FILE COPY

HANDEX OF MARYLAND, INC., 1350 Blair Drive, Suite H, Odenton, MD 21113

October 16, 1997

Mr. Charles Barksdale
Sun Company, Inc. (R&M)
Ten Penn Center
1801 Market Street
Philadelphia, Pennsylvania 19103

RE: Short Pier Area: Recovery Well Installation and Feasibility Test Report
Sun Company, Inc.
Philadelphia Refinery
Point Breeze Processing Area

Dear Mr. Coladonato,

Handex of Maryland, Inc. is pleased to forward an original and fourteen copies of the Recovery Well Installation and Feasibility Test Report for the Short Pier Area of the Point Breeze Processing Area.

Please review this draft report and call either of the undersigned at (410) 674-3200 to discuss your to comments.

Sincerely,

Kathleen M. Wehnes FOR
Environmental Engineer
Senior Hydrogeologist

Arsin M. Samba
Senior Hydrogeologist

John J. Canzeri FOR
General Manager

KMW\AMS\JCC:
Attachments

(j:\winuser\sunref\ptbreeze\shortpie\sysdsgn.doc)

SHORT PIER AREA

Recovery Well Installation And Feasibility Test Report

October 23, 1997

Prepared For
SUN COMPANY, INC.
PHILADELPHIA REFINERY
POINT BREEZE PROCESSING AREA
3144 PASSYUNK AVENUE
PHILADELPHIA, PENNSYLVANIA 19145

Prepared By
HANDEX OF MARYLAND, INC.
360 Morgan Road
Odenton, Maryland 21113

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SHORT PIER AREA

Recovery Well Installation And Feasibility Test Report

1.0 INTRODUCTION

Handex of Maryland, Inc. (Handex) was retained by Sun Company, Inc. (Sun) to prepare a conceptual system design package to address the migration of non-aqueous phase liquids (NAPL) into the Schuylkill River at the Short Pier Area of the Point Breeze Processing Area located at the Philadelphia Refinery. As presented to Sun in a letter dated December 6, 1996, a phased work plan consisting of recovery well design, recovery well installation, and feasibility testing were required prior to preparation of the conceptual system design package. This report presents the results of the recovery well design, recovery well installation and feasibility test, and concludes with a summary of the system design parameters that will be used to formulate the conceptual system design.

Based on the conclusions of the Short Pier investigations completed prior to this report, the remedial system goal is the abatement of NAPL sheens detected on the Schuylkill River along the Short Pier Area by impeding the migration of NAPL before the subsurface decking structure and the river. Impeding NAPL migration prior to the decking is necessary because the primary pathway for NAPL migration to the river is below the wooden decking at low tide. In addition, NAPL recovery near the river will be complicated by ground water fluctuations caused by river tidal and flood/drought conditions, and the manmade subsurface structures associated with the decking.

The following system design parameters have been determined based on the data presented in this report along with the historical investigation data:

- The ground water elevation will need to be depressed below the low tide river elevation of -6 feet. Based on an estimated pumping intake of -12 feet, the maximum drawdown in the recovery wells will be 11 to 14 feet.
- Based on the specific capacity data obtained during the feasibility test, the estimated pumping rate will be 4.1 to 4.6 gallons per minute (gpm). Flow rates for the extracted ground water will vary due to tidal fluctuations, with high tide resulting in greater flow rates.
- Total fluids pumping is necessary from all three recovery wells to create a sufficient capture zone during both high and low tide events.

This report includes a brief background of the Short Pier Area investigations, summarizes the recovery well design and installation, discusses the feasibility test data, and presents preliminary parameters applicable to the conceptual remediation system design.

2.0 BACKGROUND

The Short Pier Area is located along the eastern shore of the Schuylkill River in the South Yard of the Point Breeze Processing Area as shown on Figure 1. A detailed site plan of the Short Pier Area is presented as Figure 2. The Short Pier Area is currently utilized for the transfer of product employing barges that dock south of the investigation area.

Preliminary investigations commenced at the Short Pier Area in June 1996 due to the detection of NAPL sheens on the water surface of the Schuylkill River near the Short Pier Area. A summary of the investigations conducted at the Short Pier Area prior to this report is presented below:

July 1996:	Installation of six monitoring wells and collection of soil samples
	NAPL sampling and analysis
August 1996:	Short Pier Initial Investigation Report
	Initiate weekly gauging and NAPL bailing from wells
	NAPL sampling and analysis
October 1996:	Trench excavation investigation and installation of Sump A
	Ground-Penetrating Radar (GPR) survey
January 1997:	Short Pier Area Investigation Report: Trench Excavation Activities and Results

The soils at the Short Pier Area are predominantly fill material comprised of fine sand and silt, underlain by sand and gravel. A portion of the lower coarse unit is comprised of slag and coke fill material from former refinery operations. A subsurface, wood deck is located near the river, although the precise lateral extent could not been determined. A profile of the Short Pier Area is presented as Figure 3.

Ground water occurs under unconfined conditions and flows west towards the river. The wells near the river are affected by tidal fluctuations. During low tide, the river level is below the bulkhead and extends to the river bank which is located below the base of the wood deck; the ground water table is also below the deck. At high tide, the river level and the ground water table are above the deck, and near the river there is a slight reversal of the ground water gradient. These conditions are shown on Figure 3.

NAPL and soil residual hydrocarbons were identified in the subsurface at the Short Pier Area. NAPL migrate east to west based on the westerly ground water gradient towards the river. NAPL migration west of the well S-107 area is a function of the tidally influenced ground water table and the presence of manmade structures located near the river. During high tide, NAPL migrate along the water table above the wood deck, but migration to the river is limited by the relatively intact bulkhead face and the slight ground water gradient reversal. During low tide, NAPL migrate to the river along the water table which is below the deck and at its maximum gradient; this serves as the primary pathway for NAPL migrating to the river.

3.0 RECOVERY WELL DESIGN

During advancement of the borings for wells S-105 through S-109, continuous soil sampling was conducted from a depth of five feet to the total depth of the boring. Based on the heterogeneity of the formation and its composition as predominantly fill material, five soil samples from the wells (S-105 through S-108) located near the proposed location of the recovery wells were submitted for sieve analysis; the results are presented in Appendix A. The sieve analyses data were evaluated using the Correlation Chart of Screen Openings and Sieve Sizes (Groundwater and Wells, Driscoll, 1986) to select the proper screen slot size and gravel pack material. The materials used in well construction are presented on the boring logs (Appendix B).

4.0 RECOVERY WELL INSTALLATION

Three recovery wells (RW-600, RW-601, and RW-602) were installed at the Short Pier Area from June 2-6, 1997, for feasibility testing and potential use as part of the NAPL recovery system. The wells are located along a line parallel to the Schuylkill River, about 40 to 55 feet from the bulkhead; the well locations are presented on Figure 2. The recovery well locations are based on the premise that prevention of NAPL migration to the river will require a sufficient ground water depression upgradient of the decking structure. A well spacing of approximately 30 feet was estimated based on ground water pumping experience in similar formations. However, the recovery well planned for the area near well S-105 could not be installed due to subsurface obstructions, so the final well spacing was increased to 40 to 50 feet.

The boreholes were drilled using mud rotary techniques operated from a mobile drill rig. This drilling method involves progression of a drag bit downward, while a mixture of water and bentonite (mud) is pumped through the drill bit. The viscosity of the mud maintains the stability of the borehole, while the upward force of the fluid removes the drill cuttings. The mud that flows to the top of the hole is recirculated after the coarser sediments are removed. Upon reaching the desired total depth, water is pumped through the drill bit to thin the mud allowing for installation of the well. Due to the drilling method and the presence of formerly sampled monitoring wells near each recovery well, soil samples were not collected for formation logging.

The recovery wells were installed to a total depth of approximately 25 feet, which is a minimum of 10 feet below the water table at low tide. The wells are constructed of 6-inch diameter, schedule 40, 0.010 or 0.020 slotted V-wire polyvinyl chloride (PVC) screen and 6-inch diameter, schedule 40, PVC casing. The annular space from the total depth of the borehole to about two feet above the well screen was completed with #0 or #1 well gravel. The annular space above the well gravel was sealed with at least one foot of hydrated bentonite. The remaining annulus to grade was filled with a cement/bentonite grout. All of the wells were completed flush-to-grade with a round, 10-inch diameter steel manhole and sealed with a watertight cap. Boring logs depicting well construction details are provided in Appendix B.

All of the recovery wells were developed for three to five hours using a combination of surging followed by overpumping. The top of each well casing was surveyed.

5.0 FEASIBILITY TESTING

The third task in the phased approach to system design was the performance of a ground water pumping test from one recovery well at the Short Pier Area to determine hydrogeologic parameters such as transmissivity and hydraulic conductivity, and the resulting ground water capture zone. The test provided data necessary to select the number of recovery wells, and system design parameters such as pumping flow rate, pump type, and pump intake depth. The pumping test was designed to consider the tidal fluctuations of up to seven feet in the Schuylkill River which directly affect the ground water elevation in the monitoring and recovery wells located within at least 75 feet of the river.

5.1 Methodology

5.1.1 Tidal Test

On June 19, 1997, a tidal test was conducted to determine tidal fluctuations which represent baseline ground water conditions. The test consisted of measuring the water elevation in the Schuylkill River and in most of the Short Pier Area wells during a time period approximately from low to high tide. The test was performed for 620 minutes from 0825 to 1845 hours. According to National Oceanic and Atmospheric Administration (NOAA) tidal charts for Philadelphia Municipal Pier 11, low tide was at 0830 hours and high tide was at 1345 hours. Philadelphia Municipal Pier 11 is located on the Delaware River near the Ben Franklin Bridge so the tides for the Schuylkill River at the Short Pier were estimated to occur earlier than the tides at Philadelphia Municipal Pier 11.

The equipment used to measure the water elevation in the river and wells consisted of an oil/water interface probe which records the depth to water and NAPL, and an In-Situ Inc. Hermit 2000 Environmental Data Logger (data logger) which uses transducers placed in the wells to record the water column pressure. Transducers were placed in well S-107, recovery wells (RW) RW-601 and RW-602, and River Gauge Point 3. In addition, water elevation data were collected from wells S-106 through S-109, RW-600 through RW-602, and River Gauge Point 3 using an interface probe. During the test, data were collected on a logarithmic scale using the data logger and on a linear scale using the interface probe; the data are presented in Appendix C.

5.1.2 Pumping Test

On June 20, 1997, the second phase of the feasibility test was performed, consisting of a 465 minute constant flow rate pumping test from RW-602. The test was performed during a similar time period as the tidal test and the results represent the combined effects of ground water pumping and tidal conditions on the ground water elevation. The effects of ground water pumping are isolated by calculating the difference between the ground water elevations during the tidal test (baseline conditions) and the pumping test. This calculation is performed after a time adjustment is made to the data based on the daily lag time in tidal cycles.

An electric submersible pump set approximately one foot above the bottom of the well was used for ground water extraction from RW-602. The discharge from the submersible pump passed through a flow meter and discharged into a holding tank. Step drawdown tests performed during development of the three recovery wells indicated that a flow rate of approximately 2 gallons per minute (gpm) could be sustained. The ball valve on the discharge line of the submersible pump was adjusted so the flow rate was maintained at approximately 1.9 gallons per minute (gpm).

The data logger was activated at 0900 hours and the submersible pump was started at 0915 hours. As with the tidal test, data were collected using the data logger and the interface probe; these data are presented in Appendix D. The test was completed at 1700 hours by deactivating the pump. The pumping test was performed for 465 minutes, during which time 860 gallons of water were extracted at a corresponding flow rate slightly less than 1.9 gpm.

5.1.3 Effluent Sampling

Near completion of the pumping test (1540 hours), a sample of the pumped water was collected for analysis of hardness, total iron, alkalinity, bicarbonate, carbonate, and pH. The water sample was submitted to EMSL Analytical, Inc. in Westmont, New Jersey. The laboratory analytical report is included in Appendix E.

5.2 Results

5.2.1 Tidal Test

The tidal test commenced near low tide, included rising tide and high tide, and ceased during falling tide as shown by the data collected at River Gauge Point 3 on June 19 (Appendix C). The river elevation during the tidal test is presented on Figure 4. High tide during the tidal test was recorded in the Schuylkill River at 1235 hours based on the data logger results (Figure 4 and Appendix C); low tide was not recorded during the test.

The wells that were monitored ranged from 5 to 55 feet from the river. The highest ground water elevation in each well occurred approximately 5 minutes before to 35 minutes after the river high tide. The tidal amplitude of the river was 5.17 feet based on the data logger results and 5.99 feet based on the gauging data. The gauging data results are considered less reliable because the interface probe records brief fluctuations in the river such as waves, whereas these fluctuations are not recorded by the data logger. The tidal amplitude in the wells during the monitoring period ranged from 0.64 to 2.55 feet. The time elapsed from the river high tide to the well high tide and the tidal amplitude data for the wells do not exhibit a consistent correlation with the well's distance from the river. Typically, a well closer to the river would have shorter time elapsed from river high tide to well high tide and a higher tidal amplitude. Relative to the other wells a similar distance from the river, well S-106 had a lower time elapsed from river high tide to well high tide and a higher tidal amplitude; this may suggest a high permeability connection between well S-106 and the river. The lower tidal amplitude at wells S-108 and RW-600 was expected as these two wells are farthest from the river. These data are summarized on Table 1.

All of the ground water elevation data presented in this report are corrected for the presence of NAPL on the ground water surface. A specific gravity of 0.80 was used as the correction factor for all of the wells, except S-107 (0.86) and S-109 (0.83). The values for wells S-107 and S-109 are based on NAPL sample analyses performed during earlier investigations at the Short Pier Area.

5.2.2 Pumping Test

The data collected at the wells during the pumping test represents the influence of daily tidal fluctuations and potential ground water drawdown achieved by pumping (Appendix D). The data collected at River Gauge Point 3 during the pumping test was independent of the ground water pumping. The data collected at River Gauge Point 3 on June 19 and June 20 is presented on Figure 4 with the x-axis representing actual time; this figure exhibits the daily change in tidal cycles.

The high tide peak on June 19 was at 1235 hours, whereas the high tide peak on June 20 was at 1330 hours; this equates to a 55 minute tidal lag time. Figure 5 shows the river elevation for each day with the tidal test data adjusted by 55 minutes. Zero on the x-axis represents an actual time of 0915 hours for the pumping test data (start of the pumping test) and an actual time of 0820 hours for tidal test data (55 minute tidal lag time adjustment). The tidal amplitude on June 20 was consistently higher than June 19, with a maximum amplitude difference of 0.516 feet. As shown on Figure 6, the tidal amplitude difference for the data on June 19 and June 20 stabilized between 0.3 and 0.5 feet 185 minutes into the test.

RW-602 was pumped at a constant flow rate of approximately 1.9 gpm for 465 minutes. The ground water elevation during the tidal and pumping tests is presented in Figure 7; the tidal test data has been adjusted by 55 minutes. The x-axis on this graph is the same as the river graph shown on Figure 5. The difference in the ground water elevation between the two tests represents the drawdown (Figure 8). After pumping for approximately 105 minutes, the drawdown stabilized at approximately 4 feet below the static ground water elevation.

The ground water elevation data for the wells during the tidal test (June 19) represents baseline conditions, although the ground water elevation does fluctuate due to the river tide. The drawdown induced by ground water pumping on June 20 is reflected as a decrease in the ground water elevation data during the pumping test when compared to the baseline ground water elevation data collected during the tidal test. The drawdown data is determined by the following procedure:

- All of the ground water elevation data is corrected for the presence of NAPL.
- Due to the daily variations in tidal cycles, the ground water data collected on June 19 is adjusted by 55 minutes to correspond with the data collected on June 20. The data for wells S-106, S-108, and RW-600 were adjusted by 60 minutes rather than 55 minutes so the data collection time intervals would correspond. This is presented on Figures 9, 11, 14, 16, and 18. On all of these figures, zero on the x-axis represents an actual time of 0915 hours for the pumping test data (start of the pumping test). For the tidal test data, zero represents an actual time of 0820 hours (55 minute tidal lag adjustment) or 0815 hours (60 minute tidal lag adjustment).

- The difference between the tidal test data (June 19) and the pumping test data (June 20) represents the drawdown induced by ground water pumping. If the ground water elevation during the pumping test is greater than during the tidal test, there was essentially no influence at the well related to ground water pumping or the higher tidal amplitude of the river on June 20 muted any minimal drawdown. This is presented on Figures 10, 12, 15, 17, and 19. The x-axis is the same as described above.

Wells S-107 and RW-601 exhibited drawdown data which could be analyzed for hydrogeologic parameters. The remaining wells (S-106, S-107, and RW-600) exhibited minimal or no drawdown. The drawdown data for wells S-107 and RW-601 were analyzed by Neuman's theory of delayed gravity response for unconfined aquifers using Aquifer Test Solver (AQTESOLV) (Geraghty & Miller, 1989). The drawdown data were analyzed using Neuman's type curve fitting analysis, which is based on the following assumptions and conditions:

- the aquifer is unconfined
- the aquifer has a seemingly infinite areal extent
- the aquifer is homogenous and of uniform thickness over the area influenced by the test
- prior to pumping, the water table is horizontal over the area that will be influenced by the test
- the aquifer is pumped at a constant discharge rate
- the well penetrates the entire aquifer and thus receives water from the entire saturated thickness of the aquifer.

Actual field conditions vary from these assumptions; thus, calculated hydrogeologic parameters should be interpreted as an approximation. The Neuman type curve fitting calculates values for transmissivity (T), storativity (S), and specific yield (S_y). The hydraulic conductivity (K) is calculated from the transmissivity using an aquifer thickness (b) of 16 feet, which is based on the static column of water in RW-602 prior to the pumping test. A discussion of the pumping test results is detailed below and a summary of the hydrogeologic parameters is presented on Table 2.

Well S-106 (Figures 9 & 10)

Well S-106 is located approximately 33 feet cross-gradient of pumping well RW-602. The maximum drawdown was 0.14 feet (excluding the data point collected at 105 minutes elapsed time). These data indicate that there was minimal or no influence at this well after ground water pumping for 465 minutes.

Well S-107 (Figures 11, 12, & 13)

Well S-107 is located approximately 10 feet cross-gradient of pumping well RW-602. The maximum drawdown was approximately 2.3 feet during the 465 minutes of pumping. These data indicate well S-107 was immediately influenced by the ground water pumping and the drawdown stabilized after about 155 minutes of pumping. During 465 minutes of ground water pumping, NAPL were detected in MW-107 but were not detected at RW-602.

The calculated hydrogeologic parameters are a transmissivity of 458 gallons per day per foot (gpd/ft), a hydraulic conductivity of 28.6 gpd/ft^2, a storativity of 3.4655×10^{-6}, and a specific yield of 0.001834. The hydrogeologic parameter data for this well are considered more reliable than the data for RW-601 (see below), because this well exhibited greater and more consistent drawdown.

Well S-108 (Figures 14 & 15)

Well S-108 is located approximately 45 feet cross-gradient of pumping well RW-602. The maximum drawdown was less than 0.06 feet. These data indicate that there was minimal or no influence at this well after ground water pumping for 465 minutes.

RW-600 (Figures 16 & 17)

RW-600 is located approximately 50 feet cross-gradient of pumping well RW-600. The maximum drawdown was 0.16 feet. These data indicate that there was minimal or no influence at this well after ground water pumping for 465 minutes.

RW-601 (Figures 18, 19, & 20)

RW-601 is located approximately 42 feet cross-gradient of pumping well RW-602. The drawdown near the end of the 465 minute pumping test was 0.17 feet. These data indicate that there was slight drawdown at this well after ground water pumping for 465 minutes. In addition, the drawdown during the latter half of the test may have been muted by the higher amplitude of the tide during the pumping test.

The calculated hydrogeologic parameters are a transmissivity of 1372 gpd/ft, a hydraulic conductivity of 85.8 gpd/ft^2, a storativity of 0.01107, and a specific yield of 0.01451. The hydrogeologic parameter data for this well are not as reliable as the data for well S-107 because there much less drawdown.

Specific Capacity Evaluation

At a pumping rate of 1.9 gpm and a stabilized drawdown of approximately 4.0 feet, the specific capacity of pumping well RW-602 is 0.5 gpm per foot of drawdown. This is supported by the transmissivity data ranging from 0.32 to 0.95 gpm/ft for wells S-107 and RW-601. During static conditions RW-602 had 16.45 feet of available water column, so the drawdown of 4.0 feet equates to 24-percent drawdown. Based on a graph relating specific capacity to drawdown (Groundwater And Wells, Driscoll, 1986), 24-percent drawdown occurs at 87-percent of the well's specific capacity, so the theoretical 100-percent specific capacity of RW-602 is 0.55 gpm/ft.

Radius of Influence Evaluation

After ground water pumping for 465 minutes at a rate of 1.9 gpm, the radius of influence was at least 10 feet (S-107) but less than 33 feet. Figure 21 presents a contoured drawdown map using a logarithmic scale. To estimate the radius of influence after 10,000 minutes (approximately one week) of pumping, the following was conducted:

- The x-axis of the pumping test drawdown graphs for S-107 and RW-601 (Figures 12 and 19) were changed to logarithmic
- The drawdown was extrapolated to 10,000 minutes, yielding a drawdown of approximately 3.7 feet for well S-107 (Figure 22) and approximately 0.29 feet for RW-601 (Figure 23).
- These data were placed on a distance-drawdown graph which allows an estimation of the drawdown at any distance based on 10,000-minutes of pumping. As shown on Figure 24, the distance from RW-602 to reach a drawdown of 0.5 feet is approximately 38 feet.

5.2.3 Effluent Sampling

The laboratory analytical results for the ground water sample indicated concentrations for all of the compounds analyzed. The total iron concentration was 39 milligrams per liter (mg/L), the hardness concentration was 460 mg/L, and the pH was 6.38 standard units. The analytical results indicate the potential for iron and calcium fouling of equipment and plumbing, particularly if exposed to oxygen.

6.0 PRELIMINARY CONCEPTUAL SYSTEM DESIGN PARAMETERS

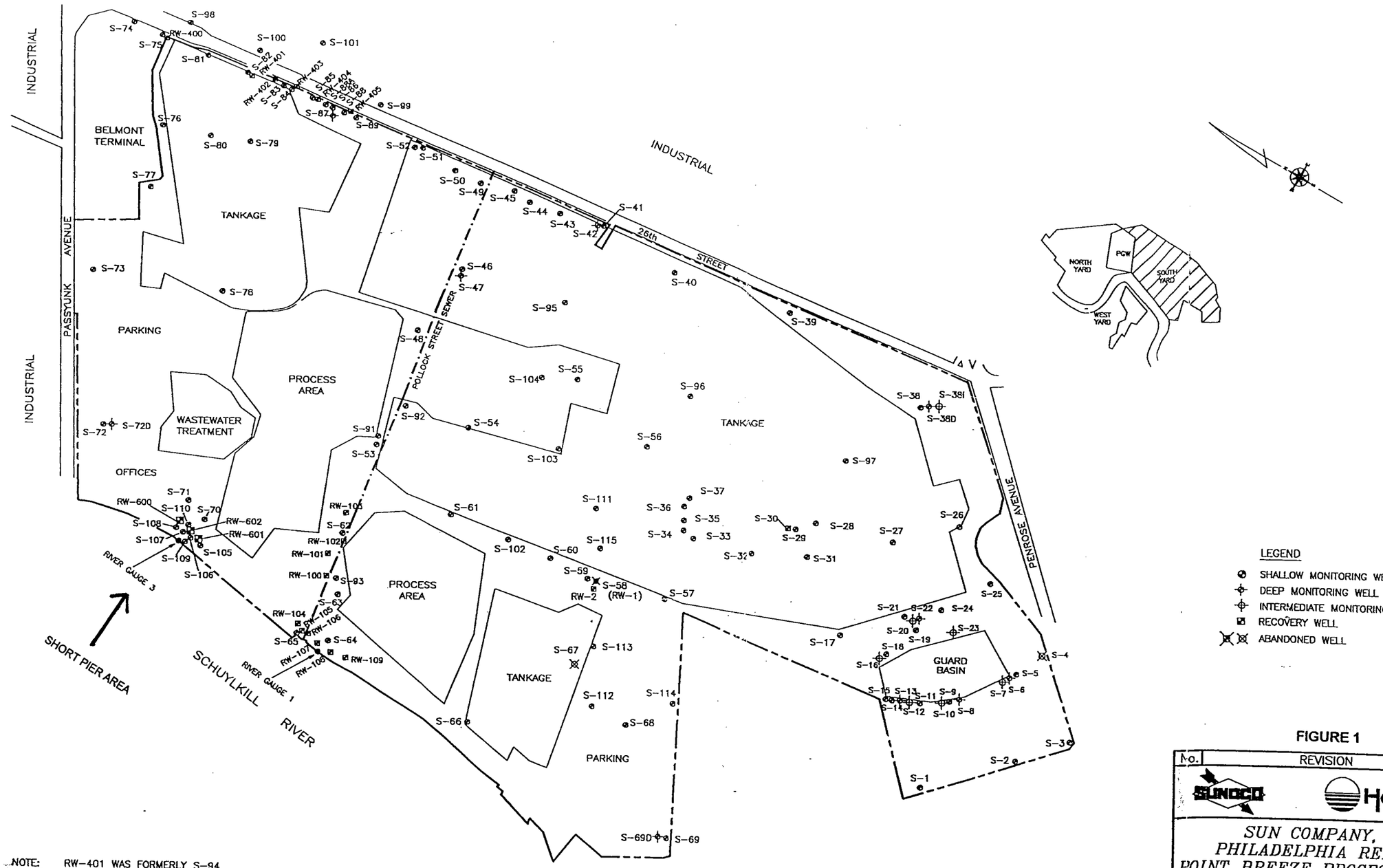
The results of the historical investigations at the Short Pier Area, the recovery well installation, and the feasibility test were evaluated to determine preliminary parameters for the conceptual remediation system design.

The ground water elevation in RW-600, RW-601, and RW-602 ranges from approximately -1 to 2 feet including tidal fluctuations, and the Schuylkill River water elevation ranges from -6 to 2 feet. In order to create a ground water capture zone to prevent NAPL from migrating to the Schuylkill River, the ground water elevation will need to be depressed below the low tide river elevation of -6 feet. Using an estimated pumping intake of -12 feet, the drawdown in the recovery wells will be 11 to 14 feet, which equates to a drawdown of 65-percent and 82-percent of the static water column. Using the graph relating specific capacity to drawdown, 67-percent and 60-percent of the specific capacity are achieved at these drawdowns. Based on the theoretical 100-percent specific capacity of 0.55 gpm/ft, the resulting specific capacities are 0.37 gpm/ft at 11 feet drawdown and 0.33 gpm/ft at 14 feet drawdown. Therefore, the estimated pumping rate will be 4.1 to 4.6 gpm. Flow rates for the extracted ground water will vary during tidal fluctuations with high tide resulting in the greater flow rate.

The radius of influence during the 465-minute pumping test was less than 33 feet, and the extrapolated radius of influence was 38 feet for 10,000 minutes of ground water pumping. These radii of influence are not sufficient to prevent NAPL migration to the river. Although the capture zone will be larger for the proposed system because the pumping rate is increased to 4.1 to 4.6 gpm, ground water extraction from RW-602 solely will not be adequate to prevent NAPL migration to the river. To achieve the appropriate capture zone during both high and low tide events, ground water will be extracted from all three existing 6-inch wells (RW-600, RW-601, and RW-602) which were installed for the purpose of ground water extraction. Pumping from all three recovery wells will create an overlap of the capture zones, so the total system pumping rate will be less than 4.1 to 4.6 gpm per well.

Ground water extraction and NAPL recovery will be accomplished by total fluids pumping rather than dual pumping, because dual pumping systems have limited flexibility in an area with tidal fluctuations. Iron and calcium fouling should be reasonably considered when selecting the equipment in the conceptual design.

FIGURES



NOTE: RW-401 WAS FORMERLY S-94
RW-403 WAS FORMERLY S-90

LEGEND

- SHALLOW MONITORING WELL
- DEEP MONITORING WELL
- INTERMEDIATE MONITORING WELL
- RECOVERY WELL
- ABANDONED WELL

FIGURE 1

No.	REVISION	DATE

SUNOCO Handex

SUN COMPANY, INC.
PHILADELPHIA REFINERY
POINT BREEZE PROCESSING AREA

SITE PLAN
SOUTH YARD

SCALE – 1" = 600'	JOB No. – 110535-01
DRAWN BY – J. Gurry	REV BY. – JG 06/26/97
CHECKED BY –	DWG. NAME –110535SY
DATE – 04/09/96	DWG. No. –

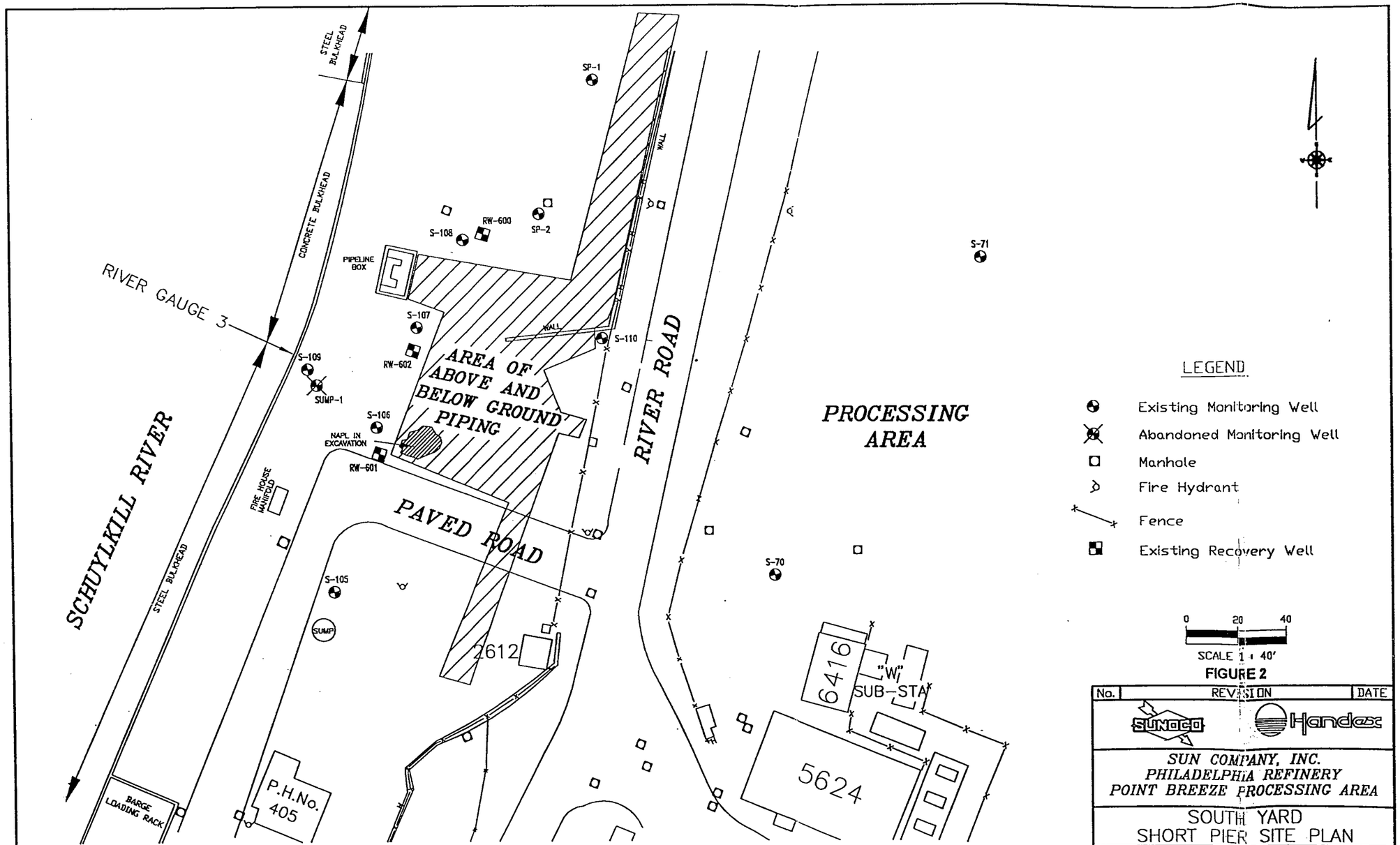


FIGURE 2

No.	REVISION	DATE

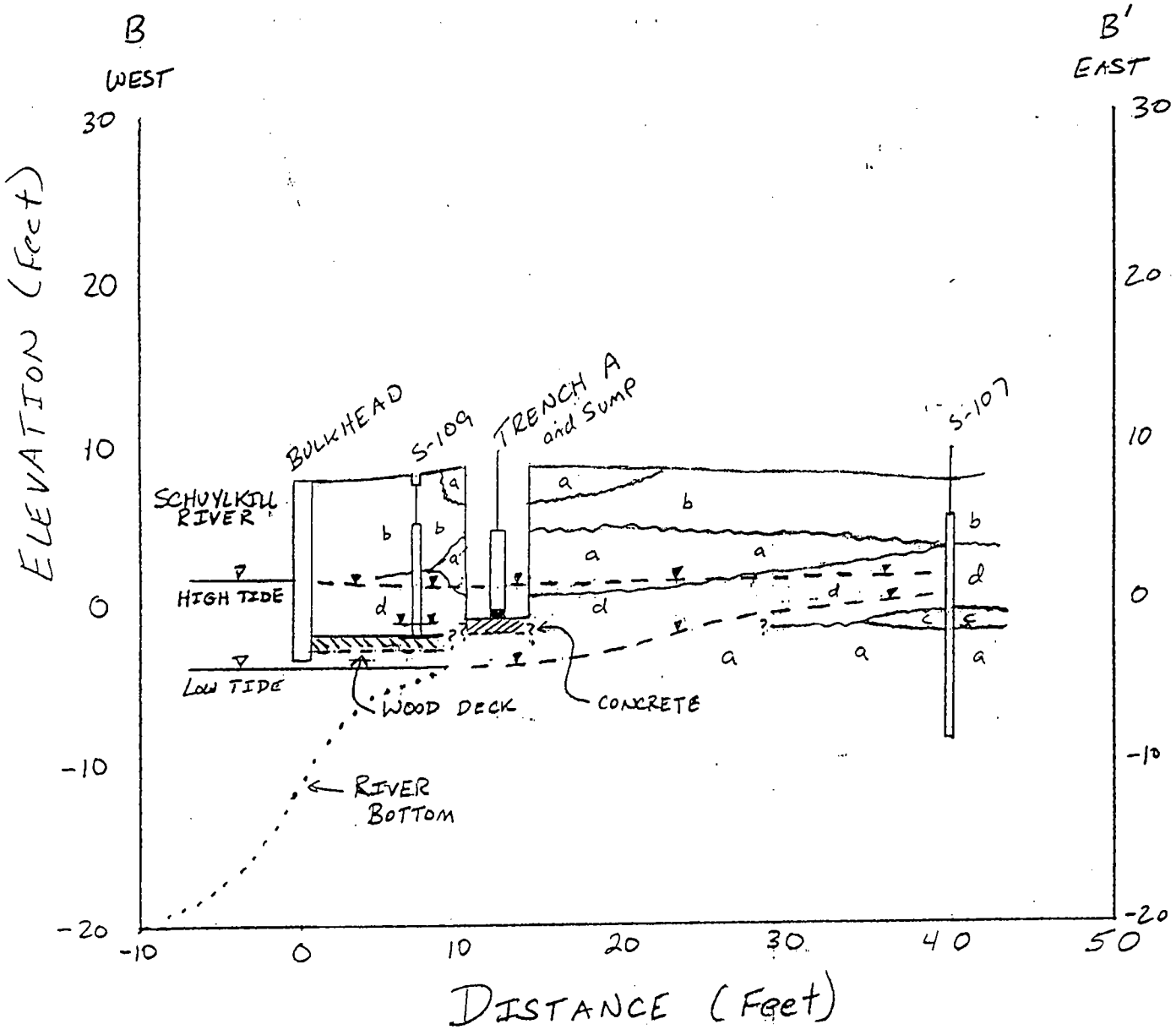
SUNOCO Handex

SUN COMPANY, INC.
PHILADELPHIA REFINERY
POINT BREEZE PROCESSING AREA

SOUTH YARD
SHORT PIER SITE PLAN

SCALE - 1" = 40'	JOB No. - 110535-13
DRAWN BY - J. Gurry	REV BY. - JG 06/25/97
CHECKED BY -	DWG. NAME - PB_SP_05
DATE - 10/30/96	DWG. No. -

CROSS-SECTION B-B'



KEY

- Ground Water Elevation
- River Level
- Well Casing / Well Screen

Geologic Key

a: Sand & Gravel (tan/brown)
b: Fine Sand & Silt
c: Clay
d: Sand & Gravel (black)

Notes

1. Depth of bulkhead estimated
2. Vertical and horizontal extent of wood deck and concrete unknown
3. River bottom estimated

SUN COMPANY INC
Philadelphia Refinery
Pt. Breeze Processing Area

SHORT PIER AREA

FIGURE 3

FIGURE 4

RIVER, TIDAL & PUMPING TESTS, DATA LOGGER RESULTS

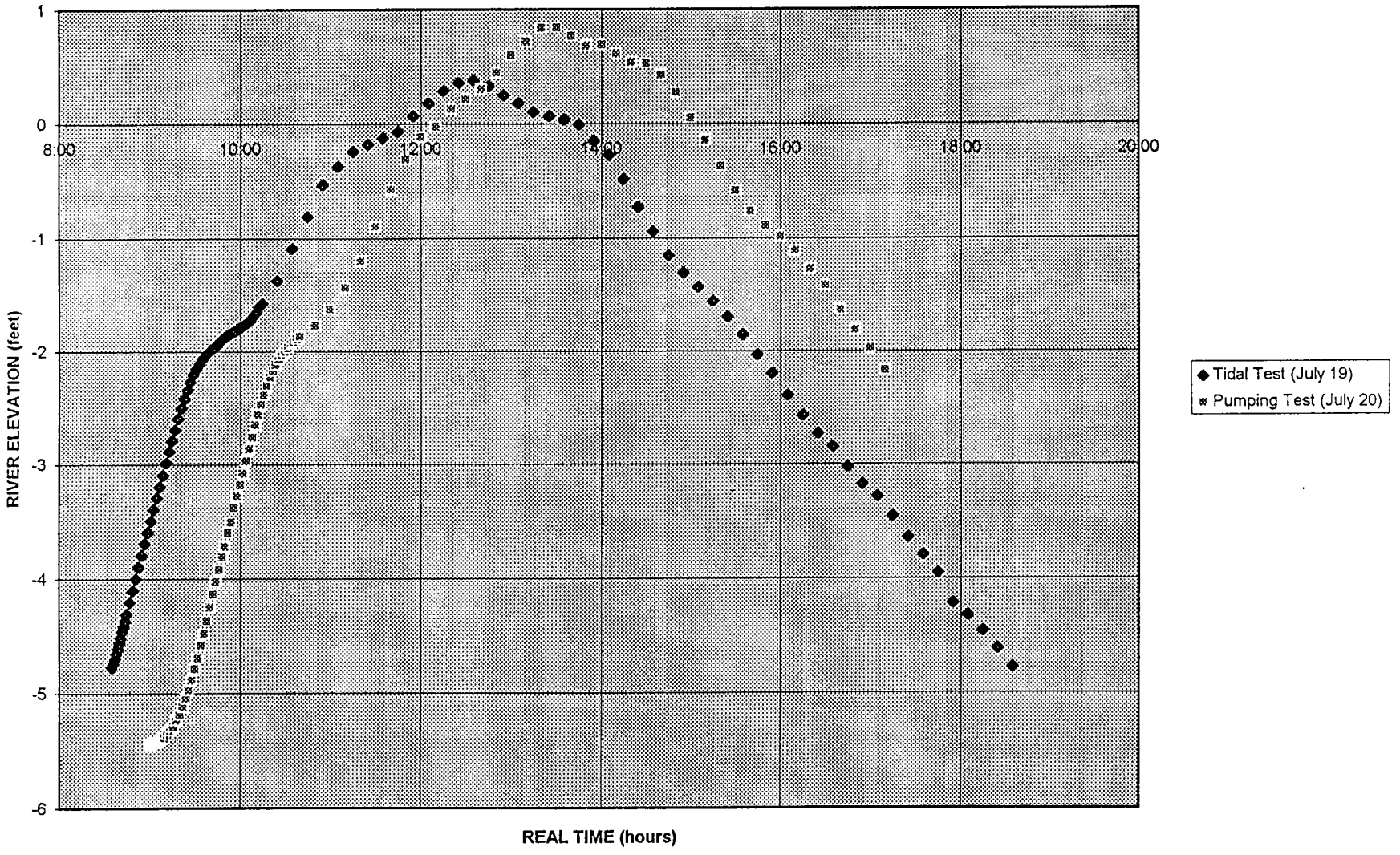


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FIGURE 5

RIVER, TIDAL (adjusted for lag time) & PUMPING TESTS, DATA LOGGER RESULTS

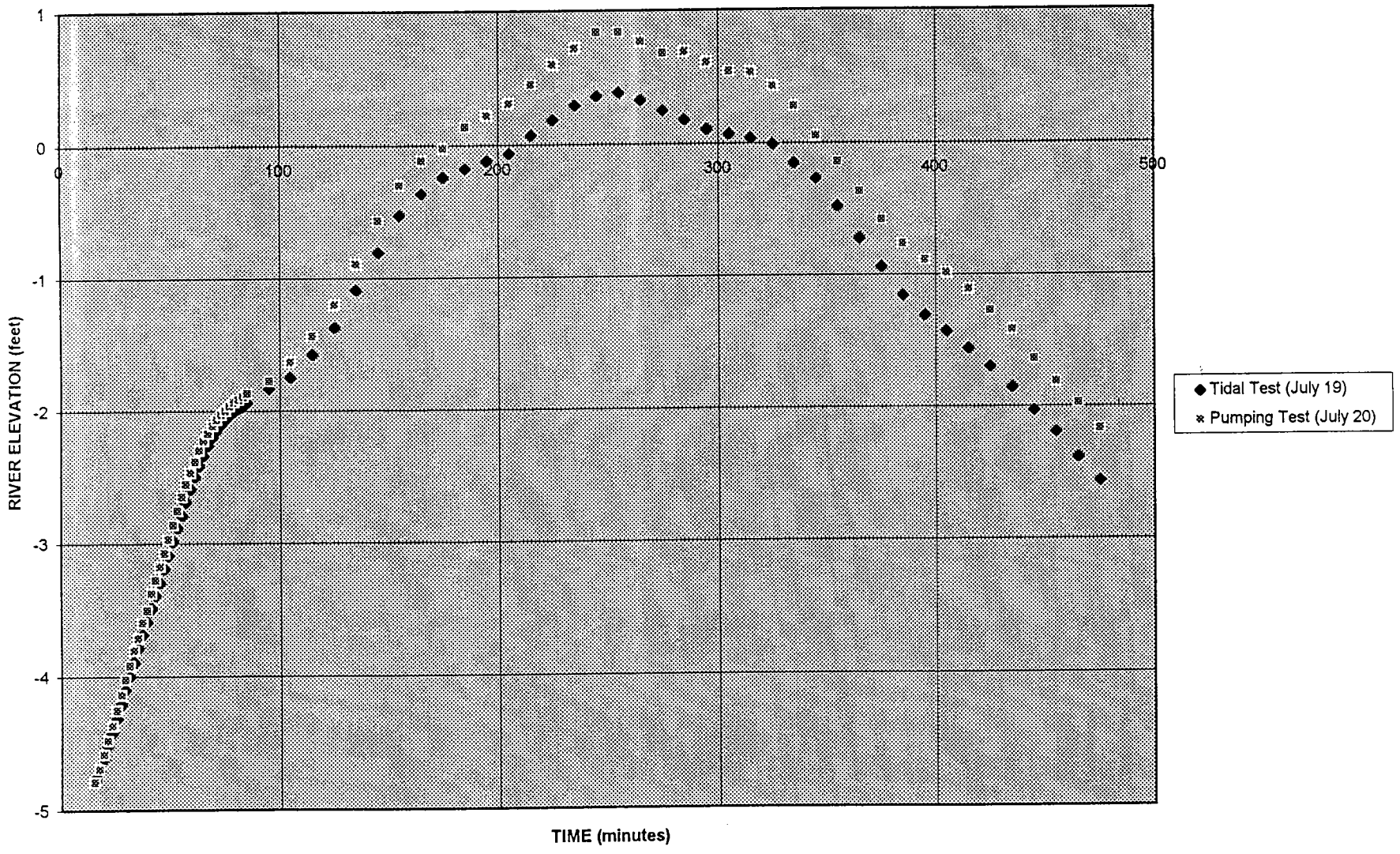

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FIGURE 6

RIVER, DIFFERENCE IN WATER ELEVATION (TIDAL TEST DATA MINUS PUMPING TEST DATA), DATA LOGGER RESULTS

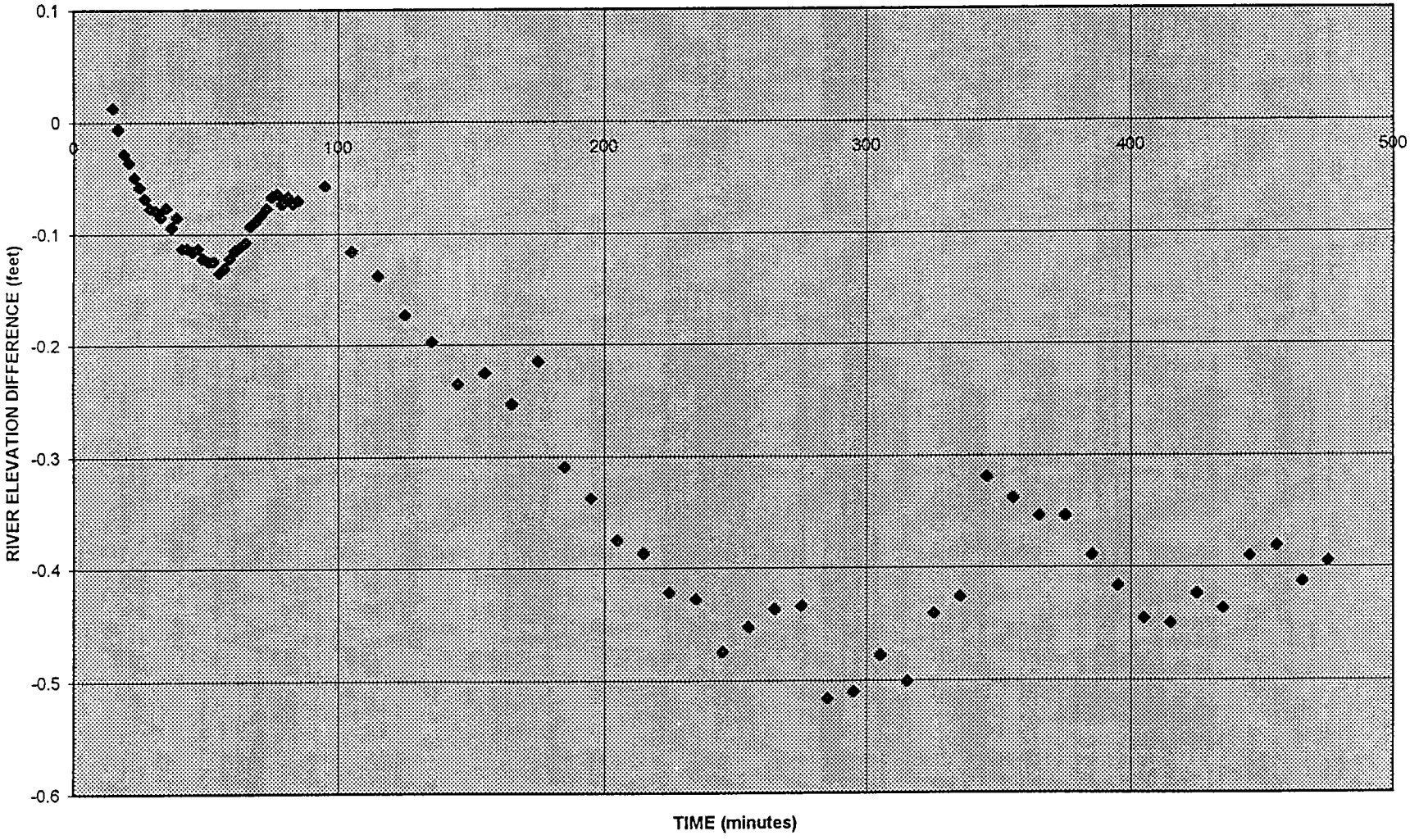

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FIGURE 7

RW-602, TIDAL & PUMPING TESTS, DATA LOGGER RESULTS

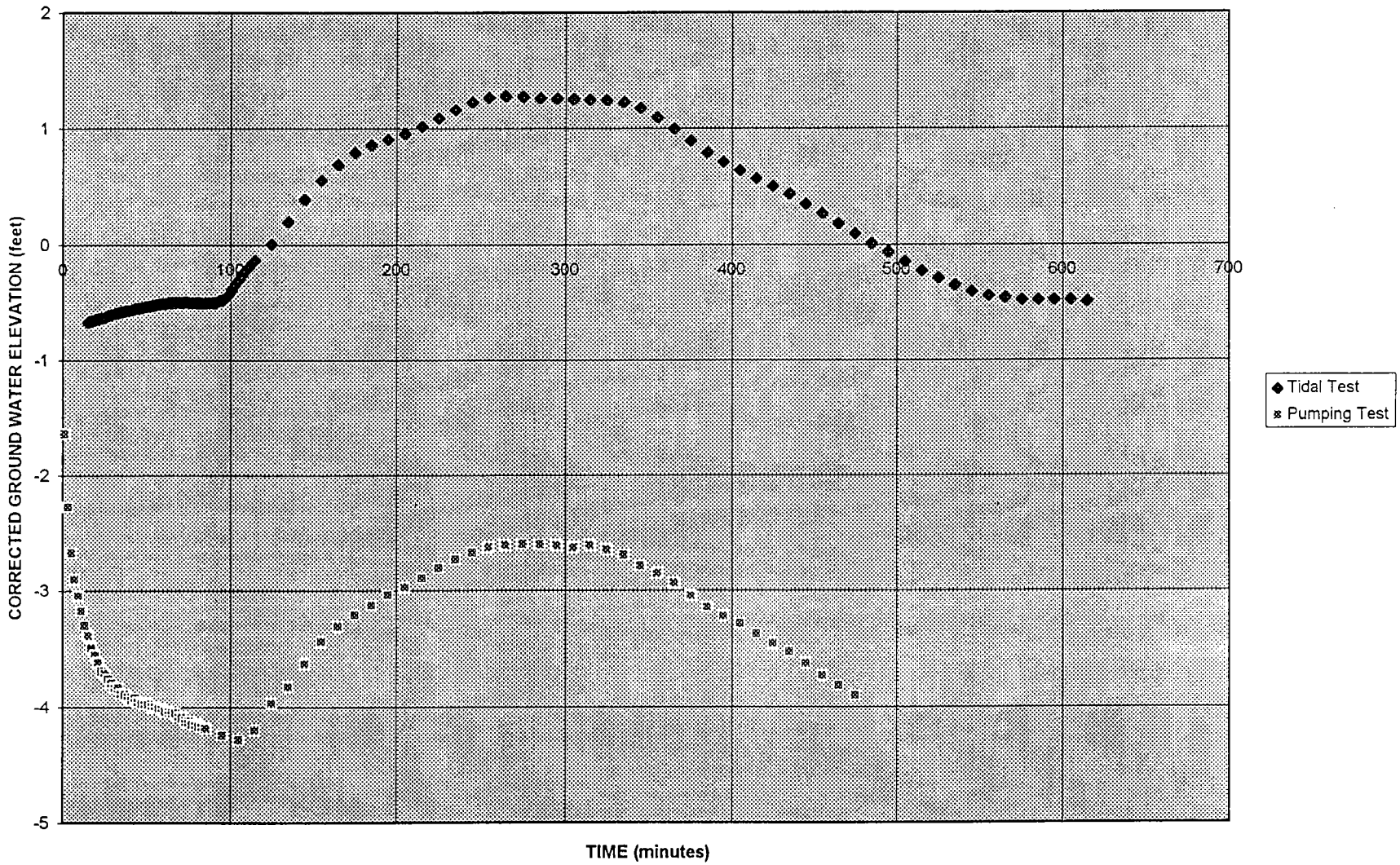

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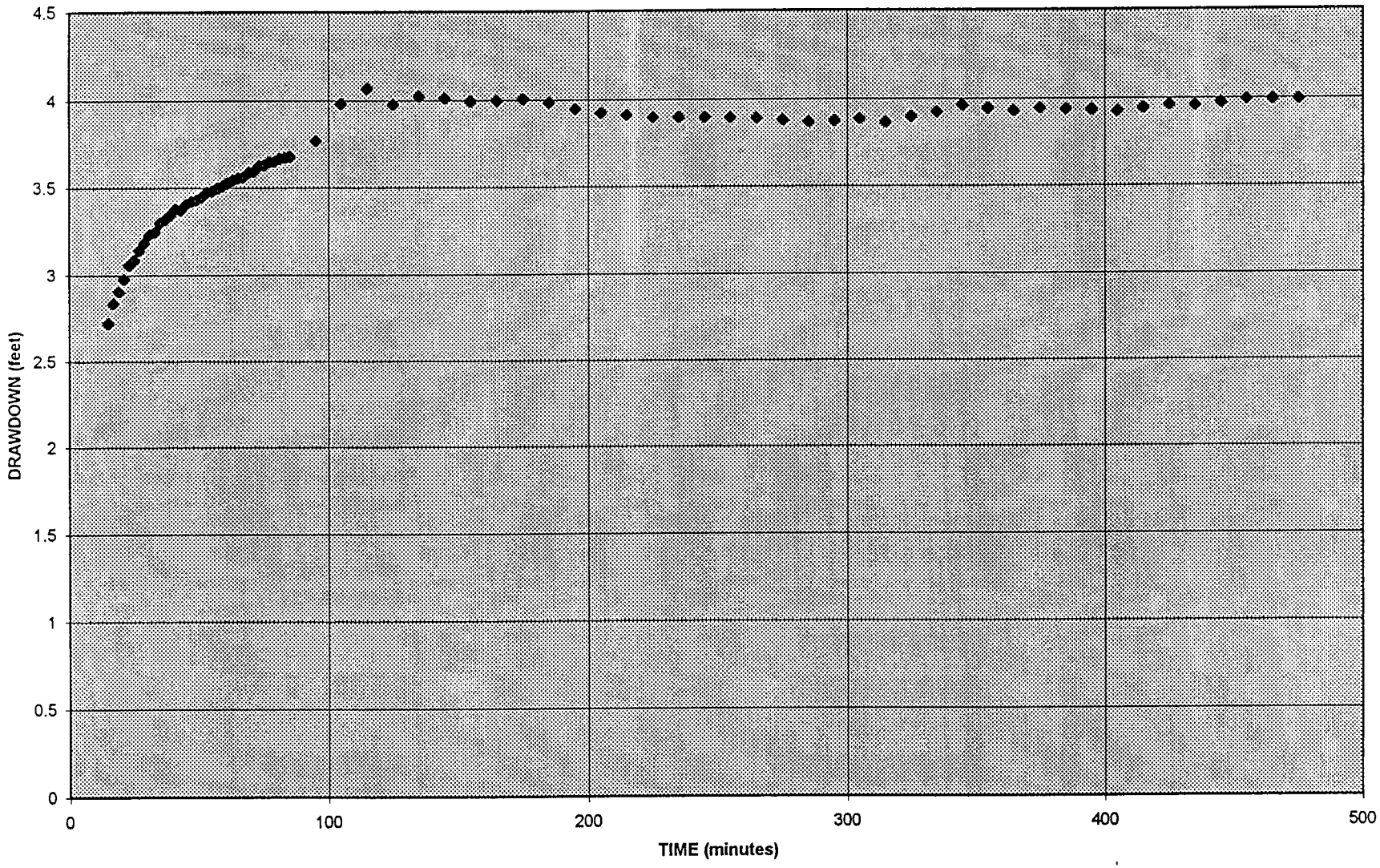
FIGURE 8

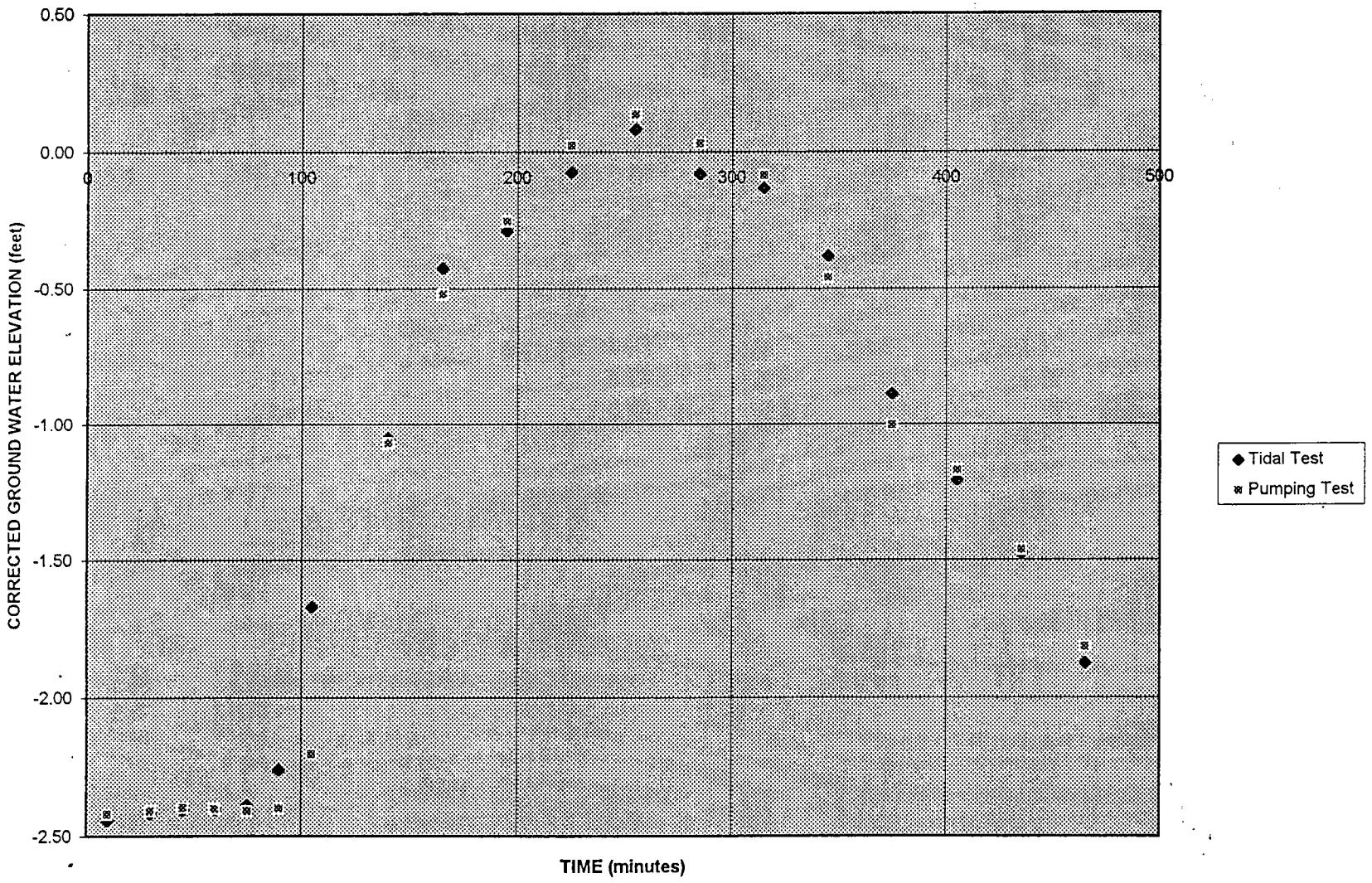
RW-602, PUMPING TEST DRAWDOWN DATA, DATA LOGGER RESULTS



Handex®

FIGURE 9

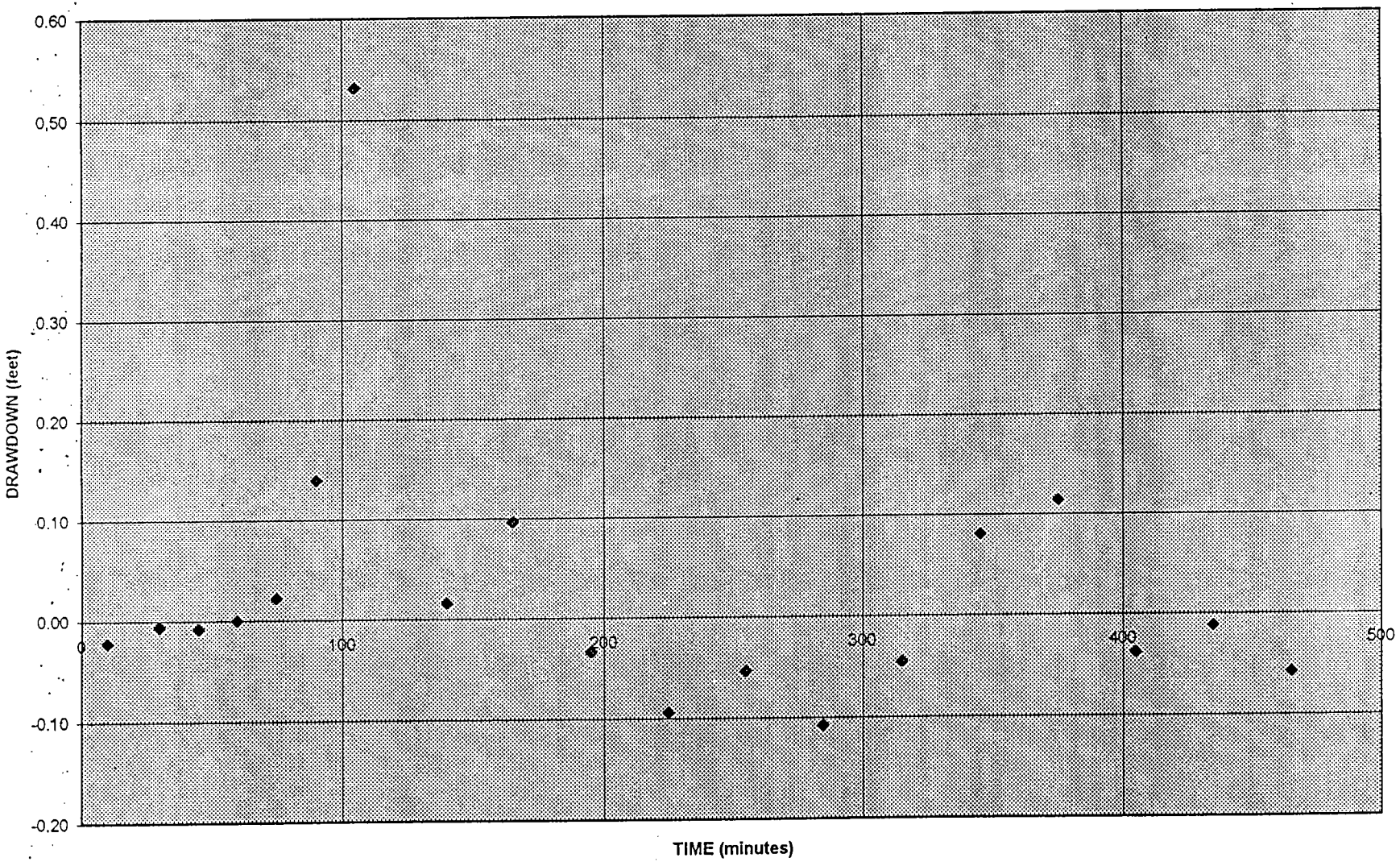
S-106, TIDAL & PUMPING TESTS, INTERFACE PROBE RESULTS



Handex®

FIGURE 10

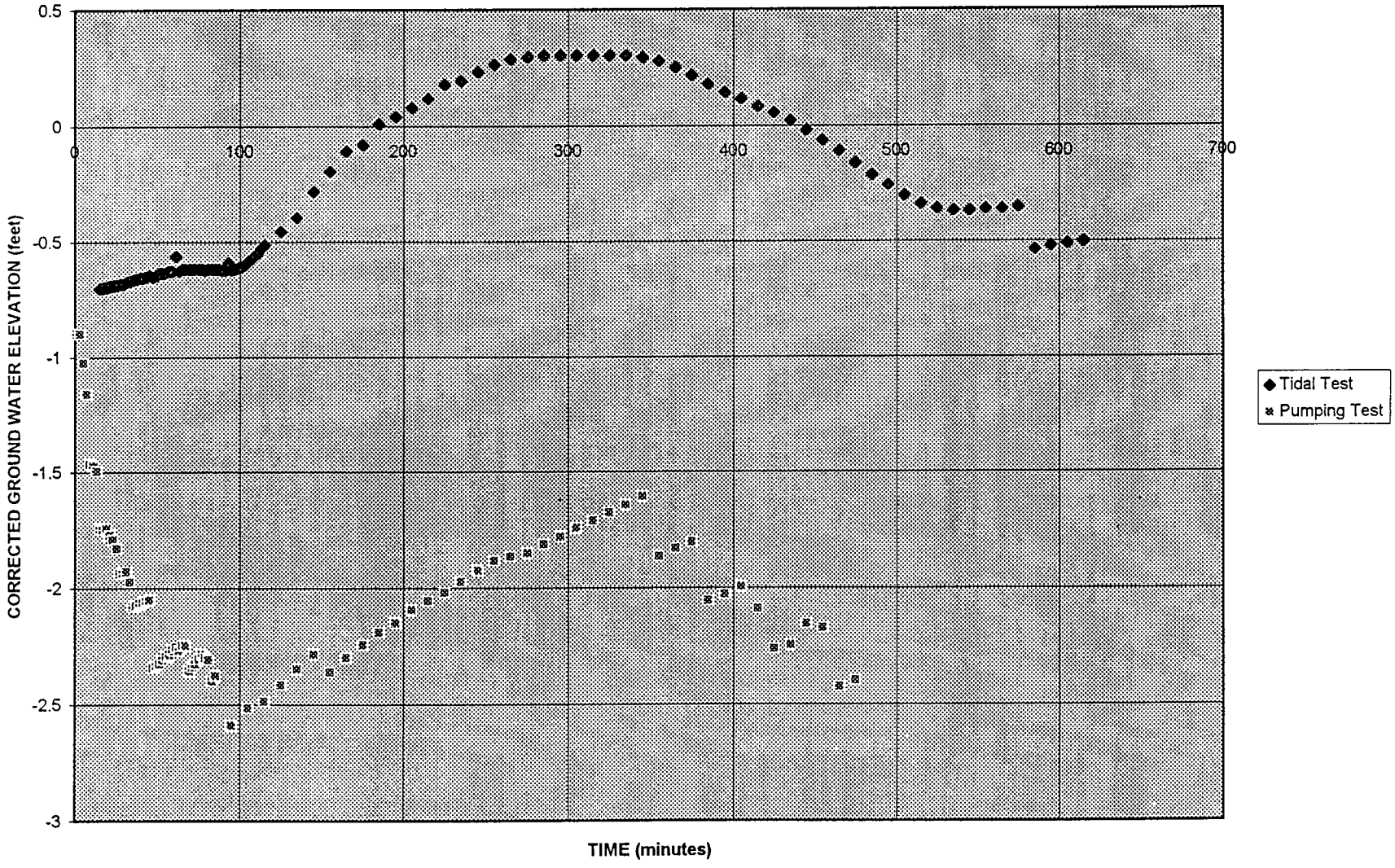
S-106, PUMPING TEST DRAWDOWN DATA, INTERFACE PROBE RESULTS



Handex®

FIGURE 11

S-107, TIDAL & PUMPING TESTS, DATA LOGGER RESULTS



Handex®

FIGURE 12

S-107, PUMPING TEST DRAWDOWN DATA, DATA LOGGER RESULTS

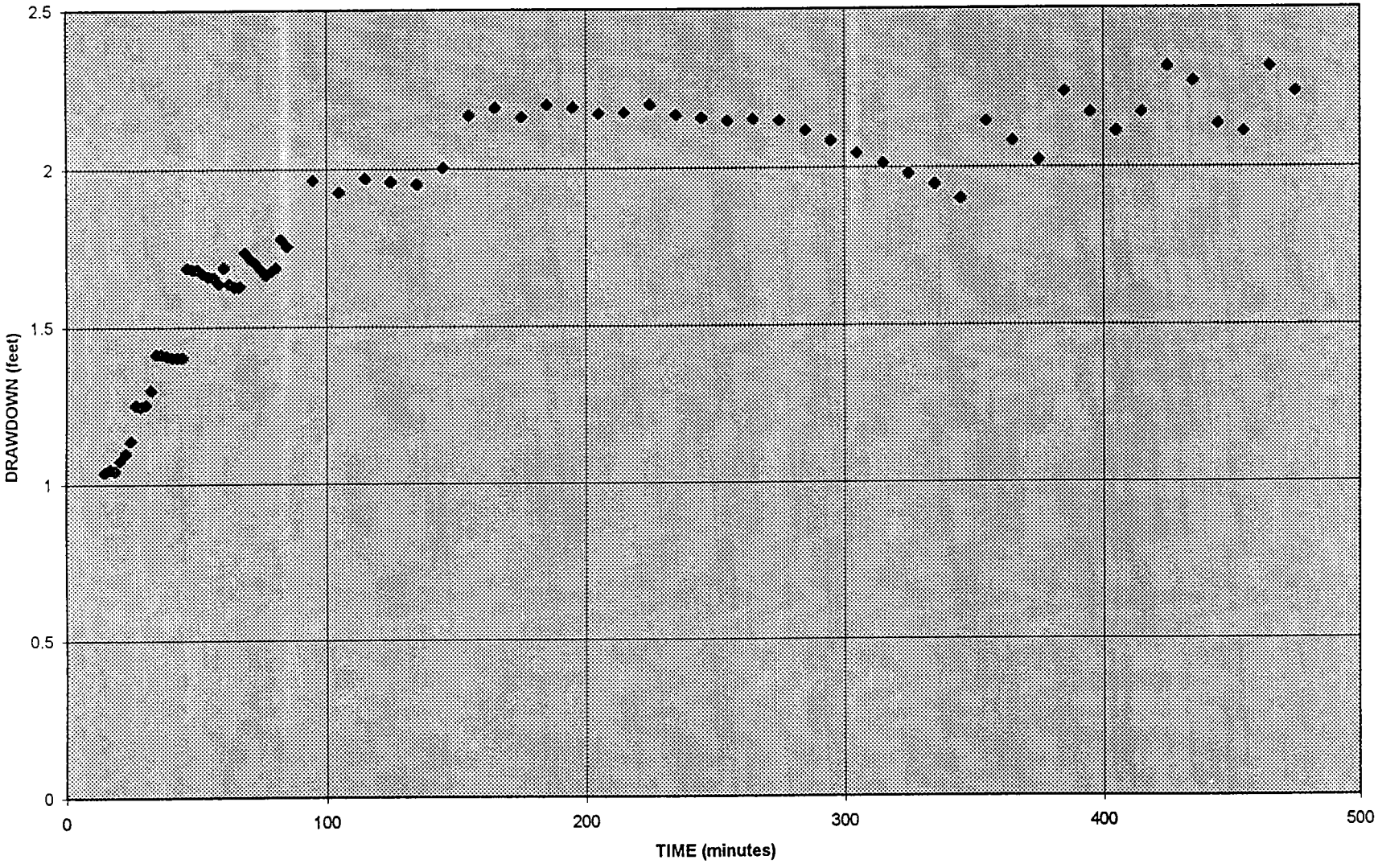


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FIGURE 13

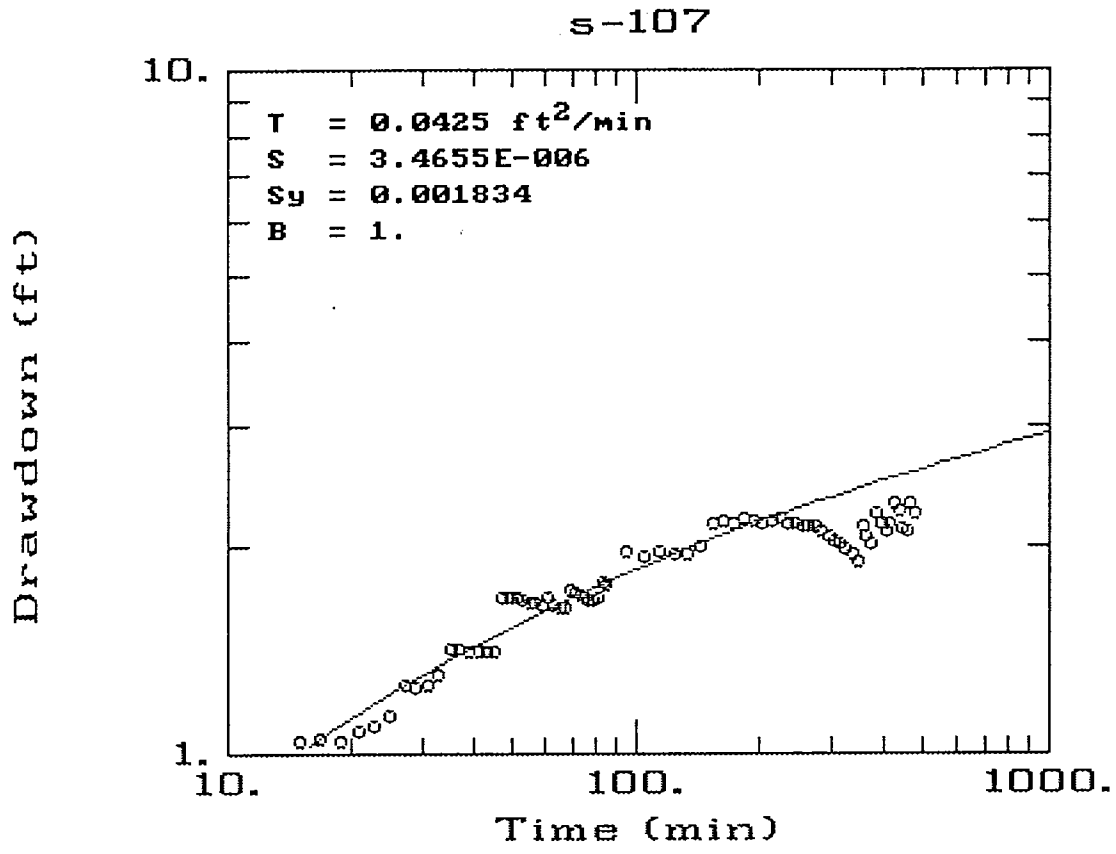

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FIGURE 14

S-108, TIDAL & PUMPING TESTS, INTERFACE PROBE RESULTS

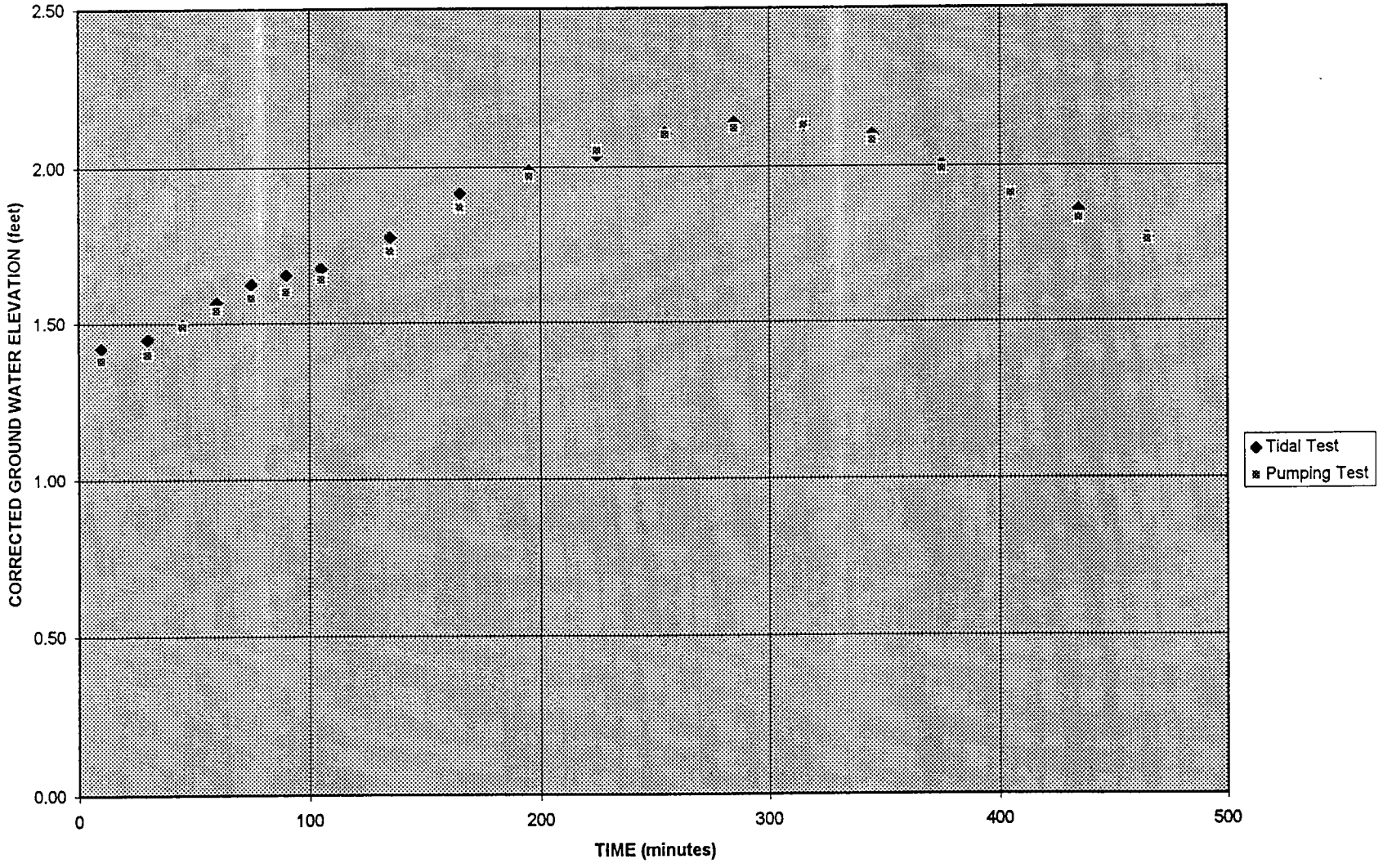

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FIGURE 15

S-108, PUMPING TEST DRAWDOWN DATA, INTERFACE PROBE RESULTS

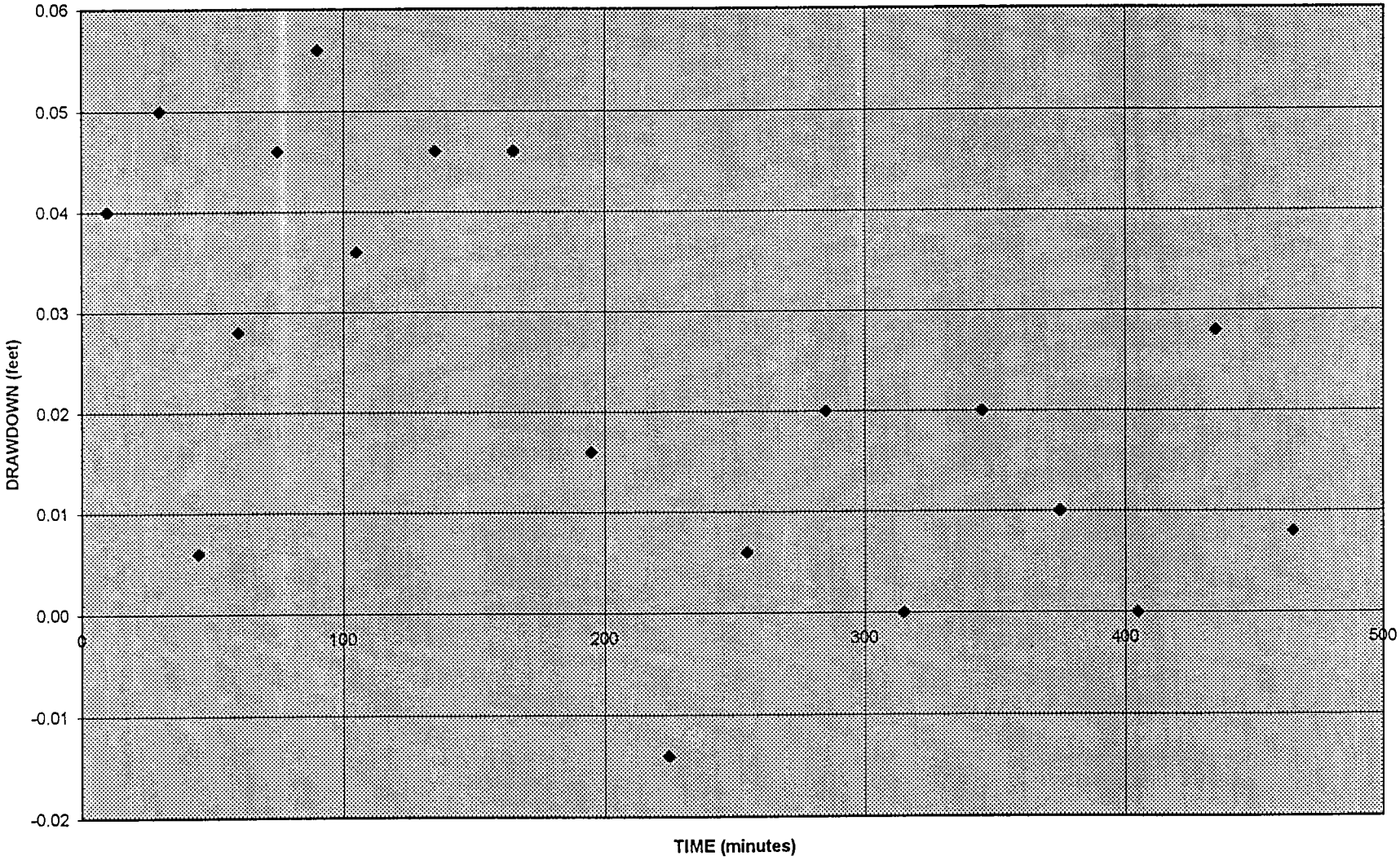

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FIGURE 16

RW-600, TIDAL & PUMPING TEST, INTERFACE PROBE RESULTS

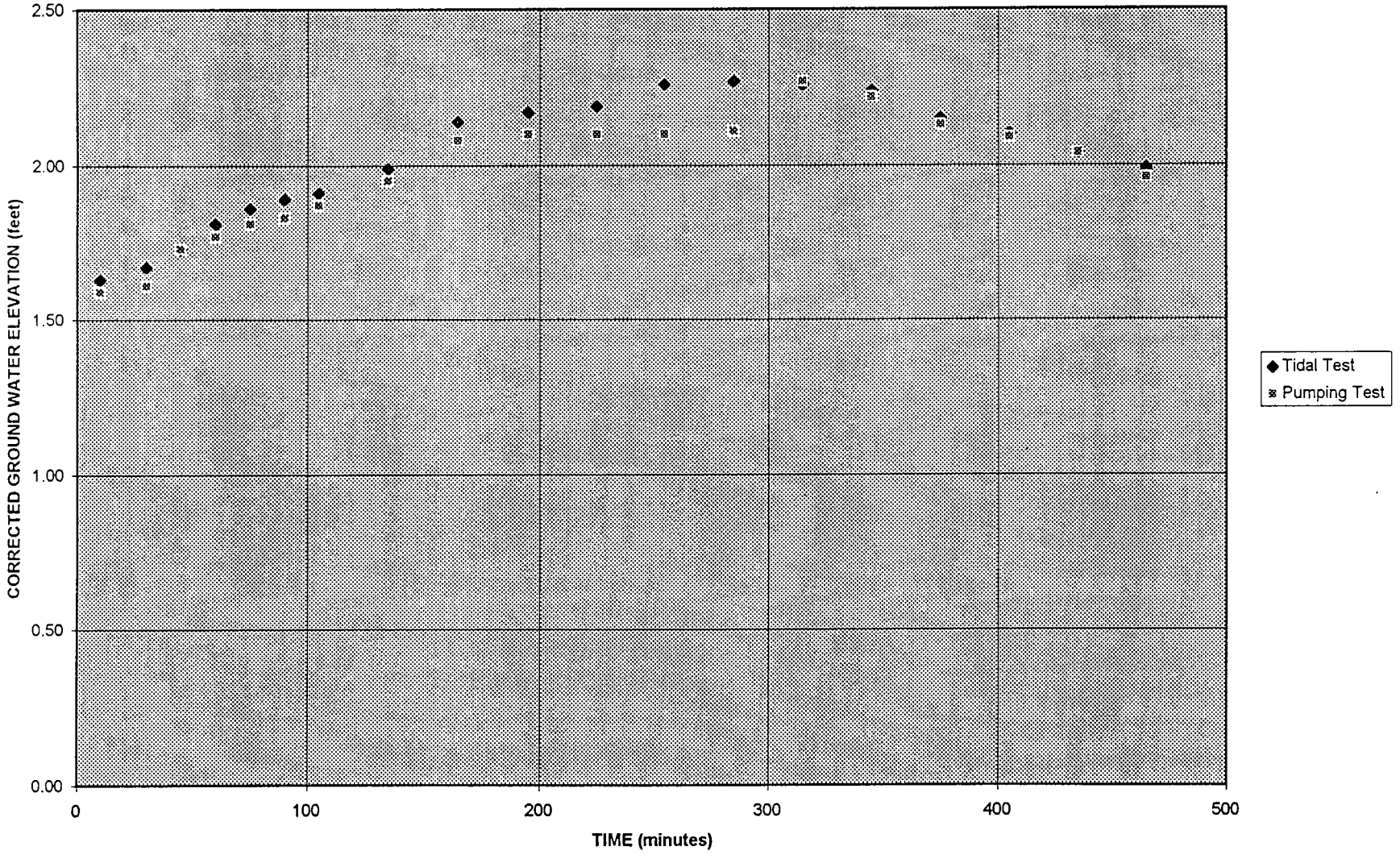

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FIGURE 17

RW-600, PUMPING TEST DRAWDOWN DATA, INTERFACE PROBE RESULTS

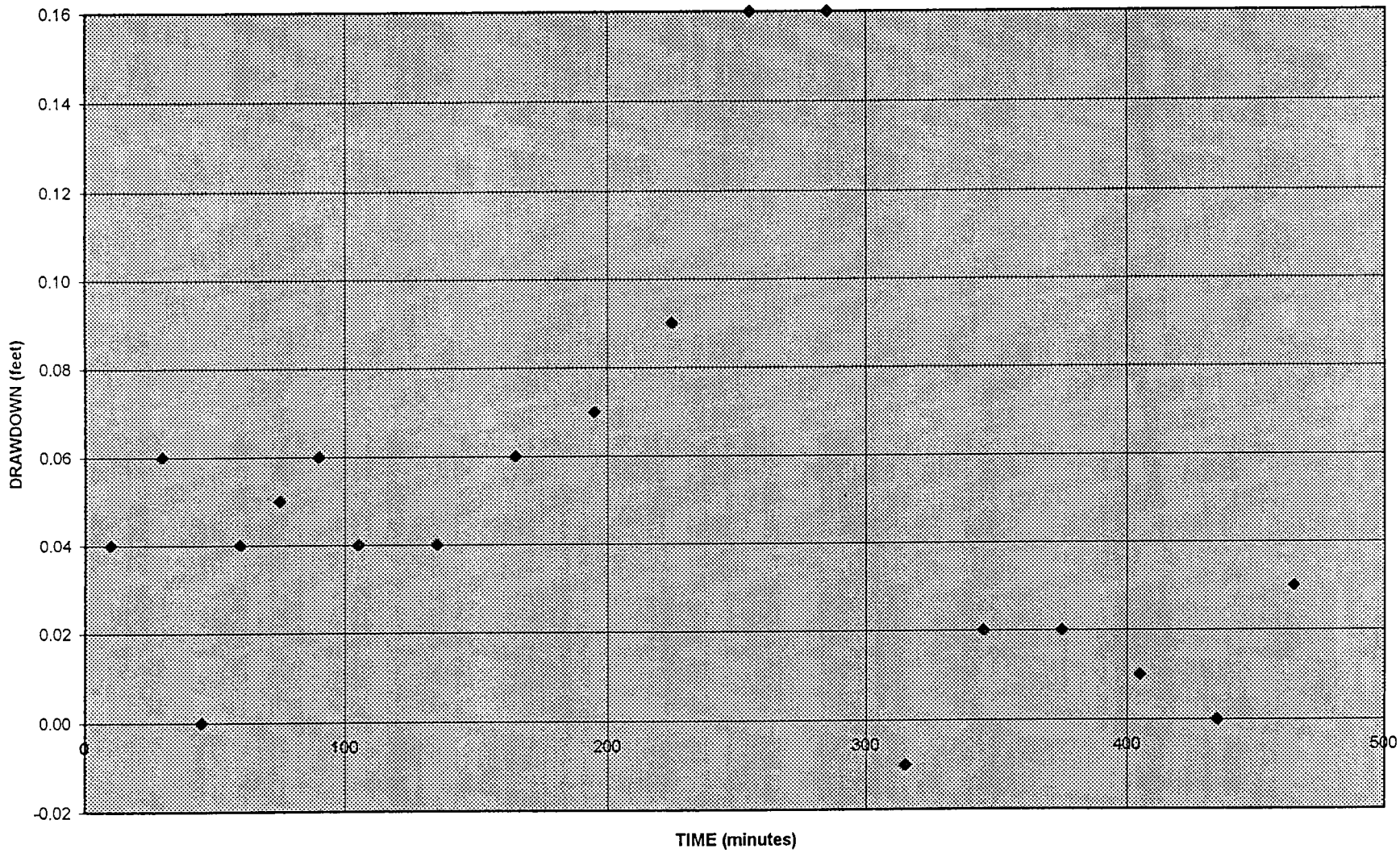

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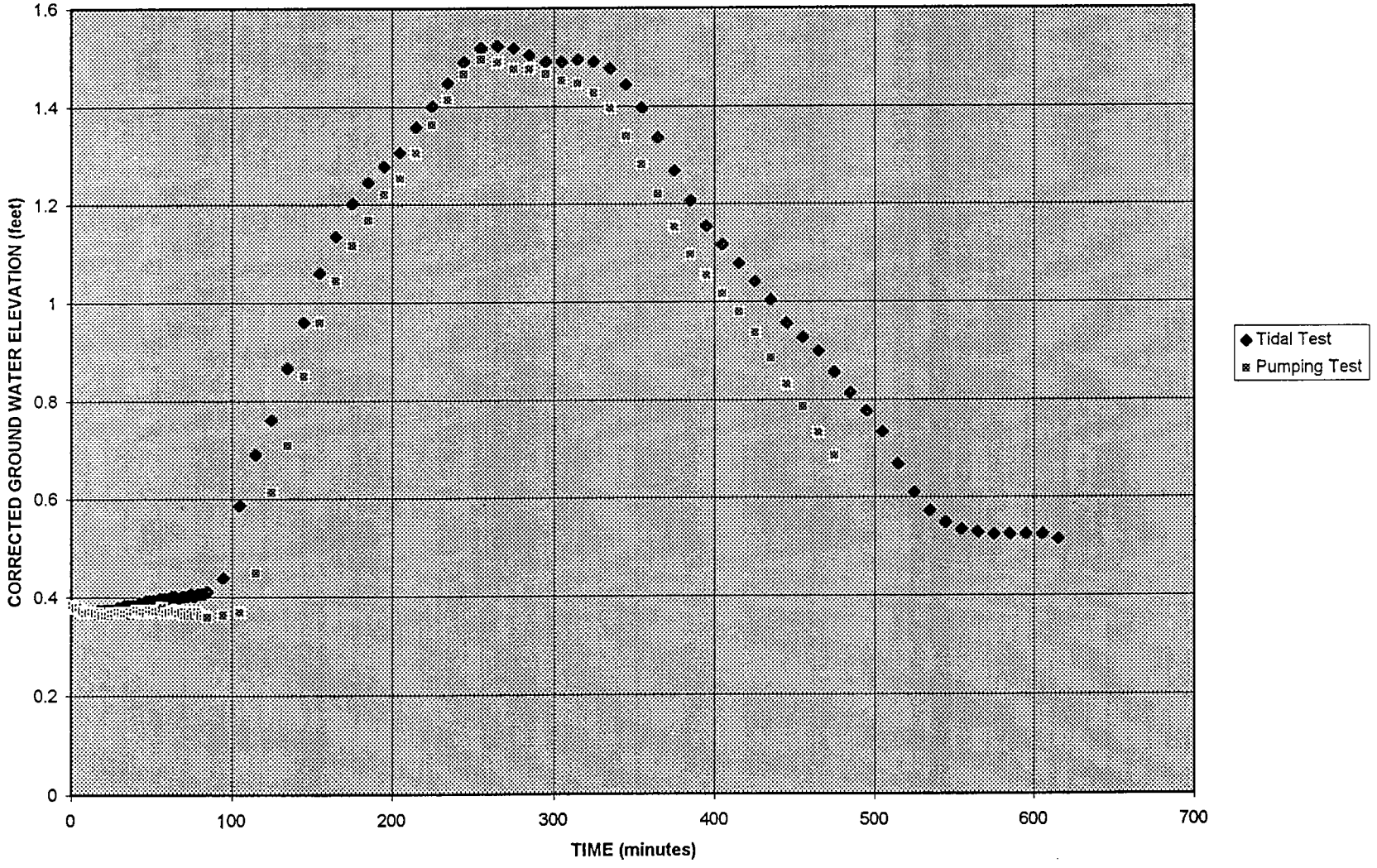
FIGURE 18

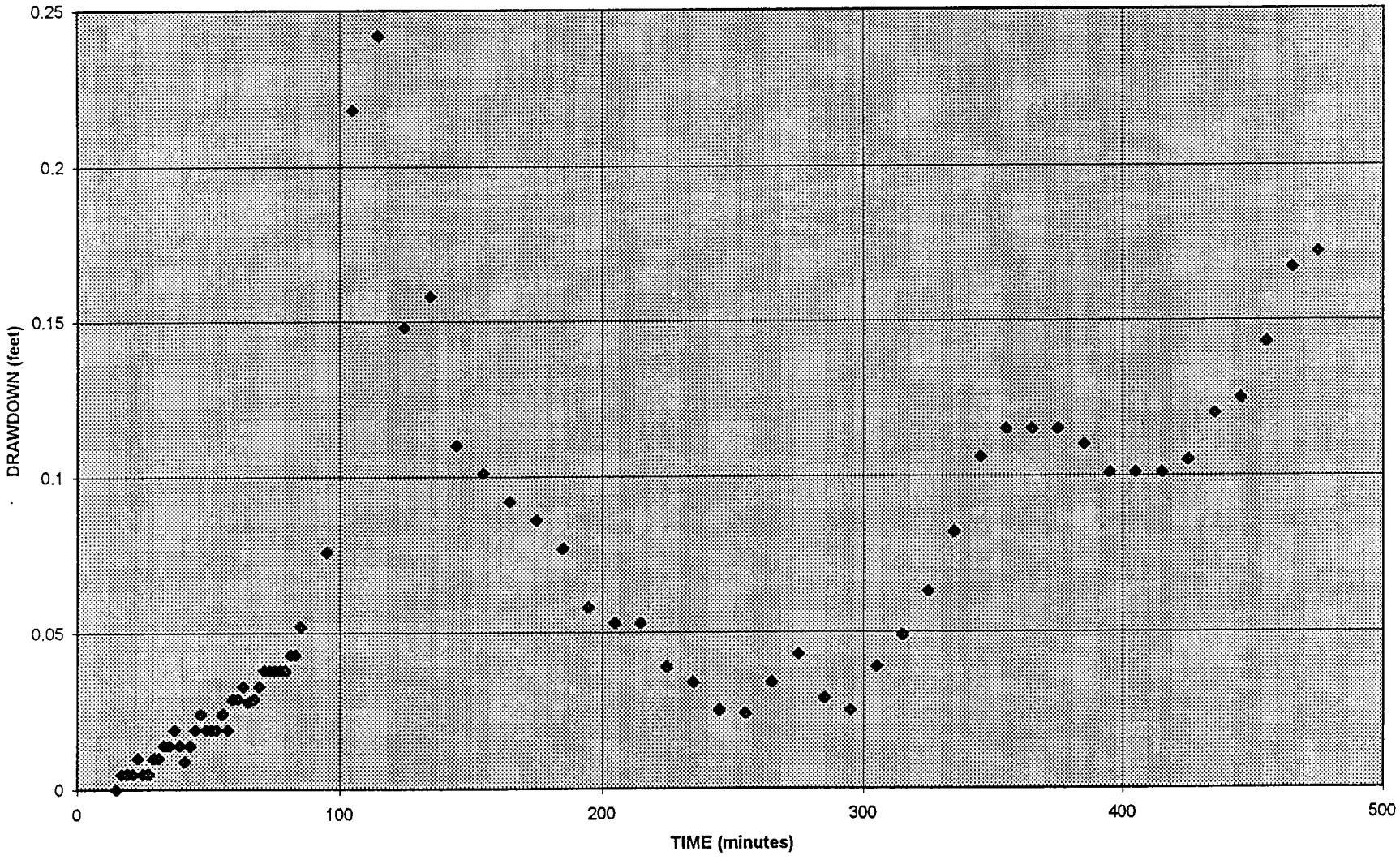
RW-601, TIDAL & PUMPING TESTS, DATA LOGGER RESULTS



Handex®

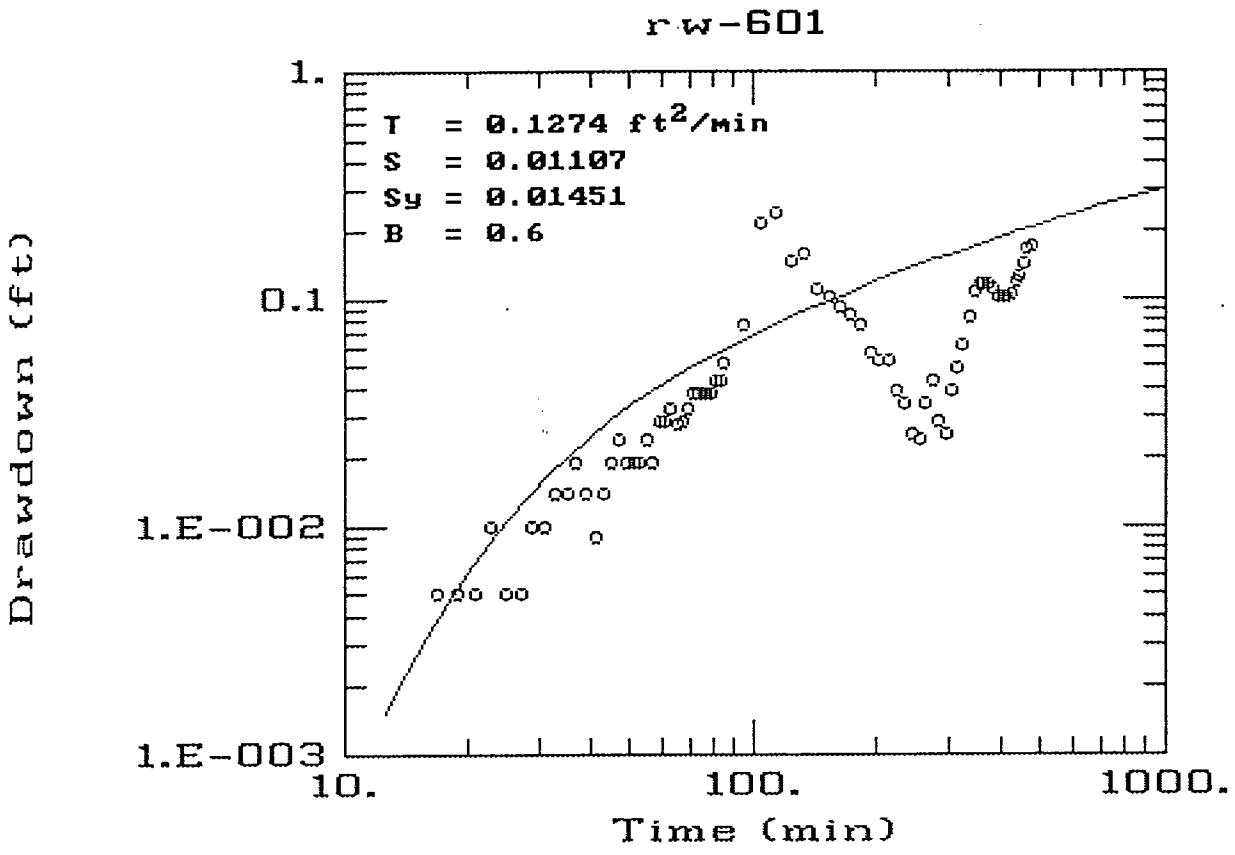
FIGURE 19

RW-601, PUMPING TEST DRAWDOWN DATA, DATA LOGGER RESULTS

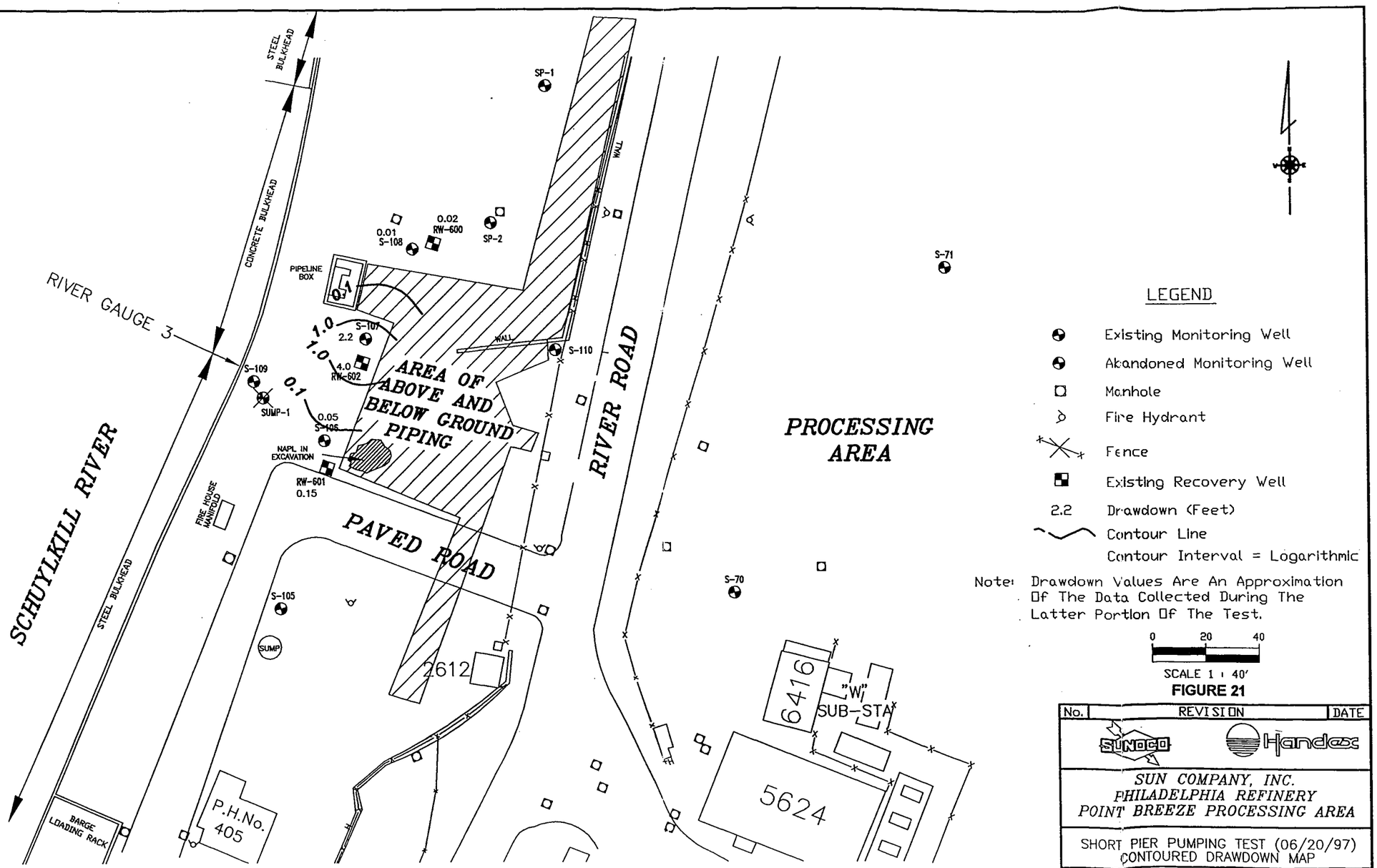


Handex®

FIGURE 20



Handex®



LEGEND

- Existing Monitoring Well
- Abandoned Monitoring Well
- Manhole
- Fire Hydrant
- Fence
- Existing Recovery Well
- 2.2 Drawdown (Feet)
- Contour Line
- Contour Interval = Logarithmic

Note: Drawdown Values Are An Approximation Of The Data Collected During The Latter Portion Of The Test.

0 20 40

SCALE 1 : 40'

FIGURE 21

No.	REVISION	DATE

SUNOCO Handex

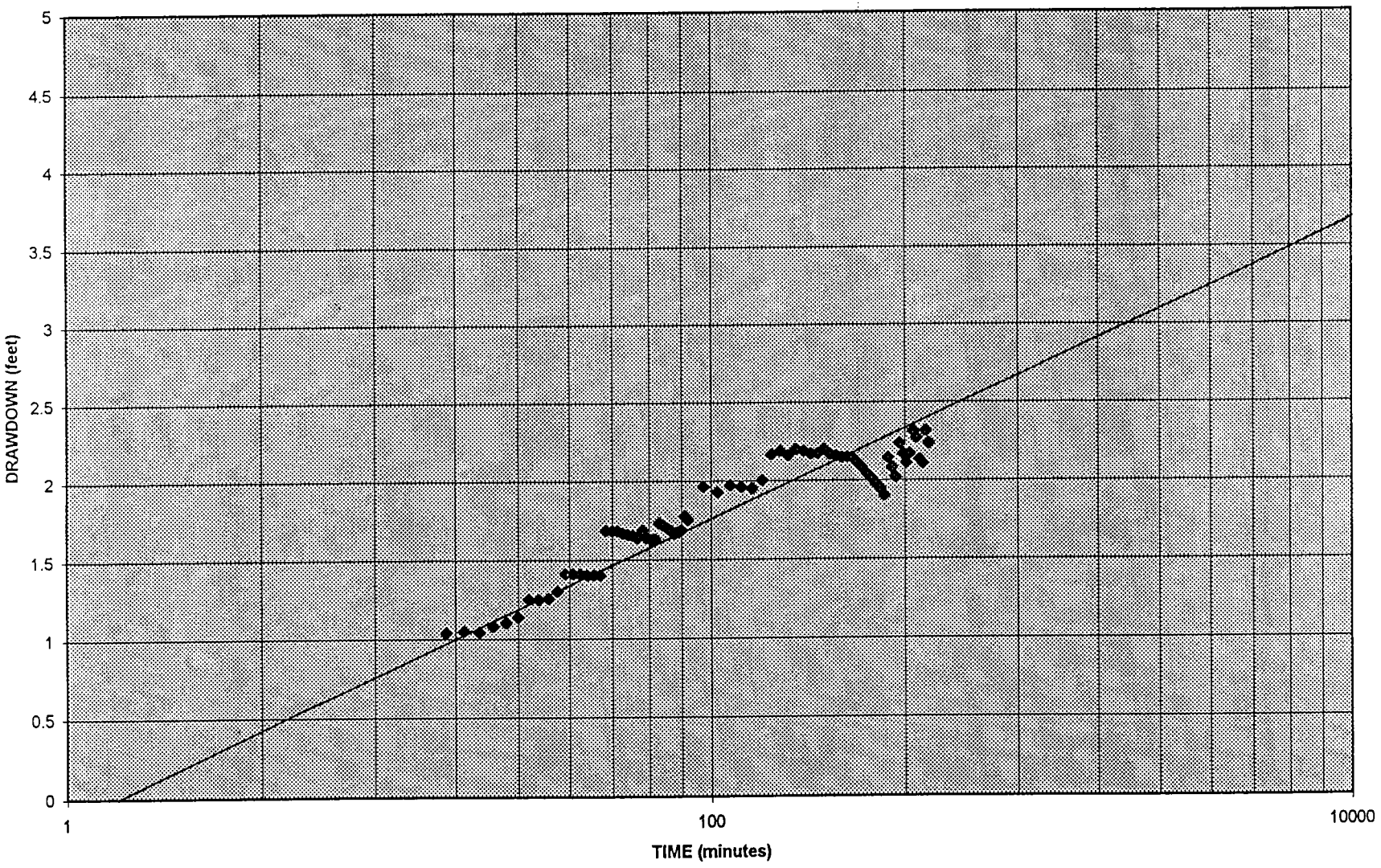
SUN COMPANY, INC.
PHILADELPHIA REFINERY
POINT BREEZE PROCESSING AREA

SHORT PIER PUMPING TEST (06/20/97)
CONTOURED DRAWDOWN MAP

SCALE - 1' = 40'	JOB No. - 110535-13
DRAWN BY - A. Taylor	REV BY. - JG 06/25/97
CHECKED BY -	DWG. NAME - PB_SP_05
DATE - 09/26/97	DWG. No. -

FIGURE 22

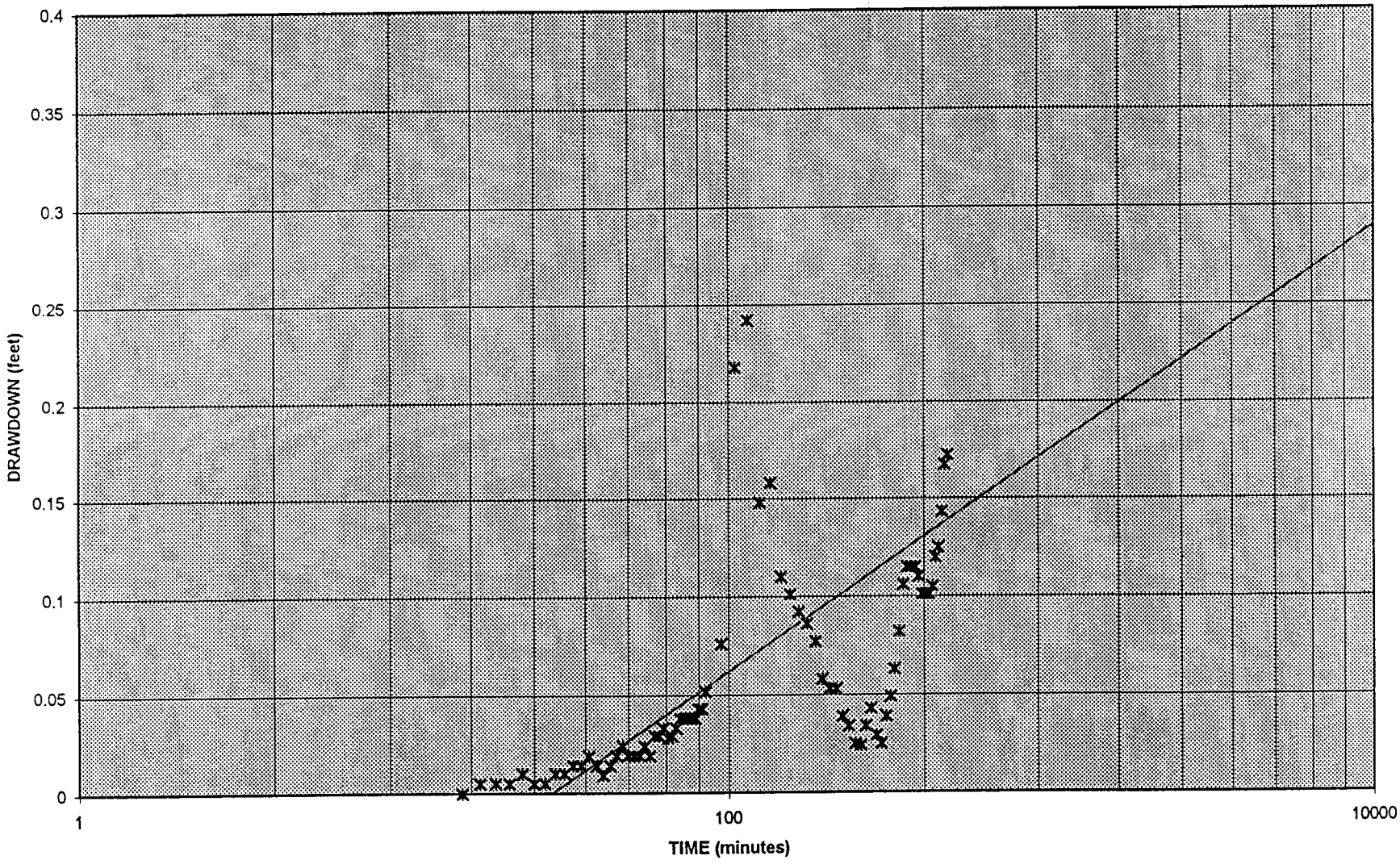
S-107, PUMPING TEST DRAWDOWN DATA, DATA LOGGER RESULTS



Handex®

FIGURE 23

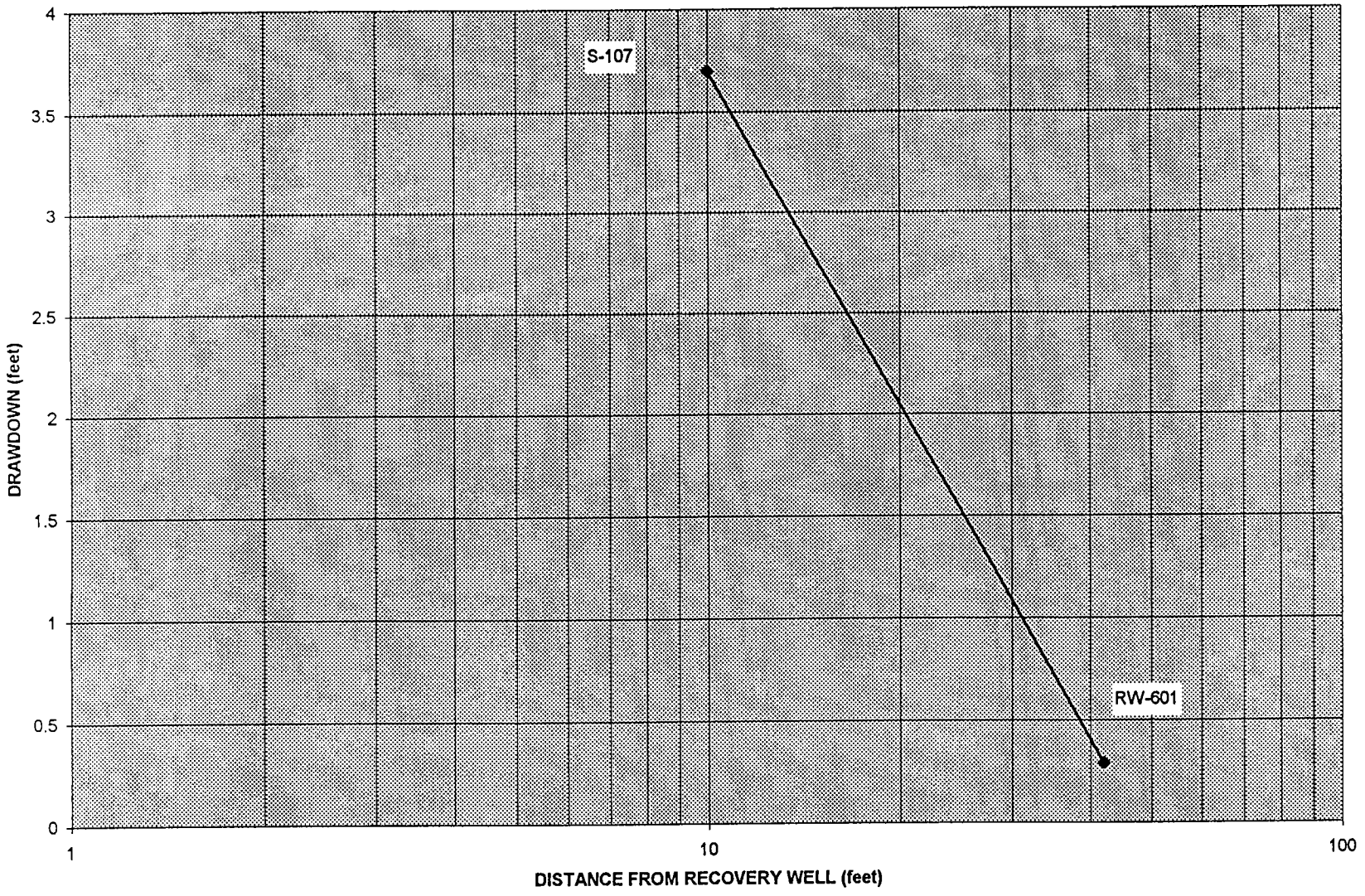
RW-601, PUMPING TEST DRAWDOWN DATA, DATA LOGGER RESULTS



Handex®

FIGURE 24

SHORT PIER PUMPING TEST, DISTANCE - DRAWDOWN



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TABLES

TABLE 1

Tidal Test Measurements
Sun Philadelphia Refinery
Short Pier Area

June 19, 1997

Well	Distance from Schuylkill River (ft)	Observed Tidal Amplitude (ft)	Time Elapsed From High Tide at River Gauge Point 3 (1235 hours) to Highest Ground Water Elevation at the Well
S-106	40	2.55	-5 minutes
S-107	40	1.10 (1.02)	30 minutes
S-108	47	0.69	30 minutes
S-109	5	1.83	-5 minutes
RW-600	55	0.64	30 minutes
RW-601	45	1.13 (1.16)	35 minutes
RW-602	42	1.89 (1.98)	35 minutes
RIVER GAUGE POINT 3	--	5.99 (5.17)	(HIGH TIDE AT 1235 HOURS)

NOTES
1. Observed tidal amplitude is based on interface probe results. Data logger results are presented in parentheses.
2. Time differential data is based on data logger results if available, otherwise based on interface probe results.
3. ft = feet

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TABLE 2

Calculated Hydrogeologic Properties
Sun Philadelphia Refinery
Short Pier Area

June 20, 1997

Data Collection Point	Transmissivity (T) [gpd/ft]	Hydraulic Conductivity (K) [gpd/ft^2]	Storativity (S) [dimensionless]	Specific Yield (S_y) [dimensionless]
S-107	458	28.6	3.4655×10^{-6}	0.001834
RW-601	1372	85.8	0.01107	0.01451

NOTES
gpd/ft = gallons per day per foot
gpd/ft^2 = gallons per day per square foot

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APPENDIX A

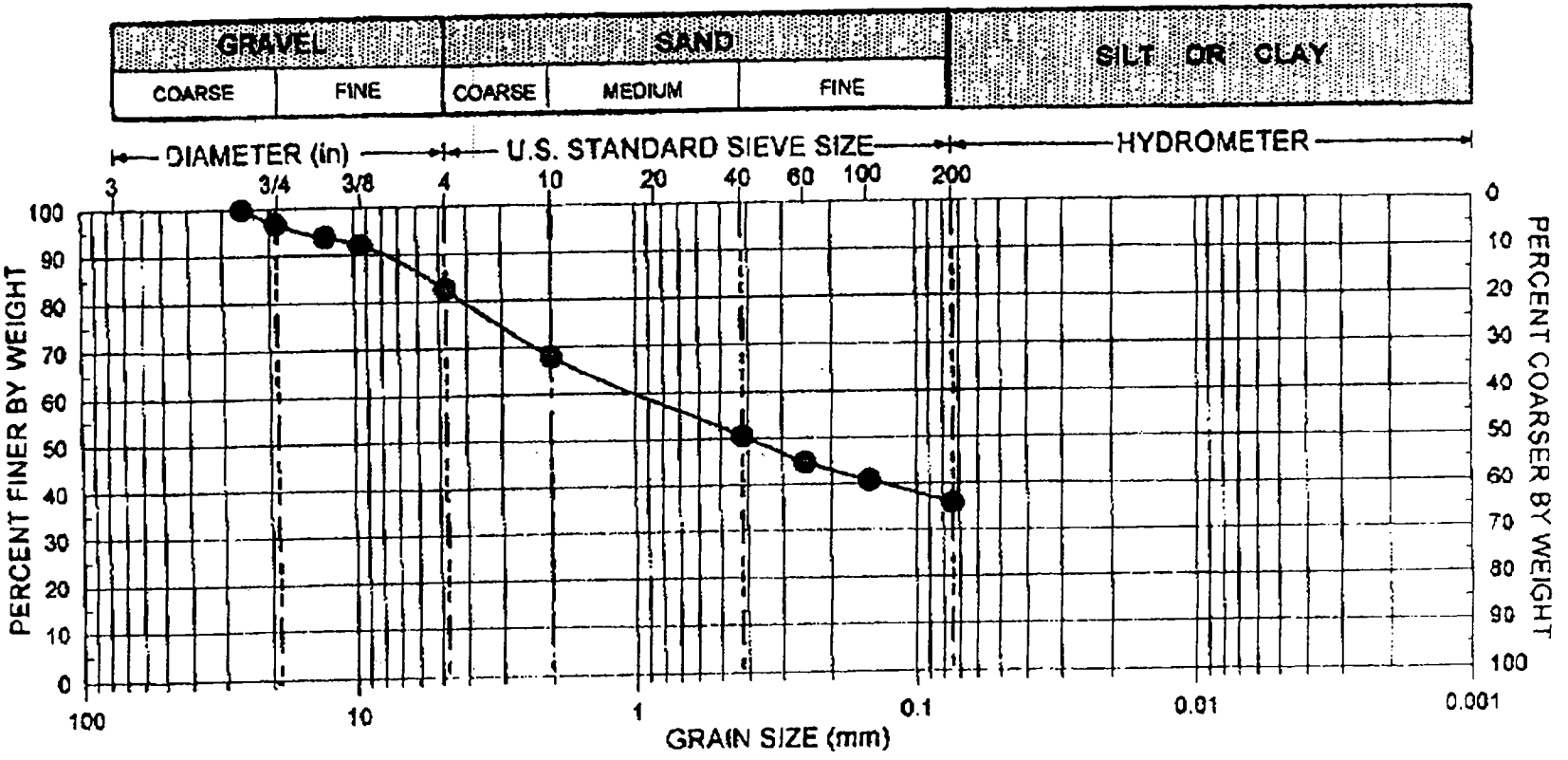
SIEVE ANALYSIS RESULTS

APPENDIX 12.B.

Correlation Chart of Screen Openings and Sieve Sizes

Geologic Material Grain-size Range	Johnson Slot No.	Gauze No.	Tyler			U.S. Standard	
			Sieve No.	Size of Openings Inches	mm	Sieve No.	Size of Openings Inches
clay & silt	—	—	400	0.0015	0.038	400	0.0015
	—	—	325	0.0017	0.043	325	0.0017
	—	—	270	0.0021	0.053	270	0.0021
	—	—	250	0.0024	0.061	230	0.0024
	—	—	200	0.0029	0.074	200	0.0029
fine sand	—	—	170	0.0035	0.088	170	0.0035
	—	—	150	0.0041	0.104	140	0.0041
	—	—	115	0.0049	0.124	120	0.0049
	6	90	100	0.0058	0.147	100	0.0059
	7	80	80	0.0069	0.175	80	0.0070
	8	70	65	0.0082	0.208	70	0.0083
	10	60	60	0.0097	0.246	60	0.0098
medium sand	12	50	48	0.0116	0.295	50	0.0117
	14	—	42	0.0138	0.351	45	0.0138
	16		35	0.0164	0.417	40	0.0165 (1/64)
	18	40	—	0.0180	0.457	—	0.0180
	20		32	0.0195	0.495	35	0.0197
	23		28	0.0232	0.589	30	0.0232
coarse sand	25	30	—	0.0250	0.635	—	0.0250
	28		24	0.0276	0.701	25	0.0280
	31		—	0.0310	0.788	—	0.0310 (1/32)
	33		20	0.0328	0.833	20	0.0331
	35	20	—	0.035	0.889	—	0.0350
	39		16	0.039	0.991	18	0.0394
very coarse sand	47		14	0.046	1.168	16	0.0469
	56		12	0.055	1.397	14	0.0555
	62		—	0.062	1.590	—	0.062 (1/16)
	66		10	0.065	1.651	12	0.0661
	79		9	0.078	1.981	10	0.0787
very fine gravel	93		8	0.093	2.362	8	0.0931
	94		—	0.094	2.390	—	0.094 (3/32)
	111		7	0.110	2.794	7	0.111
	125		—	0.125	3.180	—	0.125 (1/8)
	132		6	0.131	3.327	6	0.132
fine gravel	157		5	0.156	3.962	5	0.157
	187		4	0.185	4.699	4	0.187 (3/16)
	223		3½	0.221	5.613	3½	0.223
	250		—	0.250	6.350	¼	0.250 (1/4)
	263		3	0.263	6.680	—	0.263
	312		2½	0.312	7.925	5/16	0.312 (5/16)
	375		0.371	0.371	9.423	3/8	0.375 (3/8)
	438		0.441	0.441	11.20	7/16	0.438 (7/16)
	500		0.525	0.525	13.33	½	0.500 (1/2)

PROJECT: Sun Refinery



KEY	BORING NUMBER	SAMPLE NUMBER	DEPTH (FT)	MC (%)	LL	PL	PI	SOIL DESCRIPTION
●	S-105	B2+T3		---	---	---	---	Brown silty SAND, little gravel

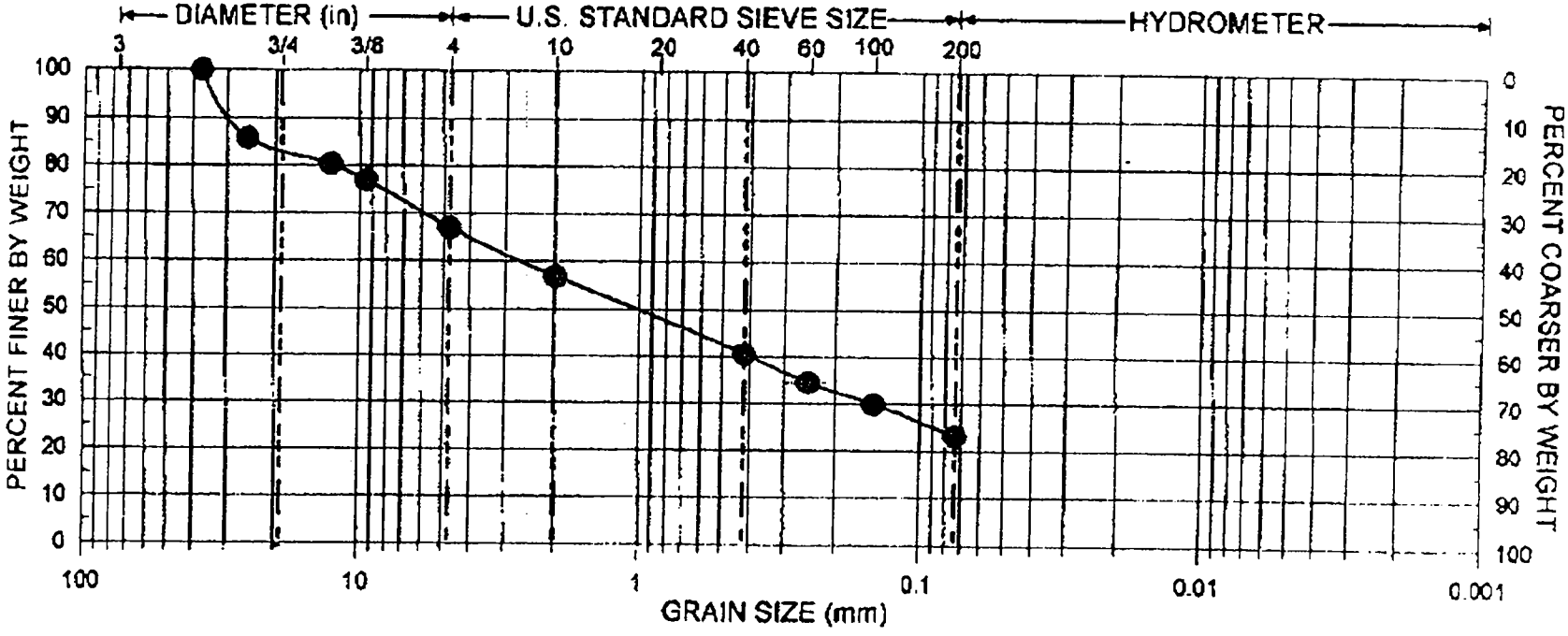
GRADATION ANALYSIS

TESTED BY: JMK
CHECKED BY: SK

DATE: 4-26-97
SHEET 1 of 5

PROJECT: Sun Refinery

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

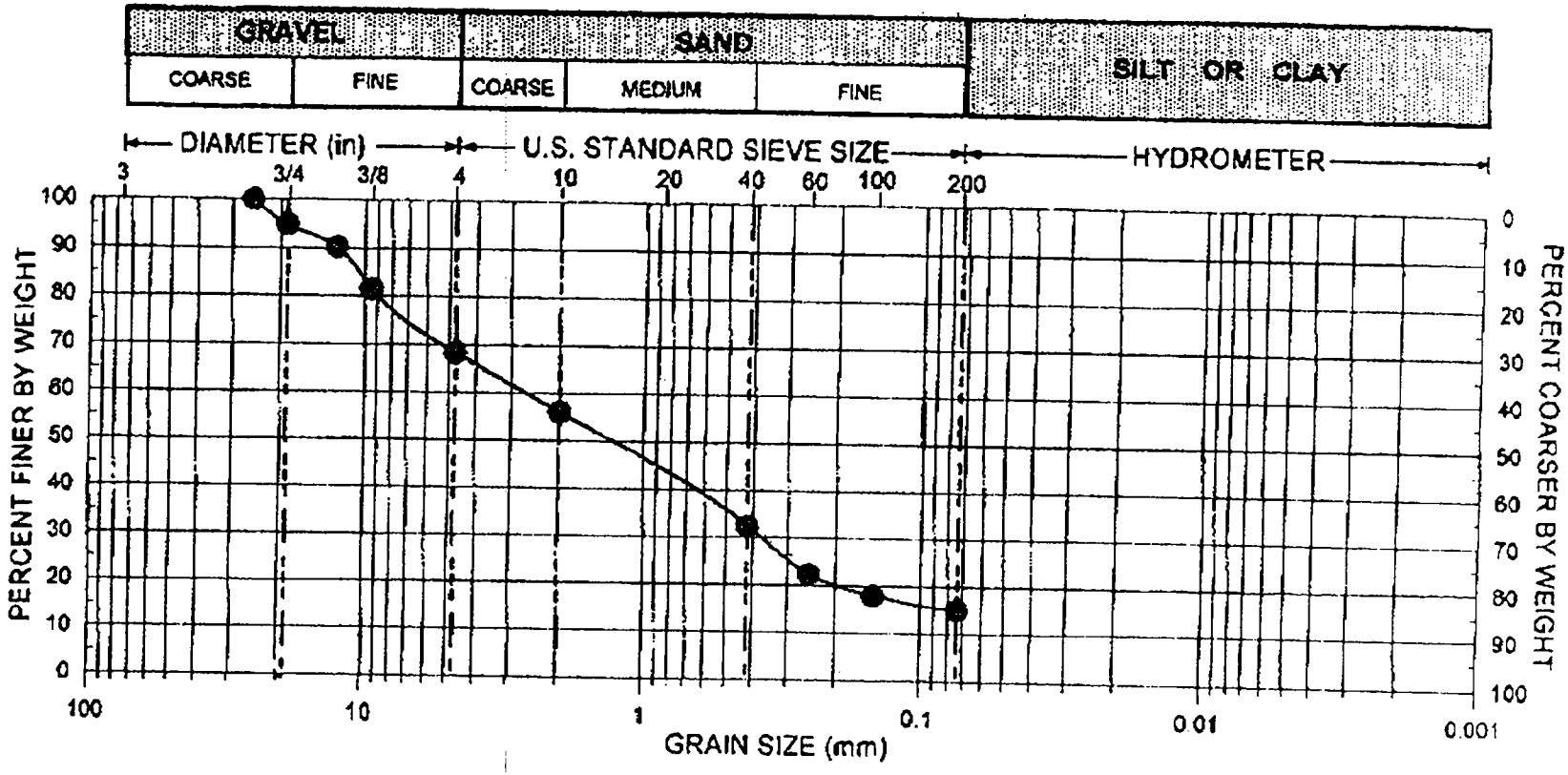


KEY	BORING NUMBER	SAMPLE NUMBER	DEPTH (FT)	MC (%)	LL	PL	PI	SOIL DESCRIPTION
●	S-106	3,4,5		---	—	---	---	Brown SAND, some gravel, some silt

GRADATION ANALYSIS

TESTED BY: JMK
CHECKED BY: SK
DATE: 4-26-97
SHEET 2 of 5

PROJECT: Sun Refinery

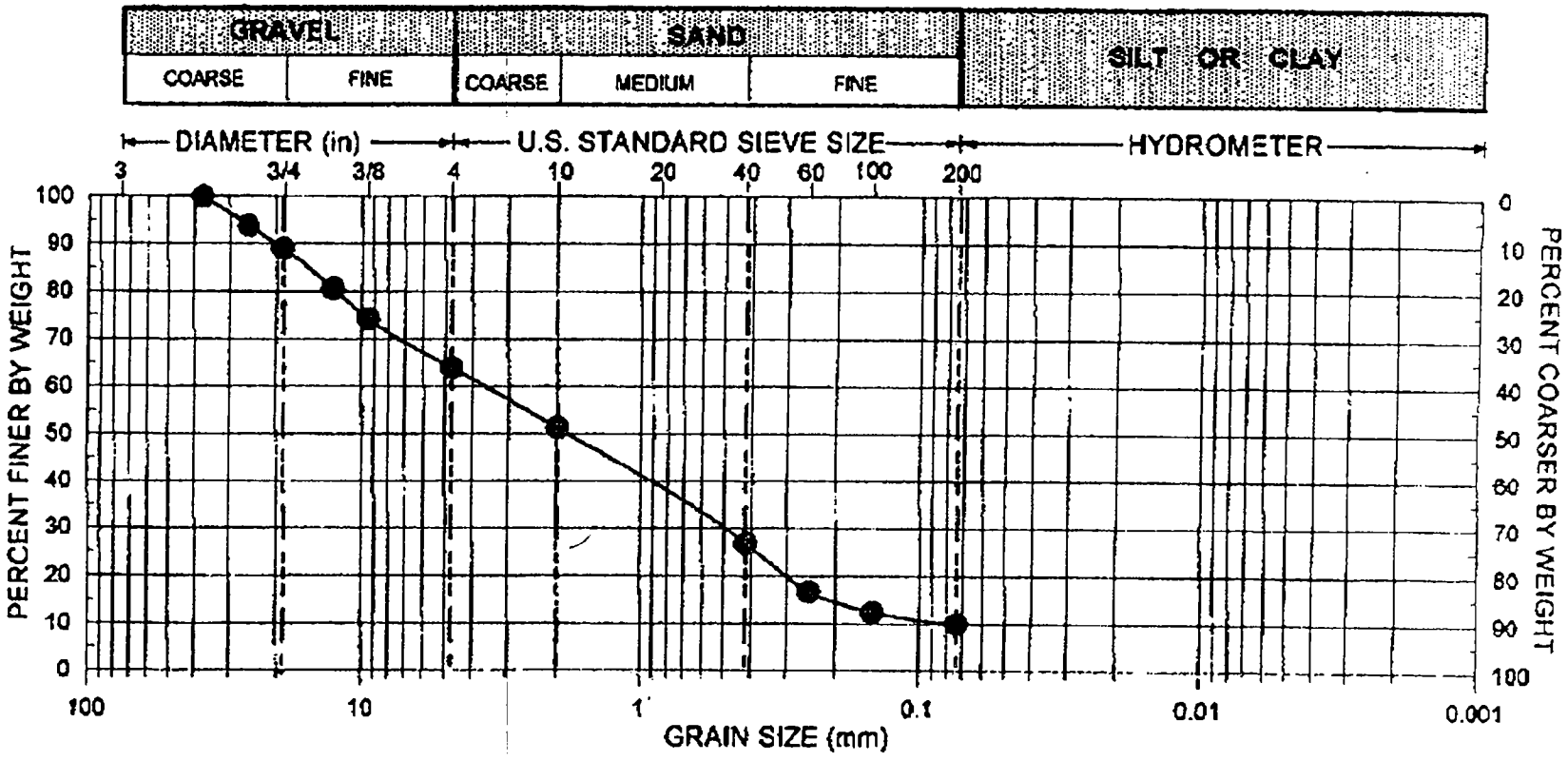


KEY	BORING NUMBER	SAMPLE NUMBER	DEPTH (FT)	MC (%)	LL	PL	PI	SOIL DESCRIPTION
●	S-107	4		--	--	--	--	Brown SAND, some gravel, little silt

GRADATION ANALYSIS

TESTED BY: JMK
CHECKED BY: SK
DATE: 4-28-97
SHEET 3 of 5

PROJECT: Sun Refinery



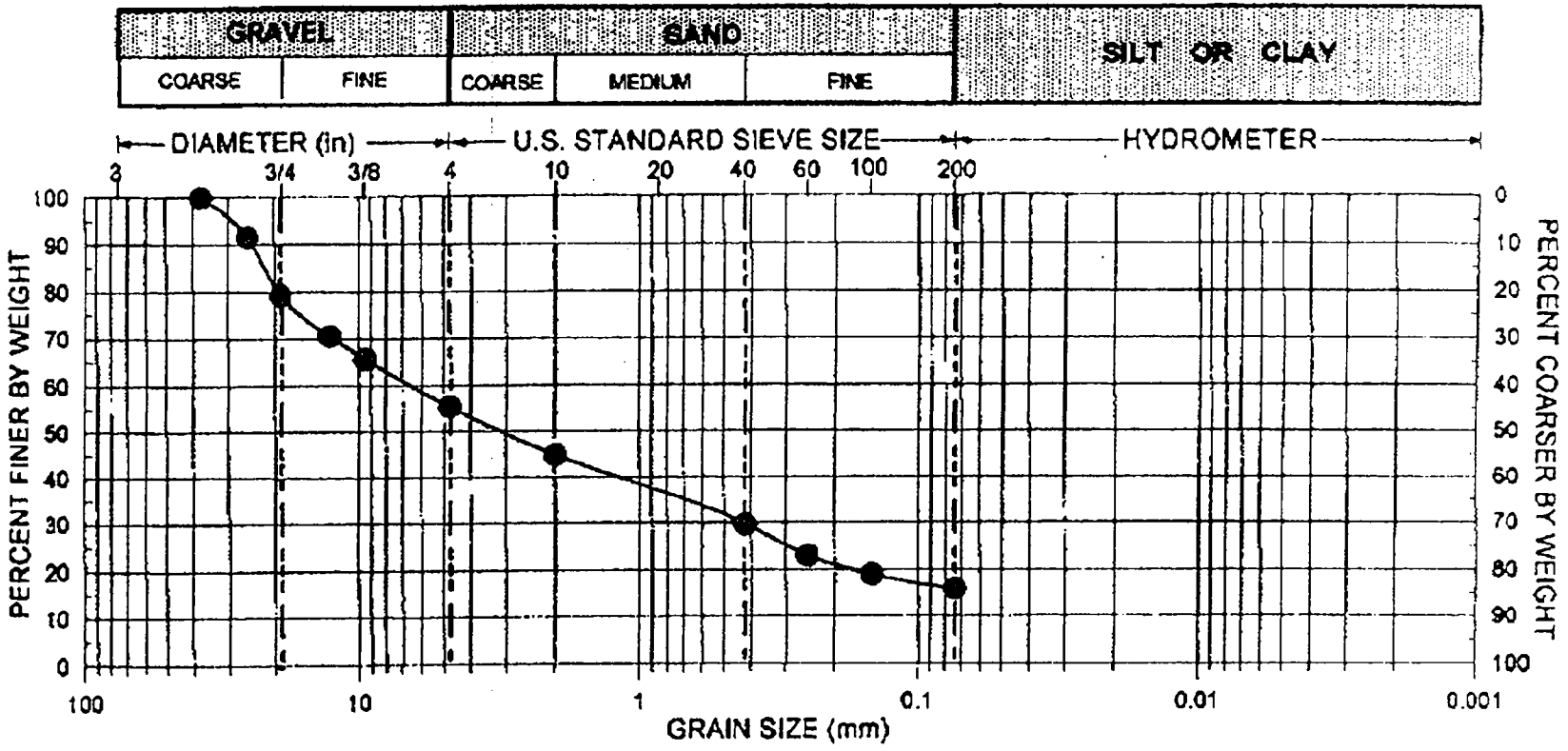
KEY	BORING NUMBER	SAMPLE NUMBER	DEPTH (FT)	MC (%)	LL	PL	PI	SOIL DESCRIPTION
●	S-107	6		—	--	—	--	Brown SAND, some gravel, little silt

GRADATION ANALYSIS

TESTED BY: JMK
CHECKED BY: SK

DATE: 4-26-97
SHEET 4 of 5

PROJECT: Sun Refinery



KEY	BORING NUMBER	SAMPLE NUMBER	DEPTH (FT)	MC (%)	LL	PL	PI	SOIL DESCRIPTION
●	S-108	2+3		—	---	---	---	Brown sandy GRAVEL, little silt

GRADATION ANALYSIS

TESTED BY: JMK
CHECKED BY: SK

DATE: 4-26-97
SHEET 5 of 5

APPENDIX B

WELL BORING LOGS

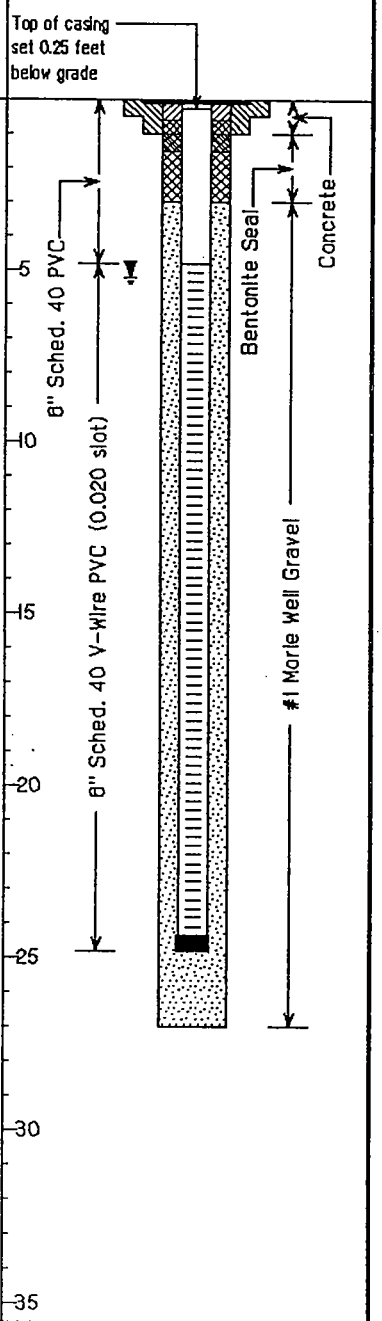
Handex Of Maryland

WELL LOG: RW-600

Permit #: *N/A*	Drill Date: *June 3, 1997*	Use: *Recovery*
Location: *3144 Passyunk Avenue, Philadelphia, PA*		Owner Loc #: *Philadelphia Refinery*
Owner: *Sun Company, Inc.*		Handex Loc #: *110535*
Owner Address: *Philadelphia, PA*	BORING - Depth: *27 ft.*	Diameter: *10 in.*
Drilling Method: *Mud Rotary*	CASING - Length: *4.58 ft.*	Diameter: *6 in.*
Sampling Method: *None*	SCREEN - Length: *20 ft.*	Diameter: *6 in.*
Static Water Level: *4.99 ft.* *(June 4, 1997)*	WELL - Depth: *24.83 ft.*	

Depth (ft.)	Sample ID	Sample Depth	Blows/6 in.		Graphic Log	Geologic Description
5						NOTES:
10						1. Not Logged Due to Drilling Method. See Well S-108 boring log.
15						2. A piece of wood was contacted at 7 feet.
20						3. The coarse fraction of the sediment below 20' is predominantly slag and coke fill material.
25						4. Well Development (June 3, 1997) Surge and Pump for 3 hours
30						
35						

Well Diagram



NOTES: ▼ = Static Water Level (from TOC)

Geologist: Arsin Sahba

Driller: Robert Brown

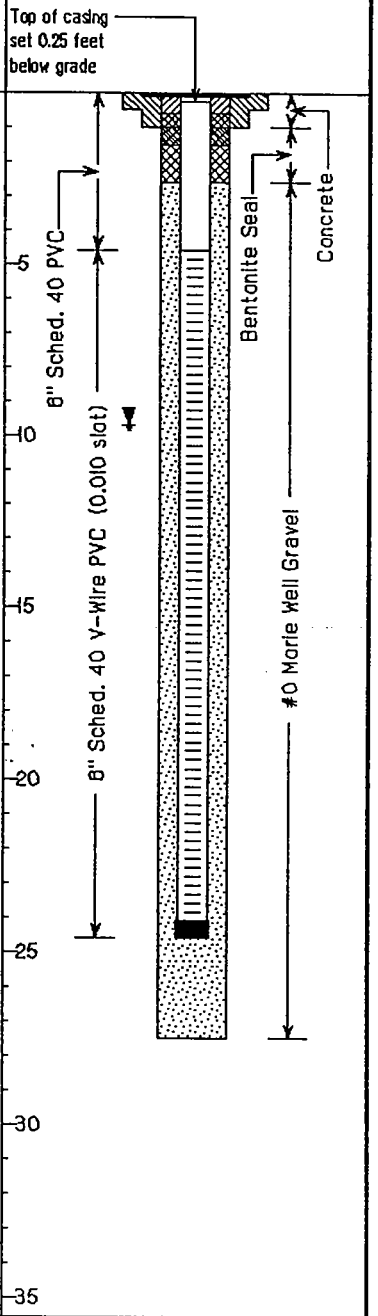
Handex®
Handex Of Maryland

WELL LOG: RW-601

Permit #: *N/A*	Drill Date: *June 4, 1997*	Use: *Recovery*
Location: *3144 Passyunk Avenue, Philadelphia, PA*		Owner Loc #: *Philadelphia Refinery*
Owner: *Sun Company, Inc.*		Handex Loc #: *110535*
Owner Address: *Philadelphia, PA*	BORING - Depth: *27.5 ft.*	Diameter: *10 in.*
Drilling Method: *Mud Rotary*	CASING - Length: *4.33 ft.*	Diameter: *6 in.*
Sampling Method: *None*	SCREEN - Length: *20 ft.*	Diameter: *6 in.*
Static Water Level: *9.45 ft. (June 5, 1997)*	WELL - Depth: *24.58 ft.*	

Depth (ft.)	Sample ID	Sample Depth	Blows/6 in.		Graphic Log	Geologic Description
5						NOTES:
10						1. Not Logged Due to Drilling Method. See Well S-106 boring log.
15						2. Wood chips recovered.
20						3. The coarse fraction of the sediment below 20' is predominantly slag and coke fill material.
25						4. Well Development (June 5, 1997) Surge and Pump for 5 hours
30						
35						

Well Diagram



NOTES: ⧩ = Static Water Level (from TOC)

Geologist: Arsin Sahba

Driller: Robert Brown

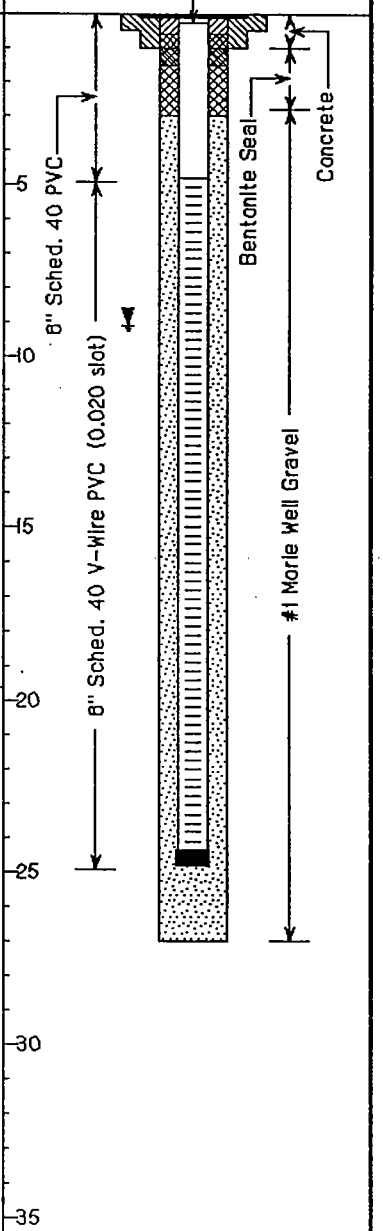
Handex Of Maryland

WELL LOG: RW-602

Permit #: *N/A*	Drill Date: *June 5, 1997*	Use: *Recovery*
Location: *3144 Passyunk Avenue, Philadelphia, PA*		Owner Loc #: *Philadelphia Refinery*
Owner: *Sun Company, Inc.*		Handex Loc #: *110535*
Owner Address: *Philadelphia, PA*	BORING - Depth: *27 ft.*	Diameter: *10 in.*
Drilling Method: *Mud Rotary*	CASING - Length: *4.67 ft.*	Diameter: *6 in.*
Sampling Method: *None*	SCREEN - Length: *20 ft.*	Diameter: *6 in.*
Static Water Level: *8.86 ft. (June 6, 1997)*	WELL - Depth: *24.92 ft.*	

Depth (ft.)	Sample ID	Sample Depth	Blows/6 in.		Graphic Log	Geologic Description
5						NOTES:
10						1. Not Logged Due to Drilling Method. See Well S-107 boring log.
15						2. Wood encountered at 17 feet.
20						3. The coarse fraction of the sediment below 20' is predominantly slag and coke fill material.
25						4. Well Development (June 6, 1997) Surge and Pump for 3.5 hours
30						
35						

Well Diagram



NOTES: ⧩ = Static Water Level (from TOC)

Geologist: Arsin Sahba

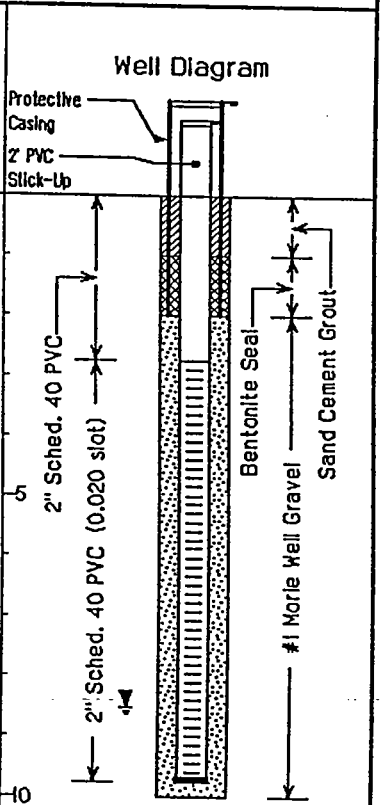
Driller: Robert Brown

Handex 01 Maryland

WELL LOG: S-105

Permit #: *N/A*	Drill Date: *July 10, 1996*	Use: *Monitoring*
Location: *3144 Passyunk Avenue, Philadelphia, PA*		Owner Loc #: *Philadelphia Refinery*
Owner: *Sun Company, Inc.*		Handex Loc #: *110535*
Owner Address: *Philadelphia, PA*	BORING - Depth: *10 ft.*	Diameter: *8 in.*
Drilling Method: *Hollow-Stem Auger*	CASING - Length: *4.75 ft.*	Diameter: *2 in.*
Sampling Method: *Split Spoon*	SCREEN - Length: *7 ft.*	Diameter: *2 in.*
Static Water Level: *10.54 ft. (July 11, 1996)*	WELL - Depth: *9.75 ft.*	

Depth (ft.)	Sample ID	Sample Depth	Blows/6 in.	Graphic Log	Geologic Description
5	105-1		3-3-2-2		Tan to light orange SILT, some fine Sand (wet @8.5')
	105-2		2-1-1-2		
10	105-3		1-2-2-38		Black CLAY, and fine to coarse SAND, trace fine to medium Gravel (moist to wet; clay as matrix and nodules; gravel angular; slight organic odor; strong hydrocarbon odor and stain at 10.0'-10.5')
					WOOD (Top 1/3 was wet and stained with hydrocarbons; bottom 2/3 was dry and clean; horizontal layering)
15					NOTE: A second boring was drilled 3 feet northwest due to the refusal on the wood. A sample was collected from 10-12 foot interval (blow counts: 1-2-35/3). The spoon refused on wood at 11 feet. The wood was similar to the first boring, except layering was diagonal (45 degrees). The well was installed in the second boring.
20					



NOTES: ☒ = Sample Interval/recovery; ⧩ = Static Water Level (from TOC)

Geologist: Arsin Sahba

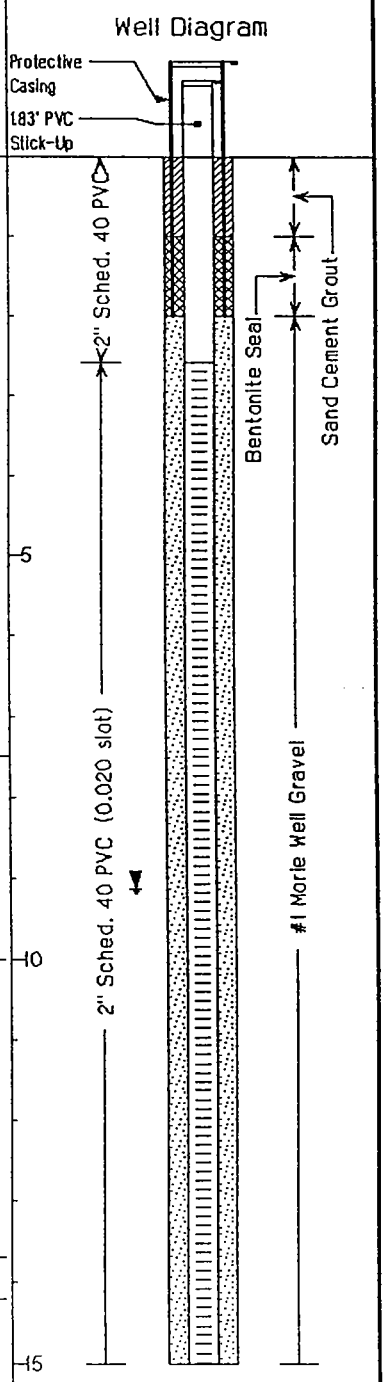
Driller: Jay Korron (Hardin-Huber)

Handex Of Maryland

WELL LOG: S-106

Permit #: *N/A*	Drill Date: *July 10, 1996*	Use: *Monitoring*
Location: *3144 Passyunk Avenue, Philadelphia, PA*		Owner Loc #: *Philadelphia Refinery*
Owner: *Sun Company, Inc.*		Handex Loc #: *110535*
Owner Address: *Philadephia, PA*	BORING - Depth: *20 ft.*	Diameter: *8 in.*
Drilling Method: *Hollow-Stem Auger*	CASING - Length: *4.42 ft.*	Diameter: *2 in.*
Sampling Method: *Split Spoon*	SCREEN - Length: *17 ft.*	Diameter: *2 in.*
Static Water Level: *10.95 ft. (July 11, 1996)*	WELL - Depth: *19.59 ft.*	

Depth (ft.)	Sample ID	Sample Depth	Blows/6 in.	Graphic Log	Geologic Description
5	106-1		4-7-8-23		Tan to light brown SILT, some fine Sand (wet @ 6.75')
	106-2		3-3-4-3		
	106-3		8-4-3-3		Black CLAY, and fine (-) to coarse SAND, trace fine to medium Gravel (moist to wet, angular gravel, slight organic and hydrocarbon odor)
10	106-4		2-7-3-3		Black CLAY, some fine (-) to coarse Sand, trace fine to medium Gravel (wet, residual hydrocarbons, 2 inch piece of wood at 13 feet with hydrocarbon stain)
	106-5		2-2-1-2		Black Silty CLAY (residual hydrocarbons; high plasticity)
15	106-6		2-2-3-3		Green-gray Silty CLAY (high plasticity, moist, slight hydrocarbon odor)



NOTES: ☒ = Sample interval/recovery; ⧩ = Static Water Level (from TOC)

Geologist: Arsin Sahba

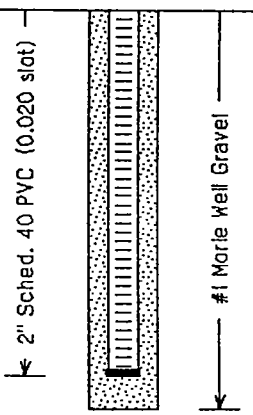
Driller: Jay Korron (Hardin-Huber)

Handex Of Maryland

WELL LOG: S-106

Permit #: *N/A*	Drill Date: *July 10, 1996*	Use: *Monitoring*
Location: *3144 Passyunk Avenue, Philadelphia, PA*		Owner Loc #: *Philadelphia Refinery*
Owner: *Sun Company, Inc.*		Handex Loc #: *110535*
Owner Address: *Philadephia, PA*	BORING - Depth: *20 ft.*	Diameter: *8 in.*
Drilling Method: *Hollow-Stem Auger*	CASING - Length: *4.42 ft.*	Diameter: *2 in.*
Sampling Method: *Split Spoon*	SCREEN - Length: *17 ft.*	Diameter: *2 in.*
Static Water Level: *10.95 ft. (July 11, 1996)*	WELL - Depth: *19.59 ft.*	

Depth (ft.)	Sample ID	Sample Depth	Blows/6 in.	Graphic Log	Geologic Description
					Brown fine to medium SAND (wet, moderate hydrocarbon odor)
	108-7		3-3-11-2		Brown Silty CLAY (moist, high plasticity, 1 inch piece of wood at 17 feet)
					Green Silty CLAY (moist, high plasticity)
	108-8		2-2-3-3		Black fine to coarse (+) SAND, and fine to medium GRAVEL, trace Clay (organic odor, clay is matrix, wet)
					Tan Silty CLAY (moist, low-medium plasticity)
20					Orange Silty CLAY (moist, medium plasticity)
					Brown to black Silty CLAY (dry, low plasticity)
25					
30					



NOTE: The sample for 5-7 feet was collected from the first boring, however refusal occurred on some concrete material at 7 feet. The samples and well were completed is a second boring located 3 feet to the west.

NOTES: ☒ = Sample interval/recovery; ⧩ = Static Water Level (from TOC)

Geologist: Arsin Sahba	Driller: Jay Korron (Hardin-Huber)

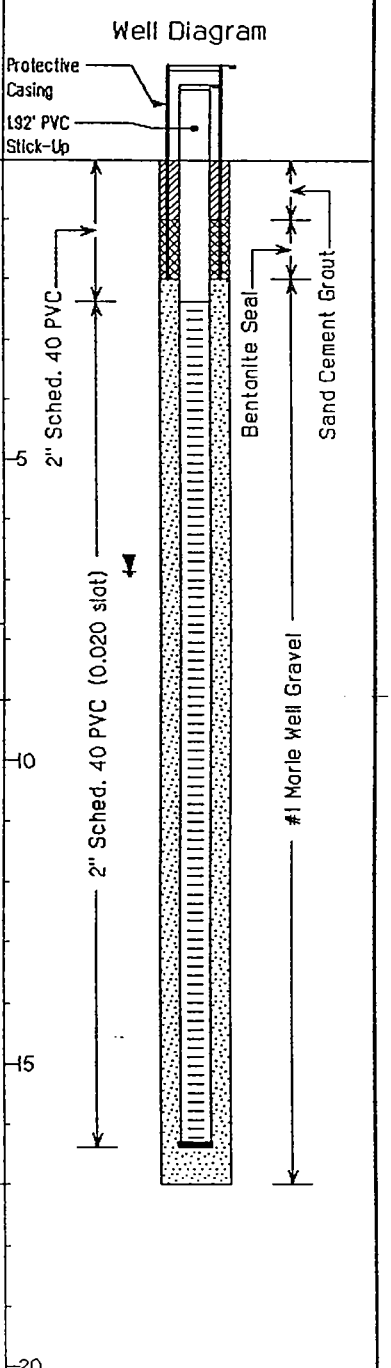
Handex 01 Maryland

WELL LOG: S-107

Permit #: *N/A*	Drill Date: *July 10, 1996*	Use: *Monitoring*
Location: *3144 Passyunk Avenue, Philadelphia, PA*		Owner Loc #: *Philadelphia Refinery*
Owner: *Sun Company, Inc.*		Handex Loc #: *110535*
Owner Address: *Philadephia, PA*	BORING - Depth: *17 ft.*	Diameter: *8 in.*
Drilling Method: *Hollow-Stem Auger*	CASING - Length: *4.33 ft.*	Diameter: *2 in.*
Sampling Method: *Split Spoon*	SCREEN - Length: *14 ft.*	Diameter: *2 in.*
Static Water Level: *8.78 ft. (July 11, 1996)*	WELL - Depth: *16.41 ft.*	

Depth (ft.)	Sample ID	Sample Depth	Blows/6 in.	Graphic Log	Geologic Description
5	107-1		2-2-2-4		Tan to brown fine SAND, trace Silt, trace Clay (moist)
	107-2		3-3-2-2		Brown to black medium to coarse SAND, some fine (+) to medium Gravel, trace Clay (moist to wet, strong hydrocarbon odor and stain, clay as matrix)
	107-3		3-2-1-2		Tan to brown Silty CLAY (dry, low plasticity)
10					Brown Silty CLAY, little fine to coarse Sand, trace Gravel (wet, hydrocarbon odor)
	107-4		3-3-4-5		Brown fine, medium (+) to coarse SAND, little Clay (matrix), trace fine Gravel (wet, residual hydrocarbons)
	107-5		3-5-5-8		Brown fine, medium (+) to coarse SAND, little fine to medium Gravel (wet, residual hydrocarbons; 1 inch green gray clay nodule at 13 feet)
15	107-6		2-3-5-20		Brown fine (-) to coarse SAND, little fine to medium Gravel (wet, slight to moderate hydrocarbon odor; 1 inch green gray Clay at 15.5 feet)
	107-7		30/2		WOOD (wet, horizontal layering)
20					

Well Diagram



NOTES: ☒ = Sample interval/recovery; ⧩ = Static Water Level (from TOC)

Geologist: Arsin Sahba

Driller: Jay Korron (Hardin-Huber)

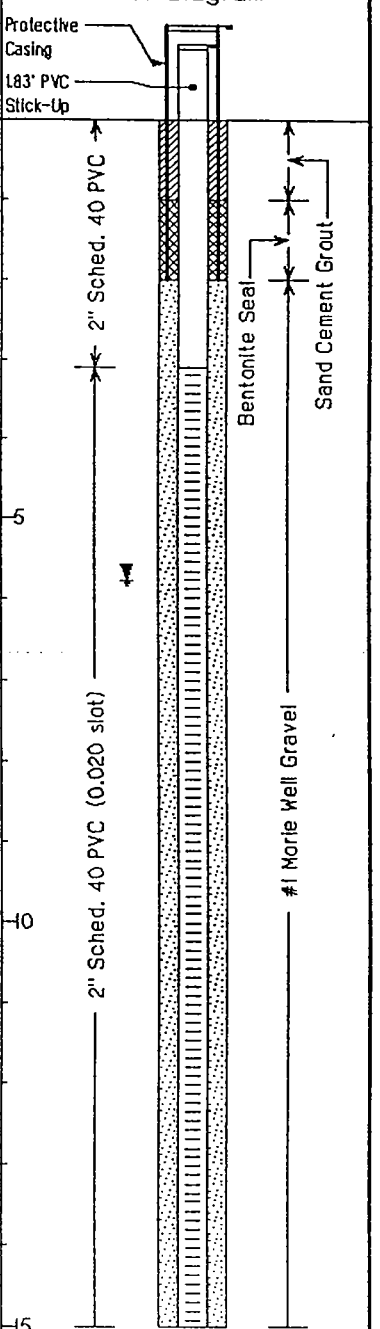
Handex Of Maryland

WELL LOG: S-108

Permit #: *N/A*	Drill Date: *July 10, 1996*	Use: *Monitoring*
Location: *3144 Passyunk Avenue, Philadelphia, PA*		Owner Loc #: *Philadelphia Refinery*
Owner: *Sun Company, Inc.*		Handex Loc #: *110535*
Owner Address: *Philadephia, PA*	BORING - Depth: *17.25 ft.*	Diameter: *8 in.*
Drilling Method: *Hollow-Stem Auger*	CASING - Length: *4.92 ft.*	Diameter: *2 in.*
Sampling Method: *Split Spoon*	SCREEN - Length: *14 ft.*	Diameter: *2 in.*
Static Water Level: *7.61 ft.* *(July 11, 1996)*	WELL - Depth: *17.09 ft.*	

Depth (ft.)	Sample ID	Sample Depth	Blows/6 in.	Graphic Log	Geologic Description
					Reddish brown fine, medium (+) to coarse SAND and CLAY, some medium to fine Gravel (dry to moist)
5	108-1		2-2-3-4		Black medium to coarse SAND, some fine to medium (+) Gravel (wet, hydrocarbon odor)
					Tan to green Silty CLAY, little medium to coarse Gravel (moist, medium plasticity)
	108-2		8-8-5-4		Brown fine, medium (+) to coarse SAND, little fine to medium Gravel, trace Clay (wet, hydrocarbon odor)
	108-3		1-2-1-1		Brown fine (-) to coarse SAND and fine to coarse GRAVEL, little Clay (moist 7-9 feet, wet 9-11.7 feet; slight hydrocarbon odor 7-9 feet; residual hydrocarbons 9-11.7 feet)
10					
	108-4		2-3-4-5		
					Black to brown CLAY, little fine to coarse Gravel, little fine to medium (+) Sand (wet)
	108-5		3-3-5-2		Black fine (-) to coarse GRAVEL, some Clay (matrix), little Sand (wet, strong hydrocarbon odor and stain)
					Gray to tan SILT and CLAY (dry to moist; low plasticity)
15	108-6		3-3-5-5		

Well Diagram



NOTES: ⊠ = Sample interval/recovery; ⧩ = Static Water Level (from TOC)

Geologist: Arsin Sahba

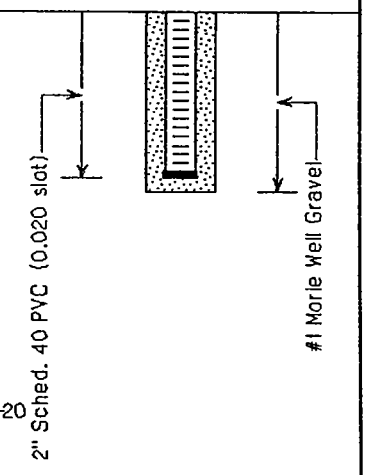
Driller: Jay Korron (Hardin-Huber)

Handex 01 Maryland

WELL LOG: S-108

Permit #: *N/A*	Drill Date: *July 10, 1996*	Use: *Monitoring*
Location: *3144 Passyunk Avenue, Philadelphia, PA*		Owner Loc #: *Philadelphia Refinery*
Owner: *Sun Company, Inc.*		Handex Loc #: *110535*
Owner Address: *Philadephia, PA*	BORING - Depth: *17.25 ft.*	Diameter: *8 in.*
Drilling Method: *Hollow-Stem Auger*	CASING - Length: *4.92 ft.*	Diameter: *2 in.*
Sampling Method: *Split Spoon*	SCREEN - Length: *14 ft.*	Diameter: *2 in.*
Static Water Level: *7.61 ft.* *(July 11, 1996)*	WELL - Depth: *17.09 ft.*	

Depth (ft.)	Sample ID	Sample Depth	Blows/6 in.	Graphic Log	Geologic Description	Well Diagram
	108-7		3-3-4-3		Orange-yellow Silty CLAY (moist; high plasticity)	
					Brown Silty CLAY (dry; low to medium plasticity)	
20						20
25					NOTE: First boring refused on wood at 7 feet. Moved 3 feet to north and completed second boring which included samples 108-2 through 108-7 and the well.	25
30						30



NOTES: ☒ = Sample interval/recovery; ⚱ = Static Water Level (from TOC)

Geologist: Arsin Sahba

Driller: Jay Korron (Hardin-Huber)

Handex®

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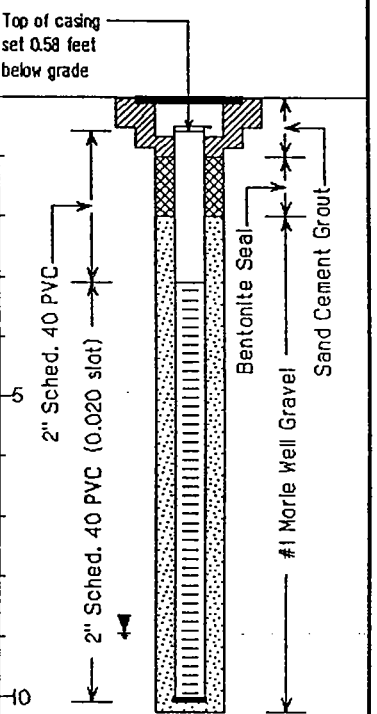
WELL LOG: S-109

Permit #: *N/A*	Drill Date: *July 10, 1996*	Use: *Monitoring*
Location: *3144 Passyunk Avenue, Philadelphia, PA*		Owner Loc #: *Philadelphia Refinery*
Owner: *Sun Company, Inc.*		Handex Loc #: *110535*
Owner Address: *Philadephia, PA*	BORING - Depth: *10.25 ft.*	Diameter: *8 in.*
Drilling Method: *Hollow-Stem Auger*	CASING - Length: *2.5 ft.*	Diameter: *2 in.*
Sampling Method: *Split Spoon*	SCREEN - Length: *7 ft.*	Diameter: *2 in.*
Static Water Level: *8.34 ft. (July 11, 1996)*	WELL - Depth: *10.08 ft.*	

Depth (ft.)	Sample ID	Sample Depth	Blows/6 in.	Graphic Log	Geologic Description
5	109-1		2-3-4-5		Tan SILT, some fine Sand, trace fine Gravel (moist)
	109-2		8-8-30/2		Black medium to coarse (+) SAND and fine GRAVEL, trace Clay (moist)
					Tan to brown fine to coarse (+) SAND and fine to medium GRAVEL (moist to wet)
	109-3		3-18-30/2		Black fine to coarse (+) SAND, some fine to medium Gravel (wet, strong hydrocarbon odor)
10					WOOD (Top 8 inches are black, stained with residual hydrocarbons; bottom 4 inches moderate hydrocarbon stain; horizontal layering)
15					
20					

NOTE: First boring refused on brick/wood at 8 feet. Second boring was drilled 3 feet to north and included sample #109-3. Third boring was drilled 1.5 feet to southwest on July 11.

Well Diagram



NOTES: ☒ = Sample interval/recovery; ⏚ = Static Water Level (from TOC)

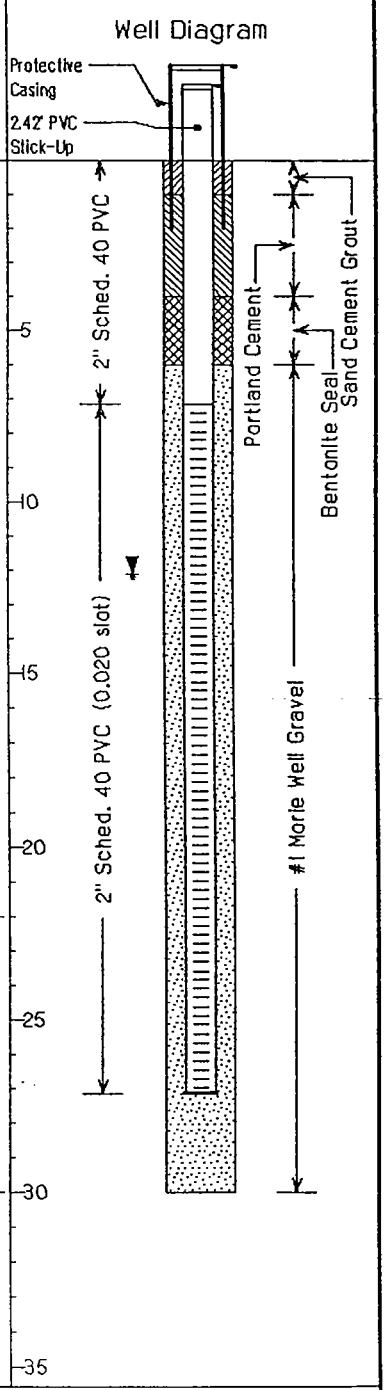
Geologist: Arsin Sahba	Driller: Jay Korron (Hardin-Huber)

Handex Of Maryland

WELL LOG: S-110

Permit #: *N/A*	Drill Date: *July 11, 1996*	Use: *Monitoring*
Location: *3144 Passyunk Avenue, Philadelphia, PA*		Owner Loc #: *Philadelphia Refinery*
Owner: *Sun Company, Inc.*		Handex Loc #: *110535*
Owner Address: *Philadephia, PA*	BORING - Depth: *30 ft.*	Diameter: *8 In.*
Drilling Method: *Hollow-Stem Auger*	CASING - Length: *9.58 ft.*	Diameter: *2 In.*
Sampling Method: *None*	SCREEN - Length: *20 ft.*	Diameter: *2 In.*
Static Water Level: *14.51 ft. (July 11, 1996)*	WELL - Depth: *27.16 ft.*	

Depth (ft.)	Sample ID	Sample Depth	Blows/6 in.		Graphic Log	Geologic Description
5						NO CUTTINGS. Loose sediments including gravel and rubble. Possible backfill.
10						
15						
20						
25						NO CUTTINGS. Sediments firmer than 0-22 foot range. Less gravel, no rubble. Possible natural formation.
30						NOTE: Split spoon samples were not collected because the drill rig could not be raised due to overhead utilities. Residual hydrocarbons were detected on the bottom 20 feet of augers.
35						



NOTES: ☒ = Sample interval/recovery; ⏚ = Static Water Level (from TOC)

Geologist: Arsin Sahba

Driller: Jay Korron (Hardin-Huber)

APPENDIX C

TIDAL TEST GROUND WATER ELEVATION DATA

SUN PHILADELPHIA REFINERY
SHORT PIER AREA
TIDAL TEST PORTION OF FEASIBILITY TEST
JUNE 19, 1997

NOTES

1. These data were collected with an interface probe during the tidal portion of the feasibility testing.
2. The corrected ground water elevation data (presented below) was calculated after recording depth to ground water and depth to NAPL.
3. The corrected ground water elevation was calculated using well casing elevation.
4. These data show fluctuation in levels strictly as a result of tidal influence.

	GROUND WATER ELEVATION (feet) - INTERFACE PROBE							
TIME	S-106	S-107	S-108	S-109	RW-600	RW-601	RW-602	RIVER GP3
8:25	-2.44	-0.72	1.42	-1.15	1.63	0.36	-0.70	-5.08
8:45	-2.42	-0.69	1.45	-1.14	1.67	0.37	-0.63	-4.19
9:00	-2.41	-0.65	1.49	-1.16	1.73	0.37	-0.57	-3.42
9:15	-2.40	-0.62	1.57	-1.17	1.81	0.37	-0.52	-2.27
9:30	-2.39	-0.63	1.63	-1.17	1.86	0.39	-0.52	-1.65
9:45	-2.26	-0.64	1.66	-1.18	1.89	0.42	-0.52	-1.42
10:00	-1.67	-0.59	1.68	-1.19	1.91	0.60	-0.31	-1.32
10:10								-1.22
10:30	-1.05	-0.39	1.78	-1.17	1.99	0.85	0.14	-0.74
10:45								-0.32
11:00	-0.43	-0.07	1.92	-0.51	2.14	1.18	0.73	0.08
11:25								0.33
11:30	-0.29	0.03	1.99	0.11	2.17	1.27	0.88	0.37
11:45								0.49
12:00	-0.07	0.14	2.04	0.40	2.19	1.37	1.03	0.61
12:15								0.81
12:30	0.08	0.22	2.11	0.67	2.26	1.49	1.19	0.91
13:05	-0.08	0.24	2.14	0.66	2.27	1.44	1.13	0.65
13:20				0.63				0.56
13:30	-0.13	0.28	2.13	0.60	2.26	1.44	1.10	0.55
13:45								0.50
14:00	-0.38	0.26	2.10	0.48	2.24	1.36	0.99	0.30
14:15								-0.05
14:30	-0.89	0.17	2.00	-0.06	2.15	1.15	0.68	-0.40
14:45								-0.64
15:00	-1.21	0.06	1.91	-0.51	2.10	1.00	0.44	-0.90
15:15								-1.13
15:30	-1.48	-0.04	1.86	-0.79	2.04	0.89	0.23	-1.31
15:45								-1.54
16:00	-1.88	-0.18	1.77	-0.98	1.99	0.73	-0.03	-1.89
16:15								-2.15
16:30	-2.16	-0.31	1.69	-1.09	1.91	0.62	-0.27	-2.37
16:45								-2.57
17:00	-2.45	-0.47	1.62	-1.13	1.81	0.48	-0.49	-2.82
17:15								-3.01
17:30	-2.47	-0.62	1.54	-1.14	1.77	0.41	-0.66	-3.38
17:45								-3.60
18:00	-2.42	-0.68	1.49	-1.16	1.70	0.42	-0.68	-3.87
18:15								-4.17
18:30	-2.43	-0.77	1.45	-1.19	1.67	0.41	-0.69	-4.22
18:45								-4.53

SE2000
Environmental Logger
06/23 14:40

Unit# HERMIT=1 Test 0

Setups:	INPUT 1	INPUT 2	INPUT 3	INPUT 4
Type	Level (F)	Level (F)	Level (F)	Level (F)
Mode	TOC	TOC	TOC	TOC
I.D.	601	602	3	107
Reference	0.000	0.000	0.000	0.000
PSI at Ref.	5.011	6.005	3.154	2.764
SG	1.000	1.000	1.000	1.000
Linearity	0.099	0.048	0.048	0.109
Scale factor	14.975	9.970	9.941	14.837
Offset	0.030	0.174	0.130	0.020
Delay mSEC	50.000	50.000	50.000	50.000

Step 0 06/19 08:35:19

Elapsed Time	INPUT 1	INPUT 2	INPUT 3	INPUT 4
0.0000	-0.004	-0.031	-0.304	-0.014
0.0083	-0.004	-0.031	-0.304	-0.014
0.0166	-0.004	-0.031	-0.304	-0.014
0.0250	-0.004	-0.031	-0.304	-0.014
0.0333	-0.004	-0.031	-0.307	-0.014
0.0416	-0.004	-0.031	-0.307	-0.014
0.0500	-0.004	-0.031	-0.307	-0.014
0.0583	-0.004	-0.031	-0.307	-0.014
0.0666	-0.004	-0.031	-0.307	-0.014
0.0750	-0.004	-0.034	-0.307	-0.014
0.0833	-0.004	-0.034	-0.307	-0.014
0.0916	-0.004	-0.031	-0.307	-0.014
0.1000	-0.004	-0.031	-0.307	-0.014
0.1083	-0.004	-0.031	-0.310	-0.014
0.1166	-0.004	-0.031	-0.310	-0.014
0.1250	-0.004	-0.031	-0.310	-0.014
0.1333	-0.004	-0.031	-0.310	-0.014
0.1416	-0.004	-0.031	-0.310	-0.014
0.1500	-0.004	-0.034	-0.310	-0.014
0.1583	-0.004	-0.031	-0.310	-0.014
0.1666	-0.004	-0.031	-0.310	-0.014
0.1750	-0.004	-0.034	-0.310	-0.014
0.1833	-0.004	-0.034	-0.310	-0.014
0.1916	-0.004	-0.034	-0.310	-0.014
0.2000	-0.004	-0.031	-0.313	-0.014
0.2083	-0.004	-0.031	-0.313	-0.014
0.2166	-0.004	-0.034	-0.313	-0.014
0.2250	-0.004	-0.031	-0.313	-0.014
0.2333	-0.004	-0.031	-0.313	-0.014

0.2416	-0.004	-0.031	-0.313	-0.014
0.2500	-0.004	-0.034	-0.317	-0.014
0.2583	-0.004	-0.034	-0.313	-0.014
0.2666	-0.004	-0.034	-0.317	-0.014
0.2750	-0.004	-0.031	-0.317	-0.014
0.2833	-0.004	-0.034	-0.313	-0.014
0.2916	-0.004	-0.034	-0.317	-0.014
0.3000	-0.004	-0.031	-0.317	-0.014
0.3083	-0.004	-0.031	-0.317	-0.014
0.3166	-0.004	-0.031	-0.317	-0.014
0.3250	-0.004	-0.034	-0.317	-0.014
0.3333	-0.004	-0.034	-0.317	-0.014
0.3500	-0.004	-0.034	-0.320	-0.014
0.3666	-0.004	-0.034	-0.320	-0.014
0.3833	-0.004	-0.034	-0.320	-0.014
0.4000	-0.004	-0.034	-0.320	-0.014
0.4166	-0.004	-0.034	-0.323	-0.014
0.4333	-0.004	-0.034	-0.323	-0.014
0.4500	-0.004	-0.034	-0.323	-0.014
0.4666	-0.004	-0.034	-0.323	-0.014
0.4833	-0.004	-0.034	-0.323	-0.014
0.5000	-0.004	-0.034	-0.323	-0.014
0.5166	-0.004	-0.034	-0.326	-0.014
0.5333	-0.004	-0.034	-0.326	-0.014
0.5500	-0.004	-0.034	-0.326	-0.014
0.5666	-0.004	-0.034	-0.326	-0.014
0.5833	-0.004	-0.034	-0.326	-0.014
0.6000	-0.004	-0.034	-0.326	-0.014
0.6166	-0.004	-0.034	-0.329	-0.014
0.6333	-0.004	-0.034	-0.329	-0.014
0.6500	-0.004	-0.034	-0.329	-0.014
0.6666	-0.004	-0.034	-0.329	-0.014
0.6833	-0.004	-0.034	-0.332	-0.014
0.7000	-0.004	-0.034	-0.332	-0.014
0.7166	-0.004	-0.034	-0.332	-0.014
0.7333	-0.004	-0.034	-0.332	-0.014
0.7500	-0.004	-0.034	-0.332	-0.014
0.7666	-0.004	-0.037	-0.335	-0.014
0.7833	-0.004	-0.037	-0.335	-0.014
0.8000	-0.004	-0.034	-0.335	-0.014
0.8166	-0.004	-0.034	-0.335	-0.014
0.8333	-0.004	-0.034	-0.335	-0.014
0.8500	-0.004	-0.034	-0.335	-0.014
0.8666	-0.004	-0.037	-0.339	-0.014
0.8833	-0.004	-0.034	-0.335	-0.014
0.9000	-0.004	-0.034	-0.335	-0.014
0.9166	-0.004	-0.037	-0.339	-0.014
0.9333	-0.004	-0.034	-0.339	-0.014
0.9500	-0.004	-0.034	-0.339	-0.014
0.9666	-0.004	-0.034	-0.339	-0.014
0.9833	-0.004	-0.037	-0.342	-0.014
1.0000	-0.004	-0.034	-0.342	-0.014
1.2000	-0.004	-0.037	-0.348	-0.014
1.4000	-0.004	-0.037	-0.354	-0.014

1.6000	-0.004	-0.037	-0.364	-0.018
1.8000	-0.004	-0.037	-0.373	-0.018
2.0000	-0.009	-0.037	-0.379	-0.018
2.2000	-0.004	-0.041	-0.389	-0.018
2.4000	-0.004	-0.041	-0.398	-0.018
2.6000	-0.004	-0.041	-0.408	-0.018
2.8000	-0.004	-0.044	-0.417	-0.018
3.0000	-0.004	-0.044	-0.427	-0.018
3.2000	-0.009	-0.044	-0.433	-0.018
3.4000	-0.009	-0.044	-0.442	-0.018
3.6000	-0.009	-0.047	-0.452	-0.018
3.8000	-0.004	-0.047	-0.461	-0.018
4.0000	-0.004	-0.047	-0.470	-0.018
4.2000	-0.009	-0.047	-0.477	-0.018
4.4000	-0.009	-0.047	-0.486	-0.023
4.6000	-0.009	-0.050	-0.496	-0.023
4.8000	-0.009	-0.050	-0.505	-0.023
5.0000	-0.009	-0.050	-0.518	-0.023
5.2000	-0.009	-0.050	-0.527	-0.023
5.4000	-0.009	-0.053	-0.536	-0.023
5.6000	-0.009	-0.053	-0.546	-0.023
5.8000	-0.009	-0.056	-0.555	-0.023
6.0000	-0.004	-0.056	-0.565	-0.023
6.2000	-0.009	-0.056	-0.577	-0.023
6.4000	-0.004	-0.056	-0.587	-0.023
6.6000	-0.004	-0.059	-0.596	-0.023
6.8000	-0.009	-0.059	-0.605	-0.023
7.0000	-0.009	-0.059	-0.615	-0.023
7.2000	-0.009	-0.059	-0.624	-0.023
7.4000	-0.009	-0.059	-0.634	-0.028
7.6000	-0.009	-0.063	-0.643	-0.028
7.8000	-0.009	-0.066	-0.653	-0.028
8.0000	-0.009	-0.063	-0.662	-0.028
8.2000	-0.009	-0.063	-0.671	-0.028
8.4000	-0.009	-0.066	-0.681	-0.028
8.6000	-0.009	-0.066	-0.690	-0.028
8.8000	-0.009	-0.069	-0.703	-0.028
9.0000	-0.009	-0.066	-0.712	-0.028
9.2000	-0.009	-0.069	-0.722	-0.028
9.4000	-0.009	-0.069	-0.734	-0.028
9.6000	-0.014	-0.072	-0.747	-0.028
9.8000	-0.009	-0.072	-0.756	-0.028
10.0000	-0.009	-0.072	-0.769	-0.028
12.0000	-0.009	-0.082	-0.872	-0.032
14.0000	-0.014	-0.091	-0.979	-0.032
16.0000	-0.014	-0.101	-1.080	-0.042
18.0000	-0.018	-0.110	-1.187	-0.046
20.0000	-0.018	-0.116	-1.290	-0.051
22.0000	-0.018	-0.123	-1.391	-0.056
24.0000	-0.018	-0.129	-1.491	-0.060
26.0000	-0.018	-0.135	-1.589	-0.060
28.0000	-0.023	-0.145	-1.689	-0.065
30.0000	-0.023	-0.148	-1.787	-0.070
32.0000	-0.028	-0.151	-1.890	-0.065

34.0000	-0.028	-0.161	-1.988	-0.070
36.0000	-0.028	-0.167	-2.094	-0.079
38.0000	-0.028	-0.170	-2.198	-0.079
40.0000	-0.033	-0.179	-2.292	-0.084
42.0000	-0.033	-0.183	-2.390	-0.089
44.0000	-0.033	-0.186	-2.487	-0.089
46.0000	-0.033	-0.189	-2.578	-0.154
48.0000	-0.037	-0.195	-2.663	-0.089
50.0000	-0.037	-0.198	-2.739	-0.098
52.0000	-0.033	-0.202	-2.814	-0.098
54.0000	-0.037	-0.202	-2.874	-0.098
56.0000	-0.037	-0.198	-2.927	-0.098
58.0000	-0.037	-0.202	-2.971	-0.098
60.0000	-0.042	-0.198	-3.012	-0.098
62.0000	-0.037	-0.195	-3.047	-0.098
64.0000	-0.042	-0.195	-3.069	-0.093
66.0000	-0.042	-0.195	-3.094	-0.098
68.0000	-0.042	-0.192	-3.113	-0.098
70.0000	-0.047	-0.192	-3.138	-0.098
72.0000	-0.047	-0.195	-3.169	-0.098
74.0000	-0.052	-0.195	-3.191	-0.093
76.0000	-0.056	-0.195	-3.210	-0.093
78.0000	-0.066	-0.208	-3.232	-0.126
80.0000	-0.075	-0.221	-3.245	-0.093
82.0000	-0.089	-0.236	-3.257	-0.098
84.0000	-0.118	-0.265	-3.279	-0.103
86.0000	-0.156	-0.309	-3.295	-0.107
88.0000	-0.194	-0.353	-3.311	-0.117
90.0000	-0.222	-0.397	-3.330	-0.131
92.0000	-0.251	-0.438	-3.355	-0.140
94.0000	-0.269	-0.473	-3.393	-0.154
96.0000	-0.288	-0.505	-3.424	-0.168
98.0000	-0.312	-0.539	-3.474	-0.187
100.000	-0.326	-0.568	-3.503	-0.201
110.000	-0.397	-0.707	-3.704	-0.262
120.000	-0.502	-0.899	-3.987	-0.323
130.000	-0.596	-1.086	-4.273	-0.435
140.000	-0.696	-1.256	-4.550	-0.524
150.000	-0.772	-1.383	-4.710	-0.609
160.000	-0.838	-1.490	-4.839	-0.637
170.000	-0.881	-1.556	-4.902	-0.726
180.000	-0.914	-1.607	-4.959	-0.759
190.000	-0.942	-1.654	-5.012	-0.796
200.000	-0.994	-1.721	-5.148	-0.838
210.000	-1.037	-1.793	-5.261	-0.899
220.000	-1.084	-1.866	-5.371	-0.913
230.000	-1.127	-1.926	-5.443	-0.951
240.000	-1.155	-1.967	-5.468	-0.983
250.000	-1.160	-1.983	-5.412	-1.007
260.000	-1.155	-1.977	-5.330	-1.016
270.000	-1.141	-1.964	-5.258	-1.021
280.000	-1.127	-1.958	-5.185	-1.021
290.000	-1.127	-1.955	-5.148	-1.021
300.000	-1.132	-1.951	-5.116	-1.021

310.000	-1.127	-1.945	-5.069	-1.021
320.000	-1.113	-1.926	-4.930	-1.021
330.000	-1.080	-1.876	-4.811	-1.012
340.000	-1.032	-1.797	-4.597	-0.998
350.000	-0.971	-1.695	-4.355	-0.969
360.000	-0.904	-1.594	-4.138	-0.937
370.000	-0.843	-1.490	-3.924	-0.899
380.000	-0.791	-1.408	-3.770	-0.862
390.000	-0.753	-1.335	-3.647	-0.834
400.000	-0.715	-1.269	-3.518	-0.801
410.000	-0.677	-1.199	-3.380	-0.773
420.000	-0.639	-1.130	-3.223	-0.740
430.000	-0.592	-1.048	-3.047	-0.698
440.000	-0.563	-0.966	-2.883	-0.655
450.000	-0.535	-0.880	-2.688	-0.609
460.000	-0.492	-0.792	-2.512	-0.557
470.000	-0.449	-0.707	-2.352	-0.505
480.000	-0.412	-0.634	-2.236	-0.463
490.000	-0.369	-0.552	-2.054	-0.416
500.000	-0.303	-0.473	-1.906	-0.379
510.000	-0.246	-0.410	-1.796	-0.360
520.000	-0.208	-0.344	-1.626	-0.351
530.000	-0.184	-0.290	-1.441	-0.351
540.000	-0.170	-0.255	-1.290	-0.356
550.000	-0.165	-0.239	-1.133	-0.356
560.000	-0.161	-0.217	-0.863	-0.365
570.000	-0.161	-0.221	-0.759	-0.182
580.000	-0.161	-0.221	-0.621	-0.196
590.000	-0.161	-0.217	-0.470	-0.206
600.000	-0.151	-0.205	-0.307	-0.215

END

APPENDIX D

PUMPING TEST GROUND WATER ELEVATION DATA

SUN PHILADELPHIA REFINERY
SHORT PIER AREA
PUMPING TEST PORTION OF FEASIBILITY TEST
JUNE 20, 1997

NOTES

1. These data were collected with an interface probe during the pumping test portion of the feasibility testing.
2. The corrected ground water elevation data (presented below) was calculated after recording depth to ground water and depth to NAPL.
3. The corrected ground water elevation was calculated using well casing elevation.
4. These data made it possible to compare the pumping versus the tidal data.

	GROUND WATER ELEVATION (feet) - INTERFACE PROBE							
TIME	S-106	S-107	S-108	S-109	RW-600	RW-601	RW-602	RIVER GP3
7:45	-2.40	-0.75	1.45	-1.11	1.63	0.40	-0.09	
7:55								-4.52
8:30	-2.40	-0.82	1.40	-1.12	1.59	0.38	-0.71	-5.41
8:55								-5.09
9:05	-2.41	-0.84	1.38	-1.15	1.57	0.36	-0.72	-5.19
9:15		-1.25	1.38	-1.15	1.56		-2.70	-5.04
9:23		-1.43					-3.02	
9:25		-1.53					-3.15	
9:28		-1.70					-3.37	
9:30	-2.42	-1.86	1.38	-1.15	1.59	0.36	-3.60	-4.44
9:40		-1.97					-3.73	
9:45	-2.41	-3.37	1.40	-1.17	1.61	0.37	-3.89	-3.75
10:00	-2.40	-2.29	1.49	-1.18	1.73	0.37	-4.04	-2.64
10:10		-2.33					-4.06	
10:15	-2.40	-2.36	1.54	-1.18	1.77	0.36	-4.10	-2.03
10:25							-4.16	
10:30	-2.41	-2.44	1.58	-1.19	1.81	0.36	-4.21	-1.69
10:40							-4.24	
10:45	-2.40	-2.51	1.60	-1.19	1.83	0.36	-4.30	-1.52
10:55							-4.32	
11:00	-2.20	-2.56	1.64	-1.19	1.87	0.40	-4.32	-1.37
11:10		-2.56					-4.24	
11:15	-1.53	-2.48	1.68	-1.21	1.88	0.65	-3.97	-0.97
11:25							-3.89	
11:30	-1.09	-2.38	1.73	-1.21	1.95	0.82	-3.77	-0.62
11:40		-2.32					-3.65	
12:00	-0.52	-2.11	1.87	-0.53	2.08	1.11	-3.28	0.13
12:15		-2.04					-3.17	0.32
12:30	-0.25	-1.96	1.97	0.23	2.10	1.28	-3.02	0.46
12:45		-1.93					-2.93	0.63
13:00	0.02	-1.83	2.05	0.51	2.10	1.43	-2.79	0.81
13:15		-1.79					-2.73	0.94
13:30	0.13	-1.73	2.10	0.80	2.10	1.51	-2.63	1.04
13:45		-1.71					-2.62	0.93
14:00	0.03	-1.70	2.12	0.82	2.11	1.49	-2.64	0.80
14:15		-1.71					-2.64	0.73
14:30	-0.09	-1.71	2.13	0.73	2.27	1.46	-2.66	
14:45		-1.72					-2.69	0.23
15:00	-0.46	-1.78	2.08	0.49	2.22	1.33	-2.83	-0.34
15:15		-1.82					-2.91	-0.02
15:03	-1.00	-1.96	1.99	-0.22	2.13	1.11	-3.17	-0.57
15:45		-1.99					-3.26	-1.02
16:00	-1.17	-2.06	1.91	-0.50	2.09	1.02	-3.37	-1.17
16:15		-2.11					-3.45	-3.12
16:30	-1.46	-2.20	1.83	-0.80	2.04	0.88	-3.62	-1.82
16:45		-2.24					-3.69	-3.17
17:00	-1.82	-2.35	1.76	-0.96	1.96	0.74	-3.87	-2.07

SE2000
Environmental Logger
06/23 14:45

Unit# HERMIT=1 Test 1

Setups:	INPUT 1	INPUT 2	INPUT 3	INPUT 4
Type	Level (F)	Level (F)	Level (F)	Level (F)
Mode	TOC	TOC	TOC	TOC
I.D.	601	602	3	107
Reference	0.000	0.000	0.000	0.000
PSI at Ref.	5.056	4.723	1.481	2.770
SG	1.000	1.000	1.000	1.000
Linearity	0.099	0.048	0.048	0.109
Scale factor	14.975	9.970	9.941	14.837
Offset	0.030	0.174	0.130	0.020
Delay mSEC	50.000	50.000	50.000	50.000

Step 0 06/20 08:59:55

Elapsed Time	INPUT 1	INPUT 2	INPUT 3	INPUT 4
0.0000	0.023	0.006	0.250	-0.028
0.0083	0.023	0.009	0.250	-0.028
0.0166	0.023	0.009	0.253	-0.028
0.0250	0.023	0.009	0.253	-0.028
0.0333	0.023	0.009	0.250	-0.028
0.0416	0.023	0.009	0.250	-0.028
0.0500	0.023	0.009	0.250	-0.028
0.0583	0.023	0.009	0.250	-0.028
0.0666	0.023	0.009	0.250	-0.028
0.0750	0.023	0.009	0.250	-0.028
0.0833	0.023	0.009	0.250	-0.028
0.0916	0.023	0.009	0.253	-0.028
0.1000	0.023	0.009	0.250	-0.028
0.1083	0.023	0.009	0.250	-0.028
0.1166	0.023	0.009	0.250	-0.028
0.1250	0.023	0.009	0.250	-0.028
0.1333	0.023	0.009	0.250	-0.028
0.1416	0.023	0.009	0.250	-0.028
0.1500	0.018	0.009	0.250	-0.028
0.1583	0.023	0.009	0.250	-0.028
0.1666	0.023	0.009	0.250	-0.028
0.1750	0.018	0.009	0.250	-0.028
0.1833	0.023	0.009	0.250	-0.028
0.1916	0.023	0.009	0.250	-0.028
0.2000	0.018	0.009	0.250	-0.028
0.2083	0.023	0.009	0.250	-0.028
0.2166	0.018	0.006	0.250	-0.028
0.2250	0.023	0.009	0.250	-0.028
0.2333	0.023	0.009	0.250	-0.028

0.2416	0.023	0.009	0.247	-0.028
0.2500	0.018	0.009	0.250	-0.028
0.2583	0.023	0.009	0.247	-0.028
0.2666	0.023	0.009	0.247	-0.028
0.2750	0.018	0.009	0.247	-0.028
0.2833	0.023	0.009	0.247	-0.028
0.2916	0.023	0.009	0.247	-0.028
0.3000	0.023	0.009	0.247	-0.028
0.3083	0.023	0.009	0.247	-0.028
0.3166	0.018	0.009	0.247	-0.028
0.3250	0.018	0.009	0.247	-0.028
0.3333	0.023	0.009	0.247	-0.028
0.3500	0.023	0.009	0.247	-0.028
0.3666	0.023	0.009	0.247	-0.028
0.3833	0.023	0.009	0.247	-0.028
0.4000	0.023	0.009	0.247	-0.028
0.4166	0.023	0.006	0.247	-0.028
0.4333	0.023	0.009	0.244	-0.028
0.4500	0.023	0.009	0.247	-0.028
0.4666	0.023	0.009	0.244	-0.028
0.4833	0.023	0.009	0.244	-0.028
0.5000	0.023	0.009	0.247	-0.028
0.5166	0.018	0.009	0.244	-0.028
0.5333	0.023	0.009	0.244	-0.028
0.5500	0.023	0.009	0.244	-0.028
0.5666	0.023	0.009	0.244	-0.028
0.5833	0.023	0.006	0.244	-0.028
0.6000	0.023	0.009	0.244	-0.028
0.6166	0.023	0.009	0.244	-0.028
0.6333	0.023	0.006	0.244	-0.028
0.6500	0.023	0.006	0.244	-0.028
0.6666	0.023	0.009	0.241	-0.028
0.6833	0.018	0.009	0.244	-0.028
0.7000	0.023	0.009	0.241	-0.028
0.7166	0.023	0.009	0.241	-0.028
0.7333	0.018	0.006	0.241	-0.028
0.7500	0.023	0.006	0.241	-0.028
0.7666	0.023	0.006	0.244	-0.028
0.7833	0.023	0.006	0.241	-0.028
0.8000	0.023	0.006	0.241	-0.028
0.8166	0.018	0.006	0.241	-0.028
0.8333	0.023	0.009	0.241	-0.028
0.8500	0.023	0.006	0.241	-0.028
0.8666	0.023	0.006	0.241	-0.028
0.8833	0.023	0.006	0.241	-0.028
0.9000	0.023	0.006	0.241	-0.028
0.9166	0.018	0.006	0.241	-0.028
0.9333	0.018	0.009	0.241	-0.028
0.9500	0.023	0.006	0.241	-0.028
0.9666	0.023	0.006	0.241	-0.028
0.9833	0.023	0.006	0.241	-0.028
1.0000	0.023	0.006	0.241	-0.028
1.2000	0.023	0.006	0.241	-0.028
1.4000	0.023	0.006	0.241	-0.028

1.6000	0.023	0.006	0.241	-0.028
1.8000	0.023	0.006	0.238	-0.028
2.0000	0.023	0.006	0.238	-0.028
2.2000	0.023	0.006	0.238	-0.028
2.4000	0.023	0.006	0.238	-0.028
2.6000	0.023	0.006	0.241	-0.028
2.8000	0.023	0.006	0.238	-0.028
3.0000	0.023	0.006	0.238	-0.028
3.2000	0.023	0.009	0.238	-0.028
3.4000	0.023	0.009	0.238	-0.028
3.6000	0.028	0.006	0.238	-0.028
3.8000	0.028	0.006	0.235	-0.028
4.0000	0.023	0.006	0.235	-0.028
4.2000	0.023	0.006	0.231	-0.028
4.4000	0.028	0.006	0.231	-0.028
4.6000	0.028	0.006	0.231	-0.028
4.8000	0.023	0.006	0.231	-0.028
5.0000	0.023	0.006	0.231	-0.028
5.2000	0.028	0.006	0.231	-0.028
5.4000	0.028	0.006	0.231	-0.028
5.6000	0.023	0.000	0.231	-0.028
5.8000	0.028	-0.034	0.231	-0.028
6.0000	0.028	0.006	0.228	-0.028
6.2000	0.023	0.006	0.228	-0.028
6.4000	0.023	0.003	0.225	-0.037
6.6000	0.028	0.006	0.222	-0.028
6.8000	0.028	0.003	0.222	-0.032
7.0000	0.028	0.006	0.222	-0.028
7.2000	0.028	0.003	0.219	-0.028
7.4000	0.018	0.003	0.216	-0.032
7.6000	0.033	0.006	0.216	-0.028
7.8000	0.028	0.003	0.213	-0.028
8.0000	0.028	0.003	0.209	-0.032
8.2000	0.028	0.003	0.206	-0.032
8.4000	0.033	0.003	0.203	-0.032
8.6000	0.028	0.003	0.203	-0.032
8.8000	0.028	0.003	0.200	-0.032
9.0000	0.028	0.003	0.200	-0.032
9.2000	0.028	0.003	0.200	-0.032
9.4000	0.028	0.000	0.197	-0.032
9.6000	0.028	0.003	0.197	-0.032
9.8000	0.028	0.000	0.194	-0.032
10.0000	0.028	0.000	0.194	-0.032
12.0000	0.028	-0.003	0.166	-0.032
14.0000	0.033	-0.006	0.128	-0.032
16.0000	0.033	0.923	0.097	-0.028
18.0000	0.037	1.554	0.040	-0.028
20.0000	0.037	1.954	-0.012	0.098
22.0000	0.042	2.177	-0.075	0.234
24.0000	0.047	2.322	-0.144	0.538
26.0000	0.047	2.461	-0.216	0.543
28.0000	0.047	2.584	-0.304	0.566
30.0000	0.047	2.669	-0.401	0.814
32.0000	0.047	2.776	-0.495	0.819

34.0000	0.052	2.836	-0.608	0.814
36.0000	0.052	2.899	-0.711	0.843
38.0000	0.052	2.971	-0.821	0.861
40.0000	0.047	2.993	-0.937	0.899
42.0000	0.047	3.037	-1.050	1.011
44.0000	0.047	3.072	-1.166	1.006
46.0000	0.047	3.110	-1.269	1.002
48.0000	0.047	3.116	-1.382	1.044
50.0000	0.047	3.163	-1.476	1.152
52.0000	0.052	3.173	-1.595	1.147
54.0000	0.047	3.195	-1.686	1.138
56.0000	0.042	3.223	-1.812	1.133
58.0000	0.042	3.204	-1.912	1.128
60.0000	0.047	3.236	-2.013	1.124
62.0000	0.047	3.248	-2.113	1.414
64.0000	0.042	3.248	-2.220	1.404
66.0000	0.042	3.258	-2.329	1.395
68.0000	0.042	3.283	-2.433	1.381
70.0000	0.042	3.280	-2.537	1.367
72.0000	0.037	3.292	-2.631	1.358
74.0000	0.047	3.302	-2.719	1.339
76.0000	0.047	3.317	-2.803	1.325
78.0000	0.047	3.327	-2.885	1.339
80.0000	0.042	3.333	-2.957	1.320
82.0000	0.047	3.336	-3.017	1.320
84.0000	0.047	3.362	-3.073	1.428
86.0000	0.052	3.374	-3.120	1.409
88.0000	0.052	3.402	-3.158	1.395
90.0000	0.047	3.409	-3.189	1.376
92.0000	0.052	3.431	-3.221	1.358
94.0000	0.047	3.431	-3.252	1.372
96.0000	0.052	3.450	-3.271	1.381
98.0000	0.052	3.459	-3.296	1.470
100.000	0.056	3.465	-3.318	1.447
110.000	0.052	3.525	-3.412	1.662
120.000	0.047	3.566	-3.556	1.587
130.000	-0.033	3.478	-3.751	1.559
140.000	-0.198	3.248	-3.987	1.489
150.000	-0.293	3.103	-4.294	1.419
160.000	-0.435	2.905	-4.618	1.358
170.000	-0.544	2.719	-4.885	1.433
180.000	-0.629	2.593	-5.073	1.372
190.000	-0.701	2.496	-5.164	1.316
200.000	-0.753	2.410	-5.321	1.264
210.000	-0.805	2.319	-5.406	1.222
220.000	-0.838	2.250	-5.497	1.166
230.000	-0.890	2.171	-5.645	1.128
240.000	-0.947	2.083	-5.793	1.091
250.000	-0.999	2.010	-5.909	1.044
260.000	-1.051	1.951	-6.028	0.997
270.000	-1.080	1.906	-6.031	0.955
280.000	-1.075	1.888	-5.959	0.936
290.000	-1.061	1.881	-5.874	0.922
300.000	-1.061	1.884	-5.884	0.885

310.000	-1.051	1.894	-5.805	0.852
320.000	-1.037	1.910	-5.736	0.814
330.000	-1.032	1.894	-5.727	0.782
340.000	-1.013	1.932	-5.620	0.749
350.000	-0.980	1.976	-5.466	0.716
360.000	-0.923	2.064	-5.240	0.679
370.000	-0.866	2.127	-5.045	0.936
380.000	-0.805	2.215	-4.819	0.903
390.000	-0.738	2.329	-4.602	0.875
400.000	-0.682	2.429	-4.423	1.128
410.000	-0.639	2.508	-4.297	1.100
420.000	-0.601	2.571	-4.203	1.067
430.000	-0.563	2.656	-4.078	1.161
440.000	-0.521	2.741	-3.914	1.334
450.000	-0.468	2.807	-3.770	1.320
460.000	-0.416	2.905	-3.547	1.227
470.000	-0.369	3.009	-3.374	1.245
480.000	-0.317	3.094	-3.211	1.498
490.000	-0.269	3.182	-3.017	1.470

END

APPENDIX E

EFFLUENT SAMPLING LABORATORY ANALYTICAL REPORT

EMSL ANALYTICAL, INC.

Asbestos – Lead – Environmental – Materials

New Jersey

Corporate Office
Main Laboratory
108 Haddon Avenue
Westmont, NJ 08108
(609) 858-4800

3 Cooper Street
Westmont, NJ 08108
(609) 858-4800

Piscataway, NJ
(908) 981-0550

New York

New York, NY
(212) 290-0051

Carle Place, NY
(516) 997-7251

California

San Mateo, CA
(415) 570-5401

Georgia

Smyrna, GA
(770) 333-6066

Kentucky

Lexington, KY
(606) 293-1590

Michigan

Ann Arbor, MI
(313) 668-6810

North Carolina

Charlotte, NC
(704) 567-1521

Greensboro, NC
(910) 297-1487

Texas

Dallas, TX
(214) 831-9725

Houston, TX
(713) 686-3635

Washington

Seattle, WA
(206) 233-9007

07/08/1997

Attention: Arsin Sahba
Handex of Maryland, Inc.
1350 Blair Drive, Suite H
Odenton, MD 21113-3200

The following report covers the analysis performed on samples submitted to EMSL Analytical on 06/23/1997. The results are tabulated on the attached data pages for the following client designated project:

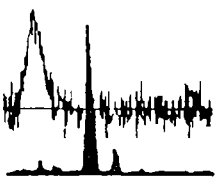
Sunoco Pt.Breeze

The reference number for these samples is EMSL Project #97067046. Please use this reference when calling about these samples.

If you have any questions, please do not hesitate to contact me at (609) 858-9573.

Reviewed and Approved By:

Paul Laraia, Jr.
Laboratory Manager
NJ Certification No:04653



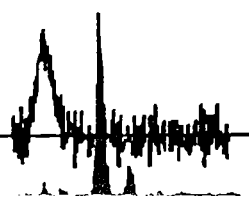
Date of Report: 07/14/97
Project Number: 97067046
Lab ID: 97-0038328
Date Collected: 06/20/97 00:00
Collected By: Client
Date Received: 06/23/97 17:00

Attention: Arsin Sahba
Handex of Maryland, Inc.
1350 Blair Drive, Suite H
Odenton MD 21113-3200

Client Project: Sunoco Pt.Breeze

Client Designation: 1

	Conc.	Unit
LIMITED		
Hardness as CaCO3	460	mg/l
METALS		
Iron	39	mg/l



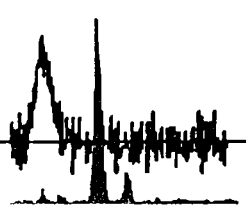
Date of Report: 07/14/97
Project Number: 97067046
Lab ID: 97-0038329
Date Collected: 06/20/97 00:00
Collected By: Client
Date Received: 06/23/97 17:00

Attention: Arsin Sahba
Handex of Maryland, Inc.
1350 Blair Drive, Suite H
Odenton MD 21113-3200

Client Project: Sunoco Pt.Breeze

Client Designation: 2

	Conc.	Unit
LIMITED		
Alkalinity at pH4.5 as CaCO3	330	mg/l
Bicarbonate by Calculation	300	mg/l
Carbonate by Calculation	<1	mg/l
pH	6.38	S.U.



EMSL ANALYTICAL INC.
3 Cooper Street
Westmont, New Jersey 08108
609-858-9573
609-858-4571 (Fax)

Chain of Custody / Analysis Request Form

EMSL Project # 970607 04LC
PO # _____

Custody and Sample Information - Print ALL information. Put N/A in blanks not applicable. Press firmly.

1. Report to:	2. Bill to:	Project: Sunoco Pt. Breeze Refinery
Arpin Sahba Hunter of Maryland The Morgan Rd Odenton, MD		Tel #: (410) 674-3200 FAX #: (410) 674-3203

3. Sampled by: (Signature)	4. # of Samples in Shipment	5. Date of Sample Shipment	6. Date Results Needed
[signature]	2		7/6/97

Item No.	Sample Number	Station Location / Sample ID	COMP	GRAB	Matrix: WATER	SOIL	AIR	SLUDGE	OTHER	Method Preserved: HCl	HNO_3	H_2SO_4	ICE	NONE	OTHER	Sampling: Date	Time	Number of Containers	Indicate Analysis Requested: Total Iron 6010A	Hardness	Alkalinity 310.2	Turbidity 180.1	Color				Laboratory Number
1	1	RW602 Discharge		X	X						X		X			6/20/97	1500	1	X	X								38398
2	2	RW602 Discharge		X	X								X			6/20/97	1542	1			X	X	X					29
3																											
4																											
5																											
6																											
7																											
8																											
9																											

Released by (Signature)	Date/Time Released	Delivery Method	Received by (Signature)	Company/Agency Affiliation	Date/Time Received	Condition Noted
[signature]	6/20/97 1630	Hand	[signature]	Hunter	6/20/97 1635	
[signature]	6/23/97 1100	Hand	[signature]	ESI	6/23/97	
	/ /		[signature]	QSL	6/24/97	

Please indicate turnaround time: standard (10D) 5D 72HR 48HR 24HR (Must call for quick turn)

Comments:

Please indicate reporting requirements:
1) Results only 2) Results & QC 3) Reduced Deliverables