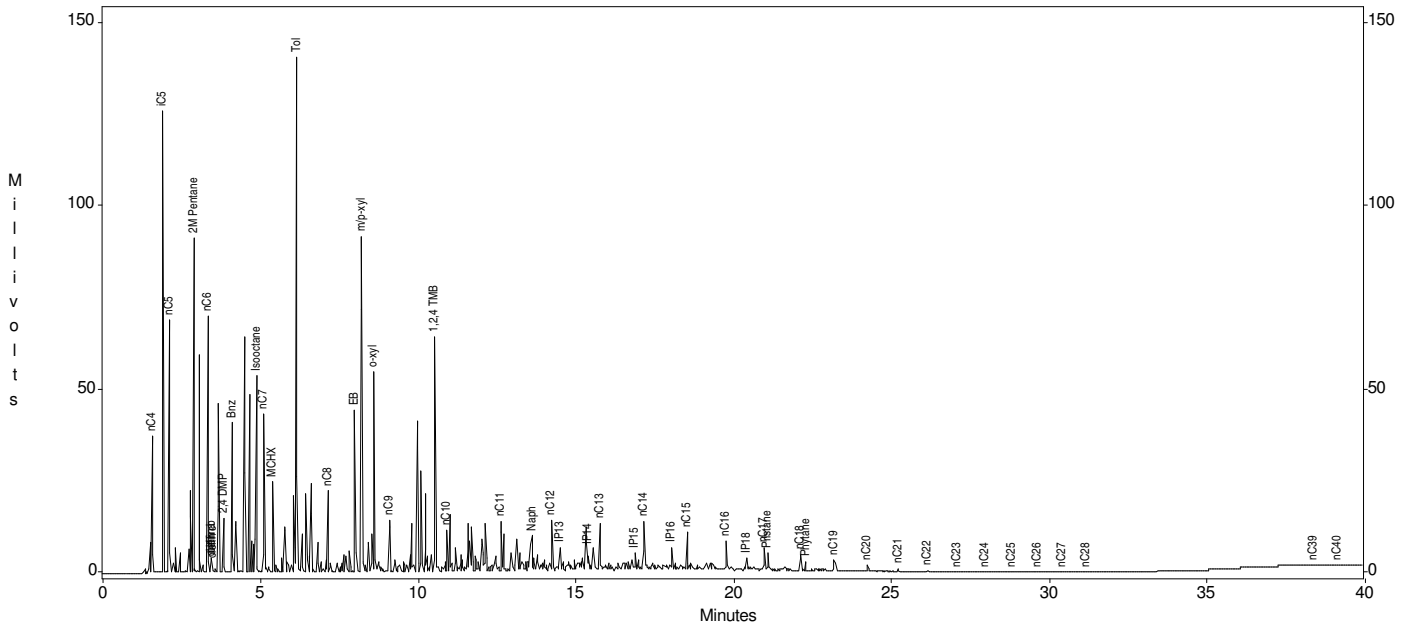
Peak	Area	Height
nC4	57671	82361
iC5	134636	175049
nC5	80953	96987
MTBE	0	0
2M Pentane	92978	95771
nC6	82877	80080
olefin a	2599	2284
olefin b	5344	4607
olefin c	6549	5686
2,4 DMP	18102	15467
Bnz	47747	34385
Isooctane	65798	52880
nC7	65404	48412
MCHX	47279	36143
Tol	172477	103748
nC8	40238	29657
EB	57089	32961
m/p-xyl	206606	74366
o-xyl	75113	45449
nC9	39909	23669
1,2,4 TMB	110044	56312
nC10	35303	22421
nC11	62436	31713
Naph	37625	11767
nC12	71215	32866
IP13	36174	15170
IP14	25951	14256
nC13	83062	32532
IP15	27489	13896
nC14	74637	36313
IP16	45428	17095
nC15	67196	30025
nC16	80322	24220
IP18	64717	12325
nC17	43741	18790
Pristane	62264	15924
nC18	54740	14164
Phytane	39895	9215
nC19	42639	10074
nC20	19189	6393
nC21	10403	3620
nC22	6924	2179
nC23	3748	1097
nC24	1742	501
nC25	1129	204
nC26	293	85
nC27	122	40
nC28	74	19
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	0	0
nC40	59	30

Sun - Belmont Terminal (AOI-1)
Sample ID : MW28-LNAPL-042705
Acquired : May 03, 2005 14:16:59







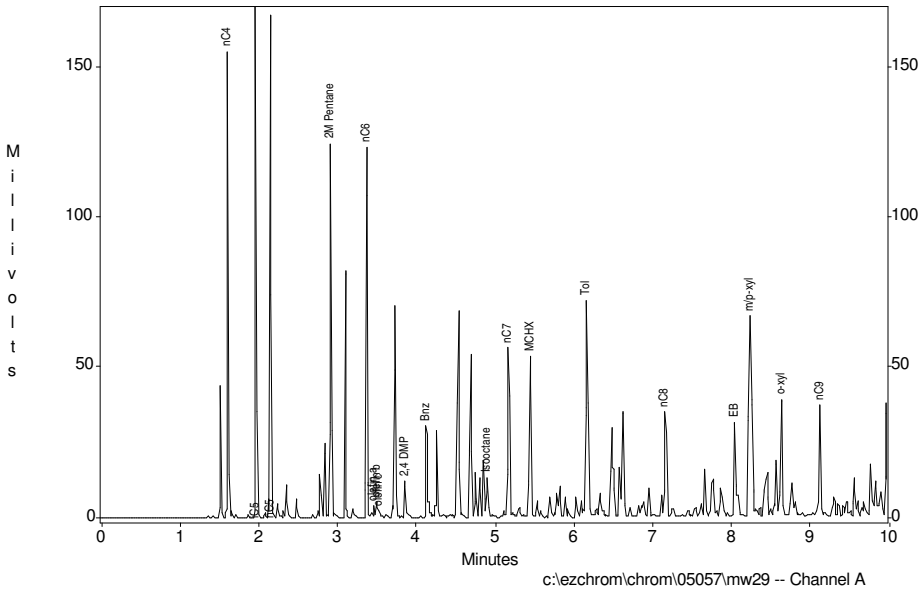


Channel A Results

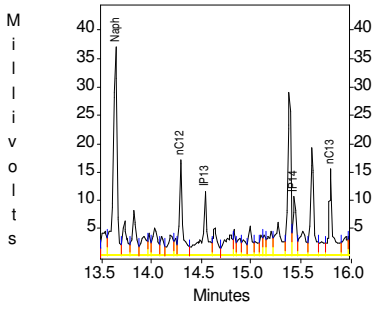
Peak	Area	Height
nC4	27914	37284
iC5	100685	125663
nC5	60625	68865
MTBE	0	0
2M Pentane	86741	91266
nC6	71998	69914
olefin a	3596	3071
olefin b	4602	3822
olefin c	3851	2346
2,4 DMP	17168	15053
Bnz	55695	41141
Isooctane	66290	53708
nC7	55678	43220
MCHX	32489	24665
Tol	262334	140148
nC8	30116	22457
EB	70689	44289
m/p-xyl	264951	91501
o-xyl	91719	54792
nC9	24190	14370
1,2,4 TMB	122054	63663
nC10	16701	11253
nC11	29798	13274
Naph	29055	9366
nC12	24307	13636
IP13	13354	6298
IP14	10051	5914
nC13	27916	12974
IP15	9259	5116
nC14	27115	13300
IP16	12543	6401
nC15	26152	10523
nC16	22665	8232
IP18	17071	3629
nC17	12461	6242
Pristane	17011	4960
nC18	11925	4395
Phytane	12556	2732
nC19	9726	3102
nC20	5452	1919
nC21	2754	1054
nC22	1385	563
nC23	603	270
nC24	495	121
nC25	216	63
nC26	143	41
nC27	102	27
nC28	59	14
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	24	9
nC40	52	14

Sun - Belmont Terminal (AOI-1)
Sample ID : MW29-LNAPL-042705
Acquired : May 03, 2005 12:27:23

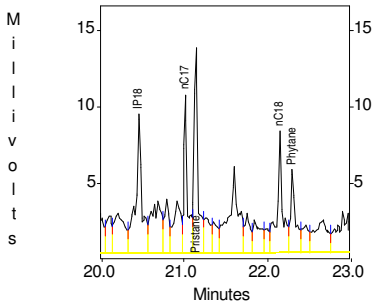
c:\ezchrom\chrom\05057\mw29 -- Channel A



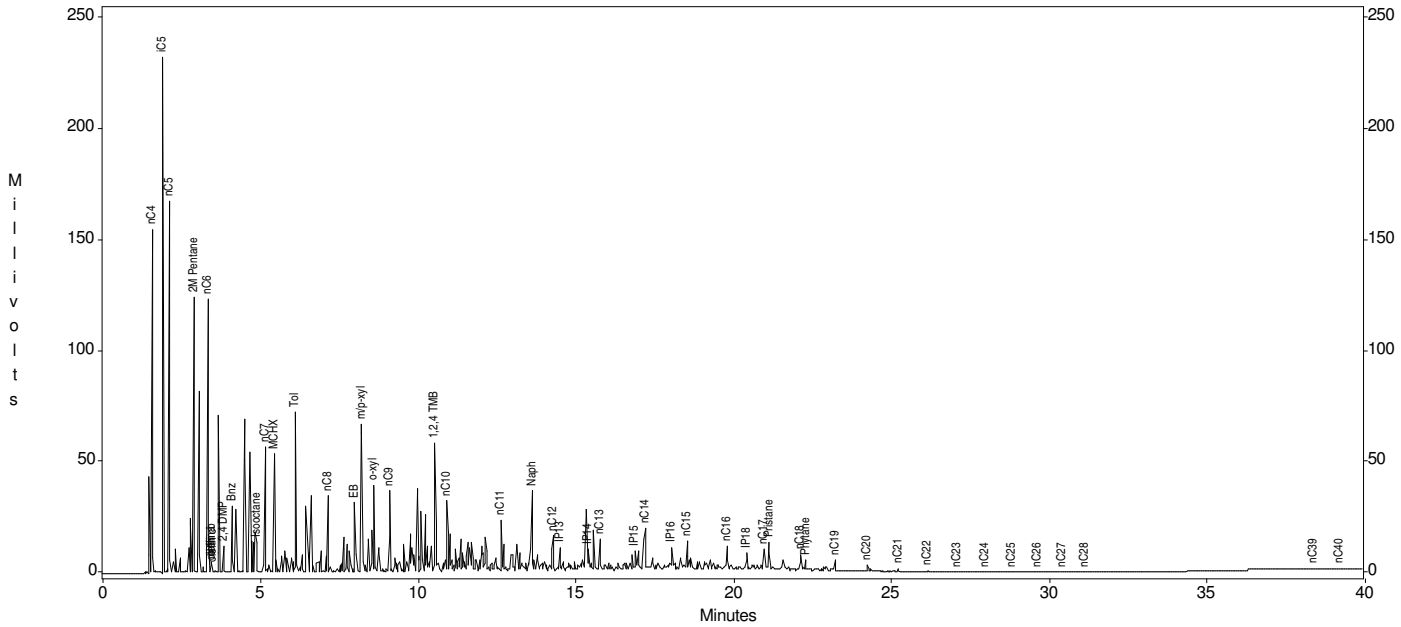
c:\ezchrom\chrom\05057\mw29 -- Channel A



c:\ezchrom\chrom\05057\mw29 -- Channel A



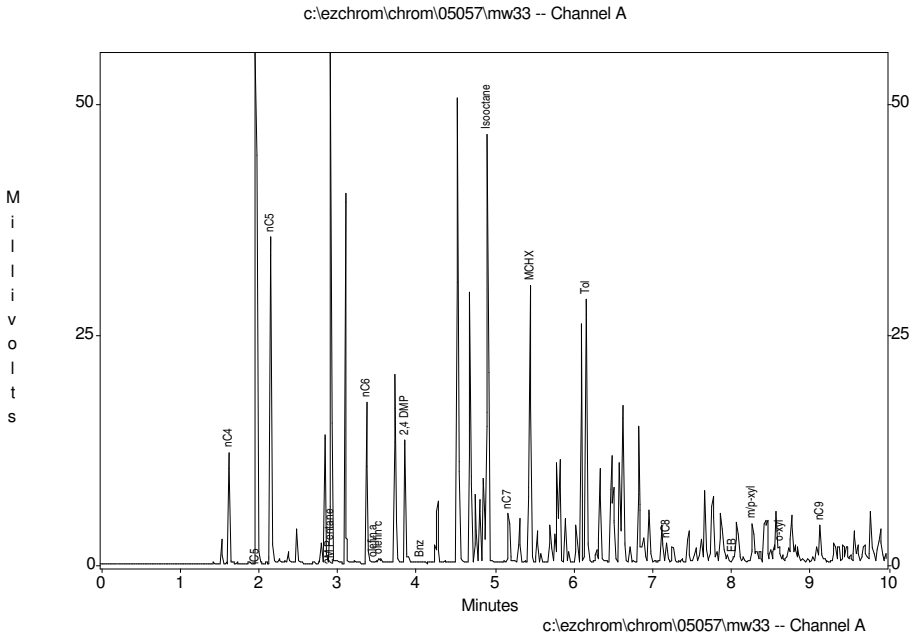
c:\ezchrom\chrom\05057\mw29 -- Channel A

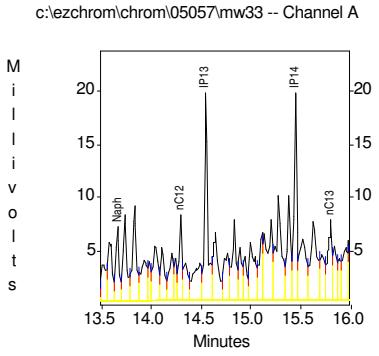


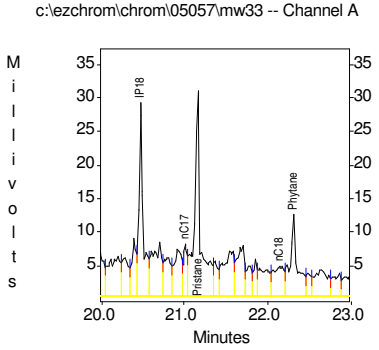
Channel A Results

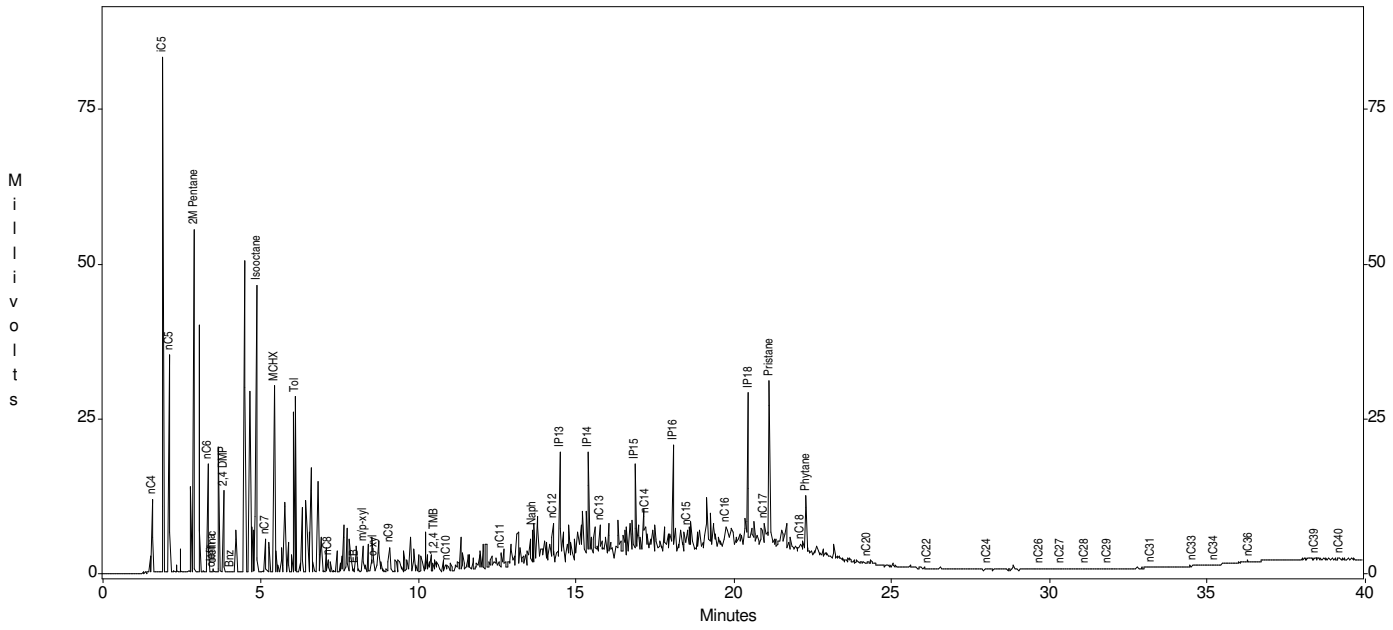
Peak	Area	Height
nC4	102455	154839
iC5	169106	232228
nC5	132044	167085
MTBE	0	0
2M Pentane	121799	124265
nC6	137059	123537
olefin a	4431	3734
olefin b	5745	4832
olefin c	4106	2426
2,4 DMP	13933	12249
Bnz	42971	30472
Isooctane	16934	13376
nC7	75875	56898
MCHX	72294	53856
Tol	107831	72301
nC8	47627	35095
EB	49962	31946
m/p-xyl	187366	67086
o-xyl	66221	39223
nC9	63748	37287
1,2,4 TMB	124670	58393
nC10	54993	32363
nC11	50995	24063
Naph	91312	36816
nC12	37967	16772
IP13	41002	11218
IP14	18357	10378
nC13	43053	15284
IP15	18588	9561
nC14	43378	19601
IP16	40227	11625
nC15	33147	14217
nC16	47949	11805
IP18	44705	8985
nC17	30748	10221
Pristane	41303	13369
nC18	35034	7918
Phytane	21367	5372
nC19	31607	5691
nC20	12097	3347
nC21	8573	1704
nC22	1913	786
nC23	1080	318
nC24	389	146
nC25	521	70
nC26	296	67
nC27	127	24
nC28	135	27
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	60	24
nC40	50	17

Sun - Belmont Terminal (AOI-1)
Sample ID : MW33-LNAPL-042605
Acquired : May 04, 2005 11:48:19







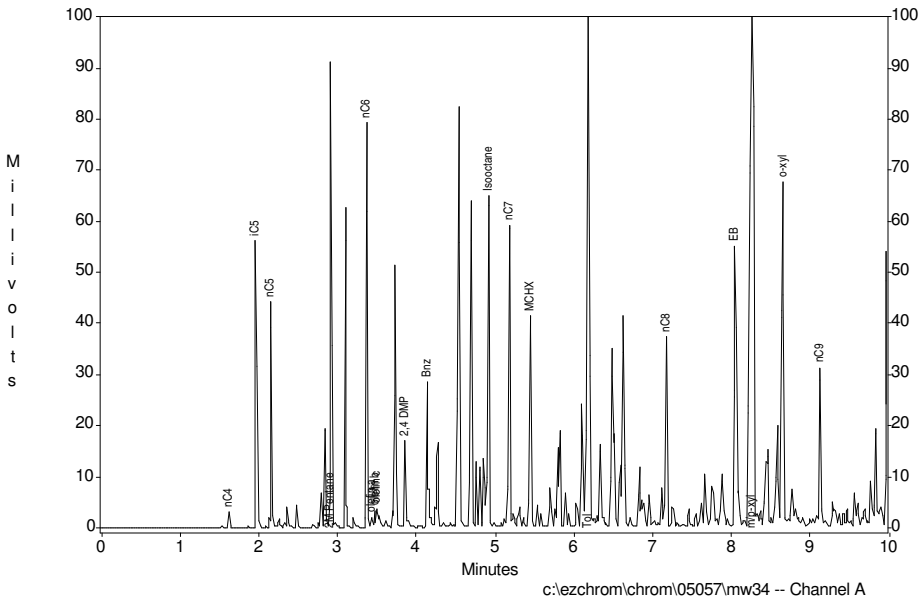


Channel A Results

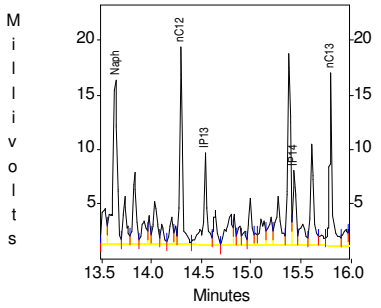
Peak	Area	Height
nC4	8729	12079
iC5	63772	83310
nC5	31634	35371
MTBE	0	0
2M Pentane	53007	55689
nC6	19961	17431
olefin a	215	143
olefin b	0	0
olefin c	708	578
2,4 DMP	14751	13412
Bnz	159	58
Isooctane	56389	46442
nC7	7934	5427
MCHX	38188	30065
Tol	36543	28594
nC8	3574	2109
EB	930	628
m/p-xyl	6806	4130
o-xyl	2427	1752
nC9	8081	4009
1,2,4 TMB	4221	1898
nC10	3748	1209
nC11	9119	3064
Naph	15240	6783
nC12	16009	7929
IP13	43115	19337
IP14	36430	19263
nC13	23228	7358
IP15	34902	17333
nC14	27167	8536
IP16	55295	20445
nC15	29214	6513
nC16	79166	7165
IP18	98183	28635
nC17	22342	7616
Pristane	154608	30601
nC18	38453	4271
Phytane	71785	12203
nC19	0	0
nC20	8993	1335
nC21	0	0
nC22	1364	287
nC23	0	0
nC24	931	115
nC25	0	0
nC26	287	88
nC27	263	52
nC28	182	43
nC29	247	41
nC30	0	0
nC31	37	21
nC32	0	0
nC33	262	53
nC34	245	64
nC35	0	0
nC36	19	14
nC37	0	0
nC38	0	0
nC39	59	15
nC40	159	40

Sun - Belmont Terminal (AOI-1)
Sample ID : MW34-LNAPL-042605
Acquired : May 04, 2005 10:58:59

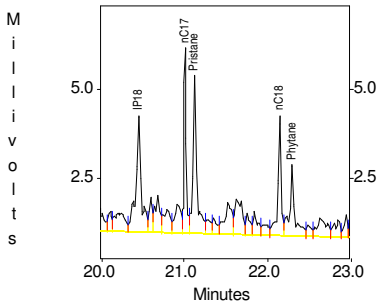
c:\ezchrom\chrom\05057\mw34 -- Channel A



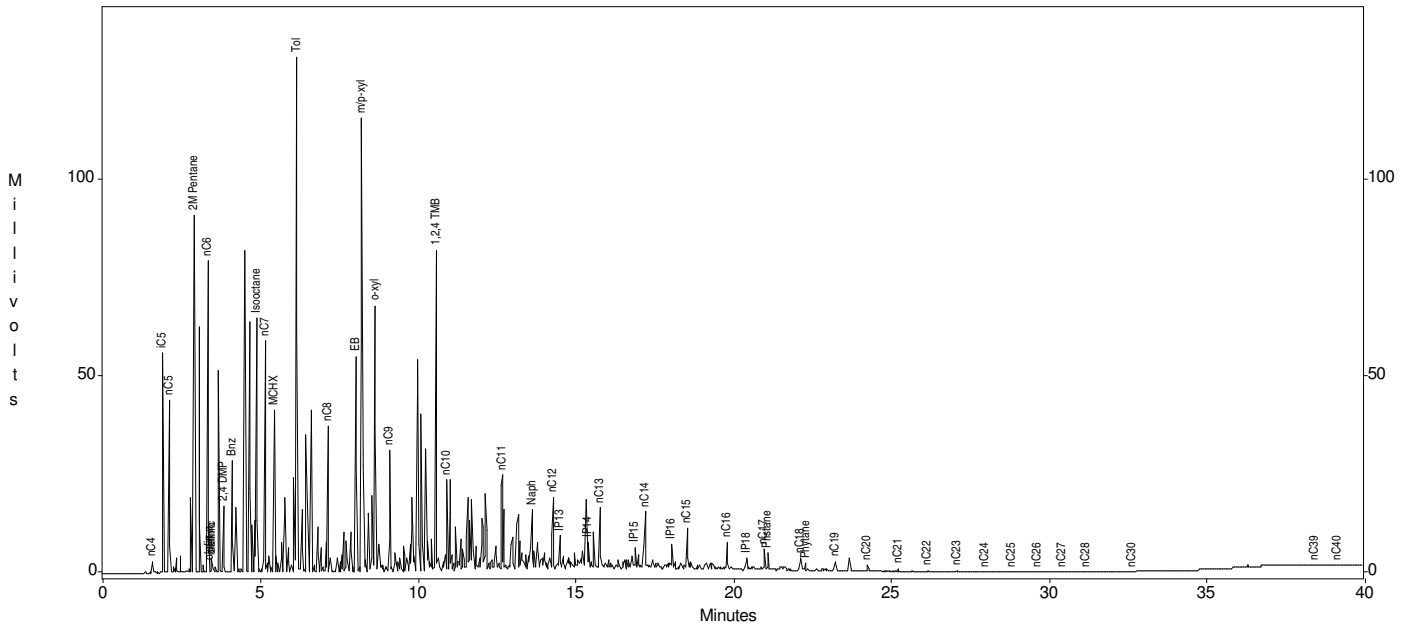
c:\ezchrom\chrom\05057\mw34 -- Channel A



c:\ezchrom\chrom\05057\mw34 -- Channel A



c:\ezchrom\chrom\05057\mw34 -- Channel A

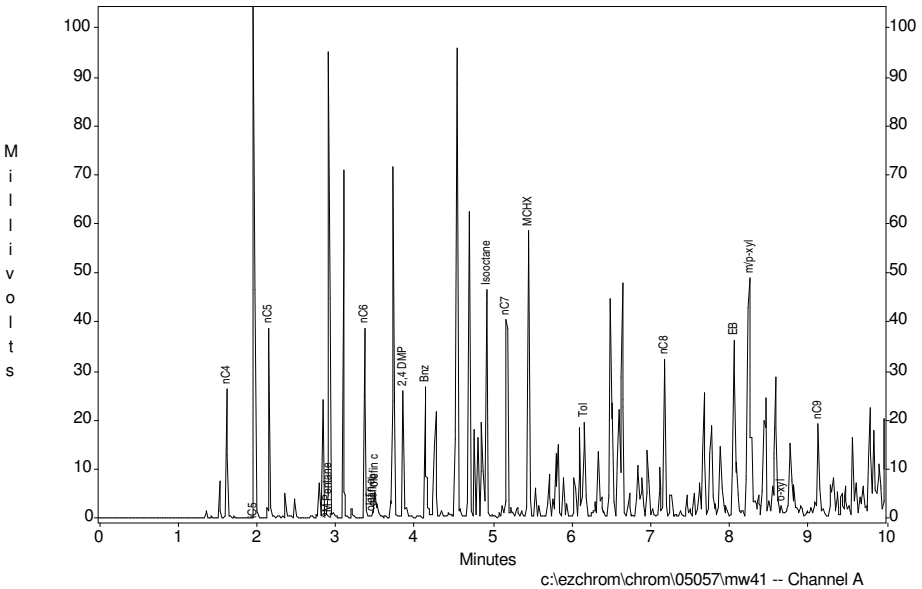


Channel A Results

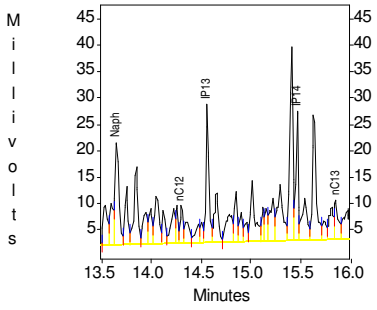
Peak	Area	Height
nC4	2435	3037
iC5	44326	56061
nC5	38549	44041
MTBE	0	0
2M Pentane	87453	91006
nC6	83387	79281
olefin a	2119	1785
olefin b	4033	3401
olefin c	4304	3562
2,4 DMP	18942	16767
Bnz	40887	28372
Isooctane	82387	64747
nC7	80330	59049
MCHX	55269	41422
Tol	234470	130904
nC8	50729	37189
EB	96766	54851
m/p-xyl	308130	115456
o-xyl	120134	67526
nC9	48725	30976
1,2,4 TMB	179405	81489
nC10	35052	23180
nC11	50329	24035
Naph	43656	15088
nC12	33544	18214
IP13	23598	8516
IP14	11684	6985
nC13	33913	15880
IP15	9635	5391
nC14	29400	14680
IP16	12332	6367
nC15	23612	10489
nC16	18811	7059
IP18	13981	3310
nC17	10201	5247
Pristane	14212	4469
nC18	8865	3395
Phytane	8644	2007
nC19	7192	2416
nC20	3512	1522
nC21	1582	833
nC22	943	456
nC23	416	224
nC24	291	105
nC25	177	60
nC26	106	36
nC27	117	29
nC28	160	61
nC29	0	0
nC30	104	18
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	50	20
nC40	65	15

Sun - Belmont Terminal (AOI-1)
Sample ID : MW41-LNAPL-042705
Acquired : May 03, 2005 10:49:05

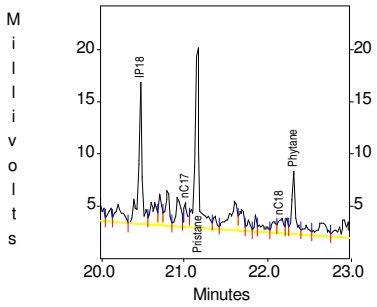
c:\ezchrom\chrom\05057\mw41 -- Channel A



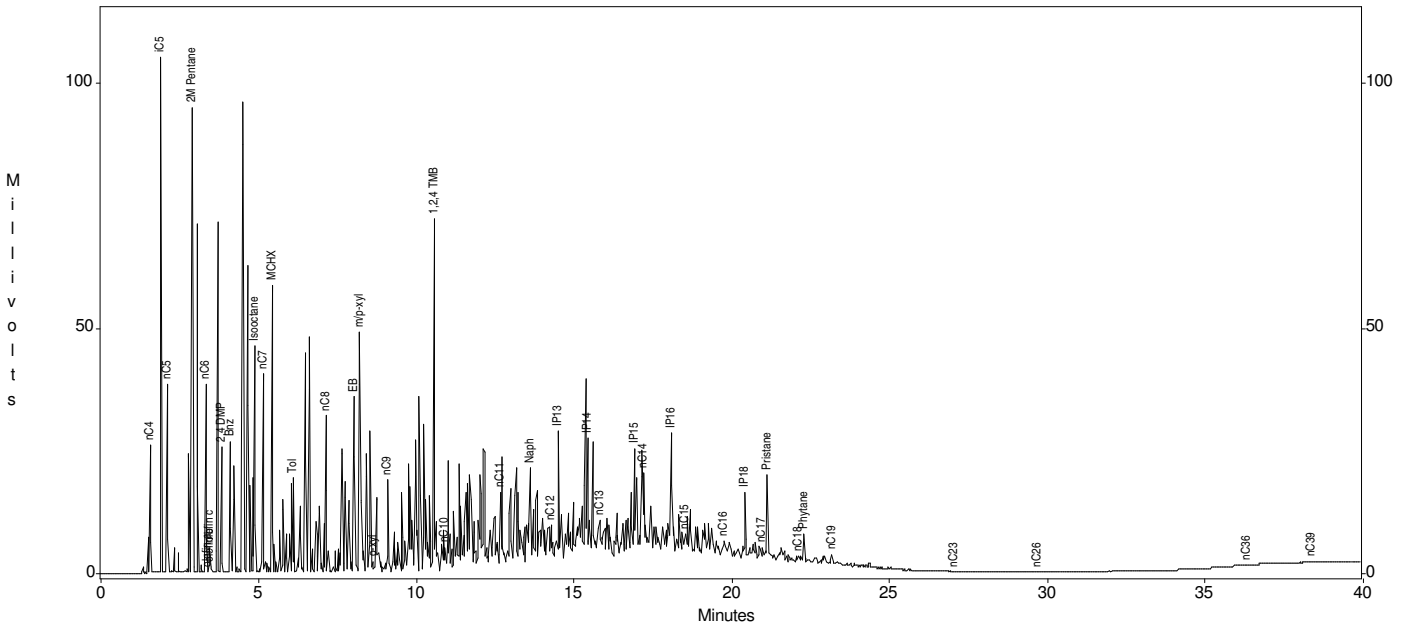
c:\ezchrom\chrom\05057\mw41 -- Channel A



c:\ezchrom\chrom\05057\mw41 -- Channel A



c:\ezchrom\chrom\05057\mw41 -- Channel A

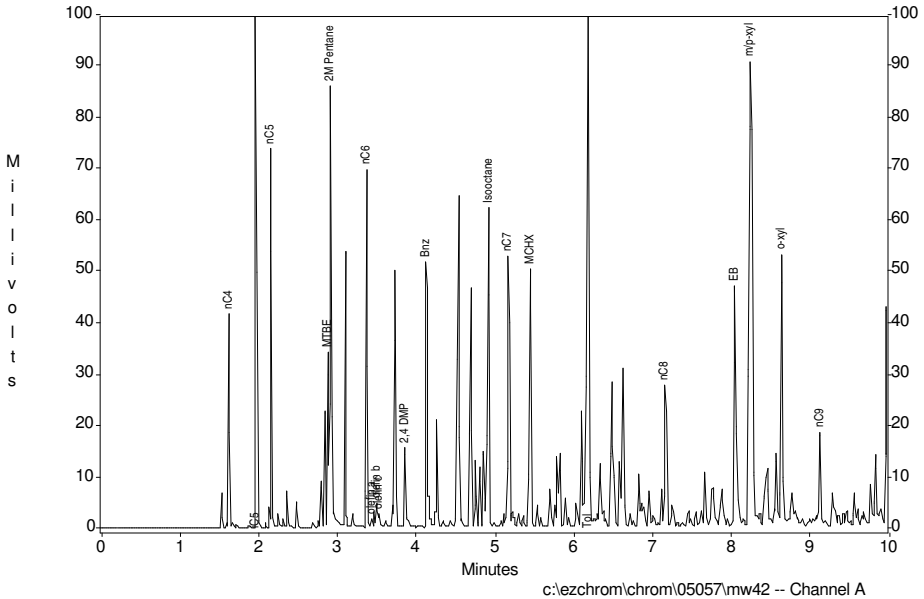


Channel A Results

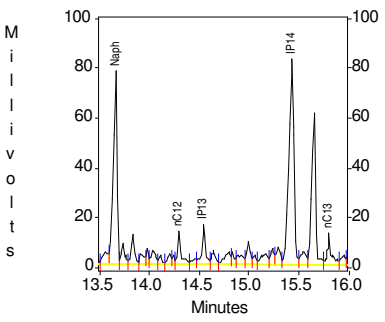
Peak	Area	Height
nC4	18905	26183
iC5	82124	104942
nC5	34784	38598
MTBE	0	0
2M Pentane	91998	94891
nC6	39584	38564
olefin a	374	300
olefin b	1139	1215
olefin c	5765	5085
2,4 DMP	28639	25751
Bnz	38255	26623
Isooctane	56238	46208
nC7	51568	40370
MCHX	78441	58546
Tol	26431	19268
nC8	43394	32084
EB	57865	35957
m/p-xyl	74338	48916
o-xyl	4402	2237
nC9	39891	18873
1,2,4 TMB	160790	71547
nC10	12149	4277
nC11	29122	14872
Naph	55631	19268
nC12	13336	7120
IP13	54380	26173
IP14	42176	24314
nC13	22940	7462
IP15	37105	21363
nC14	35844	16394
IP16	49990	23915
nC15	7500	2549
nC16	23043	2986
IP18	40898	13661
nC17	5963	2324
Pristane	54583	17362
nC18	5868	1296
Phytane	16529	5992
nC19	9248	2079
nC20	0	0
nC21	0	0
nC22	0	0
nC23	113	26
nC24	0	0
nC25	0	0
nC26	92	16
nC27	0	0
nC28	0	0
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	164	30
nC37	0	0
nC38	0	0
nC39	53	28
nC40	0	0

Sun - Belmont Terminal (AOI-1)
Sample ID : MW42-LNAPL-042705
Acquired : May 04, 2005 13:29:40

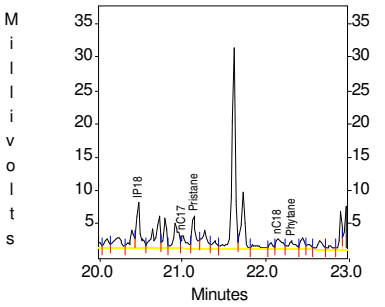
c:\ezchrom\chrom\05057\mw42 -- Channel A



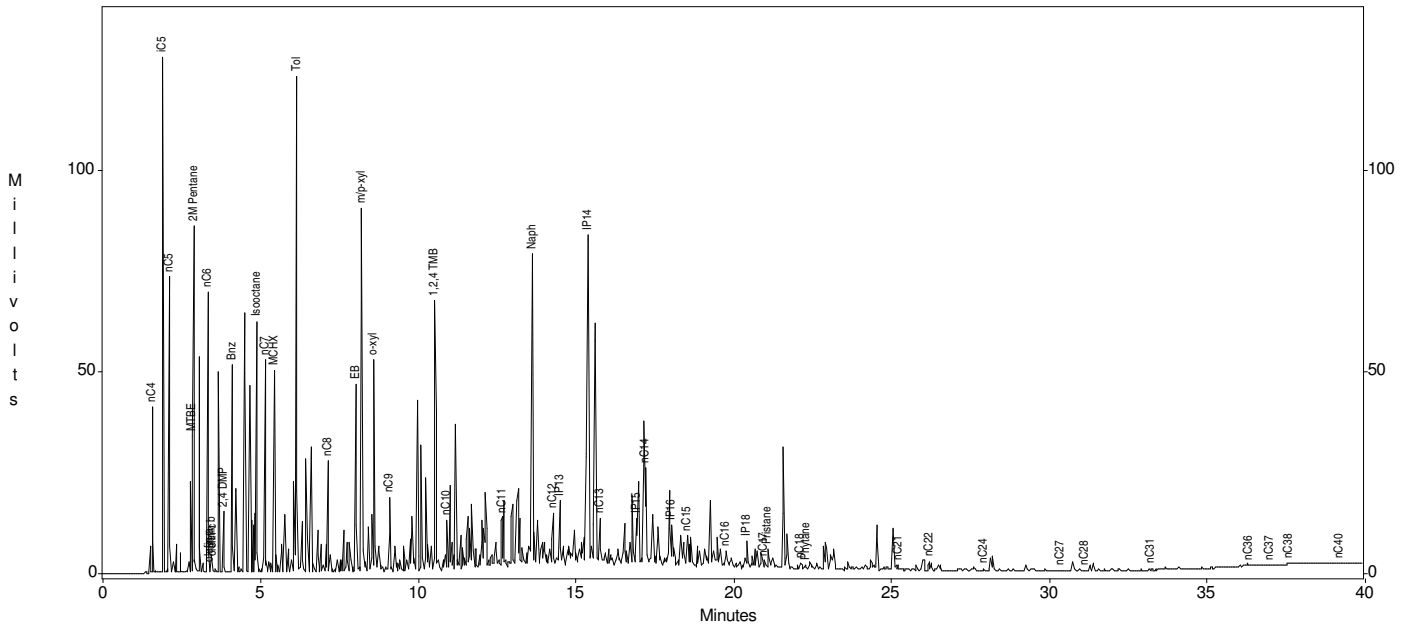
c:\ezchrom\chrom\05057\mw42 -- Channel A



c:\ezchrom\chrom\05057\mw42 -- Channel A



c:\ezchrom\chrom\05057\mw42 -- Channel A

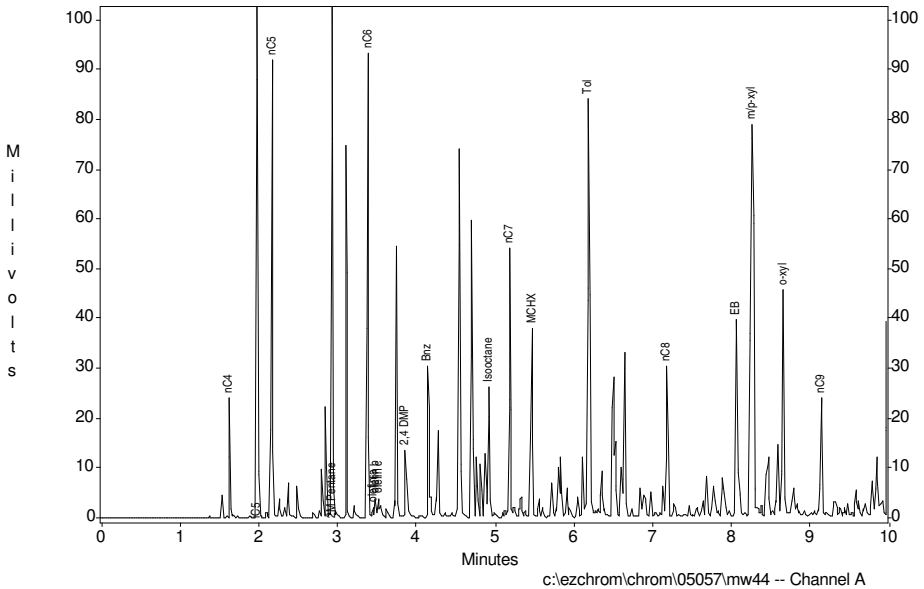


Channel A Results

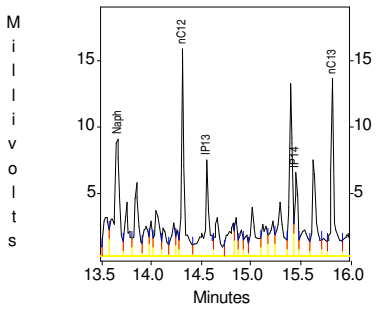
Peak	Area	Height
nC4	27770	41369
iC5	95273	127820
nC5	60310	73565
MTBE	30427	33977
2M Pentane	88756	85928
nC6	70770	69476
olefin a	1709	1423
olefin b	5392	4597
olefin c	4201	2695
2,4 DMP	17681	15353
Bnz	66354	51486
Isooctane	79691	62095
nC7	71072	52700
MCHX	67431	50349
Tol	211061	122263
nC8	36835	27415
EB	79610	46630
m/p-xyl	255810	90131
o-xyl	90107	52727
nC9	33424	18320
1,2,4 TMB	141927	66956
nC10	19473	12353
nC11	35112	12022
Naph	206296	77626
nC12	31471	13486
IP13	39675	16252
IP14	276802	82467
nC13	36823	12373
IP15	21127	12274
nC14	55868	24881
IP16	22115	10749
nC15	20204	8247
nC16	24642	4154
IP18	21441	6877
nC17	8584	1957
Pristane	14181	4674
nC18	7682	1518
Phytane	5791	1139
nC19	0	0
nC20	0	0
nC21	4495	1015
nC22	4982	1929
nC23	0	0
nC24	1178	303
nC25	0	0
nC26	0	0
nC27	1102	188
nC28	243	103
nC29	0	0
nC30	0	0
nC31	186	66
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	112	51
nC37	103	29
nC38	182	29
nC39	0	0
nC40	56	14

Sun - Belmont Terminal (AOI-1)
Sample ID : MW44-LNAPL-042605
Acquired : May 04, 2005 08:22:55

c:\ezchrom\chrom\05057\mw44 -- Channel A



c:\ezchrom\chrom\05057\mw44 -- Channel A



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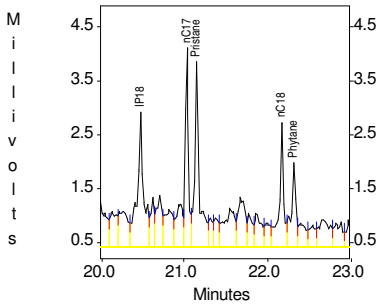
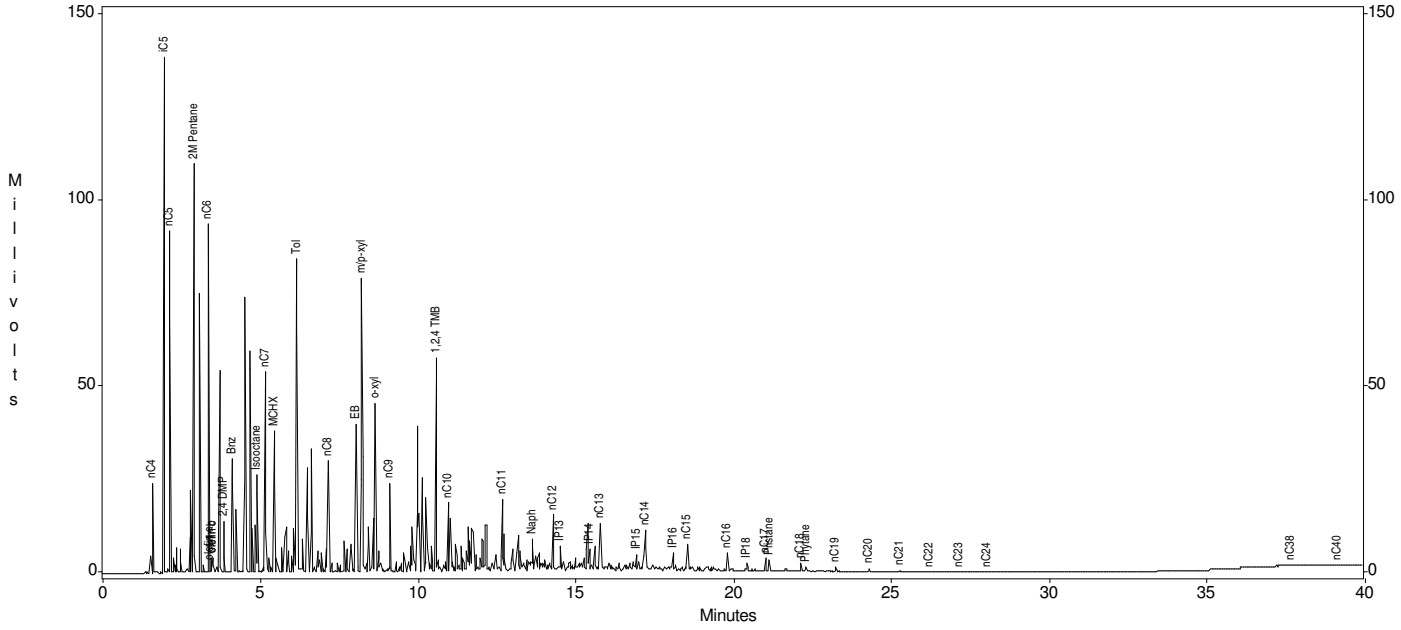


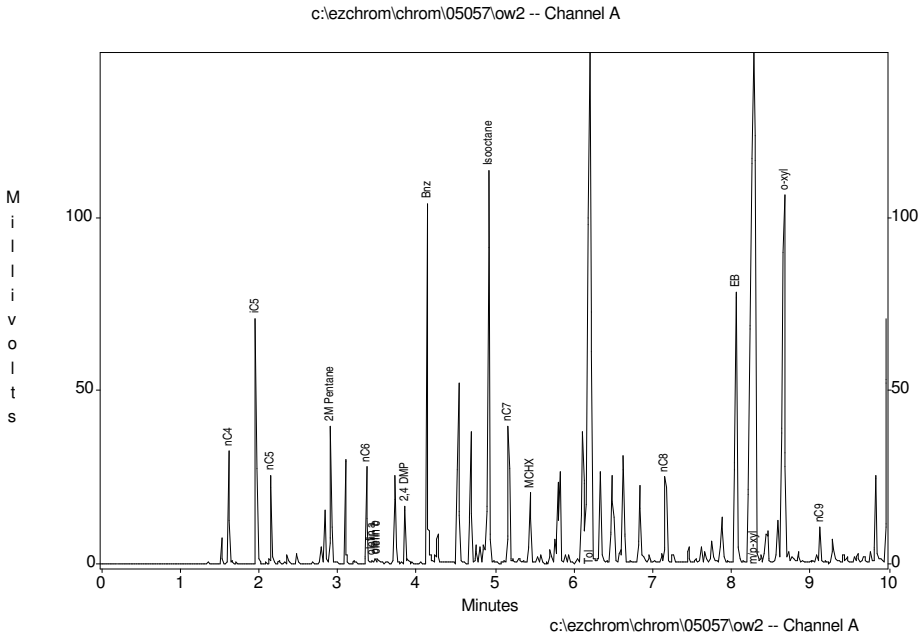
c:\ezchrom\chrom\05057\mw44 -- Channel A

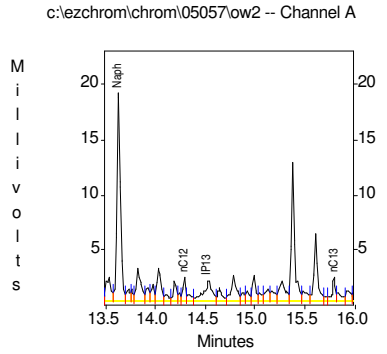


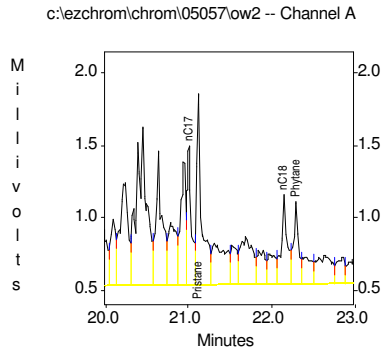
Channel A Results

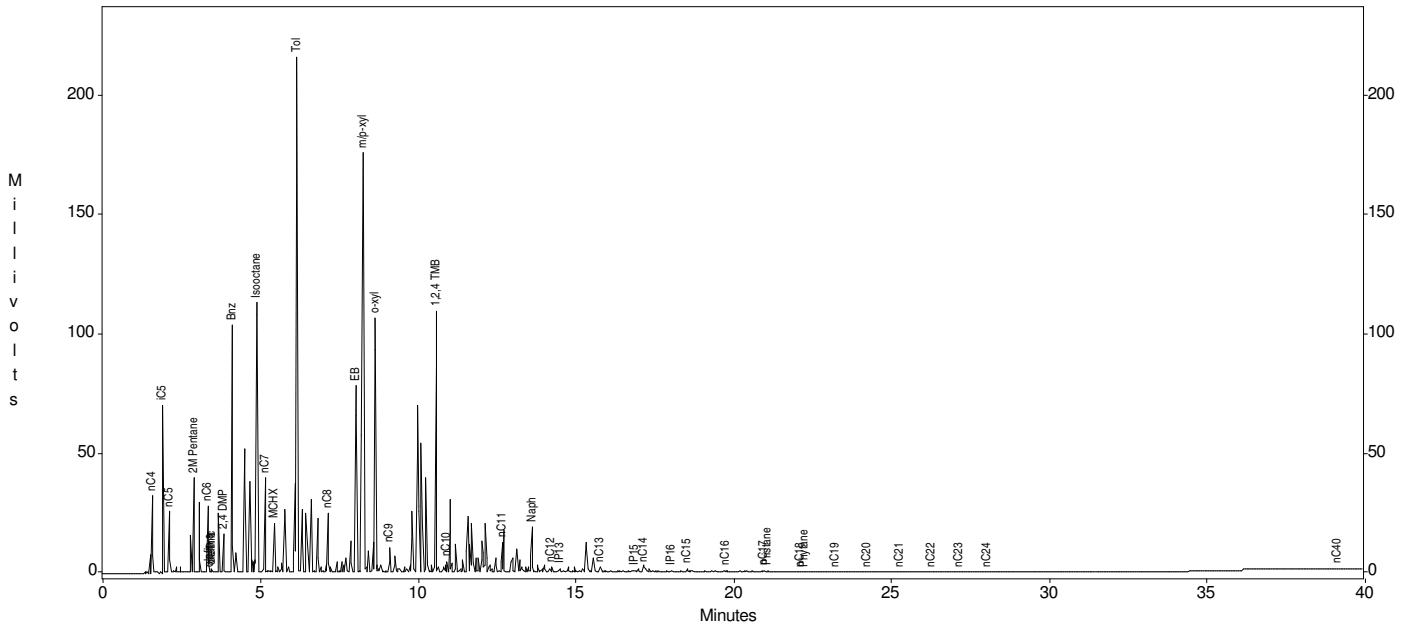
Peak	Area	Height
nC4	17925	24177
iC5	109200	138198
nC5	79032	91863
MTBE	0	0
2M Pentane	108037	110042
nC6	98392	93478
olefin a	2441	2074
olefin b	4612	3718
olefin c	4452	3743
2,4 DMP	15252	13589
Bnz	41861	30336
Isooctane	31810	26083
nC7	71623	53972
MCHX	49903	37960
Tol	131536	84202
nC8	39981	30025
EB	66527	39495
m/p-xyl	223342	78910
o-xyl	73787	45521
nC9	36816	24063
1,2,4 TMB	110491	57662
nC10	28851	18844
nC11	40656	19866
Naph	33533	8802
nC12	31343	15578
IP13	25371	7171
IP14	11295	6350
nC13	31693	13308
IP15	9334	4614
nC14	24982	11280
IP16	17518	5216
nC15	21177	7657
nC16	17275	5080
IP18	13370	2518
nC17	8003	3719
Pristane	13042	3446
nC18	7817	2310
Phytane	6315	1571
nC19	10725	1554
nC20	3996	928
nC21	1585	506
nC22	1363	228
nC23	339	77
nC24	125	22
nC25	0	0
nC26	0	0
nC27	0	0
nC28	0	0
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	85	29
nC39	0	0
nC40	24	13

Sun - Belmont Terminal (AOI-1)
Sample ID : OW2-LNAPL-042605
Acquired : May 03, 2005 11:38:40





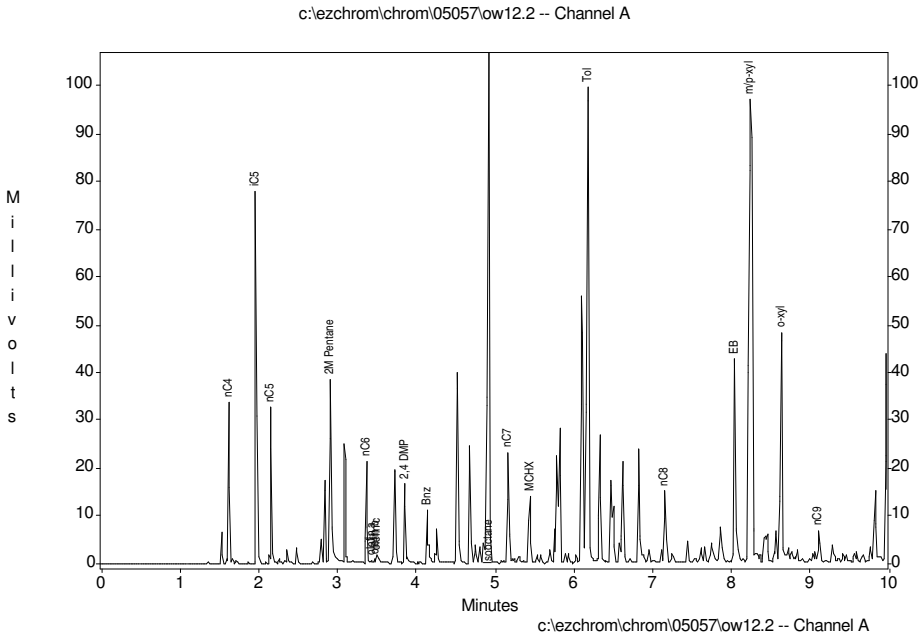


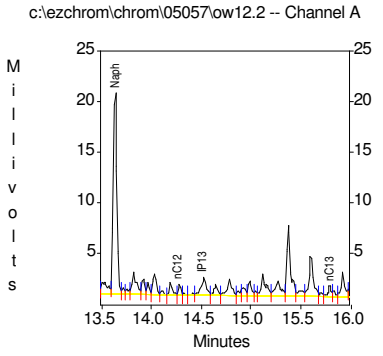


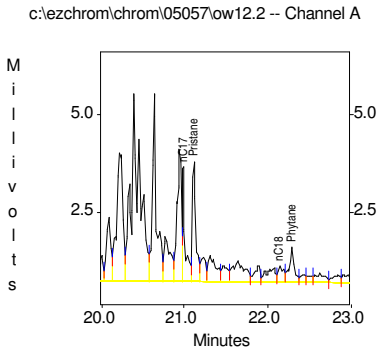
Channel A Results

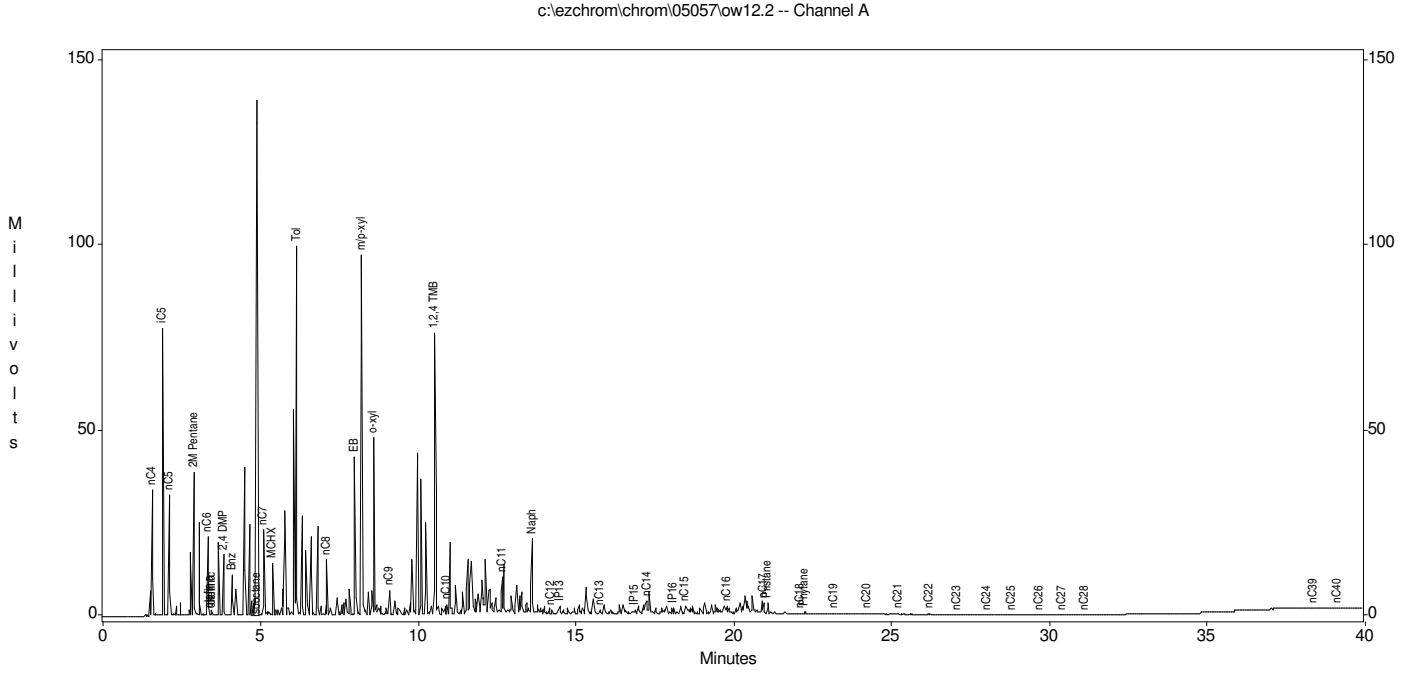
Peak	Area	Height
nC4	24317	32462
iC5	58235	70754
nC5	24615	25559
MTBE	0	0
2M Pentane	39064	39439
nC6	30576	27785
olefin a	875	649
olefin b	1520	1233
olefin c	1959	1528
2,4 DMP	18510	16342
Bnz	130756	103992
Isooctane	176104	113519
nC7	50185	39570
MCHX	27459	20666
Tol	373720	215957
nC8	33944	25118
EB	133850	78370
m/p-xyl	625002	176325
o-xyl	227902	106549
nC9	15895	10653
1,2,4 TMB	270759	109864
nC10	8228	4511
nC11	27334	13062
Naph	43591	18951
nC12	3920	2219
IP13	10420	1937
IP14	0	0
nC13	5026	2147
IP15	3625	1138
nC14	7896	2390
IP16	4613	1324
nC15	6060	1454
nC16	11989	1202
IP18	0	0
nC17	3669	961
Pristane	5530	1322
nC18	2798	616
Phytane	2365	560
nC19	2667	402
nC20	892	233
nC21	648	103
nC22	600	165
nC23	189	21
nC24	93	12
nC25	0	0
nC26	0	0
nC27	0	0
nC28	0	0
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	0	0
nC40	59	15

Sun - Belmont Terminal (AOI-1)
Sample ID : OW12-LNAPL-042705
Acquired : May 03, 2005 17:34:58







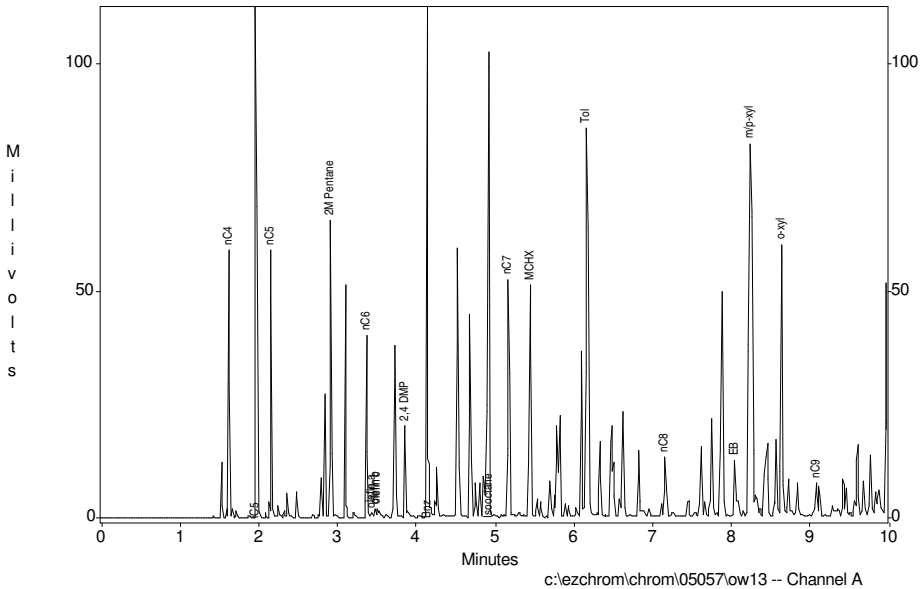


Channel A Results

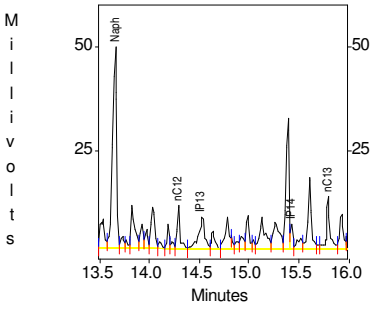
Peak	Area	Height
nC4	27644	33948
iC5	67555	77823
nC5	32226	32565
MTBE	0	0
2M Pentane	47520	38671
nC6	24567	21538
olefin a	644	433
olefin b	1055	846
olefin c	2258	1768
2,4 DMP	18724	16619
Bnz	18034	11022
Isooctane	235824	139087
nC7	29743	23355
MCHX	18882	14232
Tol	160432	99578
nC8	20697	15210
EB	68887	42685
m/p-xyl	227281	97339
o-xyl	77716	48243
nC9	10677	6751
1,2,4 TMB	163537	75969
nC10	5233	2514
nC11	20393	9675
Naph	44920	19938
nC12	1770	1163
IP13	6264	1716
IP14	0	0
nC13	1998	967
IP15	2675	1177
nC14	6038	3361
IP16	2923	1433
nC15	9828	2096
nC16	11808	1844
IP18	0	0
nC17	7761	2913
Pristane	8600	3036
nC18	1968	423
Phytane	3583	874
nC19	1371	303
nC20	781	222
nC21	287	82
nC22	649	107
nC23	148	38
nC24	303	46
nC25	380	49
nC26	174	27
nC27	114	14
nC28	97	17
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	53	14
nC40	40	21

Sun - Belmont Terminal (AOI-1)
Sample ID : OW13-LNAPL-042705
Acquired : May 04, 2005 14:19:18

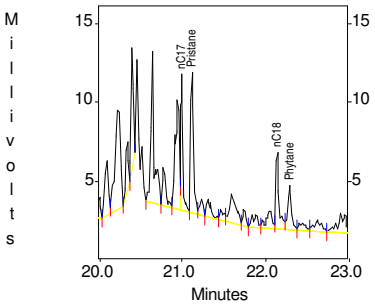
c:\ezchrom\chrom\05057\ow13 -- Channel A



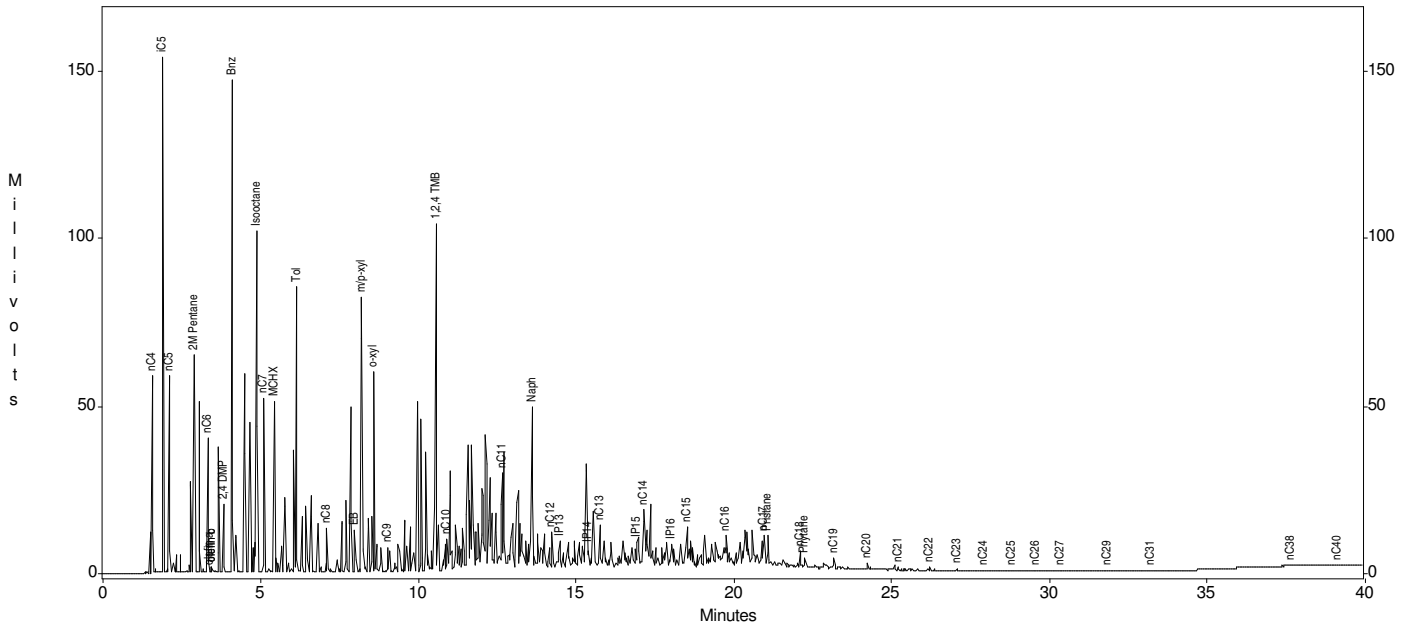
c:\ezchrom\chrom\05057\ow13 -- Channel A



c:\ezchrom\chrom\05057\ow13 -- Channel A



c:\ezchrom\chrom\05057\ow13 -- Channel A



Channel A Results

Peak	Area	Height
nC4	40365	59021
iC5	113300	154158
nC5	49637	58905
MTBE	0	0
2M Pentane	62298	65478
nC6	41473	40294
olefin a	1218	994
olefin b	2267	1853
olefin c	2223	1920
2,4 DMP	22438	20356
Bnz	198432	147370
Isooctane	151669	102403
nC7	66558	52304
MCHX	67575	51286
Tol	133345	85697
nC8	18121	13190
EB	19429	12597
m/p-xyl	248567	82338
o-xyl	101611	59858
nC9	11683	7269
1,2,4 TMB	279880	103688
nC10	22397	8991
nC11	76136	27601
Naph	126253	47980
nC12	20082	10549
IP13	32340	7761
IP14	9305	6040
nC13	30184	12414
IP15	12872	7384
nC14	30071	17279
IP16	12372	6454
nC15	32521	12036
nC16	76307	8705
IP18	0	0
nC17	20210	8562
Pristane	21434	8849
nC18	12143	4835
Phytane	8553	2772
nC19	8750	3063
nC20	4441	1881
nC21	2292	1057
nC22	4362	1104
nC23	986	359
nC24	814	242
nC25	748	197
nC26	595	145
nC27	299	65
nC28	0	0
nC29	159	42
nC30	0	0
nC31	51	22
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	118	15
nC39	0	0
nC40	23	20

Sun - Belmont Terminal (AOI-1)
Sample ID : OW17-LNAPL-042705
Acquired : May 04, 2005 15:08:13

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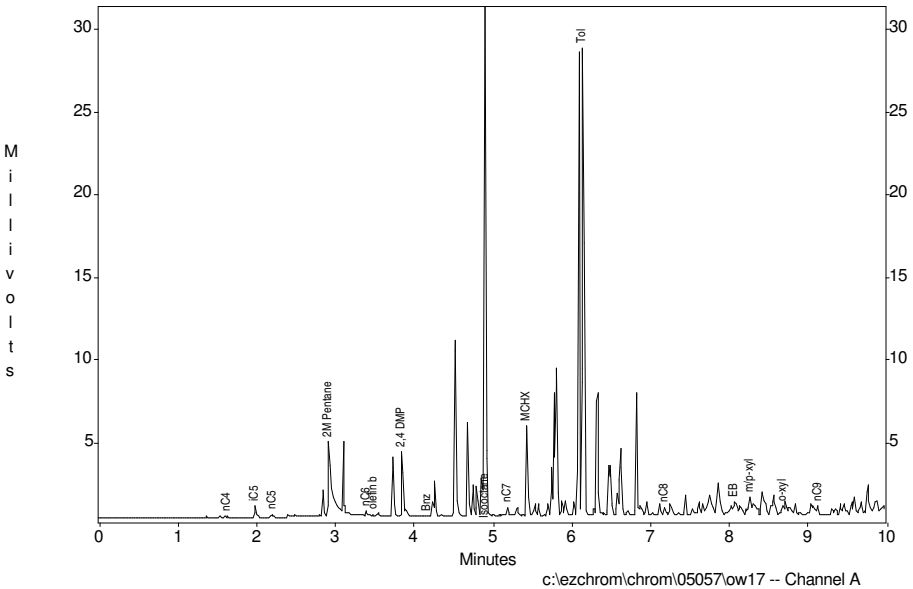

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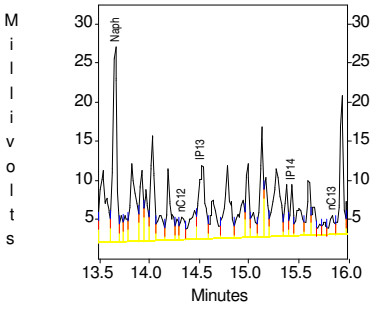

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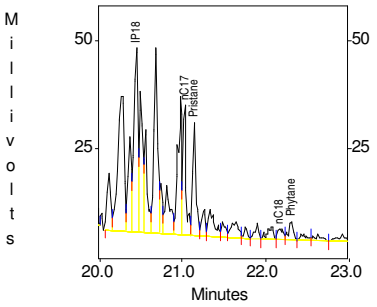
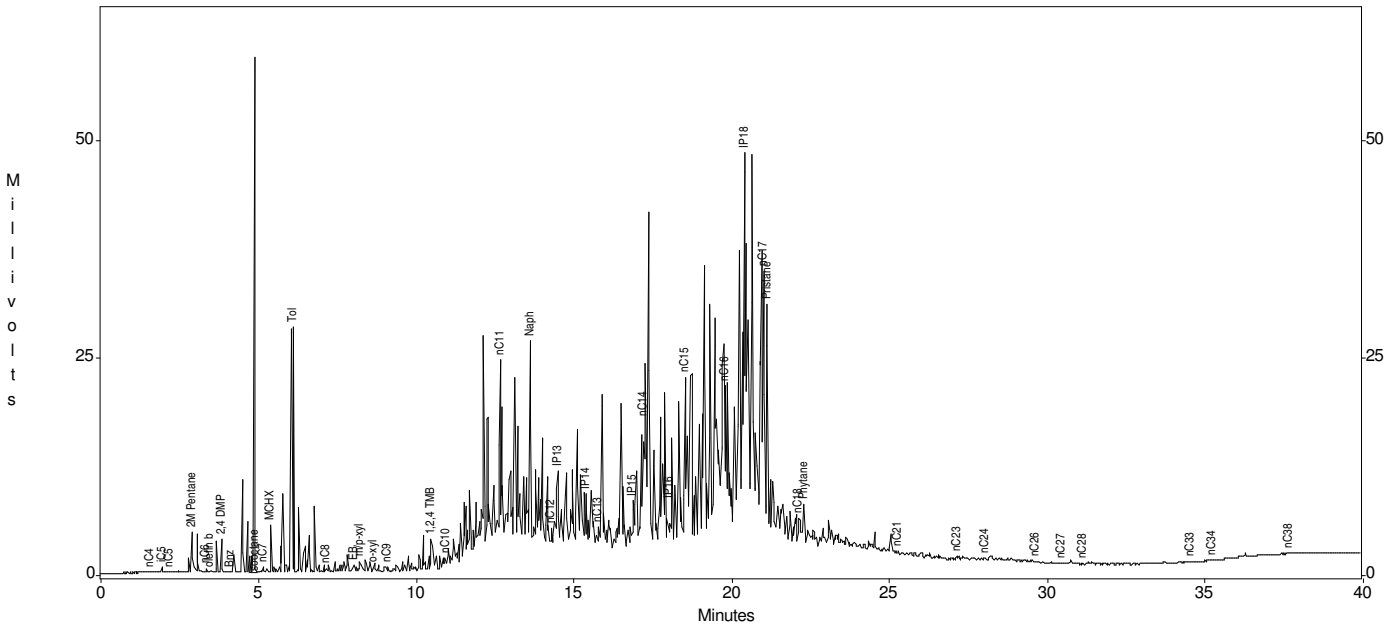


c:\ezchrom\chrom\05057\ow17 -- Channel A

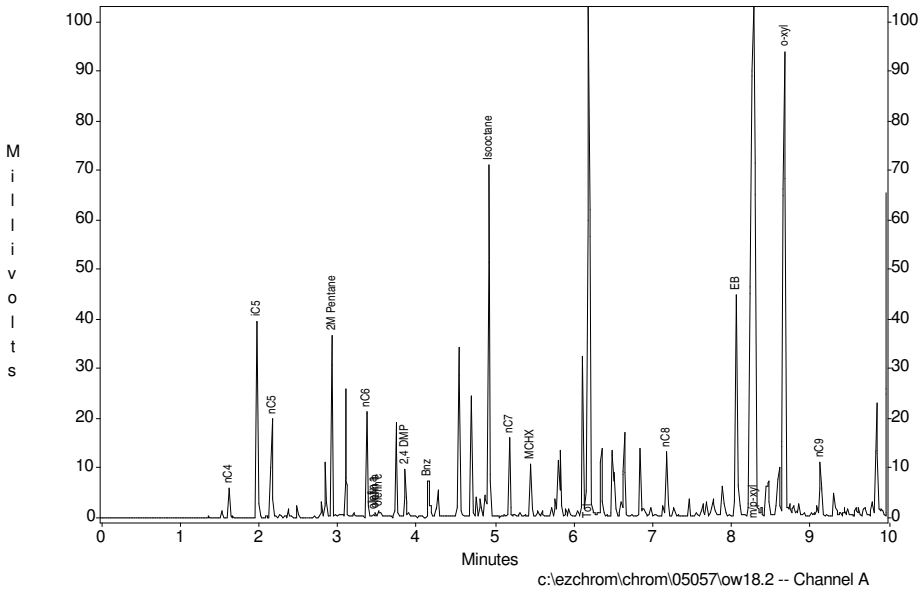


Channel A Results

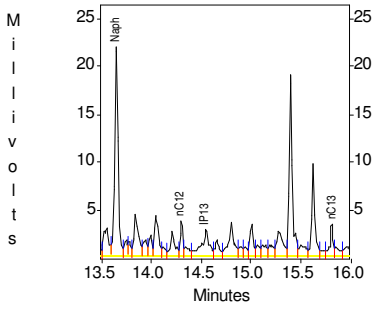
Peak	Area	Height
nC4	96	81
iC5	766	698
nC5	215	120
MTBE	0	0
2M Pentane	13548	4618
nC6	932	363
olefin a	0	0
olefin b	186	91
olefin c	0	0
2,4 DMP	4567	3886
Bnz	206	71
Isooctane	74428	59147
nC7	1266	534
MCHX	7684	5452
Tol	36333	28296
nC8	1126	478
EB	2330	848
m/p-xyl	2466	1149
o-xyl	1073	621
nC9	960	522
1,2,4 TMB	10853	3424
nC10	3308	1068
nC11	60908	23079
Naph	65271	24954
nC12	10282	2937
IP13	40986	9421
IP14	11892	6507
nC13	7381	2447
IP15	10475	4952
nC14	40095	13959
IP16	7749	4133
nC15	52066	18290
nC16	28992	14671
IP18	128857	42806
nC17	66757	29913
Pristane	66591	26120
nC18	11589	2719
Phytane	18000	4405
nC19	0	0
nC20	0	0
nC21	1050	343
nC22	0	0
nC23	2065	277
nC24	3120	322
nC25	0	0
nC26	1170	172
nC27	159	62
nC28	137	53
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	73	33
nC34	304	62
nC35	0	0
nC36	0	0
nC37	0	0
nC38	71	18
nC39	0	0
nC40	0	0

Sun - Belmont Terminal (AOI-1)
Sample ID : OW18-LNAPL-042605
Acquired : May 03, 2005 09:58:53

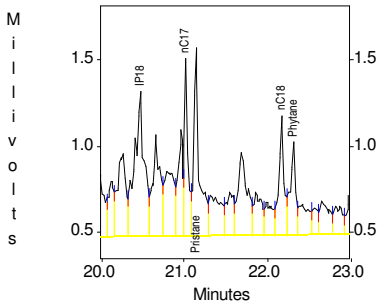
c:\ezchrom\chrom\05057\ow18.2 -- Channel A



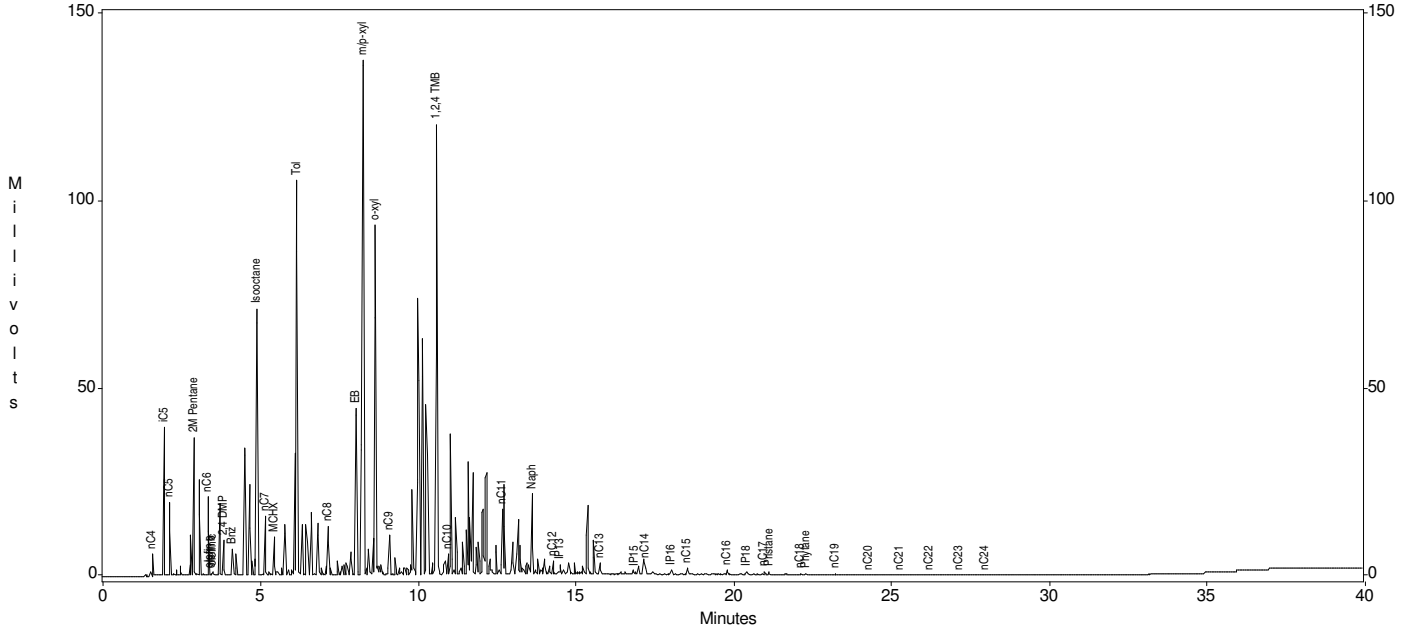
c:\ezchrom\chrom\05057\ow18.2 -- Channel A



c:\ezchrom\chrom\05057\ow18.2 -- Channel A



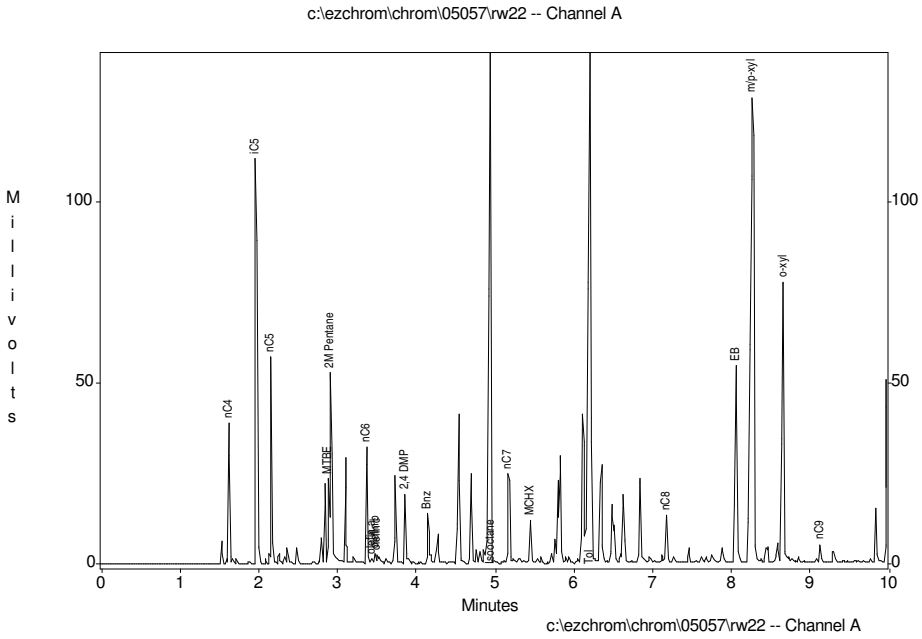
c:\ezchrom\chrom\05057\ow18.2 -- Channel A

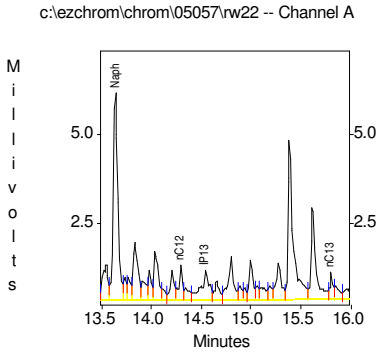


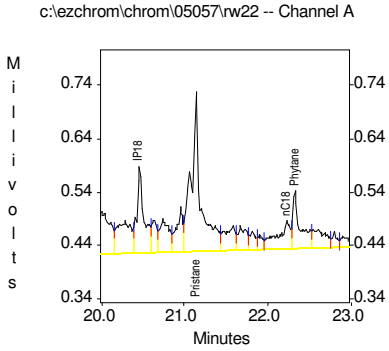
Channel A Results

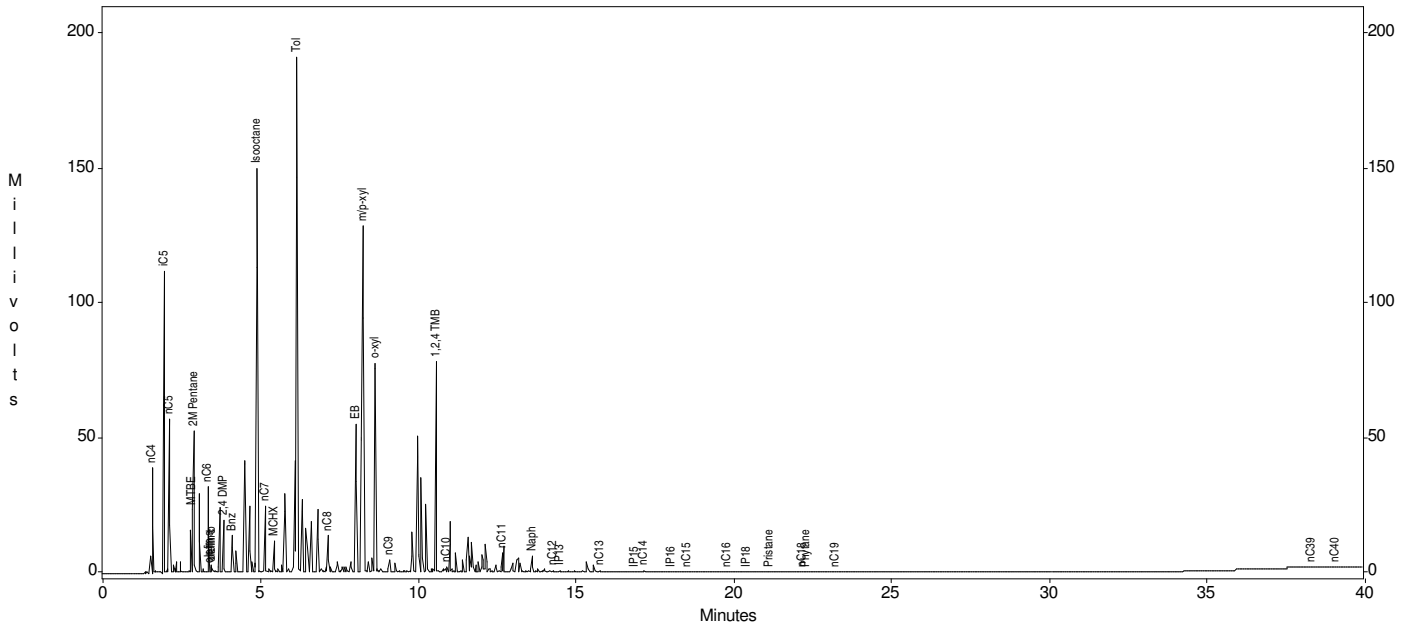
Peak	Area	Height
nC4	4955	5994
iC5	34804	39574
nC5	20058	19743
MTBE	0	0
2M Pentane	36087	36804
nC6	24119	21147
olefin a	756	497
olefin b	1195	897
olefin c	1684	1295
2,4 DMP	11222	9689
Bnz	12633	7262
Isooctane	96336	71264
nC7	21616	16104
MCHX	14838	10659
Tol	174622	105746
nC8	18791	13318
EB	73609	44798
m/p-xyl	446547	137458
o-xyl	187077	93691
nC9	21787	11042
1,2,4 TMB	320495	120252
nC10	10233	5862
nC11	38352	17880
Naph	49155	21848
nC12	6368	3689
IP13	13923	2750
IP14	0	0
nC13	7100	3268
IP15	2519	1283
nC14	11829	3242
IP16	5594	1406
nC15	6307	1784
nC16	9210	1331
IP18	6844	844
nC17	2998	1030
Pristane	4843	1092
nC18	2758	693
Phytane	2431	544
nC19	3689	499
nC20	1718	273
nC21	1499	172
nC22	494	73
nC23	107	25
nC24	91	13
nC25	0	0
nC26	0	0
nC27	0	0
nC28	0	0
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	0	0
nC40	0	0

Sun - Belmont Terminal (AOI-1)
Sample ID : RW22-LNAPL-042605
Acquired : May 04, 2005 10:09:46







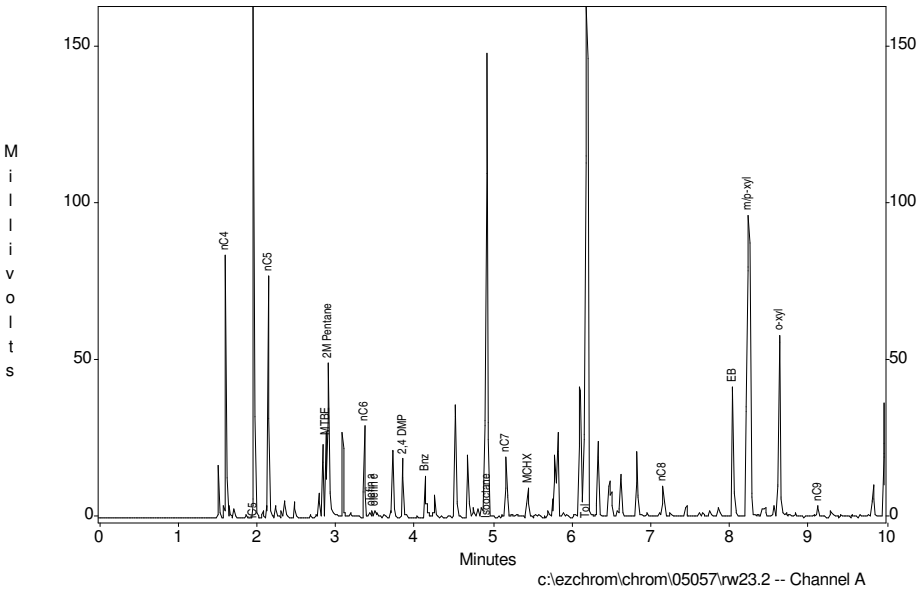


Channel A Results

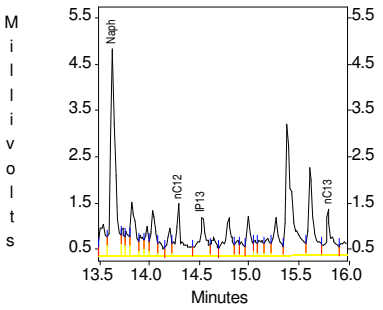
Peak	Area	Height
nC4	31283	38899
iC5	96026	111954
nC5	55050	57230
MTBE	21395	23579
2M Pentane	60608	52893
nC6	35752	32106
olefin a	2028	1527
olefin b	3334	2596
olefin c	3006	2350
2,4 DMP	22121	19380
Bnz	23250	14003
Isooctane	267649	150324
nC7	33202	24821
MCHX	16693	11864
Tol	413355	191051
nC8	19464	13553
EB	85575	55013
m/p-xyl	401740	128749
o-xyl	142919	77705
nC9	11121	5042
1,2,4 TMB	163313	78342
nC10	3771	1959
nC11	14834	7418
Naph	17204	5804
nC12	2394	967
IP13	4757	836
IP14	0	0
nC13	1725	771
IP15	1280	485
nC14	6335	994
IP16	2017	312
nC15	1041	270
nC16	2429	191
IP18	920	162
nC17	0	0
Pristane	2326	299
nC18	562	53
Phytane	681	109
nC19	53	14
nC20	0	0
nC21	0	0
nC22	0	0
nC23	0	0
nC24	0	0
nC25	0	0
nC26	0	0
nC27	0	0
nC28	0	0
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	21	10
nC40	45	16

Sun - Belmont Terminal (AOI-1)
Sample ID : RW23-LNAPL-042605
Acquired : May 03, 2005 15:55:29

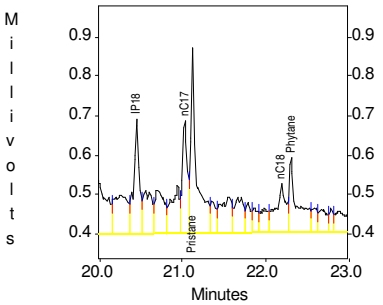
c:\ezchrom\chrom\05057\rw23.2 -- Channel A



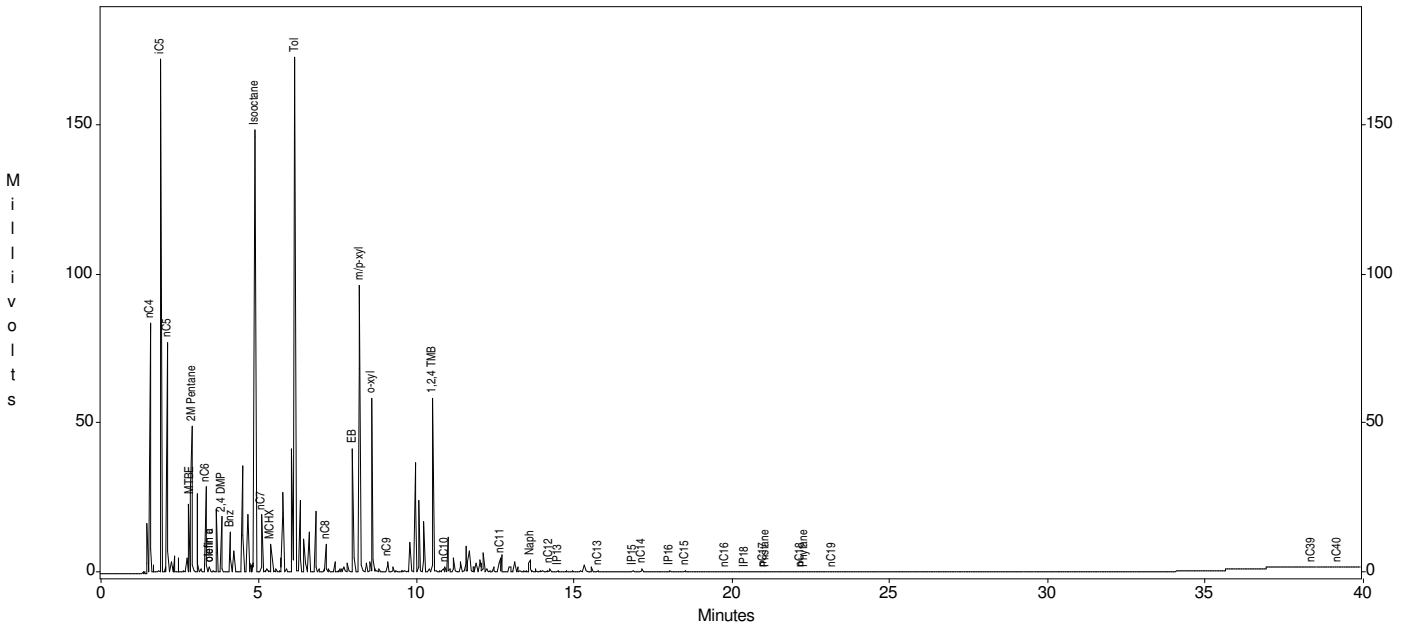
c:\ezchrom\chrom\05057\rw23.2 -- Channel A



c:\ezchrom\chrom\05057\rw23.2 -- Channel A



c:\ezchrom\chrom\05057\rw23.2 -- Channel A

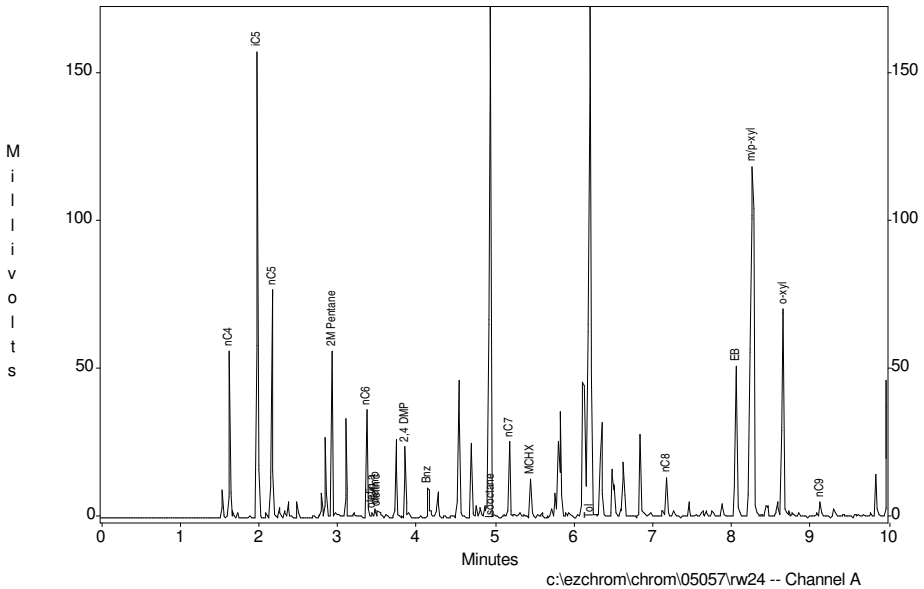


Channel A Results

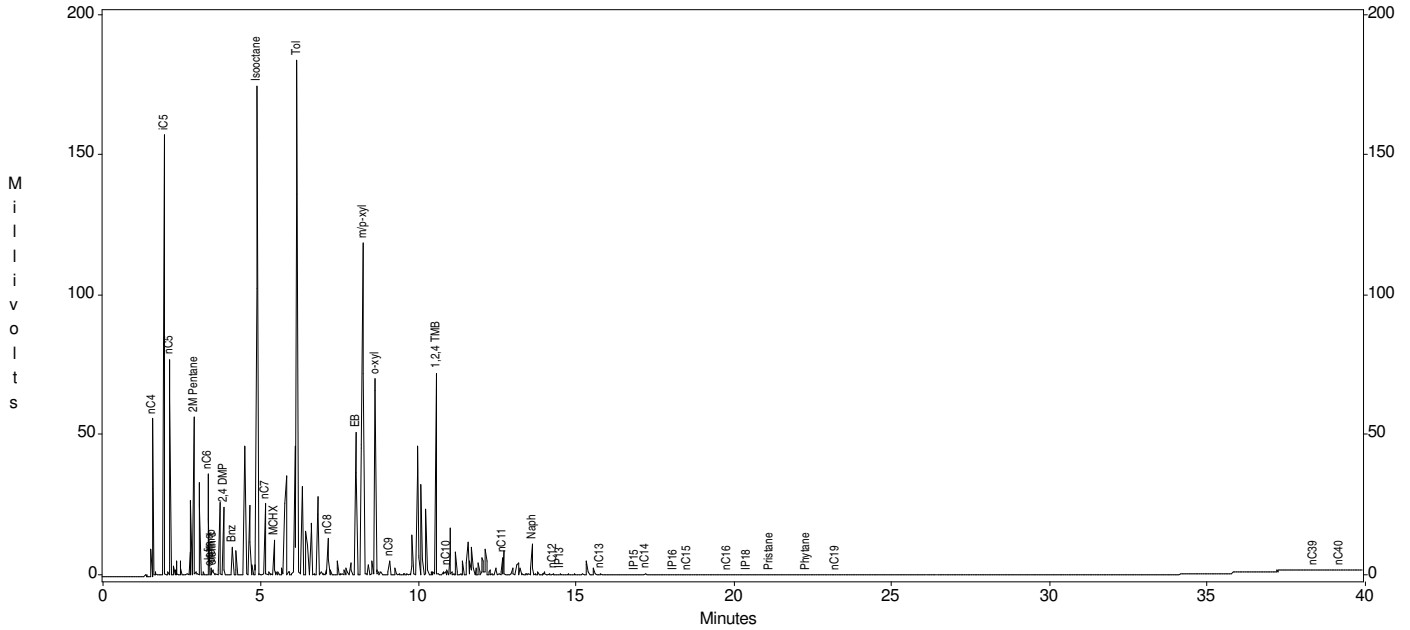
Peak	Area	Height
nC4	62020	83860
iC5	138390	172523
nC5	68376	77110
MTBE	24938	24630
2M Pentane	56667	49439
nC6	32112	29116
olefin a	2905	2296
olefin b	0	0
olefin c	2771	2125
2,4 DMP	21299	18883
Bnz	22406	13460
Isooctane	258976	148276
nC7	26496	19576
MCHX	13607	9565
Tol	350797	172675
nC8	14444	9720
EB	63338	41683
m/p-xyl	278325	96546
o-xyl	99204	58327
nC9	8740	3934
1,2,4 TMB	107819	58873
nC10	3452	1773
nC11	10791	4914
Naph	13713	4484
nC12	4273	1152
IP13	3979	842
IP14	0	0
nC13	4006	1003
IP15	1609	657
nC14	6877	1226
IP16	3101	588
nC15	1777	577
nC16	2738	404
IP18	1319	292
nC17	1217	287
Pristane	2204	473
nC18	1000	125
Phytane	1293	191
nC19	254	52
nC20	0	0
nC21	0	0
nC22	0	0
nC23	0	0
nC24	0	0
nC25	0	0
nC26	0	0
nC27	0	0
nC28	0	0
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	45	16
nC40	41	9

Sun - Belmont Terminal (AOI-1)
Sample ID : RW24-LNAPL-042605
Acquired : May 04, 2005 09:20:56

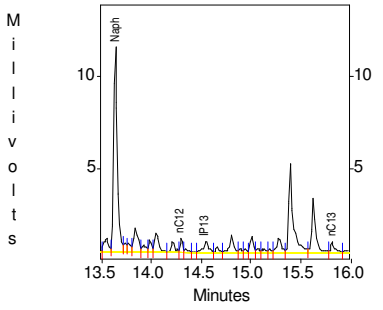
c:\ezchrom\chrom\05057\rw24 -- Channel A



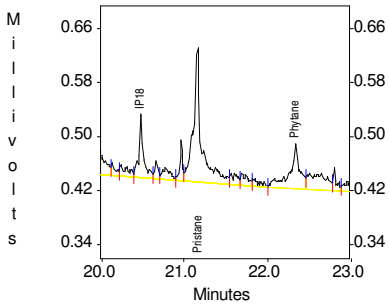
c:\ezchrom\chrom\05057\rw24 -- Channel A



c:\ezchrom\chrom\05057\rw24 -- Channel A



c:\ezchrom\chrom\05057\rw24 -- Channel A

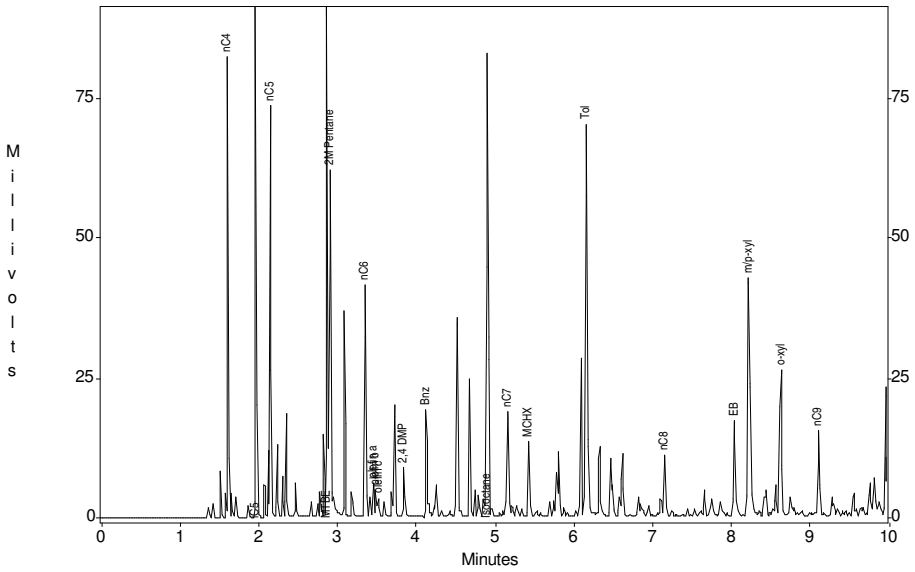


Channel A Results

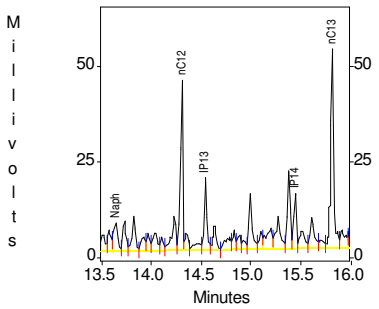
Peak	Area	Height
nC4	43728	56306
iC5	129714	157274
nC5	70007	77096
MTBE	0	0
2M Pentane	53849	56504
nC6	39208	36455
olefin a	2038	1592
olefin b	3419	2725
olefin c	3174	2451
2,4 DMP	26995	24202
Bnz	16909	10096
Isooctane	336959	174935
nC7	34214	25764
MCHX	17820	12894
Tol	391439	183680
nC8	18843	13343
EB	79584	51136
m/p-xyl	280055	118430
o-xyl	125526	70461
nC9	10535	5104
1,2,4 TMB	144783	71939
nC10	3104	1766
nC11	12467	6416
Naph	25246	11124
nC12	1237	751
IP13	2294	593
IP14	0	0
nC13	1820	559
IP15	1448	357
nC14	4495	823
IP16	790	204
nC15	596	151
nC16	624	94
IP18	367	94
nC17	0	0
Pristane	1306	200
nC18	0	0
Phytane	541	66
nC19	33	12
nC20	0	0
nC21	0	0
nC22	0	0
nC23	0	0
nC24	0	0
nC25	0	0
nC26	0	0
nC27	0	0
nC28	0	0
nC29	0	0
nC30	0	0
nC31	0	0
nC32	0	0
nC33	0	0
nC34	0	0
nC35	0	0
nC36	0	0
nC37	0	0
nC38	0	0
nC39	38	18
nC40	53	20

Sun - Belmont Terminal (AOI-1)
Sample ID : Gas/Dies/Wax std
Acquired : May 03, 2005 13:24:28

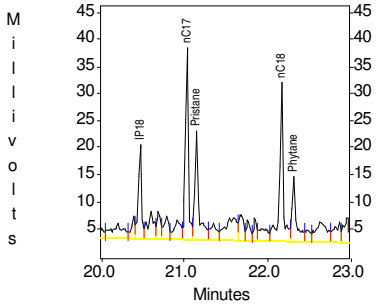
c:\ezchrom\chrom\05057\gadiwax2 -- Channel A



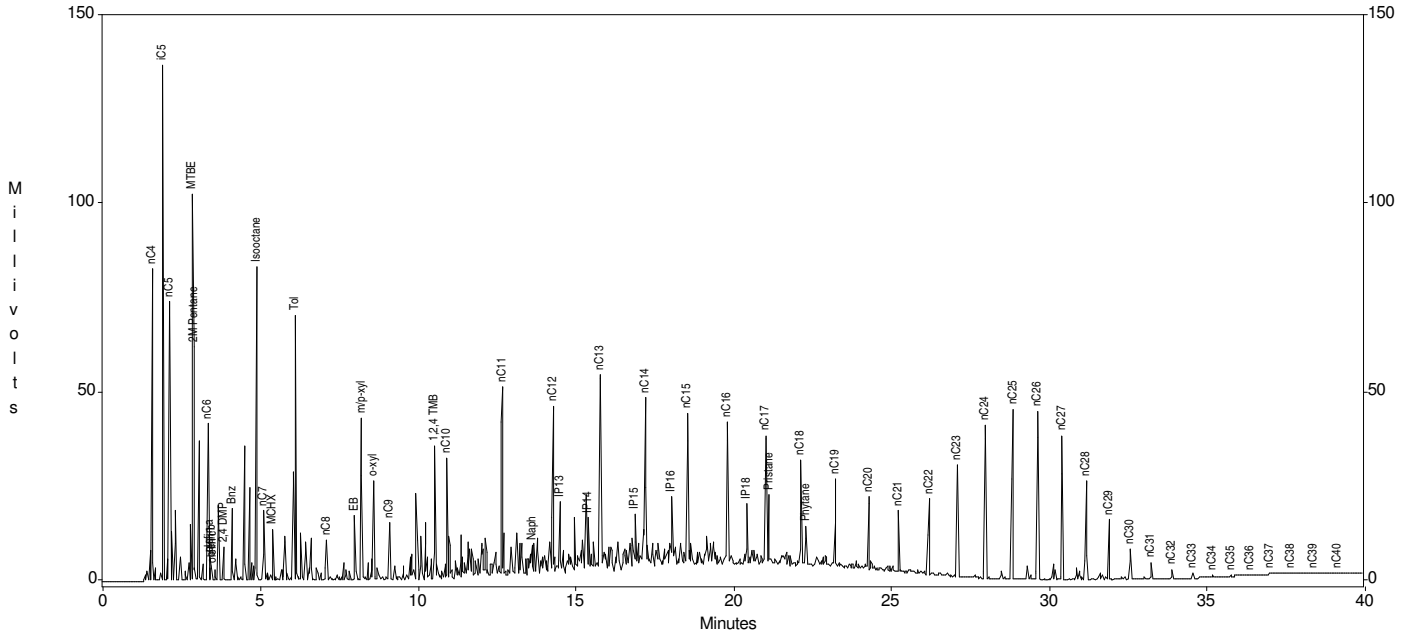
c:\ezchrom\chrom\05057\gadiwax2 -- Channel A



c:\ezchrom\chrom\05057\gadiwax2 -- Channel A



c:\ezchrom\chrom\05057\gadiwax2 -- Channel A

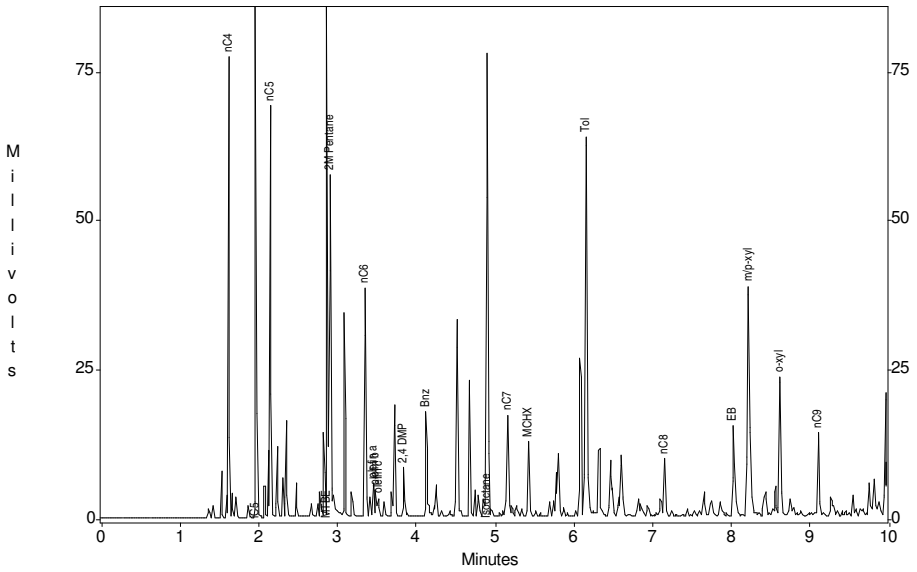


Channel A Results

Peak	Area	Height
nC4	54843	82471
iC5	100180	136393
nC5	58334	73630
MTBE	89713	102485
2M Pentane	63188	62064
nC6	41784	41515
olefin a	7132	6056
olefin b	5451	4910
olefin c	4774	3328
2,4 DMP	9621	8817
Bnz	27795	19135
Isooctane	112869	83027
nC7	24272	18782
MCHX	18713	13582
Tol	105068	70116
nC8	14646	10853
EB	29120	17071
m/p-xyl	94470	42771
o-xyl	41173	26233
nC9	23279	15395
1,2,4 TMB	62866	35433
nC10	49637	32104
nC11	89737	50331
Naph	23483	7679
nC12	82387	44515
IP13	36720	19152
IP14	24844	14668
nC13	118105	51942
IP15	17200	12361
nC14	92607	44477
IP16	37881	18544
nC15	88480	41072
nC16	106737	39077
IP18	43673	17327
nC17	84763	35656
Pristane	64310	20110
nC18	88501	29390
Phytane	42627	11982
nC19	80967	24887
nC20	45432	20355
nC21	43253	17120
nC22	41062	20756
nC23	63990	29668
nC24	98688	40652
nC25	118119	44941
nC26	122205	44542
nC27	93159	38007
nC28	58565	26116
nC29	33706	16093
nC30	16706	8007
nC31	8553	4095
nC32	4158	2198
nC33	2185	1121
nC34	1196	604
nC35	628	320
nC36	360	153
nC37	625	87
nC38	677	51
nC39	163	28
nC40	77	19

Sun - Belmont Terminal (AOI-1)
Sample ID : Gas/Dies/Wax std
Acquired : May 04, 2005 16:01:10

c:\ezchrom\chrom\05057\gadiwax2.2 -- Channel A



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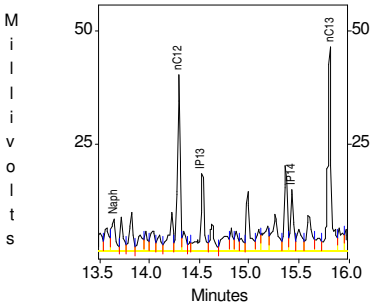
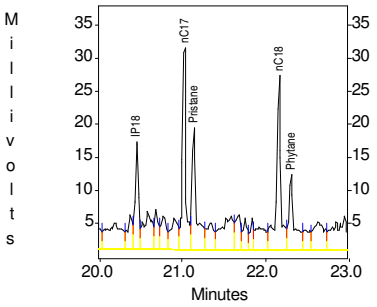
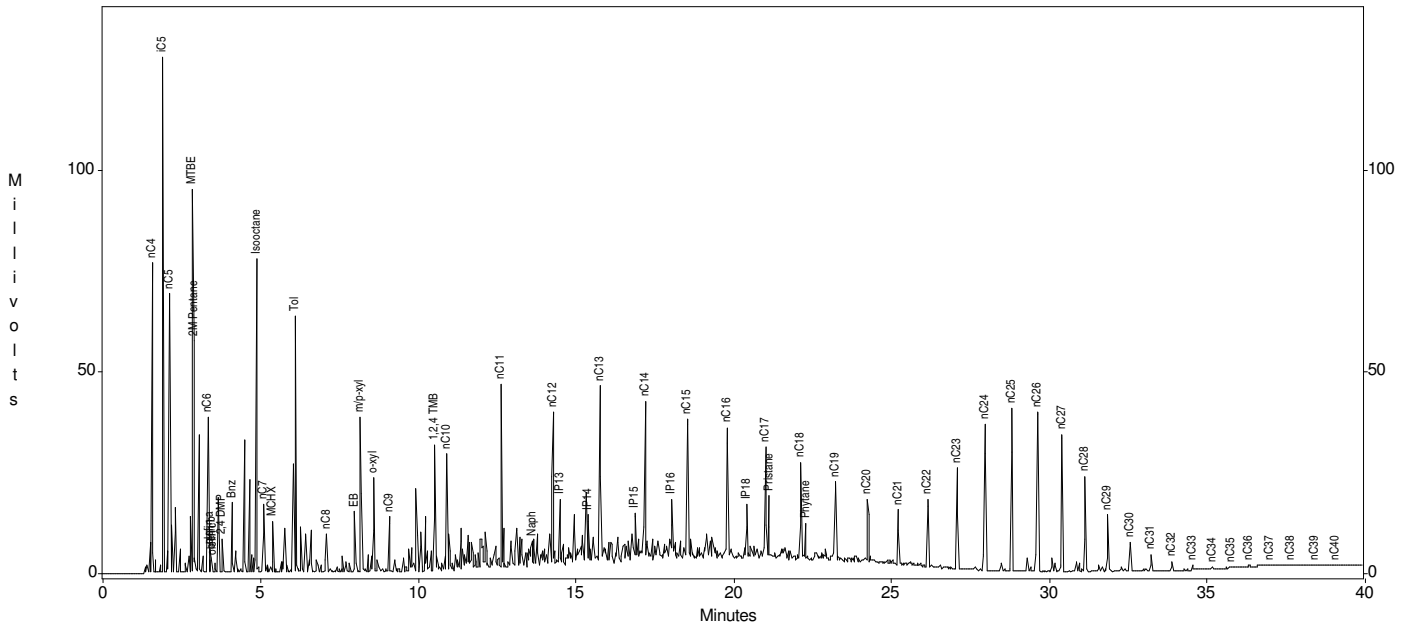


c:\ezchrom\chrom\05057\gadiwax2.2 -- Channel A



c:\ezchrom\chrom\05057\gadiwax2.2 -- Channel A



Channel A Results

Peak	Area	Height
nC4	50098	77133
iC5	92384	127634
nC5	53684	68982
MTBE	82928	95110
2M Pentane	58478	57424
nC6	38488	38379
olefin a	6560	5625
olefin b	5032	4495
olefin c	4410	3056
2,4 DMP	8858	8170
Bnz	25484	17496
Isooctane	104944	77846
nC7	22224	17091
MCHX	17148	12551
Tol	95562	63571
nC8	13315	9745
EB	25945	15113
m/p-xyl	83552	38611
o-xyl	36654	23249
nC9	20881	13897
1,2,4 TMB	54809	31292
nC10	44138	28818
nC11	77809	45412
Naph	21090	6947
nC12	72656	38798
IP13	43401	17018
IP14	24053	13417
nC13	109726	45266
IP15	50559	13906
nC14	89380	41242
IP16	39674	17467
nC15	100286	36992
nC16	111475	35227
IP18	45064	16209
nC17	82683	30591
Pristane	68998	18331
nC18	89999	26384
Phytane	49276	11436
nC19	82861	22058
nC20	39038	17724
nC21	44792	14979
nC22	38162	17927
nC23	56371	25508
nC24	87528	36337
nC25	102454	40377
nC26	106099	39312
nC27	81730	33957
nC28	51939	23365
nC29	30202	14169
nC30	15081	7189
nC31	7745	3858
nC32	3829	2060
nC33	2025	1074
nC34	1128	574
nC35	618	288
nC36	364	154
nC37	682	86
nC38	742	49
nC39	54	21
nC40	102	36

```
*****************************************************************
*                                                               *
*     Analysis of soil hydraulic properties                     *
*                                                               *
*     Sunoco Philadelphia Refinery SS-S34-21-21.5               *

*     Mualem-based restriction, M=1-1/N                         *
*     Analysis of retention data only                           *
*     MType= 3     Method= 3                                    *
*                                                               *
*****************************************************************
```

INITial values of the coefficients

No	Name	INITial value	Index
1	ThetaR	.0650	1
2	ThetaS	.4100	1
3	Alpha	.0750	1
4	n	1.8900	1
5	m	.4709	0
6	l	.5000	0
7	Ks	24.9600	0

Observed data

Obs. No.	Pressure head	Water content	Weighting coefficient
1	.000	.3200	1.0000
2	5.810	.3200	1.0000
3	13.100	.3155	1.0000
4	23.300	.3062	1.0000
5	36.300	.2787	1.0000
6	52.300	.2144	1.0000
7	71.200	.1571	1.0000
8	93.000	.1398	1.0000
9	145.000	.1229	1.0000
10	209.000	.1120	1.0000
11	285.000	.1021	1.0000
12	372.000	.0954	1.0000
13	471.000	.0992	1.0000
14	581.000	.0861	1.0000
15	1308.000	.0794	1.0000

NIT	SSQ	ThetaR	ThetaS	Alpha	n
0	.02636	.0650	.4100	.0750	1.8900
1	.01513	.0637	.3126	.0186	1.7929
2	.00744	.1071	.3296	.0297	2.1756
3	.00691	.0941	.3188	.0168	2.8308
4	.00142	.0884	.3240	.0230	2.5540
5	.00093	.0930	.3215	.0217	2.9666
6	.00080	.0930	.3213	.0216	3.1358
7	.00079	.0934	.3210	.0215	3.2051
8	.00079	.0936	.3209	.0215	3.2257
9	.00079	.0937	.3209	.0215	3.2320
10	.00079	.0937	.3209	.0215	3.2339
11	.00079	.0937	.3209	.0215	3.2344

12	.00079	.0937	.3209	.0215	3.2346

Correlation matrix

	Theta 1	Theta 2	Alpha 3	n 4
1	1.0000			
2	-.1443	1.0000		
3	-.0908	.5946	1.0000	
4	.5407	-.3851	-.6652	1.0000

RSquated for regression of observed vs fitted values = .99403460

Nonlinear least-squares analysis: final results

Variable	Value	S.E.Coeff.	T-Value	95% Confidence limits Lower	Upper
ThetaR	.09369	.00399	23.50	.0849	.1025
ThetaS	.32088	.00484	66.29	.3102	.3315
Alpha	.02146	.00117	18.27	.0189	.0241
n	3.23460	.29053	11.13	2.5951	3.8741

Observed abd fitted data

NO	P	log-P	WC-obs	WC-fit	WC-dev
1	.1000E-04	-5.0000	.3200	.3209	-.0009
2	.5810E+01	.7642	.3200	.3207	-.0007
3	.1310E+02	1.1173	.3155	.3183	-.0028
4	.2330E+02	1.3674	.3062	.3056	.0007
5	.3630E+02	1.5599	.2787	.2698	.0090
6	.5230E+02	1.7185	.2144	.2159	-.0015
7	.7120E+02	1.8525	.1571	.1690	-.0119
8	.9300E+02	1.9685	.1398	.1389	.0010
9	.1450E+03	2.1614	.1229	.1114	.0115
10	.2090E+03	2.3201	.1120	.1016	.0104
11	.2850E+03	2.4548	.1021	.0977	.0044
12	.3720E+03	2.5705	.0954	.0959	-.0005
13	.4710E+03	2.6730	.0992	.0950	.0042
14	.5810E+03	2.7642	.0861	.0945	-.0084
15	.1308E+04	3.1166	.0794	.0938	-.0145

Sum of squares of observed versus fitted values

	Unweighted	Weighted
Retention data	.00079	.00079
Cond/Diff data	.00000	.00000
All data	.00079	.00079

Soil hydraulic properties (MType = 3)

WC	P	logP	Cond	logK	Dif	logD
.0943	-.6742E+03	2.829	.1870E-07	-7.728	.9735E-02	-2.012

.0949	-.4943E+03	2.694	.1967E-06	-6.706	.3756E-01	-1.425
.0960	-.3624E+03	2.559	.2070E-05	-5.684	.1450E+00	-.839
.0983	-.2656E+03	2.424	.2179E-04	-4.662	.5605E+00	-.251
.1006	-.2213E+03	2.345	.8639E-04	-4.064	.1238E+01	.093
.1030	-.1944E+03	2.289	.2297E-03	-3.639	.2175E+01	.338
.1053	-.1757E+03	2.245	.4904E-03	-3.309	.3372E+01	.528
.1076	-.1617E+03	2.209	.9119E-03	-3.040	.4830E+01	.684
.1099	-.1507E+03	2.178	.1541E-02	-2.812	.6550E+01	.816
.1122	-.1418E+03	2.152	.2429E-02	-2.615	.8536E+01	.931
.1146	-.1343E+03	2.128	.3628E-02	-2.440	.1079E+02	1.033
.1169	-.1279E+03	2.107	.5197E-02	-2.284	.1332E+02	1.125
.1192	-.1223E+03	2.088	.7195E-02	-2.143	.1613E+02	1.208
.1215	-.1174E+03	2.070	.9686E-02	-2.014	.1922E+02	1.284
.1238	-.1131E+03	2.053	.1273E-01	-1.895	.2260E+02	1.354
.1261	-.1092E+03	2.038	.1641E-01	-1.785	.2628E+02	1.420
.1285	-.1057E+03	2.024	.2078E-01	-1.682	.3026E+02	1.481
.1308	-.1024E+03	2.010	.2593E-01	-1.586	.3455E+02	1.538
.1331	-.9946E+02	1.998	.3192E-01	-1.496	.3916E+02	1.593
.1354	-.9672E+02	1.986	.3885E-01	-1.411	.4409E+02	1.644
.1377	-.9419E+02	1.974	.4678E-01	-1.330	.4936E+02	1.693
.1401	-.9182E+02	1.963	.5581E-01	-1.253	.5498E+02	1.740
.1424	-.8961E+02	1.952	.6603E-01	-1.180	.6095E+02	1.785
.1447	-.8754E+02	1.942	.7752E-01	-1.111	.6729E+02	1.828
.1470	-.8559E+02	1.932	.9038E-01	-1.044	.7401E+02	1.869
.1493	-.8374E+02	1.923	.1047E+00	-.980	.8111E+02	1.909
.1516	-.8199E+02	1.914	.1206E+00	-.919	.8863E+02	1.948
.1540	-.8033E+02	1.905	.1382E+00	-.860	.9655E+02	1.985
.1563	-.7875E+02	1.896	.1575E+00	-.803	.1049E+03	2.021
.1586	-.7724E+02	1.888	.1787E+00	-.748	.1137E+03	2.056
.1609	-.7580E+02	1.880	.2019E+00	-.695	.1230E+03	2.090
.1632	-.7441E+02	1.872	.2273E+00	-.643	.1328E+03	2.123
.1656	-.7309E+02	1.864	.2548E+00	-.594	.1430E+03	2.155
.1679	-.7181E+02	1.856	.2847E+00	-.546	.1538E+03	2.187
.1702	-.7058E+02	1.849	.3171E+00	-.499	.1651E+03	2.218
.1725	-.6940E+02	1.841	.3521E+00	-.453	.1770E+03	2.248
.1748	-.6825E+02	1.834	.3899E+00	-.409	.1894E+03	2.277
.1771	-.6714E+02	1.827	.4305E+00	-.366	.2025E+03	2.306
.1795	-.6607E+02	1.820	.4742E+00	-.324	.2162E+03	2.335
.1818	-.6503E+02	1.813	.5210E+00	-.283	.2306E+03	2.363
.1841	-.6402E+02	1.806	.5711E+00	-.243	.2457E+03	2.390
.1864	-.6303E+02	1.800	.6248E+00	-.204	.2615E+03	2.418
.1887	-.6207E+02	1.793	.6820E+00	-.166	.2781E+03	2.444
.1911	-.6114E+02	1.786	.7431E+00	-.129	.2955E+03	2.471
.1934	-.6023E+02	1.780	.8082E+00	-.093	.3137E+03	2.497
.1957	-.5934E+02	1.773	.8774E+00	-.057	.3329E+03	2.522
.1980	-.5847E+02	1.767	.9509E+00	-.022	.3529E+03	2.548
.2003	-.5762E+02	1.761	.1029E+01	.012	.3739E+03	2.573
.2026	-.5678E+02	1.754	.1112E+01	.046	.3960E+03	2.598
.2050	-.5597E+02	1.748	.1200E+01	.079	.4192E+03	2.622
.2073	-.5516E+02	1.742	.1292E+01	.111	.4435E+03	2.647
.2096	-.5438E+02	1.735	.1391E+01	.143	.4690E+03	2.671
.2119	-.5360E+02	1.729	.1494E+01	.174	.4958E+03	2.695
.2142	-.5284E+02	1.723	.1604E+01	.205	.5240E+03	2.719
.2166	-.5209E+02	1.717	.1720E+01	.235	.5537E+03	2.743
.2189	-.5134E+02	1.710	.1842E+01	.265	.5849E+03	2.767
.2212	-.5061E+02	1.704	.1970E+01	.295	.6177E+03	2.791
.2235	-.4989E+02	1.698	.2106E+01	.323	.6523E+03	2.814
.2258	-.4918E+02	1.692	.2248E+01	.352	.6887E+03	2.838
.2281	-.4847E+02	1.685	.2398E+01	.380	.7272E+03	2.862

.2305	-.4777E+02	1.679	.2556E+01	.408	.7678E+03	2.885
.2328	-.4708E+02	1.673	.2722E+01	.435	.8107E+03	2.909
.2351	-.4639E+02	1.666	.2896E+01	.462	.8561E+03	2.933
.2374	-.4571E+02	1.660	.3079E+01	.488	.9042E+03	2.956
.2397	-.4503E+02	1.653	.3271E+01	.515	.9551E+03	2.980
.2421	-.4435E+02	1.647	.3472E+01	.541	.1009E+04	3.004
.2444	-.4368E+02	1.640	.3684E+01	.566	.1067E+04	3.028
.2467	-.4301E+02	1.634	.3906E+01	.592	.1128E+04	3.052
.2490	-.4234E+02	1.627	.4139E+01	.617	.1193E+04	3.077
.2513	-.4167E+02	1.620	.4383E+01	.642	.1262E+04	3.101
.2536	-.4100E+02	1.613	.4639E+01	.666	.1336E+04	3.126
.2560	-.4034E+02	1.606	.4908E+01	.691	.1416E+04	3.151
.2583	-.3967E+02	1.598	.5189E+01	.715	.1501E+04	3.176
.2606	-.3900E+02	1.591	.5484E+01	.739	.1593E+04	3.202
.2629	-.3832E+02	1.583	.5794E+01	.763	.1692E+04	3.228
.2652	-.3764E+02	1.576	.6118E+01	.787	.1798E+04	3.255
.2676	-.3696E+02	1.568	.6459E+01	.810	.1914E+04	3.282
.2699	-.3627E+02	1.560	.6816E+01	.834	.2039E+04	3.309
.2722	-.3557E+02	1.551	.7190E+01	.857	.2176E+04	3.338
.2745	-.3486E+02	1.542	.7584E+01	.880	.2326E+04	3.367
.2768	-.3415E+02	1.533	.7997E+01	.903	.2490E+04	3.396
.2791	-.3342E+02	1.524	.8431E+01	.926	.2671E+04	3.427
.2815	-.3268E+02	1.514	.8887E+01	.949	.2872E+04	3.458
.2838	-.3192E+02	1.504	.9367E+01	.972	.3095E+04	3.491
.2861	-.3114E+02	1.493	.9873E+01	.994	.3346E+04	3.525
.2884	-.3035E+02	1.482	.1041E+02	1.017	.3629E+04	3.560
.2907	-.2953E+02	1.470	.1097E+02	1.040	.3951E+04	3.597
.2931	-.2868E+02	1.458	.1156E+02	1.063	.4321E+04	3.636
.2954	-.2779E+02	1.444	.1220E+02	1.086	.4751E+04	3.677
.2977	-.2687E+02	1.429	.1286E+02	1.109	.5256E+04	3.721
.3000	-.2590E+02	1.413	.1358E+02	1.133	.5859E+04	3.768
.3023	-.2486E+02	1.396	.1434E+02	1.157	.6594E+04	3.819
.3046	-.2376E+02	1.376	.1516E+02	1.181	.7509E+04	3.876
.3070	-.2256E+02	1.353	.1604E+02	1.205	.8686E+04	3.939
.3093	-.2123E+02	1.327	.1700E+02	1.230	.1026E+05	4.011
.3116	-.1974E+02	1.295	.1805E+02	1.256	.1250E+05	4.097
.3139	-.1799E+02	1.255	.1922E+02	1.284	.1597E+05	4.203
.3162	-.1580E+02	1.199	.2057E+02	1.313	.2223E+05	4.347
.3186	-.1271E+02	1.104	.2221E+02	1.347	.3811E+05	4.581
.3197	-.1024E+02	1.010	.2325E+02	1.366	.6387E+05	4.805
.3203	-.8253E+01	.917	.2390E+02	1.378	.1055E+06	5.023
.3206	-.6213E+01	.793	.2440E+02	1.387	.2024E+06	5.306
.3209	-.3048E+01	.484	.2485E+02	1.395	.1010E+07	6.004
.3209	-.1496E+01	.175	.2494E+02	1.397	.4974E+07	6.697
.3209	.0000E+00		.2496E+02	1.397		

End of problem
==========

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*********************************************************************
*                                                                   *
*     Analysis of soil hydraulic properties                         *
*                                                                   *
*     SS-MW-42-041505-22.5-23                                       *
*                                                                   *
*     Mualem-based restriction, M=1-1/N                             *
*     Analysis of retention data only                               *
*     MType= 3     Method= 3                                        *
*                                                                   *
*********************************************************************
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INITial values of the coefficients

No	Name	INITial value	Index
1	ThetaR	.0780	1
2	ThetaS	.4300	1
3	Alpha	.0360	1
4	n	1.5600	1
5	m	.3590	0
6	l	.5000	0
7	Ks	24.9600	0

Observed data

Obs. No.	Pressure head	Water content	Weighting coefficient
1	.000	.4670	1.0000
2	5.830	.4670	1.0000
3	13.100	.4670	1.0000
4	23.300	.4670	1.0000
5	36.400	.4670	1.0000
6	52.500	.4610	1.0000
7	71.400	.4491	1.0000
8	93.300	.4312	1.0000
9	146.000	.3894	1.0000
10	210.000	.3535	1.0000
11	286.000	.3177	1.0000
12	373.000	.2938	1.0000
13	472.000	.2759	1.0000
14	583.000	.2592	1.0000
15	1312.000	.2114	1.0000

NIT	SSQ	ThetaR	ThetaS	Alpha	n
0	.26462	.0780	.4300	.0360	1.5600
1	.14780	.0644	.4661	.0097	1.0474
2	.12075	.0051	.4655	.0120	1.0549
3	.11947	.0024	.4655	.0121	1.0552
4	.11884	.0010	.4655	.0122	1.0554
5	.11853	.0004	.4655	.0122	1.0555

wcr is less then 0.001: Changed to fit with wcr=0.0

NIT SSQ ThetaS Alpha n

0	.45131	.4300	.0360	1.5600
1	.21965	.4732	.0219	1.0050
2	.10050	.4916	.2458	1.1490
3	.02282	.5143	.1062	1.1313
4	.02097	.5156	.0897	1.1341
5	.01747	.5098	.0579	1.1461
6	.01613	.5086	.0538	1.1533
7	.01490	.4989	.0219	1.1814
8	.00897	.4952	.0232	1.1993
9	.00791	.4948	.0225	1.2095
10	.00727	.4950	.0215	1.2173
11	.00521	.4898	.0142	1.2486
12	.00414	.4833	.0084	1.3149
13	.00184	.4769	.0065	1.3967
14	.00136	.4781	.0072	1.3958
15	.00135	.4775	.0070	1.4035
16	.00135	.4777	.0070	1.4022
17	.00135	.4776	.0070	1.4025
18	.00135	.4776	.0070	1.4025
19	.00135	.4776	.0070	1.4025

Correlation matrix

	Theta	Alpha	n
	1	2	3
1	1.0000		
2	.6842	1.0000	
3	-.4761	-.9167	1.0000

RSquated for regression of observed vs fitted values = .98845907

Nonlinear least-squares analysis: final results

Variable	Value	S.E.Coeff.	T-Value	95% Confidence limits Lower	Upper
ThetaS	.47762	.00532	89.83	.4660	.4892
Alpha	.00701	.00104	6.77	.0048	.0093
n	1.40248	.03782	37.09	1.3201	1.4849

Observed abd fitted data

NO	P	log-P	WC-obs	WC-fit	WC-dev
1	.1000E-04	-5.0000	.4670	.4776	-.0106
2	.5830E+01	.7657	.4670	.4761	-.0091
3	.1310E+02	1.1173	.4670	.4729	-.0059
4	.2330E+02	1.3674	.4670	.4673	-.0003
5	.3640E+02	1.5611	.4670	.4592	.0078
6	.5250E+02	1.7202	.4610	.4484	.0126
7	.7140E+02	1.8537	.4491	.4356	.0135
8	.9330E+02	1.9699	.4312	.4211	.0101
9	.1460E+03	2.1644	.3894	.3896	-.0003
10	.2100E+03	2.3222	.3535	.3584	-.0049
11	.2860E+03	2.4564	.3177	.3293	-.0116
12	.3730E+03	2.5717	.2938	.3036	-.0098

13	.4720E+03	2.6739	.2759	.2809	-.0050
14	.5830E+03	2.7657	.2592	.2611	-.0019
15	.1312E+04	3.1179	.2114	.1931	.0183

Sum of squares of observed versus fitted values

	Unweighted	Weighted
Retention data	.00135	.00135
Cond/Diff data	.00000	.00000
All data	.00135	.00135

Soil hydraulic properties (MType = 3)

WC	P	logP	Cond	logK	Dif	logD
.0012	-.3959E+09	8.598	.8775E-19	-19.057	.7084E-07	-7.150
.0024	-.7073E+08	7.850	.1555E-16	-16.808	.1121E-05	-5.950
.0049	-.1264E+08	7.102	.2755E-14	-14.560	.1775E-04	-4.751
.0097	-.2258E+07	6.354	.4882E-12	-12.311	.2810E-03	-3.551
.0146	-.8246E+06	5.916	.1009E-10	-10.996	.1414E-02	-2.850
.0195	-.4035E+06	5.606	.8651E-10	-10.063	.4448E-02	-2.352
.0244	-.2318E+06	5.365	.4580E-09	-9.339	.1082E-01	-1.966
.0292	-.1473E+06	5.168	.1788E-08	-8.748	.2238E-01	-1.650
.0341	-.1004E+06	5.002	.5654E-08	-8.248	.4137E-01	-1.383
.0390	-.7208E+05	4.858	.1533E-07	-7.814	.7043E-01	-1.152
.0439	-.5379E+05	4.731	.3695E-07	-7.432	.1126E+00	-.948
.0487	-.4140E+05	4.617	.8118E-07	-7.091	.1714E+00	-.766
.0536	-.3267E+05	4.514	.1654E-06	-6.781	.2506E+00	-.601
.0585	-.2631E+05	4.420	.3169E-06	-6.499	.3545E+00	-.450
.0634	-.2156E+05	4.334	.5763E-06	-6.239	.4878E+00	-.312
.0682	-.1793E+05	4.254	.1003E-05	-5.999	.6555E+00	-.183
.0731	-.1511E+05	4.179	.1679E-05	-5.775	.8632E+00	-.064
.0780	-.1286E+05	4.109	.2719E-05	-5.566	.1117E+01	.048
.0829	-.1106E+05	4.044	.4278E-05	-5.369	.1422E+01	.153
.0877	-.9594E+04	3.982	.6559E-05	-5.183	.1787E+01	.252
.0926	-.8385E+04	3.924	.9826E-05	-5.008	.2218E+01	.346
.0975	-.7378E+04	3.868	.1442E-04	-4.841	.2723E+01	.435
.1023	-.6533E+04	3.815	.2077E-04	-4.683	.3309E+01	.520
.1072	-.5816E+04	3.765	.2942E-04	-4.531	.3987E+01	.601
.1121	-.5205E+04	3.716	.4103E-04	-4.387	.4764E+01	.678
.1170	-.4679E+04	3.670	.5643E-04	-4.249	.5650E+01	.752
.1218	-.4224E+04	3.626	.7660E-04	-4.116	.6655E+01	.823
.1267	-.3828E+04	3.583	.1028E-03	-3.988	.7791E+01	.892
.1316	-.3482E+04	3.542	.1364E-03	-3.865	.9068E+01	.958
.1365	-.3178E+04	3.502	.1791E-03	-3.747	.1050E+02	1.021
.1413	-.2909E+04	3.464	.2331E-03	-3.632	.1209E+02	1.083
.1462	-.2671E+04	3.427	.3006E-03	-3.522	.1387E+02	1.142
.1511	-.2458E+04	3.391	.3846E-03	-3.415	.1584E+02	1.200
.1560	-.2268E+04	3.356	.4883E-03	-3.311	.1801E+02	1.256
.1608	-.2098E+04	3.322	.6155E-03	-3.211	.2041E+02	1.310
.1657	-.1944E+04	3.289	.7706E-03	-3.113	.2304E+02	1.363
.1706	-.1806E+04	3.257	.9588E-03	-3.018	.2593E+02	1.414
.1755	-.1680E+04	3.225	.1186E-02	-2.926	.2910E+02	1.464
.1803	-.1566E+04	3.195	.1458E-02	-2.836	.3256E+02	1.513
.1852	-.1462E+04	3.165	.1784E-02	-2.749	.3633E+02	1.560
.1901	-.1367E+04	3.136	.2172E-02	-2.663	.4044E+02	1.607
.1949	-.1280E+04	3.107	.2631E-02	-2.580	.4490E+02	1.652
.1998	-.1201E+04	3.079	.3173E-02	-2.499	.4975E+02	1.697

.2047	-.1127E+04	3.052	.3810E-02	-2.419	.5501E+02	1.740
.2096	-.1060E+04	3.025	.4558E-02	-2.341	.6070E+02	1.783
.2144	-.9972E+03	2.999	.5431E-02	-2.265	.6685E+02	1.825
.2193	-.9395E+03	2.973	.6447E-02	-2.191	.7350E+02	1.866
.2242	-.8859E+03	2.947	.7628E-02	-2.118	.8068E+02	1.907
.2291	-.8362E+03	2.922	.8995E-02	-2.046	.8842E+02	1.947
.2339	-.7900E+03	2.898	.1057E-01	-1.976	.9677E+02	1.986
.2388	-.7469E+03	2.873	.1239E-01	-1.907	.1058E+03	2.024
.2437	-.7067E+03	2.849	.1448E-01	-1.839	.1154E+03	2.062
.2486	-.6692E+03	2.826	.1688E-01	-1.773	.1259E+03	2.100
.2534	-.6340E+03	2.802	.1963E-01	-1.707	.1371E+03	2.137
.2583	-.6010E+03	2.779	.2276E-01	-1.643	.1491E+03	2.173
.2632	-.5701E+03	2.756	.2634E-01	-1.579	.1621E+03	2.210
.2681	-.5410E+03	2.733	.3040E-01	-1.517	.1760E+03	2.245
.2729	-.5136E+03	2.711	.3503E-01	-1.456	.1909E+03	2.281
.2778	-.4878E+03	2.688	.4027E-01	-1.395	.2070E+03	2.316
.2827	-.4635E+03	2.666	.4621E-01	-1.335	.2243E+03	2.351
.2875	-.4405E+03	2.644	.5293E-01	-1.276	.2429E+03	2.385
.2924	-.4187E+03	2.622	.6053E-01	-1.218	.2629E+03	2.420
.2973	-.3981E+03	2.600	.6910E-01	-1.161	.2844E+03	2.454
.3022	-.3786E+03	2.578	.7876E-01	-1.104	.3076E+03	2.488
.3070	-.3600E+03	2.556	.8965E-01	-1.047	.3325E+03	2.522
.3119	-.3424E+03	2.535	.1019E+00	-.992	.3593E+03	2.555
.3168	-.3256E+03	2.513	.1157E+00	-.937	.3883E+03	2.589
.3217	-.3097E+03	2.491	.1312E+00	-.882	.4195E+03	2.623
.3265	-.2944E+03	2.469	.1486E+00	-.828	.4533E+03	2.656
.3314	-.2799E+03	2.447	.1681E+00	-.774	.4898E+03	2.690
.3363	-.2660E+03	2.425	.1900E+00	-.721	.5293E+03	2.724
.3412	-.2527E+03	2.403	.2146E+00	-.668	.5722E+03	2.758
.3460	-.2400E+03	2.380	.2422E+00	-.616	.6187E+03	2.791
.3509	-.2278E+03	2.358	.2732E+00	-.564	.6693E+03	2.826
.3558	-.2161E+03	2.335	.3080E+00	-.512	.7244E+03	2.860
.3607	-.2049E+03	2.312	.3470E+00	-.460	.7846E+03	2.895
.3655	-.1941E+03	2.288	.3908E+00	-.408	.8504E+03	2.930
.3704	-.1837E+03	2.264	.4401E+00	-.356	.9226E+03	2.965
.3753	-.1736E+03	2.240	.4955E+00	-.305	.1002E+04	3.001
.3801	-.1639E+03	2.215	.5578E+00	-.253	.1090E+04	3.037
.3850	-.1546E+03	2.189	.6281E+00	-.202	.1187E+04	3.074
.3899	-.1455E+03	2.163	.7075E+00	-.150	.1294E+04	3.112
.3948	-.1368E+03	2.136	.7973E+00	-.098	.1414E+04	3.151
.3996	-.1282E+03	2.108	.8991E+00	-.046	.1549E+04	3.190
.4045	-.1199E+03	2.079	.1015E+01	.006	.1701E+04	3.231
.4094	-.1119E+03	2.049	.1147E+01	.059	.1873E+04	3.273
.4143	-.1040E+03	2.017	.1297E+01	.113	.2070E+04	3.316
.4191	-.9632E+02	1.984	.1470E+01	.167	.2296E+04	3.361
.4240	-.8879E+02	1.948	.1671E+01	.223	.2559E+04	3.408
.4289	-.8138E+02	1.911	.1903E+01	.279	.2869E+04	3.458
.4338	-.7408E+02	1.870	.2175E+01	.337	.3237E+04	3.510
.4386	-.6687E+02	1.825	.2496E+01	.397	.3683E+04	3.566
.4435	-.5969E+02	1.776	.2881E+01	.460	.4233E+04	3.627
.4484	-.5253E+02	1.720	.3348E+01	.525	.4932E+04	3.693
.4533	-.4532E+02	1.656	.3927E+01	.594	.5848E+04	3.767
.4581	-.3798E+02	1.580	.4667E+01	.669	.7112E+04	3.852
.4630	-.3041E+02	1.483	.5653E+01	.752	.8986E+04	3.954
.4679	-.2239E+02	1.350	.7073E+01	.850	.1213E+05	4.084
.4727	-.1344E+02	1.128	.9471E+01	.976	.1905E+05	4.280
.4752	-.8129E+01	.910	.1172E+02	1.069	.2819E+05	4.450
.4764	-.4939E+01	.694	.1374E+02	1.138	.3993E+05	4.601
.4771	-.2563E+01	.409	.1604E+02	1.205	.6029E+05	4.780

```
 .4776   -.4956E+00  -.305    .2011E+02   1.303    .1458E+06   5.164
 .4776   -.9595E-01 -1.018    .2239E+02   1.350    .3143E+06   5.497
 .4776    .0000E+00           .2496E+02   1.397
```

End of problem
==============

APPENDIX F

SOIL GAS SAMPLING AND MODELING PROCEDURES

APPENDIX F
SOIL GAS SAMPLING AND MODELING PROCEDURES
AOI 1: SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

F.1 SITE SPECIFIC VAPOR INTRUSION MODELING

Site specific soil properties, building characteristics, and vapor sample analytical results were input to a mathematical model used to evaluate whether unacceptable inhalation risks from the vapor intrusion pathway potentially exist at the site. Site specific vapor intrusion modeling was applied to soil vapor sample results found to be above the PADEP non-residential soil-vapor screening criteria (Table 8). The evaluation used the various site specific inputs and a vapor intrusion model to predict indoor air concentrations. Predicted indoor air concentrations were then compared to the PADEP non-residential indoor air criteria and to site-specific criteria derived for the Credit Union building and the former office building/maintenance building/supply storage located in Belmont Terminal. The locations of these buildings are shown on Figure A1 (included in Appendix A). The predicted groundwater concentrations based on the fate and transport calculations were also compared to the PADEP groundwater screening values for the off-site non-residential receptors shown in Figure 12. No exceedances of the screening values were noted, so no additional modeling was necessary.

To provide input of site-specific soil properties in the vapor intrusion model for the buildings located within Belmont Terminal, undisturbed soil samples were collected from the areas of investigation and analyzed for physical properties such as, air permeability, bulk density, total porosity, and water filled porosity, via method API-RP40. The results of these analyses are presented in Table F1 within this appendix. These soil attributes can influence vapor migration and these site specific characteristics were incorporated in the site specific soil vapor modeling discussed below.

F.2 MODEL AND APPROACH

The Johnson and Ettinger (J&E) Model for Predicting Soil Vapor Intrusion Into Overlying Structures Version 3.0 was used to predict indoor air concentrations from soil vapor results while taking into account site-specific soil properties and building characteristics. The soil-vapor model is based upon the J&E infinite source solution to convective and diffusive transport. This equation incorporates the main bounding physical and chemical attenuation processes that can reduce a source concentration as it migrates from the source, through the soil, and into a building.

J&E model simulations start with a measured soil vapor concentration which is assumed to be constant and never depleted (i.e. infinite source). From the source depth, soil vapor moves vertically as a result of higher vapor pressure in subsurface pore spaces versus lower vapor pressures in an overlying building. The amount of soil that vapors have to pass through to reach the bottom of a building influences the amount of attenuation that can occur. In addition the physical properties of a soil can influence how effectively soil vapor is transported vertically. The most influential soil properties on vapor migration are: soil vapor permeability, soil porosity, and soil pore saturation. Important attenuation factors that are not included in the J&E model are chemical transformation processes (i.e., biodegradation). The infinite source assumption and lack of chemical transformation are two considerably conservative aspects of the model.

The model assumes that all soil-vapor originating below a building will enter the building from soil through cracks in the foundation (floor and walls). The model simplifies the total crack area by assuming a crack length equivalent to the perimeter of the building (where the walls meet the floor) and a crack width. The USEPA default crack width of 0.1 cm is based on radon studies (Eaton, R.S., and A.G. Scott. 1984; and Loureiro, C.O., L.M. Abriola, J.E. Martin, and R.G. Sextro. 1990). The ventilation system of a building can cause further attenuation of soil vapor concentrations as it exchanges inside air with the outside.

The advanced version of the J&E soil-vapor model was used to adjust the building footprint area and perimeter crack/seam length for the larger irregularly-shaped on-site buildings.

F.3 MODEL INPUTS

Model input parameters were adjusted to be representative of site-specific conditions and generally included soil-vapor concentrations, soil properties, and building characteristics. Soil-vapor samples were collected and analyzed for VOCs by Method TO-15 and analytical results are summarized in Table 8. All soil-vapor concentrations found to exceed the screening criteria were input into the model as source concentrations. The specific compounds that were considered in the model are: 1,2-DCA, benzene, toluene, ethylbenzene, and total xylene because these were the only compounds which exceeded the screening values. The mid-point of the soil-vapor sample interval was input as the soil-vapor sampling depth. For one instance (SG-10) where the soil-vapor sample depth was shallower than the USEPA default basement depth (about 6.5 ft), a depth of 7.5 feet, equivalent to the sample depth for all other soil-vapor samples modeled was assigned.

During soil-vapor sampling, soil samples were collected adjacent to buildings of concern and submitted to PTS Laboratories of California for analysis of soil physical properties including bulk density, total porosity, water-filled porosity, and soil vapor permeability. Soil laboratory testing data are summarized in Table F1.

Buildings were found to have basements through site inspection and building footprint dimensions were determined through analysis of map data (e.g. aerial photograph and CADD drawings).

PADEP default values were used as input for any required parameters not measured on a site specific basis. The temperature of soil in all J&E soil-vapor simulations was determined to be 11.1°C using the map provided in the USEPA J&E Model User's Guide that provides the mean shallow groundwater temperature across the contiguous United States. The model input parameters are summarized in Table F2.

F.4 MODEL RESULTS

The model-predicted indoor air concentrations were below the indoor air screening criteria for all soil-vapor results that exceeded the soil-vapor screening criteria except for benzene at SG-10 (0.0123 mg/m^3) and SG-11 (0.0476 mg/m^3) associated with the former office building/maintenance building/supply storage. The model results are summarized in Table F2 and model simulation summary sheets are provided as Attachment F1 to this appendix.

The former office building/maintenance building/supply storage is used only for maintenance, supply and storage purposes. A site specific indoor air criteria of 0.126 mg/m^3 was calculated assuming a worker exposure of one hour per day. The calculation is based on the equation and assumptions provided in Table 7 of the PADEP Vapor Intrusion into Buildings Guidance (January 24, 2004) and is summarized in Table F3. The model-predicted indoor air concentrations are below the site specific indoor air criteria for benzene.

Based on the screening and model results, the vapor intrusion pathway at buildings of concern is incomplete.

TABLES

PROJECT NAME: Sunoco Belmont Terminal
PROJECT NO: N/A

		METHODOLOGY:	API RP 40 / ASTM D2216	API RP 40				API RP 40	API RP 40 25.0 PSI CONFINING STRESS
SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENTATION (1)	MOISTURE CONTENT (% wt)	DENSITY BULK (g/cc)	DENSITY GRAIN (g/cc)	POROSITY, %Vb (2) TOTAL	POROSITY, %Vb (2) AIR FILLED	TOTAL PORE FLUID SATURATIONS, % Pv (3)	NATIVE STATE EFFECTIVE PERMEABILITY TO AIR (4) (millidarcy)
BH-SG-10-041505-8-9.2	8.4	V	30.1	1.17	1.93	39.6	2.3	94.1	11.8
BH-SG-9-041505-6-8	7.0	V	15.6	1.70	2.64	35.7	9.3	74.0	6.42
SS-SG-6-041505-8-10	8.8	V	21.0	1.57	2.70	41.8	8.6	79.5	0.193

(1) Sample Orientation: H = horizontal, V = vertical, R = remold; (2) Total Porosity = no pore fluids in place; all interconnected pore channels; Air Filled = pore channels not occupied by pore fluids;
(3) Water = 0.9999 g/cc, Hydrocarbon = 0.7900 g/cc; (4) Air permeability measured at native conditions (as-received) Vb = Bulk Volume, cc; Pv = Pore Volume, cc; ND = Not Detected

Table F2
Input Parameters and Results from Johnson & Ettinger Vapor Intrusion Modeling
AOI - 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

	Non-Residential PADEP Soil Gas and Indoor Air Criteria	Sample ID Sample Depth Interval (ft) Depth Below Foundation (ft)	SG-2 5-10 1	SG-8 5-10 1	SG-10 3-8 1*	SG-11 5-10 1
Depth below grade to enclosed space floor		cm	200 (default)		200 (default)	
Soil gas sampling depth below grade		cm	228.6		228.6	
Average soil temperature		°C	11.1 (default)		11.1 (default)	
Vadose zone soil vapor permeability		cm^2	1.90E-12		1.16E-10	
Vadose zone soil dry bulk density		g/cm^3	1.57		1.17	
Vadose zone soil total porosity		unitless	0.418		0.396	
Vadose zone soil water-filled porosity		unitless	0.332		0.373	
Average vapor flow rate into building		L/minute	Calculated using soil vapor permeability and other inputs			
Basement Floor Slab Thickness		cm	10 (default)		10 (default)	
Basement Length		cm	2683.15		5532.12	
Basement Width		cm	2683.15		5532.12	
Enclosed Space Height		cm	366 (default)		366 (default)	
Floor-wall Seem Crack Width		cm	0.1 (default)		0.1 (default)	
Indoor Air Exchange Rate		1/hr	0.25 (default)		0.25 (default)	
1,2-Dichloroethane						
Soil-Gas Concentration	3.10E-01	Input	NA	NA	540	2200
Model Predicted Indoor Air Concentration	3.10E-03	Output	NA	NA	3.06E-03	1.25E-03
Benzene						
Soil-Gas Concentration	1.10E+00	Input	9	NA	22000	85000
Model Predicted Indoor Air Concentration	1.10E-02	Output	9.04E-07	NA	1.23E-02	4.76E-02
Toluene						
Soil-Gas Concentration	1.20E+02	Input	NA	200	1000	2600
Model Predicted Indoor Air Concentration	1.20E+00	Output	NA	1.96E-05	5.57E-04	1.45E-03
Ethylbenzene						
Soil-Gas Concentration	7.30E+00	Input	NA	NA	NA	150
Model Predicted Indoor Air Concentration	7.30E-02	Output	NA	NA	NA	8.33E-05
Total Xylene						
Soil-Gas Concentration	3.00E+01	Input	NA	NA	65	540
Model Predicted Indoor Air Concentration	3.00E-01	Output	NA	NA	3.62E-05	3.00E-04

NOTES:

All concentrations shown in this table are mg/m^3

All concentrations shown in the modeling sheets are in ug/m^3

= Concentration Exceeds PADEP soil gas criteria

= Concentration Exceeds PADEP indoor air criteria

Model predicted Indoor Air concentrations of benzene at SG-10 and SG-11 are are below the site-specific Indoor Air criteria of 0.125 mg/m^3 derived assuming an exposure of one hr/day at the former office building/maintenance building/supply storage.

* Depth is based on an assumption that the sample depth interval is 7.5 feet.

NA - Not applicable, soil-gas concentration below respective PADEP screening value.

Table F3

Calculation of Site Specific Indoor Air Concentration for Former Office Building/Maintenance Building/Supply Storage
AOI - 1 Site Characterization Report
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Benzene			
TCR	1.00E-05	unitless	target cancer risk
AT_c	25550	days	averaging time, carcinogens (USEPA)
URF	7.80E-06	$1/(ug/m^3)$	unit risk factor (USEPA)
EF	10.4	days/yr	exposure frequency (PADEP non-residential)
ED	25.0	yr	exposure duration (PADEP non-residential)
C_{cancer}	**126.0**	**ug/m3**	**target indoor air concentration**

Note:
Calculation based on equation and assumptions provided in Table 7 PADEP Vapor Intrusion Into Buildings Guidance, January 24, 2004

ATTACHMENT F1

SG-ADV Version 2.0; 02/03

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
108883	2.00E+05			Toluene

MORE

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
200	228.6	11.1	228.9					1.90E-12

MORE

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.57	0.418	0.332								

MORE

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	2683.15	2683.15	366	0.1	0.25	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	28.6	0.086	ERROR	ERROR	#N/A	#N/A	#N/A	1.90E-12	10,733	2.00E+05	1.83E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
9.35E+06	1.15E-04	200	9,143	3.11E-03	1.34E-01	1.76E-04	1.50E-04	0.00E+00	0.00E+00	1.49E-04	28.6

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	2.00E+05	0.10	3.52E-03	1.50E-04	1.07E+03	1.24E+00	9.81E-08	1.96E-02	NA	4.0E-01

END

SG-ADV Version 2.0; 02/03

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
71432	9.00E+03			Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
200	228.6	11.1	228.6					1.90E-12

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.57	0.418	0.332								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	2683.15	2683.15	366	0.1	0.25	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	28.6	0.086	ERROR	ERROR	#N/A	#N/A	#N/A	1.90E-12	10,733	9.00E+03	1.83E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
9.35E+06	1.15E-04	200	8,111	2.83E-03	1.22E-01	1.76E-04	1.54E-04	0.00E+00	0.00E+00	1.54E-04	28.6

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	9.00E+03	0.10	3.52E-03	1.54E-04	1.07E+03	1.24E+00	1.00E-07	9.04E-04	7.8E-06	NA

END

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Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
107062	5.40E+08			1,2-Dichloroethane

MORE

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
200	228.6	11.1	228.6	0	0			1.16E-10

MORE

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.17	0.396	0.373								

MORE

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5532.12	5532.12	366	0.1	0.25	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	28.6	0.023	ERROR	ERROR	#N/A	#N/A	#N/A	1.16E-10	22,128	5.40E+08	7.78E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
3.50E+07	6.32E-05	200	8,510	4.84E-04	2.07E-02	1.76E-04	1.16E-04	0.00E+00	0.00E+00	1.16E-04	28.6

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	5.40E+08	0.10	4.43E-01	1.16E-04	2.21E+03	2.89E+07	5.67E-07	3.06E+02	2.6E-05	NA

END

SG-ADV Version 2.0; 02/03

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
71432	2.20E+07			Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
200	228.6	11.1	228.6	0	0			1.16E-10

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.17	0.396	0.373								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5532.12	5532.12	366	0.1	0.25	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)
70	30	30	255	2.9E-05

END

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	28.6	0.023	ERROR	ERROR	#N/A	#N/A	#N/A	1.16E-10	22,128	2.20E+07	7.78E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
3.50E+07	6.32E-05	200	8,111	2.83E-03	1.22E-01	1.76E-04	2.12E-05	0.00E+00	0.00E+00	2.12E-05	28.6

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	2.20E+07	0.10	4.43E-01	2.12E-05	2.21E+03	7.80E+40	5.59E-07	1.23E+01	7.8E-06	NA

END

SG-ADV Version 2.0; 02/03

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
108883	1.00E+06			Toluene

MORE

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
200	228.6	11.1	228.6	0	0			1.16E-10

MORE

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.17	0.396	0.373								

MORE

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5532.12	5532.12	366	0.1	0.25	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	28.6	0.023	ERROR	ERROR	#N/A	#N/A	#N/A	1.16E-10	22,128	1.00E+06	7.78E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
3.50E+07	6.32E-05	200	9,143	3.11E-03	1.34E-01	1.76E-04	1.73E-05	0.00E+00	0.00E+00	1.73E-05	28.6

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	1.00E+06	0.10	4.43E-01	1.73E-05	2.21E+03	1.25E+50	5.57E-07	5.57E-01	NA	4.0E-01

END

SG-ADV Version 2.0; 02/03

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
106423	6.50E+04			p-Xylene

MORE

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
200	228.6	11.1	228.6	0	0			1.16E-10

MORE

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.17	0.396	0.373								

MORE

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5532.12	5532.12	366	0.1	0.25	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	28.6	0.023	ERROR	ERROR	#N/A	#N/A	#N/A	1.16E-10	22,128	6.50E+04	7.78E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
3.50E+07	6.32E-05	200	10,236	3.28E-03	1.41E-01	1.76E-04	1.61E-05	0.00E+00	0.00E+00	1.61E-05	28.6

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	6.50E+04	0.10	4.43E-01	1.61E-05	2.21E+03	1.30E+54	5.56E-07	3.62E-02	NA	7.0E+00

END

SG-ADV Version 2.0; 02/03

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
107062	2.20E+06			1,2-Dichloroethane

MORE

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
200	228.6	11.1	228.6	0	0			1.16E-10

MORE

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.17	0.396	0.373								

MORE

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5532.12	5532.12	366	0.1	0.25	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	28.6	0.023	ERROR	ERROR	#N/A	#N/A	#N/A	1.16E-10	22,128	2.20E+06	7.78E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
3.50E+07	6.32E-05	200	8,510	4.84E-04	2.07E-02	1.76E-04	1.16E-04	0.00E+00	0.00E+00	1.16E-04	28.6

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	2.20E+06	0.10	4.43E-01	1.16E-04	2.21E+03	2.89E+07	5.67E-07	1.25E+00	2.6E-05	NA

END

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Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
71432	8.50E+07			Benzene

MORE

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
200	228.6	11.1	228.6	0	0			1.16E-10

MORE

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.17	0.396	0.373								

MORE

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5532.12	5532.12	366	0.1	0.25	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	28.6	0.023	ERROR	ERROR	#N/A	#N/A	#N/A	1.16E-10	22,128	8.50E+07	7.78E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
3.50E+07	6.32E-05	200	8,111	2.83E-03	1.22E-01	1.76E-04	2.12E-05	0.00E+00	0.00E+00	2.12E-05	28.6

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	8.50E+07	0.10	4.43E-01	2.12E-05	2.21E+03	7.80E+40	5.59E-07	4.76E+01	7.8E-06	NA

END

SG-ADV Version 2.0; 02/03

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
100414	1.50E+05			Ethylbenzene

MORE

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
200	228.6	11.1	228.6	0	0			1.16E-10

MORE

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.17	0.396	0.373								

MORE

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5532.12	5532.12	366	0.1	0.25	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	28.6	0.023	ERROR	ERROR	#N/A	#N/A	#N/A	1.16E-10	22,128	1.50E+05	7.78E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
3.50E+07	6.32E-05	200	10,143	3.40E-03	1.46E-01	1.76E-04	1.45E-05	0.00E+00	0.00E+00	1.45E-05	28.6

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	1.50E+05	0.10	4.43E-01	1.45E-05	2.21E+03	1.24E+60	5.55E-07	8.33E-02	1.1E-06	1.0E+00

END

DATA ENTRY SHEET

SG-ADV
Version 2.0; 02/03

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
108883	2.60E+06			Toluene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
200	228.6	11.1	228.6	0	0			1.16E-10

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.17	0.396	0.373								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5532.12	5532.12	366	0.1	0.25	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

DATA ENTRY SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	28.6	0.023	ERROR	ERROR	#N/A	#N/A	#N/A	1.16E-10	22,128	2.60E+06	7.78E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
3.50E+07	6.32E-05	200	9,143	3.11E-03	1.34E-01	1.76E-04	1.73E-05	0.00E+00	0.00E+00	1.73E-05	28.6

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	2.60E+06	0.10	4.43E-01	1.73E-05	2.21E+03	1.25E+50	5.57E-07	1.45E+00	NA	4.0E-01

END

SG-ADV
Version 2.0; 02/03

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
106423	5.40E+05			p-Xylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
200	228.6	11.1	228.6	0	0			1.16E-10

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.17	0.396	0.373								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5532.12	5532.12	366	0.1	0.25	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
9.46E+08	28.6	0.023	ERROR	ERROR	#N/A	#N/A	#N/A	1.16E-10	22,128	5.40E+05	7.78E+05

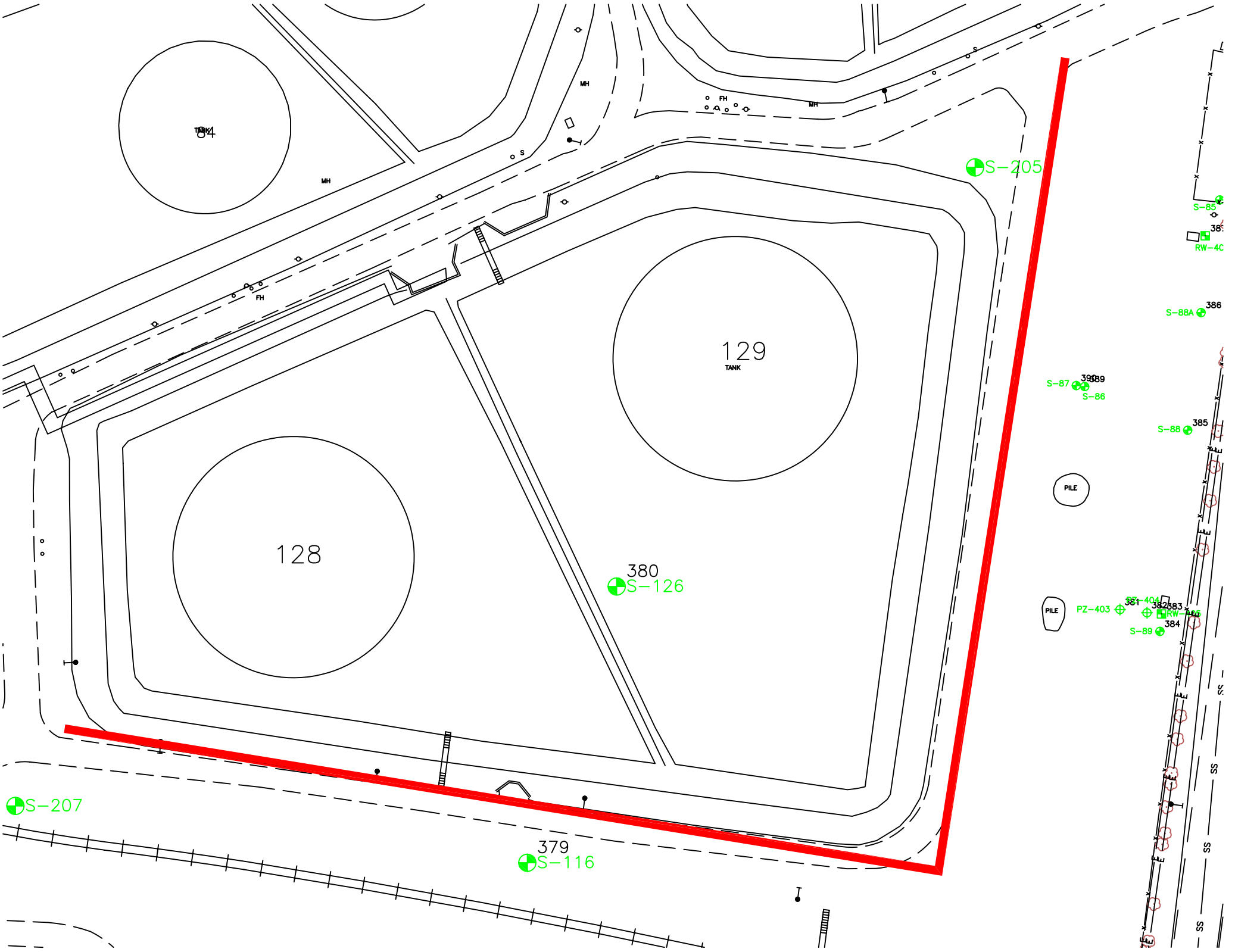
Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
3.50E+07	6.32E-05	200	10,236	3.28E-03	1.41E-01	1.76E-04	1.61E-05	0.00E+00	0.00E+00	1.61E-05	28.6

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	5.40E+05	0.10	4.43E-01	1.61E-05	2.21E+03	1.30E+54	5.56E-07	3.00E-01	NA	7.0E+00

END

APPENDIX G

GROUNDWATER MOUNDING INVESTIGATION SUPPORT INFORMATION


84
TANK
MH
FH
S
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TANK
128
380
S-126
379
S-116
S-205
S-207
S-85
RW-4C
386
S-88A
S-87
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S-88
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PZ-403
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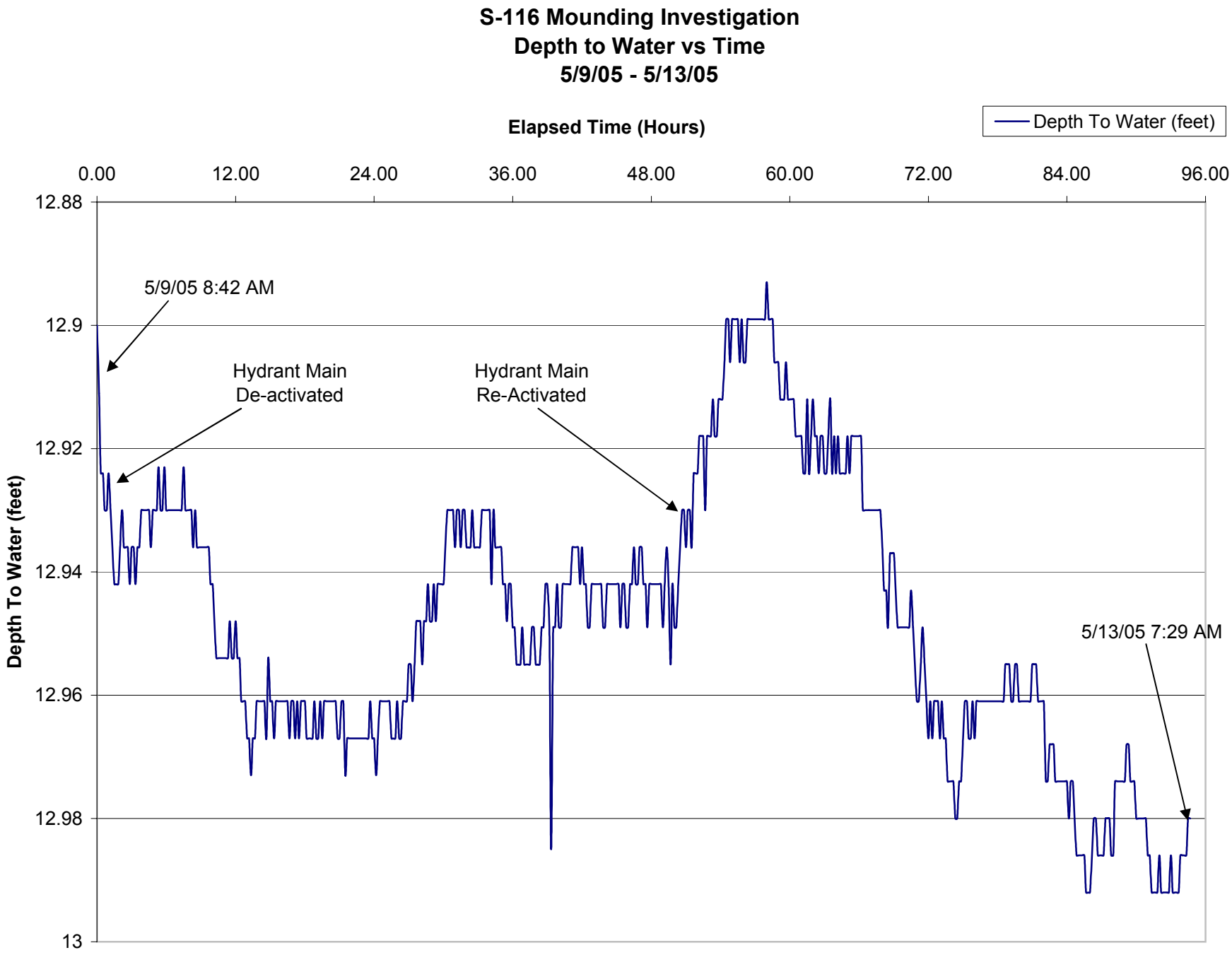
S-89
PILE
SS


S-116 Mounding Investigation
Depth to Water vs Time
5/9/05 - 5/13/05
Elapsed Time (Hours)
Depth To Water (feet)
0.00
12.00
24.00
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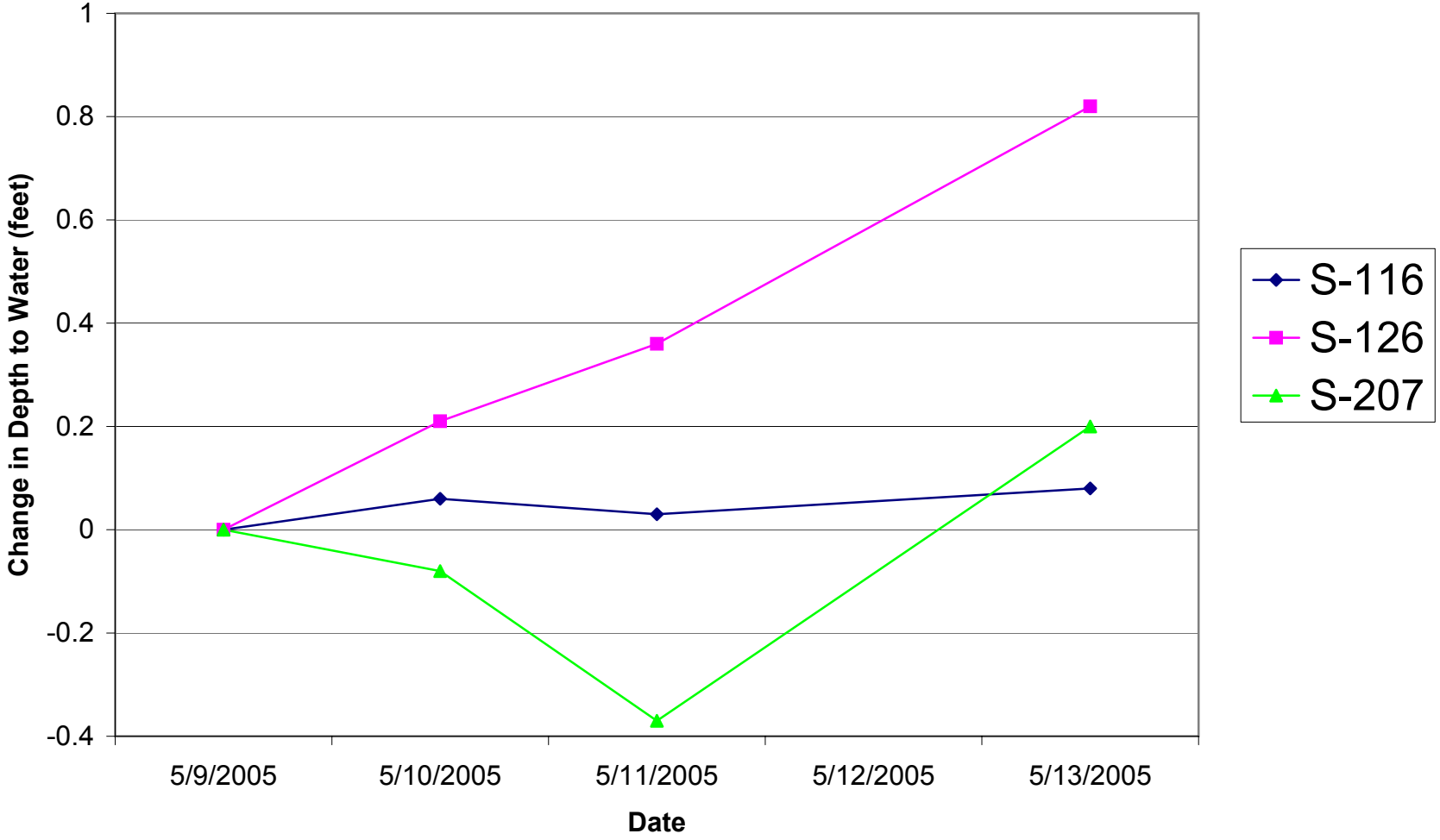
48.00
60.00
72.00
84.00
96.00
12.88
12.9
12.92
12.94
12.96
12.98
13
Depth To Water (feet)
5/9/05 8:42 AM
Hydrant Main
De-activated
Hydrant Main
Re-Activated
5/13/05 7:29 AM

Sunoco - Philadelphia Refinery
Depth to Water (feet) Change vs. Time
5/9/05 - 5/13/05



APPENDIX H

FATE AND TRANSPORT MODELING PROCEDURES

APPENDIX H
FATE AND TRANSPORT MODELING PROCEDURES
AOI 1: SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

H.1 INTRODUCTION

Fate and transport calculations were completed for groundwater in AOI 1 to evaluate potential migration pathways/potential impacts to receptors and to support development of the Site Conceptual Model. The Quick Domenico (QD - v2.0) spreadsheet model, developed by the PADEP, and site-specific data were used to complete the fate and transport calculations.

H.2 MODEL OVERVIEW

The QD Model is a Microsoft Excel spreadsheet application 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 model incorporates the processes of advection, first order decay, retardation, and dispersion to describe fate and transport of compounds. In addition, the QD model displays the results as a two dimensional chart to facilitate interpretation of the results.

H.3 MODEL LIMITATIONS

Limitations of the QD model 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.

H.4 MODEL INPUT PARAMETERS

In preparation of this report, input values for the QD model were compiled from available site data. When no site data was available, estimated input values from the PA Code, Chapter 250, Appendix A, Table 5 or other acceptable literature source were utilized. The input parameters are discussed in greater detail in the sections that follow, and are summarized in the input tables preceding each model sheet in this appendix.

H.4.1 Source Concentration

Using the most-recent groundwater quality data, COC concentrations at selected wells were used as the source value. Table 5 and Figures 8 and 9 present a summary of the COC data used for the fate and transport modeling.

H.4.2 Distance to Location of Concern (x)

The distance to the location of concern (x) is the distance along the plume centerline from the source to a point where a concentration is desired. For AOI 1 fate and transport calculations, "x" was chosen to represent the distance from the monitoring well to the downgradient property boundary. Selection of this distance does not affect the model calculations, only the way the output is displayed in the QD graphs.

H.4.3 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 very small number (0.001) unless vertical monitoring can reliably justify a larger number. Additionally, a value of 0.0001 is suggested for uncalibrated or conceptual applications).

For the fate and transport modeling in AOI 1, the dispersivity values were estimated using the above relationships. Typically, X is the distance a contaminant has traveled by advective transport. For conservative estimates in the QD modeling for the site, the distance to the point of concern (site boundary) was chosen as X, and values for A_y were estimated to be 10 percent of A_x. In all cases, a value of 0.001 was used as a value for A_z.

H.4.4 Lambda

Lambda is the first order decay constant. It is determined by dividing 0.693 by the half-life of the compound (in days). 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, then 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, default values for lambda were obtained from the list of lambda values in PA Code, Chapter 250, Appendix A, Table 5. Sunoco will continue to evaluate site data as investigations of the AOIs proceed to determine if site specific lambdas can be calculated for other areas of the refinery.

H.4.5 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 contaminated soils below the water table that contribute contamination to groundwater. In addition to the saturated zone, fluctuation in groundwater elevation may create a smear zone in the unsaturated portion of an aquifer. As an estimate of the thickness of the smear zone, average fluctuation can be used.

H.4.6 Hydraulic Conductivity (k)

The hydraulic conductivity of a geologic material is a measure of its ability to transmit water. No aquifer testing was performed in AOI 1 since sufficient aquifer testing data was available from former aquifer tests (pumping tests, recovery tests, and slug tests) performed in AOI 1 by others (SECOR, 2003; USGS, 2001; URS, 2002; Chevron USA, Inc., 1992; USGS, 1988). The hydraulic conductivity value used in AOI 1 for fate and transport modeling of the Fill/Alluvium and Trenton Gravel (Intermediate Wells) was 24 feet/day. This value is representative of the geometric mean of hydraulic conductivity values calculated using recovery data in Well RW-406 by SECOR in 2003 (SECOR, 2003), and appears to be most representative of the Trenton Gravel.

H.4.7 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. The hydraulic gradient used in the fate and transport modeling in AOI 1 was calculated using groundwater elevation data from Handex's May 2005 groundwater gauging data.

H.4.8 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 1 were based on historical geotechnical analysis.

H.4.9 Soil Bulk Density (p_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

$$P_b = 2.65 * (1 - \text{porosity}).$$

Soil bulk density values used in the fate and transport modeling were based on historical geotechnical analysis.

H.4.10 Organic Carbon Partition Coefficient (K_{OC})

The organic carbon partition coefficient is chemical specific and is provided in PA Code, Chapter 250, Appendix A, Table 5. These values were used in the fate and transport modeling.

H.4.11 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.

H.4.12 Plume Coordinates ('y' and 'z')

The plume coordinates, 'y' and 'z', define the horizontal and vertical extent of the impacted area, respectfully. For a solution on the centerline of the plume down gradient from the source, 'y' was set equal to zero. Additionally, to yield the highest concentration, which is located at the water table, 'z' was also set equal to zero.

H.4.13 Time (t)

'Time zero' is the point at which contamination was introduced into the aquifer. Time since 'time zero' is measured in days. A specific simulation time was chosen for each well based on the groundwater conditions expressed in Figure 12 of the report. Specifically, groundwater in the zone of capture in the northern portion of AOI 1 was modeled using a time of 4 months. This time period is representative of the routine system shutdown period (system is shutdown between December and March of each year). All other groundwater was modeled using a simulation time of 30 years.

H.4.14 Grid Dimensions

The grid dimensions form the window through which the plume is viewed and the locations where concentrations are calculated. The grid is determined by user specified length and width measurements from the source of the plume. Because plume dimensions and source concentrations varied greatly across the Facility, the grid dimensions selected for the fate and transport calculations were selected individually for each source (well) and compound.

H.5 OUTPUT DATA AND RESULTS

The results of the QD Fate and Transport modeling task were used to predict potential impacts to down-gradient receptors. The results were also used to predict potential distance and time for contaminant concentrations to attain the MSCs. Copies of all QD model simulation spreadsheets are included at the end of this appendix. A summary of input values and output results are also provided in this Appendix and illustrated in Figure 13 of the report.

H.6 ADDITIONAL MODELING IN AOI 1

A numerical groundwater flow model (model) was utilized to evaluate the groundwater recovery systems located along 26th Street and within the Belmont Terminal. The model has incorporated in it the pumping schedules of the existing recovery wells, which are used in the simulation.

H.6.1 Modeling Tools

The model was created using the United States Department of Defense's Groundwater Modeling System (GMS) version 5.0. The computer code used for calculating groundwater elevation was the United States Geological Survey's (USGS) Modular Finite-Difference Ground-Water Flow Model 2000 (MODFLOW 2000). The computer code used for calculating mass transport of a theoretical, conservative, tracer was Mass Transport in Three-Dimension with Multiple Species (MT3DMS) by Zheng, and Wang, 1999. All of these models are commonly used for numerical modeling of groundwater flow and transport simulations.

H.6.2 Model Construction

H.6.2.1 Model Grid Description

The model grid represents the Trenton Gravel and overlying fill and alluvium as a single layer, which was consistent with site lithology and hydrological data. The model grid consists of 70 columns and 188 rows. The model grid is 4,600 ft in length west to east and 3,400 ft in length north to south. The top of the model grid represents the ground surface and is 20 feet above mean sea level (amsl). The bottom of the model grid represents the top of the Lower/Middle Clay and is -30 ft amsl.

The model grid consists of 31, 960 cells that change in dimension from 100 ft by 100 ft at the edges of the model grid, to 10 ft by 10 ft where recovery wells are represented. Use of a refined grid in the vicinity of the remedial systems provided increased resolution at the most important points in the model.

H.6.2.2 Model Boundary Description

The model boundaries consist of constant hydraulic heads along the west and east sides, and hydraulic no-flow boundaries along the north and south sides and across the bottom of the model grid. The top of the model is unbounded. The constant hydraulic

head across the west boundary of the model is 13 ft amsl. The constant hydraulic head along the east boundary of the model is -3.0 ft amsl. The ambient hydraulic gradient over the entire model is 0.00347. Use of these boundary conditions and hydraulic gradient agree with the data presented in the Current Conditions Report.

H.6.2.3 Water Bearing Unit Parameters

The hydraulic conductivity of the fill/Trenton gravel unit was assigned a value of 12 ft/d and a porosity of value of 0.35. This value is representative of the geometric mean of hydraulic conductivity values calculated using aquifer test data (rising head slug tests and pumping tests) in 26th Street area wells gathered by SECOR in 2003 (SECOR, 2003). Using this value of hydraulic conductivity, the pieziometric surface calculated by the numerical model (i.e., zones of drawdown) are more consistent with actual zones of drawdown based on site-specific measurements.

H.6.2.4 AOI 1 Recovery System

The current recovery well system consists of 30 wells screened in the Trenton Gravel (Figures H-1 through H-4). Ten of the recovery wells are located within the Belmont Terminal. The recovery wells in Belmont Terminal pump at a constant rate of 385 ft^3/day (2.0 gallons per minute). The remaining twenty recovery wells are located along 26th Street and also pump at a rate 385 ft^3/day (2.0 gallons per minute), however, for four consecutive months of the year they are shut down during winter months.

To gauge the effect(s) of the annual shutdown of the 26th Street recovery system on the distribution of impacted groundwater, a MODFLOW model was constructed to simulate groundwater flow. Once the MODFLOW model was calibrated, the flow information was used in conjunction with chemical fate and transport data in a mass transport simulation using MT3DMS. A very conservative approach was utilized to develop the inputs to the model. The model simulations applied a concentration of 1,000 mg/L within all areas containing LNAPL, and did not include dispersion, degradation or sorption effects. The model was then set to run individual time steps for a 30 year period. The model outputs are time = 0 months, 8 months, 12 months and 30 year simulations, and are shown in Figures H-1 through H-4, respectively.

H.6.3 Simulation Results

The results of the modeling indicate that the current pumping system captures all dissolved phase concentrations that would migrate downgradient from the site except in a very limited area in the vicinity of S-194. The modeling indicates that concentrations in the vicinity of S-194 will not migrate more than 100 feet from the wells as supported by downgradient data from S-197. The model also indicates that, while the upgradient portion of the dissolved plume in the vicinity of MW-34 will not be captured by the remedial system in Belmont Terminal, the downgradient portion of the plume is under control and it will not migrate beyond the area shown in Figure H-4.

H.6.4 Conclusion

Based on the results of the modeling, the current recovery well system in AOI 1 may not control all of the migration of impacted groundwater in AOI 1.

With regard to migration of impacted groundwater along 26th Street, by shutting down the 26th Street system for four consecutive months during the winter months, impacted groundwater does not move beyond the system's zone of recovery when the system is restarted.

FATE AND TRANSPORT MODELS

(4 MONTH PROJECTIONS)

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-84
Sample Date			4/19/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	51

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.0720
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	0.42
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 4-months)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	7.13E-02	1	14
Sim 2 - Naphthalene	0.1	0.1	2.23E-01	1	1.5

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

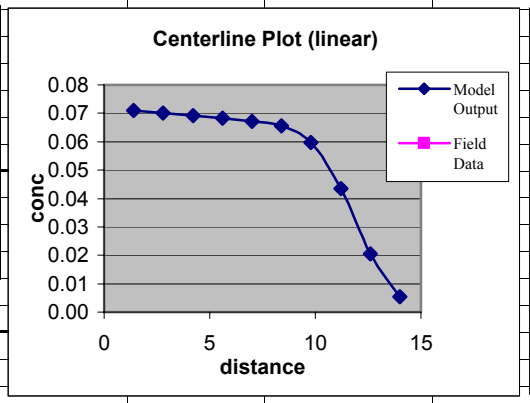
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
0	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	120

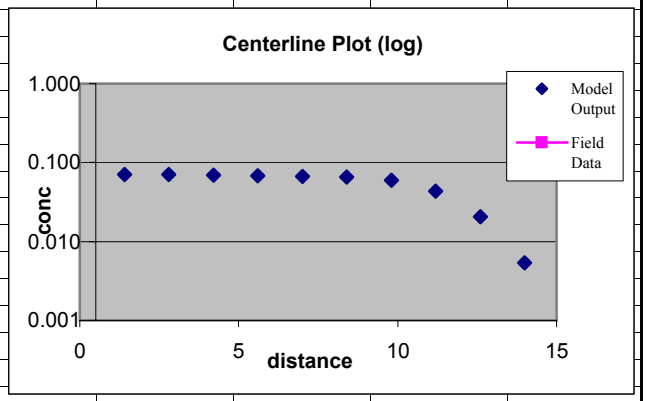
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	0.071 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	14
	Width (ft)	51

	1.4	2.8	4.2	5.6	7	8.4	9.8	11.2	12.6	14
51	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000
25.5	0.071	0.070	0.069	0.068	0.067	0.066	0.060	0.043	0.021	0.005
0	0.071	0.070	0.069	0.068	0.067	0.066	0.060	0.043	0.021	0.005
-25.5	0.071	0.070	0.069	0.068	0.067	0.066	0.060	0.043	0.021	0.005
-51	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

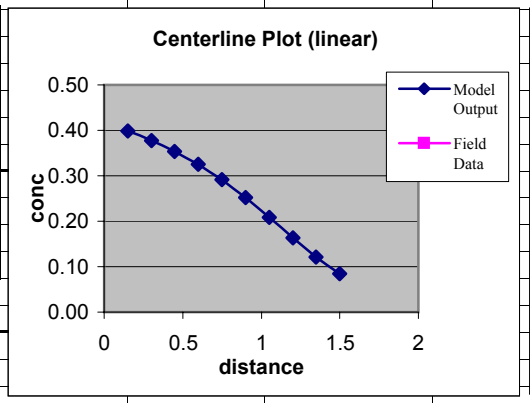
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	1.00E-01	1.00E-02	1.00E-04	0.00268493	100	15	120

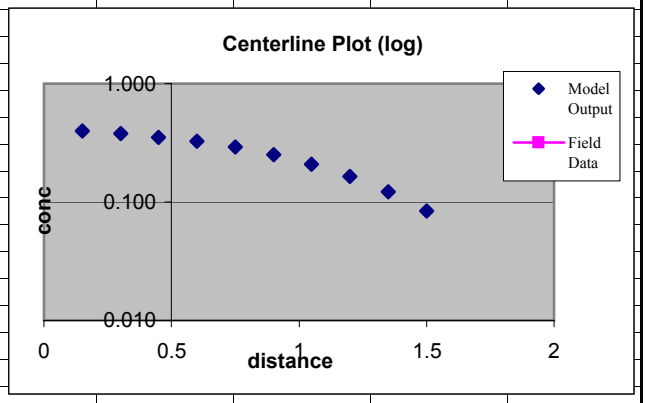
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	0.223 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	1.5
Width (ft)	51

	0.15	0.3	0.45	0.6	0.75	0.9	1.05	1.2	1.35	1.5
51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25.5	0.399	0.378	0.354	0.325	0.291	0.252	0.208	0.164	0.121	0.084
0	0.399	0.378	0.354	0.325	0.291	0.252	0.208	0.164	0.121	0.084
-25.5	0.399	0.378	0.354	0.325	0.291	0.252	0.208	0.164	0.121	0.084
-51	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									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-84P
Sample Date			4/19/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	51

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.0720
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	0.42
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 4-months)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	7.13E-02	1	14
Sim 2 - Naphthalene	0.1	0.1	2.23E-01	1	1.5

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

NEW QUICK_DOMENICO.XLS

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Modified to Include Retardation

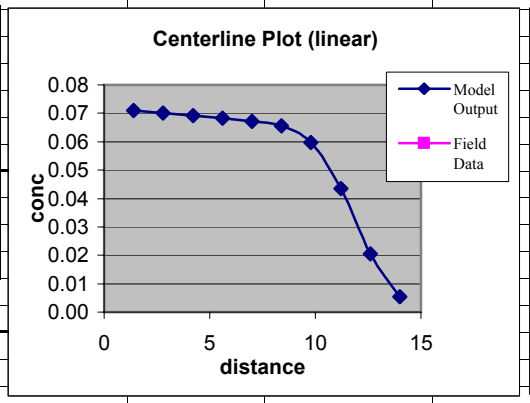
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
0	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	120

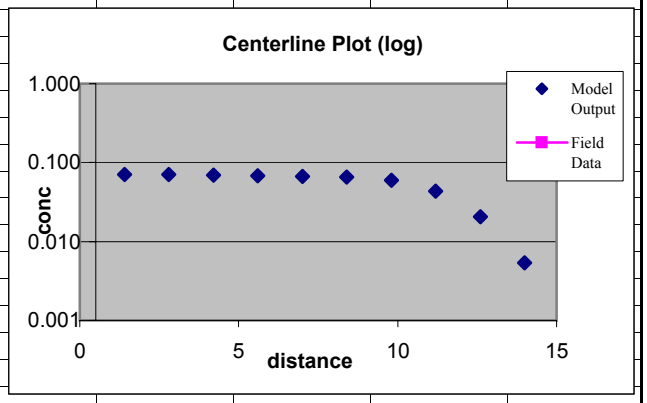
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	0.071 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 14
Width (ft) 51

	1.4	2.8	4.2	5.6	7	8.4	9.8	11.2	12.6	14
51	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000
25.5	0.071	0.070	0.069	0.068	0.067	0.066	0.060	0.043	0.021	0.005
0	0.071	0.070	0.069	0.068	0.067	0.066	0.060	0.043	0.021	0.005
-25.5	0.071	0.070	0.069	0.068	0.067	0.066	0.060	0.043	0.021	0.005
-51	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

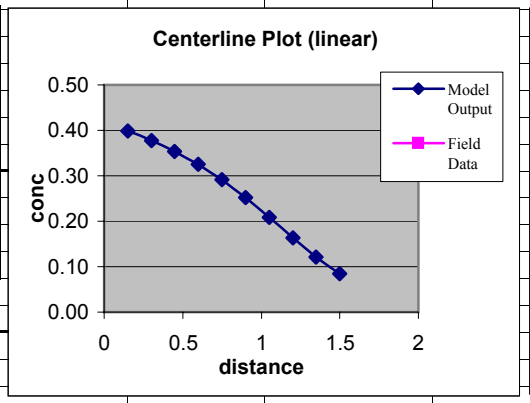
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
0	1.00E-01	1.00E-02	1.00E-04	0.00268493	100	15	120

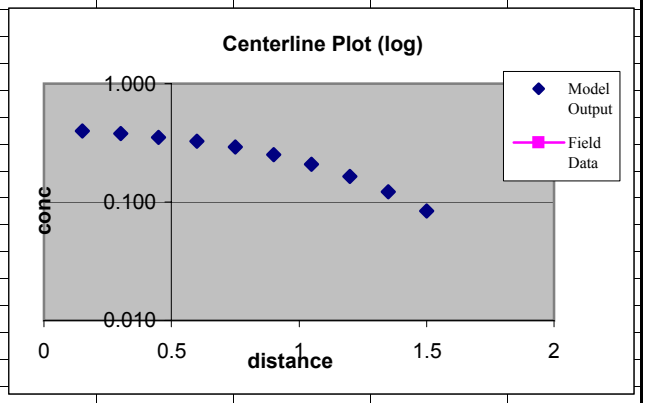
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	
			0.223
			mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	1.5
Width (ft)	51

	0.15	0.3	0.45	0.6	0.75	0.9	1.05	1.2	1.35	1.5
51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25.5	0.399	0.378	0.354	0.325	0.291	0.252	0.208	0.164	0.121	0.084
0	0.399	0.378	0.354	0.325	0.291	0.252	0.208	0.164	0.121	0.084
-25.5	0.399	0.378	0.354	0.325	0.291	0.252	0.208	0.164	0.121	0.084
-51	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	

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-88
Sample Date			4/21/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	51.1

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.0280
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	0.59
Lambda (per day)		day^{-1}	0.00189863
KOC			12
Sim 3			
Contaminant			Chrysene
Source Concentration (mg/l)		mg/l	0.018
Lambda (per day)		day^{-1}	0.000345205
KOC			490000

Output (Concentration at the Downgradient Property Boundary in 4-months)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	2.77E-02	1	13.1
Sim 2 - MTBE	0.02	0.02	5.84E-01	1	25.9
Sim 3 - Chrysene	0.0019	0.0019	0.00E+00	1	0.04

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

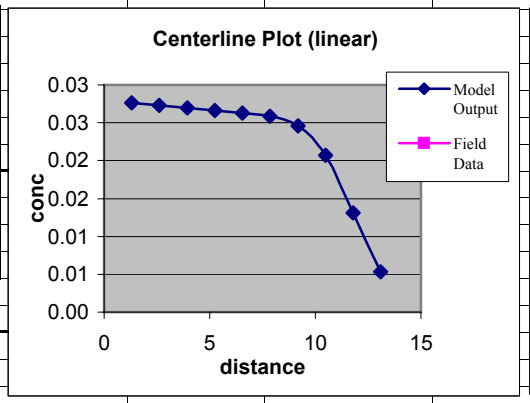
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
0	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	120

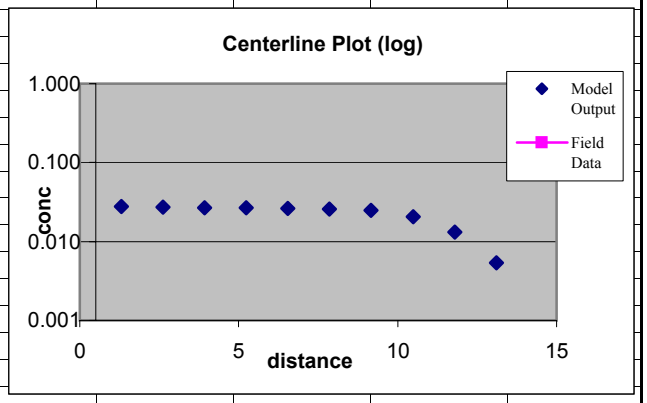
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	0.028 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	13.1
	Width (ft)	51.1

	1.31	*2.62*	*3.93*	*5.24*	*6.55*	*7.86*	*9.17*	*10.48*	*11.79*	*13.1*
51.1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25.55	0.028	0.027	0.027	0.027	0.026	0.026	0.025	0.021	0.013	0.005
0	0.028	0.027	0.027	0.027	0.026	0.026	0.025	0.021	0.013	0.005
-25.55	0.028	0.027	0.027	0.027	0.026	0.026	0.025	0.021	0.013	0.005
-51.1	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

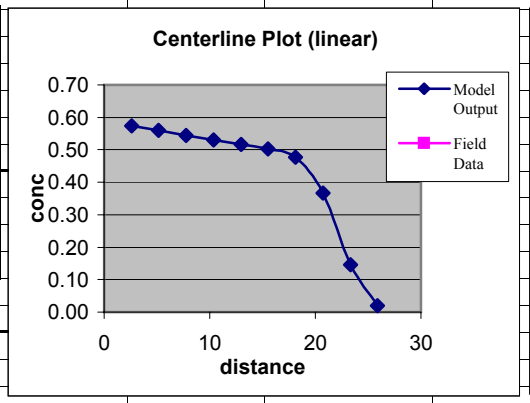
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
1	1.00E-01	1.00E-02	1.00E-04	0.00189863	100	15	120

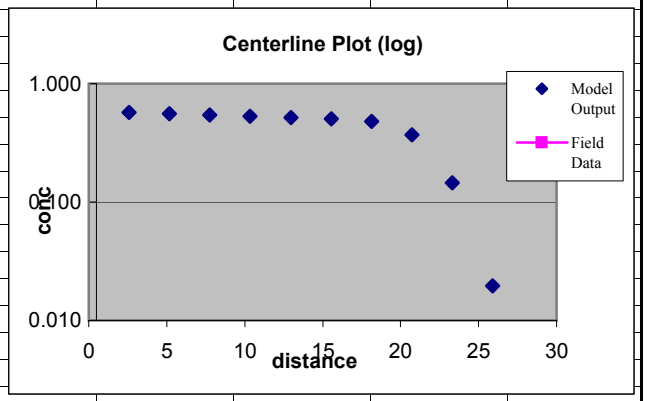
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	0.584 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	25.9
	Width (ft)	51.1

	2.59	5.18	7.77	10.36	12.95	15.54	18.13	20.72	23.31	25.9
51.1	0.000	0.000	0.001	0.004	0.008	0.012	0.016	0.016	0.008	0.001
25.55	0.575	0.560	0.545	0.531	0.517	0.503	0.478	0.368	0.145	0.019
0	0.575	0.560	0.545	0.531	0.517	0.503	0.478	0.368	0.145	0.019
-25.55	0.575	0.560	0.545	0.531	0.517	0.503	0.478	0.368	0.145	0.019
-51.1	0.000	0.000	0.001	0.004	0.008	0.012	0.016	0.016	0.008	0.001

Field Data:	Centerline C	Concentration
	Distance from Source	

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Chrysene

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

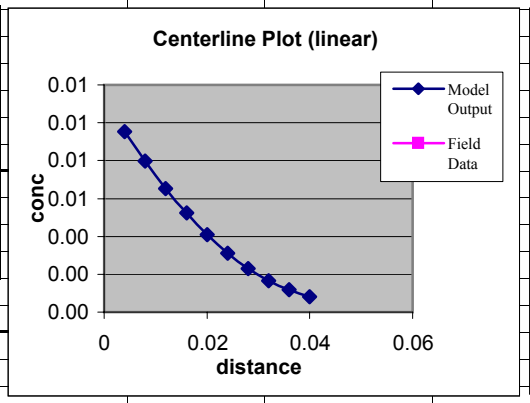
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
0	1.00E-01	1.00E-02	1.00E-04	0.00034521	100	15	120

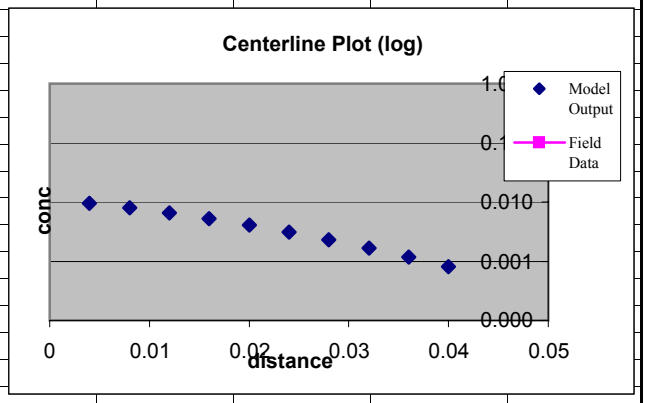
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	490000	5.00E-03	12058.5	1.9903E-05

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 0.04
Width (ft) 51.1

	0.004	0.008	0.012	0.016	0.02	0.024	0.028	0.032	0.036	0.04
51.1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25.55	0.010	0.008	0.007	0.005	0.004	0.003	0.002	0.002	0.001	0.001
0	0.010	0.008	0.007	0.005	0.004	0.003	0.002	0.002	0.001	0.001
-25.55	0.010	0.008	0.007	0.005	0.004	0.003	0.002	0.002	0.001	0.001
-51.1	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

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-125
Sample Date			4/19/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	52

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	17.0000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	11
Lambda (per day)		day^{-1}	0.00189863
KOC			12
Sim 3			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	0.16
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 4-months)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	1.68E+01	1	17.2
Sim 2 - MTBE	0.02	0.02	1.09E+01	1	28.3
Sim 3 - Naphthalene	0.1	0.1	8.49E-02	1	0.86

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

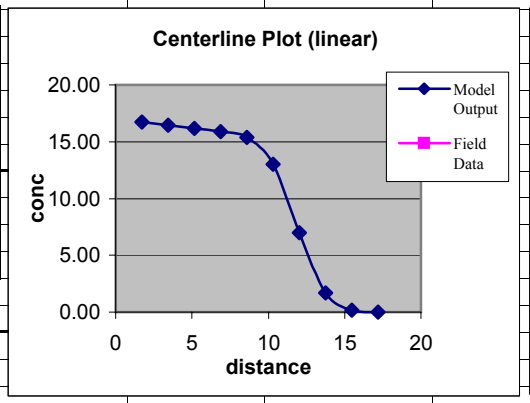
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001				
17	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	120

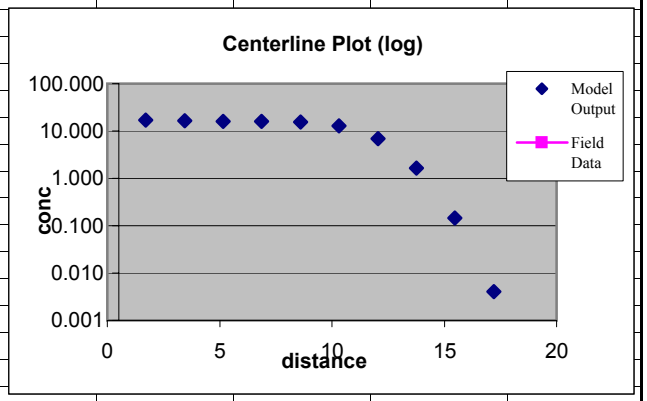
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	16.836 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	17.2
	Width (ft)	52

	1.72	*3.44*	*5.16*	*6.88*	*8.6*	*10.32*	*12.04*	*13.76*	*15.48*	*17.2*
52	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	16.719	16.443	16.171	15.895	15.385	13.009	6.971	1.669	0.144	0.004
0	16.719	16.443	16.171	15.895	15.385	13.009	6.971	1.669	0.144	0.004
-26	16.719	16.443	16.171	15.895	15.385	13.009	6.971	1.669	0.144	0.004
-52	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

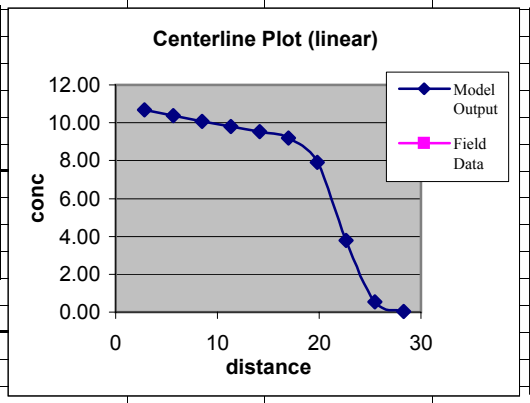
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
11	1.00E-01	1.00E-02	1.00E-04	0.00189863	100	15	120

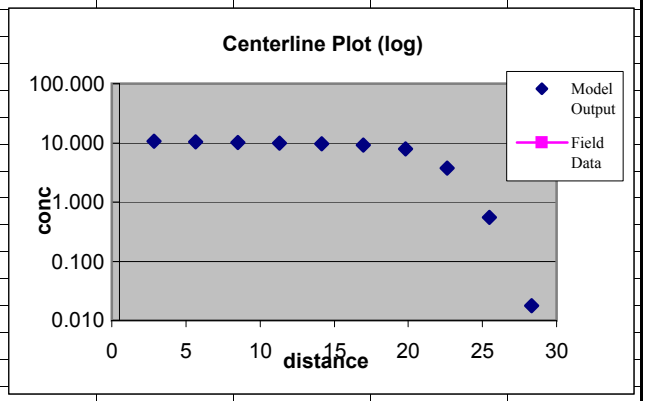
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	10.888 mg/l





	AREAL MODEL	CALCULATION DOMAIN								
	Length (ft)	28.3								
	Width (ft)	52								
	2.83	*5.66*	*8.49*	*11.32*	*14.15*	*16.98*	*19.81*	*22.64*	*25.47*	*28.3*
52	0.000	0.000	0.000	0.000	0.001	0.003	0.006	0.006	0.001	0.000
26	10.686	10.381	10.084	9.796	9.516	9.190	7.897	3.771	0.552	0.018
0	10.686	10.381	10.084	9.796	9.516	9.190	7.897	3.771	0.552	0.018
-26	10.686	10.381	10.084	9.796	9.516	9.190	7.897	3.771	0.552	0.018
-52	0.000	0.000	0.000	0.000	0.001	0.003	0.006	0.006	0.001	0.000
Field Data:	Centerline C	Concentration								
	Distance from Source									

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

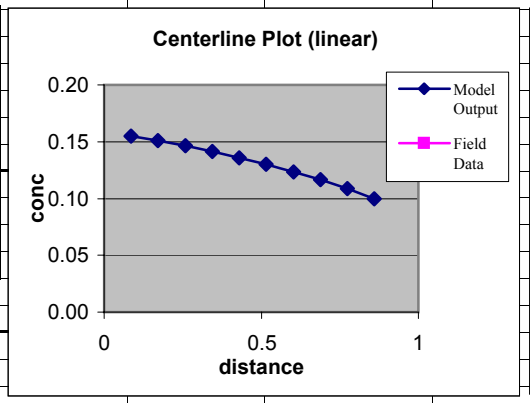
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	1.00E-01	1.00E-02	1.00E-04	0.00268493	100	15	120

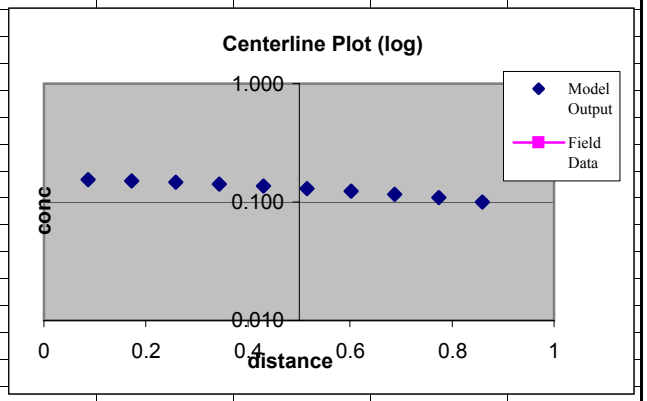
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	**0.085** mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	0.86
	Width (ft)	52

	0.086	0.172	0.258	0.344	0.43	0.516	0.602	0.688	0.774	0.86
52	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	0.155	0.151	0.146	0.141	0.136	0.130	0.124	0.116	0.109	0.100
0	0.155	0.151	0.146	0.141	0.136	0.130	0.124	0.116	0.109	0.100
-26	0.155	0.151	0.146	0.141	0.136	0.130	0.124	0.116	0.109	0.100
-52	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	

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-181
Sample Date			4/19/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	51

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.4600
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	0.24
Lambda (per day)		day^{-1}	0.00189863
KOC			12

Output (Concentration at the Downgradient Property Boundary in 4-months)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	4.56E-01	1	15.4
Sim 2 - MTBE	0.02	0.02	2.38E-01	1	24.9

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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 day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	120

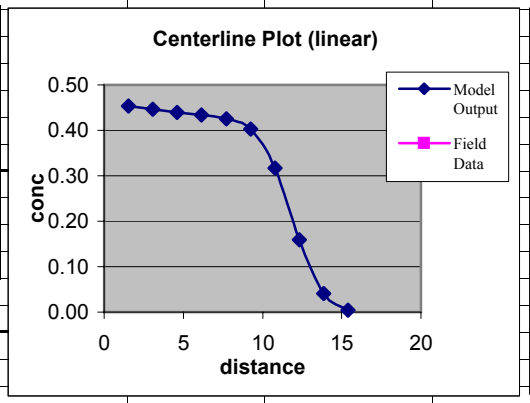
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

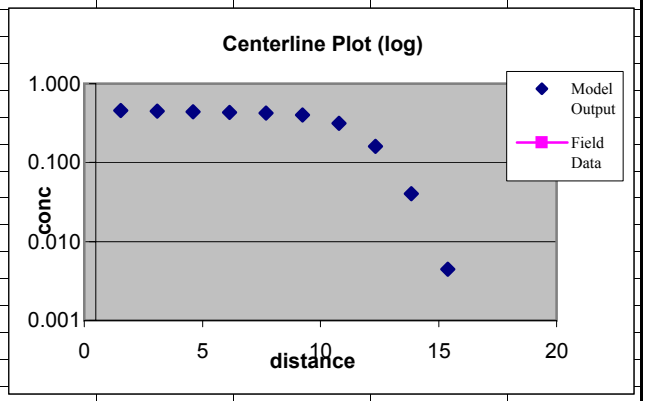
Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	

0.456 mg/l





AREAL MODEL DOMAIN	CALCULATION
Length (ft)	15.4
Width (ft)	51

	1.54	3.08	4.62	6.16	7.7	9.24	10.78	12.32	13.86	15.4
51	0.000	0.000	0.000	0.001	0.002	0.004	0.005	0.003	0.001	0.000
25.5	0.453	0.446	0.440	0.433	0.426	0.403	0.317	0.159	0.040	0.004
0	0.453	0.446	0.440	0.433	0.426	0.403	0.317	0.159	0.040	0.004
-25.5	0.453	0.446	0.440	0.433	0.426	0.403	0.317	0.159	0.040	0.004
-51	0.000	0.000	0.000	0.001	0.002	0.004	0.005	0.003	0.001	0.000

Field Data:	Centerline C	Concentration
	Distance from Source	

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

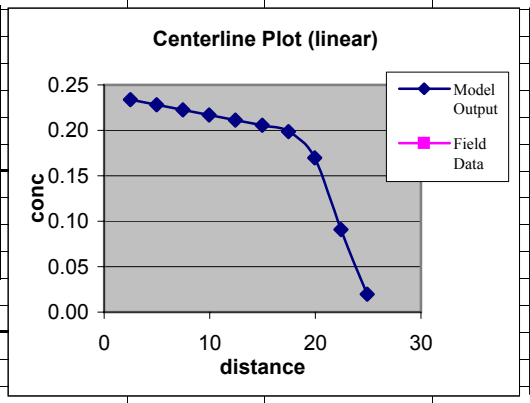
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
0	1.00E-01	1.00E-02	1.00E-04	0.00189863	100	15	120

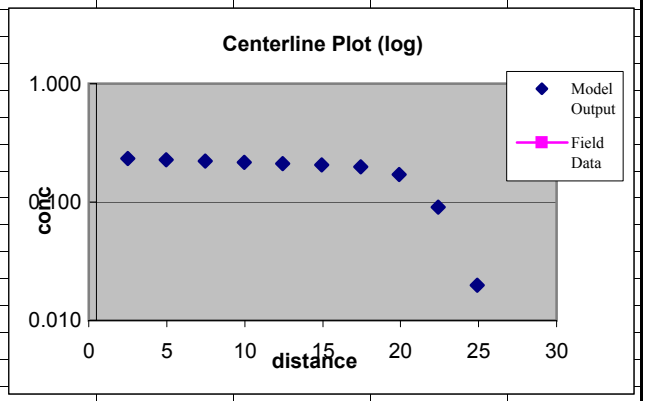
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	0.238 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	24.9
	Width (ft)	51

	2.49	4.98	7.47	9.96	12.45	14.94	17.43	19.92	22.41	24.9
51	0.000	0.000	0.001	0.003	0.005	0.007	0.009	0.010	0.006	0.002
25.5	0.234	0.228	0.222	0.217	0.211	0.206	0.199	0.170	0.091	0.020
0	0.234	0.228	0.222	0.217	0.211	0.206	0.199	0.170	0.091	0.020
-25.5	0.234	0.228	0.222	0.217	0.211	0.206	0.199	0.170	0.091	0.020
-51	0.000	0.000	0.001	0.003	0.005	0.007	0.009	0.010	0.006	0.002

Field Data:	Centerline C	Concentration
	Distance from Source	

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-182
Sample Date			4/18/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	51

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	12.0000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	0.34
Lambda (per day)		day^{-1}	0.00189863
KOC			12
Sim 3			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	0.24
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 4-months)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	1.19E+01	1	17
Sim 2 - MTBE	0.02	0.02	3.37E-01	1	25.3
Sim 3 - Naphthalene	0.1	0.1	1.27E-01	1	1.2

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

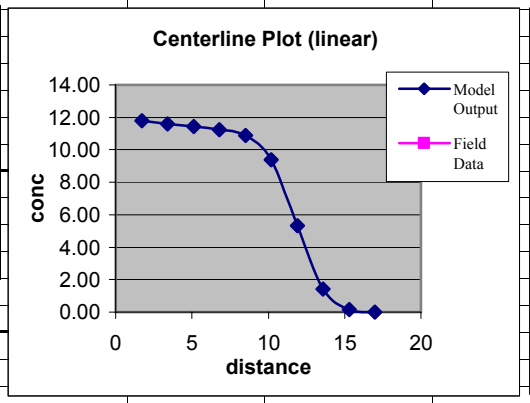
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001				
12	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	120

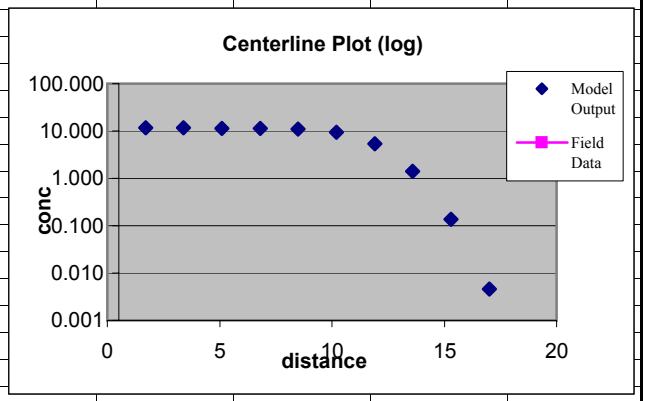
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	11.884 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	17
Width (ft)	51

	1.7	3.4	5.1	6.8	8.5	10.2	11.9	13.6	15.3	17
51	0.000	0.001	0.010	0.038	0.083	0.126	0.107	0.039	0.005	0.000
25.5	11.804	11.611	11.421	11.230	10.898	9.387	5.315	1.402	0.139	0.005
0	11.804	11.611	11.421	11.230	10.898	9.387	5.315	1.402	0.139	0.005
-25.5	11.804	11.611	11.421	11.230	10.898	9.387	5.315	1.402	0.139	0.005
-51	0.000	0.001	0.010	0.038	0.083	0.126	0.107	0.039	0.005	0.000

Field Data:	Centerline C	Concentration
	Distance from Source	

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

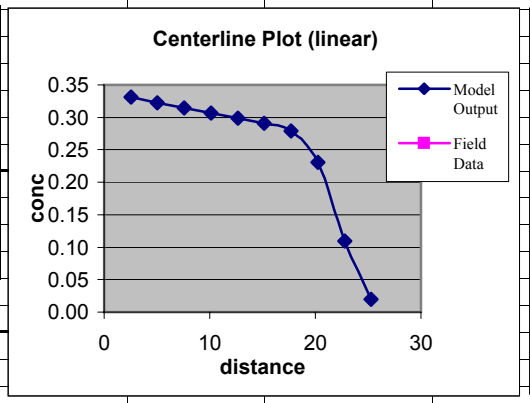
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
0	1.00E-01	1.00E-02	1.00E-04	0.00189863	100	15	120

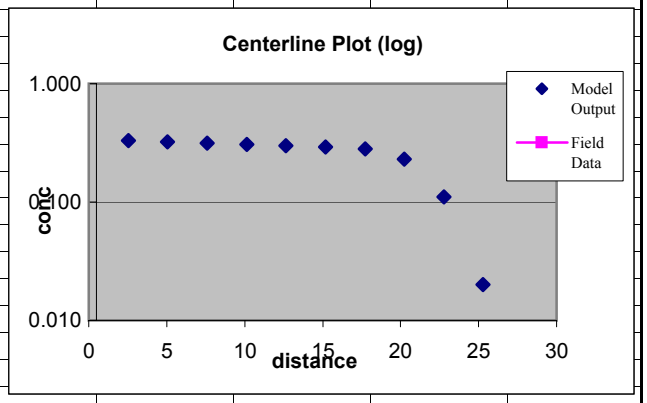
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	
			0.337
			mg/l





AREAL MODEL DOMAIN		
Length (ft)	25.3	
Width (ft)	51	

	2.53	5.06	7.59	10.12	12.65	15.18	17.71	20.24	22.77	25.3
51	0.000	0.000	0.002	0.004	0.007	0.010	0.013	0.013	0.008	0.002
25.5	0.331	0.323	0.315	0.307	0.299	0.291	0.279	0.230	0.110	0.020
0	0.331	0.323	0.315	0.307	0.299	0.291	0.279	0.230	0.110	0.020
-25.5	0.331	0.323	0.315	0.307	0.299	0.291	0.279	0.230	0.110	0.020
-51	0.000	0.000	0.002	0.004	0.007	0.010	0.013	0.013	0.008	0.002

Field Data:	Centerline C	Concentration
	Distance from Source	

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

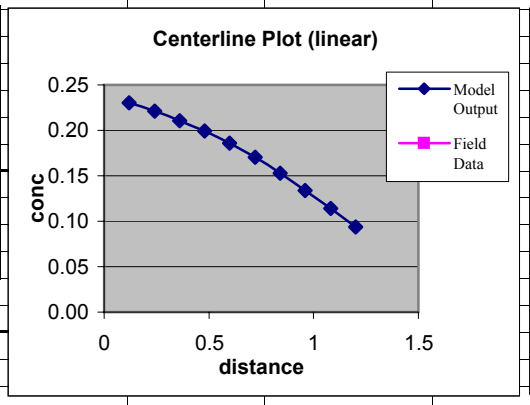
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001				
0	1.00E-01	1.00E-02	1.00E-04	0.00268493	100	15	120

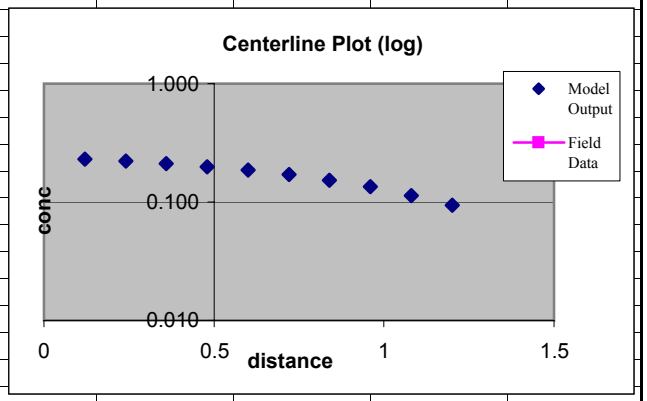
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	
			0.127
			mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	1.2
	Width (ft)	51

	0.12	0.24	0.36	0.48	0.6	0.72	0.84	0.96	1.08	1.2
51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25.5	0.230	0.221	0.211	0.199	0.186	0.170	0.153	0.134	0.114	0.094
0	0.230	0.221	0.211	0.199	0.186	0.170	0.153	0.134	0.114	0.094
-25.5	0.230	0.221	0.211	0.199	0.186	0.170	0.153	0.134	0.114	0.094
-51	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									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-183
Sample Date			4/18/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	51

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	14.0000
Lambda (per day)		day $^{-1}$	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	0.14
Lambda (per day)		day $^{-1}$	0.00189863
KOC			12
Sim 3			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	0.54
Lambda (per day)		day $^{-1}$	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 4-months)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	1.39E+01	1	17.1
Sim 2 - MTBE	0.02	0.02	1.39E-01	1	24.2
Sim 3 - Naphthalene	0.1	0.1	2.87E-01	1	1.6

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

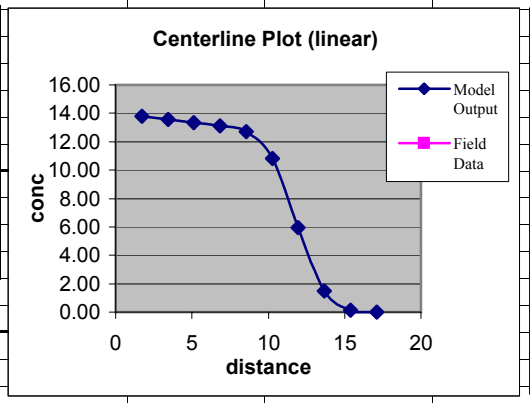
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
14	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	120

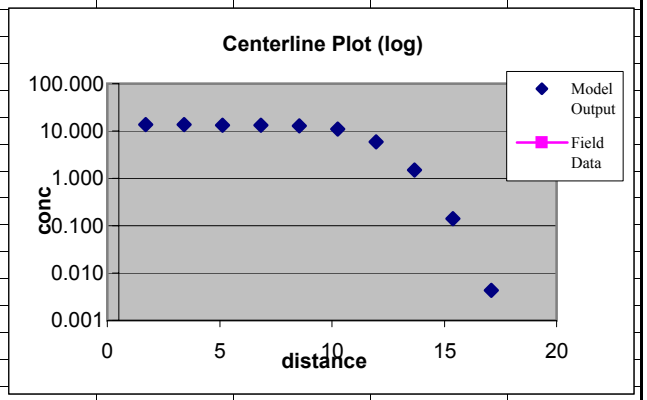
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	13.865 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	17.1
	Width (ft)	51

	1.71	*3.42*	*5.13*	*6.84*	*8.55*	*10.26*	*11.97*	*13.68*	*15.39*	*17.1*
51	0.000	0.001	0.012	0.045	0.099	0.148	0.122	0.042	0.005	0.000
25.5	13.770	13.544	13.321	13.095	12.692	10.834	5.970	1.501	0.139	0.004
0	13.770	13.544	13.321	13.095	12.692	10.834	5.970	1.501	0.139	0.004
-25.5	13.770	13.544	13.321	13.095	12.692	10.834	5.970	1.501	0.139	0.004
-51	0.000	0.001	0.012	0.045	0.099	0.148	0.122	0.042	0.005	0.000
Field Data:	Centerline C	Concentration								
	Distance from Source									

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

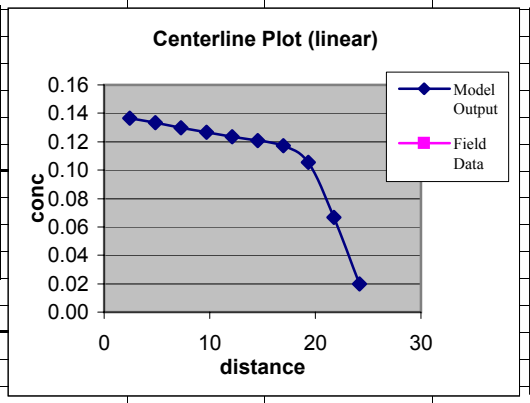
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
0	1.00E-01	1.00E-02	1.00E-04	0.00189863	100	15	120

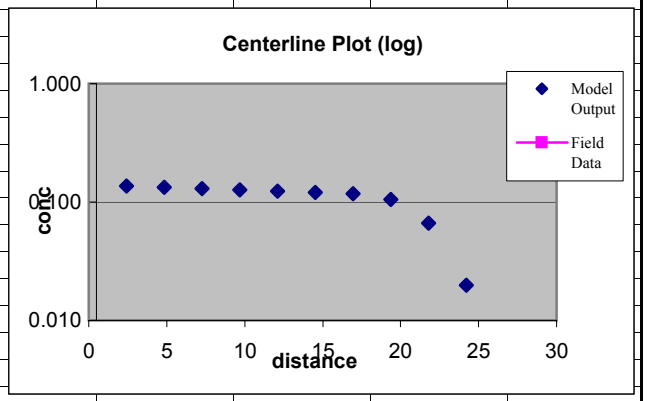
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	
			0.139
			mg/l





	AREAL MODEL DOMAIN									
	Length (ft)	24.2								
	Width (ft)	51								
	2.42	*4.84*	*7.26*	*9.68*	*12.1*	*14.52*	*16.94*	*19.36*	*21.78*	*24.2*
51	0.000	0.000	0.001	0.001	0.003	0.004	0.005	0.006	0.004	0.001
25.5	0.137	0.133	0.130	0.127	0.124	0.121	0.117	0.105	0.067	0.020
0	0.137	0.133	0.130	0.127	0.124	0.121	0.117	0.105	0.067	0.020
-25.5	0.137	0.133	0.130	0.127	0.124	0.121	0.117	0.105	0.067	0.020
-51	0.000	0.000	0.001	0.001	0.003	0.004	0.005	0.006	0.004	0.001
Field Data:	Centerline C	Concentration								
	Distance from Source									

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

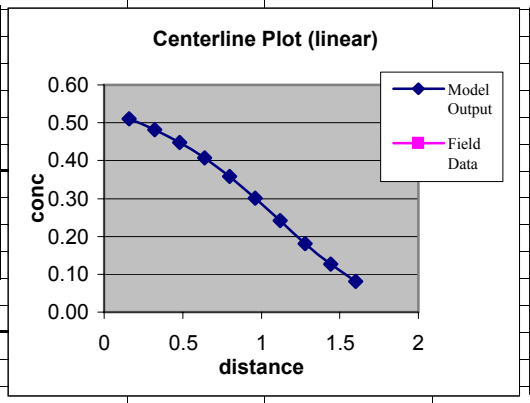
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	1.00E-01	1.00E-02	1.00E-04	0.00268493	100	15	120

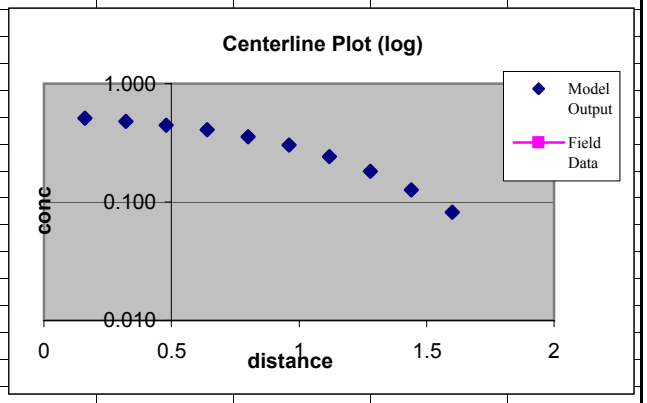
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	0.287 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	1.6
Width (ft)	51

	0.16	0.32	0.48	0.64	0.8	0.96	1.12	1.28	1.44	1.6
51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25.5	0.511	0.482	0.448	0.407	0.358	0.302	0.241	0.181	0.127	0.082
0	0.511	0.482	0.448	0.407	0.358	0.302	0.241	0.181	0.127	0.082
-25.5	0.511	0.482	0.448	0.407	0.358	0.302	0.241	0.181	0.127	0.082
-51	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									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			MW-184
Sample Date			4/18/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	51

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.6500
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output (Concentration at the Downgradient Property Boundary in 4-months)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	6.44E-01	1	15.6

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

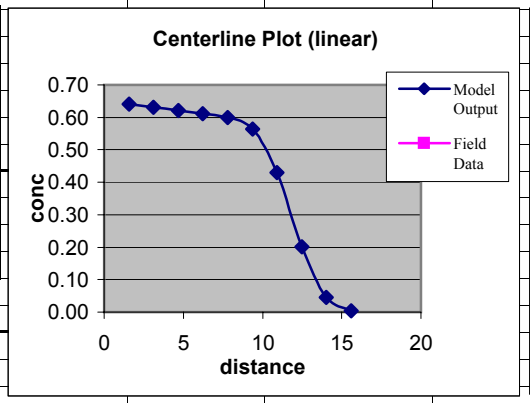
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	120

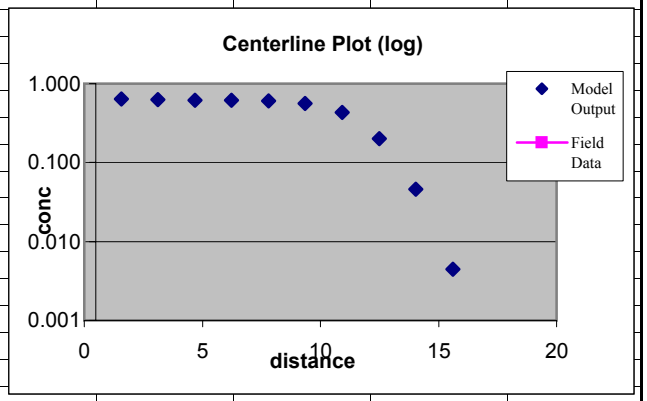
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	0.644 mg/l





AREAL MODEL DOMAIN		
Length (ft)	15.6	
Width (ft)	51	

	1.56	3.12	4.68	6.24	7.8	9.36	10.92	12.48	14.04	15.6
51	0.000	0.000	0.000	0.001	0.003	0.006	0.007	0.005	0.001	0.000
25.5	0.640	0.631	0.621	0.612	0.600	0.564	0.430	0.202	0.046	0.004
0	0.640	0.631	0.621	0.612	0.600	0.564	0.430	0.202	0.046	0.004
-25.5	0.640	0.631	0.621	0.612	0.600	0.564	0.430	0.202	0.046	0.004
-51	0.000	0.000	0.000	0.001	0.003	0.006	0.007	0.005	0.001	0.000
Field Data:	Centerline C	Concentration								
	Distance from Source									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-185
Sample Date			4/18/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	51

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.8500
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	0.56
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 4-months)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	8.42E-01	1	15.7
Sim 2 - Naphthalene	0.1	0.1	2.97E-01	1	1.6

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

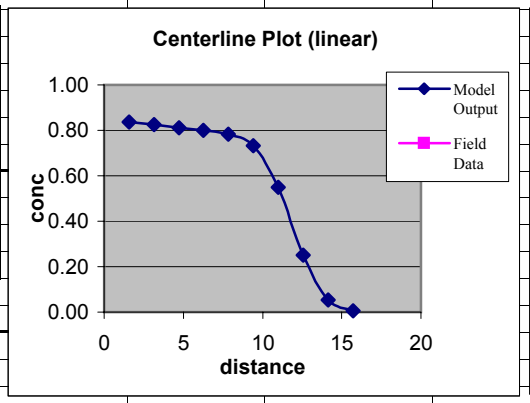
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	120

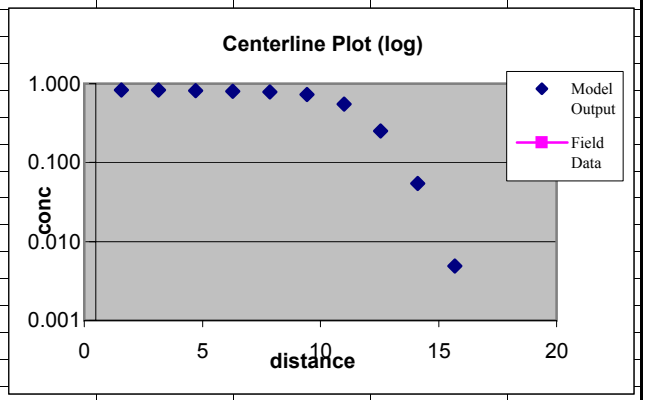
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	0.842 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	15.7
Width (ft)	51

	1.57	3.14	4.71	6.28	7.85	9.42	10.99	12.56	14.13	15.7
51	0.000	0.000	0.000	0.002	0.005	0.008	0.009	0.006	0.002	0.000
25.5	0.837	0.825	0.812	0.800	0.784	0.734	0.550	0.249	0.054	0.005
0	0.837	0.825	0.812	0.800	0.784	0.734	0.550	0.249	0.054	0.005
-25.5	0.837	0.825	0.812	0.800	0.784	0.734	0.550	0.249	0.054	0.005
-51	0.000	0.000	0.000	0.002	0.005	0.008	0.009	0.006	0.002	0.000
Field Data:	Centerline C	Concentration								
	Distance from Source									

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

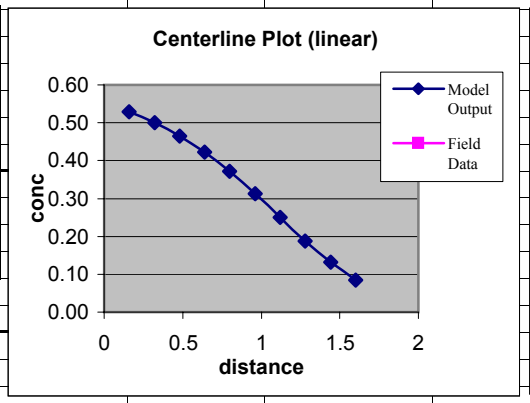
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	1.00E-01	1.00E-02	1.00E-04	0.00268493	100	15	120

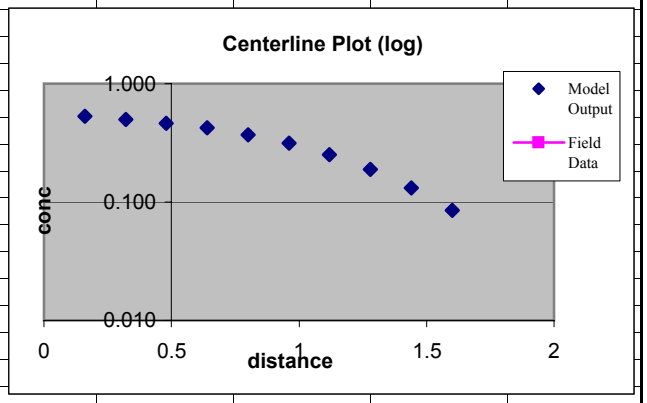
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	0.297 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	1.6
	Width (ft)	51

	0.16	0.32	0.48	0.64	0.8	0.96	1.12	1.28	1.44	1.6
51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25.5	0.530	0.500	0.464	0.422	0.371	0.313	0.250	0.188	0.131	0.085
0	0.530	0.500	0.464	0.422	0.371	0.313	0.250	0.188	0.131	0.085
-25.5	0.530	0.500	0.464	0.422	0.371	0.313	0.250	0.188	0.131	0.085
-51	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									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-186
Sample Date			4/18/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	51

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.0470
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output (Concentration at the Downgradient Property Boundary in 4-months)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	4.65E-02	1	13.7

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

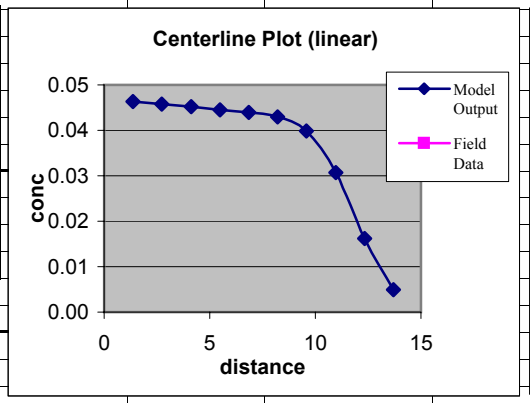
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
0	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	120

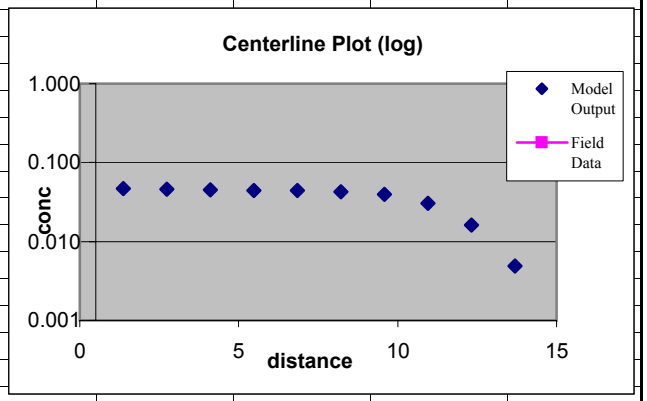
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	0.047
			mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft)	13.7
Width (ft)	51

	1.37	2.74	4.11	5.48	6.85	8.22	9.59	10.96	12.33	13.7
51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
25.5	0.046	0.046	0.045	0.045	0.044	0.043	0.040	0.031	0.016	0.005
0	0.046	0.046	0.045	0.045	0.044	0.043	0.040	0.031	0.016	0.005
-25.5	0.046	0.046	0.045	0.045	0.044	0.043	0.040	0.031	0.016	0.005
-51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000

Field Data: Centerline C Concentration
Distance from Source

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters				
Source Identification (or Well ID)			S-187	
Sample Date			4/18/2005	
Source Width		ft	100	
Source Thickness		ft	15	
Distance to Location of Concern	x	ft	1	0
Perpendicular Distance to Location of Concern	y	ft	0	
Vertical Axis Perpendicular to x and y	z	ft	0	
Longitudinal Dispersivity	A_x	ft	0.1	
Transverse Dispersivity	A_y	ft	0.0	
Vertical Dispersivity	A_z	ft	0.0001	
Hydraulic Conductivty	k	ft/day	24	
Hydraulic Gradient		ft/ft	0.0035	
Porosity		decimal fraction	0.35	
Soil Bulk Density	p_b	g/cm3	1.7225	
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005	
Time		days	120	
Length of Grid Dimension		ft	1	
Width of Grid Dimension		ft	50.8	

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.1300
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output (Concentration at the Downgradient Property Boundary in 4-months)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	1.29E-01	1	14.5

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

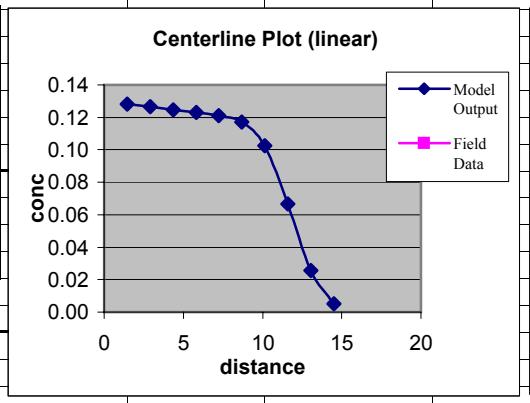
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	120

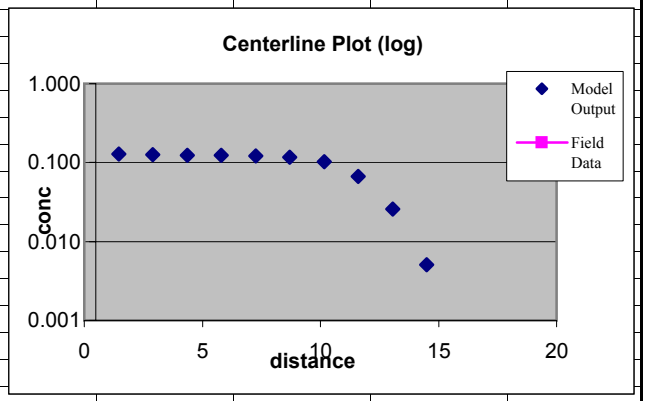
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	
			0.129
			mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 14.5
Width (ft) 50.8

	1.45	2.9	4.35	5.8	7.25	8.7	10.15	11.6	13.05	14.5
50.8	0.000	0.000	0.000	0.001	0.002	0.003	0.004	0.003	0.002	0.000
25.4	0.128	0.126	0.125	0.123	0.121	0.117	0.103	0.067	0.026	0.005
0	0.128	0.126	0.125	0.123	0.121	0.117	0.103	0.067	0.026	0.005
-25.4	0.128	0.126	0.125	0.123	0.121	0.117	0.103	0.067	0.026	0.005
-50.8	0.000	0.000	0.000	0.001	0.002	0.003	0.004	0.003	0.002	0.000

Field Data: Centerline C Concentration
Distance from Source

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-188
Sample Date			4/18/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	52

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	1.2000
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output (Concentration at the Downgradient Property Boundary in 4-months)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	1.19E+00	1	15.9

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

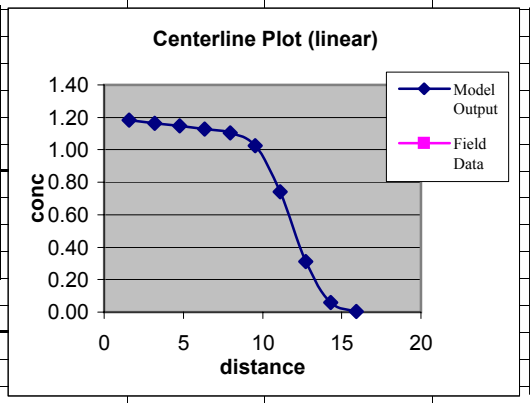
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001				
1	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	120

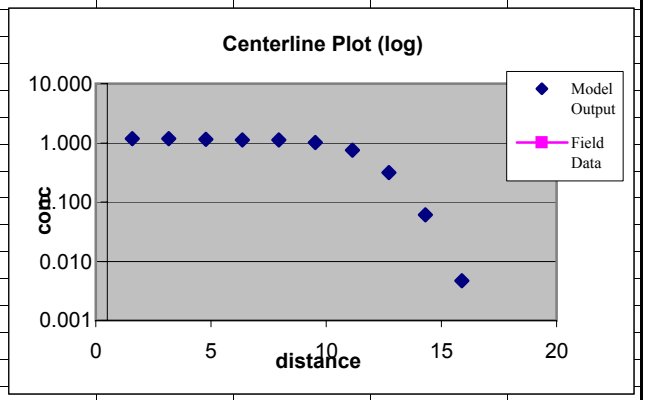
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	1.188 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	15.9
	Width (ft)	52

	1.59	3.18	4.77	6.36	7.95	9.54	11.13	12.72	14.31	15.9
52	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	1.182	1.164	1.146	1.128	1.105	1.024	0.742	0.313	0.061	0.005
0	1.182	1.164	1.146	1.128	1.105	1.024	0.742	0.313	0.061	0.005
-26	1.182	1.164	1.146	1.128	1.105	1.024	0.742	0.313	0.061	0.005
-52	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

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			PZ-402
Sample Date			4/20/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	51.4

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	25.0000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Ethylbenzene
Source Concentration (mg/l)		mg/l	2.2
Lambda (per day)		day^{-1}	0.003041096
KOC			220
Sim 3			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	2.3
Lambda (per day)		day^{-1}	0.00189863
KOC			12
Sim 4			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	0.98
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 4-months)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	2.48E+01	1	17.3
Sim 2 - Ethylbenzene	0.7	0.7	2.03E+00	1	4.66
Sim 3 - MTBE	0.02	0.02	2.28E+00	1	27.1
Sim 4 - Naphthalene	0.1	0.1	5.20E-01	1	1.73

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

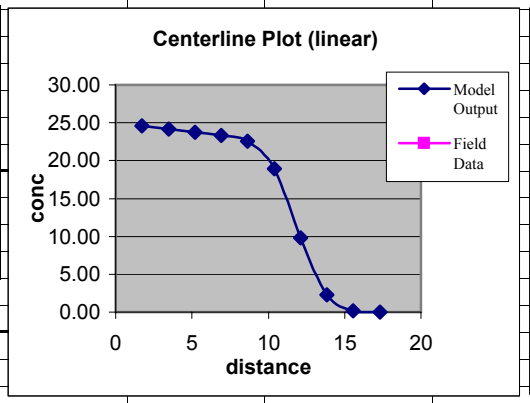
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
25	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	120

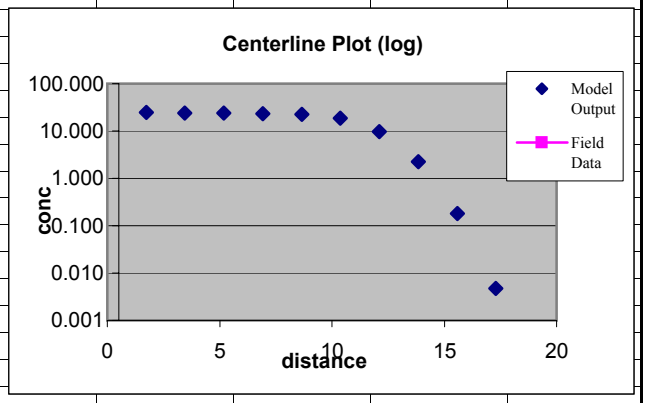
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	24.759 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	17.3
	Width (ft)	51.4

	1.73	3.46	5.19	6.92	8.65	10.38	12.11	13.84	15.57	17.3
51.4	0.000	0.000	0.000	0.002	0.009	0.020	0.022	0.009	0.001	0.000
25.7	24.584	24.176	23.774	23.364	22.582	18.906	9.845	2.243	0.181	0.005
0	24.584	24.176	23.774	23.364	22.582	18.906	9.845	2.243	0.181	0.005
-25.7	24.584	24.176	23.774	23.364	22.582	18.906	9.845	2.243	0.181	0.005
-51.4	0.000	0.000	0.000	0.002	0.009	0.020	0.022	0.009	0.001	0.000

Field Data: Centerline C Concentration
Distance from Source

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Ethylbenzene

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	1.00E-01	1.00E-02	1.00E-04	0.0030411	100	15	120

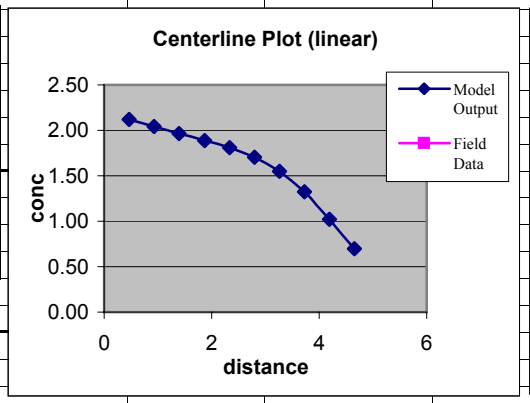
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	220	5.00E-03	6.413571429	0.037420648

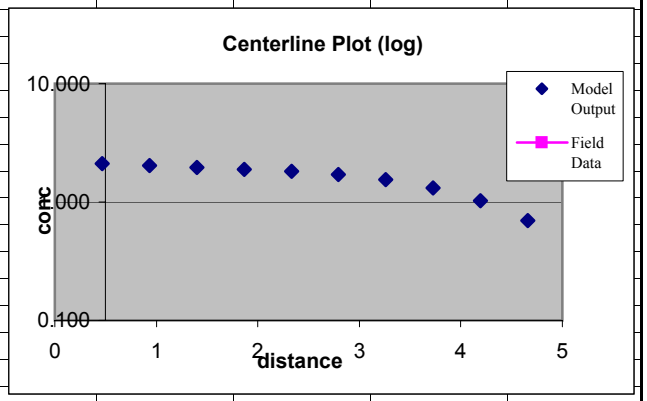
Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0

at 120 days = **2.029** mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	4.66
	Width (ft)	51.4

	0.466	*0.932*	*1.398*	*1.864*	*2.33*	*2.796*	*3.262*	*3.728*	*4.194*	*4.66*
51.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25.7	2.119	2.041	1.965	1.889	1.806	1.701	1.548	1.321	1.022	0.694
0	2.119	2.041	1.965	1.889	1.806	1.701	1.548	1.321	1.022	0.694
-25.7	2.119	2.041	1.965	1.889	1.806	1.701	1.548	1.321	1.022	0.694
-51.4	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

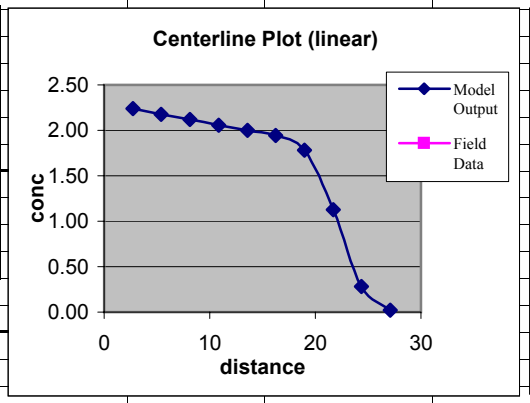
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
2	1.00E-01	1.00E-02	1.00E-04	0.00189863	100	15	120

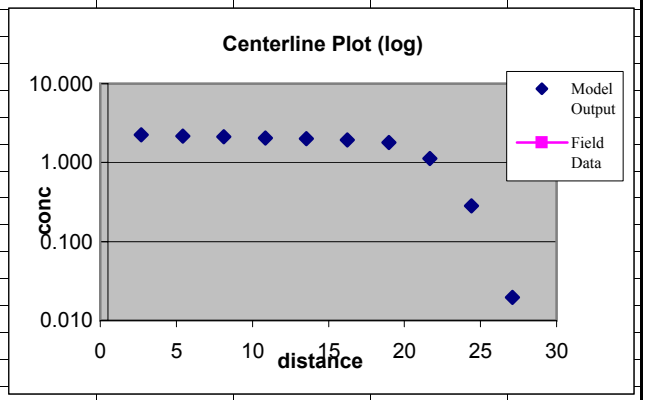
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	2.277 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	27.1
	Width (ft)	51.4

	2.71	5.42	8.13	10.84	13.55	16.26	18.97	21.68	24.39	27.1
51.4	0.000	0.000	0.001	0.003	0.007	0.014	0.021	0.019	0.006	0.001
25.7	2.237	2.176	2.116	2.058	2.002	1.943	1.784	1.127	0.284	0.019
0	2.237	2.176	2.116	2.058	2.002	1.943	1.784	1.127	0.284	0.019
-25.7	2.237	2.176	2.116	2.058	2.002	1.943	1.784	1.127	0.284	0.019
-51.4	0.000	0.000	0.001	0.003	0.007	0.014	0.021	0.019	0.006	0.001

Field Data: Centerline C Concentration
Distance from Source

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

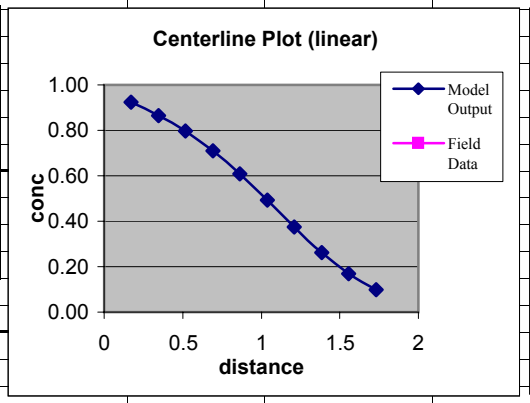
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
1	1.00E-01	1.00E-02	1.00E-04	0.00268493	100	15	120

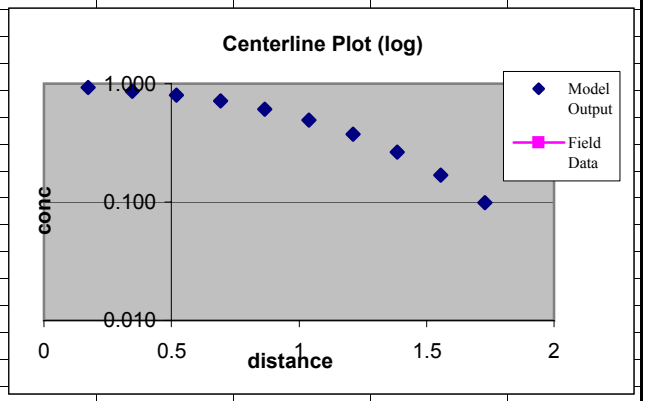
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	120	days =	
			0.520
			mg/l





	AREAL MODEL	CALCULATION DOMAIN								
	Length (ft)	1.73								
	Width (ft)	51.4								
	0.173	*0.346*	*0.519*	*0.692*	*0.865*	*1.038*	*1.211*	*1.384*	*1.557*	*1.73*
51.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25.7	0.923	0.865	0.796	0.711	0.609	0.494	0.375	0.262	0.168	0.098
0	0.923	0.865	0.796	0.711	0.609	0.494	0.375	0.262	0.168	0.098
-25.7	0.923	0.865	0.796	0.711	0.609	0.494	0.375	0.262	0.168	0.098
-51.4	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									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-77P
Sample Date			4/20/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	875
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	87.5
Transverse Dispersivity	A_y	ft	8.8
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	137

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	17.0000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	10
Lambda (per day)		day^{-1}	0.00189863
KOC			12
Sim 3			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	0.11
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 4-months)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	0.00E+00	875	163
Sim 2 - MTBE	0.02	0.02	0.00E+00	875	190
Sim 3 - Naphthalene	0.1	0.1	0.00E+00	875	1

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

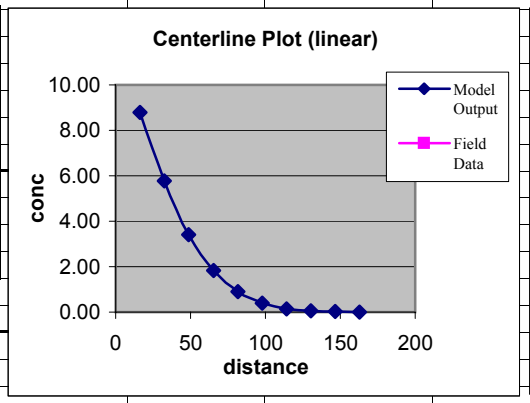
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
17	8.75E+01	8.75E+00	1.00E-04	0.0009589	100	15	120

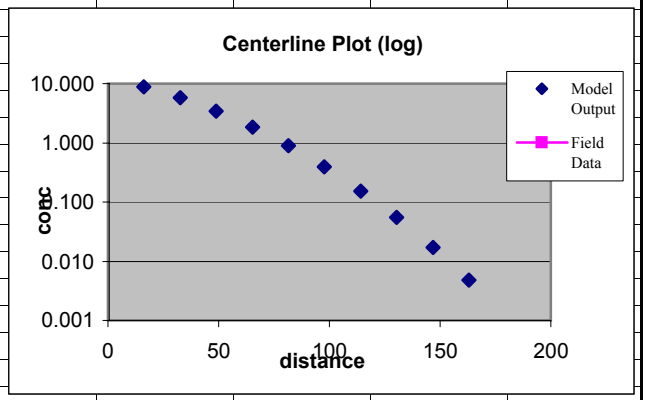
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
875	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	875	0	0
at	120	days =	0.000 mg/l





AREAL MODEL DOMAIN		
Length (ft)	163	
Width (ft)	137	

	16.3	32.6	48.9	65.2	81.5	97.8	114.1	130.4	146.7	163
137	0.000	0.001	0.005	0.011	0.012	0.009	0.005	0.003	0.001	0.000
68.5	1.206	1.315	0.986	0.620	0.340	0.164	0.070	0.026	0.009	0.003
0	8.793	5.779	3.415	1.830	0.889	0.390	0.154	0.054	0.017	0.005
-68.5	1.206	1.315	0.986	0.620	0.340	0.164	0.070	0.026	0.009	0.003
-137	0.000	0.001	0.005	0.011	0.012	0.009	0.005	0.003	0.001	0.000

Field Data: Centerline C Concentration
Distance from Source

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

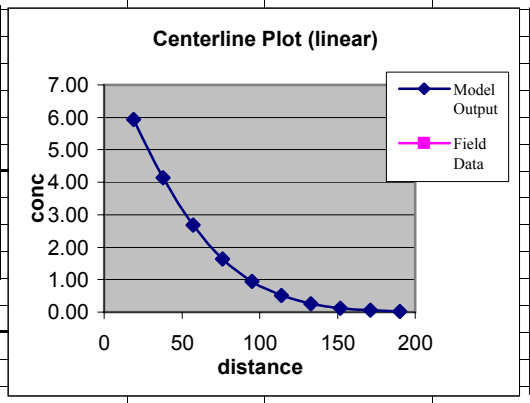
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
10	8.75E+01	8.75E+00	1.00E-04	0.00189863	100	15	120

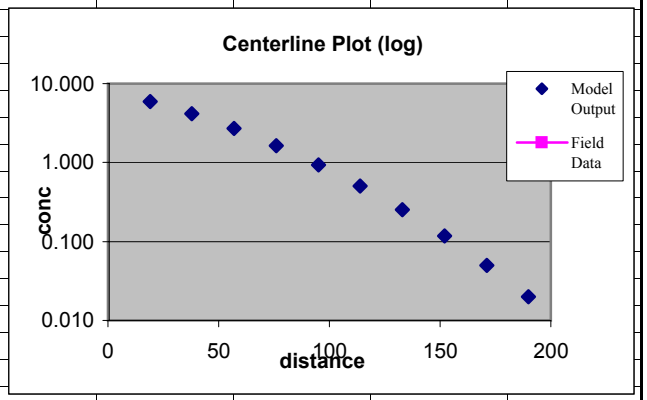
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
875	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	875	0	0
at	120	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	190
	Width (ft)	137

	19	38	57	76	95	114	133	152	171	190
137	0.000	0.002	0.009	0.017	0.020	0.018	0.013	0.008	0.004	0.002
68.5	0.928	1.036	0.847	0.604	0.389	0.229	0.123	0.061	0.028	0.012
0	5.943	4.150	2.691	1.640	0.939	0.503	0.251	0.117	0.050	0.020
-68.5	0.928	1.036	0.847	0.604	0.389	0.229	0.123	0.061	0.028	0.012
-137	0.000	0.002	0.009	0.017	0.020	0.018	0.013	0.008	0.004	0.002

Field Data: Centerline C Concentration
Distance from Source

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	10/4/2007

Generic Input Parameters			
Source Identification (or Well ID)			S-204
Sample Date			4/19/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	415
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	41.5
Transverse Dispersivity	A_y	ft	4.2
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	135

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	26.0000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	370
Lambda (per day)		day^{-1}	0.00189863
KOC			12
Sim 3			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	0.29
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 4-months)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	0.00E+00	415	122
Sim 2 - MTBE	0.02	0.02	0.00E+00	415	185
Sim 3 - Naphthalene	0.1	0.1	0.00E+00	415	17

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

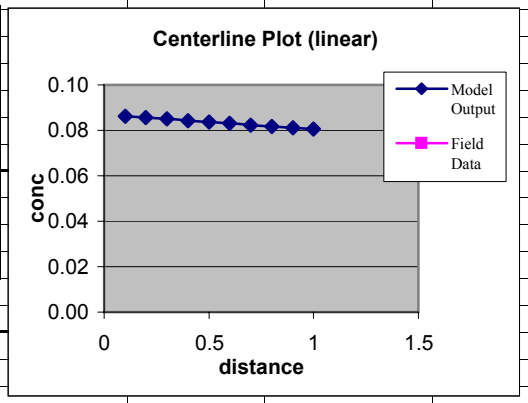
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	8.75E+01	8.75E+00	1.00E-04	0.00268493	100	15	120

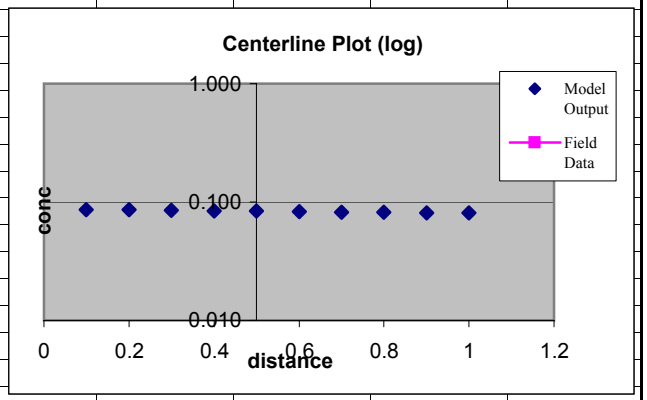
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
875	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	875	0	0
at	120	days =	**0.000** mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	1
	Width (ft)	137

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
137	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
68.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.086	0.086	0.085	0.084	0.084	0.083	0.082	0.082	0.081	0.080
-68.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-137	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:	10/4/2007	Prepared by:	Allison Jelinek
		Contaminant:	Benzene

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

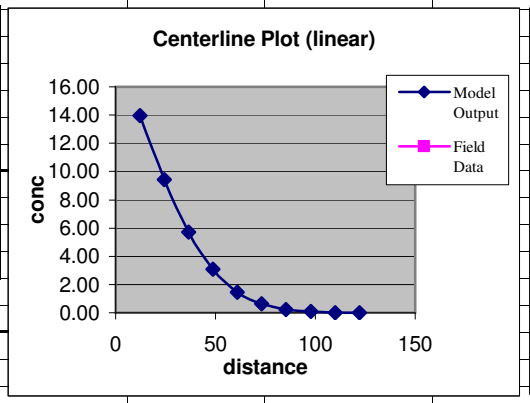
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
26	4.15E+01	4.15E+00	1.00E-04	0.0009589	100	15	120

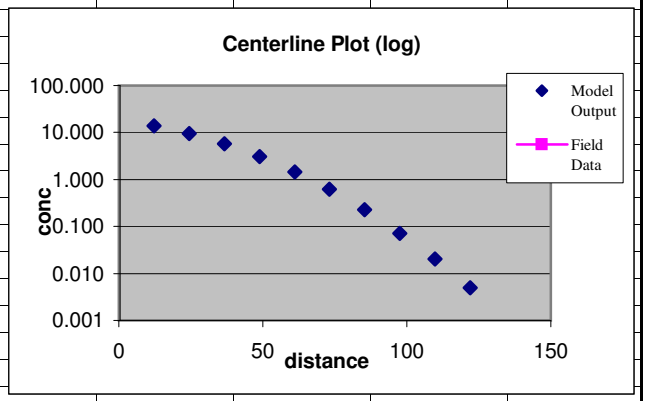
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
415	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	415	0	0
at	120	days =	0.000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	122
Width (ft)	111

	12.2	24.4	36.6	48.8	61	73.2	85.4	97.6	109.8	122
111	0.000	0.000	0.001	0.004	0.005	0.004	0.003	0.001	0.000	0.000
55.5	4.082	3.290	2.157	1.225	0.609	0.265	0.100	0.033	0.010	0.002
0	13.962	9.408	5.710	3.083	1.470	0.616	0.226	0.072	0.020	0.005
-55.5	4.082	3.290	2.157	1.225	0.609	0.265	0.100	0.033	0.010	0.002
-111	0.000	0.000	0.001	0.004	0.005	0.004	0.003	0.001	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:	10/4/2007	Prepared by:	Allison Jelinek
		Contaminant:	MTBE

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

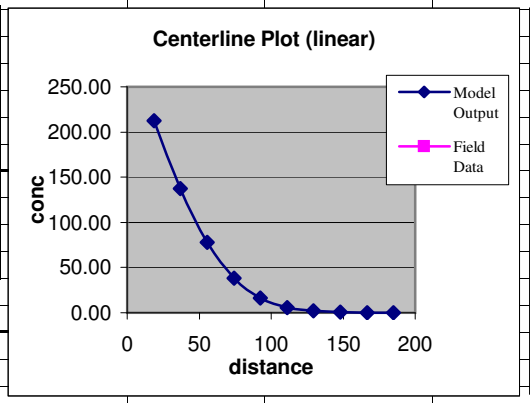
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
370	4.15E+01	4.15E+00	1.00E-04	0.00189863	100	15	120

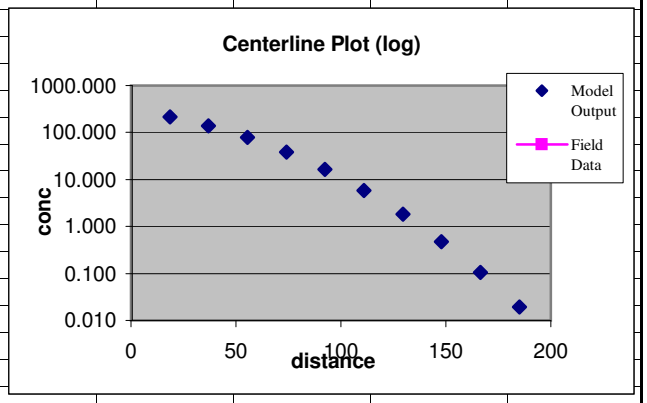
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
415	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	415	0	0
at	120	days =	0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft)	185
Width (ft)	135

	18.5	37	55.5	74	92.5	111	129.5	148	166.5	185
135	0.000	0.000	0.003	0.012	0.019	0.017	0.010	0.004	0.001	0.000
67.5	16.770	21.890	16.446	9.589	4.591	1.833	0.613	0.172	0.040	0.008
0	212.441	137.088	77.712	38.203	16.165	5.852	1.803	0.471	0.104	0.019
-67.5	16.770	21.890	16.446	9.589	4.591	1.833	0.613	0.172	0.040	0.008
-135	0.000	0.000	0.003	0.012	0.019	0.017	0.010	0.004	0.001	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:	10/4/2007	Prepared by:	Allison Jelinek
		Contaminant:	Naphthalene

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

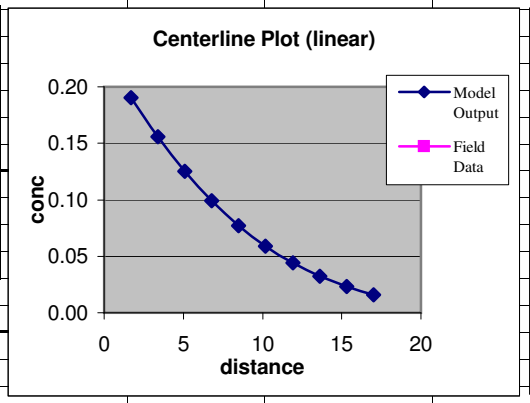
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	4.15E+01	4.15E+00	1.00E-04	0.00268493	100	15	120

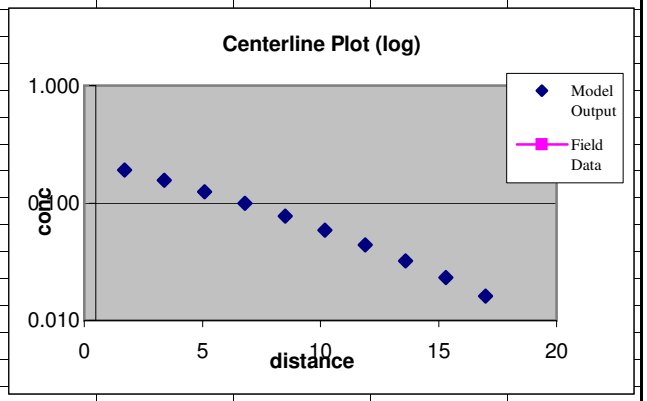
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
415	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	415	0	0
at	120	days =	0.000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	17
Width (ft)	135

	1.7	3.4	5.1	6.8	8.5	10.2	11.9	13.6	15.3	17
135	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
67.5	0.000	0.000	0.000	0.001	0.001	0.002	0.002	0.002	0.001	0.001
0	0.190	0.156	0.125	0.099	0.077	0.059	0.044	0.032	0.023	0.016
-67.5	0.000	0.000	0.000	0.001	0.001	0.002	0.002	0.002	0.001	0.001
-135	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									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-79P
Sample Date			4/20/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	440
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	44
Transverse Dispersivity	A_y	ft	4.4
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	94

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	2.4000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	0.18
Lambda (per day)		day^{-1}	0.00189863
KOC			12

Output (Concentration at the Downgradient Property Boundary in 4-months)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	0.00E+00	440	103
Sim 2 - MTBE	0.02	0.02	0.00E+00	440	74

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

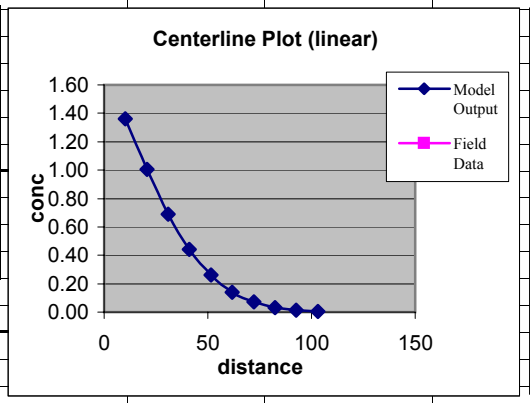
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
2	4.40E+01	4.40E+00	1.00E-04	0.0009589	100	15	120

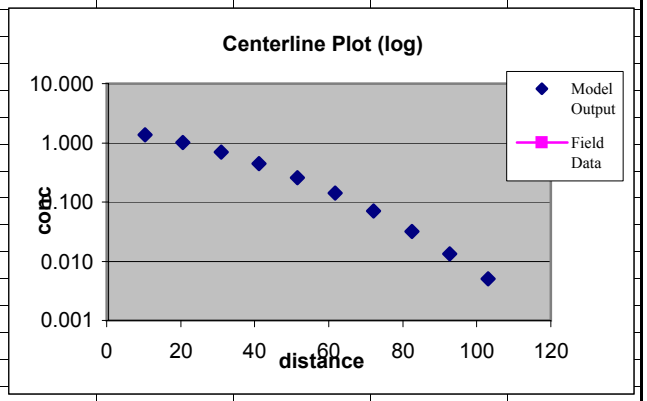
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
440	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	440	0	0
at	120	days =	
			0.000
			mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	103
	Width (ft)	94

	10.3	20.6	30.9	41.2	51.5	61.8	72.1	82.4	92.7	103
94	0.000	0.001	0.003	0.005	0.005	0.004	0.003	0.002	0.001	0.000
47	0.850	0.591	0.397	0.251	0.147	0.080	0.040	0.018	0.008	0.003
0	1.363	1.004	0.692	0.442	0.260	0.141	0.070	0.032	0.013	0.005
-47	0.850	0.591	0.397	0.251	0.147	0.080	0.040	0.018	0.008	0.003
-94	0.000	0.001	0.003	0.005	0.005	0.004	0.003	0.002	0.001	0.000

Field Data:	Centerline C	Concentration
	Distance from Source	

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

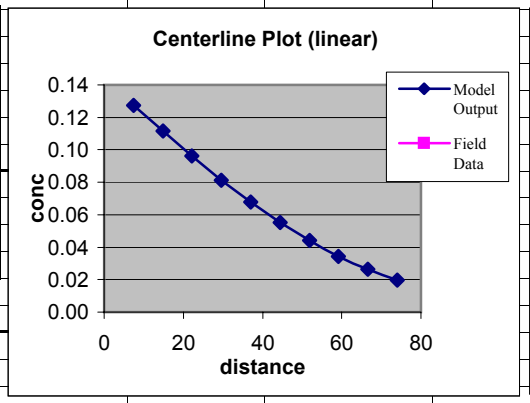
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	4.40E+01	4.40E+00	1.00E-04	0.00189863	100	15	120

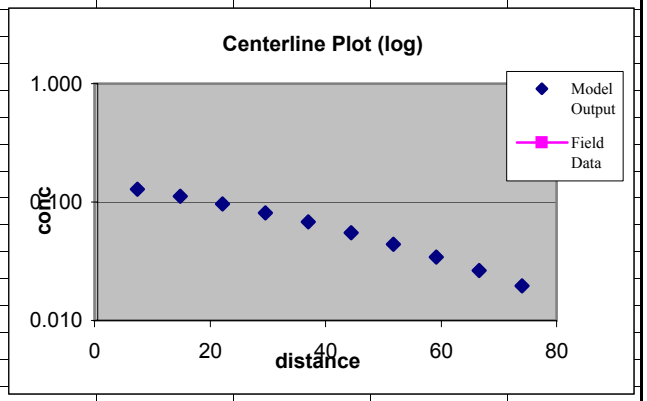
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
440	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	440	0	0
at	120	days =	**0.000** mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	74
	Width (ft)	94

	7.4	14.8	22.2	29.6	37	44.4	51.8	59.2	66.6	74
94	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001
47	0.082	0.067	0.056	0.047	0.039	0.031	0.025	0.020	0.015	0.011
0	0.128	0.112	0.096	0.081	0.068	0.055	0.044	0.034	0.026	0.020
-47	0.082	0.067	0.056	0.047	0.039	0.031	0.025	0.020	0.015	0.011
-94	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001

Field Data:	Centerline C	Concentration
	Distance from Source	

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			MW-35
Sample Date			4/27/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	500
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	50
Transverse Dispersivity	A_y	ft	5.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	55

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.0290
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Ethylbenzene
Source Concentration (mg/l)		mg/l	0.97
Lambda (per day)		day^{-1}	0.003041096
KOC			220
Sim 3			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	5.7
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 4-months)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	0.00E+00	500	45
Sim 2 - Ethylbenzene	0.7	0.7	0.00E+00	500	2.5
Sim 3 - Naphthalene	0.1	0.1	0.00E+00	500	24

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

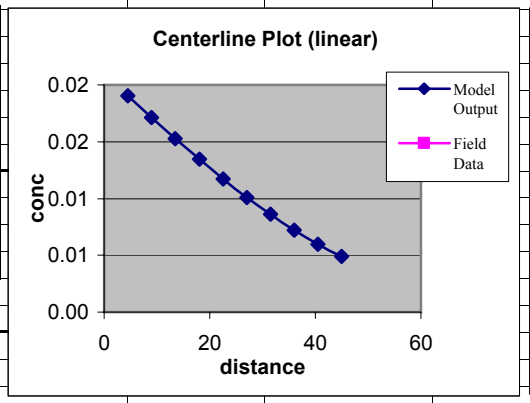
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	5.00E+01	5.00E+00	1.00E-04	0.0009589	100	15	120

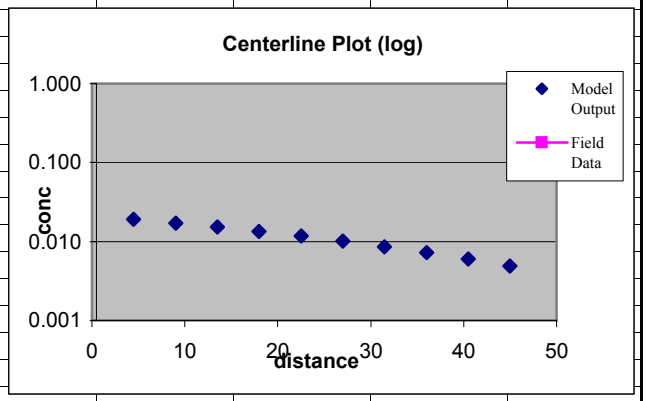
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
500	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	500	0	0
at	120	days =	
			0.000
			mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	45
Width (ft)	55

	4.5	9	13.5	18	22.5	27	31.5	36	40.5	45
55	0.004	0.005	0.005	0.005	0.004	0.004	0.003	0.003	0.002	0.002
27.5	0.019	0.017	0.015	0.013	0.011	0.009	0.008	0.006	0.005	0.004
0	0.019	0.017	0.015	0.013	0.012	0.010	0.009	0.007	0.006	0.005
-27.5	0.019	0.017	0.015	0.013	0.011	0.009	0.008	0.006	0.005	0.004
-55	0.004	0.005	0.005	0.005	0.004	0.004	0.003	0.003	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Ethylbenzene

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

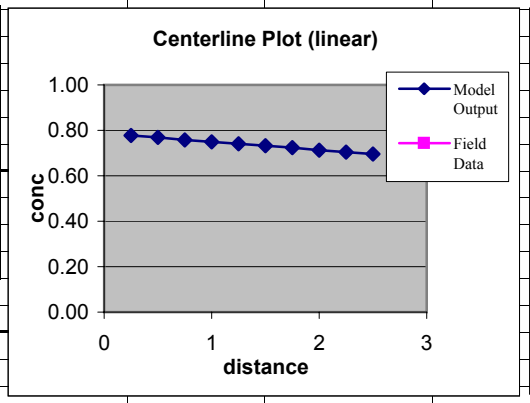
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	5.00E+01	5.00E+00	1.00E-04	0.0030411	100	15	120

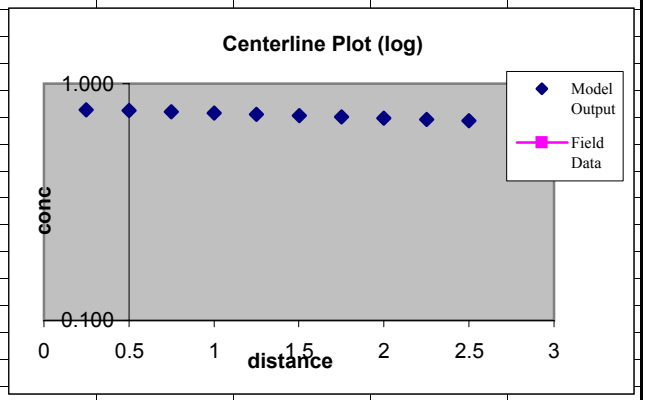
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm³)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	220	5.00E-03	6.413571429	0.037420648

Point Concentration

x(ft)	y(ft)	z(ft)
500	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	500	0	0
at	120	days =	
			0.000
			mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	2.5
	Width (ft)	55

	0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5
55	0.001	0.010	0.026	0.043	0.058	0.072	0.084	0.094	0.103	0.111
27.5	0.777	0.768	0.759	0.750	0.741	0.732	0.723	0.714	0.705	0.697
0	0.777	0.768	0.759	0.750	0.741	0.732	0.723	0.714	0.705	0.697
-27.5	0.777	0.768	0.759	0.750	0.741	0.732	0.723	0.714	0.705	0.697
-55	0.001	0.010	0.026	0.043	0.058	0.072	0.084	0.094	0.103	0.111

Field Data:	Centerline C	Concentration
	Distance from Source	

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

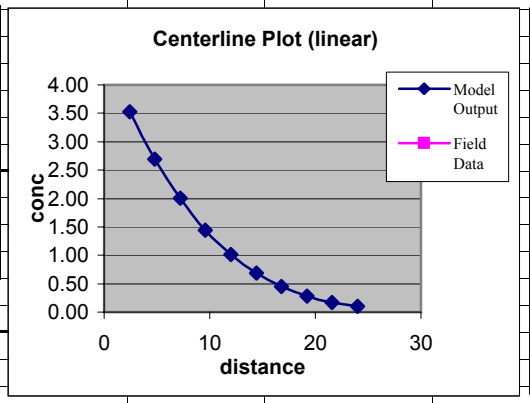
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
6	5.00E+01	5.00E+00	1.00E-04	0.00268493	100	15	120

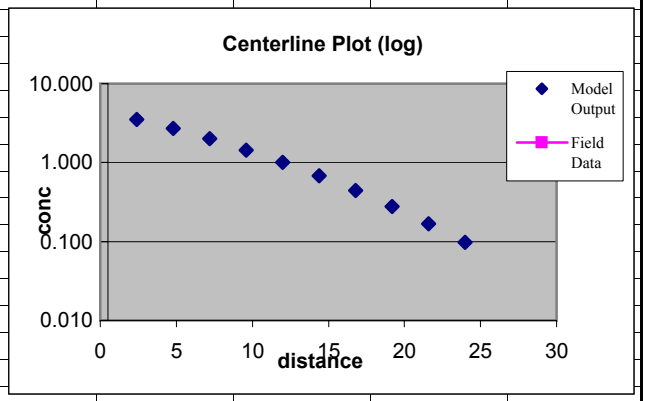
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
500	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	500	0	0
at	120	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	24
	Width (ft)	55

	2.4	4.8	7.2	9.6	12	14.4	16.8	19.2	21.6	24
55	0.542	0.633	0.556	0.440	0.327	0.231	0.156	0.100	0.062	0.037
27.5	3.526	2.690	1.993	1.429	0.990	0.662	0.427	0.265	0.158	0.091
0	3.526	2.692	2.001	1.445	1.010	0.683	0.445	0.280	0.169	0.098
-27.5	3.526	2.690	1.993	1.429	0.990	0.662	0.427	0.265	0.158	0.091
-55	0.542	0.633	0.556	0.440	0.327	0.231	0.156	0.100	0.062	0.037

Field Data: Centerline C Concentration
Distance from Source

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			MW-36
Sample Date			4/25/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	325
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	32.5
Transverse Dispersivity	A_y	ft	3.3
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	112

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	150.0000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	5.8
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 4-months)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	0.00E+00	325	122
Sim 2 - Naphthalene	0.1	0.1	0.00E+00	325	20

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

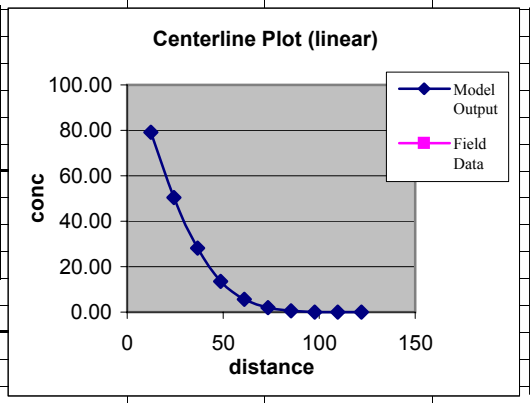
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
150	3.25E+01	3.25E+00	1.00E-04	0.0009589	100	15	120

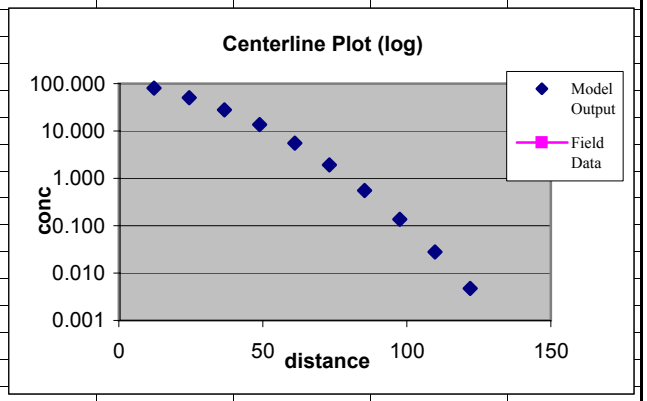
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
325	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	325	0	0
at	120	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	122
	Width (ft)	112

	12.2	24.4	36.6	48.8	61	73.2	85.4	97.6	109.8	122
112	0.000	0.000	0.001	0.003	0.005	0.004	0.002	0.001	0.000	0.000
56	19.823	16.000	9.833	5.012	2.144	0.770	0.232	0.058	0.012	0.002
0	79.218	50.487	28.172	13.547	5.550	1.923	0.560	0.137	0.028	0.005
-56	19.823	16.000	9.833	5.012	2.144	0.770	0.232	0.058	0.012	0.002
-112	0.000	0.000	0.001	0.003	0.005	0.004	0.002	0.001	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

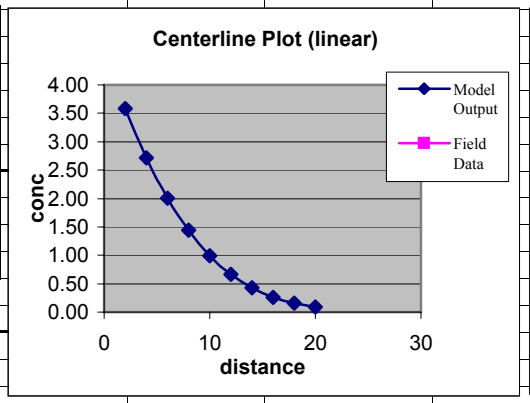
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
6	3.25E+01	3.25E+00	1.00E-04	0.00268493	100	15	120

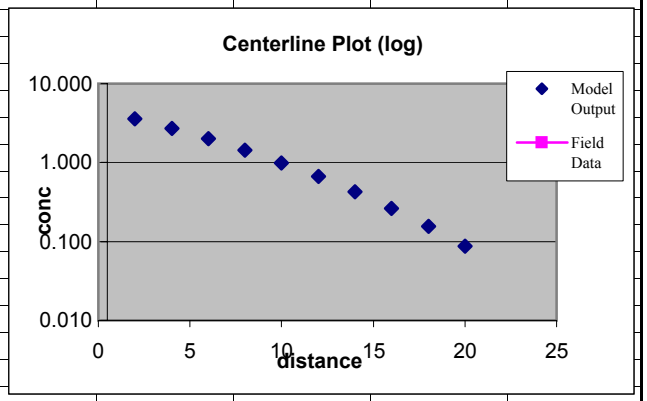
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
325	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	325	0	0
at	120	days =	0.000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	20
Width (ft)	112

	2	4	6	8	10	12	14	16	18	20
112	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	0.172	0.326	0.338	0.291	0.227	0.164	0.112	0.073	0.045	0.026
0	3.581	2.721	2.009	1.437	0.993	0.662	0.425	0.262	0.154	0.087
-56	0.172	0.326	0.338	0.291	0.227	0.164	0.112	0.073	0.045	0.026
-112	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									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			MW-37
Sample Date			4/26/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	175
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	17.5
Transverse Dispersivity	A_y	ft	1.8
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	94

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	370.0000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Ethylbenzene
Source Concentration (mg/l)		mg/l	12
Lambda (per day)		day^{-1}	0.003041096
KOC			220
Sim 3			
Contaminant			Toluene
Source Concentration (mg/l)		mg/l	31
Lambda (per day)		day^{-1}	0.024684932
KOC			130
Sim 4			
Contaminant			Total Xylenes
Source Concentration (mg/l)		mg/l	41
Lambda (per day)		day^{-1}	0.001890411
KOC			350

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Output (Concentration at the Downgradient Property Boundary in 4-months)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	1.93E-13	175	98
Sim 2 - Ethylbenzene	0.7	0.7	0.00E+00	175	24
Sim 3 - Toluene	1	1	0.00E+00	175	25
Sim 4 - Total Xylenes	10	10	0.00E+00	175	11

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

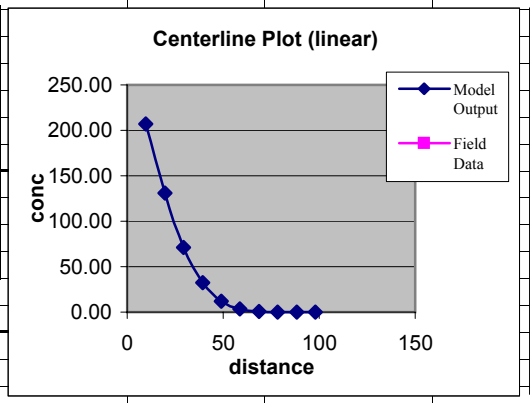
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
370	1.75E+01	1.75E+00	1.00E-04	0.0009589	100	15	120

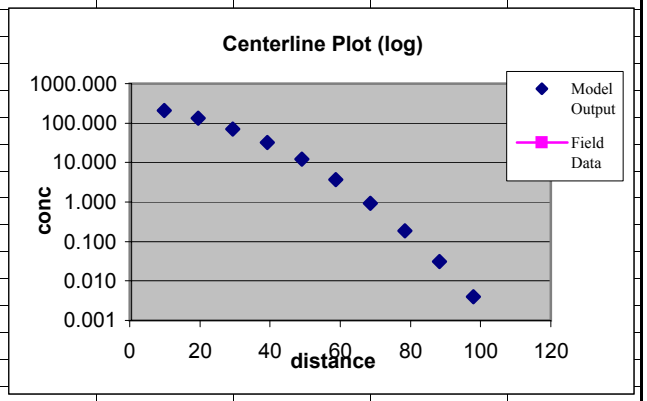
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
175	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	175	0	0
at	120	days =	0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft)	98
Width (ft)	94

	9.8	19.6	29.4	39.2	49	58.8	68.6	78.4	88.2	98
94	0.000	0.000	0.001	0.003	0.005	0.004	0.002	0.001	0.000	0.000
47	144.028	84.033	43.693	19.350	7.145	2.171	0.538	0.108	0.018	0.002
0	207.008	131.014	70.898	32.193	12.097	3.724	0.932	0.189	0.031	0.004
-47	144.028	84.033	43.693	19.350	7.145	2.171	0.538	0.108	0.018	0.002
-94	0.000	0.000	0.001	0.003	0.005	0.004	0.002	0.001	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Ethylbenzene

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

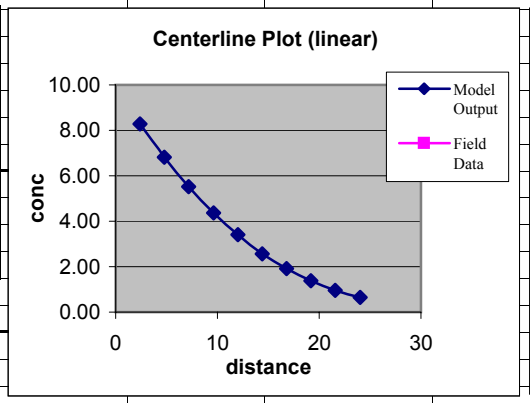
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
12	1.75E+01	1.75E+00	1.00E-04	0.0030411	100	15	120

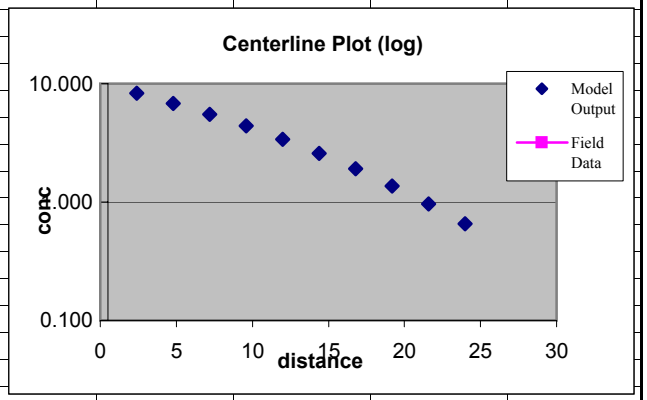
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm³)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	220	5.00E-03	6.413571429	0.037420648

Point Concentration

x(ft)	y(ft)	z(ft)
175	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	175	0	0
at	120	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	24
	Width (ft)	94

	2.4	4.8	7.2	9.6	12	14.4	16.8	19.2	21.6	24
94	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47	7.031	5.238	4.002	3.055	2.304	1.709	1.241	0.881	0.609	0.410
0	8.275	6.821	5.521	4.379	3.397	2.575	1.903	1.370	0.960	0.653
-47	7.031	5.238	4.002	3.055	2.304	1.709	1.241	0.881	0.609	0.410
-94	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Toluene

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

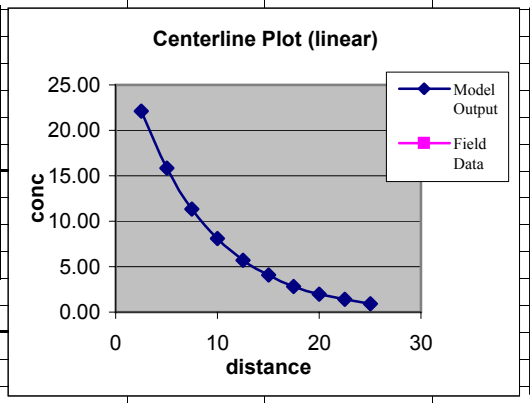
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
31	1.75E+01	1.75E+00	1.00E-04	0.02468493	100	15	120

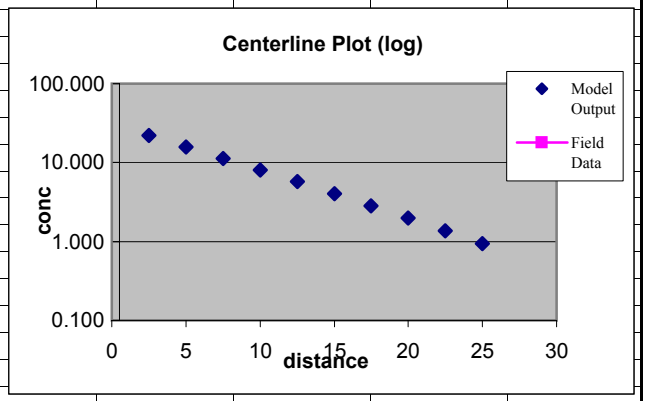
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	130	5.00E-03	4.198928571	0.057157438

Point Concentration

x(ft)	y(ft)	z(ft)
175	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	175	0	0
at	120	days =	0.000
			mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	25
	Width (ft)	111

	2.5	5	7.5	10	12.5	15	17.5	20	22.5	25
111	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55.5	0.696	1.494	1.603	1.423	1.163	0.907	0.686	0.507	0.368	0.262
0	22.105	15.842	11.327	8.074	5.733	4.052	2.846	1.986	1.374	0.942
-55.5	0.696	1.494	1.603	1.423	1.163	0.907	0.686	0.507	0.368	0.262
-111	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 TOO

Project: 2574601 - Sunoco Philadelphia Refinery
Date: 6/6/2005 Prepared by: Allison Jelinek
Contaminant: Total Xylenes

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
41	1.75E+01	1.75E+00	1.00E-04	0.00189041	100	15	120

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	0.0035	0.35	1.7225	350	5.00E-03	9.6125	0.02496749

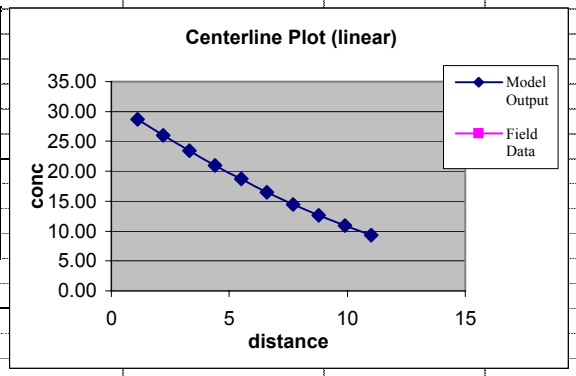
NEW QUICK_DOMENICO.XLS

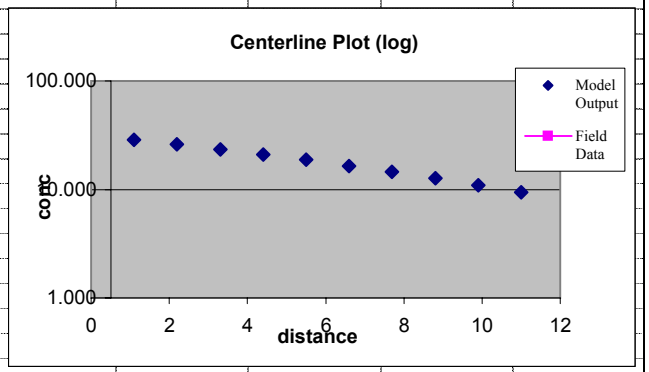
SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

Point Concentration

x(ft)	y(ft)	z(ft)
175	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	175	0	0
at	120	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	11
	Width (ft)	94

	1.1	2.2	3.3	4.4	5.5	6.6	7.7	8.8	9.9	11
94	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47	26.911	22.397	19.037	16.343	14.079	12.125	10.415	8.911	7.585	6.418
0	28.725	26.038	23.465	21.015	18.699	16.524	14.500	12.629	10.916	9.361
-47	26.911	22.397	19.037	16.343	14.079	12.125	10.415	8.911	7.585	6.418
-94	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

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			OW-14
Sample Date			4/25/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	85
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	8.5
Transverse Dispersivity	A_y	ft	0.9
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	57

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.1600
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output (Concentration at the Downgradient Property Boundary in 4-months)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	1.91E-08	85	38

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

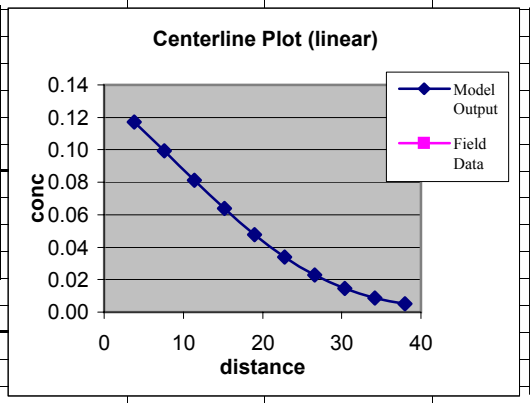
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	8.50E+00	8.50E-01	1.00E-04	0.0009589	100	15	120

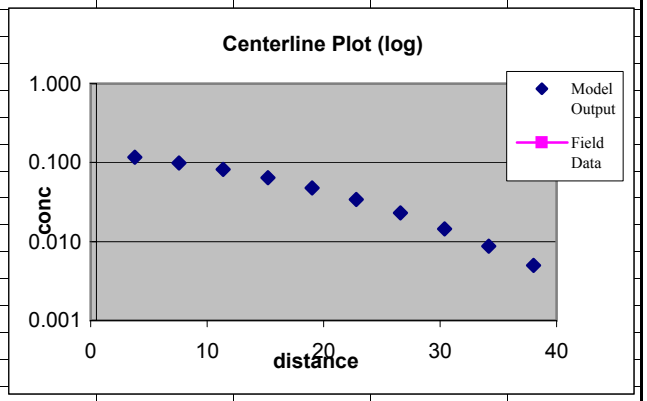
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
85	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	85	0	0
at	120	days =	0.000 mg/l





AREAL MODEL DOMAIN	CALCULATION
Length (ft)	38
Width (ft)	57

	3.8	7.6	11.4	15.2	19	22.8	26.6	30.4	34.2	38
57	0.000	0.003	0.005	0.005	0.005	0.004	0.003	0.002	0.002	0.001
28.5	0.117	0.099	0.081	0.064	0.048	0.034	0.023	0.015	0.009	0.005
0	0.117	0.099	0.081	0.064	0.048	0.034	0.023	0.015	0.009	0.005
-28.5	0.117	0.099	0.081	0.064	0.048	0.034	0.023	0.015	0.009	0.005
-57	0.000	0.003	0.005	0.005	0.005	0.004	0.003	0.002	0.002	0.001

Field Data:	Centerline C Concentration
	Distance from Source

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			TW-3
Sample Date			4/25/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	350
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	35
Transverse Dispersivity	A_y	ft	3.5
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	111

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	63.0000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Ethylbenzene
Source Concentration (mg/l)		mg/l	2.7
Lambda (per day)		day^{-1}	0.003041096
KOC			220
Sim 3			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	56
Lambda (per day)		day^{-1}	0.00189863
KOC			12
Sim 4			
Contaminant			Toluene
Source Concentration (mg/l)		mg/l	29
Lambda (per day)		day^{-1}	0.024684932
KOC			130
Sim 5			
Contaminant			Total Xylenes
Source Concentration (mg/l)		mg/l	17
Lambda (per day)		day^{-1}	0.001890411
KOC			350
Sim 6			
Contaminant			Chrysene
Source Concentration (mg/l)		mg/l	0.016
Lambda (per day)		day^{-1}	0.000345205
KOC			490000
Sim 7			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	1.5
Lambda (per day)		day^{-1}	0.002684932
KOC			950
Sim 8			
Contaminant			Ethylene Dibromide
Source Concentration (mg/l)		mg/l	0.000058
Lambda (per day)		day^{-1}	0.005780822
KOC			54

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Output (Concentration at the Downgradient Property Boundary in 4-months)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	0.00E+00	350	120
Sim 2 - Ethylbenzene	0.7	0.7	0.00E+00	350	16.9
Sim 3 - MTBE	0.02	0.02	1.56E-15	350	153
Sim 4 - Toluene	1	1	0.00E+00	350	32.6
Sim 5 - Total Xylenes	10	10	0.00E+00	350	3.9
Sim 6 - Chrysene	0.0019	0.0019	0.00E+00	350	1
Sim 7 - Naphthalene	0.1	0.1	0.00E+00	350	15
Sim 8 - Ethylene Dibromide	0.00005	0.00005	0.00E+00	350	1.1

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

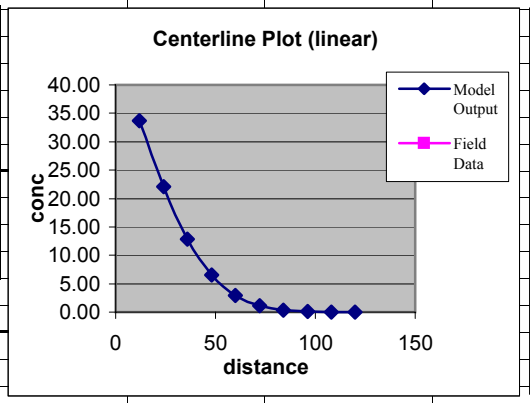
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
63	3.50E+01	3.50E+00	1.00E-04	0.0009589	100	15	120

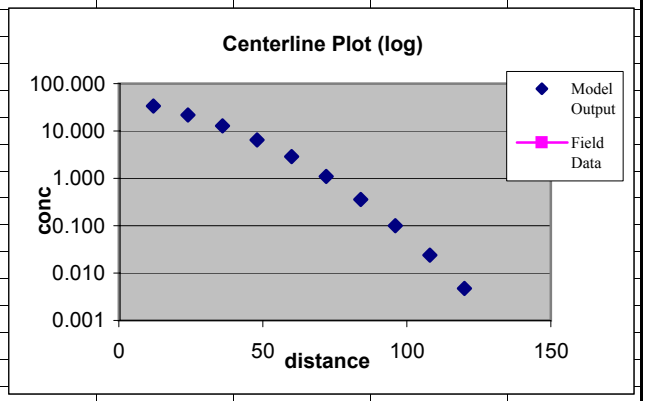
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
350	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	350	0	0
at	120	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	120
	Width (ft)	111

	12	24	36	48	60	72	84	96	108	120
111	0.000	0.000	0.001	0.003	0.004	0.004	0.002	0.001	0.000	0.000
55.5	9.227	7.401	4.684	2.513	1.155	0.454	0.153	0.044	0.011	0.002
0	33.647	22.046	12.829	6.535	2.886	1.097	0.358	0.100	0.024	0.005
-55.5	9.227	7.401	4.684	2.513	1.155	0.454	0.153	0.044	0.011	0.002
-111	0.000	0.000	0.001	0.003	0.004	0.004	0.002	0.001	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Ethylbenzene

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)
3	3.50E+01	3.50E+00	1.00E-04	0.0030411	100	15	120

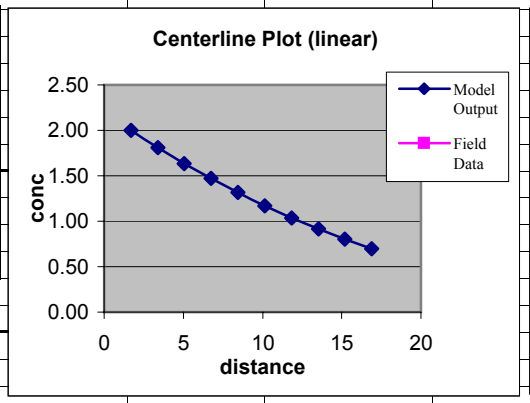
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	220	5.00E-03	6.413571429	0.037420648

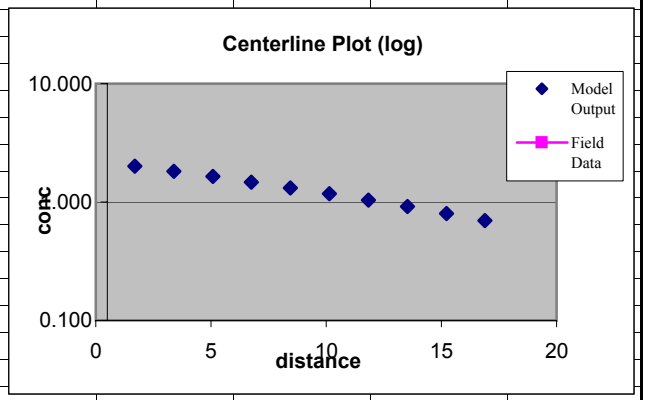
Point Concentration

x(ft)	y(ft)	z(ft)
350	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	350	0	0
at	120	days =	

0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	16.9
	Width (ft)	111

	1.69	*3.38*	*5.07*	*6.76*	*8.45*	*10.14*	*11.83*	*13.52*	*15.21*	*16.9*
111	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55.5	0.110	0.234	0.291	0.312	0.312	0.301	0.283	0.262	0.238	0.214
0	1.999	1.813	1.637	1.471	1.316	1.172	1.038	0.915	0.802	0.699
-55.5	0.110	0.234	0.291	0.312	0.312	0.301	0.283	0.262	0.238	0.214
-111	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

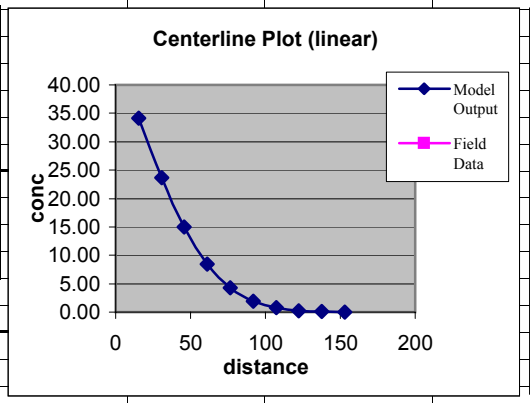
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
56	3.50E+01	3.50E+00	1.00E-04	0.00189863	100	15	120

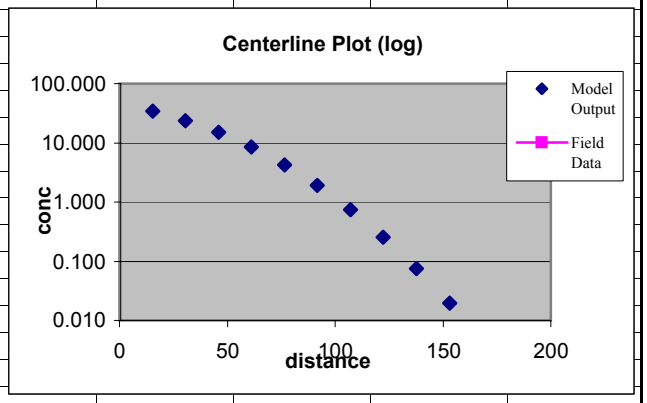
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
350	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	350	0	0
at	120	days =	0.000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	153
Width (ft)	111

	15.3	30.6	45.9	61.2	76.5	91.8	107.1	122.4	137.7	153
111	0.000	0.000	0.005	0.014	0.018	0.016	0.010	0.005	0.002	0.001
55.5	10.150	8.389	5.713	3.401	1.783	0.822	0.332	0.117	0.036	0.010
0	34.111	23.713	14.975	8.471	4.256	1.888	0.736	0.251	0.075	0.019
-55.5	10.150	8.389	5.713	3.401	1.783	0.822	0.332	0.117	0.036	0.010
-111	0.000	0.000	0.005	0.014	0.018	0.016	0.010	0.005	0.002	0.001
Field Data:	Centerline C	Concentration								
	Distance from Source									

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by:	Allison Jelinek
		Contaminant:	Toluene

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

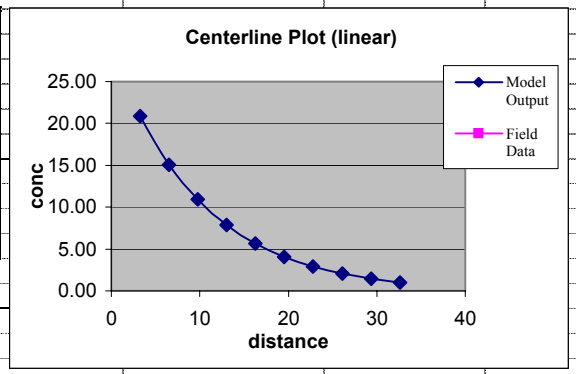
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
29	3.50E+01	3.50E+00	1.00E-04	0.02468493	100	15	120

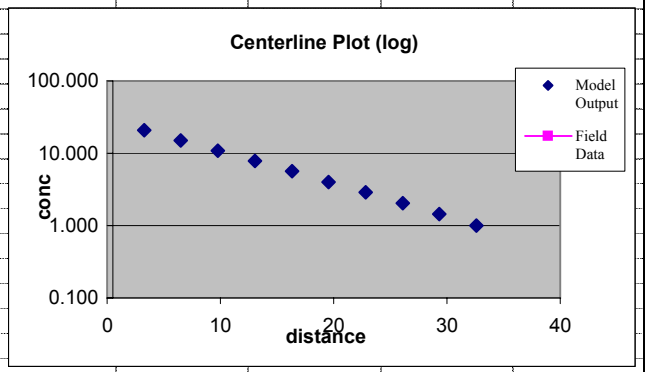
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	130	5.00E-03	4.198928571	0.057157438

Point Concentration

x(ft)	y(ft)	z(ft)
350	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	350	0	0
at	120	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	32.6
	Width (ft)	111

	3.26	6.52	9.78	13.04	16.3	19.56	22.82	26.08	29.34	32.6
111	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55.5	2.604	3.137	2.760	2.218	1.711	1.288	0.953	0.696	0.502	0.358
0	20.866	15.098	10.904	7.855	5.641	4.035	2.873	2.034	1.430	0.998
-55.5	2.604	3.137	2.760	2.218	1.711	1.288	0.953	0.696	0.502	0.358
-111	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Total Xylenes

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

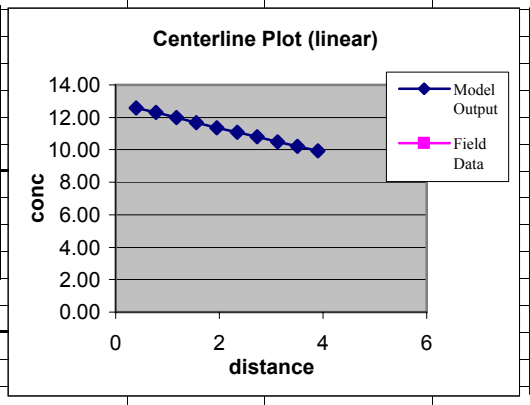
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
17	3.50E+01	3.50E+00	1.00E-04	0.00189041	100	15	120

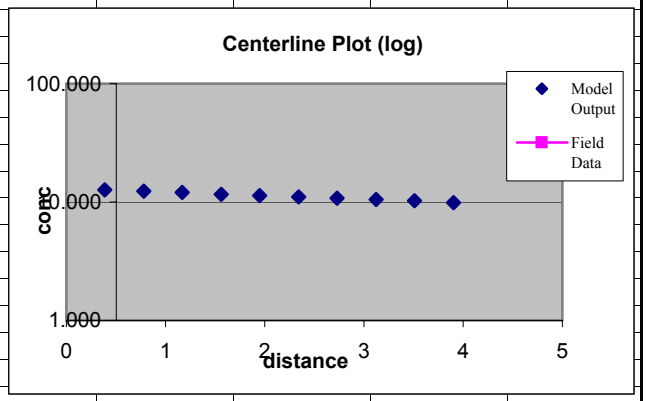
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	350	5.00E-03	9.6125	0.02496749

Point Concentration

x(ft)	y(ft)	z(ft)
350	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	350	0	0
at	120	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	3.9
	Width (ft)	111

	0.39	0.78	1.17	1.56	1.95	2.34	2.73	3.12	3.51	3.9
111	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55.5	0.005	0.114	0.327	0.561	0.777	0.965	1.124	1.256	1.365	1.453
0	12.597	12.287	11.980	11.677	11.377	11.082	10.790	10.501	10.217	9.936
-55.5	0.005	0.114	0.327	0.561	0.777	0.965	1.124	1.256	1.365	1.453
-111	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Chrysene

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

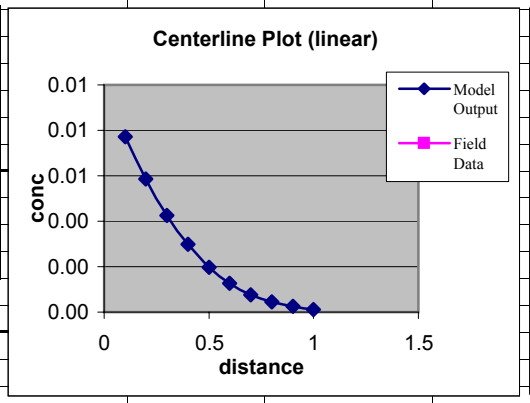
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	3.50E+01	3.50E+00	1.00E-04	0.00034521	100	15	120

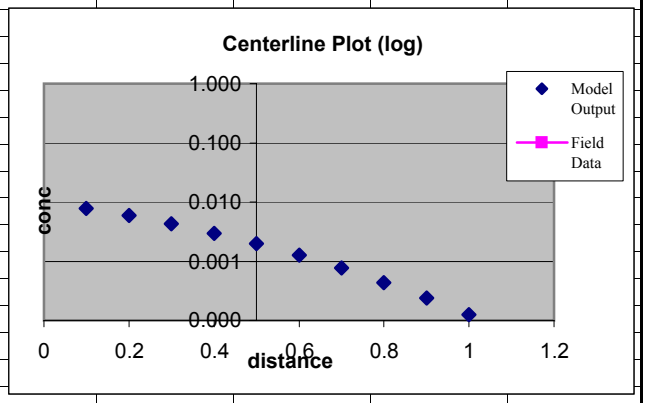
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	490000	5.00E-03	12058.5	1.9903E-05

Point Concentration

x(ft)	y(ft)	z(ft)
350	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	350	0	0
at	120	days =	
			0.000
			mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	1
	Width (ft)	111

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
111	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.008	0.006	0.004	0.003	0.002	0.001	0.001	0.000	0.000	0.000
-55.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-111	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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	3.50E+01	3.50E+00	1.00E-04	0.00268493	100	15	120

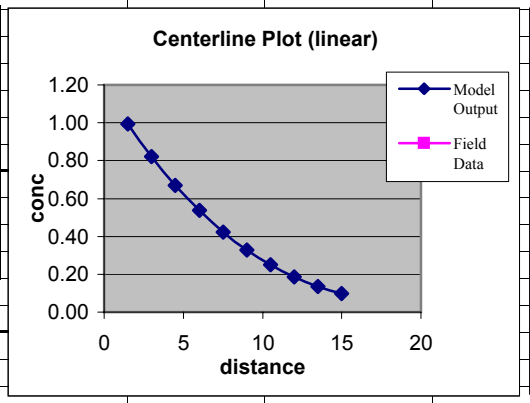
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

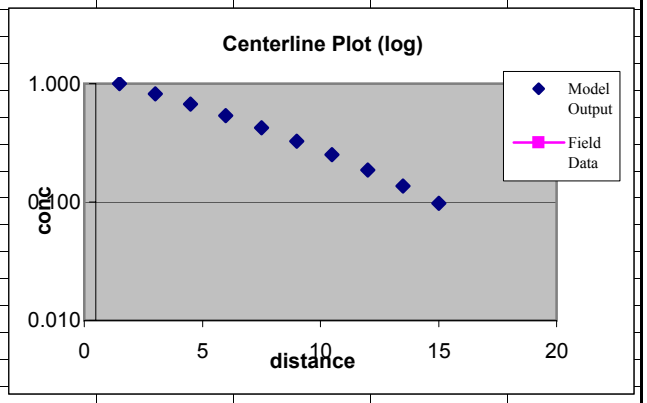
Point Concentration

x(ft)	y(ft)	z(ft)
350	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	350	0	0
at	120	days =	

0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	15
	Width (ft)	111

	1.5	3	4.5	6	7.5	9	10.5	12	13.5	15
111	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55.5	0.045	0.094	0.109	0.106	0.095	0.080	0.065	0.051	0.039	0.029
0	0.994	0.821	0.668	0.536	0.423	0.328	0.250	0.187	0.137	0.098
-55.5	0.045	0.094	0.109	0.106	0.095	0.080	0.065	0.051	0.039	0.029
-111	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Ethylene Dibromide

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

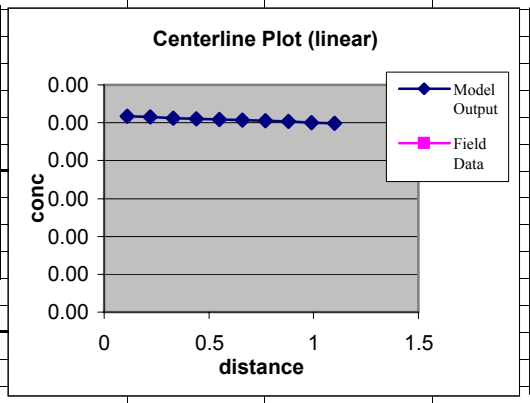
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	3.50E+01	3.50E+00	1.00E-04	0.00578082	100	15	120

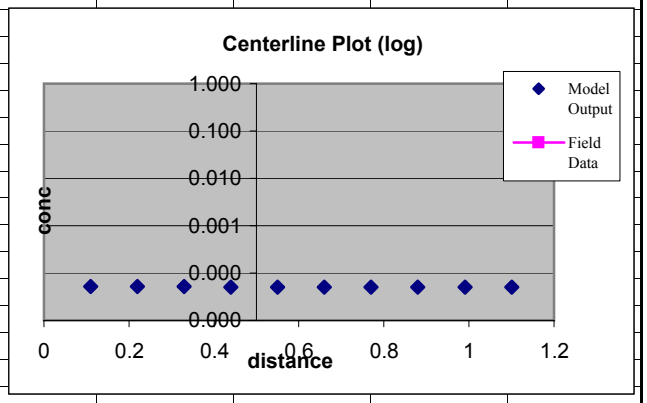
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	54	5.00E-03	2.328785714	0.103058001

Point Concentration

x(ft)	y(ft)	z(ft)
350	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	350	0	0
at	120	days =	0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft)	1.1
Width (ft)	111

	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.99	1.1
111	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55.5	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
-55.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-111	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

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			TW-5
Sample Date			4/25/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	165
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	16.5
Transverse Dispersivity	A_y	ft	1.7
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	93

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	450.0000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Toluene
Source Concentration (mg/l)		mg/l	8.5
Lambda (per day)		day^{-1}	0.024684932
KOC			130

Output (Concentration at the Downgradient Property Boundary in 4-months)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	1.99E-12	165	96
Sim 2 - Toluene	1	1	0.00E+00	165	15.4

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

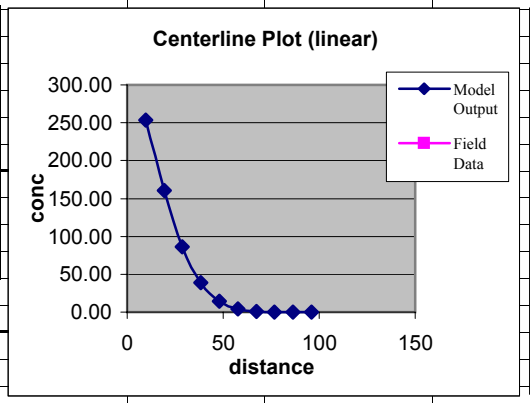
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
450	1.65E+01	1.65E+00	1.00E-04	0.0009589	100	15	120

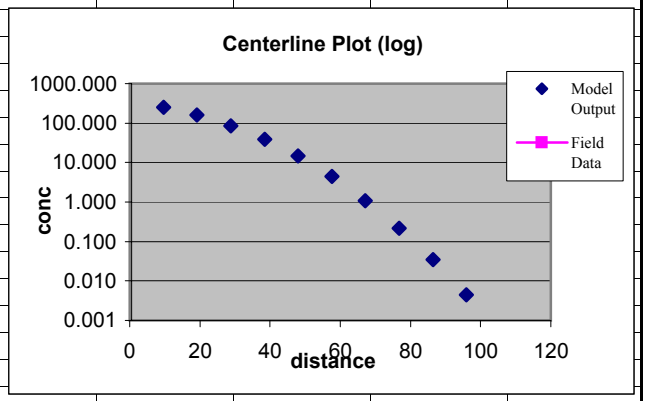
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
165	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	165	0	0
at	120	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	96
	Width (ft)	93

	9.6	19.2	28.8	38.4	48	57.6	67.2	76.8	86.4	96
93	0.000	0.000	0.000	0.003	0.005	0.004	0.002	0.001	0.000	0.000
46.5	185.830	107.493	55.448	24.327	8.877	2.657	0.647	0.127	0.020	0.003
0	253.529	160.455	86.609	39.106	14.562	4.426	1.090	0.216	0.034	0.004
-46.5	185.830	107.493	55.448	24.327	8.877	2.657	0.647	0.127	0.020	0.003
-93	0.000	0.000	0.000	0.003	0.005	0.004	0.002	0.001	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Toluene

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	1.65E+01	1.65E+00	1.00E-04	0.02468493	100	15	120

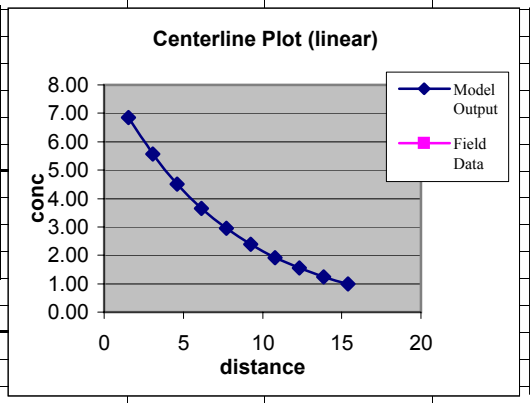
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	130	5.00E-03	4.198928571	0.057157438

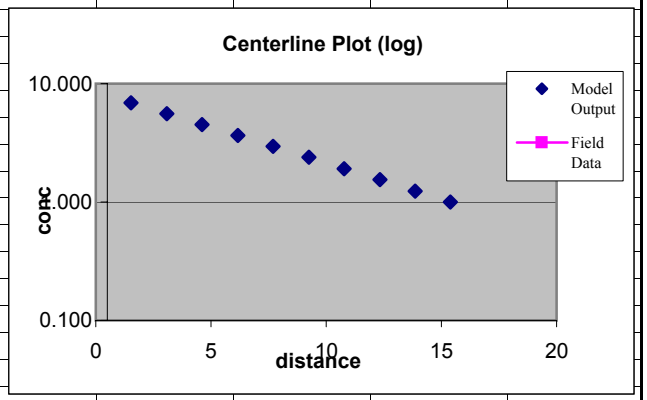
Point Concentration

x(ft)	y(ft)	z(ft)
165	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	165	0	0
at	120	days =	

0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	15.4
	Width (ft)	93

	1.54	3.08	4.62	6.16	7.7	9.24	10.78	12.32	13.86	15.4
93	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46.5	6.438	4.799	3.669	2.847	2.229	1.754	1.385	1.095	0.867	0.685
0	6.851	5.556	4.502	3.645	2.947	2.381	1.920	1.546	1.242	0.996
-46.5	6.438	4.799	3.669	2.847	2.229	1.754	1.385	1.095	0.867	0.685
-93	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									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			TW-8
Sample Date			4/25/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	465
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	46.5
Transverse Dispersivity	A_y	ft	4.7
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	81

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.4800
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Ethylbenzene
Source Concentration (mg/l)		mg/l	2.1
Lambda (per day)		day^{-1}	0.003041096
KOC			220
Sim 3			
Contaminant			Chrysene
Source Concentration (mg/l)		mg/l	0.2
Lambda (per day)		day^{-1}	0.000345205
KOC			490000
Sim 4			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	22
Lambda (per day)		day^{-1}	0.002684932
KOC			950
Sim 5			
Contaminant			Pyrene
Source Concentration (mg/l)		mg/l	0.5
Lambda (per day)		day^{-1}	0.000191781
KOC			68000

Output (Concentration at the Downgradient Property Boundary in 4-months)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	0.00E+00	465	88
Sim 2 - Ethylbenzene	0.7	0.7	0.00E+00	465	16
Sim 3 - Chrysene	0.0019	0.0019	0.00E+00	465	1.2
Sim 4 - Naphthalene	0.1	0.1	0.00E+00	465	29
Sim 5 - Pyrene	0.13	0.13	0.00E+00	465	1

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

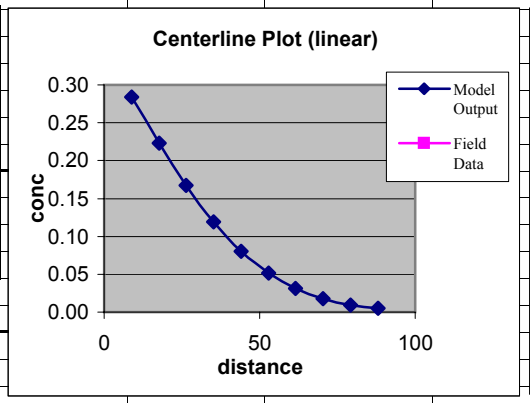
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	4.65E+01	4.65E+00	1.00E-04	0.0009589	100	15	120

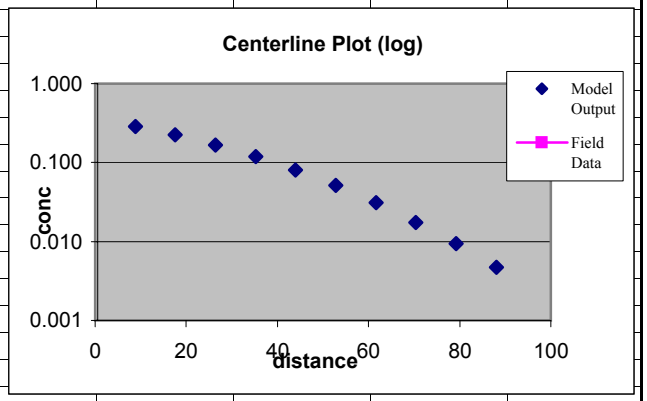
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
465	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	465	0	0
at	120	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	88
	Width (ft)	81

	8.8	17.6	26.4	35.2	44	52.8	61.6	70.4	79.2	88
81	0.000	0.002	0.004	0.005	0.005	0.004	0.003	0.002	0.001	0.001
40.5	0.242	0.172	0.122	0.084	0.056	0.035	0.021	0.012	0.006	0.003
0	0.284	0.223	0.167	0.119	0.080	0.051	0.031	0.018	0.009	0.005
-40.5	0.242	0.172	0.122	0.084	0.056	0.035	0.021	0.012	0.006	0.003
-81	0.000	0.002	0.004	0.005	0.005	0.004	0.003	0.002	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Ethylbenzene

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	4.65E+01	4.65E+00	1.00E-04	0.0030411	100	15	120

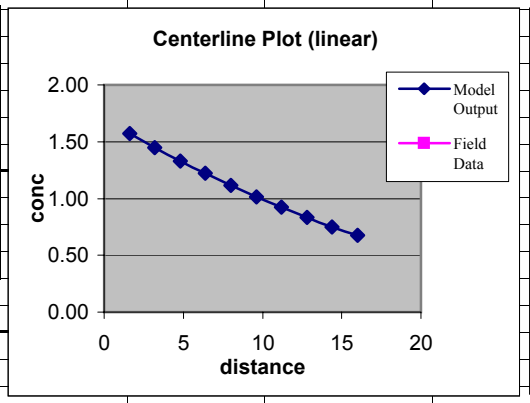
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	220	5.00E-03	6.413571429	0.037420648

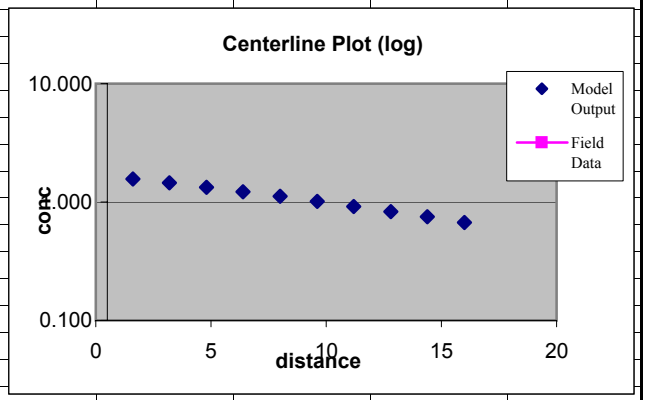
Point Concentration

x(ft)	y(ft)	z(ft)
465	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	465	0	0
at	120	days =	

0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft)	16
Width (ft)	81

	1.6	3.2	4.8	6.4	8	9.6	11.2	12.8	14.4	16
81	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.003	0.004
40.5	1.563	1.391	1.229	1.088	0.964	0.856	0.759	0.673	0.597	0.527
0	1.574	1.450	1.332	1.221	1.115	1.015	0.921	0.833	0.751	0.674
-40.5	1.563	1.391	1.229	1.088	0.964	0.856	0.759	0.673	0.597	0.527
-81	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.003	0.004

Field Data:	Centerline C	Concentration
	Distance from Source	

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery						
Date:	6/6/2005	Prepared by	Allison Jelinek				
		Contaminant	Chrysene				

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001				
0	4.65E+01	4.65E+00	1.00E-04	0.00034521	100	15	120

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	0.0035	0.35	1.7225	490000	5.00E-03	12058.5	1.9903E-05

NEW QUICK_DOMENICO.XLS

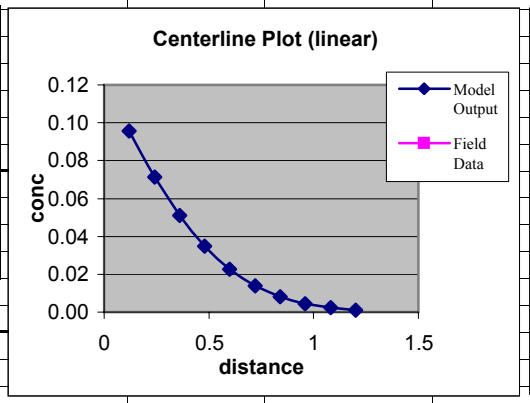
SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987)
Modified to Include Retardation

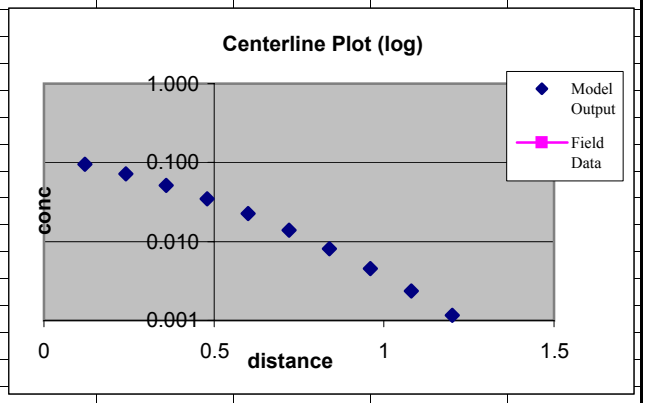
Point Concentration

x(ft)	y(ft)	z(ft)
465	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	465	0	0
at	120	days =	

0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	1.2
	Width (ft)	81

	0.12	0.24	0.36	0.48	0.6	0.72	0.84	0.96	1.08	1.2
81	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40.5	0.096	0.071	0.051	0.035	0.023	0.014	0.008	0.005	0.002	0.001
0	0.096	0.071	0.051	0.035	0.023	0.014	0.008	0.005	0.002	0.001
-40.5	0.096	0.071	0.051	0.035	0.023	0.014	0.008	0.005	0.002	0.001
-81	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 TOO

Project: 2574601 - Sunoco Philadelphia Refinery
Date: 6/6/2005 Prepared by: Allison Jelinek
Contaminant: Naphthalene

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
22	4.65E+01	4.65E+00	1.00E-04	0.00268493	100	15	120

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	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

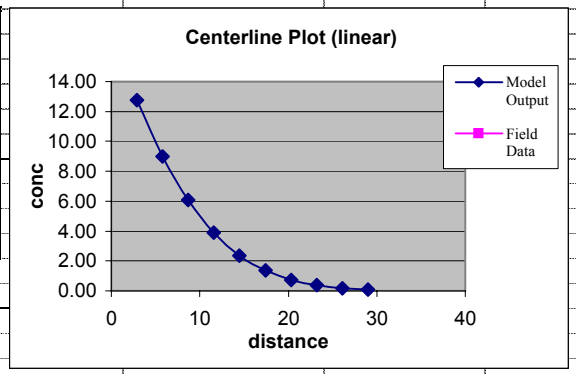
NEW QUICK_DOMENICO.XLS

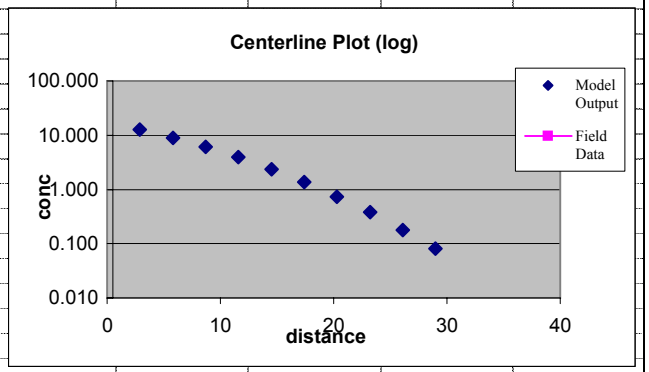
SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

Point Concentration

x(ft)	y(ft)	z(ft)
465	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	465	0	0
at	120	days =	0.000 mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 29
Width (ft) 81

	2.9	5.8	8.7	11.6	14.5	17.4	20.3	23.2	26.1	29
81	0.000	0.000	0.002	0.006	0.009	0.010	0.009	0.007	0.004	0.002
40.5	12.326	8.114	5.186	3.196	1.884	1.056	0.559	0.280	0.131	0.058
0	12.756	8.994	6.068	3.898	2.375	1.366	0.741	0.377	0.180	0.080
-40.5	12.326	8.114	5.186	3.196	1.884	1.056	0.559	0.280	0.131	0.058
-81	0.000	0.000	0.002	0.006	0.009	0.010	0.009	0.007	0.004	0.002

Field Data: Centerline C Concentration
Distance from Source

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Pyrene

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

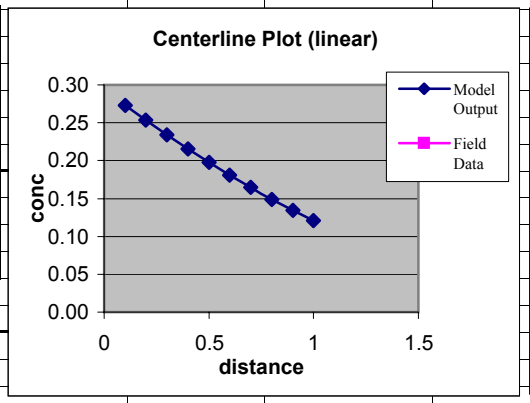
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	4.65E+01	4.65E+00	1.00E-04	0.00019178	100	15	120

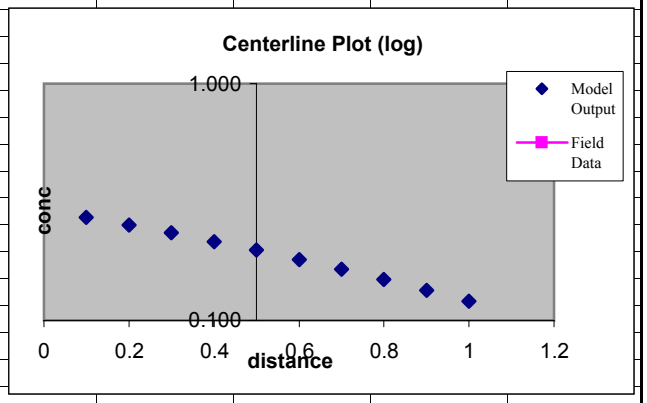
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	68000	5.00E-03	1674.285714	0.000143345

Point Concentration

x(ft)	y(ft)	z(ft)
465	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	465	0	0
at	120	days =	**0.000** mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	1
Width (ft)	179

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
179	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
89.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.273	0.253	0.234	0.216	0.198	0.181	0.164	0.149	0.134	0.120
-89.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-179	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	

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			TW-10
Sample Date			4/27/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	525
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	52.5
Transverse Dispersivity	A_y	ft	5.3
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	134

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	9.2000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Ethylbenzene
Source Concentration (mg/l)		mg/l	3.2
Lambda (per day)		day^{-1}	0.003041096
KOC			220
Sim 3			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	84
Lambda (per day)		day^{-1}	0.00189863
KOC			12
Sim 4			
Contaminant			Toluene
Source Concentration (mg/l)		mg/l	24
Lambda (per day)		day^{-1}	0.024684932
KOC			130
Sim 5			
Contaminant			Total Xylenes
Source Concentration (mg/l)		mg/l	20
Lambda (per day)		day^{-1}	0.001890411
KOC			350
Sim 6			
Contaminant			Chrysene
Source Concentration (mg/l)		mg/l	0.18
Lambda (per day)		day^{-1}	0.000345205
KOC			490000
Sim 7			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	12
Lambda (per day)		day^{-1}	0.002684932
KOC			950
Sim 8			
Contaminant			Pyrene
Source Concentration (mg/l)		mg/l	0
Lambda (per day)		day^{-1}	0.000191781
KOC			68000
Sim 9			
Contaminant			Ethylene Dibromide
Source Concentration (mg/l)		mg/l	0.000089
Lambda (per day)		day^{-1}	0.005780822
KOC			54

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Output (Concentration at the Downgradient Property Boundary in 4-months)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	0.00E+00	525	125
Sim 2 - Ethylbenzene	0.7	0.7	0.00E+00	525	23
Sim 3 - MTBE	0.02	0.02	0.00E+00	525	186
Sim 4 - Toluene	1	1	0.00E+00	525	37
Sim 5 - Total Xylenes	10	10	0.00E+00	525	7.1
Sim 6 - Chrysene	0.0019	0.0019	0.00E+00	525	1.2
Sim 7 - Naphthalene	0.1	0.1	0.00E+00	525	27.6
Sim 8 - Pyrene	0.13	0.13	0.00E+00	525	1
Sim 9 - Ethylene Dibromide	0.00005	0.00005	0.00E+00	525	14.3

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

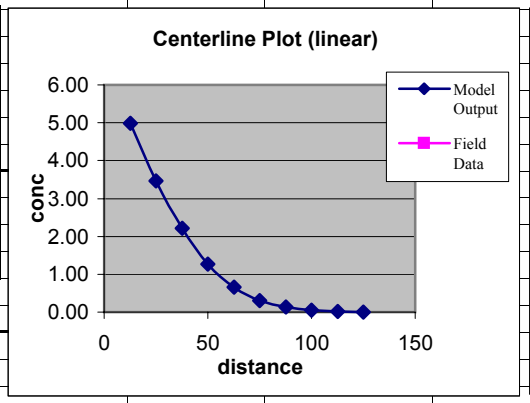
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
9	5.25E+01	5.25E+00	1.00E-04	0.0009589	100	15	120

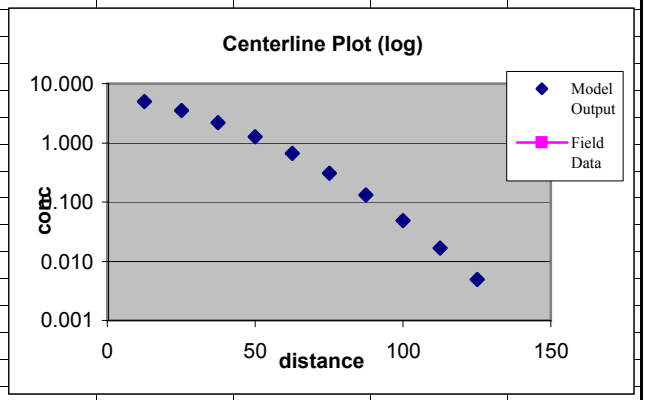
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
525	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	525	0	0
at	120	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	125
	Width (ft)	134

	12.5	25	37.5	50	62.5	75	87.5	100	112.5	125
134	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
67	0.343	0.511	0.438	0.300	0.177	0.091	0.042	0.017	0.006	0.002
0	4.982	3.472	2.209	1.274	0.662	0.310	0.130	0.049	0.016	0.005
-67	0.343	0.511	0.438	0.300	0.177	0.091	0.042	0.017	0.006	0.002
-134	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Ethylbenzene

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)
3	5.25E+01	5.25E+00	1.00E-04	0.0030411	100	15	120

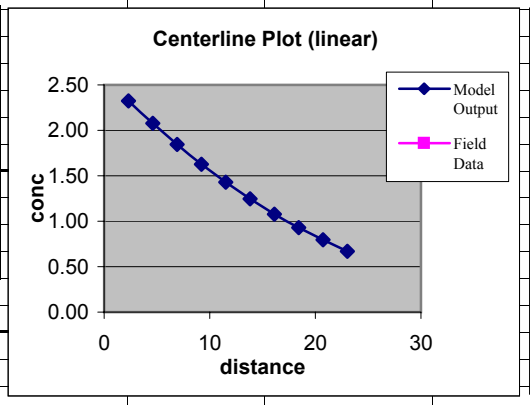
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	220	5.00E-03	6.413571429	0.037420648

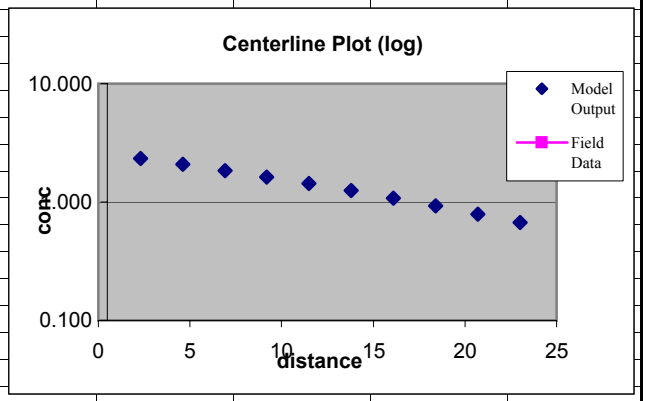
Point Concentration

x(ft)	y(ft)	z(ft)
525	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	525	0	0
at	120	days =	

0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	23
	Width (ft)	134

	2.3	4.6	6.9	9.2	11.5	13.8	16.1	18.4	20.7	23
134	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
67	0.001	0.015	0.042	0.068	0.087	0.098	0.103	0.103	0.099	0.092
0	2.325	2.075	1.842	1.626	1.427	1.244	1.078	0.928	0.793	0.672
-67	0.001	0.015	0.042	0.068	0.087	0.098	0.103	0.103	0.099	0.092
-134	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

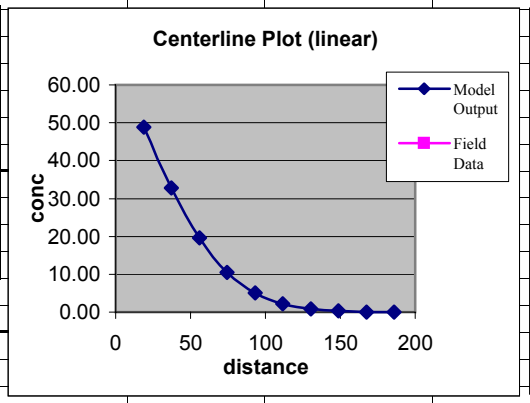
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
84	5.25E+01	5.25E+00	1.00E-04	0.00189863	100	15	120

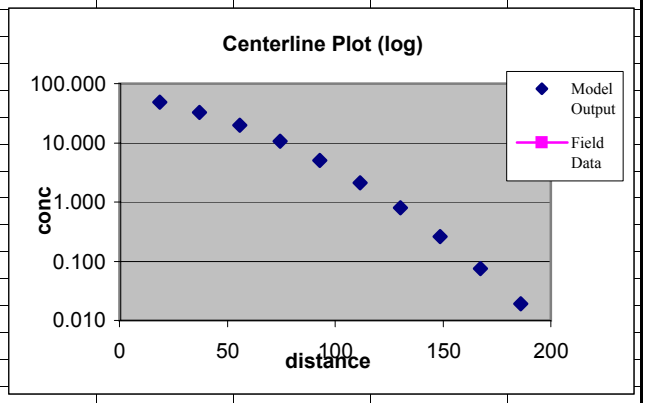
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
525	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	525	0	0
at	120	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	186
	Width (ft)	134

	18.6	*37.2*	*55.8*	*74.4*	*93*	*111.6*	*130.2*	*148.8*	*167.4*	*186*
134	0.000	0.000	0.005	0.015	0.020	0.018	0.011	0.006	0.002	0.001
67	5.466	6.451	4.935	3.093	1.660	0.772	0.312	0.110	0.034	0.009
0	48.831	32.732	19.663	10.552	5.043	2.137	0.799	0.263	0.076	0.019
-67	5.466	6.451	4.935	3.093	1.660	0.772	0.312	0.110	0.034	0.009
-134	0.000	0.000	0.005	0.015	0.020	0.018	0.011	0.006	0.002	0.001

Field Data: Centerline C Concentration
Distance from Source

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by:	Allison Jelinek
		Contaminant:	Toluene

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

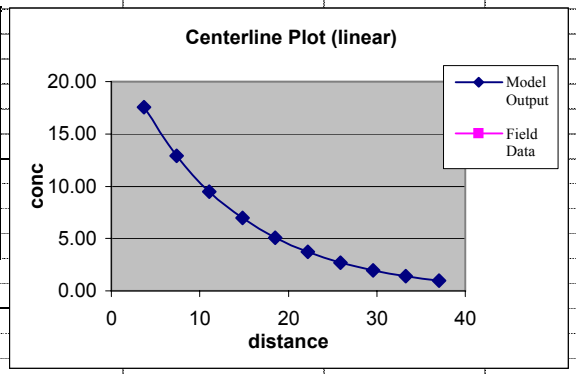
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
24	5.25E+01	5.25E+00	1.00E-04	0.02468493	100	15	120

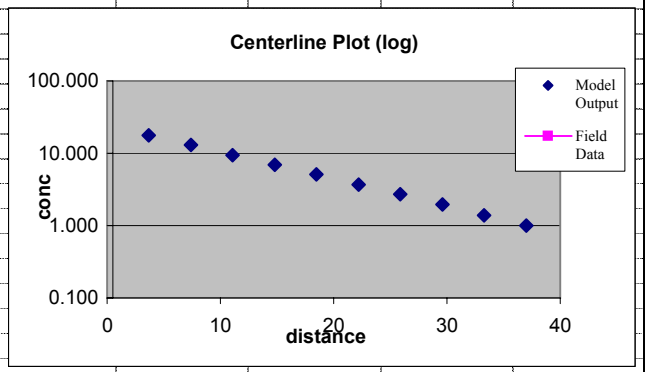
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	130	5.00E-03	4.198928571	0.057157438

Point Concentration

x(ft)	y(ft)	z(ft)
525	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	525	0	0
at	120	days =	0.000 mg/l





AREAL MODEL: CALCULATION DOMAIN

Length (ft) 37

Width (ft) 134

	3.7	7.4	11.1	14.8	18.5	22.2	25.9	29.6	33.3	37
134	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
67	0.056	0.347	0.547	0.601	0.566	0.492	0.408	0.326	0.255	0.195
0	17.555	12.918	9.490	6.957	5.087	3.705	2.688	1.939	1.391	0.991
-67	0.056	0.347	0.547	0.601	0.566	0.492	0.408	0.326	0.255	0.195
-134	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Field Data: Centerline Concentration

Distance from Source

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Total Xylenes

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

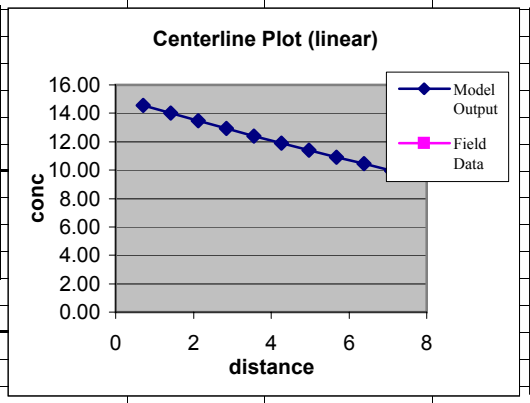
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
20	5.25E+01	5.25E+00	1.00E-04	0.00189041	100	15	120

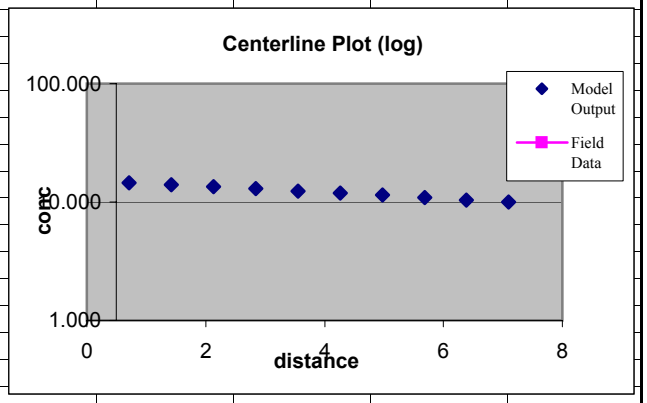
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	350	5.00E-03	9.6125	0.02496749

Point Concentration

x(ft)	y(ft)	z(ft)
525	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	525	0	0
at	120	days =	
			0.000
			mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	7.1
	Width (ft)	177

	0.71	1.42	2.13	2.84	3.55	4.26	4.97	5.68	6.39	7.1
177	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
88.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	14.562	14.008	13.465	12.933	12.412	11.902	11.404	10.917	10.441	9.977
-88.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-177	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Chrysene

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

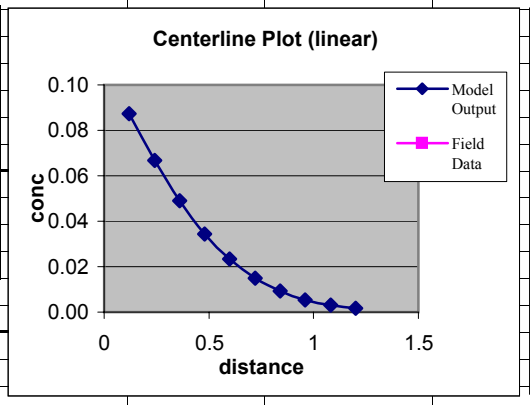
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	5.25E+01	5.25E+00	1.00E-04	0.00034521	100	15	120

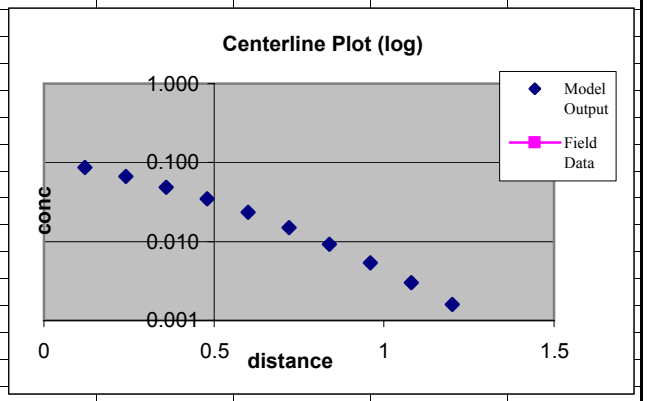
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	490000	5.00E-03	12058.5	1.9903E-05

Point Concentration

x(ft)	y(ft)	z(ft)
525	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	525	0	0
at	120	days =	
			0.000
			mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	1.2
Width (ft)	134

	0.12	0.24	0.36	0.48	0.6	0.72	0.84	0.96	1.08	1.2
134	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
67	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.087	0.067	0.049	0.034	0.023	0.015	0.009	0.005	0.003	0.002
-67	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-134	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

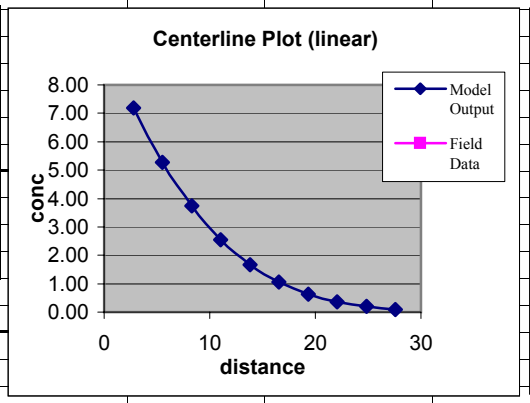
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
12	5.25E+01	5.25E+00	1.00E-04	0.00268493	100	15	120

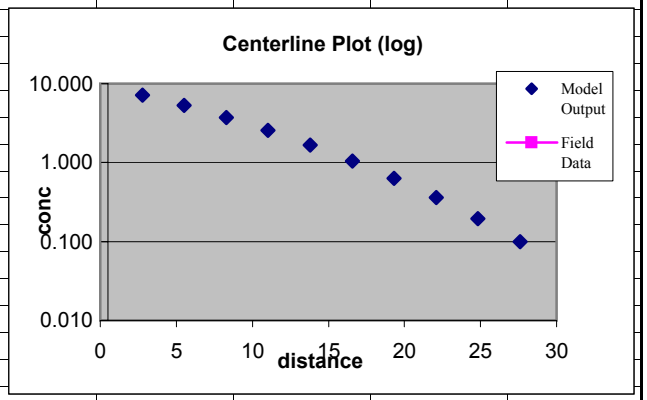
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
525	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	525	0	0
at	120	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	27.6
	Width (ft)	134

	2.76	5.52	8.28	11.04	13.8	16.56	19.32	22.08	24.84	27.6
134	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
67	0.006	0.067	0.128	0.146	0.132	0.104	0.073	0.047	0.028	0.016
0	7.186	5.277	3.744	2.557	1.675	1.050	0.628	0.358	0.194	0.100
-67	0.006	0.067	0.128	0.146	0.132	0.104	0.073	0.047	0.028	0.016
-134	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Pyrene

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	5.25E+01	5.25E+00	1.00E-04	0.00019178	100	15	120

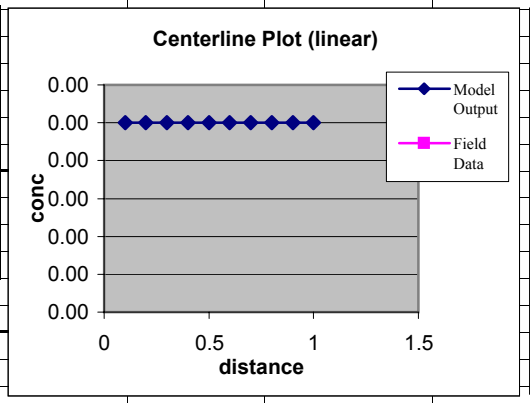
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	68000	5.00E-03	1674.285714	0.000143345

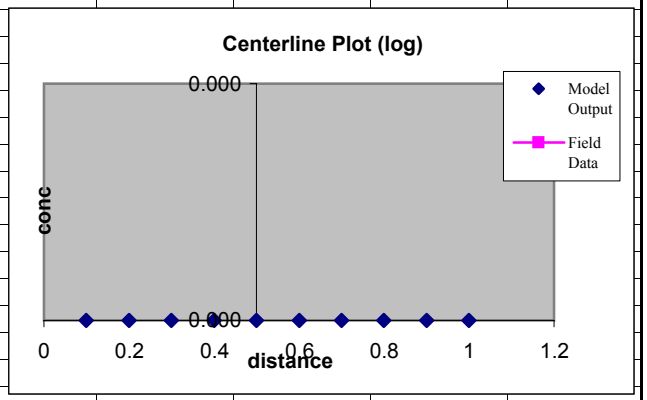
Point Concentration

x(ft)	y(ft)	z(ft)
525	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	525	0	0
at	120	days =	

0.000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	1
Width (ft)	134

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
134	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
67	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
-67	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-134	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Ethylene Dibromide

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

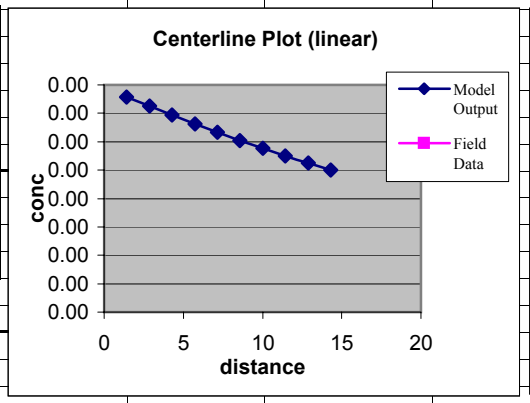
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	5.25E+01	5.25E+00	1.00E-04	0.00578082	100	15	120

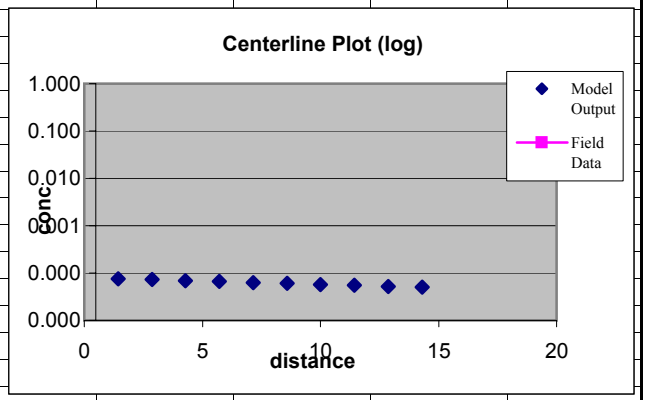
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm³)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	54	5.00E-03	2.328785714	0.103058001

Point Concentration

x(ft)	y(ft)	z(ft)
525	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	525	0	0
at	120	days =	0.000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	14.3
Width (ft)	134

	1.43	2.86	4.29	5.72	7.15	8.58	10.01	11.44	12.87	14.3
134	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
67	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
-67	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-134	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

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			MW-31
Sample Date			4/26/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	775
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	77.5
Transverse Dispersivity	A_y	ft	7.8
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	116

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	2.6000
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output (Concentration at the Downgradient Property Boundary in 4-months)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	0.00E+00	775	132

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

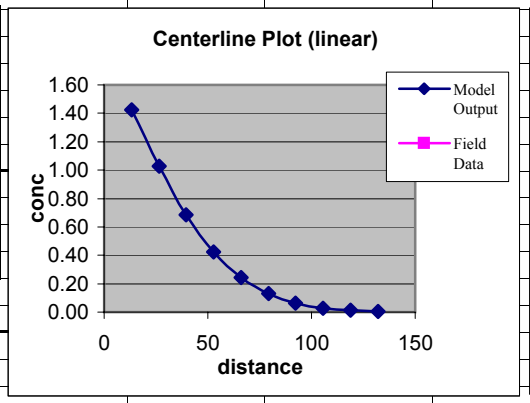
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
3	7.75E+01	7.75E+00	1.00E-04	0.0009589	100	15	120

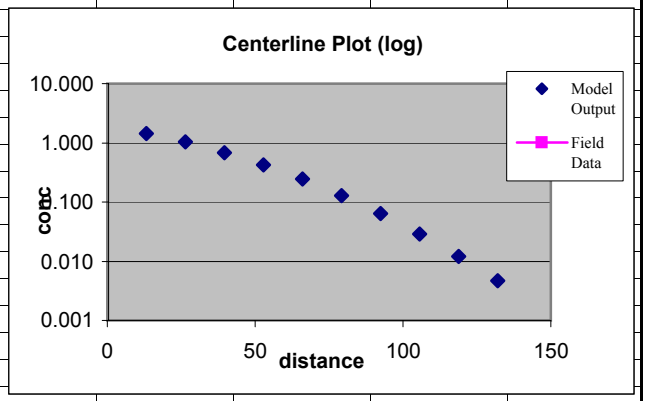
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm³)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
775	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	775	0	0
at	120	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	132
	Width (ft)	116

	13.2	26.4	39.6	52.8	66	79.2	92.4	105.6	118.8	132
116	0.000	0.001	0.003	0.005	0.005	0.005	0.003	0.002	0.001	0.000
58	0.411	0.361	0.267	0.179	0.110	0.062	0.032	0.015	0.007	0.003
0	1.425	1.028	0.685	0.423	0.243	0.129	0.064	0.029	0.012	0.005
-58	0.411	0.361	0.267	0.179	0.110	0.062	0.032	0.015	0.007	0.003
-116	0.000	0.001	0.003	0.005	0.005	0.005	0.003	0.002	0.001	0.000

Field Data:	Centerline C	Concentration
	Distance from Source	

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			MW-32
Sample Date			4/26/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	565
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	56.5
Transverse Dispersivity	A_y	ft	5.7
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	120
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	84

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.4200
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Ethylbenzene
Source Concentration (mg/l)		mg/l	1.1
Lambda (per day)		day^{-1}	0.003041096
KOC			220
Sim 3			
Contaminant			Toluene
Source Concentration (mg/l)		mg/l	4.6
Lambda (per day)		day^{-1}	0.024684932
KOC			130
Sim 4			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	0.12
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 4-months)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	0.00E+00	565	93
Sim 2 - Ethylbenzene	0.7	0.7	0.00E+00	565	5.2
Sim 3 - Toluene	1	1	0.00E+00	565	19
Sim 4 - Naphthalene	0.1	0.1	0.00E+00	565	1

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

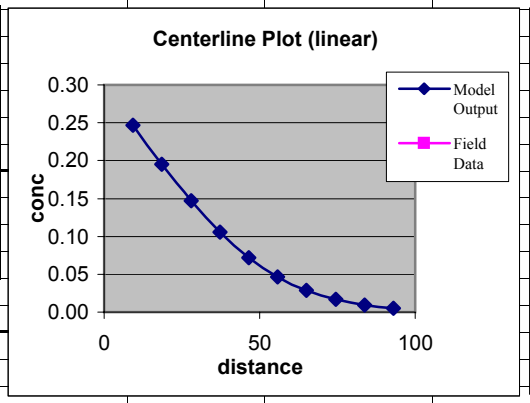
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	5.65E+01	5.65E+00	1.00E-04	0.0009589	100	15	120

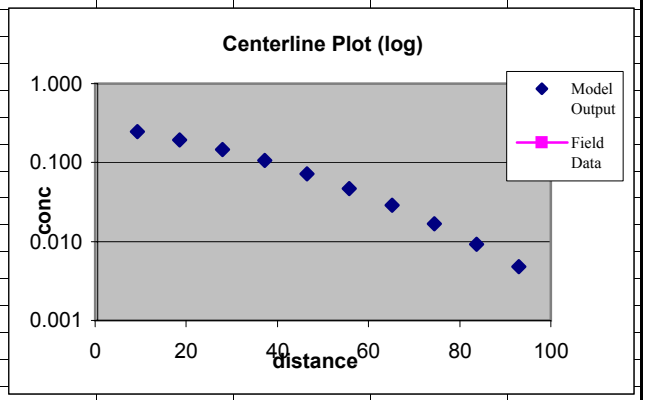
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
565	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	565	0	0
at	120	days =	0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft)	93
Width (ft)	84

	9.3	18.6	27.9	37.2	46.5	55.8	65.1	74.4	83.7	93
84	0.000	0.002	0.004	0.005	0.005	0.004	0.003	0.002	0.001	0.001
42	0.193	0.138	0.100	0.070	0.047	0.031	0.019	0.011	0.006	0.003
0	0.247	0.195	0.147	0.106	0.072	0.047	0.029	0.017	0.009	0.005
-42	0.193	0.138	0.100	0.070	0.047	0.031	0.019	0.011	0.006	0.003
-84	0.000	0.002	0.004	0.005	0.005	0.004	0.003	0.002	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Ethylbenzene

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	5.65E+01	5.65E+00	1.00E-04	0.0030411	100	15	120

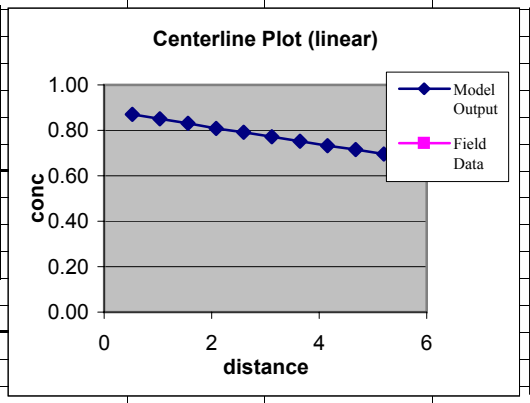
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	220	5.00E-03	6.413571429	0.037420648

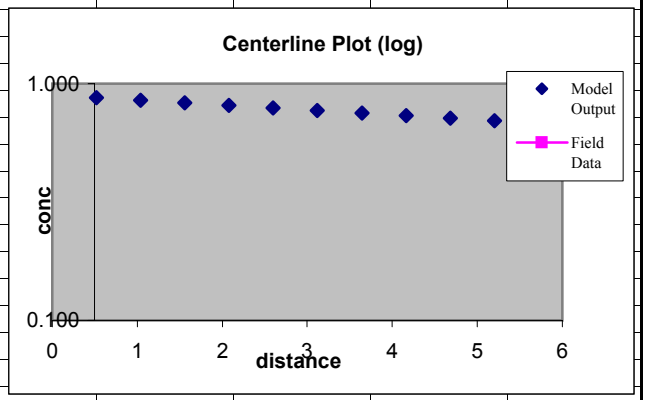
Point Concentration

x(ft)	y(ft)	z(ft)
565	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	565	0	0
at	120	days =	

0.000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	5.2
Width (ft)	84

	0.52	1.04	1.56	2.08	2.6	3.12	3.64	4.16	4.68	5.2
84	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42	0.870	0.841	0.806	0.770	0.735	0.702	0.672	0.644	0.618	0.594
0	0.870	0.850	0.830	0.810	0.790	0.771	0.752	0.733	0.715	0.697
-42	0.870	0.841	0.806	0.770	0.735	0.702	0.672	0.644	0.618	0.594
-84	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery						
Date:	6/6/2005	Prepared by	Allison Jelinek				
		Contaminant	Toluene				

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001				
5	5.65E+01	5.65E+00	1.00E-04	0.02468493	100	15	120

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	0.0035	0.35	1.7225	130	5.00E-03	4.198928571	0.057157438

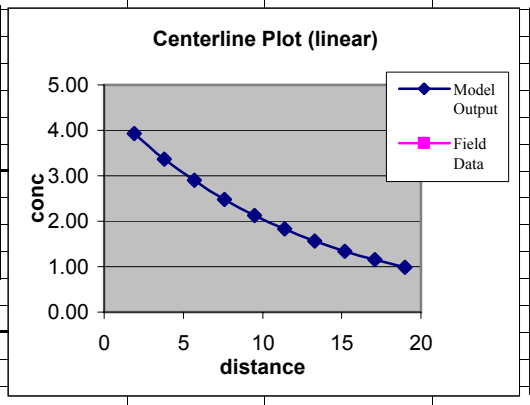
NEW QUICK_DOMENICO.XLS

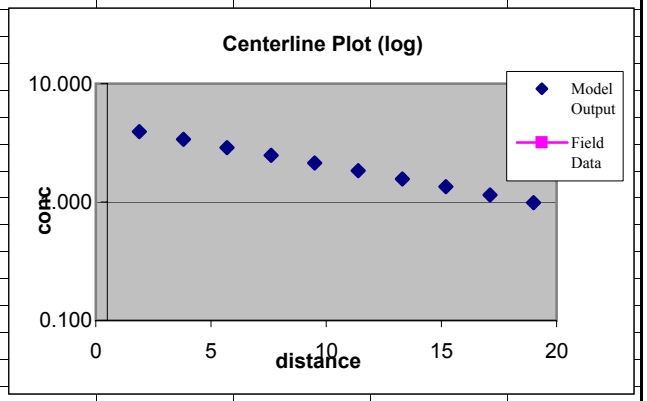
SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

Point Concentration

x(ft)	y(ft)	z(ft)
565	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	565	0	0
at	120	days =	
			0.000
			mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	19
	Width (ft)	84

	1.9	3.8	5.7	7.6	9.5	11.4	13.3	15.2	17.1	19
84	0.000	0.000	0.000	0.000	0.001	0.003	0.004	0.006	0.008	0.010
42	3.759	2.997	2.434	2.003	1.664	1.390	1.165	0.980	0.826	0.697
0	3.924	3.371	2.895	2.485	2.133	1.830	1.569	1.344	1.151	0.984
-42	3.759	2.997	2.434	2.003	1.664	1.390	1.165	0.980	0.826	0.697
-84	0.000	0.000	0.000	0.000	0.001	0.003	0.004	0.006	0.008	0.010

Field Data:	Centerline C	Concentration
	Distance from Source	

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by:	Allison Jelinek
		Contaminant:	Naphthalene

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	5.65E+01	5.65E+00	1.00E-04	0.00268493	100	15	120

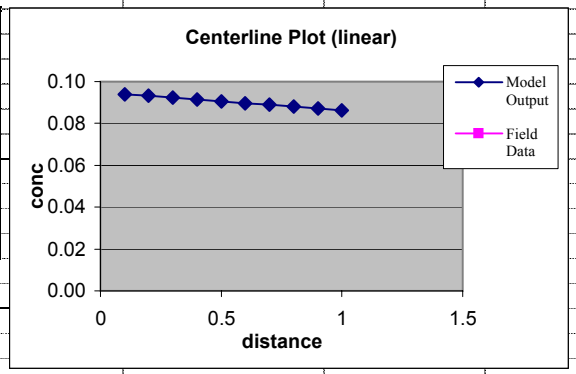
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

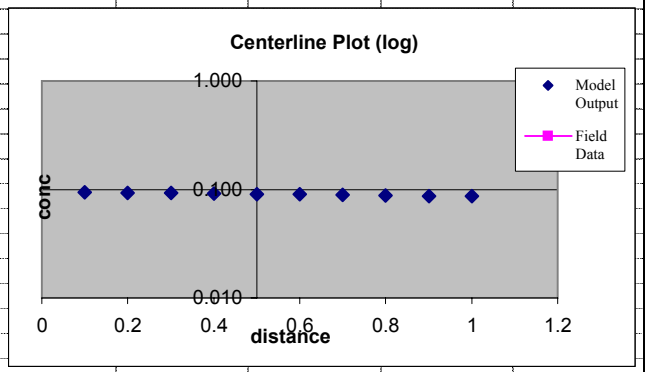
Point Concentration

x(ft)	y(ft)	z(ft)
565	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	565	0	0
at	120	days =	

0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	1
	Width (ft)	84

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
84	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42	0.094	0.093	0.092	0.091	0.091	0.090	0.089	0.088	0.087	0.086
0	0.094	0.093	0.092	0.091	0.091	0.090	0.089	0.088	0.087	0.086
-42	0.094	0.093	0.092	0.091	0.091	0.090	0.089	0.088	0.087	0.086
-84	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	

FATE AND TRANSPORT MODELS

(30 YEAR PROJECTIONS)

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/8/2005

Generic Input Parameters			
Source Identification (or Well ID)			MW-38
Sample Date			4/26/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	51.6

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.1100
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output (Concentration at the Downgradient Property Boundary in 30-years)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	1.09E-01	1	310

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/8/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

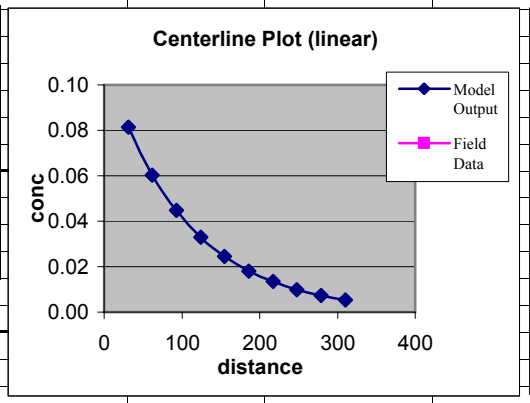
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	10950

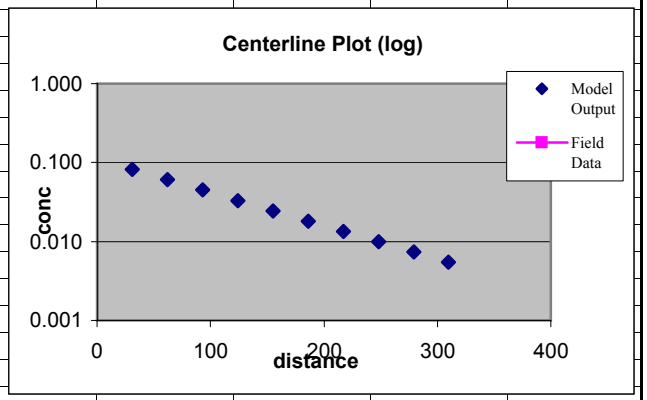
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	
			0.109
			mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	310
Width (ft)	51.6

	31	62	93	124	155	186	217	248	279	310
51.6	0.002	0.005	0.005	0.005	0.004	0.004	0.003	0.002	0.002	0.001
25.8	0.081	0.060	0.045	0.033	0.025	0.018	0.013	0.010	0.007	0.005
0	0.081	0.060	0.045	0.033	0.025	0.018	0.013	0.010	0.007	0.005
-25.8	0.081	0.060	0.045	0.033	0.025	0.018	0.013	0.010	0.007	0.005
-51.6	0.002	0.005	0.005	0.005	0.004	0.004	0.003	0.002	0.002	0.001

Field Data: Centerline C Concentration
Distance from Source

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/8/2005

Generic Input Parameters			
Source Identification (or Well ID)			MW-39
Sample Date			4/26/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	49.9

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.0080
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output (Concentration at the Downgradient Property Boundary in 30-years)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	7.92E-03	1	48.6

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/8/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

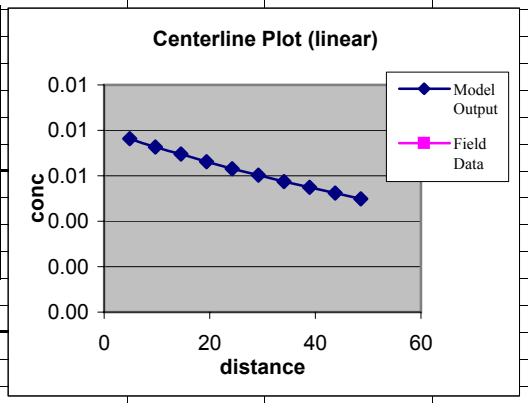
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
0	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	10950

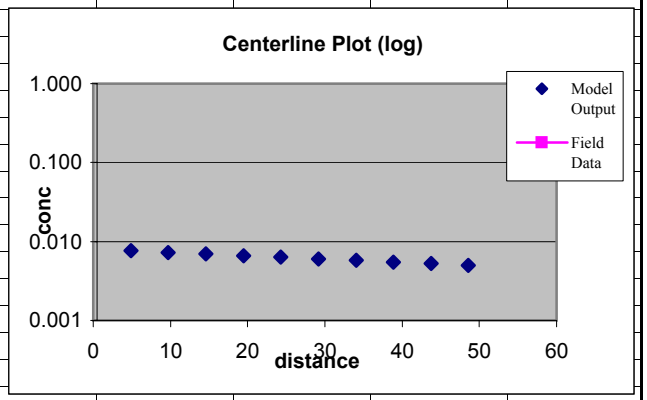
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	
			0.008
			mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 48.6
Width (ft) 49.9

	4.86	9.72	14.58	19.44	24.3	29.16	34.02	38.88	43.74	48.6
49.9	0.005	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.003	0.003
24.95	0.008	0.007	0.007	0.007	0.006	0.006	0.006	0.005	0.005	0.005
0	0.008	0.007	0.007	0.007	0.006	0.006	0.006	0.005	0.005	0.005
-24.95	0.008	0.007	0.007	0.007	0.006	0.006	0.006	0.005	0.005	0.005
-49.9	0.005	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.003	0.003

Field Data: Centerline C Concentration
Distance from Source

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/8/2005

Generic Input Parameters			
Source Identification (or Well ID)			MW-40
Sample Date			4/26/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	50

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	0.15
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 30-years)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Naphthalene	0.1	0.1	1.15E-01	1	1.6

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/8/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

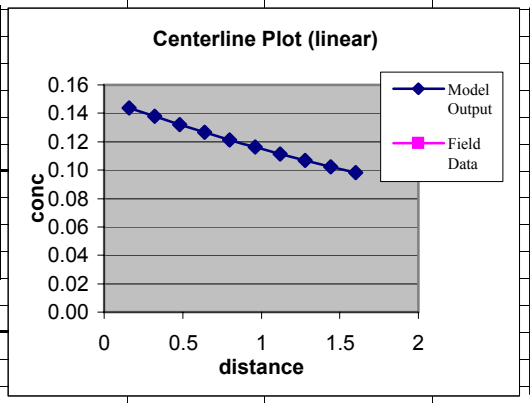
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
0	1.00E-01	1.00E-02	1.00E-04	0.00268493	100	15	10950

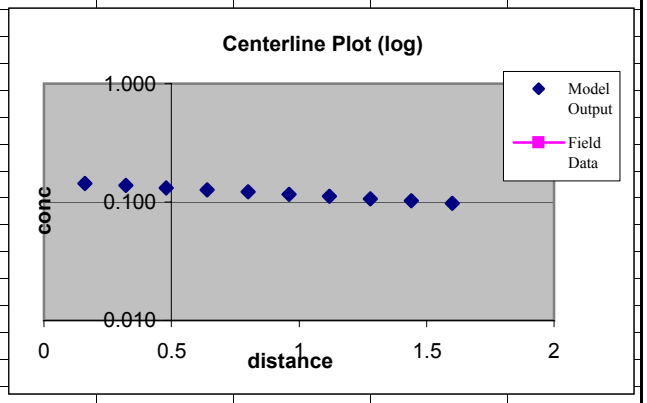
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	
			0.115
			mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	1.6
Width (ft)	50

	0.16	0.32	0.48	0.64	0.8	0.96	1.12	1.28	1.44	1.6
50	0.072	0.069	0.066	0.063	0.061	0.058	0.056	0.053	0.051	0.049
25	0.144	0.138	0.132	0.127	0.121	0.116	0.111	0.107	0.102	0.098
0	0.144	0.138	0.132	0.127	0.121	0.116	0.111	0.107	0.102	0.098
-25	0.144	0.138	0.132	0.127	0.121	0.116	0.111	0.107	0.102	0.098
-50	0.072	0.069	0.066	0.063	0.061	0.058	0.056	0.053	0.051	0.049

Field Data: Centerline C Concentration
Distance from Source

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-41
Sample Date			4/22/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	52

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.0650
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	0.53
Lambda (per day)		day^{-1}	0.00189863
KOC			12
Sim 3			
Contaminant			1,2-Dichloroethane
Source Concentration (mg/l)		mg/l	0.05
Lambda (per day)		day^{-1}	0.001890411
KOC			38

Output (Concentration at the Downgradient Property Boundary in 30-years)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	6.44E-02	1	255
Sim 2 - MTBE	0.02	0.02	5.25E-01	1	318
Sim 3 - 1,2-Dichloroethane	0.005	0.005	4.92E-02	1	146

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

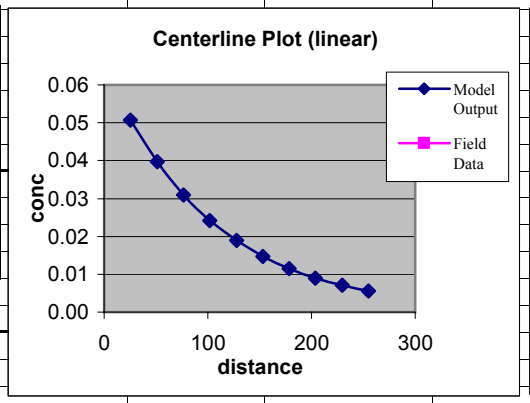
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	10950

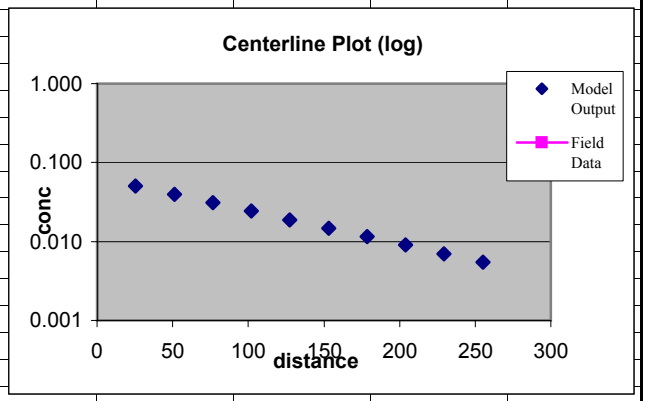
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	0.064 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 255
Width (ft) 52

	25.5	51	76.5	102	127.5	153	178.5	204	229.5	255
52	0.000	0.001	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001
26	0.051	0.040	0.031	0.024	0.019	0.015	0.012	0.009	0.007	0.005
0	0.051	0.040	0.031	0.024	0.019	0.015	0.012	0.009	0.007	0.005
-26	0.051	0.040	0.031	0.024	0.019	0.015	0.012	0.009	0.007	0.005
-52	0.000	0.001	0.002	0.002	0.002	0.002	0.002	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

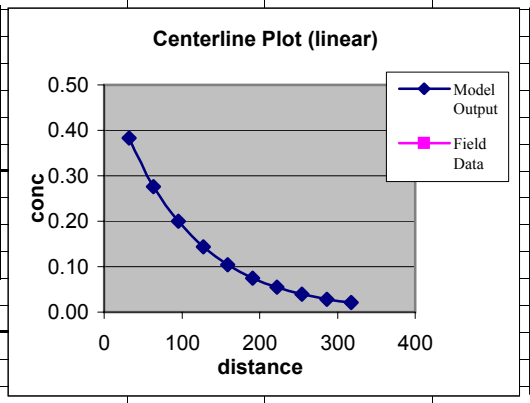
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	1.00E-01	1.00E-02	1.00E-04	0.00189863	100	15	10950

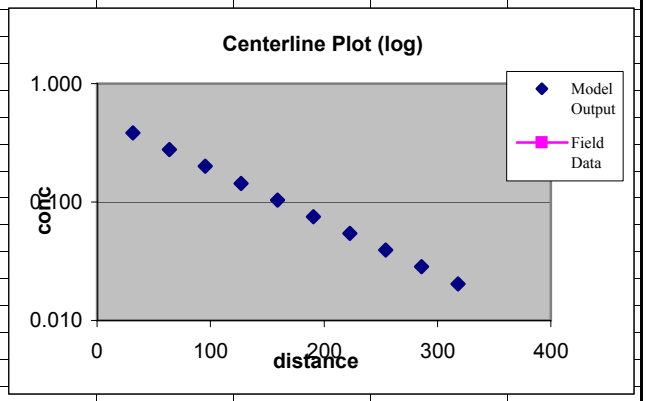
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	
			0.525
			mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	318
	Width (ft)	52

	31.8	63.6	95.4	127.2	159	190.8	222.6	254.4	286.2	318
52	0.002	0.011	0.015	0.015	0.014	0.011	0.009	0.007	0.006	0.004
26	0.383	0.276	0.200	0.144	0.104	0.075	0.054	0.039	0.028	0.020
0	0.383	0.276	0.200	0.144	0.104	0.075	0.054	0.039	0.028	0.020
-26	0.383	0.276	0.200	0.144	0.104	0.075	0.054	0.039	0.028	0.020
-52	0.002	0.011	0.015	0.015	0.014	0.011	0.009	0.007	0.006	0.004

Field Data:	Centerline C	Concentration
	Distance from Source	

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	1,2-Dichloroethane

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	1.00E-01	1.00E-02	1.00E-04	0.00189041	100	15	10950

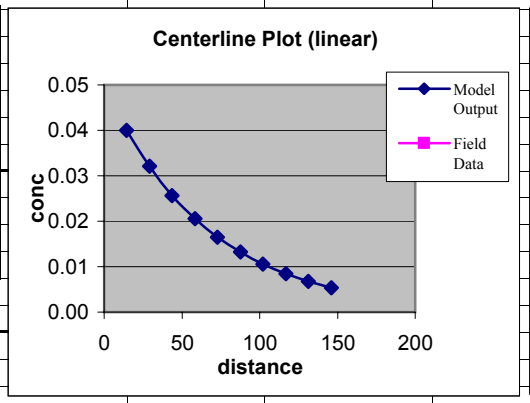
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	38	5.00E-03	1.935071429	0.124026429

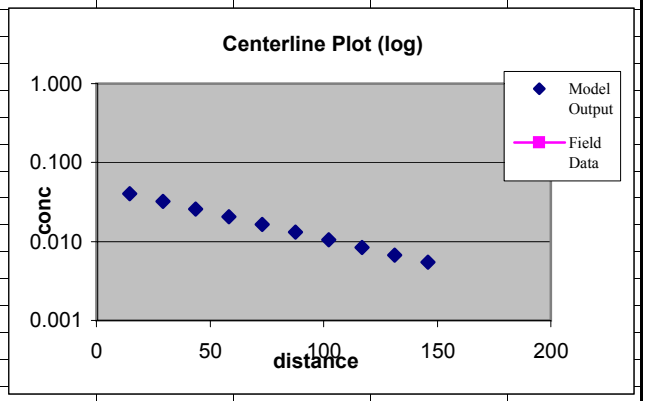
Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	

0.049 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	146
Width (ft)	52

	14.6	*29.2*	*43.8*	*58.4*	*73*	*87.6*	*102.2*	*116.8*	*131.4*	*146*
52	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001
26	0.040	0.032	0.026	0.021	0.016	0.013	0.011	0.008	0.007	0.005
0	0.040	0.032	0.026	0.021	0.016	0.013	0.011	0.008	0.007	0.005
-26	0.040	0.032	0.026	0.021	0.016	0.013	0.011	0.008	0.007	0.005
-52	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Field Data: Centerline C Concentration
Distance from Source

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-44
Sample Date			4/21/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	55

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	2.1000
Lambda (per day)		day $^{-1}$	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	0.034
Lambda (per day)		day $^{-1}$	0.00189863
KOC			12

Output (Concentration at the Downgradient Property Boundary in 30-years)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	2.08E+00	1	614
Sim 2 - MTBE	0.02	0.02	3.37E-02	1	49.5

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

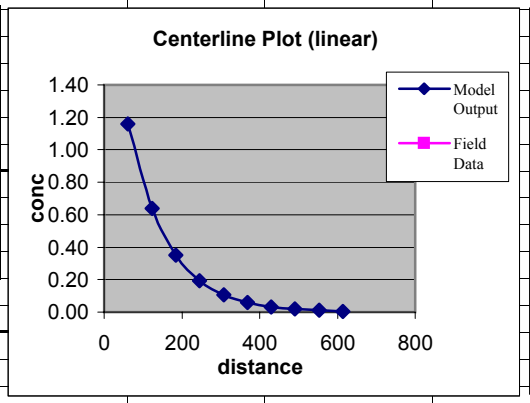
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
2	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	10950

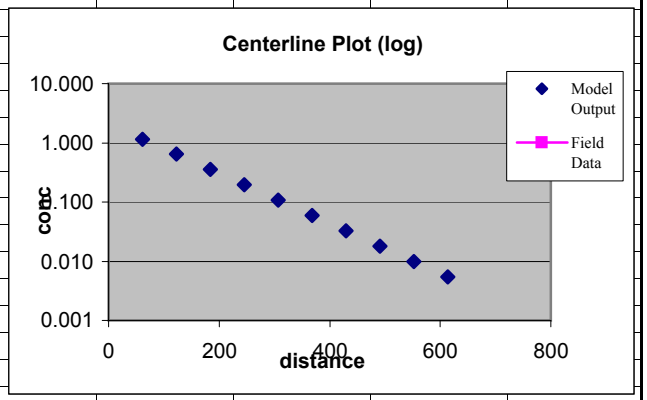
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	2.080 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 614
Width (ft) 55

	61.4	122.8	184.2	245.6	307	368.4	429.8	491.2	552.6	614
55	0.000	0.000	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.000
27.5	1.158	0.639	0.353	0.194	0.107	0.059	0.033	0.018	0.010	0.005
0	1.158	0.639	0.353	0.194	0.107	0.059	0.033	0.018	0.010	0.005
-27.5	1.158	0.639	0.353	0.194	0.107	0.059	0.033	0.018	0.010	0.005
-55	0.000	0.000	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.000

Field Data: Centerline C Concentration
Distance from Source

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

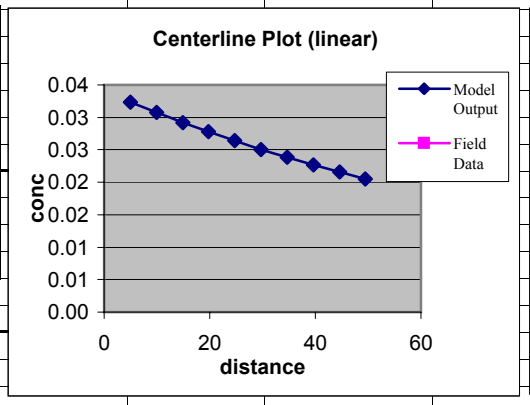
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
0	1.00E-01	1.00E-02	1.00E-04	0.00189863	100	15	10950

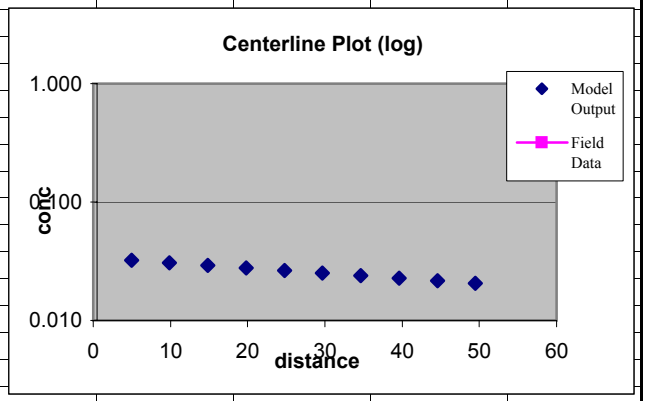
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	
			0.034
			mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	49.5
Width (ft)	179

	4.95	9.9	14.85	19.8	24.75	29.7	34.65	39.6	44.55	49.5
179	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
89.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.032	0.031	0.029	0.028	0.026	0.025	0.024	0.023	0.022	0.020
-89.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-179	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	

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-51
Sample Date			4/19/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	54

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.5900
Lambda (per day)		day $^{-1}$	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	1.9
Lambda (per day)		day $^{-1}$	0.00189863
KOC			12

Output (Concentration at the Downgradient Property Boundary in 30-years)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	5.84E-01	1	483
Sim 2 - MTBE	0.02	0.02	1.88E+00	1	443

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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			
1	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	10950

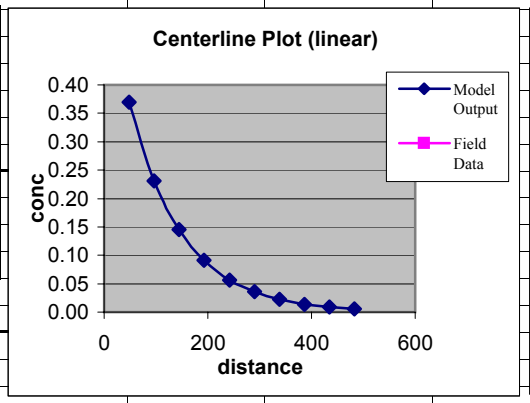
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

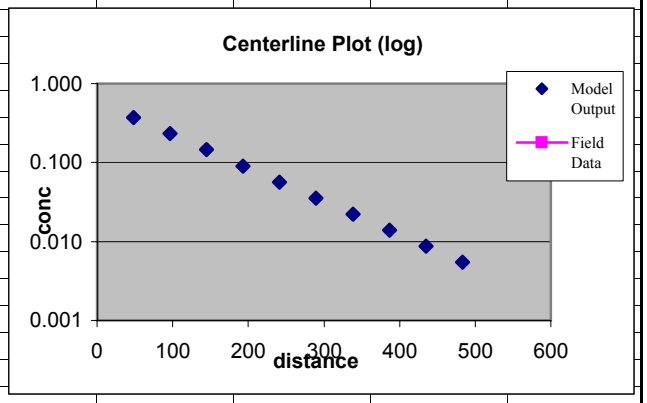
Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	

0.584 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	483
	Width (ft)	54

	48.3	*96.6*	*144.9*	*193.2*	*241.5*	*289.8*	*338.1*	*386.4*	*434.7*	*483*
54	0.000	0.000	0.001	0.002	0.002	0.002	0.001	0.001	0.001	0.001
27	0.370	0.231	0.145	0.091	0.057	0.036	0.022	0.014	0.009	0.005
0	0.370	0.231	0.145	0.091	0.057	0.036	0.022	0.014	0.009	0.005
-27	0.370	0.231	0.145	0.091	0.057	0.036	0.022	0.014	0.009	0.005
-54	0.000	0.000	0.001	0.002	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

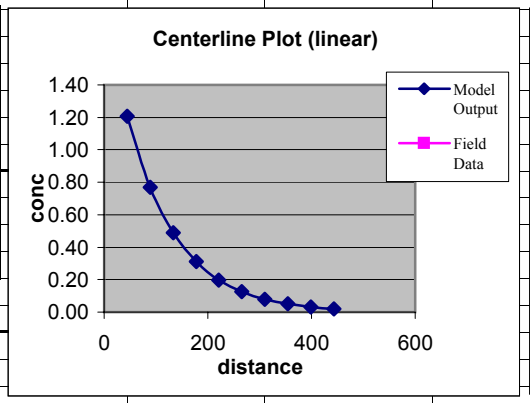
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
2	1.00E-01	1.00E-02	1.00E-04	0.00189863	100	15	10950

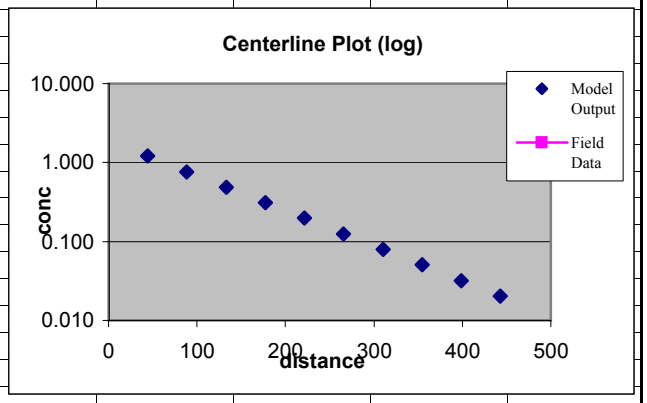
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	1.881 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	443
Width (ft)	179

Field Data:	Centerline C	Concentration								
	Distance from Source									
	44.3	*88.6*	*132.9*	*177.2*	*221.5*	*265.8*	*310.1*	*354.4*	*398.7*	*443*
179	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
89.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	1.207	0.767	0.487	0.310	0.197	0.125	0.079	0.050	0.032	0.020
-89.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-179	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-52
Sample Date			4/19/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	53

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.2300
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	1.2
Lambda (per day)		day^{-1}	0.00189863
KOC			12

Output (Concentration at the Downgradient Property Boundary in 30-years)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	2.28E-01	1	386
Sim 2 - MTBE	0.02	0.02	1.19E+00	1	398

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery						
Date:	6/6/2005	Prepared by	Allison Jelinek				
		Contaminant	Benzene				

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
0	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	10950

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	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

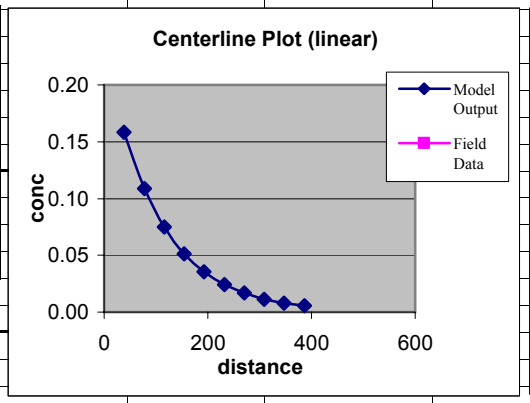
NEW QUICK_DOMENICO.XLS

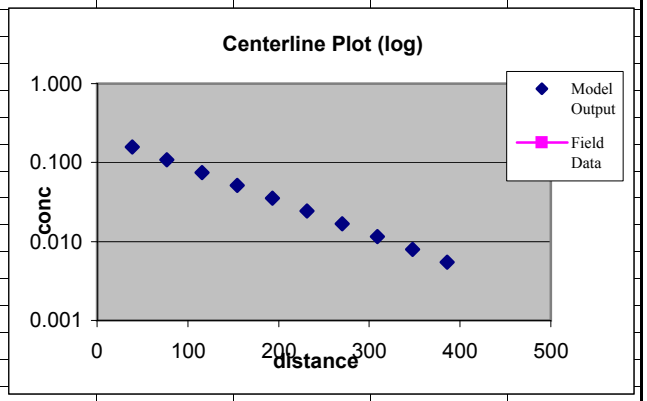
SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	
			0.228
			mg/l





	AREAL MODEL	CALCULATION DOMAIN								
	Length (ft)	386								
	Width (ft)	53								
	38.6	*77.2*	*115.8*	*154.4*	*193*	*231.6*	*270.2*	*308.8*	*347.4*	*386*
53	0.000	0.001	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001
26.5	0.158	0.109	0.075	0.052	0.035	0.024	0.017	0.012	0.008	0.005
0	0.158	0.109	0.075	0.052	0.035	0.024	0.017	0.012	0.008	0.005
-26.5	0.158	0.109	0.075	0.052	0.035	0.024	0.017	0.012	0.008	0.005
-53	0.000	0.001	0.002	0.002	0.002	0.002	0.002	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

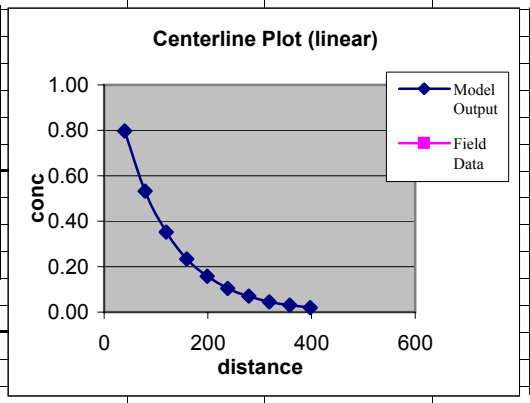
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	1.00E-01	1.00E-02	1.00E-04	0.00189863	100	15	10950

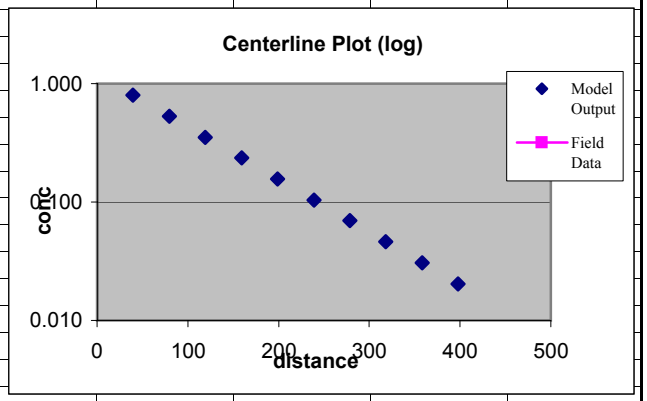
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	1.188 mg/l





	AREAL MODEL	CALCULATION DOMAIN								
	Length (ft)	398								
	Width (ft)	53								
	39.8	*79.6*	*119.4*	*159.2*	*199*	*238.8*	*278.6*	*318.4*	*358.2*	*398*
53	0.000	0.005	0.009	0.011	0.010	0.009	0.007	0.005	0.004	0.003
26.5	0.798	0.531	0.353	0.235	0.156	0.104	0.069	0.046	0.031	0.020
0	0.798	0.531	0.353	0.235	0.156	0.104	0.069	0.046	0.031	0.020
-26.5	0.798	0.531	0.353	0.235	0.156	0.104	0.069	0.046	0.031	0.020
-53	0.000	0.005	0.009	0.011	0.010	0.009	0.007	0.005	0.004	0.003
Field Data:	Centerline C	Concentration								
	Distance from Source									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-226
Sample Date			4/22/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	100
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	10
Transverse Dispersivity	A_y	ft	1.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	133

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	91.0000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Ethylbenzene
Source Concentration (mg/l)		mg/l	1.2
Lambda (per day)		day^{-1}	0.003041096
KOC			220
Sim 3			
Contaminant			Toluene
Source Concentration (mg/l)		mg/l	6.1
Lambda (per day)		day^{-1}	0.024684932
KOC			130
Sim 4			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	1.2
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 30-years)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	3.73E+01	100	1058
Sim 2 - Ethylbenzene	0.7	0.7	5.94E-03	100	10.2
Sim 3 - Toluene	1	1	4.72E-07	100	11.1
Sim 4 - Naphthalene	0.1	0.1	5.72E-06	100	20.3

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

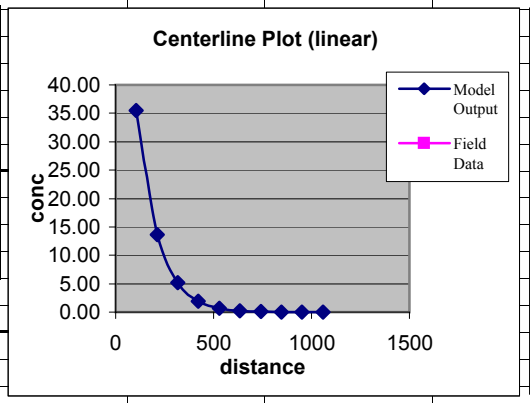
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
91	1.00E+01	1.00E+00	1.00E-04	0.0009589	100	15	10950

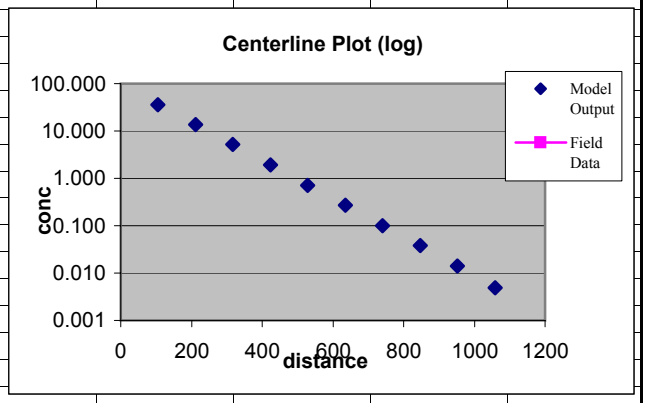
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
100	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	100	0	0
at	10950	days =	37.336 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	1058
	Width (ft)	133

	105.8	*211.6*	*317.4*	*423.2*	*529*	*634.8*	*740.6*	*846.4*	*952.2*	*1058*
133	0.000	0.000	0.003	0.005	0.004	0.003	0.002	0.001	0.001	0.000
66.5	4.552	2.921	1.381	0.599	0.250	0.103	0.041	0.017	0.007	0.002
0	35.451	13.618	5.135	1.921	0.717	0.268	0.100	0.038	0.014	0.005
-66.5	4.552	2.921	1.381	0.599	0.250	0.103	0.041	0.017	0.007	0.002
-133	0.000	0.000	0.003	0.005	0.004	0.003	0.002	0.001	0.001	0.000

Field Data: Centerline C Concentration
Distance from Source

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Ethylbenzene

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

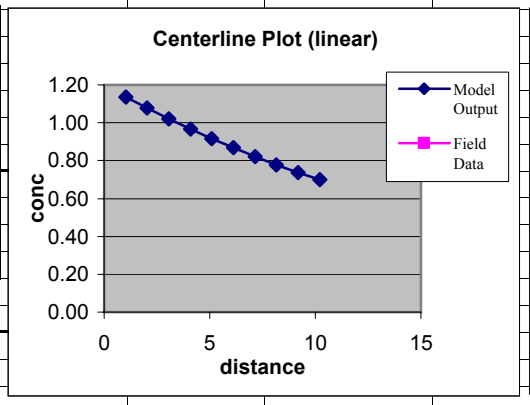
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	1.00E+01	1.00E+00	1.00E-04	0.0030411	100	15	10950

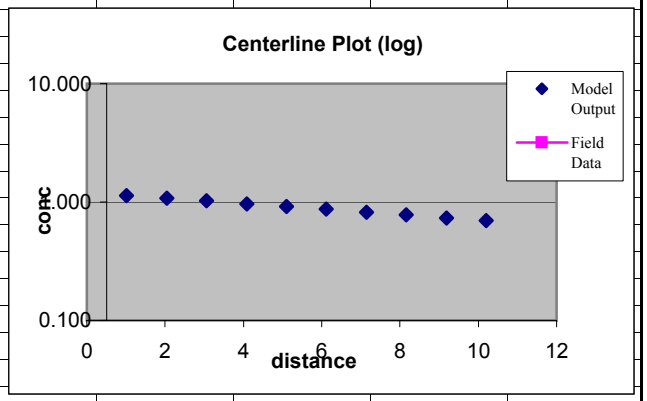
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	220	5.00E-03	6.413571429	0.037420648

Point Concentration

x(ft)	y(ft)	z(ft)
100	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	100	0	0
at	10950	days =	
			0.006
			mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	10.2
	Width (ft)	133

	1.02	2.04	3.06	4.08	5.1	6.12	7.14	8.16	9.18	10.2
133	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
66.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	1.137	1.077	1.020	0.966	0.915	0.867	0.821	0.778	0.737	0.698
-66.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-133	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Toluene

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	1.00E+01	1.00E+00	1.00E-04	0.02468493	100	15	10950

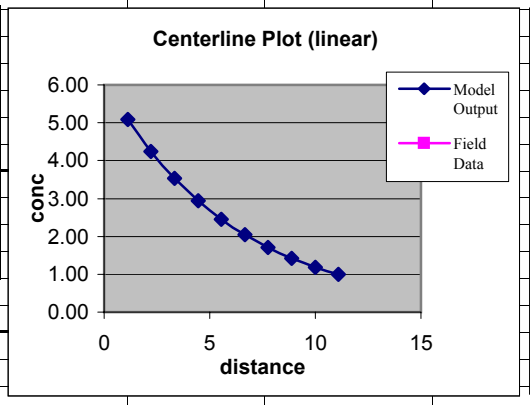
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	130	5.00E-03	4.198928571	0.057157438

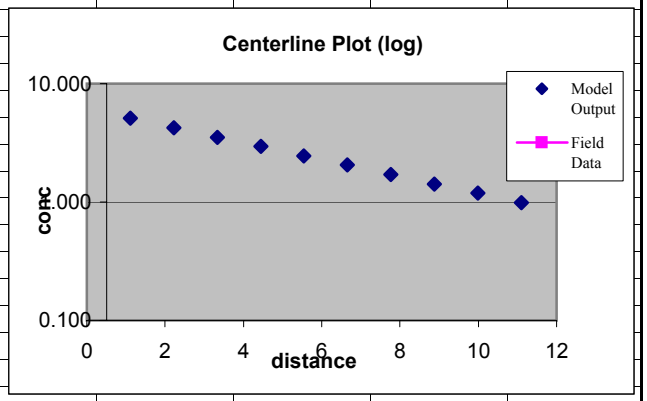
Point Concentration

x(ft)	y(ft)	z(ft)
100	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	100	0	0
at	10950	days =	

0.000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	11.1
Width (ft)	133

	1.11	2.22	3.33	4.44	5.55	6.66	7.77	8.88	9.99	11.1
133	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
66.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	5.086	4.241	3.536	2.948	2.458	2.050	1.709	1.425	1.188	0.991
-66.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-133	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

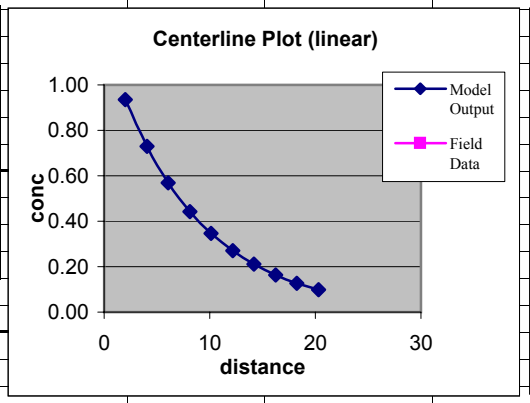
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	1.00E+01	1.00E+00	1.00E-04	0.00268493	100	15	10950

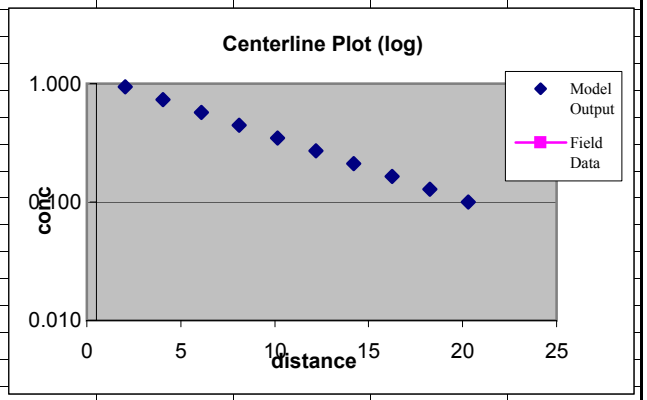
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
100	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	100	0	0
at	10950	days =	
			0.000
			mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	20.3
	Width (ft)	133

	2.03	4.06	6.09	8.12	10.15	12.18	14.21	16.24	18.27	20.3
133	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
66.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.936	0.730	0.569	0.444	0.346	0.270	0.210	0.164	0.128	0.100
-66.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-133	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	

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-43
Sample Date			4/21/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1500
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	150
Transverse Dispersivity	A_y	ft	15.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	227

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.9400
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output (Concentration at the Downgradient Property Boundary in 30-years)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	5.50E-05	1500	728

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

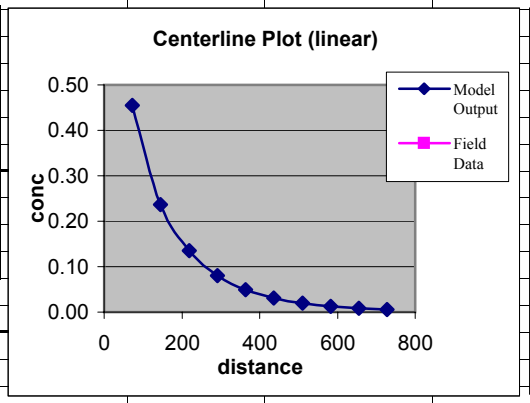
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	1.50E+02	1.50E+01	1.00E-04	0.0009589	100	15	10950

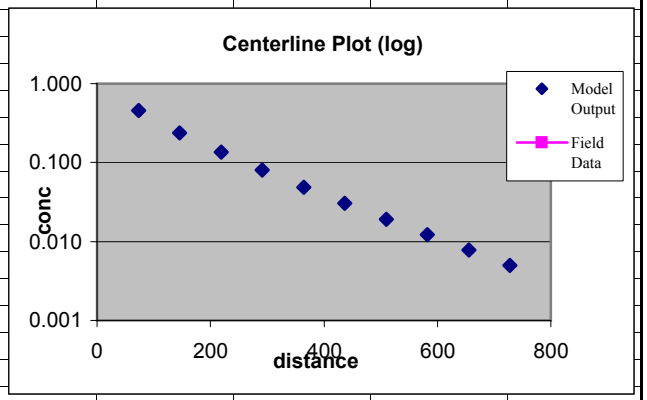
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1500	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1500	0	0
at	10950	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	728
	Width (ft)	227

	72.8	145.6	218.4	291.2	364	436.8	509.6	582.4	655.2	728
227	0.000	0.002	0.004	0.005	0.005	0.005	0.004	0.003	0.002	0.002
113.5	0.055	0.070	0.057	0.041	0.028	0.019	0.013	0.009	0.006	0.004
0	0.455	0.237	0.135	0.080	0.049	0.030	0.019	0.012	0.008	0.005
-113.5	0.055	0.070	0.057	0.041	0.028	0.019	0.013	0.009	0.006	0.004
-227	0.000	0.002	0.004	0.005	0.005	0.005	0.004	0.003	0.002	0.002
Field Data:	Centerline C	Concentration								
	Distance from Source									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-47I
Sample Date			4/21/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	565
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	56.5
Transverse Dispersivity	A_y	ft	5.7
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	62

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	0.092
Lambda (per day)		day^{-1}	0.00189863
KOC			12

Output (Concentration at the Downgradient Property Boundary in 30-years)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - MTBE	0.02	0.02	7.11E-04	565	170

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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	5.65E+01	5.65E+00	1.00E-04	0.00189863	100	15	10950

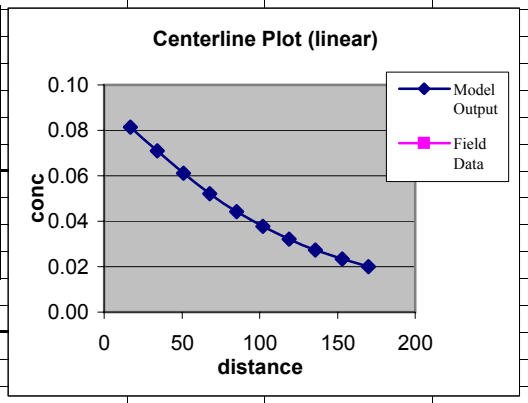
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

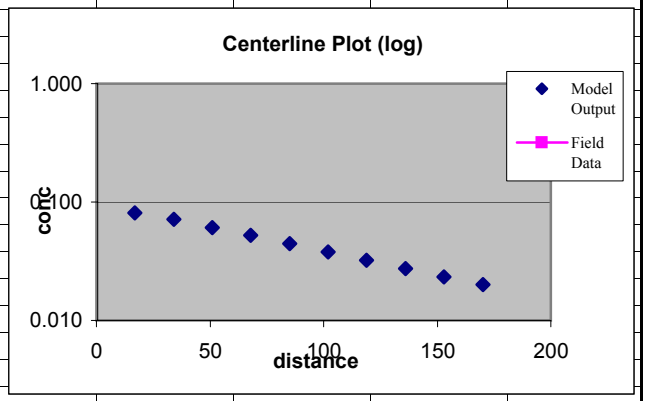
Point Concentration

x(ft)	y(ft)	z(ft)
565	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	565	0	0
at	10950	days =	

0.001 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 170
Width (ft) 62

	17	34	51	68	85	102	119	136	153	170
62	0.016	0.019	0.020	0.019	0.017	0.016	0.014	0.013	0.012	0.010
31	0.074	0.060	0.050	0.042	0.036	0.031	0.027	0.023	0.020	0.017
0	0.081	0.071	0.061	0.052	0.044	0.038	0.032	0.027	0.023	0.020
-31	0.074	0.060	0.050	0.042	0.036	0.031	0.027	0.023	0.020	0.017
-62	0.016	0.019	0.020	0.019	0.017	0.016	0.014	0.013	0.012	0.010

Field Data: Centerline C Concentration
Distance from Source

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-98
Sample Date			4/22/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	54

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.5800
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	0.11
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 30-years)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	5.74E-01	1	491
Sim 2 - Naphthalene	0.1	0.1	8.43E-02	1	<1

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

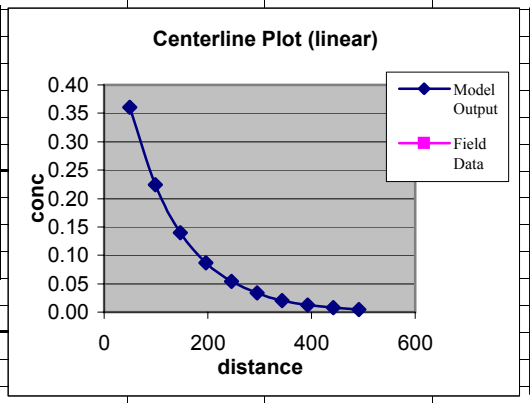
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	10950

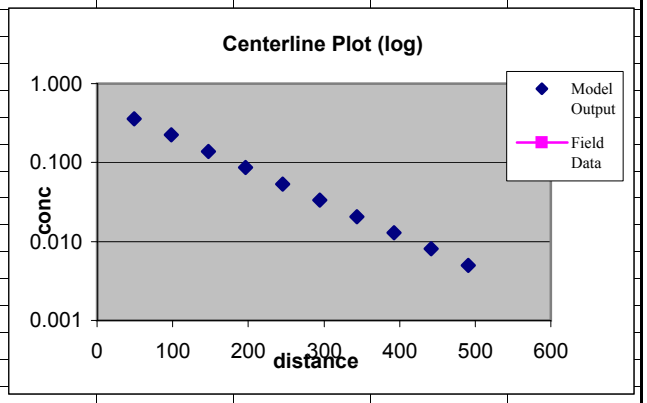
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	
			0.574
			mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	491
	Width (ft)	54

	49.1	98.2	147.3	196.4	245.5	294.6	343.7	392.8	441.9	491
54	0.000	0.000	0.001	0.002	0.002	0.002	0.001	0.001	0.001	0.001
27	0.360	0.224	0.139	0.087	0.054	0.033	0.021	0.013	0.008	0.005
0	0.360	0.224	0.139	0.087	0.054	0.033	0.021	0.013	0.008	0.005
-27	0.360	0.224	0.139	0.087	0.054	0.033	0.021	0.013	0.008	0.005
-54	0.000	0.000	0.001	0.002	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

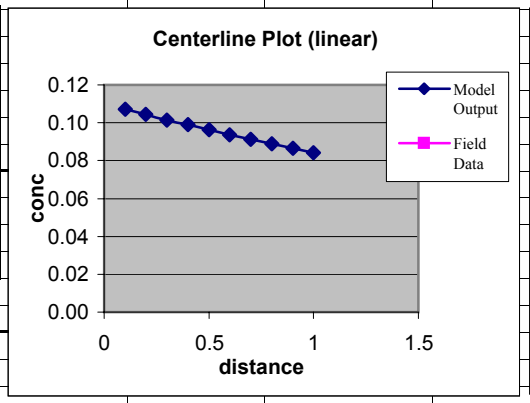
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	1.00E-01	1.00E-02	1.00E-04	0.00268493	100	15	10950

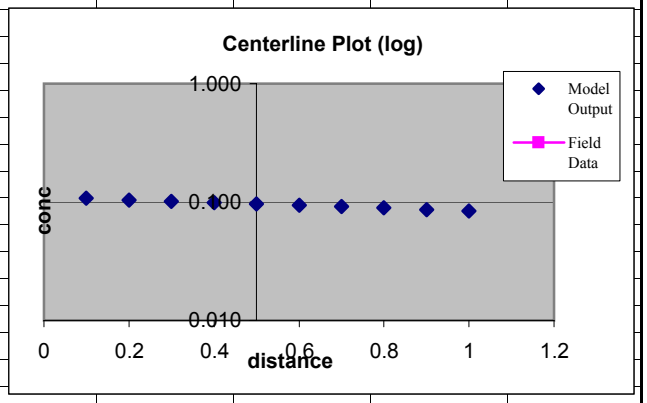
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	0.084 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	1
	Width (ft)	54

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
54	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	0.107	0.104	0.102	0.099	0.096	0.094	0.091	0.089	0.087	0.084
0	0.107	0.104	0.102	0.099	0.096	0.094	0.091	0.089	0.087	0.084
-27	0.107	0.104	0.102	0.099	0.096	0.094	0.091	0.089	0.087	0.084
-54	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

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-99
Sample Date			4/22/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	53

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.2000
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output (Concentration at the Downgradient Property Boundary in 30-years)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	1.98E-01	1	381

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

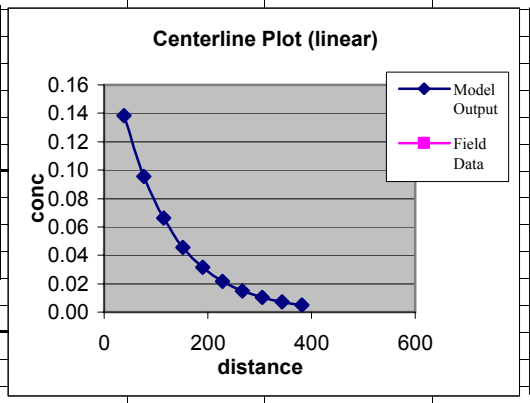
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001				
0	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	10950

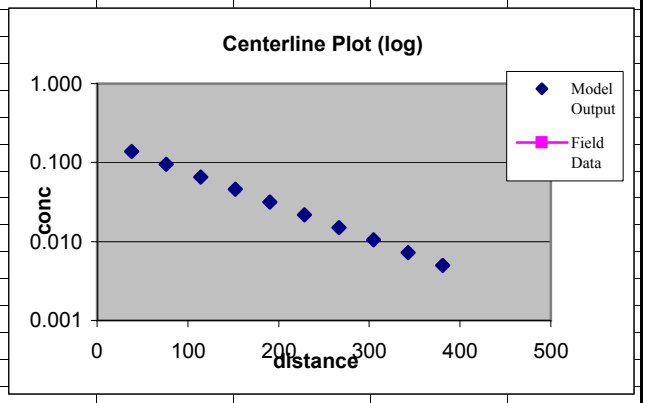
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	
			0.198
			mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	381
	Width (ft)	53

	38.1	*76.2*	*114.3*	*152.4*	*190.5*	*228.6*	*266.7*	*304.8*	*342.9*	*381*
53	0.000	0.001	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001
26.5	0.138	0.096	0.066	0.046	0.032	0.022	0.015	0.010	0.007	0.005
0	0.138	0.096	0.066	0.046	0.032	0.022	0.015	0.010	0.007	0.005
-26.5	0.138	0.096	0.066	0.046	0.032	0.022	0.015	0.010	0.007	0.005
-53	0.000	0.001	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001

Field Data:	Centerline C	Concentration
	Distance from Source	

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-101
Sample Date			4/22/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	54

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	1.4000
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output (Concentration at the Downgradient Property Boundary in 30-years)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	1.39E+00	1	582

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

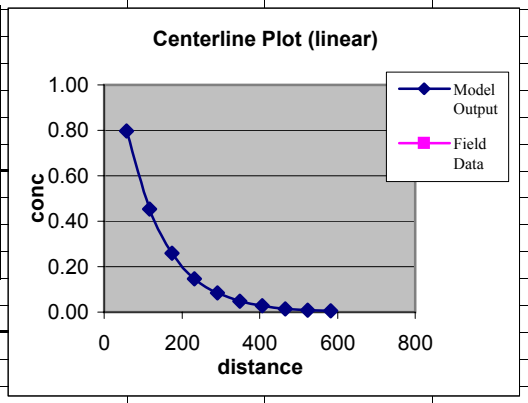
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
1	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	10950

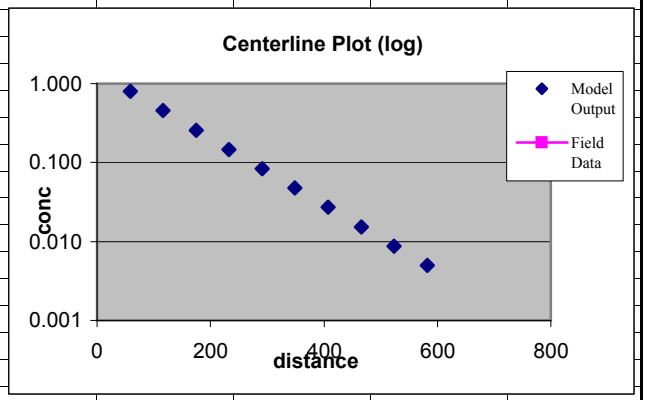
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^{3})	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	1.387 mg/l





	AREAL MODEL	CALCULATION DOMAIN								
	Length (ft)	582								
	Width (ft)	54								
	58.2	*116.4*	*174.6*	*232.8*	*291*	*349.2*	*407.4*	*465.6*	*523.8*	*582*
54	0.000	0.002	0.004	0.005	0.004	0.003	0.002	0.001	0.001	0.001
27	0.797	0.453	0.258	0.147	0.084	0.048	0.027	0.015	0.009	0.005
0	0.797	0.453	0.258	0.147	0.084	0.048	0.027	0.015	0.009	0.005
-27	0.797	0.453	0.258	0.147	0.084	0.048	0.027	0.015	0.009	0.005
-54	0.000	0.002	0.004	0.005	0.004	0.003	0.002	0.001	0.001	0.001
Field Data:	Centerline C	Concentration								
	Distance from Source									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-117
Sample Date			4/22/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	375
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	37.5
Transverse Dispersivity	A_y	ft	3.8
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	172

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	8.8000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	0.1
Lambda (per day)		day^{-1}	0.00189863
KOC			12
Sim 3			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	0.36
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 30-years)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	3.38E-01	375	887
Sim 2 - MTBE	0.02	0.02	3.38E-03	375	180
Sim 3 - Naphthalene	0.1	0.1	3.06E-13	375	17.6

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery						
Date:	6/6/2005	Prepared by	Allison Jelinek				
		Contaminant	Benzene				

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
9	3.75E+01	3.75E+00	1.00E-04	0.0009589	100	15	10950

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	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

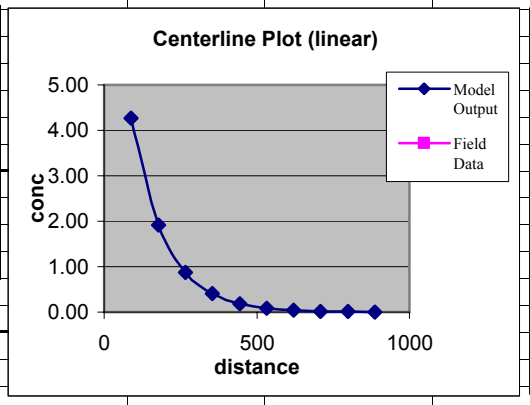
NEW QUICK_DOMENICO.XLS

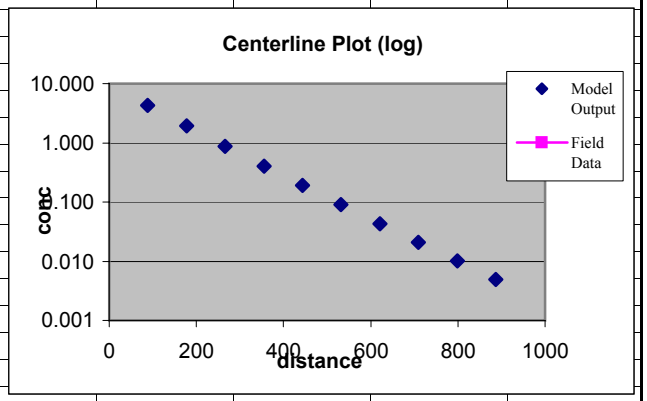
SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

Point Concentration

x(ft)	y(ft)	z(ft)
375	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	375	0	0
at	10950	days =	
			0.338
			mg/l





	AREAL MODEL	CALCULATION DOMAIN								
	Length (ft)	887								
	Width (ft)	172								
	88.7	*177.4*	*266.1*	*354.8*	*443.5*	*532.2*	*620.9*	*709.6*	*798.3*	*887*
172	0.000	0.001	0.004	0.005	0.005	0.004	0.003	0.002	0.001	0.001
86	0.366	0.372	0.246	0.144	0.079	0.042	0.022	0.012	0.006	0.003
0	4.265	1.910	0.868	0.402	0.189	0.090	0.043	0.021	0.010	0.005
-86	0.366	0.372	0.246	0.144	0.079	0.042	0.022	0.012	0.006	0.003
-172	0.000	0.001	0.004	0.005	0.005	0.004	0.003	0.002	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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	3.75E+01	3.75E+00	1.00E-04	0.00189863	100	15	10950

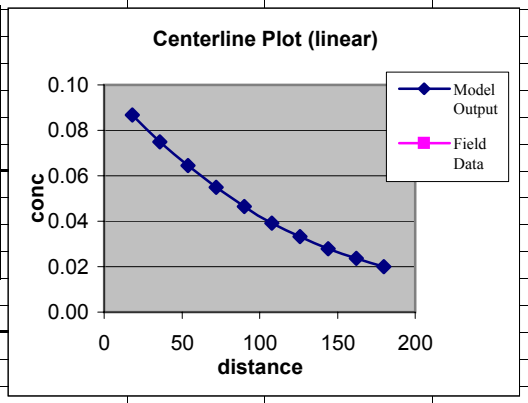
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

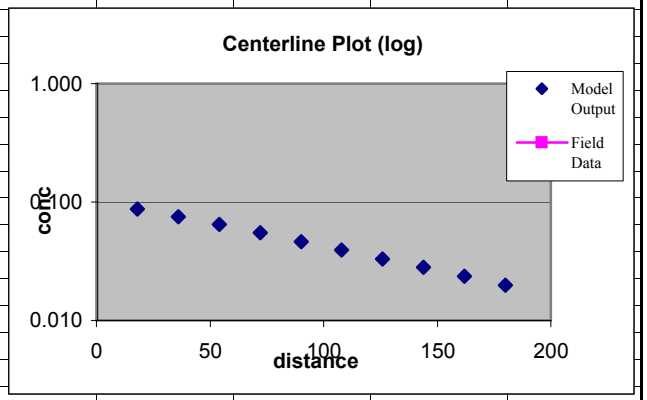
Point Concentration

x(ft)	y(ft)	z(ft)
375	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	375	0	0
at	10950	days =	

0.003 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft)	180
Width (ft)	172

	18	36	54	72	90	108	126	144	162	180
172	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
86	0.000	0.001	0.002	0.003	0.004	0.004	0.004	0.004	0.004	0.004
0	0.087	0.075	0.064	0.055	0.046	0.039	0.033	0.028	0.024	0.020
-86	0.000	0.001	0.002	0.003	0.004	0.004	0.004	0.004	0.004	0.004
-172	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

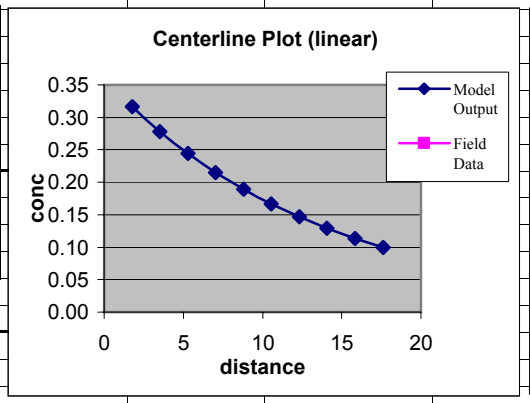
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	3.75E+01	3.75E+00	1.00E-04	0.00268493	100	15	10950

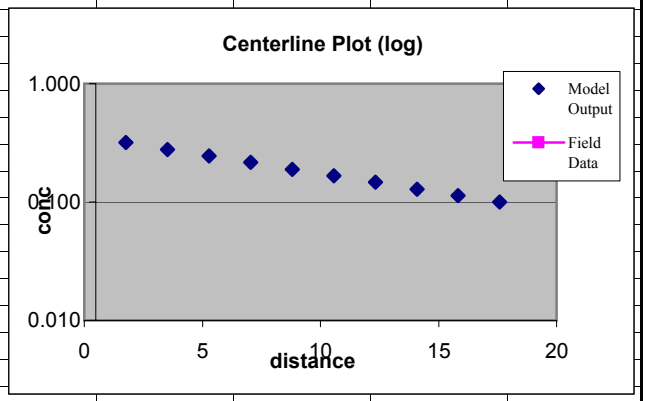
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
375	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	375	0	0
at	10950	days =	0.000 mg/l





AREAL MODEL DOMAIN	CALCULATION
Length (ft)	17.6
Width (ft)	172

	1.76	3.52	5.28	7.04	8.8	10.56	12.32	14.08	15.84	17.6
172	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
86	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.317	0.278	0.245	0.215	0.189	0.167	0.146	0.129	0.113	0.100
-86	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-172	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

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-118
Sample Date			4/22/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	250
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	25
Transverse Dispersivity	A_y	ft	2.5
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	112

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.9200
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	0.17
Lambda (per day)		day^{-1}	0.00189863
KOC			12

Output (Concentration at the Downgradient Property Boundary in 30-years)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	1.03E-01	250	592
Sim 2 - MTBE	0.02	0.02	1.73E-02	250	235

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

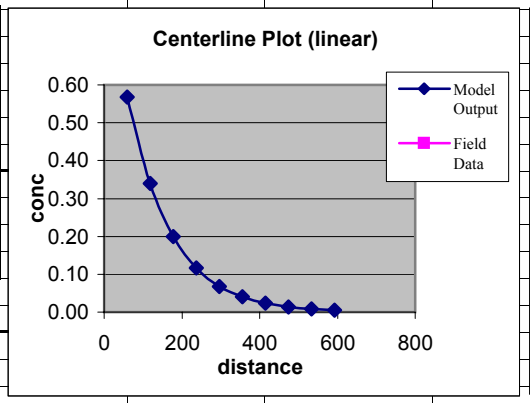
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	2.50E+01	2.50E+00	1.00E-04	0.0009589	100	15	10950

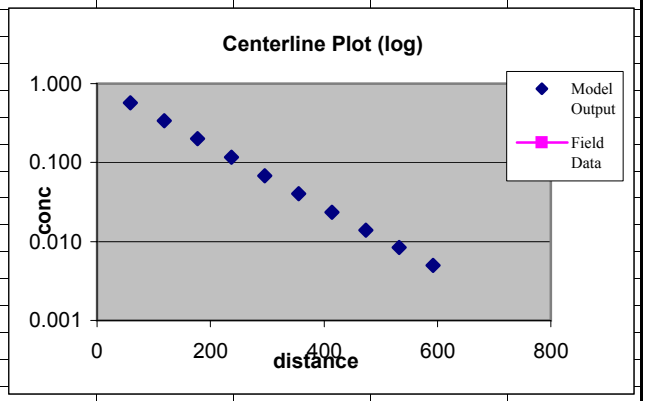
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
250	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	250	0	0
at	10950	days =	0.103 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	592
	Width (ft)	112

	59.2	118.4	177.6	236.8	296	355.2	414.4	473.6	532.8	592
112	0.000	0.002	0.004	0.005	0.005	0.004	0.003	0.002	0.001	0.001
56	0.207	0.142	0.092	0.058	0.037	0.023	0.014	0.009	0.005	0.003
0	0.568	0.340	0.199	0.116	0.068	0.040	0.024	0.014	0.008	0.005
-56	0.207	0.142	0.092	0.058	0.037	0.023	0.014	0.009	0.005	0.003
-112	0.000	0.002	0.004	0.005	0.005	0.004	0.003	0.002	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

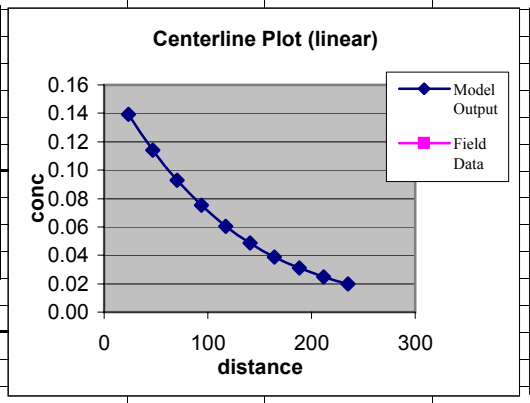
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	2.50E+01	2.50E+00	1.00E-04	0.00189863	100	15	10950

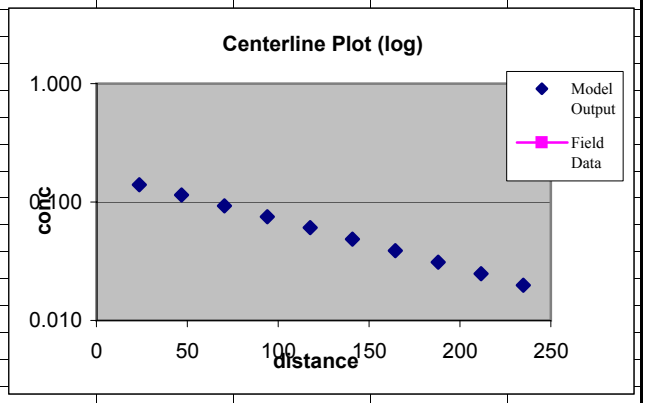
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
250	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	250	0	0
at	10950	days =	0.017 mg/l





	AREAL MODEL	CALCULATION DOMAIN								
	Length (ft)	235								
	Width (ft)	112								
	23.5	*47*	*70.5*	*94*	*117.5*	*141*	*164.5*	*188*	*211.5*	*235*
112	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001
56	0.040	0.040	0.035	0.030	0.025	0.021	0.018	0.015	0.012	0.010
0	0.139	0.114	0.093	0.075	0.060	0.049	0.039	0.031	0.025	0.020
-56	0.040	0.040	0.035	0.030	0.025	0.021	0.018	0.015	0.012	0.010
-112	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001
Field Data:	Centerline C	Concentration								
	Distance from Source									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-127
Sample Date			4/22/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	225
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	22.5
Transverse Dispersivity	A_y	ft	2.3
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	149

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	15.0000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	1.7
Lambda (per day)		day^{-1}	0.00189863
KOC			12
Sim 3			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	0.24
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 30-years)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	2.10E+00	225	908
Sim 2 - MTBE	0.02	0.02	2.18E-01	225	479
Sim 3 - Naphthalene	0.1	0.1	3.34E-10	225	9.8

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

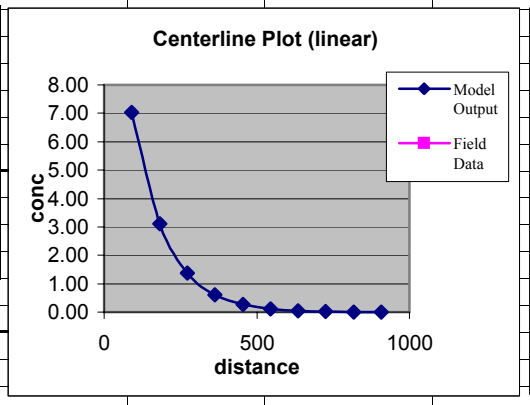
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
15	2.25E+01	2.25E+00	1.00E-04	0.0009589	100	15	10950

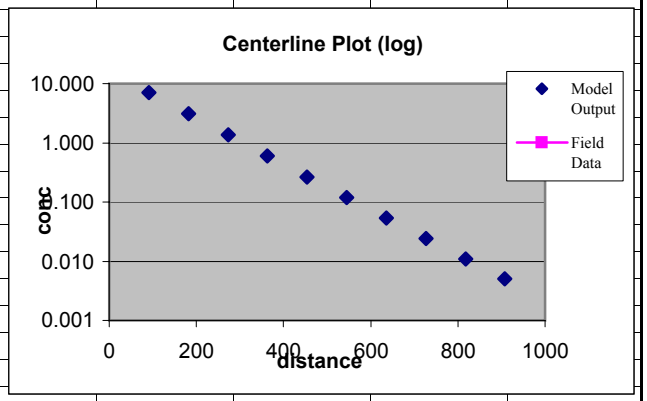
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
225	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	225	0	0
at	10950	days =	
			2.100
			mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	908
	Width (ft)	149

	90.8	181.6	272.4	363.2	454	544.8	635.6	726.4	817.2	908
149	0.000	0.001	0.004	0.005	0.005	0.004	0.003	0.002	0.001	0.001
74.5	0.804	0.664	0.390	0.208	0.106	0.053	0.026	0.013	0.006	0.003
0	7.036	3.118	1.365	0.601	0.266	0.119	0.054	0.024	0.011	0.005
-74.5	0.804	0.664	0.390	0.208	0.106	0.053	0.026	0.013	0.006	0.003
-149	0.000	0.001	0.004	0.005	0.005	0.004	0.003	0.002	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

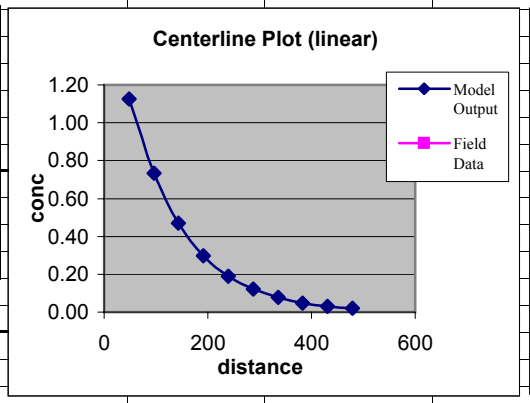
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
2	2.25E+01	2.25E+00	1.00E-04	0.00189863	100	15	10950

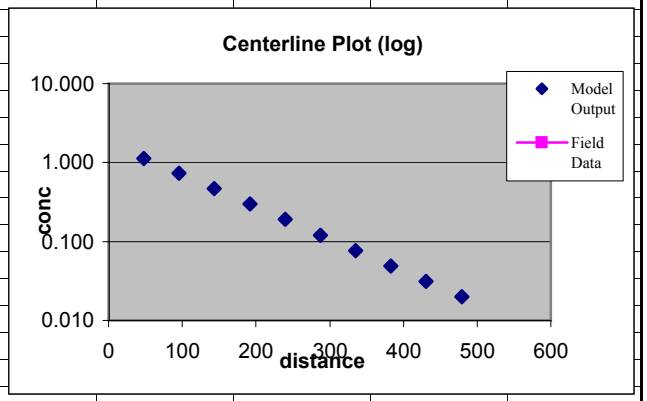
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
225	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	225	0	0
at	10950	days =	0.218 mg/l





	AREAL MODEL	CALCULATION DOMAIN								
	Length (ft)	479								
	Width (ft)	149								
	47.9	*95.8*	*143.7*	*191.6*	*239.5*	*287.4*	*335.3*	*383.2*	*431.1*	*479*
149	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.000
74.5	0.054	0.089	0.083	0.066	0.049	0.036	0.025	0.017	0.012	0.008
0	1.126	0.735	0.471	0.299	0.190	0.120	0.077	0.049	0.031	0.020
-74.5	0.054	0.089	0.083	0.066	0.049	0.036	0.025	0.017	0.012	0.008
-149	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.000
Field Data:	Centerline C	Concentration								
	Distance from Source									

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

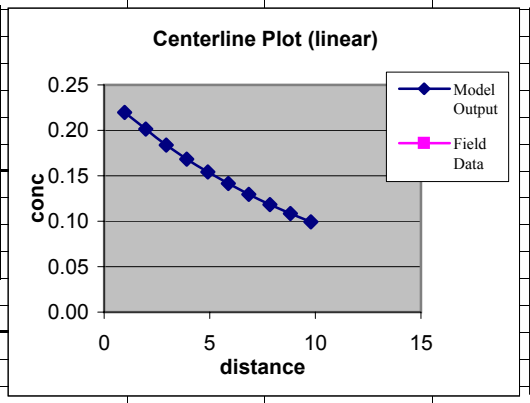
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	2.25E+01	2.25E+00	1.00E-04	0.00268493	100	15	10950

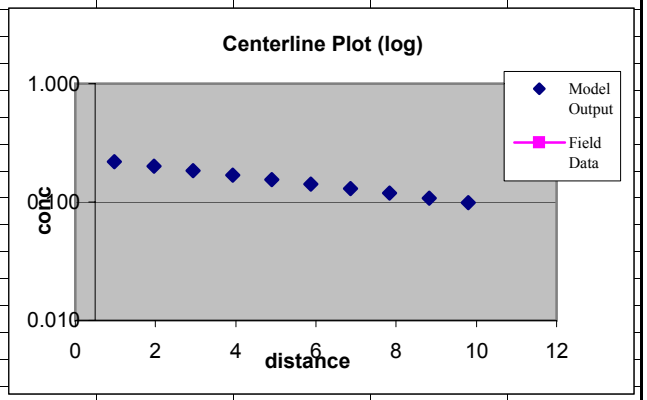
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
225	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	225	0	0
at	10950	days =	
			0.000
			mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	9.8
	Width (ft)	149

	0.98	1.96	2.94	3.92	4.9	5.88	6.86	7.84	8.82	9.8
149	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
74.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.220	0.201	0.184	0.169	0.154	0.141	0.129	0.118	0.108	0.099
-74.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-149	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

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-173
Sample Date			4/22/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	690
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	69
Transverse Dispersivity	A_y	ft	6.9
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	162

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.9900
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	0.14
Lambda (per day)		day^{-1}	0.00189863
KOC			12

Output (Concentration at the Downgradient Property Boundary in 30-years)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	3.95E-03	690	658
Sim 2 - MTBE	0.02	0.02	4.59E-04	690	217

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

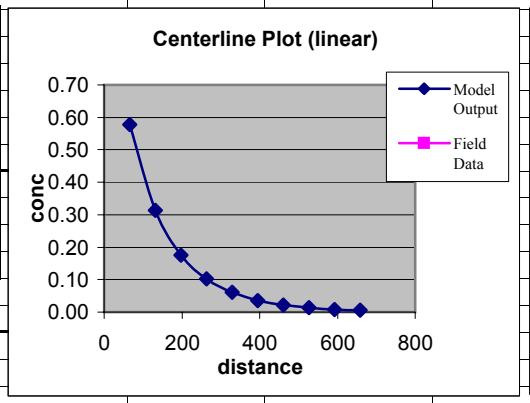
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	6.90E+01	6.90E+00	1.00E-04	0.0009589	100	15	10950

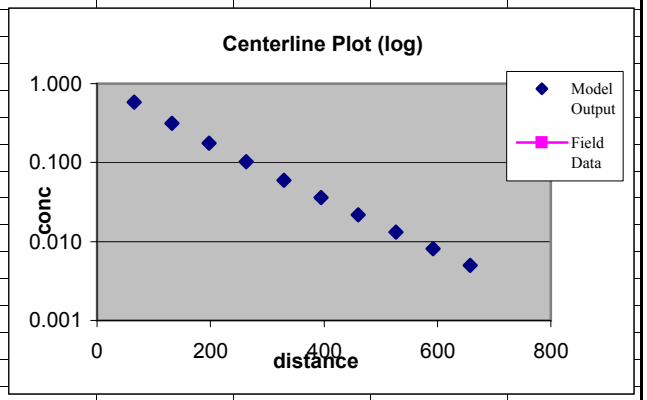
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
690	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	690	0	0
at	10950	days =	0.004 mg/l





	AREAL MODEL	CALCULATION DOMAIN								
	Length (ft)	658								
	Width (ft)	162								
	65.8	*131.6*	*197.4*	*263.2*	*329*	*394.8*	*460.6*	*526.4*	*592.2*	*658*
162	0.000	0.002	0.004	0.005	0.005	0.004	0.004	0.003	0.002	0.001
81	0.097	0.096	0.072	0.050	0.033	0.021	0.014	0.009	0.006	0.004
0	0.577	0.313	0.176	0.102	0.060	0.036	0.022	0.013	0.008	0.005
-81	0.097	0.096	0.072	0.050	0.033	0.021	0.014	0.009	0.006	0.004
-162	0.000	0.002	0.004	0.005	0.005	0.004	0.004	0.003	0.002	0.001
Field Data:	Centerline C	Concentration								
	Distance from Source									

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

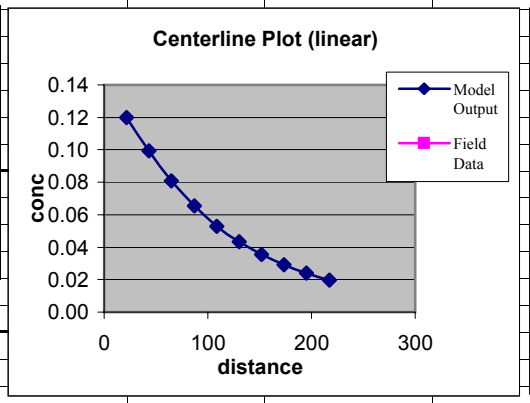
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	6.90E+01	6.90E+00	1.00E-04	0.00189863	100	15	10950

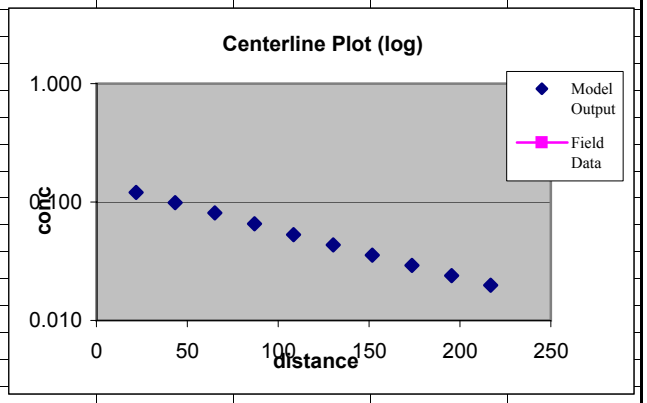
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
690	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	690	0	0
at	10950	days =	0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 217
Width (ft) 162

	21.7	43.4	65.1	86.8	108.5	130.2	151.9	173.6	195.3	217
162	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
81	0.004	0.011	0.013	0.014	0.014	0.013	0.012	0.011	0.010	0.009
0	0.120	0.099	0.081	0.065	0.053	0.043	0.035	0.029	0.024	0.020
-81	0.004	0.011	0.013	0.014	0.014	0.013	0.012	0.011	0.010	0.009
-162	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001

Field Data: Centerline C Concentration
Distance from Source

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-193
Sample Date			4/22/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	53

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.2200
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output (Concentration at the Downgradient Property Boundary in 30-years)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	2.18E-01	1	391

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

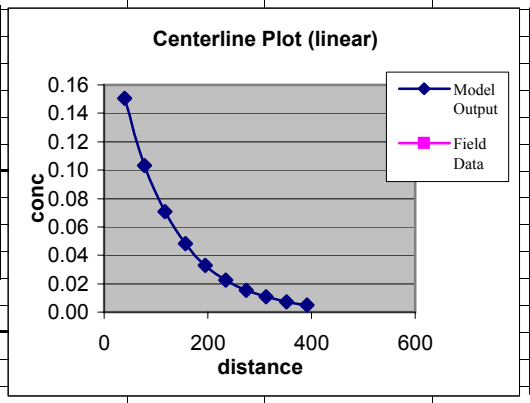
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	10950

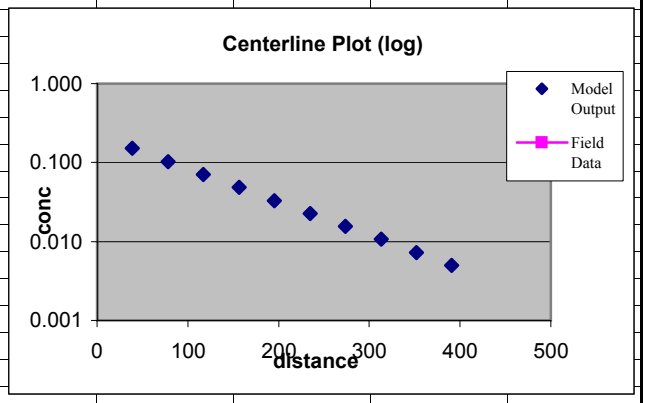
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	0.218 mg/l





	AREAL MODEL	CALCULATION DOMAIN								
	Length (ft)	391								
	Width (ft)	53								
	39.1	*78.2*	*117.3*	*156.4*	*195.5*	*234.6*	*273.7*	*312.8*	*351.9*	*391*
53	0.000	0.001	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001
26.5	0.151	0.103	0.071	0.048	0.033	0.023	0.016	0.011	0.007	0.005
0	0.151	0.103	0.071	0.048	0.033	0.023	0.016	0.011	0.007	0.005
-26.5	0.151	0.103	0.071	0.048	0.033	0.023	0.016	0.011	0.007	0.005
-53	0.000	0.001	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001
Field Data:	Centerline C	Concentration								
	Distance from Source									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-194
Sample Date			4/22/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	0.1
Transverse Dispersivity	A_y	ft	0.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	51

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.0160
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output (Concentration at the Downgradient Property Boundary in 30-years)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	1.58E-02	1	121

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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	1.00E-01	1.00E-02	1.00E-04	0.0009589	100	15	10950

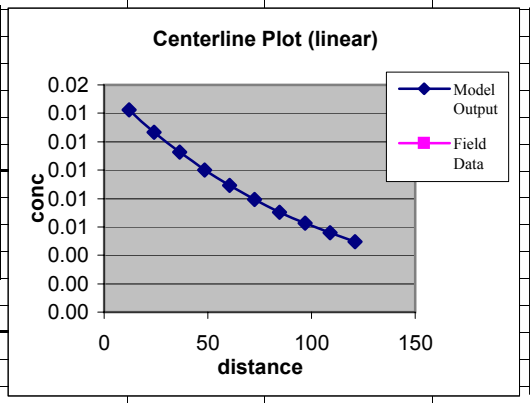
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

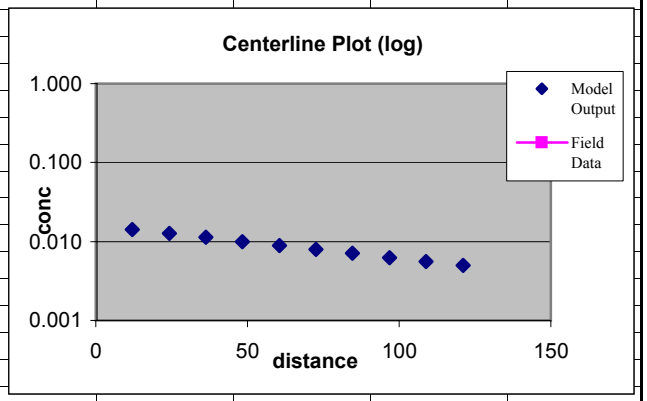
Point Concentration

x(ft)	y(ft)	z(ft)
1	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1	0	0
at	10950	days =	

0.016 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	121
	Width (ft)	51

	12.1	24.2	36.3	48.4	60.5	72.6	84.7	96.8	108.9	121
51	0.000	0.001	0.001	0.002	0.002	0.002	0.002	0.001	0.001	0.001
25.5	0.014	0.013	0.011	0.010	0.009	0.008	0.007	0.006	0.006	0.005
0	0.014	0.013	0.011	0.010	0.009	0.008	0.007	0.006	0.006	0.005
-25.5	0.014	0.013	0.011	0.010	0.009	0.008	0.007	0.006	0.006	0.005
-51	0.000	0.001	0.001	0.002	0.002	0.002	0.002	0.001	0.001	0.001

Field Data: Centerline C Concentration
Distance from Source

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-202
Sample Date			4/19/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1125
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	112.5
Transverse Dispersivity	A_y	ft	11.3
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	214

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	1.4000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	0.13
Lambda (per day)		day^{-1}	0.00189863
KOC			12
Sim 3			
Contaminant			Toluene
Source Concentration (mg/l)		mg/l	1.6
Lambda (per day)		day^{-1}	0.024684932
KOC			130

Output (Concentration at the Downgradient Property Boundary in 30-years)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	4.78E-04	1125	757
Sim 2 - MTBE	0.02	0.02	3.42E-05	1125	206
Sim 3 - Toluene	1	1	2.62E-29	1125	8.2

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

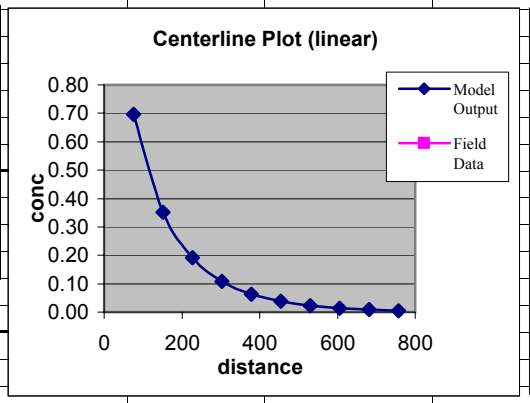
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	1.13E+02	1.13E+01	1.00E-04	0.0009589	100	15	10950

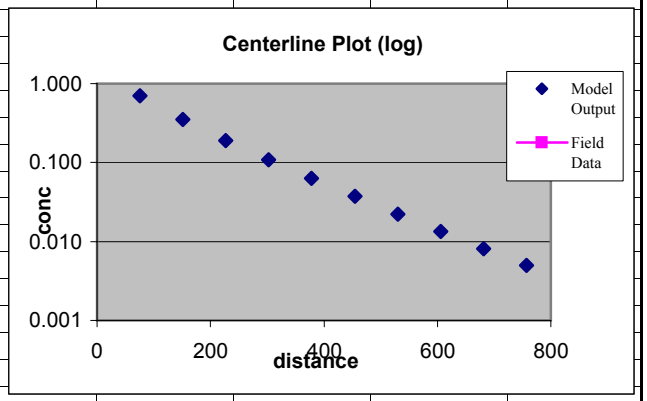
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1125	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1125	0	0
at	10950	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN								
	Length (ft)	757								
	Width (ft)	214								
	75.7	*151.4*	*227.1*	*302.8*	*378.5*	*454.2*	*529.9*	*605.6*	*681.3*	*757*
214	0.000	0.001	0.004	0.005	0.005	0.005	0.004	0.003	0.002	0.001
107	0.075	0.093	0.074	0.052	0.034	0.022	0.014	0.009	0.006	0.004
0	0.696	0.351	0.191	0.108	0.063	0.037	0.022	0.013	0.008	0.005
-107	0.075	0.093	0.074	0.052	0.034	0.022	0.014	0.009	0.006	0.004
-214	0.000	0.001	0.004	0.005	0.005	0.005	0.004	0.003	0.002	0.001
Field Data:	Centerline C	Concentration								
	Distance from Source									

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

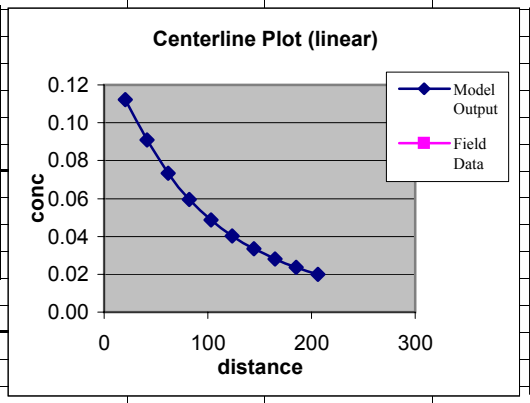
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	1.13E+02	1.13E+01	1.00E-04	0.00189863	100	15	10950

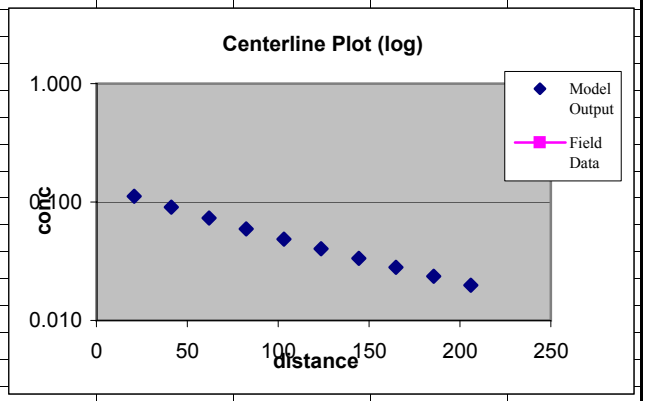
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
1125	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1125	0	0
at	10950	days =	0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft)	206
Width (ft)	214

	20.6	41.2	61.8	82.4	103	123.6	144.2	164.8	185.4	206
214	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
107	0.000	0.003	0.006	0.007	0.008	0.008	0.008	0.008	0.008	0.007
0	0.112	0.091	0.073	0.059	0.049	0.040	0.034	0.028	0.024	0.020
-107	0.000	0.003	0.006	0.007	0.008	0.008	0.008	0.008	0.008	0.007
-214	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Toluene

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			
2	1.13E+02	1.13E+01	1.00E-04	0.02468493	100	15	10950

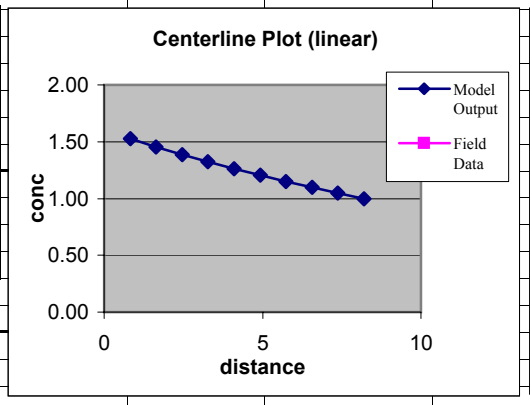
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	130	5.00E-03	4.198928571	0.057157438

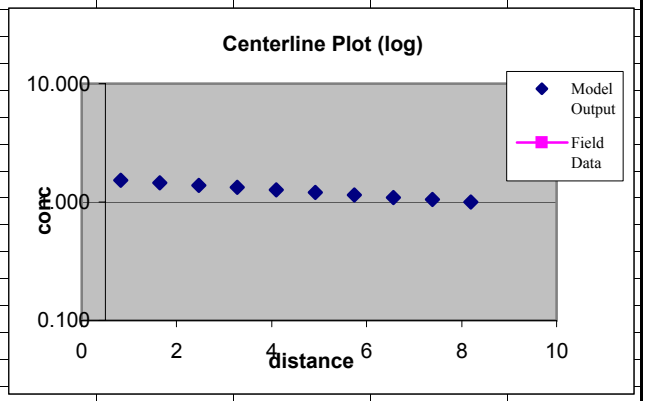
Point Concentration

x(ft)	y(ft)	z(ft)
1125	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1125	0	0
at	10950	days =	

0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft)	8.2
Width (ft)	214

	0.82	1.64	2.46	3.28	4.1	4.92	5.74	6.56	7.38	8.2
214	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
107	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	1.526	1.456	1.388	1.324	1.263	1.205	1.149	1.096	1.045	0.997
-107	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-214	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

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-203
Sample Date			4/20/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	750
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	75
Transverse Dispersivity	A_y	ft	7.5
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	212

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.9400
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	17
Lambda (per day)		day^{-1}	0.00189863
KOC			12

Output (Concentration at the Downgradient Property Boundary in 30-years)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	2.57E-03	750	658
Sim 2 - MTBE	0.02	0.02	3.79E-02	750	837

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

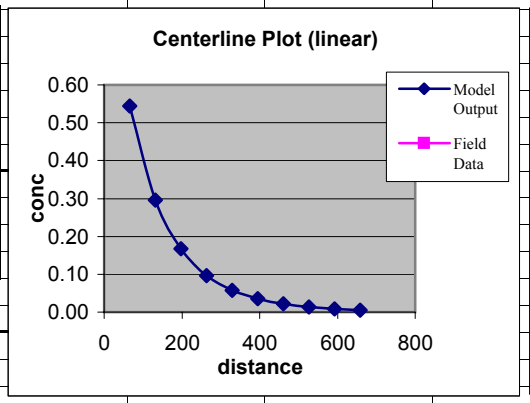
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	7.50E+01	7.50E+00	1.00E-04	0.0009589	100	15	10950

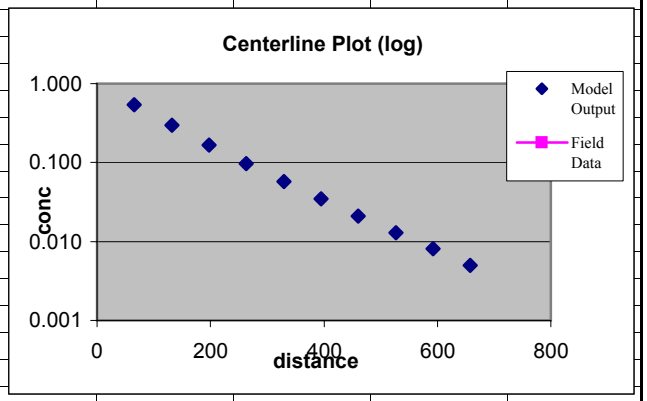
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
750	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	750	0	0
at	10950	days =	0.003 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	658
	Width (ft)	212

	65.8	131.6	197.4	263.2	329	394.8	460.6	526.4	592.2	658
212	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001
106	0.023	0.041	0.039	0.030	0.022	0.015	0.010	0.007	0.005	0.003
0	0.544	0.295	0.167	0.097	0.058	0.035	0.021	0.013	0.008	0.005
-106	0.023	0.041	0.039	0.030	0.022	0.015	0.010	0.007	0.005	0.003
-212	0.000	0.000	0.000	0.001	0.001	0.001	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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)
17	7.50E+01	7.50E+00	1.00E-04	0.00189863	100	15	10950

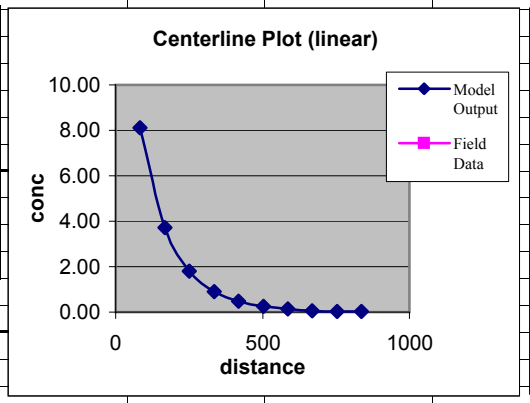
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

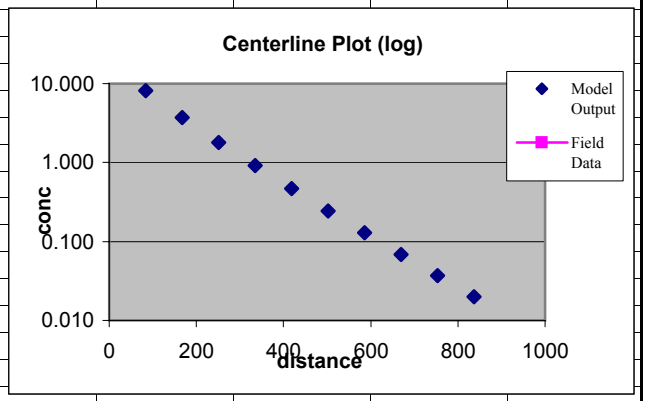
Point Concentration

x(ft)	y(ft)	z(ft)
750	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	750	0	0
at	10950	days =	

0.038 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	837
Width (ft)	212

	83.7	167.4	251.1	334.8	418.5	502.2	585.9	669.6	753.3	837
212	0.000	0.003	0.013	0.019	0.020	0.017	0.013	0.009	0.006	0.004
106	0.549	0.714	0.542	0.352	0.214	0.125	0.072	0.041	0.023	0.013
0	8.107	3.719	1.807	0.910	0.468	0.245	0.129	0.069	0.037	0.020
-106	0.549	0.714	0.542	0.352	0.214	0.125	0.072	0.041	0.023	0.013
-212	0.000	0.003	0.013	0.019	0.020	0.017	0.013	0.009	0.006	0.004

Field Data: Centerline C Concentration
Distance from Source

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-206
Sample Date			4/19/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1250
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	125
Transverse Dispersivity	A_y	ft	12.5
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	95

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.0520
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	0.076
Lambda (per day)		day^{-1}	0.00189863
KOC			12

Output (Concentration at the Downgradient Property Boundary in 30-years)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	9.59E-06	1250	274
Sim 2 - MTBE	0.02	0.02	1.06E-05	1250	141

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery						
Date:	6/6/2005	Prepared by	Allison Jelinek				
		Contaminant	Benzene				

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
			>=.001	day-1			
0	1.25E+02	1.25E+01	1.00E-04	0.0009589	100	15	10950

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	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

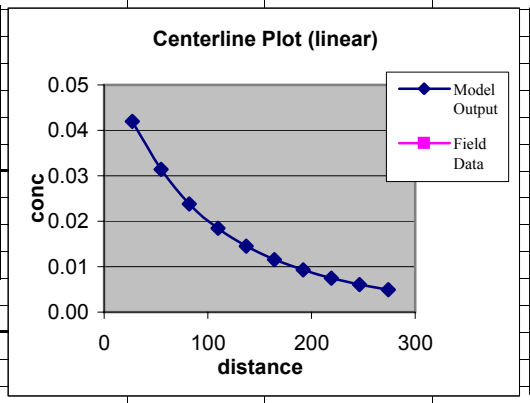
NEW QUICK_DOMENICO.XLS

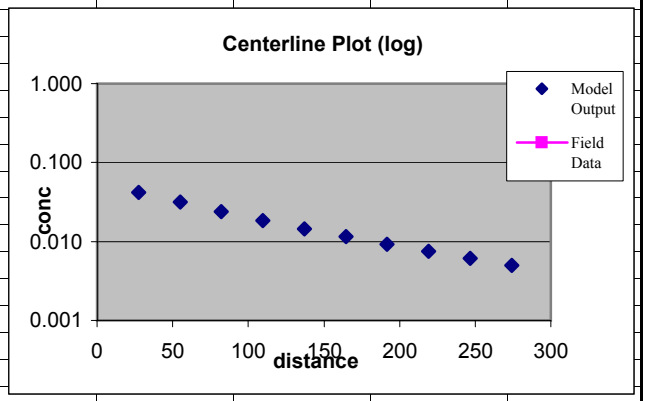
SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

Point Concentration

x(ft)	y(ft)	z(ft)
1250	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1250	0	0
at	10950	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	274
	Width (ft)	95

	27.4	54.8	82.2	109.6	137	164.4	191.8	219.2	246.6	274
95	0.002	0.004	0.005	0.005	0.005	0.005	0.004	0.004	0.003	0.003
47.5	0.024	0.020	0.017	0.014	0.011	0.009	0.008	0.006	0.005	0.004
0	0.042	0.031	0.024	0.018	0.015	0.012	0.009	0.008	0.006	0.005
-47.5	0.024	0.020	0.017	0.014	0.011	0.009	0.008	0.006	0.005	0.004
-95	0.002	0.004	0.005	0.005	0.005	0.005	0.004	0.004	0.003	0.003

Field Data:	Centerline C	Concentration
	Distance from Source	

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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	1.25E+02	1.25E+01	1.00E-04	0.00189863	100	15	10950

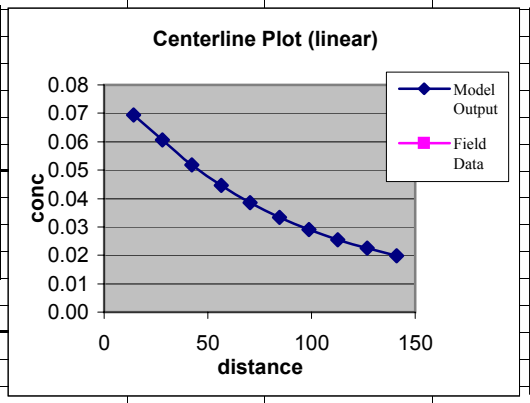
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

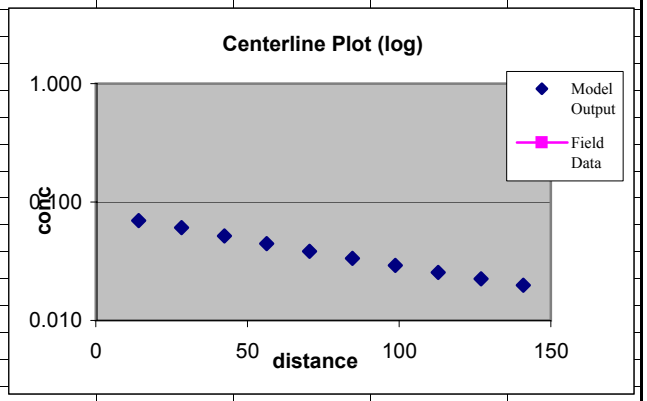
Point Concentration

x(ft)	y(ft)	z(ft)
1250	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1250	0	0
at	10950	days =	

0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	141
	Width (ft)	95

	14.1	28.2	42.3	56.4	70.5	84.6	98.7	112.8	126.9	141
95	0.001	0.003	0.005	0.006	0.007	0.008	0.008	0.008	0.007	0.007
47.5	0.039	0.035	0.031	0.028	0.026	0.023	0.021	0.019	0.017	0.015
0	0.069	0.061	0.052	0.045	0.038	0.033	0.029	0.026	0.022	0.020
-47.5	0.039	0.035	0.031	0.028	0.026	0.023	0.021	0.019	0.017	0.015
-95	0.001	0.003	0.005	0.006	0.007	0.008	0.008	0.008	0.007	0.007

Field Data: Centerline C Concentration
Distance from Source

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-209
Sample Date			4/22/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	175
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	17.5
Transverse Dispersivity	A_y	ft	1.8
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	127

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	7.6000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	0.077
Lambda (per day)		day^{-1}	0.00189863
KOC			12

Output (Concentration at the Downgradient Property Boundary in 30-years)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	1.66E+00	175	817
Sim 2 - MTBE	0.02	0.02	1.56E-02	175	149

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

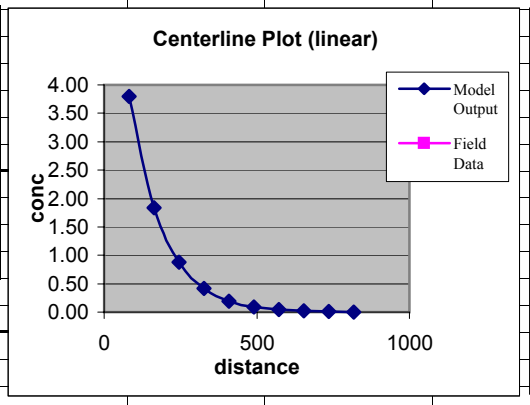
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
8	1.75E+01	1.75E+00	1.00E-04	0.0009589	100	15	10950

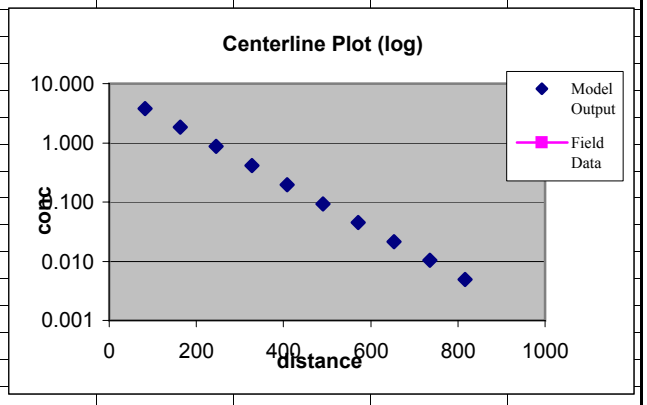
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
175	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	175	0	0
at	10950	days =	
			1.658
			mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	817
	Width (ft)	127

	81.7	163.4	245.1	326.8	408.5	490.2	571.9	653.6	735.3	817
127	0.000	0.001	0.004	0.005	0.005	0.004	0.003	0.002	0.001	0.001
63.5	0.809	0.547	0.309	0.166	0.087	0.045	0.023	0.012	0.006	0.003
0	3.799	1.841	0.874	0.414	0.196	0.093	0.045	0.021	0.010	0.005
-63.5	0.809	0.547	0.309	0.166	0.087	0.045	0.023	0.012	0.006	0.003
-127	0.000	0.001	0.004	0.005	0.005	0.004	0.003	0.002	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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	1.75E+01	1.75E+00	1.00E-04	0.00189863	100	15	10950

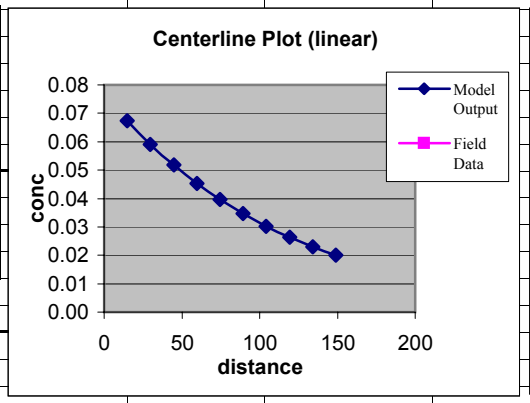
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

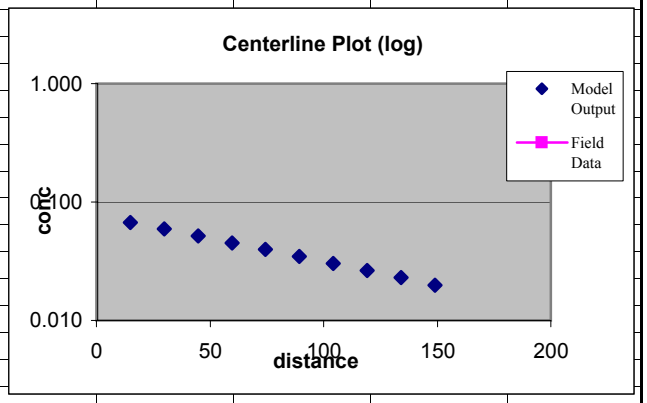
Point Concentration

x(ft)	y(ft)	z(ft)
175	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	175	0	0
at	10950	days =	

0.016 mg/l





	AREAL MODEL	CALCULATION DOMAIN								
	Length (ft)	149								
	Width (ft)	127								
	14.9	*29.8*	*44.7*	*59.6*	*74.5*	*89.4*	*104.3*	*119.2*	*134.1*	*149*
127	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63.5	0.002	0.006	0.007	0.008	0.008	0.008	0.007	0.007	0.006	0.006
0	0.067	0.059	0.052	0.045	0.040	0.035	0.030	0.026	0.023	0.020
-63.5	0.002	0.006	0.007	0.008	0.008	0.008	0.007	0.007	0.006	0.006
-127	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									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-211
Sample Date			5/2/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	815
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	81.5
Transverse Dispersivity	A_y	ft	8.2
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	115

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.1500
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	0.037
Lambda (per day)		day^{-1}	0.00189863
KOC			12

Output (Concentration at the Downgradient Property Boundary in 30-years)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	2.78E-04	815	411
Sim 2 - MTBE	0.02	0.02	5.51E-05	815	71

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

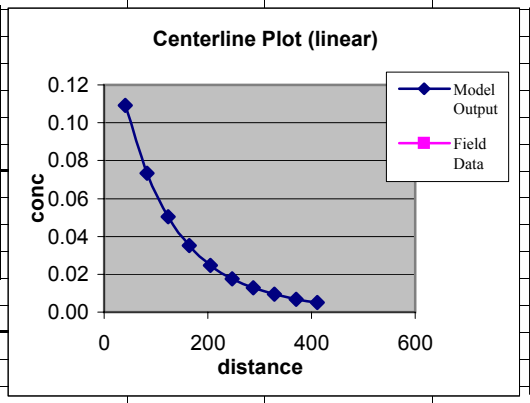
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	8.15E+01	8.15E+00	1.00E-04	0.0009589	100	15	10950

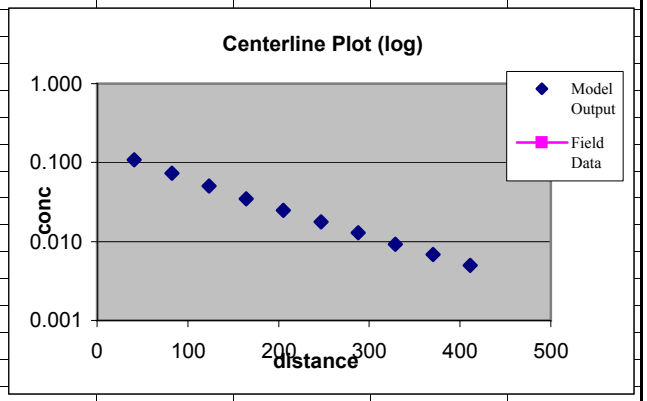
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
815	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	815	0	0
at	10950	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	411
	Width (ft)	115

	41.1	*82.2*	*123.3*	*164.4*	*205.5*	*246.6*	*287.7*	*328.8*	*369.9*	*411*
115	0.001	0.003	0.005	0.005	0.005	0.005	0.004	0.003	0.003	0.002
57.5	0.045	0.037	0.029	0.022	0.017	0.013	0.010	0.007	0.005	0.004
0	0.109	0.074	0.050	0.035	0.025	0.018	0.013	0.009	0.007	0.005
-57.5	0.045	0.037	0.029	0.022	0.017	0.013	0.010	0.007	0.005	0.004
-115	0.001	0.003	0.005	0.005	0.005	0.005	0.004	0.003	0.003	0.002
Field Data:	Centerline C	Concentration								
	Distance from Source									

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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	8.15E+01	8.15E+00	1.00E-04	0.00189863	100	15	10950

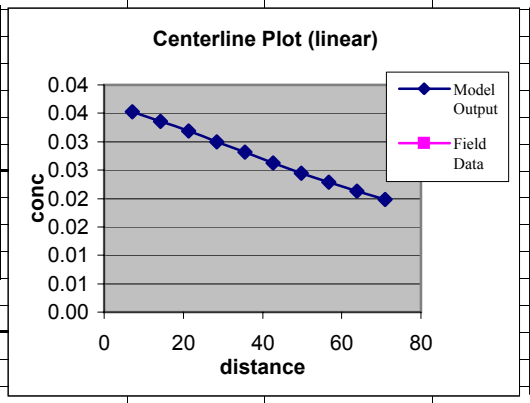
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

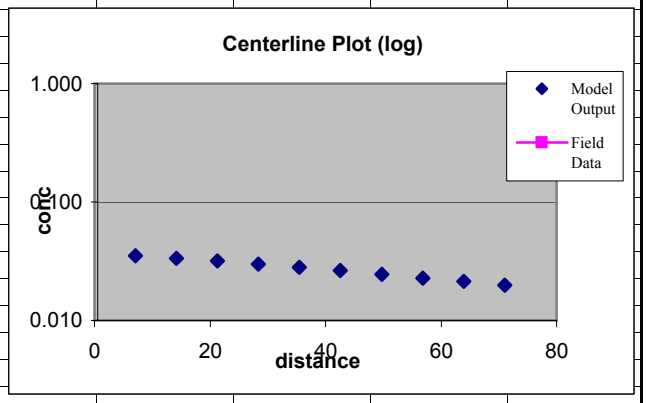
Point Concentration

x(ft)	y(ft)	z(ft)
815	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	815	0	0
at	10950	days =	

0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	71
	Width (ft)	115

	7.1	14.2	21.3	28.4	35.5	42.6	49.7	56.8	63.9	71
115	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
57.5	0.009	0.010	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010
0	0.035	0.034	0.032	0.030	0.028	0.026	0.024	0.023	0.021	0.020
-57.5	0.009	0.010	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010
-115	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001

Field Data:	Centerline C	Concentration
	Distance from Source	

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-212
Sample Date			5/2/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	500
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	50
Transverse Dispersivity	A_y	ft	5.0
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	54

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	0.4500
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 30-years)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Naphthalene	0.1	0.1	2.28E-15	500	24

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

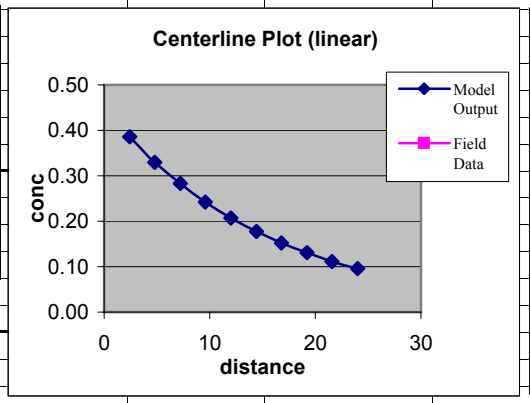
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0	5.00E+01	5.00E+00	1.00E-04	0.00268493	100	15	10950

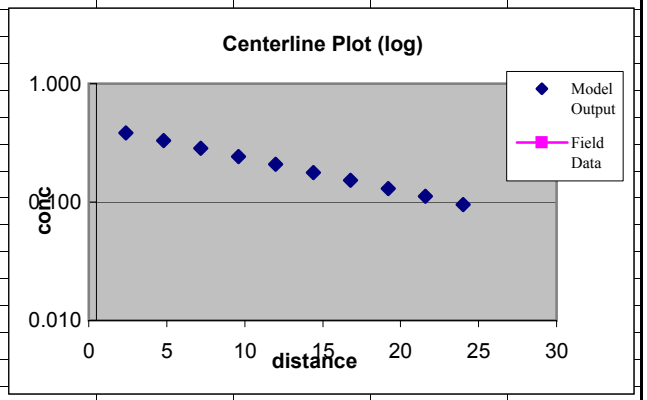
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
500	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	500	0	0
at	10950	days =	
			0.000
			mg/l





	AREAL MODEL	CALCULATION DOMAIN								
	Length (ft)	24								
	Width (ft)	54								
	2.4	4.8	7.2	9.6	12	14.4	16.8	19.2	21.6	24
54	0.080	0.093	0.090	0.083	0.074	0.066	0.058	0.050	0.044	0.038
27	0.385	0.330	0.282	0.240	0.204	0.173	0.146	0.124	0.105	0.089
0	0.385	0.330	0.283	0.242	0.207	0.178	0.152	0.130	0.112	0.096
-27	0.385	0.330	0.282	0.240	0.204	0.173	0.146	0.124	0.105	0.089
-54	0.080	0.093	0.090	0.083	0.074	0.066	0.058	0.050	0.044	0.038
Field Data:	Centerline C	Concentration								
	Distance from Source									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-214
Sample Date			4/20/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	625
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	62.5
Transverse Dispersivity	A_y	ft	6.3
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	141

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.5800
Lambda (per day)		day^{-1}	0.000958904
KOC			58

Output (Concentration at the Downgradient Property Boundary in 30-years)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	3.53E-03	625	580

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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	6.25E+01	6.25E+00	1.00E-04	0.0009589	100	15	10950

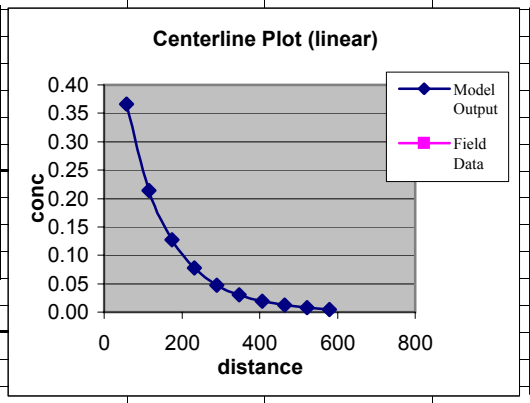
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

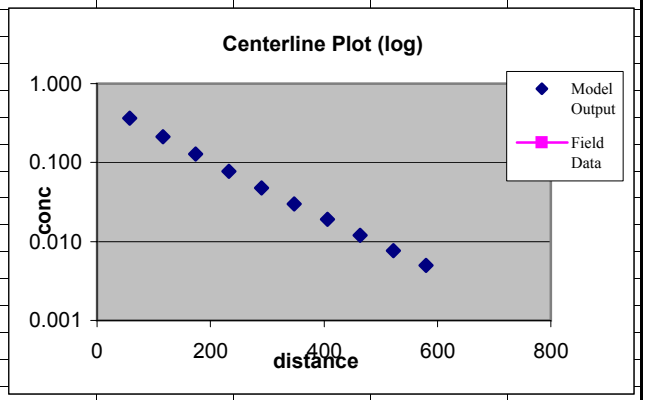
Point Concentration

x(ft)	y(ft)	z(ft)
625	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	625	0	0
at	10950	days =	

0.004 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	580
	Width (ft)	141

	58	116	174	232	290	348	406	464	522	580
141	0.000	0.002	0.005	0.005	0.005	0.004	0.004	0.003	0.002	0.001
70.5	0.087	0.078	0.058	0.041	0.028	0.019	0.013	0.008	0.006	0.004
0	0.366	0.214	0.127	0.077	0.048	0.030	0.019	0.012	0.008	0.005
-70.5	0.087	0.078	0.058	0.041	0.028	0.019	0.013	0.008	0.006	0.004
-141	0.000	0.002	0.005	0.005	0.005	0.004	0.004	0.003	0.002	0.001

Field Data:	Centerline C	Concentration
	Distance from Source	

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-215
Sample Date			4/19/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	750
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	75
Transverse Dispersivity	A_y	ft	7.5
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	273

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	29.0000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Ethylbenzene
Source Concentration (mg/l)		mg/l	3.3
Lambda (per day)		day^{-1}	0.003041096
KOC			220
Sim 3			
Contaminant			MTBE
Source Concentration (mg/l)		mg/l	51
Lambda (per day)		day^{-1}	0.00189863
KOC			12
Sim 4			
Contaminant			Toluene
Source Concentration (mg/l)		mg/l	29
Lambda (per day)		day^{-1}	0.024684932
KOC			130
Sim 5			
Contaminant			Total Xylenes
Source Concentration (mg/l)		mg/l	19
Lambda (per day)		day^{-1}	0.001890411
KOC			350
Sim 6			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	2.2
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 30-years)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	7.94E-02	750	1144
Sim 2 - Ethylbenzene	0.7	0.7	2.04E-09	750	55
Sim 3 - MTBE	0.02	0.02	1.14E-01	750	987
Sim 4 - Toluene	1	1	2.41E-22	750	48
Sim 5 - Total Xylenes	10	10	2.72E-08	750	25
Sim 6 - Naphthalene	0.1	0.1	1.98E-18	750	56

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

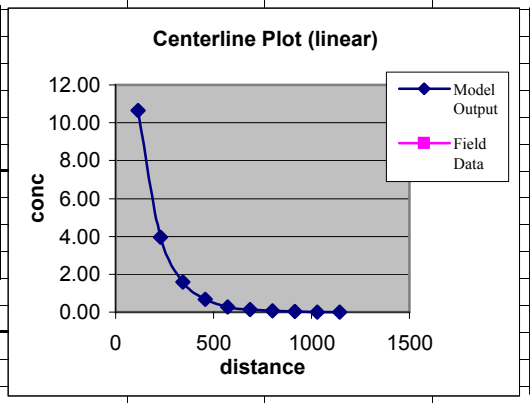
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
29	7.50E+01	7.50E+00	1.00E-04	0.0009589	100	15	10950

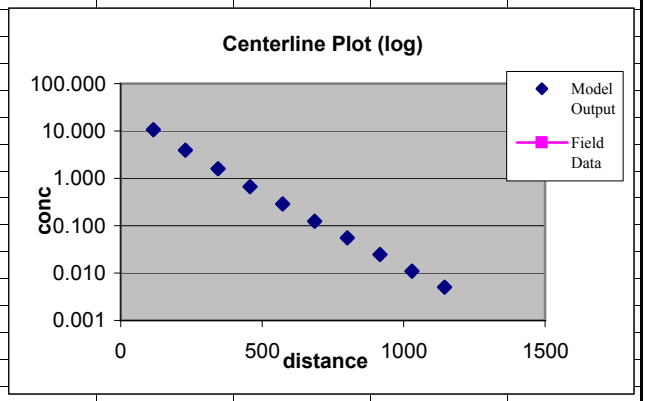
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
750	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	750	0	0
at	10950	days =	0.079 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	1144
	Width (ft)	273

	114.4	228.8	343.2	457.6	572	686.4	800.8	915.2	1029.6	1144
273	0.000	0.000	0.003	0.005	0.005	0.004	0.003	0.002	0.001	0.001
136.5	0.253	0.452	0.339	0.200	0.107	0.054	0.027	0.013	0.006	0.003
0	10.633	3.962	1.594	0.668	0.287	0.125	0.055	0.025	0.011	0.005
-136.5	0.253	0.452	0.339	0.200	0.107	0.054	0.027	0.013	0.006	0.003
-273	0.000	0.000	0.003	0.005	0.005	0.004	0.003	0.002	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Ethylbenzene

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

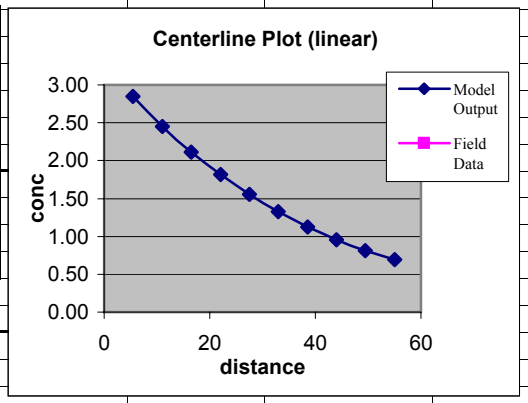
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
3	7.50E+01	7.50E+00	1.00E-04	0.0030411	100	15	10950

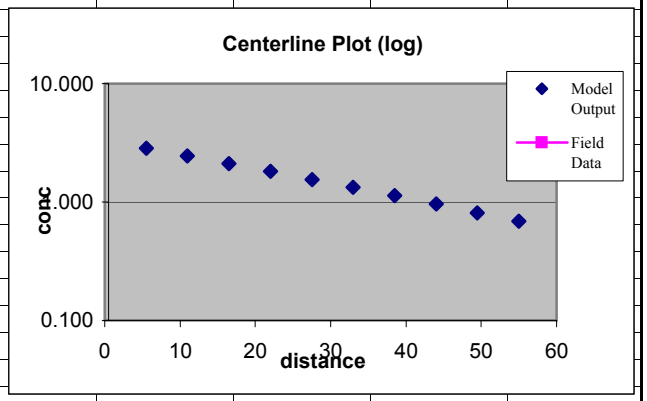
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	220	5.00E-03	6.413571429	0.037420648

Point Concentration

x(ft)	y(ft)	z(ft)
750	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	750	0	0
at	10950	days =	0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft)	55
Width (ft)	273

	5.5	11	16.5	22	27.5	33	38.5	44	49.5	55
273	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
136.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
0	2.846	2.454	2.113	1.814	1.552	1.324	1.127	0.957	0.813	0.689
-136.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
-273	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	MTBE

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

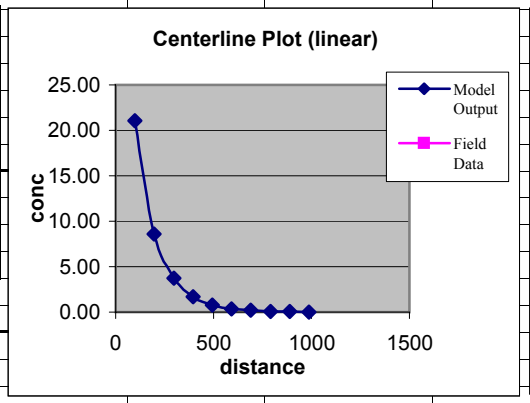
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
51	7.50E+01	7.50E+00	1.00E-04	0.00189863	100	15	10950

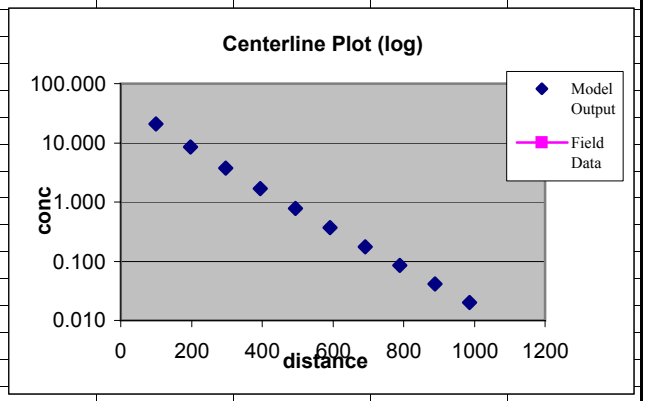
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	12	5.00E-03	1.295285714	0.185287306

Point Concentration

x(ft)	y(ft)	z(ft)
750	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	750	0	0
at	10950	days =	0.114 mg/l





	AREAL MODEL	CALCULATION DOMAIN								
	Length (ft)	987								
	Width (ft)	273								
	98.7	*197.4*	*296.1*	*394.8*	*493.5*	*592.2*	*690.9*	*789.6*	*888.3*	*987*
273	0.000	0.000	0.003	0.007	0.008	0.008	0.006	0.004	0.003	0.002
136.5	0.321	0.743	0.646	0.429	0.254	0.142	0.077	0.041	0.021	0.011
0	21.037	8.569	3.736	1.692	0.785	0.370	0.176	0.085	0.041	0.020
-136.5	0.321	0.743	0.646	0.429	0.254	0.142	0.077	0.041	0.021	0.011
-273	0.000	0.000	0.003	0.007	0.008	0.008	0.006	0.004	0.003	0.002
Field Data:	Centerline C	Concentration								
	Distance from Source									

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by:	Allison Jelinek
		Contaminant:	Toluene

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

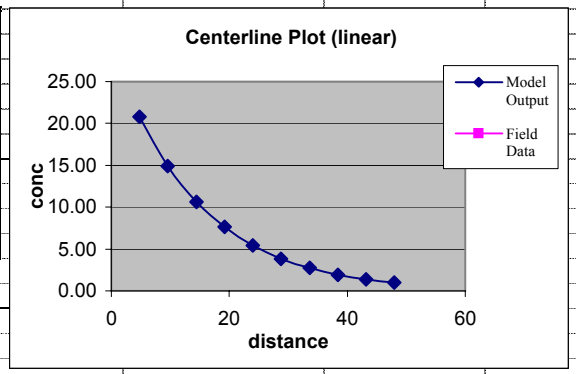
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
29	7.50E+01	7.50E+00	1.00E-04	0.02468493	100	15	10950

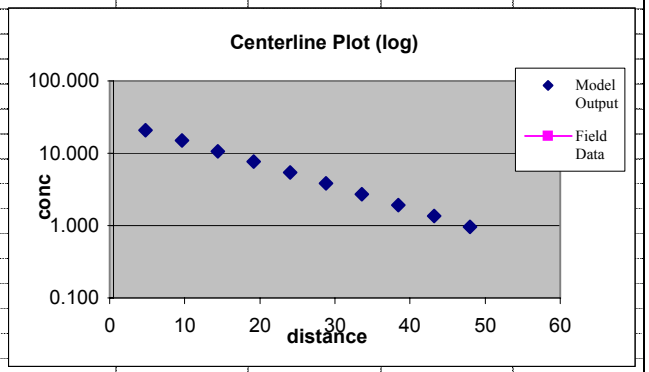
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	130	5.00E-03	4.198928571	0.057157438

Point Concentration

x(ft)	y(ft)	z(ft)
750	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	750	0	0
at	10950	days =	0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft)	48
Width (ft)	273

	4.8	9.6	14.4	19.2	24	28.8	33.6	38.4	43.2	48
273	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
136.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
0	20.773	14.879	10.651	7.610	5.423	3.854	2.733	1.935	1.368	0.967
-136.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
-273	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Total Xylenes

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

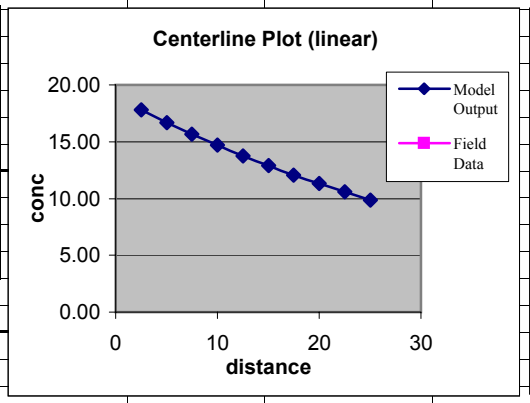
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
19	7.50E+01	7.50E+00	1.00E-04	0.00189041	100	15	10950

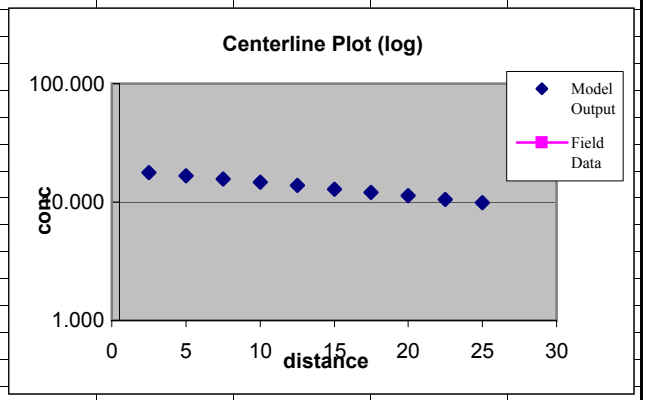
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	350	5.00E-03	9.6125	0.02496749

Point Concentration

x(ft)	y(ft)	z(ft)
750	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	750	0	0
at	10950	days =	
			0.000
			mg/l





	AREAL MODEL DOMAIN	
	Length (ft)	25
	Width (ft)	179

	2.5	5	7.5	10	12.5	15	17.5	20	22.5	25
179	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
89.5	0.000	0.000	0.002	0.009	0.027	0.055	0.089	0.128	0.168	0.206
0	17.813	16.701	15.657	14.679	13.759	12.892	12.073	11.297	10.564	9.871
-89.5	0.000	0.000	0.002	0.009	0.027	0.055	0.089	0.128	0.168	0.206
-179	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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	7.50E+01	7.50E+00	1.00E-04	0.00268493	100	15	10950

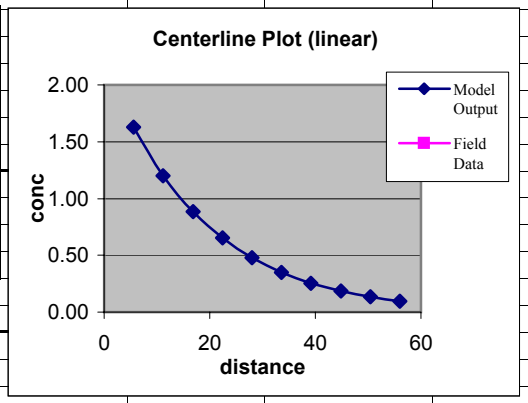
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

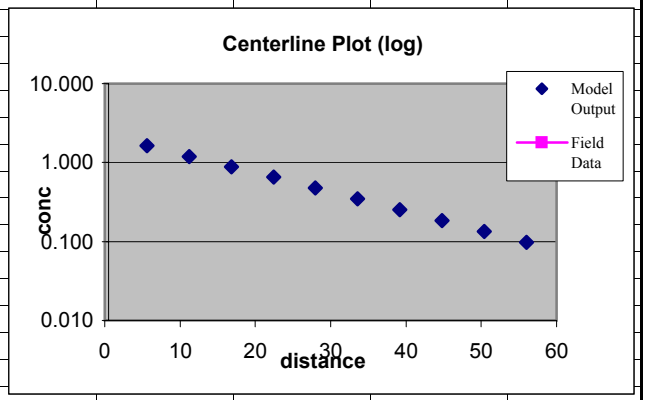
Point Concentration

x(ft)	y(ft)	z(ft)
750	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	750	0	0
at	10950	days =	

0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	56
	Width (ft)	273

	5.6	11.2	16.8	22.4	28	33.6	39.2	44.8	50.4	56
273	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
136.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	1.626	1.201	0.887	0.652	0.478	0.349	0.255	0.185	0.135	0.098
-136.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-273	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									

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			S-227
Sample Date			4/20/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	30
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	3
Transverse Dispersivity	A_y	ft	0.3
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	69

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.7500
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Ethylbenzene
Source Concentration (mg/l)		mg/l	1.5
Lambda (per day)		day^{-1}	0.003041096
KOC			220
Sim 3			
Contaminant			Toluene
Source Concentration (mg/l)		mg/l	0.047
Lambda (per day)		day^{-1}	0.024684932
KOC			130

Output (Concentration at the Downgradient Property Boundary in 30-years)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	5.65E-01	30	531
Sim 2 - Ethylbenzene	0.7	0.7	1.98E-01	30	11.3
Sim 3 - Toluene	1	1	2.78E-05	30	<1

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery						
Date:	6/6/2005	Prepared by	Allison Jelinek				
		Contaminant	Benzene				

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	3.00E+00	3.00E-01	1.00E-04	0.0009589	100	15	10950

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	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

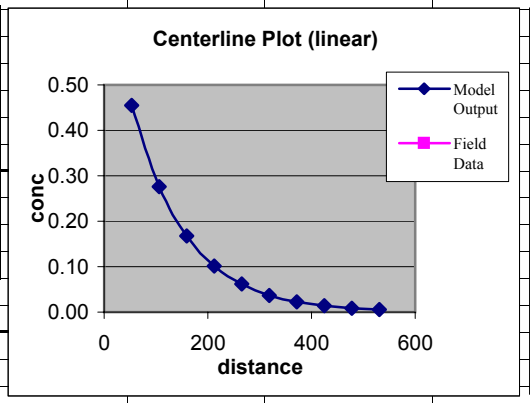
NEW QUICK_DOMENICO.XLS

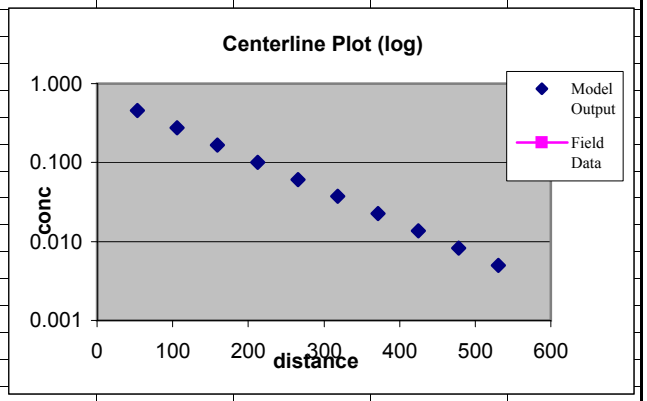
SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

Point Concentration

x(ft)	y(ft)	z(ft)
30	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	30	0	0
at	10950	days =	
			0.565
			mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	531
	Width (ft)	69

	53.1	106.2	159.3	212.4	265.5	318.6	371.7	424.8	477.9	531
69	0.000	0.002	0.004	0.005	0.004	0.003	0.002	0.002	0.001	0.001
34.5	0.453	0.268	0.158	0.093	0.055	0.032	0.019	0.011	0.007	0.004
0	0.455	0.275	0.167	0.101	0.061	0.037	0.023	0.014	0.008	0.005
-34.5	0.453	0.268	0.158	0.093	0.055	0.032	0.019	0.011	0.007	0.004
-69	0.000	0.002	0.004	0.005	0.004	0.003	0.002	0.002	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery						
Date:	6/6/2005	Prepared by	Allison Jelinek				
		Contaminant	Ethylbenzene				

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
2	3.00E+00	3.00E-01	1.00E-04	0.0030411	100	15	10950

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	0.0035	0.35	1.7225	220	5.00E-03	6.413571429	0.037420648

NEW QUICK_DOMENICO.XLS

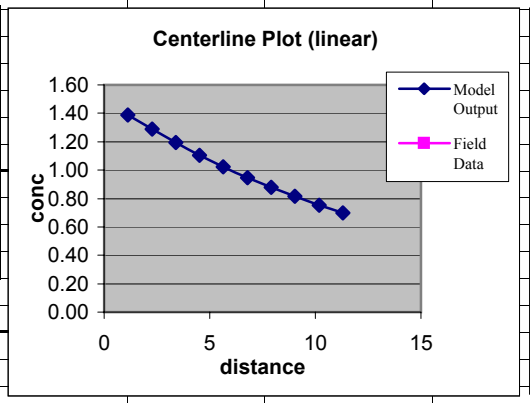
SPREADSHEET APPLICATION OF
"AN ANALYTICAL MODEL FOR
MULTIDIMENSIONAL TRANSPORT OF A
DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

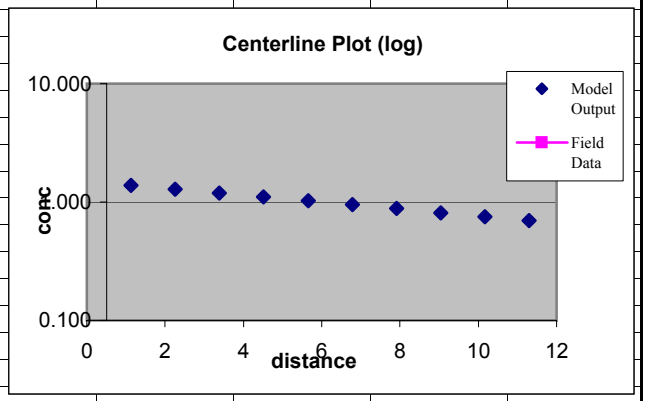
Point Concentration

x(ft)	y(ft)	z(ft)
30	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	30	0	0
at	10950	days =	

0.198 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	11.3
	Width (ft)	69

	1.13	2.26	3.39	4.52	5.65	6.78	7.91	9.04	10.17	11.3
69	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34.5	1.390	1.288	1.193	1.105	1.024	0.949	0.879	0.814	0.754	0.699
0	1.390	1.288	1.193	1.105	1.024	0.949	0.879	0.814	0.754	0.699
-34.5	1.390	1.288	1.193	1.105	1.024	0.949	0.879	0.814	0.754	0.699
-69	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Toluene

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	3.00E+00	3.00E-01	1.00E-04	0.02468493	100	15	10950

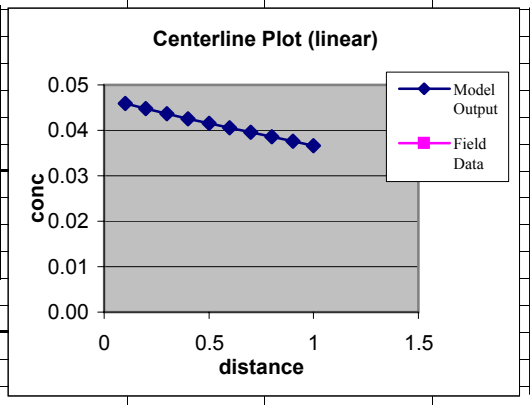
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	130	5.00E-03	4.198928571	0.057157438

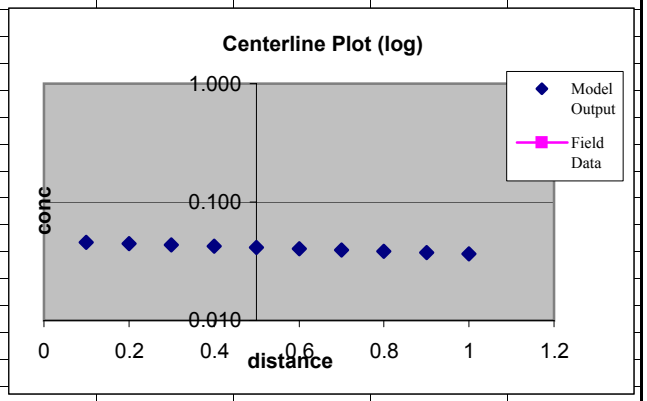
Point Concentration

x(ft)	y(ft)	z(ft)
30	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	30	0	0
at	10950	days =	

0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft)	1
Width (ft)	69

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
69	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34.5	0.046	0.045	0.044	0.043	0.042	0.041	0.040	0.039	0.038	0.037
0	0.046	0.045	0.044	0.043	0.042	0.041	0.040	0.039	0.038	0.037
-34.5	0.046	0.045	0.044	0.043	0.042	0.041	0.040	0.039	0.038	0.037
-69	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

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			MW-30
Sample Date			4/27/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1125
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	112.5
Transverse Dispersivity	A_y	ft	11.3
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	199

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parameters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	0.9600
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	3
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Output (Concentration at the Downgradient Property Boundary in 30-years)

Contaminant	GW MSC[1] Residential (mg/l)	GW MSC[2] Non-Residential (mg/l)	Concentration at Property Boundary (mg/l)	Distance to Property Boundary (ft)	Distance to Meet Residential GW MSC (ft)
Sim 1 - Benzene	0.005	0.005	3.28E-04	1125	699
Sim 2 - Naphthalene	0.1	0.1	5.27E-23	1125	70.4

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.
[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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

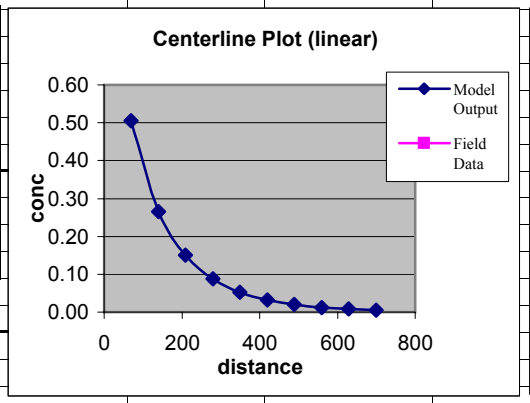
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	1.13E+02	1.13E+01	1.00E-04	0.0009589	100	15	10950

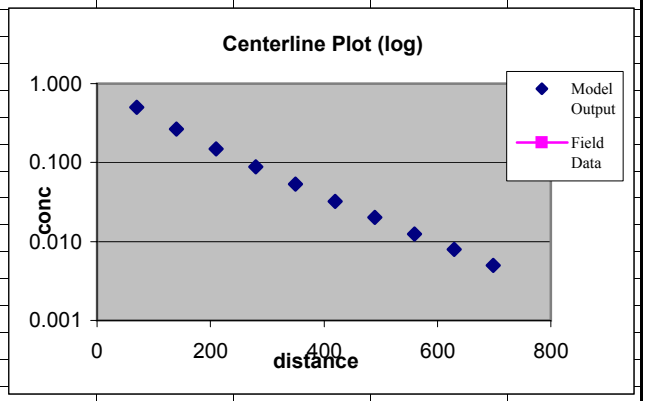
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

Point Concentration

x(ft)	y(ft)	z(ft)
1125	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1125	0	0
at	10950	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	699
	Width (ft)	199

	69.9	139.8	209.7	279.6	349.5	419.4	489.3	559.2	629.1	699
199	0.000	0.002	0.004	0.005	0.005	0.005	0.004	0.003	0.002	0.002
99.5	0.068	0.078	0.062	0.044	0.030	0.020	0.013	0.009	0.006	0.004
0	0.506	0.266	0.150	0.088	0.053	0.032	0.020	0.013	0.008	0.005
-99.5	0.068	0.078	0.062	0.044	0.030	0.020	0.013	0.009	0.006	0.004
-199	0.000	0.002	0.004	0.005	0.005	0.005	0.004	0.003	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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)
3	1.13E+02	1.13E+01	1.00E-04	0.00268493	100	15	10950

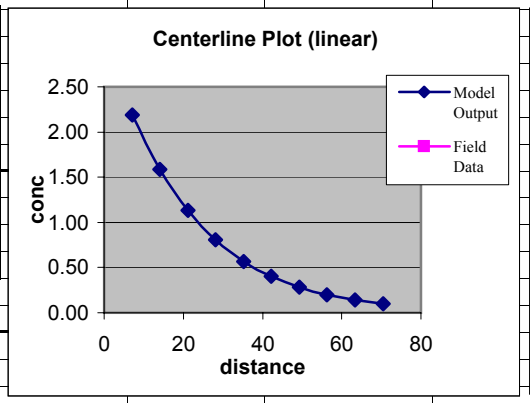
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

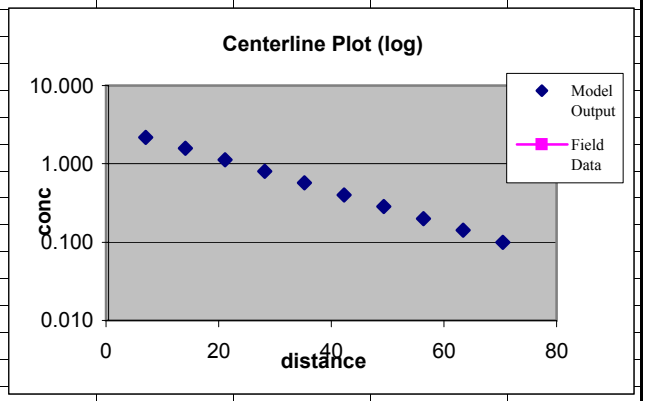
Point Concentration

x(ft)	y(ft)	z(ft)
1125	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1125	0	0
at	10950	days =	

0.000 mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	70.4
Width (ft)	199

	7.04	14.08	21.12	28.16	35.2	42.24	49.28	56.32	63.36	70.4
199	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
99.5	0.000	0.004	0.013	0.021	0.024	0.024	0.022	0.020	0.016	0.013
0	2.185	1.584	1.135	0.805	0.569	0.402	0.283	0.200	0.141	0.100
-99.5	0.000	0.004	0.013	0.021	0.024	0.024	0.022	0.020	0.016	0.013
-199	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

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Project	2574601 - Sunoco Philadelphia Refinery
Prepared by	Allison Jelinek
Date Prepared	6/6/2005

Generic Input Parameters			
Source Identification (or Well ID)			MW-43
Sample Date			5/2/2005
Source Width		ft	100
Source Thickness		ft	15
Distance to Location of Concern	x	ft	1065
Perpendicular Distance to Location of Concern	y	ft	0
Vertical Axis Perpendicular to x and y	z	ft	0
Longitudinal Dispersivity	A_x	ft	106.5
Transverse Dispersivity	A_y	ft	10.7
Vertical Dispersivity	A_z	ft	0.0001
Hydraulic Conductivty	k	ft/day	24
Hydraulic Gradient		ft/ft	0.0035
Porosity		decimal fraction	0.35
Soil Bulk Density	p_b	g/cm3	1.7225
Fraction of Organic Carbon	f_{OC}	decimal fraction	0.005
Time		days	10950
Length of Grid Dimension		ft	1
Width of Grid Dimension		ft	261

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Chemical Specific Input Parmaters			
Sim 1			
Contaminant			Benzene
Source Concentration (mg/l)		mg/l	5.4000
Lambda (per day)		day^{-1}	0.000958904
KOC			58
Sim 2			
Contaminant			Ethylbenzene
Source Concentration (mg/l)		mg/l	1
Lambda (per day)		day^{-1}	0.003041096
KOC			220
Sim 3			
Contaminant			Naphthalene
Source Concentration (mg/l)		mg/l	7.4
Lambda (per day)		day^{-1}	0.002684932
KOC			950

Quick Domenico
Fate and Transport Model Input and Output
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

Output (Concentration at the Downgradient Property Boundary in 30-years)					
Contaminant	**GW MSC[1] Residential (mg/l)**	**GW MSC[2] Non-Residential (mg/l)**	**Concentration at Property Boundary (mg/l)**	**Distance to Property Boundary (ft)**	**Distance to Meet Residential GW MSC (ft)**
Sim 1 - Benzene	0.005	0.005	2.51E-03	1065	958
Sim 2 - Ethylbenzene	0.7	0.7	4.23E-12	1065	16
Sim 3 - Naphthalene	0.1	0.1	6.69E-22	1065	88

[1] ACT 2 TGM, Appendix A, Table 1 MSC for a Residential Used Aquifer with Total Dissolved Solids less than or equal to 2500.

[2] 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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Benzene

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)
5	1.07E+02	1.07E+01	1.00E-04	0.0009589	100	15	10950

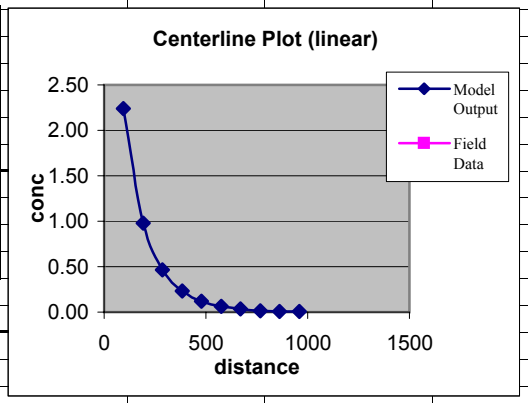
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	58	5.00E-03	2.427214286	0.098878785

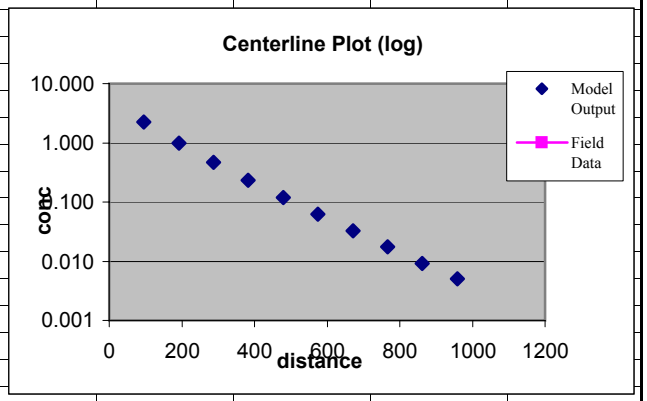
Point Concentration

x(ft)	y(ft)	z(ft)
1065	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1065	0	0
at	10950	days =	

0.003 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 958
Width (ft) 261

	95.8	191.6	287.4	383.2	479	574.8	670.6	766.4	862.2	958
261	0.000	0.001	0.003	0.005	0.005	0.005	0.003	0.002	0.002	0.001
130.5	0.114	0.176	0.138	0.091	0.055	0.032	0.019	0.011	0.006	0.003
0	2.236	0.980	0.467	0.233	0.119	0.062	0.033	0.017	0.009	0.005
-130.5	0.114	0.176	0.138	0.091	0.055	0.032	0.019	0.011	0.006	0.003
-261	0.000	0.001	0.003	0.005	0.005	0.005	0.003	0.002	0.002	0.001

Field Data: Centerline C Concentration
Distance from Source

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Ethylbenzene

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

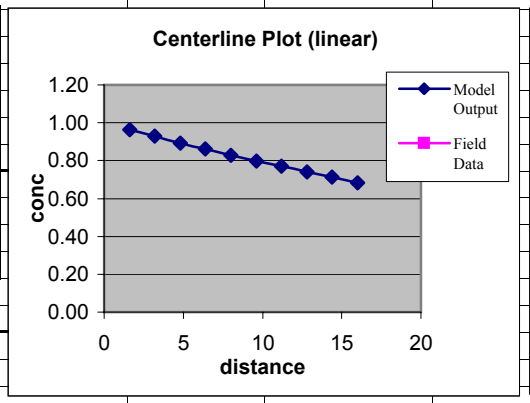
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1	1.07E+02	1.07E+01	1.00E-04	0.0030411	100	15	10950

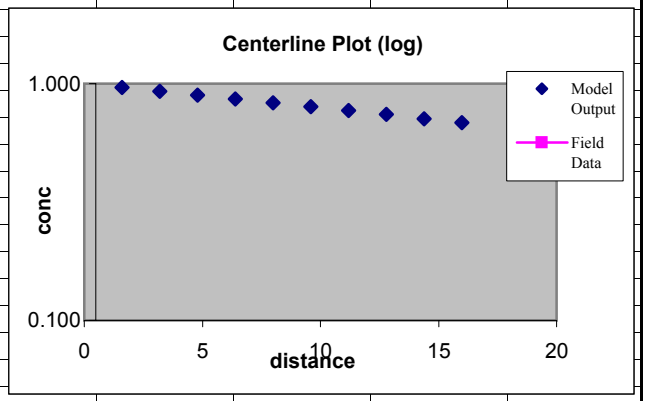
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	220	5.00E-03	6.413571429	0.037420648

Point Concentration

x(ft)	y(ft)	z(ft)
1065	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1065	0	0
at	10950	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	16
	Width (ft)	261

	1.6	3.2	4.8	6.4	8	9.6	11.2	12.8	14.4	16
261	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
130.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.963	0.928	0.894	0.861	0.830	0.799	0.769	0.740	0.712	0.684
-130.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-261	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 TOO

Project:	2574601 - Sunoco Philadelphia Refinery		
Date:	6/6/2005	Prepared by	Allison Jelinek
		Contaminant	Naphthalene

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

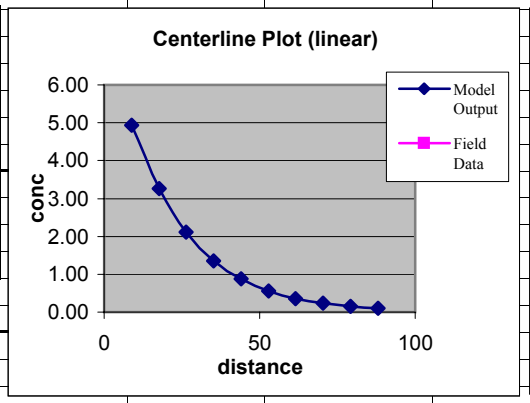
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
7	1.07E+02	1.07E+01	1.00E-04	0.00268493	100	15	10950

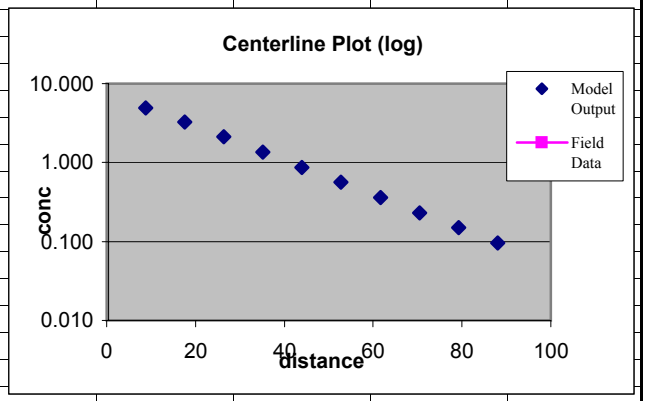
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
2.40E+01	0.0035	0.35	1.7225	950	5.00E-03	24.37678571	0.009845433

Point Concentration

x(ft)	y(ft)	z(ft)
1065	0	0

	x(ft)	y(ft)	z(ft)
Conc. At	1065	0	0
at	10950	days =	0.000 mg/l





	AREAL MODEL	CALCULATION DOMAIN
	Length (ft)	88
	Width (ft)	111

	8.8	17.6	26.4	35.2	44	52.8	61.6	70.4	79.2	88
111	0.000	0.003	0.011	0.019	0.023	0.022	0.020	0.017	0.013	0.010
55.5	1.696	1.276	0.894	0.613	0.417	0.281	0.189	0.127	0.085	0.056
0	4.930	3.254	2.113	1.360	0.873	0.560	0.359	0.231	0.149	0.096
-55.5	1.696	1.276	0.894	0.613	0.417	0.281	0.189	0.127	0.085	0.056
-111	0.000	0.003	0.011	0.019	0.023	0.022	0.020	0.017	0.013	0.010

Field Data:	Centerline C	Concentration
	Distance from Source	

FIGURES H-1 THROUGH H-4

Conservative Tracer Concentration Scale

1,000.0 mg/L

0.001 mg/L

Legend

- AOI Boundaries
- Total Fluids Recovery Well Approximate Radius of Influence
- Estimated Zone of Fluids Capture
- Groundwater Elevation Contour
- Groundwater Depression Contour
- Inferred Groundwater Contour
- S-34 7.87 — Trenton Gravel Wells and Groundwater Elevations (ft amsl)
- S-34 7.87 — Trenton Gravel Recovery Wells and Groundwater Elevations (ft amsl)
- S-75 4.27 — Fill / Alluvium Wells and Groundwater Elevations (ft amsl)
- S-75 4.27 — Fill / Alluvium Recovery Wells and Groundwater Elevations (ft amsl)
- Recovery Wells
- S-100 — 26th Street Area Off-Site Wells
- Other Existing Wells
- Other Existing Recovery Wells

Notes:
1. All Groundwater elevations collected by Handex during May 2005. Only wells accessible during gauging event are listed.
2. The approximated extent of dissolved groundwater concentrations is based on Quick Domenico results for monitoring and recovery wells S-226, S-51, S-99, S-88, S-84, S-181, S-125, PZ-402, S-182, S-183, S-184, S-186, S-187, S-193, S-194, and MW-38.

Figure H-1: Simulated Conservative Tracer Distribution at Time = 0.0 Months
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 250 Feet

SCALE: 1" = 250'
DATE: October 4, 2007
DRN. BY: DT
CKD. BY: TS
JOB#: 2574601

Q:\Data\2574601\ArcGIS\Map Documents\AOI 1 Site Characterization Report\Figure H-1 - Fate and Transport Results_Revised 10\2007 (11x17).mxd

Conservative Tracer Concentration Scale

1,000.0 mg/L

0.001 mg/L

Legend

- AOI Boundaries
- Total Fluids Recovery Well Approximate Radius of Influence
- Estimated Zone of Fluids Capture
- Groundwater Elevation Contour
- Groundwater Depression Contour
- Inferred Groundwater Contour
- S-34 7.87 — Trenton Gravel Wells and Groundwater Elevations (ft amsl)
- S-34 7.87 — Trenton Gravel Recovery Wells and Groundwater Elevations (ft amsl)
- S-75 4.27 — Fill / Alluvium Wells and Groundwater Elevations (ft amsl)
- S-75 4.27 — Fill / Alluvium Recovery Wells and Groundwater Elevations (ft amsl)
- Recovery Wells
- S-100 — 26th Street Area Off-Site Wells
- Other Existing Wells
- Other Existing Recovery Wells

Notes:
1. All Groundwater elevations collected by Handex during May 2005. Only wells accessible during gauging event are listed.
2. The approximated extent of dissolved groundwater concentrations is based on Quick Domenico results for monitoring and recovery wells S-226, S-51, S-99, S-88, S-84, S-181, S-125, PZ-402, S-182, S-183, S-184, S-186, S-187, S-193, S-194, and MW-38.

Figure H-2: Simulated Conservative Tracer Distribution at Time = 8.0 months
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 250 Feet

SCALE: 1" = 250'
DATE: October 4, 2007
DRN. BY: DT
CKD. BY: TS
JOB#: 2574601

G:\Data\2574601\ArcGIS\MapDocuments\AOI 1 Site Characterization Report\Figure H-2 - Fate and Transport Results_Revised 100207 (11x17).mxd

AOI-1

N
W E
S

Conservative Tracer Concentration Scale

1,000.0 mg/L

0.001 mg/L

- AOI Boundaries
- Total Fluids Recovery Well Approximate Radius of Influence
- Estimated Zone of Fluids Capture
- Groundwater Elevation Contour
- Groundwater Depression Contour
- Inferred Groundwater Contour

Legend

- Trenton Gravel Wells and Groundwater Elevations (ft amsl)
- Trenton Gravel Recovery Wells and Groundwater Elevations (ft amsl)
- Fill / Alluvium Wells and Groundwater Elevations (ft amsl)
- Fill / Alluvium Recovery Wells and Groundwater Elevations (ft amsl)
- Recovery Wells
- 26th Street Area Off-Site Wells
- Other Existing Wells
- Other Existing Recovery Wells

Notes:
1. All Groundwater elevations collected by Handex during May 2005. Only wells accessible during gauging event are listed.
2. The approximated extent of dissolved groundwater concentrations is based on Quick Domenico results for monitoring and recovery wells S-226, S-51, S-99, S-88, S-84, S-181, S-125, PZ-402, S-182, S-183, S-184, S-186, S-187, S-193, S-194, and MW-38.

Figure H-3: Simulated Conservative Tracer Distribution at Time = 12.0 Months
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 250 Feet

SCALE: 1" = 250'
DATE: October 4, 2007
DRN. BY: DT
CKD. BY: TS
JOB#: 2574601

Q:\Data\2574601\ArcGIS\MapDocuments\AOI 1 Site Characterization Report\Figure H-3 - Fate and Transport Results_Revised 102007 (11x17).mxd

AOI-1

N
W E
S

Legend

Conservative Tracer Concentration Scale

1,000.0 mg/L

0.001 mg/L

- AOI Boundaries
- Total Fluids Recovery Well Approximate Radius of Influence
- Estimated Zone of Fluids Capture
- Groundwater Elevation Contour
- Groundwater Depression Contour
- Inferred Groundwater Contour

S-34 7.87 — Trenton Gravel Wells and Groundwater Elevations (ft amsl)

S-34 7.87 — Trenton Gravel Recovery Wells and Groundwater Elevations (ft amsl)

S-75 4.27 — Fill / Alluvium Wells and Groundwater Elevations (ft amsl)

S-75 4.27 — Fill / Alluvium Recovery Wells and Groundwater Elevations (ft amsl)

- Recovery Wells
- S-100 — 26th Street Area Off-Site Wells
- Other Existing Wells
- Other Existing Recovery Wells

Notes:
1. All Groundwater elevations collected by Handex during May 2005. Only wells accessible during gauging event are listed.
2. The approximated extent of dissolved groundwater concentrations is based on Quick Domenico results for monitoring and recovery wells S-226, S-51, S-99, S-88, S-84, S-181, S-125, PZ-402, S-182, S-183, S-184, S-186, S-187, S-193, S-194, and MW-38.

Figure H-4: Simulated Conservative Tracer Distribution at Time = 30.0 Years
Sunoco Philadelphia Refinery
Philadelphia, Pennsylvania

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

0 250 Feet

SCALE: 1" = 250'
DATE: October 4, 2007
DRN. BY: DT
CKD. BY: TS
JOB#: 2574601

O:\Data\2574601\ArcGIS\Map Documents\AOI 1 Site Characterization Report\Figure H-4 - Fate and Transport Results_Revised 102207 (11x17).mxd

APPENDIX I

DERIVATION OF SITE-SPECIFIC SOIL VALUE

Appendix I
Derivation of Site-Specific Soil Value

Benzene

Inhalation		Non-Residential (Onsite Worker)
THQ	Target Hazard Quotient	**1**
RfD_i	Oral Reference Dose (mg/kg-day)	**0.0017**
BW	Body weight (kg)	**70**
AT_{NC}	Averaging Time for systemic toxicants (yr)	**25**
TF	Transport Factor (mg/kg)/(mg/m^3)	
	Surface Soil	**13100**
	Particulate	**1.00E+10**
Abs	Absorption (unitless)	**1**
ET	Exposure Time (hr/day)	**8**
EF	Exposure Frequency (d/yr)	**180**
ED	Exposure Duration	**25**
IR	Inhalation Rate (m^3/hr)	**1.25**
TR	Target Risk	**1.00E-04**
CSF_i	Inhalation Cancer Slope Factor (mg/kg-day^{-1})	**0.027**
At_c	Averaging Time for carcinogens (yr)	**70**
Ifadj	Inhalation factor	**0.4**

Site-Specific Non-Residential Value
2152

Note: All Values in mg/kg

Note:
1. The inhalation MSC was modified to calculate the site-specific standard since it was the most conservative value for benzene.
2. The risk level for benzene was modified from $1e^{-5}$ to $1e^{-4}$. Since the risk range in only one compound in one sample was modified, a cumulative risk evaluation was not necessary.

APPENDIX J

SOIL CORE PHOTOGRAPHS

20.0

Each Interval Equals 0.1 ft.

Project: Sun-Philadelphia Refinery

PTS File No.: 35262

Boring ID: SS-S34

PTS Laboratories
ENVIRONMENTAL SERVICES

21.0

Each Interval Equals 0.1 ft.

Project: Sun-Philadelphia Refinery

PTS File No.: 35262

Boring ID: SS-S34

PTS Laboratories
ENVIRONMENTAL SERVICES

22.0

Each Interval
Equals 0.1 ft.

Project: Sun-Philadelphia Refinery

PTS File No.: 35252

BORING: SS-MW-42-041505

PTS Laboratories
ENVIRONMENTAL SERVICES

23.0

Each Interval
Equals 0.1 ft.

Project: Sun-Philadelphia Refinery

PTS File No.: 35252

BORING: SS-MW-42-041505

PTS Laboratories
ENVIRONMENTAL SERVICES