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

January 31, 2003

Pennsylvania DEP
Southeast Regional Office
Lee Park, Suite 6010
555 North Lane
Conshohocken PA 19428

Attn: Mr. David Burke

Re: 26th Street Border Investigation
Sunoco Philadelphia Refinery
Point Breeze Processing Area

Dear Dave:

Enclosed are two hard copies and one electronic copy of the Remedial Investigation Report for the 26th Street Border of Sunoco's Point Breeze Processing Area. Sunoco Inc.(R&M) retained Secor International, Inc. to complete this investigation and report.

Included in this investigation was additional monitoring well installation, an evaluation of historical gauging data, an analytical characterization of LNAPL types on and off -site, an evaluation of the existing recovery system performance, an evaluation of pump tests and slug tests on and off- site, and an analysis of dissolved hydrocarbon data at the 26th Street perimeter.

Based on the information gathered in this investigation, we have developed a list of recommendations. Included as recommendations are the need for further site characterization/LNAPL definition, implementation of an extended pilot test of the reconfigured 400 series recovery system, implementation of off-site remediation in the vicinity of well S-98, remedial testing in the vicinity of well S-50 and remedial testing in the vicinity of well S-124.

As we discussed, a new survey will be performed to provide accurate locations and elevations of all wells in the eastern portion of the Point Breeze Processing Area South Yard relative to NAD 83 (horizontal datum) and NGVD 88 (vertical datum). In addition, all of the wells on the Belmont Terminal will be tied into this survey.

The existing 400 series recovery wells remediation system has been reconfigured to operate as a pneumatic total fluids recovery system. Currently, the discharge pipe is frozen solid, preventing operation of the system. In the interim, LNAPL will be recovered from the LNAPL bearing wells on the border by either vacuum truck or a portable submersible pump. This will be done on a weekly basis until the remediation systems are reactivated.

I look forward to discussing the findings of this report with you. Please call me at (610) 859-1881 with any questions or comments.

Best Regards,

James R. Oppenheim, PE
Sr. Environmental Consultant

Enclosure

Cc: Steve Coladonato, Sunoco, Inc.
Ed Ciechon, Sunoco, Inc.
Ray Toto, Sunoco, Inc. w/o enclosure
Steve Baggett, Secor International
S. Hon Lee, USEPA, Region III

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

January 31, 2003

Environmental Protection Agency, Region III
3WC22
1650 Arch Street
Philadelphia, PA 19103-2029
Attn: S. Hon Lee

Re: Remedial Investigation Report
26th Street Border
Point Breeze Processing Area

Dear Hon:

Enclosed is a copy of the above referenced report. An investigation of LNAPL occurrence and elevated dissolved hydrocarbon levels near the 26th Street border of the Point Breeze Processing Area was conducted for Sunoco Inc. (R&M) by Secor International Inc. in the fourth quarter of 2002. Secor also evaluated the effectiveness of Sunoco's current recovery system along 26th Street.

As you are aware, Sunoco had previously submitted "Documentation of Environmental Indicator Determination for Migration of Contaminated Groundwater Under Control" (EI RCRIS Code CA750) for the Point Breeze Processing Area and had indicated that further information was necessary to evaluate the potential migration of contaminated groundwater at the facility. This report is intended to address that evaluation and provides recommendations for further work to quantify and address areas of groundwater contamination with a goal of meeting EPA's EI determination in 2005. We also have conducted this work to be consistent with the Statement of Intent between EPA and Sunoco particularly to focus on a results oriented, performance based approach to addressing groundwater conditions at the Philadelphia Refinery.

After review of this report, please give me a call at 610-859-1881 with any questions or comments on the recommendations and proposed next steps outlined for this facility.

Sincerely,

James R. Oppenheim, PE

cc: S. Coladonato, Sunoco, Inc
D. Burke, PADEP

bcc: E. Ciechon
R. Toto
C. Barksdale
F. Aceto, Secor

SECOR

SECOR INTERNATIONAL INCORPORATED

www.secor.com

SUNOCO, INC.

26TH STREET BORDER
POINT BREEZE PROCESSING AREA
PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

REMEDIAL INVESTIGATION REPORT

January 31, 2003

Prepared for:

Sunoco, Inc. (R&M)
3144 Passyunk Avenue
Philadelphia, PA 19145-5299

Completed by:

SECOR International Incorporated
102 Pickering Way, Suite 200
Exton, PA 19341

Steve Baggett
Steve Baggett, P.G. (PG000790G)
Principal Hydrogeologist

Frank Aceto
Frank Aceto, Jr. P.G. (PG000892G)
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1.0 INTRODUCTION

This Remedial Investigation Report was prepared for Sunoco, Inc. (R&M) (Sunoco) for the eastern portion of the Point Breeze Processing Area of the Philadelphia Refinery located in Philadelphia, Pennsylvania (refer to **Figure 1-1**). The investigation was performed to characterize the occurrence of light non-aqueous phase liquids (LNAPL) along the eastern perimeter of the Point Breeze Processing Area (refer to **Figure 1-2**) which borders 26th Street (also referred to as PA Route 291). Site-specific information was used in the evaluation of an appropriate remedial approach for the recovery of LNAPL along the 26th Street border and across (east of) 26th Street from the northern portion of the Point Breeze Processing Area.

This investigation was also performed to provide baseline site characterization data in order to direct additional site activities needed to assess groundwater under the United States Environmental Protection Agency (USEPA) Resource Conservation and Recovery Act (RCRA) Corrective Action Environmental Indicators (EI) program.

1.1 Objectives

In a September 26, 2002 letter from the Pennsylvania Department of Environmental Protection (PADEP) to Sunoco, PADEP requested Sunoco provide a report detailing actions taken to investigate and prevent off-site migration of LNAPL along the 26th Street border of the refinery. PADEP referenced the apparent increases of LNAPL thickness in wells on adjacent properties which border 26th Street and requested Sunoco investigate the LNAPL occurrence. In their letter, PADEP also requested that Sunoco communicate the operational status of the 400 series recovery wells when changes occur. This investigation was performed to address PADEP's requests expressed in the September 26, 2002 letter to Sunoco.

As mentioned above, this investigation was also performed to provide baseline data in order to direct additional site activities as needed for the USEPA EI program. The EPA is using two environmental indicators to assess conditions at facilities undergoing RCRA corrective action. The two indicators relate to current human exposures to contamination and the migration of contaminated groundwater. During September 2002, Sunoco completed EI determination forms for the "Current Human Exposures Under Control" and "Migration of Contaminated Groundwater Under Control" to USEPA for the Point Breeze Processing Area. Sunoco responded to the "Current Human Exposures Under Control" indicating that there are no "unacceptable" human exposures to "contamination" (i.e., constituents in concentrations in excess of appropriate risk-based levels at the Philadelphia Refinery) that can be reasonably expected under current land and groundwater use conditions. The "Migration of Contaminated Groundwater Under Control" response submitted to USEPA indicated that more information is needed to make a determination. This investigation reviewed and consolidated baseline information to support additional site activities needed to make a determination of the status of groundwater migration along the 26th Street border of the facility.

Activities performed during this investigation and documented in this report include:

- Installation of 12 monitoring wells,
- Liquid level gauging,
- Aquifer characterization including the performance of an aquifer test and seven slug tests,
- Redevelopment and short-duration capacity testing of the 400 series recovery wells,
- Performance of four LNAPL bail-down tests, and
- Collection and laboratory analyses of LNAPL samples for product characterization.

1.2 Report Organization

The remainder of the remedial investigation report has been divided into the following sections:

Section 2.0 – Summarizes the site setting including location and description, geology and hydrogeology, and provides a description of the 400 series recovery well system.

Section 3.0 – Provides a description of the field methods utilized.

Section 4.0 – Provides a discussion of the results of the investigation including site geology and hydrogeology, recovery well testing, extent of LNAPL occurrence, LNAPL bail-down testing, and characterization of the LNAPL.

Section 5.0 – Presents a preliminary evaluation of remedial alternatives for the 26th Street perimeter of the Point Breeze Processing Area.

Section 6.0 – Presents the conclusions of the investigations and recommendations for future activities.

2.0 SITE SETTING

This section provides a brief description of the project area. Included is a discussion of the project location, the regional geology and hydrogeology, and the 400 series recovery well remedial system.

2.1 Site Location and Description

The Point Breeze Processing Area of the Philadelphia Refinery is located in south Philadelphia, Pennsylvania (refer to **Figure 1-1**). The Point Breeze Processing Area is bounded to the north by Sunoco's Belmont Terminal and Passyunk Avenue; to the west by the Schuylkill River and the Girard Point Processing Area of the Philadelphia Refinery; to the south by Penrose Avenue; and to the east by 26th Street.

As indicated on **Figure 1-2**, the area of investigation includes the eastern portion of the Point Breeze Processing Area. Areas also investigated were adjacent to the eastern side of 26th Street and to the west of the railroad tracks, which are properties owned by Consolidated Railroad Corporation (Conrail), Steen Company, and Ryder Company (these properties are depicted on **Figure 3-2**). This investigation included the testing, gauging and LNAPL sampling of previously existing wells on the Conrail property (refer to **Figure 1-2**).

As indicated on **Figure 1-1**, to the east of the railroad tracks that parallel 26th Street, are the Defense Support Center Philadelphia (DSCP) and a former residential area owned by the Philadelphia Housing Authority (the former PHA property). A LNAPL plume on the water table occurs to the east of the Point Breeze Processing Area and encompasses the central and southern portion of the DSCP property, the northern portion of the Philadelphia Housing Authority Property, and the Steen Property. The DSCP is working under an order from PADEP to address this area.

2.2 Geology and Hydrogeology

The Point Breeze Processing Area is located within the Coastal Plain Physiographic Province approximately one mile southeast of the Fall Line. The topographic elevation of the study area generally ranges from 15 to 30 feet above mean sea level with a gentle slope to the west and south. The Coastal Plain is characterized by gently southeastern dipping, unconsolidated marine and fluvial deposits of clay, silt, sand, and gravel of late Cretaceous and Tertiary Age.

Previous investigations in the area indicate that the surficial geology consists of localized fill, Quaternary Alluvium and Pleistocene-age Trenton Gravel. The Quaternary Alluvium in the area is reported to consist predominantly of sandy silt and sandy micaceous clay. This unit generally ranges in thickness from 0 to 20 feet. The Trenton Gravel underlies the Quaternary Alluvium.

The Trenton Gravel is described as gray or pale reddish-brown, very gravelly sand interstratified with semi-consolidated limonite cemented sand and clayey silt beds; and includes areas of alluvium and swamp deposits. The sediments are poorly sorted (Balmer and Davis, 1996). The thickness of the Trenton Gravel is underlain by a sequence of Upper Cretaceous Age sand and clay units which overlie the crystalline bedrock of the Wissahichon Formation (a well foliated schist and gneiss). A generalized stratigraphic column for the Coastal Plain is presented as **Figure 2-1**, although the wedge of Coastal Plain sediments thin to the northwest towards the Fall Line.

The maximum depth of exploration for this investigation was approximately 35 feet below ground surface (bgs). A description of the subsurface materials encountered during this investigation is provided in Section 4.1

2.3 RW-400 Series Recovery System

A groundwater/LNAPL recovery system was installed in 1995 on the northern portion of the 26th Street perimeter of the Point Breeze Processing Area and the southern portion of the Belmont Terminal (RW-400) as part of the work conducted under the 1993 Consent Order between Sunoco and PADEP. The recovery system consists of RW-400, RW-402, RW-403, RW-404, RW-405, and RW-406 (RW-401 was replaced by RW-406 during 2000 because of excess silt in the bottom of RW-401). These wells were installed to recover LNAPL along the 26th Street perimeter of the refinery. The locations of the RW-400 series recovery wells are depicted on **Figure 2-2** and well construction specifications are presented on **Table 2-1**.

Each recovery well was equipped with a dual pump system (a LNAPL pump and a submersible water pump). The volume of LNAPL and groundwater recovered was monitored by individual in-line flow meters. The pumps operated using water/LNAPL level probes connected to a control panel located in the immediate vicinity of each well. Recovered LNAPL was pumped directly to an adjacent aboveground recovery tank while water was routed to the facility wastewater treatment plant. The operation of this system has been documented in quarterly progress reports submitted to PADEP.

In addition to recovery system operation, Sunoco also performs liquid level gauging of a network of groundwater monitoring wells and annual groundwater sampling (and laboratory analyses of samples) of eight perimeter monitoring wells within the Point Breeze Processing Area. This data is provided to PADEP in quarterly and annual status reports.

3.0 SITE CHARACTERIZATION METHODS

This section describes the field activities performed in order to meet the objectives of the investigation. Activities performed included monitoring well installation, liquid level measurements, aquifer characterization, recovery well capacity testing, LNAPL bail-down testing, and LNAPL sampling and analyses.

3.1 Monitoring Well Installation

A total of 12 monitoring wells (designated S-116 through S-127) were installed between August 12, 2002 and September 19, 2002. These wells were installed to provide additional delineation of the extent of LNAPL and for future use in the EI Program. Monitoring wells S-116 through S-127 were installed along the eastern perimeter of the Point Breeze Processing Area (refer to **Figure 3-1**).

Monitoring well installation was initiated on August 12, 2002 by Parratt-Wolffe, Inc. under the supervision of a SECOR professional geologist registered in Pennsylvania. Soil borings were advanced at each location using continuous flight hollow-stem auger drilling techniques. During drilling, soil samples were collected for lithologic description continuously to the target depth with a split-barrel sampling device. Organic vapors in the headspace of soil samples were monitored with a photoionization detector (PID). Soil borings were advanced to depths ranging from 22 to 35 feet below bgs. The subsurface lithology and PID measurements were recorded by the supervising geologist on a lithologic log (refer to **Appendix A**).

Once the termination depth of each soil boring was reached, the well casing and screen was inserted into the boring through the center of the hollow-stem auger. The monitoring wells were constructed of 4-inch diameter schedule 40 polyvinyl chloride (PVC) well screen and solid PVC riser. Lengths of pipe were joined using threaded flush joint couplings. The well screen was pre-constructed, commercially slotted, with a slot size of 0.020 inches. The bottom of each screen was provided with a threaded flush joint cap. A well sorted silica filter sand (#2 grade) was poured through the augers from the bottom of the boring to a level above the top of the screened interval to fill the annular space. The remaining annular space above the sand pack was filled with a bentonite grout to the surface. Soil cuttings were placed in the vicinity of the wellheads for management by the facility. Monitoring well construction specifications are summarized on **Table 3-1**.

Monitoring wells were developed to provide efficient hydraulic communication between the well and the surrounding aquifer using a surge block and vacuum truck. No water was added to the wells during development. All well development water was routed to the refinery's NPDES permitted wastewater treatment facility.

3.2 Liquid Level Gauging

Depths to liquids were gauged in monitoring wells within the area of investigation on April 30, 2002; September 3, 2002; and October 22, 2002. The depth to groundwater and the depth to LNAPL (if present) in each well were measured using an electronic oil/water interface probe. This instrument is capable of measuring the depth to liquids to an accuracy of 0.01 foot. The depth to water was measured from the top of the PVC well casing (TOC).

Well gauging events were performed on April 30, 2002 to evaluate LNAPL occurrence in order to direct monitoring well installations. The September 3, 2002 well gauging event was performed following the installation and development of monitoring wells S-116 through S-125. As a result of this gauging event, monitoring wells S-126 and S-127 were installed. The October 22, 2002 well gauging event included all site monitoring wells used in this investigation. Data collected during these and other gauging events conducted as part of other facility activities were used to evaluate water table fluctuations and LNAPL occurrence.

3.3 Site Survey

Following completion, each monitoring well was located and surveyed for vertical control relative to the established site-specific datum (refer to **Table 3-1**). This data, in conjunction with liquid level measurements were used to prepare groundwater elevation maps.

As will be described in Section 6.0, Sunoco is currently in the process of performing an area-wide site survey by a surveyor licensed in Pennsylvania. The survey will present a “compiled” base map including the eastern portion of the Point Breeze Processing Area, Belmont Terminal and areas immediately east of 26th Street. All wells and key features will be included. Monitoring wells will be surveyed relative to NAD 83 (horizontal datum) and NGVD 88 (vertical datum).

3.4 Aquifer Characterization

Aquifer characterization activities included a pumping test of recovery well RW-406 and seven slug tests. These tests are described below.

3.4.1 RW-406 Pumping Test

A pumping test was performed at RW-406 (refer to **Figure 2-2** for well location) in order to estimate aquifer characteristics, evaluate LNAPL recovery, and evaluate the extent of influence from pumping. Prior to conducting the test, RW-406 was redeveloped using a surge block and vacuum truck.

The test was initiated on October 1, 2002 and consisted of pumping RW-406 for 3,300 minutes and monitoring depth to liquids in nearby observation wells. The extraction rate from RW-406 was monitored using an in-line electronic flow meter. The liquid levels in the pumping well and nearby observation wells were monitored using an electronic data logger and/or a hand held interface probe capable of detecting water and LNAPL.

In order to meet the objectives of the testing, the flow rate was initially kept constant in order to estimate aquifer characteristics using constant flow rate calculations. Periodic LNAPL removal was required in order to prevent LNAPL from being pumped through the water pump and to prevent the pump from undesired cycling as LNAPL thickness increased. A hand-held pump was used to remove LNAPL. The discharge rate was incrementally increased during the test in order to evaluate the sustainable yield of the well and to evaluate the influence on groundwater/LNAPL elevations in nearby observation wells. The pumping intervals of the test are summarized below:

- 0 to 1,275 minutes (elapsed time since pumping began): average discharge rate was approximately 1.85 gpm (one LNAPL removal event performed at 505 minutes),

- 1,275 to 1,835 minutes: average discharge rate was approximately 1.85 gpm (water pump was cycling using the water level probe installed in the well),

- 1,835 to 2,254 minutes: average discharge rate was approximately 2.5 gpm with periodic product removal from RW-406, and

- 2,254 to 3,300 minutes: average discharge rate was approximately 2.74 gpm with periodic product removal from RW-406.

Water levels in RW-406 and nearby observation wells were monitored for approximately 600 minutes following the cessation of active pumping. RW-406 pumping test data is included in **Appendix C** and the results of the testing will be described in Section 4.2.2.1.

3.4.2 Slug Testing

During October 2002, seven slug tests were performed to approximate the hydraulic conductivity of the saturated unconsolidated material in the vicinity of the well tested. Slug tests were performed on wells adjacent to 26th Street (S-43, S-86, S-116, S-120, S-122, S-127, and RW-406).

A slug test is a single well test that consists of rapidly changing the water level in the well and recording the response of the aquifer. The slug test involves placing a cylindrical object (a "slug") in the well. When water levels stabilized following insertion, the object was removed resulting in an increasing water level (rising head) in the well. Care was taken to ensure that adequate water was displaced so that the test was measuring aquifer properties rather than the properties of the sand pack. Following removal of the slug, the change in water level was monitored using a pressure transducer and data logger. The data logger was set to record at intervals of seconds or fractions of a second to obtain the necessary data.

Slug test data were reduced and analyzed using the Bouwer and Rice (1976) method for determining the hydraulic conductivity of unconfined water-bearing zones. Slug test data is presented in **Appendix D** and results of the slug testing program are discussed in Section 4.2.2.2.

3.5 Recovery Well Capacity Testing

Short duration capacity tests were performed on RW-402, RW-403, RW-404, and RW-405. RW-400 was not tested because the existing submersible pump did not function properly during the testing period. These tests were performed to evaluate LNAPL recovery and sustainable groundwater extraction rates for use in future system operation. Prior to testing, the existing pumps were removed from the well and each well was redeveloped (including RW-400) using a surge block and vacuum truck.

Each test was performed by pumping the wells at incrementally increasing or decreasing (RW-404) flow rates. Water was pumped using the existing submersible pumps. Water extraction rates were monitored using an in-line electronic flow meter. Liquid levels were monitored in the pumping well and nearby observation wells (depending on distances to existing monitoring wells).

Total pumping periods ranged from 59 minutes (RW-404) to 367 minutes (RW-405). The maximum pumping rate intervals for the wells ranged from 0.88 gpm (RW-404) to 2.00 gpm (RW-402) although in some instances the pumping rate was limited by the capacity of the existing pumps (refer to Section 4.3). These extraction rates are consistent with the low permeability and water bearing capacity of the local geology. Recovery well testing data is presented in **Appendix E** and the results are discussed in Section 4.3.

3.6 LNAPL Bail-down Testing

LNAPL bail-down tests were performed at monitoring wells S-50, S-98, S-100, and CSX-MW-5 on October 17, 2002. The tests were performed by removing as much product as feasible, using a stainless steel bailer, while removing as little water as practical. After LNAPL removal, depth to LNAPL and depth to water measurements were recorded as the liquid levels recovered. LNAPL recovered during these tests was transferred to the recovery tanks for the RW-400 series recovery wells. Graphic presentation of the bail-down test data is presented in **Appendix G** and the results are discussed in Section 4.5.2.

3.7 LNAPL Sample Collection

LNAPL samples were collected from select wells along the 26th Street perimeter of the refinery and to the east of 26th Street. Samples were collected to characterize the composition of the LNAPL in order to assess the source of the LNAPL. LNAPL samples were collected from S-50, S-88A, S-89, S-98, S-100, PZ-400, RW-401, RW-402, and CSX-MW-5.

In order to assure representativeness of the samples collected, LNAPL was bailed from the wells on September 25 or 26, 2002 and LNAPL was allowed to re-enter the wells prior to sample collection on September 27, 2002. Liquid level gauging data for these wells recorded before LNAPL bailing, after LNAPL bailing, and before sample collection are contained in **Table 3-2**. It was also intended that a sample be collected from S-51. However, LNAPL was not detected in this well during sampling activities. **Figure 3-2** displays LNAPL sample locations.

After collection, the samples were transported to ICF located in Cambridge, Massachusetts for analyses. The samples were analyzed to determine the product-type of each sample. Qualitative analysis was performed using chemical data generated by ICF for the field samples and for known reference samples. Identifications were based on comparisons of hydrocarbon distributions, gas chromatographic patterns (primarily gasoline range hydrocarbons), and/or indicator compounds. The assessment of weathering degree was made by evaluating loss of major constituents and assumed a typical initial composition.

4.0 SITE CHARACTERIZATION RESULTS

This section presents the results of the site investigation activities described in Section 3.0. In order to present a comprehensive characterization of subsurface conditions along the 26th Street border of the refinery, also included is a summary of the annual perimeter groundwater sampling and analyses program.

4.1 Site Geology

Twelve monitoring wells were installed during the investigation. The maximum depth of exploration in these wells was approximately 35 feet bgs. Lithologic descriptions presented on the well logs (refer to **Appendix A**) and select previously installed monitoring wells and recovery wells were used to prepare geologic cross-sections.

Lines of geologic cross-sections are presented on **Figure 4-1**. Cross-sections A-A' through D-D' are presented as **Figures 4-2** through **4-5**. Also presented on these figures are depths to liquid measurements recorded on October 22, 2002.

Figure 4-2 is a cross-section extending north-south from the area of S-124 (near Penrose Avenue) to S-126. At each location, the near surface materials typically consist of fill, silt, and silty sands, which extend to depths generally ranging from 5 to 17 feet bgs. Beneath these deposits, the materials encountered were predominantly well-graded, medium grained sands and poorly-graded sands with less frequent clay and silt horizons. Clay was encountered at the bottom of S-127 (elevation -10 feet or approximately 29 feet bgs) and S-126 (elevation 5 feet or 23 feet bgs).

Figure 4-3 is a cross-section extending north-south in the general area of the RW-400 series recovery wells. This cross-section was prepared using available well logs for the existing recovery wells and the log for newly installed S-125. The thickness of the surficial silt and fill generally ranges from 2 to 17 feet bgs. Beneath these deposits the materials encountered included, sandy silt, sands, and gravels with some clay horizons. Silty clay was encountered at the bottom of RW-402 (elevation -21 feet or approximately 47 feet bgs) and RW-400 (elevation -14 feet or approximately 41 feet bgs). Clay and peat was encountered in RW-404 at depth of 47 to 48 feet bgs (elevation –22 to –23 feet).

Figure 4-4 is a cross-section extending east-west from S-48 to S-50. This cross-section was prepared using well logs for the previously existing and newly installed wells. This cross-section also depicts near surface clay/silt overlying sands and gravels with some clay horizons.

Figure 4-5 is a cross-section extending east-west from S-77 across 26th Street to S-100. This cross-section was also prepared using well logs for the previously existing and newly installed wells. This cross-section is generally consistent with **Figure 4-4** (C-C') although the materials encountered at S-100 are predominantly silts and clays.

4.2 Site Hydrogeology

Site-specific data collected to characterize hydrogeologic conditions include depth to liquids measurements and aquifer testing.

4.2.1 Groundwater Elevation

Depth to liquids measurements and site survey data were used to prepare groundwater elevation maps for the September 3, 2002 and October 22, 2002 well gauging events (**Figures 4-6** and **4-7,** respectively). Liquid level measurements recorded on the April 30, 2002, September 3, 2002 and October 22, 2002 well gauging events are presented on **Tables 4-1**, **4-2**, and **4-3**, respectively.

Figures 4-6 and **4-7** depict an overall southerly direction of groundwater movement. During both gauging events, groundwater elevations generally range from 5 feet in the general area of the Belmont Terminal/Point Breeze Processing Area border to the north to -1 foot near Penrose Avenue to the south. Ground surface elevations range from 19 feet to 29 feet for these areas.

Hydrographs for select monitoring wells are included in **Appendix B** for the general period of late 1995 through 2002 (not all wells were gauged during each gauging event). Seasonal water table fluctuations are depicted on these hydrographs (additional discussion will be presented in Section 4.5 in the context of LNAPL occurrence). These hydrographs indicate an overall decrease in the water table elevation of approximately 2 to 3 feet from spring 2001 through late summer/early fall 2002. The lowest water table elevations in the time period depicted in the hydrographs occurred during summer/early fall 2002. This decline in water table elevation is attributed to regional drought conditions during the period. Liquid level elevations recorded from late October 2002 into early January 2003 depict a general increase in the water table elevation of approximately 1 foot (refer to hydrographs for S-50, S-51, S-81, S-98 and S-100 in **Appendix B**).

A profile of the depth to liquids along 26th Street using data from the October 22, 2002 gauging event was prepared in order to evaluate the water table elevation relative to the 26th Street Sewer (sewer construction was based on drawings provided by the City of Philadelphia Water Department). **Figure 4-8** presents the line of profile and the location of the 26th Street Sewer. **Figure 4-9** presents the October 22, 2002 liquid level elevations relative to the elevation of the 26th Street Sewer for select wells extending from S-124 (near Penrose Avenue) to S-74 (located on the Belmont Terminal). The 26th Street Sewer consists of a 48-inch (36-inch in one segment) steel pipe surrounded by a cement collar approximately one-foot thick. As indicated on **Figure 4-9**, the sewer slopes to the north top of the cement collar ranging in elevation from approximately -

7 feet to -12 feet. The lowest water table elevation depicted is approximately -2 feet at S-44. As indicated, the water and LNAPL surface is above the top of the 26th Street Sewer throughout the area evaluated.

4.2.2 Aquifer Characterization

The following discussion presents the results of the RW-406 aquifer test and the slug testing program.

4.2.2.1 RW-406 Aquifer Test

As described in Section 3.4.1, an aquifer test was performed at RW-406 in order to estimate aquifer characteristics, evaluate LNAPL recovery, and assess the extent of influence from the pumping. RW-406 was pumped for 3,300 minutes at rates ranging from approximately 1.85 gpm to 2.74 gpm.

Figure 4-10 is a hydrograph of RW-406 during the pumping portion of the test. As indicated, measurable and increasing product thickness accumulations were recorded during the test. The maximum LNAPL thickness recorded during the test was 7 feet. Periodic LNAPL recovery was performed during the test using a hand-held recovery pump. Approximately 116 gallons of LNAPL was recovered during the test. It is anticipated that a larger volume of LNAPL would have been recovered if continual/automated LNAPL recovery was performed, although this was not the intention of the test. **Figure 4-10** demonstrates that if a lowered water level in RW-406 is maintained, LNAPL can be recovered at improved rates. However, under conditions of a rising water table, the ability to recover LNAPL may be decreased.

Liquid level measurements were recorded during the test in nearby observation wells using data logging devices and an interface probe. **Figure 4-11** presents water elevation data recorded by an electronic data logger in RW-406 and observation wells RW-401, RW-402, PZ-401, S-82, and S-125. S-100 (located to the east of 26th Street) was also monitored during the test but did not indicate any response to the pumping.

Table 4-4 summarizes the liquid level data collected in RW-406, observation wells RW-401, RW-402, PZ-401, PZ-402, S-82, and S-125. The observed drawdown from the pumping ranged from approximately 0.14 feet at S-82 (approximately 56 feet from RW-406) to 0.87 feet at PZ-402 (approximately 10 feet from RW-406). A change in water level elevation of approximately 0.08 feet was observed at RW-402 (approximately 110 feet from RW-406) although it is not conclusive that this change resulted from the pumping of RW-406 or from background groundwater level fluctuations.

The apparent LNAPL thickness in RW-401 (21 feet from RW-406) increased from 0.12 feet to 1.67 feet during the pumping of RW-406. However, a similar increase in the LNAPL thickness was not observed in the other observation wells monitored.

Drawdown data collected during the constant flow rate (approximately 1.85 gpm) portion of the test was used to estimate aquifer transmissivity and hydraulic conductivity. Aquifer transmissivity was estimated using the Cooper-Jacob (1946) time-drawdown straight-line approximation method using the correction for unconfined aquifers.

Table 4-5 provides a summary of the transmissivity values estimated from the drawdown data. Transmissivity values ranged from 252 ft^2/day (RW-406) to 554 ft^2/day (RW-401) with a geometric mean of 357 ft^2/day. Assuming an aquifer thickness for the aquifer test of 12.5 feet (based the depth of RW-406 minus the static corrected depth to water), the estimated hydraulic conductivity values ranged from 20 feet/day (RW-406) to 44 feet/day (RW-401) with a geometric mean of 28.5 feet/day (hydraulic conductivity is equal to the transmissivity divided by the aquifer thickness).

Recovery data recorded at RW-406 was also analyzed to provide an estimate of aquifer transmissivity. The recovery data was analyzed using the Theis (1935) method for the analyses of recovery data with the correction for unconfined aquifer conditions. An average flow rate of 2.18 gpm was assumed for the duration of pumping. The transmissivity values estimated from recovery data are also summarized on **Table 4-5**. As indicated, the transmissivity values ranged from 200 ft^2/day (PZ-402) to 427 ft^2/day (RW-406) with a geometric mean of 301 ft^2/day. Estimated hydraulic conductivity values ranged from 16 feet/day (PZ-402) to 34 feet/day (RW-406) with a geometric mean of 24 feet/day.

As indicated above, the geometric mean of the transmissivity and hydraulic conductivity values from drawdown and recovery data were consistent. The data plots used to estimate these values are included in **Appendix C**.

4.2.2.2 Slug Test Analyses

Slug tests were performed in seven wells in order to estimate the saturated aquifer hydraulic conductivity in the vicinity of the well tested. Slug test rising head data were analyzed using the Bouwer and Rice (1976) method for unconfined water bearing zones (data graphs are presented in **Appendix D**).

Estimated hydraulic conductivity values are summarized on **Table 4-6**. Hydraulic conductivity values ranged from 0.29 ft/day (S-127) to 12.6 feet/day (S-122). The highest hydraulic conductivity values were reported near the southern boundary of 26th Street perimeter of the refinery at S-122 (12.6 ft/day) and S-120 (11.7 feet/day). Significantly lower hydraulic conductivity values were reported north of this area at S-127, S-86 (0.30 feet/day), and S-43 (0.76 feet/day). The estimated hydraulic conductivity at RW-406 was 7.22 feet/day, although the values estimated from the aquifer test drawdown and recovery data were 20 feet/day and 34 feet/day respectively. Note that data obtained from slug tests are considered estimates and representative only of materials in the immediate vicinity of the well tested.

4.3 RW-400 Series Recovery Well Testing

Short-duration capacity tests were performed on RW-402, RW-403, RW-404, and RW-405 in order to evaluate LNAPL recovery and sustainable flow rates for future systems operation. As previously mentioned, these wells were redeveloped using a surge block and vacuum truck prior to testing. **Table 4-7** presents a summary of testing results. The data from the RW-406 aquifer test is included on **Table 4-7** for comparison purposes. Capacity test data and hydrographs for the wells pumped are provided in **Appendix E**.

RW-402 was pumped for approximately 158 minutes at discharge rate intervals ranging from approximately 0.60 gpm to 2.0 gpm (the maximum capacity of the submersible pump installed in the well). A maximum drawdown of 2.49 feet and change in LNAPL thickness of 0.15 to 0.31 feet was reported during the test. Liquid levels were monitored at S-125 (approximately 70 feet from RW-402) although no noticeable influence was observed.

RW-403 was pumped for a total of 122 minutes using discharge rate intervals of 0.5 gpm and 0.88 gpm. A maximum drawdown of 9.10 feet was measured and no LNAPL was reported during the testing (the water level was decreasing at a flow rate of 0.88 gpm upon test termination). Liquid levels were measured in S-84 (36 feet from RW-403) although no influence from the pumping was observed.

RW-404 was pumped for approximately 59 minutes. The well was initially pumped at 1.20 gpm but the flow rate was reduced to 0.72 gpm after approximately 20 minutes of pumping due to excessive drawdown. No LNAPL was detected in the well during pumping. Liquid levels were monitored at S-85 (approximately 22 feet from RW-404) and S-88A (approximately 45 feet from RW-404). The water level in S-85 decreased 0.14 feet during the testing while the water level in S-88A increased 0.04 feet during the testing. This suggests that the water level change observed at S-85 may be attributed to the pumping.

RW-405 was pumped for a total of approximately 367 minutes at discharge rate intervals ranging from approximately 0.40 gpm to an average of 1.20 gpm (a flow rate as high as 1.7 gpm was reported with the pump at maximum capacity, although the rate decreased likely attributable to back pressure in the discharge line). A maximum drawdown of 1.73 feet was observed. The

LNAPL thickness increased from 1.25 feet to 4.20 feet during the pumping and 7.5 gallons of LNAPL were removed from the well. Liquid levels were monitored at S-89 (approximately 10 feet from RW-405), PZ-404 (approximately 9 feet from RW-405), and PZ-403 (approximately 25 feet from RW-405). Corrected water level decreases of 0.22 feet, 0.21 feet, and 0.35 feet, respectively, were observed during the testing. An increase in apparent LNAPL thickness of 0.36 feet and 0.30 feet were reported at S-89 and PZ-404, respectively during the testing.

As previously mentioned, RW-400 was not tested since the pump in the well did not function at the time of the test. However, data from the Delaware River Basin Commission groundwater extraction permit application prepared in 1994 reported that the well yield was approximately 1 gpm with a specific capacity (discharge rate divided by the drawdown) of 0.08 gpm/ft. The LNAPL thickness in this well ranged from 0.41 feet to 0.67 feet during the well gauging events performed.

Based on the testing performed, it is anticipated that product can be recovered from the RW-400 series wells if a lowered water level can be maintained. Under a low water table elevation, similar to the elevation of the test period, an increased product recovery rate as compared to previous well performance can be accomplished. Individual well groundwater extraction rates of approximately 0.5 to 2.5 gpm are anticipated during future system operation. Improvement in LNAPL recovery volumes are anticipated from all wells, with RW-402, RW-405, and RW-406 expected to show the greatest improvement.

4.4 Perimeter Groundwater Sampling Results

As mentioned previously, eight perimeter monitoring wells (S-3, S-25, S-38, S-39, S-40, S-43, S-50, and S-81) in the Point Breeze Processing Area are sampled on an annual basis. The laboratory analyses of these samples are performed for benzene, toluene, ethyl benzene and xylenes (BTEX), methyl tert butyl ether (MTBE); base neutral organic compounds, metals, and other water quality parameters (alkalinity, chloride, specific conductance, fluoride, ammonia-nitrogen, nitrate-nitrogen, sulfate, total dissolved solids, and total organic compounds). The historical analytical data is presented in **Appendix F**.

Figures 4-12 and **4-13** summarize the BTEX and MTBE results for the 2001 (November) and 2002 (October) sampling events. As indicated on **Figure 4-12**, during the 2001 sampling event benzene was reported at concentrations from below detection levels in S-39 (the detection level was 1 ug/L) and S-25 (the detection level was 10 ug/L) to 53,000 ug/L (S-50). Toluene concentrations ranged from below detection levels in five wells (detection levels ranged from 2 ug/L to 500 ug/L) to 1,400 ug/L (S-50). Ethyl benzene concentrations ranged from below detection levels in six wells (detection levels ranged from 2 ug/L to 1,000 ug/L) to 260 ug/L (S-38). Xylene concentrations ranged from below detection levels in six wells (detection levels ranged from 4 ug/L to 1,000 ug/L) to 1,300 ug/L (S-50). MTBE was not detected in three wells (detection levels ranged from 2 ug/L to 500 ug/L) and was detected in five wells at concentrations ranging from 1 ug/L (S-39) to 5,200 ug/L (S-50).

Figure 4-13 indicates that during the 2002 sampling event, LNAPL was detected in S-50 and S-81. As a result, only the remaining six wells were sampled. Benzene was reported at concentrations ranging from below detection levels in four wells (the detection level was 1 ug/L) to 5,500 ug/L (S-43). Toluene concentrations ranged from below detection levels in four wells (the detection level was 1 ug/L) to 170 ug/L (S-43). Ethyl benzene concentrations ranged from below detection levels in four wells (the detection level was 1 ug/L) to 790 ug/L (S-43). Xylene concentrations ranged from below detection levels in four wells (the detection level was 1 ug/L) to 460 ug/L (S-43). MTBE was not detected in three wells (detection levels ranged from 1 ug/L to 5 ug/L) and was detected in S-25 (2 ug/L) and S-3 (4 ug/L). MTBE data for S-43 was not reported during this sampling event.

4.5 Light Nonaqueous Phase Liquids (LNAPL)

4.5.1 LNAPL Occurrence

This investigation included the characterization of the aerial distribution of LNAPL occurrence in order to direct future remedial activities. **Figures 4-14** and **4-15** present the apparent product thickness measurements recorded during the September 3, 2002 and October 22, 2002 gauging events.

Figure 4-14 indicates LNAPL occurrence along 26th Street in the general area of the RW-400 series recovery wells although LNAPL was not detected in several wells between RW-402 and S-88A. LNAPL was detected to the east of 26th Street in S-98 and S-100 but not in S-99 or S-101.

LNAPL was also detected at S-50 and S-51. The extent of LNAPL in this area is delineated to the north by S-52, to the west by S-117 (S-127 was subsequently installed and further defines this area) and to the south by S-45.

LNAPL was detected in several wells in the interior of site extending from S-48 to S-97. S-123 and S-124 were installed to further delineate LNAPL occurrence historically detected at S-97. These wells are located in the southeastern portion of the Point Breeze Processing Area and also reported the occurrence of LNAPL. LNAPL was not detected along the 26th Street border between S-50 and S-124.

Figure 4-15 (October 22, 2002) depicts a similar distribution of LNAPL occurrence as **Figure 4-14** (September 3, 2002). However, LNAPL was not detected in S-51 or in S-127, which is immediately west of S-50.

Recently, PADEP has verbally expressed concern over the occurrence of LNAPL in certain wells that did not historically indicate the presence of LNAPL. These wells include S-50, S-51 S-81and S-98 (hydrographs for the period late 1995 through early January 2003 for these wells are presented in **Appendix B**). The hydrograph for S-50 indicates that LNAPL was not detected since 1996 (only 0.01 foot of LNAPL on one event during 1996) until early 2002 when the groundwater elevation decreased approximately 3.5 feet from elevations recorded during 2000. Similarly, LNAPL was detected for the first time in S-51 during May 2002 when groundwater was at the lowest elevation during the reporting period. LNAPL was not detected in the well when gauged on January 7, 2002 after the water elevation increased approximately one foot from October 2002. LNAPL was also detected in S-81 during April 2002 for the first time during the reporting period when the water elevation was approximately 2 feet lower than in 2000. LNAPL was detected in S-98 during 2002 for the first time since 1999/early 2000. However, the groundwater elevation during 2002 was at a similar elevation as LNAPL was in 1999/early 2000 when LNAPL was detected.

As described by USEPA (1996), fluctuations in the water table can result in large differences in the LNAPL thickness even though the volume of LNAPL in the subsurface has not significantly changed. The referenced literature also notes that increasing LNAPL thickness is commonly observed with declining water tables. The increase was attributed to drainage from the unsaturated zone or as the water table falls LNAPL previously trapped in the residual phase (in the zone of water saturation) is mobilized and detected in monitoring wells. Conversely, as the groundwater elevation rises, residual LNAPL may be trapped below the water table (USEPA, 1995). The increase in LNAPL thickness under a falling water table and the decrease in LNAPL thickness under a rising water table are depicted on the hydrographs from the site wells described above.

Based on the review of historical liquid level gauging data and as supported by the referenced literature, the recent occurrence of LNAPL in monitoring wells S-50, S-51, S-81, and S-98 is attributed to a decline in the water table elevation during 2002 (under the prevailing drought conditions) rather than a new release or the expansion of an existing LNAPL plume. LNAPL occurrence at these locations will be further evaluated as additional well gauging data is gathered.

4.5.2 LNAPL Bail-down Testing

LNAPL bail-down tests were performed at S-50, S-98, S-100, and CSX-MW5. The tests were performed in order to provide a qualitative evaluation of LNAPL accumulation and recoverability at each well tested. Typically, apparent LNAPL thickness measured in wells that are installed in finer grained sediments generally exaggerate the thickness/volume of LNAPL actually in the formation with respect to coarser grained sediments. This is of significance in heterogeneous geologic settings such as the subject site. LNAPL bail-down tests are commonly performed to estimate the “true” product thickness in the formation. As described by Testa and Paczkowski (1989), there are several potential procedural and data interpretation inaccuracies with these types of tests and they do not provide data on LNAPL trapped by capillary forces (Durnford, et. al. 1991). However, the results of these tests are summarized below in order to provide qualitative information on the feasibility of the recovery of LNAPL and LNAPL accumulations.

Depth to water and LNAPL versus time plots are presented in **Appendix G** and the results of the testing are summarized on **Table 4-8**. As indicated, the LNAPL thickness in S-98 recovered more than the other wells (greater than 100% recovery in 45 minutes) with an apparent LNAPL thickness of 0.62 feet at the end of the test. The LNAPL thickness in the other wells tested recovered approximately 39% (S-100) to 49% (CSX-MW5) of the pre-testing LNAPL thickness. Apparent LNAPL thicknesses in these wells ranged from 0.24 feet (S-100) to 0.43 feet (S-50) at the completion of the tests. The testing suggests that S-98 is capable of sustaining a higher LNAPL recovery rate than the other wells tested.

4.5.3 LNAPL Characterization

LNAPL samples were collected from S-50, S-88A, S-98, S-100, RW-401, RW-402, PZ-400, and CSX-MW-5. Qualitative analyses were performed by ICF to identify the composition of the LNAPL (the sample collected from S-88A contained mostly water and did not have sufficient LNAPL to determine the product type). The qualitative analyses were performed using chemical data generated by ICF for the field samples and for known reference samples. Identifications were based on comparisons of hydrocarbon distributions, gas chromatographic patterns (primarily gasoline range hydrocarbons), and/or indicator compounds. The assessment of weathering degree was made by evaluating loss of major constituents and assumed a typical initial composition. ICF also made comparison of these analyses to the analyses of samples which were reported in March 1998 to determine if content of the LNAPL has changed. In addition, the results were compared to a representative sample of the DSCP LNAPL plume. The correspondence from ICF reporting the results of the analyses is presented in **Appendix H.**

A summary of the LNAPL characterization results is presented on **Table 4-9** and is presented graphically on **Figure 4-16**. Samples S-100, RW-401, RW-402, PZ-400 are comprised of a mixture of gasoline and diesel in roughly equal proportions with minor variation between the samples. Sample S-98 is comprised primarily of mildly weathered gasoline with trace amounts of hydrocarbons in the diesel range. Samples S-89 and CSX-MW-5 are comprised of a heavily degraded gasoline and diesel mixture.

Composition of samples S-100, RW-401, RW-402, and S-89 is the same as previously observed in analyses reported in March 1998 (IST, 1998). Current composition of sample PZ-400 differs slightly from the March 1998 report (IST, 1998) in that the sample contains a noticeably higher proportion of diesel range material than previously observed. Samples S-98 and CSX-MW-5 were not analyzed previously.

All of the samples mentioned above differ from the DSCP LNAPL plume (a sample from MW-5 at the DSCP was used to represent the DSCP plume), which is described in the March 1998 report (IST, 1998) as a mixture of gasoline and a naphtha-like product. The differences of the DSCP plumes from the Sunoco plumes are observed as variations in the chromatographic patterns as well as the overall boiling range distribution, and are indicative of different sources.
Sample S-50 is comprised of a refinery intermediate most closely resembling light refinery naphtha or reformed light refinery naphtha or a mixture of the two. The proportion of benzene in the sample is higher than in reference samples for these products indicating a difference in the specific refinery process used or an additional input. Assuming that the constituents were high-grade refinery intermediates, the sample is only mildly weathered. This well did not have LNAPL previously so historic comparisons could not be made. The chemical composition of S-50 differs from that of the DSCP plume (based on a sample from MW-5 at DSCP) in that boiling distribution of S-50 in terms of end point is lower (indicating that the naphtha components of the mixtures are different) and absolute concentrations of monoaromatic compounds such as benzene are significantly higher (indicating that the gasoline components of the mixtures are also different). Based on chemical differences, the plumes are composed of distinct materials. This supports implementation of further Sunoco remedial efforts to address the plume on its property.

5.0 REMEDIAL APPROACH

Data collected during this and previous investigations were evaluated in order to develop a strategy for the recovery of LNAPL along the 26th perimeter of the refinery and to the east of 26th Street in the vicinity of S-98 and S-100. This strategy will consider the recent information regarding increased LNAPL thickness monitoring data and LNAPL occurrences in wells due to lower water table elevations (as a result of drought conditions observed during 2002). In addition, the proposed remedial approach will provide a basis for improving the remedial system performance.

5.1 LNAPL along the 26th Street Border of the Point Breeze Processing Area

LNAPL has been detected along the 26th Street border of the Point Breeze Processing Area in three general areas. These areas include the area of RW-400 series recovery wells, the area of S-50, and the area of S-124. Proposed activities in these areas are discussed below.

5.1.1 General Area of the RW-400 Series Recovery Wells

In order to enhance LNAPL recovery, the RW-400 series recovery wells were redeveloped and the recovery system was reconfigured. Based on the testing performed, it is anticipated that an improved rate of LNAPL recovery can be sustained from the RW-400 series wells if a lowered water level can be maintained. To accomplish this, the existing pumps were removed during December 2002 and replaced with total fluids (water and LNAPL) pumps. It is anticipated that this system will allow more effective LNAPL recovery.

Total fluids pneumatic recovery pumps were placed in RW-400, RW-402, RW-403, RW-404, RW-405, and RW-406 during December 2002/January 2003. A remediation trailer that contains an air compressor and an oil/water separator has been placed adjacent to RW-400. The air compressor and the oil/water separator are appropriately sized for the six recovery wells based on the results of the capacity testing. Air supply line has been connected from the air compressor to each total fluids pump. The existing HDPE discharge line has also been reconfigured to route fluids from each recovery well to the oil/water separator. Recovered LNAPL from the oil/water separator will gravity drain to the existing recovery tank adjacent to RW-400. Water from the oil/water separator will be routed to the refinery NPDES-permitted wastewater treatment facility.

The current system configuration is not considered permanent. A period of pilot testing of the current system configuration is proposed to evaluate the performance of the total fluids extraction system. Since the testing described in this report was conducted under low water conditions, a period of pilot testing is proposed in order to evaluate the effectiveness of the system as the water table recovers. The system is currently ready for operation and will be activated upon weather conditions which will not cause freezing of the surface discharge line (water in the line is currently frozen).

If the technology is considered effective, the placement of additional recovery wells will be evaluated from monitoring data and a more expansive and permanent system will be installed and operated. Other containment technologies may also be considered based on the pilot testing results.

5.1.2 Area of S-50

The detection of LNAPL in the vicinity of S-50 is a relatively recent occurrence and requires additional characterization and remedial testing before a remediation plan is developed. Since S-50 is a two-inch diameter well, a larger diameter well will be installed in the vicinity of S-50. Monitoring wells will also be installed to the east of S-50 (between the S-50 and the perimeter fence) and to south of S-50. These wells will provide additional characterization of the extent of LNAPL.

After monitoring well installation, a pumping test will be performed on the newly installed larger diameter well. Water will be pumped using a submersible pump and LNAPL will be removed as needed using a hand-held LNAPL pump. Liquid level measurements will be recorded in the existing S-50 and the proposed monitoring wells in order to evaluate the extent of influence from the pumping.

Upon completion of the well installations and testing, recommendations for additional activities will be developed. Based on the current data, it is likely that control of the water table elevation would be required in order to effectively remove LNAPL when the water table is higher than the current elevation. However, at these higher water table elevations, LNAPL is more likely to be immobile and absent from monitoring wells.

5.1.3 Area of S-124

Monitoring wells S-123 and S-124 were installed during August 2002 and LNAPL was detected in these wells during September 2002. This area also requires additional characterization and remedial testing before a remediation plan is developed. Additional monitoring wells will be installed between S-124 and S-26, and between S-124 and S-38. In addition, two (or more if necessary) monitoring wells will be installed to the southeast of S-124.

After well installation, a pumping test is also proposed for this area in a manner similar to the testing described for the S-50 area. Additional monitoring wells may also be installed for pilot testing purposes depending of the spacing of the additional monitoring wells to be installed.

Upon completion of the well installations and testing, recommendations for additional activities will be developed.

5.2 LNAPL to the East of 26th Street (Area of S-98 and S-100)

Options for the recovery of LNAPL in the vicinity of S-98 are currently being evaluated. The area of S-98 is proposed for the initial evaluation of the recovery of LNAPL across 26th Street. This area was selected because it accommodates the drilling of observation or recovery wells and the LNAPL bail-down testing data suggest increased LNAPL recovery at this location with respect to the other areas tested.

Since the property in the vicinity of S-98 is owned by a third party (Conrail), the lack of existing utility service, and complications associated with the storage of recovered LNAPL, the remedial options currently being evaluated include drilling horizontally under 26th Street to install a utility/product conduit or installing a horizontal well under 26th Street. The utility conduit would be used to supply power (electricity or compressed air) to pumps installed in vertical recovery well(s) placed on Conrail property and to route recovered fluids (water and LNAPL) back to the refinery. Both options would limit the placement of equipment and storage of recovered fluids on the Conrail property.

SECOR has been in contact with utility companies with service lines along 26th Street, the property owner, the City of Philadelphia Streets Department, the City of Philadelphia Water Department, and the Pennsylvania Department of Transportation (26th Street is a state road). Preliminary indications are that the City of Philadelphia will need supporting documentation for the need to install a recovery system, a traffic control plan, verification from the utility companies that there are no conflicts with underground service lines, and verification that the property owner is aware of the proposed installation. In addition, the property owner will require an access agreement.

As will be recommended (refer to Section 6.2), a new site survey will be performed and a revised site plan developed for the 26th Street area. Included in this survey will be the preparation of a base map identifying utilities along 26th Street. It is anticipated that this map will be completed in March 2003 and will aid in the planning for the recovery system.

After installation of the utility conduit or the horizontal well and additional vertical well(s) (for use as pilot test observation wells) on the Conrail property, a pilot test will be performed. The test will be performed by pumping either total fluids or water and LNAPL separately, and measuring the influence in nearby observation wells.

Upon completion of the well installations and testing, recommendations for additional activities will be developed. It is anticipated that the same technology proposed for the S-98 area will be utilized for the vicinity of S-100.

6.0 CONCLUSIONS AND RECOMMENDATIONS

This Remedial Investigation Report was prepared for Sunoco for the eastern portion of the Point Breeze Processing Area of the Philadelphia Refinery. The investigation was performed to characterize the occurrence of light non-aqueous phase liquids (LNAPL) along the eastern perimeter of the Point Breeze Processing Area, which borders 26th Street. Site-specific information was used to develop an approach for the recovery of LNAPL along the 26th Street border and across (west of) 26th Street from the northern portion of the Point Breeze Processing Area.

This investigation was also performed to provide baseline site characterization data in order to direct additional site activities needed to make a determination of the status of the migration of groundwater under the RCRA Environmental Indicators program.

6.1 Conclusions

The conclusions of this investigation are summarized below.

- A review of historical liquid level gauging data was prompted by the recent occurrence of LNAPL in monitoring wells S-50, S-51, S-81, and S-98. The data reviewed suggest that the recent occurrence of LNAPL in these wells as well as increased LNAPL thickness detected in wells along 26th Street result from a decline in the water table elevation during 2002 (under the prevailing drought conditions) rather than from a new release or the expansion of an existing LNAPL plume.

- LNAPL samples were collected and analyzed to characterize the LNAPL in each location and determine if the recent observation of increased LNAPL thickness in certain wells represented any significant deviations from previous descriptions of LNAPL composition in the Sunoco plumes.

    - LNAPL samples collected from S-100, RW-401, RW-402, and PZ-400 are comprised of a mixture of gasoline and diesel in roughly equal proportions with minor variation between the samples. The composition of samples S-100, RW-401, and RW-402 is the same as previously observed in analyses performed during March 1998 (IST, 1998). The current composition of sample PZ-400 differs slightly from March 1998 (IST, 1998) in that the sample contains a noticeably higher proportion of diesel range material than previously observed.

  - The LNAPL sample from S-98 is comprised primarily of mildly weathered gasoline with trace amounts of hydrocarbons in the diesel range.

  - LNAPL samples from S-89 and CSX-MW-5 are comprised of a heavily degraded gasoline and diesel mixture. The composition of S-89 is the same as previously observed in analyses performed during March 1998 (IST, 1998). CSX-MW-5 was not previously analyzed and no comparison could be made.

  - The LNAPL sample from S-50 is comprised of a refinery intermediate most closely resembling light refinery naphtha or reformed light refinery naphtha or a mixture of the two.

  - All of the LNAPL sample results reported differ from the DSCP LNAPL plume (a sample MW-5 at DSCP was used to represent the DSCP plume) that is described in the March 1998 report (IST, 1998) as a mixture of gasoline and a naphtha-like product.

- Based on the testing of the RW-400 series recovery wells performed, it is anticipated that improved rates of product recovery can be accomplished if a lowered water level is maintained. The highest LNAPL recovery volumes are anticipated from RW-402, RW-405, and RW-406.

- The evaluation of the previously existing dual pump recovery system indicated that the reconfiguration of the system to a total fluids recovery system would likely enhance LNAPL recovery. As a result, the RW-400 series recovery wells were redeveloped and the recovery system was modified for total fluids recovery.

- LNAPL bail-down testing suggests that S-98 is capable of sustaining a higher LNAPL recovery rate than the other wells tested (S-50, S-100, and CSX-MW-5).

- LNAPL has been detected along the 26th Street Perimeter of the Point Breeze Processing Area in three general areas. These areas include the area of RW-400 series recovery wells, the area of S-50, and the area of S-124 (installed during this investigation).

- Dissolved hydrocarbons (mainly benzene and MTBE) were reported in certain wells along the 26th Street border through the annual perimeter groundwater sampling program.

6.2 Recommendations

Data collected during this and previous site investigations was evaluated to develop proposed activities for the recovery of LNAPL along the 26th Street perimeter of the refinery and across 26th Street in the vicinity of S-98 and S-100. Annual groundwater sampling of perimeter wells is recommended to continue with the data be submitted to PADEP in annual progress reports. The focus of site activities during the year 2003 will address the following:

- A period of pilot testing of the total fluids recovery equipment recently installed in the RW-400 series. The testing of RW-400 series wells described in this report was conducted under low water conditions. A period of pilot testing is proposed in order to evaluate the effectiveness of the system as the water table recovers. It is recommended that the pilot test be performed through November 2003.

- The operation of the RW-400 series recovery wells during the pilot test period will be reviewed. If the technology is considered effective, the need for additional recovery wells in order to control off-site LNAPL migration will be evaluated from monitoring data. If appropriate, the remedial design of a more expansive permanent system will be developed. Other containment technologies may also be considered depending on the results of the pilot testing.

- Additional characterization and remedial testing is proposed to address the recent occurrence of LNAPL in the vicinity of S-50. A larger diameter well in the vicinity of S-50 and monitoring wells to the east of S-50 (between S-50 and the perimeter fence) and to south of S-50 will be installed. After well installation, a groundwater/LNAPL extraction test will be performed on the newly installed larger diameter well. Upon completion of the well installations and testing, recommendations for additional activities will be developed.

- Additional characterization and remedial testing is also proposed to address the recent detection of LNAPL in the vicinity of S-124. Additional monitoring wells will be installed between S-124 and S-26, and between S-124 and S-38. In addition, two (or more if necessary) monitoring wells will be installed to the southeast of S-124. After well installation, a pumping test is also proposed for this area. Upon completion of the well installations and testing, recommendations for additional activities will be developed.

- In order to address the occurrence of LNAPL in the vicinity of S-98 (located to the east of 26th Street from the refinery) either a utility/product conveyance conduit under 26th

Street or a horizontal well under 26th Street will be installed. The utility conduit would be used to power recovery equipment and route recovered fluids to the refinery from vertical recovery well(s) across 26th Street. Upon installation, pilot testing of the selected configuration will be performed. Upon completion of the well installations and testing, recommendations for site remediation will be developed. It is anticipated that the same technology proposed for the S-98 area will be utilized for the vicinity of S-100.

- Additional monitoring wells will be installed in the vicinity of S-98 and S-100 to provide further delineation of the extent of LNAPL. Site constraints such as the 26th Street ramp to the Schuylkill Expressway, traffic on 26th Street (during installation and future access to wells installed in the roadway), underground and aboveground utilities, and the steep slope of the hillside east of S-98 and S-100, may not allow access to the optimum drilling locations. As a result, monitoring wells may be installed along the top of the embankment and west of the railroad tracks and/or other areas accessible for monitoring well installation.

- A new base map will be prepared and a new survey will be performed for monitoring wells along the eastern portion of the Point Breeze Processing Area, the Belmont Terminal, and the area immediately east of 26th Street/west of the CSX railroad tracks. The monitoring wells will be surveyed by a Pennsylvania licensed professional surveyor relative to NAD 83 (horizontal datum) and NGVD 88 (vertical datum). The location of utilities along 26th Street will also be placed on the base map for use in the design of recovery systems that may include drilling horizontally under 26th Street.

- Once the new base map has been prepared, extent of LNAPL maps prepared for the Point Breeze Processing Area will also include the Belmont Terminal in order to provide a complete depiction of conditions along 26th Street.

- Monitoring wells installed during this investigation will be incorporated into the ongoing facility groundwater monitoring program as appropriate.

- Initiate periodic manual LNAPL skimming from select wells in the RW-400 series wells area (RW-400, RW-405, and RW-406), to the east of 26th Street (S-98, S-100, CSX-MW-5), S-50, and S-124. Periodic manual LNAPL recovery will be terminated in these areas when the current recovery systems are activated (RW-400 series area).

- Year 2003 activities will be reported to PADEP in an annual summary report.

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TABLE 2-1

RW-400 Series Recovery Well Construction Summary

26th Street Area Investigation
Sunoco Philadelphia Refinery

Well No.	Well Completion Date	Ground Elevation (see Note 1)	Top of Casing Elevation (see Note 1)	Well Screen Diamater (inches) (see Note 2)	Reported Depth of Screen Interval (feet bgs) (see Note 2)	Measured Well Depth (feet bgs) (see Note 3)
RW-400	5/26/94	29.12	30.19	6	22 - 37	36
RW-401	9/9/93	26.23	26.78	6	15 - 50	29.5
RW-402	5/24/94	25.59	23.69	6	23 - 33	30.5
RW-403	7/01/94	25.42	26.02	6	15 - 50	49
RW-404	8/25/94	24.87	25.62	6	22 - 32	34
RW-405	5/20/94	25.33	26.08	6	25.5 - 35.5	38
RW-406	11/20/00	25.94	28.59	8	16 - 36	34.5

Notes:
Note 1: Survey is releative to existing monitoring well network
Note 2: Based on available well log and DRBC (1994) permit application data
Note 3: Based on field measurements recorded by SECOR during October and November 2002
bgs = below ground surface

TABLE 3-1

Monitoring Well Construction Summary

26th Street Area Investigation
Sunoco Philadelphia Refinery

Original Well No.	Well Completion Date	Ground Elevation (see Note 1)	Top of Casing Elevation (see Note 1)	Well Screen Diamater (in)	Depth of Screen Interval (feet bgs)
S-116	8/12/02	28.60	28.36	4	10 - 30
S-117	8/13/02	22.52	22.32	4	8 - 28
S-118	8/14/02	20.42	20.01	4	9.5 - 19.5
S-119	8/15/02	25.68	28.57	4	14 - 34
S-120	8/16/02	18.71	21.98	4	10 - 30
S-121	8/22/02	20.68	23.30	4	10 - 30
S-122	8/19/02	25.04	27.84	4	14.6 - 34.6
S-123	8/20/02	22.26	25.18	4	10 - 30
S-124	8/22/02	22.52	25.27	4	10 - 30
S-125	8/27/02	25.75	27.95	4	10 - 30
S-126	9/18/02	28.38	30.48	4	12.3 - 22.3
S-127	9/19/02	19.26	20.99	4	9 - 29

Notes:
Note 1: Survey is releative to existing monitoring well network
bgs = below ground surface

TABLE 3-2

Product Sample Collection
Liquid Level Data - September 2002

26th Street Area Investigation
Philadelphia Refinery

	Pre-Sampling Product Purging							Sample Collection September 27, 2002		
		Pre-Purging			Post-Purging					
Well ID	Date	DTW	DTP	PT	DTW	DTP	PT	DTW	DTP	PT
S-50	9/26/2002	25.75	24.68	1.07	26.25	26.15	0.10	25.31	24.66	0.65
S-88A	9/26/2002	27.05	26.98	0.07	28.21	---	---	27.00	26.99	0.01
S-89	9/25/2002	28.95	28.20	0.75	NM	NM	NM	28.60	28.12	0.48
S-98	9/25/2002	26.20	25.43	0.77	25.41	---	---	26.12	25.31	0.81
S-100	9/25/2002	25.30	24.69	0.61	24.90	---	---	24.93	24.56	0.37
PZ-400	9/26/2002	25.56	24.76	0.80	24.90	24.88	0.02	25.36	24.68	0.68
RW-401	9/25/2002	22.35	22.06	0.29	22.12	---	---	22.21	21.91	0.30
RW-402	9/25/2002	19.62	19.51	0.11	19.70	19.68	0.02	20.41	20.33	0.08
CSX-MW-5	9/26/2002	48.28	47.41	0.87	47.92	47.91	0.01	47.96	47.43	0.53

Notes:
DTW = Depth to water
DTP = Depth to product
PT = Product Thickness

TABLE 4-1

LIQUID LEVEL MEASUREMENTS
APRIL 30, 2002

26th STREET INVESTIGATION
PHILADELPHIA REFINERY

Well	TOC Elevation (Feet)	Depth To NAPL (Feet)	Depth To Water (Feet)	NAPL Data Apparent Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)
S-25	16.28	NP	14.07	--	2.21
S-26	22.88	NP	23.04	--	-0.16
S-27	22.00	NP	29.15	--	-7.15
S-28	27.91	NP	23.43	--	4.48
S-29	25.44	23.09	28.07	4.98	1.15
S-33	25.62	25.92	28.14	2.22	-0.83
S-34	25.45	25.25	27.41	2.16	-0.32
S-35	26.83	26.67	28.69	2.02	-0.32
S-38	21.00	NP	21.35	--	-0.35
S-39	25.02	NP	25.15	--	-0.13
S-40	26.37	NP	24.76	--	1.61
S-42	27.85	NP	28.09	--	-0.24
S-43	25.35	NP	26.73	--	-1.38
S-44	25.46	NP	27.68	--	-2.22
S-45	23.73	NP	24.68	--	-0.95
S-46	24.69	NP	23.50	--	1.19
S-48	23.37	21.11	21.61	0.50	2.14
S-50	26.37	24.21	25.07	0.86	1.95
S-51	25.38	25.12	25.44	0.32	0.18
S-52	24.75	NP	24.45	--	0.30
S-55	18.10	17.96	18.52	0.56	0.01
S-56	17.12	16.86	16.87	0.01	0.26
S-74	32.11	NP	26.84	--	5.27
S-75	33.24	27.85	28.98	1.13	5.12
S-76	33.05	27.85	28.54	0.69	5.03
S-77P	35.07	29.93	30.25	0.32	5.06
S-78	32.93	NP	27.55	--	5.38
S-79P	32.27	29.93	30.25	0.32	2.26
S-80	33.60	NP	29.32	--	4.28
S-81	29.82	24.59	25.62	1.03	4.98
S-82	29.27	23.48	24.10	0.62	5.64
S-83	25.37	20.86	22.18	1.32	4.19
S-84P	24.89	20.95	20.96	0.01	3.94
S-85	26.93	NP	25.41	--	1.52
S-86	29.04	NP	27.88	--	1.16
S-88A	26.78	26.78	26.81	0.03	-0.01
S-89	27.99	27.99	28.37	0.38	-0.09
S-95	25.34	NP	25.15	--	0.19
S-96	22.27	NP	17.36	--	4.91

TABLE 4-1

LIQUID LEVEL MEASUREMENTS
APRIL 30, 2002

26th STREET INVESTIGATION
PHILADELPHIA REFINERY

Well	TOC Elevation (Feet)	Depth To NAPL (Feet)	Depth To Water (Feet)	NAPL Data Apparent Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)
S-97	33.33	32.44	33.10	0.66	0.73
S-98	30.94	25.44	26.32	0.88	5.29
S-99	27.30	NP	27.28	--	0.02
S-100	29.08	24.55	24.58	0.03	4.52
S-101	51.28	NP	49.11	--	2.17
S-104	20.88	19.76	20.38	0.62	0.97
PZ-400	30.20	24.80	25.78	0.98	5.16
PZ-401	25.89	NP	20.45	--	5.44
PZ-402	25.38	NP	21.04	--	4.34
PZ-403	28.27	NP	26.03	--	2.24
PZ-404	28.02	27.96	28.37	0.41	-0.04
RW-400	30.19	24.92	25.33	0.41	5.17
RW-401	26.78	22.39	23.16	0.77	4.21
RW-402	23.69	19.50	19.60	0.10	4.17
RW-403	26.02	23.41	23.42	0.01	2.61
RW-404	25.62	NP	21.14	--	4.48
RW-405	26.08	26.05	26.36	0.31	-0.04
RW-406	28.59	24.29	24.42	0.13	4.27

NOTES:

TOC = Top of casing

NM = Not measured

NAPL = Non aqueous phase liquid

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

Assumed NAPL specific gravity = 0.76

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TABLE 4-2

LIQUID LEVEL MEASUREMENTS
SEPTEMBER 3, 2002

26th STREET INVESTIGATION
PHILADELPHIA REFINERY

Well	TOC Elevation (Feet)	Depth To NAPL (Feet)	Depth To Water (Feet)	NAPL Data Apparent Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)
S-25	16.28	NP	14.83	--	1.45
S-26	22.88	NP	23.85	--	-0.97
S-27	22.00	NP	29.91	--	-7.91
S-28	27.91	NP	24.39	--	3.52
S-29	25.44	23.10	27.70	4.60	1.24
S-33	25.62	26.29	28.80	2.51	-1.27
S-34	25.45	25.64	28.31	2.67	-0.83
S-35	26.83	27.05	29.55	2.50	-0.82
S-38	21.00	NP	22.22	--	-1.22
S-39	25.02	NP	25.90	--	-0.88
S-40	26.37	NP	26.18	--	0.19
S-42	27.85	NP	28.54	--	-0.69
S-43	25.35	NP	26.98	--	-1.63
S-44	25.46	NP	27.77	--	-2.31
S-45	23.73	NP	24.90	--	-1.17
S-46	24.69	NP	23.82	--	0.87
S-48	23.37	21.55	22.21	0.66	1.66
S-50	26.37	24.52	25.57	1.05	1.60
S-51	25.38	25.56	25.58	0.02	-0.18
S-52	24.75	NP	24.82	--	-0.07
S-55	18.10	18.20	19.06	0.86	-0.31
S-56	17.12	17.14	18.77	1.63	-0.41
S-74	32.11	NP	26.55	--	5.56
S-75	33.24	27.70	28.50	0.80	5.35
S-76	33.05	27.72	28.86	1.14	5.06
S-77P	35.07	29.90	30.42	0.52	5.05
S-78	32.93	NP	27.62	--	5.31
S-79P	32.27	NP	27.54	--	4.73
S-80	33.60	NP	29.13	--	4.47
S-81	29.82	24.35	25.32	0.97	5.24
S-82	29.27	23.82	23.95	0.13	5.42
S-83	25.37	NP	18.65	--	6.72
S-84P	24.89	NP	20.57	--	4.32
S-85	26.93	NP	25.63	--	1.30
S-86	29.04	NP	28.05	--	0.99
S-88A	26.78	26.83	26.90	0.07	-0.07
S-89	27.99	28.12	28.69	0.57	-0.27
S-95	25.34	NP	25.47	--	-0.13
S-96	22.27	NP	17.48	--	4.79

TABLE 4-2

LIQUID LEVEL MEASUREMENTS
SEPTEMBER 3, 2002

26th STREET INVESTIGATION
PHILADELPHIA REFINERY

Well	TOC Elevation (Feet)	Depth To		NAPL Data	Corrected Groundwater Elevation (FAMSL)
		NAPL (Feet)	Water (Feet)	Apparent Thickness (Feet)	
S-97	33.33	33.17	34.85	1.68	-0.24
S-98	30.94	25.32	25.95	0.63	5.47
S-99	27.30	NP	27.55	--	-0.25
S-100	29.08	24.50	25.08	0.58	4.44
S-101	51.28	NP	49.31	--	1.97
S-104	20.88	20.02	20.65	0.63	0.71
S-116	28.36	NP	23.48	--	4.88
S-117	22.32	NP	19.56	--	2.76
S-118	20.01	NP	20.60	--	-0.59
S-119	28.57	NP	29.15	--	-0.58
S-120	21.98	NP	22.79	--	-0.81
S-121	23.30	NP	23.48	--	-0.18
S-122	27.84	NP	28.83	--	-0.99
S-123	25.18	25.24	25.90	0.66	-0.22
S-124	25.27	26.45	26.77	0.32	-1.26
S-125	27.95	NP	23.32	--	4.63
PZ-400	30.20	24.64	25.50	0.86	5.35
PZ-401	25.89	NP	21.13	--	4.76
PZ-402	25.38	NP	20.85	--	4.53
PZ-403	28.27	NP	26.30	--	1.97
PZ-404	28.02	28.09	28.60	0.51	-0.19
RW-400	30.19	24.63	25.52	0.89	5.35
RW-401	26.78	24.10	24.19	0.09	2.66
RW-402	23.69	19.40	19.42	0.02	4.29
RW-403	26.02	NP	23.19	--	2.83
RW-404	25.62	NP	24.35	--	1.27
RW-405	26.08	26.22	26.78	0.56	-0.27
RW-406	28.59	21.90	22.18	0.28	6.62

NOTES:

TOC = Top of casing

NM = Not measured

NAPL = Non aqueous phase liquid

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

MW-A through MW-K installed August, 2002

Assumed NAPL specific gravity = 0.76

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TABLE 4-3

LIQUID LEVEL MEASUREMENTS
OCTOBER 22, 2002

26th STREET INVESTIGATION
PHILADELPHIA REFINERY

Well	TOC Elevation (Feet)	Depth To NAPL (Feet)	Depth To Water (Feet)	NAPL Data Apparent Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)
S-25	16.28	NP	14.88	--	1.40
S-26	22.88	NP	23.75	--	-0.87
S-27	22.00	NP	29.85	--	-7.85
S-28	27.91	NP	24.46	--	3.45
S-29	25.44	23.07	27.90	4.83	1.21
S-33	25.62	26.32	28.92	2.60	-1.32
S-34	25.45	25.69	28.47	2.78	-0.91
S-35	26.83	27.11	29.75	2.64	-0.91
S-38	21.00	NP	22.34	--	-1.34
S-39	25.02	NP	26.15	--	-1.13
S-40	26.37	NP	27.50	--	-1.13
S-42	27.85	NP	28.73	--	-0.88
S-43	25.35	NP	27.31	--	-1.96
S-44	25.46	NP	28.11	--	-2.65
S-45	23.73	NP	25.10	--	-1.37
S-46	24.69	NP	24.00	--	0.69
S-48	23.37	21.64	22.31	0.67	1.57
S-50	26.37	24.68	25.73	1.05	1.44
S-51	25.38	NP	25.67	--	-0.29
S-52	24.75	NP	24.96	--	-0.21
S-55	18.10	18.51	19.79	1.28	-0.72
S-56	17.12	17.38	19.06	1.68	-0.66
S-74	32.11	NP	26.40	--	5.71
S-75	33.24	27.60	28.25	0.65	5.48
S-76	33.05	27.54	28.75	1.21	5.22
S-77P	35.07	30.05	30.49	0.44	4.91
S-78	32.93	NP	27.83	--	5.10
S-79P	32.27	NP	27.77	--	4.50
S-80	33.60	NP	29.24	--	4.36
S-81	29.82	24.37	25.27	0.90	5.23
S-82	29.27	23.93	24.10	0.17	5.30
S-83	25.37	NP	16.35	--	9.02
S-84P	24.89	NP	19.34	--	5.55
S-85	26.93	NP	25.61	--	1.32
S-86	29.04	NP	28.25	--	0.79
S-88A	26.78	26.99	27.00	0.01	-0.21
S-89	27.99	28.07	29.46	1.39	-0.41
S-95	25.34	NP	25.80	--	-0.46
S-96	22.27	NP	22.06	--	0.21
S-97	33.33	33.37	34.91	1.54	-0.41

TABLE 4-3

LIQUID LEVEL MEASUREMENTS
OCTOBER 22, 2002

26th STREET INVESTIGATION
PHILADELPHIA REFINERY

Well	TOC Elevation (Feet)	Depth To		NAPL Data	Corrected Groundwater Elevation (FAMSL)
		NAPL (Feet)	Water (Feet)	Apparent Thickness (Feet)	
S-98	30.94	25.21	25.73	0.52	5.61
S-99	27.30	NP	27.61	--	-0.31
S-100	29.08	24.47	24.74	0.27	4.55
S-101	51.28	NP	49.48	--	1.80
S-104	20.88	20.30	20.77	0.47	0.47
S-116	28.36	NP	23.18	--	5.18
S-117	22.32	NP	19.80	--	2.52
S-118	20.01	NP	20.95	--	-0.94
S-119	28.57	NP	29.43	--	-0.86
S-120	21.98	NP	23.06	--	-1.08
S-121	23.30	NP	23.81	--	-0.51
S-122	27.84	NP	29.03	--	-1.19
S-123	25.18	25.29	26.32	1.03	-0.36
S-124	25.27	26.14	28.06	1.92	-1.33
S-125	27.95	NP	23.43	--	4.52
S-126	30.48	NP	12.90	--	17.58
S-127	20.99	NP	18.93	--	2.06
PZ-400	30.20	24.55	25.22	0.67	5.49
PZ-401	25.89	21.20	21.22	0.02	4.69
PZ-402	25.38	NP	20.94	--	4.44
PZ-403	28.27	26.13	27.06	0.93	1.92
PZ-404	28.02	28.00	29.65	1.65	-0.38
RW-400	30.19	24.55	25.22	0.67	5.48
RW-401	26.78	22.04	22.31	0.27	4.68
RW-402	23.69	21.16	21.22	0.06	2.52
RW-403	26.02	NP	23.17	--	2.85
RW-404	25.62	NP	24.41	--	1.21
RW-405	26.08	26.80	28.17	1.37	-1.05
RW-406	28.59	24.22	24.40	0.18	4.33

NOTES:
TOC = Top of casing
NAPL = Non aqueous phase liquid
FAMSL = Feet above mean sea level
Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))
MW-A through MW-K installed August, 2002
MW-L and MW-M installed September, 2002
Assumed NAPL specific gravity = 0.76

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TABLE 4-4

RW-406 Aquifer Test Liquid Level Measurement Data Summary

26th Street Area Investigation
Philadelphia Refinery

Well No.	Distance From RW-406 (feet)	Static Liquid Level Measurements			Liquid Level Measurements at End of Test			Corrected Change in Water Level (feet)
		Depth to Water (feet btoc)	Depth to LNAPL (feet btoc)	Product Thickness (feet)	Depth to Water (feet btoc)	Depth to LNAPL (feet btoc)	Product Thickness (feet)	
RW-406	NA	24.60	24.16	0.44	29.36	27.58	1.78	3.74
RW-401	21	22.14	22.02	0.12	23.91	22.24	1.67	0.59
RW-402	110	21.19	21.15	0.04	21.29	21.23	0.06	0.08
PZ-401	12	21.22	--	--	22.02	--	--	0.80
PZ-402	10	20.93	--	--	21.80	--	--	0.87
S-125	38	23.44	--	--	24.00	--	--	0.56
S-82	56	23.63	23.42	0.21	23.76	23.56	0.20	0.14

Notes:
btoc = below top of casing
LNAPL specific gravity assumed to be 0.76

TABLE 4-5

RW-406 Aquifer Test Data Analyses Summary

26th Street Area Investigation
Philadelphia Refinery

Well No.	Distance From RW-406 (feet)	Drawdown Data (1) Estimated Transmissivity (ft2/day)	Drawdown Data (1) Estaimated Hydraulic Condcutivity (ft/day) (3)	Recovery Data (2) Estimated Transmissivity (ft2/day)	Recovery Data (2) Estaimated Hydraulic Condcutivity (ft/day) (3)
RW-406	NA	252	20.13	427	34.11
RW-401	21	554	44.25	394	31.47
PZ-401	12	330	26.36	251	20.05
PZ-402	10	258	20.61	200	15.97
S-125	38	492	39.30	292	23.32
Geometric Mean		**357**	**28.56**	**301**	**24.04**

Notes:

(1) Drawdown data analyzed using Cooper-Jacob Straight-Line Approximation Method adjusted for unconfined aquifers

(2) Recovery data analyzed using Theis Recovery Method adjusted for unconfined aqyuifers

(3) Saturated aquifer thickness assumed to be 12.52 feet (based on RW-406 static liquid level measurements)

TABLE 4-6

Summary of Hydraulic Conductivity Values
from Rising Head Slug Tests
October 2002

26th Street Area Investigation
SUNOCO Philadelphia Refinery

Well No.	Hydraulic Conductivity (K)	
	ft/day	cm/sec
S-43	0.78	2.75E-04
S-86	0.30	1.06E-04
S-116	2.11	7.45E-04
S-120	11.70	4.13E-03
S-122	12.60	4.45E-03
S-127	0.29	1.02E-04
RW-406	7.22	2.55E-03

Note: Bouwer and Rice (1976) method used for slug test analyses

TABLE 4-7

RW-400 Series Recovery Well Capacity Test Summary

26th Street Area Investigation
Philadelphia Refinery

Well No.	Total Pumping Duration (minutes)	Maximum Pumping Rate Interval (gpm)	Static Liquid Level Measurements: Depth to Water (feet btoc)	Static Liquid Level Measurements: Depth to LNAPL (feet btoc)	Static Liquid Level Measurements: Product Thickness (feet)	Liquid Level Measurements at End of Pumping: Depth to Water (feet btoc)	Liquid Level Measurements at End of Pumping: Depth to LNAPL (feet btoc)	Liquid Level Measurements at End of Pumping: Product Thickness (feet)	Corrected Drawdown (feet)	Comments
RW-400	NA	--	--	--	--	--	--	--	--	Not tested, water pump not operable. DRBC permit application (June 1995) indicates that the well yield is 1 gpm with a specific capacity of 0.08 gpm/ft
RW-401	NA	--	--	--	--	--	--	--	--	Not tested, RW-406 was installed as a replacement well
RW-402	158	2.00	19.25	19.10	0.15	21.86	21.55	0.31	2.49	Maximum pumping rate was at the capacity of the pump
RW-403	122	0.88	22.36	--	--	31.42	31.37	0.05	9.10	
RW-404	59	1.20	24.21	--	--	29.85	--	--	5.64	
RW-405	367	1.20	27.92	26.67	1.25	31.89	27.69	4.20	1.73	Maximum pumping rate was at the capacity of the pump, 7.5 gallons of product removed during testing
RW-406	3300	2.74	24.60	24.16	0.44	29.36	27.58	1.78	3.74	116 gallons of product removed during test, refer discussion of test

Notes:
btoc = below top of casing
maximum pumping rate intervals are average rates during the highest flow rate interval

TABLE 4-8

Product Bail-down
Test Summary

26th Street Area Investigation
Philadelphia Refinery

Well No.	Well Diameter (inches)	Static Product Thickness (feet)	Length of Test (minutes)	Volume of Product Removed (gallons)	Product Thickness at End of Test (feet)	Recovery Attained During Test	Estimated Inflection Point Time (1) (minutes)	Estimated Inflection Point Product Thickness (feet)
S-50	2	1.03	50	0.75	0.43	42%	18	0.37
S-98 (2)	4	0.57	45	3	0.62	109%	(3)	(3)
S-100 (2)	4	0.61	209	2	0.24	39%	5	0.24
CSX-MW-5	2	0.63	41.5	0.13	0.31	49%	14	0.28

Notes:

(1) Estimated using methodology presented in Gruszenski (1987) and as described in Testa and Paczkowski (1989)

(2) Sorbent removed from well prior to product bailing

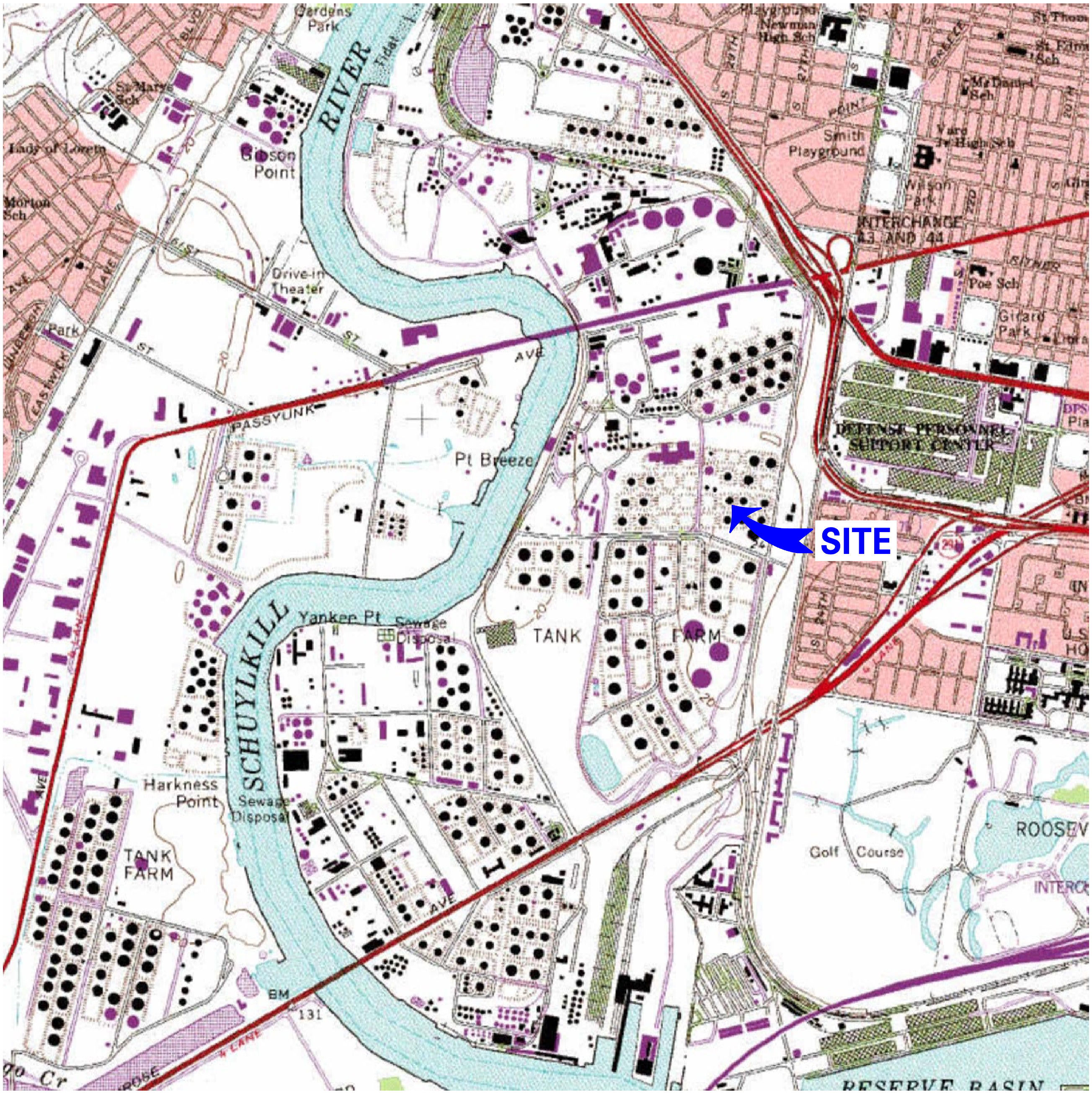
(3) Inflection point not clearly indicated from graph

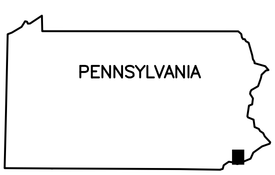
TABLE 4-9

LNAPL Characterization
Results Summary
September 27, 2002

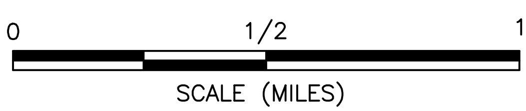
26th Street Area Investigation
Philadelphia Refinery

Well ID	LNAPL Characterization Description
S-50	Refinery intermediate (resembling naphtha or reformed light naphtha or a mixure of the two)
S-88A	Sample contained only a sheen, not enough sample for LNAPL-type characterization
S-89	Heavily degraded gasoline and diesel mixture
S-98	Weathered gasoline, trace diesel-range hydrocarbons
S-100	Gasoline and diesel
PZ-400	Gasoline and diesel
RW-401	Gasoline and diesel
RW-402	Gasoline and diesel
CSX-MW-5	Heavily degraded gasoline and diesel mixture





QUADRANGLE LOCATION



REFERENCE: USGS 7.5 MINUTE QUADRANGLE; PHILADELPHIA, PENNSYLVANIA–NEW JERSEY; 1995

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SITE LOCATION MAP
26th STREET AREA / POINT BREEZE PROCESSING AREA

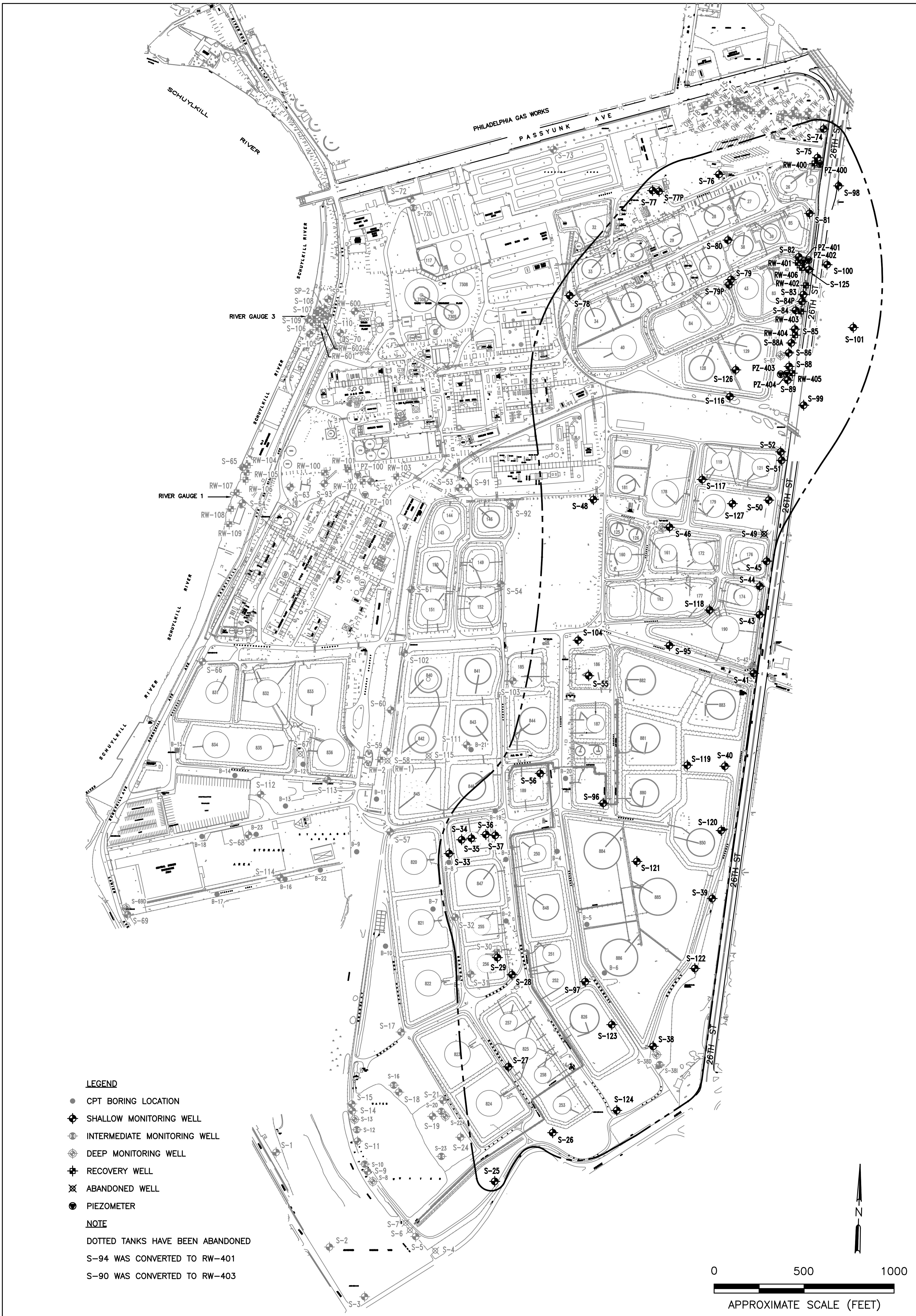
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE:

1-1

JOB#: **62SU.01017.02** APPR: DWN: **KPM** DATE: **01/08/03**

N:/OFFICE-062 DWG: 62SU-1017-2-6(1-1)



REFERENCE: HANDEX ENVIRONMENTAL RECOVERY, INC.; PROJECT 110535-12; DRAWINGNAME: PB_SY_05.DWG; TITLE: SOUTH YARD BASE MAP; DATE: 05/21/96

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GENERAL AREA OF INVESTIGATION
26TH STREET AREA

SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **1-2**

JOB#: **62SU.01017.02.0006** APPR: DWN: **KPM** DATE: **01/30/03**

N:/SECOR-062

DWG: 62SU-1017-2-6(1-2)

SYSTEM	SERIES	GEOHYDROLOGIC UNIT				RANGE OF THICKNESS (ft)	SYMBOL
		Paulachok (1991)		Greenman and others (1961)			
Quaternary	Holocene	Alluvium		Alluvium		0-78	Qal
Quaternary	Pleistocene	"Trenton gravel" (informal usage)		Cape May Formation		0-80	Qp
				Pensauken Formation		0-80	
Tertiary	Miocene	Bridgeton Formation				0-10	Tb
Cretaceous	Upper Cretaceous	Potomac-Raritan Magothy aquifer system	Upper clay unit	Magothy Formation		0-35	Ku
				Upper Clay member		0-35	
			Upper sand unit	Raritan Formation	Old Bridge Sand Member	0-50	Ko
			Middle clay unit		Middle Clay member	0-60	Km
			Middle sand unit		Sayreville Sand Member	0-40	Ks
			Lower clay unit		Lower Clay Member	0-61	Kl
			Lower sand unit		Farrington Sand Member	0-90	Kf
	Lower Cretaceous						
Pre-Cretaceous		Crystalline rocks, includes Chickies Formation and Wissahickon Formation of Glenarm Group		Crystalline rocks of Glenarm Series (former usage)			Wa

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GENERALIZED STRATIGRAPHIC COLUMN

SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **2-1**

JOB#: **62SU.01017.02.0006** APPR: DWN: **KPM** DATE: **01/10/03**

N:/SECOR-062

DWG: 62SU-1017-2-6(2-1)

LEGEND

- CPT BORING LOCATION
- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- DEEP MONITORING WELL
- RECOVERY WELL
- ABANDONED WELL
- PIEZOMETER

NOTE

DOTTED TANKS HAVE BEEN ABANDONED

S-94 WAS CONVERTED TO RW-401

S-90 WAS CONVERTED TO RW-403

REFERENCE: HANDEX ENVIRONMENTAL RECOVERY, INC.; PROJECT 110535-12; DRAWINGNAME: PB_SY_05.DWG; TITLE: SOUTH YARD BASE MAP; DATE: 05/21/96

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RW-400 SERIES RECOVERY WELLS AREA

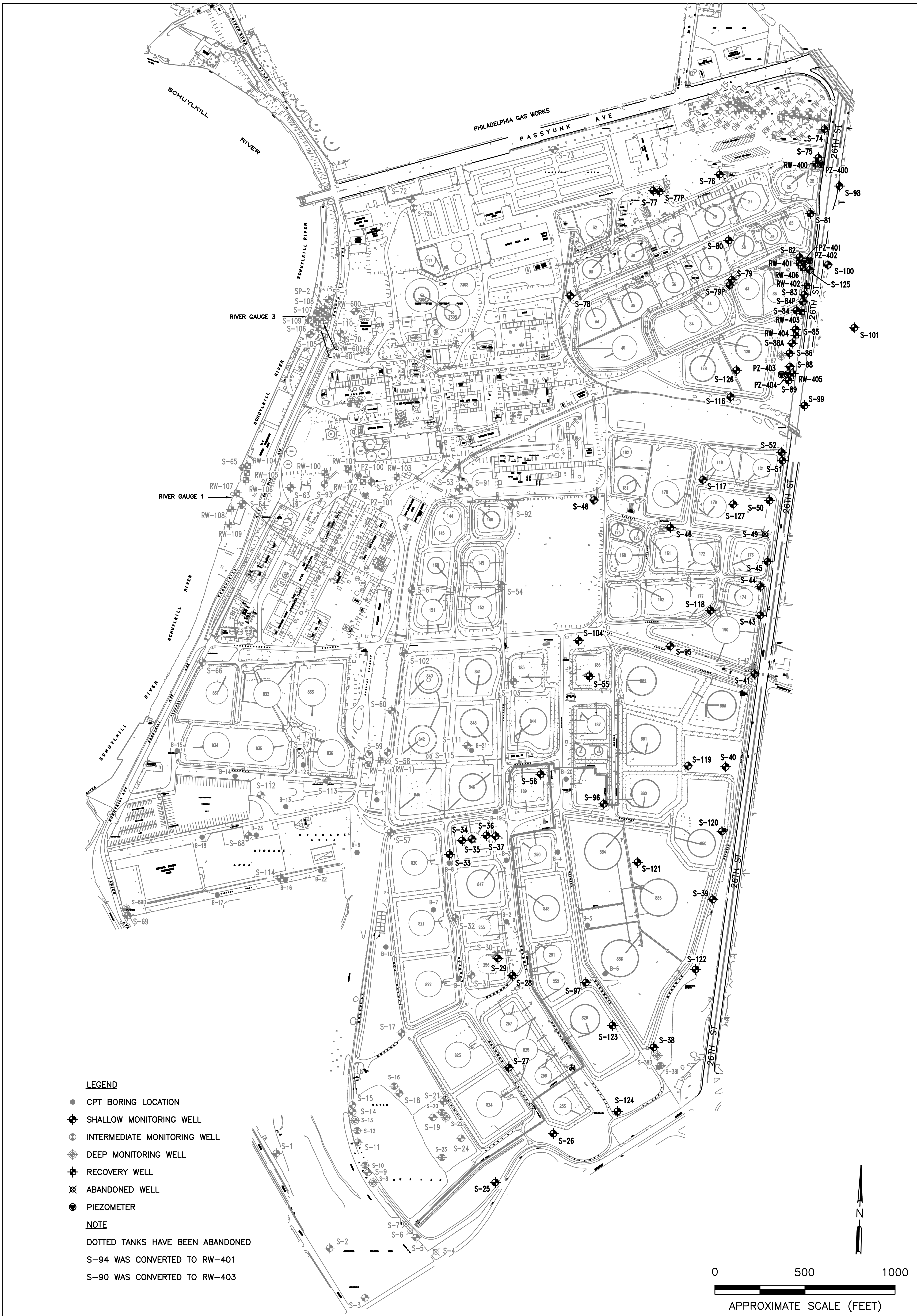
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: 2-2

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 01/08/03

N:/SECOR-062

DWG: 62SU-1017-2-6(2-2)



REFERENCE: HANDEX ENVIRONMENTAL RECOVERY, INC.; PROJECT 110535-12; DRAWINGNAME: PB_SY_05.DWG; TITLE: SOUTH YARD BASE MAP; DATE: 05/21/96

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26TH STREET INVESTIGATION
SITE MONITORING WELL LOCATIONS

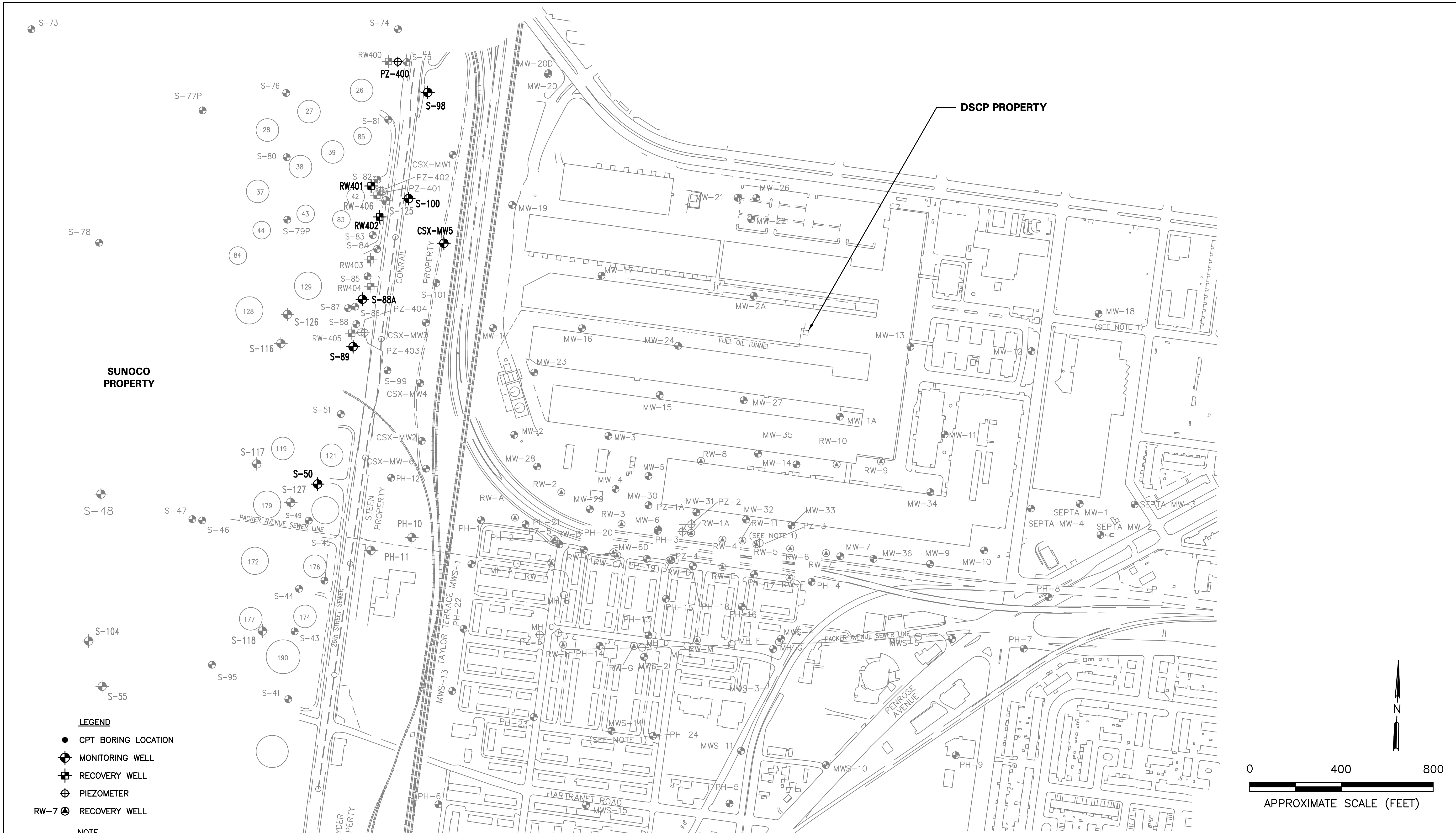
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE:
3-1

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 01/27/03

N:/SECOR-062

DWG: 62SU-1017-2-6(3-1)



LEGEND

- CPT BORING LOCATION
- MONITORING WELL
- RECOVERY WELL
- PIEZOMETER
- RW-7 RECOVERY WELL

NOTE

LNAPL SAMPLE LOCATIONS SHOWN BOLD
DOTTED TANKS HAVE BEEN ABANDONED
S-94 WAS CONVERTED TO RW-401
S-90 WAS CONVERTED TO RW-403

REFERENCE: IT CORPORATION; DRAWINGNAME: 0233-0011.DWG; TITLE: GROUNDWATER ELEVATION CONTOUR MAP; DATE: 10/20/99

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LNAPL SAMPLE COLLECTION LOCATIONS
(SEPTEMBER 27, 2002)
26TH STREET AREA
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: 3-2

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 01/08/03

N:/SECOR-062

DWG: 62SU-1017-2-6(3-2)

REFERENCE: HANDEX ENVIRONMENTAL RECOVERY, INC.; PROJECT 110535-12; DRAWINGNAME: PB_SY_05.DWG; TITLE: SOUTH YARD BASE MAP; DATE: 05/21/96

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LINES OF GENERALIZED HYDROGEOLOGIC CROSS-SECTIONS

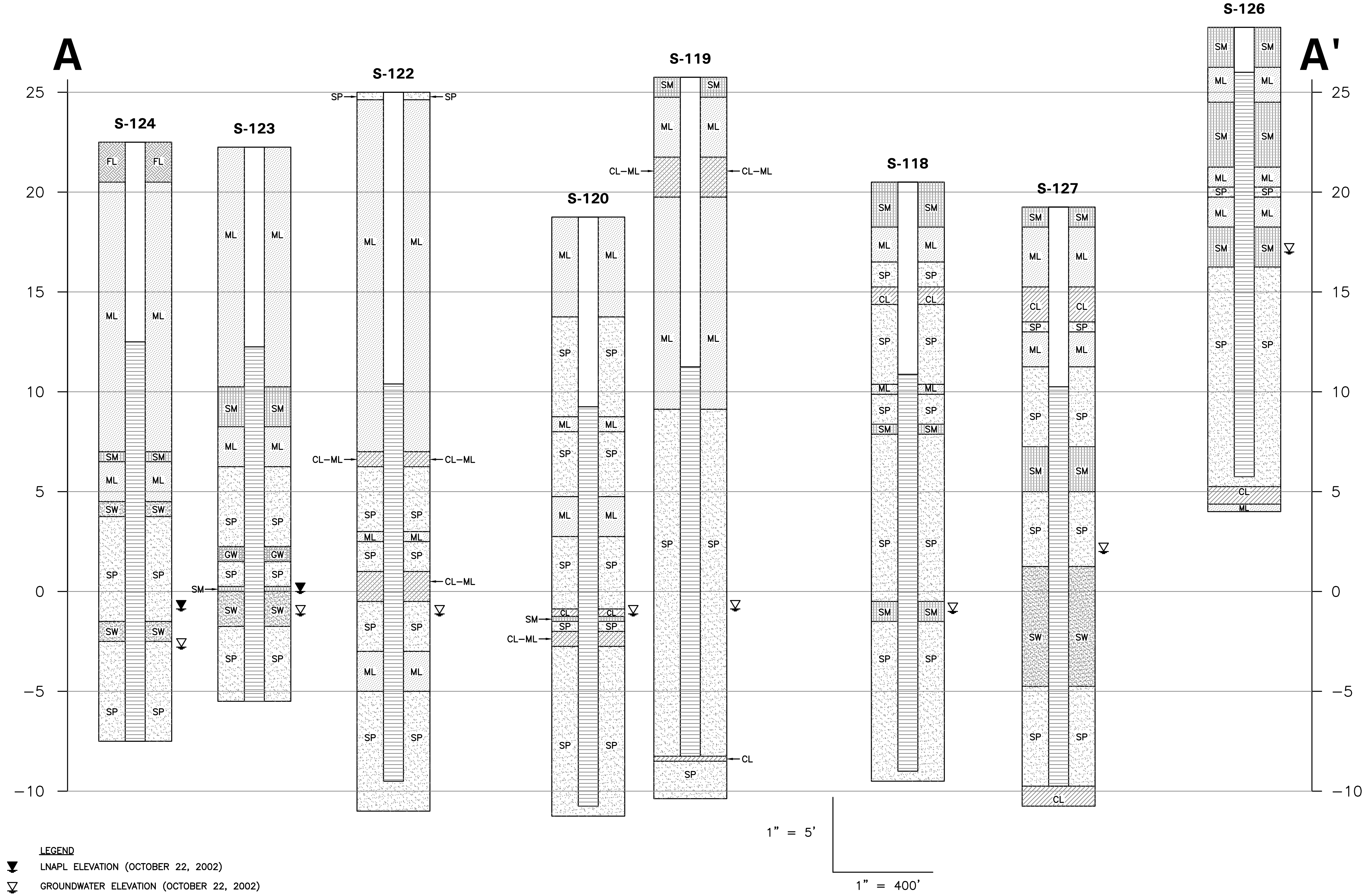
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE:
4-1

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 01/29/03

N:/SECOR-062

DWG: 62SU-1017-2-6SX(4-1)



LEGEND

- LNAPL ELEVATION (OCTOBER 22, 2002)
- GROUNDWATER ELEVATION (OCTOBER 22, 2002)

WELL SCREEN	FILL (FL)	SANDY SILT (MLS)	SILT & SAND (ML/SW)
CLAY (CL)	CLAYEY SAND (SW−CL)	SILTY SAND (SM)	CLAY & SAND (CL/SW)
SAND & GRAVEL (SWG)	GRAVEL & SAND (GWS)	WELL-GRADED SAND (SW)	POORLY-GRADED SAND (SP)
SILTY CLAY (CL−ML)	CLAYEY SILT (ML−CL)	WELL-GRADED GRAVEL (GW)	GRAVEL (GP)
CLAY & PEAT (CL/PT)	SILT & CLAY (ML/CL)	SILT (ML)	

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HYDROGEOLOGIC CROSS-SECTION A-A'

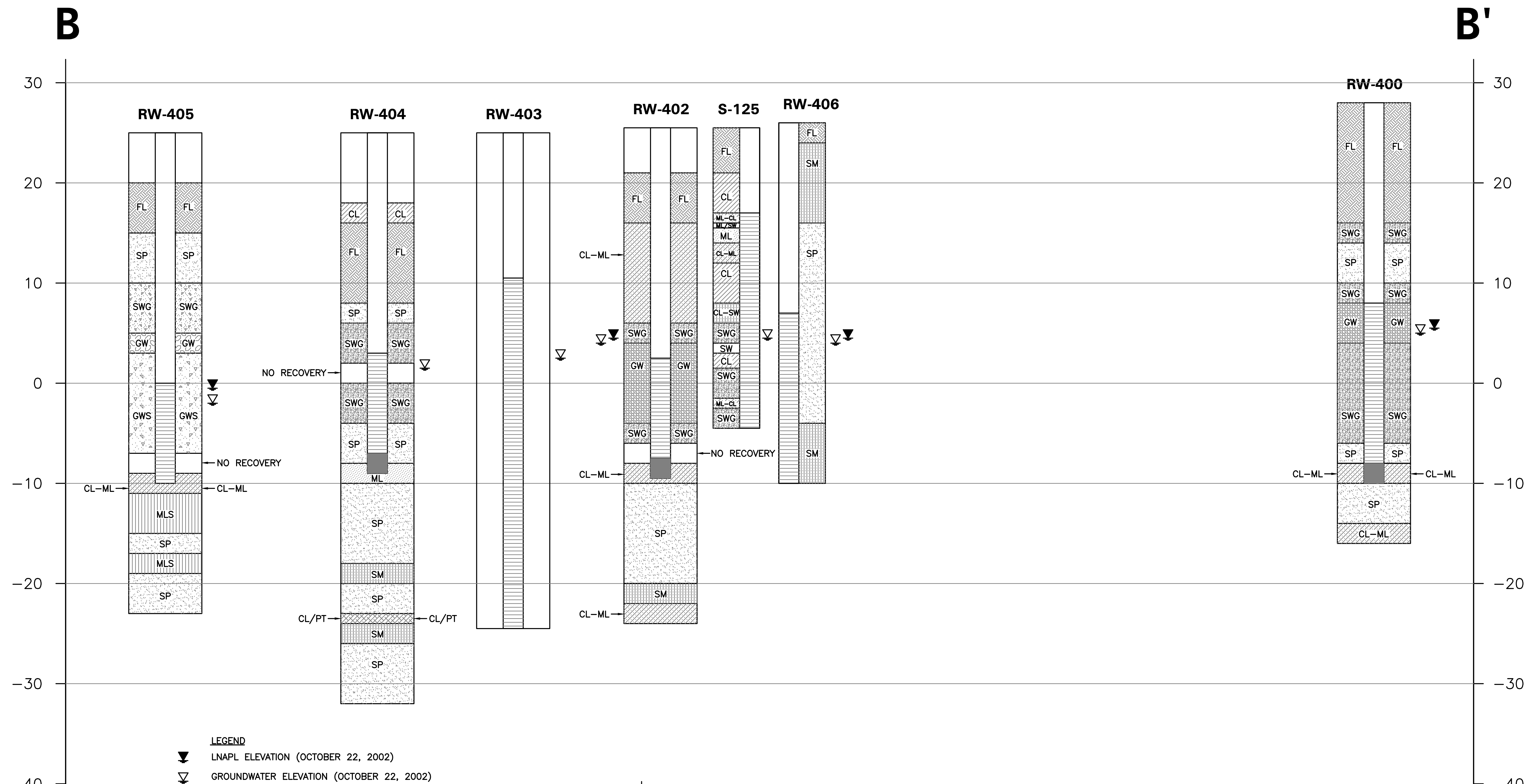
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: 4-2

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 01/10/03

N:/SECOR−062

DWG: 62SU−1017−2−6(4−2).DWG



LEGEND

- LNAPL ELEVATION (OCTOBER 22, 2002)
- GROUNDWATER ELEVATION (OCTOBER 22, 2002)

WELL SCREEN	FILL (FL)
CLAY (CL)	CLAYEY SAND (SW–CL)
SAND & GRAVEL (SWG)	GRAVEL & SAND (GWS)
SILTY CLAY (CL–ML)	CLAYEY SILT (ML–CL)
CLAY & PEAT (CL/PT)	SILT & CLAY (ML/CL)
SANDY SILT (MLS)	SILT & SAND (ML/SW)
SANDY CLAY (CL–SW)	CLAY & SAND (CL/SW)
WELL–GRADED SAND (SW)	POORLY–GRADED SAND (SP)
WELL–GRADED GRAVEL (GW)	GRAVEL (GP)
SILT (ML)	SILTY SAND (SM)

1" = 10'

1" = 100'

VERTICAL EXAGGERATION: 10X

NOTES

WELL SCREEN NOT SHOWN WHERE DATA IS NOT AVAILABLE

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HYDROGEOLOGIC CROSS-SECTION B-B'

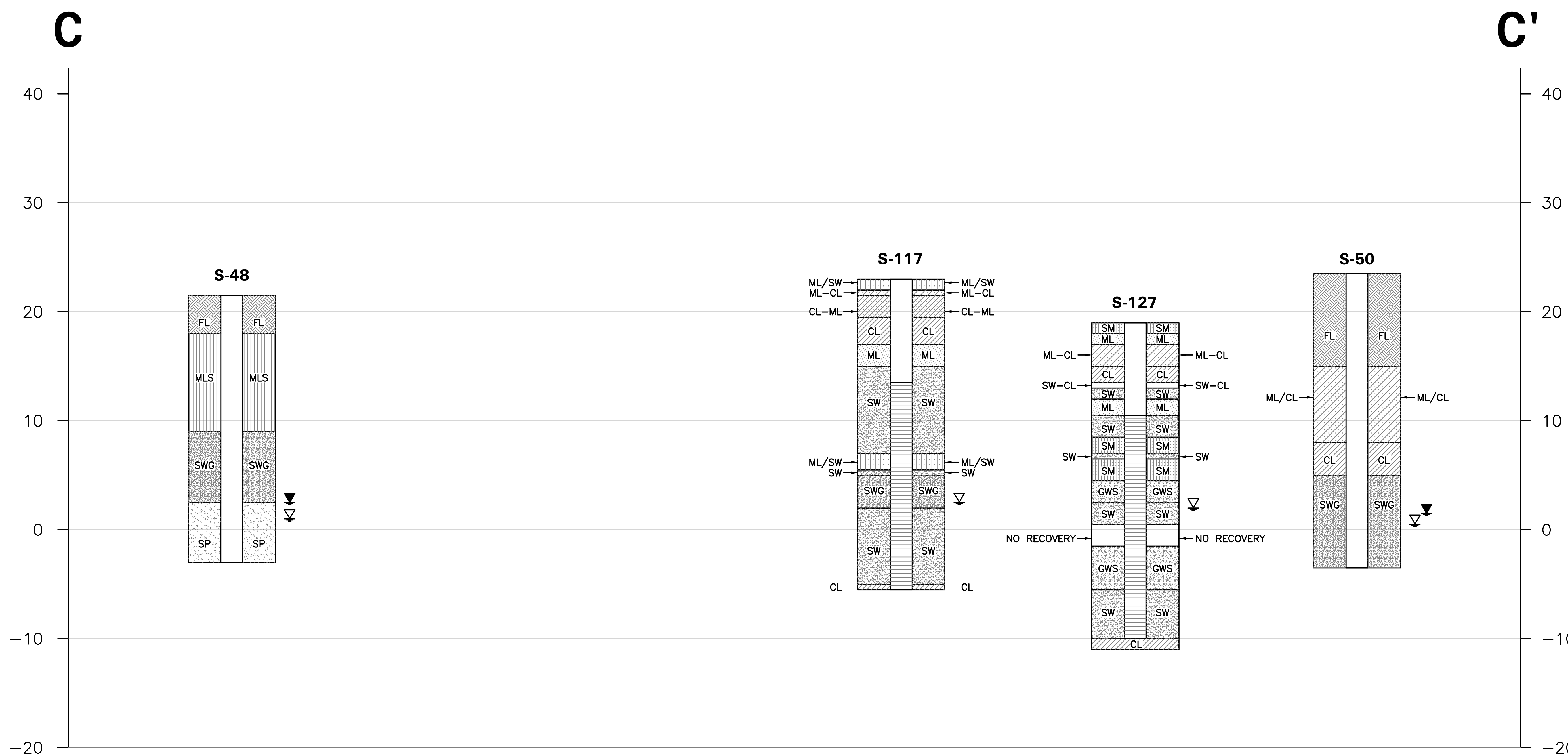
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE:
4-3

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 01/10/03

N:/SECOR–062

DWG: 62SU–1017–2–643(B–B).DWG



LEGEND

- LNAPL ELEVATION (OCTOBER 22, 2002)
- GROUNDWATER ELEVATION (OCTOBER 22, 2002)
- WELL SCREEN
- CLAY (CL)
- SAND & GRAVEL (SWG)
- SILTY CLAY (CL–ML)
- CLAY & PEAT (CL/PT)
- SANDY SILT (MLS)
- SILTY SAND (SM)
- POORLY–GRADED SAND (SP)
- WELL–GRADED SAND (SW)
- FILL (FL)
- CLAYEY SAND (SW–CL)
- GRAVEL & SAND (GWS)
- CLAYEY SILT (ML–CL)
- SILT & CLAY (ML/CL)
- SILT & SAND (ML/SW)
- CLAY & SAND (CL/SW)
- SILT (ML)

1" = 10'

1" = 100'

VERTICAL EXAGGERATION: 10X

NOTES

WELL SCREEN NOT SHOWN WHERE DATA IS NOT AVAILABLE

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HYDROGEOLOGIC CROSS-SECTION C-C'

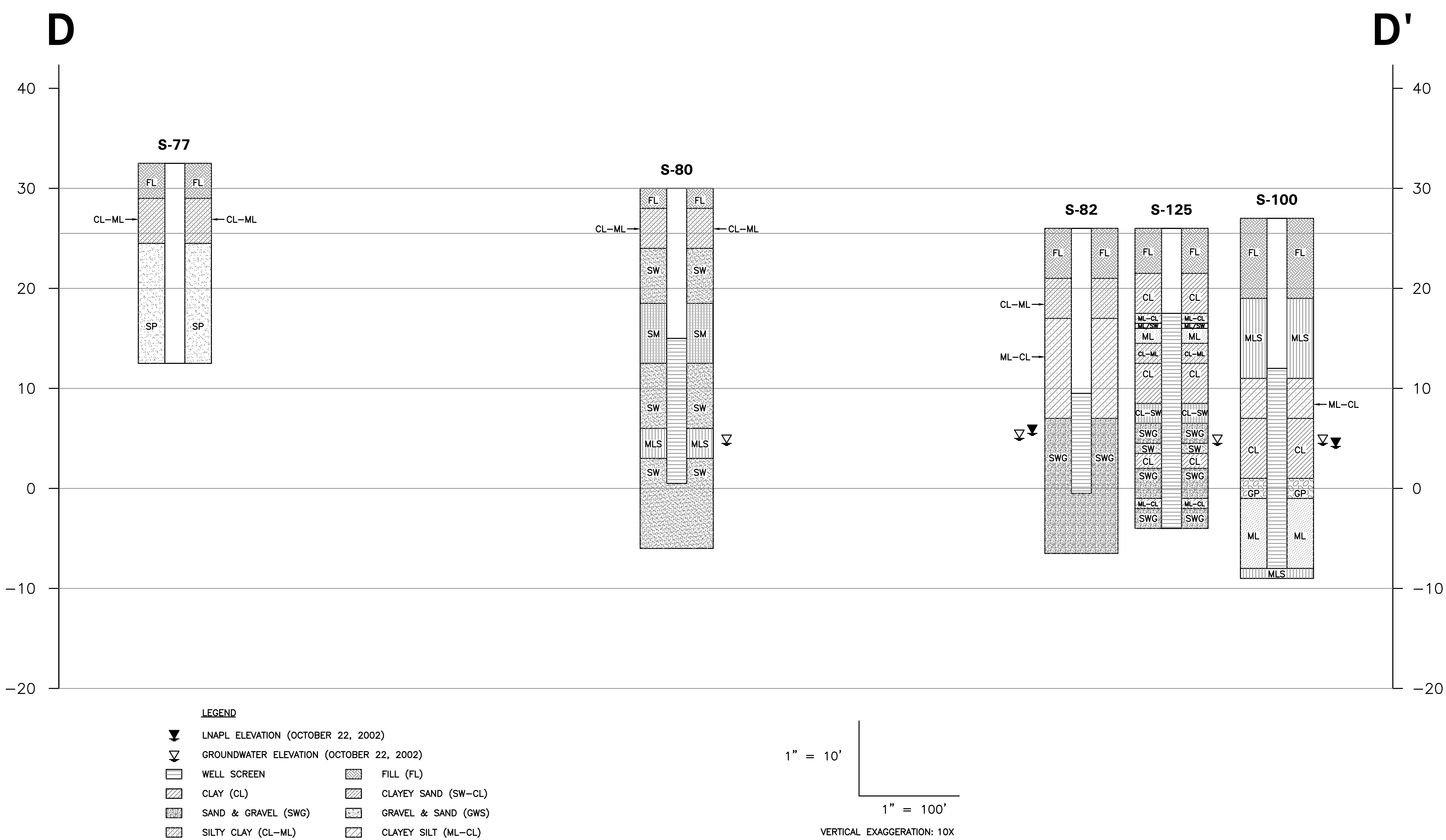
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: 4-4

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 01/10/03

N:/SECOR–062

DWG: 62SU–1017–2–644(C–C)).DWG



LEGEND

- LNAPL ELEVATION (OCTOBER 22, 2002)
- GROUNDWATER ELEVATION (OCTOBER 22, 2002)
- WELL SCREEN
- CLAY (CL)
- SAND & GRAVEL (SWG)
- SILTY CLAY (CL–ML)
- CLAY & PEAT (CL/PT)
- SANDY SILT (MLS)
- SILTY SAND (SM)
- WELL–GRADED SAND (SW)
- WELL–GRADED GRAVEL (GW)
- SILT (ML)
- FILL (FL)
- CLAYEY SAND (SW–CL)
- GRAVEL & SAND (GWS)
- CLAYEY SILT (ML–CL)
- SILT & CLAY (ML/CL)
- SILT & SAND (ML/SW)
- CLAY & SAND (CL/SW)
- POORLY–GRADED SAND (SP)
- GRAVEL (GP)

NOTES

WELL SCREEN NOT SHOWN WHERE DATA IS NOT AVAILABLE

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HYDROGEOLOGIC CROSS-SECTION D-D'

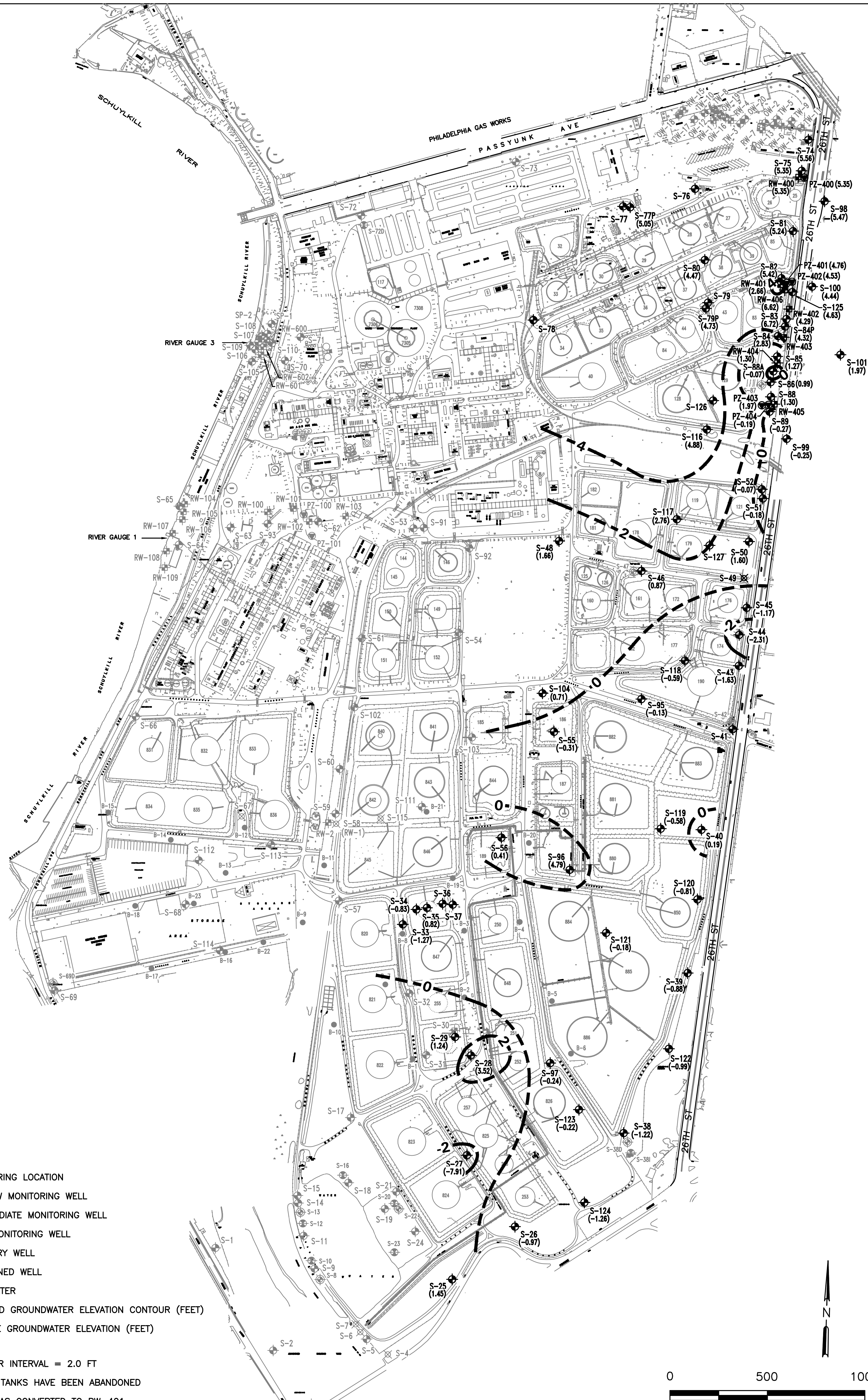
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: 4-5

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 01/10/03

N:/SECOR–062

DWG: 62SU–1017–2–645(D–D).DWG



LEGEND

- CPT BORING LOCATION
- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- DEEP MONITORING WELL
- RECOVERY WELL
- ABANDONED WELL
- PIEZOMETER
- INFERRED GROUNDWATER ELEVATION CONTOUR (FEET)
- (1.45) RELATIVE GROUNDWATER ELEVATION (FEET)

NOTE

CONTOUR INTERVAL = 2.0 FT

DOTTED TANKS HAVE BEEN ABANDONED

S-94 WAS CONVERTED TO RW-401

S-90 WAS CONVERTED TO RW-403

N

0 500 1000

APPROXIMATE SCALE (FEET)

REFERENCE: HANDEX ENVIRONMENTAL RECOVERY, INC.; PROJECT 110535-12; DRAWINGNAME: PB_SY_05.DWG; TITLE: SOUTH YARD BASE MAP; DATE: 05/21/96

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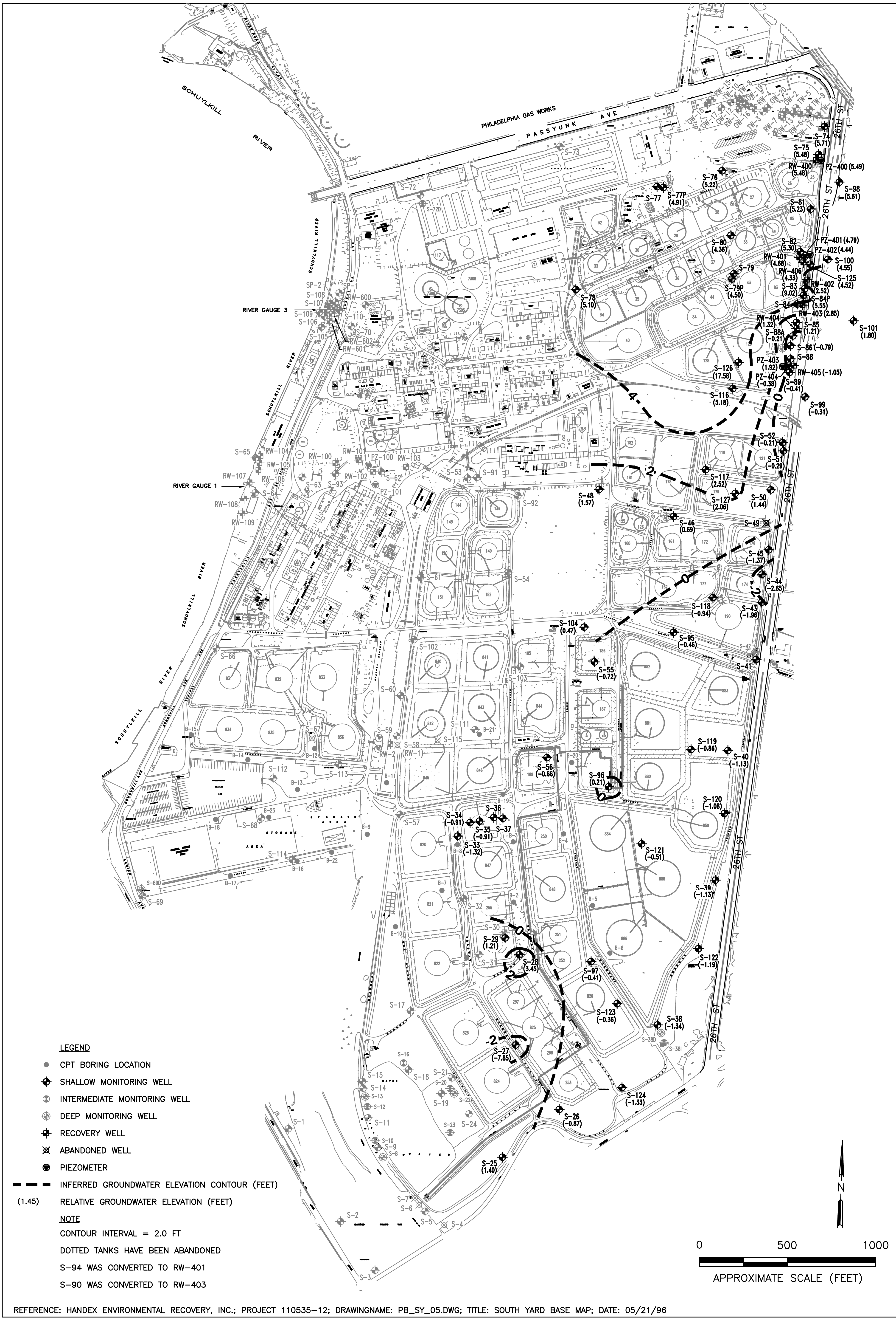
GROUNDWATER ELEVATION CONTOUR MAP
(SEPTEMBER 3, 2002)
26TH STREET AREA
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: 4-6

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 01/08/03

N:/SECOR-062

DWG: 62SU-1017-2-646(0902)



REFERENCE: HANDEX ENVIRONMENTAL RECOVERY, INC.; PROJECT 110535-12; DRAWINGNAME: PB_SY_05.DWG; TITLE: SOUTH YARD BASE MAP; DATE: 05/21/96

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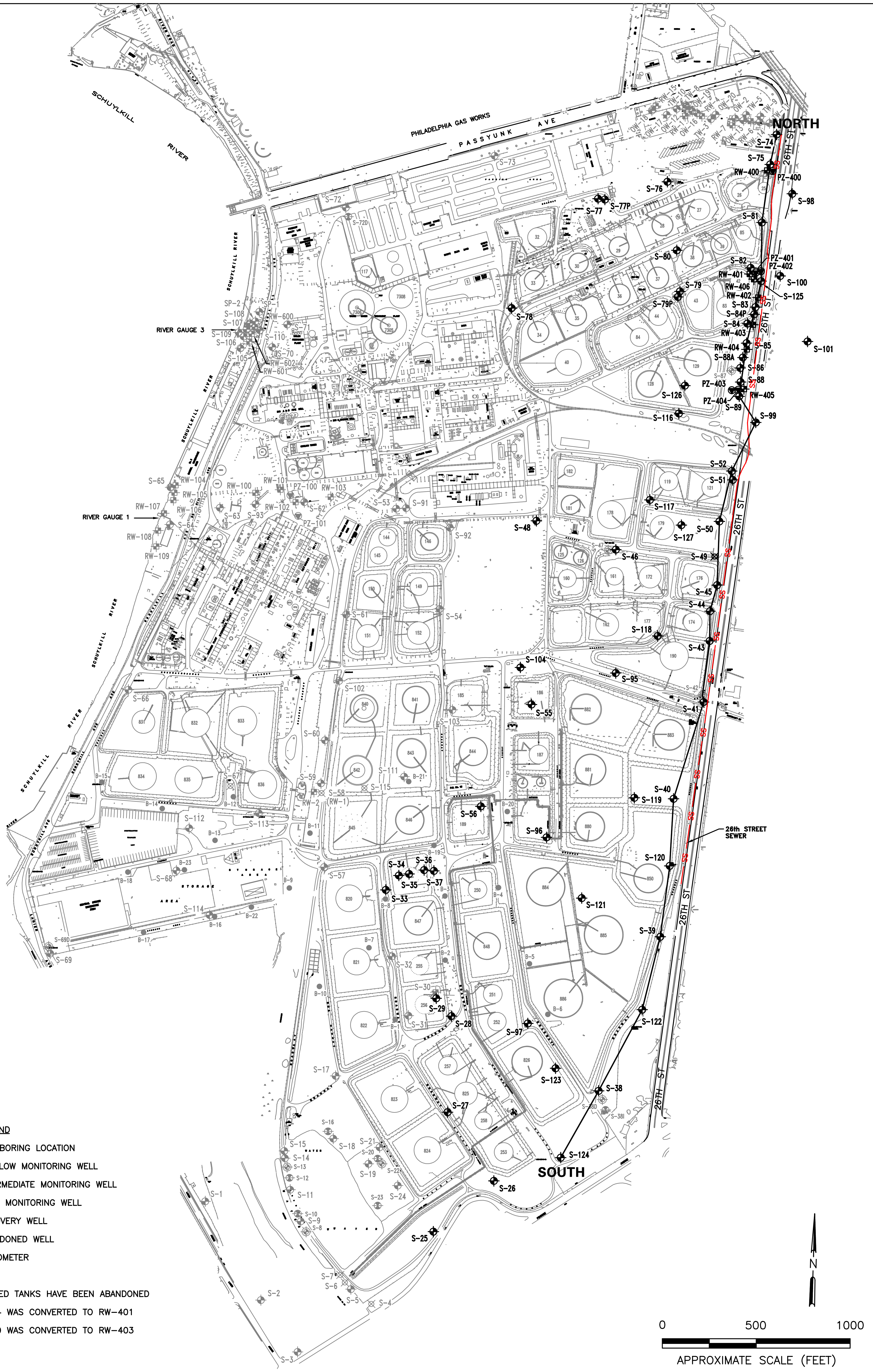
GROUNDWATER ELEVATION CONTOUR MAP
(OCTOBER 22, 2002)
26TH STREET AREA
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **4-7**

JOB#: **62SU.01017.02.0006** APPR: DWN: **KPM** DATE: **01/08/03**

N:/SECOR-062

DWG: 62SU-1017-2-647(1002).DWG



REFERENCE: HANDEX ENVIRONMENTAL RECOVERY, INC.; PROJECT 110535-12; DRAWINGNAME: PB_SY_05.DWG; TITLE: SOUTH YARD BASE MAP; DATE: 05/21/96

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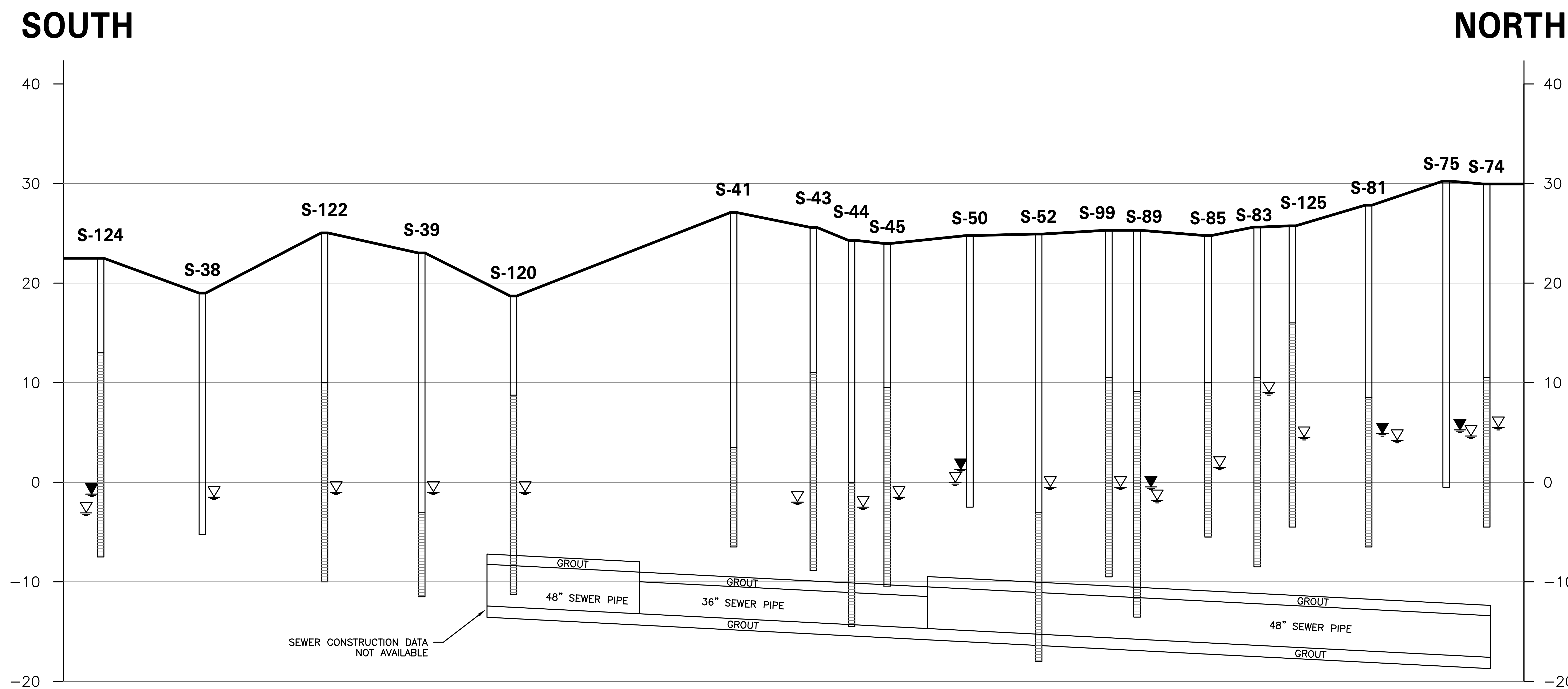
LOCATION OF 26TH STREET SEWER AND GROUNDWATER / LNAPL ELEVATION PROFILE
26TH STREET AREA
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: 4-8

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 01/27/03

N:/SECOR-062

DWG: 62SU-1017-2-6(4-8)



LEGEND

- LNAPL ELEVATION (OCTOBER 22, 2002)
- GROUNDWATER ELEVATION (OCTOBER 22, 2002)
- WELL SCREEN

NOTES

WELL SCREEN NOT SHOWN WHERE DATA IS NOT AVAILABLE

1" = 10'

1" = 400'

VERTICAL EXAGGERATION: 40X

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PROFILE OF 26TH STREET SEWER AND GROUNDWATER / LNAPL ELEVATION PROFILE (OCTOBER 22, 2002)

SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

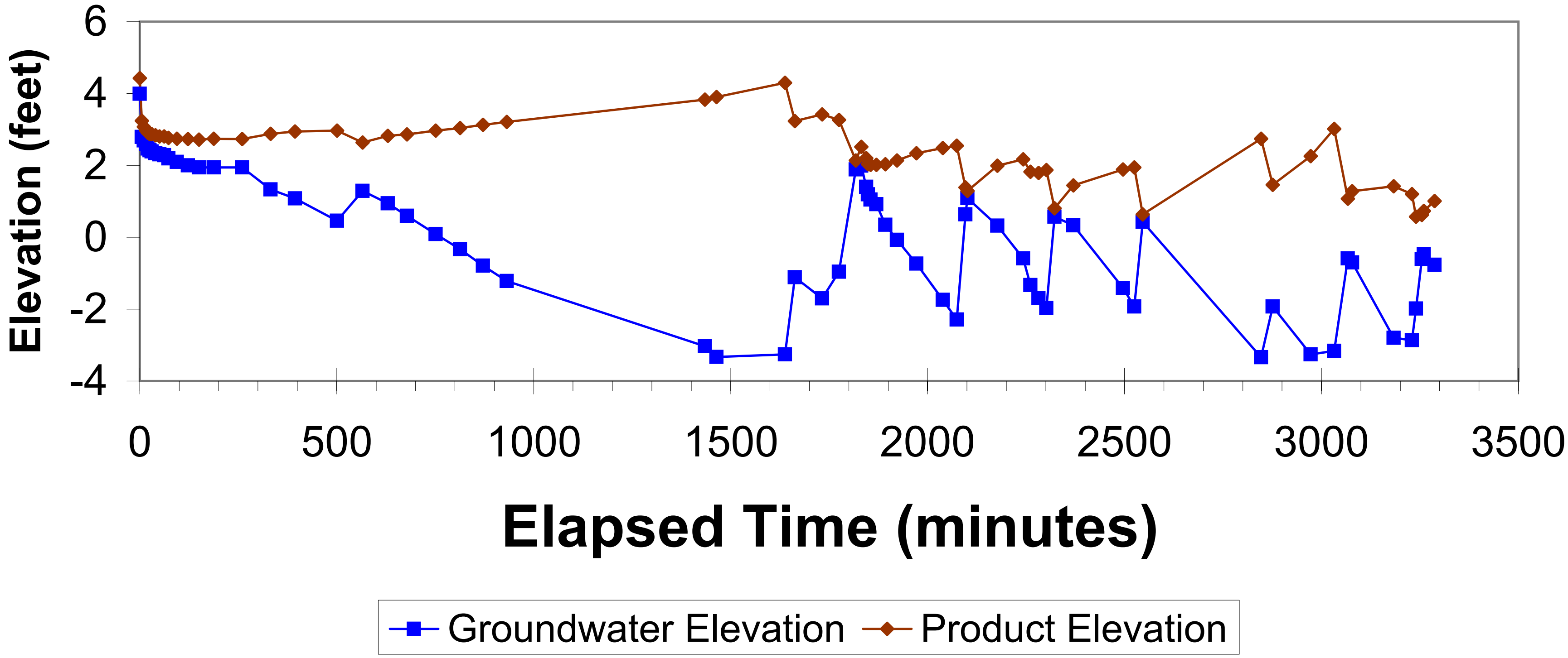
FIGURE: 4-9

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 01/10/03

N:/SECOR-062

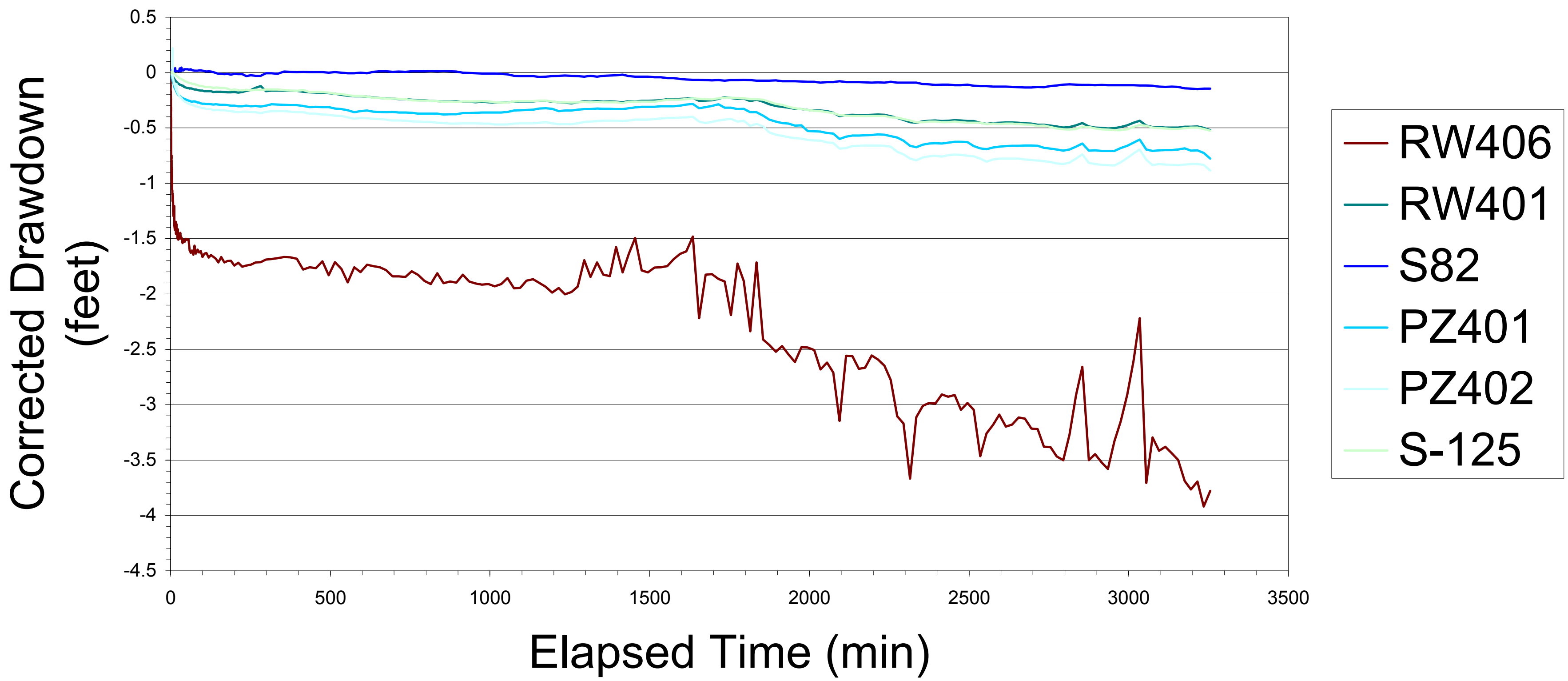
DWG: 62SU-1017-2-6(4-9).DWG

FIGURE 4-10
RW-406 HYDROGRAPH FROM AQUIFER TEST (10/1/02 - 10/3/02)

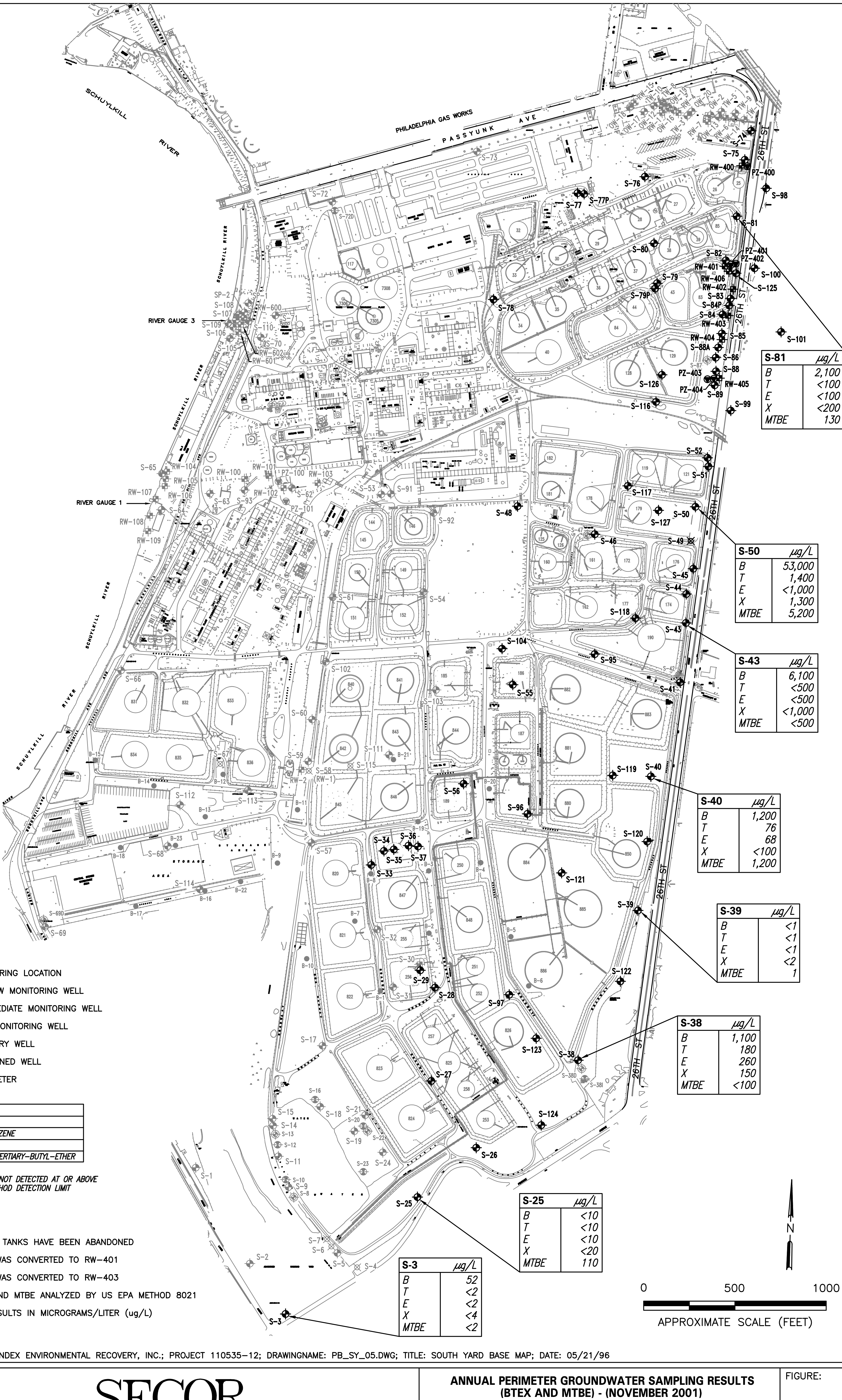


0 to 1275 min: Q = 1.85 gpm (one product removal event at 505 min)
1275 to 1835 min: Q = 1.85 gpm with pump cycling
1835 to 2254 min: ave. Q = 2.5 gpm with periodic product recovery
2254 to 3300 min: ave. Q = 2.74 gpm with periodic product recovery

FIGURE 4-11
RW-406 Aquifer Test Drawdown Data
(10/1/02 - 10/3/02)



0 to 1275 min: Q = 1.85 gpm (one product recovery event at 505 min)
1275 to 1835 min: Q = 1.85 gpm with pump cycling
1835 to 2254 min: ave. Q = 2.5 gpm with periodic product recovery
2254 to 3300 min: ave. Q = 2.74 gpm with periodic product recovery



S-81	μg/L
B	2,100
T	<100
E	<100
X	<200
MTBE	130

S-50	μg/L
B	53,000
T	1,400
E	<1,000
X	1,300
MTBE	5,200

S-43	μg/L
B	6,100
T	<500
E	<500
X	<1,000
MTBE	<500

S-40	μg/L
B	1,200
T	76
E	68
X	<100
MTBE	1,200

S-39	μg/L
B	<1
T	<1
E	<1
X	<2
MTBE	1

S-38	μg/L
B	1,100
T	180
E	260
X	150
MTBE	<100

S-25	μg/L
B	<10
T	<10
E	<10
X	<20
MTBE	110

S-3	μg/L
B	52
T	<2
E	<2
X	<4
MTBE	<2

LEGEND

- CPT BORING LOCATION
- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- DEEP MONITORING WELL
- RECOVERY WELL
- ABANDONED WELL
- PIEZOMETER

ANALYTE

B	BENZENE
T	TOLUENE
E	ETHYLBENZENE
X	XYLENES
MTBE	METHYL-TERTIARY-BUTYL-ETHER

<1 ANALYTE NOT DETECTED AT OR ABOVE THIS METHOD DETECTION LIMIT

NOTE

DOTTED TANKS HAVE BEEN ABANDONED

S-94 WAS CONVERTED TO RW-401

S-90 WAS CONVERTED TO RW-403

BTEX AND MTBE ANALYZED BY US EPA METHOD 8021

ALL RESULTS IN MICROGRAMS/LITER (ug/L)

REFERENCE: HANDEX ENVIRONMENTAL RECOVERY, INC.; PROJECT 110535-12; DRAWINGNAME: PB_SY_05.DWG; TITLE: SOUTH YARD BASE MAP; DATE: 05/21/96

SECOR
International Incorporated
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA 19341
(484) 875-3075/875-9286 (FAX)

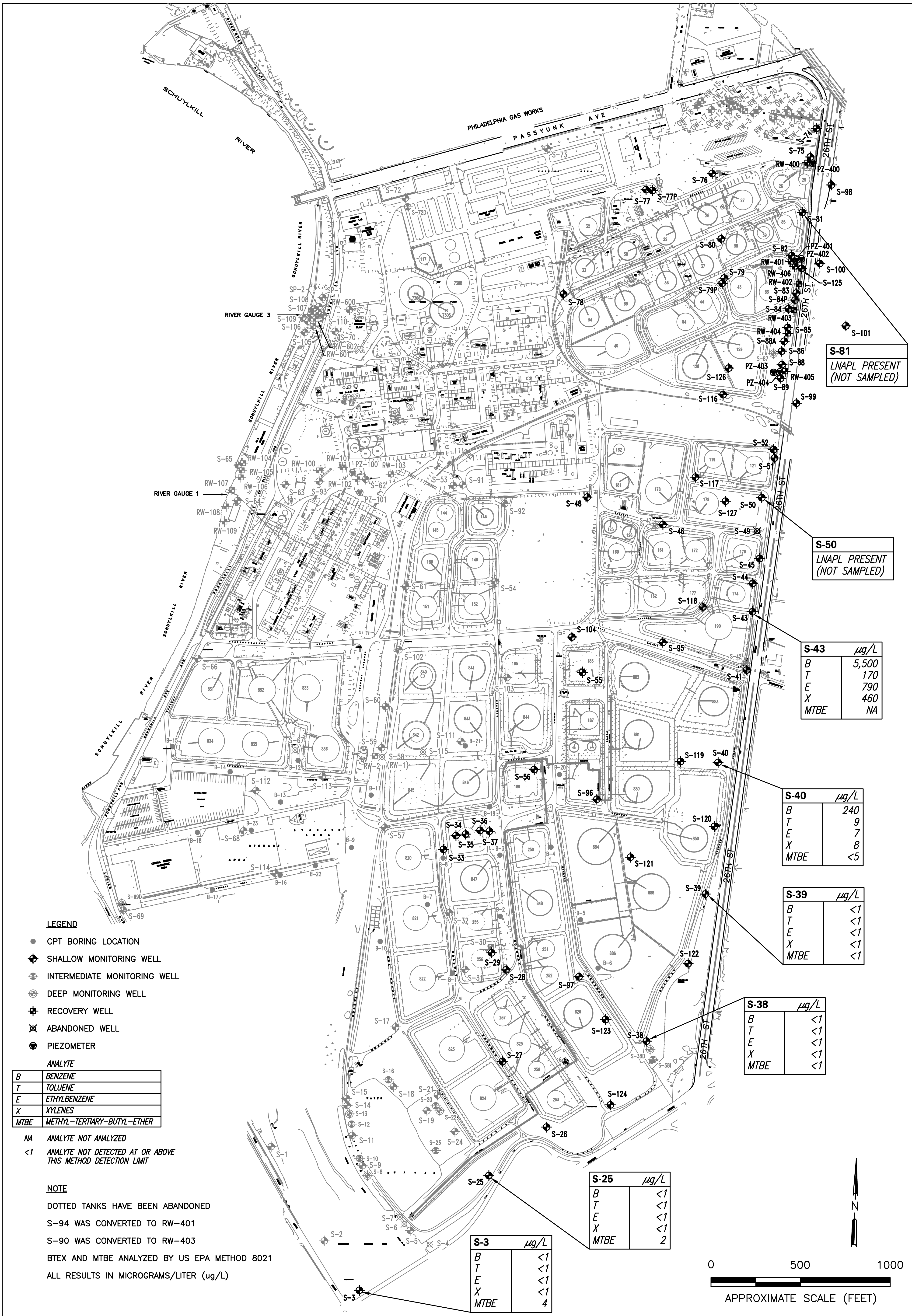
ANNUAL PERIMETER GROUNDWATER SAMPLING RESULTS (BTEX AND MTBE) - (NOVEMBER 2001)
POINT BREEZE PROCESSING AREA
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **4-12**

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 01/27/03

N:/SECOR-062

DWG: 62SU-1017-2-6A(4-12)



S-43	μg/L
B	5,500
T	170
E	790
X	460
MTBE	NA

S-40	μg/L
B	240
T	9
E	7
X	8
MTBE	<5

S-39	μg/L
B	<1
T	<1
E	<1
X	<1
MTBE	<1

S-38	μg/L
B	<1
T	<1
E	<1
X	<1
MTBE	<1

S-25	μg/L
B	<1
T	<1
E	<1
X	<1
MTBE	2

S-3	μg/L
B	<1
T	<1
E	<1
X	<1
MTBE	4

LEGEND

- CPT BORING LOCATION
- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- DEEP MONITORING WELL
- RECOVERY WELL
- ABANDONED WELL
- PIEZOMETER

ANALYTE

B	BENZENE
T	TOLUENE
E	ETHYLBENZENE
X	XYLENES
MTBE	METHYL-TERTIARY-BUTYL-ETHER

NA ANALYTE NOT ANALYZED

<1 ANALYTE NOT DETECTED AT OR ABOVE THIS METHOD DETECTION LIMIT

NOTE

DOTTED TANKS HAVE BEEN ABANDONED

S-94 WAS CONVERTED TO RW-401

S-90 WAS CONVERTED TO RW-403

BTEX AND MTBE ANALYZED BY US EPA METHOD 8021

ALL RESULTS IN MICROGRAMS/LITER (ug/L)

REFERENCE: HANDEX ENVIRONMENTAL RECOVERY, INC.; PROJECT 110535-12; DRAWINGNAME: PB_SY_05.DWG; TITLE: SOUTH YARD BASE MAP; DATE: 05/21/96

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International Incorporated
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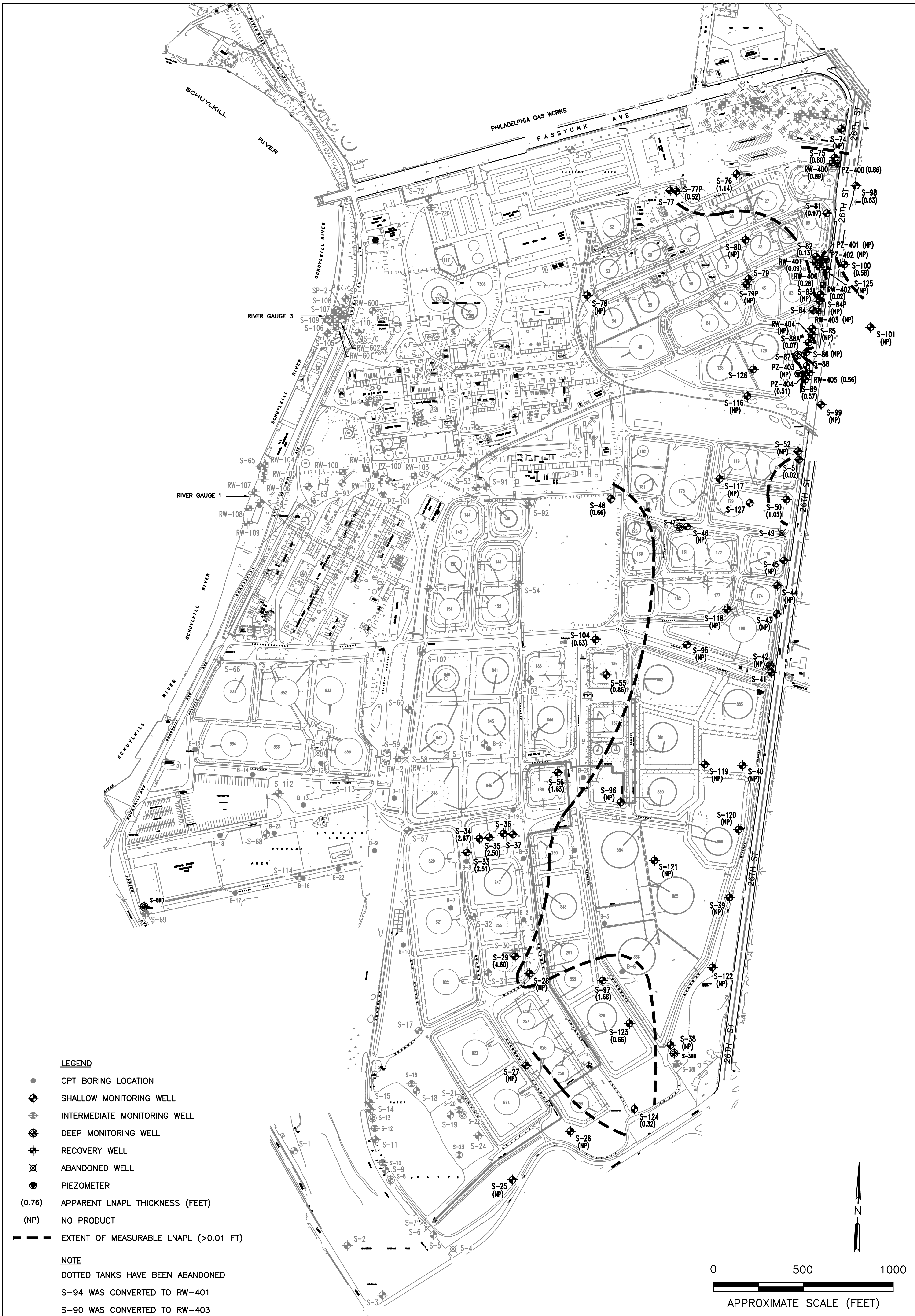
ANNUAL PERIMETER GROUNDWATER SAMPLING RESULTS
(BTEX AND MTBE) - (OCTOBER 2002)
POINT BREEZE PROCESSING AREA
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: 4-13

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 01/27/03

N:/SECOR-062

DWG: 62SU-1017-2-6A(4-13)



REFERENCE: HANDEX ENVIRONMENTAL RECOVERY, INC.; PROJECT 110535-12; DRAWINGNAME: PB_SY_05.DWG; TITLE: SOUTH YARD BASE MAP; DATE: 05/21/96

SECOR
International Incorporated
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA 19341
(484) 875-3075/875-9286 (FAX)

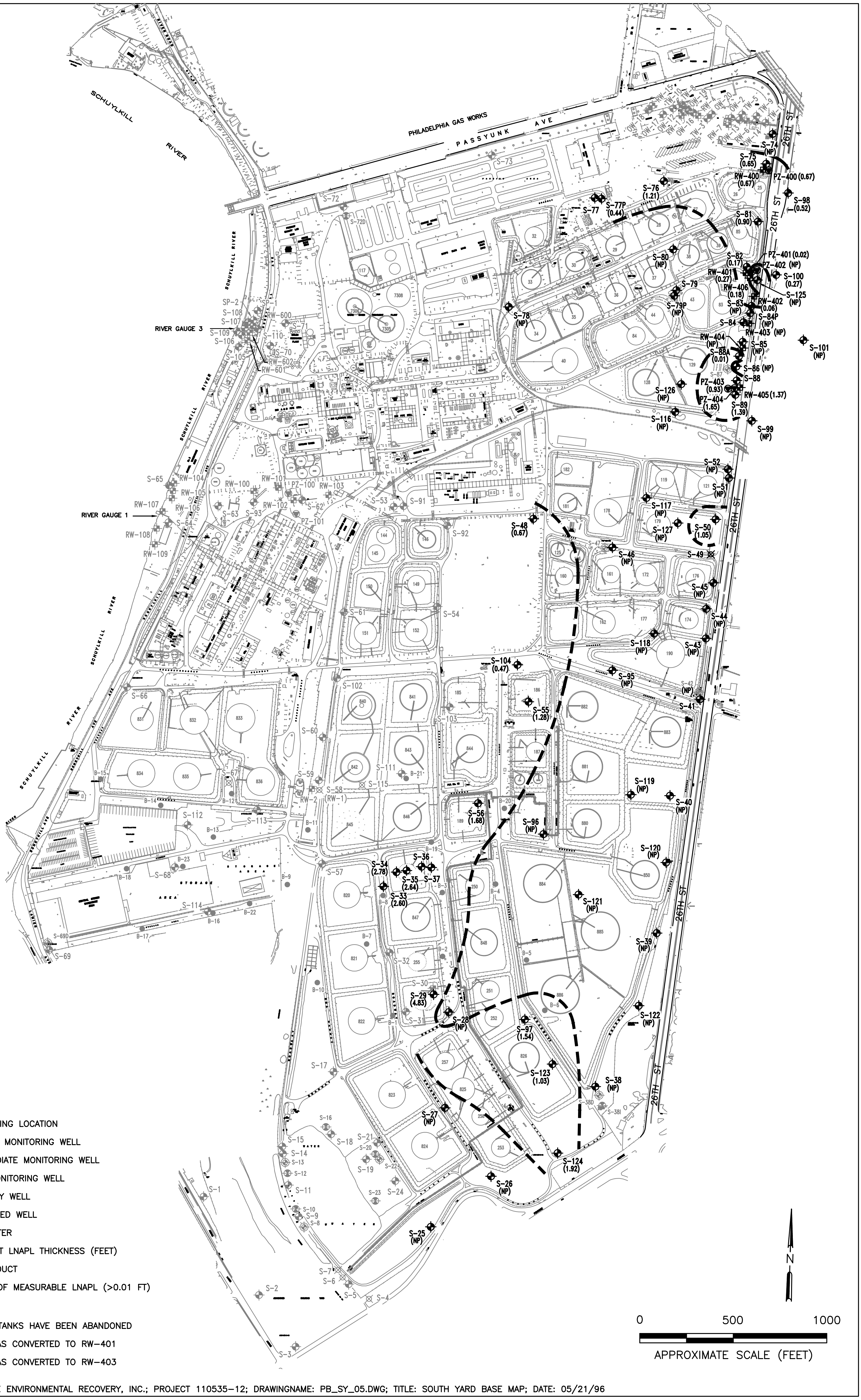
APPROXIMATE EXTENT OF MEASURABLE LNAPL
(SEPTEMBER 3, 2002)
26TH STREET AREA
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **4-14**

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 01/27/03

N:/SECOR-062

DWG: 62SU-1017-2-6(4-14).DWG



LEGEND

- CPT BORING LOCATION
- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- DEEP MONITORING WELL
- RECOVERY WELL
- ABANDONED WELL
- PIEZOMETER
- (0.76) APPARENT LNAPL THICKNESS (FEET)
- (NP) NO PRODUCT
- EXTENT OF MEASURABLE LNAPL (>0.01 FT)

NOTE

DOTTED TANKS HAVE BEEN ABANDONED

S-94 WAS CONVERTED TO RW-401

S-90 WAS CONVERTED TO RW-403

0 500 1000

APPROXIMATE SCALE (FEET)

REFERENCE: HANDEX ENVIRONMENTAL RECOVERY, INC.; PROJECT 110535-12; DRAWINGNAME: PB_SY_05.DWG; TITLE: SOUTH YARD BASE MAP; DATE: 05/21/96

SECOR
International Incorporated
102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA 19341
(484) 875-3075/875-9286 (FAX)

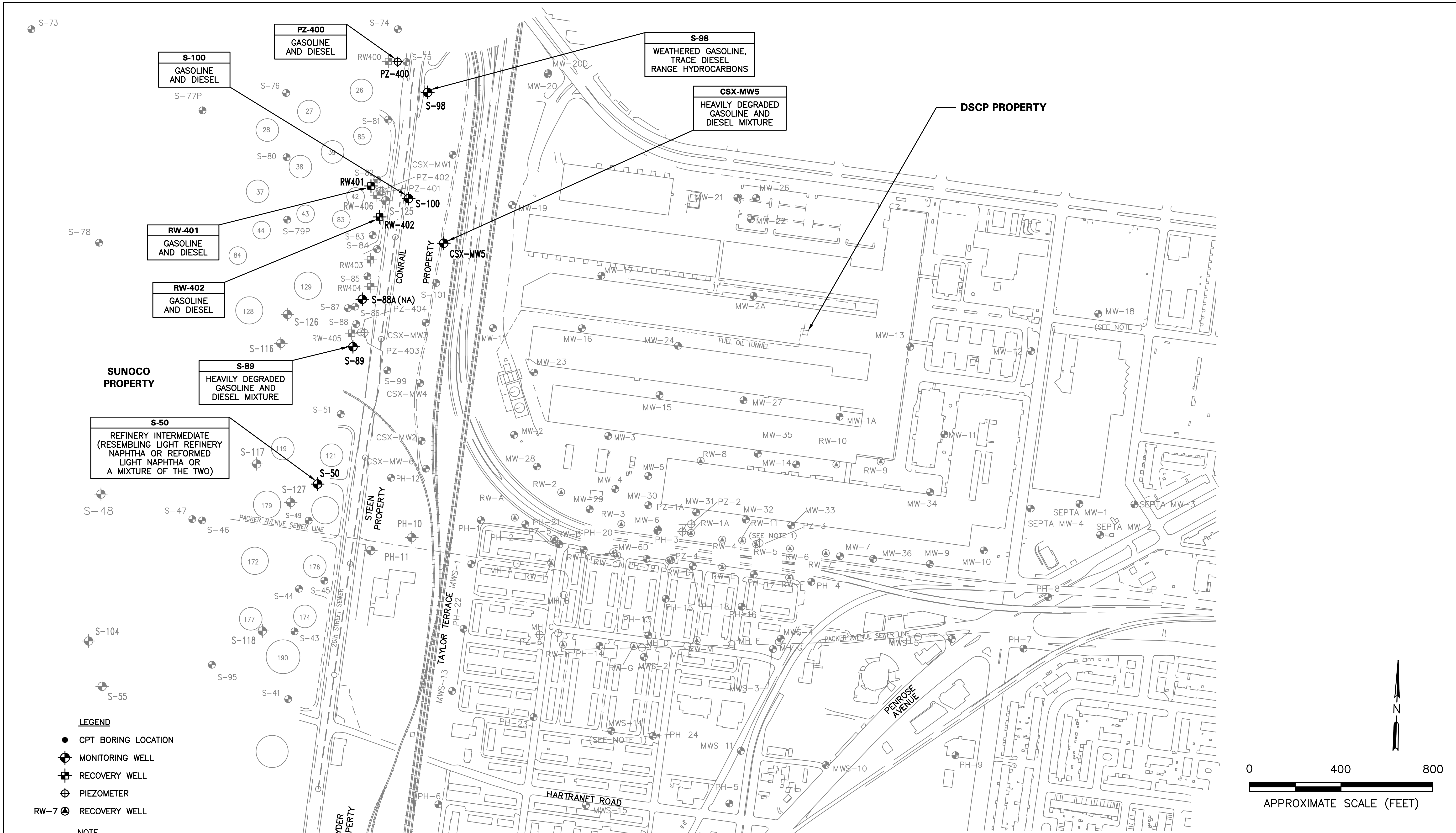
APPROXIMATE EXTENT OF MEASURABLE LNAPL (OCTOBER 22, 2002)
26TH STREET AREA
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **4-15**

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 01/08/03

N:/SECOR-062

DWG: 62SU-1017-2-6(4-15).DWG



LEGEND

- CPT BORING LOCATION
- MONITORING WELL
- RECOVERY WELL
- PIEZOMETER
- RW-7 RECOVERY WELL

NOTE

LNAPL SAMPLE LOCATIONS SHOWN BOLD

DOTTED TANKS HAVE BEEN ABANDONED

S-94 WAS CONVERTED TO RW-401

S-90 WAS CONVERTED TO RW-403

REFERENCE: IT CORPORATION; DRAWINGNAME: 0233-0011.DWG; TITLE: GROUNDWATER ELEVATION CONTOUR MAP; DATE: 10/20/99

SECOR

International Incorporated

102 PICKERING WAY, SUITE 200
EXTON, PENNSYLVANIA 19341
(484) 875-3075/875-9286 (FAX)

LNAPL CHARACTERIZATION RESULTS (SEPTEMBER 27, 2002)
26TH STREET AREA
SUNOCO PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

FIGURE: **4-16**

JOB#: 62SU.01017.02.0006 APPR: DWN: KPM DATE: 01/27/03

N:/SECOR-062

DWG: 62SU-1017-2-6(4-16)

APPENDIX A

Monitoring Well Logs

SECOR
International Incorporated

Logged By:	Dates Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/12/02 08/13/02	Parratt-Wolff, Inc.	Sunoco, Inc. Philadelphia Refinery, PA	Hollow Stem Auger Split Spoon	S-116

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		∇ 23.8	30.0		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
Grout			SILT; some fine to coarse sand, little fine gravel, dark brown, dry.	1.6	0.0
			SAND, fine to coarse; trace silt, black, dry.	0.8	0.0
			CLAY AND SILT; trace fine sand, brown, dry.		0.0
	5		SILT AND CLAY; little fine to medium sand, brown, dry.	1.8	0.0
Bentonite Seal			SILT AND CLAY; little fine to medium sand, brown, dry.	2.0	0.0
#1 Sand and Riser			SILT AND CLAY; trace fine sand, brown, dry.	1.5	0.0
Schedule 40 PVC, 20 Slot	10		SILT; some clay, trace fine sand, brown, dry.	1.4	0.0
			SILT; little fine sand, little clay, brown, dry.	1.6	0.0
			SILT; some fine sand, little clay, brown and gray, dry.		0.0
			SAND, fine to medium; little silt, brown, dry.	0.7	0.0
			SAND, fine to medium; trace silt, brown, dry.		0.0
	15		SAND, fine to coarse AND GRAVEL, fine; brown, moist.		0.0
			SILT; little fine sand, little clay, brown, moist.	0.6	0.0
			SAND, fine to coarse; some fine gravel, tan and brown, dry.	2.0	17.1
	20		SAND, fine to coarse; some fine gravel, tan and brown, dry.	1.6	16.8
			SAND, fine to coarse; some fine gravel, tan and brown, dry.	1.2	14.5
∇			SAND, medium to coarse; some fine gravel, some fine sand, brown and dark	1.1	103

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

SECOR
International Incorporated

Logged By:	Dates Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/12/02 08/13/02	Parratt-Wolff, Inc.	Sunoco, Inc. Philadelphia Refinery, PA	Hollow Stem Auger Split Spoon	S-116

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		▽ 23.8	30.0		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
			red, dry.		
			SAND, medium to coarse; some fine gravel, some fine sand, brown and dark red, moist.	1.1	204
			SAND, fine to medium; some fine gravel, some coarse sand, dark red and brown, wet.	1.3	1196
	30				
	35				
	40				
	45				

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01011.02** Date **August 2002**

Log of Well

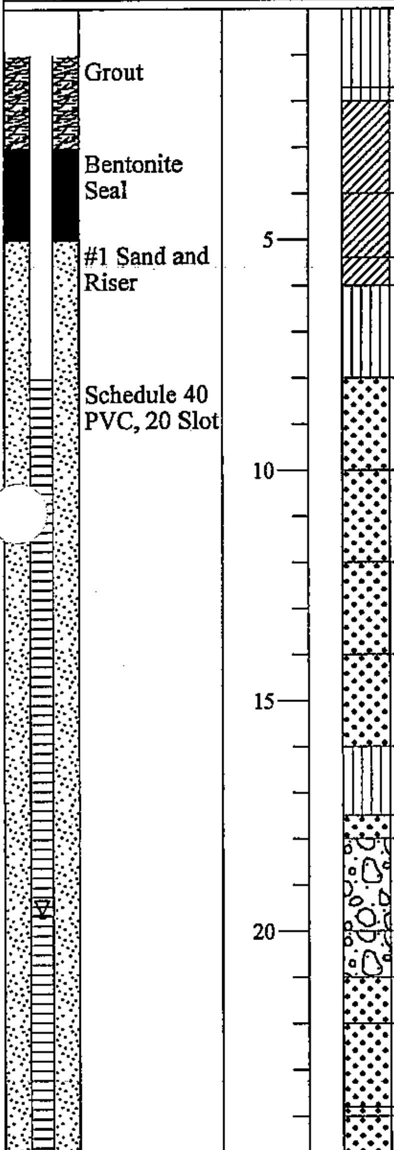
Figure

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

SECOR
International Incorporated

Logged By:	Date Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/13/02	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery, PA**	**Hollow Stem Auger Split Spoon**	**S-117**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		∇ 19.63	28.0		



Description	Recovery (feet)	PID Reading (ppm)
SILT; some fine to coarse sand, little fine gravel, brown and black, dry.	1.7	7.3
SILT; some clay, little fine sand, brown and black, dry.	0.6	850
CLAY; some silt, some fine to coarse sand, black and brown, moist.		2171
CLAY; trace fine sand, little silt, brown and black, dry.	1.4	1670
CLAY; little silt, some fine sand, black and brown, dry.		163
SILT; little fine sand, trace clay, black, dry.	0.3	1280
SAND, fine to medium; little coarse sand, brown, dry.	0.2	252
SAND, fine to coarse; little fine to coarse gravel, dark red and brown, dry.	0.6	646
SAND, fine to coarse; little fine gravel, dark red and brown, dry.	0.7	804
SAND, medium to coarse; some fine sand, some fine gravel, brown, red and tan, dry.	2.0	848
SILT; some fine to coarse sand, little clay, brown and black, dry.	2.0	564
SAND, fine to coarse; little fine gravel, trace silt, black, dry.	2.0	1028
SAND, fine to coarse AND GRAVEL, fine to coarse; reddish-brown and black, moist.		2141
SAND, fine to coarse AND GRAVEL, fine; black, wet.	1.6	1816
SAND, fine to coarse; some fine gravel, brown, wet.		1787
SAND, fine to coarse; some fine gravel, trace clay, trace silt, brown, wet.	2.0	948
SAND, fine to medium; gray, white and pink, dry.	1.5	396
SAND, fine to medium; some coarse sand, some fine gravel, black, wet.		793

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

ject No. **62SU.01011.02** Date **August 2002**

Log of Well

Figure

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

SECOR
International Incorporated

Logged By:	Date Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/13/02	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery, PA**	**Hollow Stem Auger Split Spoon**	**S-117**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		▽ 19.63	28.0		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
			SAND, fine to medium AND SAND, coarse; gray, wet.	2.0	805
			CLAY; trace silt, trace fine sand, orangish-brown, wet.		9.5
	30				
	35				
	40				
	45				

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01011.02** Date **August 2002**

Log of Well

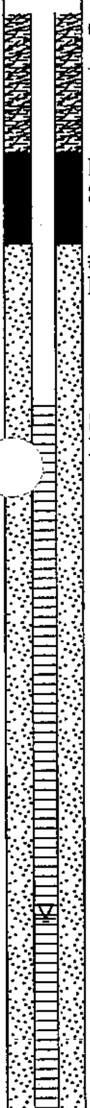
Figure

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

SECOR
International Incorporated

Logged By:	Date Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/14/02	Parratt-Wolff, Inc.	Sunoco, Inc. Philadelphia Refinery, PA	Hollow Stem Auger Split Spoon	S-118

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		▽ 20.62	29.5		



Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
			SILT AND SAND, fine to coarse; little fine gravel, brown, dry.	2.0	0.0
Grout			SILT; little fine sand, trace clay, dark brown, dry.	0.7	0.0
			SILT; some clay, little fine to coarse sand, dark brown, dry.		0.0
Bentonite Seal			SAND, coarse AND SAND, fine to medium; trace silt, black, moist.	1.0	18.4
	5		CLAY; some silt, little fine sand, black and brown, moist.		277
#1 Sand and Riser			SILT; little fine sand, little clay, brown and gray, dry.	1.6	0.0
			SAND, fine to medium; some coarse sand, little fine gravel, brown, dry.		9.0
			SAND, fine to medium; some coarse sand, some fine gravel, dark red, white and brown, dry.	1.5	0.0
Schedule 40 PVC, 20 Slot	10		SILT; some clay, little fine to coarse sand, brown, dry.	1.3	0.0
			SAND, fine to medium; some coarse sand, red, white and brown, dry.		8.4
			SILT AND SAND, fine to coarse; little fine gravel, brown, dry.	1.5	0.0
			SAND, fine to coarse; some silt, some fine gravel, red, white and brown, dry.		9.9
	15		SAND, fine to medium; some fine gravel, some coarse sand, red, white and brown, dry.	0.5	18.8
			SAND, fine to medium; little coarse sand, little silt, little fine gravel, dark red and brown, dry.	1.1	25.9
			SAND, fine; some medium to coarse sand, little fine gravel, red and brown, dry.	1.2	83.2
	20		SAND, fine; some medium to coarse sand, little fine gravel, red and brown, moist.	1.4	228
			SAND, fine AND SILT; some medium to coarse sand, trace fine gravel, brown and red, wet.		118
			SAND, fine to coarse; some fine gravel, brown, wet.	1.7	647
			SAND, fine; some medium to coarse sand, little gravel, brown, wet.	2.0	1823

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

.oject No. **62SU.01011.02** Date **August 2002**

Log of Well

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

Figure

SECOR
International Incorporated

Logged By:	Date Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/14/02	Parratt-Wolff, Inc.	Sunoco, Inc. Philadelphia Refinery, PA	Hollow Stem Auger Split Spoon	S-118

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		∇ 20.62	29.5		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
			SAND, fine; some medium to coarse sand, little gravel, brown, wet.	2.0	2092
			SAND, fine to medium; some coarse sand, little fine to coarse gravel, brown, wet.	1.5	1657
	30				
	35				
	40				
	45				

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

SECOR
International Incorporated

Logged By:	Dates Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/14/02 08/15/02	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery, PA**	**Hollow Stem Auger Split Spoon**	**S-119**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		∇ 29.14	34.0		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
Riser			SILT AND SAND, fine; little medium to coarse sand, brown, dry.	1.3	0.0
Grout			SILT; little fine to medium sand, dark brown, dry.		0.0
			SILT; little fine sand, dark brown, dry.	1.0	0.0
	5		CLAY AND SILT; trace fine sand, black, dry.	0.2	0.0
			SILT; little fine sand, brown and gray, dry.	2.0	0.0
			SILT; little fine sand, brown and gray, dry.	2.0	0.0
Bentonite Seal	10		NO RECOVERY; stone in shoe of spoon.	0.0	
#1 Sand and Riser			SILT; trace fine sand, brown and gray, dry.	2.0	0.0
Schedule 40 PVC, 20 Slot			SILT; trace fine sand, brown and gray, dry.	2.0	0.0
	15		SILT; some clay, little fine sand, brown, dry.		0.0
			SAND, fine; little medium to coarse sand, little silt, trace fine gravel, orangish-brown, dry.	1.7	0.0
			SAND, fine; some medium to coarse sand, little fine gravel, trace silt, orangish-brown, dry.	2.0	0.0
	20		SAND, fine to coarse; some fine gravel, orangish-brown, dry.	1.5	0.0
			SAND, fine to coarse; some fine gravel, orangish-brown, dry.		
			SAND, fine to coarse; little fine gravel, brown, dry (wet at 25.9 feet).	2.0	0.0

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01011.02** Date **August 2002**

Log of Well

Figure

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

SECOR
International Incorporated

Logged By:	Dates Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/14/02 08/15/02	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery, PA**	**Hollow Stem Auger Split Spoon**	**S-119**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		∇ **29.14**	**34.0**		

Depth, (ft.)	Description	Recovery (feet)	PID Reading (ppm)
	SAND, fine to medium; little coarse sand, trace fine gravel, brown, wet.	1.8	0.0
	SAND, fine to coarse; some fine gravel, brown, wet.	1.6	0.0
30	SAND, fine to medium; some coarse sand, little fine gravel, brown, wet.	1.5	7.1
	SAND, fine to medium; some coarse sand, little fine gravel, brown, wet.	2.0	9.1
	SAND, fine to medium; little coarse sand, little fine gravel, gray, wet.	2.0	57.5
	SAND, fine to coarse; brown, wet.		26.8
35	CLAY; little fine sand, little silt, gray and orangish-brown, wet.		0.0
	SAND, fine; gray, wet.		5.4
40			
45			

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01011.02** Date **August 2002**

Log of Well

Figure

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

SECOR
International Incorporated

Logged By:	Dates Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/15/02 08/16/02	Parratt-Wolff, Inc.	Sunoco, Inc. Philadelphia Refinery, PA	Hollow Stem Auger Split Spoon	S-120

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		∇ 22.75	30.0		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
Riser			SILT; some fine to medium sand, brown, moist.	1.7	0.0
Grout			SILT; trace fine sand, orangish-brown and brown, moist.	1.1	0.0
			SILT; little clay, little fine to coarse sand, brown, moist.	2.0	0.0
	5		SAND, fine to coarse; little fine gravel, brown, dry.		0.0
Bentonite Seal			SAND, fine; little medium to coarse sand, brown, dry.	1.5	0.0
			SAND, fine to coarse; little fine gravel, brown, dry.		0.0
#1 Sand and Riser			SAND, fine; little medium to coarse sand, trace fine gravel, brown, dry.	1.6	0.0
			SAND, fine; trace medium to coarse sand, reddish-brown, dry.		0.0
Schedule 40 PVC, 20 Slot	10		SAND, fine; little medium to coarse sand, trace fine gravel, brown, dry.		0.0
			SILT; some clay, little fine to coarse sand, brown, moist.	1.4	0.0
			SAND, fine to coarse; little fine gravel, brown, dry.		0.0
			SAND, fine AND SAND, medium to coarse; little fine gravel, trace silt, dark red, brown and white, dry.	2.0	0.0
			SILT; little fine to coarse sand, brown, dry.	1.7	0.0
	15		SAND, fine to medium; little coarse sand, brown, dry.		0.0
			SAND, fine to medium; little coarse sand, brown, dry.	1.9	0.0
			SAND, fine; little medium to coarse sand, dark red, dry.		0.0
			SAND, fine to medium; little coarse sand, brown, dry.	2.0	0.0
			SAND, fine to medium; little coarse sand, brown, wet.		
	20		CLAY; some silt, white and tan, dry.		0.0
			SILT AND SAND, fine; little clay, brown, wet.	2.0	0.0
			SAND, fine; some medium to coarse sand, little silt, trace fine gravel, brown, wet.		0.0 0.0
			CLAY AND SILT; trace fine sand, tan and white, dry.	2.0	0.0
			SAND, fine; gray, wet.		0.0
			SAND, fine; gray, wet.		
			SAND, fine; orangish-brown, wet.	0.8	0.0
			SAND, fine; some silt, some medium to coarse sand, orangish-brown, wet.		0.0

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. 62SU.01011.02 Date August 2002

Log of Well

Figure

SECOR
International Incorporated

Logged By:	Dates Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/15/02 08/16/02	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery, PA**	**Hollow Stem Auger Split Spoon**	**S-120**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		⊻ 22.75	30.0		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
			SAND, fine; gray, wet.		0.0
			SAND, fine; gray, wet.	1.1	0.0
			SAND, fine; tan, wet.	1.0	0.0
	30		SAND, fine to medium; little coarse sand, light brown, wet.		0.0
	35				
	40				
	45				

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

ject No. **62SU.01011.02** Date **August 2002**

Log of Well

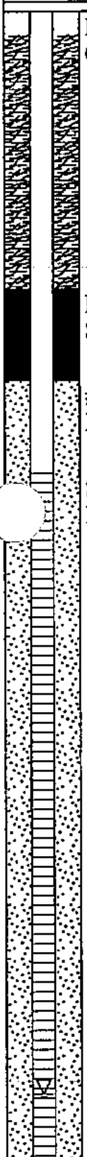
Figure

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

SECOR
International Incorporated

Logged By:	Date Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/22/02	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery, PA**	**Hollow Stem Auger Split Spoon**	**S-121**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		⊻ 23.46	**30.0**		



Depth, (ft.)	Description	Recovery (feet)	PID Reading (ppm)
	SILT; little fine sand, brown, dry.	0.6	0.0
	SILT; little fine sand, brown and light gray, dry.	1.5	0.0
	SILT; little fine sand, brown and light gray, dry.	2.0	0.0
5	SILT; little fine sand, brown and light gray, dry.	1.8	0.0
	SILT; little fine to coarse sand, reddish-brown, dry. SILT; little fine sand, brown and gray, dry. SAND, fine to coarse; little silt, red and orangish-brown, dry.	2.0	0.0 0.0 0.0
10	SILT; little fine sand, brown and gray, dry. SAND, fine to coarse; trace fine gravel, reddish-brown, dry.	1.8	0.0 0.0
	SAND, fine; little medium sand, brown, dry. SILT; little fine sand, gray and brown, dry.	0.6	0.0 0.0
	SAND, fine to coarse; trace fine gravel, red and brown, dry. SAND, fine to coarse; little fine gravel, reddish-brown, dry.	1.1	0.0 0.0
15	SAND, fine; some medium to coarse sand, trace fine gravel, orangish-brown, dry.	0.8	0.0
	SILT; little fine sand, brown and gray, dry. SAND, fine to coarse; trace fine gravel, reddish-brown, dry.	2.0	0.0 0.0
20	SAND, fine to coarse; trace fine gravel, reddish-brown, dry at top of section, wet at bottom of section.	1.8	0.0
	SAND, fine to coarse; trace fine gravel, reddish-brown, wet.	2.0	0.0
	SILT; little fine sand, trace clay, brown, dry to moist. CLAY; little silt, dark gray, wet.	2.0	0.0 0.0

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

...ject No. **62SU.01011.02** Date **August 2002**

Log of Well

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

Figure

SECOR

International Incorporated

Logged By:	Date Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/22/02	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery, PA**	**Hollow Stem Auger Split Spoon**	**S-121**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		∇ **23.46**	**30.0**		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
			SILT AND CLAY; little fine sand, gray, wet.		0.0
			SAND, fine; some silt, orangish-brown and gray, wet.		0.0
			SAND, fine; trace silt, orangish-brown, wet.	2.0	0.0
			SAND, fine; trace medium to coarse sand, gray, wet.	2.0	0.0
			SAND, fine; some medium to coarse sand, orangish-brown, wet.		0.0
	30		SAND, fine; trace medium to coarse sand, brown, wet.		0.0
	35				
	40				
	45				

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

ject No. **62SU.01011.02** Date **August 2002**

Log of Well

Figure

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

SECOR
International Incorporated

Logged By:	Date Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/19/02	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery, PA**	**Hollow Stem Auger Split Spoon**	**S-122**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		∇ 29.77	34.6		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
Riser			SAND, fine to coarse; brown, dry.	0.9	0.0
Grout			SILT; little fine sand, brown, dry.		0.0
			SILT; little fine sand, trace clay, brown, slightly moist.	0.8	0.0
			SILT; little fine sand, little clay, brown, slightly moist.	1.2	0.0
	5		SILT; some fine sand, orangish-brown and gray, dry.		0.0
			SILT; some fine sand, trace medium sand, orangish-brown and gray, dry.	0.6	0.0
			SILT; some fine sand, pieces of brick, dark brown, dry.	1.2	0.0
			SILT; little fine sand, little clay, orangish-brown, moist.		0.0
	10		NO RECOVERY	0	0.0
Bentonite Seal					
#1 Sand and Riser			SILT; some clay, little fine sand, pieces of brick, brown, wet. Coarse gravel sized piece of brick in shoe of spoon.	0.2	0.0
Schedule 40 PVC, 20 Slot	15		SILT; some clay, little fine sand, brown, wet.	1.0	0.0
			SILT; some clay, little fine sand, brown, moist to dry.	2.0	0.0
			SILT AND CLAY; trace fine sand, dark gray, moist.	2.0	0.0
			SAND, fine; brown, dry.		0.0
			SAND, fine to coarse; little fine gravel, brown, dry.		0.0
	20		SAND, fine AND SAND, medium to coarse; gray, dry.	0.7	0.0
			SAND, fine to medium; dark brown, moist.		0.0
			SAND, fine AND SAND, medium to coarse; gray, dry.		0.0
			SILT; little fine sand, little clay, orangish-brown and gray, dry.	2.0	0.0
			SILT; some clay, trace fine sand, dark brown, moist.		0.0
			SAND, fine to medium; gray, dry.		0.0
			SILT AND CLAY; trace fine sand, dark brown, moist.	1.5	0.0

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01011.02** Date **August 2002**

Log of Well

Figure

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

SECOR
International Incorporated

Logged By:	Date Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/19/02	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery, PA**	**Hollow Stem Auger Split Spoon**	**S-122**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		∇ 29.77	34.6		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
			SAND, fine to medium; some coarse sand, brown, dry.		0.0
			SAND, fine to coarse; trace fine to coarse gravel, brown, wet.	1.1	0.0
			SILT; some clay, little fine sand, brown, wet.	0.7	0.0
	30		SAND, fine to coarse; little fine to coarse gravel, brown, wet.	0.1	0.0
			SAND, fine to coarse; little fine to coarse gravel, brown, wet.	1.5	0.0
			SAND, fine; brown, wet.		0.0
			SAND, fine to coarse; brown, wet.	1.4	0.0
			SAND, fine to coarse; trace fine gravel, brown, wet.		14.1
	35		SAND, fine; some medium sand, trace silt, brown, wet.		473
			SAND, fine to coarse; black, wet.		281
	40				
	45				

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...ject No. **62SU.01011.02** Date **August 2002**

Log of Well

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

Figure

SECOR
International Incorporated

Logged By:	Date Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/20/02	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery, PA**	**Hollow Stem Auger Split Spoon**	**S-123**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		∇ 24.35	30.0		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
Riser			SILT; trace fine sand, brown, dry.		
Grout			SILT; trace fine sand, brown, dry.	0.6	0.0
	5		SILT; trace fine sand, trace clay, brown and gray, moist.	0.8	0.0
Bentonite Seal			SILT; trace fine sand, trace clay, brown and gray, moist.	1.4	0.0
			SILT; little fine to medium sand, light gray, dry.		0.0
#1 Sand and Riser			SILT; some fine to medium sand, brown, dry.	1.2	0.0
			SILT; some fine sand, brown, dry.		0.0
Schedule 40 PVC, 20 Slot	10		SILT; some fine sand, trace clay, brown, dry.	1.0	0.0
			SILT AND SAND, fine; little medium to coarse sand, trace fine gravel, brown, dry.	0.6	0.0
	15		SILT; some clay, little fine to coarse sand, brown, moist. Stone in shoe of spoon.	0.1	0.0
			SAND, fine; little medium to coarse sand, tan and gray, dry.	1.4	0.0
			SAND, fine to coarse; some fine gravel, brown and dark red, dry.	1.0	333
	20		GRAVEL, fine to coarse; white, dry.	0.6	0.0
			SAND, fine; some medium to coarse sand, little fine gravel, black, dry.		630
			SILT AND SAND, fine; little medium to coarse sand, moist.	1.3	76.7
			SAND, fine to coarse AND GRAVEL, fine; black, wet.		1111
∇			SAND, fine; gray and brown, wet.	1.5	1326

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01011.02** Date **August 2002**

Log of Well

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 2)

SECOR
International Incorporated

Logged By:	Date Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/20/02	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery, PA**	**Hollow Stem Auger Split Spoon**	**S-123**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		∇ **24.35**	**30.0**		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
			SAND, fine to medium; trace coarse sand, brown, wet.		1900
			SAND, fine to medium; trace coarse sand, trace fine gravel, brown, wet.	1.7	2020
			SAND, fine; some medium sand, trace coarse sand, brown, wet.		3327
			SAND, fine; little medium to coarse sand, trace fine gravel, brown, wet.	2.0	3437
	30				
	35				
	40				
	45				

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01011.02** Date **August 2002**

Log of Well

Figure

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

SECOR
International Incorporated

Logged By:	Dates Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/21/02 08/22/02	Parratt-Wolff, Inc.	Sunoco, Inc. Philadelphia Refinery, PA	Hollow Stem Auger Split Spoon	S-124

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		▽ 26.79	30.0		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
Riser			FILL - SAND, fine to coarse AND GRAVEL, fine to coarse; brown, dry.		
Grout			SILT; some fine to coarse sand, brown, dry.	2.0	0.0
			SILT; some fine to coarse sand, brown, dry.	2.0	0.0
	5		SILT; some cinders, little fine sand, brown, dry.		0.0
			SILT; little fine sand, brown, dry.		0.0
Bentonite Seal			SILT; little fine sand, brown and tan, dry.	1.5	0.0
#1 Sand and Riser			SILT; some fine sand, brown, dry.	0.6	0.0
Schedule 40 PVC, 20 Slot	10		SILT; little fine sand, little clay, gray and brown, dry.	1.7	22.6
			SILT; little fine sand, brown, dry.	0.5	15.2
			SILT; some fine sand, trace clay, gray and brown, dry.	1.3	0.0
	15		SILT AND SAND, fine; brown, dry.		25.6
			SILT; little fine sand, trace clay, gray, dry.	0.5	14.1
			SAND, fine to coarse AND GRAVEL, fine to coarse; brown, dry.	1.1	11.9
			SAND, fine; trace medium to coarse sand, gray and brown, dry.		723
	20		SAND, fine; trace medium to coarse sand, gray, dry.	1.6	849
			SAND, fine; little coarse sand, brown and gray, dry.		640
			SAND, fine; some medium to coarse sand, brown, dry.		312
			SAND, fine; some medium to coarse sand, brown, dry.	1.0	326
			SAND, fine; gray, dry.		429
			SAND, fine; some medium to coarse sand, little fine gravel, brown, dry.		1085
			SAND, fine to coarse AND GRAVEL, fine; brown, wet.	1.8	2311

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Project No. **62SU.01011.02** Date **August 2002**

Log of Well

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

Figure

SECOR
International Incorporated

Logged By:	Dates Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/21/02 08/22/02	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery, PA**	**Hollow Stem Auger Split Spoon**	**S-124**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		▽ 26.79	30.0		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
			SAND, fine to medium; some coarse sand, brown, wet.		1969
			SAND, fine to coarse; brown and gray, wet.	1.7	2220
			SAND, fine to medium; some coarse sand, gray, wet.	1.8	2415
	30				
	35				
	40				
	45				

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01011.02** Date **August 2002**

Log of Well

Figure

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

SECOR
International Incorporated

Logged By:	Dates Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/26/02 08/27/02	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery, PA**	**Hollow Stem Auger Split Spoon**	**S-125**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		⊻ 18.2	30.0		

Well Construction: Riser; Grout; Bentonite Seal; #1 Sand and Riser; Schedule 40 PVC, 20 Slot

Depth, (ft.): 5, 10, 15, 20

Description	Recovery (feet)	PID Reading (ppm)
ASPHALT		5.5
SILT AND SAND, fine; some medium to coarse sand, some fine gravel, brown, dry.		166
SILT; some fine to coarse sand, pieces of brick, dark brown, dry.		103
SILT AND SAND, fine; some medium to coarse sand; large cobble sized piece of brick, dark gray and black, dry.		68.4
SAND, fine to coarse; little silt, little fine gravel, black, dry (wet at bottom).		
CLAY; little silt, little fine to medium sand, gray, moist.	1.0	334
CLAY; trace fine sand, trace silt, brown and gray, moist.		121
CLAY; little silt, trace fine sand, brown and gray, dry.		5.6
CLAY; little silt, trace fine sand, brown and gray, dry.	1.1	29.5
SILT AND CLAY; little fine sand, brown and gray, dry.		9.5
SILT AND SAND, fine to coarse; trace fine gravel, gray and black, moist.	1.4	25.6
SILT; little fine to medium sand, trace clay, brown and gray, dry.		21.6
CLAY; some silt, little fine to coarse sand, gray, dry.	2.0	19.4
CLAY; little silt, little fine sand, gray, dry.	2.0	11.1
CLAY; some silt, trace fine sand, gray, wet.	2.0	0.0
CLAY; little silt, trace fine sand, gray, dry to moist at top of section, wet at bottom of section.		0.0
CLAY AND SAND, fine to coarse; dark brown, moist.	2.0	9.5
CLAY; little silt, trace fine sand, brown and gray, dry.		0.0
CLAY AND SAND, fine to medium; gray, moist.	0.7	0.0
SAND, fine to coarse AND GRAVEL, fine; trace silt, brown, gray and red, moist.		169
SAND, fine; some medium to coarse sand, little fine gravel, green and gray, moist to wet, product present.	0.6	2230
CLAY; trace fine sand, gray, moist.	0.6	5.5

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01011.02** Date **August 2002**

Log of Well

Figure

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

SECOR
International Incorporated

Logged By:	Dates Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	08/26/02 08/27/02	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery, PA**	**Hollow Stem Auger Split Spoon**	**S-125**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		∇ 18.2	30.0		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
			SAND, fine to coarse AND GRAVEL, fine; brown, wet.		152
			SAND, fine to coarse AND GRAVEL, fine; red, white and brown, wet.	0.8	357
			SILT; some clay, little fine to coarse sand, little fine gravel, gray, wet.	1.3	141
			SAND, fine to coarse AND GRAVEL, fine; brown, wet.		221
	30				
	35				
	40				
	45				

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

...ject No. **62SU.01011.02** Date **August 2002**

Log of Well

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

Figure

SECOR
International Incorporated

Logged By:	Date Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	09/18/02	**Parratt-Wolff, Inc.**	**Sunoco, Inc. Philadelphia Refinery, PA**	**Hollow Stem Auger Split Spoon**	**S-126**

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		∇ 12	24.0		

Well Construction: Bentonite Seal; #1 Sand and Riser Schedule 40 PVC, 20 Slot

Depth, (ft.)	Description	Recovery (feet)	PID Reading (ppm)
	SILT AND SAND, fine; some medium to coarse sand, trace fine gravel, piece of brick, black and brown, dry.	2.0	0.0
	SILT AND CINDERS; black, dry.	0.7	0.0
5	SAND, fine to medium AND SILT; little cinders, piece of wire mesh, black, moist.	1.0	17
	SAND, fine to medium AND SILT; little cinders, black, moist.	0.7	24
	SILT; little clay, little fine to coarse sand, piece of wood in end of spoon, black, moist.		40
	SAND, fine; little medium to coarse sand, black, moist.	1.2	24
	SILT; little clay, little cinders, brown, moist.		20.4
	SILT; some cinders, little fine to coarse sand, black, moist.		27.3
10	SAND, fine AND SILT; little medium to coarse sand, black, dry. Piece of brick at 10.6 feet and in end of spoon.	0.8	5.9
	SAND, fine to medium; some silt, some coarse sand, little pieces of brick, black, wet.	0.5	70.1
15	NO RECOVERY; brick in shoe of spoon.	0.0	
	SAND, fine to medium; some silt, pieces of brick, black, wet.	1.2	40.1
	SAND, fine; trace medium sand, slight sheen, black, wet.		218
	SAND, fine; trace medium sand, black, wet.	1.0	84.4
	SAND, fine; some medium to coarse sand, little silt, black, wet.		45.5
20	SAND, fine to coarse; some silt, nail in end of spoon, black, wet.	0.4	67.3
	SAND, fine to medium; some coarse sand, little silt, little cinders, black, wet.	1.3	49.7
	CLAY; little fine to medium sand, little silt, gray and brown, moist.		5.4
	SILT AND SAND, fine to coarse; trace clay, gray, wet.		50.3

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Project No. **62SU.01011.02** Date **August 2002**

Log of Well

Figure

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

SECOR
International Incorporated

Logged By:	Date Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	09/19/02	Parratt-Wolff, Inc.	Sunoco, Inc. Philadelphia Refinery, PA	Hollow Stem Auger Split Spoon	S-127

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		∇ 18	30.0		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
Riser			SAND, fine AND SILT; some medium to coarse sand, brown, dry.	0.7	0.0
Grout			SILT; little fine to medium sand, trace clay, black and gray, dry.		119
			SILT; some clay, trace fine sand, gray, moist.	0.5	765
			CLAY; little fine sand, little silt, gray, dry.	2.0	1017
Bentonite Seal	5				
			SAND, fine; some clay, little medium to coarse sand, gray, dry.	1.5	1311
			SAND, fine; little silt, little medium to coarse sand, gray, dry.		480
#1 Sand and Riser			SILT; little fine sand, little clay, gray, moist.		642
			SAND, fine; little silt, little medium to coarse sand, gray, dry.	0.7	784
Schedule 40 PVC, 20 Slot			SAND, fine; little silt, trace medium sand, brown, dry.		221
	10		SAND, fine; some silt, trace medium sand, gray, moist.	1.2	490
			SAND, fine; some medium to coarse sand, little fine gravel, brown, dry.	0.4	17.4
			SAND, coarse AND SILT; some fine to medium sand, gray, brown and dark red, moist.		212
	15		SAND, fine to medium; some coarse sand, some fine gravel, brown, dark red and gray, moist.	0.9	918
			SAND, fine to coarse; little fine gravel, trace silt, dark red, brown and gray, moist to wet.	2.0	979
∇			NO RECOVERY; stone in shoe of spoon.	0.0	
	20		GRAVEL, fine and SAND, coarse; some fine to medium sand, gray and red, wet.	0.8	489
			GRAVEL, fine AND SAND, fine to coarse, dark red and brown, wet.	2.0	869
			SAND, medium to coarse, some fine sand, some fine gravel, dark red and brown	2.0	850

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01011.02** Date **August 2002**

Log of Well

Figure

DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

SECOR
International Incorporated

Logged By:	Date Drilled:	Drilling Contractor	Project Name:	Method/Equipment:	Well Number:
SM	09/19/02	Parratt-Wolff, Inc.	Sunoco, Inc. Philadelphia Refinery, PA	Hollow Stem Auger Split Spoon	S-127

See "Legend to Logs" for sampling method, classifications and laboratory testing methods	Boring Diam.(in.):	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.):	Drive wt.(lbs.):	Drop Dist.(in.):
	4		▽ 18	30.0		

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery (feet)	PID Reading (ppm)
			with a little bit of green, wet.		
			SAND, medium to coarse, some fine sand, some fine gravel, dark red and brown with a little bit of green, wet.	2.0	419
					60.3
			SAND, medium; some fine sand, little coarse sand, trace fine gravel, brown, wet.	1.2	82.2
			SAND, medium; some fine sand, little coarse sand, trace fine gravel, brown, wet.		0.0
	30		CLAY; trace fine silt, brown, moist.		
	35				
	40				
	45				

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. 62SU.01011.02 Date August 2002

Log of Well

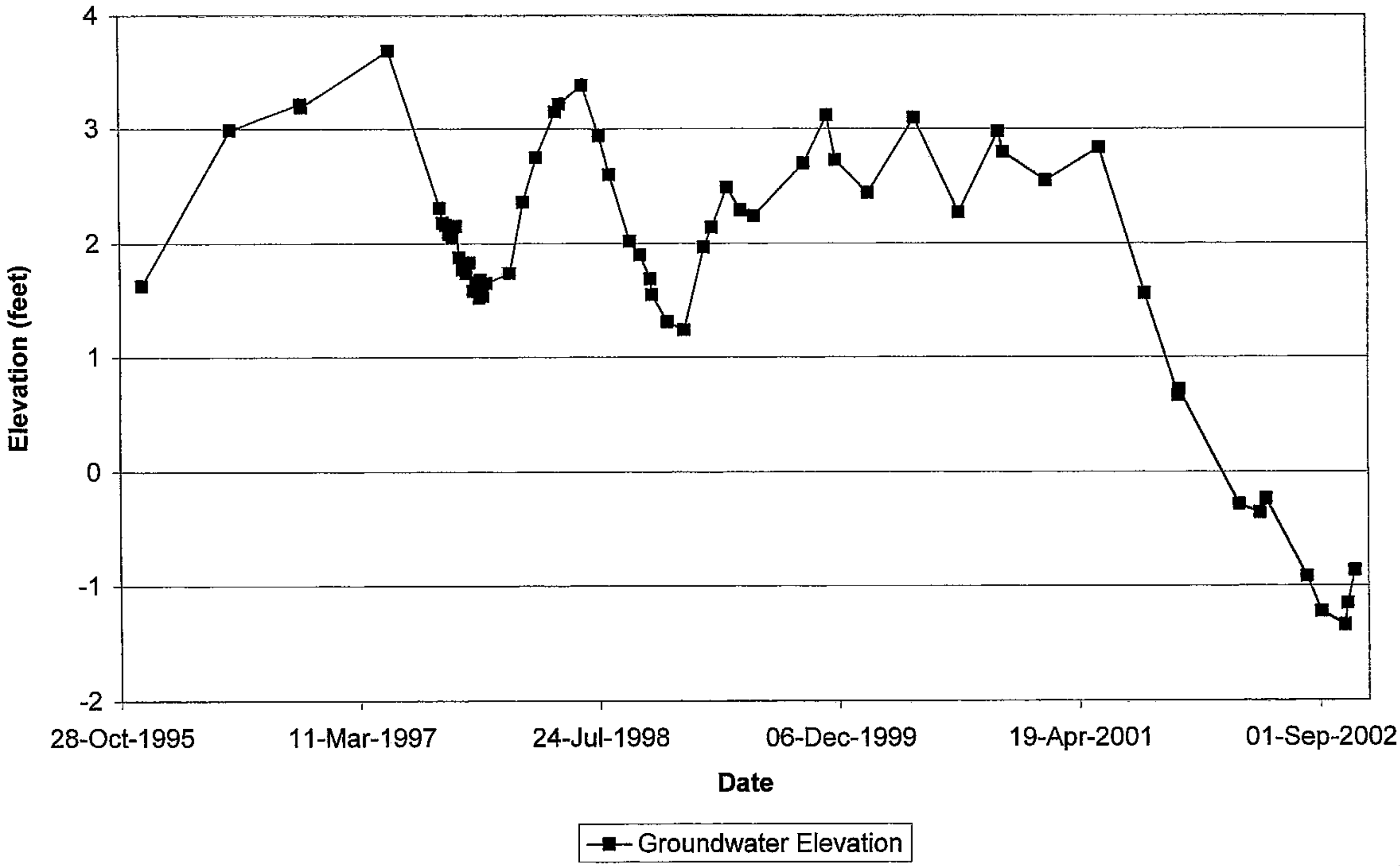
Figure

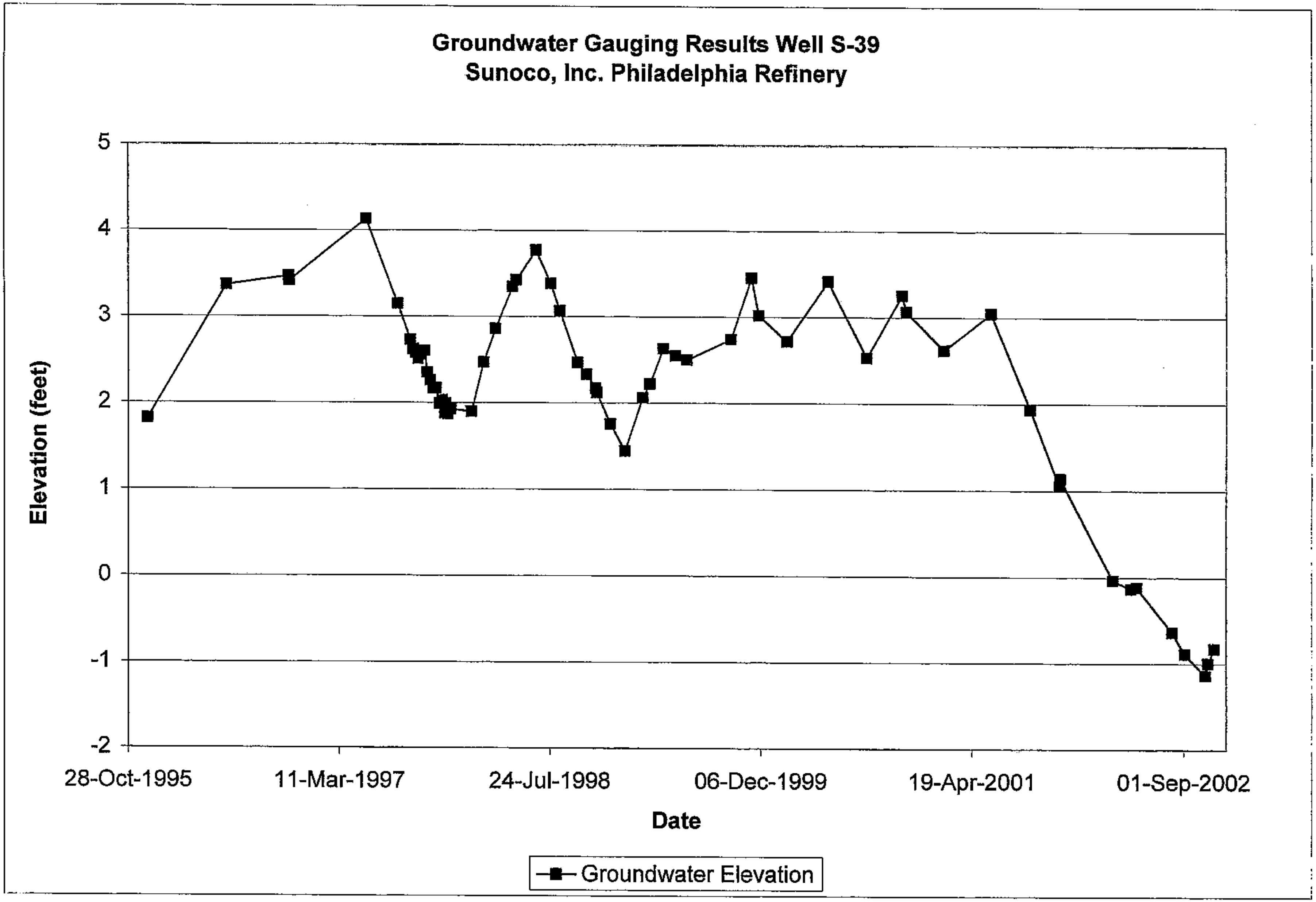
DRILL LOGS AUG 2002.GPJ
LOG OF BOREHOLE

APPENDIX B

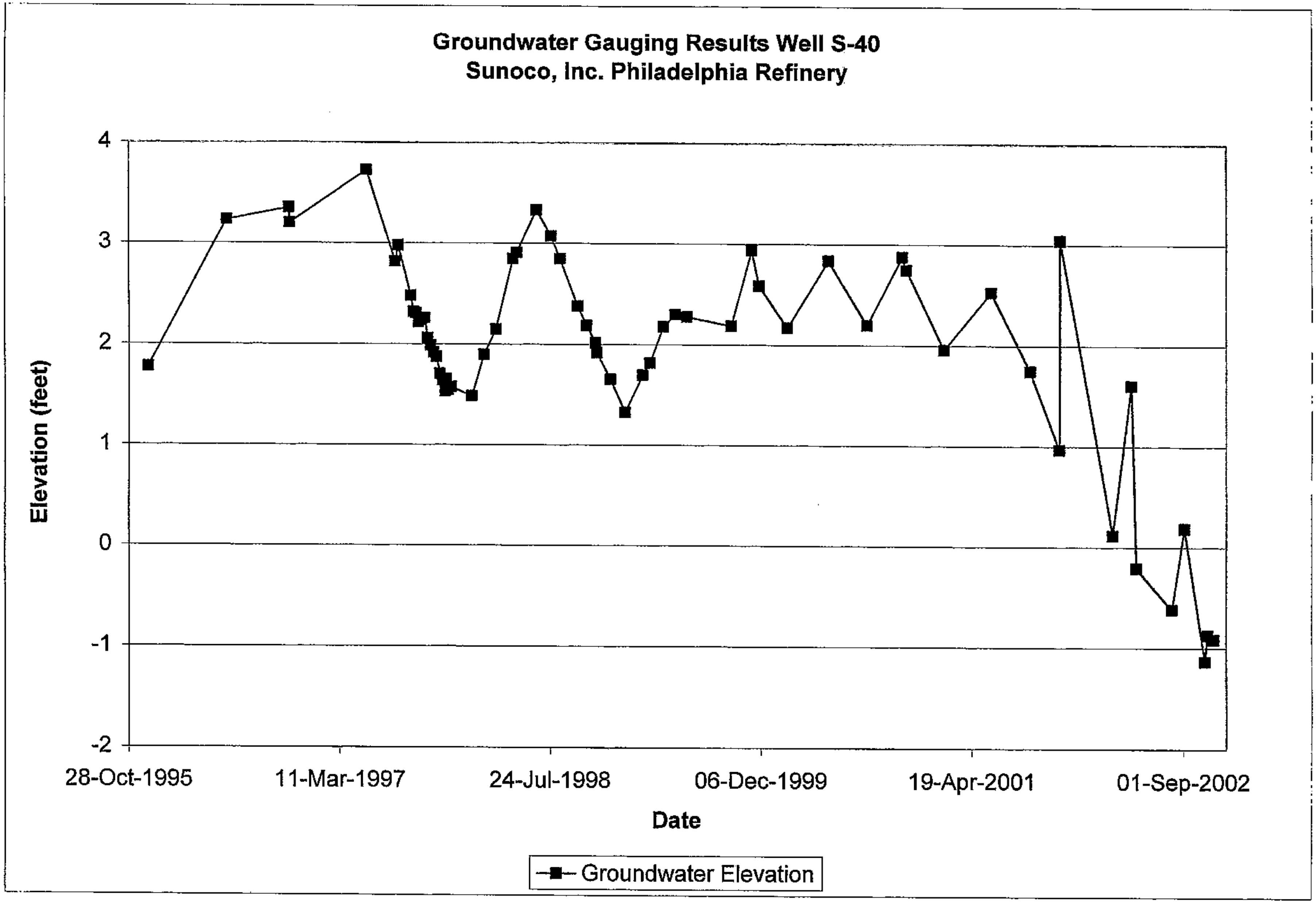
Monitoring Well Hydrographs

Groundwater Gauging Results Well S-38
Sunoco, Inc. Philadelphia Refinery

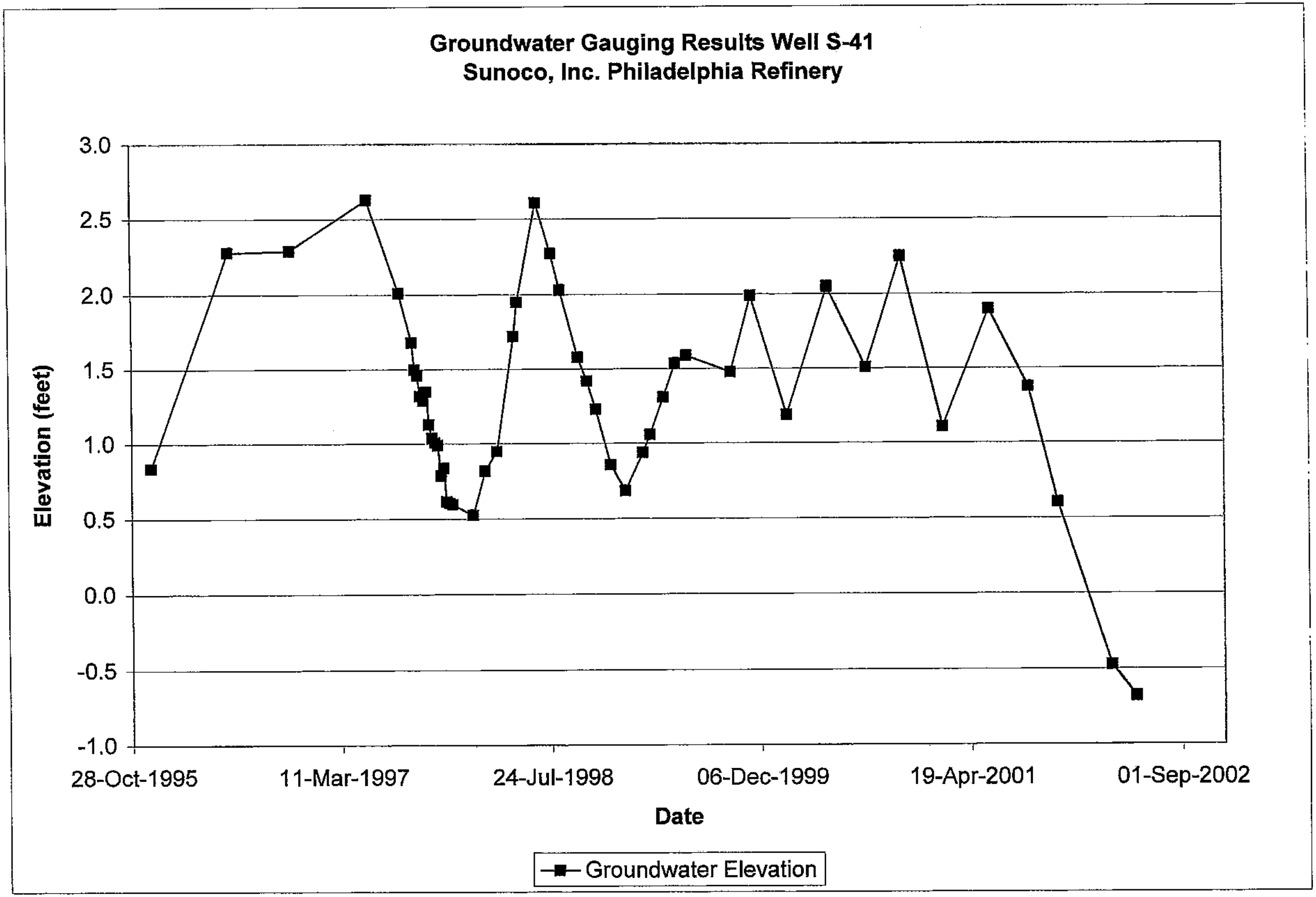


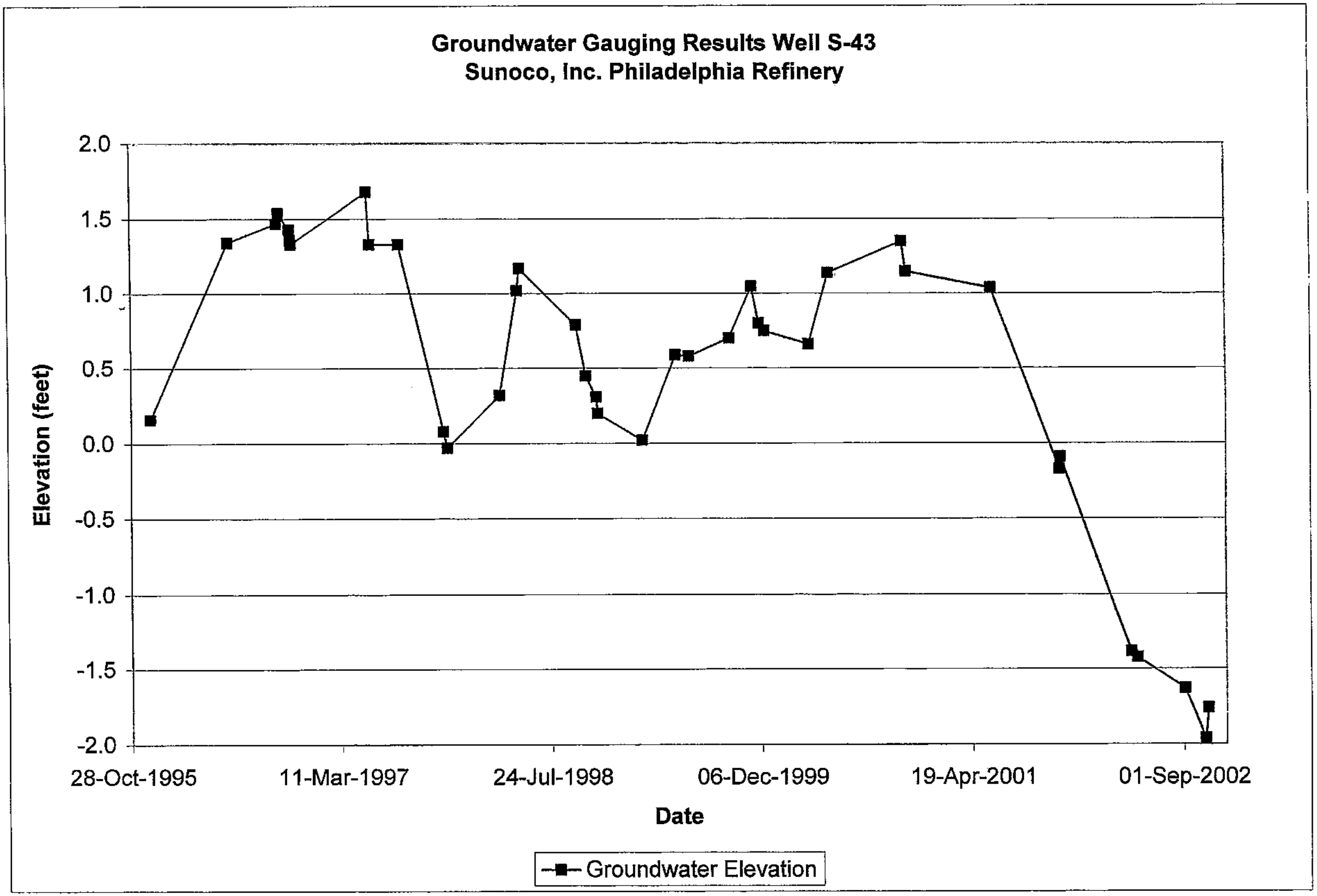


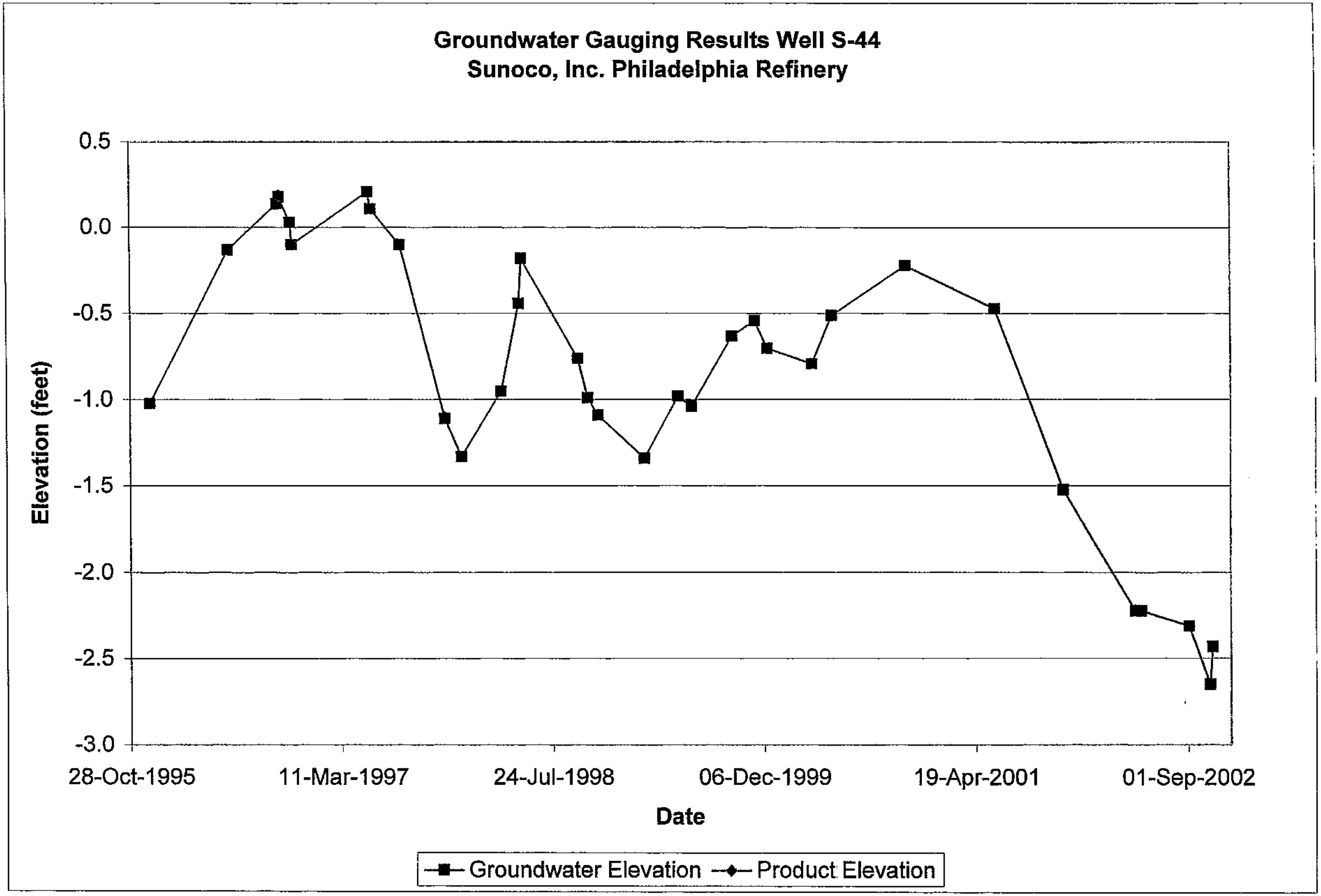
Groundwater Gauging Results Well S-39
Sunoco, Inc. Philadelphia Refinery
Elevation (feet)
5
4
3
2
1
0
-1
-2
28-Oct-1995
11-Mar-1997
24-Jul-1998
06-Dec-1999
19-Apr-2001
01-Sep-2002
Date
Groundwater Elevation

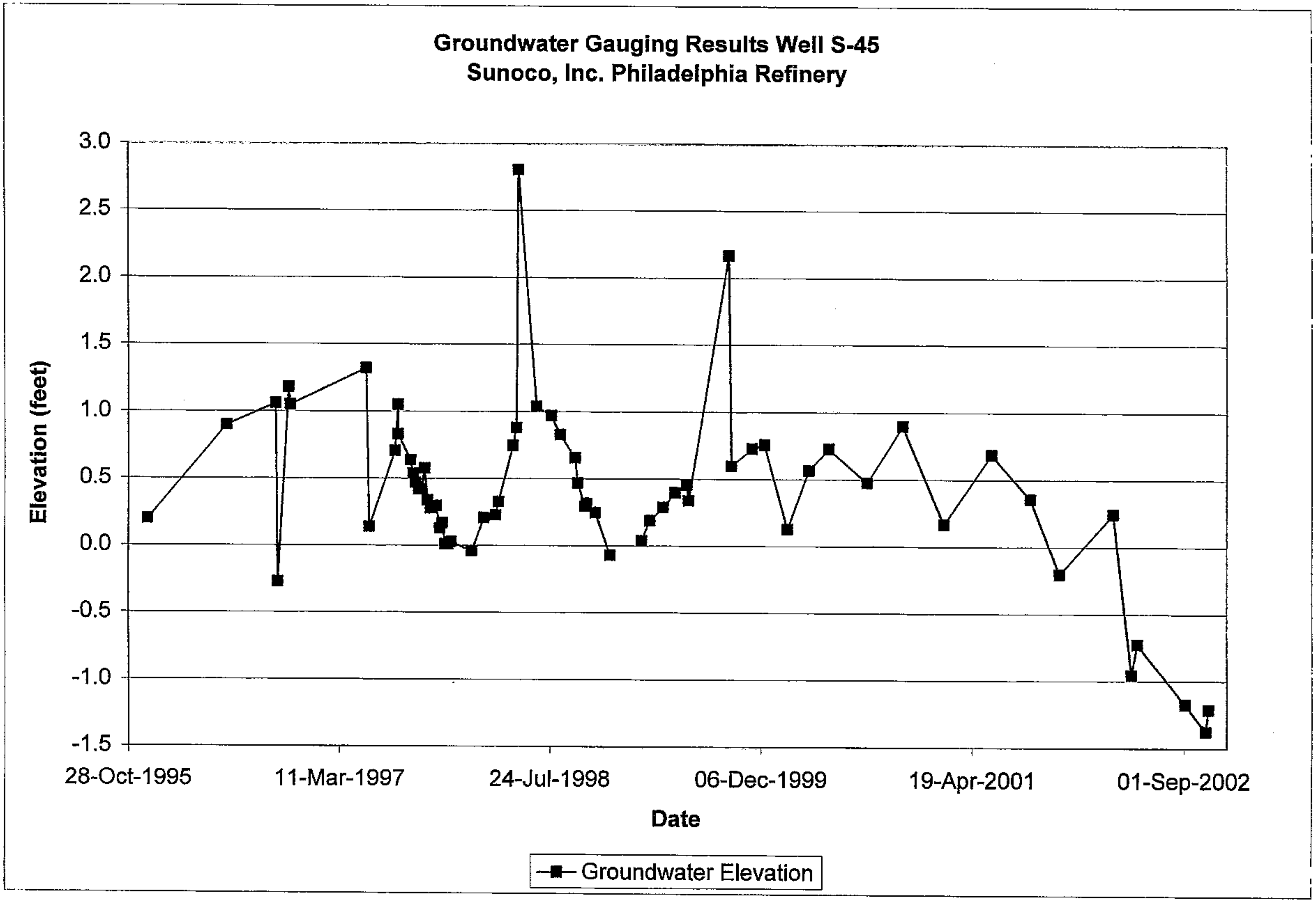


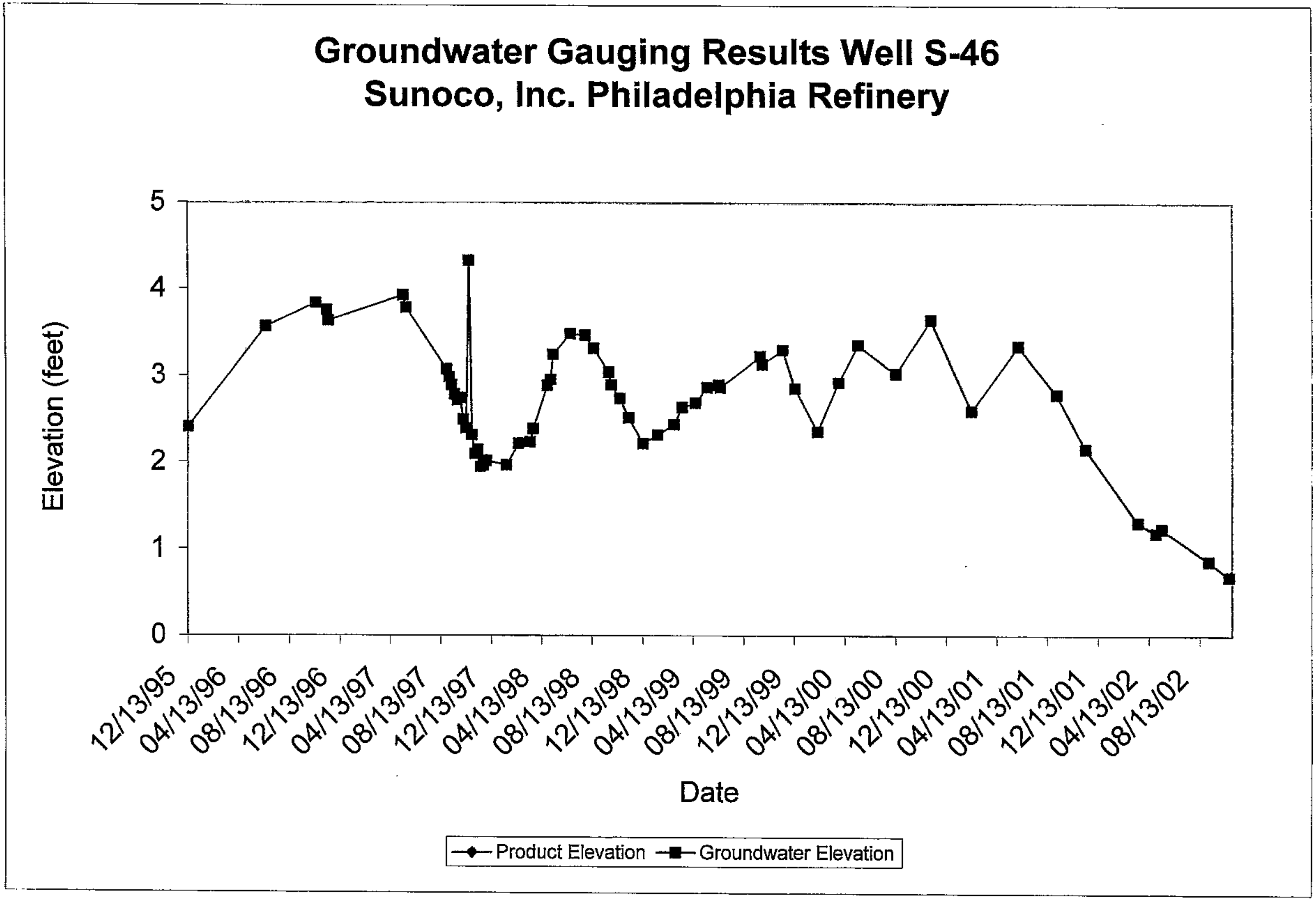
Groundwater Gauging Results Well S-40
Sunoco, Inc. Philadelphia Refinery
Elevation (feet)
4
3
2
1
0
-1
-2
28-Oct-1995
11-Mar-1997
24-Jul-1998
06-Dec-1999
19-Apr-2001
01-Sep-2002
Date
Groundwater Elevation


Groundwater Gauging Results Well S-41
Sunoco, Inc. Philadelphia Refinery
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
Elevation (feet)
28-Oct-1995
11-Mar-1997
24-Jul-1998
06-Dec-1999
19-Apr-2001
01-Sep-2002
Date
Groundwater Elevation

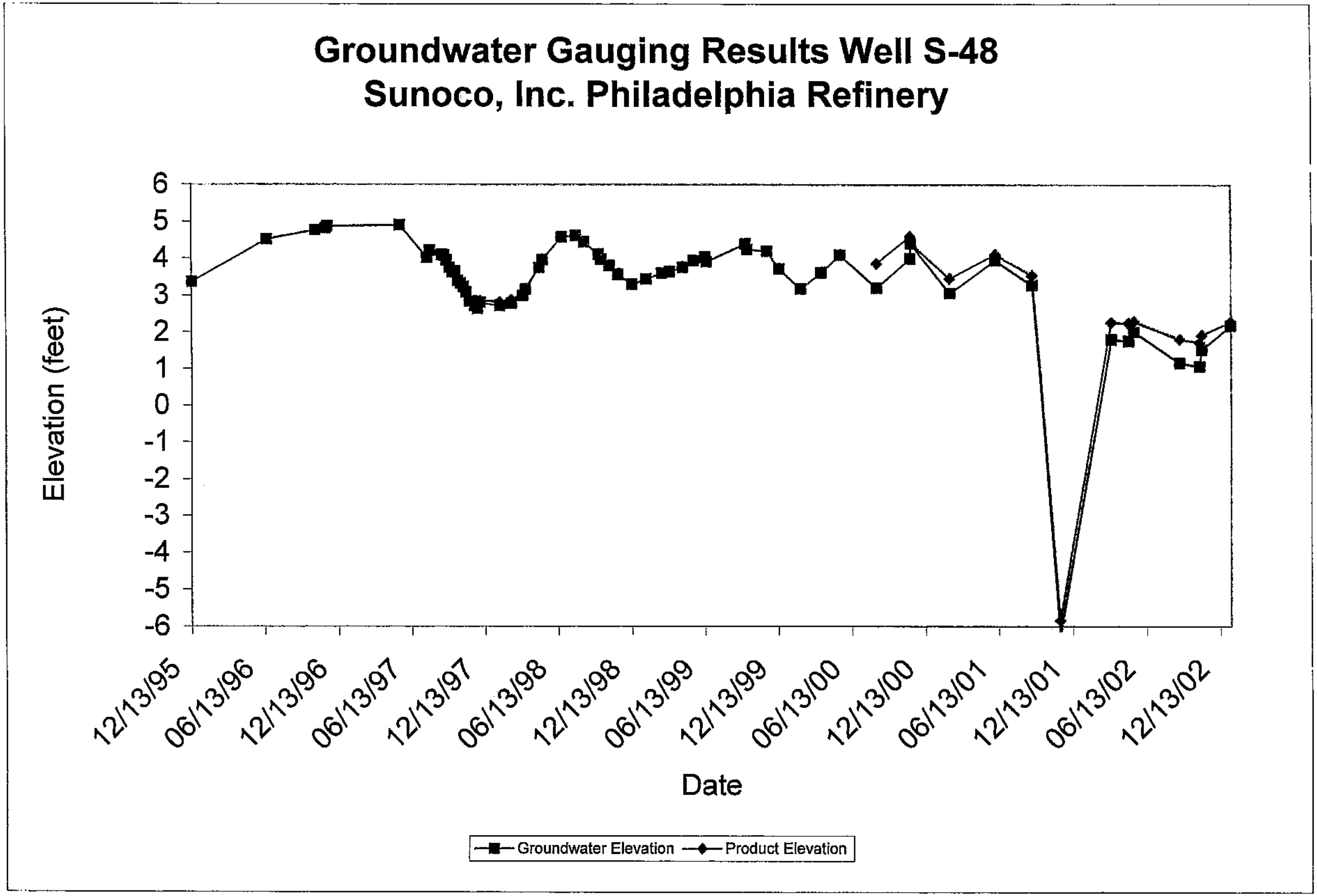

Groundwater Gauging Results Well S-43
Sunoco, Inc. Philadelphia Refinery
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
Elevation (feet)
28-Oct-1995
11-Mar-1997
24-Jul-1998
06-Dec-1999
19-Apr-2001
01-Sep-2002
Date
Groundwater Elevation

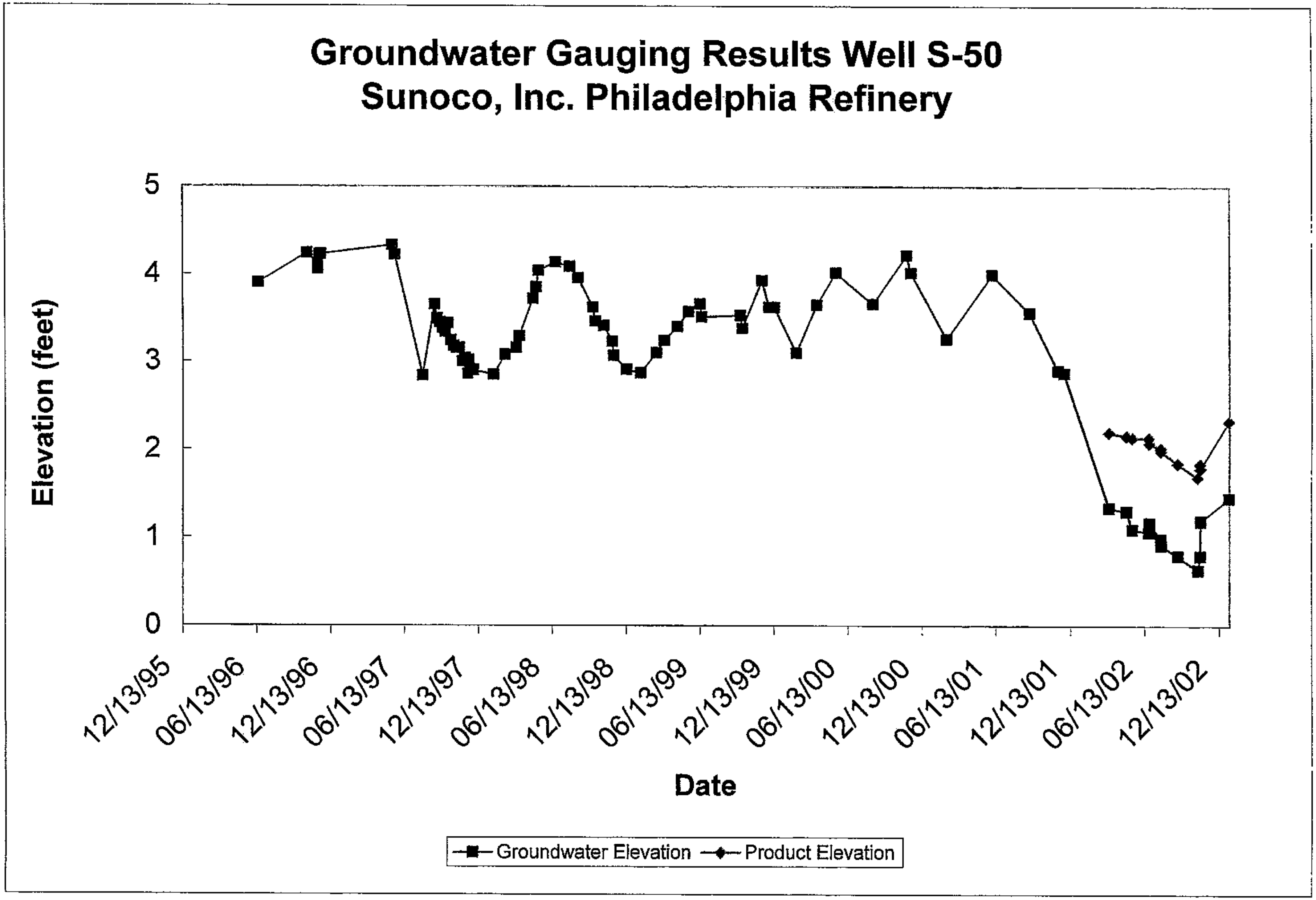

Groundwater Gauging Results Well S-44
Sunoco, Inc. Philadelphia Refinery
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
Elevation (feet)
28-Oct-1995
11-Mar-1997
24-Jul-1998
06-Dec-1999
19-Apr-2001
01-Sep-2002
Date
Groundwater Elevation
Product Elevation


Groundwater Gauging Results Well S-45
Sunoco, Inc. Philadelphia Refinery
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
Elevation (feet)
28-Oct-1995
11-Mar-1997
24-Jul-1998
06-Dec-1999
19-Apr-2001
01-Sep-2002
Date
Groundwater Elevation

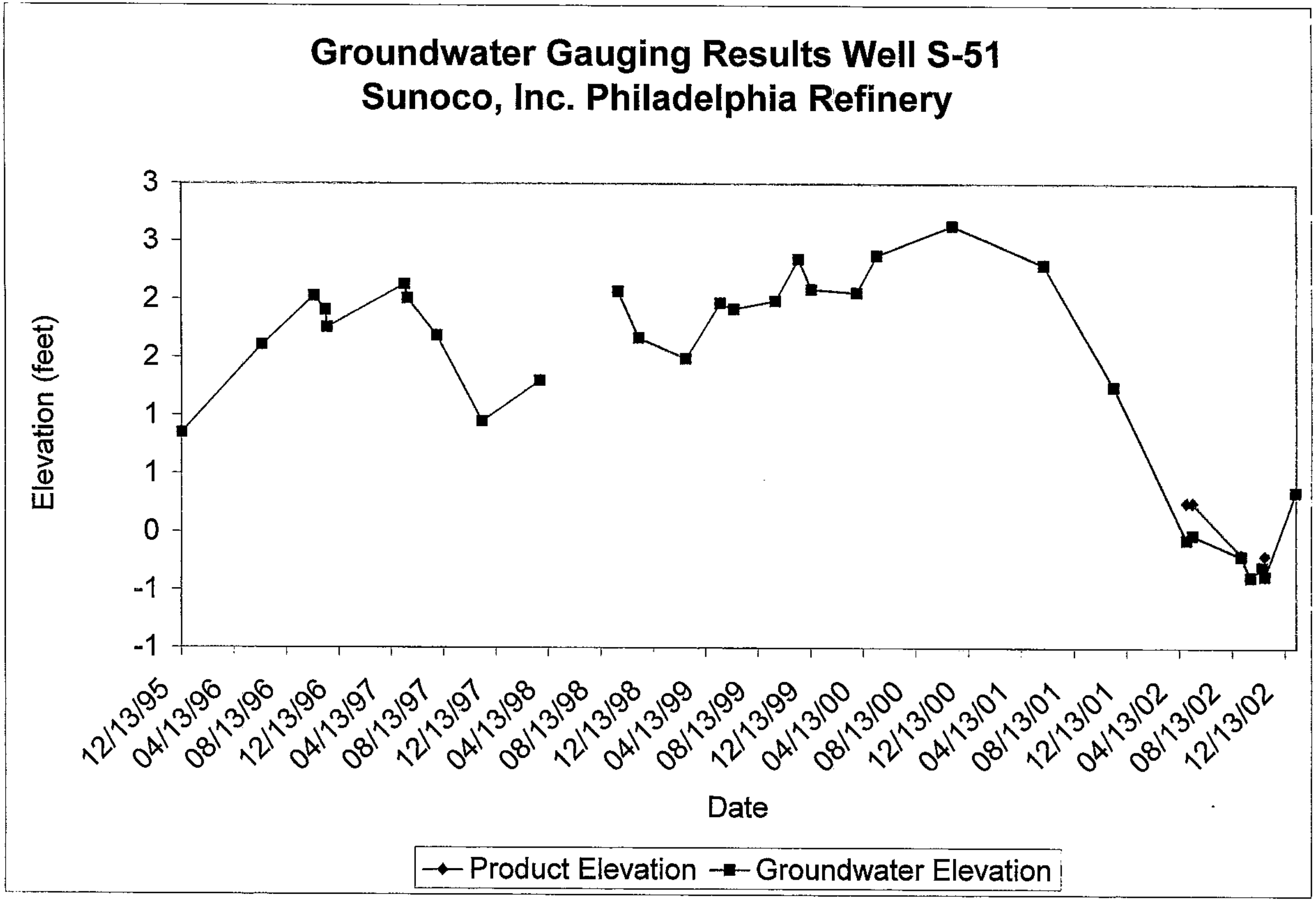


Groundwater Gauging Results Well S-46
Sunoco, Inc. Philadelphia Refinery
Elevation (feet)
5
4
3
2
1
0
12/13/95
04/13/96
08/13/96
12/13/96
04/13/97
08/13/97
12/13/97
04/13/98
08/13/98
12/13/98
04/13/99
08/13/99
12/13/99
04/13/00
08/13/00
12/13/00
04/13/01
08/13/01
12/13/01
04/13/02
08/13/02
Date
Product Elevation
Groundwater Elevation

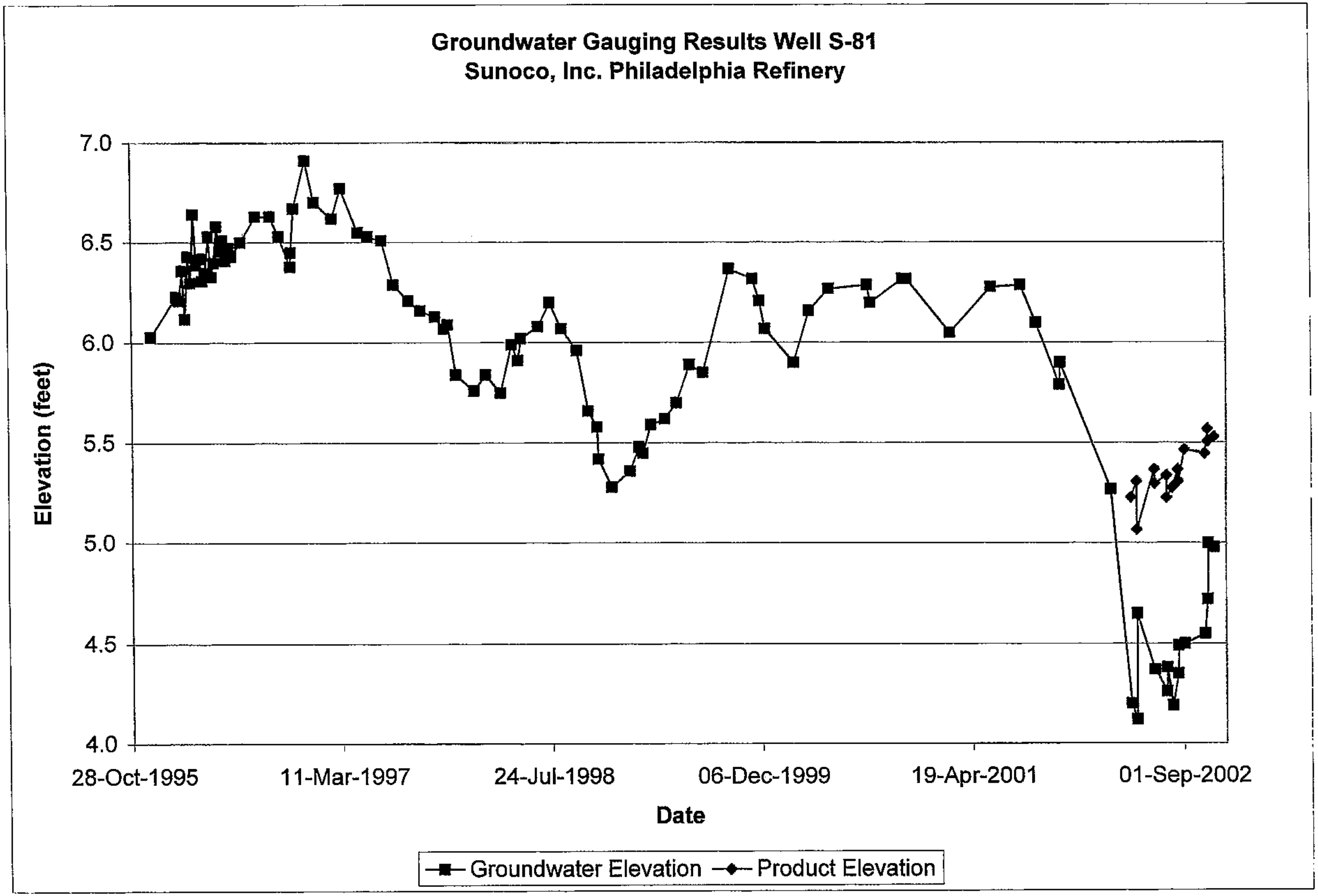

Groundwater Gauging Results Well S-48
Sunoco, Inc. Philadelphia Refinery
Elevation (feet)
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
12/13/95
06/13/96
12/13/96
06/13/97
12/13/97
06/13/98
12/13/98
06/13/99
12/13/99
06/13/00
12/13/00
06/13/01
12/13/01
06/13/02
12/13/02
Date
Groundwater Elevation
Product Elevation

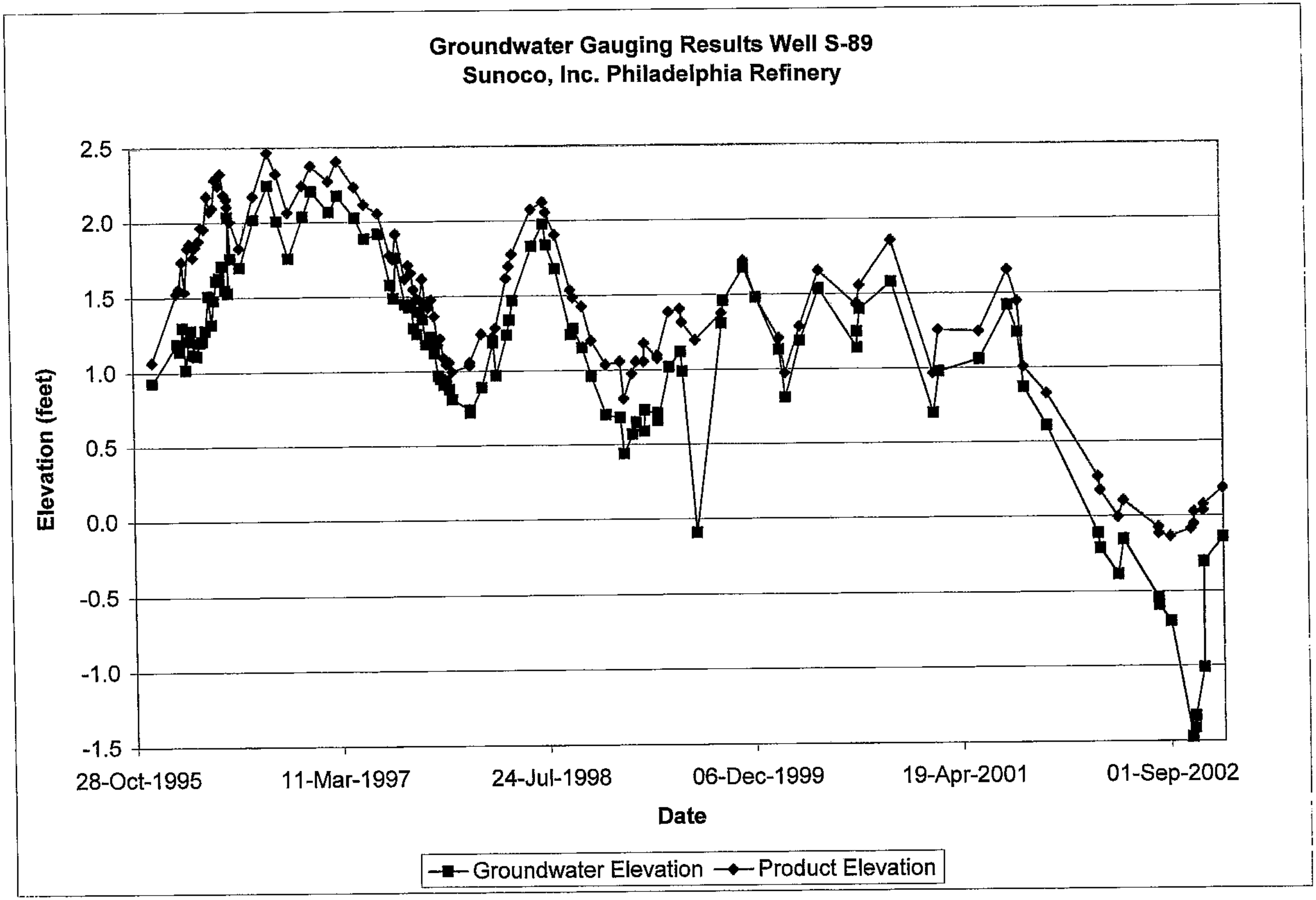


Note: A discrepancy between Handex's and Dames and Moore's reference elevations was normalized to Handex's datum for the purpose of this graph.

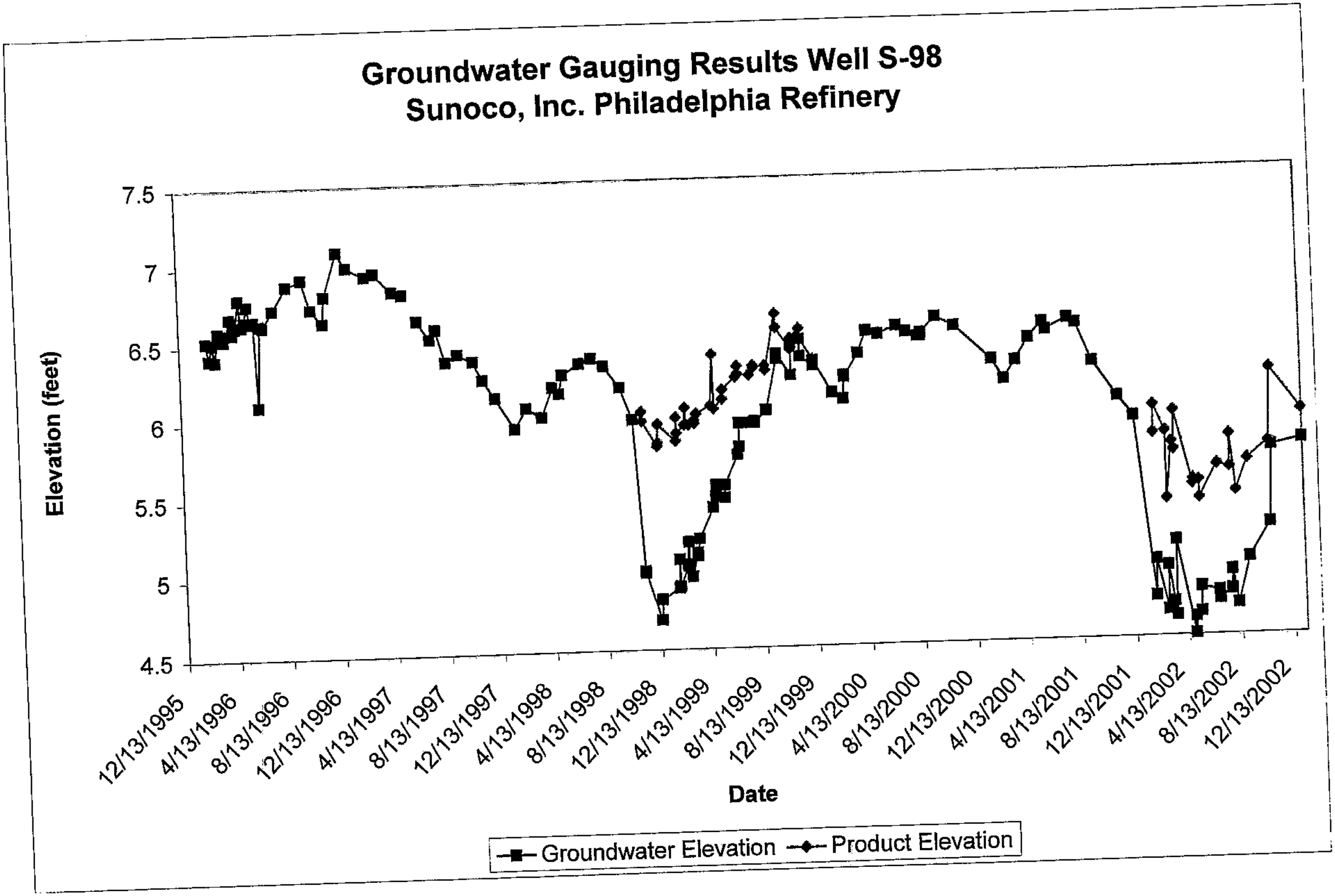


Note: A discrepancy between Handex's and Dames and Moore's reference elevations was normalized to Handex's current datum for this graph.

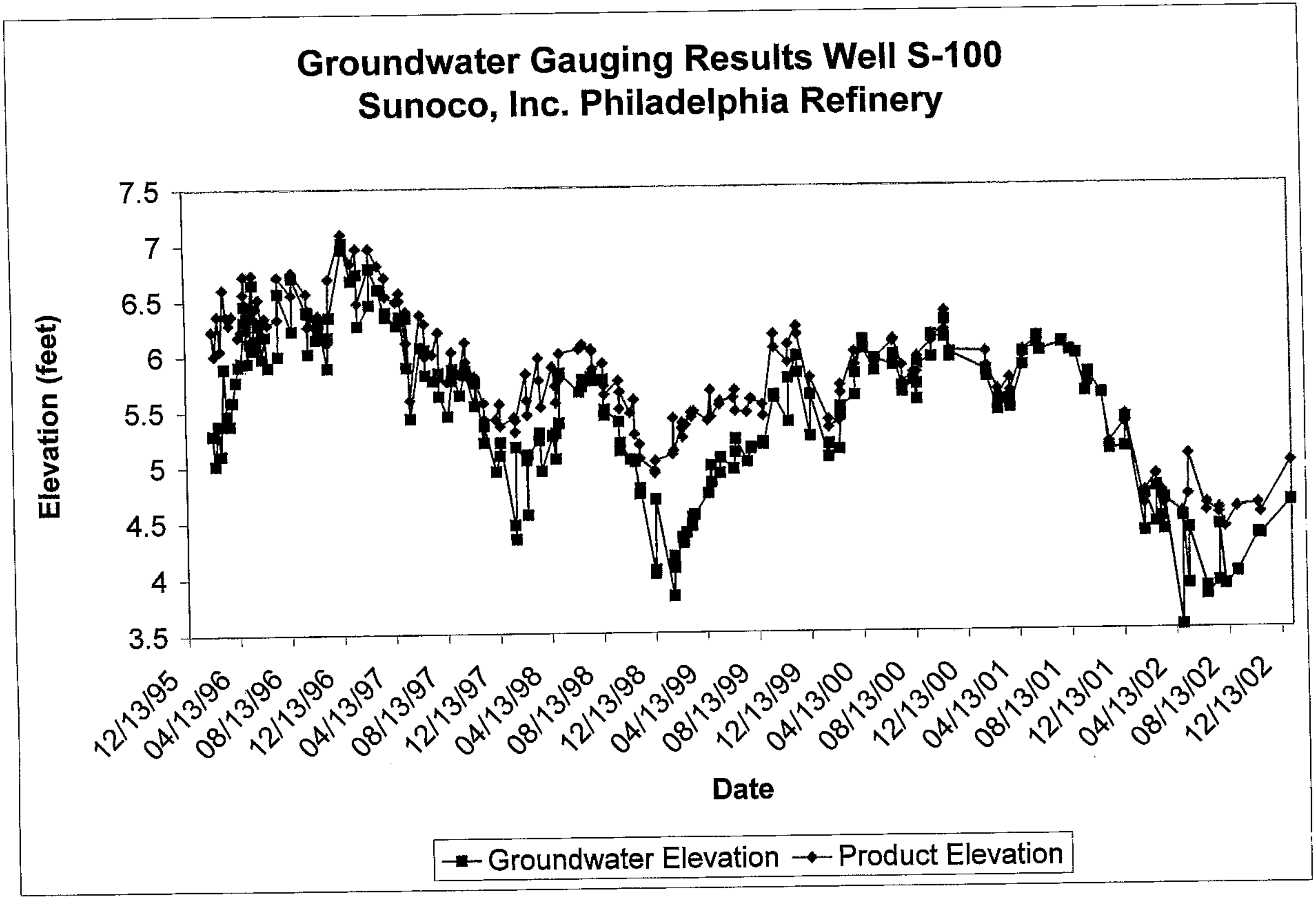

Groundwater Gauging Results Well S-81
Sunoco, Inc. Philadelphia Refinery
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Elevation (feet)
28-Oct-1995
11-Mar-1997
24-Jul-1998
06-Dec-1999
19-Apr-2001
01-Sep-2002
Date
Groundwater Elevation
Product Elevation



Groundwater Gauging Results Well S-89
Sunoco, Inc. Philadelphia Refinery
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
Elevation (feet)
28-Oct-1995
11-Mar-1997
24-Jul-1998
06-Dec-1999
19-Apr-2001
01-Sep-2002
Date
Groundwater Elevation
Product Elevation



Groundwater Gauging Results Well S-98
Sunoco, Inc. Philadelphia Refinery
7.5
7
6.5
6
5.5
5
4.5
Elevation (feet)
12/13/1995
4/13/1996
8/13/1996
12/13/1996
4/13/1997
8/13/1997
12/13/1997
4/13/1998
8/13/1998
12/13/1998
4/13/1999
8/13/1999
12/13/1999
4/13/2000
8/13/2000
12/13/2000
4/13/2001
8/13/2001
12/13/2001
4/13/2002
8/13/2002
12/13/2002
Date
Groundwater Elevation
Product Elevation

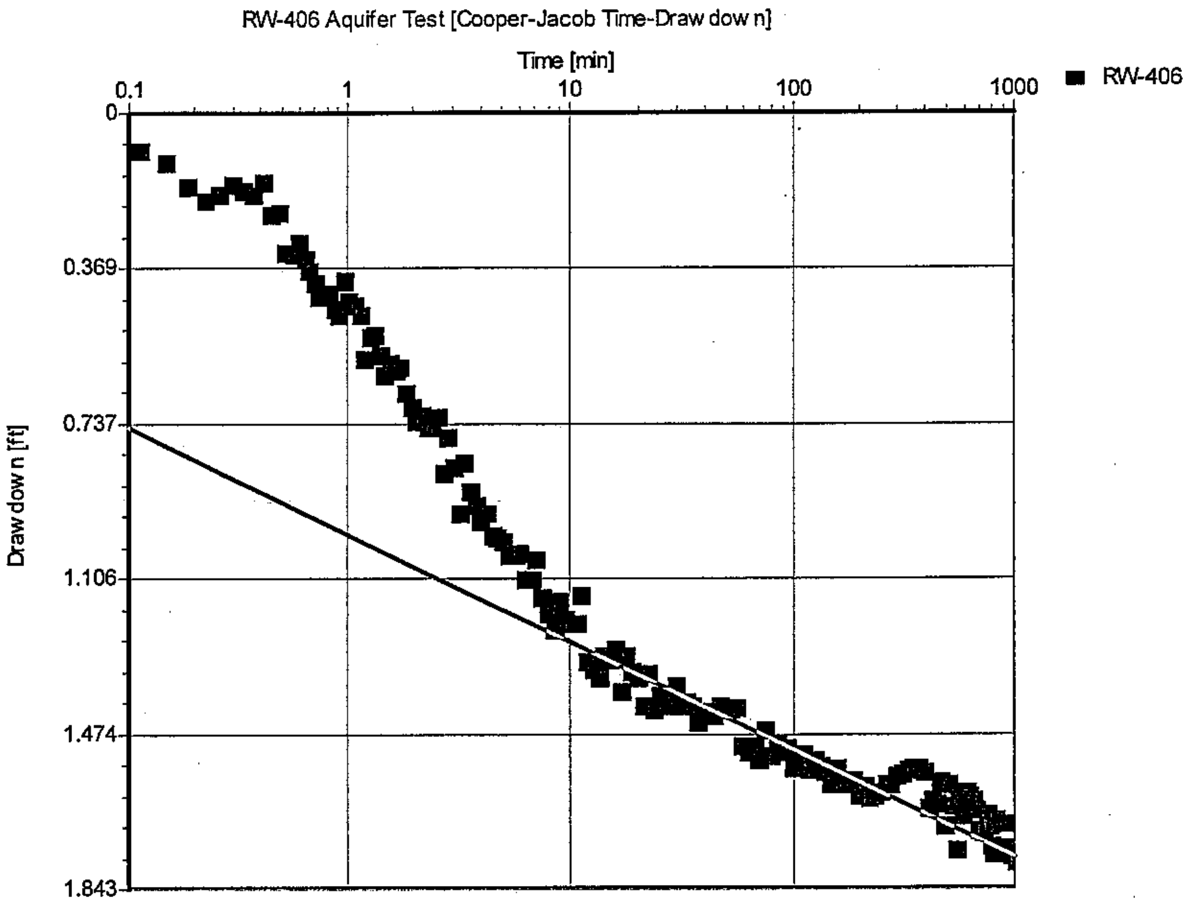


Groundwater Gauging Results Well S-100
Sunoco, Inc. Philadelphia Refinery
Elevation (feet)
7.5
7
6.5
6
5.5
5
4.5
4
3.5
12/13/95
04/13/96
08/13/96
12/13/96
04/13/97
08/13/97
12/13/97
04/13/98
08/13/98
12/13/98
04/13/99
08/13/99
12/13/99
04/13/00
08/13/00
12/13/00
04/13/01
08/13/01
12/13/01
04/13/02
08/13/02
12/13/02
Date
Groundwater Elevation
Product Elevation

APPENDIX C

RW-406 Aquifer Test Data

SECOR International, Inc.	Pumping Test Analysis Report
102 Pickering Way - Suite 200	Project: 26th Street Aquifer Test
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



Pumping Test: **RW-406 Aquifer Test**

Analysis Method: **Cooper-Jacob Time-Drawdown**

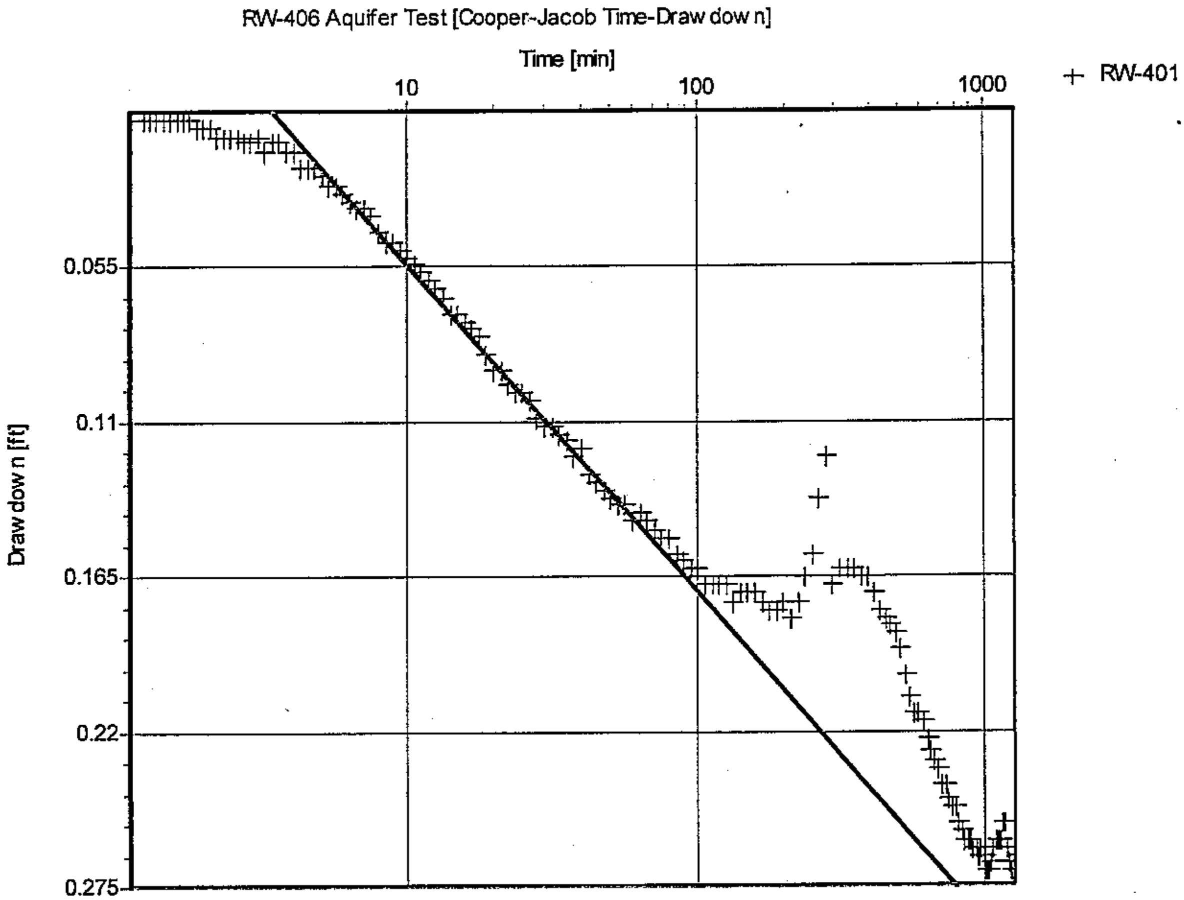
Analysis Results:	Transmissivity:	2.52E+2 [ft²/d]	Conductivity:	2.01E+1 [ft/d]
Test parameters:	Pumping Well:	RW-406	Aquifer Thickness:	12.52 [ft]
	Casing radius:	0 [ft]	Unconfined Aquifer	
	Screen length:	0 [ft]		
	Boring radius:	0 [ft]		
	Discharge Rate:	1.825 [U.S. gal/min]		

Comments:

Evaluated by:

Evaluation Date: 10/24/02

SECOR International, Inc.	Pumping Test Analysis Report
102 Pickering Way - Suite 200	Project: 26th Street Aquifer Test
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



Pumping Test: **RW-406 Aquifer Test**

Analysis Method: **Cooper-Jacob Time-Drawdown**

Analysis Results:	Transmissivity:	5.54E+2 [ft²/d]	Conductivity:	4.42E+1 [ft/d]

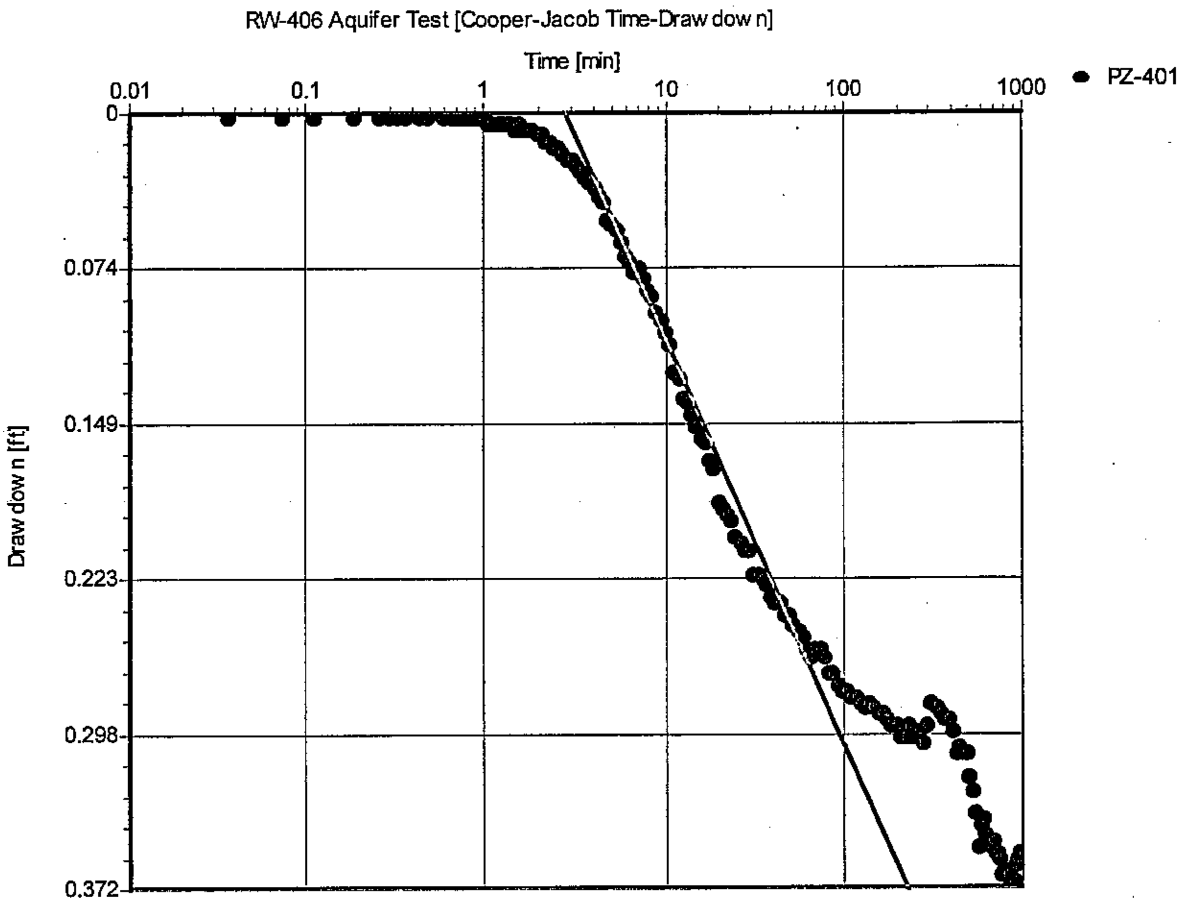
Test parameters:	Pumping Well:	RW-406	Aquifer Thickness:	12.52 [ft]
	Casing radius:	0 [ft]	Unconfined Aquifer	
	Screen length:	0 [ft]		
	Boring radius:	0 [ft]		
	Discharge Rate:	1.825 [U.S. gal/min]		

Comments:

Evaluated by:

Evaluation Date: 10/24/02

SECOR International, Inc.	Pumping Test Analysis Report
102 Pickering Way - Suite 200	Project: 26th Street Aquifer Test
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



Pumping Test: **RW-406 Aquifer Test**

Analysis Method: **Cooper-Jacob Time-Drawdown**

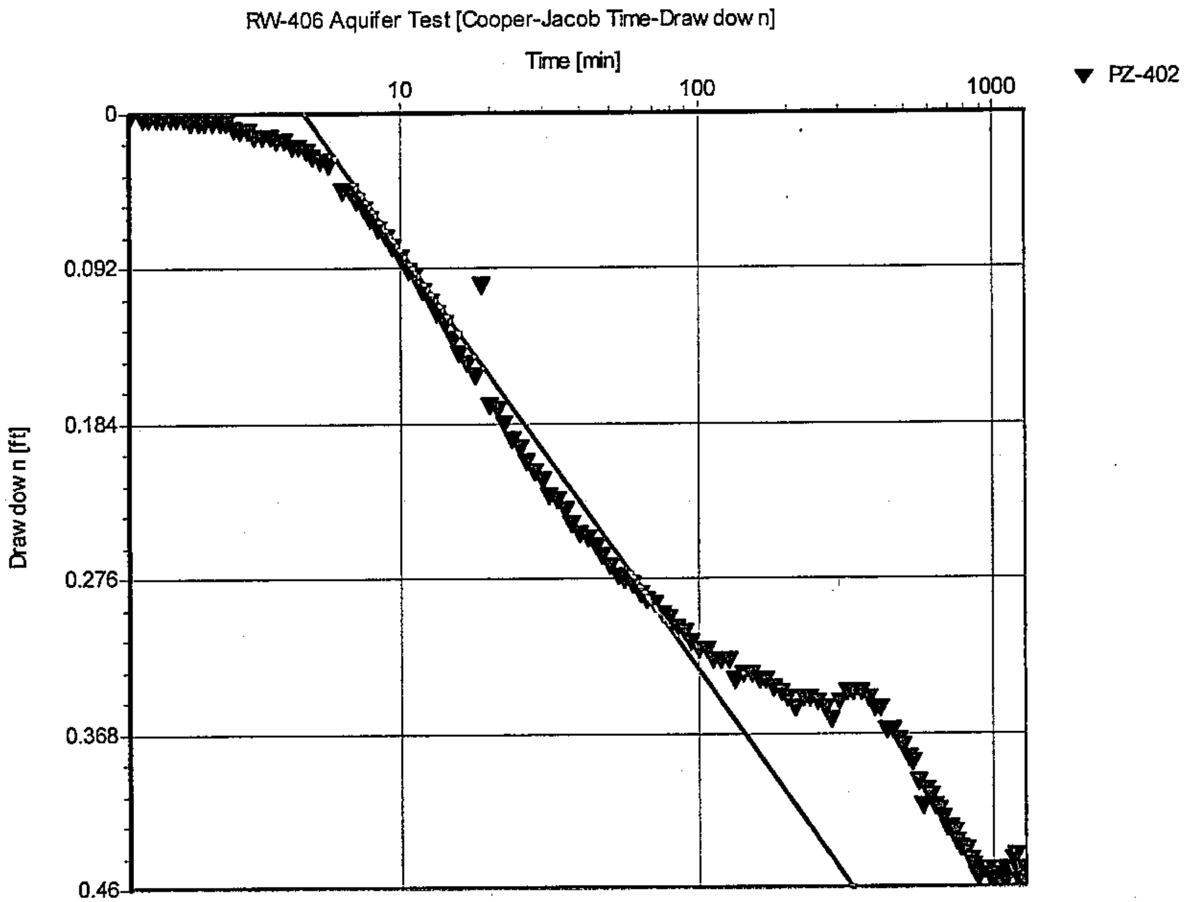
Analysis Results:	Transmissivity:	3.30E+2 [ft²/d]	Conductivity:	2.64E+1 [ft/d]
Test parameters:	Pumping Well:	RW-406	Aquifer Thickness:	12.52 [ft]
	Casing radius:	0 [ft]	Unconfined Aquifer	
	Screen length:	0 [ft]		
	Boring radius:	0 [ft]		
	Discharge Rate:	1.825 [U.S. gal/min]		

Comments:

Evaluated by:

Evaluation Date: 10/24/02

SECOR International, Inc.	Pumping Test Analysis Report
102 Pickering Way - Suite 200	Project: 26th Street Aquifer Test
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



Pumping Test: **RW-406 Aquifer Test**

Analysis Method: **Cooper-Jacob Time-Drawdown**

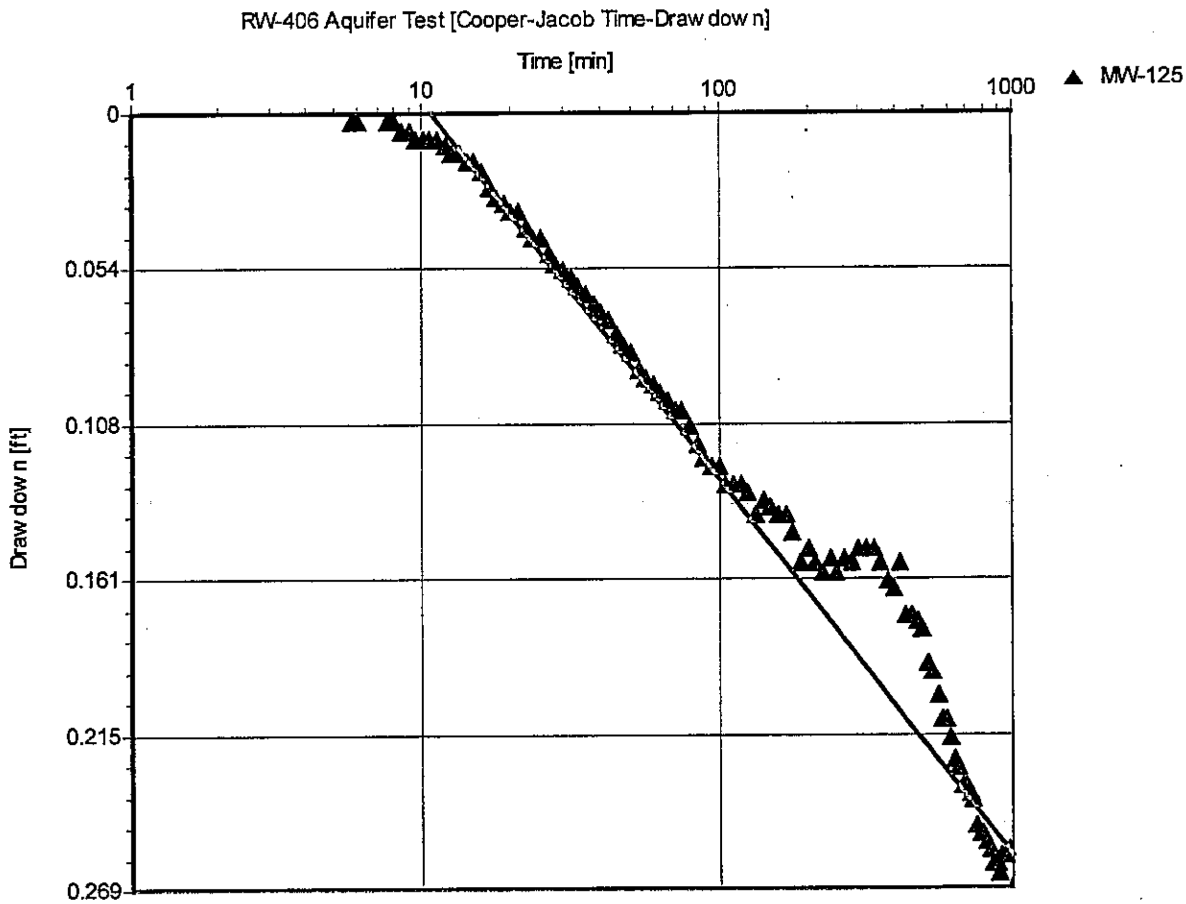
Analysis Results:	Transmissivity:	2.58E+2 [ft²/d]	Conductivity:	2.06E+1 [ft/d]
Test parameters:	Pumping Well:	RW-406	Aquifer Thickness:	12.52 [ft]
	Casing radius:	0 [ft]	Unconfined Aquifer	
	Screen length:	0 [ft]		
	Boring radius:	0 [ft]		
	Discharge Rate:	1.825 [U.S. gal/min]		

Comments:

Evaluated by:

Evaluation Date: 10/24/02

SECOR International, Inc.	Pumping Test Analysis Report
102 Pickering Way - Suite 200	Project: 26th Street Aquifer Test
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



Pumping Test: **RW-406 Aquifer Test**

Analysis Method: **Cooper-Jacob Time-Drawdown**

Analysis Results:	Transmissivity:	4.92E+2 [ft²/d]	Conductivity:	3.93E+1 [ft/d]

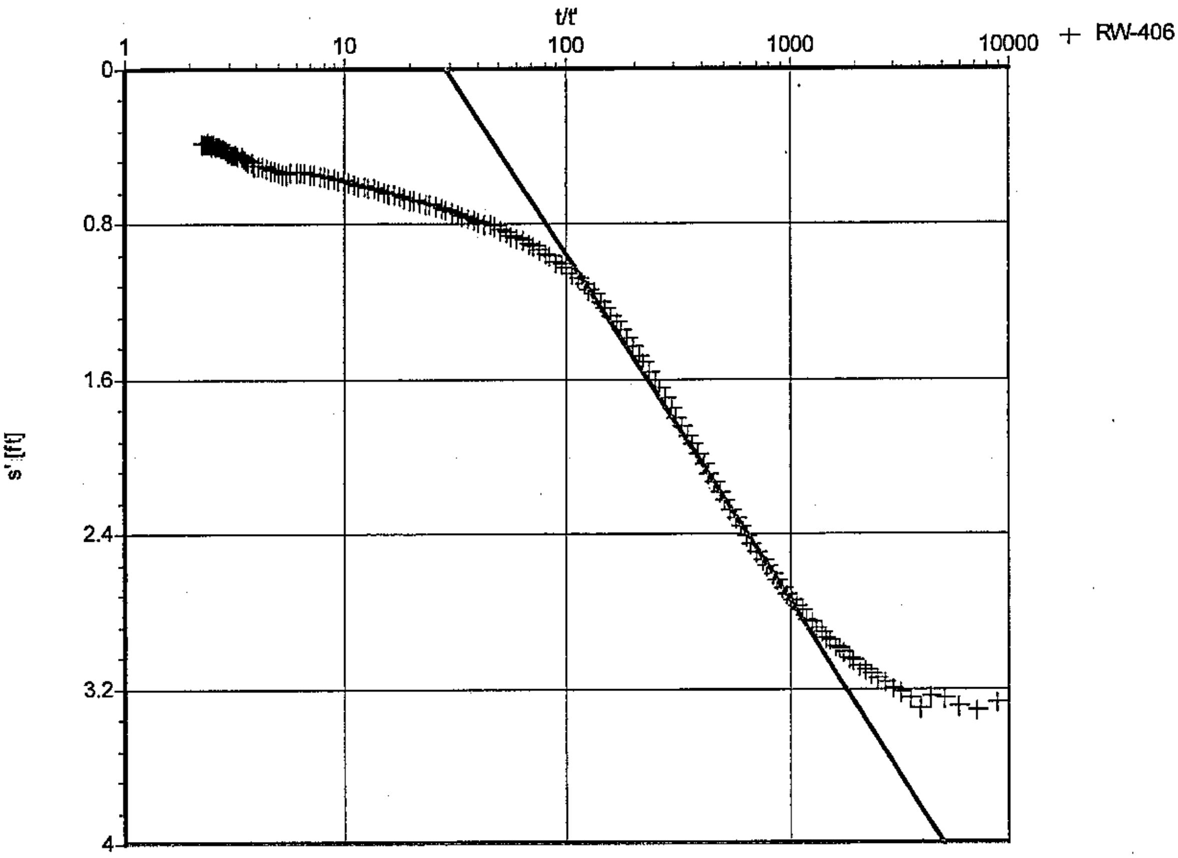
Test parameters:	Pumping Well:	RW-406	Aquifer Thickness:	12.52 [ft]
	Casing radius:	0 [ft]	Unconfined Aquifer	
	Screen length:	0 [ft]		
	Boring radius:	0 [ft]		
	Discharge Rate:	1.825 [U.S. gal/min]		

Comments:

Evaluated by:

Evaluation Date: 10/24/02

SECOR International, Inc.	Pumping Test Analysis Report
102 Pickering Way - Suite 200	Project: RW-406 Recovery Test
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



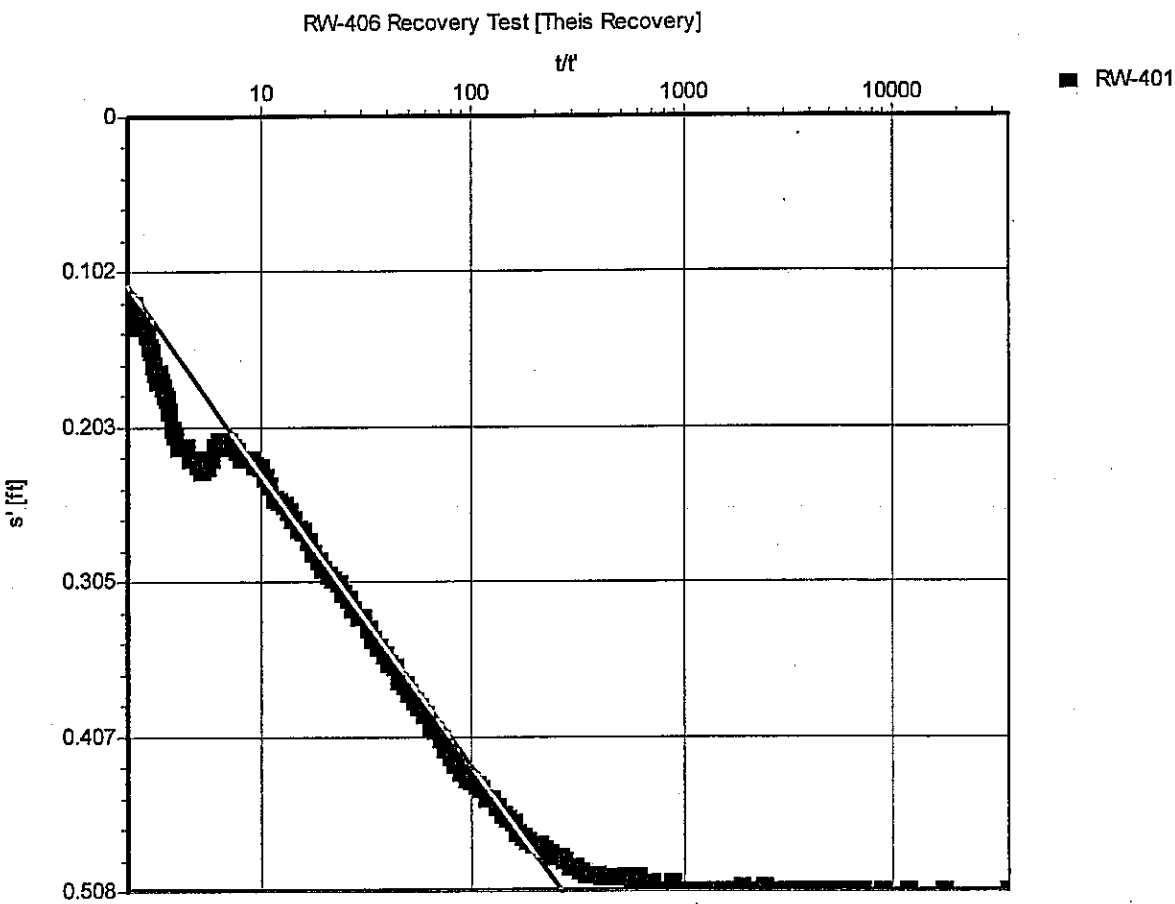
Pumping Test:	**RW-406 Recovery Test**			
Analysis Method:	**Theis Recovery**			
Analysis Results:	Transmissivity:	4.27E+1 [ft²/d]	Conductivity:	3.41E+0 [ft/d]
Test parameters:	Pumping Well:	RW-406	Aquifer Thickness:	12.52 [ft]
	Casing radius:	0 [ft]	Unconfined Aquifer	
	Screen length:	0 [ft]		
	Boring radius:	0 [ft]		
	Discharge Rate:	2.15 [U.S. gal/min]		
	Pumping Time	1330 [min]		

Comments:

Evaluated by:

Evaluation Date: 10/28/02

SECOR International, Inc.	Pumping Test Analysis Report
102 Pickering Way - Suite 200	Project: RW-406 Recovery Test
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



Pumping Test: **RW-406 Recovery Test**

Analysis Method: **Theis Recovery**

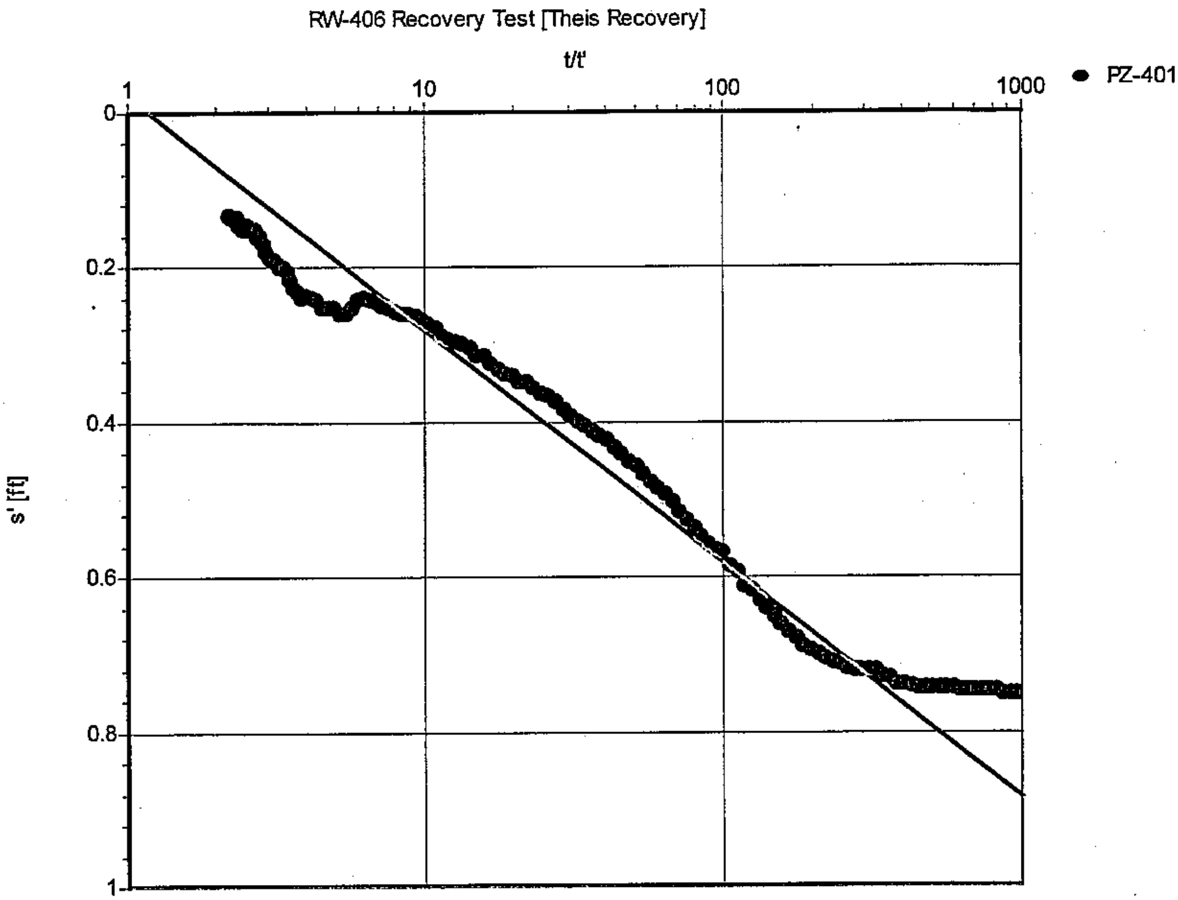
Analysis Results:	Transmissivity:	3.94E+2 [ft²/d]	Conductivity:	3.15E+1 [ft/d]
Test parameters:	Pumping Well:	RW-406	Aquifer Thickness:	12.52 [ft]
	Casing radius:	0 [ft]	Unconfined Aquifer	
	Screen length:	0 [ft]		
	Boring radius:	0 [ft]		
	Discharge Rate:	2.15 [U.S. gal/min]		
	Pumping Time	1330 [min]		

Comments:

Evaluated by:

Evaluation Date: 10/28/02

SECOR International, Inc.	Pumping Test Analysis Report
102 Pickering Way - Suite 200	Project: RW-406 Recovery Test
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



Pumping Test: **RW-406 Recovery Test**

Analysis Method: **Theis Recovery**

Analysis Results: Transmissivity: 2.51E+2 [ft²/d] Conductivity: 2.00E+1 [ft/d]

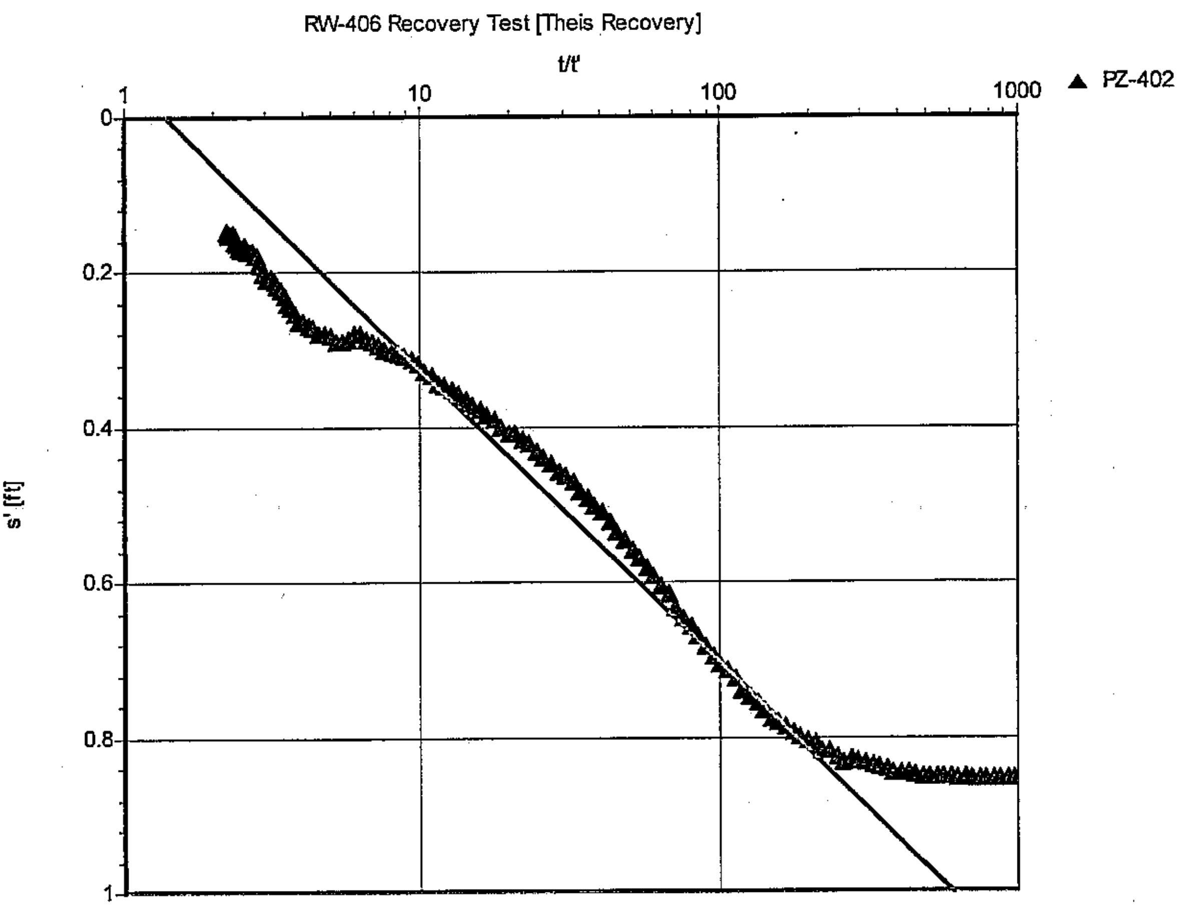
Test parameters:				
	Pumping Well:	RW-406	Aquifer Thickness:	12.52 [ft]
	Casing radius:	0 [ft]	Unconfined Aquifer	
	Screen length:	0 [ft]		
	Boring radius:	0 [ft]		
	Discharge Rate:	2.15 [U.S. gal/min]		
	Pumping Time	1330 [min]		

Comments:

Evaluated by:

Evaluation Date: 10/28/02

SECOR International, Inc.	**Pumping Test Analysis Report**
102 Pickering Way - Suite 200	Project: RW-406 Recovery Test
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



Pumping Test: **RW-406 Recovery Test**

Analysis Method: **Theis Recovery**

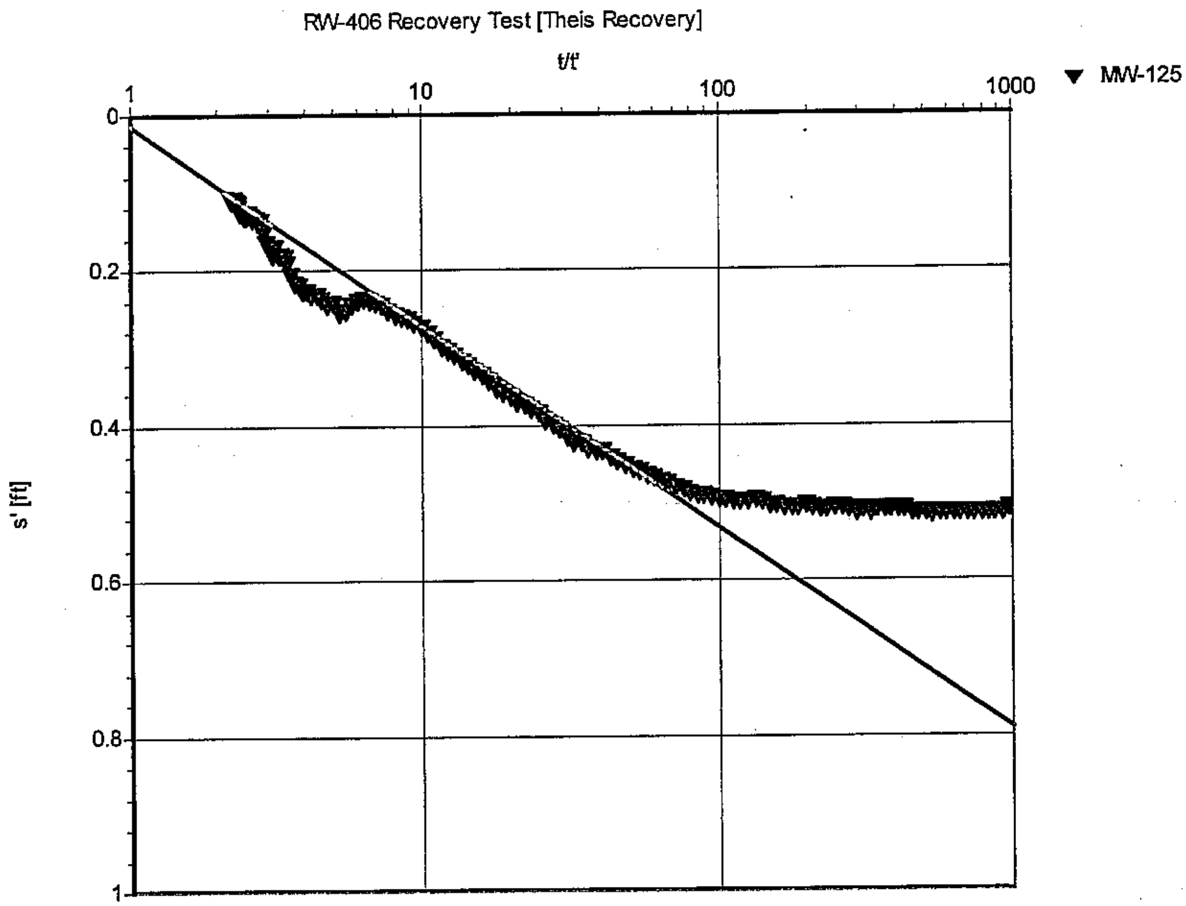
Analysis Results:	Transmissivity:	2.00E+2 [ft²/d]	Conductivity:	1.60E+1 [ft/d]
Test parameters:	Pumping Well:	RW-406	Aquifer Thickness:	12.52 [ft]
	Casing radius:	0 [ft]	Unconfined Aquifer	
	Screen length:	0 [ft]		
	Boring radius:	0 [ft]		
	Discharge Rate:	2.15 [U.S. gal/min]		
	Pumping Time	1330 [min]		

Comments:

Evaluated by:

Evaluation Date: 10/28/02

SECOR International, Inc.	Pumping Test Analysis Report
102 Pickering Way - Suite 200	Project: RW-406 Recovery Test
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



Pumping Test: **RW-406 Recovery Test**

Analysis Method: **Theis Recovery**

Analysis Results:	Transmissivity:	2.92E+2 [ft²/d]	Conductivity:	2.33E+1 [ft/d]

Test parameters:	Pumping Well:	RW-406	Aquifer Thickness:	12.52 [ft]
	Casing radius:	0 [ft]	Unconfined Aquifer	
	Screen length:	0 [ft]		
	Boring radius:	0 [ft]		
	Discharge Rate:	2.15 [U.S. gal/min]		
	Pumping Time	1330 [min]		

Comments:

Evaluated by:

Evaluation Date: 10/28/02

RW-406 PUMP TEST
OBSERVATION WELL DATA - RW-401

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 26.78 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
8:30	0:00	22.02	22.14	0.12	4.73	0.00
8:38	0:08	22.05	22.28	0.23	4.67	0.06
8:42	0:12	22.07	22.31	0.24	4.65	0.08
8:50	0:20	22.10	22.36	0.26	4.62	0.11
8:55	0:25	22.11	22.37	0.26	4.61	0.12
9:01	0:31	22.11	22.40	0.29	4.60	0.13
9:10	0:40	22.13	22.42	0.29	4.58	0.15
9:16	0:46	22.12	22.47	0.35	4.58	0.16
9:20	0:50	22.12	22.48	0.36	4.57	0.16
9:26	0:56	22.12	22.48	0.36	4.57	0.16
9:33	1:03	22.11	22.55	0.44	4.56	0.17
9:37	1:07	22.12	22.57	0.45	4.55	0.18
9:42	1:12	22.11	22.58	0.47	4.56	0.17
9:50	1:20	22.11	22.63	0.52	4.55	0.19
10:12	1:42	22.09	22.75	0.66	4.53	0.20
10:35	2:05	22.06	22.87	0.81	4.53	0.21
11:11	2:41	22.05	22.99	0.94	4.50	0.23
11:45	3:15	22.03	23.05	1.02	4.51	0.23
13:05	4:35	22.03	23.10	1.07	4.49	0.24
14:16	5:46	22.02	23.08	1.06	4.51	0.23
15:23	6:53	22.03	23.09	1.06	4.50	0.24
17:01	8:31	22.05	23.12	1.07	4.47	0.26
18:04	9:34	22.06	23.18	1.12	4.45	0.28
19:14	10:44	22.06	23.16	1.10	4.46	0.28
20:07	11:37	22.08	23.23	1.15	4.42	0.31
21:12	12:42	22.09	23.26	1.17	4.41	0.32
22:13	13:43	22.09	23.29	1.20	4.40	0.33
23:31	15:01	22.09	23.30	1.21	4.40	0.33
0:12	15:42	22.09	23.30	1.21	4.40	0.33
8:50	24:20	22.11	23.17	1.06	4.42	0.32
10:15	25:45	22.10	23.14	1.04	4.43	0.30
11:45	27:15	22.10	23.07	0.97	4.45	0.28
13:22	28:52	22.09	23.09	1.00	4.45	0.28
14:22	29:52	22.10	23.10	1.00	4.44	0.29
15:44	31:14	22.13	23.24	1.11	4.38	0.35
16:17	31:47	22.14	23.32	1.18	4.36	0.37

RW-406 PUMP TEST
OBSERVATION WELL DATA - RW-401

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 26.78 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
17:30	33:00	22.14	23.45	1.31	4.33	0.41
18:45	34:15	22.14	23.54	1.40	4.30	0.43
19:42	35:12	22.16	23.63	1.47	4.27	0.46
20:58	36:28	22.15	23.64	1.49	4.27	0.46
22:31	38:01	22.16	23.70	1.54	4.25	0.48
2:22	41:52	22.15	23.80	1.65	4.23	0.50
8:17	47:47	22.21	23.86	1.65	4.17	0.56
10:15	49:45	22.21	23.91	1.70	4.16	0.57
11:46	51:16	22.24	23.84	1.60	4.16	0.58
13:45	53:15	22.23	23.85	1.62	4.16	0.57
15:15	54:45	22.24	23.91	1.67	4.14	0.59
15:47	55:17	22.19	23.76	1.57	4.21	0.52
16:15	55:45	22.17	23.31	1.14	4.34	0.39

NOTES:

Test started at 8:30 on 10/1/02 and ended at 15:30 on 10/3/02

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

S:\Clients\Sunoco\26th Street\Aquifer Test Data\[obs well data.xls]RW-401

RW-406 PUMP TEST
OBSERVATION WELL DATA - PZ-401

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 25.89 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
8:30	0:00	NP	21.22	0.00	4.67	0.00
8:37	0:07	21.28	21.29	0.01	4.61	0.06
8:41	0:11	21.33	21.34	0.01	4.56	0.11
8:49	0:19	NP	21.41	0.00	4.48	0.19
8:54	0:24	NP	21.42	0.00	4.47	0.20
9:00	0:30	NP	21.44	0.00	4.45	0.22
9:08	0:38	NP	21.45	0.00	4.44	0.23
9:16	0:46	NP	21.46	0.00	4.43	0.24
9:20	0:50	NP	21.47	0.00	4.42	0.25
9:25	0:55	NP	21.47	0.00	4.42	0.25
9:32	1:02	NP	21.48	0.00	4.41	0.26
9:37	1:07	NP	21.48	0.00	4.41	0.26
9:42	1:12	NP	21.49	0.00	4.40	0.27
9:49	1:19	NP	21.49	0.00	4.40	0.27
10:11	1:41	21.50	21.51	0.01	4.39	0.28
10:34	2:04	21.50	21.51	0.01	4.39	0.28
11:10	2:40	21.51	21.52	0.01	4.38	0.29
11:44	3:14	NP	21.53	0.00	4.36	0.31
13:04	4:34	NP	21.53	0.00	4.36	0.31
14:13	5:43	NP	21.52	0.00	4.37	0.30
15:21	6:51	NP	21.53	0.00	4.36	0.31
16:59	8:29	NP	21.56	0.00	4.33	0.34
18:04	9:34	NP	21.58	0.00	4.31	0.36
19:12	10:42	NP	21.59	0.00	4.30	0.37
20:05	11:35	NP	21.61	0.00	4.28	0.39
21:10	12:40	NP	21.61	0.00	4.28	0.39
22:11	13:41	NP	21.63	0.00	4.26	0.41
23:30	15:00	NP	21.63	0.00	4.26	0.41
0:10	15:40	NP	21.62	0.00	4.27	0.40
8:48	24:18	NP	21.59	0.00	4.30	0.37
10:14	25:44	NP	21.58	0.00	4.31	0.36
11:43	27:13	21.56	21.57	0.01	4.33	0.34
13:21	28:51	21.58	21.59	0.01	4.31	0.36
14:21	29:51	21.60	21.61	0.01	4.29	0.38
15:42	31:12	21.70	21.71	0.01	4.19	0.48

RW-406 PUMP TEST
OBSERVATION WELL DATA - PZ-401

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 25.89 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
16:16	31:46	21.72	21.73	0.01	4.17	0.50
17:29	32:59	NP	21.77	0.00	4.12	0.55
18:44	34:14	NP	21.78	0.00	4.11	0.56
19:42	35:12	NP	21.83	0.00	4.06	0.61
20:57	36:27	NP	21.81	0.00	4.08	0.59
22:30	38:00	NP	21.89	0.00	4.00	0.67
2:20	41:50	NP	21.90	0.00	3.99	0.68
8:15	47:45	NP	21.95	0.00	3.94	0.73
10:14	49:44	NP	21.94	0.00	3.95	0.72
11:45	51:15	NP	22.00	0.00	3.89	0.78
13:43	53:13	NP	21.98	0.00	3.91	0.76
15:14	54:44	NP	22.02	0.00	3.87	0.80
15:46	55:16	21.79	21.80	0.01	4.10	0.57
16:14	55:44	NP	21.60	0.00	4.29	0.38

NOTES:

Test started at 8:30 on 10/1/02 and ended at 15:30 on 10/3/02

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

S:\Clients\Sunoco\26th Street\Aquifer Test Data\[obs well data.xls]PZ-401

RW-406 PUMP TEST
OBSERVATION WELL DATA - PZ-402

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 25.38 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
8:30	0:00	NP	20.93	0.00	4.45	0.00
8:36	0:06	NP	20.96	0.00	4.42	0.03
8:40	0:10	NP	21.01	0.00	4.37	0.08
8:48	0:18	NP	21.09	0.00	4.29	0.16
8:54	0:24	NP	21.12	0.00	4.26	0.19
9:00	0:30	NP	21.14	0.00	4.24	0.21
9:07	0:37	NP	21.15	0.00	4.23	0.22
9:15	0:45	NP	21.18	0.00	4.20	0.25
9:19	0:49	NP	21.19	0.00	4.19	0.26
9:24	0:54	NP	21.20	0.00	4.18	0.27
9:31	1:01	NP	21.21	0.00	4.17	0.28
9:36	1:06	NP	21.21	0.00	4.17	0.28
9:41	1:11	NP	21.22	0.00	4.16	0.29
9:48	1:18	NP	21.22	0.00	4.16	0.29
10:10	1:40	NP	21.25	0.00	4.13	0.32
10:33	2:03	NP	21.25	0.00	4.13	0.32
11:10	2:40	NP	21.27	0.00	4.11	0.34
11:43	3:13	NP	21.28	0.00	4.10	0.35
13:03	4:33	NP	21.28	0.00	4.10	0.35
14:12	5:42	NP	21.28	0.00	4.10	0.35
15:20	6:50	NP	21.28	0.00	4.10	0.35
16:59	8:29	NP	21.32	0.00	4.06	0.39
18:03	9:33	NP	21.35	0.00	4.03	0.42
19:11	10:41	NP	21.35	0.00	4.03	0.42
20:04	11:34	NP	21.36	0.00	4.02	0.43
21:09	12:39	NP	21.37	0.00	4.01	0.44
22:11	13:41	NP	21.38	0.00	4.00	0.45
23:28	14:58	NP	21.39	0.00	3.99	0.46
0:09	15:39	NP	21.39	0.00	3.99	0.46
8:47	24:17	21.35	21.36	0.01	4.03	0.42
10:12	25:42	NP	21.34	0.00	4.04	0.41
11:42	27:12	NP	21.33	0.00	4.05	0.40
13:20	28:50	21.35	21.36	0.01	4.03	0.42
14:20	29:50	21.35	21.36	0.01	4.03	0.42
15:41	31:11	21.45	21.46	0.01	3.93	0.52
16:15	31:45	NP	21.50	0.00	3.88	0.57

RW-406 PUMP TEST
OBSERVATION WELL DATA - PZ-402

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 25.38 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
17:28	32:58	21.53	21.54	0.01	3.85	0.60
18:43	34:13	21.56	21.57	0.01	3.82	0.63
19:41	35:11	NP	21.63	0.00	3.75	0.70
20:57	36:27	21.59	21.60	0.01	3.79	0.66
22:29	37:59	21.65	21.66	0.01	3.73	0.72
2:19	41:49	NP	21.69	0.00	3.69	0.76
8:14	47:44	21.68	21.69	0.01	3.70	0.75
10:13	49:43	21.73	21.74	0.01	3.65	0.80
11:43	51:13	NP	21.78	0.00	3.60	0.85
13:43	53:13	NP	21.77	0.00	3.61	0.84
15:13	54:43	NP	21.80	0.00	3.58	0.87
15:44	55:14	NP	21.65	0.00	3.73	0.72
16:14	55:44	NP	21.38	0.00	4.00	0.45

NOTES:

Test started at 8:30 on 10/1/02 and ended at 15:30 on 10/3/02

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

S:\Clients\Sunoco\26th Street\Aquifer Test Data\[obs well data.xls]PZ-402

RW-406 PUMP TEST
OBSERVATION WELL DATA - MW-K

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 27.95 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
8:30	0:00	NP	23.44	0.00	4.51	0.00
8:35	0:05	NP	23.43	0.00	4.52	-0.01
8:39	0:09	NP	23.44	0.00	4.51	0.00
8:45	0:15	NP	23.45	0.00	4.50	0.01
8:53	0:23	NP	23.48	0.00	4.47	0.04
8:59	0:29	NP	23.49	0.00	4.46	0.05
9:05	0:35	NP	23.50	0.00	4.45	0.06
9:14	0:44	NP	23.51	0.00	4.44	0.07
9:18	0:48	NP	23.52	0.00	4.43	0.08
9:23	0:53	NP	23.53	0.00	4.42	0.09
9:30	1:00	NP	23.53	0.00	4.42	0.09
9:35	1:05	NP	23.54	0.00	4.41	0.10
9:37	1:07	NP	23.54	0.00	4.41	0.10
9:45	1:15	NP	23.54	0.00	4.41	0.10
10:09	1:39	NP	23.56	0.00	4.39	0.12
10:32	2:02	NP	23.56	0.00	4.39	0.12
11:01	2:31	NP	23.57	0.00	4.38	0.13
11:42	3:12	NP	23.59	0.00	4.36	0.15
12:59	4:29	NP	23.60	0.00	4.35	0.16
14:10	5:40	NP	23.59	0.00	4.36	0.15
15:19	6:49	NP	23.60	0.00	4.35	0.16
16:57	8:27	NP	23.64	0.00	4.31	0.20
18:02	9:32	NP	23.65	0.00	4.30	0.21
19:07	10:37	NP	23.66	0.00	4.29	0.22
20:03	11:33	NP	23.67	0.00	4.28	0.23
21:08	12:38	NP	23.68	0.00	4.27	0.24
22:10	13:40	NP	23.69	0.00	4.26	0.25
23:27	14:57	NP	23.70	0.00	4.25	0.26
0:08	15:38	NP	23.70	0.00	4.25	0.26
8:41	24:11	NP	23.71	0.00	4.24	0.27
10:10	25:40	NP	23.71	0.00	4.24	0.27
10:36	26:06	NP	23.69	0.00	4.26	0.25
13:18	28:48	NP	23.68	0.00	4.27	0.24
14:14	29:44	NP	23.68	0.00	4.27	0.24
15:39	31:09	NP	23.71	0.00	4.24	0.27
16:14	31:44	NP	23.74	0.00	4.21	0.30

RW-406 PUMP TEST
OBSERVATION WELL DATA - MW-K

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 27.95 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
17:26	32:56	NP	23.79	0.00	4.16	0.35
18:38	34:08	NP	23.81	0.00	4.14	0.37
19:40	35:10	NP	23.85	0.00	4.10	0.41
20:56	36:26	NP	23.85	0.00	4.10	0.41
22:24	37:54	NP	23.86	0.00	4.09	0.42
2:13	41:43	NP	23.91	0.00	4.04	0.47
8:10	47:40	NP	23.95	0.00	4.00	0.51
10:11	49:41	NP	23.98	0.00	3.97	0.54
11:42	51:12	NP	23.96	0.00	3.99	0.52
13:42	53:12	NP	23.97	0.00	3.98	0.53
15:10	54:40	NP	24.00	0.00	3.95	0.56
15:43	55:13	NP	23.99	0.00	3.96	0.55
16:13	55:43	NP	23.91	0.00	4.04	0.47

NOTES:

Test started at 8:30 on 10/1/02 and ended at 15:30 on 10/3/02

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

S:\Clients\Sunoco\26th Street\Aquifer Test Data\[obs well data.xls]MW-K

RW-406 PUMP TEST
OBSERVATION WELL DATA - S-82

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 29.27 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
8:30	0:00	23.42	23.63	0.21	5.80	0.00
8:34	0:04	23.41	23.62	0.21	5.81	-0.01
8:38	0:08	23.41	23.62	0.21	5.81	-0.01
8:43	0:13	23.41	23.60	0.19	5.81	-0.01
8:51	0:21	23.41	23.60	0.19	5.81	-0.01
8:57	0:27	23.41	23.60	0.19	5.81	-0.01
9:03	0:33	23.40	23.60	0.20	5.82	-0.02
9:11	0:41	23.38	23.59	0.21	5.84	-0.04
9:17	0:47	23.38	23.60	0.22	5.84	-0.04
9:21	0:51	23.38	23.59	0.21	5.84	-0.04
9:28	0:58	23.38	23.58	0.20	5.84	-0.04
9:34	1:04	23.38	23.59	0.21	5.84	-0.04
9:38	1:08	23.38	23.59	0.21	5.84	-0.04
9:43	1:13	23.38	23.58	0.20	5.84	-0.04
10:08	1:38	23.38	23.59	0.21	5.84	-0.04
10:31	2:01	23.38	23.58	0.20	5.84	-0.04
11:00	2:30	23.38	23.60	0.22	5.84	-0.04
11:40	3:10	23.39	23.58	0.19	5.83	-0.03
12:58	4:28	23.38	23.58	0.20	5.84	-0.04
14:09	5:39	23.38	23.59	0.21	5.84	-0.04
15:17	6:47	23.38	23.58	0.20	5.84	-0.04
16:56	8:26	23.39	23.59	0.20	5.83	-0.03
18:00	9:30	23.40	23.60	0.20	5.82	-0.02
19:05	10:35	23.40	23.61	0.21	5.82	-0.02
20:02	11:32	23.40	23.61	0.21	5.82	-0.02
21:05	12:35	23.40	23.61	0.21	5.82	-0.02
22:08	13:38	23.41	23.62	0.21	5.81	-0.01
23:25	14:55	23.41	23.61	0.20	5.81	-0.01
0:05	15:35	23.41	23.61	0.20	5.81	-0.01
8:38	24:08	23.45	23.68	0.23	5.76	0.03
10:05	25:35	23.46	23.68	0.22	5.76	0.04
11:34	27:04	23.46	23.69	0.23	5.75	0.04
13:17	28:47	23.46	23.68	0.22	5.76	0.04
14:13	29:43	23.46	23.69	0.23	5.75	0.04
15:38	31:08	23.47	23.69	0.22	5.75	0.05
16:13	31:43	23.47	23.69	0.22	5.75	0.05

RW-406 PUMP TEST
OBSERVATION WELL DATA - S-82

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 29.27 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
17:32	33:02	23.47	23.68	0.21	5.75	0.05
18:37	34:07	23.47	23.68	0.21	5.75	0.05
19:39	35:09	23.47	23.67	0.20	5.75	0.05
20:52	36:22	23.48	23.68	0.20	5.74	0.06
22:22	37:52	23.49	23.70	0.21	5.73	0.07
2:11	41:41	23.50	23.70	0.20	5.72	0.08
8:07	47:37	23.54	23.75	0.21	5.68	0.12
10:07	49:37	23.55	23.75	0.20	5.67	0.13
11:38	51:08	23.55	23.76	0.21	5.67	0.13
13:38	53:08	23.56	23.74	0.18	5.67	0.13
15:07	55:08	23.56	23.77	0.21	5.66	0.14
15:33	55:03	23.56	23.76	0.20	5.66	0.14
16:08	55:38	23.56	23.76	0.20	5.66	0.14

NOTES:

Test started at 8:30 on 10/1/02 and ended at 15:30 on 10/3/02

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

S:\Clients\Sunoco\26th Street\Aquifer Test Data\[obs well data.xls]S-82

RW-406 PUMP TEST
OBSERVATION WELL DATA - RW-402

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 23.69 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
8:30	0:00	21.15	21.19	0.04	2.53	0.00
8:46	0:16	21.17	21.22	0.05	2.51	0.02
9:05	0:35	21.15	21.20	0.05	2.53	0.00
9:46	1:16	21.14	21.19	0.05	2.54	-0.01
11:03	2:33	21.12	21.17	0.05	2.56	-0.03
13:02	4:32	21.10	21.15	0.05	2.58	-0.05
19:09	10:39	21.13	21.17	0.04	2.55	-0.02
22:15	13:45	21.15	21.20	0.05	2.53	0.00
23:34	15:04	21.15	21.20	0.05	2.53	0.00
8:44	24:14	21.16	21.23	0.07	2.51	0.02
11:41	27:11	21.14	21.21	0.07	2.53	0.00
14:17	29:47	21.10	21.16	0.06	2.58	-0.05
18:42	34:12	21.11	21.15	0.04	2.57	-0.04
22:27	37:57	21.15	21.20	0.05	2.53	0.00
2:17	41:47	21.18	21.23	0.05	2.50	0.03
8:09	47:39	21.21	21.28	0.07	2.46	0.07
10:09	49:39	21.24	21.30	0.06	2.44	0.09
11:40	51:10	21.22	21.29	0.07	2.45	0.08
13:41	53:11	21.22	21.28	0.06	2.46	0.07
15:08	54:38	21.22	21.28	0.06	2.46	0.07
15:41	55:11	21.23	21.29	0.06	2.45	0.08
16:11	55:41	21.23	21.29	0.06	2.45	0.08

NOTES:

Test started at 8:30 on 10/1/02 and ended at 15:30 on 10/3/02

FAMSL = Feet above mean sea level

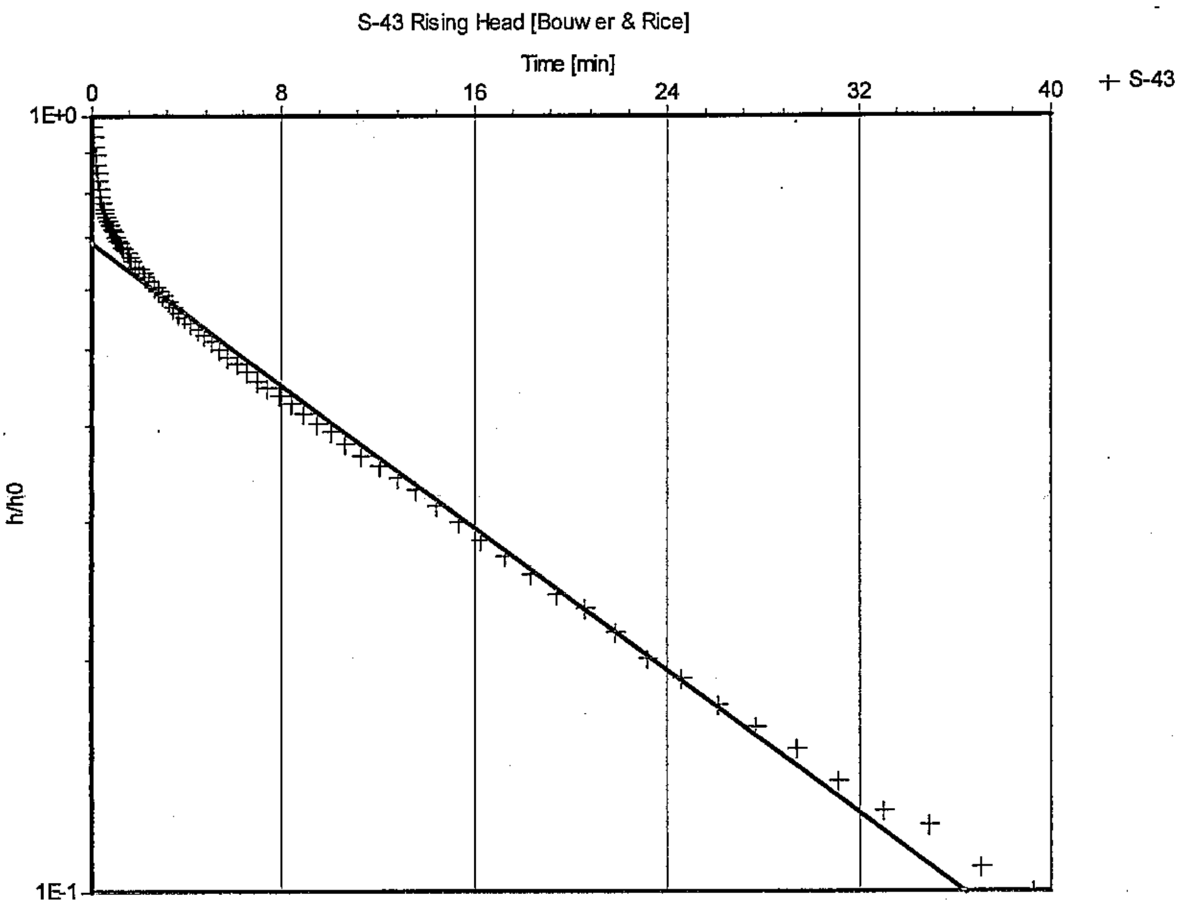
Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

S:\Clients\Sunoco\26th Street\Aquifer Test Data\[obs well data.xls]RW-402

APPENDIX D

Slug Test Data Graphs

SECOR International, Inc.	**Slug Test Analysis Report**
102 Pickering Way - Suite 200	Project: 26th Street Investigation
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



Slug Test: **S-43 Rising Head**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 7.58E-1 [ft/d]

Test parameters:

Test Well:	S-43	Aquifer Thickness:	4.91 [ft]
Casing radius:	0.167 [ft]	Gravel Pack Porosity (%)	25
Screen length:	4.91 [ft]		
Boring radius:	0.333 [ft]		
r(eff):	0.221 [ft]		

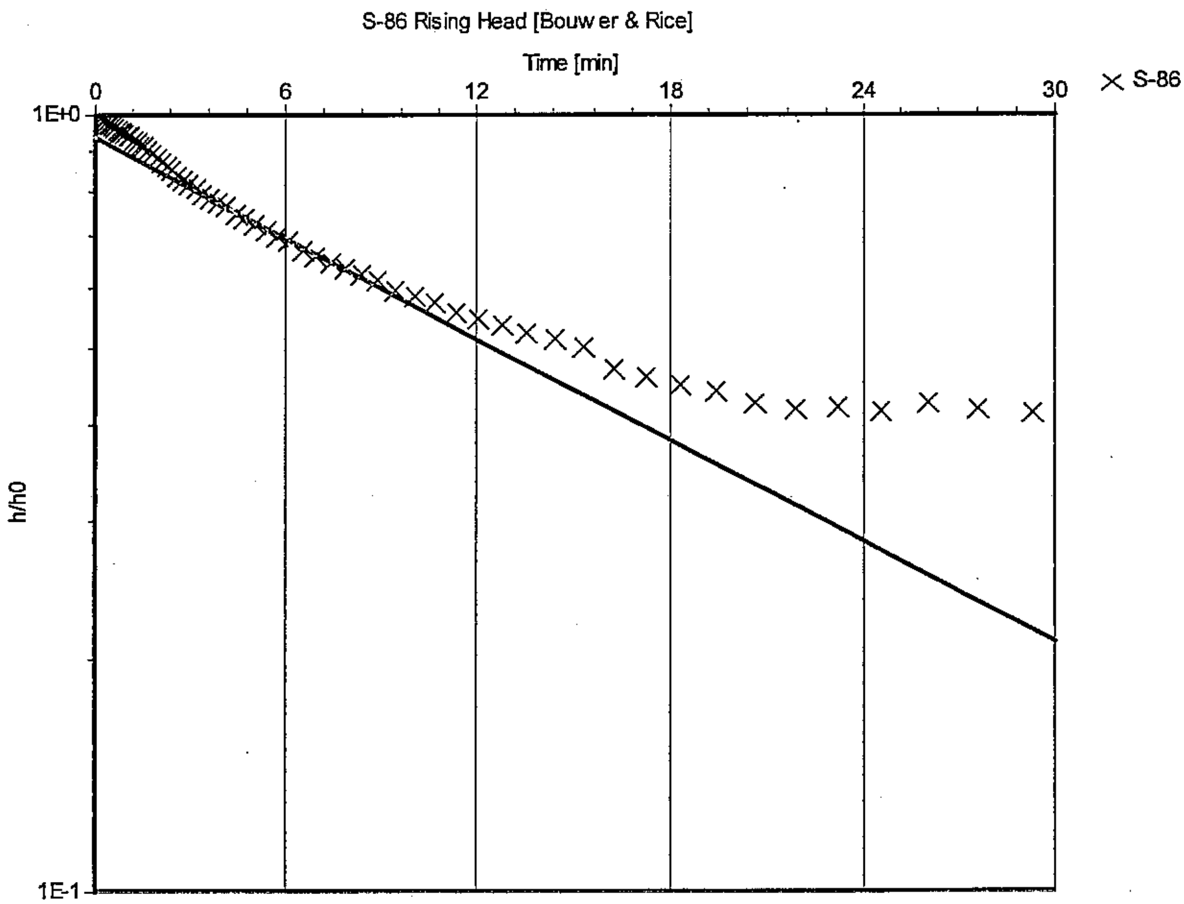
Comments:

Evaluated by:

Evaluation Date: 10/23/02

SECOR International, Inc.
102 Pickering Way - Suite 200
Exton, PA
Phone: (484) 875-3075

Slug Test Analysis Report
Project: 26th Street Investigation
Number:
Client: Sunoco



Slug Test: **S-86 Rising Head**

Analysis Method: **Bouwer & Rice**

Analysis Results: Conductivity: 2.97E-1 [ft/d]

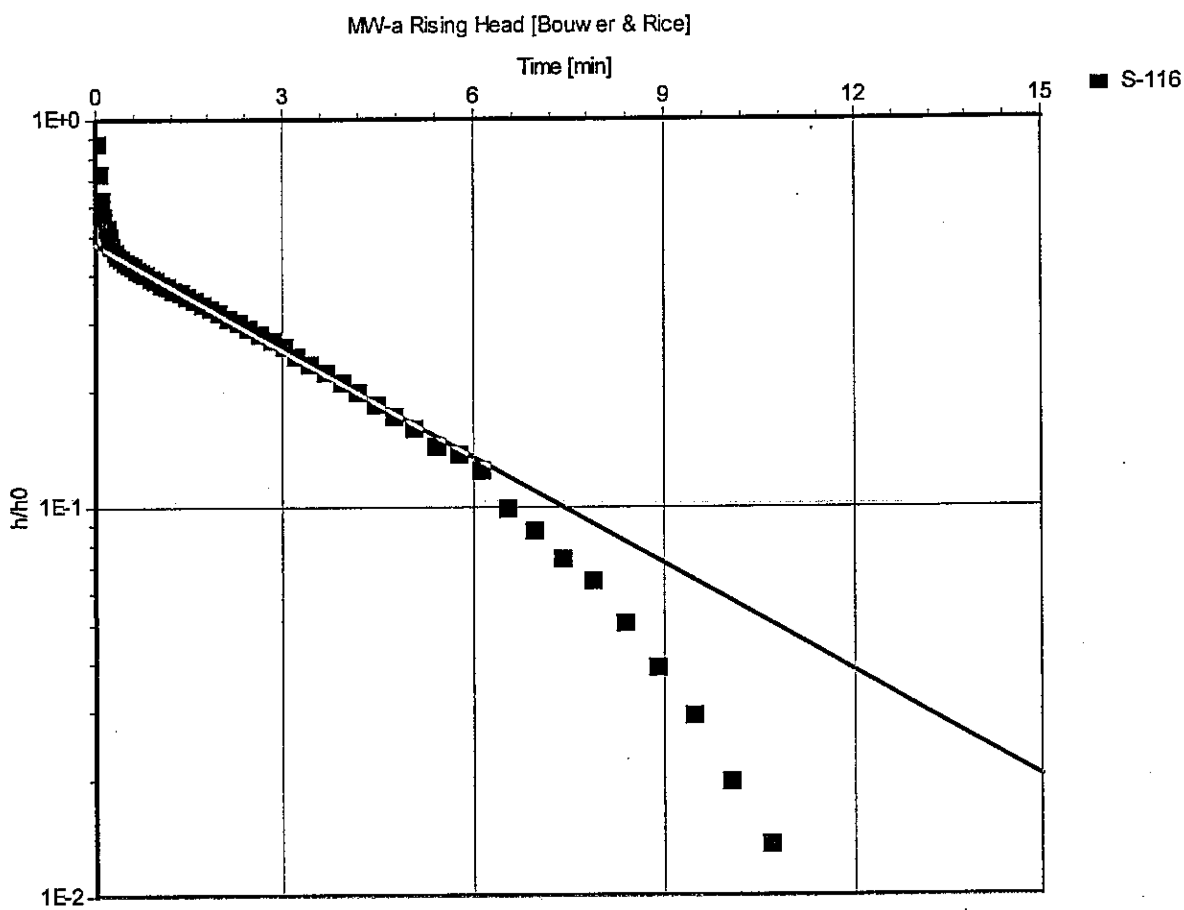
Test parameters:				
	Test Well:	S-86	Aquifer Thickness:	6.09 [ft]
	Casing radius:	0.0833 [ft]	Gravel Pack Porosity (%)	25
	Screen length:	6.09 [ft]		
	Boring radius:	0.25 [ft]		
	r(eff):	0.144 [ft]		

Comments:

Evaluated by:

Evaluation Date: 10/23/02

SECOR International, Inc.	**Slug Test Analysis Report**
102 Pickering Way - Suite 200	Project: 26th Street Investigation
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



Slug Test: **MW-a Rising Head**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 2.11E+0 [ft/d]

Test parameters:

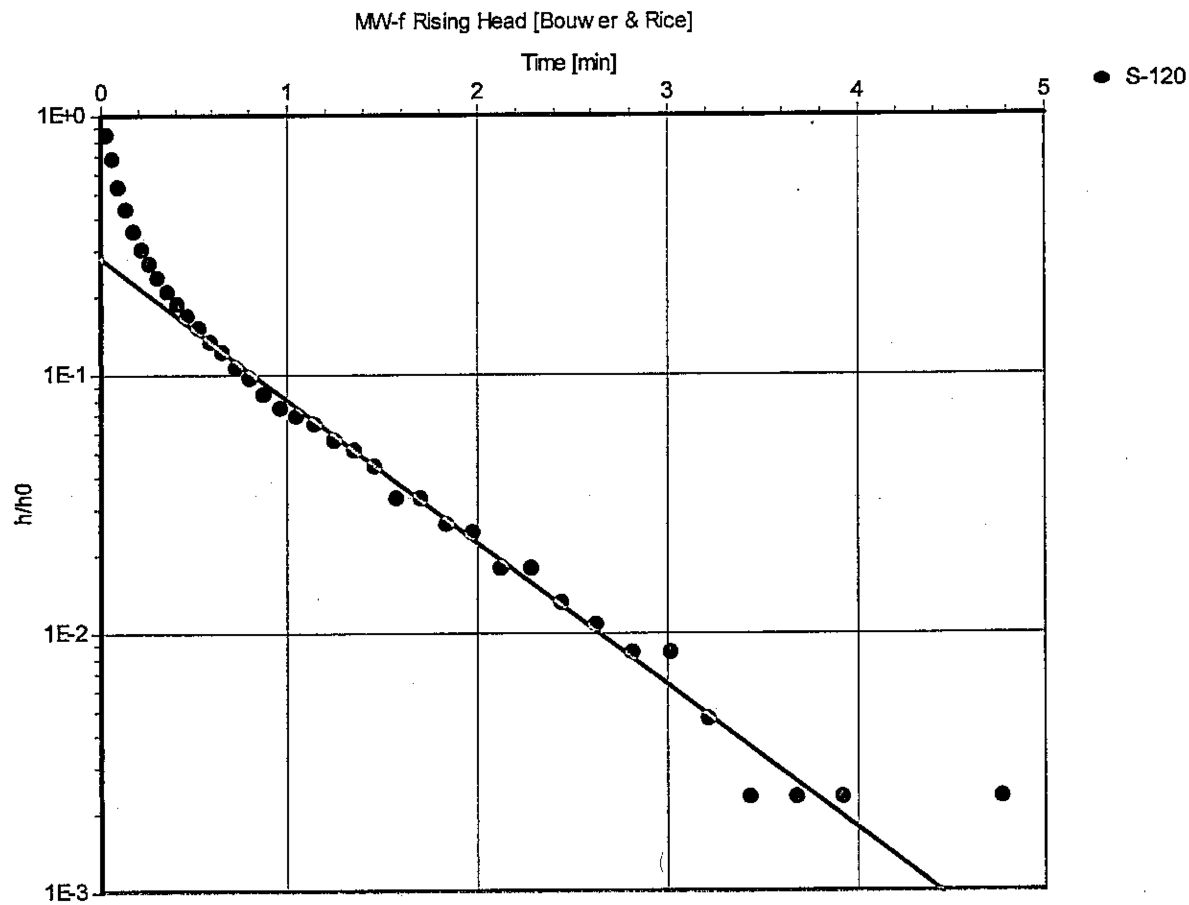
Test Well:	S-116	Aquifer Thickness:	8.62 [ft]
Casing radius:	0.167 [ft]	Gravel Pack Porosity (%)	25
Screen length:	8.62 [ft]		
Boring radius:	0.333 [ft]		
r(eff):	0.221 [ft]		

Comments:

Evaluated by:

Evaluation Date: 10/23/02

SECOR International, Inc.	**Slug Test Analysis Report**
102 Pickering Way - Suite 200	Project: 26th Street Investigation
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



Slug Test: **MW-f Rising Head**

Analysis Method: **Bouwer & Rice**

Analysis Results: Conductivity: 1.17E+1 [ft/d]

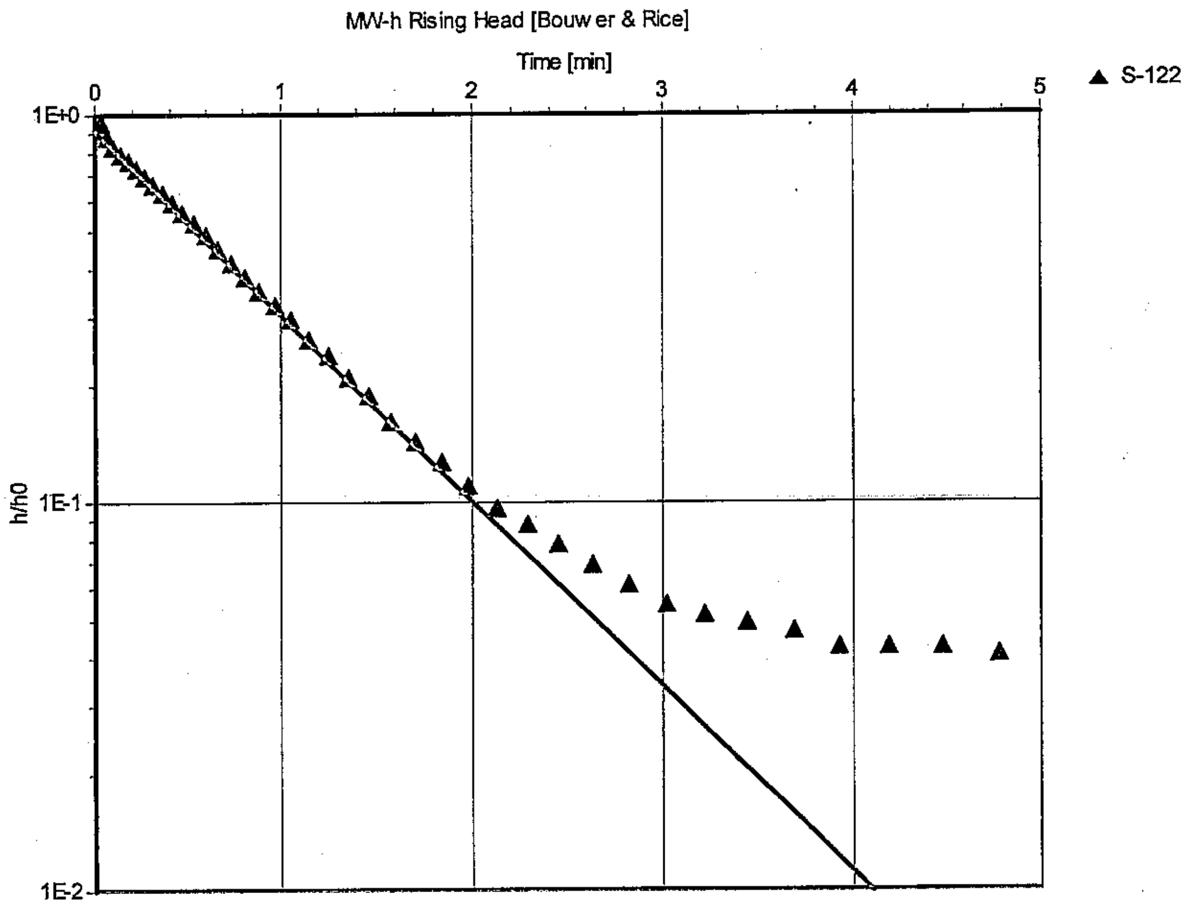
Test parameters:				
	Test Well:	S-120	Aquifer Thickness:	9.75 [ft]
	Casing radius:	0.167 [ft]	Gravel Pack Porosity (%)	25
	Screen length:	9.75 [ft]		
	Boring radius:	0.333 [ft]		
	r(eff):	0.221 [ft]		

Comments:

Evaluated by:

Evaluation Date: 10/23/02

SECOR International, Inc.	Slug Test Analysis Report
102 Pickering Way - Suite 200	Project: 26th Street Investigation
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



Slug Test: **MW-h Rising Head**

Analysis Method: **Bouwer & Rice**

Analysis Results: Conductivity: 1.26E+1 [ft/d]

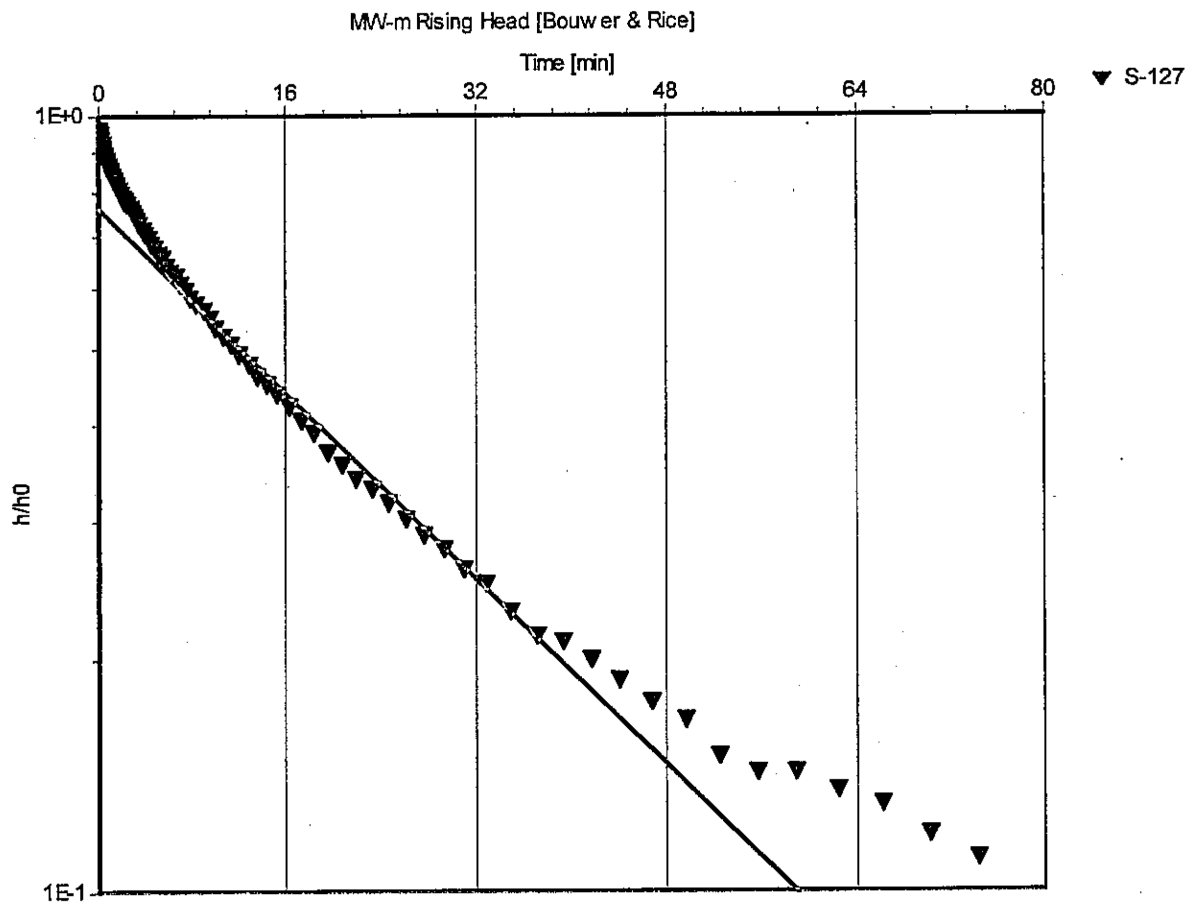
Test parameters:				
	Test Well:	S-122	Aquifer Thickness:	7.09 [ft]
	Casing radius:	0.167 [ft]	Gravel Pack Porosity (%)	25
	Screen length:	7.09 [ft]		
	Boring radius:	0.333 [ft]		
	r(eff):	0.221 [ft]		

Comments:

Evaluated by:

Evaluation Date: 10/23/02

SECOR International, Inc.	**Slug Test Analysis Report**
102 Pickering Way - Suite 200	Project: 26th Street Investigation
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



Slug Test: **MW-m Rising Head**

Analysis Method: **Bouwer & Rice**

Analysis Results: Conductivity: 2.88E-1 [ft/d]

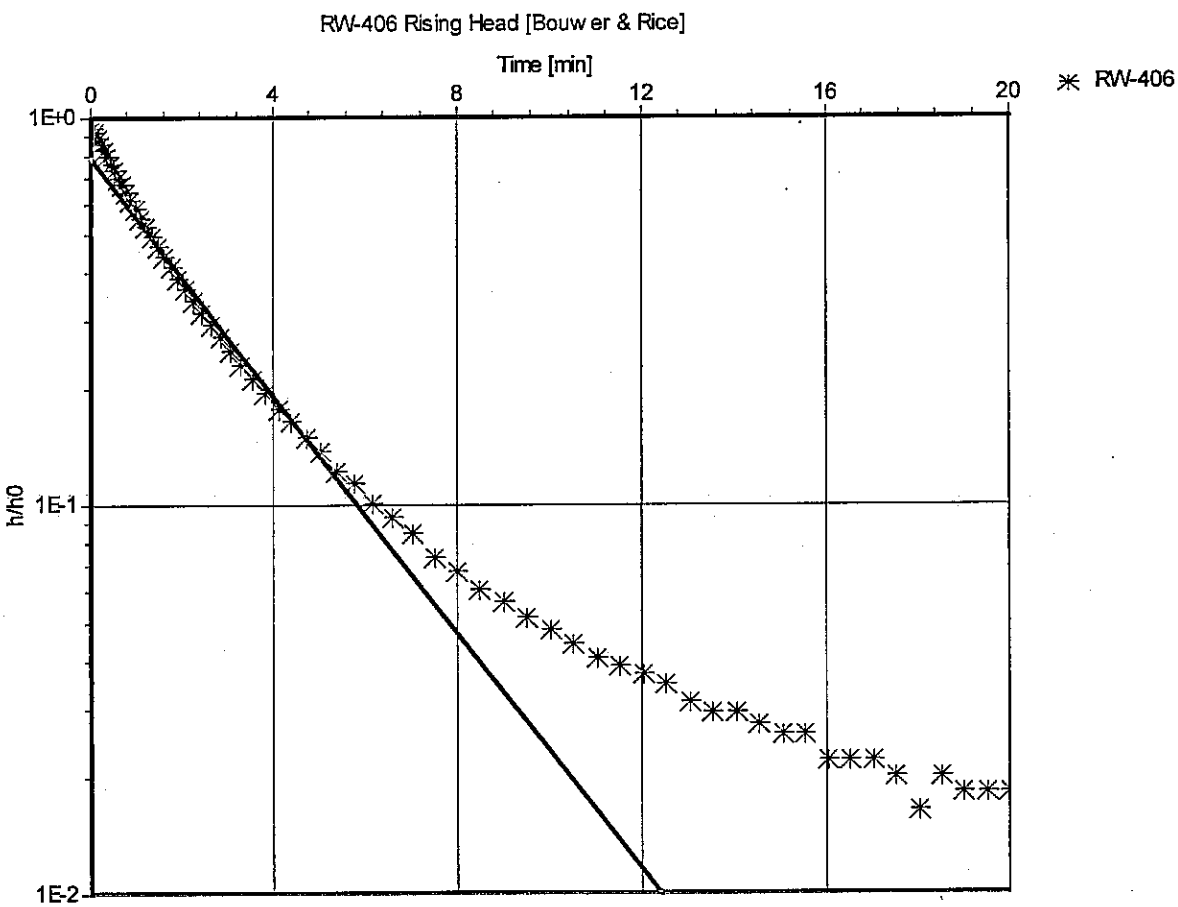
Test parameters:				
	Test Well:	S-127	Aquifer Thickness:	11.19 [ft]
	Casing radius:	0.167 [ft]	Gravel Pack Porosity (%)	25
	Screen length:	11.19 [ft]		
	Boring radius:	0.333 [ft]		
	r(eff):	0.221 [ft]		

Comments:

Evaluated by:

Evaluation Date: 10/23/02

SECOR International, Inc.	**Slug Test Analysis Report**
102 Pickering Way - Suite 200	Project: 26th Street Investigation
Exton, PA	Number:
Phone: (484) 875-3075	Client: Sunoco



Slug Test: **RW-406 Rising Head**

Analysis Method: **Bouwer & Rice**

Analysis Results: Conductivity: 7.22E+0 [ft/d]

Test parameters:			
Test Well:	RW-406	Aquifer Thickness:	12.52 [ft]
Casing radius:	0.333 [ft]	Gravel Pack Porosity (%)	25
Screen length:	12.52 [ft]		
Boring radius:	0.5 [ft]		
r(eff):	0.382 [ft]		

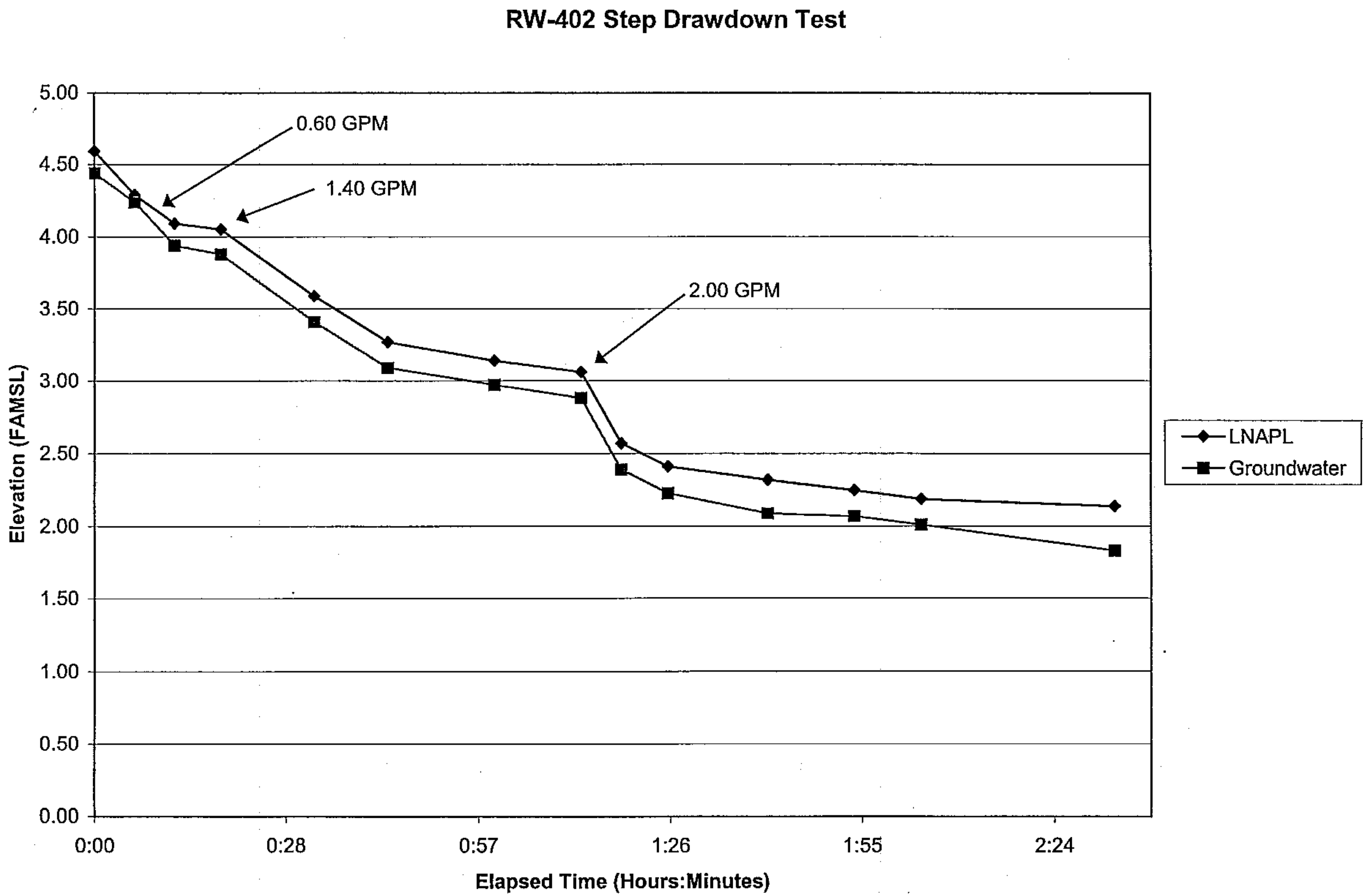
Comments:

Evaluated by:

Evaluation Date: 10/23/02

APPENDIX E

RW-400 Series Recovery Wells Capacity Test Data



RW-402 Step Drawdown Test
0.60 GPM
1.40 GPM
2.00 GPM
Elevation (FAMSL)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0:00
0:28
0:57
1:26
1:55
2:24
Elapsed Time (Hours:Minutes)
LNAPL
Groundwater

RW-402
STEP DRAWDOWN TEST

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 23.69 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To LNAPL (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	LNAPL Elevation (FAMSL)	Groundwater Elevation (FAMSL)
11:16	0:00	19.10	19.25	0.15	4.59	4.44
11:22	0:06	19.40	19.45	0.05	4.29	4.24
11:28	0:12	19.60	19.75	0.15	4.09	3.94
11:35	0:19	19.64	19.81	0.17	4.05	3.88
11:49	0:33	20.10	20.28	0.18	3.59	3.41
12:00	0:44	20.42	20.60	0.18	3.27	3.09
12:16	1:00	20.55	20.72	0.17	3.14	2.97
12:29	1:13	20.63	20.81	0.18	3.06	2.88
12:35	1:19	21.12	21.30	0.18	2.57	2.39
12:42	1:26	21.28	21.46	0.18	2.41	2.23
12:57	1:41	21.37	21.60	0.23	2.32	2.09
13:10	1:54	21.44	21.62	0.18	2.25	2.07
13:20	2:04	21.50	21.68	0.18	2.19	2.01
13:49	2:33	21.55	21.86	0.31	2.14	1.83

NOTES:

Test started at 11:17 and ended at 13:55 on 11/14/02

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

S:\Clients\Sunoco\26th Street\Step Drawdown Tests\[RW-402 Step Test.xls]RW-402

RW-402 STEP DRAWDOWN TEST
OBSERVATION WELL DATA - S-125

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 27.95 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
11:21	0:00	--	23.14	0.00	4.81	0.00
12:22	1:01	--	23.11	0.00	4.84	-0.03
13:22	2:01	--	23.12	0.00	4.83	-0.02
13:52	2:31	--	23.12	0.00	4.83	-0.02

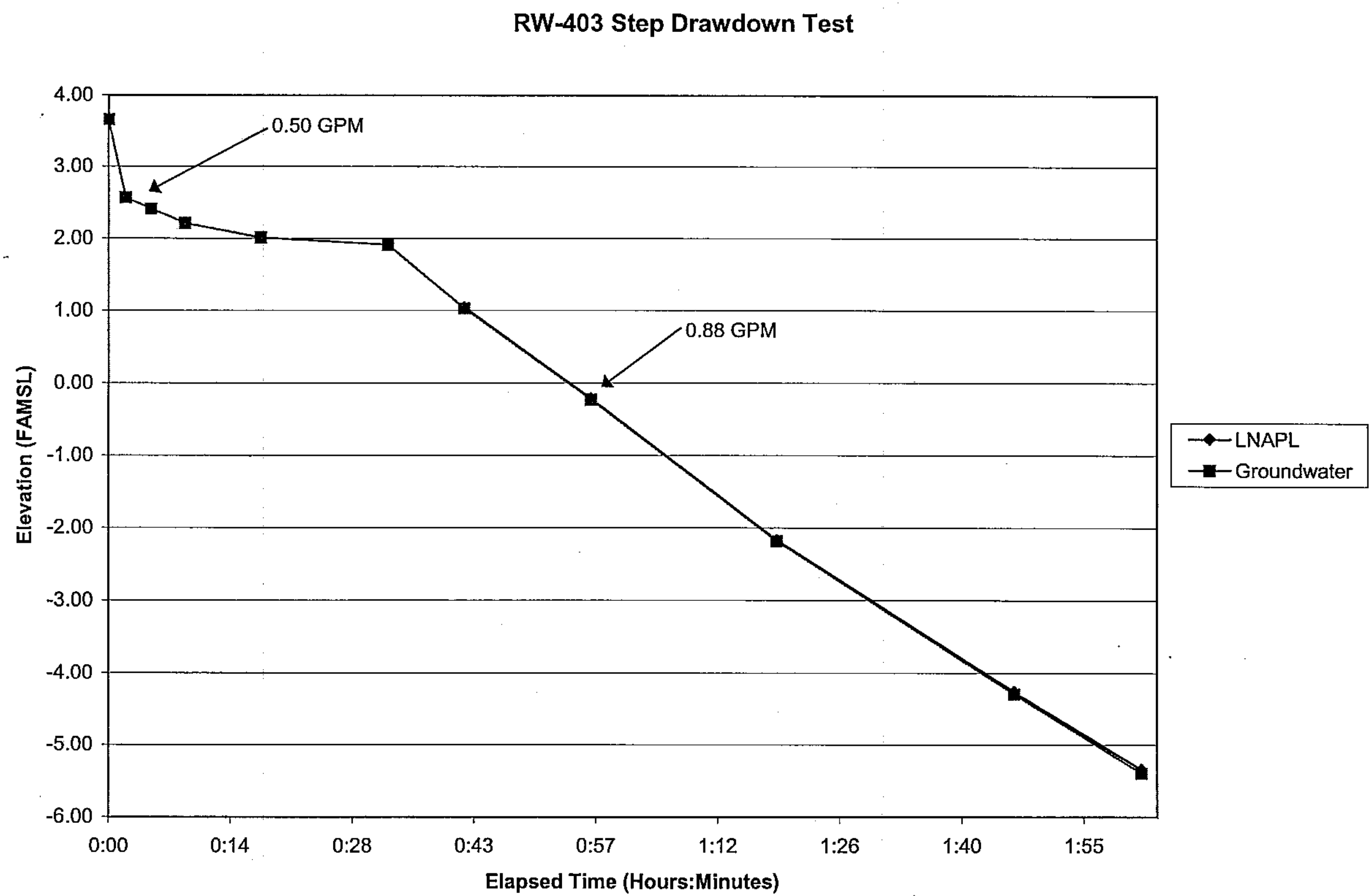
NOTES:

Test started at 11:17 and ended at 13:55 on 11/14/02

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

S:\Clients\Sunoco\26th Street\Step Drawdown Tests\[RW-402 Step Test.xls]S-125


RW-403 Step Drawdown Test
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
-5.00
-6.00
Elevation (FAMSL)
0.50 GPM
0.88 GPM
0:00
0:14
0:28
0:43
0:57
1:12
1:26
1:40
1:55
Elapsed Time (Hours:Minutes)
LNAPL
Groundwater

RW-403
STEP DRAWDOWN TEST

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 26.02 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To LNAPL (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	LNAPL Elevation (FAMSL)	Groundwater Elevation (FAMSL)
11:14	0:00	--	22.36	0.00		3.66
11:16	0:02	--	23.45	0.00		2.57
11:19	0:05	--	23.61	0.00		2.41
11:23	0:09	--	23.81	0.00		2.21
11:32	0:18	--	24.01	0.00		2.01
11:47	0:33	Film	24.11	0.00		1.91
11:56	0:42	24.98	24.99	0.01	1.04	1.03
12:11	0:57	26.24	26.25	0.01	-0.22	-0.23
12:33	1:19	28.19	28.20	0.01	-2.17	-2.18
13:01	1:47	30.28	30.31	0.03	-4.26	-4.29
13:16	2:02	31.37	31.42	0.05	-5.35	-5.40

NOTES:

Test started at 11:14 and ended at 13:16 on 11/20/02

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

S:\Clients\Sunoco\26th Street\Step Drawdown Tests\[RW-403Step Test.xls]RW-403

RW-403 STEP DRAWDOWN TEST
OBSERVATION WELL DATA - S-84

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 25.05 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
11:12	0:00	--	18.05	0.00	7.00	0.00
11:22	0:10	--	17.15	0.00	7.90	-0.90
11:36	0:24	--	16.70	0.00	8.35	-1.35
11:58	0:46	--	16.13	0.00	8.92	-1.92
12:15	1:03	--	16.00	0.00	9.05	-2.05
12:50	1:38	--	15.95	0.00	9.10	-2.10
13:04	1:52	--	15.96	0.00	9.09	-2.09
13:14	2:02	--	15.97	0.00	9.08	-2.08

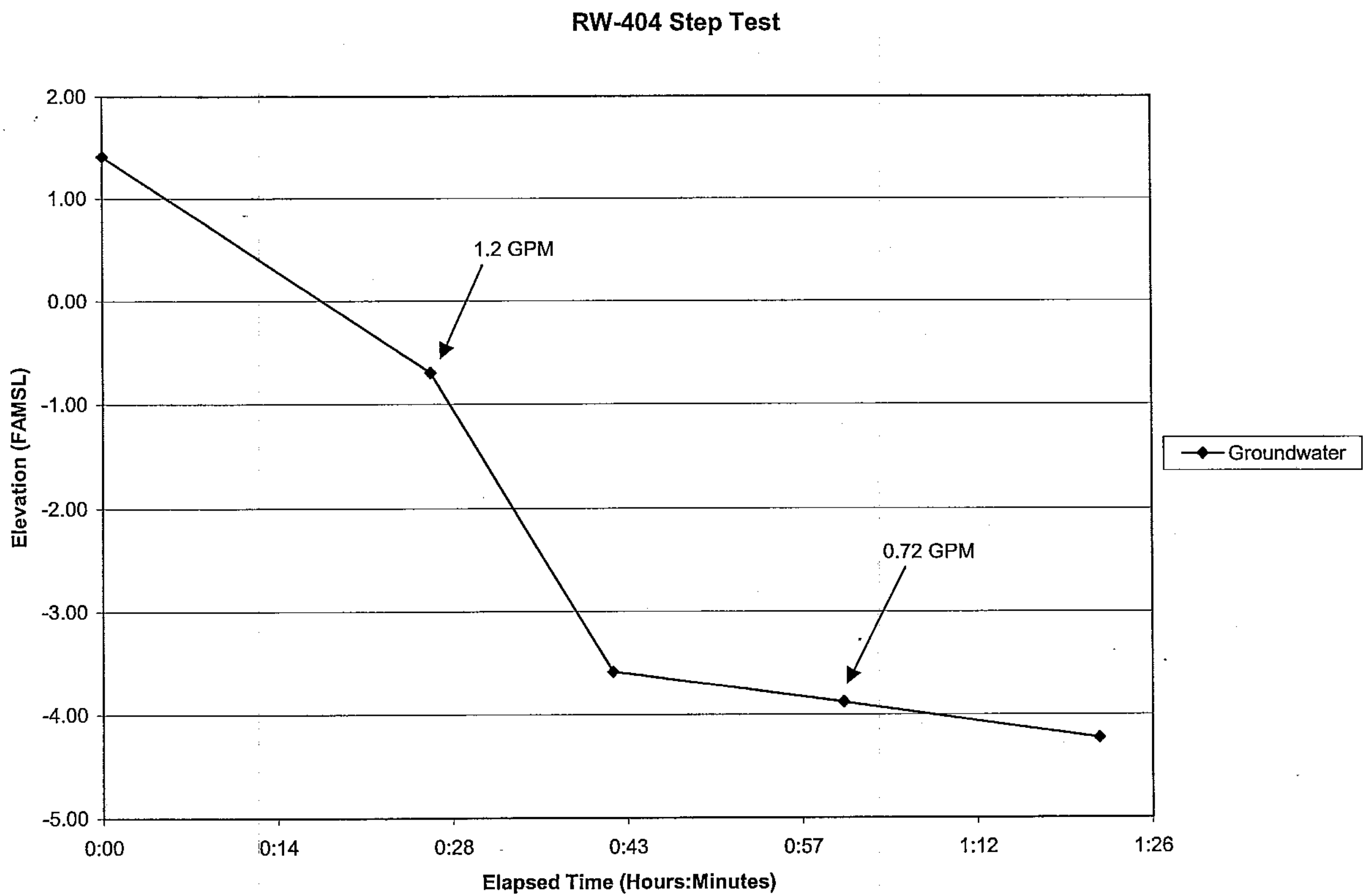
NOTES:

Test started at 11:14 and ended at 13:16 on 11/20/02

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

S:\Clients\Sunoco\26th Street\Step Drawdown Tests\[RW-403Step Test.xls]S-84


RW-404 Step Test
Elevation (FAMSL)
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
-5.00
1.2 GPM
0.72 GPM
Groundwater
0:00
0:14
0:28
0:43
0:57
1:12
1:26
Elapsed Time (Hours:Minutes)

RW-404
STEP DRAWDOWN TEST

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 25.62 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To LNAPL (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Groundwater Elevation (FAMSL)
14:14	0:00	--	24.21	0.00	1.41
14:41	0:27	--	26.32	0.00	-0.70
14:56	0:42	--	29.21	0.00	-3.59
15:15	1:01	--	29.50	0.00	-3.88
15:36	1:22	--	29.85	0.00	-4.23

NOTES:
Test started at 14:37 and ended at 15:36 on 11/14/02
FAMSL = Feet above mean sea level
Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))
S:\Clients\Sunoco\26th Street\Step Tests\[RW-404 Step Test.xls]RW-404

RW-404 STEP DRAWDOWN TEST
OBSERVATION WELL DATA - S-85

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 26.93 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
14:30	0:00	--	25.43	0.00	1.50	0.00
14:59	0:29	--	25.48	0.00	1.45	0.05
15:19	0:49	--	25.54	0.00	1.39	0.11
15:39	1:09	--	25.57	0.00	1.36	0.14

NOTES:

Test started at 14:37 and ended at 15:36 on 11/14/02

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

S:\Clients\Sunoco\26th Street\Step Tests\[RW-404 Step Test.xls]S-85

RW-404 STEP DRAWDOWN TEST
OBSERVATION WELL DATA - S-88A

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 26.78 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
14:35	0:00	--	26.72	0.00	0.06	0.00
15:00	0:25	--	26.72	0.00	0.06	0.00
15:22	0:47	--	26.68	0.00	0.10	-0.04

NOTES:

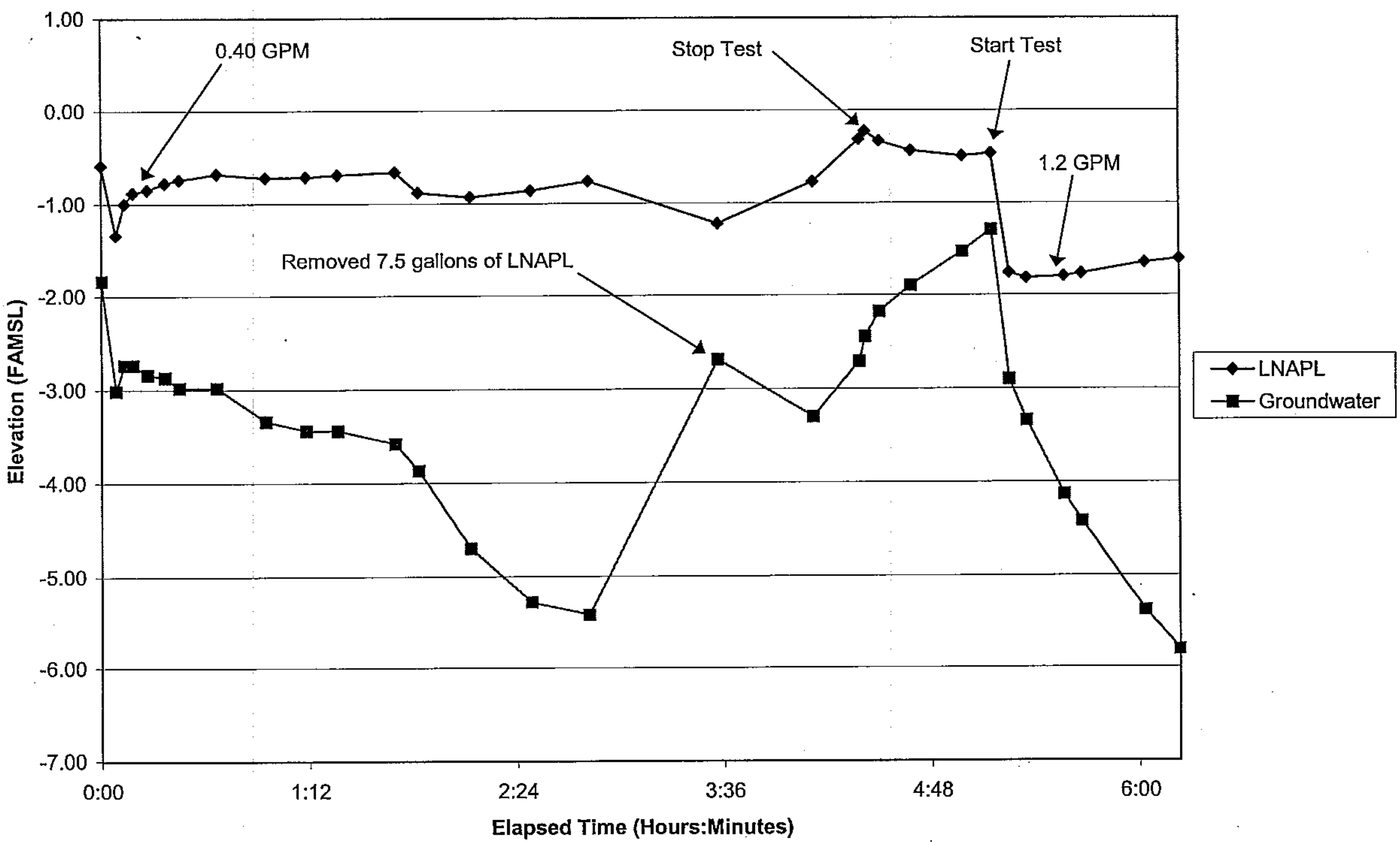
Test started at 14:37 and ended at 15:36 on 11/14/02

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

S:\Clients\Sunoco\26th Street\Step Tests\[RW-404 Step Test.xls]S-88A

RW-405 Step Drawdown Test



RW-405
STEP DRAWDOWN TEST

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 26.08 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To LNAPL (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	LNAPL Elevation (FAMSL)	Groundwater Elevation (FAMSL)
8:36	0:00	26.67	27.92	1.25	-0.59	-1.84
8:41	0:05	27.42	29.09	1.67	-1.34	-3.01
8:44	0:08	27.08	28.82	1.74	-1.00	-2.74
8:47	0:11	26.96	28.82	1.86	-0.88	-2.74
8:52	0:16	26.93	28.92	1.99	-0.85	-2.84
8:58	0:22	26.86	28.95	2.09	-0.78	-2.87
9:03	0:27	26.82	29.06	2.24	-0.74	-2.98
9:16	0:40	26.76	29.06	2.30	-0.68	-2.98
9:33	0:57	26.80	29.42	2.62	-0.72	-3.34
9:47	1:11	26.79	29.52	2.73	-0.71	-3.44
9:58	1:22	26.77	29.52	2.75	-0.69	-3.44
10:18	1:42	26.74	29.66	2.92	-0.66	-3.58
10:26	1:50	26.96	29.95	2.99	-0.88	-3.87
10:44	2:08	27.01	30.78	3.77	-0.93	-4.70
11:05	2:29	26.94	31.36	4.42	-0.86	-5.28
11:25	2:49	26.84	31.50	4.66	-0.76	-5.42
12:10	3:34	27.30	28.77	1.47	-1.22	-2.69
12:43	4:07	26.85	29.38	2.53	-0.77	-3.30
12:59	4:23	26.40	28.79	2.39	-0.32	-2.71
13:01	4:25	26.31	28.53	2.22	-0.23	-2.45
13:06	4:30	26.42	28.26	1.84	-0.34	-2.18
13:17	4:41	26.52	27.98	1.46	-0.44	-1.90
13:35	4:59	26.58	27.61	1.03	-0.50	-1.53
13:45	5:09	26.55	27.37	0.82	-0.47	-1.29
13:51	5:15	27.84	28.98	1.14	-1.76	-2.90
13:57	5:21	27.90	29.42	1.52	-1.82	-3.34
14:10	5:34	27.88	30.21	2.33	-1.80	-4.13
14:16	5:40	27.85	30.50	2.65	-1.77	-4.42
14:38	6:02	27.73	31.46	3.73	-1.65	-5.38
14:50	6:14	27.69	31.89	4.20	-1.61	-5.81

NOTES:

Test started at 8:36 and ended at 14:53 on 11/13/02

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

S:\Clients\Sunoco\26th Street\[RW-405 Step Test.xls]RW-405

RW-405 STEP DRAWDOWN TEST
OBSERVATION WELL DATA - S-89

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 27.99 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
8:27	0:00	27.91	29.15	1.24	-0.22	0.00
9:21	0:54	27.97	29.26	1.29	-0.29	0.07
10:00	1:33	27.97	29.28	1.31	-0.29	0.07
10:21	1:54	27.98	29.29	1.31	-0.30	0.08
10:46	2:19	27.99	29.34	1.35	-0.32	0.10
11:15	2:48	28.00	29.48	1.48	-0.37	0.15
11:28	3:01	27.97	29.43	1.46	-0.33	0.11
12:19	3:52	27.95	29.43	1.48	-0.32	0.10
13:10	4:43	27.95	29.17	1.22	-0.25	0.03
13:38	5:11	27.96	29.09	1.13	-0.24	0.02
14:06	5:39	28.06	29.40	1.34	-0.39	0.17
14:18	5:51	28.09	29.52	1.43	-0.44	0.22
14:43	6:16	28.05	29.65	1.60	-0.44	0.22

NOTES:

Test started at 8:36 and ended at 14:53 on 11/13/02

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

S:\Clients\Sunoco\26th Street\[RW-405 Step Test.xls]S-89

RW-405 STEP DRAWDOWN TEST
OBSERVATION WELL DATA - PZ-404

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 28.02 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
8:28	0:00	27.90	29.34	1.44	-0.23	0.00
9:22	0:54	27.95	29.46	1.51	-0.29	0.06
10:01	1:33	27.95	29.44	1.49	-0.29	0.06
10:22	1:54	27.95	29.44	1.49	-0.29	0.07
10:47	2:19	27.97	29.52	1.55	-0.32	0.09
11:17	2:49	27.97	29.60	1.63	-0.34	0.14
11:29	3:01	27.96	29.54	1.58	-0.32	0.10
12:20	3:52	27.93	29.50	1.57	-0.29	0.09
13:12	4:44	27.91	29.31	1.40	-0.23	0.02
13:40	5:12	27.89	29.25	1.36	-0.20	0.01
14:07	5:39	28.01	29.68	1.67	-0.39	0.16
14:19	5:51	28.02	29.75	1.73	-0.42	0.21
14:45	6:17	28.01	29.75	1.74	-0.41	0.21

NOTES:

Test started at 8:36 and ended at 14:53 on 11/13/02

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

S:\Clients\Sunoco\26th Street\[RW-405 Step Test.xls]PZ-404

RW-405 STEP DRAWDOWN TEST
OBSERVATION WELL DATA - PZ-403

SUNOCO, INC.
PHILADELPHIA REFINERY
26th STREET INVESTIGATION

Top of Casing Elevation = 28.27 FAMSL
Product Specific Gravity = 0.76

Time	Elapsed Time (Hour:Minutes)	Depth To Product (Feet)	Depth To Water (Feet)	Apparent Product Thickness (Feet)	Corrected Groundwater Elevation (FAMSL)	Corrected Drawdown (Feet)
8:29	0:00	25.85	26.20	0.35	2.34	0.00
9:23	0:54	26.05	26.35	0.30	2.15	0.19
10:02	1:33	26.07	26.39	0.32	2.12	0.22
10:23	1:54	26.09	26.39	0.30	2.11	0.23
10:48	2:19	26.08	26.36	0.28	2.12	0.22
11:20	2:51	26.13	26.51	0.38	2.05	0.29
11:30	3:01	26.13	26.39	0.26	2.08	0.26
12:22	3:53	26.10	26.40	0.30	2.10	0.24
13:14	4:45	26.11	26.43	0.32	2.08	0.26
13:42	5:13	26.13	26.45	0.32	2.06	0.28
14:08	5:39	26.18	26.45	0.27	2.03	0.31
14:20	5:51	26.22	26.43	0.21	2.00	0.34
14:46	6:17	26.22	26.46	0.24	1.99	0.35

NOTES:

Test started at 8:36 and ended at 14:53 on 11/13/02

FAMSL = Feet above mean sea level

Corrected groundwater elevation = TOC - (Depth to groundwater - (Product thickness * specific gravity))

S:\Clients\Sunoco\26th Street\[RW-405 Step Test.xls]PZ-403

APPENDIX F

Annual Groundwater Sampling Analytical Data

TABLE 1

HISTORICAL GROUND WATER SAMPLING RESULTS

SUNOCO, INC. (R+M)
PHILADELPHIA REFINERY
POINT BREEZE PROCESSING AREA

Sample Well	Date Collected	INORGANIC										METALS						VOLATILE ORGANICS					BASE/NEUTRAL ORGANICS						
		Alkalinity (mg/l)	Chloride (mg/l)	Specific Conductance (umhos/cm)	Fluoride (mg/l)	pH (Standard units)	Nitrogen, Ammonia (mg/l)	Nitrogen, Nitrate-Nitrite (mg/l)	Sulfate (mg/l)	Total Dissolved Solids (mg/l)	Total Organic Carbon (mg/l)	Arsenic (mg/l)	Barium (mg/l)	Cobalt (mg/l)	Chromium (mg/l)	Lead (mg/l)	Selenium (mg/l)	Benzene (ug/l)	Toluene (ug/l)	Ethyl-Benzene (ug/l)	Total Xylenes (ug/l)	MTBE (ug/l)	Benzo (a) anthracene (ug/l)	Benzo (b) fluoranthene (ug/l)	Benzo (a) pyrene (ug/l)	Bis (2-ethylhexyl) phthalate (ug/l)	Chrysene (ug/l)	Dibenz (a,h) anthracene (ug/l)	Indene (ug/l)
N-64	1993	619	110	1,450	0.70	6.91	1.1	BDL	40	860	25	0.071	0	BDL	BDL	0.19	0.02	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1994	520	12	1,000	0.65	6.70	1.4	<0.1	37	630	35	0.018	0.29	0.027	<0.02	0.45	<0.01	<250	<250	90 J	<500	NA	<10	<10	<10	<10	<10	<10	<10
	1995	400	24.8	680	0.56	6.92	2.31	0.16	361	500	67	0.994	4.120	0.102	BDL	5.440	0.0205	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1996	460	16	840	0.80	6.72	<0.50	<0.050	11	500	21	0.076	7.9	0.22	<0.025	6.0	0.017	ND	ND	ND	ND	NA	ND	ND	ND	3	ND	ND	ND
	1997	530	4.8	790	0.54	7.11	<0.50	<0.050	15	590	24	2.8	17	0.57	0.060	20	0.019	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND
	1998	600	6.7	680	0.64	6.6	1.1	0.060	2.6	550	30	2.9	16	0.54	0.054	18	<0.050	ND	ND	ND	ND	NA	1	ND	ND	1	1	ND	ND
	1999	510	8.5	740	0.66	7.86	0.56	<0.050	23	540	43	7.6	41	1.3	0.12	42	<0.20	<1	<1	<1	<2	NA	<1	<1	<1	1	<1	<1	<10
	2000	470	70.2	640	1.14	7.20	13.5	0.12	3.58	430	23.6	0.017	<0.100	0.119	<0.010	1.90	<0.020	<1	<1	<1	<2	<1	<1	<3	<2	<3	<1	<4	<10
	2001	410	7.0	780	1.06	7.40	4.7	<0.10	3.4	430	26.3	19.300	22	0.178	0.02	8.08	<0.020	<1	<1	<1	<2	<1	3	<3	3	22	4	<4	<10
	2002	280	6.36	892	0.63	6.92	2.32	0.28	19.4	530	24.3	1.07	3.15	0.032	<0.010	0.815	<0.020	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	2	ND (2)	ND (2)	ND (10)
S-1	1985	944	26	4,020	1.10	12.55	BDL	3.30	35	1870	30	0.007	0	0.004	0.006	0.03	BDL	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1986	160	42	1,100	1.1	10.19	7.2	BDL	115	390	45	0.01	0.017	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1988	149	47	572	1.1	8.70	2.9	BDL	62	370	64	BDL	0.04	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	21	BDL	BDL	BDL
	1993	52	12	229	1	9.62	0.9	1.3	36	150	9	0.012	N/A	BDL	N/A	BDL	N/A	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1994	340	12	1,200	0.57	11.80	2.2	2.2	13	400	13	<0.005	0.56	0.049	0.029	0.31	<0.005	<50	<50	<50	<100	NA	<10	<10	<10	<10	<10	<10	<10
	1995	154	21.3	180	0.64	9.17	5.19	0.11	491	306	16	0.0105	0.101	BDL	BDL	0.255	BDL	2.7	BDL	BDL	0.8 J	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1996	48	22	190	0.41	9.74	3.9	0.28	9.2	150	11	0.015	0.14	<0.020	0.035	0.65	< 0.0050	ND	ND	ND	ND	NA	ND	ND	ND	3	ND	ND	ND
	1997	220	12	750	0.38	11.66	2.1	0.68	8.5	290	15	0.017	<0.20	<0.050	0.061	0.65	<0.0050	ND	ND	ND	2	NA	ND	ND	ND	2	ND	ND	ND
	1998	74	14	140	0.51	8.9	<0.50	2.2	22	140	8.1	<0.0080	<0.10	<0.010	0.014	0.080	<0.020	ND	ND	ND	ND	NA	ND	ND	ND	2	ND	ND	ND
	1999	120	6.6	200	0.29	8.93	0.90	0.11	25	170	17	0.010	0.25	0.018	0.059	0.58	<0.020	<1	<1	<1	<2	NA	1	<1	1	2	1	<1	<10
	2000	190	170	570	0.66	7.80	<0.5	0.37	48.9	360	4.35	0.124	0.522	0.024	0.103	1.11	<0.020	<1	<1	<1	<2	10	1.2	<3	<2	<3	1.4	<4	<10
	2001	460	103	1,200	0.73	7.40	5.11	0.97	4.73	540	18.9	0.039	7.430	0.347	0.509	6.38	<0.020	<1	<1	1	3	38	<10	<30	<20	<30	12	<40	<100
	2002	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
S-3	1985	540	67	1,260	0.40	7.21	BDL	BDL	37	900	270	0.006	BDL	0.012	BDL	BDL	BDL	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	17	BDL	BDL	BDL
	1986	553	63	1,340	0.5	6.80	10	BDL	36	730	81	0.002	0.14	0.007	BDL	BDL	BDL	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1988	296	25	736	0.9	7.30	BDL	3.2	47	480	40	0.006	0.1	BDL	BDL	0.007	BDL	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1993	689	38	1,320	0.5	6.76	4.6	0.6	6	760	24	0.0127	N/A	BDL	N/A	BDL	N/A	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1994	630	44	1,500	0.47	6.30	6.5	0.11	<20	670	46	0.021	0.55	0.034	<0.02	0.37	<0.005	2 J	<5	<5	<10	NA	<10	<10	<10	<10	<10	<10	<10
	1995	638	84.9	1,200	0.44	6.77	6.07	BDL	434	808	.8	BDL	0.214	BDL	BDL	BDL	BDL	1.3	BDL	BDL	BDL	NA	BDL	BDL	BDL	6 J	BDL	BDL	BDL
	1996	510	55	1,200	0.64	6.43	2.5	<0.050	45	730	41	0.038	0.52	0.031	0.091	0.30	< 0.0050	ND	ND	ND	ND	NA	ND	ND	ND	2	ND	ND	ND
	1997	630	28	990	0.47	7.12	3.7	0.070	<2.0	690	18	0.011	<0.20	<0.050	<0.050	0.060	<0.0050	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND
	1998	630	35	840	0.45	6.6	3.4	0.080	5.2	740	19	0.082	1.50	0.10	0.36	0.62	<0.040	ND	ND	ND	ND	NA	ND	ND	ND	1	ND	ND	ND
	1999	470	26	610	0.61	8.13	3.2	<0.050	32	500	54	0.021	0.21	<0.010	0.019	0.090	<0.020	<1	<1	<1	<2	NA	<1	<1	<1	1	<1	<1	<10
	2000	520	120	900	0.58	7.80	9.83	0.23	8.4	600	28.1	0.013	0.185	<0.010	<0.010	0.035	<0.020	<1	<1	<1	<2	94	<1	<3	<2	<3	<1	<4	<10
	2001	540	22	1,100	0.45	7.00	11.20	0.30	1.92	340	31.4	0.012	0.844	0.03	0.038	0.060	<0.020	52	<2	<2	<4	<2	2	<3	2	11	3	<4	<10
	2002	240	4.29	515	0.52	7.02	0.58	0.31	23.6	240	12.7	<0.008	<0.100	<0.010	<0.010	0.093	<0.020	ND (1)	ND (1)	ND (1)	ND (1)	4	ND (1)	ND (1)	ND (1)	ND (1)	ND (2)	ND (2)	ND (10)

TABLE 1

HISTORICAL GROUND WATER SAMPLING RESULTS

SUNOCO, INC. (R+M)
PHILADELPHIA REFINERY
POINT BREEZE PROCESSING AREA

Sample Well	Date Collected	INORGANIC										METALS						VOLATILE ORGANICS					BASE/NEUTRAL ORGANICS						
		Alkalinity (mg/l)	Chloride (mg/l)	Specific Conductance (umhos/cm)	Fluoride (mg/l)	pH (Standard units)	Nitrogen, Ammonia (mg/l)	Nitrogen, Nitrate-Nitrite (mg/l)	Sulfate (mg/l)	Total Dissolved Solids (mg/l)	Total Organic Carbon (mg/l)	Arsenic (mg/l)	Barium (mg/l)	Cobalt (mg/l)	Chromium (mg/l)	Lead (mg/l)	Selenium (mg/l)	Benzene (ug/l)	Toluene (ug/l)	Ethyl-Benzene (ug/l)	Total Xylenes (ug/l)	MTBE (ug/l)	Benzo (a) anthracene (ug/l)	Benzo (b) fluoranthene (ug/l)	Benzo (a) pyrene (ug/l)	Bis (2-ethylhexyl) phthalate (ug/l)	Chrysene (ug/l)	Dibenz (a,h) anthracene (ug/l)	Indene (ug/l)
S-25	1985	262	48	717	0.50	8.23	BDL	0.30	49	465	14	BDL	0	0.012	BDL	BDL	BDL	BDL	BDL	BDL	5	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1986	250	17	594	0.8	7.33	0.6	BDL	52	455	25	0.002	0.037	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1988	117	13	270	3	9.80	0.2	1.4	47	180	23	BDL	0.007	BDL	0.03	BDL	0.002	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1993	123	29	443	1.8	8.30	0.4	3.42	39	260	7	0.0058	N/A	BDL	N/A	BDL	N/A	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1994	58	15	320	1.9	9.90	0.1	3.2	63	280	7.6	<0.005	0.16	<0.02	0.13	<0.2	<0.005	<5	<5	<5	<10	NA	<10	<10	<10	<10	<10	<10	<10
	1996	23	6.6	200	2.0	10.50	0.57	2.9	44	150	3.2	0.0051	0.039	<0.020	0.099	0.017	<0.050	ND	ND	ND	ND	NA	ND	ND	ND	2	ND	ND	ND
	1997	61	8.7	240	2.3	10.91	<0.50	4.1	68	250	5.6	0.0063	<0.20	<0.050	0.16	0.045	<0.0050	ND	ND	ND	ND	NA	ND	ND	ND	3	ND	ND	ND
	1998	190	41	400	0.72	8.2	<0.50	0.34	19	330	12	0.015	0.29	0.050	0.19	0.16	<0.020	ND	ND	ND	ND	NA	ND	ND	ND	2	ND	ND	ND
	1999	84	10	320	2.9	10.43	<0.50	3.6	39	210	3.8	<0.0080	<0.10	<0.010	0.13	<0.010	<0.020	<1	<1	<1	<2	NA	<1	<1	<1	3	<1	<1	<10
	2000	40.6	0.049	220	1.61	8.10	1.56	2.02	29.1	220	4.44	<0.008	<0.100	<0.010	0.049	0.024	<0.020	<1	<1	<1	<2	140	<10	<3	<2	<3	<1	<4	<10
	2001	130	21.300	370	0.94	8.00	<0.50	0.51	26.8	170	9.08	<0.008	0.16	<0.010	0.063	0.067	<0.020	<10	<10	<10	<20	110	<1	<3	<2	<3	<1	<4	<10
	2002	240	7.97	613	2.01	7.16	<0.50	1.40	46.3	350	6.06	<0.008	<0.100	<0.010	0.128	0.055	<0.020	ND (1)	ND (1)	ND (1)	ND (1)	2	ND (1)	ND (1)	ND (1)	3	ND (2)	ND (2)	ND (10)
S-38	1985	219	12	491	0.50	8.42	BDL	BDL	28	325	7.1	BDL	0	0.017	BDL	BDL	BDL	1200	BDL	BDL	BDL	NA	BDL	BDL	BDL	100	BDL	BDL	BDL
	1986	160	10	420	1.5	6.84	0.1	BDL	29	245	14	BDL	0.042	0.013	BDL	BDL	BDL	1300	160	BDL	210	NA	BDL	BDL	BDL	BDL	BDL	BDL	23
	1988	131	10	368	2.8	6.70	BDL	0.2	31	240	35	BDL	0.039	BDL	BDL	BDL	BDL	930	260	240	280	NA	BDL	BDL	BDL	11	BDL	BDL	12
	1993	78	5	233	1.9	6.75	BDL	1.3	23	160	9	0.0065	N/A	BDL	N/A	BDL	N/A	310	120	60	94	NA	BDL	BDL	BDL	BDL	BDL	BDL	32
	1994	76	5	290	2.1	6.50	<0.1	1.4	30	260	4.3	0.005	0.20	0.031	0.089	0.34	<0.005	1 J	<5	<5	<10	NA	<10	<10	<10	<10	<10	<10	<10
	1995	134	24.3	240	2.19	6.65	BDL	0.58	1380	210	8	BDL	0.173	BDL	0.0403	0.202	BDL	300	42	80	100	NA	BDL	BDL	BDL	BDL	BDL	BDL	5 J
	1996	78	22	350	1.4	6.30	<0.50	1.4	58	240	2.7	0.026	0.21	0.047	0.14	0.29	<0.050	9.3	5.5	3.9	4.4	NA	ND	ND	ND	2	ND	ND	ND
	1997	91	7.7	230	2.1	7.35	<0.50	0.52	18	180	3.1	0.055	0.36	0.12	0.64	0.65	<0.0050	1300	720	220	500	NA	ND	ND	ND	3	ND	ND	ND
	1998	150	8.6	240	1.9	7.2	<0.50	0.91	20	240	4.6	0.053	0.51	0.13	0.77	0.70	<0.040	700	410	220	430	NA	ND	ND	ND	ND	ND	ND	25
	1999	84	9.0	200	2.0	7.75	<0.50	1.3	34	180	4.1	0.029	0.46	0.10	0.81	0.74	<0.020	89	3	3	5	NA	<1	<1	<1	2	<1	<1	<10
	2000	75.9	93.8	260	1.68	7.00	<0.5	1.99	44.8	180	<1.00	<0.008	0.145	0.032	0.246	0.21	<0.020	8.5	5.1	2.5	2.5	<1	<1	<3	<2	<3	<1	<4	<10
	2001	150	11.1	370	1.94	6.90	<0.5	0.47	13.3	130	7.36	0.021	0.555	0.070	0.233	0.58	<0.020	1100	180	260	150	<100	<1	<3	<2	5	1	<4	9.8
	2002	47.2	6.73	238	1.69	6.89	<0.5	1.78	30.3	160	3.18	<0.008	0.135	0.033	0.110	0.075	<0.020	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	6	ND (2)	ND (2)	ND (10)
S-39	1993	365	210	1,540	0.20	6.59	BDL	6.60	94	860	2	0.003	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1994	400	220	1,800	0.25	6.90	< 0.1	5	100	980	12	0.008	0.24	0.02	0.026	<0.2	<0.005	1 J	<5	<5	<10	NA	<10	<10	<10	<10	<10	<10	<10
	1995	451	130	1,200	0.34	6.82	BDL	4.34	549	750	10	BDL	0.0724	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	4 J
	1996	380	160	1,300	0.34	6.73	<0.50	2.9	100	820	3.2	0.0074	0.074	<0.020	0.022	0.013	<0.050	ND	ND	ND	ND	NA	ND	ND	ND	3	ND	ND	ND
	1997	370	160	1,200	0.23	7.11	<0.50	3.7	140	860	3.2	0.022	<0.20	<0.050	0.092	0.034	<0.0050	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND
	1998	390	100	910	0.24	6.6	<0.50	2.5	110	730	2.0	0.020	0.14	0.040	0.088	0.024	<0.020	ND	ND	ND	ND	NA	ND	ND	ND	2	ND	ND	ND
	1999	190	36	490	0.27	7.60	<0.50	3.0	63	400	5.7	0.019	0.16	0.049	0.091	0.028	<0.020	<1	<1	<1	<2	NA	<1	<1	<1	3	<1	<1	<10
	2000	190	260	870	0.16	7.90	<0.5	1.55	140	590	<1.00	<0.008	<0.100	<0.010	0.010	<0.010	<0.020	<1	<1	<1	<2	1.7	<1	<3	<2	<3	<1	<4	<10
	2001	340	166	1,500	0.32	7.00	<0.5	2.71	121	740	4.3	<0.008	0.21	0.020	0.024	0.012	<0.020	<1	<1	<1	<2	1	<1	<3	<2	<3	<1	<4	<10
	2002	300	100	1,143	0.29	6.70	<0.5	4.41	98.8	650	5.00	<0.008	<0.100	<0.010	<0.010	<0.010	<0.020	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (2)	ND (2)	ND (10)

TABLE 1

HISTORICAL GROUND WATER SAMPLING RESULTS

SUNOCO, INC. (R+M)
PHILADELPHIA REFINERY
POINT BREEZE PROCESSING AREA

Sample Well	Date Collected	INORGANIC Alkalinity (mg/l)	Chloride (mg/l)	Specific Conductance (umhos/cm)	Fluoride (mg/l)	pH (Standard units)	Nitrogen, Ammonia (mg/l)	Nitrogen, Nitrate-Nitrite (mg/l)	Sulfate (mg/l)	Total Dissolved Solids (mg/l)	Total Organic Carbon (mg/l)	METALS Arsenic (mg/l)	Barium (mg/l)	Cobalt (mg/l)	Chromium (mg/l)	Lead (mg/l)	Selenium (mg/l)
S-40	1985	226	273	1,240	0.20	7.49	BDL	0.20	13	680	140	0.017	0	0.02	0.01	BDL	BDL
	1986	348	135	1,070	0.2	7.46	1	BDL	16	745	27	0.008	0.15	0.01	BDL	BDL	BDL
	1988	263	172	1,040	0.4	6.80	BDL	0.2	6	500	52	BDL	0.15	BDL	BDL	BDL	BDL
	1993	81	26	292	1.6	6.68	0.2	BDL	21	160	8	0.0229	N/A	BDL	N/A	0.19	N/A
	1994	280	230	1,400	1	6.50	1.1	0.7	<20	1300	23	<0.005	0.086	<0.02	<0.02	<0.2	<0.005
	1995	363	180	920	1.22	6.67	1.64	BDL	595	598	25	0.0113	0.163	BDL	0.030	0.0411	BDL
	1996	260	190	1,100	1.8	6.75	<0.50	<0.050	26	720	7.1	0.021	0.16	<0.020	<0.020	0.022	<0.050
	1997	210	160	790	0.94	6.76	<0.50	0.070	3.1	520	7.8	0.025	0.25	<0.050	0.11	0.099	<0.0050
	1998	280	230	830	0.28	6.5	<0.50	0.060	8.7	670	13	0.029	0.38	0.028	0.13	0.10	<0.020
	1999	230	180	680	1.3	7.45	<0.50	0.10	10	550	20	0.020	0.26	0.018	0.068	0.049	<0.020
	2000	230	70.2	1,000	0.76	7.00	0.60	0.19	9.3	640	7.60	0.037	0.738	0.093	0.337	0.238	<0.020
	2001	260	368.0	1,800	0.77	6.60	1.72	0.26	2.54	1000	17.60	<0.008	0.974	0.045	0.114	0.099	<0.020
	2002	240	100	889	0.54	6.57	<0.5	0.24	2.25	440	5.54	0.015	0.187	0.013	0.036	0.057	<0.020
S-43	1993	297	62	867	0.30	6.40	0.9	BDL	6	470	21	0.033	0	BDL	BDL	BDL	BDL
	1994	330	63	840	0.27	6.70	4.9	< 0.1	<20	404	46	0.02	0.22	0.037	<0.02	0.2	<0.005
	1995	286	55.1	620	0.33	6.42	0.10	BDL	211	422	62	0.0169	0.182	0.0367	BDL	BDL	BDL
	1996	340	47	1,100	0.55	6.25	0.57	<0.050	2.4	460	13	0.013	0.15	<0.020	<0.020	0.0063	<0.050
	1997	290	45	530	0.25	6.90	<0.50	<0.050	<2.0	410	17	0.026	<0.20	<0.050	<0.050	0.0071	<0.0050
	1998	310	140	620	0.45	6.4	<0.50	0.070	<2.0	450	16	0.030	0.25	0.036	0.056	0.025	<0.020
	1999	390	40	570	0.39	7.56	<0.50	0.15	2.1	440	29	0.027	0.34	0.058	0.093	0.044	<0.020
	2000	320	110	610	0.41	6.80	1.44	0.16	6.3	440	9.67	<0.008	0.242	0.015	0.025	0.013	<0.020
	2001	360	39	800	0.38	6.60	<0.50	<0.10	1.01	<10.0	15.2	<0.008	0.338	0.033	0.042	0.029	<0.020
	2002	280	35.2	765	0.43	6.44	<0.5	<0.10	5.72	370	20.0	0.016	0.125	0.010	<0.010	<0.010	<0.020
S-50	1985	296	46	735	0.20	7.32	BDL	0.10	5	420	30	0.003	0	0.019	BDL	BDL	BDL
	1986	293	35	764	0.2	7.20	BDL	BDL	6	385	66	BDL	0.054	0.006	BDL	BDL	BDL
	1988	465	34	878	0.5	6.60	BDL	BDL	5	470	107	0.003	0.037	BDL	BDL	BDL	BDL
	1994	330	33	710	0.45	6.10	0.29	0.6	<25	350	67	0.013	0.14	0.035	<0.02	0.2	<0.005
	1995	330	37.2	480	0.53	6.37	0.36	BDL	154	318	71	0.0186	0.0642	BDL	BDL	0.0248	BDL
	1996	270	33	540	0.72	6.28	<0.50	0.080	<2.0	410	24	0.025	0.17	<0.025	0.073	0.073	< 0.0050
	1997	290	19	400	0.42	6.92	<0.50	0.25	2.2	410	27	0.043	0.42	0.13	0.36	0.11	<0.0050
	1998	270	16	430	0.58	6.5	<0.50	0.080	<2.0	380	24	0.026	0.21	0.053	0.14	0.037	<0.020
	1999	360	44	530	0.46	7.63	<0.50	0.21	9.6	460	52	0.017	<0.10	0.013	0.025	<0.010	<0.020
	2000	240	110	590	0.51	7.00	<0.5	0.18	11.3	350	14.1	0.012	<0.100	0.012	0.025	<0.010	<0.020
	2001	500	13	560	0.41	7.42	<0.5	<0.10	3.98	400	25.3	0.027	<0.100	0.02	0.026	<0.010	<0.020
	2002						NAPL	NAPL	NAPL	NAPL	NAPL	NAPL	NAPL	NAPL	NAPL	NAPL	NAPL

Sample Well	Date Collected	VOLATILE ORGANICS Benzene (ug/l)	Toluene (ug/l)	Ethyl-Benzene (ug/l)	Total Xylenes (ug/l)	MTBE (ug/l)	BASE/NEUTRAL ORGANICS Benzo (a) anthracene (ug/l)	Benzo (b) fluoranthene (ug/l)	Benzo (a) pyrene (ug/l)	Bis (2-ethylhexyl) phthalate (ug/l)	Chrysene (ug/l)	Dibenz (a,h) anthracene (ug/l)	Indene (ug/l)
S-40	1985	2800	BDL	1200	6100	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1986	600	BDL	210	1520	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1988	2000	BDL	2900	4100	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1993	78	6	12	16	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1994	280	55 J	140 J	75 J	NA	<10	<10	<10	<10	<10	<10	<10
	1995	150	23	29	51.2	NA	BDL	BDL	BDL	1 J	BDL	BDL	BDL
	1996	12	1.8	3.4	1.9	NA	ND	ND	ND	3	ND	ND	ND
	1997	350	ND	ND	56 J	NA	1	1	ND	4	1	ND	ND
	1998	630	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND
	1999	1000	<100	<100	<200	NA	<1	<1	<1	5	<1	<1	<10
	2000	600	<100	<100	<200	<100	2	<3	<2	8	3	<4	<10
	2001	1200	76	68	<100	1200	2	<3	<2	7	4	<4	<10
	2002	240	9	7	8	ND (5)	ND (13)	ND (14)	ND (10)	ND (9)	ND (15)	ND (17)	ND(100)
S-43	1993	12000	190	1300	1000	NA	BDL	BDL	BDL	BDL	BDL	BDL	86
	1994	17000	1700	250 J	1680	NA	<10	<10	<10	<10	<10	<10	<10
	1995	12000	1200	170	860	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1996	2100	110	120	110	NA	ND	ND	ND	5	ND	ND	ND
	1997	13000	210	1200	1000	NA	ND	ND	ND	2	ND	ND	ND
	1998	6700	94 J	720	470	NA	ND	ND	ND	3	ND	ND	ND
	1999	3600	<100	<100	250	NA	<1	<1	<1	3	<1	<1	<10
	2000	990	<100	<100	<200	<100	<1	<3	<2	<3	<1	<4	<10
	2001	6100	<500	<500	<1000	<500	<1	<3	<2	<3	<1	<4	<10
	2002	5500	170	790	460		ND (13)	ND (14)	ND (10)	ND (9)	ND (15)	ND (17)	ND(100)
S-50	1985	23000	BDL	5400	23000	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1986	24000	BDL	2300	1520	NA	BDL	BDL	BDL	BDL	BDL	BDL	38
	1988	24000	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1994	290	20 J	160 J	40 J	NA	<10	<10	<10	5J	<10	<10	<10
	1995	17000	1600	98 J	3000	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1996	14	ND	ND	ND	NA	ND	ND	ND	3	ND	ND	ND
	1997	21000	210	1300	2200	NA	ND	ND	ND	3	ND	ND	ND
	1998	18000	57 J	570	960	NA	ND	ND	ND	1	ND	ND	ND
	1999	28000	<1000	<1000	<2000	NA	<1	<1	<1	25	<1	<1	<10
	2000	47000	<100	240	370	590	<1	<3	<2	<3	<1	<4	<10
	2001	53000	1400	<1000	1300	5200	<2	<3	<2	<3	<2	<4	<10
	2002	NAPL	NAPL	NAPL	NAPL	NAPL	NAPL	NAPL	NAPL	NAPL	NAPL	NAPL	NAPL

TABLE 1

HISTORICAL GROUND WATER SAMPLING RESULTS

SUNOCO, INC. (R+M)
PHILADELPHIA REFINERY
POINT BREEZE PROCESSING AREA

		INORGANIC											METALS						VOLATILE ORGANICS					BASE/NEUTRAL ORGANICS						
Sample Well	Date Collected	Alkalinity (mg/l)	Chloride (mg/l)	Specific Conductance (umhos/cm)	Fluoride (mg/l)	pH (Standard units)	Nitrogen, Ammonia (mg/l)	Nitrogen, Nitrate-Nitrite (mg/l)	Sulfate (mg/l)	Total Dissolved Solids (mg/l)	Total Organic Carbon (mg/l)	Arsenic (mg/l)	Barium (mg/l)	Cobalt (mg/l)	Chromium (mg/l)	Lead (mg/l)	Selenium (mg/l)	Benzene (ug/l)	Toluene (ug/l)	Ethyl-Benzene (ug/l)	Total Xylenes (ug/l)	MTBE (ug/l)	Benzo (a) anthracene (ug/l)	Benzo (b) fluoranthene (ug/l)	Benzo (a) pyrene (ug/l)	Bis (2-ethylhexyl) phthalate (ug/l)	Chrysene (ug/l)	Dibenz (a,h) anthracene (ug/l)	Indene (ug/l)
S-66	1985	206	300	1,510	0.30	8.09	BDL	4.40	170	925	7	BDL	0	0.004	BDL	BDL	BDL	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1986	314	113	1,150	1.1	7.14	0.1	BDL	133	630	48	BDL	0.099	0.011	BDL	BDL	BDL	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1988	342	272	1,620	1.2	6.50	BDL	2.5	90	910	65	BDL	0.1	0.02	BDL	BDL	BDL	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	72	BDL	BDL	BDL
	1993	443	170	1,360	1.1	6.79	2.1	BDL	34	710	13	0.005	N/A	BDL	N/A	BDL	N/A	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1994	380	170	1,500	0.59	6.50	1.7	1	33	760	17	<0.005	0.17	<0.02	0.053	<0.2	<0.005	<5	<5	<5	<10	NA	<10	<10	<10	<10	<10	<10	<10
	1996	410	240	1,500	0.90	6.96	11	<0.050	19	810	5.9	0.020	0.41	0.039	0.59	0.11	< 0.0050	ND	ND	ND	ND	NA	ND	ND	ND	4	ND	ND	ND
	1997	300	91	770	0.54	7.07	5.7	<0.050	21	500	7.3	0.028	0.60	0.12	0.6	0.19	<0.0050	ND	ND	ND	ND	NA	ND	ND	ND	3	ND	ND	ND
	1998	360	220	1,000	0.43	6.6	0.56	0.060	75	890	7.1	0.027	0.97	0.15	0.94	0.21	<0.040	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND
	1999	410	100	760	1.1	7.90	1.7	0.18	22	570	7.4	0.0081	0.31	0.036	0.16	0.049	<0.020	<1	<1	<1	<2	NA	<1	<1	<1	4	<1	<1	<10
	2000	250	200	840	1.68	7.20	2.28	0.09	100	490	3.12	<0.008	0.323	0.051	0.240	0.062	<0.020	<1	<1	<1	<2	10	<1	<3	<2	<3	<4	<4	<10
	2001	220	144	1,100	1.46	6.40	<0.5	0.30	75.9	450	9.62	<0.008	0.380	0.038	0.146	0.053	<0.020	<1	<1	<1	<2	1	<1	<3	<2	4	<1	<4	<10
	2002	190	160	949	1.36	6.93	1.12	<0.10	26.8	400	8.08	0.015	0.243	0.031	0.190	0.044	<0.020	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (2)	ND (2)	ND (10)
S-69	1985	118	61	538	0.20	7.71	BDL	2.20	71	345	7.8	BDL	0	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1986	139	33	504	0.2	6.58	BDL	1	71	265	18	BDL	0.046	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1988	136	6	479	0.6	6.20	BDL	3.8	74	320	50	BDL	0.06	BDL	BDL	0.007	0.007	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	38	BDL	BDL	BDL
	1993	124	4	393	0.7	6.62	BDL	3.4	53	270	3	0.0279	N/A	BDL	N/A	BDL	N/A	BDL	BDL	BDL	1	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1994	140	11	540	0.61	6.60	<0.1	2.3	78	480	16	<0.005	0.072	<0.02	<0.02	0.25	<0.005	21	<5	<5	<10	NA	<10	<10	<10	<10	<10	<10	<10
	1995	176	17.4	360	0.61	6.38	BDL	1.44	1210	334	14	BDL	0.396	BDL	BDL	0.312	BDL	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND
	1996	160	42	550	0.86	6.91	<0.50	1.3	56	390	6.4	0.036	1.1	0.12	0.34	0.27	< 0.0050	ND	ND	ND	ND	NA	ND	ND	ND	4	ND	ND	ND
	1997	99	92	520	0.49	6.92	<0.50	2.4	69	450	4.4	0.026	0.78	0.088	0.30	0.043	<0.0050	ND	16	7	27	NA	ND	ND	ND	2	ND	ND	ND
	1998	120	56	390	0.42	6.4	<0.50	5.0	45	200	5.2	0.052	3.2	0.37	0.95	0.56	<0.040	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND
	1999	170	36	420	0.56	8.19	<0.50	2.7	47	370	6.0	0.013	0.70	0.069	0.17	0.10	<0.020	<1	<1	<1	<2	NA	<1	<1	<1	<1	<1	<1	<10
	2000	60.6	140	200	0.45	6.40	<0.5	1.01	41.5	720	5.08	<0.008	0.250	0.017	0.045	0.029	<0.020	<1	<1	<1	<2	6.8	<1	<3	<2	<3	<1	<4	<10
	2001	120	149	870	0.43	6.20	<0.5	2.06	36.4	450	7.30	<0.008	1.600	0.029	0.055	0.063	<0.020	<1	<1	<1	<2	3	<1	<3	<2	<3	<1	<4	<10
	2002	150	28.8	560	0.59	6.64	<0.50	3.19	64.8	300	8.92	<0.008	0.227	0.022	0.052	0.043	<0.020	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	3	ND (2)	ND (2)	ND(10)
S-72	1993	665	470	2,740	0.30	6.59	11.4	BDL	33	1500	27	0.046	0	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	NA	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1994	720	580	3,400	0.39	6.50	11	<0.1	<25	1700	44	0.078	0.32	0.03	<0.02	<0.2	<0.01	<250	<250	<250	<500	NA	<10	<10	<10	<10	<10	<10	<10
	1995	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA	NS	NS	NS	NS	NS	NS	NS
	1996	720	570	2,700	0.53	6.17	2.8	<0.050	18	1700	18	0.015	0.28	<0.025	<0.025	< 0.0050	< 0.0050	ND	32	110	180	NA	ND	ND	ND	3	ND	ND	ND
	1997	850	530	2,700	0.37	7.19	<0.50	<0.050	14	1800	21	0.068	0.30	<0.050	<0.050	<0.0050	<0.0050	5	22	22	97	NA	ND	ND	ND	4	ND	ND	ND
	1998	810	670	21,000	0.45	6.6	0.67	0.050	17	1700	22	0.13	0.30	0.026	0.030	0.019	<0.020	69	14	ND	12	NA	ND	ND	ND	1	ND	ND	ND
	1999	850	510	2,100	0.40	7.43	4.9	0.12	110	1700	52	0.080	0.16	0.032	<0.010	<0.010	<0.020	<20	<20	<20	<40	NA	<1	<1	<1	3	1	<1	<10
	2000	600	150	2,100	0.36	7.00	19.0	0.16	37.2	1400	22.7	0.029	0.601	<0.010	<0.010	<0.010	<0.020	<100	<100	<100	<200	<100	2	<3	3	24	6	<4	<10
	2001	600	276	2,200	0.41	6.70	17.4	0.25	16.5	1100	19.3	0.057	0.337	0.018	<0.010	<0.010	<0.020	<1	24	35	48	<1	<1	<3	<2	5	1	<4	9.8

TABLE 1

HISTORICAL GROUND WATER SAMPLING RESULTS

SUNOCO, INC. (R+M)
PHILADELPHIA REFINERY
POINT BREEZE PROCESSING AREA

INORGANIC

Sample Well	Date Collected	Alkalinity (mg/l)	Chloride (mg/l)	Specific Conductance (umhos/cm)	Fluoride (mg/l)	pH (Standard units)	Nitrogen, Ammonia (mg/l)	Nitrogen, Nitrate-Nitrite (mg/l)	Sulfate (mg/l)	Total Dissolved Solids (mg/l)	Total Organic Carbon (mg/l)
S-73	1993	337	180	1,160	0.20	6.77	8.4	BDL	4	570	20
	1994	290	200	1,300	0.34	6.80	4.4	<0.1	<20	840	36
	1995	308	119	820	0.26	6.79	4.11	BDL	9340	526	51
	1996	320	120	980	0.66	6.56	1.4	<0.050	5.6	540	16
	1997	320	46	630	0.40	7.51	<0.50	<0.050	2.7	460	19
	1998	340	32	550	0.34	7.1	2.4	<0.050	<2.0	460	23
	1999	350	73	650	0.54	7.86	2.0	0.13	9.0	510	29
	2000	280	93.6	680	0.49	7.30	4.67	0.07	5.4	430	11.3
	2001	320	21.9	700	0.53	7.00	<0.50	<0.10	0.6	320	30.2
	2002	290	14.1	680	0.46	6.92	2.06	<0.10	3.13	430	31.2
S-81	1993	339	72	944	0.50	6.48	1.0	BDL	BDL	490	40
	1994	740	77	1,000	0.4	6.10	0.75	1.1	<20	450	61
	1995	374	86.9	780	0.50	6.53	0.69	BDL	200	457	85
	1996	340	96	780	0.61	6.08	<0.50	0.080	<2.0	560	23
	1997	300	150	820	0.37	6.98	<0.50	<0.050	<2.0	660	25
	1998	320	210	890	0.45	6.5	<0.50	<0.050	4.7	790	28
	1999	490	16	920	0.42	7.62	<0.50	0.15	<2.0	710	34
	2000	350	140	950	0.45	7.40	<0.5	0.10	7.6	700	24.7
	2001	420	306	1,900	0.54	6.50	2.57	0.24	0.82	1000	28.8

METALS

Sample Well	Date Collected	Arsenic (mg/l)	Barium (mg/l)	Cobalt (mg/l)	Chromium (mg/l)	Lead (mg/l)	Selenium (mg/l)
S-73	1993	0.156	2	0.068	0.153	BDL	BDL
	1994	0.033	1.8	0.14	0.22	0.49	BDL
	1995	0.0228	0.960	BDL	BDL	0.119	BDL
	1996	0.067	1.3	0.065	0.19	0.21	< 0.0050
	1997	0.079	1.4	0.12	0.30	0.10	<0.0050
	1998	0.064	1.5	0.12	0.32	0.090	<0.040
	1999	0.027	0.73	0.023	0.055	0.021	<0.020
	2000	0.021	0.612	<0.010	<0.010	<0.010	<0.020
	2001	<0.008	0.998	0.016	0.029	0.155	<0.020
	2002	0.013	0.600	0.016	0.029	0.066	<0.020
S-81	1993	0.028	0	BDL	BDL	0.14	BDL
	1994	0.012	0.59	0.058	<0.02	0.34	<0.005
	1995	0.0145	0.347	BDL	BDL	0.041	BDL
	1996	0.016	0.34	<0.025	<0.025	0.08	< 0.0050
	1997	0.044	0.56	0.064	0.11	0.32	<0.050
	1998	0.038	0.66	0.085	0.100	0.27	<0.020
	1999	0.036	0.62	0.094	0.11	0.25	<0.020
	2000	0.013	0.396	0.026	0.020	0.070	<0.020
	2001	<0.008	0.984	0.14	0.138	0.357	<0.020

VOLATILE ORGANICS

Sample Well	Date Collected	Benzene (ug/l)	Toluene (ug/l)	Ethyl-Benzene (ug/l)	Total Xylenes (ug/l)	MTBE (ug/l)
S-73	1993	520	9	27	18	NA
	1994	900	<250	<250	<500	NA
	1995	430	34	ND	15 J	NA
	1996	5.6	ND	ND	ND	NA
	1997	840	49 J	61 J	55 J	NA
	1998	320	ND	36	20	NA
	1999	400	<20	110	31	NA
	2000	340	<10	20	11	<10
	2001	220	<10	10	10	<10
	2002	98	2	2	7	ND (1)
S-81	1993	20000	64	680	600	NA
	1994	9500	180 J	70 J	150 J	NA
	1995	21000	300	BDL	470 J	NA
	1996	130	ND	3.7	2.6	NA
	1997	17000	92 J	230	280	NA
	1998	12000	ND	120	94 J	NA
	1999	4000	<100	110	230	NA
	2000	54000	<100	<100	<200	<100
	2001	2100	<100	<100	<200	130

BASE/NEUTRAL ORGANICS

Sample Well	Date Collected	Benzo (a) anthracene (ug/l)	Benzo (b) fluoranthene (ug/l)	Benzo (a) pyrene (ug/l)	Bis (2-ethylhexyl) phthalate (ug/l)	Chrysene (ug/l)	Dibenz (a,h) anthracene (ug/l)	Indene (ug/l)
S-73	1993	52	44	36	BDL	55	BDL	81
	1994	6 J	6 J	3 J	<10	4 J	<10	<10
	1995	110	68 J	59 J	ND	100	ND	ND
	1996	55	37	34	4	77	6	ND
	1997	29	21	15	2	39	4	ND
	1998	2	ND	1	ND	2	ND	ND
	1999	13	7	7	6	14	1	<10
	2000	7	5	6	<3	9	<4	<10
	2001	23	13	15	18	31	<4	<10
	2002	6	4	4	7	6	ND (2)	ND(10)
S-81	1993	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	1994	<10	<10	<10	<10	<10	<10	<10
	1995	ND	ND	ND	9 J	ND	ND	ND
	1996	1	ND	ND	5	2	ND	ND
	1997	1	ND	ND	8	2	ND	ND
	1998	ND	ND	ND	ND	ND	ND	ND
	1999	2	1	1	8	3	1	<10
	2000	2	<3	<2	5	2	<4	<10
	2001	2	<3	<2	5	2	<4	<10

NOTES

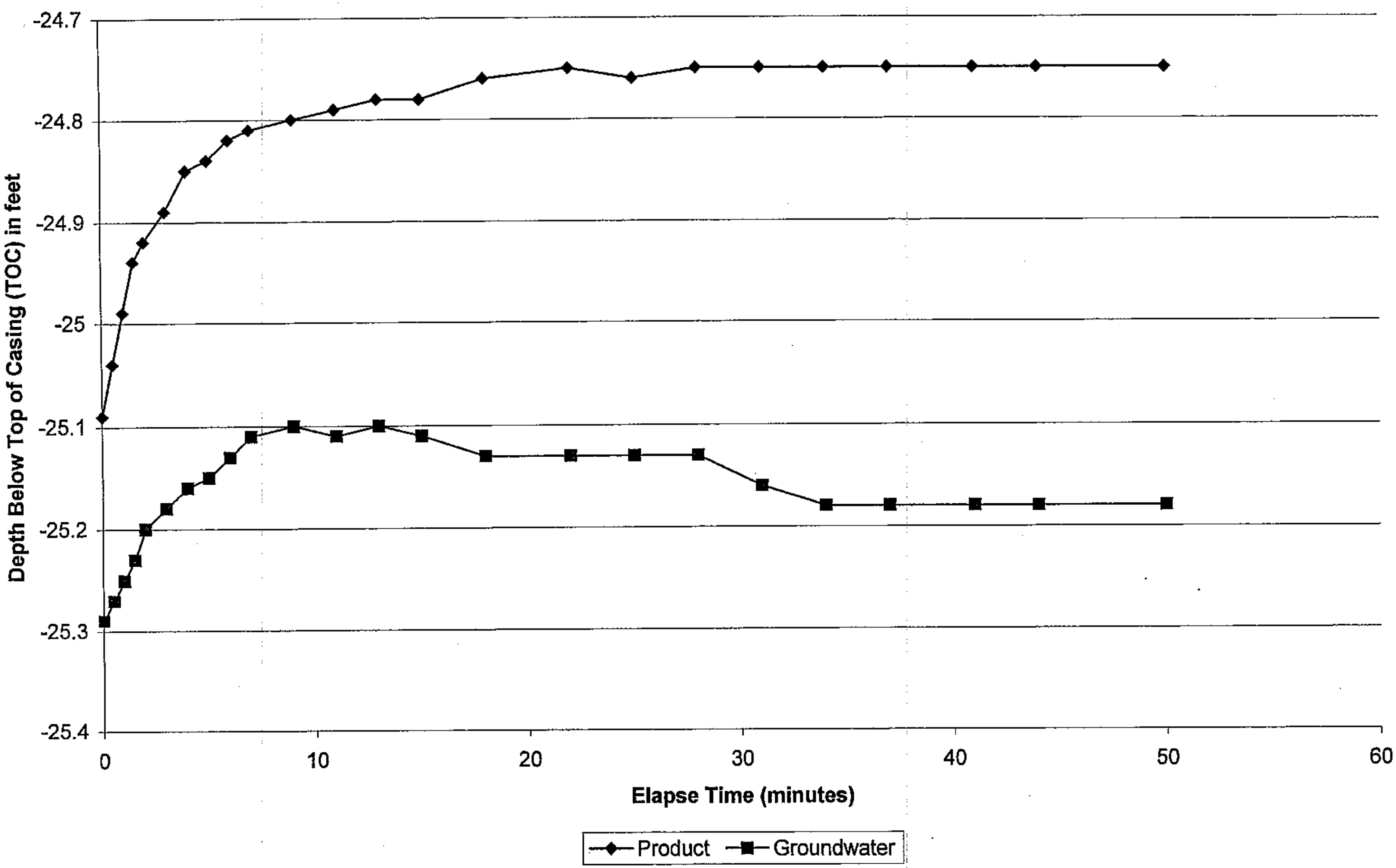
ND = Not Detected (value listed on attached table)
NS = Not sampled due to presence of NAPL
NA = Not analyzed
ug/l = micrograms per liter

mg/l = milligrams per liter
umhos/cm = micromhos per centimeter
BDL = below method detection limit
J = indicates an estimated value below method detection limit

APPENDIX G

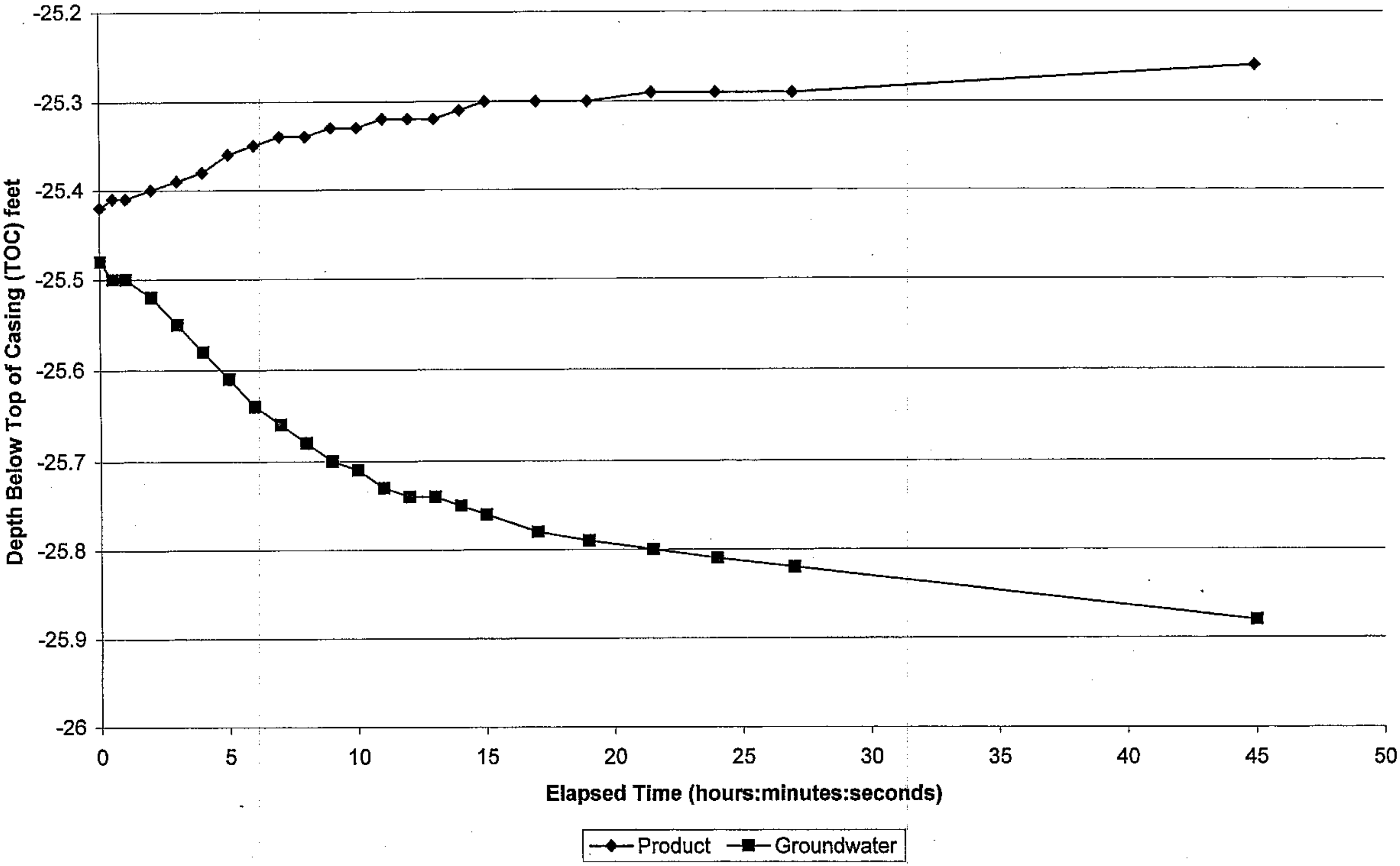
Product Bail-down Test Data Graphs

Observations Well S-50 Product Bail-Down Test Results



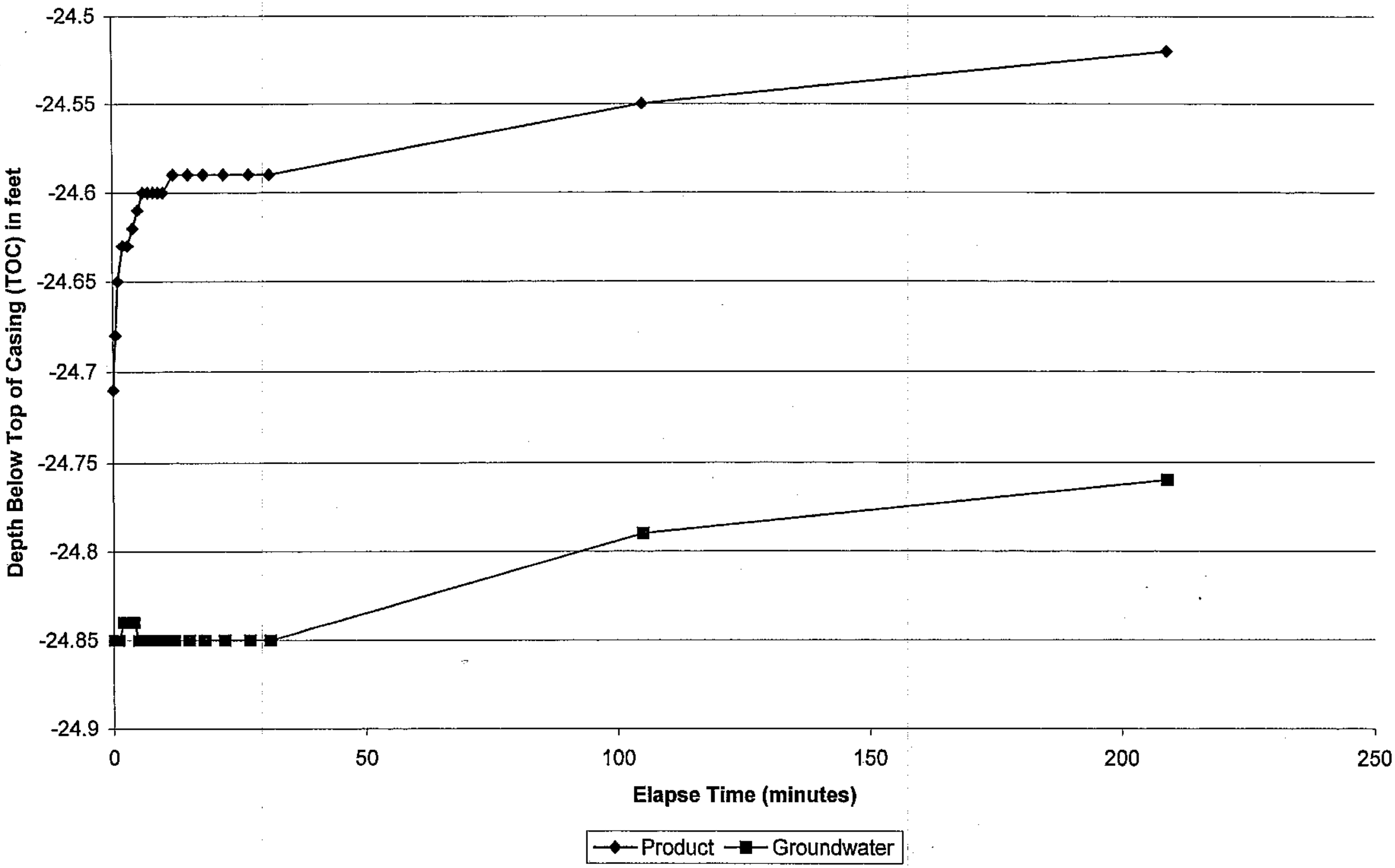
Static Depth to Product = - 24.67 (from TOC)
Static Depth to Water = - 25.60 (from TOC)

Observations Well S-98 Product Bail-Down Test Results



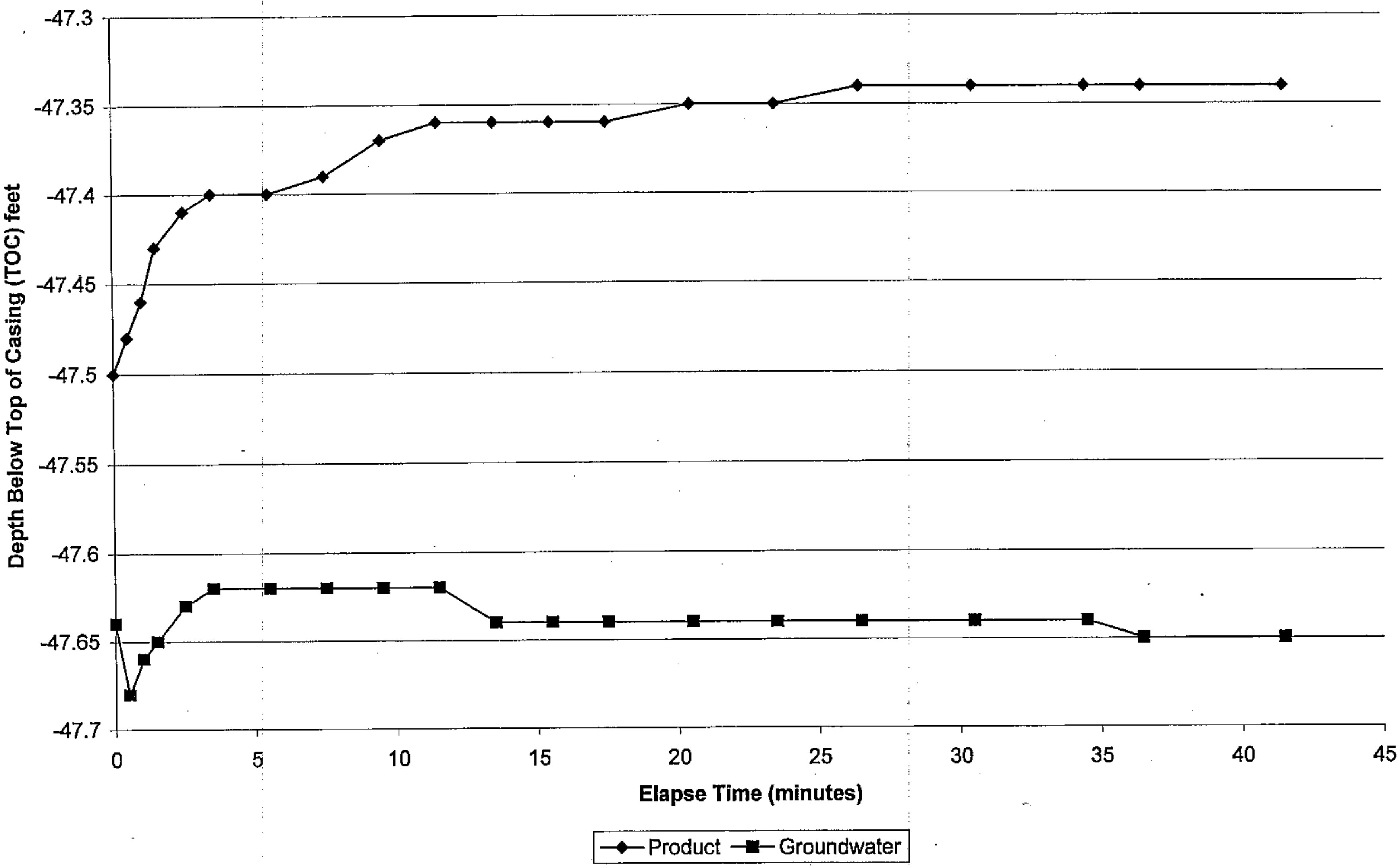
Static Depth to Product = - 25.28 (from TOC)
Static Depth to Water = - 25.85 (from TOC)

Observation Well S-100 Product Bail-Down Test Results



Static Depth to Product = - 24.52 (from TOC)
Static Depth to Water = - 25.13 (from TOC)

Observations Well CSXMW-5 Product Bail-Down Test Results



Static Depth to Product = - 47.24 (from TOC)
Static Depth to Water = - 47.87 (from TOC)

APPENDIX H

Product Characterization Report

January 24, 2003

Mr. Steve Baggett
Secor International, Inc.
102 Pickering Way
Suite 200
Exton, Pennsylvania
19341

Dear Steve:

At your request, I conducted analysis of chemical data from samples collected from the Sunoco refinery in Philadelphia, Pennsylvania in order to provide a qualitative identification of the constituents and to assess sample relationships. I also conducted a comparison to previously reported data for the same samples to evaluate differences, if any, and to sample MW-5 from the DSCP site.

The qualitative analysis was performed using chemical data generated by ICF for the field samples and for known reference samples. Identifications were based on comparisons of hydrocarbon distributions, gas chromatographic patterns (primarily gasoline-range hydrocarbons), and/or indicator compounds. The assessment of weathering degree was made by evaluating loss of major constituents and assumed a typical initial composition. The degree that the product had weathered was generally described and relied on ratios of compounds easily lost through environmental factors to more labile components. Comparisons to samples previously analyzed from the #1 Tank Farm area were made using the chromatograms and data for the same samples contained in the March 1998 report (IST, 1998[1]). If data were not available, this is noted in this letter. Comparison to MW-5 from the DSCP site was made using data in the same report.

#1 Tank Farm Samples

Samples S-100, RW-401, RW-402, and PZ-400 are comprised of a mixture of gasoline and #2 diesel fuel. Visual analysis of the gas chromatogram indicates that the components are in approximately equal proportions, with minor variation within the sample set. Sample S-98 is comprised primarily of mildly weathered gasoline with trace amounts of hydrocarbons in the diesel range. Samples S-89 and CSX-MW-5 are comprised of a heavily degraded gasoline and diesel mixture.

Composition of samples S-100, RW-401, RW-402, and S-89 is the same as previously observed. Current composition of sample PZ-400 differs slightly in that the sample contains a higher proportion of diesel-range material than previously observed. Samples S-98 and CSX-MW-5 were not analyzed previously.

All of the samples mentioned differ from sample MW-5, which is described in the March 1998 report as a mixture of gasoline and a naphtha-like material. A difference in the chemical composition of the gasoline component is observed and is likely due to the refinery processing or formulation: sample RW-402, which is representative of the #1 Tank Farm, is relatively higher in alkylates such as isooctane, whereas sample MW-5 is higher in light olefins.

[1] Integrated Science & Technology. 1998. *Non-Aqueous Phase Liquid (NAPL) Source Study at Defense Supply Center Philadelphia. Philadelphia, Pennsylvania.* Report prepared for Sunoco. March.

Sample S-50

Sample S-50 is comprised of a refinery intermediate most closely resembling light refinery naphtha or reformed light refinery naphtha or a mixture of the two. The proportion of benzene in the sample is higher than comparable reference samples, indicating a difference in the specific refinery process used or an additional input. Assuming that the constituents were high-grade refinery intermediates, the sample is only mildly weathered. This sample was not previously analyzed.

Compared to sample MW-5, the naphtha material in sample S-50 differs in that the boiling range of the hydrocarbons ends at approximately n-C12. The naphtha material in sample MW-5 extends to n-C15 and beyond, which is greater than the typical specification for light refinery naphtha or for heavy refinery naphtha. In addition, absolute concentration of monoaromatic compounds, especially benzene, is significantly higher in sample S-50.

Please call me if you have any questions on this letter report. We look forward to continuing our work on this interesting project.

Sincerely,

W. Henry Camp
Vice President

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