MALCOLM PIRNIE

NAPL PLUME STUDY

FINAL REPORT

For
Defense Personnel Support Center
Philadelphia, Pennsylvania

USACE Contract No. DACA31-94-D-0017

August 1997
0285657

US Army Corps
of Engineers
Baltimore District
DRIVEN BY A VISION...to be the BEST

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RECYCLED PAPER

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EXECUTIVE SUMMARY

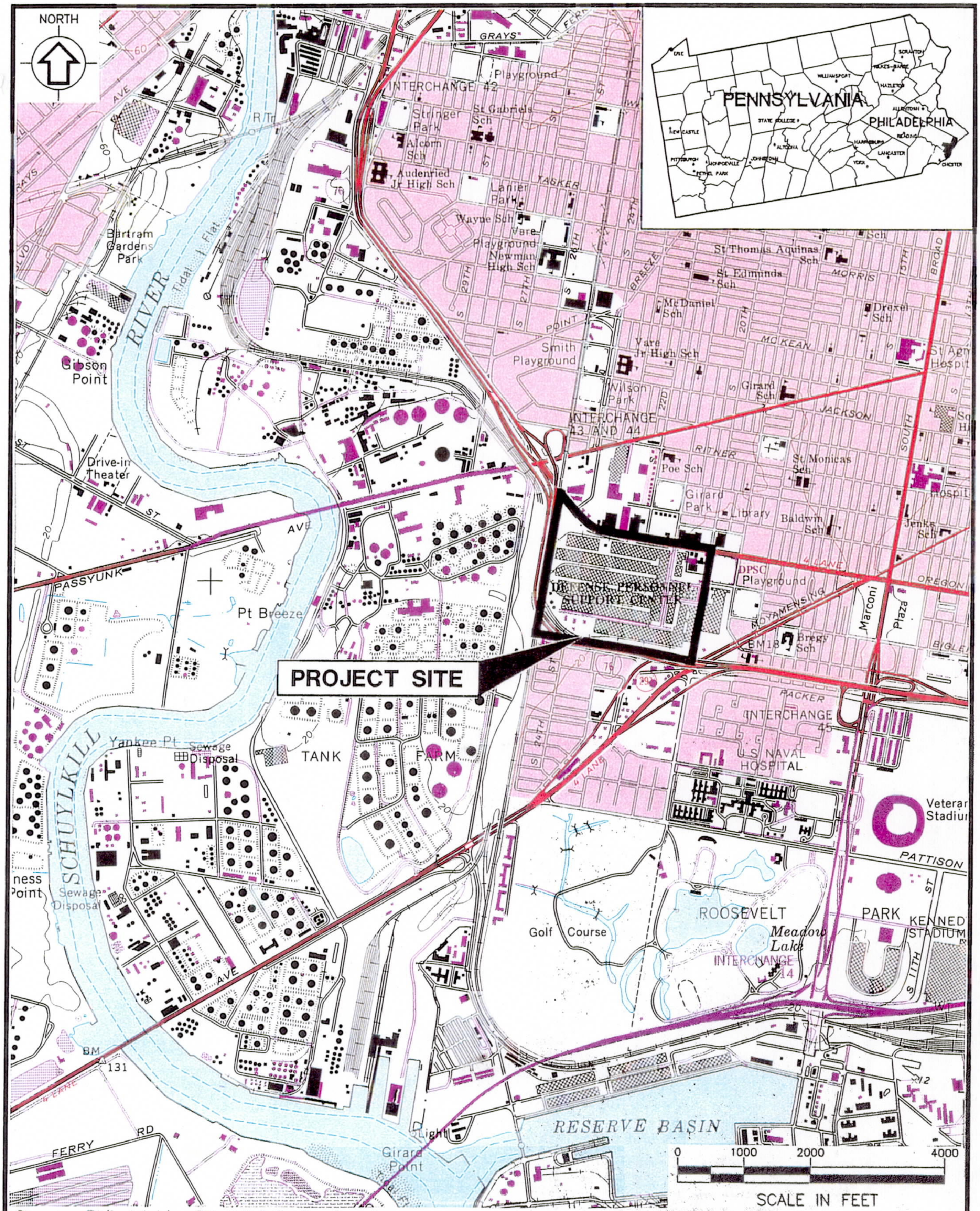
The Defense Personnel Support Center (DPSC) is scheduled to close in 1999 under the 1993 Base Realignment and Closure (BRAC) Act. DPSC is a federal facility which is operated by the Defense Logistics Agency (DLA) and is located on 86 acres in southeastern Philadelphia, Pennsylvania, see Figure ES-1. The area in which DPSC is located consists of a mix of commercial, industrial, and residential properties, see Figure ES-2. A refinery, formerly owned and operated by Atlantic Richfield Company (ARCO), and now owned and operated by Sun Company, Inc. (Sun), is located approximately 500 feet to the west of DPSC and separated from DPSC by 26th Street and CSX railroad property.

Malcolm Pirnie was tasked by the United States Army Corps of Engineers (USACE), Baltimore District to conduct a study of a light non-aqueous phase liquid (NAPL) plume, composed of petroleum, located on the top of the groundwater. This study is being performed under Army Corps Indefinite Delivery Contract No. DACA31-94-D-0017, Delivery Orders DO-0057 and DO-0079, with modifications. The findings of this study, which were based on existing information and data gathered through additional field and laboratory investigations, are summarized below in the form of answers to six specific questions.

In accordance with the review process utilized by the Technical Oversight Committee which was established under the Consent Order and Agreement dated September 24, 1996, and signed by DPSC, Sun, and the Pennsylvania Department of Environmental Protection (PADEP), Sun reviewed the draft version of this report. In preparing this final document, the comments and concerns expressed by Sun have been reviewed and considered.

1. How much NAPL is beneath DPSC property?

The NAPL plume is present in the southern portion of DPSC beneath approximately 42 of the 86 acres of the DPSC property. The volume of NAPL on the water table beneath DPSC is estimated to range from 690,000 to 920,000 gallons. In addition to this NAPL, up to 350,000 gallons of residual NAPL is present in soils above the NAPL plume. These NAPL



Source: Philadelphia, PA U.S.G.S. Quadrangle

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DEFENSE PERSONNEL SUPPORT CENTER – PHILADELPHIA, PA

SITE LOCATION MAP

USACE CONTRACT No. DACA 31-94-D-0017

FIGURE ES-1

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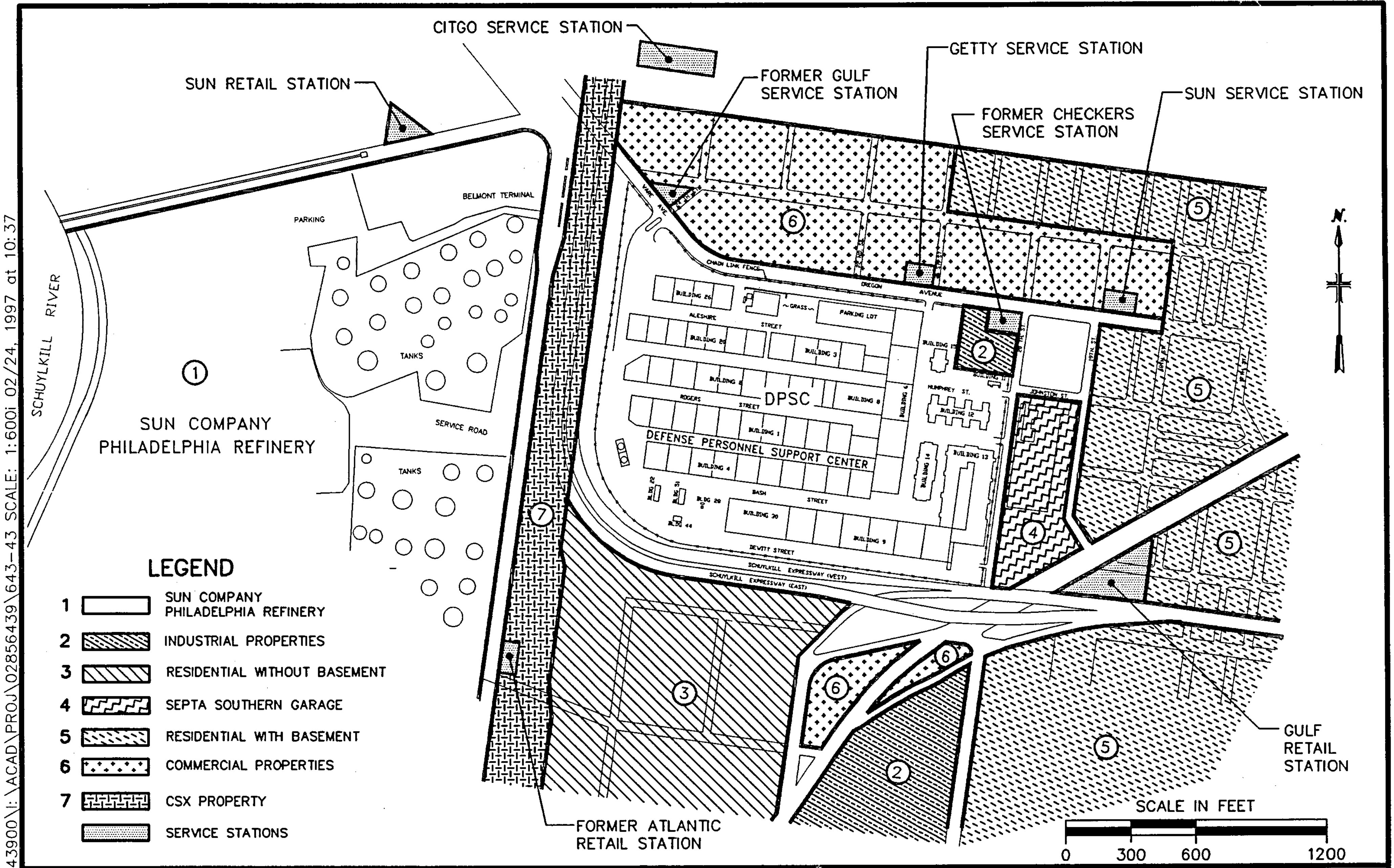

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ADJACENT PROPERTIES

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FIGURE ES-2

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volume estimates are based on the results of supplemental laboratory testing (specific gravity, oil surficial tension, and oil-water interfacial tension), which were conducted to reduce the uncertainty associated with previous NAPL volume estimates.

The distribution of NAPL beneath DPSC documented during the course of this study (April through November 1996) is generally consistent with historical information from previous studies. One exception is the presence of a thin (0.32 foot) NAPL layer in monitoring well MW-12, along the east-central border of DPSC where NAPL in the well had not been documented previously. However, the NAPL layer measured in monitoring well MW-12 during this study is consistent with the observation of petroleum sheens on soil samples from the borehole for this well in 1994. The NAPL apparently accumulated in the well over time, and the appearance of NAPL in the well during this study does not necessarily indicate an extension or migration of the NAPL plume beneath DPSC.

During the synoptic fluid-level measurements conducted in November 1996, a 0.02 foot thick layer of NAPL was present in the westernmost monitoring well (SMW-4) on the Southeast Philadelphia Transportation Authority (SEPTA) property, located to the east of DPSC. Prior to this, petroleum odors and petroleum sheens had been noted in this well. No analytical data are available for this NAPL to allow for a comparison with the NAPL beneath DPSC. It is not known if this NAPL is related to the NAPL beneath DPSC.

2. Is there NAPL still migrating onto DPSC property?

Synoptic fluid-level measurements conducted in monitoring wells on and off of DPSC show that measurable NAPL is not currently migrating from an upgradient, off-site source. The NAPL plume on the ARCO/Sun Refinery property and the NAPL plume beneath DPSC are, however, connected by a continuous area of residual NAPL contamination, as shown in Figure ES-3. The presence of this residual NAPL, coupled with the historical southeastward groundwater flow direction, indicate that a former NAPL pathway was from the ARCO/Sun Refinery property, through the CSX property, and onto DPSC.

The present and former NAPL migration pathways were evaluated by investigating the groundwater flow regime in conjunction with the distribution of NAPL and residual NAPL in monitoring wells and soil borings in the study area. Based on historical and regional groundwater flow information, the general, unaltered direction of groundwater flow in the vicinity of DPSC is to the south-southeast. This flow pattern has been affected by groundwater withdrawals and the presence of sewers. Current groundwater flow patterns are affected by the operation of NAPL recovery systems, along the eastern boundary (26th Street) of the ARCO/Sun Refinery property. The newest system, which was activated in January 1996, was installed pursuant to a PADEP Consent Order and Agreement signed by Sun in 1993 to recover NAPL at the ARCO/Sun Refinery property and limit the off-site migration of NAPL. Because local groundwater flow directions have recently been affected by the operation of remediation systems and may have varied in the last 30 years due to changes in groundwater withdrawals, the current groundwater flow regime is not equivalent to the groundwater flow conditions present during the release and migration of NAPL through the study area.

Groundwater flow patterns and the migration of NAPL in the study area have been affected by the presence of sewers at or below the water table. The construction of the 26th Street sewer in the mid-1960s, and the subsequent installation of the initial 26th Street NAPL recovery wells by the refinery shortly thereafter (1967) (Sun, 1997), has affected groundwater flow patterns along the sewer's north-south route. During the construction of this sewer, petroleum product was encountered in tunnel shafts and boreholes along its entire length within the study area. Soil borings and monitoring wells drilled along the Pollock Street/Packer Avenue sewer show that, under some groundwater regimes, the sewer impedes the migration of NAPL on the water table. Because the sewer extends several feet below the water table, NAPL which is on the water table is "dammed" and is thicker on the northern side of the sewer and diminished or absent on the southern side of the sewer.

3. Is the NAPL moving through and off of DPSC property?

Off-site subsurface investigations show that NAPL extends to the south of DPSC. Based on existing groundwater flow patterns, NAPL has migrated, and continues to migrate, from beneath DPSC to the south. Soil borings and monitoring wells drilled at or adjacent to Passyunk Homes encountered NAPL in the western portion of this residential area. The existing groundwater flow patterns indicate that some of this NAPL has migrated from beneath DPSC. NAPL migration has also been affected by the geology of the study area. DPSC is located in the Coastal Plain Physiographic Province and is underlain by unconsolidated Pleistocene and Cretaceous sediments which overlie crystalline bedrock. The site is characterized by varying thicknesses of fill which overlie a silt unit which is up to approximately 15 feet thick. The silt unit is underlain by undifferentiated sand and gravel in which the water table is present. The water table is present at approximately 15 to 20 feet below ground surface. The majority of NAPL is present within the sand and gravel unit, on top of the water table; however, the upper silt unit intersects the water table and NAPL layer in the southeastern portion of DPSC. This southeastward dipping upper silt layer has limited the migration of NAPL to the east of DPSC.

The intersection of the Pollock Street/Packer Avenue sewer with the water table has likely promoted migration of NAPL in directions which are cross-gradient and upgradient of the ambient groundwater gradient. Information on historic water levels indicate that the water table is at times below the bottom of the sewer and therefore under these conditions the sewer would not affect the southward migration of NAPL. The backfilled bedding around the Pollock Street/Packer Avenue sewer does not appear to be a major migration pathway for NAPL in this area.

4. What is the composition of the NAPL beneath DPSC?

Through the implementation of a Multi-Tiered Analytical Sequence, the laboratory has conclusively identified the NAPL present on top of the groundwater as a light refinery naphtha (characteristic of Jet Petroleum-4, JP-4). Based on the presence of relatively small amounts of organic lead and isooctane in some NAPL samples, a maximum of 10 percent gasoline may be present in the NAPL.

Soil, NAPL, and groundwater samples were collected on and adjacent to the DPSC facility from October 1995 through October 1996. Samples were analyzed in accordance with the USACE-approved Multi-Tiered Analytical Sequence to characterize the nature of the material present. The Friedman & Bruya, Inc. laboratory, located in Seattle, Washington, performed the Multi-Tiered Analytical Sequence. This laboratory was selected by the

USACE Baltimore District and Malcolm Pirnie chemists based on the recognized expertise of Friedman & Bruya, Inc. in petroleum analyses and identification.

According to Dr. James Bruya, the NAPL is composed of a minimum of 90 percent light refinery naphtha (characteristic of JP-4). The NAPL is not a mixture of gasoline and diesel, as had been reported previously. The NAPL is not a fuel oil, diesel, or boiler fuel and its composition is not indicative of motor oil, lubricating oil, or a solvent. The presence of detectable levels of isooctane and organic lead compounds indicate that the NAPL plume contains a maximum of 10 percent gasoline. NAPL samples with the highest concentrations of organic lead do not correspond with the former locations of leaded gasoline storage at DPSC, which suggests that the gasoline was distributed by the naphtha.

Dr. James Bruya has also concluded that degraded and undegraded naphtha are present as a residual phase in soil samples from near the water table in the area of the NAPL plume beneath DPSC.

5. How much, if any, of the NAPL originated from DPSC activities?

Based on the characterization of the NAPL as light refinery naphtha (characteristic of JP-4), and the lack of bulk storage or significant usage of such products on DPSC, a conclusion from these studies is that the source of the NAPL is not DPSC. Investigations of areas on DPSC which had the highest potential to have released petroleum constituents indicate that these areas are not significant contributors to the NAPL plume.

To date, the most likely areas of potential petroleum releases on DPSC have been investigated during the Phase I and Phase II Expanded Site Investigations (ESIs) conducted as part of BRAC activities and previous investigations conducted since 1987. Based on analytical results of soil and groundwater samples collected during the Phase II ESI, petroleum products including gasoline, fuel oil, and waste oil are present in isolated areas separated from, and above, the NAPL plume which is on top of the water table and the residual NAPL which is above the water table. The results of the ESIs (Phases I and II), coupled with these analytical results, indicate that these areas are not significant contributors to the NAPL plume. As the BRAC process continues, investigations of additional, lower priority, petroleum storage and handling areas will be conducted. It is important to note that light refinery naphtha (characteristic of JP-4) has never been stored or handled at these locations.

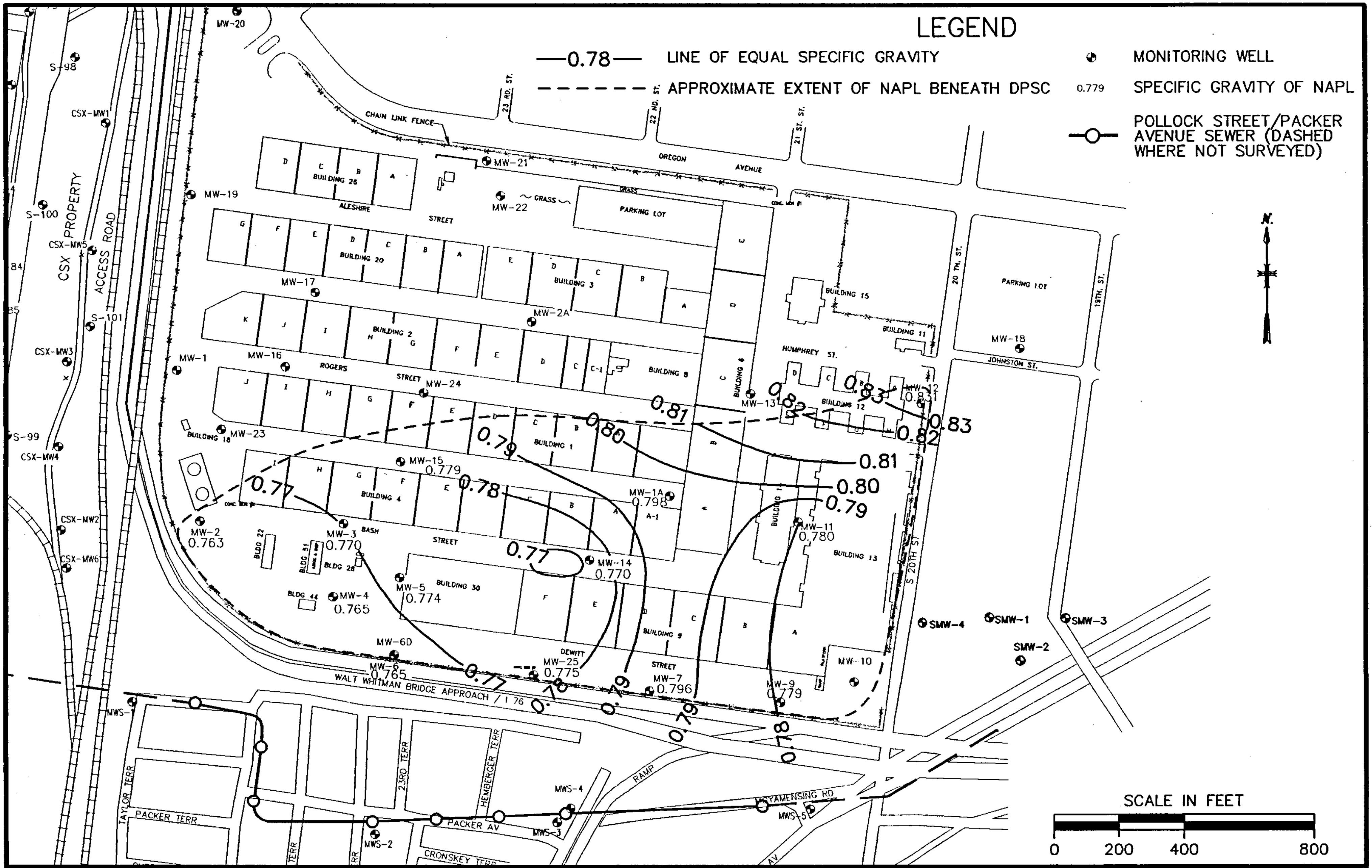
6. What is the source of the NAPL?

The general direction of groundwater flow and the presence of historical storage of crude oil, finished products, and refinery intermediates at the ARCO/Sun Refinery, coupled with the areal distribution of NAPL and relict NAPL contamination, indicate that the source of the NAPL plume was the ARCO/Sun Refinery property.

This conclusion was based on NAPL composition, former NAPL migration pathways, and potential source areas of NAPL. Based on the analytical results, the dominant component (a minimum of 90 percent) of the NAPL beneath DPSC is a light refinery naphtha. The characteristics of the naphtha match JP-4, a jet fuel. The remaining portion of the NAPL plume may be leaded gasoline based on the presence of organic lead and isooctane, which are common leaded gasoline constituents. Historically, jet fuel, leaded gasoline, crude oil, refinery intermediates, and other finished petroleum products have been stored in locations on the ARCO/Sun Refinery property which are hydraulically upgradient of other NAPL plumes in the eastern portion of the ARCO/Sun Refinery South Yard and at DPSC.

Although measurable NAPL is not present in monitoring wells between the NAPL plume on the ARCO/Sun Refinery property and the NAPL beneath DPSC, these two areas are connected by a continuous area of residual or relict NAPL contamination, as shown in Figure ES-3. During the drilling of soil borings at the CSX property, NAPL, petroleum sheens and staining, and petroleum vapors were detected at or near the water table. Analytical results of soil samples collected at the CSX property identified the presence of degraded and undegraded naphtha, which are the dominant components of the NAPL beneath DPSC. In addition, a soil sample collected near the water table in the northern portion of the CSX property contained gasoline, indicating that some portion of the gasoline in the NAPL plume migrated onto DPSC from an off-site source. Based on the general, south-southeastward direction of groundwater flow, the area of residual NAPL beneath the CSX property is located downgradient from the ARCO/Sun Refinery property and upgradient from DPSC.

Laboratory analyses of NAPL samples collected at DPSC identified a pattern of relatively undegraded, new NAPL in the western portion of DPSC and relatively degraded, old NAPL in the eastern portion of DPSC. The distribution of *n*-alkanes in NAPL and soil samples, and site-wide differences in the specific gravities of NAPL samples (Figure ES-4), indicate that the NAPL plume migrated onto DPSC from the ARCO/Sun Refinery property, an off-site source to the west-northwest of DPSC.



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NAPL SPECIFIC GRAVITY CONTOURS

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FIGURE ES-4

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DEFENSE PERSONNEL SUPPORT CENTER
NAPL REPORT

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As noted above, the analyses chosen for this investigation were based on the assumption that the NAPL plume was a mixture of gasoline and diesel. This assumption was based on the storage of these products at the facility. There is no indication that the results of the Fuel Contamination Study (CENAB, 1988), which stated that the NAPL was a mixture of gasoline and kerosene, were used to direct this investigation. Specifically, the TPH analysis was performed to assess the diesel and gasoline concentration and the BTEX analysis was performed to assess the amount of gasoline present.

The basic premise of this investigation was that the NAPL plume was a gasoline/diesel mix; therefore, the analyses chosen were meant to confirm this hypothesis. The results of these investigations indicate that there are components of the plume that are detected by TPH analysis and that the BTEX compounds are present. These results are not contradictory to this NAPL study; however, it is clearly inappropriate to apply the results of standard analytical procedures to fingerprint a free product sample.

3.1.4.3 Site Characterization for the New Admin./ADP Building (1992)

The purpose of this study (U.S. Army Corps of Engineers, 1992) was to assess the extent of contamination in support of construction activities for a proposed Administration/ADP building. This report also began with the premise that the NAPL plume was a gasoline/diesel mix. Based on this assumption, TPH and BTEX analyses were performed. The results of this investigation indicated that there were TPH and BTEX compounds present. This led to the conclusion to support the NAPL plume being a mix of gasoline and diesel. As in the previous studies, the results of this study do not contradict those of this NAPL Plume study; but once again, the analytical methods applied during this investigation cannot be used to fingerprint the free product.

3.1.4.4 Phase I RI/FS Report (1995)

The purpose of the Phase I RI/FS Report (Kemron/Versar, 1995) was to assess the extent and nature of the NAPL plume and assess potential sources. As in the previous studies, the investigators began with the premise that the NAPL plume was a mix of gasoline and diesel. Based on this assumption, 29 soil samples and 25 groundwater samples were analyzed for TPH, Gasoline Range Organics (GRO), Diesel Range Organics (DRO), and Benzene, Toluene, Ethyl Benzene and Xylene (total) (BTEX). Eleven NAPL samples were also analyzed for GRO, DRO, and BTEX. It should be noted that the TPH analysis (IR Scan) for the NAPL can not be performed by the laboratory since such analysis was designed for contaminants in soil or groundwater; this method cannot be performed on free product.

It is important for the reader to have a basic understanding of the analyses performed during the Phase I report, since the results may appear contradictory otherwise. The following provides a simple discussion of each of the analyses performed and its usefulness. A detailed discussion of the actual laboratory methods are not provided in this section. The reader is directed to the Quality Control Summary Report (QCSR) for such information.

> Total Petroleum Hydrocarbon (TPH): TPH analysis (IR Scan) is used to generate a curve depicting the petroleum constituents present in a soil or groundwater sample. From this curve, the analyst determines the concentration of petroleum based hydrocarbons which are present in the sample. Petroleum hydrocarbons include every cut from a refinery distillation process from unrefined crude oil, to gasoline, fuel oils, and asphalt. Under PADEP regulations, this analysis is used during a site characterization study to assess the extent of contamination and establish the need for remediation. It is not possible to determine the composition of the hydrocarbons detected using this analysis alone. Typically, the investigator and regulator assume that if TPH is detected in the soils or groundwater, it is related to the tank or spill which is being characterized. For the limited purpose of assessing the extent of a petroleum hydrocarbon spill, this analysis is adequate. In fact, in areas where the contaminant is known to be a petroleum hydrocarbon, this analysis has no added benefit. This method cannot be used to analyze a free product petroleum hydrocarbon sample.
>
> Gasoline Range Organics (GRO): The GRO analysis is a gas chromatography (GC) method used to determine the amount or concentration of light fraction hydrocarbons (C2 through C10, according to the American Petroleum Institute) present in a sample. These hydrocarbons are indicative of gasoline, kerosene, and jet fuels. Specifically, during a GRO analysis a chromatograph (a graphical depiction of a series of peaks on a time line which represents individual carbon chain compounds) is generated. The area under these peaks is determined and reported as the concentration of GRO. The actual locations of the peaks on the chromatograph is not considered; only the area under the peaks from C2 through C10. This analysis is used and recommended by regulators in conjunction with site history and the Diesel Range Organics (DRO) analysis for UST closures where gasoline and diesel has been stored. The results aid in assessing the point of discharge, i.e., the gasoline storage or the diesel storage. This analysis is useful in a preliminary manner to assess the general characteristic of a sample. GRO analysis cannot be used on its own to determine the composition of

a sample. It is inappropriate to use the results of this analysis to fingerprint a free product sample. This method can only be properly applied if the potential petroleum products are known to the investigator. Specifically, the method is not a fingerprint method; using the results for such interpretations is inappropriate and such interpretations cannot be made with any certainty.

Diesel Range Organics (DRO): The purpose of the analysis is to determine the amount or concentration of medium to heavy fraction hydrocarbons (a nominal C10 through C28, according to the American Petroleum Institute) present in a sample. These hydrocarbons are indicative of fuel oil #2, #4, #6, motor oil, and asphalts. Specifically, during a DRO analysis a chromatograph is generated. The area under these peaks is determined and reported as the concentration of DRO. The actual locations of the peaks on the chromatograph is not considered; only the area under the peaks from C10 through C28. Similarly to GRO, DRO analysis cannot be used on its own to determine the composition of a sample. Also as noted above, the application of DRO results for fingerprinting a free product sample is inappropriate, such interpretations can not be made with any certainty.

Benzene, Toluene, Ethyl benzene, Total Xylene (BTEX): The BTEX analysis is used to determine the concentrations of the noted compounds. The BTEX compounds are used during an investigation when there has been known storage of gasoline at a site. Each of these compounds are highly volatile and therefore have the ability to move quickly through the soil/groundwater matrices. Often the leading edge of a gasoline plume can be delineated using the BTEX analysis results. BTEX analysis is always used to gather supporting information when investigating a site. The absence of BTEX in a sample does not necessarily indicate the absence of gasoline. Due to their high volatility, the BTEX compounds are first to be lost; therefore, a highly degraded gasoline sample may not contain much, if any, BTEX.

Lead and PCBs: The analysis for lead and PCBs is conducted on samples where there is a history of leaded gasolines and waste oils, respectively. As with BTEX, these analyses are used to supplement site history and other analytical methods being performed during the investigation.

The results of the Phase I RI report stated that the NAPL plume was a 2:1 to 3:1 mix of gasoline and diesel. These ratios were based on the relative concentrations of GRO and DRO found in the samples during the investigation. The GRO and DRO analytical results in the Phase I RI report provide limited information as to the general location of the hydrocarbons in the free product. The interpretation and application of the GRO and DRO concentrations to the fingerprint of the NAPL as presented in the Phase I report was inappropriate. To provide a fingerprint interpretation based on GRO and DRO analysis is not technically possible. As noted above, GRO and DRO analyses are only useful when the possible petroleum contamination is known to the investigator. Since the results of previous (and subsequent) studies show that there was no connection between the potential gasoline and diesel contamination at DPSC, the potential petroleum contamination was not limited to gasoline and diesel. Therefore, GRO and DRO analysis of the free product provides little information as to the composition of the NAPL and falls short of the approach taken in this NAPL Plume Study. Specifically, knowing the concentration of GRO and DRO compounds in a sample is useful, but does not indicate the actual NAPL composition. It is interesting to note that the laboratory case narrative for one of the samples collected during the Phase I RI activities stated "that the BTEX analysis appears to be anomalous when compared with the GRO analysis. Both BTEX and GRO chromatographs show multiple hydrocarbon peaks which do not confirm with benzene, ethyl benzene, toluene or xylene, although they elute within the gasoline range." This apparent contradiction is a simple indication that the results generated were being used to answer a different question than originally planned.

To properly fingerprint a sample the entire chromatograph must be interpreted by an experienced chemist and compared against standard chromatographs. Each individual peak and its location on the chromatograph must be considered. The height and shape of the peak is considered to assess the weathering that may have affected the sample. All of this information is considered and the chemist provides an interpretation of the chromatograph. The apparent inconsistencies between the BTEX and GRO results are not a concern in the fingerprint approach. This highlights the one major difference between the analyses completed to date and the fingerprint analysis completed for this NAPL Plume study. The difference is that all the previous investigations considered concentrations of individual compounds, i.e., the area under a portion of the chromatograph, while this NAPL Plume study fingerprint analysis targeted the entire chromatograph - each and every peak.

3.1.4.5 DPSC UST Closures

The purpose of these investigations were specifically for the site characterization and closure as required under PADEP UST regulations. The analysis performed under these investigations was based on the historical storage of material in the area and the regulatory requirements. For areas where there was gasoline and diesel storage, the required analysis was TPH, GRO, DRO and lead (where leaded gasoline was stored). For waste oil USTs, PCBs are added to the suite of parameters analyzed, and for the DDT USTs, pesticide analysis was included as a supplement to TPH analysis.

Each of the analyses performed for these site closures was conducted to answer a specific question. As noted above, to use this data alone to determine the composition of the NAPL is inappropriate. As stated above, these analyses provide information about areas under portions of the chromatograph; not specific information concerning the peaks or their locations.

3.1.5 Groundwater/NAPL/Soil Sampling and Analysis

A total of 85 field samples were collected from October 1995 to September 1996 as part of this study; 30 NAPL samples collected from monitoring wells on DPSC property, 41 soil and 14 aqueous samples from locations on, and adjacent to, the property. Sample analysis was performed in accordance with the USACE approved Multi-Tiered Analytical Sequence (Appendix L) to characterize the nature of the material present and to attempt to assess its origin. Ten percent of these samples were analyzed for an expanded parameter list approved by the USACE, DLA, and DPSC. The following expanded parameters were chosen to identify common refined fuel additives and quantify volatile organic constituents:

- Resource Conservation and Recovery Act (RCRA) metals
- Thin Layer Chromatography (TLC)
- Organic Lead
- Benzene, Toluene, Ethylbenzene, Xylene (BTEX)
- Ethers
- Semi-Volatile Organic Compounds
- Alcohols
- Paraffins, Olefins, Naphtha, Aromatics (PONA)
- Ethylene Glycol Monomethyl Ether

Samples were analyzed by Friedman & Bruya, Inc. laboratory (Friedman & Bruya), located in Seattle, Washington. This laboratory was selected based on its qualifications and experience in petroleum analyses and identification, which met the specific objectives of the project. Laboratory results are summarized in Section 4.3 and Appendix I. The laboratory analyses were performed in accordance with the QAPP and Section 6.0 of the QAPjP. Appendix L presents the Multi-Tiered Analytical Sequence and supplemental quality assurance and quality control measures.

Data Validation of sample results generated from sampling activities at DPSC was performed by a data validator certified by EPA in both organic and inorganic fractions. Validation was performed following general procedures and rules outlined in the National Functional Guidelines with United States Environmental Protection Agency (USEPA) Region III modifications. Evaluation of the inorganic fractions was in accordance with Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses (April 1993). Evaluation of the organic fractions was in accordance with Region III Modifications to National Functional Guidelines for Organic Data Review (September 1994). Since there is no data validation determination of NAPL characterization methods (EPA SW-846 or method developed by Friedman & Bruya, Inc.), validation was performed using both professional judgment and specific rules developed by USEPA Region III which apply to the general procedures used in this project. USEPA Region III rules were used since DPSC is located in USEPA Region III.

A Quality Control Summary Report was generated for this investigation which details events from the time of sample collection until data validation. The report summarizes the measures that were implemented to provide project quality control. The QCSR (Volumes I through V) addresses: Sampling Procedures (planned vs. implemented); Sample Handling and Sample Custody; Equipment Calibration and Maintenance; Analytical Procedures; Data Analysis and Validation; Data Summaries; System Audits; Chemical Analytical and QA/QC Problems Encountered; and Conclusions. The QCSR has been submitted separately from this NAPL Plume Study report.

Additional analyses which were not described in the QAPjP, QAPP, or FSP-NAPL Plume Confirmation Study, were performed to better estimate the thickness and volume of NAPL at DPSC. During baildown/recovery testing, NAPL was collected from each tested well and analyzed for specific gravity. In October 1996, NAPL from MW-25 was sampled and analyzed for specific gravity, oil surface tension, and oil-water interfacial tension. These

LIST OF ACRONYMS AND ABBREVIATIONS

AEHA	Army Environmental Health Agency
AMSL	Above Mean Sea Level
AOC	Area of Concern
ARCO	Atlantic Richfield Company
AST	Aboveground Storage Tank
BCT	BRAC Closure Team
BGS	Below Ground Surface
BRAC	Base Realignment and Closure
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CA	California
DDT	Dichlorodiphenyltrichloroethane
DLA	Defense Logistics Agency
DOD	Department of Defense
DPSC	Defense Personnel Support Center
DRO	Diesel Range Organics
EBS	Environmental Baseline Survey
ESI	Expanded Site Investigation
FSP	Field Sampling Plan
GC/ECD	Gas Chromatography/Electron Capture Detector
GC/MS	Gas Chromatography/Mass Spectrometry
GPR	Ground-Penetrating Radar
GRO	Gasoline Range Organics
HFS	Hydrocarbon Fuel Scan
IR	Infrared
IRP	Installation Restoration Program
JP-4	Jet Petroleum 4
MW	Monitoring Well
NAPL	Non-Aqueous Phase Liquid
OVA	Organic Vapor Analyzer
PADEP	Pennsylvania Department of Environmental Protection
PCB	Polychorinated biphenyls
PHA	Philadelphia Housing Authority
PID	Photoionization Detector
POL	Petroleum/Oil/Lubricant
PONA	Paraffins, Olefins, Naphtha, Aromatics
PVC	Polyvinyl chloride
QA/QC	Quality Assurance/Quality Control
QAPjP	Quality Assurance Project Plan
QAPP	Quality Assurance Program Plan
QCSR	Quality Control Summary Report
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
SEPTA	Southeast Philadelphia Transportation Authority
SOW	Scope of Work
TAL	Target Analyte List

LIST OF ACRONYMS AND ABBREVIATIONS (cont.)

TLC	Thin Layer Chromatography
TPH	Total Petroleum Hydrocarbons
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compound

1.0 PROJECT DESCRIPTION

The Defense Personnel Support Center (DPSC) has been scheduled under the 1993 Base Realignment and Closure (BRAC) Act to close in 1999. The City of Philadelphia is currently responsible for the post-closure reuse plan for the facility. There is a concern with the potential liability associated with a non-aqueous phase liquid (NAPL) plume beneath the facility, which appears to be migrating onto the facility property and along the groundwater surface from an off-site source. The Phase I Remedial Investigation/ Feasibility Study (RI/FS) completed by the Philadelphia District Corps of Engineers included field investigations to determine the extent and source of the plume. The data reported in the Phase I RI/FS and other investigations completed at the DPSC conducted since 1987 were reanalyzed and supplemented with a review of available records to identify data gaps. Based on the results of this process, additional subsurface investigations were undertaken as part of this NAPL Plume Study to address the data gaps which were identified.

At the completion of the Final Draft report stage, the report was provided to Sun Company Inc. (Sun) for review and comment. This review was conducted in accordance with the procedure utilized by the Technical Oversight Committee, which has been formed in response to the Consent Order and Agreement dated September 24, 1997 and signed by DPSC, Sun and the Pennsylvania Department of Environmental Protection (PADEP).

1.1 AUTHORIZATION

The United States Army Corps of Engineers (USACE), Baltimore District has tasked Malcolm Pirnie, Inc. and their subconsultant, Louis Berger Associates, Inc., with gathering and evaluating existing information relating to the NAPL plume which is present on the groundwater surface under DPSC.

The work is being performed in accordance with the Army Corps Scope of Work dated August 28, 1995 and scope clarifications discussed by the Army Corps and Malcolm Pirnie, at the Baltimore District's offices on September 7, 1995. The NAPL Plume Study is being performed under Army Corps Indefinite Delivery Contract No. DACA31-94-D-0017, Delivery Orders DO-0057 and DO-0079.

1.2 SITE HISTORY AND PROJECT BACKGROUND

DPSC is a government owned facility operated by the Defense Logistics Agency (DLA) and is located in southeastern Philadelphia, Pennsylvania. Construction of the original facility began in the early 1900s, with major renovation and expansion occurring in the 1940s.

DPSC's mission at this location was the procurement and distribution of food, medical supplies, and clothing for the Department of Defense (DOD). DPSC also conducted the actual manufacturing of the textile products for all branches of the United States armed forces. The manufacturing process occurred from some time before World War II, to September 1994, when the mission was terminated. The manufacturing operation also included mothproofing of textiles, as discussed in Section 1.2.1, below.

Other present and historical uses and features of the property which may have an impact on the environment are underground storage tanks (USTs) of fuels, above ground storage tanks (ASTs), petroleum/oil/lubricant (POL) releases, bulk storage of mothproofing chemicals, motor pool activities, paint shop activities, battery shop activities, and railway operations.

DPSC is currently scheduled under the 1993 BRAC Act for final closure to military use in 1999. The BRAC Closure Team (BCT) is responsible for the following:

1. Determining "reasonable" investigations and remedial work to be performed.
2. Determining what clean-up standards are applicable.
3. Determining when the site or an area of site does not require any additional work.

The City of Philadelphia has developed a reuse plan for the property. As communicated between the BCT and the USACE, Baltimore District, the assumed reuse of the property will coincide with prior uses, i.e., light industrial, textile manufacturing, etc.

In September, 1994 the Environmental Baseline Survey (EBS) was completed by PRC Environmental Management, Inc. (PRC) under contract with the Huntsville District Army Corps of Engineers for the DLA. EBS researched the past uses of the property and identified Areas of Concern (AOCs) which required additional investigations prior to releasing the property for reuse. A BRAC Clean-up Plan was finalized for DPSC in June, 1995 and has been periodically updated (last updated in October 1996). The plan outlined all of the AOCs and determined that additional information was needed to close some of the areas on the facility.

A draft Phase I RI/FS was completed by the Philadelphia District Army Corps of Engineers in 1995. This document focused on the NAPL plume under a portion of the facility. The final report was completed in July, 1995. The report concluded that historical and present operations on DPSC were not the cause of the NAPL plume under the property, however, the migration pathways and source of the NAPL plume were not conclusively determined.

1.2.1 Mothproofing Operations

There are detailed, published historic records documenting DPSC's use of DDT for mothproofing cloth, both in storage and during the sponging process (Haggard, 1956). The Philadelphia Quartermaster Depot pioneered the experimentation of various methods of DDT application in the 1940's and 1950's. Prior to 1946, the method of protecting woolen cloth from moth infestation consisted of placing naphthalene flakes in the stacks of rolls of cloth. This process was done by hand, and was required to be performed semiannually to maintain effectiveness. Given the time and expense involved in such a procedure, the need for economy and simplification was apparent. In 1946, the Philadelphia Quartermaster Depot began a two-fold procedure, consisting of applying naphthalene to each stack using a blower, and spraying the ends of the rolls of cloth with a DDT solution. The historical record clearly indicates that the carrier fluid used in the fogging process was "deodorized kerosene." Kerosene was specified because there was extreme concern about the explosion hazards associated with creating a fog from a petroleum compound at DPSC. Even kerosene created vapors that were considered dangerous. Because of this, the local fire department only allowed DDT fogging to be performed on weekends.

Considerable effort was devoted to finding a substitute for kerosene as the carrier fluid. A water-based emulsion was developed but rejected because of cost. Finally, in 1952, DPSC adopted a non-kerosene carrier fluid composed of 10% DDT, 2% lindane, 5% motor oil SAE 50, and 83% tetrachloroethylene.

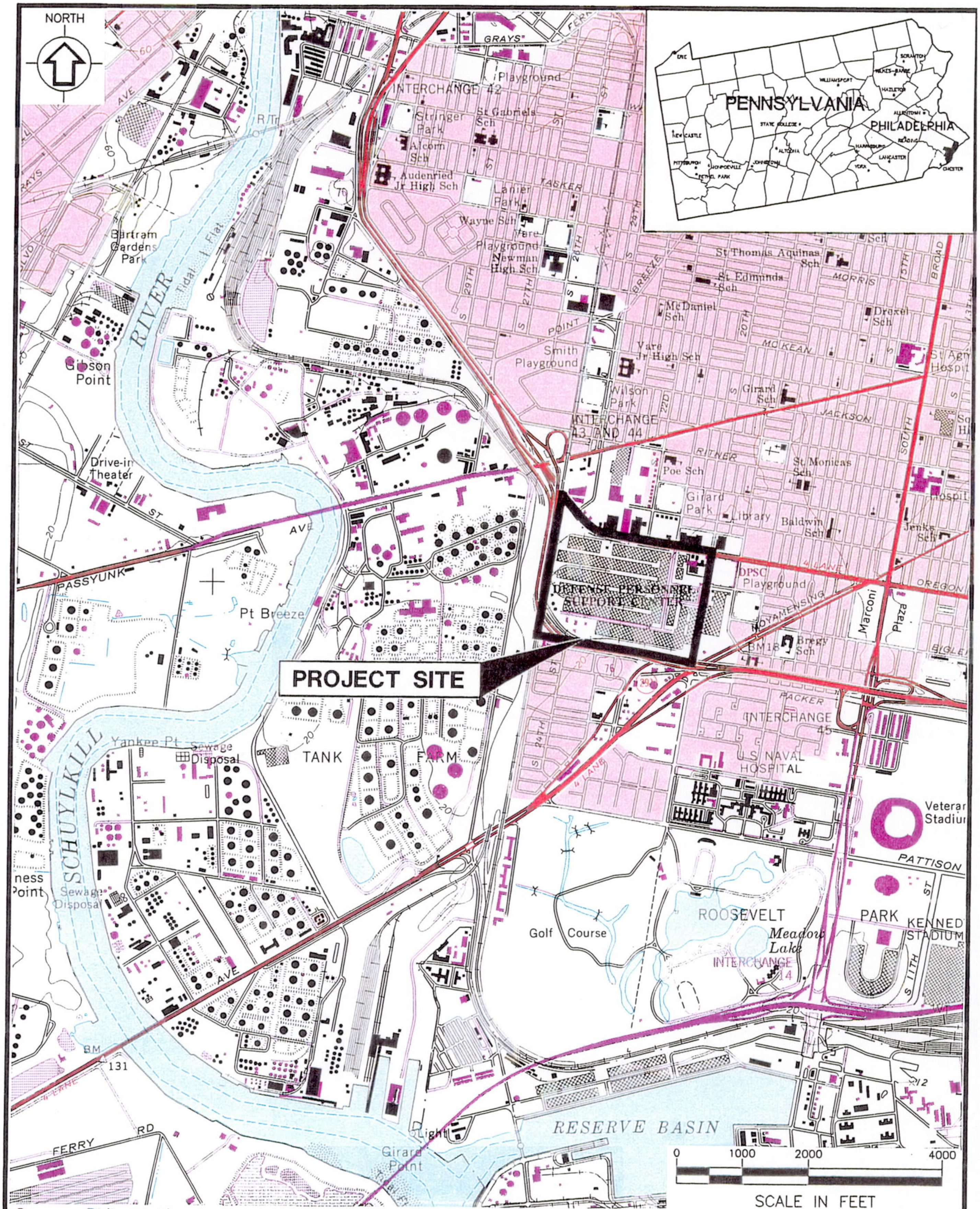
In addition to the fogging process, DDT was applied via solvent in the sponging process. Haggard (1956) is not specific about the composition of this fluid, though he mentions a considerable amount of research and testing. Research began on this in 1949, and a routine formula was not perfected until 1952 (the same year as the acceptance of the tetrachloroethylene formula mentioned above). The carrier fluid had to be compatible with the processes and machinery, and it could not leave petroleum residues on the fabric. Each solvent under consideration was tested to be sure "that no explosive atmosphere would be created during sponging and mothiciding operations." Since the sponging process required high temperatures and injected vapors, the use of a highly volatile carrier solvent is unlikely, especially considering the installation's concern about explosion hazards.

1.3 PHYSICAL SETTING

1.3.1 Location

DPSC is centrally located in the southeastern portion of Philadelphia, Pennsylvania (Figure 1-1). The installation occupies approximately 86 acres and is located at 39°55'45" north latitude and 75°11'45" west longitude on the Philadelphia PA-NJ 7.5 minute US Geological Survey (USGS) topographic quadrangle.

The installation is bounded by South 20th Street to the east, Oregon Avenue to the north, and the Schuylkill Expressway to the south and west. A CSX property and a former ARCO Refinery, now operated by Sun, are located to the west of the Schuylkill Expressway. Figure 1-2 shows the location of DPSC in relation to surrounding land use and properties.



Source: Philadelphia, PA U.S.G.S. Quadrangle

U.S. Army Corps of Engineers Baltimore District

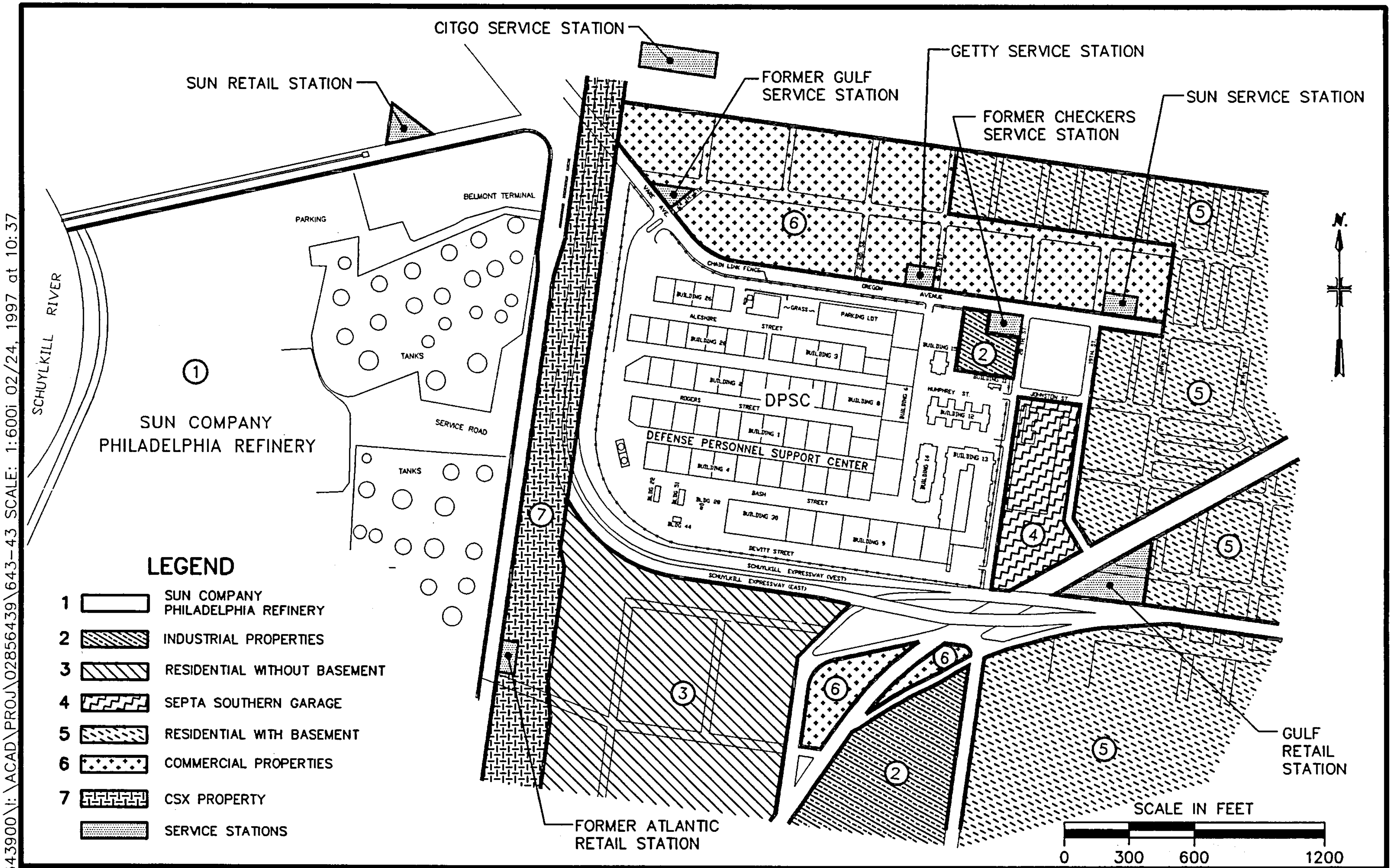
DEFENSE PERSONNEL SUPPORT CENTER – PHILADELPHIA, PA

SITE LOCATION MAP

USACE CONTRACT No. DACA 31-94-D-0017

FIGURE 1-1

DPS-FRM2/27DEC95/U4



US Army Corps of Engineers

DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

ADJACENT PROPERTIES

MALCOLM PIRNIE, INC.

FIGURE 1-2

3705 : 02856439001: \ACAD\PROJ\02856439\643-43 SCALE: 1:600i 02/24, 1997 at 10:37

1.3.2 Climate

DPSC and surrounding areas are in the Southeast Piedmont climatic division. The climate is classified as humid continental, modified by the Atlantic Ocean. Prevailing winds during the summer are from the south-southwest and average eight miles per hour, while winter winds are from the west-northwest and average 10 to 12 mph. The average annual temperature is 54°F and the area receives approximately 40 to 42 inches of precipitation annually.

1.3.3 Geology

Information on regional and local geology was obtained from literature sources and field data collected on DPSC and surrounding properties. A summary of this information is provided, below.

1.3.3.1 Regional

DPSC is located in the Coastal Plain Physiographic Province (Paulachok, 1991). The Coastal Plain consists of soft unconsolidated deposits that erode easily, forming flat lowlands. The soils dip gently to the southeast and form a southeasterly thickening wedge toward the Atlantic Ocean. The regional stratigraphy consists of alternating layers of sand, gravel, silt, and clay. Macrostratigraphy (areal extent of individual formations) in the area is controlled largely by paleochannels. The youngest of these deposits is the Holocene alluvium, which consists of fine sand, silt, and clay. The Pleistocene Trenton gravel, predominantly a brown to gray medium-to-coarse grained sand and gravel, underlies these alluvial deposits. The Trenton gravel overlies the Cretaceous Magothy Formation, a marine sand. The Magothy Formation overlies the Raritan Formation, which consists of alternating layers of nonmarine sand, clay, and gravel. In the immediate vicinity of DPSC, the Magothy Formation is not present. The Cretaceous Raritan Formation has been subdivided into six members including, from upper to lower, the Upper Clay member, Old Bridge Sand member, Middle Clay member, Sayerville Sand member, Lower Clay member, and the Farrington or Basal Sand member. A regional stratigraphic column is included in Figure 1-3. The Wissahickon Schist is the crystalline bedrock in the area.

SYSTEM	SERIES	GEOHYDROLOGIC UNIT			
		Paulachok (1991)		Greenman and others (1961)	
Quaternary	Holocene	Alluvium		Alluvium	
	Pleistocene	"Trenton gravel" (informal usage)		Cape May Formation	
				Pensauken Formation[1]	
Tertiary	Miocene	Bridgeton Formation			
Cretaceous	Upper Cretaceous	Potomac-Raritan-Magothy aquifer system	Upper clay unit	Magothy Formation[1]	
				Upper Clay member[1]	
			Upper sand unit	Raritan Formation	Old Bridge Sand Member[1]
			Middle clay unit		Middle clay member
			Middle sand unit		Sayreville Sand Member
			Lower clay unit		Lower clay member
			Lower sand unit		Farrington Sand Member
	Lower Cretaceous			Crystalline rocks of Glenarm Series (former usage)	
Pre-Cretaceous		Crystalline rocks, includes Chickies Formation and Wissahickon Formation of Glenarm Group			

---

[1] Present usage of the U.S. Geological Survey: the Pensauken Formation is of Miocene age. The Old Bridge Sand Member and Upper Clay member belong to the Magothy Formation.

SOURCE: PAULACHOK, G.N., 1991 GEOHYDROLOGY AND GROUNDWATER
RESOURCES OF PHILADELPHIA, PENNSYLVANIA
U.S. GEOLOGICAL SURVEY WATER-SUPPLY PAPER 2346.

US Army Corps
of Engineers

DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

REGIONAL STRATIGRAPHIC COLUMN

MALCOLM PIRNIE, INC.

FIGURE 1-3

1.3.3.2 Local

In the area of DPSC, the overburden deposits are approximately 90 to 120 feet thick. The log for the former production well in Building 8 on DPSC indicates that bedrock was encountered at a depth of 90 feet. A maximum of 22 feet of fill including ash, cinders, ceramics, and brick, is present in the northwestern corner of the site. Fill is also present from ground surface to a maximum of approximately 10 feet in the southeastern portion of DPSC. The thickness of this fill unit increases to the southeast of DPSC near the intersection of Penrose Avenue and 20th Street. The upper approximately 30 feet of the raised CSX property, located adjacent to and west of DPSC, is comprised of fill, including construction and burn debris.

The Holocene alluvium is present above the water table beneath the majority of the site. This layer, which was designated as silt with variable amounts of clay in this study, dips to the southeast across the site and intersects the saturated zone in the southeastern portion of DPSC property. This silt layer also intersects the water table in the northeastern portion of the site and in the northwestern portion of the study area (Figure 1-4). The thickness of this silt layer varies across the study area and is shown in Figure 1-5. Underlying this upper silt layer is a unit comprised of undifferentiated sands, gravels, and silts. The water table is located within this unit throughout most of the site.

The locations of seven geologic cross-sections in the study area are shown in Figure 1-6. These cross-sections (Figures 1-7 through 1-13) were prepared to illustrate stratigraphy at DPSC, along the CSX property, and along the 26th Street and Pollock Street/Packer Avenue Sewers. Groundwater levels, corrected for NAPL, where present, and measured on October 16, 1996, are included on each applicable cross-section. The Unified Soil Classification System (USCS) codes used on these cross-sections are summarized in Table 1-1.

Based on the geologic log of monitoring well cluster MW 20/20D, the Middle and Lower Clay units are present in the northwestern portion of the site. However, due to the absence of these units in the boreholes for MW6/6D (Figures 1-9 and 1-11), these layers appear to have been truncated by an erosional nonconformity in the central portion of DPSC. DPSC is located on the eastern flank of the League Island paleochannel and sediments on the

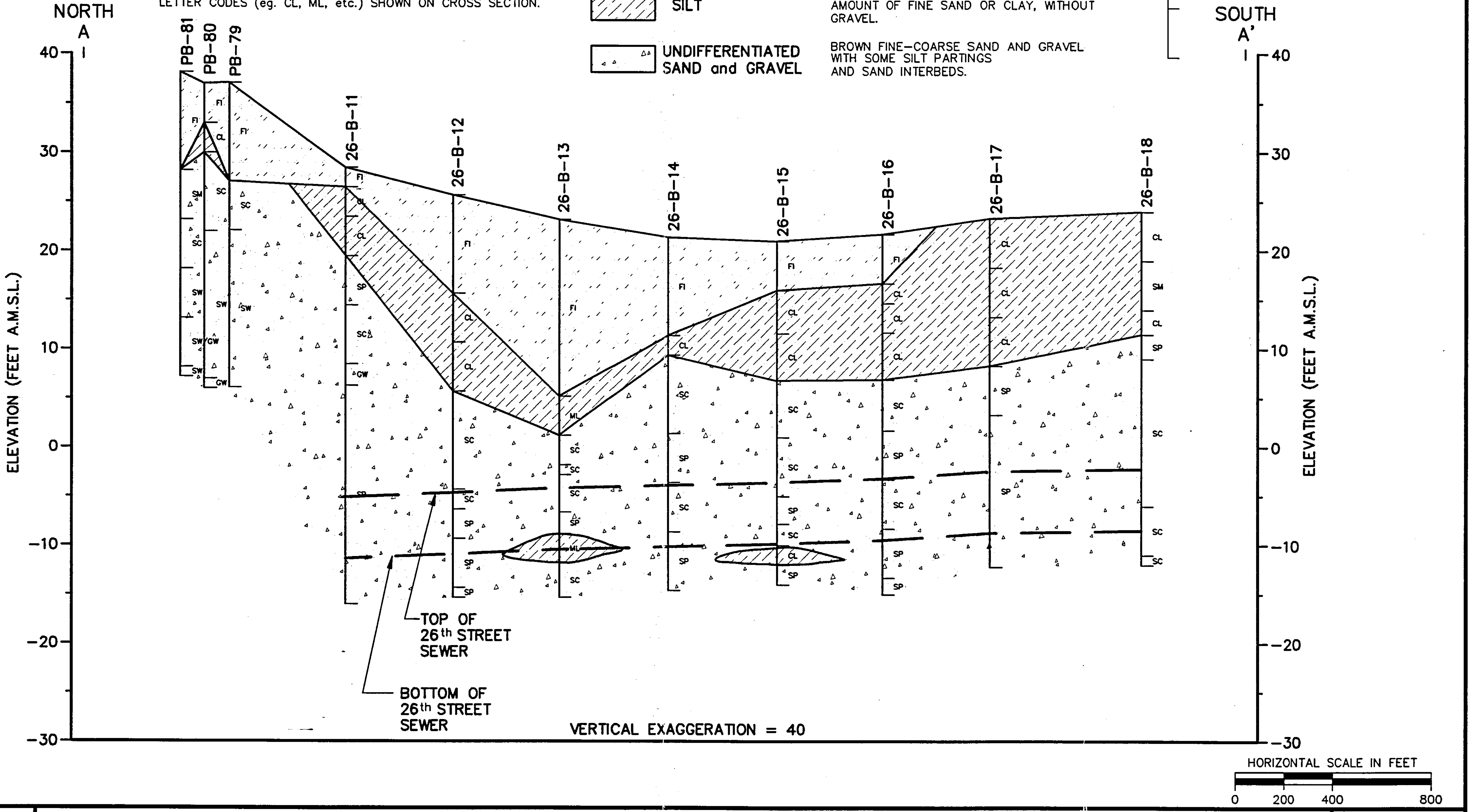
NOTES:

- THE LOCATIONS AND ELEVATIONS OF BORINGS ARE ESTIMATED BASED ON HISTORICAL INFORMATION.
- THIS CROSS-SECTION IS BASED ON THE INTERPRETATION OF SUBSURFACE INFORMATION FROM MULTIPLE SOURCES AND REQUIRED INTERPOLATION BETWEEN SOIL BORINGS.
- SEE TABLE 1-1 FOR EXPLANATION OF UNIFIED SOIL CLASSIFICATION LETTER CODES (eg. CL, ML, etc.) SHOWN ON CROSS SECTION.

LEGEND

░	FILL	BROWN-GRAY SILT AND/OR CLAY BACKFILL WITH VARIABLE AMOUNTS OF CONSTRUCTION AND BURN DEBRIS WITH SLAG AND COAL ASH.
▨	SILT	BROWN-OLIVE SILT MATRIX WITH VARIABLE AMOUNT OF FINE SAND OR CLAY, WITHOUT GRAVEL.
△	UNDIFFERENTIATED SAND and GRAVEL	BROWN FINE-COARSE SAND AND GRAVEL WITH SOME SILT PARTINGS AND SAND INTERBEDS.

26-B-16 SOIL BORING



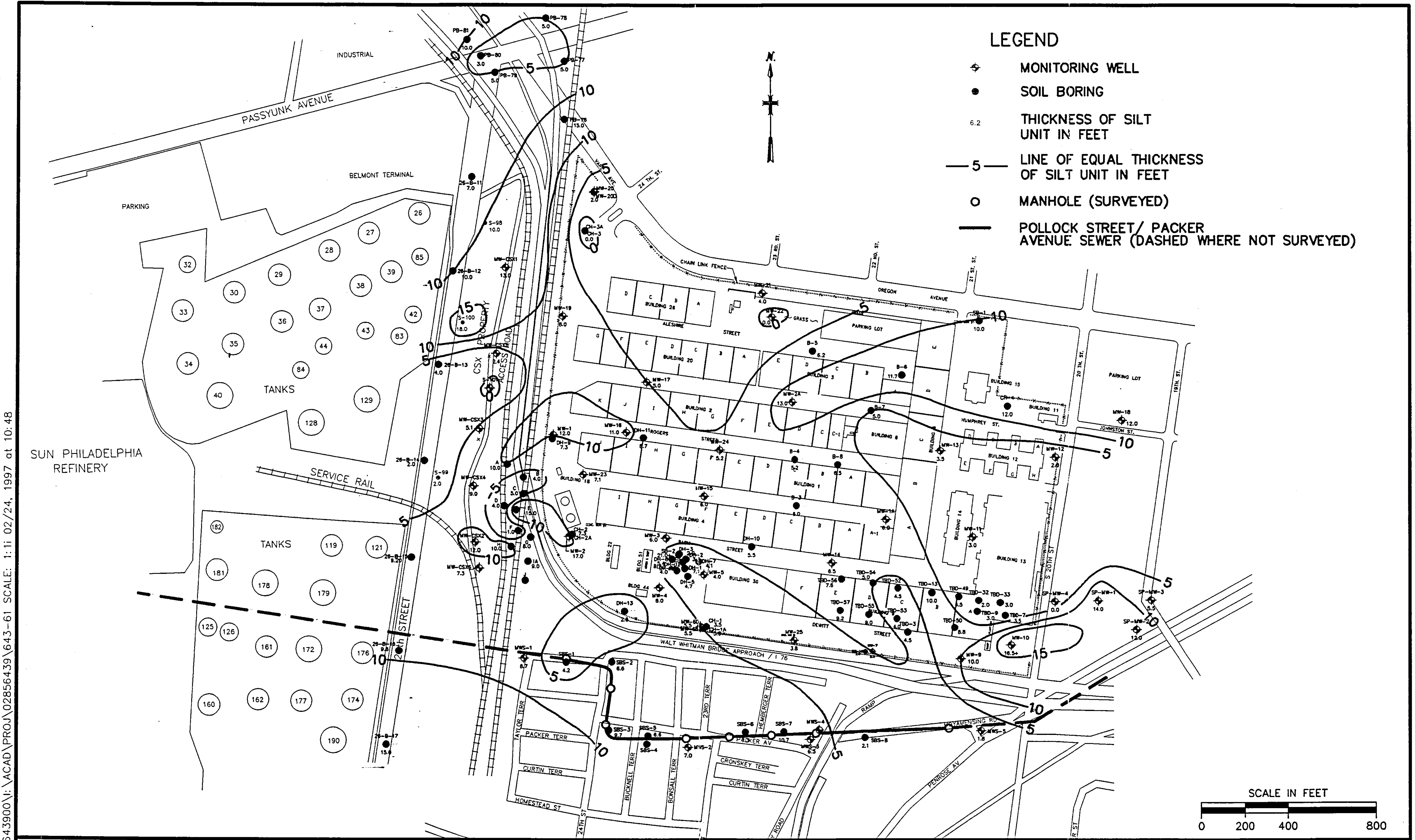
US Army Corps of Engineers

DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

CROSS-SECTION A-A'

MALCOLM PIRNIE, INC.

FIGURE 1-7



3705 : 0285643900\I:\ACAD\PROJ\02856439\643-61 SCALE: 1:1i 02/24, 1997 at 10:48

US Army Corps of Engineers

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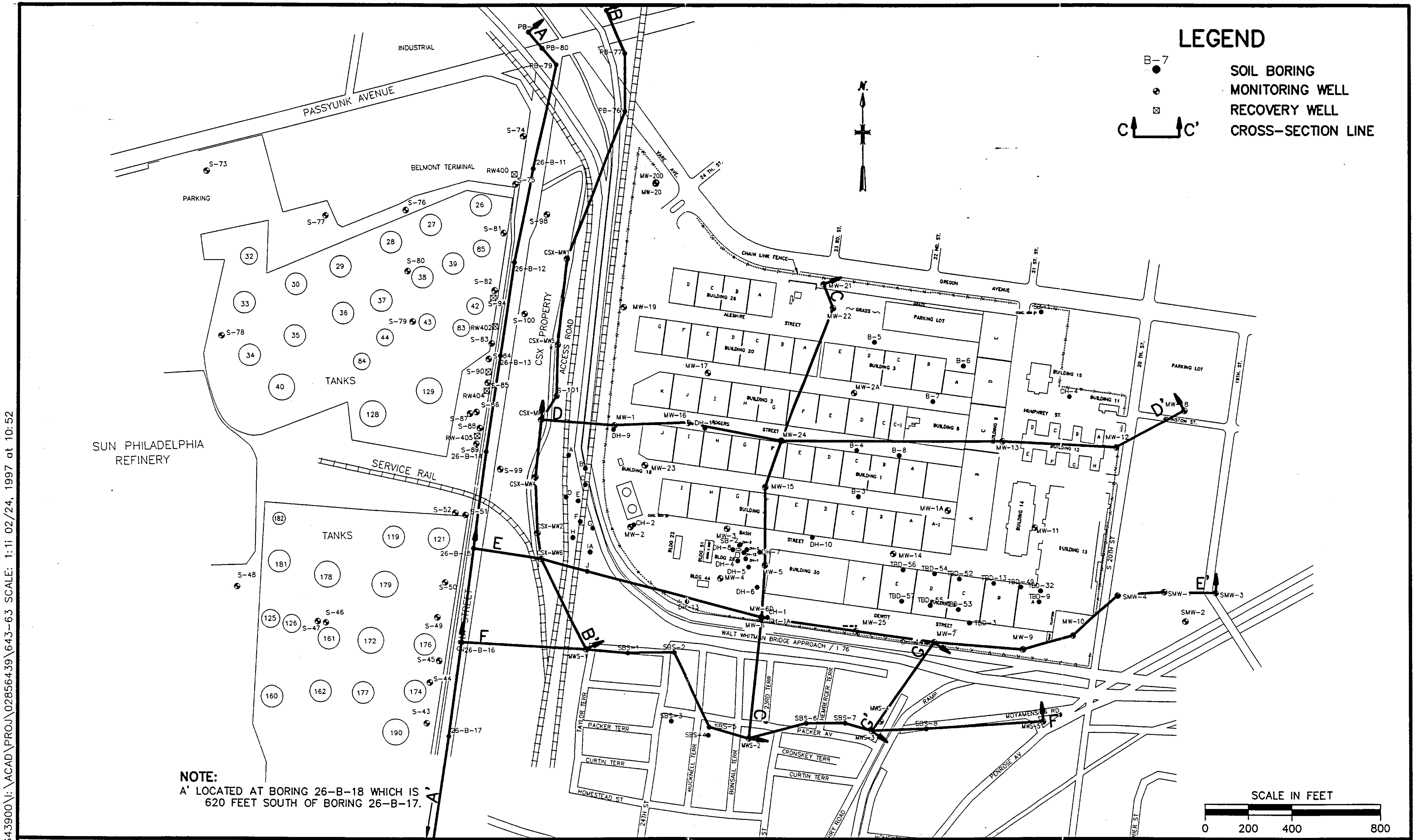
USACE CONTRACT NO. DACA31-94-D-0017

UPPER SILT UNIT ISOPACH CONTOURS

MALCOLM PIRNIE, INC.

FIGURE 1-5

XREF: X643-01



NOTE:
A' LOCATED AT BORING 26-B-18 WHICH IS 620 FEET SOUTH OF BORING 26-B-17.

US Army Corps of Engineers

DEFENSE PERSONNEL SUPPORT CENTER
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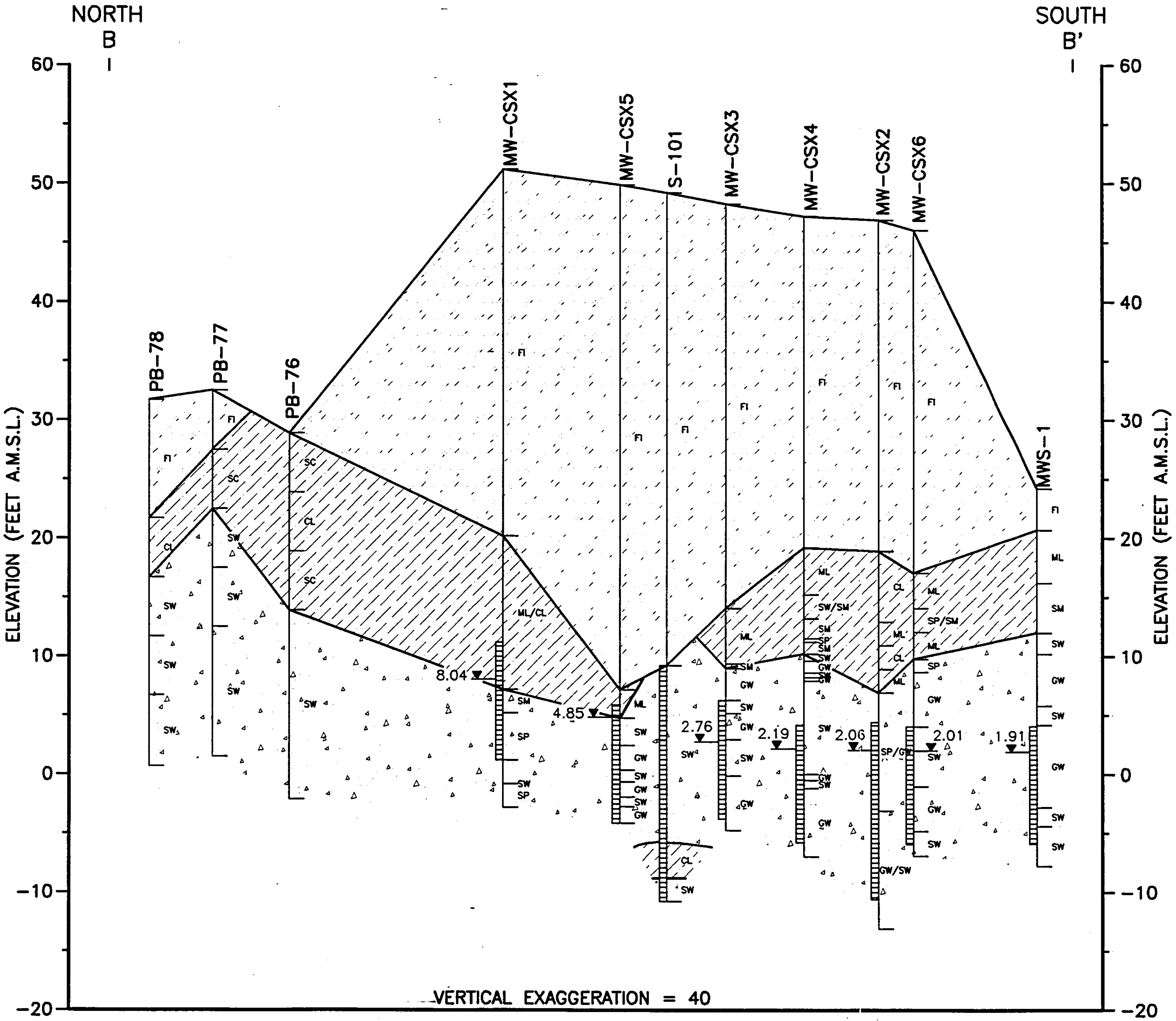
CROSS-SECTION LOCATIONS

MALCOLM PIRNIE, INC.

FIGURE 1-6

3705 : 02856439001:\ACAD\PROJ\02856439\643-63 SCALE: 1:1 02/24, 1997 at 10:52



LEGEND

░	FILL	BROWN-GRAY SILT AND/OR CLAY BACKFILL WITH VARIABLE AMOUNTS OF CONSTRUCTION AND BURN DEBRIS WITH SLAG AND COAL ASH.
▨	SILT	BROWN-OLIVE SILT MATRIX WITH VARIABLE AMOUNT OF FINE SAND OR CLAY, WITHOUT GRAVEL.
△	UNDIFFERENTIATED SAND and GRAVEL	BROWN FINE-COARSE SAND AND GRAVEL WITH SOME SILT PARTINGS AND SAND INTERBEDS.

MWS-1 MONITORING WELL OR SOIL BORING

▼ WATER LEVEL MEASURED ON 10/16/96 (CORRECTED FOR NAPL, WHERE PRESENT)

▤ SCREENED INTERVAL

NOTES:

- THE LOCATIONS AND ELEVATIONS OF BORINGS PB-76 THROUGH 78 ARE ESTIMATED BASED ON HISTORICAL INFORMATION.
- THIS CROSS-SECTION IS BASED ON THE INTERPRETATION OF SUBSURFACE INFORMATION FROM MULTIPLE SOURCES AND REQUIRED INTERPOLATION BETWEEN SOIL BORINGS.
- SEE TABLE 1-1 FOR EXPLANATION OF UNIFIED SOIL CLASSIFICATION LETTER CODES (eg. CL, ML, etc.) SHOWN ON CROSS SECTION.

HORIZONTAL SCALE IN FEET
0 200 400 800

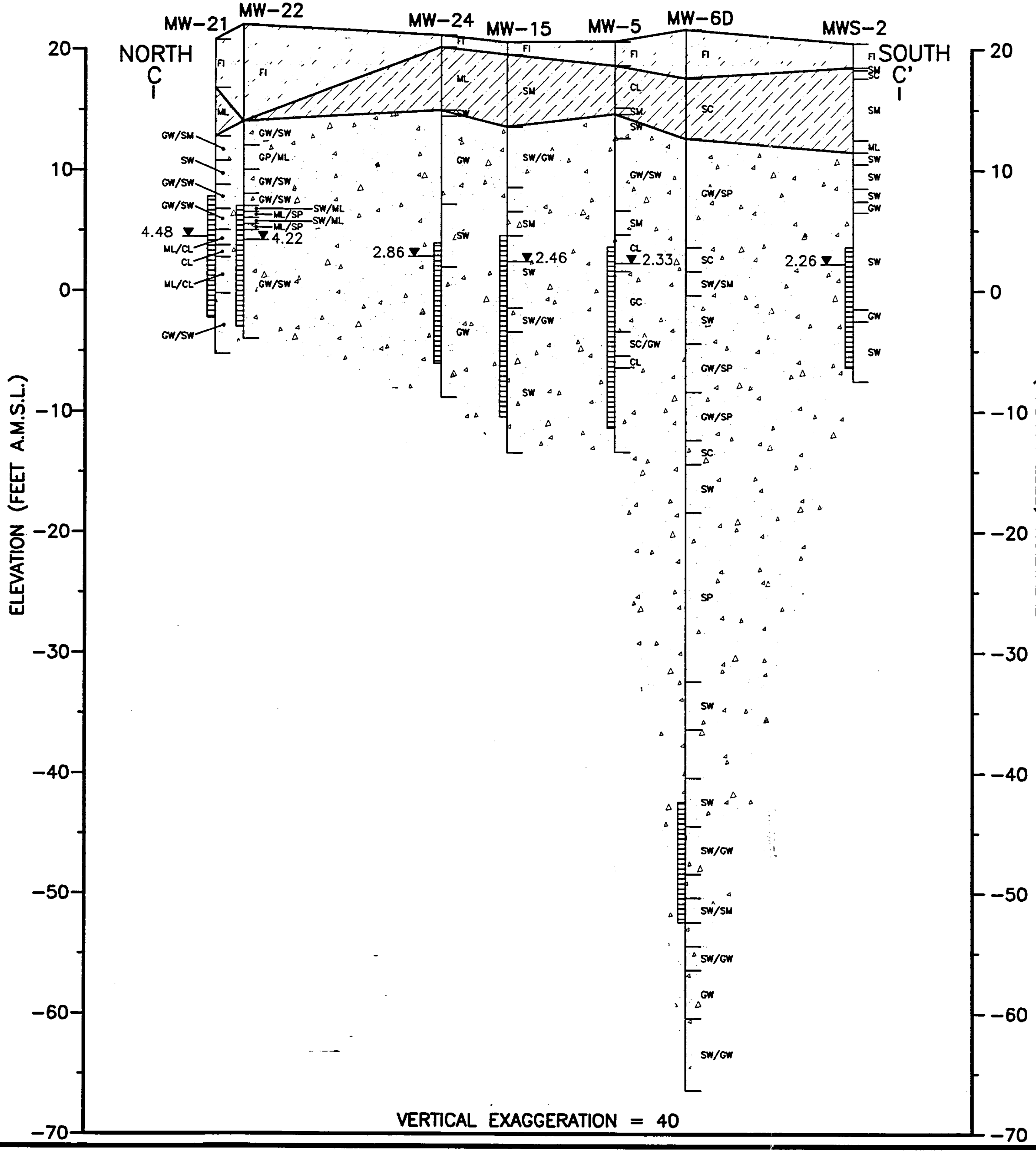
US Army Corps
of Engineers

DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

CROSS-SECTION B-B'

MALCOLM PIRNIE, INC.

FIGURE 1-8



LEGEND

⬚	FILL	BROWN-GRAY SILT AND/OR CLAY BACKFILL WITH VARIABLE AMOUNTS OF CONSTRUCTION AND BURN DEBRIS WITH SLAG AND COAL ASH.
▨	SILT	BROWN-OLIVE SILT MATRIX WITH VARIABLE AMOUNT OF FINE SAND OR CLAY, WITHOUT GRAVEL.
△	UNDIFFERENTIATED SAND and GRAVEL	BROWN FINE-COARSE SAND AND GRAVEL WITH SOME SILT PARTINGS AND SAND INTERBEDS.

MWS-1 MONITORING WELL OR SOIL BORING

▼ WATER LEVEL MEASURED ON 10/16/96 (CORRECTED FOR NAPL, WHERE PRESENT)

▤ SCREENED INTERVAL

NOTE:

- THIS CROSS-SECTION IS BASED ON THE INTERPRETATION OF SUBSURFACE INFORMATION FROM MULTIPLE SOURCES AND REQUIRED INTERPOLATION BETWEEN SOIL BORINGS.
- SEE TABLE 1-1 FOR EXPLANATION OF UNIFIED SOIL CLASSIFICATION LETTER CODES (eg. CL, ML, etc.) SHOWN ON CROSS SECTION.

HORIZONTAL SCALE IN FEET

0 200 400 800

US Army Corps of Engineers

DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

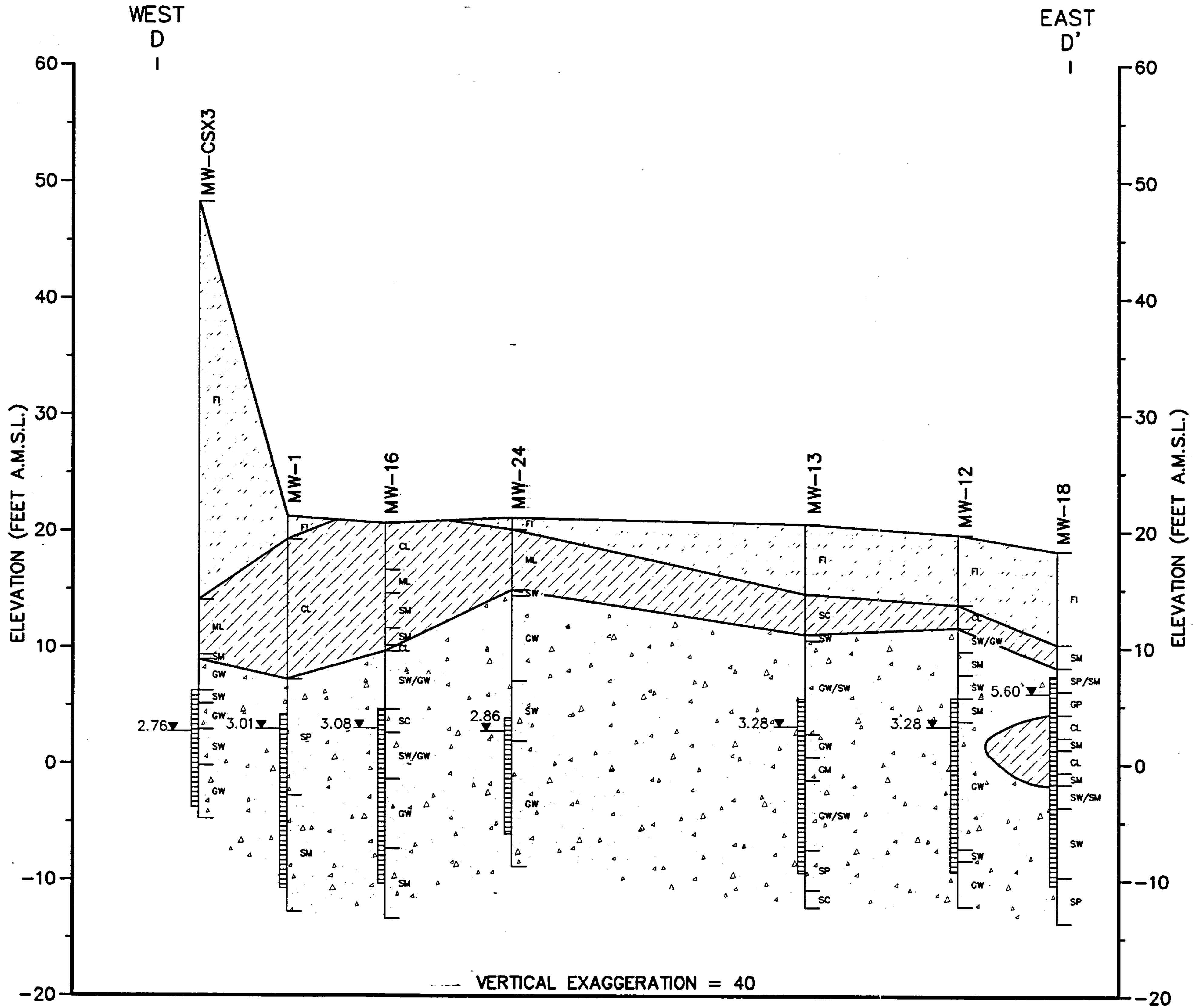
CROSS-SECTION C-C'

MALCOLM PIRNIE, INC.

FIGURE 1-9

4871 : 0285643900\I:\ACAD\PROJ\02856439\643-55 SCALE: 1:1i 12/10, 1996 at 15:30

4871 : 0285643900\I: \ACAD\PROJ\02856439\643-56 SCALE: 1:1i 12/10, 1996 at 15:33



LEGEND

▨	FILL	BROWN-GRAY SILT AND/OR CLAY BACKFILL WITH VARIABLE AMOUNTS OF CONSTRUCTION AND BURN DEBRIS WITH SLAG AND COAL ASH.
▨	SILT	BROWN-OLIVE SILT MATRIX WITH VARIABLE AMOUNT OF FINE SAND OR CLAY, WITHOUT GRAVEL.
△	UNDIFFERENTIATED SAND and GRAVEL	BROWN FINE-COARSE SAND AND GRAVEL WITH SOME SILT PARTINGS AND SAND INTERBEDS.

MWS-1 MONITORING WELL

▼ WATER LEVEL MEASURED ON 10/16/96 (CORRECTED FOR NAPL, WHERE PRESENT)

SCREENED INTERVAL

NOTE:

- THIS CROSS-SECTION IS BASED ON THE INTERPRETATION OF SUBSURFACE INFORMATION FROM MULTIPLE SOURCES AND REQUIRED INTERPOLATION BETWEEN SOIL BORINGS.
- SEE TABLE 1-1 FOR EXPLANATION OF UNIFIED SOIL CLASSIFICATION LETTER CODES (eg. CL, ML, etc.) SHOWN ON CROSS SECTION.

HORIZONTAL SCALE IN FEET

0 200 400 800

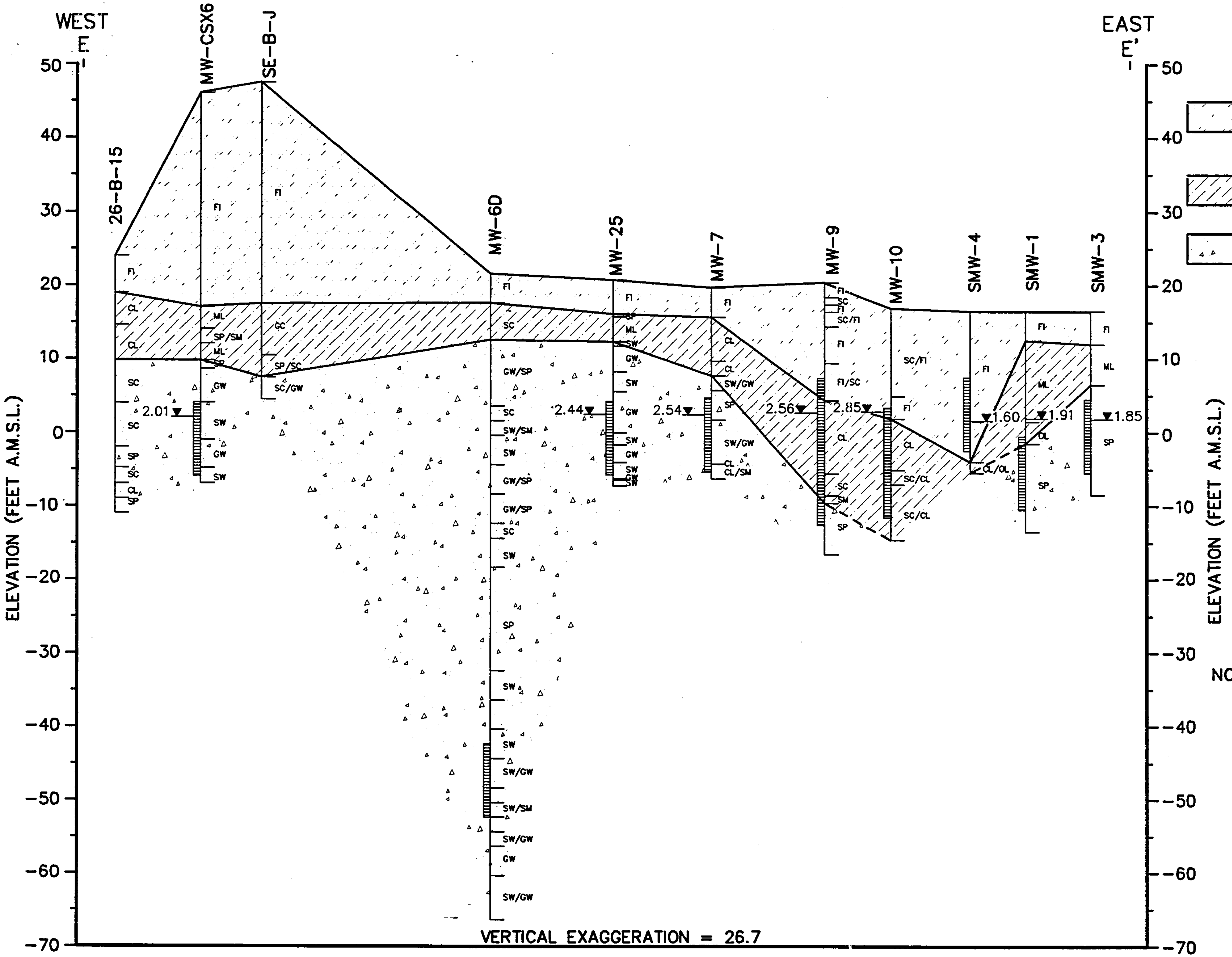
US Army Corps of Engineers

DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

CROSS-SECTION D-D'

MALCOLM PIRNIE, INC.

FIGURE 1-10



LEGEND

⬚	**FILL**	BROWN-GRAY SILT AND/OR CLAY BACKFILL WITH VARIABLE AMOUNTS OF CONSTRUCTION AND BURN DEBRIS WITH SLAG AND COAL ASH.
▨	**SILT**	BROWN-OLIVE SILT MATRIX WITH VARIABLE AMOUNT OF FINE SAND OR CLAY, WITHOUT GRAVEL.
△	**UNDIFFERENTIATED SAND and GRAVEL**	BROWN FINE-COARSE SAND AND GRAVEL WITH SOME SILT PARTINGS AND SAND INTERBEDS.

MWS-1 MONITORING WELL OR SOIL BORING

▼ WATER LEVEL MEASURED ON 10/16/96 (CORRECTED FOR NAPL, WHERE PRESENT)

SCREENED INTERVAL

NOTES:

- THE LOCATIONS AND ELEVATIONS OF BORINGS 26-B-15, SE-B-J, SMW-4, SMW-1, SMW-3 ARE ESTIMATED, BASED ON HISTORICAL INFORMATION.
- THIS CROSS-SECTION IS BASED ON THE INTERPRETATION OF SUBSURFACE INFORMATION FROM MULTIPLE SOURCES AND REQUIRED INTERPOLATION BETWEEN SOIL BORINGS.
- SEE TABLE 1-1 FOR EXPLANATION OF UNIFIED SOIL CLASSIFICATION LETTER CODES (eg. CL, ML, etc.) SHOWN ON CROSS SECTION.

HORIZONTAL SCALE IN FEET
0 200 400 800

4871 : 02856439̶00\I:\ACAD\PROJ\02856439\643-57 SCALE: 1:1 12/10, 1996 at 15:35

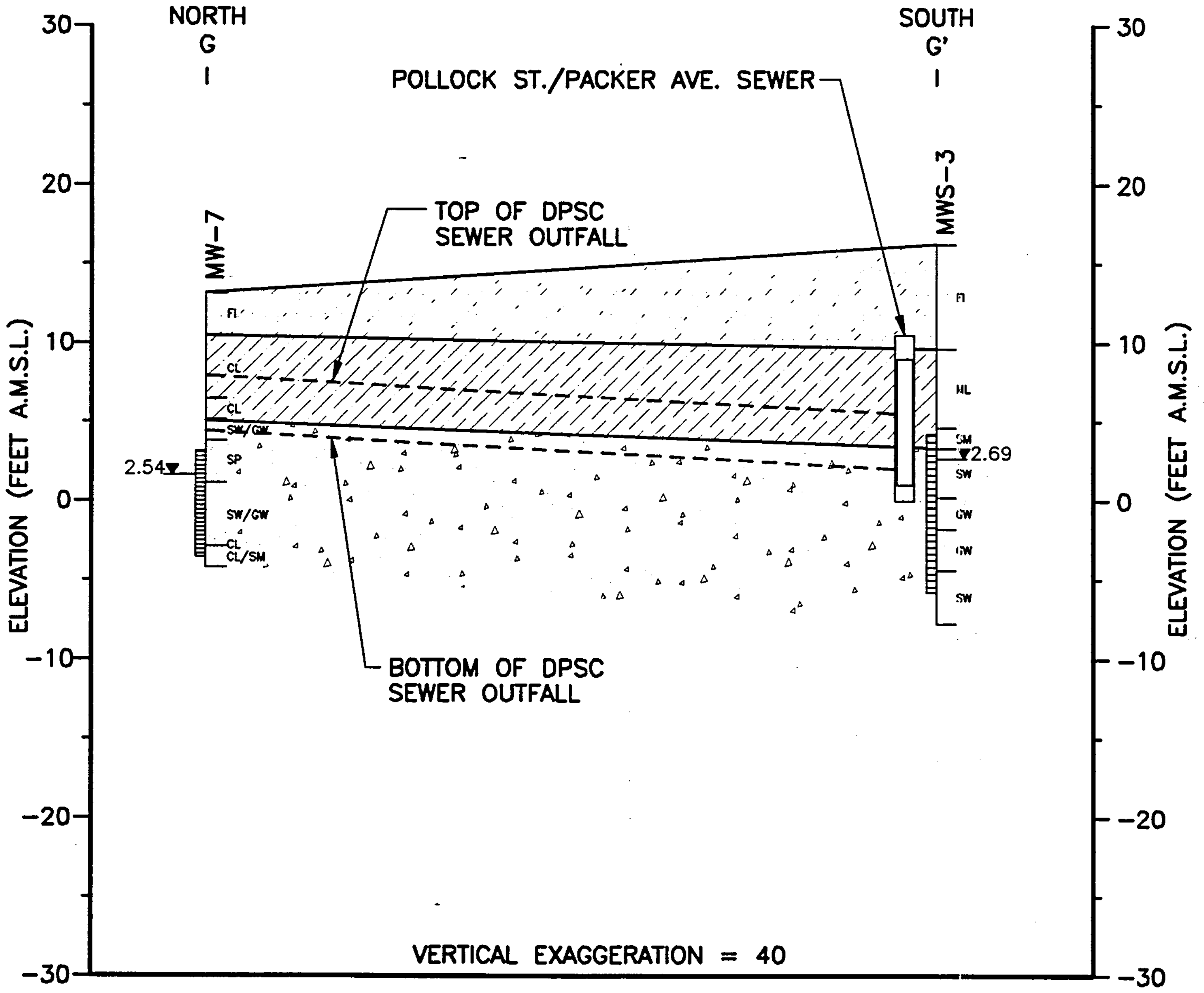
US Army Corps
of Engineers

DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

CROSS-SECTION E-E'

MALCOLM PIRNIE, INC.

FIGURE 1-11



LEGEND

░	FILL	BROWN-GRAY SILT AND/OR CLAY BACKFILL WITH VARIABLE AMOUNTS OF CONSTRUCTION AND BURN DEBRIS WITH SLAG AND COAL ASH.
▨	SILT	BROWN-OLIVE SILT MATRIX WITH VARIABLE AMOUNT OF FINE SAND OR CLAY, WITHOUT GRAVEL.
△	UNDIFFERENTIATED SAND and GRAVEL	BROWN FINE-COARSE SAND AND GRAVEL WITH SOME SILT PARTINGS AND SAND INTERBEDS.

MWS-1 MONITORING WELL OR SOIL BORING

▼ WATER LEVEL MEASURED ON 10/16/96 (CORRECTED FOR NAPL, WHERE PRESENT)

▤ SCREENED INTERVAL

NOTE:

- THIS CROSS-SECTION IS BASED ON THE INTERPRETATION OF SUBSURFACE INFORMATION FROM MULTIPLE SOURCES AND REQUIRED INTERPOLATION BETWEEN SOIL BORINGS.
- SEE TABLE 1-1 FOR EXPLANATION OF UNIFIED SOIL CLASSIFICATION LETTER CODES (eg. CL, ML, etc.) SHOWN ON CROSS SECTION.

HORIZONTAL SCALE IN FEET
0 200 400 800

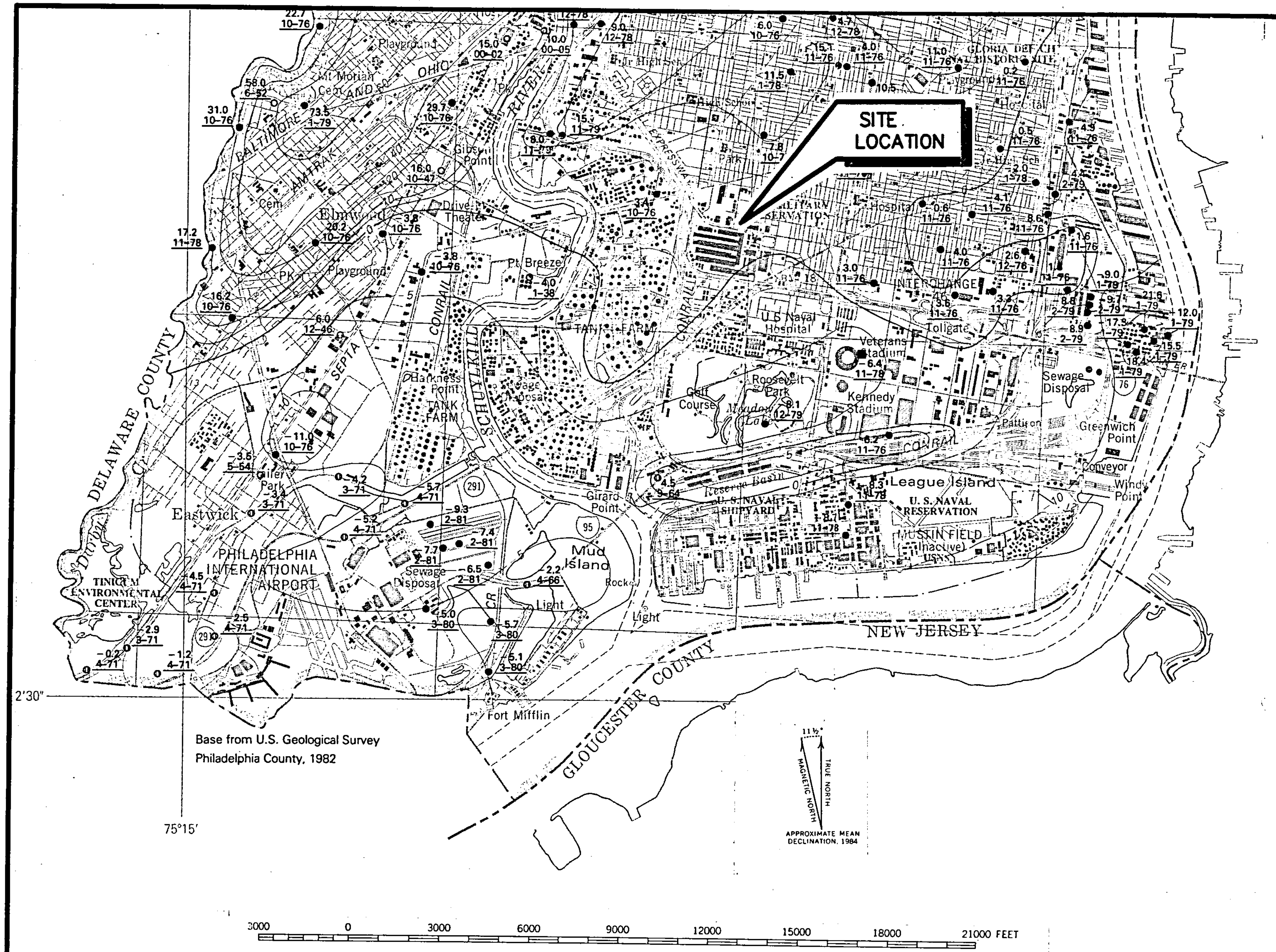
US Army Corps
of Engineers

DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

CROSS-SECTION G-G'

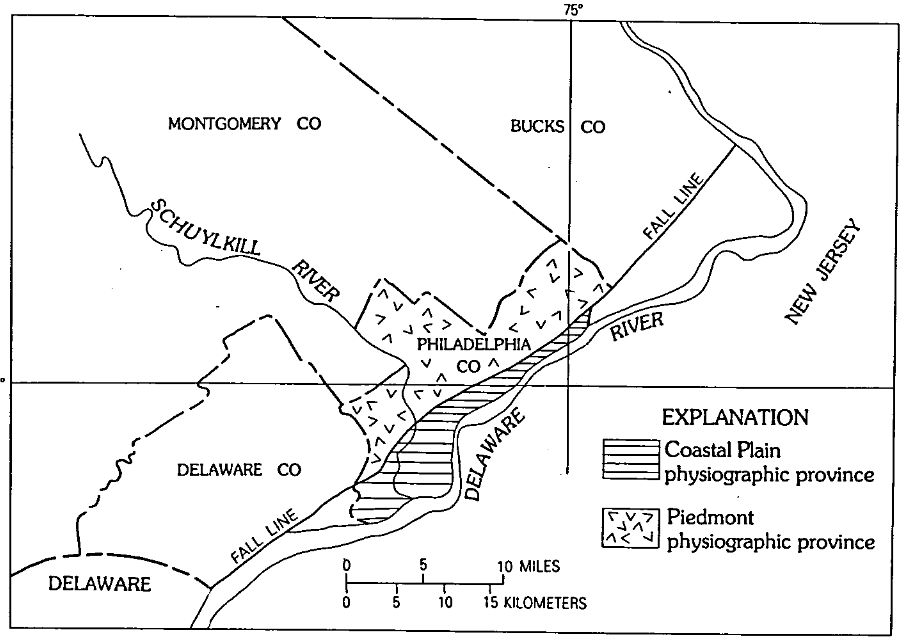
MALCOLM PIRNIE, INC.

FIGURE 1-13



Base from U.S. Geological Survey
Philadelphia County, 1982

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929



Location and physiography of Philadelphia, Pennsylvania

EXPLANATION

—200— WATER-TABLE CONTOUR—Shows altitude of water table. Dashed where approximately located. Contour intervals 5, 10, and 20 feet. National Geodetic Vertical Datum of 1929

● 4.7 / 8-76 HYDRAULIC HEAD—Altitude of water level measured in cased hole and month and year of observation (underscored)

○ 50.0 / 00-25 HYDRAULIC HEAD—Altitude of water level reported in cased hole and month and year of observation (underscored)

○ -3.4 / 3-71 HYDRAULIC HEAD—Altitude of water level reported in uncased hole and month and year of observation (underscored)

■ -6.4 / 11-78 HYDRAULIC HEAD—Altitude of drain field and month and year of water-level observation (underscored)

Notes:

(1) <31.0 denotes water-level altitude less than value shown

(2) Unknown month of observation denoted by 00; <30 denotes observation was made prior to year shown.

SOURCE: PAULACHOK, G.N. AND WOOD, C.R. 1984, WATER-TABLE MAP OF PHILADELPHIA, PENNSYLVANIA, 1976-1980.

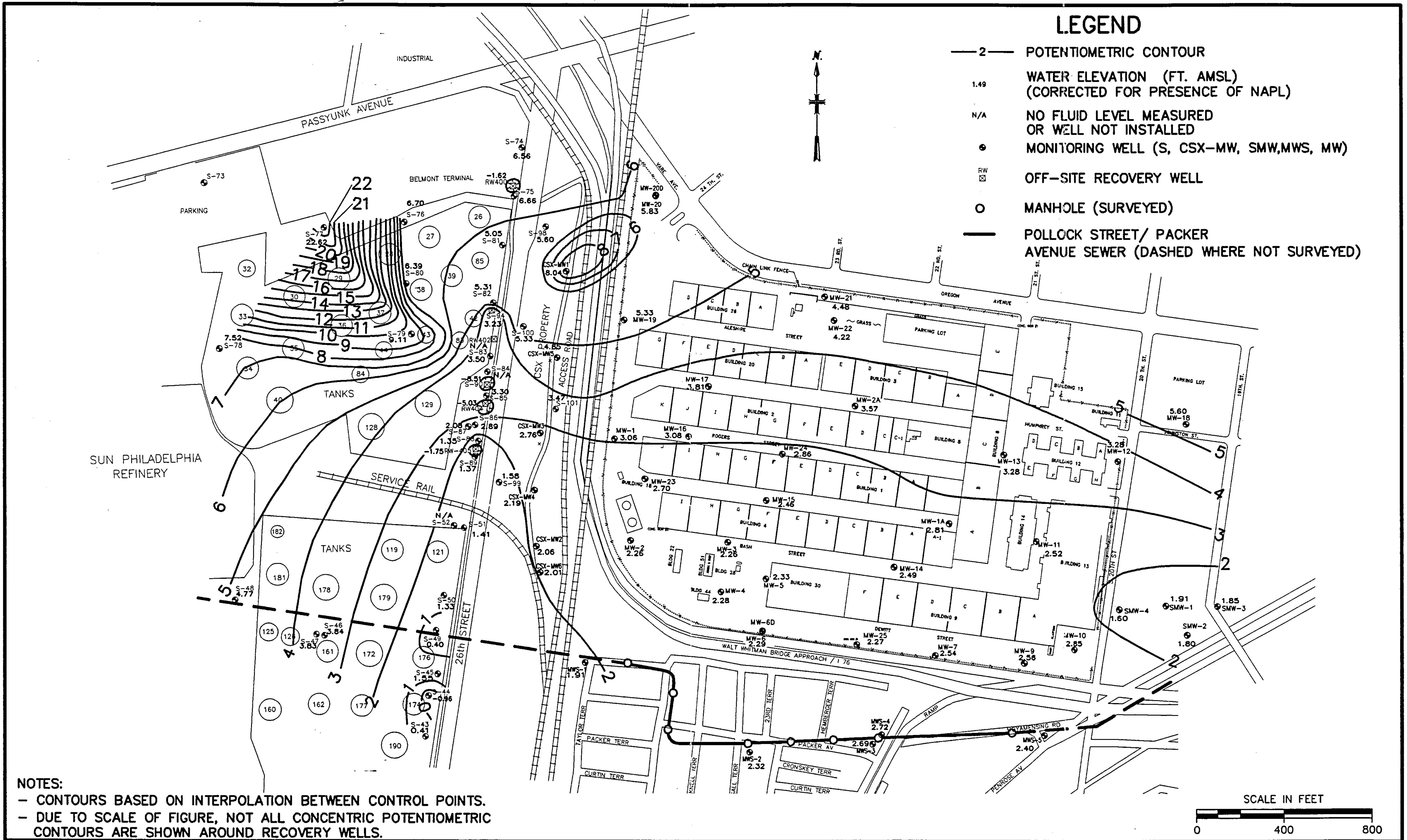
US Army Corps of Engineers

DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

REGIONAL HISTORIC POTENTIOMETRIC CONTOURS
(1976-1980)

MALCOLM PIRNIE, INC.

FIGURE 1-14



NOTES:
- CONTOURS BASED ON INTERPOLATION BETWEEN CONTROL POINTS.
- DUE TO SCALE OF FIGURE, NOT ALL CONCENTRIC POTENTIOMETRIC CONTOURS ARE SHOWN AROUND RECOVERY WELLS.

US Army Corps of Engineers

DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

POTENTIOMETRIC CONTOURS
(OCTOBER 16, 1996)

MALCOLM PIRNIE, INC.

FIGURE 1-15

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TABLE 1-1

NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA

UNIFIED SOIL CLASSIFICATION SYSTEM SUMMARY

PRIMARY DIVISION			USCS CODE	SECONDARY DIVISION
COARSE-GRAINED	GRAVEL	CLEAN GRAVEL < 5% SILT AND CLAY	GW	WELL-GRADED (POORLY SORTED) GRAVEL, GRAVEL-SAND MIXTURES
			GP	POORLY GRADED (WELL SORTED) GRAVEL, GRAVEL-SAND MIXTURES
		GRAVEL WITH > 5% SILT AND CLAY	GC	CLAYEY GRAVEL, GRAVEL-SAND-CLAY MIXTURES
	SAND	CLEAN SANDS < 5% SILT AND CLAY	SW	WELL-GRADED (POORLY SORTED) SAND
			SP	POORLY GRADED (WELL SORTED) SAND
		SANDS WITH > 5% SILT AND CLAY	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC SILT AND CLAY
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC SILT AND CLAY
FINE-GRAINED	SILT	LIQUID LIMIT < 50	ML	INORGANIC SILT, SANDY SILT, SILT WITH CLAY, SLIGHT PLASTICITY
	CLAY		CL	INORGANIC CLAY OF LOW OF LOW TO MEDIUM PLASTICITY, LEAN CLAY

flanks of paleochannels tend to pinch out or be truncated by younger channel-fill deposits. The stratigraphy within the League Island paleochannel suggests that the Middle and Lower Clay units may have been eroded by the paleochannel.

1.3.4 Hydrogeology

Regional and local hydrogeologic information was obtained from literature sources and field data collected on DPSC and surrounding properties. A summary of this information is provided, below.

1.3.4.1 Regional

Regional hydrogeologic data for the Southeastern Pennsylvania Coastal Plain and adjacent New Jersey area indicate the presence of three unconsolidated aquifers in the area, with the Middle and Lower Clay units separating the aquifers (Paulachok, 1991). The Upper, Middle, and Lower Sand units comprise the Potomac-Raritan-Magothy Aquifer System and are also referred to as the Old Bridge Sand Member, the Sayreville Sand Member, and the Farrington Sand Member, respectively (Greenman, et al., 1961). In the southeastern portion of Philadelphia, between the Schuylkill River and the Delaware River, the Upper Clay unit is discontinuous. Where this clay layer is absent, the Upper Sand Member and the Trenton Gravel combine to form a single, unconsolidated aquifer. The thickness of this undifferentiated sand and gravel unit is approximately 35 feet, but can locally exceed 50 feet (Paulachok, 1991).

The Middle Sand unit of the Potomac-Raritan-Magothy Aquifer System is also discontinuous in southeastern Philadelphia and is generally less than 20 feet thick (Greenman, et al., 1961). The Lower Sand unit is generally continuous and lies on top of bedrock. This unit is the most productive aquifer in southwestern Philadelphia and constitutes a major source of industrial and public water supply withdrawals in southwestern New Jersey (Paulachok, 1991).

Regionally, groundwater in the upper aquifer discharges to the Delaware River and the Schuylkill River, the confluence of which is situated at the south-central border of the city. Groundwater flow in southwest Philadelphia is generally southwest, toward the Schuylkill

River. Groundwater flow in southeast Philadelphia is generally to the south-southeast, toward the Delaware River (Paulachok, et al., 1984). A regional water-table potentiometric contour map is shown in Figure 1-14.

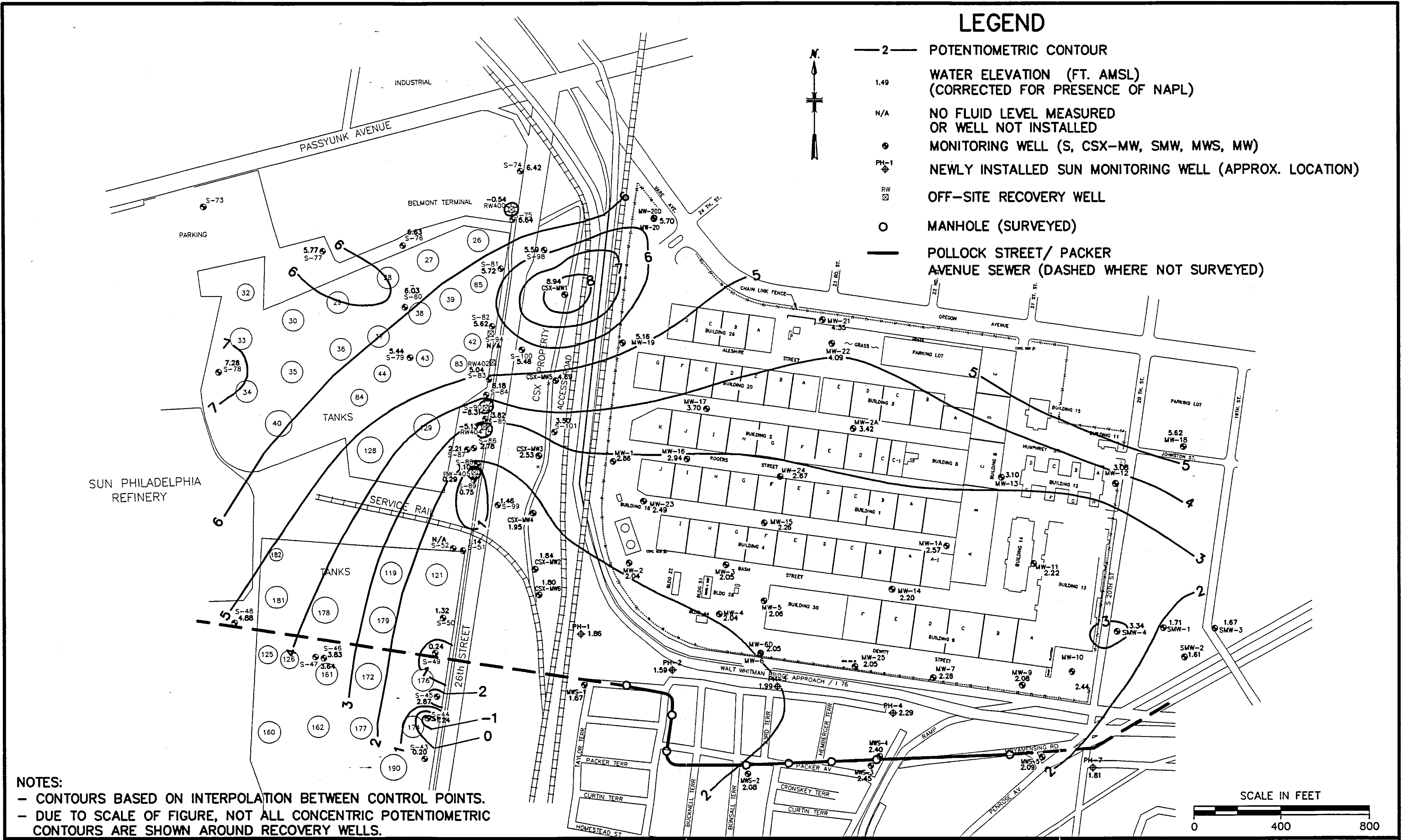
Regional groundwater flow directions have been consistent, historically, based on data collected in 1944-1945 and 1976-1980 (Paulachok, 1991 and Paulachok, et al., 1984). Historical records indicate local maximum water-table fluctuations of approximately nine feet due to seasonal changes in withdrawal of groundwater from the aquifer (Paulachok, 1991). Historic water levels recorded in wells located to the southeast and southwest of DPSC and screened in the Trenton Gravel range from six to 10 feet below mean sea level (Paulachok, et al., 1984). Other areas of local water-table fluctuations and changes in groundwater flow directions occur due to withdrawals for industrial and commercial uses. Recharge to, and discharge from the upper aquifer in southeastern Philadelphia are influenced by leakage from brick-lined sewers and water pipes (Paulachok, 1991).

Major groundwater withdrawals from the middle and lower aquifers in New Jersey cause downward hydraulic gradients throughout southern Philadelphia (Paulachok, et al., 1984). Prior to the mid-1960s, these gradients were enhanced by withdrawals at the U.S. Naval Shipyard (south of DPSC) and industrial operations near the Walt Whitman Bridge (east of DPSC). Pumping from the lower aquifer was curtailed in Philadelphia from the mid-1950s to the late 1970s. However, downward gradients are still present in Philadelphia due to pumping of deep municipal and industrial water supply wells in New Jersey (Paulachok, 1991).

1.3.4.2 Local

Based on subsurface information, the Middle and Lower Clay members are absent beneath portions of DPSC and a single aquifer exists at DPSC. Therefore, potential cross contamination between aquifers during drilling is not likely.

The water table is at approximately 15 to 20 feet below ground surface at DPSC. The maximum known thickness of the aquifer is approximately 80 feet. In general, groundwater flow at DPSC is to the south (Figures 1-15 and 1-16). A southeasterly component of groundwater flow is present in the northwestern portion of DPSC and the eastern portion of



LEGEND

—2—	POTENTIOMETRIC CONTOUR
1.49	WATER ELEVATION (FT. AMSL) (CORRECTED FOR PRESENCE OF NAPL)
N/A	NO FLUID LEVEL MEASURED OR WELL NOT INSTALLED
⊗	MONITORING WELL (S, CSX-MW, SMW, MWS, MW)
PH-1 ⊕	NEWLY INSTALLED SUN MONITORING WELL (APPROX. LOCATION)
RW ⊠	OFF-SITE RECOVERY WELL
○	MANHOLE (SURVEYED)
▬	POLLOCK STREET/ PACKER AVENUE SEWER (DASHED WHERE NOT SURVEYED)

NOTES:
- CONTOURS BASED ON INTERPOLATION BETWEEN CONTROL POINTS.
- DUE TO SCALE OF FIGURE, NOT ALL CONCENTRIC POTENTIOMETRIC CONTOURS ARE SHOWN AROUND RECOVERY WELLS.

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POTENTIOMETRIC CONTOURS
(NOVEMBER 15, 1996)

MALCOLM PIRNIE, INC.

FIGURE 1-16

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the ARCO/Sun Refinery South Yard. In the western portion of the ARCO/Sun Refinery South Yard, groundwater flows west toward the Schuylkill River. Water-level measurements (March, 1995 through November, 1996) in well clusters MW-6/6D and MW-20/20D indicate the presence of downward hydraulic gradients in these areas. Groundwater flow patterns in the vicinity of DPSC are discussed in more detail in Sections 5.1 and 5.2.1.

Historical water-level data from nearby wells within 2.5 miles of DPSC screened in the Trenton Gravel/Upper Aquifer indicate water-table fluctuations of approximately two to three feet (Paulachok, et al., 1984). These water-level changes are due to seasonal variations in recharge and evapo-transpiration. Tidal influences on water levels are negligible in the vicinity of DPSC (Greenman, et al., 1961). On-site water-table fluctuations recorded in the past five years are consistent with historical information. During this study, water levels in all on-site wells were approximately two feet higher than levels recorded during the Phase I RI/FS conducted in 1994 and 1995 (Figure 1-17). The difference in water levels appears to have been caused by higher than normal precipitation in early to mid 1996.

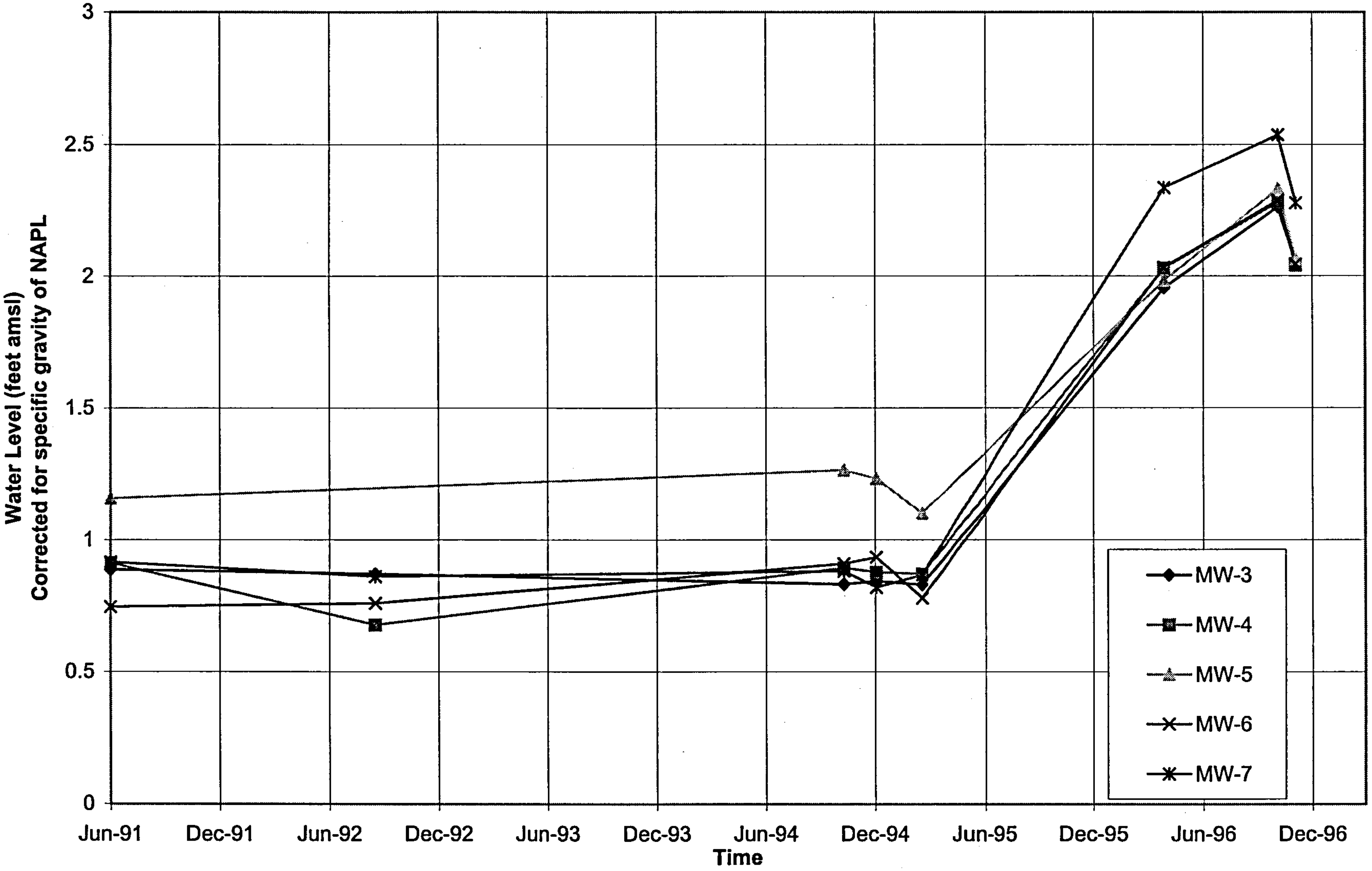
FIGURE 1-17

NAPL PLUME STUDY

DEFENSE PERSONNEL SUPPORT CENTER

PHILADELPHIA, PENNSYLVANIA

WATER-LEVEL FLUCTUATIONS - ON-SITE MONITORING WELLS



2.0 OBJECTIVES AND SCOPE

2.1 OBJECTIVES

The purpose of the NAPL Plume Study is to gather the existing, available information relating to the NAPL plume, quantities and location of bulk petroleum/ oil/lubricant (POL) storage, underground storage tank (UST) locations, and aquifer and groundwater flow data for the purposes of answering the following questions:

1. How much NAPL is beneath DPSC property?
2. Is NAPL still migrating onto DPSC property?
3. Is NAPL moving through DPSC and off of DPSC property?
4. What is the composition of the NAPL?
5. How much of the NAPL originated from DPSC activities?
6. What is the source of the NAPL?

If the above questions could not be answered with existing data, additional field and research activities were performed to address these data gaps. Beyond answering specific questions about the NAPL plume, the principle objectives of this work are to:

- Gather necessary existing data into a stand alone document that is clear and concise to a non-technical audience.
- Expedite the work so the government may make informed decisions for property transfer and the potential liabilities associated with transfer.
- Aid in the decision making process for future reuse of the facility (restrictions).
- Confirm historical and record searches for bulk POL storage locations, and quantities at DPSC.
- Evaluate utility corridors and water/sewer lines on and off DPSC to determine if the corridors could influence the flow of NAPL onto the property.
- Complete record searches for potential off-site sources.
- Determine if any additional data must be collected in order to determine if DPSC contributed to the NAPL plume.

2.2 SCOPE

The scope of the NAPL Plume Study includes the following six tasks as described in the USACE Scope of Work (SOW) dated August 28, 1995:

Task 1 - Document Review (Previous Investigations)
Task 2 - Records/Historical Search
Task 3 - Preparation of Outline/Recommendations (Interim Report)
Task 4 - Evaluation of Data
Task 5 - Additional Field Work (Optional)
Task 6 - Report of Findings

These tasks are summarized below:

- **Task 1 - Document Review.** Task 1 included a review of the Final Phase I RI/FS and available previous investigations (including UST Closure Reports) that contain information relative to the NAPL plume to assess potential data gaps. The RI/FS Report was reviewed to determine if technically accurate responses were made to comments generated by the USACE, Baltimore District on the Draft Phase I RI/FS.

- **Task 2 - Records/Historical Search.** Task 2 required the confirmation of available records/historical searches performed in the past to assure all pertinent data had been acquired. This included records available for properties surrounding/near the site and available regulatory/governmental information. A search of critical records that had not been obtained in the past was initiated. Utility companies were contacted to identify existing utilities and sewers.

- **Task 3 - Preparation of Outline/Recommendations.** Based on records/historical searches and the review of documents, an outline was developed and presented to the USACE, DPSC and the BRAC Clean-up Team showing the proposed strategy to accomplish the compilation of data. The document discussed identified data gaps that were needed to answer the fundamental questions presented in the USACE statement of work. The NAPL Plume Confirmation Study - Interim Report produced under Task 3 functioned as an official work plan for the services required by the Army Corps delivery order to Malcolm Pirnie. Based on the review of historical records, additional field work was required. Malcolm Pirnie completed addenda work plans and health and safety plans for this work.

- **Task 4 - Evaluation of Data**. The evaluation focussed on the following:
  - Approximate size of the NAPL plume.
  - Location of the NAPL, and movement of the NAPL.
  - Description of the aquifer(s) at the installation.
  - Assessment of the potential (beyond ordinary circumstances) that the hydropunch sampling, well installations, and selected well screen depths might have caused cross contamination of the aquifers.
  - Determination of applicable regulations related to the circumstances (sources) of the NAPL plume to assist DPSC with the determination if the NAPL plume must be remediated by DPSC.
  - Assessment of potential sources (if possible) and if not, an explanation of why. (Completed under the Expanded Site Investigation activities).
  - Assessment of pathways of the movement of the NAPL and dissolved phase product.

- **Task 5 - Additional Field Work (optional)**. At the direction of the USACE Contracting Officer, additional drilling activities were completed by Malcolm Pirnie. Monitoring wells and soil borings were surveyed by a surveyor licensed in Pennsylvania. Also as directed by the USACE Contracting Officer, in April and June 1996, groundwater samples were collected from new and existing wells and analyzed by Hydrocarbon Fuel Scan, IR Scan, and for a host of additional parameters related to identification of refined fuel additives and quantification of volatile organic constituents. This task was modified to include NAPL baildown/recovery tests, the results of which were used to supplement previously reported NAPL volume estimates.

- **Task 6 - Report of Findings**. This NAPL Plume Study Report is a stand-alone document. The report summarizes the results of the literature, field, and laboratory investigations conducted as part of the NAPL study. The report does not include a quantitative human health or ecological risk assessment.

3.0 PROJECT APPROACH

The field, analytical, and research methods used to complete the scope of work are discussed herein according to the major objectives of the project. The previously submitted Draft Final Quality Control Summary Report (QCSR) for the DPSC NAPL Study details the analytical and quality assurance/quality control (QA/QC) procedures used during the implementation of this study. The project approaches were designed to evaluate the characteristics, migration, and potential sources of the NAPL plume. In general, the field activities and procedures were performed as outlined in the following USACE-approved documents prepared by Malcolm Pirnie:

- Final Quality Assurance Project Plan (QAPjP); June 1996.
- Final Quality Assurance Program Plan (QAPP); June 1996.
- Draft Final Monitoring Well Installation Plan; June 1996.
- Draft Final Field Sampling Plan- NAPL Plume Confirmation Study; June 1996.
- Draft Final Field Sampling Plan- Expanded Site Investigation; June 1996.
- Recommendation Letter - Light Non-Aqueous Phase Liquid Baildown/ Recovery Testing; April 1996.

The Facility-wide Quality Assurance Program Plan (QAPP) provides general information and standard operating procedures applicable to work throughout the DPSC facility. The information includes definitions and generic goals for data quality and minimum requirements for QA/QC samples. The Site-Specific Quality Assurance Project Plans (QAPjP) serves as an addendum to the Facility-wide QAPP. The QAPjP contains a site description; intended data uses; project specific data quality objectives; and information on site field activities such as sample locations, sampling procedures, and analytical methods. The QAPjP is not considered a stand-alone document from the QAPP. The QAPP provides the majority of the QA/QC information; the QAPjP is used to supplement the information in the QAPP by providing for site-specific condition requirements.

Modifications to or deviations from the methods described in the above-referenced documents were approved by the USACE prior to performing the field activity and are described below.

3.1 NAPL PLUME

The results of previously conducted field activities related to the NAPL plume were reviewed to identify data gaps related to the extent, thickness, quantity, composition, and aging/weathering of the NAPL plume. Summaries of these field activities and their findings are included in Section 4.1.1. Based on the results of this review, additional field work was deemed warranted to meet the project objectives. The delineation of dissolved or vapor phase organic constituents associated with the NAPL plume was not addressed in this study.

3.1.1 Monitoring Well Installation

In accordance with the Draft Final Monitoring Well Installation Plan and the approved modifications to the Field Sampling Plan (FSP)-NAPL Plume Confirmation Study, 12 monitoring wells were installed on DPSC and on nearby properties from June through August 1996. Three wells were drilled in the central and southern portion of DPSC to better assess the quantity and extent of NAPL beneath DPSC. Four wells on the CSX property were installed to evaluate the potential pathway between the adjacent ARCO/Sun Refinery South Yard and DPSC. After discussion and approval by USACE, the FSP-NAPL Plume Confirmation Study was modified to include the installation of five two-inch monitoring wells south of DPSC along the Pollock Street/Packer Avenue Sewer, in lieu of three four-inch wells in this area. The revised plan included the installation of three monitoring wells along the southern side of the sewer and one pair of wells on opposite sides (north and south) of the sewer. Four of these wells were installed within the Passyunk Homes housing complex, which is operated by the Philadelphia Housing Authority (PHA). The other well was located within the City of Philadelphia drainage right-of-way at the intersection of Penrose Avenue and Moyamensing Avenue. The locations of all newly installed and existing monitoring wells in the study area are shown on Figure 3-1. Well construction diagrams and borehole drilling logs are provided in Appendix A and Appendix B, respectively.

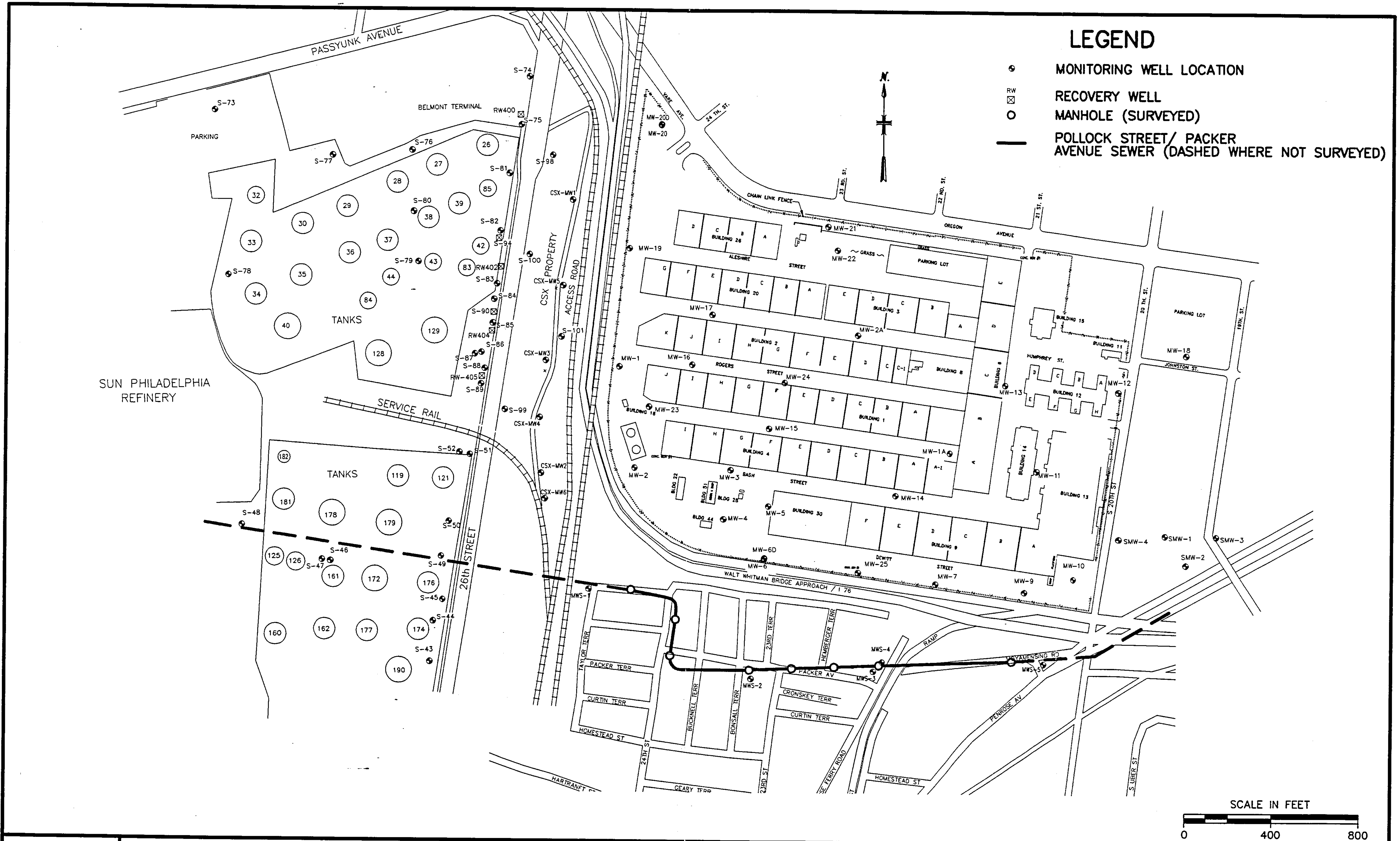
Following well installation activities, each newly installed well, with the exception of MW-25, was developed according to the procedures outlined in the Draft Final Monitoring Well Installation Plan. The majority of liquid removed from MW-25 during development was NAPL. Development was discontinued to prevent the removal of large quantities of NAPL from the well. Monitoring well development logs are provided in Appendix C. Groundwater/NAPL sampling activities, discussed below, were initiated at least two weeks after well development. All non-dedicated equipment placed in a well was decontaminated in accordance with the approved QAPP.

3.1.2 Pollock Street/Packer Avenue Soil Borings

The Pollock Street/Packer Avenue sewer bedding investigation activities described in the FSP-NAPL Plume Confirmation Study were revised to include two days of hollow-stem auger drilling in lieu of three days of Geoprobe borings. This revision was based on the presumed incompatibility of using the Geoprobe boring method to penetrate the dense sand and gravel unit. A total of eight soil borings were drilled along either side of the sewer from the western end of Pollock Terrace in Passyunk Homes to Moyamensing Avenue, west of Penrose Avenue (Figure 3-2). Drilling activities along the Pollock Street/Packer Avenue sewer were intended to provide information on geology, groundwater flow, and the presence or absence of NAPL south of DPSC. The details and findings of this work are described in Section 4.1.2. Graphs of photoionization detector (PID) measurements versus depth for each soil boring are shown in Appendix D.

3.1.3 NAPL Baildown/Recovery Tests

To supplement previously reported apparent NAPL thicknesses with more representative NAPL thicknesses, baildown/recovery tests were performed in on-site monitoring wells which contained NAPL. The results of the NAPL baildown/recovery tests were used to revise the volume estimates reported in the Phase I RI/FS. NAPL baildown/



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DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

MONITORING WELL LOCATIONS
(AUGUST 1996)

MALCOLM PIRNIE, INC.

FIGURE 3-1

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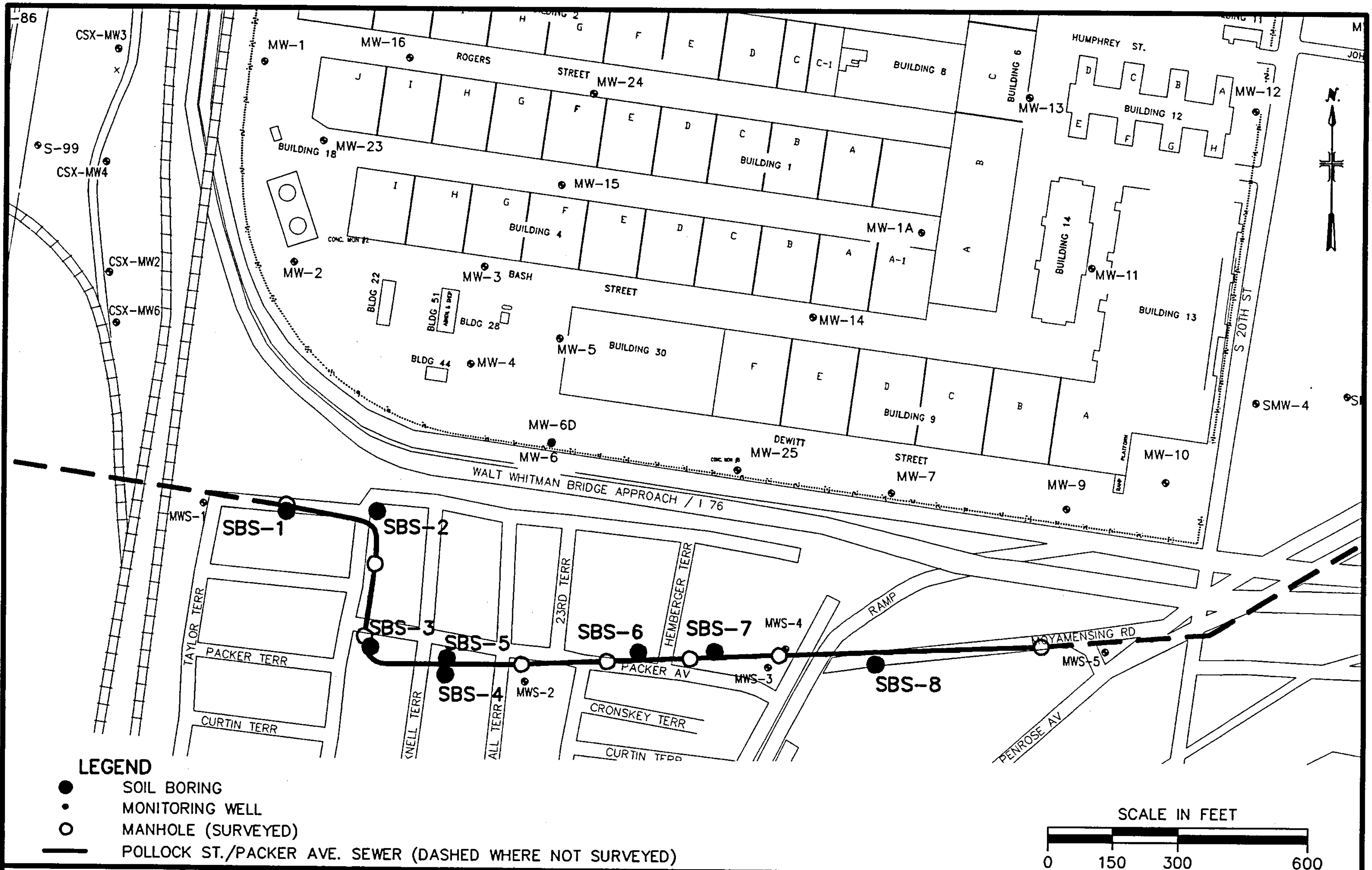

US Army Corps of Engineers

DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

DRILLING LOCATIONS – SOUTH OF DPSC

MALCOLM PIRNIE, INC.

FIGURE 3-2

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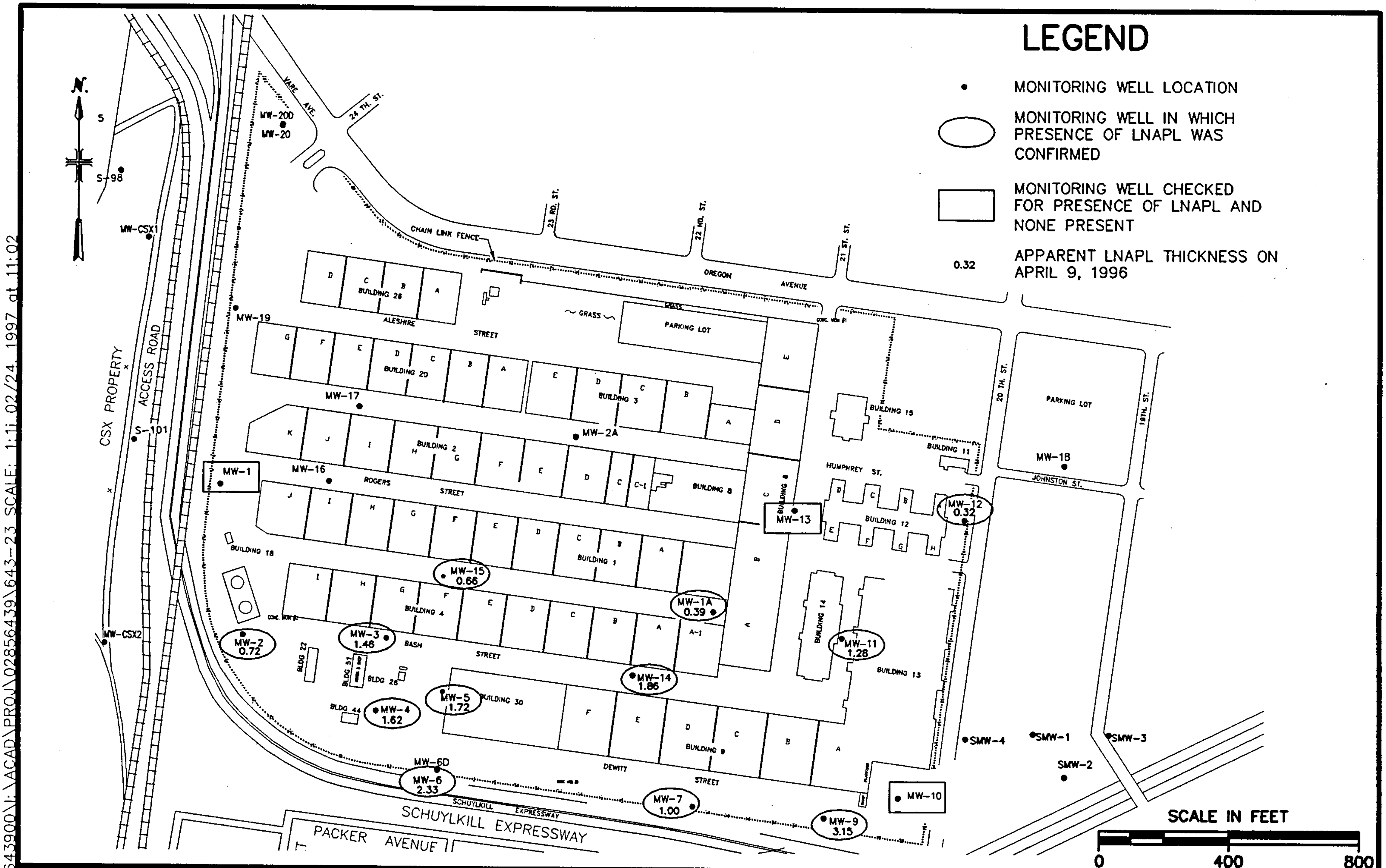
recovery tests were performed on 12 wells in which NAPL thicknesses were measured in April 1996 (Figure 3-3).

In general, the field and analytical methods outlined in the Recommendation Letter-Light Non-Aqueous Phase Liquid Baildown/Recovery Testing were employed. Due to the limited thickness of the NAPL and the imprecise nature of bailing, some water was removed during the baildown/recovery tests in all wells with the exception of MW-9 and MW-11. Based on the percentages of NAPL and water removed from tested wells (Table 3-1) and the shapes of the resulting data curves (Appendix E), the analysis method proposed by Gruszczenski (1987) was determined to be the most appropriate and was utilized for all baildown/recovery tests. The data from baildown/recovery tests on some wells from which mostly NAPL was removed were also analyzed using the Hughes et al. (1988) analysis method for comparison. Details of the data analysis utilizing these methods are discussed in Section 4.2.2.

As outlined in the approved NAPL baildown/recovery test protocol, measurements were continued until NAPL and water-level changes had stabilized over approximately 30-minute intervals, until liquid levels had recovered to approximately 90 percent of the original measurements, or until sufficient data had been collected for analysis. Due to the relatively slow recovery in MW-9, MW-7, MW-5, and MW-15, extended test times and longer measurement intervals were employed. The results of the baildown/recovery tests, and the revised volume estimates are discussed in Section 4.2.2 and Section 4.2.3, respectively.

3.1.4 Previous Analytical Testing

The following sections present a discussion of the investigations and resulting analysis that were conducted at DPSC to assess the composition of the NAPL. During the courses of these investigations, available information was considered which directed the approach and analytical methods used. Therefore, the scope of each investigation was limited by the assumptions made and the information available. In most cases, it is inappropriate to use the results from one investigation to answer those questions which do not fit the original assumptions. The results of each of the previous investigations were also limited by the purpose of that investigation and its assumptions.



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DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

NAPL BAILDOWN/RECOVERY TEST LOCATIONS

MALCOLM PIRNIE, INC.

FIGURE 3-3

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TABLE 3-1

NAPL PLUME STUDY

DEFENSE PERSONNEL SUPPORT CENTER

PHILADELPHIA, PENNSYLVANIA

VOLUME OF NAPL/WATER REMOVED AND NAPL APPEARANCE

Well ID	Approximate volume of liquid removed (gallons)	Approximate percentage of NAPL removed	Approximate percentage of water removed	NAPL Appearance
MW-1A	1	10%	90%	Medium/dark brown, opaque, low viscosity
MW-2	4	50%	50%	Medium/dark brown, opaque, low viscosity
MW-3	2	90%	10%	Medium/dark brown, opaque, low viscosity
MW-4	1	50%	50%	Medium/dark brown, opaque, low viscosity, black particulates
MW-5	5	75%	25%	Medium/dark brown, opaque, low viscosity
MW-6	3	90%	10%	Medium/dark brown, opaque, low viscosity
MW-7	1	95%	5%	Medium/dark brown, opaque, low viscosity
MW-9	3	100%	0%	Medium/dark brown, opaque, low viscosity
MW-11	2	90%	10%	Medium/dark brown, opaque, low viscosity
MW-12	0.5	10%	90%	Medium/dark brown, opaque, low viscosity
MW-14	4.5	95%	5%	Medium/dark brown, opaque, low viscosity
MW-15	1	30%	70%	Medium/dark brown, opaque, low viscosity

During the studies conducted for this report, the only assumption made concerning the composition of the NAPL was that it was a petroleum hydrocarbon, which was a clear certainty provided by the previous investigations. Section 3.2.1 of the accompanying Quality Control Summary Report (QCSR) (Malcolm Pirnie, 1997) provides a detailed discussion of the Multi-Tiered Analytical Sequence used during this study to assess the composition of the NAPL. The Multi-Tiered Analytical Sequence is also summarized in Appendix L.

Numerous environmental studies conducted at DPSC have presented statements about the composition of the NAPL dating back to the document entitled "DPSC Fuel Contamination Study" (CENAB, 1988). The following is a list of these studies, the number and types of samples collected, and the analyses conducted during the investigation.

Site Assessment (1)	Date	Soil Samples	Groundwater Samples	Analysis Conducted
DPSC Fuel Contamination Study (2)	1988	78	None	TPH
Final Engineering Report for the DPSC	1991	65	7	TPH (CA method), BTEX
Site Characterization for the New Admin./ADP Bldg.	1992	37	4	TPH, BTEX
DPSC Gasoline Station UST Closures	1994	28	None	TPH, GRO, DRO, BTEX, Lead
Oregon Avenue UST Closure	1994	13	None	TPH, GRO, DRO
Rogers Street and Bldg. 8 UST Closures	1995 & 1994	8	None	TPH, BTEX, DRO, PCBs
DDT UST Closures	1994	55	7	TPH, Pesticides
Phase I RI/FS Report (3)	1995	29	25	TPH, GRO, DRO, BTEX

NOTES:

(1) Source of this table is the Phase I RI/FS Report (Kemron/Versar, 1995).
(2) One sample of "liquid floating on the groundwater" was analyzed by the AEHA laboratory.
(3) Eleven NAPL samples were collected and analyzed for the noted parameters during this investigation.

During each of these studies assumptions were made which guided the investigations. Although such an approach is standard practice and supported by regulations, the use of the results to answer other questions not anticipated during the investigation can be confusing. For example, during an UST closure investigation where there has been gasoline and diesel storage, PADEP regulations recommend the use of TPH, BTEX (benzene, toluene, ethyl benzene, and total xylene) and lead (if leaded gasoline was potentially stored) analyses to assess the nature of the contamination.

This approach is standard practice, but makes obvious assumptions as to the potential composition of the material being analyzed. The results of these analyses are concentrations of TPH, BTEX and lead. To determine the composition of the material tested during the UST closure, the only available information is concentration data of TPH, BTEX and lead. It is not possible from the data generated to determine if the material detected by the TPH analysis is diesel (fuel oil #2), fuel oil #4 or fuel oil #6. The investigator and regulators assume that the material detected in the samples originated from the UST and therefore must be diesel (fuel oil #2). Based on the UST storage history, the lead results allow the investigator to assess if there has been a potential leaded gasoline storage discharge. The BTEX results are indicators of gasoline; however, other light petroleum products contain the BTEX compounds. Therefore, once again, the investigator is making an assumption as to the composition of the material based on the BTEX results and the history of the site.

The following paragraphs provide a brief discussion of each of the previous investigations, the purpose of the investigation and the usefulness of the result. Each of these studies were reviewed during the preparation of this report.

3.1.4.1 DPSC Fuel Contamination Study (1988)

The purpose of the DPSC Fuel Contamination Study (CENAB, 1988) was to assess the extent of contamination adjacent to the Building 28 Gasoline Station which was discovered during site improvement construction activities. Specifically, a computerized fuel management system was being installed in September 1987. During the excavation activities, the feed and vent lines were noted to be corroded and leaking diesel fuel was discovered. As noted in the table above, 78 soil samples were collected for TPH analysis. The sole purpose of this analysis was to asses the extent of diesel contamination.

This report states that:

> "gasoline-smelling liquid floating on the groundwater surface (the free product) was taken from DH-12 and sent to the AEHA lab for analysis. The results showed that the liquid was indeed gasoline with some kerosene. No diesel fuel was detected, indicating that the groundwater contamination was not related to the current pipe corrosion and resultant oil (diesel fuel) leak."

No information is provided in the report as to the methods used by the AEHA lab.

The results of these investigations conducted in 1988 are in agreement with the results of the Expanded Site Investigation Study which investigated Building 28 and this NAPL study. With respect to the analysis conducted, the results of the Fuel Contamination study indicate that the material is a light naphtha which was interpreted in the study as a gasoline-kerosene mix. No other tests were conducted to determine the presence of other compounds which could have better characterized the material discovered. The tests conducted under this NAPL study have been more exhaustive and therefore are more accurate indicators of the composition of the NAPL. Once again, it must be stated that the results of this report are not contradictory to the results of the NAPL study.

The DPSC Fuel Contamination Study is the first investigation conducted at DPSC which states that the NAPL plume is a mix of gasoline and kerosene. The conclusion of this report formed the basis for subsequent activities at DPSC and was the first indication that the DPSC facility was not the source of the NAPL.

3.1.4.2 Final Engineering Report for the DPSC (1991)

The purpose of this study (ESE, 1991) was to further assess the soil and groundwater contamination resulting from the damaged diesel product flow line at Building 28 Gasoline Station. Additionally, this study was to evaluate the potential for offsite and onsite migration of hydrocarbons from discharges at DPSC; identify background soil and groundwater conditions; and, verify and identify the source of off-site contaminants. The analyses conducted during this investigation were TPH (California Method) and BTEX.

parameters were used in the van Genuchten capillary model to estimate NAPL volume at DPSC. The results of these analyses are summarized in Section 4.2.3.

3.2 NAPL PATHWAYS

Information obtained during the additional field activities was also used to evaluate potential NAPL migration pathways. The water-level measurement task outlined in the FSP-NAPL Plume Confirmation Study was modified to include long-term water-level monitoring in CSX-MW5, CSX-MW2, MW-17, and MW-11. Well MW-17 was selected in place of MW-1 due to security and logistical reasons. Well CSX-MW5 was selected in lieu of CSX-MW1 due to its more proximate location to recovery wells on the ARCO/Sun Refinery property. In addition, barometric pressure was continuously measured in MW-17. This data was used to confirm groundwater flow directions and determine the presence or absence of water-table fluctuations over time. The results of two rounds of synoptic fluid-level measurements, which were conducted concurrently with long-term water-level monitoring, are detailed in Section 5.1.

The findings of the synoptic fluid-level measurements were used in conjunction with new stratigraphic information to evaluate potential NAPL pathways. Specifically, monitoring wells on the CSX property were installed to define the horizontal extent of NAPL, and to determine the presence or absence of current or former pathways from an off-site source to DPSC. Soil borings were drilled and monitoring wells installed to the south of DPSC to provide information on potential NAPL migration away from DPSC. In addition, the field activities performed along the Pollock Street/Packer Avenue sewer were intended to assess the effects, if any, of the sewer and associated bedding material on the migration of NAPL south of DPSC.

The data collected during these field activities supplements existing geologic, hydrogeologic, and infrastructure data presented in the Phase I RI/FS and other previous studies. The interpretation of this information and a description of the suspected NAPL migration pathways are included in Section 5.0.

3.3 POTENTIAL ON-SITE NAPL SOURCES

Many potential on-site contributors were identified as part of the Base Realignment and Closure (BRAC) process. An Environmental Baseline Survey (EBS) was performed in 1994 (PRC, 1994) to document the environmental condition of DPSC in preparation for future leasing or transfer of the property. This report identified potential environmental hazards and the status of each area of the base with respect to availability for property transfer. The EBS also identified areas which potentially require additional investigation or cleanup prior to transfer. The report identified the on-site storage tanks, their contents and present status. Thirty-two Installation Restoration Program (IRP) sites were identified at DPSC. The goal of the IRP is to address the identification and cleanup of contamination. Among the sites listed are storage tanks, hazardous waste and hazardous materials management areas, railroad track beds, and areas where soils and groundwater may have been affected by free product releases.

The Base Realignment and Closure Cleanup Plan, prepared by DLA in June, 1995 and periodically updated, expanded the IRP list to 36 sites. In accordance with BRAC objectives, a Phase I RI/FS was performed to investigate many of the IRP sites, as well as the NAPL plume beneath DPSC.

Potential on-site contributors were assessed by reviewing previously conducted field activities, researching on-site storage tank information, interviewing site personnel, and performing additional field activities. The results of these assessments are included in Section 6.1. An overview of the reports reviewed and the field methods employed is provided, below.

3.3.1 Review of Site Investigation Studies

The following field activities/investigations performed at DPSC were reviewed in order to evaluate potential on-site sources of the NAPL plume:

- USACE Investigation of Building 28 Gasoline Tanks and Piping (1987 - 1988).
- ESE Investigation of Building 28 (November 1991).
- USACE Investigation of New ADP/Administration Building (1992).
- Environmental Baseline Survey (1994).
- Kemron/Versar Phase I Remedial Investigation/Feasibility Study (1995).

The results of these field activities/investigations are summarized in Section 6.1.1. The discussion of these five investigations describe the progression of investigations relating to the on-site NAPL plume, from its discovery until Malcolm Pirnie Inc. (MPI) began to study the plume in 1996.

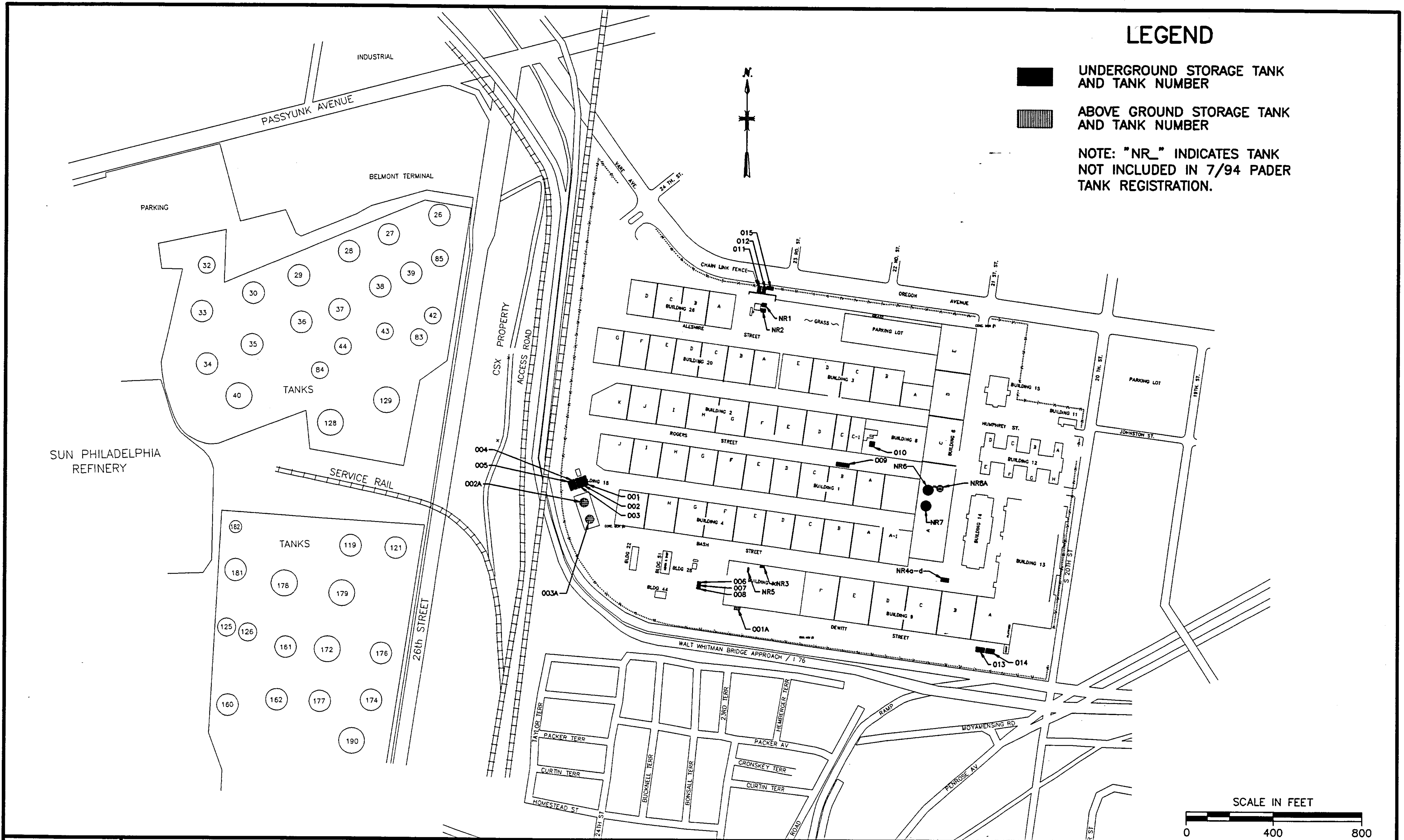
3.3.2 Review of Storage Tank Records

Many of the available reports had presented information regarding storage tanks at DPSC. In many cases, different literature sources provided contradictory information for any given storage tank. An evaluation and discussion of the results of this review are summarized in Section 6.1.2.

The locations of on-site storage tanks are shown in Figure 3-4. The storage tanks have been numbered in accordance with their designation on the PADEP Tank Registration and Closure Notification forms. Underground storage tanks (USTs) are designated as Tanks 001 through 015. Eleven additional tanks have been identified which are not included on the PADEP Tank Registration and Closure Notification forms. These are denoted as Tanks NR1 through NR8A ("NR" indicating "Not Registered"). Aboveground storage tanks are designated as Tanks 001A through 005A and NR6A through NR8A.

3.3.3 Review of Regulatory and Historical Records

Environmental Risk Information and Imaging Services, Inc. (ERIIS) performed a database search of available environmental records maintained by federal and state sources for DPSC and facilities in the vicinity of DPSC. The databases included in their search, and the search distances used, are provided in the ERIIS report (Appendix F), which was prepared on October 30, 1996. Historical maps including Sanborn Company Fire Insurance (Sanborn) Maps for DPSC were included in the ERIIS report and were reviewed to identify potential on-site and off-site sources of the NAPL plume. The results of the database search are summarized in Section 6.1.3 and Section 6.2.1.



LEGEND

■ UNDERGROUND STORAGE TANK AND TANK NUMBER

▥ ABOVE GROUND STORAGE TANK AND TANK NUMBER

NOTE: "NR_" INDICATES TANK NOT INCLUDED IN 7/94 PADER TANK REGISTRATION.

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ON-SITE STORAGE TANK LOCATIONS

MALCOLM PIRNIE, INC.

FIGURE 3-4

3705 : 02856439 00\I:\ACAD\PROJ\02856439\0285DPR2 SCALE: 1:1i 02/24, 1997 at 09:29

XREF: X643_01

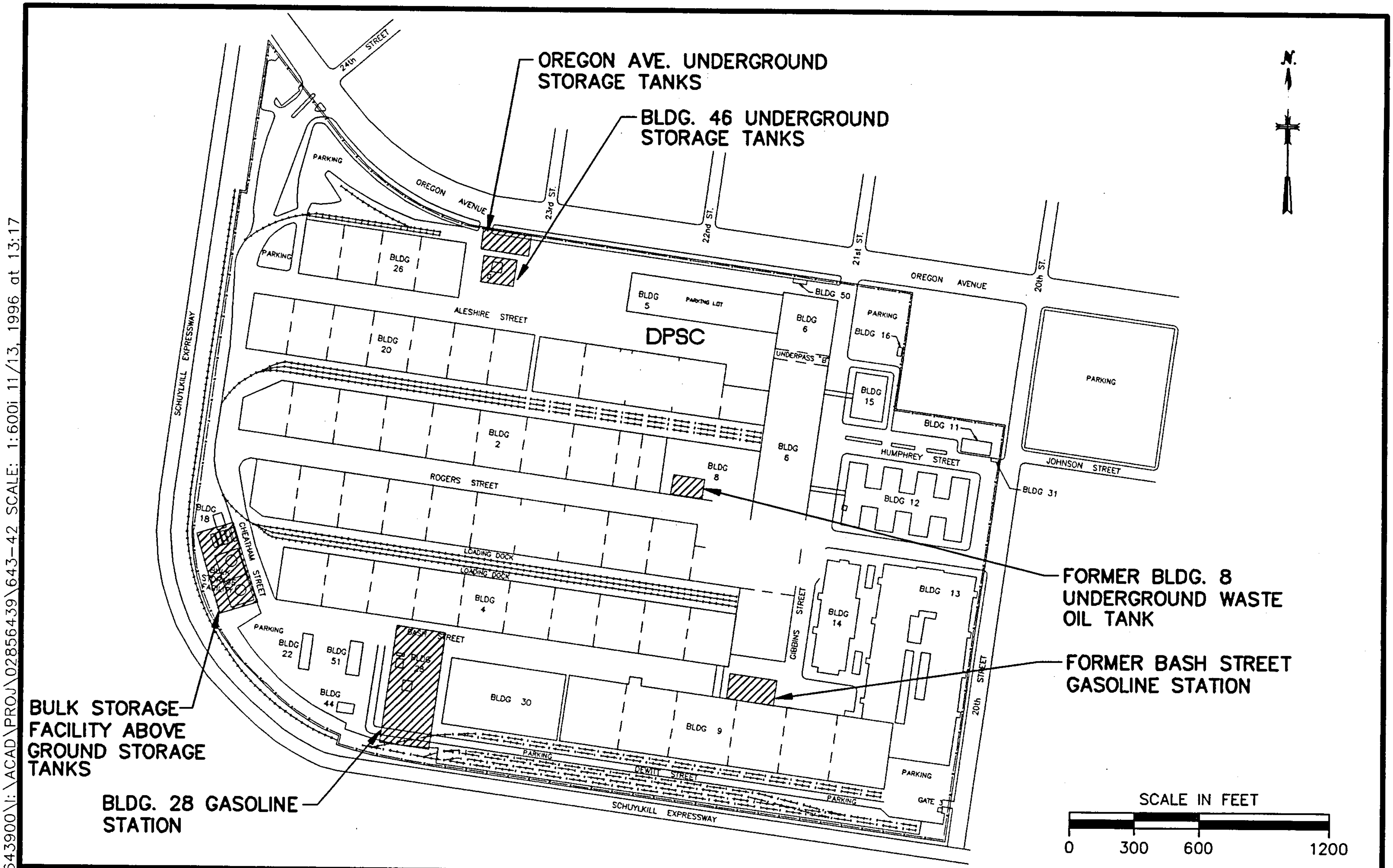
3.3.4 Phase II Expanded Site Investigation

In support of BRAC activities, a Phase II Expanded Site Investigation (ESI) was performed to address seven prioritized sites at DPSC (Figure 3-5). Six of these sites were locations of present or former storage tanks studied during the review of storage tank records. As part of the review, the need for further investigation was evaluated, and six tank areas identified as having the greatest potential to have contributed to the plume were investigated under the Phase II ESI program. The results of the Phase II ESI are incorporated into this report and are also summarized in Section 6.1.4. Field and investigative methods for the Phase II ESI were performed in accordance with the FSP - Expanded Site Investigation. The rationale for investigating each of these sites is included, below.

3.3.4.1 Building 8 Waste Oil Tank

The Building 8 waste oil tank has a capacity of 550 gallons and is designated Tank 010. This tank was reportedly in operation between 1973 and 1992, and stored used oils from two facility emergency diesel generators within the Building 8 boiler plant. This tank was removed in May 1994 in accordance with applicable PADEP tank closure regulations. The condition of the tank was described as intact, with no evidence of holes or leakage from the tank or piping. No record of previous pressure testing of the tank was indicated in the literature. The tank closure report states that during the tank closure and removal, no contaminated soil was encountered. Upon review of the tank closure report by PADEP, additional sampling and analytical testing was required at this location due to a high level of TPH in one post-excavation sample.

To satisfy PADEP tank closure requirements and to assess the potential contribution of the site to the plume, four soil borings were drilled around the perimeter of this former UST as part of the recent ESI program to assess the horizontal and vertical extent of potential contamination. The results of soil samples and drilling activities at this site are summarized in Section 6.1.4.1.



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PHASE II ESI STUDY AREAS

MALCOLM PIRNIE, INC.

FIGURE 3-5

4871 : 0285643900\I:\ACAD\PROJ\02856439\643-42 SCALE: 1:600i 11/13, 1996 at 13:17

3.3.4.2 Former Bash Street Gasoline Station

Historic drawings indicated that a former gasoline station had been present where Building 9 is currently located. Prior to 1941, this station was supplied by four USTs located adjacent to Building 9, near Buildings 6 and 14. The four tanks, designated as NR4-a through NR4-d, were installed within a concrete vault. Limited information was known about the usage of the tanks, years in service, or their exact contents. None of the available records indicated that the tanks had been removed. However, given the proximity of the tanks to Building 9, it is likely that they were removed prior to or during the construction of Building 9 to prevent interference with the foundation or basement of the building.

A geophysical survey, comprised of both a ground-penetrating radar (GPR) survey and a cable-and-pipe locator survey, was performed to assess the presence or absence of the USTs, to locate adjacent utilities and to determine potential soil boring locations which were clear of utilities or obstructions. Four soil borings were drilled in this area. Soil samples were collected and analyzed in accordance with the approved FSP- Expanded Site Investigation. The results of the geophysical survey and soil sampling and analysis are summarized in Section 6.1.4.2.

3.3.4.3 Bulk Storage Facility and Fill/Transport Area

The Bulk Storage Facility consists of five active 25,000 gallon USTs (Tanks 001 through 005), two 200,000 gallon ASTs (Tanks 002A and 003A), and the fuel unloading ports. These tanks, which store No. 6 fuel oil, are located south of and adjacent to Building 18 and are situated within the northern boundary of the NAPL plume. They also supply fuel to the Boiler House in Building 8 by means of a fuel tunnel, which is discussed in Section 3.3.4.7.

The five USTs were tested for tightness in November, 1994, and passed. It is not known whether the ASTs have ever been tested for tightness. There have been no documented releases from the USTs, ASTs or associated piping.

The investigation of the Bulk Storage Facility was designed to evaluate the presence or absence of lead contamination in the surrounding soils as a result of tank maintenance, through deterioration of lead-based paint, over-sprays or drips. This study was also designed to evaluate these tanks as potential sources to the NAPL plume, since no integrity testing or prior investigations were known to have been performed. Investigation of the ASTs consisted of six hand-augered borings around the perimeters of the tanks inside the barrier walls. The results of these field activities and soil sample analyses, as performed according to the FSP-Expanded Site Investigation, are summarized in Section 6.1.4.3.

Investigation of the fuel unloading ports was prompted by a PADEP site visit in October 1995, when staining of surficial soil around the ports was observed. DPSC remediated the area by removing the contaminated soil and backfilling with "clean" material. The Phase II ESI scope included eight soil borings, drilled adjacent to the fill ports and along the fuel transport utility trench. Soil samples were collected and analyzed in accordance with the FSP-Expanded Site Investigation to assess any potential environmental impact of the Bulk Storage Facility. The results of this investigation are summarized in Section 6.1.4.3.

3.3.4.4 Building 28 Gasoline Station

In 1988, three former USTs (Tanks 006, 007, and 008) and associated piping for the Building 28 Gasoline Station were tested for tightness. Although no report of the pressure testing results has been made available, no leaks were detected, as documented in the Final Phase I RI/FS (Kemron/Versar, 1995) and the Draft Feasibility Report for Replacement of USTs at DPSC (Baker Environmental, Inc., 1992). These tanks stored gasoline and diesel fuel from 1971 until May 1994, when they were removed as part of a site-wide tank closure effort. The tank closure report submitted to PADEP stated that 30 cubic yards of contaminated soil were removed during closure and removal of the tanks in 1994, but additional contaminated soil was left in place.

The Building 28 investigation included a geophysical survey, soil borings and test pits, and soil sampling and analytical testing in order to delineate the limits of contamination in this area and to assess the potential contribution of this AOC to the NAPL plume. This investigation was also performed to satisfy PADEP additional requirements for tank closure. The results of these field activities are summarized in Section 6.1.4.4.

Available DPSC fuel records were reviewed, and a product mass balance was performed for the Building 28 gasoline station. The frequency or volume of deliveries made to the site were compared to the rate of fuel consumption. The results of this analysis are also included in Section 6.1.4.4.

3.3.4.5 Building 46 USTs

These two tanks, designated as NR1 and NR2, are included in the discussion of USTs in the BRAC Cleanup Plan final report. They were located on the east end of Building 46. The dates of installation and service, the size and capacity, and the contents of these tanks are unknown. The BRAC report also states that the existence of these tanks had not been confirmed.

A geophysical survey, comprised of both a GPR survey, and a cable-and-pipe locator survey, was performed at the Building 46 UST area. This survey was intended to determine the presence or absence of the two USTs in this area. The results of the Building 46 area investigation are provided in Section 6.1.4.5.

3.3.4.6 Oregon Avenue USTs

This area is located along the southern side of Oregon Avenue, at the northern border of the site, and approximately 800 feet north of the limits of the NAPL plume as delineated in the Final Phase I RI/FS. Tanks 011 and 012 were in operation from 1922 until 1941, and were removed in July 1994. Tank 015 was discovered during excavation of Tanks 011 and 012 for closure. The operational history of these tanks is unknown. The tank closure reports indicated that Tanks 011 and 012 were intact, however, a small hole was discovered in the bottom of Tank No. 015 during closure.

Analyses of soil samples taken during closure indicated TPH values ranging from 3,400 ppm to 57,000 ppm. The Closure Report Form for Tanks 011 and 012 indicates that excavation was performed to the bottom of the tanks, and that the excavated soil was contaminated with petroleum. The bottom of the excavation was covered with plastic prior to backfilling. Not all of the contaminated soil was removed.

ESI field activities included a geophysical survey to locate the former tank excavation, tank piping, and identify areas where soil borings could be drilled. A total of 20 soil borings were drilled in this area. Monitoring wells were installed in two of these borings and were designated MW-21 and MW-22 (Figure 3-1). Soil samples collected during drilling were analyzed according to the FSP-Expanded Site Investigation. Groundwater samples collected from MW-21 and MW-22 were analyzed for Target Analyte List (TAL) volatile organic compounds (VOCs). Results of drilling and sampling activities are summarized in Section 6.1.4.6.

3.3.4.7 Fuel Transport Tunnel

The Fuel Transport Tunnel was used to transport No. 6 fuel oil from the Bulk Storage Facility to the boiler plant. This site was not investigated during the Phase II ESI program due to the inability to video inspect or otherwise visually inspect the tunnel. Its potential contribution to the NAPL plume is considered extremely low, due to several factors. The tunnel is of concrete construction, and is frequently flooded due to infiltration of surface runoff. It is connected to the storm drainage system, which discharges into the Schuylkill River. Any fuel spills which did occur would likely be contained within the tunnel, and subsequently flushed out of the tunnel during a flooding event. Furthermore, the No. 6 fuel transported within the tunnel has physical properties which hinder its mobility within the ground, as explained in Section 6.1.4.3. Any breaches along the length of the tunnel would result in an extremely localized spill. The base of tunnel is typically more than eight feet above the water table, making it very unlikely that a fuel spill could affect the groundwater. This site has been eliminated as a potential source of the NAPL plume for these reasons. However, this area will be investigated as part of the proposed Phase III ESI program.

3.4 POTENTIAL OFF-SITE NAPL SOURCES

The ERIIS regulatory database search included the identification of federal and state-listed facilities located within specified distances from DPSC. Potential off-site sources of NAPL were also evaluated by reviewing the findings of previously conducted field activities on the ARCO/Sun Refinery property located on the west side of the CSX property, and the Southeast Pennsylvania Transportation Authority (SEPTA) property located across 20th Street to the east of DPSC. Historic maps dated from the 1920s to the 1990s were reviewed to identify other potential off-site sources. A summary of the records review is included in Section 6.2.1. The ERIIS report is provided in Appendix F.

4.0 NAPL CHARACTERISTICS

One of the main objectives of this study was to assess the characteristics of the NAPL plume at DPSC and the surrounding area. This information was used to evaluate the potential sources and migration pathways of the NAPL plume, and to estimate the volume of NAPL beneath DPSC. Available historical information related to the extent, quantity, and composition of NAPL was incomplete. These data gaps were addressed by implementing the FSP-NAPL Plume Confirmation Study and performing NAPL baildown/recovery tests. This section summarizes the data collected during these studies and provides an interpretation of the findings.

4.1 EXTENT OF NAPL

4.1.1 Historical Information

A review of previous field activities/investigations on DPSC and on surrounding properties was performed. Prior subsurface activities included soil borings associated with the construction of on-site buildings, the Schuylkill Expressway, and the 26th Street, Pollock Street/Packer Avenue, and Passyunk Avenue sewers. Information from these borings and the tunneling associated with the 26th Street sewer, provided evidence on the historical distribution of petroleum contamination in the study area. The results of each field activity/study, with respect to the extent of, and potential contribution to, the NAPL plume in the study area, are summarized, below. A discussion of this historical information with respect to the migration of NAPL in the study area is provided in Section 5.0.

4.1.1.1 Pollock Street/Packer Avenue Sewer Borings

During pre-construction activities of the Pollock Street/Packer Avenue Sewer in 1916, soil borings were drilled along the proposed sewer line (Plate 4-1). These borings were drilled into the water table. The logs for these soil borings do not indicate the presence of petroleum in this area on this date.

4.1.1.2 DPSC Geotechnical Borings

In the 1940s, approximately 50 soil borings were drilled during geotechnical investigations of the southeastern portion of DPSC prior to the construction of Buildings 9, 13, and 14. All of these borings were drilled into the water table. No reference to NAPL or petroleum contamination was recorded on the logs of these borings. Based on this information, these borings appear to have pre-dated the presence of NAPL beneath the southeastern portion of DPSC.

4.1.1.3 Schuylkill Expressway Borings

Soil borings were drilled in 1955 along the proposed Schuylkill Expressway, which was subsequently constructed along the southern and western boundaries of DPSC. These soil borings were drilled into the water table. The log for one of these borings, Boring B, located between the western portion of DPSC and the current CSX property (Plate 4-1) refers to 14 feet of oil-saturated soils.

4.1.1.4 26th Avenue and Passyunk Avenue Sewer Construction

During the construction of the 26th Avenue and Passyunk Avenue Sewers from 1964 through 1966, petroleum was encountered in tunnel shafts, manholes, and soil borings in this area. The soil borings were drilled into the water table. Numerous references to the presence of petroleum were indicated in construction field logs and are presented on Plate 4-1. This information indicates that in the mid-1960s, petroleum extended along the length of 26th Street in the study area.

4.1.2 Drilling Activities

To better define the extent of NAPL on DPSC and on adjacent properties, additional field work was performed as outlined in the modified FSP-NAPL Plume Confirmation Study. A total of 20 borings were drilled on DPSC, CSX property, and the area to the south of DPSC. Monitoring wells were installed in 12 of these boreholes. A summary of observations made during drilling activities is provided below for each newly drilled boring. Well construction details are summarized below for each newly installed monitoring well.

Monitoring well and soil boring locations are shown on Figures 3-1 and 3-2, respectively. Well construction diagrams and boring logs are provided in Appendix A and Appendix B, respectively.

4.1.2.1 Monitoring Wells on DPSC

- **MW-23.** The borehole for this well was drilled in the southwestern portion of the site to 30 feet below ground surface (bgs). The upper two feet of this boring consisted of silt and angular gravel and was designated as railroad bedding fill. Silt and silty sand were present from two feet bgs to approximately eight feet bgs. A poorly sorted sand layer was present from eight feet bgs to 12 feet bgs. Interbeds of poorly sorted gravel and sand were encountered in the remaining 18 feet of the borehole. The water table was estimated to be at approximately 18.5 feet bgs. PID readings of greater than 20 parts per million (ppm) and petroleum odors were detected in an interval of approximately 11 to 18 feet bgs. Strong petroleum odors and PID readings in excess of 100 ppm were noted from 18 to 30 feet bgs. Petroleum stained soils were present from approximately 25 to 26 feet bgs. A four-inch PVC well, screened from 16 to 26 feet bgs and intersecting the water table, was installed in the borehole.

- **MW-24.** The 30-foot deep borehole for this well was drilled in the central portion of DPSC along Rodgers Street. An oxidized silt layer was present from zero to approximately six feet bgs. This silt layer graded to sand and gravel from six to eight feet bgs. The remainder of the boring consisted of a poorly sorted gravel with the exception of an approximately five-foot thick poorly sorted sand layer from 14 to 19 feet bgs. The water table was estimated to be at approximately 18.5 feet bgs. PID readings of greater than 20 ppm and petroleum odors were detected in soil samples collected at a depth of approximately 14 feet bgs. Strong petroleum odors and PID readings in excess of 100 ppm were noted from 16 to 30 feet bgs. Petroleum stained soils were present from approximately 20 to 21 feet bgs and from 22 to 23 feet bgs. The borehole was completed with a four-inch PVC well, which was screened across the water table from approximately 17 to 27 feet bgs.

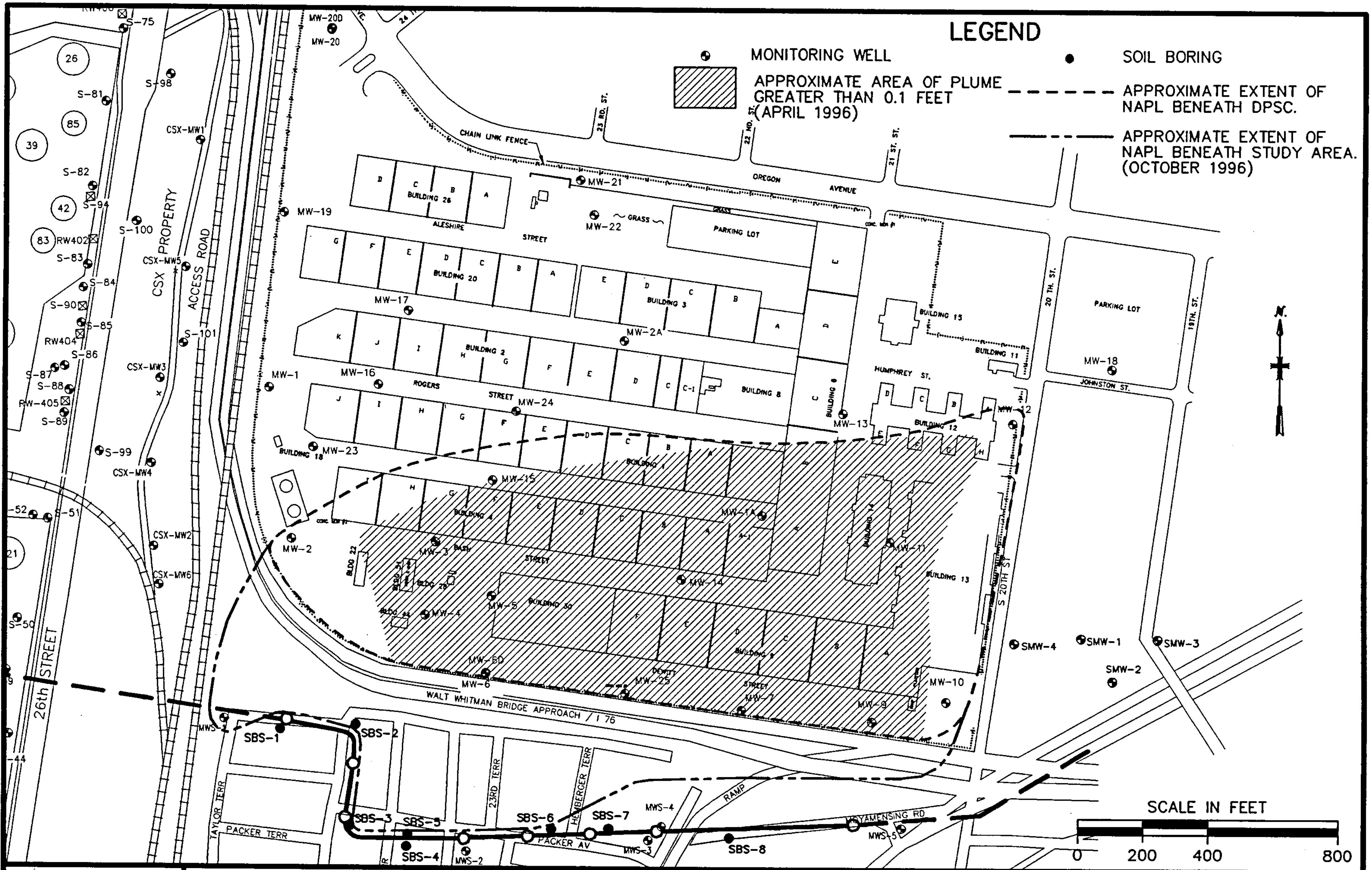
- **MW-25.** The borehole for this well was drilled to 30 feet bgs along the southern side of Dewitt Street in the south-central portion of DPSC. Fill, consisting of ash, slag, and fire brick comprised the zero to approximately five-foot depth interval. This fill unit was underlain by silt and fine sand to nine feet bgs. The remaining 21 feet of the boring consisted of alternating layers of sand and gravel. PID readings of greater than 20 ppm and petroleum odors were detected in soil samples collected from 12 to 16 feet bgs. Strong petroleum odors and PID readings of 100 ppm and greater were noted from 16 to 30 feet bgs. Soil samples collected from approximately 18 to 22 feet bgs were saturated with NAPL. The level of NAPL was estimated at approximately 18 feet bgs. A petroleum sheen was visible on the surfaces of sand and gravel collected from 22 to 30 feet bgs. A six-inch PVC well, screened from 16.5 to 26.5 feet bgs and intersecting the top of NAPL and the water table, was installed in the borehole.

The presence or absence of NAPL was monitored in these wells following well development. Due to the absence of measurable NAPL in MW-24 on October 16, 1996, and the minimal amount (0.01 feet) of measurable NAPL in MW-24 on November 15, 1996, the north-central extent of the on-site NAPL plume has been approximated. The northwestern extent of the on-site NAPL plume has been approximated, based on the absence of NAPL in MW-23. The installation of MW-25 confirmed the presence of the NAPL plume in the southern portion of DPSC. The on-site extent of the NAPL plume on October 1996 and November 1996 are depicted in Figures 4-1 and 4-2, respectively. NAPL is present beneath approximately 42 acres in the southern portion of DPSC.

4.1.2.2 Monitoring Wells on CSX Property

- **CSX-MW-3.** The 53-foot borehole for this well was drilled along the western side of the access road on the CSX property. A fill unit, consisting of coal ash, slag, and brick was present from zero to approximately 34 feet bgs. Native silt comprised the 34 to 39-foot depth interval. Alternating layers of gravel and sand were encountered in the remainder of the boring. The water table was estimated to be at approximately 45.5 feet bgs. Strong petroleum odors and PID readings in excess of 90 ppm were present from approximately 45 to 51 feet bgs. Thin layers (less than one foot thick) of petroleum stained soils were present from approximately 47 to 48 feet bgs and from 48 to 48.5 feet bgs. A petroleum sheen was noted on gravel at approximately 50 feet bgs. A two-inch PVC well, screened from 42 to 52 feet bgs and intersecting the water table, was installed in the borehole.

- **CSX-MW-4.** The borehole for this well was drilled to a depth of 54 feet bgs along the eastern side of the CSX access road. The fill unit in this boring extended from the ground surface to approximately 29 feet bgs. An oxidized silt layer was present from 29 to approximately 32 feet bgs. This silt layer was underlain by sand to a depth of approximately 37 feet. An approximately two-foot thick gravel layer separated this sand layer from an eight-foot thick petroleum stained sand unit. Gravel interbedded with thin sand layers was encountered in the remainder of the boring. The water table was estimated to be at approximately 45.5 feet bgs. PID readings of greater than 20 ppm and



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APPROXIMATE EXTENT OF NAPL PLUME BENEATH DPSC AND STUDY AREA (OCTOBER 16, 1996)

MALCOLM PIRNIE, INC.

FIGURE 4-1

3705 : 02856439001:\ACAD\PROJ\02856439\643-68 SCALE: 1:1i 02/24, 1997 at 11:03

XREF: X643-01

petroleum odors were detected in soil samples collected from approximately 37 to 43 feet bgs. Strong petroleum odors and PID readings in excess of 100 ppm were noted from 43 to 54 feet bgs. The borehole was completed with a two-inch PVC well, which was screened across the water table from approximately 43 to 53 feet bgs. Volatile organic vapors vented from the top of the well following installation.

- **CSX-MW-5.** The 54-foot deep borehole for this well was drilled along the eastern side of the CSX access road. The upper approximately 43 feet consisted of fill. A two-foot thick silt layer separated the fill from alternating sand and gravel units, which were encountered in the remainder of the boring. A saturated layer was perched above the silt from approximately 35 to 43 feet bgs. The water table was estimated to be present at approximately 45.5 feet bgs. Strong petroleum odors and PID readings in excess of 100 ppm were noted from 45 to 54 feet bgs. Petroleum stained soils were present at approximately 49 and 53 feet bgs. A two-inch PVC well, screened from approximately 44 to 54 feet bgs and intersecting the water table, was installed in the borehole.

- **CSX-MW-6.** The borehole for this well extended to a depth of 52 feet bgs and was drilled near the service railroad leading onto the ARCO/Sun Refinery property. The fill unit at this location extended from the ground surface to approximately 30 feet bgs. Layers of silt and fine sand were present from 30 to 37 feet bgs. Alternating layers of sand and gravel were encountered in the remainder of the boring. The water table was estimated to be at approximately 41 feet bgs. Strong petroleum odors and PID readings in excess of 100 ppm were noted from 42 to 52 feet bgs. Petroleum stained soils and a petroleum sheen were present from approximately 46 to 49 feet bgs. The borehole was completed with a two-inch PVC well, which was screened across the water table from approximately 42 to 52 feet bgs.

Petroleum sheens were present on the water purged from these wells during development and prior to sampling. During synoptic fluid-level measurements on October 16, 1996 and November 15, 1996, no measurable NAPL was present in these wells. As discussed in Section 5.2.2, the data indicate that the petroleum sheens which are present are part of the residuum from prior NAPL in this area.

4.1.2.3 Monitoring Wells/Soil Borings South of DPSC

- **MWS-1.** The borehole for this well was drilled to a depth of 32 feet bgs in the northwestern portion of Passyunk Homes along the southern side of the Pollock Street/Packer Avenue sewer. A silt layer was present from zero to approximately eight feet bgs. Undifferentiated sands and gravels were encountered in the remainder of the boring. PID readings of 20 ppm and greater were detected at depths of approximately 14 to 20 feet bgs. Strong petroleum odors and PID readings in excess of 100 ppm were noted from 20 to 30 feet bgs. Petroleum stained soils and a petroleum sheen were noted from approximately 27 to 30 feet bgs. The water table was estimated to be at 25 feet bgs. A two-inch PVC well, screened from 20 to 30 feet bgs and intersecting the water table, was installed in the borehole.

- **MWS-2.** This well was located along the southern side of the sewer in the north-central portion of Passyunk Homes. The borehole for this well was drilled to a depth of 28 feet bgs. The upper nine feet consisted of sand and silt, which was underlain by alternating layers of sand and gravel. The water table was estimated to be at approximately 19 feet bgs. PID readings of greater than 20 ppm were detected in soil samples collected from approximately nine to 12 feet bgs. Strong petroleum odors and PID readings in excess of 100 ppm were noted from 18 to 28 feet bgs. Petroleum stained soils and a petroleum sheen were present from approximately 22 to 28 feet bgs. The borehole was completed with a two-inch PVC well, which was screened across the water table from 17 to 27 feet bgs.

- **MWS-3.** The 24-foot deep borehole for this well was drilled along the southern side of the Pollock Street/Packer Avenue sewer in the northwest portion of Passyunk Homes. Fill, containing brick and coal, was present from zero to approximately six feet bgs. The fill was underlain by silt which extended to approximately 13 feet bgs. An undifferentiated gravel and sand unit was encountered in the remainder of the boring. The water table was estimated to be at approximately 15 feet bgs. PID readings of greater than 20 ppm and petroleum odors were detected in soil samples collected from approximately four to 10 feet bgs. Strong petroleum odors and PID readings in excess of 100 ppm were noted from 15 to 24 feet bgs. Petroleum stained soils and a petroleum sheen were present from approximately 17 to 24 feet bgs. A two-inch PVC well, screened from 12 to 22 feet bgs and intersecting the water table, was installed in the borehole.

- **MWS-4.** The borehole for this well was drilled to a depth of 26 feet bgs. The borehole was located on the opposite (north) side of the Pollock Street/Packer Avenue sewer from MWS-3. No logging of soils was performed on this borehole due to its proximity to MWS-3. The water table was estimated to be at approximately 18 feet bgs. The borehole was completed with a two-inch PVC well, which was screened across the water table from 15 to 25 feet bgs.

- **MWS-5.** The borehole for this well was drilled at the intersection of Penrose Avenue and Moyamensing Avenue. The total depth of this borehole was approximately 29 feet bgs. A fill unit, containing ash and burn debris, was present from ground surface to approximately 14 feet bgs. A less than two-foot thick silt layer separated the fill from an undifferentiated sand and gravel unit, which extended to 29 feet bgs. The water table was estimated to be at approximately 12 feet bgs. Strong petroleum odors, a petroleum sheen, and PID readings of 90 ppm and greater were present from 24 to 28 feet bgs. A two-inch PVC well, screened from approximately 18 to 28 feet bgs, was installed in the borehole. The well screen did not intersect the water table, but was screened across the interval where evidence of petroleum contamination was present.

- **SBS-1.** This boring was drilled along the southern side of the Pollock Street/Packer Avenue sewer on the south side of Pollock Terrace in Passyunk Homes. The total depth of the boring was 24 feet, approximately two feet below the measured bottom of the sewer invert in this area. Silt, sand, and gravel, designated as fill, were encountered in the upper six feet of this boring. Sand was present from six to approximately 21 feet. Alternating layers of sand, silt and gravel were encountered in the remainder of the boring. Strong petroleum odors and PID readings in excess of 100 ppm were noted from 22 to 24 feet bgs. Petroleum stained soils were present at approximately 23 feet bgs.

- **SBS-2.** This boring was drilled along the eastern side of 24th street in Passyunk Homes. This location was selected in order to characterize lithology and determine the presence or absence of NAPL along the northern portion of the Pollock Street/Packer Avenue sewer. The sewer curves southward along 24th street in this area. The total depth of the boring was 20 feet, approximately two feet below the estimated bottom of the sewer invert. Silt, sand, gravel and red brick fragments comprised the upper two feet of this boring. Silty sand was present from two to approximately eight feet. Alternating layers of sand, and gravel were encountered in the remainder of the boring, with an approximately one-half foot thick silt layer at 13 feet bgs. NAPL-saturated soils were encountered at approximately 19 feet bgs. Strong petroleum odors and PID readings in excess of 100 ppm were noted from 17 to 20 feet bgs.

- **SBS-3.** This boring was drilled along the eastern and northern side of the Pollock Street/Packer Avenue sewer near the intersection of 24th Street and Packer Street in Passyunk Homes. This location was chosen due to the eastward bend in the sewer approximately 100 feet south of this intersection. The bottom of the sewer invert was measured at 19.7 feet bgs through the manhole on the southern side of Packer Street. The total depth of the boring was 22 feet. Silt and sand were present from ground surface to approximately 10 feet bgs. Alternating layers of sand and gravel were encountered in the remainder of the boring. NAPL was encountered in this boring at approximately 19 feet bgs. Strong petroleum odors and PID readings in excess of 90 ppm were noted from 16 to 22 feet bgs. Black discolored soils were noted at approximately 25 feet bgs.

- **SBS-4.** This 21-foot deep boring was drilled along the southern side of the Pollock Street/Packer Avenue sewer in the north-central portion of Passyunk Homes. The bottom of the sewer invert was measured at approximately 19 feet bgs through a sewer manhole on the southern side of Packer Street. Fill comprised the upper approximately 10 feet of this boring. Upon split-spoon refusal on slag, the boring was moved approximately 10 feet to the south of the original location. Samples collected from 10 feet bgs and from 15 to 21 feet bgs were mostly sand and gravel. Saturated soils were encountered at approximately 19 feet bgs. Strong petroleum odors and PID readings in excess of 50 ppm were noted from 15 to 18 feet bgs. PID readings greater than 150 ppm were measured in samples collected from 17 to 21 feet bgs. No NAPL-saturated soils were present in this boring.

- **SBS-5.** This boring was drilled on the opposite (north) side of the Pollock Street/Packer Avenue sewer from SBS-4. The total depth of the boring was 22 feet, approximately two feet below the estimated bottom of the sewer invert in this area. The upper two feet of this boring consisted of silt, sand, and gravel and was characterized as fill. Alternating layers of silt and sand were present from two to approximately 11 feet bgs. Alternating layers of sand and gravel were encountered in the remainder of the boring. Gravel content decreased with depth. Soils saturated with NAPL were present at approximately 19 feet bgs. Strong petroleum odors and PID readings in excess of 150 ppm were noted from 16 to 22 feet bgs.

- **SBS-6.** This boring was drilled along the northern side of the Pollock Street/Packer Avenue sewer to the northeast of the intersection of 23rd Street and Packer Street. The total depth of this boring was 24 feet, approximately two feet below the estimated bottom of the sewer invert. Alternating layers of sand and silt were present from ground surface to approximately seven feet bgs. Sand and gravel comprised the seven to 12-foot depth interval. Sand, with the exception of sand and gravel at 19 to 20 feet bgs, was encountered in the remainder of the boring. NAPL was present at approximately 17 feet bgs. Strong petroleum odors and PID readings greater than 150 ppm were noted from 24 to 20 feet bgs. Petroleum stained soils were present at approximately 16 and 18 feet bgs.

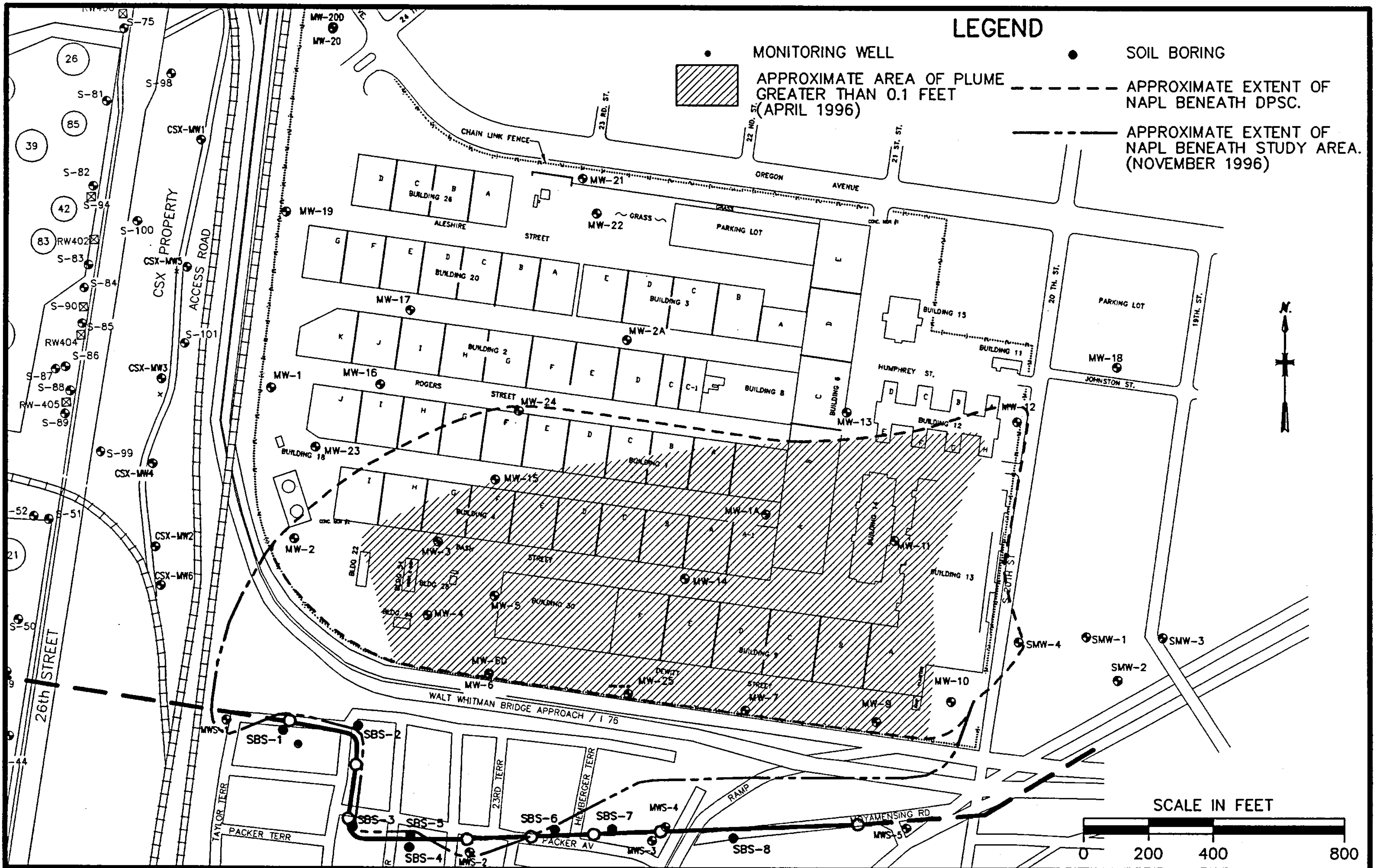
- **SBS-7.** This boring was drilled along the northern side of the Pollock Street/Packer Avenue sewer along Packer Street in the northeast section of Passyunk Homes. The bottom of the sewer invert near this location was measured at approximately 18 feet bgs. The boring was drilled to 20 feet bgs. The upper two feet were characterized as fill. Sand and silt were present from two to approximately 10 feet bgs. Alternating layers of sand and gravel were encountered in the remainder of the boring. The water table was encountered at approximately 17 feet bgs. Strong petroleum odors and PID readings in excess of 100 ppm were noted from 11 to 20 feet bgs. Petroleum stained soils were present at approximately 17 feet bgs. No NAPL-saturated soils were present in this boring, however a petroleum sheen was noted on sand and gravel from 18 to 20 feet bgs.

- **SBS-8.** This boring was drilled along the southern side of the Pollock Street/ Packer Avenue sewer along Moyamensing Avenue. The bottom of the sewer invert was estimated at 14 feet bgs in the manhole located near the intersection of Moyamensing Avenue and Penrose Avenue. The total depth of the boring was 16 feet. Gravel, brick fragments and ash were present from zero to approximately six feet bgs. A two-foot thick silt and sand layer separated the fill from a sand and gravel unit which was encountered in the remainder of the boring. Saturated soils were present at approximately nine feet bgs. No NAPL was present in this boring. Strong petroleum odors, a petroleum sheen, and PID readings in excess of 100 ppm were noted from nine to 16 feet bgs. Petroleum stained soils were present at approximately 13, 14, and 15 feet bgs. Preferential staining was noted in thin (two inches thick) sand layers from 15 to 15.5 feet bgs.

Based on these observations, soils saturated with NAPL are present on the northern side of the Pollock Street/Packer Avenue sewer. Measurable NAPL (0.05 feet thick) was present in MWS-1 and MWS-2 on November 15, 1996. Information from fluid level measurements in monitoring wells on October 16 and November 15, 1996 were used to approximate the extent of NAPL off of DPSC is shown in Figures 4-1 and 4-2.

4.2 THICKNESS AND QUANTITY OF NAPL

The volume of NAPL beneath DPSC which was reported in the Phase I RI/FS was based on assumed NAPL and soil parameters, and an approximated extent of the NAPL plume beneath DPSC. The above-mentioned drilling activities, combined with the results of supplemental laboratory testing of the physical characteristics of the NAPL, were used to revise prior estimates of the NAPL plume volume. A summary of prior apparent thickness measurements, a description of the NAPL baildown/recovery tests, and the revised NAPL plume volume estimate are provided below.



DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

APPROXIMATE EXTENT OF NAPL PLUME BENEATH DPSC AND STUDY AREA (NOVEMBER 15, 1996)

US Army Corps of Engineers

MALCOLM PIRNIE, INC.

FIGURE 4-2

XREF: X643-01

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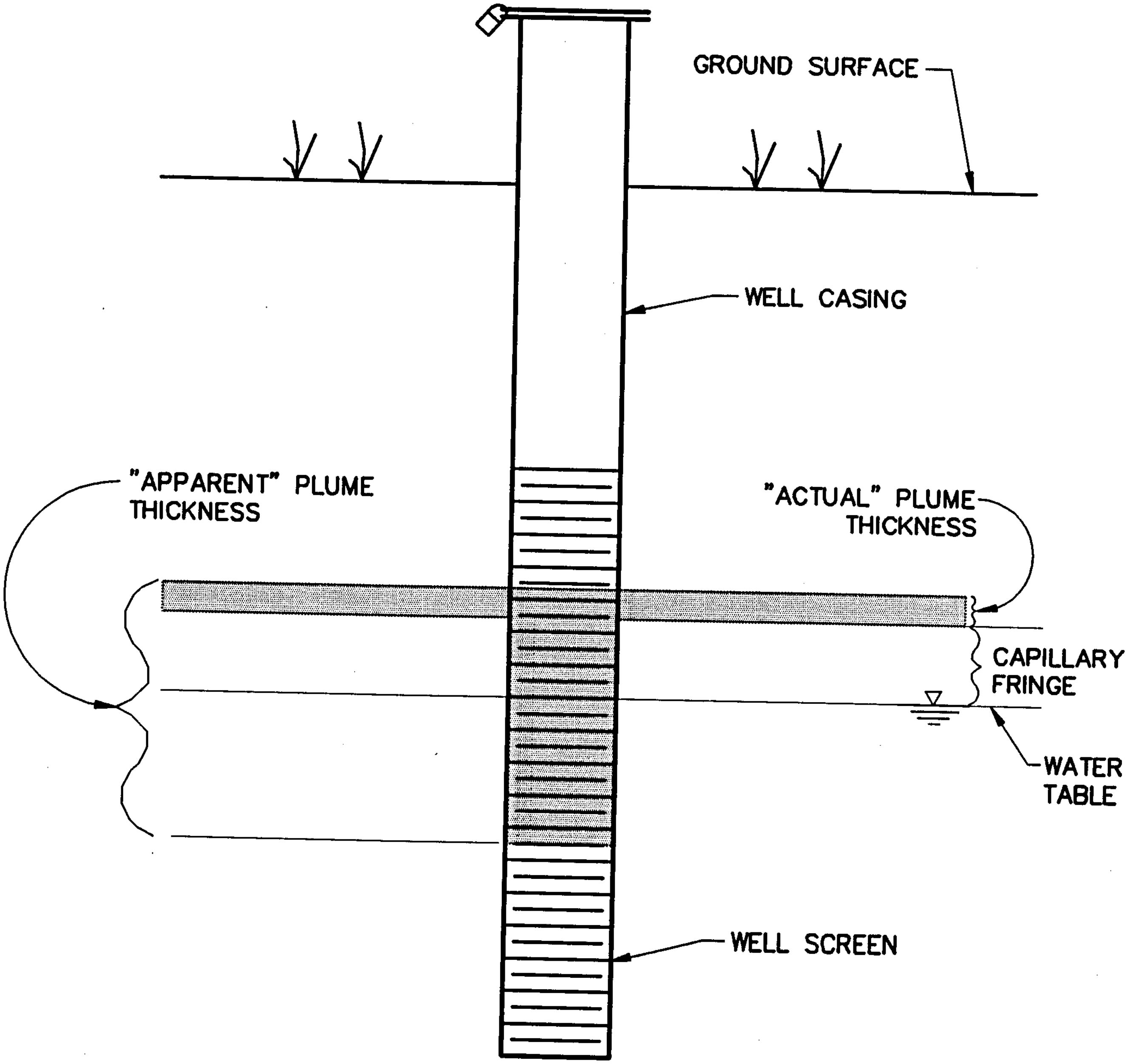
4.2.1 Apparent NAPL Thickness Measurements

On-site wells were monitored for NAPL in June 1991, September 1992, October 1994, December 1994, March 1995, April 1996, July 1996, October 1996, and November 1996. Summaries of these fluid-level measurements are included in Appendix G. Prior to March 1995, a maximum of only nine wells were monitored for NAPL. In March 1995, 11 of 25 wells contained NAPL. During the April 1996 baildown/recovery tests, measurable NAPL was confirmed in these 11 wells and also detected in MW-12, located in the northeastern portion of DPSC. This well had not contained measurable NAPL in any of the previous rounds of monitoring, although petroleum sheens were noted on soils from the borehole for MW-12 in 1994.

In July 1996, 30 on-site and off-site wells were monitored for NAPL. The presence of NAPL was confirmed in 10 of 12 wells which contained NAPL in April 1996. Monitoring wells MW-4 and MW-7, which had previously contained measurable NAPL, were not monitored during this round due to problems with well access. Measurable NAPL was also detected in MW-10, which had not contained NAPL in any of the previous rounds of monitoring. The only other well which contained NAPL in July 1996 was MW-25, which was installed after the April 1996 baildown/recovery tests. During the first round of synoptic fluid-level measurements conducted on October 16, 1996, NAPL was present in 15 of 43 on-site and off-site wells, excluding wells on the ARCO/Sun Refinery property. The only additional NAPL-containing well, MWS-1, had not been installed prior to the July 1996 round of measurements. The second synoptic round, performed on November 15, 1996, confirmed the presence of NAPL in the same 15 of 43 wells, and identified measurable NAPL in MWS-2, MW-24, and SMW-4.

The NAPL thickness measured in a well does not represent the actual thickness of NAPL on the saturated zone. The reason for this difference is illustrated in Figure 4-3. The zone of soil directly above the water table is saturated due to capillary forces, which draw water above the water table into the soil pore spaces. NAPL collects on the top of this capillary zone, or capillary fringe, because NAPL is immiscible in, and less dense than water. A capillary fringe is absent in a monitoring well, due to the absence of capillary forces within the well casing due to the relatively large diameter of the well casing. Therefore, as NAPL



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APPARENT VERSUS ACTUAL PLUME THICKNESS

MALCOLM PIRNIE, INC.

FIGURE 4-3

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enters the well through the well screen from the top of the capillary fringe, it collects on the top of the water column in the well, and equilibrates with the actual level of NAPL in the surrounding soil. If an appreciable amount of NAPL collects on the water surface in the well, the water level will be depressed by the weight of the NAPL.

Site-wide differences in apparent NAPL thicknesses are affected by a variety of factors specific to each well location. The measured NAPL thicknesses in some of the wells may be equivalent to the actual thickness of NAPL on the saturated zone due to either a negligible capillary fringe or an insufficient amount of NAPL to depress the water column in the well. In order to assess the actual thickness of NAPL on the saturated zone at DPSC site, NAPL baildown/recovery tests were performed.

4.2.2 NAPL Baildown/Recovery Tests

By removing NAPL and water from a well, and recording the response of NAPL and water levels in the well over time, the actual NAPL thickness on the water table can be approximated. Estimates of areal NAPL thickness using the results of these baildown/ recovery tests are more representative than estimates based on apparent NAPL thicknesses. In April 1996, NAPL baildown/recovery tests were performed on 12 on-site monitoring wells. NAPL thickness calculations based on these tests are summarized in Table 4-1 and graphs of time versus NAPL/water data are included as Appendix E.

The analytical method proposed by Gruszczenski (1987) was utilized for all baildown/recovery tests. Deviations from this analysis method were required for baildown/ recovery tests at MW-1A, MW-2, MW-3, and MW-9, since inflection points were not identifiable on the time versus depth-to-water curves for these tests. According to Gruszczenski (1987), the MW-1A data (Appendix E) indicates that the apparent NAPL thickness is equivalent to the NAPL thickness in the formation. Calculated NAPL thicknesses for MW-2, MW-3, and MW-9 represent estimated maximum NAPL thicknesses because the respective inflection equilibria appeared to have occurred prior to the first recovery measurements. A NAPL thickness of 0.23 feet was calculated for the baildown/ recovery test in MW-9. This test may have been terminated before the inflection equilibrium. However, a stable NAPL thickness had persisted for approximately four hours. Data curves from

TABLE 4-1

NAPL PLUME STUDY

DEFENSE PERSONNEL SUPPORT CENTER

PHILADELPHIA, PENNSYLVANIA

NAPL BAILDOWN/RECOVERY TEST SUMMARY

Well ID	Measuring Point Elevation (ft AMSL)	April 1996							
		Apparent NAPL Thickness (feet)	**Calculated NAPL Thickness (feet)**	NAPL Elevation (ft AMSL)	Depth to NAPL (ft BMP)	Depth to Water (ft BMP)	Apparent Water-table Elevation (ft AMSL)	Depth to Water (ft BMP)	Corrected Water-table Elevation (ft AMSL)
MW-1	20.78					18.03	2.75		2.75
MW-1A	21.33	0.39	0.41	2.47	18.86	19.25	2.08	0.80	2.39
MW-2	21.83	0.72	0.02	2.14	19.69	20.41	1.42	0.76	1.97
MW-3	20.34	1.46	0.20	2.29	18.05	19.51	0.83	0.77	1.95
MW-4	20.60	1.62	0.14	2.41	18.19	19.81	0.79	0.77	2.03
MW-5	20.32	1.72	0.27	2.37	17.95	19.67	0.65	0.77	1.98
MW-6	21.18	2.33	0.37	2.58	18.60	20.93	0.25	0.77	2.03
MW-7	19.30	1.00	0.12	2.54	16.76	17.76	1.54	0.80	2.34
MW-9	20.08	3.15	0.23	3.06	17.02	20.17	-0.09	0.78	2.36
MW-10	16.56					13.82	2.74		2.74
MW-11	20.21	1.28	0.19	2.45	17.76	19.04	1.17	0.78	2.17
MW-12	19.54	0.32	0.06	2.89	16.65	16.97	2.57	0.83	2.84
MW-13	20.38					17.51	2.87		2.87
MW-14	20.27	1.86	0.31	2.51	17.76	19.62	0.65	0.77	2.08
MW-15	22.58	0.66	0.18	2.28	20.30	20.96	1.62	0.78	2.13

NOTES:

AMSL = Above mean sea level

BMP = Below measuring point

baildown/recovery tests in MW-9 and MW-11 were checked with the analytical method of Hughes, et al. (1988) because relatively small amounts (0 to 10 percent) of water were removed.

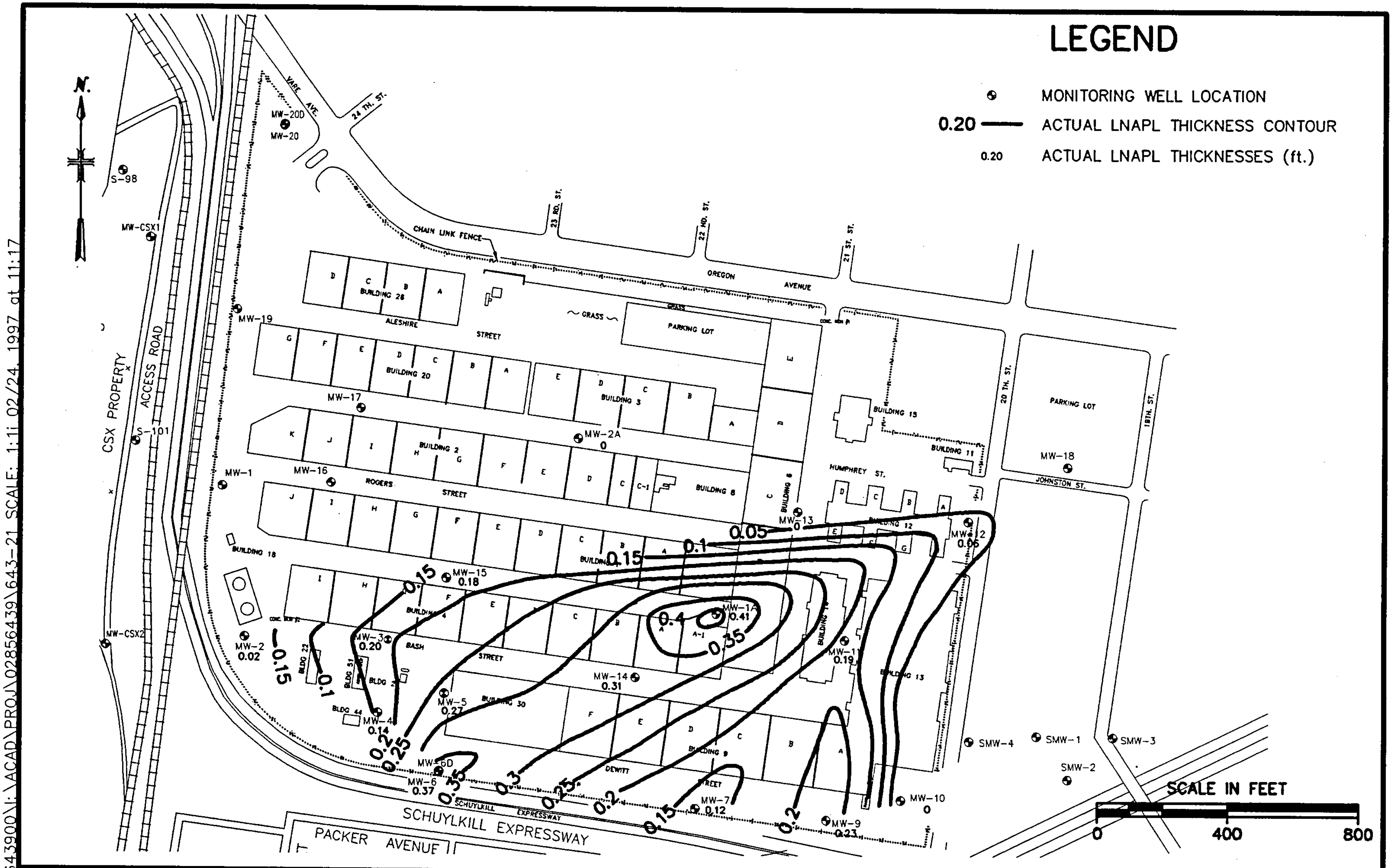
Based on the results of the NAPL baildown/recovery tests, the maximum thickness of the NAPL plume beneath DPSC is approximately 0.4 feet. At the time of the baildown/recovery tests, the thickest portion of the NAPL plume was located at MW-1A located in the center of DPSC. Figure 4-4 presents isopach contours of the NAPL thicknesses based on the baildown/recovery test results. The results of these tests indicate that the average thickness of NAPL beneath DPSC is approximately 0.16 feet.

4.2.3 NAPL Plume Volume Estimation

The apparent NAPL thickness measurements and the approximate on-site extent of NAPL were incorporated into the van Genuchten capillary model, a three-phase capillary pressure model, to estimate the volume of NAPL at DPSC. This model is widely accepted and may provide a more accurate representation of NAPL volume than other methods where relatively thin layers of NAPL are present (Fetter, 1993). The details regarding the use of this method are provided in Appendix H. Information used in this estimate included parameters which were based on geotechnical analyses of soils as reported in the Phase I RI/FS. Although the accuracy of these parameters has not been independently verified by Malcolm Pirnie, these values were considered reasonable for the NAPL volume approximations.

As part of this study, to reduce the uncertainties with the estimate of NAPL volume, specific gravities of NAPL collected from individual monitoring wells, NAPL surface tension, and NAPL-water interfacial tension were measured in the laboratory. Specific gravity contours are shown in Figure 4-5. As described in Appendix H, calculations using the van Genuchten capillary method indicate that the volume of the NAPL plume on the water table beneath DPSC is likely to range from approximately 690,000 to 920,000 gallons.

In addition to the NAPL plume on the water table, residual NAPL is present in soil pores above the NAPL plume. The Phase I RI/FS estimated the volume of residual NAPL in soil contained in a zone from 15 to 30 feet below grade beneath DPSC and within the 500 ppm Total Petroleum Hydrocarbon (TPH) contour. This zone incorporates unsaturated



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USACE CONTRACT NO. DACA31-94-D-0017

NAPL THICKNESSES BASED ON BAILDOWN/RECOVERY TESTS
(APRIL 1996)

US Army Corps
of Engineers

MALCOLM PIRNIE, INC.

FIGURE 4-4

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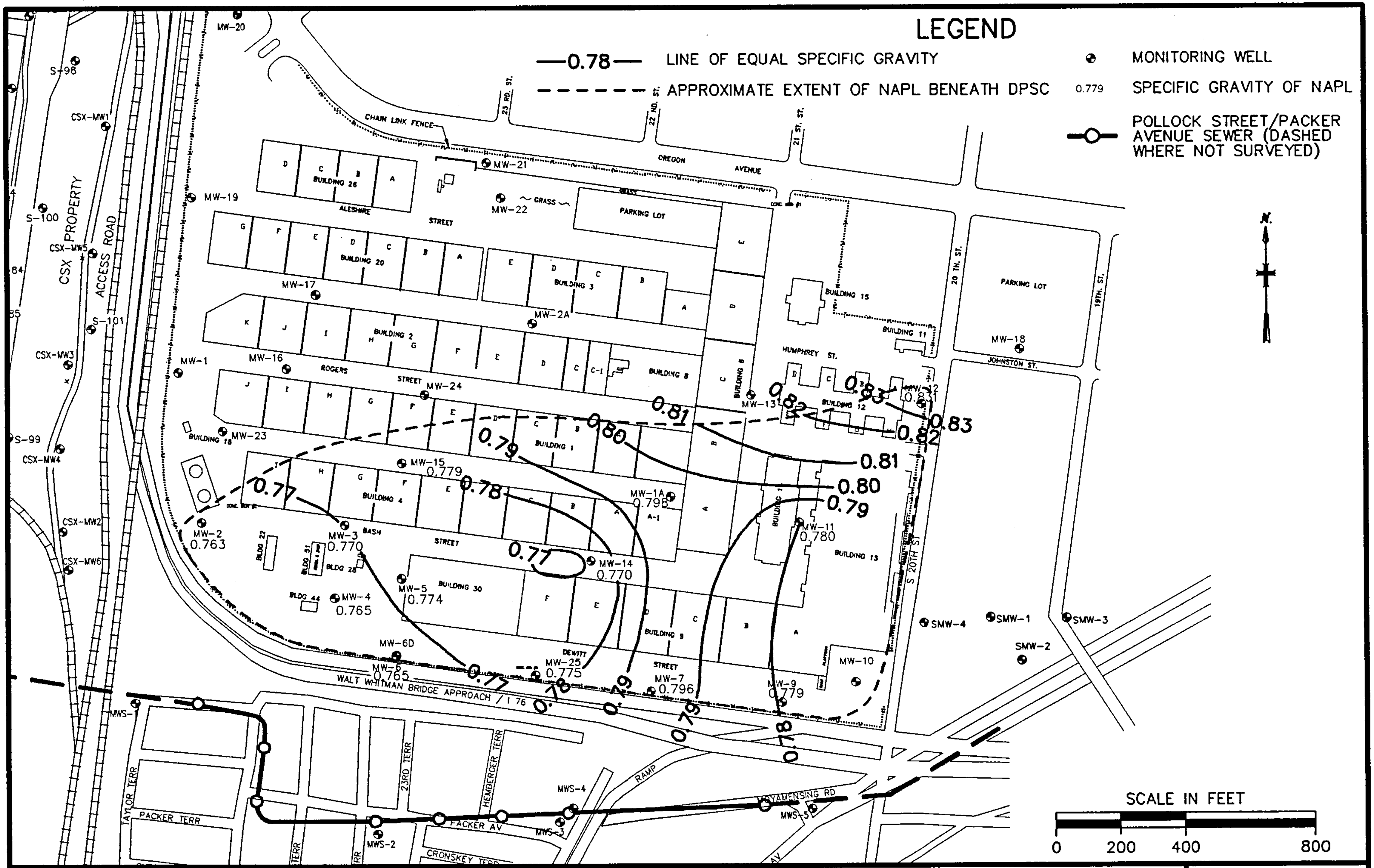

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NAPL SPECIFIC GRAVITY CONTOURS

MALCOLM PIRNIE, INC.

FIGURE 4-5

XREF: X643-01

and saturated soils as the water table below DPSC is at approximately 20 feet below grade. This estimate was conducted with TPH data from the 15- to 30-foot interval and the SoilVol module of SpillCAD. Based on this information, the Phase I RI/FS estimated that 355,000 gallons of TPH were present from 15 to 30 feet below grade. As discussed below, Malcolm Pirnie re-evaluated this estimate.

The amount of residual NAPL in soil above the NAPL plume was estimated from the "volumetric oil (NAPL) content" of soil which is a ratio based on the volume of TPH-contaminated soil. Estimating the non-aqueous phase volume directly from the TPH concentration incurs a very small error, assuming the natural organic concentration of the soil is very low (Parker et al., 1994). TPH soil data for samples collected from a depth of 15 to 30 feet were used in this estimate. The localized TPH-contaminated soil shallower than 15 feet below grade was not included in this estimate because it appears to be unrelated to the NAPL plume. Also, its volume is an order of magnitude less than TPH-contaminated soils from 15 to 30 feet below grade.

Soil in the depth interval that was beneath the air-NAPL or air-water interface was not included in the volume of contaminated soil because this contamination had been largely included as part of the NAPL plume volume calculations. Because the volume of NAPL on top of the water table had been estimated previously as 690,000 to 920,000 gallons, it was not appropriate to include this volume in an estimate of residual NAPL in the soil. Therefore, the volume of TPH-contaminated soil below the air-NAPL and air-water interface was subtracted from the volume of soil between 15 and 30 feet below grade. As discussed in Appendix H, a high estimate for the volume of residual NAPL in soil above the water table is 351,000 gallons.

4.3 COMPOSITION OF NAPL

The NAPL Plume Study and Phase II ESAs included the collection and characterization of soil, groundwater, and NAPL samples from locations on, and adjacent to, the DPSC property. The analytical results are summarized in the Friedman & Bruya, Inc. analytical report, provided as Appendix I. Based on these results, NAPL samples, which were collected from wells screened across the NAPL layer on top of the water table at DPSC, were composed of a minimum of 90 percent undegraded and degraded, light refinery naphtha characteristic of JP-4. This interpretation of the analytical data provided by Friedman & Bruya is based on the boiling point range of NAPL samples, and the pattern of *n*-alkanes indicative of a straight run refinery naphtha (characteristic of JP-4). Due to the proximity of the ARCO/Sun Refinery to DPSC, Friedman & Bruya could not rule out that the naphtha may be composed of refinery intermediates or light crude oil.

The NAPL beneath DPSC is not a fuel oil or boiler fuel due to its incompatible ratio of high to low boiling point compounds, which is not characteristic of fuel oils. The boiling range of the NAPL is not indicative of motor oil, lubricating oil, or solvent. The NAPL is not a diesel based on the uncharacteristic boiling point range and the high flash point, which would be unsafe if used in diesel engines. Although reported previously in the Phase I RI/FS (Kemron/Versar, 1995) as a mixture of gasoline and diesel, the NAPL, according to Friedman and Bruya, is not a gasoline/diesel mixture based on the absence of high octane aromatic compounds commonly found in gasoline, the high amounts of *n*-alkanes not common to gasoline, and the lack of high boiling point compounds present in diesel fuel. Although a minor component of the NAPL plume may be gasoline, as discussed below, the NAPL is not primarily gasoline due to the following:

- The boiling range of the NAPL extends beyond that of gasoline
- The abundance of *n*-alkanes in the NAPL exceeds that found in gasoline
- High octane aromatic compounds commonly found in gasoline are not present in the NAPL

Analytical results of all NAPL, soil, and groundwater samples, collected as part of this NAPL Plume Study, are summarized in Section 5.0 of the QCSR.

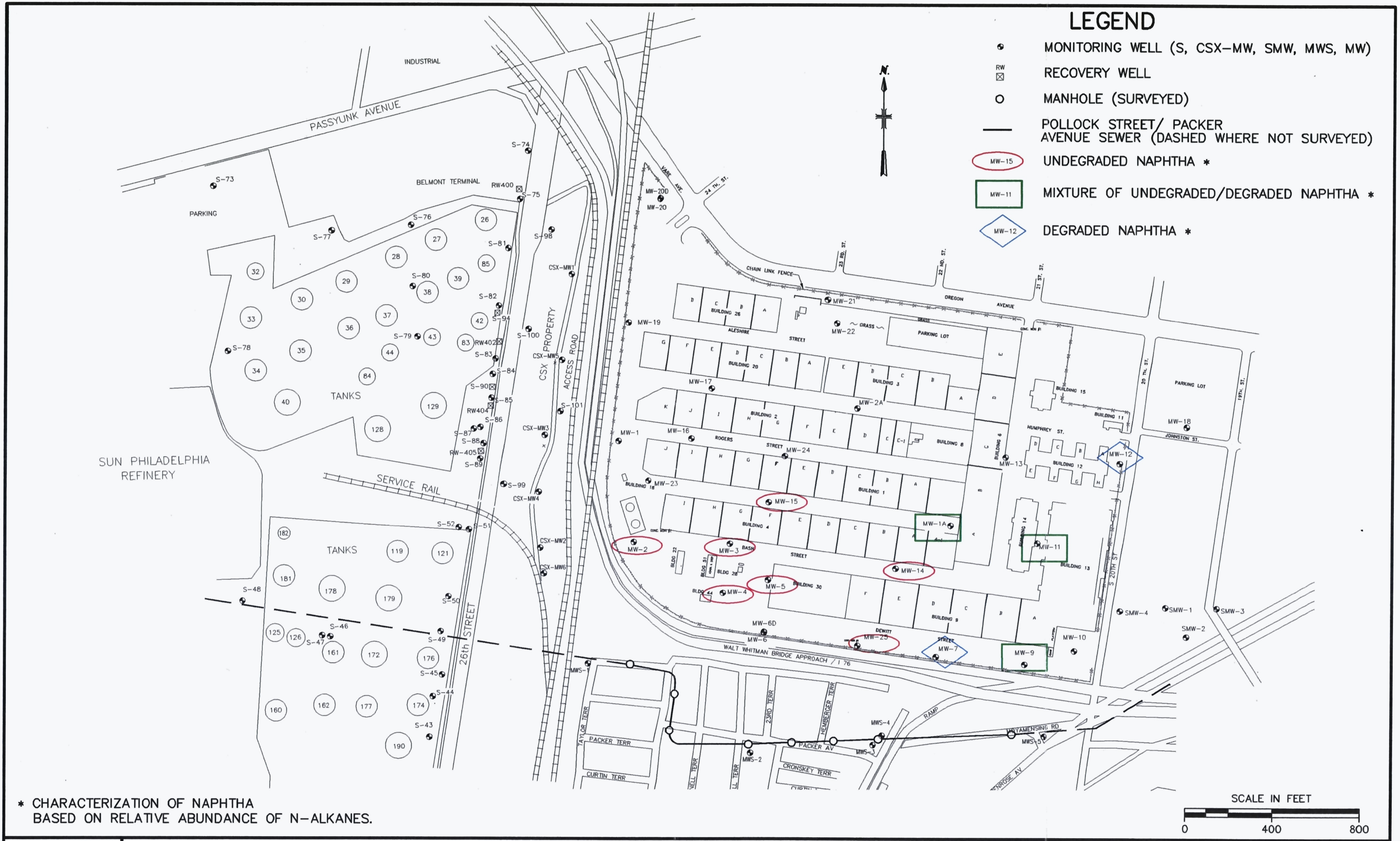
The analysis of some NAPL samples showed the presence of degraded light refinery naphtha (characteristic of JP-4), which was reported to have occurred due to varying degrees of biological degradation and evaporative weathering processes. According to Friedman and Bruya, the degree of NAPL degradation was based on the presence or absence of *n*-alkanes, and the relationship between the quantity of NAPL and its molecular weight. The presence of *n*-alkanes and other highly volatile compounds generally indicates that the NAPL is undegraded, because degradation processes would have likely caused a reduction of these compounds.

According to Friedman and Bruya, the undegraded and degraded light refinery naphtha (characteristic of JP-4) may indicate two separate historical releases. As shown in Figure 4-6, highly degraded naphtha was present in NAPL samples from MW-7 and MW-12, and moderately degraded NAPL samples were collected from MW-1A, MW-11, and MW-9. Based on the abundance of undegraded light refinery naphtha (characteristic of JP-4) in the western portion of the site, the presence of moderately degraded light refinery naphtha in the south-central portion of DPSC is indicative of mixing between the new, undegraded naphtha plume and the old, degraded naphtha plume. Despite the apparent presence of two naphtha plumes, Friedman and Bruya have concluded that the source of the undegraded and degraded light refinery naphtha is the ARCO/Sun Refinery. The proximity of the undegraded light refinery naphtha to the northeastern portion of the ARCO/Sun Refinery South Yard, and the progressive degradation away from the ARCO/Sun Refinery property (see Figures 4-5 and 4-6), further support the conclusion that the source of the NAPL plume beneath DPSC is the ARCO/Sun Refinery property (see Section 5.1.3).

In several NAPL samples, organic lead was detected in two forms, tetramethyl lead and tetraethyl lead. Figures 4-7 and 4-8 show the concentrations of total lead and organic lead in NAPL samples, respectively. The presence of these lead compounds and isooctane, which was also detected in several NAPL samples, indicates that low levels of gasoline are present in the NAPL plume. As provided and discussed in Appendix I, the following table summarizes the estimated relative percent of gasoline in NAPL samples collected at DPSC based on the concentrations of organic lead and isooctane.

Estimated Relative Percent of Gasoline in NAPL Samples

Sample Identification	Based on Lead	Based on Isooctane
MW-1	0.6	0
MW-2	14	15
MW-3	1.4	2.8
MW-4	1.1	15



* CHARACTERIZATION OF NAPHTHA
BASED ON RELATIVE ABUNDANCE OF N-ALKANES.

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CHARACTERIZATION OF NAPHTHA
IN NAPL SAMPLES

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FIGURE 4-6

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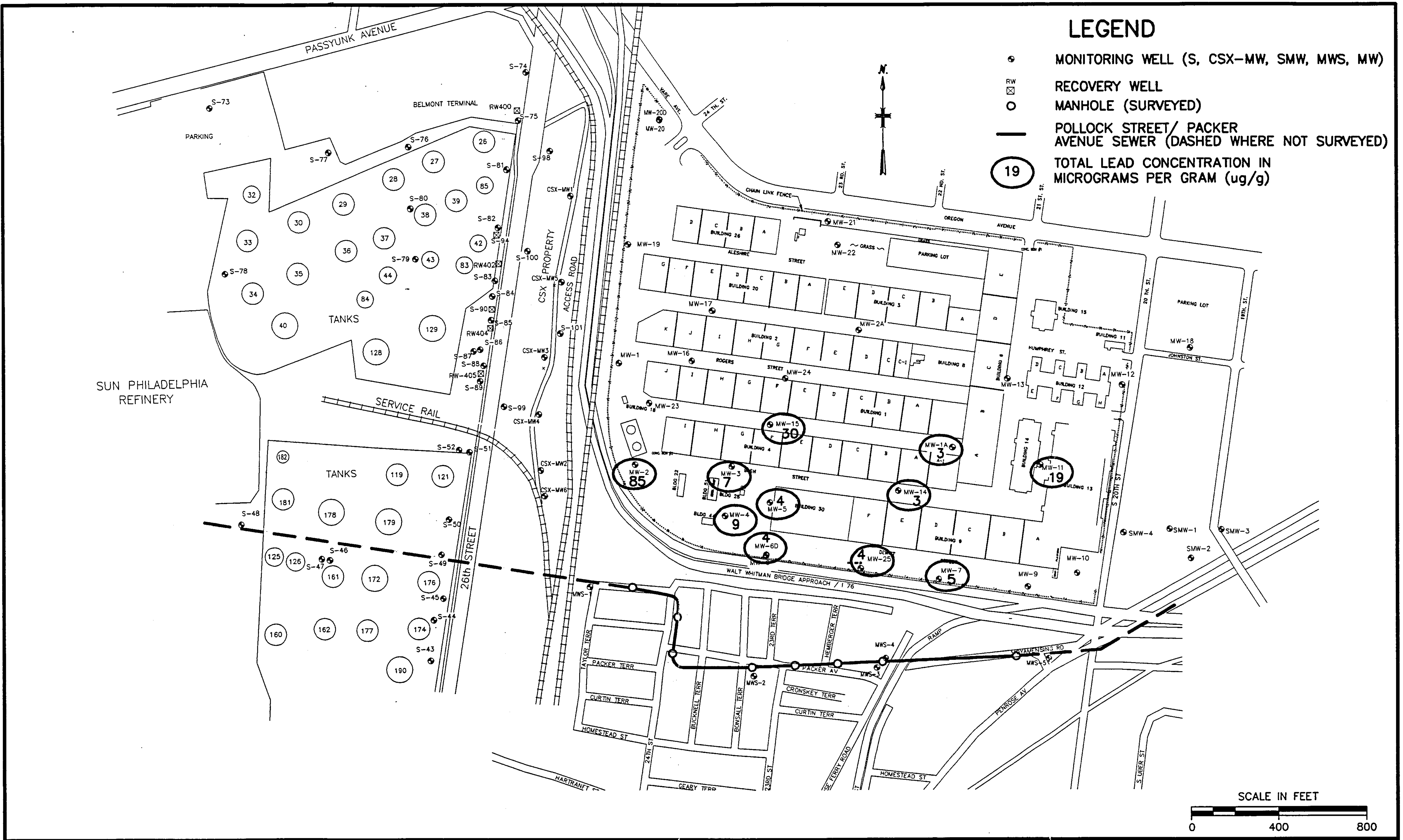

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CONCENTRATION OF TOTAL LEAD
IN NAPL SAMPLES

MALCOLM PIRNIE, INC.

FIGURE 4-7

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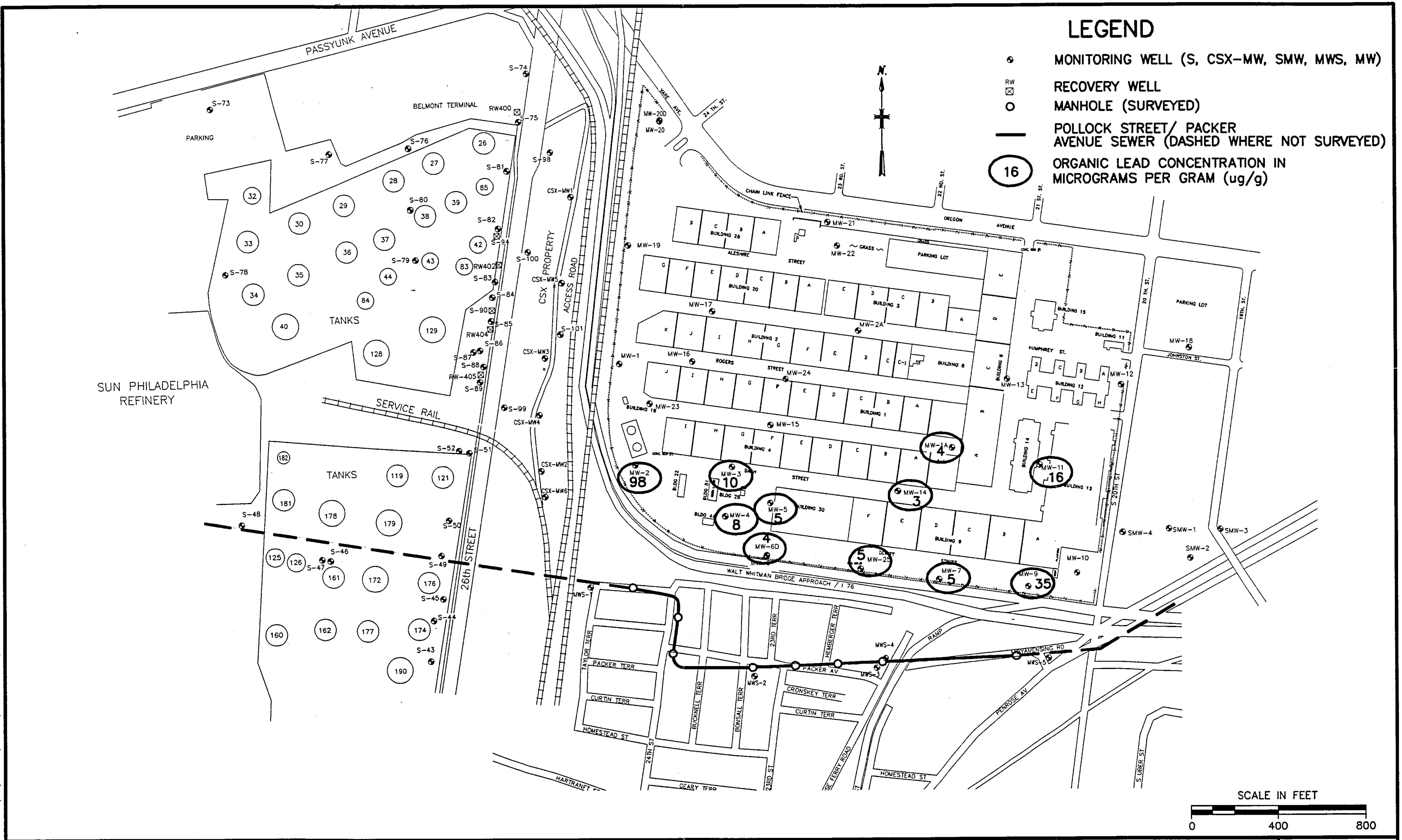

3705 : 02856-5900\I:\ACAD\PROJ\02856439\643-75 SCALE: 1:1i 02/24, 1997 at 10:34

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CONCENTRATION OF ORGANIC LEAD
IN NAPL SAMPLES

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FIGURE 4-8

XREF! X643-01

Sample Identification	Based on Lead	Based on Isooctane
MW-5	0.7	6
MW-6	0.6	16
MW-7	0.7	0
MW-9	5.0	Not Available
MW-11	2.3	0
MW-12	0	0
MW-14	0.6	0
MW-15	0	0
MW-25	0.7	1.6

According to Friedman & Bruya, the distribution and relatively low levels of these gasoline constituents indicate that the gasoline may have been distributed throughout the site (away from its source) by the naphtha as the plume migrated through the study area. In addition, a pattern of *n*-alkanes atypical of gasoline was observed in many of the NAPL samples. Based on the interpretation of these analytical data by Friedman and Bruya, the NAPL is a no more than 10 percent gasoline. See Appendix I for an explanation of the presence and distribution of gasoline constituents in the NAPL plume.

The NAPL sample from MW-12 was characterized as either a highly weathered naphtha or kerosene. The analysis of this sample indicated the lack of not only *n*-alkanes, but also the absence of the highly volatile compounds seen in the other NAPL samples. According to Friedman & Bruya, the NAPL in MW-12 has likely undergone evaporative weathering and may be located near the edge of the degraded naphtha plume, where relatively high rates of evaporative degradation would be expected.

During drilling activities at DPSC, soil samples were collected for analysis. Undegraded and degraded naphtha were present in samples collected from MW-23, MW-24, and MW-25. Motor oil or lubricating oil, and gasoline constituents were detected in shallow soil samples near Building 28. Near the Oregon Avenue USTs, analysis of shallow soil samples above the water table showed evidence of fuel oil. Soil samples from the Building 28 area and near the Oregon Avenue USTs were collected above the zone where NAPL and residual NAPL may have been vertically distributed due to water-table fluctuations.

Analysis of soil samples from borings on the CSX property showed evidence of highly degraded naphtha, with the exception of one of three soil samples from CSX-MW5. This soil sample, collected at a depth interval of 44 to 46 feet below ground surface, contained degraded gasoline or diesel fuel.

Soil samples collected from borings drilled along both sides of the Pollock Street/ Packer Avenue sewer contained undegraded and degraded naphtha similar to the soil and NAPL samples collected at the DPSC property. Soil samples collected during drilling of the borings for MWS-1 and MWS-2 also contained gasoline constituents.

All analytical data was validated by a USEPA- certified data validator. Based on the professional judgement of the data validator and specific rules developed by USEPA Region III, appropriate QA/QC measures were employed by the laboratory.

5.0 NAPL PATHWAYS

The results of the field activities conducted as part of this study were evaluated in conjunction with historical information to address three of the main objectives of this study: to determine whether NAPL is currently migrating onto DPSC from an off-site source; to assess the migration of NAPL through and off of DPSC; and to identify the potential source or sources of the NAPL plume. The main factors that have influenced the migration of NAPL in the study area are discussed separately, below.

5.1 POTENTIAL FORMER PATHWAYS

5.1.1 Historical Groundwater Flow

Historical, regional information indicates that groundwater flow in the vicinity of the ARCO/Sun Refinery and DPSC is to the southeast. Figure 1-14 (Paulachok, et al, 1984) shows that regional groundwater flow in southeastern Philadelphia was generally to the south southeast based on data collected from 1976 through 1980. Greenman, et al. (1961) indicate that the direction of groundwater flow under natural conditions in the vicinity of the ARCO/Sun Refinery property and DPSC is to the south southeast. The hydrogeologic cross-section B-B' in Figure 5-1 transects DPSC and shows that ambient groundwater flow was towards the Delaware River. Only groundwater in the immediate vicinity of the Schuylkill River flows northwestward and discharges to the river.

This general flow direction is supported by water-level data reported for 1932 (Sun, 1997) and from 1982 through 1997. Figure 5-2 shows water levels measured in 1932 during non-pumping conditions. These former monitoring points were located in the southeastern portion of the ARCO/Sun Refinery property. In instances where test holes were dry, the depth below which groundwater is present is indicated with a less than "<" sign. Water levels from a series of four wells in the vicinity of the Pollock Street/Packer Avenue sewer indicate an easterly direction of groundwater flow. As shown in Figure 5-2, Well #17, Well #15, Well #14, and Well #13 are generally arrayed along a west-northwest to east-southeast trend. The

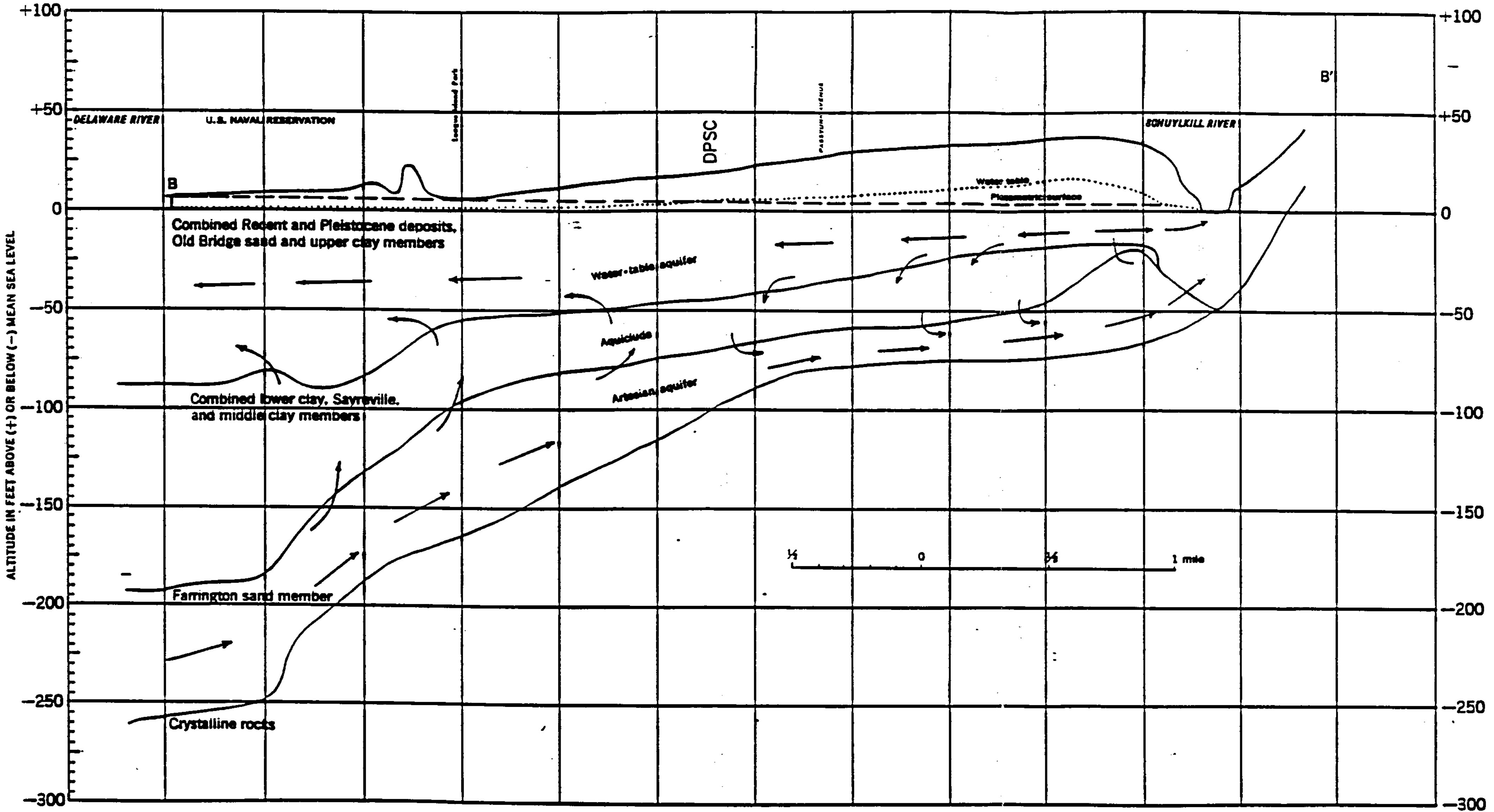
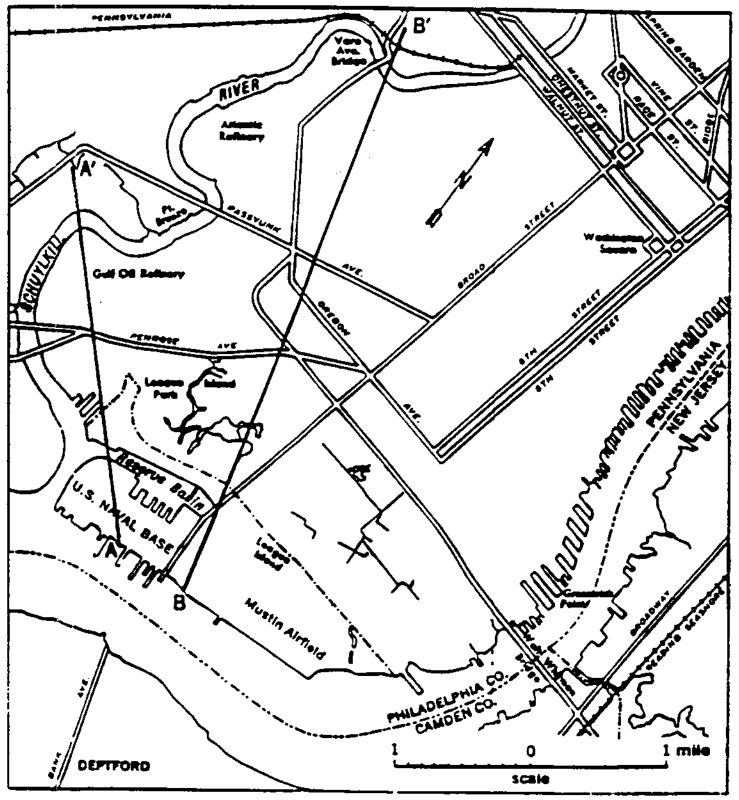


Plate 20 Cross sections showing probable directions of ground water movement in and between aquifers under natural conditions near the junction of the Delaware and Schuylkill Rivers in Pennsylvania.



SOURCE: GREENMAN, ET AL (1961)

NOT TO SCALE

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SCHEMATIC NATURAL GROUNDWATER FLOW DIRECTIONS

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FIGURE 5-1

LEGEND

●	MONITORING WELL (S,CSX-MW,SMW,MWS,MW)
RW ☒	RECOVERY WELL
○	MANHOLE (SURVEYED)
✱	SOIL BORING (SBS,A-J,SB,B,26-B,PB,TBD,DH,CH)
SB-1 ✦	SHALLOW SOIL BORING BY DAMES & MOORE
DB-2 ✦	DEEP SOIL BORING BY DAMES & MOORE
—	POLLOCK STREET/ PACKER AVENUE SEWER (DASHED WHERE NOT SURVEYED)
2 ■	1932 SAMPLING POINTS
(2.52)	GROUNDWATER ELEVATION

SCALE IN FEET

0 400 800

SOURCE: SUN TECHNICAL REPORT, 1997.

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APRIL 1932 GROUNDWATER ELEVATIONS

MALCOLM PIRNIE, INC.

FIGURE 5-2

water elevations in these wells decrease from west to east, from a high of 2.17 in Well #17 to a low of 0.58 in Well #13. In addition, the water level in test hole #20, located approximately 400 feet north of this line of wells had a water level of 11.92 feet which indicates even higher groundwater elevations in this part of the ARCO/Sun Refinery property.

Based on data reported from 1982 through 1995 (Attachments A through G in Appendix N), groundwater flow directions in the northeastern portion of the ARCO/Sun Refinery South Yard (opposite the CSX property from DPSC) are to the east-southeast. Also, numerous reports dated from 1982 through 1997 concerning the ARCO/Sun Refinery South Yard state that the direction of groundwater flow in this portion of the refinery is to the southeast. Excerpts from these reports are provided below:

Woodward-Clyde Consultants, 1982 -

> "In general, the direction of groundwater flow in this zone (upper water bearing zone), in the South Yard Tank Farm area is toward 26th Street (southwest) (sic) [southeast]" (The parenthetical reference to a southwesterly direction of groundwater flow in this document is clearly an error since, geographically, 26th Street is located east or southeast of the ARCO/Sun Refinery South Yard. Furthermore, this conclusion is supported by the figure provided as Attachment K in Appendix N of this document, which shows groundwater flow to the southeast).

Engineering Enterprises, Inc., 1987 -

> "Groundwater flow in this area is predominantly in a south/southeasterly direction."

Engineering Enterprises, Inc., 1988 -

> "Groundwater flow is predominantly in a south/south easterly direction."

Groundwater & Environmental Services, Inc., 1988 -

> "While local topographic and physiographic conditions indicate that local groundwater flow should be to the west to southwest, insufficient reliable data was obtained during the course of site investigations to fully define local hydrogeology. A southerly component of groundwater flow was detected, however, as part of the Twenty-Sixth Street Sewer investigation."

Groundwater & Environmental Services, Inc., 1992 -

> "In the eastern portion of the South Yard, along 26th Street, groundwater flows in a east/southeasterly direction at a slope of 6.86×10^{-3} feet/foot."

Groundwater and Environmental Services, Inc., 1993 -

> "The shallow aquifer in the northeastern area of the South Yard is characterized by an eastern to southeastern groundwater flow."

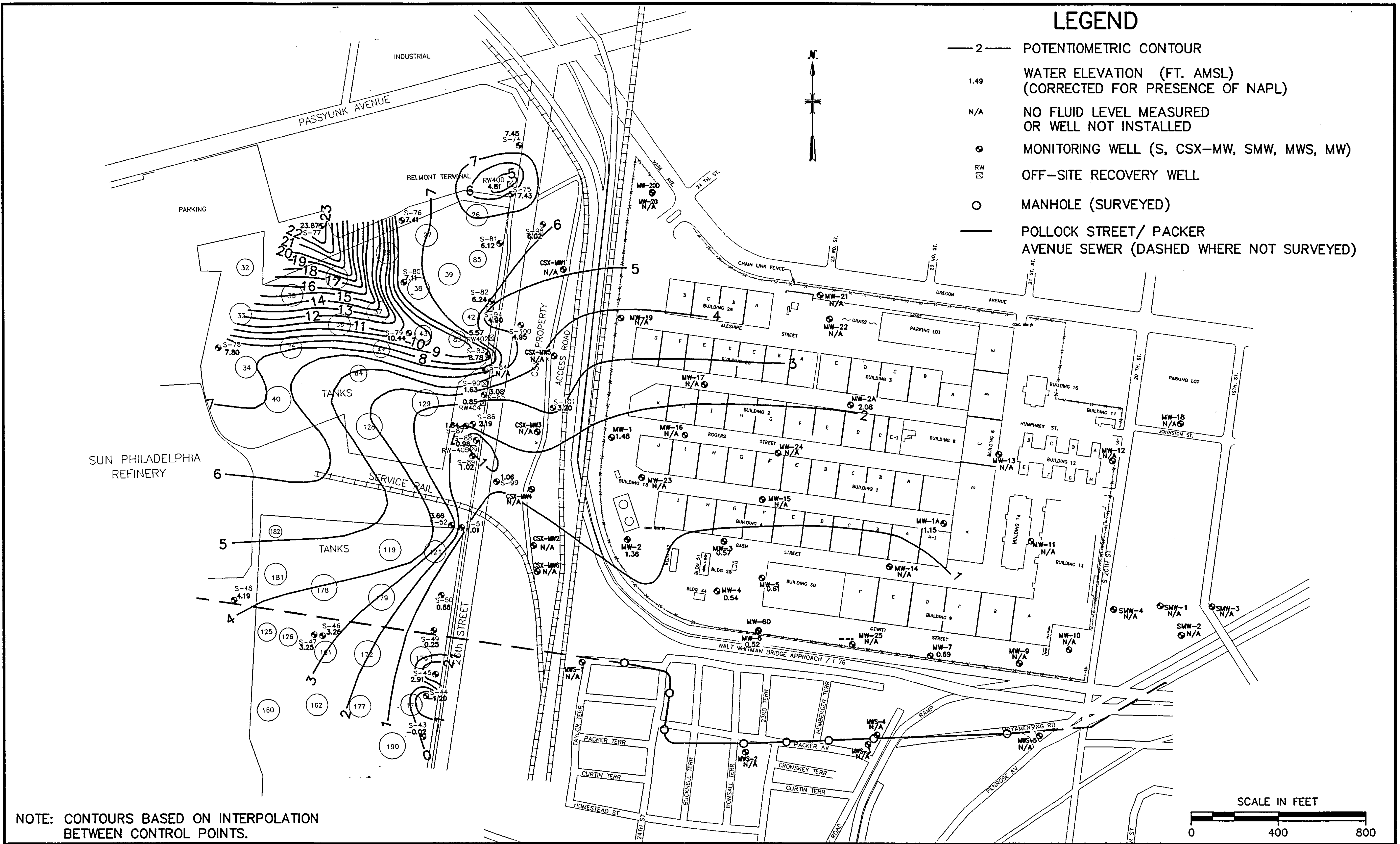
Furthermore, the Offsite Free-Phase Hydrocarbon Delineation Interim Report prepared for Sun (Dames & Moore, 1997) states (page 10):

> "A groundwater contour map prepared from November 15, 1996 groundwater elevation data are (sic) presented as Figure 2-2. This figure indicates that the overall groundwater flow direction is to the south southeast and that the 26th Street and Pollock/Packer Street sewers affect groundwater flow patterns locally."

Synoptic fluid-level measurements conducted on December 14, 1994 and in March 1995 also support a southeasterly direction of groundwater flow in this portion of the study area. Figures 5-3 and 5-4 show the potentiometric contours for the December 1994 and March 1995 synoptic rounds of fluid-level measurements, respectively. Both figures indicate that groundwater flow on the ARCO/Sun Refinery property and in the northwestern portion of DPSC was generally to the southeast. The direction of groundwater flow in the central portion of DPSC was generally to the south during the December 1994 and March 1995 synoptic fluid-level measurements.

Distortions to the potentiometric contours shown in Figures 5-3 and 5-4 are present along 26th Street. In some areas north of the Pollock Street/Packer Avenue sewer, these coincide with the locations of Sun recovery wells, which were installed by Sun in 1993 and 1994 to comply with a PADEP consent order to recover NAPL from known and existing plumes on the ARCO/Sun Refinery property and prevent the off-site migration of NAPL. Based on a review of reports submitted to PADEP by Sun, pumping of groundwater and NAPL from recovery wells (RW-400, RW-401/S-94, RW-402, RW-403/S-90, RW-404, and RW-405) along 26th Street began in January 1996 (Sun, 1996). However, recovery wells RW 401/S-94 and 403/S-90 were installed in 1993 and recovery wells RW 400, 402, 404, and 405 were installed in May 1994. These recovery wells were not reported as pumping during the period of synoptic fluid-level measurements in December 1994 and March 1995.

Along 26th Street, the reported water levels below mean sea level are indicative of groundwater withdrawals or drains that have lowered water levels below the unaltered water



NOTE: CONTOURS BASED ON INTERPOLATION
BETWEEN CONTROL POINTS.

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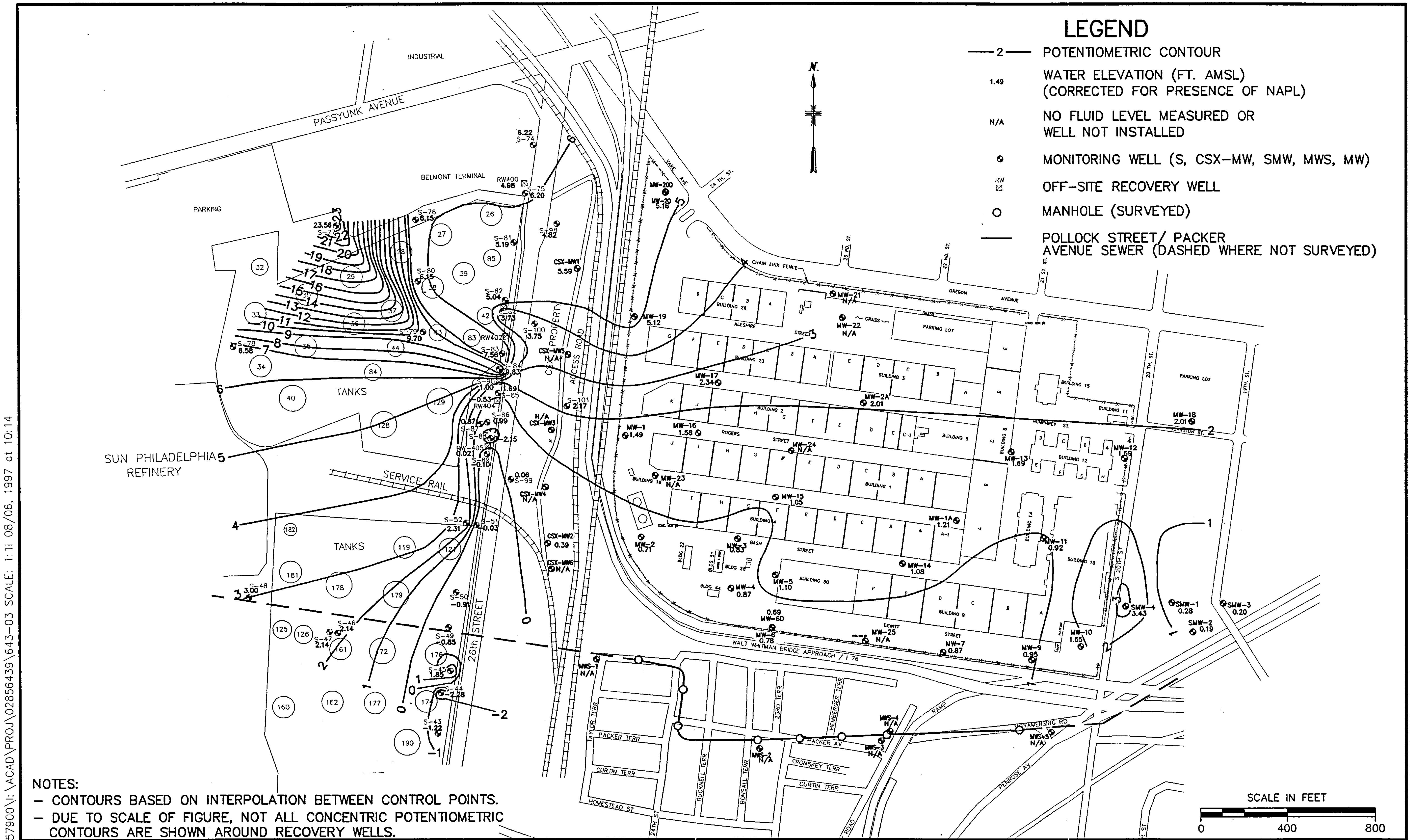
POTENTIOMETRIC CONTOURS
(DECEMBER 14, 1994)

MALCOLM PIRNIE, INC.

FIGURE 5-3

4871 : 028565790\I:\ACAD\PROJ\02856439\643-05 SCALE: 1:1 08/06, 1997 at 10:10

XREF X643-01



LEGEND

——2——	POTENTIOMETRIC CONTOUR
1.49	WATER ELEVATION (FT. AMSL) (CORRECTED FOR PRESENCE OF NAPL)
N/A	NO FLUID LEVEL MEASURED OR WELL NOT INSTALLED
⊗	MONITORING WELL (S, CSX-MW, SMW, MWS, MW)
RW ⊠	OFF-SITE RECOVERY WELL
○	MANHOLE (SURVEYED)
——	POLLOCK STREET/ PACKER AVENUE SEWER (DASHED WHERE NOT SURVEYED)

NOTES:
- CONTOURS BASED ON INTERPOLATION BETWEEN CONTROL POINTS.
- DUE TO SCALE OF FIGURE, NOT ALL CONCENTRIC POTENTIOMETRIC CONTOURS ARE SHOWN AROUND RECOVERY WELLS.

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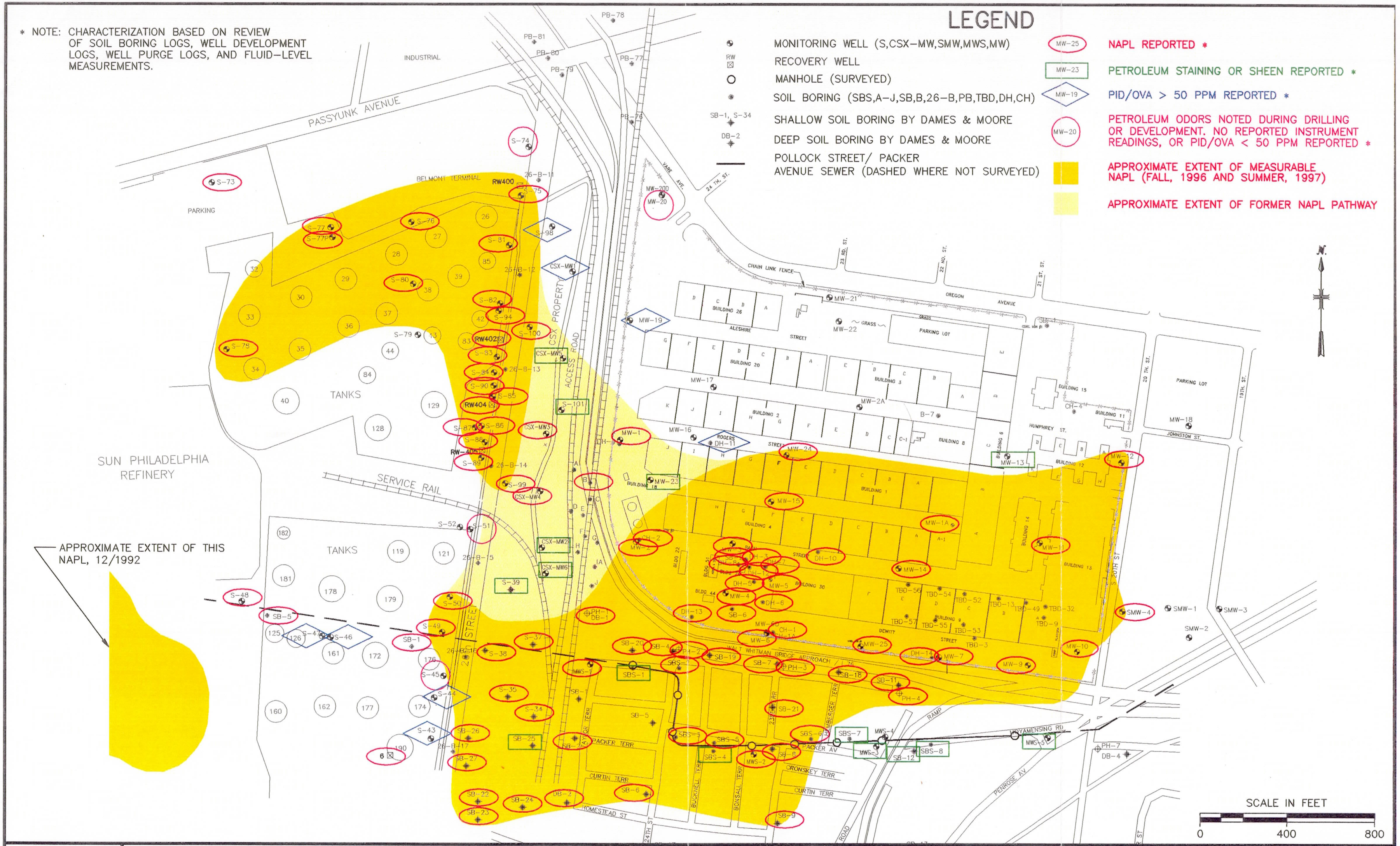
POTENTIOMETRIC CONTOURS
(MARCH 1 AND 2, 1995)

MALCOLM PIRNIE, INC.

FIGURE 5-4

4871 : 0285657900\i:\ACAD\PROJ\02856439\643-03 SCALE: 1:1i 08/06, 1997 at 10:14

XREF: X643-01



* NOTE: CHARACTERIZATION BASED ON REVIEW OF SOIL BORING LOGS, WELL DEVELOPMENT LOGS, WELL PURGE LOGS, AND FLUID-LEVEL MEASUREMENTS.

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DISTRIBUTION OF PETROLEUM CONTAMINATION

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FIGURE 5-5

4871 : 02856439001\I: \ACAD\PROJ\02856439\643-64 SCALE: 1:1i 08/14, 1997 at 14:58

table. Water levels below mean sea level are not uncommon in Southeastern Philadelphia, based on the water table elevations recorded on the potentiometric contour map shown in Figure 1-14 (Paulachok and Wood, 1984). As discussed in Section 5.4.2, the water levels below mean sea level in the study area may have been influenced by the 26th Street sewer.

Based on a review of documentation concerning petroleum recovery in the South Yard, at least three recovery wells, their recent or present use unknown, are located in the southern portion of the ARCO/Sun Refinery South Yard. With the exceptions of Well #6 (Figure 5-2) and the recovery wells along 26th Street, the available information does not clearly identify the locations of the remaining product recovery wells in the South Yard. Based on available documents which discuss recovery operations in the South Yard, two other recovery wells appear to be RW-1 and S-30 which are located in the southern portion of the South Yard. The location of these wells are shown on Attachment H in Appendix N. Well RW-1 is approximately 3,500 feet southwest of DPSC and well S-30 is approximately 2,900 feet southwest of DPSC. According to information provided by Sun (Coladonato, 1996), no groundwater pumping is known to occur in the eastern portion of the South Yard in the vicinity of 26th Street and south of the Pollock Street/Packer Avenue sewer. Despite this information, water levels below mean sea level in this area may be the result of groundwater withdrawals.

Several anomalies in the potentiometric data for December 1994 and March 1995 were noted. A difference of more than two feet is reported for water levels in two adjacent and similarly constructed monitoring wells, S-51 and S-52, south of the service rail which crosses 26th Street. Since March 1995, monitoring well S-52 has apparently been destroyed so that it was not possible to re-survey the elevation of this well. Water level elevations of greater than 20 feet amsl were reported for S-77 located in the northern portion of the ARCO/Sun Refinery South Yard. Sun (1997) indicates that this water level represents a perched zone, the areal extent of which is unknown. NAPL can migrate on perched groundwater and, in fact, NAPL has been documented in both monitoring wells S-77 and S-77P, which was installed as a replacement well adjacent to S-77 between the October 1996 and November 1996 synoptic rounds of fluid-level measurements, which are discussed in Section 5.2.

During field activities in 1996, on-site water levels were approximately two feet higher than those previously recorded (Figure 1-17). This difference in water levels appears to have been caused by relatively high precipitation in the greater Philadelphia area in 1996. The effect of these water-level changes on the migration of NAPL is discussed in Sections 5.3 and 5.4 in conjunction with stratigraphy and the presence of sewers in the saturated zone.

5.1.2 Influence of Pumping on Groundwater Flow Directions

Changes in historical groundwater withdrawals to the east of DPSC, in the area of the Walt Whitman Bridge, and to the south of DPSC, at the U.S. Naval Shipyard, may have affected the direction of groundwater flow (Paulachok, 1991). Local withdrawals that affect potentiometric contours and local groundwater flow directions are not uncommon in southern Philadelphia. The demand created by pumping of the deeper aquifer was likely met by the aquifer itself and downward leakage from the upper aquifer. The effect that this downward leakage from the shallow aquifer would have on groundwater gradients would vary based on the horizontal continuity, thickness, and hydraulic properties of any finer-grained units between the deeper and shallow aquifer. No definitive information is available to conclude that groundwater flow directions in the shallow aquifer in the vicinity of DPSC were affected by nearby pumping from the lower aquifer.

Information on the ARCO/Sun Refinery (Sun, 1997) indicates that long-term pumping has occurred since the 1930s in the southeastern portion of the ARCO/Sun Refinery property. According to this information, generally continuous petroleum recovery operations have been ongoing in the southern portion of the South Yard since the mid 1930s. Well #6 on Figure 5-2 is a recovery well, which reportedly operated from 1932 until possibly 1984 (Sun, 1997). Although the documentation is not complete, two additional recovery wells, RW-1 and S-30, are apparently operating in the southern portion of the South Yard (Attachment H in Appendix N). Well RW-1 is approximately 3,500 feet southwest of DPSC and well S-30 is approximately 2,900 feet southwest of DPSC and are too distant to have influenced the direction of groundwater flow in the northeastern portion of the ARCO/Sun Refinery South Yard or DPSC.

Other groundwater withdrawals on the ARCO/Sun Refinery property were used for refinery process water (Sun, 1997). Given the size of the South Yard, there is no basis to believe that the process water supply wells were located in proximity to DPSC and exerted any control on the direction of groundwater movement beneath the eastern portion of the South Yard. For logistical reasons, it is more likely that process-water supply wells would be in the process areas of the refinery than in the tankage areas. The process areas of the refinery are to the west of the tankage, away from DPSC, as shown in Attachment L in Appendix N.

5.1.3 Relict NAPL Contamination

As NAPL migrates, a portion of the NAPL becomes trapped in the saturated pore spaces of soil and becomes residual or relict NAPL. As water levels fluctuate, this residual NAPL can be smeared across a vertical interval of soil. This relict NAPL contamination occurs as petroleum staining on soil or petroleum sheens on soil or groundwater. In addition, low molecular weight, aromatic compounds in NAPL can volatilize or partition to the gas phase in areas where NAPL or relict NAPL are present. These vapors can be detected by instruments such as photo-ionization or flame-ionization detectors during drilling or screening of soil samples. Because of their spatial association with the current or past NAPL plume, relict NAPL contamination and elevated concentrations of petroleum vapors are indicative of the NAPL plume's pathway.

Historical records, including soil boring logs, well development logs, well purge logs, and fluid-level measurements were reviewed to identify the presence of NAPL or relict NAPL contamination. This historical evidence was combined with the results of the field activities conducted as part of this study. Figure 5-5 shows the wells and soil borings in which NAPL, petroleum staining or petroleum sheens, or petroleum vapors greater than 50 ppm have been reported. A threshold of 50 ppm for petroleum vapors is a conservative value which should effectively screen out locations which may have been affected by non-NAPL contamination. To further evaluate the potential presence of NAPL or relict NAPL, petroleum odors detected during drilling or well development were noted on Figure 5-5.

As shown in this figure, NAPL has been recorded in a continuum of monitoring wells between the ARCO/Sun Refinery South Yard and the southern portion of DPSC and the Passyunk Homes area. In general, petroleum staining or petroleum sheens were reported in borings or wells along the margins of the area which encompasses NAPL-containing borings and wells. In general, borings and wells in which only petroleum odors were noted or vapors were detected greater than 50 ppm are along the outer margin of borings and wells which contained NAPL, petroleum staining, or petroleum sheens.

Borings in the southern portion of DPSC which did not encounter NAPL or relict NAPL are the borings with the prefix "TBD" in the southeastern portion of the site. These are geotechnical/foundation borings which were drilled in the 1940s prior to construction of these buildings. The lack of recorded petroleum contamination in these boring logs indicates that the NAPL plume was not present in this portion of DPSC at this time. This interpretation is supported by the determination of the NAPL composition as light refinery naphtha (characteristically JP-4) and the lack of JP-4 production prior to the mid-1950s, which is detailed, below.

Chronologically, the next soil borings drilled in the area of DPSC were the geotechnical/foundation borings for the Schuylkill Expressway in 1955. These borings are labelled "A" through "J" on Figure 5-5 (and Figure ES-3). One of these borings, designated on Figure 5-5 as Boring B, encountered approximately 14 feet of petroleum saturated sand and gravel. The record from this boring shows that a petroleum release had occurred in this area by this date. Subsequent borings completed in 1963, prior to the 26th Street sewer construction project, and construction work on the sewer in 1965 indicated extensive presence of petroleum along 26th Street. Plate 4-1 presents a summary of this historical information. The earliest confirmation of petroleum contamination beneath DPSC is in 1987 during the investigation of a diesel fuel leak in the vicinity of Building 28.

Based on historical groundwater flow information as discussed in Section 5.1.1, the eastern portion of the ARCO/Sun Refinery was upgradient from the CSX property and DPSC. Although measurable NAPL is not currently present in MW-1, CSX-MW3 or CSX-MW4, NAPL and significant petroleum staining and sheens were observed while the boreholes for these wells were drilled. Pre-existing wells (S-99, S-101, and CSX-MW-2) and newly installed wells (CSX-MW5 and CSX-MW6) in the vicinity of MW-1, CSX-MW4 and CSX-MW3 also contained either petroleum staining or petroleum sheens during installation (Figure 5-5). Monitoring well S-99 contained NAPL in November 1996.

These petroleum sheens are residues from larger volumes of NAPL which were present in this area. Even with the effect of water-level fluctuations on smearing of petroleum, a petroleum sheen has insufficient volume to cause the large (up to 12 feet) thicknesses of petroleum stained soils which are documented in soil borings. In several boreholes drilled on the CSX property and to the south of DPSC, petroleum staining was observed approximately 10 feet below the current water table. The presence of this staining indicates that historic water levels, and corresponding former NAPL levels, have been as low as 10 feet below the current water table surface. As discussed in Section 5.4, dewatering operations during the construction of the 26th Street sewer, which is located adjacent to and west of the CSX property, likely caused the staining observed below the current water table in this area.

Based on observations made during drilling of borings on the CSX property, the thickness of petroleum-stained soil in this area averages approximately four feet across the CSX property between CSX-6 and CSX-5. Using an average TPH concentration of 2,300 mg/kg for stained soils in MW-CSX2 (Kemron/Versar, 1996), S-99 and S-101 (Sun, 1994), the volume of residual NAPL in these soils was estimated per the method outlined in Appendix H. Soil samples which contained no detectable TPH concentrations from S-100 were not used because this well presently contains measurable NAPL, indicating that the reported TPH values may not be representative. Based on the method provided in Appendix H, the volume of NAPL which is present in stained soils between 26th Street and the eastern border of DPSC from MW-CSX5 in the north to MW-CSX6 in the south is estimated to be 73,000 gallons. The historical southeastward groundwater flow direction and these field observations indicate that although NAPL is no longer migrating through the CSX property to DPSC, a former NAPL pathway was through this area.

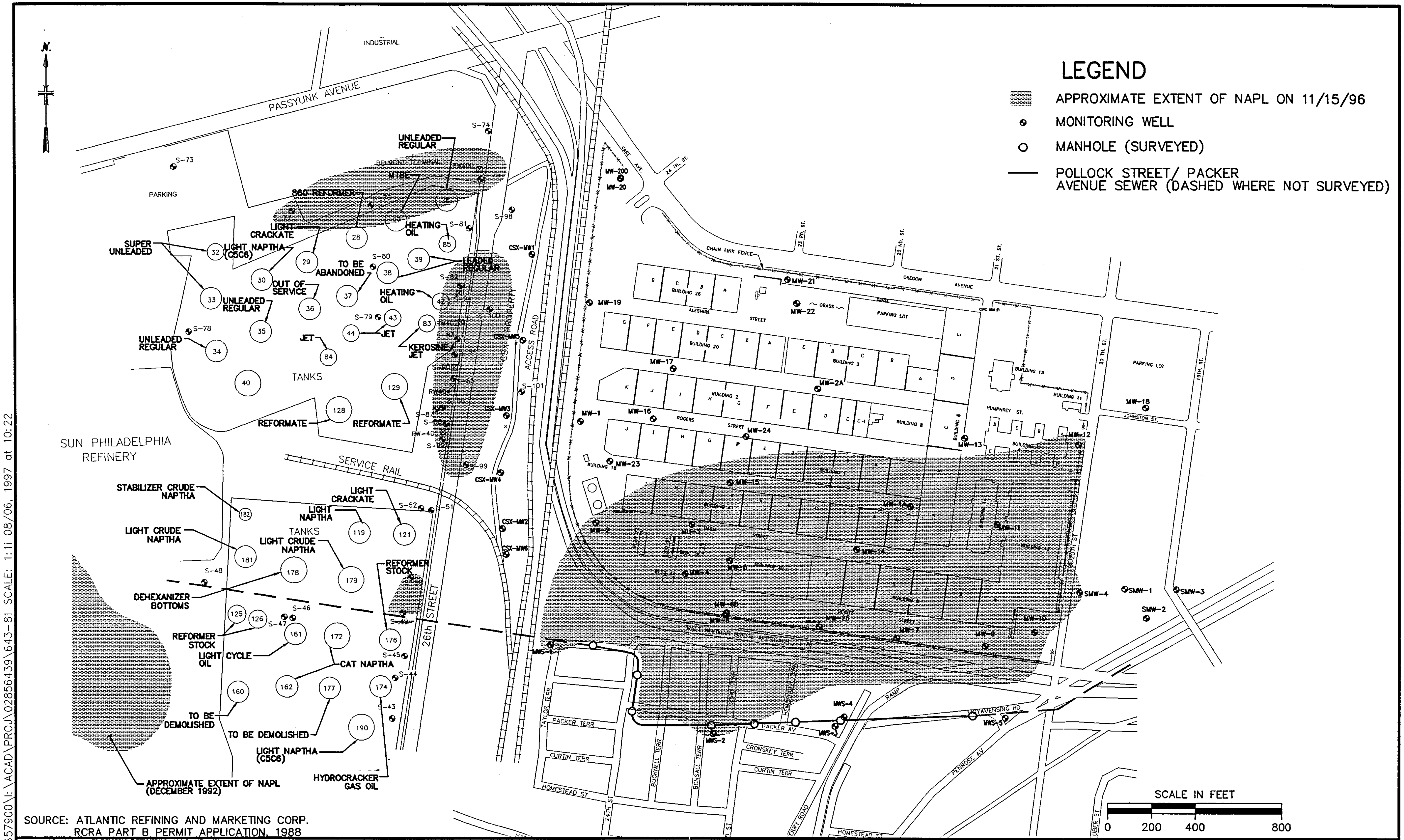
This interpretation is supported by analytical data which indicates the NAPL plume on DPSC is comprised of an undegraded and degraded light refinery naphtha (characteristic of JP-4) and the soils sampled from the CSX property contain naphtha or light crude oil.

There is no definitive information which suggests that DPSC ever used or stored JP-4. Naphtha and jet fuel were stored in aboveground tanks located in the eastern portion of the ARCO/Sun Refinery South Yard (Figure 5-6) (Sun, 1993). The NAPL plume in the eastern portion of the ARCO/Sun Refinery and the NAPL plume beneath DPSC are downgradient from these tanks according to historical potentiometric data as discussed in Section 5.1.1.

The identification of the NAPL plume as light refinery naphtha (characteristic of JP-4) is consistent with the date of the first confirmed presence of petroleum in the vicinity of the ARCO/Sun Refinery and DPSC, i.e. the Schuylkill Expressway borings drilled in 1955. The first military bid procurement for JP-4 was Military Specification MIL-F-5624A, issued on August 17, 1951. The first use of JP-4 by the Air Force would have occurred sometime in 1952. JP-4 was used initially in J-35 engines, but its use increased significantly in the mid to late 1950s with the introduction of the F-100 series of jets with J-57 engines equipped with after burners.

The migration of NAPL from the ARCO/Sun Refinery to DPSC is also supported by the results of specific gravity and other analytical tests conducted on NAPL from monitoring wells on DPSC. As shown on Figure 4-5, specific gravities of the NAPL range from 0.763, in the westernmost monitoring well, MW-2, to 0.83, in the easternmost monitoring well, MW-12. The specific gravity of JP-4 is 0.75 (Oak Ridge National Laboratory, 1989). Thus, in general, specific gravities of the NAPL increase from west to east across DPSC. This is consistent with changes in NAPL composition with time and distance traveled due to degradation and volatilization of low molecular weight petroleum compounds. These compounds tend to degrade and volatilize preferentially and because they are the lightest petroleum compounds, the specific gravity of the remaining NAPL is increased.

This west-to-east trend in degradation of the NAPL is also supported by the relative abundance of *n*-alkanes in the NAPL samples (Figure 4-6). A discussion of the determination of relative NAPL degradation based on the abundance of *n*-alkanes in NAPL samples is provided in Section 4.3. As shown in Figure 4-6, relatively undegraded naphtha is present in the western portion of DPSC while a mixture of undegraded and degraded NAPL, and degraded NAPL was detected in NAPL samples from wells in the eastern portion of DPSC.



LEGEND

▨	APPROXIMATE EXTENT OF NAPL ON 11/15/96
⊗	MONITORING WELL
○	MANHOLE (SURVEYED)
—	POLLOCK STREET/ PACKER AVENUE SEWER (DASHED WHERE NOT SURVEYED)

SOURCE: ATLANTIC REFINING AND MARKETING CORP. RCRA PART B PERMIT APPLICATION, 1988

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TANKAGE ON THE ARCO/SUN REFINERY SOUTH YARD

MALCOLM PIRNIE, INC.

FIGURE 5-6

4871 : 0285657900\I:\ACAD\PROJ\0285643\643-81 SCALE: 1:1 08/06, 1997 at 10:22

XREF: X643-01

The general direction of groundwater flow and the presence of historical storage of naphtha, jet fuel and gasoline at the ARCO/Sun Refinery coupled with the areal distribution of NAPL and relict NAPL contamination indicate that the source of the NAPL plume was the ARCO/Sun Refinery. As discussed, below, there is no evidence to indicate that an on-going release from this facility to DPSC is presently occurring. Sun recovery wells were installed along the eastern border of the ARCO/Sun Refinery South Yard pursuant to its 1993 Consent Order and Agreement with PADEP. Two of the objectives of operating these recovery wells under this Consent Order and Agreement were:

- "Elimination, to the greatest extent practicable and feasible, of all off-site migration of NAPL", and

- "Removal, to the greatest extent practicable and feasible, of all recoverable NAPL which may have migrated off-site."

5.2 EXISTING GROUNDWATER FLOW

Fluid levels in on-site and off-site monitoring wells were measured during two synoptic rounds conducted on October 16, 1996 and November 15, 1996. These synoptic rounds were coordinated with Sun and SEPTA and included all recovery and monitoring wells in the eastern portion of the ARCO/Sun Refinery South Yard along 26th Street and on the SEPTA property located on 20th Street. At least two days prior to fluid-level measurements, the oil skimmers, which are in six NAPL-containing wells on DPSC, were shut down. The recovery wells which Sun operates along the 26th Street boundary of the refinery continued to operate during the fluid-level measurements. Prior to the October 16, 1996 fluid-level measurements, pressure transducers, connected to data loggers, were installed in four wells (CSX-MW2, CSX-MW5, MW-13, and MW-17) to record long-term water-level fluctuations. Barometric pressure was also recorded by a data logger in conjunction with the long-term water levels. Each synoptic round of fluid levels was measured within approximately a three-hour period.

Potentiometric contours of water levels measured on October 16, 1996 and November 15, 1996, which were corrected for the thickness of NAPL, where present, are shown in Figures 1-15 and 1-16, respectively. Based on these contours, the primary direction of groundwater flow on DPSC is to the south. The hydraulic gradient decreases from north to south beneath DPSC and is relatively flat in the southern portion of DPSC. Groundwater in the central portion of the ARCO/Sun Refinery South Yard flows to the east-southeast toward 26th Street. The influence of pumping of the 26th Street recovery wells is shown by the concentric groundwater depressions around these wells. Due to the scale used in Figures 1-15 and 1-16, not all contours around these wells could be shown.

Based on the comparison of potentiometric surface contours from December 1994 and March 1995 to October 1996 and November 1996, pumping of the recovery wells along 26th Street has affected groundwater flow directions in the study area. Pumping these recovery wells has decreased water levels along a north-south trending line parallel to 26th Street and has changed groundwater flow directions on the CSX property and the western portion of DPSC to the south-southwest. As evidenced by these pumping effects, changes in groundwater withdrawals may have historically altered the groundwater flow patterns, and subsequently, the NAPL migration pathways in the study area. Thus, the current groundwater flow directions may not coincide with the groundwater flow regime present during the migration of the NAPL plume away from its source, the ARCO/Sun Refinery property.

As observed during the December 1994 and March 1995 synoptic rounds of fluid-level measurements, water levels below mean sea level were reported in monitoring wells S-44 and S-45 along 26th Street in the southern portion of the study area. According to a Sun representative (Coladonato, 1996), no groundwater pumping is known to occur in this area. As discussed in Section 5.4.2, water levels in this area may be influenced by the 26th Street sewer.

Continuous monitoring of water levels and barometric pressure identified a direct correlation between barometric pressure changes and water-level fluctuations. The barometric efficiencies of these wells is approximately 20 to 25 percent. Based on a review of the subsurface stratigraphy, the presence of the shallow silt unit appears to be causing semi-confined conditions. A maximum water-level fluctuation of approximately 0.45 feet was recorded in CSX-MW5 over a nine-day period. Similar patterns of water-level fluctuations were recorded in all of the four long-term monitoring locations (CSX-MW3, CSX-MW5, MW-13, and MW-17). These fluctuations reflect changes in barometric pressure and no tidal or pumping effects were observed. Graphs of water-level and barometric pressure fluctuations are included in Appendix J.

5.3 INFLUENCE OF STRATIGRAPHY

The water table and the NAPL above the water table are primarily in the undifferentiated sand and gravel unit throughout the study area.

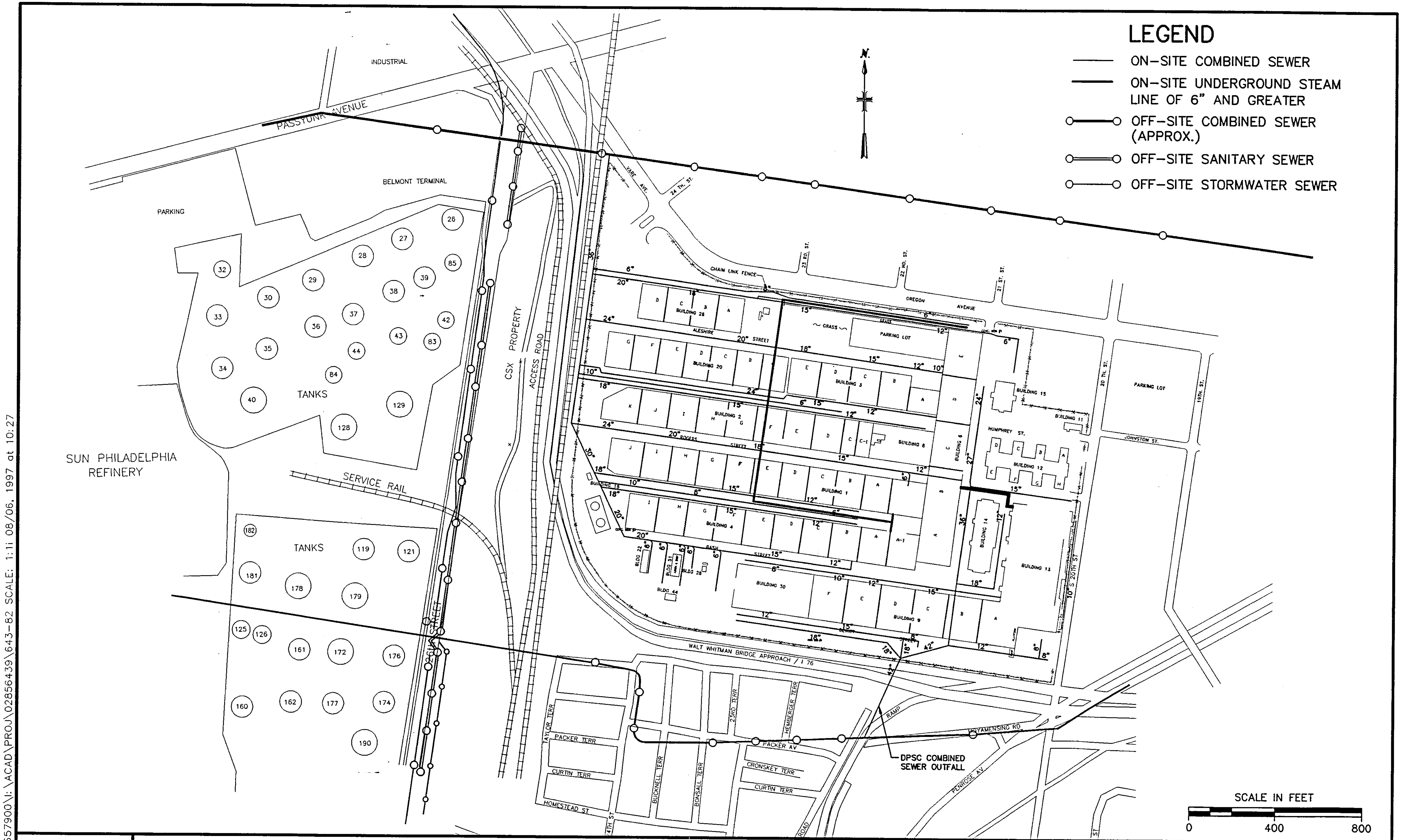
The shape and location of the NAPL plume appears to have been influenced by the intersection of the upper silt unit with the water table. As shown in Figures 1-4 and 1-5, the upper silt unit is thickest and deepest in the northwestern portion of the study area and the southeastern portion of DPSC. At wells CSX-MW1 and CSX-MW5, the water table recorded on October 16, 1996 intersected the bottom of the silt unit. No measurable NAPL was present in these wells. Under these groundwater conditions, the migration of NAPL, if any, into these wells may be impeded.

In the southeastern corner of the study area, the bottom of this silt layer intersects the water table (on October 16, 1996) in the vicinity of MW-9, MW-10, SBS-8 and MWS-5 (Figure 1-4). In MW-9 and MW-10, the silt unit also intersects the NAPL layer. The presence of this silt layer below the water table may have limited the eastward and southeastward extent of the NAPL plume on DPSC and off-site.

5.4 INFLUENCE OF INFRASTRUCTURE

5.4.1 On-Site Utilities

In general, infrastructure, including water and steam lines and sewers, on DPSC do not intersect the water table or the NAPL plume during periods of low or high water levels. The only utility associated with DPSC that may intersect the water table along some of its length is the combined sanitary and storm-water sewer outfall from DPSC located in the southeastern portion of the site (Figure 5-7). This 42-inch high concrete-lined conduit intersects the Pollock Street/Packer Avenue sewer in the vicinity of the Schuylkill expressway



DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

ON-SITE AND OFF-SITE UTILITIES

US Army Corps of Engineers

MALCOLM PIRNIE, INC.

FIGURE 5-7

4871 : 0285557900\I: \ACAD\PROJ\02856439\643-82 SCALE: 1:1i 08/06, 1997 at 10:27

XREF: X643-01

off-ramp, formerly 22nd Street. Based on the elevation data illustrated in Figure 1-13, the DPSC sewer outfall and the upper silt layer intersect the saturated zone between MW-7 and MWS-4 (to the south of DPSC) during relatively high water-table conditions. Because the northeastern portion of this sewer is above the water table, the sewer, or its bedding material, cannot act as a pathway for NAPL migration onto or off of DPSC.

5.4.2 Off-Site Utilities

5.4.2.1 Pollock Street/Packer Avenue Sewer

Soil borings along the Pollock Street/Packer Avenue sewer were drilled as close to the sewer as practical due to utility clearance requirements and the need to avoid encountering the sewer. The sewer bedding on the design drawings is reported to be approximately one foot thick, and all of the soil borings encountered native soils. However, the widespread presence of NAPL on the north side of the Pollock Street/Packer Avenue sewer indicates that the migration of NAPL has occurred through native, in-place soils, and that the sewer bedding is not the dominant migration pathway for the NAPL. Furthermore, the soil borings show that the sewer is primarily constructed in the undifferentiated sand and gravel and any backfill along the sewer is likely to have a similar hydraulic conductivity to these native soils.

The Pollock Street/Packer Avenue Sewer intersects the water table (and NAPL layer where present) during periods of high water levels. This structure has affected the migration of NAPL in the study area and can "skim" NAPL from the water table.

The interior of the Pollock Street/Packer Avenue sewer is eight feet high and 10 feet wide, and is constructed of at least one foot of concrete on all sides. The sewer gently grades from east to west in the direction of the ARCO/Sun Refinery. As shown in cross-section in Figure 1-12, this sewer intersected the water table during the October 16, 1996 synoptic round of fluid measurements. Results of the drilling activities to the south of DPSC indicate that the sewer impedes the southward migration of NAPL during high water-table conditions. Soils saturated with NAPL were present in four soil borings (SBS-2, SBS-3, SBS-5, and SBS-6) along the northern side of the sewer. Soil borings and boreholes on the southern side of the sewer (SBS-1, SBS-4, and MWS-2) did not contain NAPL-saturated soils. In 1996, during drilling of the borehole for MWS-1 on the southern side of the sewer, no NAPL-saturated soils were encountered, however, a 0.04 foot layer of NAPL was measured in MWS-1 on October 16, 1996. A 0.05-foot thick layer of NAPL was measured in both MWS-1 and MWS-2 on November 15, 1996.

Past NAPL migration beneath the Pollock Street/Packer Avenue sewer is indicated by petroleum staining and petroleum sheens in samples from soil borings and boreholes on the southern side of the sewer. A 0.3-foot thick layer of petroleum stained soil at approximately six feet below the October 1996 water table was recorded during drilling of the borehole for MWS-1. This layer of petroleum staining is lower in elevation than the bottom of the Pollock Street/Packer Avenue sewer in this area. Similar intervals of petroleum staining below the elevation of the sewer bottom were observed in the boreholes for MWS-2 and MWS-3, and in soil borings SBS-4 and SBS-8. Soil borings SBS-6 and SBS-7 on the northern side of the sewer also contained petroleum stained intervals approximately five to seven feet below the present water table.

The presence of NAPL along the northern edge of the sewer is consistent with historical information on the presence of NAPL in the sewer. Leakage of NAPL into the sewer in the eastern portion of Passyunk Homes has been documented (D'Agostino, 1996).

The presence of the Pollock Street/Packer Avenue sewer has impeded the southern migration of NAPL and likely contributed to the eastward migration of the NAPL beneath DPSC. With time, NAPL which could not freely migrate to the south due to the presence of the sewer would have migrated in a cross gradient direction to the east along the northern boundary of the sewer. The sewer may have also caused NAPL to "back up" along the northern side of the sewer and extend in an upgradient direction. The effect of this would be that NAPL could migrate in directions which are not coincident with groundwater gradients.

5.4.2.2 26th Street Sewer

As shown in Figures 1-15, 1-16, 5-3, and 5-4 which present potentiometric contours in the vicinity of DPSC, anomalously low water levels occur along 26th Street. Even before the reported January 1996 activation of the newest refinery recovery wells, water levels below mean sea level were reported (Figures 1-15 and 1-16). These water levels, which cause potentiometric contours to be deflected northward, may be due to the presence of the 26th Street sanitary sewer.

As shown on Figure 1-7, the top of the 26th Street sanitary sewer is at approximately two to five feet below mean sea level. If the condition of the sewer allows groundwater infiltration, it could locally lower water levels along its route. This sewer was constructed in the mid-1960s. Thus, after its installation it may have altered groundwater flow and the NAPL pathway between the ARCO/Sun refinery property and DPSC.

NAPL has been observed infiltrating into the 26th Street sewer (Woodward Clyde, 1982). This observation, coupled with historical water level information, indicates that the sewer is below the water table (Figure 1-7) and has affected groundwater and NAPL movement in the study area.

Further evidence that the 26th Street sewer has affected local groundwater and NAPL migration patterns includes the actual sewer construction activities. The bottom of the 26th Street sewer is at an elevation of approximately 10 feet below mean sea level. In the mid-1960s, dewatering for the sewer construction would have been required to at least this depth. As shown in Plate 4-1, large quantities of petroleum hydrocarbons were present along the entire length of 26th Street during the sewer construction in the mid-1960s. In 1967, the refinery installed the initial 26th Street NAPL recovery wells (Sun, 1997).

Dewatering to an elevation approximately 10 feet below mean sea level during the construction of this sewer, which is adjacent and parallel to the CSX property, likely caused the observed staining of soils below the water table on the CSX property. On-going infiltration of groundwater and NAPL into this sewer would also tend to cause soil staining below mean sea level. This information indicates that the presence of NAPL staining on soils below mean sea level on the CSX property is not due to groundwater depression by pumping on the ARCO/Sun Refinery property, as previously conjectured (Sun, 1997).

Groundwater withdrawals on the ARCO/Sun Refinery property are not well documented. However, available information (Sun, 1997) indicates that pumping of groundwater may have been conducted along the eastern portion of the ARCO/Sun Refinery property south of the Pollock Street/Packer Avenue Sewer. No information is available which suggests that pumping in this portion of the South Yard has lowered water levels below approximately 10 feet below mean sea level, which is the approximate base of the 26th Street sewer. Even if pumping had locally lowered water levels on the ARCO/Sun Refinery property, the influence of these wells was likely limited to the southern section of the 26th Street sewer, which would not have affected the migration of NAPL from the ARCO/Sun Refinery property, through the CSX property, and onto DPSC.

6.0 POTENTIAL NAPL SOURCES

This section summarizes the potential sources of NAPL which have been assessed as part of this study. Potential contributors include both on-site and off-site sources, evaluated by field investigations and/or review of available records.

6.1 POTENTIAL ON-SITE SOURCES

6.1.1 Previous Site Investigations

6.1.1.1 USACE DPSC Fuel Contamination Study

The presence of the NAPL plume beneath DPSC was first confirmed during a DPSC Fuel Contamination Study performed in November 1987 through January 1988 by the USACE Baltimore District (CENAB, 1988). In September 1987, a leak was discovered in the fuel line between a diesel fuel tank and the fuel dispenser at the Building 28 Gasoline Station. The leak, which was repaired in October 1987, was estimated to have contaminated an area of approximately 1,000 square feet. The contaminated soil was removed and disposed of off-site. The USACE study included drilling 21 soil borings and collecting soil samples to investigate the extent of petroleum contamination due to the diesel fuel leak.

An apparent thickness of approximately 2.2 feet of NAPL was discovered on the surface of the water table, both upgradient and downgradient of Building 28. Maximum total petroleum hydrocarbon (TPH) levels of 18,673 parts per million (ppm) were detected in soil samples. NAPL was detected in eight of the soil borings.

The results of the soil sampling indicated that the vertical extent of contamination due to the leak in the fuel line appeared to be limited to the upper 10 feet of soil. The report stated that petroleum contamination had spread laterally along two clayey soil layers at depths of approximately three feet and 17 feet. The report concluded that due to the lack of petroleum contamination in the sand layer between the two clay units (thereby identifying a clean zone), the contamination at 17 feet may have represented an older release.

6.1.1.2 ESE Investigation of Building 28 Area

In November 1991, ESE performed a subsequent investigation in the vicinity of Building 28. Seven soil borings were drilled and seven monitoring wells were installed. Soil samples were analyzed for VOCs and TPH. NAPL was detected in six of the seven monitoring wells.

The following conclusions were reported by ESE:

- "Significantly reduced concentrations of TRPH (Total Recoverable Petroleum Hydrocarbons) were detected, and VOCs were not detected in the 14 to 16 ft-bls (below land surface) interval, indicating it is unlikely that past petroleum discharges from the USTs or flow lines have migrated downward and impacted groundwater quality underlying the site..."

- "No evidence indicates the free product was introduced to the top of the water table through vertical migration mechanisms within DPSC property boundaries in the area investigated, based on soil conditions in the unsaturated zone underlying the site."

Based on the southeastward component of groundwater flow in the investigation area, ESE attributed the NAPL plume to an upgradient, off-site source. The report also determined that a layer of NAPL with a maximum apparent thickness of two feet extended for at least 2,000 feet across the southern portion of DPSC.

6.1.1.3 USACE Investigation of ADP/Administration Building

In 1992, the USACE Baltimore District performed a site characterization for a new ADP/Administration Building, with proposed location in the vicinity of the current eastern portion of Buildings 1, 2 and 3 (U.S. Army Corps of Engineers, 1992). This investigation was performed due to the close proximity of the proposed construction to the identified/suspected location of the NAPL plume. NAPL was encountered in one of the two monitoring wells installed for this investigation.

6.1.1.4 Environmental Baseline Survey

An environmental baseline survey (EBS) was completed and an EBS report was issued on December 16, 1994. This survey was performed to document the environmental condition of the installation's property. To facilitate the survey, DPSC was divided into 18 survey areas, and each area was assigned a category designation to describe the environmental condition of the area as a result of the EBS findings. Due to the uncertainty of the extent of the NAPL plume beneath the southern portion of the site at the time of the EBS, the majority of the site was given the category 7 designation, which indicates that the areas were unevaluated or required further investigation due to lack of information. The environmental status of the installation's property is periodically updated in the BRAC Cleanup Plan.

6.1.1.5 Phase I RI/FS (Kemron/Versar)

In 1993, the BRAC Team identified 36 sites which required investigation as part of DPSC's installation restoration program. These areas were identified as having the potential to impact the environment. This assumption was based on the use of the area and what may have been stored there. Kemron/Versar was contracted to perform a Phase I RI/FS to investigate the majority of these sites. The primary objectives of the Phase I RI/FS program included the characterization and delineation of petroleum hydrocarbon and DDT contamination at DPSC, and the identification of potential responsible parties for the NAPL plume. The Phase I Remedial Investigation was performed from September 1994 to April 1995, and included the following:

- Ground penetrating radar survey - at approximately 100 locations for subsurface clearance prior to drilling or soil gas surveys.

- Active and passive soil gas surveys - active soil gas survey at 81 locations, passive soil gas surveys at approximately 60 locations.

- Site Characterization Analysis Penetrometer System (SCAPS) survey - at 14 locations.

- Hydropunch sampling - at 8 locations.

- Soil borings and installation of monitoring wells in completed boreholes (14 installed on DPSC, two installed on adjacent CSX property).

- Review of regulatory files to obtain information on surrounding properties and potential contamination migration pathways.

The major findings of the Phase I RI/FS were:

- The NAPL plume was found to encompass approximately a 54-acre area, and was estimated to contain more than one million gallons of NAPL.
- Based on limited analytical testing, the NAPL plume was reported to consist of a mixture of gasoline and diesel fuel, ranging from 2:1 to 3:1.
- It was hypothesized in the report that the plume migrated onto DPSC from a southerly direction, possibly transported by the permeable Pollock Street/ Packer Avenue sewer bedding, traveling east-west to the south of DPSC.
- A review of regulatory files was conducted to determine if DPSC or any neighboring properties had any significant releases which could have been attributed to the NAPL plume beneath DPSC. Most documented releases were of insignificant volume, or were of different chemical characteristics than the plume.
- The neighboring ARCO/Sun Oil South Yard was found to have numerous product releases, including several documented releases along the Pollock Street and 26th Street sewers. These reported releases were based solely on the presence of known and existing NAPL plumes on the ARCO/Sun Refinery property. They were suggested as the most likely source of the plume.

6.1.2 Review of Storage Tank Records

Using various references, the history, usage and condition of storage tanks on DPSC were researched. The approximate locations of all known on-site storage tanks are shown on Figure 3-4. A compilation of information on storage tanks, based on previous information, is summarized in Appendix K. This matrix was compiled from a review of over 24 DPSC reports and documents, as well as over 60 drawings, site maps and blueprints. It includes known information on the capacity, contents, location, present use, installation date, tank condition, and other pertinent information relating to each tank. The sources of information are noted.

Where information from different sources conflicted, all of the information and the corresponding references have been included in Appendix K for comparison. Where data gaps have been resolved, the contradictory information has been revised.

Following this study of on-site storage tanks, several of the tanks were eliminated as potential sources, however, many data gaps were identified, which prevented some of the

AOCs from being eliminated as potential sources. Therefore, recommendations were made for additional field investigations to address these data gaps and resolve the AOCs.

In addition to storage tanks, other potential contributors (e.g. railroad tracks, former incinerator site, etc.) will also be investigated under the BRAC program. However, they are not considered to be potential contributors to the NAPL plume since these areas were not related to petroleum storage or usage.

Specifically, the potential contributors that will be investigated under the next phase (Phase III) of the BRAC process are not considered to be contributors to the NAPL plume for the following reasons:

- The materials stored at these sites do not match the composition of the NAPL plume.
- Historical information suggests that these sites have been free of any spills that may have affected groundwater.
- The Bulk Storage Facility USTs have passed tightness testing within the last three years.
- These sites did not store large enough volumes of petroleum products to be able to have made any significant contribution to the NAPL plume without being detected. DPSC records, including available mass-balance information, show that the frequency of fuel deliveries was consistent with the consumption volumes.

6.1.3 Review of Regulatory and Historical Records

Based on the results of the database search performed by ERIIS, DPSC was listed in the following federal and state databases:

- Resource Conservation and Recovery Information System (RCRIS) - Treatment, Storage, and Disposal Facilities (TSDFs)
- Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS)- No Further Action Planned (NFRAP) Sites.
- Pennsylvania List of Confirmed Releases
- Pennsylvania Underground Storage Tank Report

DPSC is listed as a RCRIS-TSDF because USEPA regulated hazardous wastes are handled and stored on-site. Corrective actions conducted by state and federal agencies included referral of DPSC to CERCLIS in 1993. The site was removed from the CERCLIS list in 1995 following a preliminary site assessment and placed on the NFRAP list. On-site registered storage tanks are addressed in Sections 6.1.2 and 6.1.4.

Three confirmed releases have been reported with the state for DPSC. These releases involved leaded gasoline, diesel fuel, and other regulated substances. Although no additional information regarding these releases were reported in the database search, these areas have been investigated under the Phase I RI/FS and the Phase II ESI, as discussed in Sections 6.1.1.5 and 6.1.4.

Sanborn maps dated 1919, 1920, 1922, 1947, 1951, 1975, and 1978 were provided in the ERIIS report (Appendix F). The 1919 and 1920 Sanborn Maps do not show the DPSC facility. In 1922, the DPSC was operated by the U.S. Army Quartermaster's Department Intermediate Depot. The depot was comprised of five rectangular warehouses and smaller surrounding support buildings. An incinerator was present in the northeastern portion of the site. Although previously reported (ESE, 1988) erroneously as fuel oil storage tanks, two 200,000-gallon water tanks and a 75,000-gallon elevated water tank were present in the eastern section of the site in 1922. Based on historical records and photographs, and interviews with DPSC personnel, these tanks were never used to store petroleum products. One transformer was situated on the eastern border of the site in 1922. Changes on the site could not be assessed because the on-site information provided on Sanborn maps dated 1947, 1957, 1975 and 1978 was not updated since April 1942.

6.1.4 Phase II ESI - Results of Investigation

The Phase II Expanded Site Investigation was performed to study and resolve several AOCs which were believed to have potentially contributed to the NAPL plume. The results of the Phase II ESI, as presented in a draft report dated August 1996, (Malcolm Pirnie, 1996) are summarized below.

6.1.4.1 Building 8 Waste Oil Tank

A photoionization detector (PID) was used to screen soil samples collected from the four soil borings drilled around the perimeter of this former UST. No PID readings greater than four parts per million (ppm) were detected in any of the samples collected in this area. The results of analytical testing indicated that no sample had any analyte concentration which exceeded PADEP remediation criteria. The purpose of comparing the analytical results to PADEP remediation criteria is to determine if significant contamination is present. Sites which exceed the criteria could have potentially impacted groundwater. Analytical results below the PADEP criteria indicate potential levels of contamination which are not of concern to groundwater quality. Based on these results and its historical use, this UST was not a source to the NAPL plume.

6.1.4.2 Former Bash Street Gas Station

The geophysical survey revealed no evidence that the USTs were still present, but did reveal an area of disturbed soil consistent with the suspected location of the former vault and tanks, indicating the likely excavation and removal of the vault and tanks.

The four soil borings drilled at this site showed visible soil staining, and field screening instruments measured several readings greater than 100 ppm. The highest readings (180 ppm and 250 ppm) were detected at 10 to 12 feet below ground surface (bgs) in two soil borings. Based on these field screening results, nine soil samples were collected during drilling and analyzed for GRO compounds and lead. The highest concentration of GRO, 20,000 µg/kg, was detected in a sample from boring GSUST-04 at 12 to 14 feet bgs (see Appendix M). GRO compounds were not detected above 1,100 µg/kg in the soil sample collected from 14 to 16 feet bgs in the same boring. Detected lead concentrations ranged from 3.69 mg/kg in the sample collected at 16 to 18 feet bgs in GSUST-04 to 146 mg/kg in the sample collected at 10 to 12 feet bgs in GSUST-02. The sample from 14 to 16 feet bgs in boring GSUST-02 contained 8.66 mg/kg of lead. No analyte concentrations exceeded their respective PADEP remediation criteria. Based on these analytical results and because these tanks were removed prior to the construction of Building 9 in the 1940s, these USTs did not contribute to the NAPL plume.

6.1.4.3 Bulk Storage Facility

Based on the physical properties of No. 6 fuel oil and analytical testing of NAPL plume samples, the potential contribution of these tanks to the NAPL plume is negligible to none. No. 6 fuel oil has a relatively high viscosity, which hinders its ability to flow in comparison to other petroleum products. The viscosity of petroleum is dependent upon its temperature. In order to be pumped, No. 6 fuel oil from the Bulk Storage Facility tanks is heated to a temperature of approximately 90°F to 120°F, which is accomplished at DPSC by means of a steam line within the fuel transport tunnel. If a leak in the No. 6 fuel tanks or piping did occur, the fuel would be subjected to ambient ground temperatures on the order of 50° to 60°F. At that temperature, the viscosity would increase and the mobility of the fuel would be reduced. If a spill did occur, it would be localized, and most likely would not migrate to the water table. In addition, the analytical results for the NAPL plume samples do not indicate the presence of No. 6 fuel oil in any samples. For this reason, the potential impact of these tanks on the NAPL plume is considered negligible to none. Based on this evaluation, the investigation of the five USTs is delayed until the Phase III ESI program.

The two ASTs (Tanks 001A and 002A) and the rail car fuel unloading ports adjacent to the ASTs were investigated. No odors or soil staining were noted during hand-augering of six soil borings, which were drilled within the containment basin surrounding the two ASTs (see Appendix M). However, field screening instruments did detect readings in soil samples from the borings drilled near the northern tank (Tank 002A). The results of soil sample analyses from the south and north tanks indicated that DRO compounds are present, although at very low levels with respect to PADEP criteria (500 mg/kg DRO). One sample from the south AST was reported by the laboratory to contain DRO compounds at 2.4 mg/kg and the north AST sample was reported to contain DRO compounds at 3.4 mg/kg. Three compounds were reported from semi-volatile analyses performed on AST soil samples. Pyrene was reported at a concentration of 568 µg/kg from the south AST and fluoranthene and phenanthrene were reported from the north AST at concentrations of 778 µg/kg and 449 µg/kg, respectively. Analysis for lead on four samples and one duplicate indicated that this analyte is present at varying levels, and in one sample, exceeds the PADEP remediation criteria of 600 mg/kg in a sample collected adjacent to the north AST.

Samples collected and analyzed for semi-volatile compounds from locations BCAST-01 and BCAST-04 were reported to contain a limited suite of these analytes. The sample from BCAST-01 contained pyrene at 568 µg/kg and the sample from BCAST-04 contained pyrene at 568 µg/kg and fluoranthene and phenanthrene at concentrations of 778 µg/kg and 449 µg/kg, respectively. These concentrations are well below their respective PADEP remediation criteria.

Samples were collected from eight borings drilled adjacent to the rail car fuel unloading ports and along the oil supply piping vault. The locations of these borings are shown in Appendix M. The analytical results of these samples indicated that DRO compounds are present at varying concentrations in soils adjacent to four of the five railcar fuel unloading ports. The sample collected from eight to 10 feet bgs from boring BS-OL-02 had the highest DRO concentration at 600 mg/kg, which is above the PADEP remediation criteria of 500 mg/kg. The samples from the remainder of the unloading port borings contained DRO compounds at concentrations ranging from 300 mg/kg from boring BS-OL-01 (eight to 10 feet bgs) to non-detect, with method detection limits (MDLs) ranging from 0.99 mg/kg to 0.85 mg/kg.

Analyses performed on soil samples for semivolatile compounds indicated that a suite of these analytes is present in the soils surrounding the unloading port adjacent to boring number BS-OL-02, which was also reported to be the location with highest reported DRO concentration. The identified analytes from this sample included acenapthene (558 µg/kg), anthracene (1,550 µg/kg), benzo(a)anthracene (311 µg/kg), bis(2-ethylhexyl) phthalate (327 µg/kg), chrysene (401 µg/kg), fluoranthene (1,450 µg/kg), fluorene (739 µg/kg), n-nitrosodiphenylamine (2,870 µg/kg), phenanthrene (1,480 µg/kg) and pyrene (712 µg/kg). All of the remaining soil samples analyzed for semi-volatile compounds were reported to contain only bis (2-ethylhexyl) phthalate at concentrations of 141 µg/kg in BSOL-01 (89.7 µg/kg in a duplicate sample) and 862 µg/kg in BSOL-03 (See Appendix M).

DRO analyses of all soil samples in this area detected concentrations ranging from non-detect to 300 ppm, with the exception of a sample from boring BS-OL-02, which contained 600 ppm DRO. Based on the relatively low levels of petroleum constituents detected, and the nature of the product stored, the Bulk Storage Facility is not considered a contributor to the NAPL plume.

6.1.4.4 Building 28 Gasoline Station

The geophysical survey located recently installed fuel lines, electric and sanitary sewer lines, and water and steam lines in the vicinity of Building 28. Abandoned fuel lines and a locomotive fuel pump were also located. The locations of 29 soil borings and nine test pits were selected based on the results of the survey.

Samples collected from an initial 10 borings drilled in the former area of the USTs and along the route of the supply piping from the tanks to the pump island were analyzed for GRO compounds and the HFS. The results of these analyses indicated that GRO compounds were present in samples from all the borings except those from 28UST-1 and 28UST-2 located immediately to the southwest and northwest of the pump island (see Appendix M). Generally, the samples were collected from six to eight feet bgs and from 14 to 16 feet bgs from each boring.

Reported concentrations of GRO compounds ranged from 110,000 µg/kg at 14 to 16 feet bgs in boring 28UST-05 to 1,400 µg/kg at 16 to 18 feet bgs in Boring 28UST-08. The highest concentrations in the initial borings were from 28UST-05, as indicated above, and from 28UST-06, located immediately south of boring 05, with a concentration of 45,000 µg/kg at 8 to 10 feet bgs. The GRO concentration in the sample at 16 to 18 feet bgs in boring 28UST-06 was 8,900 µg/kg. No deeper samples were collected for analysis in boring 28UST-05. Both of these borings are located on the east side of the gas station (See Appendix M). Two soil samples were collected from Boring 28UST-09 at a depth interval of 16 to 18 feet bgs and analyzed using the HFS. According to Friedman & Bruya, these samples contained weathered gasoline.

The 19 delineation borings were arrayed outward from the gas station based on field screening results to characterize the horizontal and vertical extent of contamination. The analytical results performed on samples from 10 of the delineation borings indicate that low levels of GRO compounds are present throughout the pump island area of the gas station and along a line to the east of the station. The selection of samples for analysis was based on field screening. The concentrations of GRO compounds in the delineation borings ranged from 27,000 µg/kg at eight to 10 feet bgs in boring 28UST-17 to 1,400 µg/kg at eight to 10 feet bgs in boring 28UST-23. (See Appendix M).

Samples were collected from eight test pits and were analyzed for GRO compounds and one test pit, associated with the locomotive fueling pump, was sampled and analyzed for DRO compounds. In addition, HFS analyses were performed on samples from two of the test pits. The results of the analyses indicate that GRO compounds are present at concentrations ranging from 3,200 µg/kg (13,000 µg/kg in a duplicate sample) and 9,400 µg/kg in test pits TP-07 and TP-09, respectively to a high of 66,000 µg/kg in test pit TP-08. The one sample analyzed for DRO compounds was collected from test pit TP-05. The results of this soil sample analysis was reported at 15 mg/kg. (See Appendix M). In general, soil samples from test pits were collected at approximately three to four feet bgs.

The HFS analytical results of two samples, both of which were collected at a depth of three feet bgs from test pit TP-03, indicated that the contaminants were most similiar to biogenic compounds or a high boiling material such as asphalt. The analytical results of two samples from test pit TP-05, which were both collected at a depth of four feet bgs, was more complex and indicated the presence of low, medium and high boiling compounds. The low boiling compounds were identified as similar to naphtha or a heavily weathered JP-4. The high boiling compounds were identified by Friedman & Bruya as being most similiar to a lubricant such as motor oil or hydraulic fluid. The testing results indicate that this material is present at low concentrations only, and therefore, it is not indicative of a potential contributor, but rather a minor constituent. Based on the extensive remedial activities conducted at the site, it is likely that these materials were backfilled from a deeper/contaminated zone.

No soil samples collected at the Building 28 Area contained GRO compounds in excess of the applicable PADEP remediation criteria. Also, as a result of the product mass balance evaluation, no significant discrepancies were noted, which indicated that there were no significant leaks in the tanks or piping. Based on these results, the Building 28 gasoline station USTs and piping are not considered likely contributors to the NAPL plume.

6.1.4.5 Building 46 USTs

The geophysical survey in this area revealed no evidence of existing USTs. The survey did, however, indicate the presence of a former excavation adjacent to the side of Building 46. The size, orientation, and location of this excavation coincided with the suspected location of the former USTs.

A total of eight soil samples were collected from the two soil borings drilled in this area and analyzed for DRO and lead. The highest concentrations of DRO and lead, 8.2 and 72.7 mg/kg, respectively, were detected in two samples from two to four feet bgs. DRO and lead concentrations in subsequently deeper samples to 18 feet bgs were either less than one mg/kg or lower than the detection limit. These values do not exceed the applicable PADEP remediation criteria (500 mg/kg for DRO and 600 mg/kg for lead). Based on these results, and their location upgradient of the NAPL plume, the former Building 46 USTs are not a contributor to the NAPL plume.

6.1.4.6 Oregon Avenue USTs

The geophysical survey in this area confirmed the previous removal of two former USTs, identified the closed-in-place tank, and identified the possible presence of a fourth tank. A total of 20 borings were drilled and sampled in the area of the Oregon Avenue tanks. A total of 32 samples were analyzed for DRO. Of these samples, all but two were reported to contain concentrations of this suite of compounds. The concentrations of eight samples were reported to exceed the PADEP remediation criteria for DRO of 500 mg/kg, and of these samples, seven were collected above the water table between the depths of 12 and 16 feet below ground surface (bgs). One sample with a DRO concentration above the PADEP 500 mg/kg criteria was collected from the eight to 10-foot depth interval.

Samples from boring number OR-6 collected from eight to 10 and 12 to 14 feet bgs were reported to contain DRO compounds at concentrations of 750 mg/kg and 610 mg/kg respectively. One sample each from borings OR-9 and OR-10 contained 580 mg/kg and 950 mg/kg of DRO compounds at 13 to 15 and 16 to 18 feet bgs, respectively. Boring OR-18 was sampled at two intervals (12 to 14 and 16 to 18 feet bgs) and the results were 3,300 and 750 mg/kg, respectively. A duplicate sample was collected at 16-18 feet bgs at boring OR-18 and the analysis confirmed the presence of DRO with a concentration of 1,900 mg/kg. A sample from boring OR-19 was collected at 14-16 feet bgs and DRO compounds were at a concentration of 2,400 mg/kg.

Two soil samples, which were collected from soil borings at depth intervals of 16 to 18 feet bgs, and 10 to 12 feet bgs, were analyzed using the HFS. The results of these analyses indicated that the contaminants found in the soils were characteristic of a "catalytically cracked fuel oil" or refined petroleum product as reported by Friedman & Bruya.

Although soil samples collected from soil borings drilled in this area contained TPH-DRO levels which exceeded PADEP remediation criteria, no measurable NAPL or petroleum sheens were reported during the installation of MW-21 and MW-22, both of which are located hydraulically downgradient from the Oregon Avenue USTs (Figure 1-16). No NAPL was measured during subsequent monitoring of these wells. No TAL VOCs were detected above method detection limits in groundwater samples collected from MW-21 and MW-22. Borings drilled between the Oregon Avenue area and the NAPL plume do not show evidence that the plume had migrated to its present position from a source to the north. Based on these results, the Oregon Avenue tanks are not potential contributors to the NAPL plume.

6.2 POTENTIAL OFF-SITE SOURCES

6.2.1 Regulatory Records Review

The ERIIS report did not reveal the presence of National Priorities List (NPL) or "Superfund" sites, CERCLIS sites, Emergency Response Notification System (ERNS) sites; Pennsylvania Solid Waste Facilities (SWF), RCRIS Large Quantity Generators (LQGs), RCRIS Small Quantity Generators (SQGs), or state-listed Hazardous Waste Sites within their respective search distances.

Six sites included on the Pennsylvania List of Confirmed Releases (PLCR) were identified within 0.25 mile of DPSC. Five registered storage tank (RST) sites were reported within 0.25 mile of DPSC. These reported sites are summarized in Table 6-1.

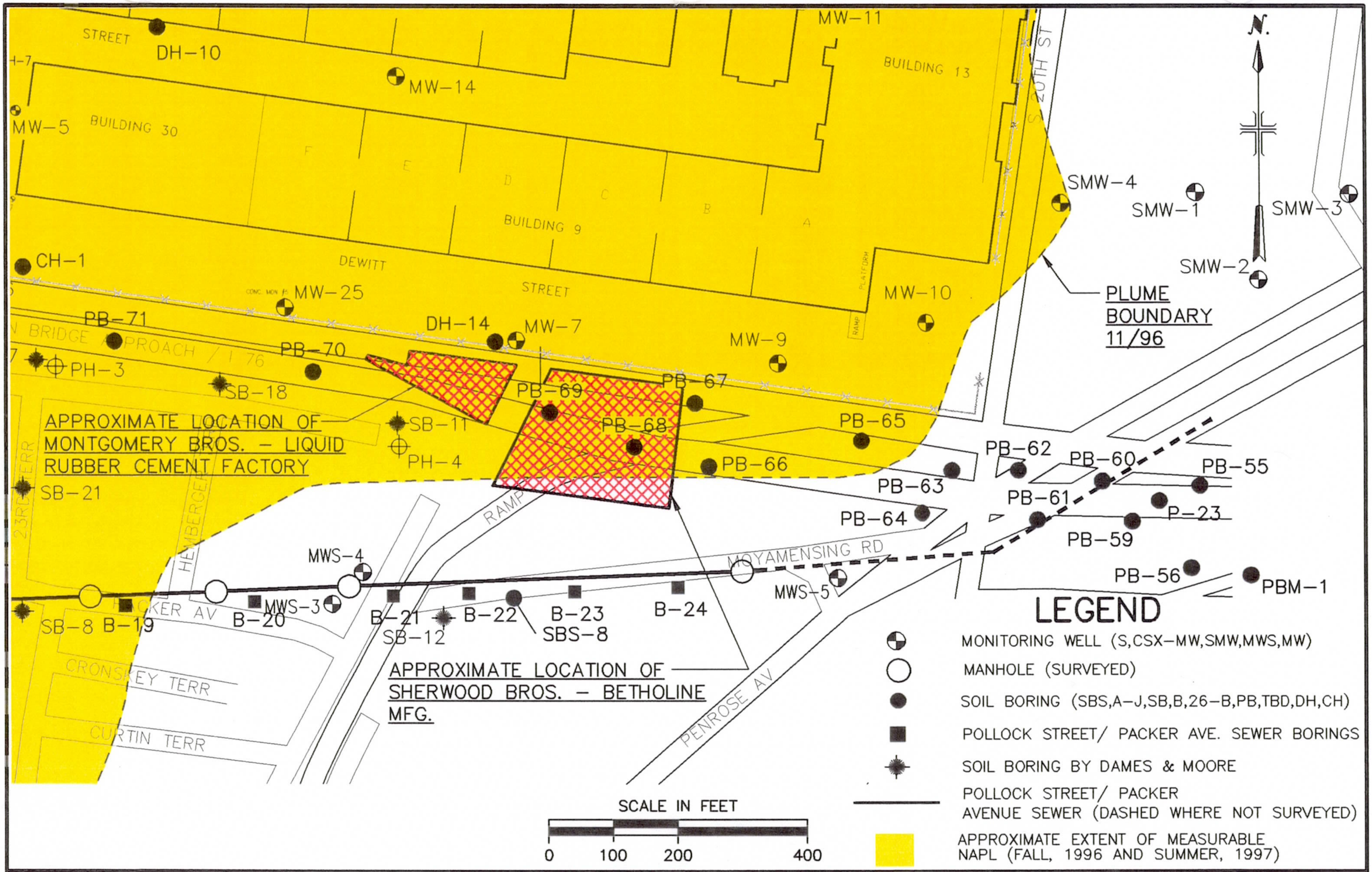
Table 6-1: Registered Tank Sites and Confirmed Releases Within 0.25 Mile of DPSC

Listed Site	Type	Approximate Distance from Subject Property	Additional Information (Number of USTs/Capacity/Contents Type/Quantity of Release)
George C. Young Co.	RST	Adjacent and northeast	One 1,000-gallon gasoline UST One 4,000-gallon diesel UST One 6,000-gallon heating oil UST
SEPTA South Garage	RST	East and across 20th Street	One 10,000-gallon diesel UST One 5,000-gallon new motor oil UST One 6,000-gallon gasoline UST Five mixture tanks- 285-1,000 gal capacities
Getty Station 67261	RST	North and across Oregon Ave.	Three 6,000-gallon gasoline USTs
Sears Roebuck & Co.	RST & PLCR	North and across Oregon Ave.	One 10,000-gallon heating oil UST Waste oil released - quantity not reported
Passyunk Homes	RST	South and across Schuylkill Expressway	One 550-gallon gasoline UST
Beverlea Enterprises, Inc. - Check Cash	PLCR	0.25 mile south	Two gasoline releases - quantities not reported
Philadelphia SD - POE 2321	PLCR	0.25 mile north	Heating oil released - quantity not reported
Laidlaw Transit - Ryder Leased Property	PLCR	0.25 mile southwest	Two gasoline releases - quantities not reported

Based on the nature of the petroleum products reported to be stored or released on these properties, the location of the properties with respect to the NAPL plume beneath DPSC, and the analytical results for NAPL plume samples, these sites are not considered likely contributors to the NAPL plume beneath DPSC.

Based on a review of historical maps provided in the ERIIS report, two former manufacturing facilities, the Sherwood Brothers Betholine manufacturing plant and the former Montgomery Brothers rubber cement factory, were located adjacent to and south of DPSC. The former locations of these facilities are shown on Figure 6-1 and were based on Sanborn Company Fire Insurance Maps dated 1922 and 1951. The following evidence indicates that these facilities are not contributors of the NAPL plume beneath DPSC.

- Based on current potentiometric data and historical groundwater flow, these facilities are hydraulically down gradient from the central and west-central portions of DPSC. NAPL would have had to migrate up gradient to extend to



US Army Corps
of Engineers

DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31–94–D–0017

SHERWOOD BROS. AND MONTGOMERY BROS.
FORMER SITE LOCATIONS

MALCOLM PIRNIE, INC.

FIGURE 6–1

its current northwestern boundary near MW-24 in the west-central portion of DPSC.

- As shown on Attachment B, borings PB-69 and PB-68, which were drilled prior to the construction of the Schuylkill Expressway in 1954, were located on the former Sherwood Brothers property. Two other Schuylkill Expressway borings, PB-67 and PB-66 were located along the eastern border of this property. No mention of the presence of petroleum hydrocarbons was noted in the drilling logs for these four borings, indicating that NAPL was not present in this area at this time. In contrast, the log for boring B, which was also drilled as part of the geotechnical investigation for the Schuylkill Expressway, located between the Refinery and DPSC, (see Figure ES-3) documents the presence of approximately 14 feet of "oil soaked" soils.

- As shown on Figure 6-1, these former facilities are located at or near the southeastern boundary of the NAPL plume. If one or both of these former facilities were contributors to the NAPL beneath DPSC, soil and groundwater to the south and southeast of these properties would likely contain significant amounts of either NAPL or residual NAPL, especially considering the relatively flat hydraulic gradient in this area. Specifically, borings SBS-8, and B-21 through B-24 do not indicate the presence of NAPL plume material in these areas.

- No petroleum staining or residual NAPL was observed from ground surface to approximately 15 feet bgs in the boring for MW-7 or boring DH-14, located along the northern edge of the former Montgomery Brothers facility. If approximately one million gallons of NAPL were released on this facility or the adjacent Sherwood Brothers site, residual product and petroleum staining would be expected directly beneath and surrounding these former facilities.

- Although the 1922 Sanborn map identifies a tank containing "naphtha" on the Sherwood Brothers property, the chemical composition of this material and the material used at the Montgomery Brothers factory is unknown. No information is available to conclude that the light refinery naphtha which comprises the majority of the NAPL plume is equivalent to the materials which may have been used at these facilities.

6.2.2 ARCO/Sun Refinery South Yard NAPL Plumes

The ARCO/Sun Refinery South Yard is located approximately 500 feet to the west of DPSC. The CSX property and 26th Street are present between the two sites. The refinery has operated since the 1880s. As shown in Figure 5-4, tankage in the South Yard has been used to store a variety of refined and unrefined petroleum products. Some of these products are consistent with the chemical analyses performed on samples from the NAPL plume beneath DPSC. A review of public documents obtained via the Freedom of Information Act (FOIA) identified numerous product releases at the ARCO/Sun Refinery property. However, specific locations and types of products released were not provided.

A review of the January 1993 Sun Company, Inc. (R&M) Philadelphia Refinery Comprehensive Remedial Plan, and synoptic well gauging conducted in late 1994, early 1995, and October and November 1996 indicate that several areas of NAPL have been or are present in the South Yard. Based on these data, two of these areas shown on Figure 5-4 are present in the northern portion of the South Yard, hydraulically upgradient from the area of relict NAPL contamination on the CSX property and the NAPL plume beneath DPSC. One east-west trending NAPL area is present along the northern edge of the South Yard near the Belmont Terminal. The historical presence of NAPL in these areas has been documented by the well gauging results included in the 1993 Comprehensive Remedial Plan. Based on data from 1996, a north-south trending NAPL area is present along the northern edge of the South Yard's eastern boundary along 26th Street. A smaller, thinner NAPL area is indicated by NAPL in the vicinity of monitoring well S-49 along the east-central South Yard boundary.

The 1993 Comprehensive Remedial Plan also indicates that up to eight separate areas of NAPL were present in the South Yard to the south of Pollock Street. One of these straddles the Pollock Street/Packer Avenue sewer and its approximate location in December 1992 is shown on Figure 5-4. The other areas of NAPL discussed in the Comprehensive Remedial Plan are located either further west or south of the NAPL area which straddles the Pollock Street/Packer Avenue sewer, at locations which are not related to the NAPL beneath DPSC.

6.2.3 SEPTA Site Investigations

The four monitoring wells located on the SEPTA South Garage property were installed during site investigations on this site in 1991 and 1992 (Figure 3-1). (R.E. Wright, 1991, and Coastal Remediation Company, 1992.) Soil samples collected during drilling of the borings for these wells were analyzed for TPH. In 1992, the highest concentrations of TPH were detected in soil and groundwater samples from SMW-4. In 1994, the highest TPH concentration was detected in a groundwater sample from SMW-1, located adjacent and west of current and former USTs. Groundwater samples collected from SMW-1, SMW-3, and SMW-4 contained detectable levels of benzene, ethylbenzene, toluene, and xylenes (BETX compounds).

Anamolous groundwater levels, approximately two feet higher than nearby wells, have been measured in SMW-4. Groundwater on the SEPTA site was reported to flow to the northeast, based on water-level measurements in the four SEPTA wells in 1992. No NAPL had been measured in any of the SEPTA wells from 1991 to 1994.

As summarized in Table 6-1, SEPTA reportedly stored diesel, new motor oil, and gasoline. None of these products are major components of the NAPL plume. Based on this information, SEPTA is not considered to be a likely potential contributor to the NAPL Plume.

7.0 CONCLUSIONS

This NAPL Plume Study was performed in conjunction with other investigative activities at DPSC to evaluate the extent, quantity, composition, migration pathways, and potential sources of the NAPL beneath DPSC. Field and research activities were conducted to compile sufficient information to meet the project objectives, which had been presented as six specific questions regarding the NAPL plume. The answers to these questions are provided, below.

1. How much NAPL is beneath DPSC property?

The volume of NAPL on the water table beneath DPSC is estimated to range from 690,000 to 920,000 gallons. A high estimate for the volume of residual NAPL in the soil beneath DPSC is approximately 350,000 gallons.

The estimate of the volume of NAPL beneath DPSC is based on the results of supplemental laboratory testing (specific gravity, oil surficial tension, and oil-water interfacial tension), and previously conducted geotechnical analyses, which were incorporated into the van Genuchten three-phase capillary pressure model. The approximate extent of NAPL on DPSC was used to revise previous NAPL volume estimates.

The presence of residual NAPL in soils above the NAPL plume was caused by fluctuations in the water table and smearing of NAPL over a vertical interval. Analytical data from the Phase I RI/FS (Kemron/Versar, 1995) was used to estimate the residual NAPL volume beneath DPSC. Data from the Phase I RI/FS and the Groundwater Assessment, South Yard, Northeast Property Boundary (GES, 1994a) was used to estimate a volume of approximately 73,000 gallons of residual NAPL on the CSX property between the ARCO/Sun Refinery and DPSC.

NAPL baildown/recovery tests were performed on 12 on-site wells to assess actual NAPL thickness. Based on the results of these tests, the average thickness of NAPL on the saturated zone beneath DPSC is approximately 0.16 feet. At the time of the baildown/recovery tests, the thickest portion of the NAPL was estimated to be 0.4 feet in MW-1A, located in the south-central portion of DPSC.

Historical information on its own was insufficient to effectively assess the extent, quantity, and composition of NAPL. These data gaps were addressed by conducting additional drilling and analytical activities, and reviewing additional literature sources. The field work was performed in accordance with approved field sampling plans, a Quality Assurance Program Plan (QAPP), and a Quality Assurance Project Plan (QAPjP). Modifications to these work plans were approved by the USACE (Baltimore District) prior to implementation. The results of previous field work and investigations were combined with these activities to characterize the NAPL plume. Information from the Phase I and II ESIs which were conducted in support of the BRAC program were also incorporated into this study.

Based on data from soil borings and fluid-level measurements in on-site monitoring wells, the NAPL plume is present in the southern portion of DPSC beneath approximately 42 acres of the 86-acre site. The northwestern on-site extent of NAPL was approximated based on the absence of measurable NAPL in well MW-23, which was installed in June 1996. Based on the absence of measurable NAPL in MW-24 on October 16, 1996, and the thin (0.01-foot thick) layer of NAPL measured in this well on November 15, 1996, the north-central extent of the on-site NAPL plume was approximated.

2. Is there NAPL still migrating onto DPSC property?

There is no evidence to indicate that NAPL is currently migrating onto DPSC property. The migration of NAPL in the study area was evaluated by investigating historical and current groundwater flow regimes, identifying areas of relict NAPL contamination, and assessing the influence of stratigraphy and buried utilities on NAPL migration. Historical, regional information indicates that groundwater flow in the vicinity of the ARCO/Sun Refinery and DPSC is to the southeast (Figure 1-14). This general flow direction was confirmed by the results of synoptic fluid-level measurements conducted on December 14, 1994 and March 1 and 2, 1995 (Figures 5-3 and 5-4, respectively). The presence of the 26th Street sewer since the mid-1960s may have affected groundwater flow patterns along its north-south route.

The operation of dual-phase recovery systems (most recently initiated in January, 1996 to limit the off-site extent of a NAPL plume) in the Sun recovery wells along 26th Street has affected groundwater flow directions in the study area. Pumping of these recovery wells has decreased water levels along a north-south trending line parallel to 26th Street and has changed groundwater flow directions on the CSX property and the western portion of DPSC to the southwest. These withdrawals and the potential infiltration of groundwater into the 26th Street sanitary sewer may have lowered water levels below mean sea level in isolated areas along 26th Street.

Based on the data collected during drilling and sampling activities on the CSX property and the northern portion of DPSC, NAPL is not currently migrating onto DPSC from properties to the west or north. The distribution of residual NAPL contamination and the historical groundwater flow directions (south-southeast between the ARCO/Sun Refinery and DPSC) show that NAPL formerly migrated through the CSX property from an off-site source to the west-northwest.

3. Is the NAPL moving through and off of DPSC property?

Based on current groundwater gradients and the presence of NAPL in the southern portion of DPSC, NAPL is migrating off of DPSC to the south.

Past and present migration of NAPL in the study area has been influenced by stratigraphy and buried utilities. The area is characterized by varying thicknesses of fill which overlie a silt unit which is up to approximately 15 feet thick. Throughout the majority of the study area, the water table is present in an underlying, undifferentiated sand and gravel unit. The upper silt unit intersects the water table in the northwestern portion of the study area and in the northeastern and southeastern portions of DPSC (Figure 1-4). Due to the intersection of the NAPL layer with this silt unit in the southeastern portion of DPSC, the migration of NAPL to the east and southeast, off of DPSC, appears to have been limited.

The intersection of the water table and the NAPL layer with the Pollock Street/Packer Avenue sewer, located to the south of DPSC, has influenced the migration of NAPL in the study area. Soil borings and monitoring wells drilled along both sides of the Pollock Street/ Packer Avenue sewer show that, under relatively high groundwater conditions, the sewer impedes the southward migration of the NAPL plume. Because the sewer extends several feet below the water table, NAPL which is on the water table is "dammed" and is thicker on the northern side of the sewer and diminished or absent on the southern side of the sewer. The intersection of the sewer with the water table may have caused migration of NAPL in directions which are not coincident with the ambient groundwater gradients in this area. Leakage of NAPL into the Pollock Street/Packer Avenue sewer has also been reported.

Information on historic water levels indicate that the water table is at times below the bottom of the sewer. Under these conditions, the sewer would not affect the southward migration of NAPL. The presence of petroleum staining below the current water table and below the bottom of the sewer in this area confirms that NAPL has migrated beneath the Pollock Street/Packer Avenue sewer. The backfilled bedding around the sewer does not appear to be a major migration pathway for NAPL in this area.

4. What is the composition of the NAPL?

According to the interpretation of the analytical results of NAPL samples by Friedman and Bruya, the NAPL beneath DPSC is a minimum of 90 percent undegraded and degraded light refinery naphtha. Based on the boiling point ranges of the NAPL samples, the light refinery naphtha, according to Friedman and Bruya, is most characteristic of JP-4. Although less similar in composition, Friedman and Bruya could not rule out that the naphtha is a refinery intermediate or light crude oil, due to the proximity of the ARCO/Sun Refinery property to DPSC. Quality assurance and quality control procedures were followed in the field and laboratory to ensure the validity of this determination and the usability of the analytical data.

The remaining portion (maximum of 10 percent) of the NAPL was identified as gasoline based on the relatively low levels of organic lead and isooctane, which are not commonly associated with JP-4. According to Friedman and Bruya, the NAPL is not a diesel, fuel oil or boiler fuel, and the composition of the NAPL is not indicative of motor oil, lubricating oil, or solvent. The NAPL is not a mixture of gasoline and diesel, contrary to the conclusions of previous reports.

Analysis of soil samples collected from soil borings drilled on DPSC, on the CSX property, and on and adjacent to Passyunk Homes property (located across the Schuylkill Expressway to the south) confirmed the presence of undegraded and degraded naphtha in addition to gasoline in these areas.

5. How much, if any, of the NAPL originated from DPSC activities?

Based on the results of the Phase I and Phase II ESIs which were conducted as part of BRAC activities, the highest priority petroleum storage and handling facilities at DPSC are not contributors to the NAPL plume which is located beneath DPSC. The entire DPSC facility was considered during the Environmental Baseline Survey (EBS), and additional environmental studies were conducted for specific areas where warranted. The six highest priority petroleum storage and handling areas investigated as part of the Phase II ESI were the:

- Building 8 Waste Oil Tank
- Former Bash Street Gasoline Station
- Bulk Storage Facility and Fill/Transport Area
- Building 28 Gasoline Station
- Building 46 USTs
- Oregon Avenue USTs

Additional, lower priority petroleum storage and handling areas on DPSC are scheduled to be investigated as part of future BRAC activities (Phase III ESI). However, based on historical use and storage information, the likelihood of these areas being potential contributors to the NAPL plume is extremely small. A review of the findings of previous site investigations at DPSC was performed to evaluate potential on-site contributors. Based on the characterization of the NAPL as a light refinery naphtha (characteristic of JP-4) and the lack of storage or usage of large quantities of such products on DPSC, the source of the NAPL is not located at DPSC. The gasoline component of the NAPL beneath DPSC is likely associated with the light refinery naphtha based on its distribution; however, a contribution of gasoline from DPSC cannot be ruled out. The presence of gasoline in samples collected at the CSX property was also reported by the laboratory. Based on these conclusions, off-site sources of the NAPL plume were evaluated.

6. What is the source of the NAPL?

The ARCO/Sun Refinery is the source of the NAPL plume beneath DPSC based on the following evidence:

- Friedman and Bruya has conclusively identified the NAPL beneath DPSC as no less than 90 percent light refinery naphtha (characteristic of JP-4). The remaining portion of the NAPL is leaded and/or unleaded gasoline.

- The dominant component of the NAPL plume beneath DPSC, JP-4, is not, and never has been, stored in large quantities or in bulk storage at DPSC.

- Petroleum products including, but not limited to, jet fuel, light naphtha, and unleaded and leaded gasoline have been stored in the northeastern portion of the ARCO/Sun Refinery South Yard, which is hydraulically upgradient from DPSC, based on historical groundwater flow information.

- NAPL recovery operations on the ARCO/Sun Refinery property, specifically along the western side of 26th Street in the eastern portion of the ARCO/Sun Refinery South Yard, are on-going. These NAPL recovery operations were implemented as per a PADEP Consent Order and Agreement signed by Sun to recover NAPL and limit the off-site migration of NAPL.

- As shown on Figures 5-5 and ES-3 and supported by the historical south-southeastward groundwater flow direction, a former pathway of NAPL was identified from the ARCO/Sun Refinery property to DPSC. The presence of this former pathway is based on analytical results of soil samples collected from borings drilled on the CSX property which contained petroleum components indicative of naphtha. This analytical data, coupled with the petroleum staining and sheens observed during drilling and sampling activities on the CSX property, confirmed the former presence of NAPL (relict NAPL) between the ARCO/Sun Refinery South Yard and DPSC.

- The presence of historical storage of unleaded and leaded gasoline at the ARCO/Sun Refinery property, coupled with the presence of gasoline in soil samples in the northern portion of the CSX property, upgradient of DPSC, indicates that the ARCO/Sun Refinery may also be, solely or partially, the source of the gasoline component of the NAPL plume.

A regulatory records review was performed for DPSC and surrounding properties. Petroleum storage was reported on several surrounding properties: the SEPTA Southern Garage property located across 20th Street to the east of DPSC; the George C. Young Company site located adjacent to and northeast of DPSC; and the Sears Roebuck & Company property and Getty Station #67261 located across Oregon Avenue to the north of DPSC. Based on the reported quantities and types of products stored, none of these sites are considered likely sources of the NAPL plume beneath DPSC. The former Montgomery Brothers and Sherwood Brothers facilities are not likely sources of the NAPL plume due to their location near the downgradient southeastern edge of the plume.

The results of an investigation on the SEPTA Southern Garage, located adjacent and east of DPSC, were reviewed. The reports concluded that petroleum constituents had been released on the SEPTA property. Although no measurable NAPL had been present in any SEPTA wells from 1991 to October 1996, a thin (0.02 foot thick) layer of NAPL was measured in the westernmost SEPTA well (SMW-4) on November 15, 1996. Analytical information was not available to compare the NAPL in SMW-4 to the NAPL beneath DPSC.

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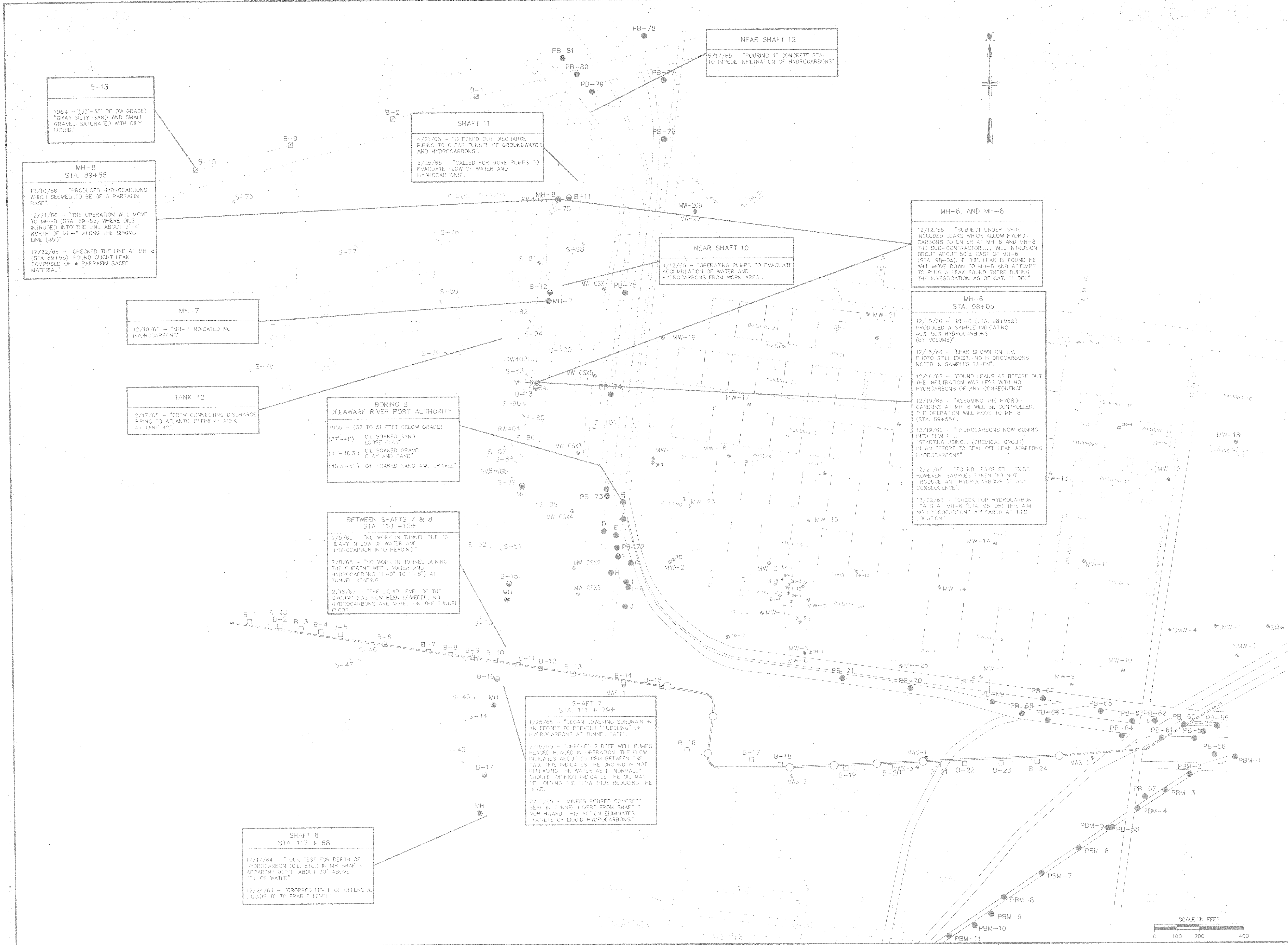


B-15

1964 – (33'-35' BELOW GRADE) "GRAY SILTY-SAND AND SMALL GRAVEL-SATURATED WITH OILY LIQUID."

MH-8
STA. 89+55

12/10/66 – "PRODUCED HYDROCARBONS WHICH SEEMED TO BE OF A PARRAFIN BASE".

12/21/66 – "THE OPERATION WILL MOVE TO MH-8 (STA. 89+55) WHERE OILS INTRUDED INTO THE LINE ABOUT 3'-4' NORTH OF MH-8 ALONG THE SPRING LINE (45°)".

12/22/66 – "CHECKED THE LINE AT MH-8 (STA 89+55). FOUND SLIGHT LEAK COMPOSED OF A PARRAFIN BASED MATERIAL".

MH-7

12/10/66 – "MH-7 INDICATED NO HYDROCARBONS".

TANK 42

2/17/65 – "CREW CONNECTING DISCHARGE PIPING TO ATLANTIC REFINERY AREA AT TANK 42".

SHAFT 11

4/21/65 – "CHECKED OUT DISCHARGE PIPING TO CLEAR TUNNEL OF GROUNDWATER AND HYDROCARBONS".

5/25/65 – "CALLED FOR MORE PUMPS TO EVACUATE FLOW OF WATER AND HYDROCARBONS".

NEAR SHAFT 12

5/17/65 – "POURING 4" CONCRETE SEAL TO IMPEDE INFILTRATION OF HYDROCARBONS".

NEAR SHAFT 10

4/12/65 – "OPERATING PUMPS TO EVACUATE ACCUMULATION OF WATER AND HYDROCARBONS FROM WORK AREA".

BORING B
DELAWARE RIVER PORT AUTHORITY

1955 – (37 TO 51 FEET BELOW GRADE)

(37'-41')	"OIL SOAKED SAND" "LOOSE CLAY"
(41'-48.3')	"OIL SOAKED GRAVEL" "CLAY AND SAND"
(48.3'-51')	"OIL SOAKED SAND AND GRAVEL"

MH-6, AND MH-8

12/12/66 – "SUBJECT UNDER ISSUE INCLUDED LEAKS WHICH ALLOW HYDROCARBONS TO ENTER AT MH-6 AND MH-8. THE SUB-CONTRACTOR...... WILL INTRUSION GROUT ABOUT 50'± EAST OF MH-6 (STA. 98+05). IF THIS LEAK IS FOUND HE WILL MOVE DOWN TO MH-8 AND ATTEMPT TO PLUG A LEAK FOUND THERE DURING THE INVESTIGATION AS OF SAT. 11 DEC".

MH-6
STA. 98+05

12/10/66 – "MH-6 (STA. 98+05±) PRODUCED A SAMPLE INDICATING 40%-50% HYDROCARBONS (BY VOLUME)".

12/15/66 – "LEAK SHOWN ON T.V. PHOTO STILL EXIST.–NO HYDROCARBONS NOTED IN SAMPLES TAKEN".

12/16/66 – "FOUND LEAKS AS BEFORE BUT THE INFILTRATION WAS LESS WITH NO HYDRCARBONS OF ANY CONSEQUENCE".

12/19/66 – "ASSUMING THE HYDROCARBONS AT MH-6 WILL BE CONTROLLED, THE OPERATION WILL MOVE TO MH-8 (STA. 89+55)".

12/19/66 – "HYDROCARBONS NOW COMING INTO SEWER ..."
"STARTING USING... (CHEMICAL GROUT) IN AN EFFORT TO SEAL OFF LEAK ADMITTING HYDROCARBONS".

12/21/66 – "FOUND LEAKS STILL EXIST, HOWEVER, SAMPLES TAKEN DID NOT PRODUCE ANY HYDROCARBONS OF ANY CONSEQUENCE".

12/22/66 – "CHECK FOR HYDROCARBON LEAKS AT MH-6 (STA. 98+05) THIS A.M. NO HYDROCARBONS APPEARED AT THIS LOCATION".

BETWEEN SHAFTS 7 & 8
STA. 110 +10±

2/5/65 – "NO WORK IN TUNNEL DUE TO HEAVY INFLOW OF WATER AND HYDROCARBON INTO HEADING."

2/8/65 – "NO WORK IN TUNNEL DURING THE CURRENT WEEK. WATER AND HYDROCARBONS (1'-0" TO 1'-6") AT TUNNEL HEADING."

2/18/65 – "THE LIQUID LEVEL OF THE GROUND HAS NOW BEEN LOWERED, NO HYDROCARBONS ARE NOTED ON THE TUNNEL FLOOR."

SHAFT 7
STA. 111 + 79±

1/25/65 – "BEGAN LOWERING SUBDRAIN IN AN EFFORT TO PREVENT "PUDDLING" OF HYDROCARBONS AT TUNNEL FACE".

2/16/65 – "CHECKED 2 DEEP WELL PUMPS PLACED PLACED IN OPERATION. THE FLOW INDICATES ABOUT 25 GPM BETWEEN THE TWO. THIS INDICATES THE GROUND IS NOT RELEASING THE WATER AS IT NORMALLY SHOULD. OPINION INDICATES THE OIL MAY BE HOLDING THE FLOW THUS REDUCING THE HEAD."

2/16/65 – "MINERS POURED CONCRETE SEAL IN TUNNEL INVERT FROM SHAFT 7 NORTHWARD. THIS ACTION ELIMINATES POCKETS OF LIQUID HYDROCARBONS."

SHAFT 6
STA. 117 + 68

12/17/64 – "TOOK TEST FOR DEPTH OF HYDROCARBON (OIL, ETC.) IN MH SHAFTS APPARENT DEPTH ABOUT 30" ABOVE 5"± OF WATER".

12/24/64 – "DROPPED LEVEL OF OFFENSIVE LIQUIDS TO TOLERABLE LEVEL."

LEGEND

CH, DH, SB ⊕	ON-SITE BORINGS (POST 1967)
⊕	MONITORING WELL (POST 1967)
☐ B-19	POLLOCK STREET/PACKER AVENUE SEWER SOIL BORINGS (1916-DEPARTMENT OF PUBLIC WORKS, BUREAU OF SURVEYS, PHILADELPHIA)
PB-78 ●	SCHUYLKILL EXPRESSWAY SOIL BORINGS (1955-DELAWARE VALLEY PORT AUTHORITY, DELAWARE RIVER BRIDGE)
B-11 ◒	26th STREET SEWER SOIL BORINGS (1962-CITY OF PHILADELPHIA WATER DEPARTMENT WORK NO. SD-297SW)
▨	RECOVERY WELL (POST 1967)
B-1 ☒	PASSYUNK AVENUE SEWER SOIL BORINGS (1961-CITY OF PHILADELPHIA WATER DEPARTMENT WORK NO. S-3117F)
—○—	POLLOCK STREET/PACKER AVENUE SEWER MANHOLES (SURVEYED)
——	POLLOCK STREET/ PACKER AVENUE SEWER (DASHED WHERE NOT SURVEYED)
MH ◉	SEWER MANHOLE (NOT SURVEYED)

(ALL LOCATIONS APPROXIMATE EXCEPT WHERE SURVEYED)

NOTES:

1. RECORDS FOR OFF-SITE BORINGS AND MANHOLES WHICH NO NOTATIONS ARE PROVIDED CONTAINED NO MENTION OF PETROLEUM CONTAMINATION.
2. CITATATIONS ARE EXCERPS FROM CONSTRUCTION DIARIES DURING 26th STREET CONSTRUCTION CONTRACT SD-297-SW (1964-1966).

PLATE 4-1

US Army Corps of Engineers

MALCOLM PIRNIE

REVISIONS			
NO.	BY	DATE	REMARKS

DES ______
DWN JJN
CKD ______

DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

OFF-SITE
HISTORICAL PETROLEUM
CONTAMINATION
(PRIOR TO 1967)

MALCOLM PIRNIE, INC.
DATE DECEMBER 1996
SHEET ____ OF ____
DWG. NO. 643-44

XREFS:

Appendix A
Monitoring Well Construction Diagrams

TABLE A-1
NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA
MONITORING WELL CONSTRUCTION SUMMARY

Well	Total Depth		Screen Interval		Filter Pack Interval		Slot Size (inches)	Well Diameter/ Material	Date Completed	Ground Elevation (ft AMSL)	Measuring Pt. Elevation (ft AMSL)
	(ft BGS)	(ft AMSL)	(ft BGS)	(ft AMSL)	(ft BGS)	(ft AMSL)					
MW-1	34	-12.73	17 to 32	4.27 to -10.73	15 to 34	6.27 to -12.73	0.010	2" PVC	5/7/91	21.27	20.78
MW-1A	28	-8.22	16 to 26	3.78 to -6.22	13 to 28	6.78 to -8.22	0.010	4" PVC	6/2/92	19.78	21.33
MW-2	34	-12.04	17 to 32	4.96 to -10.04	15 to 34	6.96 to -12.04	0.010	2" PVC	1/15/91	21.96	21.83
MW-2A	27	-5.47	14.6 to 24.6	6.93 to -3.07	11.6 to 27	9.93 to -5.47	0.010	4" PVC	6/3/92	21.53	21.13
MW-3	34.5	-13.69	17.5 to 32.5	3.31 to -11.69	15.5 to 34.5	5.31 to -13.69	0.010	2" PVC	5/13/91	20.81	20.34
MW-4	34	-12.87	17 to 32	4.13 to -10.87	15 to 34	6.13 to -12.87	0.010	2" PVC	5/14/91	21.13	20.60
MW-5	34	-13.34	17 to 32	3.66 to -11.34	15 to 34	5.66 to -13.34	0.010	6" PVC	5/17/91	20.66	20.32
MW-6	33	-11.48	16 to 31	5.52 to -9.48	14 to 33	7.52 to -11.48	0.010	2" PVC	5/10/91	21.52	21.18
MW-6D	86	-64.36	64 to 74	-42.36 to -52.36	58 to 77	-36.36 to -55.36	0.010	4" PVC	11/94 - 2/95	21.64	21.45
MW-7	26	-6.29	15 to 25	4.71 to -5.29	13 to 26	6.71 to -6.29	0.010	2" PVC	5/8/91	19.71	19.30
MW-9	37	-16.61	13 to 33	7.39 to -12.61	8 to 37	12.39 to -16.61	0.010	4" PVC	11/94 - 2/95	20.39	20.08
MW-10	31.5	-14.58	13.6 to 28.6	3.32 to -11.68	8.5 to 31.5	8.42 to -14.58	0.010	4" PVC	11/94 - 2/95	16.92	16.56
MW-11	35	-14.45	17 to 32	3.55 to -11.45	12 to 35	8.55 to -14.45	0.010	4" PVC	11/94 - 2/95	20.55	20.21
MW-12	32	-12.28	16 to 31	3.72 to -11.28	9 to 32	10.72 to -12.28	0.010	4" PVC	11/94 - 2/95	19.72	19.54
MW-13	33	-12.38	15 to 30	5.62 to -9.38	10 to 33	10.62 to -12.38	0.010	4" PVC	11/94 - 2/95	20.62	20.38
MW-14	35	-14.33	17 to 32	3.67 to -11.33	12 to 35	8.67 to -14.33	0.010	4" PVC	11/94 - 2/95	20.67	20.27
MW-15	31	-10.42	16 to 31	4.58 to -10.42	11 to 34	9.58 to -13.42	0.010	4" PVC	11/94 - 2/95	20.58	22.58
MW-16	34	-13.31	16 to 31	4.69 to -10.31	11 to 34	9.69 to -13.31	0.010	4" PVC	11/94 - 2/95	20.69	20.36
MW-17	32	-11.51	14 to 29	6.49 to -8.51	9 to 32	11.49 to -11.51	0.010	4" PVC	11/94 - 2/95	20.49	22.25
MW-18	32	-13.69	10.7 to 28.7	7.61 to -10.39	6.5 to 32	11.81 to -13.69	0.010	4" PVC	11/94 - 2/95	18.31	17.93
MW-19	31	-9.79	15 to 30	6.21 to -8.79	8 to 31	13.21 to -9.79	0.010	4" PVC	11/94 - 2/95	21.21	23.12
MW-20	34	-7.92	16 to 31	10.08 to -4.92	11 to 34	15.08 to -7.92	0.010	4" PVC	11/94 - 2/95	26.08	25.66
MW-20D	92	-65.90	76 to 91	-49.90 to -64.90	61 to 92	-34.90 to -65.90	0.010	4" PVC	11/94 - 2/95	26.10	25.80
MW-21	24	-3.21	13 to 23	7.79 to -2.21	11 to 24	9.79 to -3.21	0.010	4" PVC	6/14/96	20.79	20.18
MW-22	26	-3.96	15 to 25	7.04 to -2.96	13 to 26	9.04 to -3.96	0.010	4" PVC	6/17/96	22.04	21.73
MW-23	30	-8.86	15.7 to 25.7	5.44 to -4.56	12.7 to 27	8.44 to -5.86	0.010	4" PVC	6/11/96	21.14	20.72
MW-24	30	-8.83	17.2 to 26.2	3.97 to -5.03	14 to 27.2	7.17 to -6.03	0.010	4" PVC	6/13/96	21.17	20.95
MW-25	30	-9.24	16.5 to 26.5	4.26 to -5.74	13.5 to 26.75	7.26 to -5.99	0.020	6" PVC	6/13/96	20.76	20.36
CSX-MW-1	54	-2.81	40 to 50	11.19 to 1.19	36 to 52	15.19 to -0.81	0.010	4" PVC	11/94 - 2/95	51.19	51.32
CSX-MW-2	60	-13.09	47 to 57	-0.09 to -10.09	38 to 60	8.91 to -13.09	0.010	4" PVC	11/94 - 2/95	46.91	46.70
CSX-MW-3	53	-4.74	42 to 52	6.26 to -3.74	39 to 52.5	9.26 to -4.24	0.010	2" PVC	6/19/96	48.26	48.12
CSX-MW-4	54	-6.77	43 to 53	4.23 to -5.77	40 to 54	7.23 to -6.77	0.010	2" PVC	6/20/96	47.23	47.15
CSX-MW-5	54	-4.13	44 to 53	5.87 to -3.13	43.5 to 54	6.37 to -4.13	0.010	2" PVC	6/24/96	49.87	49.76
CSX-MW-6	53	-6.93	42 to 52	4.07 to -5.93	39 to 53	7.07 to -6.93	0.010	2" PVC	6/18/96	46.07	45.92
DPSSP-MWS-1	32	-7.80	20.1 to 30.1	4.10 to -5.90	17 to 31	7.20 to -6.80	0.010	2" PVC	8/20/96	24.20	24.01
DPSSP-MWS-2	28	-7.51	16.85 to 26.85	3.64 to -6.36	14 to 28	6.49 to -7.51	0.010	2" PVC	8/21/96	20.49	19.97
DPSSP-MWS-3	24	-7.76	12 to 22	4.24 to -5.76	9 to 23	7.24 to -6.76	0.010	2" PVC	8/22/96	16.24	16.06
DPSSP-MWS-4	26	-8.25	15 to 25	2.75 to -7.25	12 to 26	5.75 to -8.25	0.010	2" PVC	8/22/96	17.75	17.54
DPSSP-MWS-5	29	-13.60	18 to 28	-2.60 to -12.60	16 to 28.8	-0.60 to -13.40	0.010	2" PVC	8/23/96	15.40	15.20

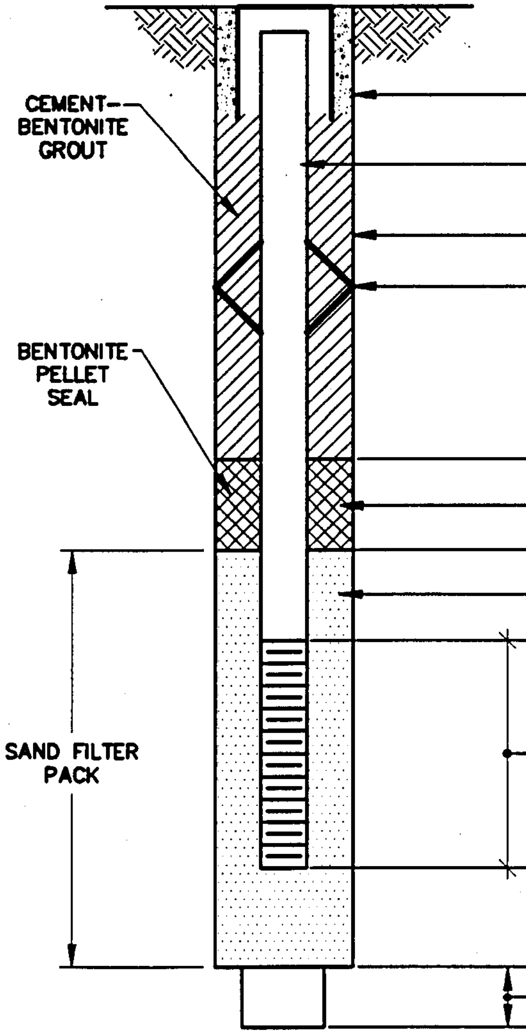
MALCOLM PIRNIE

OVERBURDEN
MONITORING WELL SHEET

WELL NO. MW-23

PROJECT DPSC
START DATE 6-11-96
END DATE 6-11-96
PROJECT NO. 0285643
FIELD GEOLOGIST J. HILTON
LOCATION DPSC, PHILADELPHIA, PA.

DRILLING CO. SJB SERVICES
DRILLER(S) T. MILLER
DRILLING METHOD(S) 6 1/4" HSA
DEVELOPMENT METHOD(S) MANUAL PURGE W/ SURGE BLOCK



DEPTH TO TOP OF GROUT/ BOTTOM OF CEMENT 1.5'
RISER DIAMETER AND MATERIAL 4" SCH 40 PVC
BOREHOLE DIAMETER 10.5"
DEPTH TO CENTRALIZERS N/A
DEPTH 9.0'
PELLET SIZE MEDIUM CHIPS
DEPTH 12.7'
SAND SIZE #1 MORIE
DEPTH 15.7'
SCREEN DIAMETER 4"
SLOT SIZE .010
MATERIAL SCH 40 PVC
DEPTH 25.7'
BOTTOM PLUG 26.0'
DEPTH 27.0'
BACKFILL MATERIAL NATIVE SAND & GRAVEL
BOTTOM OF BOREHOLE 30.0'

NOTE: DEPTHS ARE FEET BELOW GRADE

MW-OB2.DWG 8-24-95

18/1 : 0285643 \ACAD\PROJ\02856439\643-25 SCALE: 1:1 07/09, 1996 at 09

MALCOLM PIRNIE

OVERBURDEN MONITORING WELL SHEET

WELL NO. MW-24

PROJECT DPSC

START DATE 6-13-96

END DATE 6-13-96

PROJECT NO. 0285643

FIELD GEOLOGIST J. HILTON

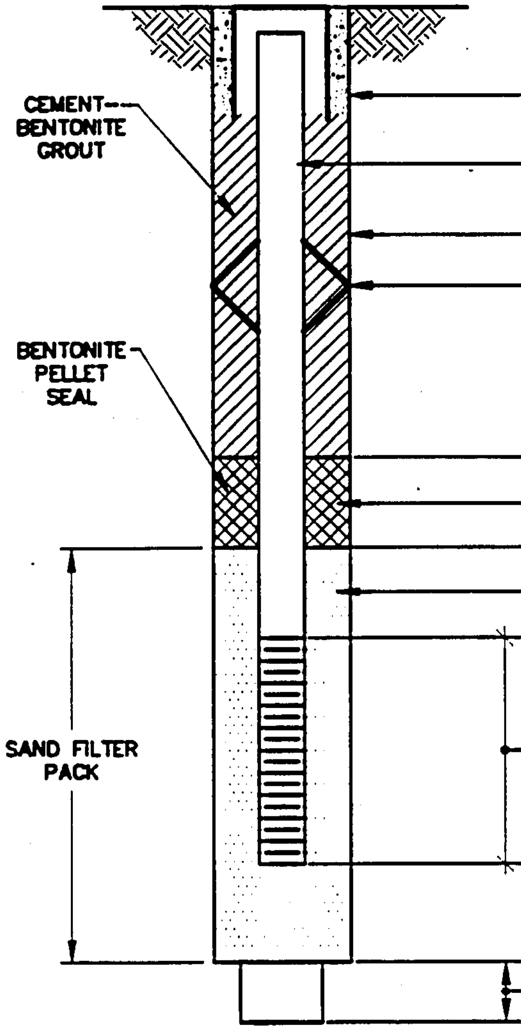
LOCATION DPSC, PHILADELPHIA, PA.

DRILLING CO. SJB SERVICES

DRILLER(S) T. MILLER

DRILLING METHOD(S) 6 1/4" HSA

DEVELOPMENT METHOD(S) MANUAL PURGE W/ SURGE BLOCK



DEPTH TO TOP OF GROUT/ BOTTOM OF CEMENT 2.0'

RISER DIAMETER AND MATERIAL 4" SCH 40 PVC

BOREHOLE DIAMETER 10.5"

DEPTH TO CENTRALIZERS N/A

DEPTH 10.3'

PELLET SIZE MEDIUM CHIPS

DEPTH 14.0'

SAND SIZE #1 MORIE

DEPTH 17.2'

SCREEN DIAMETER 4"
SLOT SIZE .010
MATERIAL SCH 40 PVC

DEPTH 26.2'

DEPTH 27.2'

BACKFILL MATERIAL NATIVE SAND & GRAVEL

BOTTOM OF BOREHOLE 30.0'

NOTE: DEPTHS ARE FEET BELOW GRADE

MALCOLM PIRNIE

OVERBURDEN
MONITORING WELL SHEET

WELL NO. MW-25

PROJECT DPSC

START DATE 6-12-96

END DATE 6-13-96

PROJECT NO. 0285643

FIELD GEOLOGIST J. HILTON

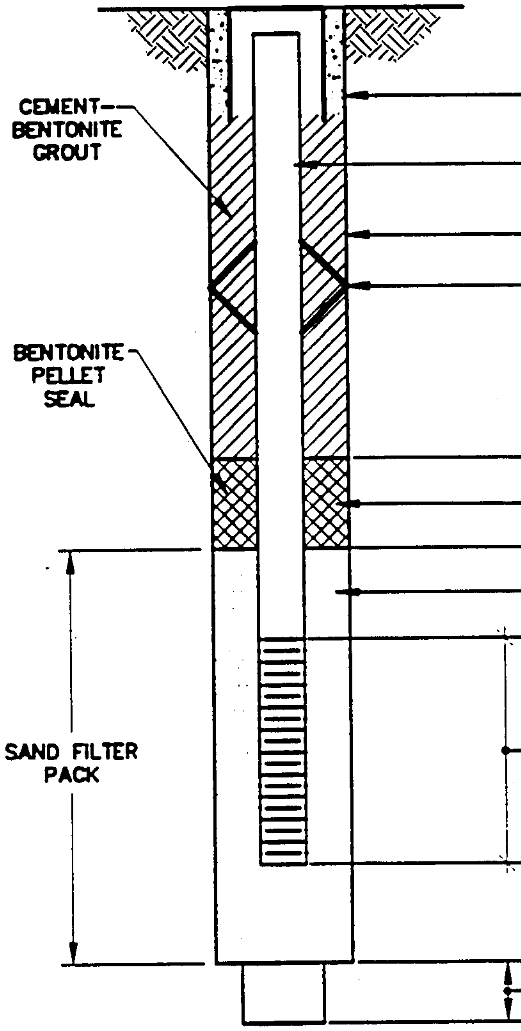
LOCATION DPSC, PHILADELPHIA, PA.

DRILLING CO. SJB SERVICES

DRILLER(S) T. MILLER

DRILLING METHOD(S) 8 1/4" HSA

DEVELOPMENT METHOD(S)



DEPTH TO TOP OF GROUT/ BOTTOM OF CEMENT 1.5'

RISER DIAMETER AND MATERIAL 6" SCH 40 PVC

BOREHOLE DIAMETER 12"

DEPTH TO CENTRALIZERS N/A

DEPTH 9.0'

PELLET SIZE MEDIUM CHIPS

DEPTH 13.5'

SAND SIZE #1 MORIE

DEPTH 16.5'

SCREEN DIAMETER 6"
SLOT SIZE .020
MATERIAL SCH 40 PVC

DEPTH 26.5'

DEPTH 26.75'

BACKFILL MATERIAL NATIVE SAND & GRAVEL

BOTTOM OF BOREHOLE 28.0'

NOTE: DEPTHS ARE FEET BELOW GRADE

MALCOLM PIRNIE

OVERBURDEN
MONITORING WELL SHEET

WELL NO. CSX-MW3

PROJECT DPSC
START DATE 6-18-96
END DATE 6-19-96

PROJECT NO. 0285643
FIELD GEOLOGIST J. HILTON

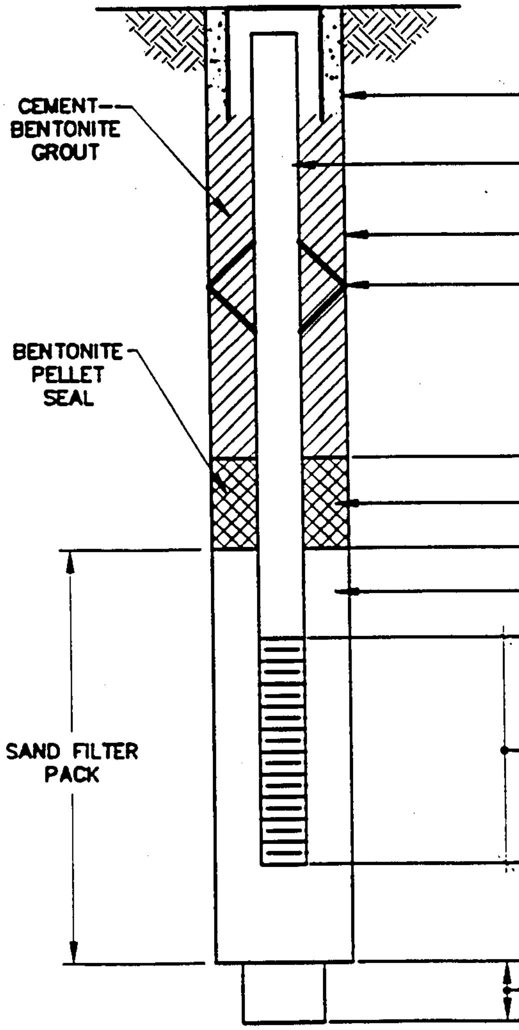
LOCATION CSX RIGHT-OF-WAY, PHILADELPHIA, PA.

DRILLING CO. SJB SERVICES

DRILLER(S) T. MILLER

DRILLING METHOD(S) 4 1/4" HSA

DEVELOPMENT METHOD(S) MANUAL PURGE W/ SURGE BLOCK



DEPTH TO TOP OF GROUT/ BOTTOM OF CEMENT 2.0'

RISER DIAMETER AND MATERIAL 2" SCH 40 PVC

BOREHOLE DIAMETER 8.5"

DEPTH TO CENTRALIZERS N/A

DEPTH 35.0'

PELLET SIZE MEDIUM CHIPS

DEPTH 39.0'

SAND SIZE #1 MORIE

DEPTH 42.0'

SCREEN DIAMETER 2"
SLOT SIZE .010
MATERIAL SCH 40 PVC

DEPTH 52.0'

DEPTH 52.5'
BACKFILL MATERIAL NATIVE SAND & GRAVEL
BOTTOM OF BOREHOLE 53.0'

NOTE: DEPTHS ARE FEET BELOW GRADE

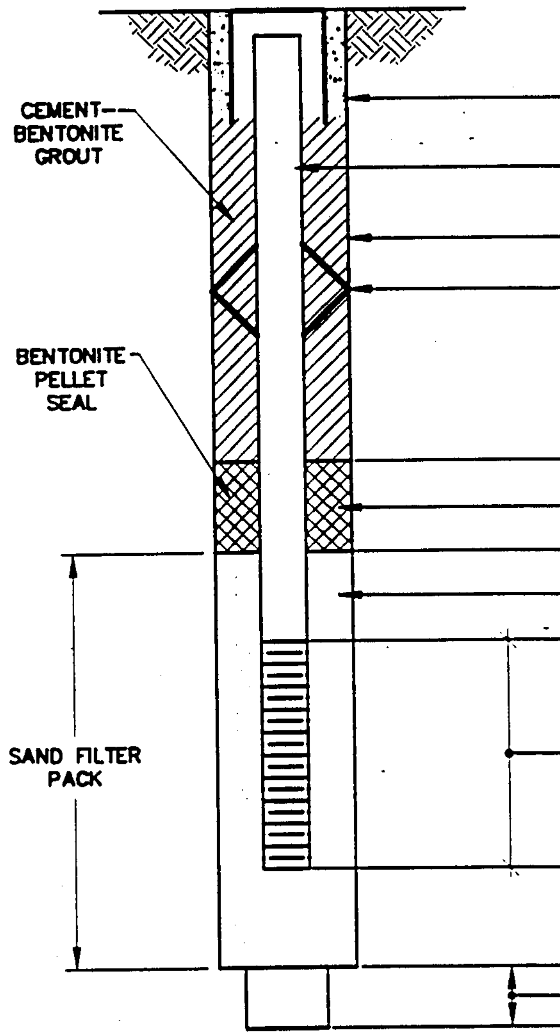
MALCOLM PIRNIE

OVERBURDEN
MONITORING WELL SHEET

WELL NO. CSX–MW4

PROJECT DPSC
START DATE 6–20–96
END DATE 6–20–96
PROJECT NO. 0285643
FIELD GEOLOGIST J. HILTON
LOCATION CSX RIGHT–OF–WAY, PHILADELPHIA, PA.

DRILLING CO. SJB SERVICES
DRILLER(S) T. MILLER
DRILLING METHOD(S) 4 1/4" HSA
DEVELOPMENT METHOD(S) MANUAL PURGE W/ SURGE BLOCK



DEPTH TO TOP OF GROUT/ BOTTOM OF CEMENT ______
RISER DIAMETER AND MATERIAL 2" SCH 40 PVC
BOREHOLE DIAMETER 8.5"
DEPTH TO CENTRALIZERS N/A
DEPTH 36.0'
PELLET SIZE MEDIUM CHIPS
DEPTH 40.0'
SAND SIZE #1 MORIE
DEPTH 43.0'
SCREEN DIAMETER 2"
SLOT SIZE .010
MATERIAL SCH 40 PVC
DEPTH 53.0'
DEPTH 54.0'
BACKFILL MATERIAL NATIVE SAND & GRAVEL
BOTTOM OF BOREHOLE 54.2'

NOTE: DEPTHS ARE FEET BELOW GRADE

MALCOLM PIRNIE

OVERBURDEN
MONITORING WELL SHEET

WELL NO. CSX-MW5

PROJECT DPSC

START DATE 6-24-96

END DATE 6-24-96

PROJECT NO. 0285643

FIELD GEOLOGIST J. HILTON

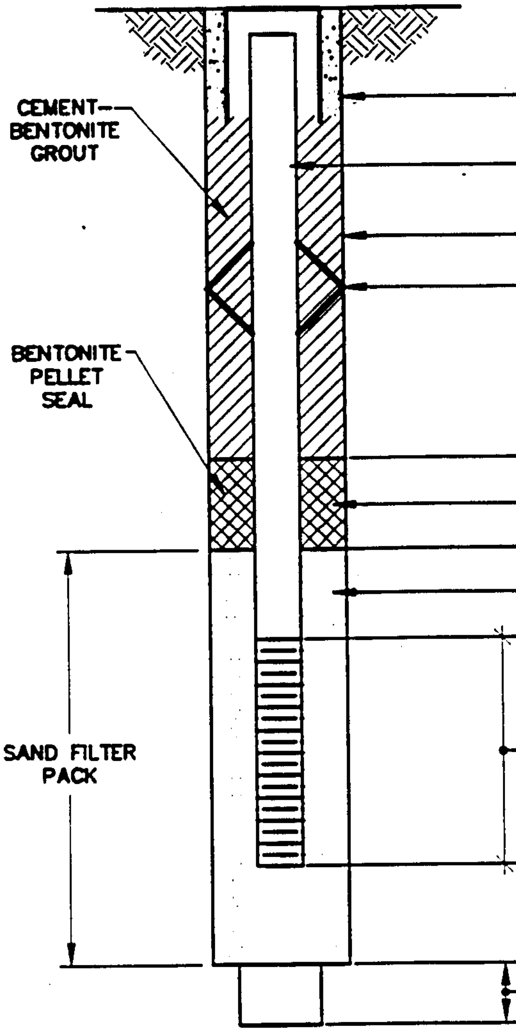
LOCATION CSX RIGHT-OF-WAY, PHILADELPHIA, PA.

DRILLING CO. SJB SERVICES

DRILLER(S) T. MILLER

DRILLING METHOD(S) 4 1/4" HSA

DEVELOPMENT METHOD(S) MANUAL PURGE W/ SURGE BLOCK



DEPTH TO TOP OF GROUT/ BOTTOM OF CEMENT 2.0'

RISER DIAMETER AND MATERIAL 2" SCH 40 PVC

BOREHOLE DIAMETER 8.5"

DEPTH TO CENTRALIZERS N/A

DEPTH 39.5'

PELLET SIZE MEDIUM CHIPS

DEPTH 43.5'

SAND SIZE #1 MORIE

DEPTH 44.0'

SCREEN DIAMETER 2"
SLOT SIZE .010
MATERIAL SCH 40 PVC

DEPTH 53.0'
SUMP TO 53.7'

DEPTH 54.0'
BACKFILL MATERIAL N/A
BOTTOM OF BOREHOLE 54.0'

NOTE: DEPTHS ARE FEET BELOW GRADE

MALCOLM PIRNIE

OVERBURDEN
MONITORING WELL SHEET

WELL NO. CSX-MW6

PROJECT DPSC

START DATE 6-17-96

END DATE 6-18-96

PROJECT NO. 0285643

FIELD GEOLOGIST J. HILTON

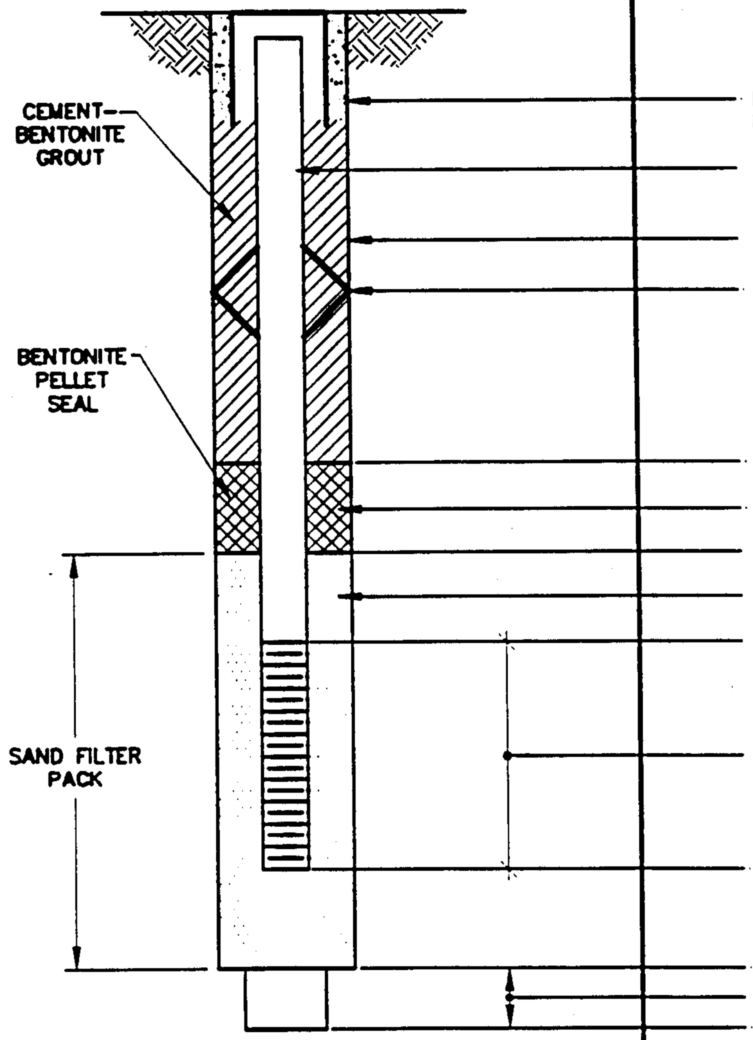
LOCATION CSX RIGHT-OF-WAY, PHILADELPHIA, PA.

DRILLING CO. SJB SERVICES

DRILLER(S) T. MILLER

DRILLING METHOD(S) 4 1/4" HSA

DEVELOPMENT METHOD(S) MANUAL PURGE W/ SURGE BLOCK



DEPTH TO TOP OF GROUT/ BOTTOM OF CEMENT

RISER DIAMETER AND MATERIAL 2" SCH 40 PVC

BOREHOLE DIAMETER 8.5"

DEPTH TO CENTRALIZERS N/A

DEPTH 35.5'

PELLET SIZE MEDIUM CHIPS

DEPTH 39.0'

SAND SIZE #1 MORIE

DEPTH 42.0'

SCREEN DIAMETER 2"
SLOT SIZE .010
MATERIAL SCH 40 PVC

DEPTH 52.0'

DEPTH 53.0'

BACKFILL MATERIAL N/A

BOTTOM OF BOREHOLE 53.0'

NOTE: DEPTHS ARE FEET BELOW GRADE

MALCOLM PIRNIE

OVERBURDEN
MONITORING WELL SHEET

WELL NO. DPSSP-MWS-1

PROJECT DPSC - NAPL INV.
START DATE 8-20-96
END DATE 8-20-96

PROJECT NO. 0285643
FIELD GEOLOGIST J. HILTON

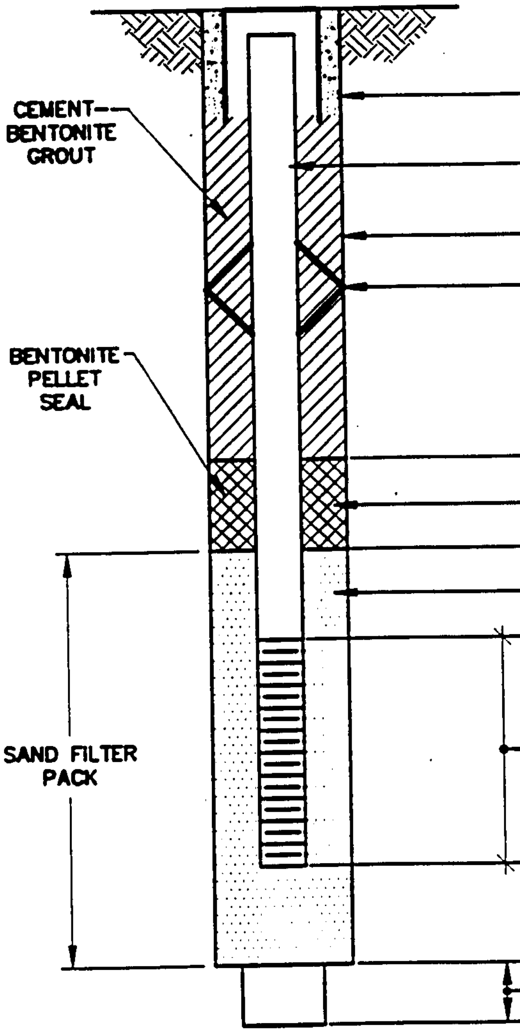
LOCATION DPSC SOUTH, PASSYUNK HOMES

DRILLING CO. SJB SERVICES

DRILLER(S) T. MILLER

DRILLING METHOD(S) 4 1/4" HSA

DEVELOPMENT METHOD(S) MANUAL PURGE W/ SURGE BLOCK



DEPTH TO TOP OF GROUT/ BOTTOM OF CEMENT 1.5'

RISER DIAMETER AND MATERIAL 2" SCH 40 PVC

BOREHOLE DIAMETER 8"

DEPTH TO CENTRALIZERS N/A

DEPTH 13.0'

PELLET SIZE MEDIUM CHIPS

DEPTH 17.0'

SAND SIZE #0 MORIE

DEPTH 20.1'

SCREEN DIAMETER 2"
SLOT SIZE .010
MATERIAL SCH 40 PVC

DEPTH 30.1'

DEPTH 31.0'

BACKFILL MATERIAL NATIVE SAND & GRAVEL

BOTTOM OF BOREHOLE 32.0'

NOTE: DEPTHS ARE FEET BELOW GRADE

MW-OB2.DWG 8-24-95

4871 : 0285643900\I:\ACAD\PROJ\02856439\643-33 SCALE: 1:1 09/04, 1996 at ..51

MALCOLM PIRNIE

OVERBURDEN
MONITORING WELL SHEET

WELL NO. DPSSP-MWS-2

PROJECT DPSC - NAPL INV. START DATE 8-21-96 END DATE 8-21-96

PROJECT NO. 0285643 FIELD GEOLOGIST J. HILTON

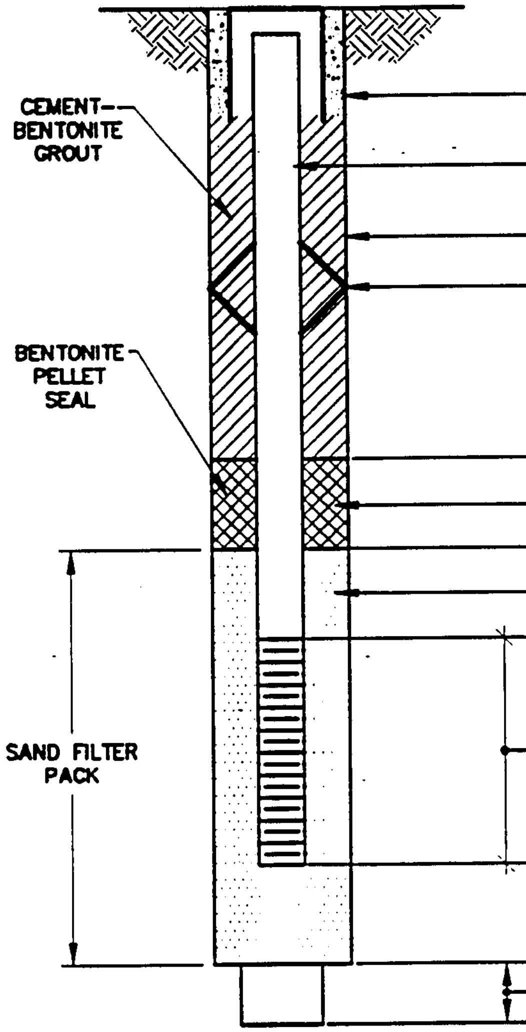
LOCATION DPSC SOUTH, PASSYUNK HOMES

DRILLING CO. SJB SERVICES

DRILLER(S) S. GARDNER

DRILLING METHOD(S) 4 1/4" HSA

DEVELOPMENT METHOD(S) MANUAL PURGE W/ SURGE BLOCK



DEPTH TO TOP OF GROUT/ BOTTOM OF CEMENT 1.5'

RISER DIAMETER AND MATERIAL 2" SCH 40 PVC

BOREHOLE DIAMETER 8"

DEPTH TO CENTRALIZERS N/A

DEPTH 10.0'

PELLET SIZE MEDIUM CHIPS

DEPTH 14.0'

SAND SIZE #0 MORIE

DEPTH 16.85'

SCREEN DIAMETER 2"
SLOT SIZE .010
MATERIAL SCH 40 PVC

DEPTH 26.85'

DEPTH 28.0'

BACKFILL MATERIAL NATIVE SAND & GRAVEL

BOTTOM OF BOREHOLE 28.0'

NOTE: DEPTHS ARE FEET BELOW GRADE

MW-082.DWG 8-24-95

4871 : 028 9000\E\ACAD\PROJ\02856439\643 34 SCALE 1:1 09/04/1996 :52

MALCOLM PIRNIE

OVERBURDEN
MONITORING WELL SHEET

WELL NO. DPSSP-MWS-3

PROJECT DPSC – NAPL INV.
START DATE 8-22-96
END DATE 8-22-96

PROJECT NO. 0285643
FIELD GEOLOGIST J. HILTON

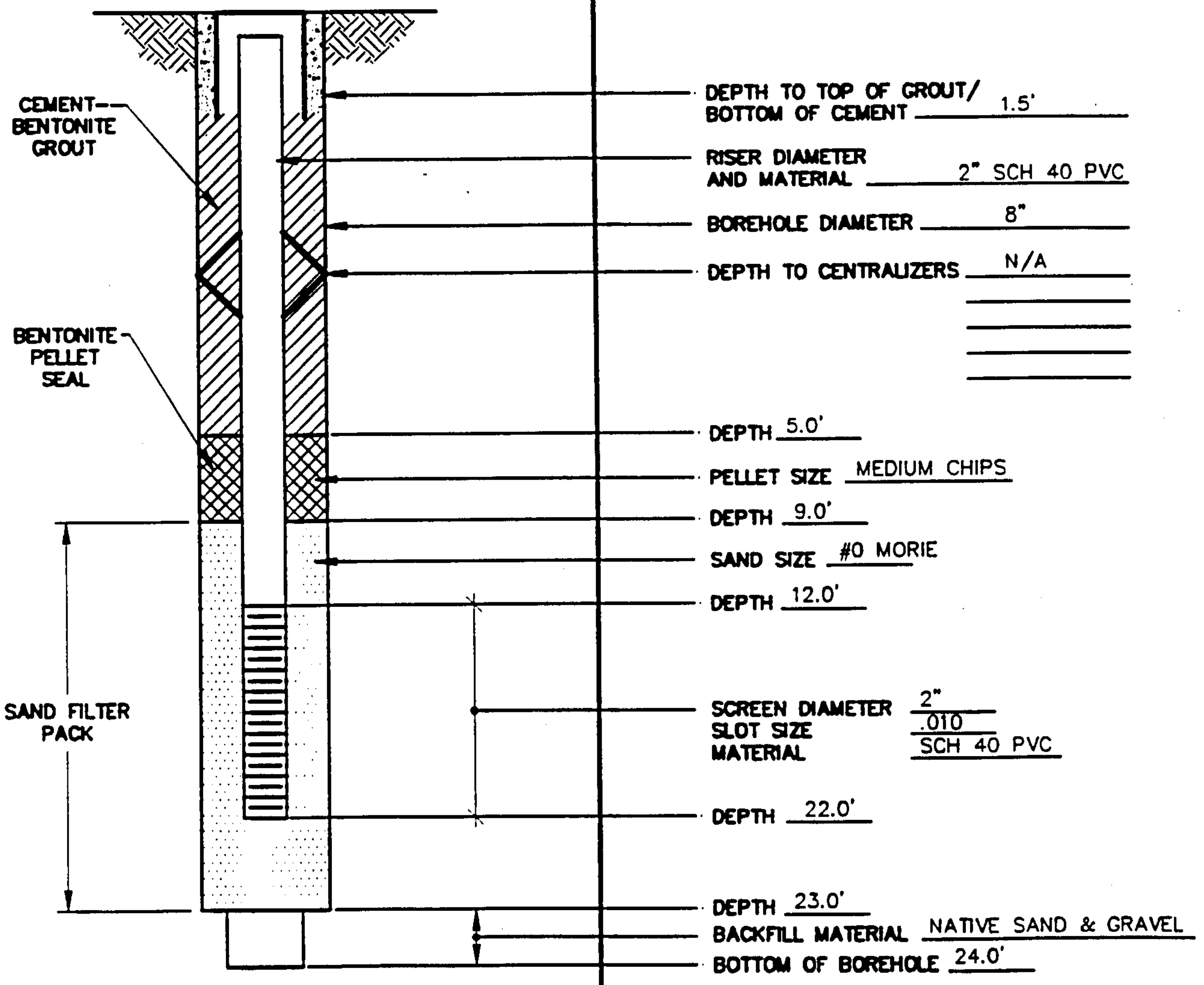
LOCATION DPSC SOUTH, PASSYUNK HOMES

DRILLING CO. SJB SERVICES

DRILLER(S) T. MILLER

DRILLING METHOD(S) 4 1/4" HSA

DEVELOPMENT METHOD(S) MANUAL PURGE W/ SURGE BLOCK



DEPTH TO TOP OF GROUT/ BOTTOM OF CEMENT 1.5'

RISER DIAMETER AND MATERIAL 2" SCH 40 PVC

BOREHOLE DIAMETER 8"

DEPTH TO CENTRALIZERS N/A

DEPTH 5.0'

PELLET SIZE MEDIUM CHIPS

DEPTH 9.0'

SAND SIZE #0 MORIE

DEPTH 12.0'

SCREEN DIAMETER 2"
SLOT SIZE .010
MATERIAL SCH 40 PVC

DEPTH 22.0'

DEPTH 23.0'

BACKFILL MATERIAL NATIVE SAND & GRAVEL

BOTTOM OF BOREHOLE 24.0'

NOTE: DEPTHS ARE FEET BELOW GRADE

MW-OB2.DWG 8-24-95

48/1 : 028. 300\I:\ACAD\PROJ\0285643 9\643-35 SCALE: 1:1 09/04, 1996 c 52

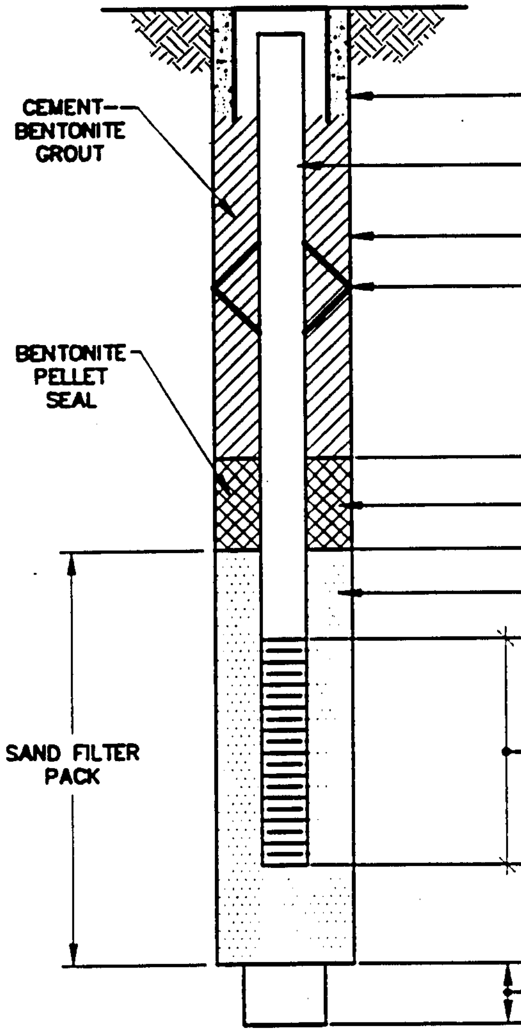
MALCOLM PIRNIE

OVERBURDEN
MONITORING WELL SHEET

WELL NO. DPSSP-MWS-4

PROJECT DPSC - NAPL INV.
START DATE 8-22-96
END DATE 8-22-96
PROJECT NO. 0285643
FIELD GEOLOGIST J. HILTON
LOCATION DPSC SOUTH, PASSYUNK HOMES

DRILLING CO. SJB SERVICES
DRILLER(S) T. MILLER
DRILLING METHOD(S) 4 1/4" HSA
DEVELOPMENT METHOD(S) MANUAL PURGE W/ SURGE BLOCK



DEPTH TO TOP OF GROUT/ BOTTOM OF CEMENT 1.5'
RISER DIAMETER AND MATERIAL 2" SCH 40 PVC
BOREHOLE DIAMETER 8"
DEPTH TO CENTRALIZERS N/A
DEPTH 8.0'
PELLET SIZE MEDIUM CHIPS
DEPTH 12.0'
SAND SIZE #0 MORIE
DEPTH 15.0'
SCREEN DIAMETER 2"
SLOT SIZE .010
MATERIAL SCH 40 PVC
DEPTH 25.0'
DEPTH 26.0'
BACKFILL MATERIAL NATIVE SAND & GRAVEL
BOTTOM OF BOREHOLE 26.2'

NOTE: DEPTHS ARE FEET BELOW GRADE

MW-OB2.DWG 8-24-95

4871 : 0285 900\:\ACAD\PROJ\02856439\643-36 SCALE: 1:1 09/04, 1996 a .55

MALCOLM PIRNIE

OVERBURDEN
MONITORING WELL SHEET

WELL NO. DPSSP-MWS-5

PROJECT DPSC - NAPL INV. START DATE 8-23-96 END DATE 8-23-96

PROJECT NO. 0285643 FIELD GEOLOGIST J. HILTON

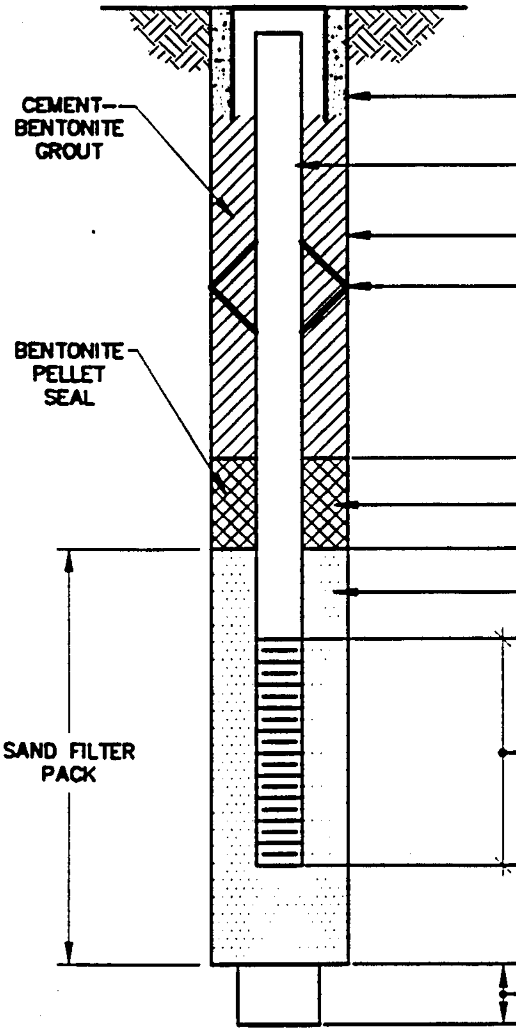
LOCATION DPSC SOUTH, PENROSE AVE.

DRILLING CO. SJB SERVICES

DRILLER(S) T. MILLER

DRILLING METHOD(S) 4 1/4" HSA

DEVELOPMENT METHOD(S) MANUAL PURGE W/ SURGE BLOCK



DEPTH TO TOP OF GROUT/ BOTTOM OF CEMENT 1.5'

RISER DIAMETER AND MATERIAL 2" SCH 40 PVC

BOREHOLE DIAMETER 8"

DEPTH TO CENTRALIZERS N/A

DEPTH 10.0'

PELLET SIZE MEDIUM CHIPS

DEPTH 16.0'

SAND SIZE #0 MORIE

DEPTH 18.0'

SCREEN DIAMETER 2"
SLOT SIZE .010
MATERIAL SCH 40 PVC

DEPTH 28.0'

DEPTH 28.8'

BACKFILL MATERIAL NATIVE SAND & GRAVEL

BOTTOM OF BOREHOLE 28.8'

NOTE: DEPTHS ARE FEET BELOW GRADE

4871 : 028 .900\E:\ACAD\PROJ\02856439\643-37 SCALE: 1:1 09/04, 1996 .50

MW-OB2.DWG 8-24-95

Appendix B
Borehole Drilling Logs

DRILLING LOG

HOLE NO. CSX-MW3

1. COMPANY NAME
Malcolm Pirnie, Inc.

2. DRILLING CONTRACTOR
SJB Services, Inc.

SHEET 1
OF 4 SHEETS

3. PROJECT
Defense Personnel Support Center

4. LOCATION
Philadelphia, Pennsylvania

5. NAME OF DRILLER
T. Miller

6. MANUFACTURER'S DESIGNATION OF DRILL
CME-85

7. Sizes & Types of Drilling & Sampling Equipment
4 1/4" HSA
3" stndrd s.s. to 24'
3" cont. s.s. to 52'

8. HOLE LOCATION
222928.1 North 2717662.9 East

9. SURFACE ELEVATION
48.3'

10. DATE STARTED
6/18/96

11. DATE COMPLETED
6/19/96

12. OVERBURDEN THICKNESS

15. DEPTH GROUNDWATER ENCOUNTERED
45 feet bgs

13. DEPTH DRILLED INTO ROCK

16. Depth to Water and Elapsed Time After Drilling Completed
45.7 feet bgs; 6/20/96

14. TOTAL DEPTH OF HOLE
53.0

17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)
45.75 feet below mp; 6/28/96

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/A			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %
(44-46),(46-48),(48-50)			HFS	IR SCAN		

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
		X		

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
48.3	0	3 3	blk coal ash, slag, fine sand, trace f gravel, loose (FILL)				rec 1.2/2.0
47.3	1	4 4		0.8 ppm			dry
46.3	2						
45.3	3						
44.3	4	4	(4-4.3') blk-brn slag, coal ash w/ sand and silt (FILL)				rec 1.8/2.0
43.3	5	4 4 2	(4.3-4.8') med-brn-gray SILT w/ trace sand and clay (FILL)	7.2 ppm			dry moist
42.3	6						
41.3	7						
40.3	8						
39.3	9		gray-blk SILT w/ slag, cobbles > 3" dia, f gravel (FILL)				rec 0.8/2.0
38.3	10	6 16					moist

DRILLING LOG

HOLE NO. CSX-MW3

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 2
OF 4 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		5 4		2.3 ppm			
37.3	11						
36.3	12						
35.3	13						
34.3	14	4 3 4 4	blk slag, cinders, red brick, wood w/ f sand, f gravel to 0.5" dia (FILL)				rec 1.3/2.0 moist
33.3	15			1.0 ppm			
32.3	16						
31.3	17						
30.3	18						
29.3	19	4 4 5 3	blk-gray, f-med SAND w/ red brick, f-crs gravel to 2" dia (FILL)				rec 1.5/2.0 moist
28.3	20			0.4 ppm			
27.3	21						
26.3	22						
25.3	23						
24.3	24	7 5 4 3	As above w/ concrete cobbles > 3" dia (FILL)				rec 1.3/2.0
23.3	25			0.3 ppm			moist
22.3	26	3 8 7 6	blk-brn silty SAND w/ red brick, slag, concrete, mortar (FILL)				rec 1.0/2.0
21.3	27			1.4 ppm			moist
20.3	28						

DRILLING LOG

HOLE NO. CSX-MW3

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 3
OF 4 **SHEETS**

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		3 4	As above (FILL)				rec 1.3/2.0
19.3	29	5 4		2.8 ppm			moist
18.3	30	3 3	dk blk-gray SILT w/ brn-red clay filling within crs gravel framework, red brick, mortar, wood, coal (FILL)				rec 1.3/2.0 moist
17.3	31	6 8		4.6 ppm			strong petroleum odor
16.3	32	6 6	SILT w/ clay, wood (FILL)				rec 0.3/2.0 moist-wet
15.3	33	11 6		36 ppm			petroleum odor
14.3	34	8 7	(34-34.2') red brick (FILL) (34.2-35.0') lt brn-gray SILT w/ f sand, oxidized 34.2-34.4' (ML)				rec 1.7/2.0 moist-wet
13.3	35	8 8	sharp contact (35.0-35.7') blk-brn SILT w/ peat, bedding fabric (ML/PT)	10.4 ppm			
12.3	36	1 2	(35.7-36.0') dk gray-brn SILT w/ f sand (ML)				rec 0.3/2.0 moist-wet
11.3	37	2 1		22 ppm			
10.3	38	4 12	(38.0-38.9') brn-red, dense SILT w/ ltl f sand and clay (ML)				rec 2.0/2.0 wet
9.3	39	25 26	(38.9-39.3') blk-brn, f-med SAND w/ Fe oxidation, trace silt (SM)	3 ppm			
8.3	40	32 32	(39.3-40.0') poorly sorted, f-crs, sub-rnd GRAVEL, some f-med sand (GW) poorly sorted, f-crs, sub-rnd GRAVEL, w/ cobbles >3" dia, little-some f-crs sand infill matrix (GW)				rec 2.0/2.0 moist
7.3	41	35 31		2 ppm			
6.3	42	17 18	(42.0-43.1') dk-brn-red, f-med SAND w/ some f-crs, sub-rnd gravel (SW)				rec 1.9/2.0 wet-saturated
5.3	43	34 35	(43.1-44) poorly sorted, fine-crs, dense GRAVEL, w/little fine sand (GW)	13 ppm			
4.3	44	17 23	(44.0-45.3') poorly sorted GRAVEL as above w/ crs silty sand interbed @ 45.2-45.3' (GW)			CSX-MW3 (44-46)	rec 1.8/2.0 saturated
3.3	45	17 13	(45.3-45.8') brn, med-crs grain SAND, trace f gravel, visible	92 ppm			strong petroleum odor
2.3	46						

DRILLING LOG

HOLE NO. CSX-MW3

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 4
OF 4 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		12 11	petroleum product (SW) brn, med-crs SAND w/ ltl f gravel interbedded, black petroleum staining @ 47.1-47.9' interval (SW)			CSX-MW3 (46-48)	rec 1.9/2.0 saturated
1.3	47	12 10		>100 ppm			strong petroleum odor
0.3	48	20 25	(48.0-48.4') blk petroleum stained, med-crs SAND w/ ltl f gravel (SW) (48.4-49.3') poorly sorted GRAVEL w/ cobbles > 3" dia w/ f-med sand as matrix infill (GW)			CSX-MW3 (48-50)	rec 1.3/2.0 saturated
-0.7	49	31 24		>100 ppm			visible free product petro sheen on gravel surfaces
-1.7	50	19 20	GRAVEL as above w/ blk petroleum stained f sand partings < 0.2' thick (GW)				rec 1.2/2.0 saturated
-2.7	51	38 47		120 ppm			sheen and product odor
-3.7	52						
-4.7	53		End of Boring				
-5.7	54						
-6.7	55						
-7.7	56						
-8.7	57						
-9.7	58						
-10.7	59						
-11.7	60						
-12.7	61						
-13.7	62						
-14.7	63						
-15.7	64						

DRILLING LOG

HOLE NO. CSX-MW4

SHEET 1 OF 4 SHEETS

1. COMPANY NAME: Malcolm Pirnie, Inc.
2. DRILLING CONTRACTOR: SJB Services, Inc.
3. PROJECT: Defense Personnel Support Center
4. LOCATION: Philadelphia, Pennsylvania
5. NAME OF DRILLER: T. Miller
6. MANUFACTURER'S DESIGNATION OF DRILL: CME-85
7. Sizes & Types of Drilling & Sampling Equipment: 4 1/4" HSA; 3" stndrd s.s. to 32'; 3" cont. s.s. to 52'
8. HOLE LOCATION: 222666.7 North 2717636.7 East
9. SURFACE ELEVATION: 47.2'
10. DATE STARTED: 6/20/96
11. DATE COMPLETED: 6/20/96
12. OVERBURDEN THICKNESS:
13. DEPTH DRILLED INTO ROCK:
14. TOTAL DEPTH OF HOLE: 54.2
15. DEPTH GROUNDWATER ENCOUNTERED: 45 feet bgs
16. Depth to Water and Elapsed Time After Drilling Completed: 45.33 feet below mp; 6/26/96
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 45.38 feet below mp; 6/28/96
18. GEOTECHNICAL SAMPLES: N/A — DISTURBED: — UNDISTURBED:
19. TOTAL NUMBER OF CORE BOXES:

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %
(46-48),(48-50),(50-52)			HFS	IR SCAN		

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
		X		

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
47.2	0	3 6 5 3	blk cinders, coal ash, slag, f gravel (FILL)				rec 1.6/2.0 dry
46.2	1			1.6 ppm			
45.2	2						
44.2	3						
43.2	4	12 23 27 13	red brick, mortar, brn silt (FILL)				rec 1.2/2.0 dry
42.2	5			8.2 ppm			
41.2	6						
40.2	7						
39.2	8						
38.2	9	4 3	brn SILT w/ little f sand, red brick, cinders, slag (FILL)				rec 1.6/2.0 moist
37.2	10						

DRILLING LOG

HOLE NO. CSX-MW4

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 2
OF 4 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		3 3		0.3 ppm			
36.2	11						
35.2	12						
34.2	13						
33.2	14	11 7	med brn, f SAND w/ ltl, f sub-rnd gravel, slag, coal, concrete (FILL)				rec 1.1/2.0 moist
32.2	15	5 4		0.2 ppm			
31.2	16						
30.2	17						
29.2	18						
28.2	19	7 8	med brn, f-med SAND w/ltl f-crs gravel to 2" dia, slag (FILL)				rec 1.0/2.0
27.2	20	6 6		1.0 ppm			moist
26.2	21						
25.2	22						
24.2	23						
23.2	24	7 5	blk coal ash, cinders, slag, w/ brn, med sand parting 24.1-24.4', loose (FILL)				rec 1.6/2.0 moist-dry
22.2	25	5 5		0.6 ppm			
21.2	26						
20.2	27						
19.2	28						

DRILLING LOG

HOLE NO.	CSX-MW4
PROJECT	Defense Personnel Support Center Philadelphia, Pennsylvania
INSPECTOR	John Hilton
SHEET 3	OF 4 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
18.2	29	4 6 10 10	lt gray-brn SILT, oxidized Fe staining, tr-ltl f sand, tr blk carbonized silt partings < 0.5" thick @ 30.5, 30.8', very thin bedding fabric (ML)				rec 2.0/2.0 moist
17.2	30			6.2 ppm			
16.2	31						
15.2	32	5 4 6 8	med gray SAND w/ oxidized brn partings <0.1' thick, ltl-some silt (SW-SM)				rec 2.0/2.0 moist-wet
14.2	33			4.8 ppm			
13.2	34	5 5 11 13	(34.0-35.7') light gray silty SAND, weak dilatancy (SM)				rec 2.0/2.0 moist
12.2	35			10.8 ppm			dry-moist
11.2	36	18 30 40 45	(35.7-36.0') med brn, oxidized, f SAND (SP) (36.0-36.8') gray-brn silty SAND (SM) sharp contact (36.8-37.0') blk vf silty SAND, carbonized (SM)				rec 2.0/2.0 moist
10.2	37		(37.0-37.6') gray-blk, med-crs SAND (SW)	22 ppm			
9.2	38	36 40 52 47	(37.6-37.0') poorly sorted, fine-crs GRAVEL w/ f sand (GW) (38.0-38.6') GRAVEL w/ sand as above (GW)				rec 2.0/2.0 moist
8.2	39		(38.6-39.0') blk petroleum stained, f-med SAND w/ f gravel (SW) (39.0-39.3') gray-blk, poorly sorted GRAVEL w/ med-crs sand (GW)	24 ppm			field blank collected @ 1050
7.2	40	31 22 22 21 (40-42)	(39.3-40.0') blk (stained) SAND w/ ltl f-crs gravel (SW) blk med-crs, loose SAND w/ltl f-crs gravel to 2" dia, black petroleum staining throughout (SW)				moist-dry
6.2	41			44 ppm			
5.2	42	14 13 13 15	(42.0-42.3') blk-brn, f SAND w/ crs gravel, stained (SW) (42.3-43.1') drk brn-orng, fine-crs SAND (SW)				rec 1.9/2.0 moist-wet
4.2	43		(43.1-43.6') blk-brn, f SAND w/ tr silt, stained (SW) (43.6-44.0') gray-blk, med-crs SAND w/ tr f gravel, some staining (SW)	150 ppm			strong petroleum odor
3.2	44	10 10 10 10	(44.0-44.2') dk brn-blk, f SAND, w/ f gravel, stained (SW) (44.2-46.0) gray-brn, loose, fine-crs SAND w/ tr f gravel (SW)				rec 2.0/2.0 water table @ approx 45' bgs
2.2	45 ▽			>120 ppm			petroleum odor
1.2	46						

DRILLING LOG

HOLE NO.	CSX-MW4
PROJECT	Defense Personnel Support Center Philadelphia, Pennsylvania
INSPECTOR	John Hilton
SHEET 4	OF 4 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		13 14 10 17	(46.0-47.2') med-crs SAND w/tr f gravel, brn w/ heavy blk petroleum staining 46.5-47.2' (SW)	>100 ppm		CSX-MW4 (46-48) Duplicate CSX-MWA (46-48)	rec 1.7/2.0 saturated strong petroleum odor
0.2	47		(47.2-47.7') poorly sorted GRAVEL w/ f-med sand (GW)				product on sand and gravel surfaces
-0.8	48	10 28 41 33	(48.0-48.4') gray-blk, stained, med-crs SAND (SW) (48.4-50.0') poorly sorted, dense GRAVEL w/ f sand, heavily stained w/ residual product @ approx. 48.6-49.7' (GW)	>120 ppm		CSX-MW4 (48-50)	rec 2.0/2.0 saturated-wet product on gravel and sand
-1.8	49						
-2.8	50	42 30 40 44	(50.0-51.0') poorly sorted GRAVEL w/ f-med sand, blk petroleum staining (GW)			CSX-MW4 (50-52)	rec 2.0/2.0 saturated
-3.8	51		(51.0-52.0') poorly sorted, fine-crs GRAVEL w/ f sand, densely compacted (GW)	>120 ppm			moist
-4.8	52						
-5.8	53						
-6.8	54		End of Boring				
-7.8	55						
-8.8	56						
-9.8	57						
-10.8	58						
-11.8	59						
-12.8	60						
-13.8	61						
-14.8	62						
-15.8	63						
-16.8	64						

DRILLING LOG

HOLE NO. CSX-MW5

SHEET 1 OF 4 SHEETS

1. COMPANY NAME: Malcolm Pirnie, Inc.

2. DRILLING CONTRACTOR: SJB Services, Inc.

3. PROJECT: Defense Personnel Support Center

4. LOCATION: Philadelphia, Pennsylvania

5. NAME OF DRILLER: T. Miller

6. MANUFACTURER'S DESIGNATION OF DRILL: CME-85

7. Sizes & Types of Drilling & Sampling Equipment:
4 1/4" HSA
3" standard s.s. to 32'
3" continuous s.s. to 54'

8. HOLE LOCATION: 223272.3 North 2717740.3 East

9. SURFACE ELEVATION: 49.9'

10. DATE STARTED: 6/24/96

11. DATE COMPLETED: 6/25/96

12. OVERBURDEN THICKNESS:

13. DEPTH DRILLED INTO ROCK:

14. TOTAL DEPTH OF HOLE: 54.0

15. DEPTH GROUNDWATER ENCOUNTERED: 45.8 feet bgs

16. Depth to Water and Elapsed Time After Drilling Completed: 44.87 feet below mp; 6/26/96

17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 45.46 feet below mp; 6/28/96

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/A			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %
(44-46),(48-50),(52-54)			HFS	IR SCAN		

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
		X		

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
49.9	0	5 5 4 28	blk coal ash, slag, asphalt, tr-ltl silt and f sand (FILL)				rec 1.4/2.0 dry
48.9	1			1.0 ppm			
47.9	2						
46.9	3						
45.9	4	7 10 12 18	dk brn-blk f SAND, w/ mortar, sub-rnd f-crs gravel, trace ash and silt (FILL)				rec 1.5/2.0 moist
44.9	5			2.6 ppm			
43.9	6						
42.9	7						
41.9	8						
40.9	9	6 5	med-dk brn f SAND as above w/ gravel to 3" dia. (FILL)				rec 0.9/2.0 moist
39.9	10						

DRILLING LOG

HOLE NO. CSX-MW5

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 2
OF 4 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		6 5		5.4 ppm			
38.9	11						
37.9	12						
36.9	13						
35.9	14	40 65 33 26	dk brn-gray f SAND w/some f-crs sub-rnd gravel w/cobbles > 3" dia, tr black asphalt (FILL)				rec 2.0/2.0 moist
34.9	15			8.8 ppm			
33.9	16						
32.9	17						
31.9	18						
30.9	19	6 5 6 6	med-brn/gray f SAND, w/ltl crs gravel to 1" dia. (FILL)				rec 1.4/2.0 moist
29.9	20			2.0 ppm			
28.9	21						
27.9	22						
26.9	23						
25.9	24	6 4 5 5	(24.0-24.8') med brn SAND w/ gravel as above (FILL) (24.8-26.0') gry-grn SILT w/tr-ltl f gravel and f sand, wood (FILL)				rec 2.0/2.0 moist moist-wet
24.9	25			1.9 ppm			
23.9	26						
22.9	27						
21.9	28						

DRILLING LOG

HOLE NO. CSX-MW5

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 3
OF 4 **SHEETS**

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
20.9	29	4 5	(29.0-29.9') drk brn f silty SAND w/ tr f gravel (FILL)				rec 2.0/2.0 moist
19.9	30	8 14	(29.9-30.5') gray-grn SILT w/ crs gravel to 3" dia. (FILL) (30.5-31.0') gray-grn SILT w/ tr clay, brn mottling (FILL)	2.2 ppm			moist-wet
18.9	31						
17.9	32	4 10	(32.0-32.4') red-brn f SAND, red brick (FILL) (32.4-33.0') olive-brn silty SAND, tr f gravel (FILL)				rec 1.3/2.0 moist
16.9	33	11 8	(33.0-33.3') blk coal ash, slag (FILL)	2.2 ppm			dry
15.9	34	5 4	coal ash, burn debris, slag, coal clinker (FILL)				rec 2.0/2.0 moist-wet
14.9	35	3 3		2.0 ppm			
13.9	36	4 4	burn debris w/ coal, ash, glass, wood, shale (FILL)				rec 1.7/2.0 wet
12.9	37	8 5		1.6 ppm			
11.9	38	6 5	burn debris as above w/metal, nails, glass (FILL)				rec 1.8/2.0 wet-saturated
10.9	39	5 5		0.0 ppm			
9.9	40	6 7	burn debris as above w/glass, wood, coal, metal (FILL)				rec 1.8/2.0 wet-saturated
8.9	41	8 9		2.4 ppm			
7.9	42	9 11	(42.0-42.7') burn debris as above (FILL) sharp contact				rec 1.8/2.0 wet-saturated - perched water @ 35.6 'bgs
6.9	43	16 15	(42.7-43.8') lt gray, dense SILT w/ brn mottling, tr f sand and clay (ML)	1.2 ppm			dry-moist
5.9	44	5 9	(44.0-44.1') lt gray, dense SILT, ltl clay (ML)			CSX-MW5 (44-46)	rec 2.0/2.0 moist
4.9	45	30 41	(45.1-46.0') gray-brn, med-crs SAND w/ f-crs, sub-rnd gravel to 2" dia. (SW)	120 ppm			strong petroleum odor
3.9	46 ∇						

DRILLING LOG

HOLE NO.	CSX-MW5
PROJECT	Defense Personnel Support Center Philadelphia, Pennsylvania
INSPECTOR	John Hilton
SHEET 4	OF 4 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		18 20	(46.0-46.5') SAND w/ gravel as above, dense (SW) (46.5-47.4) lt gray, loose, f-med SAND, ltl-some f-crs gravel (SW)				rec 2.0/2.0 wet-saturated
2.9	47	28 28		>100 ppm			strong petroleum odor
1.9	48	19 30	(47.4-48.0') brn-gray, dense fine-crs GRAVEL w/ sand (GW) (48.0-49.5') GRAVEL w/ f-med sand, gradational color change to lt gray @ 49.1' bgs (GW)			CSX-MW5 (48-50)	rec 2.0/2.0
0.9	49	23 18		130 ppm			strong petroleum odor slight petroleum staining
-0.1	50	10	(49.5-50.0') gray-brn, loose, med-crs SAND (SW) (50.0-50.5') SAND as above, tr gravel (SW)				rec 1.8/2.0
-1.1	51	32 37 35	(50.5-51.8') med brn, dense, f-crs GRAVEL to 2" dia. w/ f sand (GW)	140 ppm			strong petroleum odor
-2.1	52	15	(52.0-52.6') brn-gray, f-med SAND w/ some f-crs gravel, loose (SW)			CSXMW5 (52-54)	rec 1.6/2.0
-3.1	53	28 35 45	(52.6-53.6') poorly sorted, f-crs GRAVEL w/ ltl-some f-med sand (GW)	>100 ppm			staining @ 52.6-53.2'
-4.1	54		End of Boring				
-5.1	55						
-6.1	56						
-7.1	57						
-8.1	58						
-9.1	59						
-10.1	60						
-11.1	61						
-12.1	62						
-13.1	63						
-14.1	64						

DRILLING LOG

HOLE NO. CSX-MW6

1. COMPANY NAME: Malcolm Pirnie, Inc.
2. DRILLING CONTRACTOR: SJB Services, Inc.

SHEET 1 OF 4 SHEETS

3. PROJECT: Defense Personnel Support Center
4. LOCATION: Philadelphia, Pennsylvania
5. NAME OF DRILLER: T. Miller
6. MANUFACTURER'S DESIGNATION OF DRILL: CME-85
7. Sizes & Types of Drilling & Sampling Equipment: 4 1/4" HSA; 3" stndrd s.s. to 24'; 3" cont. s.s. to 52'
8. HOLE LOCATION: 222292.9 North 2717662.2 East
9. SURFACE ELEVATION: 46.1'
10. DATE STARTED: 6/17/96
11. DATE COMPLETED: 6/18/96
12. OVERBURDEN THICKNESS:
13. DEPTH DRILLED INTO ROCK:
14. TOTAL DEPTH OF HOLE: 53.0
15. DEPTH GROUNDWATER ENCOUNTERED: 44.5 feet bgs
16. Depth to Water and Elapsed Time After Drilling Completed: 44.2 feet bgs; 6/20/96
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 44.32 feet below mp; 6/28/96

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/A			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %
(44-46),(48-50),(50-52)			HFS	IR SCAN		

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
		X		

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
46.1	0	7 26	blk f SAND w/ f-crs gravel, w/ wood, brick, asphalt, and slag (FILL)				rec 2.0/2.0 Drilled and collected standard (5') samples through fill unit
45.1	1	27 21		2.0 ppm			
44.1	2						moist
43.1	3						
42.1	4	3 5	lt-mod red-brown, f-med SAND, ltl f-crs, sub-rnd gravel (FILL)				rec 1.3/2.0
41.1	5	5 6		0.2 ppm			
40.1	6						
39.1	7						
38.1	8		(8.0-8.2') sandy SILT (FILL) (8.2-9.9') lt-mod brn, f silty SAND,w/ gravel, red-brick, tr clay (FILL)				rec 1.9/2.0
37.1	9	4 4		0.6 ppm			moist
36.1	10						

DRILLING LOG

HOLE NO. CSX-MW6

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 2
OF 4 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		5 22					
35.1	11						
34.1	12						
33.1	13						
32.1	14	8 10	No recovery				rec 0.0/2.0
31.1	15	10 8		—			
30.1	16						
29.1	17						
28.1	18	2 2	(18.0-18.5') orng-brn fine-crs SAND, w/ tr-ltl f gravel, white plaster (chalk) (FILL)				rec 1.6/2.0
27.1	19	6 14	(18.5-19.0') mod brn sandy SILT, trace Fe staining (FILL) (19.0-19.6') mod-drk brn, med-crs SAND w/ gravel, mica schist cobble to > 3" dia (FILL)	0.8 ppm			wet
26.1	20						
25.1	21						
24.1	22						
23.1	23						
22.1	24	5 6	mod orng-brn, med-crs SAND w/fine-crs, sub-rnd gravel to 2" dia, clay clasts (FILL)				rec 1.5/2.0 dry-moist
21.1	25	7 6		1.8 ppm			
20.1	26	7 9	As above w/ red brick and clay tile (FILL)				rec 1.6/2.0
19.1	27	7 12		3.0 ppm			
18.1	28						

DRILLING LOG		HOLE NO. CSX-MW6
PROJECT Defense Personnel Support Center Philadelphia, Pennsylvania	INSPECTOR John Hilton	SHEET 3 OF 4 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
17.1	29	15 7 6 8					
16.1	30		drk gray-blk SILT w/ tr-ltl f sand, tr clay (ML)				rec 1.1/2.0 moist-wet
15.1	31	15 7 6 8		1.0 ppm			
14.1	32		(32.0-33.1') mod gray, f SAND, tr-ltl silt (SP-SM)				rec 1.9/2.0
13.1	33	11 13 21 21	(33.1-33.9') mod brn-gray SAND, Fe oxidation as mottling, tr clay (SP-SM)	2.2 ppm			water w/in borehole perched on silt interval moist
12.1	34		lt-mod gray, stiff, dense SILT, Fe oxidation 34.0 - 34.5'(ML)				rec 2.0/2.0 dry-moist
11.1	35	13 17 26 30		2.2 ppm			
10.1	36		(36.0-36.3') As above w/ f sand (ML) (36.3-36.9') mod gray, f SAND (SP)				rec 1.6/2.0 wet
9.1	37	20 28 25 32	(36.9-37.4') blk-gray, f SAND, thin bedded (SP)	6.8 ppm			moist-wet
8.1	38		(37.4-37.6') f-crs GRAVEL to 1" dia, crs sand (GW) fine-crs GRAVEL w/ f-med sand, blk organic sand/silt from 38.0-38.6', some f sand and silt interbeds < .1' thick (GW)				rec 2.0/2.0 moist
7.1	39	24 20 19 36		16 ppm			slight petroleum odor
6.1	40		poorly sorted, fine-crs, sub-rnd GRAVEL w/ f-med sand, black stained gravel and silt @ 41.6-42.0 interval - cobbles throughout to > 3" dia (GW)				rec 2.0/2.0 petroleum odor
5.1	41	29 25 37 19		12 ppm			
4.1	42		mod gray-brn, poorly sorted, fine-crs SAND w/ f gravel to 0.5" dia (SW)				rec 2.0/2.0 moist-wet
3.1	43	11 14 15 17		110 ppm			strong gas/petroleum odor
2.1	44 ▽		f-crs SAND w/ some sub-rnd f gravel to 0.25" dia, tr-ltl red-brn silt @ 44-44.5' interval (SW)			CSX-MW6 (44-46)	rec 2.0/2.0 wet-saturated
1.1	45	12 10 10 15		110 ppm			strong petroleum odor
0.1	46						

DRILLING LOG

HOLE NO. CSX-MW6

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 4
OF 4 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		18 23	(46.0-47.1') gray-brn, med-crs SAND w/ oil sheen (SW);				rec 2.0/2.0 saturated
-0.9	47	50 50	sharp contact	110 ppm			petroleum odor
			(47.1-48.0') f-crs, sub-rnd, dense GRAVEL, w/ f-med poorly sorted sand, some oil sheen (GW)				
-1.9	48		poorly sorted GRAVEL as above at 46-48 interval w/ blk hydrocarbon staining @ approx 48.4-48.7', cobble to > 3" dia. (GW)			CSX-MW6 (48-50)	rec 1.2/2.0
		4 21					saturated
-2.9	49	36 36		120 ppm			
-3.9	50					CSX-MW6 (50-52)	
		1 4	(50.0-50.9') poorly sorted GRAVEL as above w/ sand (GW)				rec 1.6/2.0 saturated
-4.9	51	15 18	sharp contact (50.9-51.6') gray-brn, fine-med SAND (SW)	120 ppm			strong petroleum odor
-5.9	52						
-6.9	53		End of Boring				
-7.9	54						
-8.9	55						
-9.9	56						
-10.9	57						
-11.9	58						
-12.9	59						
-13.9	60						
-14.9	61						
-15.9	62						
-16.9	63						
-17.9	64						

DRILLING LOG

1. COMPANY NAME Malcolm Pirnie, Inc.	2. DRILLING CONTRACTOR SJB Services, Inc.	HOLE NO. DPS-MWS1 SHEET 1 OF 3 SHEETS

3. PROJECT Defense Personnel Support Center	4. LOCATION Philadelphia, Pennsylvania
5. NAME OF DRILLER T. Miller	6. MANUFACTURER'S DESIGNATION OF DRILL CME-850
7. Sizes & Types of Drilling & Sampling Equipment 4 1/4" HSA 2" continuous s.s.	8. HOLE LOCATION 221879.6 North 2717866.2 East 9. SURFACE ELEVATION 24.2' 10. DATE STARTED 8/20/96 11. DATE COMPLETED 8/20/96
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED 25 feet bgs
13. DEPTH DRILLED INTO ROCK	16. Depth to Water and Elapsed Time After Drilling Completed 22.11 feet below mp to water; 8/23/96
14. TOTAL DEPTH OF HOLE 32.0	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/A			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %
(20-24),(26-28),(28-30)			HFS	IR SCAN		

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
		X		

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
24.2	0	2 2 2 2	dk brn-blk SILT w/ tr f sand, coal, brick (FILL)				rec 1.3/2.0 moist
23.2	1			0.5 ppm			
22.2	2	12 10 7 7	(2.0-3.5') mod brn SILT, tr f sand, f gravel, coal (FILL)				rec 2.0/2.0 moist
21.2	3			0.8 ppm			
20.2	4	2 2 3 4	(3.5-4.0') mod brn SILT w/ tr f sand, clay and rootlets (ML) lt ylw-brn SILT w/ tr f sand and lt gry clay laminae (ML)				rec 2.0/2.0
19.2	5			0.8 ppm			moist
18.2	6	5 5 5 6	SILT w/ f sand as above (ML)				rec 2.0/2.0 moist
17.2	7			0.2 ppm			
16.2	8	3 5 6 6	lt gry, f SAND w/ tr-ltl silt, few oxidized partings (SM)				rec 2.0/2.0 moist
15.2	9			0.5 ppm			
14.2	10						

DRILLING LOG

HOLE NO. DPS-MWS1

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 2
OF 3 **SHEETS**

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		5 5 6 7	lt gry sandy SILT w/ brn sand partings to 0.3' thick (ML)				rec 1.8/2.0 moist-wet
13.2	11			0.2 ppm			
12.2	12	4 10 12 12	(12.0-12.2') As above (ML) (12.2-13.5') f-med, poorly sorted SAND w/ ltl f gravel to 0.5" dia. (SW)				rec 1.5/2.0 moist
11.2	13			17.4 ppm			dry slight petroleum odor
10.2	14	7 14 12 12	dk gry-brn f-crs, broken GRAVEL w/ f-med sand (GW)				rec 0.9/2.0 dry-moist
9.2	15			28 ppm			strong petroleum odor
8.2	16	12 12 11 12	mod brn, poorly sorted, f-crs, sub-rnd GRAVEL w/ some med-crs sand w/in gravel matrix (GW)				rec 1.8/2.0 dry-moist
7.2	17			20 ppm			petroleum odor
6.2	18	6 10 11 13	(18.0-18.4') As above (GW) (18.4-19.7') dk brn-orng, med-crs SAND and f GRAVEL to 0.25" dia (SW/GW)				rec 1.7/2.0 strong petroleum odor
5.2	19			28 ppm			
4.2	20	10 11 13 13	dk brn, f-crs, poorly sorted GRAVEL and f-med SAND, tr-ltl clay @ 21.3 - 21.6' (GW/SW)				rec 1.8/2.0
3.2	21			130 ppm			
2.2	22	18 11 8 19	GRAVEL as above w/ f-crs SAND (GW/SW)			DPSSP-MWS-1 (22-24)	rec 1.3/2.0 very strong petroleum odor LEL = 30% in augers
1.2	23			>150 ppm			
0.2	24	10 16 23 22	dk gry-brn, f-crs, subrnd GRAVEL and SAND w/ gravel > 2" dia., med-crs sand partings < 0.2' thick (GW/SW)				rec 1.5/2.0 wet-saturated
-0.8	25 ∇			>150 ppm			
-1.8	26	10 20 12 12	(26.0-27.0') GRAVEL and SAND as above (GW/SW)			DPSSP-MWS-1 (26-28)	rec 1.2/2.0 saturated
-2.8	27		(27.0-27.2') dk gry f-med SAND (SW)	>150 ppm			sheen on water
-3.8	28						

MALCOLM PIRNIE

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

HOLE NO. DPS-MWS1

DRILLING LOG

HOLE NO. DPS-MWS1

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 3
OF 3 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		9 13	(28.0-28.6') SAND as above w/ petroleum staining at approx. 28.4-28.6' (SW)			DPSSP-MWS-1	saturated petroleum sheen and odor
-4.8	29	15 17	sharp contact (28.6-29.7') SAND and GRAVEL (SW/GW)	>150 ppm		(28-30)	petroleum staining
-5.8	30		(30.0-30.4') drk brn-gry, f-med SAND (SW)				saturated
		12 22	(30.4-31.4') drk gry, f-med SAND and f-crs GRAVEL to 2" dia. (SW/GW)				
-6.8	31	26 20		>150 ppm			water at 23' bgs in augers
-7.8	32		End of Boring				
-8.8	33						
-9.8	34						
-10.8	35						
-11.8	36						
-12.8	37						
-13.8	38						
-14.8	39						
-15.8	40						
-16.8	41						
-17.8	42						
-18.8	43						
-19.8	44						
-20.8	45						
-21.8	46						

DRILLING LOG

HOLE NO. DPS-MWS2

1. COMPANY NAME: Malcolm Pirnie, Inc.

2. DRILLING CONTRACTOR: SJB Services, Inc.

SHEET 1 OF 2 SHEETS

3. PROJECT: Defense Personnel Support Center

4. LOCATION: Philadelphia, Pennsylvania

5. NAME OF DRILLER: T. Miller

6. MANUFACTURER'S DESIGNATION OF DRILL: CME-850

7. Sizes & Types of Drilling & Sampling Equipment: 4 1/4" HSA; 2" continuous s.s.

8. HOLE LOCATION: 221471.0 North 2718614.1 East

9. SURFACE ELEVATION: 20.5'

10. DATE STARTED: 8/21/96

11. DATE COMPLETED: 8/21/96

12. OVERBURDEN THICKNESS:

15. DEPTH GROUNDWATER ENCOUNTERED: 18 feet bgs

13. DEPTH DRILLED INTO ROCK:

16. Depth to Water and Elapsed Time After Drilling Completed: 17.63 feet below mp to water; 8/23/96

14. TOTAL DEPTH OF HOLE: 28.0

17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/A			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %
(18-20),(20-22),(26-28)			HFS	IR SCAN		

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
		X		

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
20.5	0	2 4 6 2	dk brn SILT w/ tr f sand, micaceous, increasing sand content w/ depth (FILL)				rec 1.6/2.0 dry
19.5	1			1.2 ppm			
18.5	2	15 10 8 8	(2.0-2.2') orng-brn f SAND w/ tr silt (SM) sharp contact .M=SAND (2.2-2.9') dense, micro-laminated SILT and CLAY (ML/CL) (2.9-3.8') mod gray, f SAND w/ some silt (SM)			DPSSP-MWS-2 (2-4)	rec 1.8/2.0 dry
17.5	3			1.8 ppm			black discoloration slight petroleum odor
16.5	4	2 5 6 7	SAND w/ some silt as above, slight petroleum odor especially w/in black discolored laminae (SM)				rec 1.6/2.0
15.5	5			3.4 ppm			moist
14.5	6	5 7 7 7	SAND as above w/ increased silt content, tr blk discolored laminae (SM)				rec 1.8/2.0 moist-wet
13.5	7			10.4 ppm			faint petroleum odor
12.5	8	3 10 14 10	(8.0-9.0') olive-gry SILT w/ tr-ltl f sand, tr clay (ML)				rec 1.7/2.0 wet
11.5	9		(9.0-9.7') brn-orng f-med SAND w/ some f-crs, subrnd gravel (SW)	28 ppm			dry
10.5	10						

DRILLING LOG

HOLE NO. DPS-MWS2

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 2
OF 2 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		8 9 8 8	mod brn, f-med SAND, tr-ltl, fine, subrnd gravel (SW)				rec 1.5/2.0 petroleum odor
9.5	11			30 ppm			
8.5	12	5 8 10 11	(12.0-13.1') As above (SW)				rec 1.7/2.0 dry
7.5	13		(13.1-13.7') f GRAVEL w/ ltl f-med sand (GP)	15 ppm			
6.5	14	7 9 8 9	orng-brn, f-med SAND w/ ltl f gravel (SW) med sand partings to 0.2' thick				rec 1.2/2.0 dry
5.5	15			14.8 ppm			
4.5	16	9 11 12 10	No Recovery				rec 0.0/2.0
3.5	17			—			
2.5	18	4 5 5 5	med gry-brn, f-crs SAND w/ minor sorting as crs sand partings to 0.1' thick (SW)			DPSSP-MWS-2 (18-20)	rec 1.5/2.0 very strong light petroleum odor wet-saturated
1.5	19			>150 ppm			100% LEL
0.5	20	2 4 5 7	SAND as above w/ tr f, subrnd gravel to 0.25" dia., ltl sorting as thin-bedded partings (SW)			DPSSP-MWS-2 (20-22)	rec 1.6/2.0 strong petroleum odor 100% LEL
-0.5	21			>130 ppm			
-1.5	22	5 7 9 27	f-crs, rnd-subrnd GRAVEL w/ ltl f sand (GW)				rec 0.9/2.0 significant petroleum odor and sheen
-2.5	23			150 ppm			water measured @ 19' bgs in augers
-3.5	24	12 10 11 9	mod brn, f-crs SAND, minor sorting as crs partings > 0.2' thick, some darkened staining (SW)				rec 1.2/2.0 saturated petroleum odor and sheen
-4.5	25			>140 ppm			
-5.5	26	12 11 10 9	(26.0-26.5') mod brown-red, f-crs SAND w/ tr f gravel to 0.5" dia. (SW) (26.5-27.5') loose, med-crs SAND, black staining w/in med sand partings @ 26.5-26.9'			DPSSP-MWS-2 (26-28)	rec 1.5/2.0 very strong petroleum odor
-6.5	27			>150 ppm			
-7.5	28		End of Boring				

DRILLING LOG

HOLE NO. DPS-MWS3

SHEET 1 OF 2 SHEETS

1. COMPANY NAME: Malcolm Pirnie, Inc.
2. DRILLING CONTRACTOR: SJB Services, Inc.
3. PROJECT: Defense Personnel Support Center
4. LOCATION: Philadelphia, Pennsylvania
5. NAME OF DRILLER: T. Miller
6. MANUFACTURER'S DESIGNATION OF DRILL: CME-850
7. Sizes & Types of Drilling & Sampling Equipment: 4 1/4" HSA; 2" continuous s.s.
8. HOLE LOCATION: 221507.7 North 2719177.2 East
9. SURFACE ELEVATION: 16.2'
10. DATE STARTED: 8/22/96
11. DATE COMPLETED: 8/22/96
12. OVERBURDEN THICKNESS:
13. DEPTH DRILLED INTO ROCK:
14. TOTAL DEPTH OF HOLE: 24.0
15. DEPTH GROUNDWATER ENCOUNTERED: 14 feet bgs
16. Depth to Water and Elapsed Time After Drilling Completed: 13.15 feet below mp to water; 8/23/96
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/A			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %
(14-16),(16-18),(22-24)			HFS	IR SCAN	EXPANDED	

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
		X		

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
16.2	0	2 3 3 4	(0.0-0.6) brn-blk SILT w/ tr f sand (FILL) sharp contact (0.6-1.4) med-crs SAND w/ weathered mica schist cobbles, coal (FILL)	5.8 ppm			rec 1.4/2.0 dry moist
15.2	1						
14.2	2	4 7 7 13	mod brn-red f SAND grading to drk stained blk @ 3.3', tr clay, coal, clay brick pieces (FILL)	13.4 ppm		DPSSP-MWS-3 (2-4)	rec 2.0/2.0 moist faint petroleum odor
13.2	3						
12.2	4	3 3 3 3	dk gry-blk SILT w/ tr-ltl f sand, tr clay, coal and red brick pieces (FILL)	78 ppm			rec 2.0/2.0 moist very faint petroleum odor
11.2	5						
10.2	6	2 3 2 4	(6.0-6.6') drk brn SILT w/ slight increase in sand content (FILL) (6.6-7.8') mod gry-brn SILT w/ black-stained laminae (ML)	74 ppm			rec 2.0/2.0 moist
9.2	7						
8.2	8	1 4 9 7	(7.8-8.0') lt brn-orng SILT w/ f sand (ML) orng-brn SILT, oxidized w/ tr-ltl f, micaceous sand and clay as laminae (ML)	36 ppm			rec 1.8/2.0 moist
7.2	9						
6.2	10						

DRILLING LOG

HOLE NO. DPS-MWS3

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 2
OF 2 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		13 12 12	(10.0-11.6') SILT as above (ML)				rec 2.0/2.0 moist
5.2	11	12		9.5 ppm			
4.2	12	4 7	(11.6-12.0') drk gry-brn, f, micaceous SAND and SILT (SC) (12.0-12.9') micaceous SAND and SILT as above (SC)				rec 1.8/2.0 moist-wet
3.2	13	13 12	(12.9-13.8')drk brn-orng, f-med SAND and f-crs, subrnd GRAVEL (SW/GW)	14.8 ppm		DPSSP-MWS-3 (14-16)	petroleum odor
2.2	14	4 7	drk brn, f-crs SAND and f-crs GRAVEL w/ sorted sand (matrix) interbeds (SW/GW)				rec 1.7/2.0 wet-saturated
1.2	15	12 30		>120 ppm			very strong petroleum odor
0.2	16	31 47	f-crs, subrnd GRAVEL w/ tr-ltl f-med sand, loose, cobbles > 3" dia. (GW)			DPSSP-MWS-3 (16-18)	rec 1.2/2.0 saturated
-0.8	17	26 38	Sampled with 3" split-spoon	>110 ppm		Duplicate DPSSP-MWS-6 (16-18)	very strong petroleum odor sheen on all gravel surfaces
-1.8	18	6 7	mod brn-ylw f-crs GRAVEL and SAND, ltl black staining @ 18.0-18.3' (GW/SW)				rec 1.5/2.0 saturated
-2.8	19	10 14		>100 ppm			petroleum sheen & odor
-3.8	20	7 10	(20.0-20.6') GRAVEL and SAND as above (GW/SW) sharp contact				rec 1.3/2.0 saturated
-4.8	21	7 8	(20.6-21.3') drk brn, f-med SAND w/ tr f gravel, dk blk discoloration @ 20.6-20.8' (SW)	>100 ppm		DPSSP-MWS-3 (22-24)	petroleum odor & sheen, discoloration
-5.8	22	2 4	drk brn SAND as above w/ dk brn-blk discoloration at approx. 22.9-23.0' (SW)				rec 1.4/2.0 saturated
-6.8	23	9 9		>150 ppm			petroleum odor & sheen, discoloration
-7.8	24		End of Boring				
-8.8	25						
-9.8	26						
-10.8	27						
-11.8	28						

DRILLING LOG

HOLE NO. DPS-MWS5

1. COMPANY NAME: Malcolm Pirnie, Inc.

2. DRILLING CONTRACTOR: SJB Services, Inc.

SHEET 1 OF 3 SHEETS

3. PROJECT: Defense Personnel Support Center

4. LOCATION: Philadelphia, Pennsylvania

5. NAME OF DRILLER: T. Miller

6. MANUFACTURER'S DESIGNATION OF DRILL: CME-850

7. Sizes & Types of Drilling & Sampling Equipment: 4 1/4" HSA; 2" continuous s.s.

8. HOLE LOCATION: 221547.9 North 2719959.3 East

9. SURFACE ELEVATION: 15.4'

10. DATE STARTED: 8/23/96

11. DATE COMPLETED: 8/23/96

12. OVERBURDEN THICKNESS:

15. DEPTH GROUNDWATER ENCOUNTERED: 9 feet bgs

13. DEPTH DRILLED INTO ROCK:

16. Depth to Water and Elapsed Time After Drilling Completed: 11.74 feet below mp to water; 8/27/96

14. TOTAL DEPTH OF HOLE: 28.8

17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES: N/A

DISTURBED	UNDISTURBED

19. TOTAL NUMBER OF CORE BOXES:

20. SAMPLES FOR CHEMICAL ANALYSIS: (14-16),(24-26),(26-28)

VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %
		HFS	IR SCAN		

22. DISPOSITION OF HOLE:

BACKFILLED	Monitoring Well	OTHER (Specify)
	X	

23. SIGNATURE OF INSPECTOR:

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
15.4 14.4	0 1	3 3 5 6	(0.0-0.7') dk brn-blk SILT w/ tr f sand (FILL) (0.7-1.4') blk-brn, med-crs SAND, w/ glass, brick, coal (FILL)	0.4 ppm			rec 0.4/2.0 moist
13.4 12.4	2 3	7 6 4 6	(2.0-2.5') SAND w/ misc. debris, as above (FILL) (2.5-3.7') lt brn-orng SILT w/ tr-ltl f sand w/ metal, coal, glass, ash (FILL)	0.8 ppm			rec 1.7/2.0 moist
11.4 10.4	4 5	12 7 7 7	(4.0-4.4') SILT as above (FILL) (4.4-5.6') Ash & burn debris, glass, coal (FILL)	2.2 ppm			rec 1.6/2.0 moist-dry
9.4 8.4	6 7	8 6 2 1	(6.0-6.9') Ash & burn debris as above (FILL) (6.9-7.7') dk brn, f SAND and SILT, oxidized w/ Fe staining, brick, glass, coal (FILL)	9.4 ppm			rec 1.7/2.0 moist-wet
7.4 6.4	8 9	WOH WOH 1 1	Silt, sand and ash, burn debris as above (FILL)	3.6 ppm			rec 1.1/2.0 wet
5.4	10						

MALCOLM PIRNIE

PROJECT: Defense Personnel Support Center
Philadelphia, Pennsylvania

HOLE NO. DPS-MWS5

DRILLING LOG

HOLE NO. DPS-MWS5

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 2
OF 3 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		1 2 2 2	(10.0-10.1') burn debris as above (FILL) (10.1-10.9') mod brn, f-med SAND w/ tr-ltl sub-rnd gravel (FILL)				rec 0.9/2.0 saturated
4.4	11			2.6 ppm			perched water in auger @ 9.3' bgs
3.4	12	WOH WOH WOH WOH	(12.0-13.4') blk-gry SILT w/ ltl-some clay (FILL)				rec 2.0/2.0 saturated
2.4	13		(13.4-14.0') SILT w/ ltl blk ash and wood debris (FILL)	7.4 ppm		DPSSP-MWS-5 (14-16)	not organic peat
1.4	14	1 1 2 4	(14.0-14.2') SILT w/ burn debris (FILL) (14.2-15.4') gry-brn SILT w/ blk carbonized rootlets, some clay (ML)				rec 1.4/2.0 saturated
0.4	15			17.6 ppm			
-0.6	16	1 2 1 3	(16.0-16.7') mod brn, f SAND w/ ltl f-crs, subrnd gravel to 0.75" dia. (SW) (16.7-16.9') blk-gry, med-crs SAND w/ tr f gravel to 0.25" dia. (SW)				rec 0.9/2.0 saturated
-1.6	17			7.0 ppm			
-2.6	18	4 5 4 5	(18.0-18.2') blk-gry SAND as above (SW) (18.2-18.7') crs GRAVEL to 2" dia. w/ tr-ltl silt, tr clay (GW)				rec 0.7/2.0 saturated
-3.6	19			5.8 ppm			faint petroleum/burn odor
-4.6	20	4 13 9 11	lt brn, f-crs, subrnd GRAVEL w/ ltl silt and f sand w/ color change to drk gry @ 20.6' (GW)				rec 0.7/2.0 saturated
-5.6	21			4.8 ppm			slight odor as above
-6.6	22	2 6 13 14	GRAVEL w/ silt and sand as above (GW)				rec 1.2/2.0 saturated
-7.6	23			5.6 ppm		DPSSP-MWS-5 (24-26)	
-8.6	24	1 3 3 3	(24.0-24.5') drk brn, f-med SAND, tr petroleum sheen (SW) gradational to (24.5-25.8') mod brn, f SAND, w/ some sorting (SW)				rec 1.8/2.0 saturated
-9.6	25			90 ppm		DPSSP-MWS-5 (26-28) Duplicate DPSSP-MWS-7	significant petroleum odor and sheen
-10.6	26	9 10 11 20	(26.0-26.5') dk gry, f-med SAND w/ some f-crs gravel w/ cobbles to 3" dia. (SW) sharp contact (26.5-27.4') med-drk gry, loose, f-med SAND (SW)				rec 1.4/2.0
-11.6	27			150 ppm			very strong petroleum odor
-12.6	28						

DRILLING LOG

HOLE NO. DPS-MWS5

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 3
OF 3 **SHEETS**

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
			End of Boring			(26-28)	
-13.6	29						
-14.6	30						
-15.6	31						
-16.6	32						
-17.6	33						
-18.6	34						
-19.6	35						
-20.6	36						
-21.6	37						
-22.6	38						
-23.6	39						
-24.6	40						
-25.6	41						
-26.6	42						
-27.6	43						
-28.6	44						
-29.6	45						
-30.6	46						

DRILLING LOG

HOLE NO.
DPS-SBS1

1. COMPANY NAME
Malcolm Pirnie, Inc.

2. DRILLING CONTRACTOR
SJB Services, Inc.

SHEET 1
OF 2 SHEETS

3. PROJECT
Defense Personnel Support Center

4. LOCATION
Philadelphia, Pennsylvania

5. NAME OF DRILLER
T. Miller

6. MANUFACTURER'S DESIGNATION OF DRILL
CME-850

7. Sizes & Types of Drilling & Sampling Equipment
2 1/4" HSA
2" continuous s.s.

8. HOLE LOCATION
221861.8 North 2718059.9 East

9. SURFACE ELEVATION
22.6'

10. DATE STARTED
8/26/96

11. DATE COMPLETED
8/26/96

12. OVERBURDEN THICKNESS

15. DEPTH GROUNDWATER ENCOUNTERED
21 feet bgs

13. DEPTH DRILLED INTO ROCK

16. Depth to Water and Elapsed Time After Drilling Completed

14. TOTAL DEPTH OF HOLE
24.0

17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/A			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
	GROUT			

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
22.6	0		(0.0-0.5') asphalt blacktop (0.5-1.3') dk brn-blk, olive SILT w/ tr-ltl f sand, tr f gravel (FILL)				rec 0.8/1.5 manhole invert @ approx. 22' bgs
21.6	1	3 4 4		5.4 ppm			water in sewer @ 16' bgs auger 0.5' through blacktop
20.6	2		No Recovery				
19.6	3	3 3 7 3		—			rec 0.0/2.0
18.6	4		(4.0-4.4') dk brn SILT w/ tr sand, ltl f gravel (FILL)				rec 0.4/2.0
17.6	5	4 4 4 2		0.8 ppm			moist
16.6	6		lt gry, f SAND, tr silt, brown mottling (SP)				rec 1.8/2.0 moist
15.6	7	2 3 4 7		1.6 ppm			
14.6	8		(8.0-9.2') SAND as above (SP)				rec 1.9/2.0 moist
13.6	9	3 5 9 10	gradational to (9.2-9.9') dk brn, f-med SAND w/ ltl subrnd. f gravel (SW)	3.6 ppm			slight petroleum odor
12.6	10						

DRILLING LOG

HOLE NO. DPS-SBS1

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 2
OF 2 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		10 10	(10.0-10.3') lt-mod gry, med-crs SAND (SW) (10.3-11.8') mod-drk brn, loose, f-med SAND w/ tr-ltl f gravel (SW)				rec 1.8/2.0 dry
11.6	11	15 21		0.6 ppm			petroleum odor
10.6	12	13 12	(12.0-12.9') SAND w/ Fe staining, ltl f gravel as above (SW)				rec 1.9/2.0 dry
9.6	13	11 14	(12.9-13.9') mod gry, loose, f-med SAND w/ tr-ltl f gravel (SW)	10.8 ppm			
8.6	14	13 12	gry-brn, loose, f-med SAND, tr-ltl f gravel, some sand partings to < 0.3' thick (SW)				rec 1.8/2.0
7.6	15	10 17		5.6 ppm			
6.6	16	11 15	mod gry-brn, loose, f-med SAND w/ ltl-some fine, subrnd gravel (SW)				rec 1.8/2.0 dry-moist
5.6	17	12 12		1.8 ppm			
4.6	18	5 7	mod-dk, brn-gry, loose, med-crs SAND w/ tr f gravel (SW)				rec 1.4/2.0 dry-moist
3.6	19	6 9		2.6 ppm			petroleum odor
2.6	20	9 17	(20.0-20.7') SAND w/ f gravel as above (SW) grading into				
1.6	21	15 11	(20.7-21.3') brn-gry, f-med SAND and f-crs GRAVEL (SW/GW) (21.3-21.5') drk brn-gry SILT w/ tr f sand (ML)	7.8 ppm			
0.6	22	8 9	(22.0-22.3') lt-mod brn SILT (ML) sharp contact				
-0.5	23	15 32	(22.3-23.3') dk brn, f SAND, tr f gravel, w/ blk petroleum staining 22.6-23.0' (SW) (23.3-23.8') mod brn, med-crs SAND and f-crs, subrnd GRAVEL (SW/GW)	>150 ppm			
-1.5	24		End of Boring				
-2.5	25						
-3.5	26						
-4.5	27						
-5.5	28						

DRILLING LOG

HOLE NO. DPS-SBS2

SHEET 1 **OF** 2 **SHEETS**

1. COMPANY NAME Malcolm Pirnie, Inc.

2. DRILLING CONTRACTOR SJB Services, Inc.

3. PROJECT Defense Personnel Support Center

4. LOCATION Philadelphia, Pennsylvania

5. NAME OF DRILLER T. Miller

6. MANUFACTURER'S DESIGNATION OF DRILL CME-850

7. Sizes & Types of Drilling & Sampling Equipment 2 1/4" HSA
2" continuous s.s.

8. HOLE LOCATION 221863.2 North 2718269.1 East

9. SURFACE ELEVATION 20.8'

10. DATE STARTED 8/27/96

11. DATE COMPLETED 8/27/96

12. OVERBURDEN THICKNESS

13. DEPTH DRILLED INTO ROCK

14. TOTAL DEPTH OF HOLE 20.0

15. DEPTH GROUNDWATER ENCOUNTERED 20 feet bgs

16. Depth to Water and Elapsed Time After Drilling Completed

17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY) 19.1 ft bgs to LNAPL in augers 8/27/96

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/A			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %
(16-18)			HFS	IR SCAN		

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
	GROUT			

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
20.8	0						rec 1.2/1.5
			(0.5-0.8') brn-red SAND w/ ltl silt (FILL)				augered 0.5' through asphalt pavement
19.8	1	7 7 6	(0.8-1.7') ylw-brn mttld SILT and f sand w/ red brick and f gravel (FILL)	0.2 ppm			
18.8	2	6 7 8 12	(2.0-3.1') brn-orng SILT and sand, thin bedding fabric (ML)				rec 2.0/2.0 moist
17.8	3		(3.1-4.0') lt gry, f SAND, some silt (SM)	0.2 ppm			
16.8	4	8 5 5 6	lt gry SAND w/ Fe stained motling, ltl-some silt (SM)				rec 1.3/2.0 moist
15.8	5			2.6 ppm			
14.8	6	5 6 5 6	SAND as above w/ silt, tr f gravel (SM)				rec 2.0/2.0 moist
13.8	7			11 ppm			
12.8	8	4 6 17 35	(8.0-8.4') SAND as above (SM)				rec 1.0/2.0 slight odor
11.8	9		(8.4-8.6') dk brn-blk discoloration (SW) (8.6-9.0') mod brn, f-med SAND, ltl f-crs gravel to 2" dia. (SW)	21 ppm			
10.8	10						

MALCOLM PIRNIE

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

HOLE NO. DPS-SBS2

DRILLING LOG

HOLE NO. DPS-SBS2

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 2
OF 2 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
9.8	11	10 21 30 31	(10.0-10.7') dk brn-orng, f-med SAND, heavy Fe staining, ltl-some f-crs gravel (SW) (10.7-11.8') f-crs, subrnd GRAVEL to 2" dia., ltl f sand (GW)	20 ppm			rec 1.8/2.0 dry
8.8	12						
7.8	13	40 13 11 9	(12.0-13.0') mod brn, f-med SAND and GRAVEL grading to orng-brn @ 12.7' (SW/GW) (13.0-13.3') red-orng, denseSILT w/ tr clay (ML)	14.8 ppm			rec 1.9/2.0 dry dry
6.8	14		(13.3-13.9') brn-red, f SAND w/ ltl silt (SM)				moist rec 1.7/2.0
5.8	15	11 20 24 15	mod brn, f-med SAND and f-crs GRAVEL >2" dia., faint bedding fabric as sorted micaceous sand partings <0.2' thick w/ variable gravel content (SW/GW)	19.6 ppm			dry-moist
4.8	16		(16.0-17.0') SAND and GRAVEL as above (SW/GW)			DPSSP-SBS-2 (16-18)	rec 2.0/2.0
3.8	17	24 18 13 15	sharp contact (17.0-18.0') dk orng-brn, f-med SAND, Fe stained, tr f gravel (SW)	>150 ppm			very strong petroleum odor
2.8	18		(18.0-18.4') dk brn, f SAND, some discoloration (SW)				rec 1.5/2.0
1.8	19	10 14 28 27	(18.4-19.5') dk brn, f SAND and f-crs GRAVEL to > 2" dia. (SW/GW)	>150 ppm			saturated w/ LNAPL LNAPL level @ 19.1 ' bgs at boring termination
0.8	20		End of Boring				LNAPL minimum of 0.7' thick measured in bottom of augers
-0.2	21						
-1.2	22						
-2.2	23						
-3.2	24						
-4.2	25						
-5.2	26						
-6.2	27						
-7.2	28						

DRILLING LOG

HOLE NO. DPS-SBS3

SHEET 1 OF 2 SHEETS

1. COMPANY NAME: Malcolm Pirnie, Inc.
2. DRILLING CONTRACTOR: SJB Services, Inc.
3. PROJECT: Defense Personnel Support Center
4. LOCATION: Philadelphia, Pennsylvania
5. NAME OF DRILLER: T. Miller
6. MANUFACTURER'S DESIGNATION OF DRILL: CME-850
7. Sizes & Types of Drilling & Sampling Equipment: 2 1/4" HSA; 2" continuous s.s.
8. HOLE LOCATION: 221549.1 North 2718254.6 East
9. SURFACE ELEVATION: 21.2'
10. DATE STARTED: 8/27/96
11. DATE COMPLETED: 8/27/96
12. OVERBURDEN THICKNESS:
13. DEPTH DRILLED INTO ROCK:
14. TOTAL DEPTH OF HOLE: 22.0
15. DEPTH GROUNDWATER ENCOUNTERED:
16. Depth to Water and Elapsed Time After Drilling Completed: 18.75 ft to LNAPL in augers- LNAPL - 1.1 ft thick
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/A			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
	GROUT			

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
21.2	0	3 6 5 6	lt brn-gry SILT w/ tr f sand, lt brn Fe oxidation @ 0.0-0.4' bgs (ML)				rec 1.5/2.0 dry
20.2	1			0.2 ppm			
19.2	2	8 12 12 13	brn-orng mottld, micaceous, f SAND w/ some silt (SM)				rec 2.0/2.0 dry
18.2	3			0.4 ppm			
17.2	4	8 6 7 7	SAND w/ silt as above (SM)				rec 1.6/2.0 dry
16.2	5			1.8 ppm			
15.2	6	12 6 6 8	lt brn-orng, f SAND w/ some silt, sharp color change to lt gry-olive @ 6.0-6.2' (SM)				rec 2.0/2.0 moist
14.2	7			3.4 ppm			
13.2	8	4 3 5 6	(8.0-9.7') SAND w/ silt as above w/ tr f gravel (SM)				rec 1.8/2.0
12.2	9			3.8 ppm			
11.2	10		(9.7-9.8') dk brn, Fe stained, f SAND				

DRILLING LOG

HOLE NO. DPS-SBS3

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 2
OF 2 **SHEETS**

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
			w/ tr-ltl silt (SM)				rec 0.7/1.2
		6 6 50	dk brn, f SAND and GRAVEL (SW/GW) cobbles and boulders as per drilling character				
10.2	11			28 ppm			spoon refusal @ approx. 10.7' bgs
9.2	12	12 18 20 25	brn-gry , f-med SAND and f-crs GRAVEL to >3"dia., gradational color change to lt-mod gry @ 12.0-12.2' (SW/GW)				rec 0.8/2.0 dry
8.2	13			10.2 ppm			
7.2	14	4 7 10 10	dk gry, f-med SAND w/ tr f gravel to 0.5" dia., blk discoloration @ 15.1-15.3' (SW)				rec 1.3/2.0 dry-moist
6.2	15			22 ppm			petroleum odor
5.2	16	5 6 9 12	brn-orng, micaceous, f-crs SAND w/ ltl silt (SM)				rec 1.7/2.0 moist
4.2	17			92 ppm			strong petroleum odor
3.2	18	13 18 18 17	dk brn-gry, f-med SAND and f-crs GRAVEL >2-3" dia. (SW/GW)				rec 1.6/2.0 saturated w/ LNAPL
2.2	19			>150 ppm			LNAPL measured in augers @ 18.75' to 19.85' bgs
1.2	20	15 17 13 21	SAND and GRAVEL as above w/ tr silt (SW/GW)				
0.2	21			>150 ppm			
-0.8	22		End of Boring				
-1.8	23						
-2.8	24						
-3.8	25						
-4.8	26						
-5.8	27						
-6.8	28						

DRILLING LOG

HOLE NO. DPS-SBS4

1. COMPANY NAME: Malcolm Pirnie, Inc.
2. DRILLING CONTRACTOR: SJB Services, Inc.

SHEET 1 OF 2 SHEETS

3. PROJECT: Defense Personnel Support Center
4. LOCATION: Philadelphia, Pennsylvania
5. NAME OF DRILLER: T. Miller
6. MANUFACTURER'S DESIGNATION OF DRILL: CME-850
7. Sizes & Types of Drilling & Sampling Equipment: 2 1/4" HSA
2" standard ss to 15 ft bgs
2" continuous ss to 21 ft bgs
8. HOLE LOCATION: 221485.6 North 2718428.9 East
9. SURFACE ELEVATION: 21.1'
10. DATE STARTED: 8/27/96
11. DATE COMPLETED: 8/27/96
12. OVERBURDEN THICKNESS:
13. DEPTH DRILLED INTO ROCK:
14. TOTAL DEPTH OF HOLE: 21.0
15. DEPTH GROUNDWATER ENCOUNTERED:
16. Depth to Water and Elapsed Time After Drilling Completed:
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):
18. GEOTECHNICAL SAMPLES: N/A — DISTURBED: — UNDISTURBED:
19. TOTAL NUMBER OF CORE BOXES:

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
	GROUT			

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
21.1	0	1 3 6 15	(0.0-1.5) dk brn SILT w/ tr f sand, color gradation to lt brn @ 0.0-0.7' (FILL)				rec 1.5/2.0
20.1	1			0.2 ppm			moist
			(1.5-1.9') lt-med brn, f SAND w/ tr f gravel (FILL)				
19.1	2						
18.1	3						borehole located 30 feet south of DPSSP-SBS-5
17.1	4						
16.1	5	3 3 3 6	(5.0-6.2') mod gry-brn SAND and silt w/ lt orng mottling (FILL)				rec 1.7/2.0 moist
15.1	6			1.4 ppm			slight petroleum odor
14.1	7		(6.2-6.7') dk gry, f-med SAND w/ tr gravel (FILL)				moved drilling rig 10 ft south of original SBS-4
13.1	8						
12.1	9						slag backfill and spoon refusal @ 9.5 ft bgs
11.1	10						

DRILLING LOG

PROJECT Defense Personnel Support Center Philadelphia, Pennsylvania	INSPECTOR John Hilton	HOLE NO. DPS-SBS4 SHEET 2 OF 2 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		12 12	mod-dk gry-brn, f-crs SAND and f-crs, subrnd GRAVEL to 1" dia. (SW/GW)				rec 1.6/2.0
10.1	11	16 17		28 ppm			strong petroleum odor
9.1	12						
8.1	13						
7.1	14						
6.1	15						
		7 7	(15.0-16.3') mod brn, f SAND, sorted as fine partings w/ color changes (SW)				rec 1.7/2.0
5.1	16	14 14		62 ppm			strong petroleum odor
			(16.3-16.7') orng-brn f-med SAND and f GRAVEL (SW/GW)				
4.1	17						
		4 6	(17.0-18.1') lt brn-gry, f-med SAND w/ tr f gravel w/in partings >0.2' thick (SW)				rec 1.7/2.0
3.1	18	10 10	(18.1-18.7') brn-gry f-med SAND and GRAVEL (SW/GW)	>150 ppm			petroleum odor
2.1	19						
		4 5	(19.0-20.0) gry, f-med SAND w/ tr f gravel (SW)				rec 1.8/2.0 saturated
1.1	20	14 16	(20.0-20.8) dk gry f-med SAND and f-crs GRAVEL (SW/GW)	>150 ppm			
0.1	21		End of Boring				
-0.9	22						
-1.9	23						
-2.9	24						
-3.9	25						
-4.9	26						
-5.9	27						
-6.9	28						

DRILLING LOG

HOLE NO. DPS-SBS5

1. COMPANY NAME: Malcolm Pirnie, Inc.
2. DRILLING CONTRACTOR: SJB Services, Inc.

SHEET 1 OF 2 SHEETS

3. PROJECT: Defense Personnel Support Center
4. LOCATION: Philadelphia, Pennsylvania
5. NAME OF DRILLER: T. Miller
6. MANUFACTURER'S DESIGNATION OF DRILL: CME-850
7. Sizes & Types of Drilling & Sampling Equipment: 2 1/4" HSA; 2" continuous s.s.
8. HOLE LOCATION: 221523.3 North 2718432.5 East
9. SURFACE ELEVATION: 20.8'
10. DATE STARTED: 8/26/96
11. DATE COMPLETED: 8/26/96
12. OVERBURDEN THICKNESS:
13. DEPTH DRILLED INTO ROCK:
14. TOTAL DEPTH OF HOLE: 22.0
15. DEPTH GROUNDWATER ENCOUNTERED: 20 feet bgs
16. Depth to Water and Elapsed Time After Drilling Completed:
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 19.05 ft bgs to LNAPL in augers 8/26/96

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/A			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %
(20-22)			HFS	IR SCAN		

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
	GROUT			

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
20.8	0	3 4 7 9	(0.0-0.6') mod gry-brn SILT (FILL) sharp transition (0.6-1.8') lt brn SAND and SILT w/ tr gravel (FILL)	0.8 ppm			rec 1.8/2.0 dry
19.8	1						
18.8	2	11 14 14 13	(2.0-2.6') SILT as above w/ red brick sharp contact (2.6-3.7') lt-mod brn SILT and f SAND (ML/SC)	2.0 ppm			rec 1.7/2.0 dry moist
17.8	3						
16.8	4	10 4 7 7	mod brn f SAND grading to gry at 4.2' w/ some silt (SC)	30 ppm			rec 1.8/2.0 moist
15.8	5						
14.8	6	4 5 7 9	lt olive-gry f SAND and SILT, tr Fe staining as mottling (SC)	22 ppm			rec 1.9/2.0 moist
13.8	7						
12.8	8	4 7 7 11	(8.0-8.2') SAND and SILT as above (SC) grading to (8.2-9.2') mod gry-brn SILT w/ tr f sand and clay (ML) (9.2-9.9') dk brn-gry, f SAND, ltl f, subrnd gravel to 0.5" dia. (SW)	20.3 ppm			rec 1.9/2.0 dry
11.8	9						
10.8	10						

MALCOLM PIRNIE

PROJECT: Defense Personnel Support Center
Philadelphia, Pennsylvania

HOLE NO. DPS-SBS5

DRILLING LOG

HOLE NO. DPS-SBS5

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 2
OF 2 **SHEETS**

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		5 9	(10.0-10.3') dk brn, loose, f-med SAND (SW) (10.3-11.2') mod gry-brn, med-crs SAND, tr f gravel (SW)				rec 1.5/2.0 dry-moist
9.8	11	11 17	(11.2-11.5') br f-med SAND and GRAVEL to 1" dia. (SW/GW)	6.8 ppm			petroleum odor
8.8	12	12 12	SAND and GRAVEL as above (SW/GW)				rec 1.3/2.0 dry-moist
7.8	13	13 12		1.5 ppm			
6.8	14	9 9	mod-dk orng/brn, loose SAND grading to lt gry @ 14.6', some f-crs gravel to 1" dia. (SW)				rec 1.6/2.0 dry
5.8	15	9 9		5 ppm			
4.8	16	6 8	lt gry, loose, f-med SAND w/ tr-ltl f, subrnd gravel (SW)				rec 1.4/2.0 dry
3.8	17	10 10		>150 ppm			
2.8	18	9 9	lt-mod gry-brn, f-med SAND, ltl-some f gravel (SW)				rec 1.7/2.0 saturated w/ LNAPL
1.8	19	10 11		>150 ppm			
0.8	20	12 14	SAND w/ ltl-some gravel as above (SW)			DPSSP-SBS-5 (20-22)	rec 1.8/2.0 LNAPL level @ 19.05', water @ 20.7' bgs
-0.2	21	16 18		>150 ppm			at borehole termination
-1.2	22		End of Boring				
-2.2	23						
-3.2	24						
-4.2	25						
-5.2	26						
-6.2	27						
-7.2	28						

DRILLING LOG

HOLE NO. DPS-SBS6

SHEET 1 OF 2 SHEETS

1. COMPANY NAME: Malcolm Pirnie, Inc.
2. DRILLING CONTRACTOR: SJB Services, Inc.
3. PROJECT: Defense Personnel Support Center
4. LOCATION: Philadelphia, Pennsylvania
5. NAME OF DRILLER: T. Miller
6. MANUFACTURER'S DESIGNATION OF DRILL: CME-850
7. Sizes & Types of Drilling & Sampling Equipment: 2 1/4" HSA
2" continuous s.s.
8. HOLE LOCATION: 221540.7 North 2718877.2 East
9. SURFACE ELEVATION: 19.0'
10. DATE STARTED: 8/27/96
11. DATE COMPLETED: 8/27/96
12. OVERBURDEN THICKNESS:
15. DEPTH GROUNDWATER ENCOUNTERED: 16 feet bgs
13. DEPTH DRILLED INTO ROCK:
16. Depth to Water and Elapsed Time After Drilling Completed:
14. TOTAL DEPTH OF HOLE: 20.0
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/A			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %
(16-18)			HFS	IR SCAN		

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
	GROUT			

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
19.0	0	2 3	(0.0-0.9') gry-brn SILT w/ tr f sand (ML)				rec 1.4/2.0 dry-moist
18.0	1	6 11	(0.9-1.4') SAND and SILT w/ tr-ltl f gravel (SM)	19.4 ppm			
17.0	2	8 9	(2.0-2.7') gry-blk SILT w/ carbonaceous plant frags, tr clay (ML)				rec 2.0/2.0 dry-moist
16.0	3	8 11	(2.7-4.0) lt brn-orng, f SAND w/ some silt (SM)	14.6 ppm			
15.0	4	4 4	lt brn-orng, micaceous f SAND grading to brn-blk @ 4.7' bgs, ltl silt and organic plant debris (SM)				rec 1.6/2.0 moist
14.0	5	6 8		26 ppm			
13.0	6	4 5	(6.0-7.3') lt brn, micaceous f SAND and silt, faint bedding fabric (SM)				rec 1.8/2.0 moist-wet
12.0	7	13 13	(7.3-7.8') dk brn SAND and GRAVEL w/ blk discoloration @ 7.6-7.8' (SW/GW)	54 ppm			petroleum odor
11.0	8	17 20	(8.0-8.5') brn-orng, f-crs SAND w ltl f gravel (SW)				rec 1.4/2.0 dry
10.0	9	26 25	(8.5-9.4') f-crs GRAVEL and brn, f-med SAND (GW/SW)	36 ppm			
9.0	10						

DRILLING LOG

HOLE NO. DPS-SBS6

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 2
OF 2 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		13 18	GRAVEL and SAND as above w/ some sorted sand partings w/in gravel matrix (GW/SW)				rec 1.5/2.0 dry
8.0	11	17 16		34 ppm			
7.0	12	12 8	orng-brn, loose, f-crs SAND w/ tr, f gravel to 0.25" dia. (SW)				rec 1.6/2.0 dry
6.0	13	9 7		22 ppm			
5.0	14	6 3	SAND as above, grading to med brn, w/ tr f gravel (SW)				rec 1.3/2.0 dry
4.0	15	5 5		>150 ppm			strong petroleum odor
3.0	16	7 6	(16.0-16.2') orng-brn, f-crs SAND w/ tr-ltl gravel (SW) (16.2-17.4') gry-brn, f-med SAND, black staining (SW)			DPSSP-SBS-6 (16-18)	rec 1.4/2.0 saturated w/ LNAPL
2.0	17	6 7		>150 ppm			
1.0	18	4 6	(18.0-19.1') SAND w/ blk staining as above (SW)				rec 1.7/2.0 saturated
0.0	19	15 13	(19.1-19.7') dk gry-blk, f SAND and f-crs GRAVEL (SW/GW)	>150 ppm			
-1.0	20		End of Boring				
-2.0	21						
-3.0	22						
-4.0	23						
-5.0	24						
-6.0	25						
-7.0	26						
-8.0	27						
-9.0	28						

MALCOLM PIRNIE

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

HOLE NO. DPS-SBS6

DRILLING LOG

HOLE NO. DPS-SBS7

SHEET 1 OF 2 SHEETS

1. COMPANY NAME Malcolm Pirnie, Inc.	2. DRILLING CONTRACTOR SJB Services, Inc.
3. PROJECT Defense Personnel Support Center	4. LOCATION Philadelphia, Pennsylvania
5. NAME OF DRILLER T. Miller	6. MANUFACTURER'S DESIGNATION OF DRILL CME-850
7. Sizes & Types of Drilling & Sampling Equipment 2 1/4" HSA 2" continuous s.s.	8. HOLE LOCATION 221542.6 North 2719054.8 East
	9. SURFACE ELEVATION 18.9'
	10. DATE STARTED 8/26/96
	11. DATE COMPLETED 8/26/96
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED
13. DEPTH DRILLED INTO ROCK	16. Depth to Water and Elapsed Time After Drilling Completed
14. TOTAL DEPTH OF HOLE 20.0	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/A			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
	GROUT			

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
18.9	0	1 2 2 4	dk brn SILT grading to lt orng-brn, tr-ltl f sand (FILL)				rec 1.5/2.0 moist
17.9	1			14.6 ppm			
16.9	2	3 3 3 4	(2.0-2.6') orng-brn SILT, tr-ltl f SAND (ML) (2.6-3.0') mod brn, f SAND, tr-ltl f gravel to 0.25" dia, tr silt (SW)				rec 1.6/2.0 moist
15.9	3		(3.0-3.6') brn-gry SILT w/ tr-ltl f sand (ML)	0.2 ppm			slight petroleum odor
14.9	4	2 2 2 5	brn-blk SILT w/ ltl f sand increasing w/in silt matrix with depth, native shell material, carbonized plant frags (ML)				rec 1.6/2.0 moist
13.9	5			42 ppm			
12.9	6	2 4 4 5	(6.0-6.8') SILT as above w/ plant frags (ML)				rec 2.0/2.0 moist
11.9	7		(6.8-8.0') dk gry-blk, micaceous, f SAND w/ ltl silt (SC)	20 ppm			
10.9	8	3 4 6 7	dk gry-brn f SILT and SAND (ML/SC)				rec 2.0/2.0
9.9	9			58 ppm			
8.9	10						

DRILLING LOG

HOLE NO. DPS-SBS7

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 2
OF 2 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		6	(10.0-10.3') SILT and SAND as above (ML/SC)				rec 1.7/2.0
7.9	11	9 12 12	(10.3-10.7') dk gry-blk, loose, f-med SAND (SW) (10.7-11.7') gry-brn, f-med SAND and f GRAVEL to 1" dia. (SW/GW)	104 ppm			dry cobbles > 2" dia.
6.9	12	20	(12.0-12.5') SAND and GRAVEL as above (SW/GW)				rec 1.5/2.0
5.9	13	12 9 9	(12.5-12.9') blk-gry discolored (stained) SAND (SW) (12.9-13.5') dk gry-blk, f-med SAND and f-crs GRAVEL to 1" dia. (SW/GW)	>100 ppm			moist
4.9	14	8	(14.0-14.3') SAND and GRAVEL as above (SW/GW)				rec 1.6/2.0
3.9	15	8 8 8	(14.3-15.0') lt gry-brn, f-med SAND w/ tr gravel (SW) (15.0-15.6') med SAND w/ some f GRAVEL to 0.5" dia. (SW)	134 ppm			dry-moist petroleum odor
2.9	16	4	brn, f-med SAND w/ blk staining @ 16.9-17.1' bgs, tr-ltl f gravel to 0.25" dia. (SW)				rec 1.4/2.0
1.9	17	6 7 7		>150 ppm			saturated strong petroleum odor
0.9	18	5	brn-gry, f-crs SAND w/ some partings as sorted lenses of crs sand (SW)				rec 1.7/2.0
-0.1	19	5 7 9		>150 ppm			petroleum sheen on all surfaces
-1.1	20		End of Boring				
-2.1	21						
-3.1	22						
-4.1	23						
-5.1	24						
-6.1	25						
-7.1	26						
-8.1	27						
-9.1	28						

MALCOLM PIRNIE

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

HOLE NO. DPS-SBS7

DRILLING LOG

HOLE NO. DPS-SBS8

SHEET 1 OF 2 SHEETS

1. COMPANY NAME: Malcolm Pirnie, Inc.

2. DRILLING CONTRACTOR: SJB Services, Inc.

3. PROJECT: Defense Personnel Support Center

4. LOCATION: Philadelphia, Pennsylvania

5. NAME OF DRILLER: T. Miller

6. MANUFACTURER'S DESIGNATION OF DRILL: CME-850

7. Sizes & Types of Drilling & Sampling Equipment:
2 1/4" HSA
2" continuous s.s.

8. HOLE LOCATION: 221516.1 North 2719427.0 East

9. SURFACE ELEVATION: 12.8'

10. DATE STARTED: 8/27/96

11. DATE COMPLETED: 8/27/96

12. OVERBURDEN THICKNESS:

15. DEPTH GROUNDWATER ENCOUNTERED: 8 feet bgs

13. DEPTH DRILLED INTO ROCK:

16. Depth to Water and Elapsed Time After Drilling Completed:

14. TOTAL DEPTH OF HOLE: 16.0

17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/A			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %
(10-12)			HFS	IR SCAN		

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
	GROUT			

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
12.8	0	9	blk SILT, f sand, tr f gravel, ash (FILL)				rec 1.8/2.0
		5					
11.8	1	5					
		10		84 ppm			dry-moist
10.8	2		(2.0-2.6') As above (FILL)				rec 1.5/2.0
		11					
		6	(2.6-2.8') brn, f-med SAND, ltl f gravel (FILL)				moist
9.8	3	4		60 ppm			
		3	(2.8-3.0') blk-gry SILT and SAND w/ plant frags (FILL)				
8.8	4		(3.0-3.5') brn f-med SAND and f GRAVEL (FILL)				rec 0.5/2.0
		6	SAND and GRAVEL as above (FILL)				
		5					moist
7.8	5	6					
		4		48 ppm			
6.8	6		(6.0-6.4') SAND w/ crs angular gravel, brick frags (FILL)				rec 0.7/2.0
		10					
		13	(6.4-6.7') dk gry-blk, f SAND and silt w/ carbonized plant frags (SM)				
5.8	7	16					
		7		12 ppm			
4.8	8		(8.0-8.3') gry-blk SILT w/ tr f sand (ML)				rec 0.7/2.0
		5					
		11	(8.3-8.7') f-crs GRAVEL and dk gry-brn, f SAND (GW/SW)				wet
3.8	9	28		110 ppm			strong petroleum odor
		18					
2.8	10						

DRILLING LOG

HOLE NO.	DPS-SBS8
PROJECT	Defense Personnel Support Center Philadelphia, Pennsylvania
INSPECTOR	John Hilton
SHEET 2	OF 2 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
			(10.0-10.3') mod brn, f SAND (SP)				rec 1.5/2.0
		6 14	(10.3-11.5') brn f-med SAND and f-crs GRAVEL (SW/GW)			DPSSP-SBS-8 (10-12)	wet
1.8	11	12 14					very strong petroleum odor
				>150 ppm			
0.8	12						
		8 14	dk brn, f-med SAND and f-crs, subrnd GRAVEL to 1" dia., staining @ 13.1-13.2' interval (SW/GW)				rec 1.6/2.0 very strong petroleum odor
-0.2	13	12 14		>150 ppm			
-1.2	14						
		12	(14.0-14.3') SAND and GRAVEL as above, black staining (SW/GW)				rec 1.4/2.0
		14 14 14	(14.3-15.4') mod brn, f-crs SAND w/ some sorting as crs partings >0.1' thick, preferential staining @ 15.0-15.1, 15.2-15.4' intervals (SW)	>150 ppm			
-2.2	15						
-3.2	16		End of Boring				
-4.2	17						
-5.2	18						
-6.2	19						
-7.2	20						
-8.2	21						
-9.2	22						
-10.2	23						
-11.2	24						
-12.2	25						
-13.2	26						
-14.2	27						
-15.2	28						

DRILLING LOG

HOLE NO. MW23

SHEET 1 OF 3 SHEETS

1. COMPANY NAME: Malcolm Pirnie, Inc.
2. DRILLING CONTRACTOR: SJB Services, Inc.
3. PROJECT: Defense Personnel Support Center
4. LOCATION: Philadelphia, Pennsylvania
5. NAME OF DRILLER: T. Miller
6. MANUFACTURER'S DESIGNATION OF DRILL: CME-85
7. Sizes & Types of Drilling & Sampling Equipment: 6 1/4" HSA; 3" continuous s.s.
8. HOLE LOCATION: 222719.3 North 2718138.8 East
9. SURFACE ELEVATION: 21.1'
10. DATE STARTED: 6/11/96
11. DATE COMPLETED: 6/11/96
12. OVERBURDEN THICKNESS:
13. DEPTH DRILLED INTO ROCK:
14. TOTAL DEPTH OF HOLE: 30.0
15. DEPTH GROUNDWATER ENCOUNTERED: 18.5 feet bgs
16. Depth to Water and Elapsed Time After Drilling Completed: 18.39 feet below mp; 6/20/96
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 18.44 feet below mp; 6/28/96

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/A			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %
(18-20),(20-22),(24-26)			HFS	IR SCAN		

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
		X		

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
21.1	0	2 6 19 18	(0-0.7') mod-dark brn SILT w/ tr f sand (FILL) (0.7-1.7') sharp contact w/ f ang GRAVEL as railroad bedding, crs sand (FILL)	1.8 ppm			rec 1.7/2.0
20.1	1						
19.1	2	6 9 11 11	(2.0-2.2') gray-brown SILT w/ clay, moist (ML) (2.2-4.0') med brn-orng f silty SAND w/faint bedding fabric (SM)	0.4 ppm			rec 2.0/2.0
18.1	3						
17.1	4	6 11 10 10	f silty SAND as above w/iron staining (SM)	0.2 ppm			rec 2.0/2.0 moist
16.1	5						
15.1	6	12 12 14 13	(6.0-6.7') brn-orng f silty SAND w/color gradation to med gray-brn mottled Fe stained partings @ 7.5-7.6. (SM) sharp contact	4.0 ppm			rec 2.0/2.0
14.1	7						
13.1	8	5 5 10 13	(7.7-8.0') dk red-brn, f-med, poorly sorted SAND (SW) (8.0-8.3') dk brn-orng, f-med SAND (SW) (8.3-9.1') gray-brn f silty SAND, thin bedded (SM)	0.6 ppm			rec 2.0/2.0 moist
12.1	9						
11.1	10		(9.1-10.0') dk gray, poorly sorted				

DRILLING LOG

HOLE NO. MW23

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 2
OF 3 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		5 10 14 10	f-med SAND w/ rnd gravel to 1" dia. (SW) As above w/some blk (organic) partings, crs sub-rnd gravel to 1" dia. (SW)	42 ppm			rec 2.0/2.0 moist-wet petroleum odor
10.1	11						
9.1	12	15 18 21 17	(12.0-12.3') As above (SW) sharp contact (12.3-14.0') crs, sub-rnd-rnd GRAVEL w/ tr-ltl med-crs sand (GW)	28 ppm			rec 2.0/2.0 dry-moist petroleum odor detected
8.1	13						
7.1	14	7 20 23 20	fine-crs, rnd/sub-rnd, poorly sorted GRAVEL w/ brn, f-crs sand (GW)	30 ppm			rec 2.0/2.0 dry (drained)
6.1	15						
5.1	16	15 17 15 14	mod brn-ylw, poorly sorted, f-crs SAND w/ ltl-some, sub-rnd, f gravel (SW)	76 ppm			rec 2.0/2.0 moist (well drained) petroleum odor
4.1	17						
3.1	18	8 11 9 17	(18.0-18.2') As above (SW) (18.2-18.9') poorly sorted, f-crs, sub-rnd GRAVEL w/ ltl-some f-crs sand (GW) (18.9-19.6') mod gray, med SAND w/ f-crs gravel (SP) (19.6-19.9') dk red-brn, f-med SAND (SW)	132 ppm		DPSOS MW-23 (18-20)	rec 1.6/2.0 wet-saturated
2.1	19						
1.1	20	15 36 16 13	poorly sorted, f-crs, sub-rnd GRAVEL to 2" dia., Fe stained zonation at approx. 20.7-21.0 (GW)	140 ppm		DPSOS MW-23 (20-22)	rec 1.8/2.0 saturated sheen on gravel surfaces
0.1	21						
-0.9	22	10 41 45 75	(22.0-22.5') crs SAND w/ f gravel (SP) sharp contact (22.5-24.0) poorly sorted, f-crs GRAVEL to > 2" dia., w/ med-crs sand (GW)	144 ppm			rec 2.0/2.0 saturated
-1.9	23						
-2.9	24	31 38 41 54	poorly sorted GRAVEL as above, w/ black staining (petroleum) at 25.1-26' bgs (GW)	142 ppm		DPSOS MW-23 (24-26)	LEL=100% in HSA rec 2.0/2.0 saturated strong petroleum odor
-3.9	25						
-4.9	26						advanced augers to 30 feet to facilitate well installation
-5.9	27						
-6.9	28						

DRILLING LOG

HOLE NO.	MW23
PROJECT	Defense Personnel Support Center Philadelphia, Pennsylvania
INSPECTOR	John Hilton
SHEET 3	OF 3 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
-7.9	29						
-8.9	30		End of Boring				
-9.9	31						
-10.9	32						
-11.9	33						
-12.9	34						
-13.9	35						
-14.9	36						
-15.9	37						
-16.9	38						
-17.9	39						
-18.9	40						
-19.9	41						
-20.9	42						
-21.9	43						
-22.9	44						
-23.9	45						
-24.9	46						

DRILLING LOG

HOLE NO. MW24

SHEET 1 OF 3 SHEETS

1. COMPANY NAME Malcolm Pirnie, Inc.

2. DRILLING CONTRACTOR SJB Services, Inc.

3. PROJECT Defense Personnel Support Center

4. LOCATION Philadelphia, Pennsylvania

5. NAME OF DRILLER T. Miller

6. MANUFACTURER'S DESIGNATION OF DRILL CME-85

7. Sizes & Types of Drilling & Sampling Equipment
6 1/4" HSA
3" continuous s.s.

8. HOLE LOCATION 222832.2 North 2718764.9 East

9. SURFACE ELEVATION 21.2'

10. DATE STARTED 6/13/96

11. DATE COMPLETED 6/13/96

12. OVERBURDEN THICKNESS

15. DEPTH GROUNDWATER ENCOUNTERED 18.8 feet bgs

13. DEPTH DRILLED INTO ROCK

16. Depth to Water and Elapsed Time After Drilling Completed 18.6 feet bgs; 6/20/96

14. TOTAL DEPTH OF HOLE 30.0

17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY) 18.56 feet below mp; 6/28/96

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/A			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %
(16-18),(18-20),(20-22)			HFS	IR SCAN		

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
		X		

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
21.2 20.2	0 1	- - 3 4	l. gray SILT w/Fe stained mottling, moist (ML)	0.2 ppm			Augered through asphalt and concrete prior to starting sampling rec 0.9/1.0
19.2 18.2	2 3	7 9 10 10	l. gray-brn SILT, Fe stained (oxidation) as mottling, tr-ltl f sand throughout silt matrix (ML)	0.2 ppm			rec 2.0/2.0 moist
17.2 16.2	4 5	3 8 8 9	(4.0-5.6') As above, oxidation staining and mottling decreasing with depth (ML)	0.2 ppm			rec 1.6/2.0 moist
15.2 14.2	6 7	4 18 25 28	(6.0-6.2') orng-brn sandy SILT (ML) (6.2-6.7') dk orng-brn, f-med SAND, heavily stained w/ FeO precipitate (SW) (6.7-7.9) poorly sorted, f-crs, sub-rnd GRAVEL w/ f-crs sand (GW)	0.0 ppm			rec 1.9/2.0
13.2 12.2	8 9	5 10 14 25	poorly sorted, 2-3" dia., sub-rnd GRAVEL w/ f-crs sand as above, occasional med-crs sand partings <2" thick (GW)	1.2 ppm			rec 2.0/2.0 moist
11.2	10						

DRILLING LOG

PROJECT Defense Personnel Support Center Philadelphia, Pennsylvania	INSPECTOR John Hilton	HOLE NO. MW24 SHEET 2 OF 3 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		- - - -		-			rec 2.0/2.0
10.2	11						
9.2	12	20 30 30 26	As above w/ dk brn-orng f-crs sand throughout (GW)	1.4 ppm			rec 2.0/2.0
8.2	13						
7.2	14	9 10 11 14	mod brn/orng, f-med SAND, w/ tr-ltl silt, heavy Fe oxidation @ 14.0-14.3' interval, faint bedding fabric, micaceous (SW)	22 ppm			rec 2.0/2.0 moist
6.2	15						
5.2	16	14 17 22 25	orng-brn, loose, f-crs SAND, w/ ltl f-crs gravel interbeds < 0.3' thick; preferential Fe oxidation along sand bedding fabric, gravel to 2" dia. (SW)	162 ppm		DPSOS MW-24 (16-18)	rec 2.0/2.0 dry-moist
4.2	17						
3.2	18 ▽	5 6 20 25	(18.0-19.2') orng-brn, f-med SAND, tr silt, faint bedding fabric (SW)	160 ppm		DPSOS MW-24 (18-20)	rec 1.9/2.0 wet-saturated
2.2	19						
1.2	20	12 20 47 28	(19.2-19.9') poorly sorted, f-crs, sub-rnd GRAVEL w/ some med-crs sand (GW) As above w/ blk-gray product staining at approx. 20.0 - 20.7' w/ cobbles to > 3" dia. (GW)	> 150 ppm		DPSOS MW-24 (20-22)	rec 1.8/2.0 saturated visible free product
0.2	21						
-0.8	22	20 33 22 32	poorly sorted, f-crs, sub-rnd GRAVEL w/ cobbles to > 3" dia, some med-crs sand w/ black product staining approx 22-23' (GW)	> 150 ppm			rec 1.7/2.0 saturated 10% LEL in HSA 18% Oxygen in HSA
-1.8	23						
-2.8	24	2 5 9 13	As above w/ ltl f-med sand partings < 2" thick (GW)	160 ppm			rec 1.1/2.0 saturated
-3.8	25						
-4.8	26						
-5.8	27						
-6.8	28						

MALCOLM PIRNIE

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

HOLE NO. MW24

DRILLING LOG

HOLE NO. MW24

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 3
OF 3 **SHEETS**

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
-7.8	29						
-8.8	30		End of Boring				
-9.8	31						
-10.8	32						
-11.8	33						
-12.8	34						
-13.8	35						
-14.8	36						
-15.8	37						
-16.8	38						
-17.8	39						
-18.8	40						
-19.8	41						
-20.8	42						
-21.8	43						
-22.8	44						
-23.8	45						
-24.8	46						

DRILLING LOG

1. COMPANY NAME Malcolm Pirnie, Inc.	2. DRILLING CONTRACTOR SJB Services, Inc.	HOLE NO. MW25 SHEET 1 OF 3 SHEETS

3. PROJECT Defense Personnel Support Center	4. LOCATION Philadelphia, Pennsylvania
5. NAME OF DRILLER T. Miller	6. MANUFACTURER'S DESIGNATION OF DRILL CME-85
7. Sizes & Types of Drilling & Sampling Equipment 6 1/4" HSA 3" continuous s.s.	8. HOLE LOCATION 221963.3 North 2719104.4 East 9. SURFACE ELEVATION 20.8' 10. DATE STARTED 6/12/96 11. DATE COMPLETED 6/12/96
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED 18.5 feet bgs
13. DEPTH DRILLED INTO ROCK	16. Depth to Water and Elapsed Time After Drilling Completed 17.78 feet bgs to LNAPL; 6/20/96
14. TOTAL DEPTH OF HOLE 30.0	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY) 18.02 feet below mp to LNAPL; 6/28/96

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
N/A			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (Specify)	OTHER (Specify)	OTHER (Specify)	21. Total Core REC %
(18-20),(20-22),(24-26)			HFS	IR SCAN		

22. DISPOSITION OF HOLE	BACKFILLED	Monitoring Well	OTHER (Specify)	23. SIGNATURE OF INSPECTOR
		X		

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
20.8	0	6 9	(0.0-0.5') med orang/brn silty SAND, tr f sand (FILL)				rec 1.7/2.0 dry
19.8	1	8 9	(0.5-1.7') crs, sub-rnd slag to 1" dia w/ tr-ltl blk silt as matrix infill (FILL)	0.2 ppm			
18.8	2	15 30	Ash, blk silt and f sand, loose w/ tr-ltl coal clinker, fire brick (FILL)				rec 1.9/2.0 dry
17.8	3	13 13		0.2 ppm			
16.8	4	8 12	(4.0-4.6') As above w/ crs slag gravel to 1 " dia (FILL) sharp contact				rec 1.8/2.0 dry
15.8	5	13 10	(4.6-5.0') med brn, f SAND, ltl f gravel (SP) (5.0-5.8') lt tan SILT w/ tr-ltl f sand, tr gravel (ML)	0.4 ppm			moist
14.8	6	12 15	lt tan SILT as above w/ faint thin bedding fabric w/ tr f-med sand partings to .25" thick, cohesive (ML)				rec 2.0/2.0 moist
13.8	7	18 13		0.0 ppm			
12.8	8	5 15	(8.0-8.4') As above (ML) grading into				rec 1.9/2.0 moist
11.8	9	28 28	(8.4-9.0') mod-dk brn, f-crs SAND, w/ ltl f sub-rnd gravel to 0.5" dia (SW) (9.0-9.9') f-crs, sub-rnd GRAVEL w/ cobbles to 3" dia, some crs sand	4.8 ppm			
10.8	10						

DRILLING LOG

HOLE NO. MW25

PROJECT Defense Personnel Support Center
Philadelphia, Pennsylvania

INSPECTOR John Hilton

SHEET 2
OF 3 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
		9 23 40 40	(GW) As above, w/ f-crs sand (GW) Boulder/Cobbles @ approx 9.5 - 10' bgs	14.2 ppm			rec 0.9/2.0 moist
9.8	11						
8.8	12	19 9 8 9	(12.0-12.5') As above (GW) sharp contact (12.5-13.7') med-brn/red, poorly sorted, f-med, loose SAND w/ tr silt (SW)	38 ppm			rec 1.7/2.0 25 ppm in HSA 18% LEL in HSA moist
7.8	13						
6.8	14	14 9 8 16	(14.0-15.2') lt brn-gray, f-med, loose SAND w/ color change to brn-orng @ 14.6'(SW)	32 ppm			rec 1.6/2.0 moist
5.8	15		(15.2-15.6') poorly sorted, f-crs, sub-rnd GRAVEL w/ red-gray silt (GW)				
4.8	16	15 18 20 19	poorly sorted, f-crs, 2-3" dia., sub-rnd/rnd, loose GRAVEL w/ some f-crs sand (GW)	100 ppm			rec 2.0/2.0 moist-wet significant petroleum odor
3.8	17						
2.8	18	27 22 36 41	As above (GW)	100 ppm		DPSOS MW-25 (18-20)	rec 1.4/2.0 saturated visible LNAPL product on spoon and gravel surfaces
1.8	19						
0.8	20	31 12 12 10	(20.0-20.8') dk red-brn, f-crs, poorly sorted GRAVEL w/ silt and f sand (GW) sharp contact (20.8-21.8') dk gray-brn, f-crs, loose SAND, gradational downward to crs sand (SW)	110 ppm		DPSOS MW-25 (20-22)	rec 1.8/2.0 saturated visible, saturated product
-0.2	21						
-1.2	22	3 7 20 12	(22.0-22.4) dk gray-brn, med-crs, loose SAND (SW) sharp contact (22.4-23.5) poorly sorted, f-crs GRAVEL w/ cobbles > 3" dia, some med-crs sand (GW)	110 ppm			rec 1.5/2.0 saturated brown liquid product
-2.2	23						
-3.2	24	5 5 8 12	(24.0-24.8) As above (GW) sharp contact (24.8-25.7') med gray-brn, f-crs SAND, fining upward sequence (SW)	130 ppm		DPSOS MW-25 (24-26)	rec 1.8/2.0 saturated product sheen on sand and gravel surfaces
-4.2	25						
-5.2	26	4 5 15 16	(25.7-25.8') SAND w/ 2" dia gravel (SW) (26.0-27.0') med dk gray, f-med SAND(SW) (27.0-27.2') poorly sorted GRAVEL w/ med-crs sand (GW) (27.2-28.0) dk gry-blk, med-crs	100 ppm			rec 1.7/2.0 saturated free product within spoon
-6.2	27						
-7.2	28						

DRILLING LOG

PROJECT Defense Personnel Support Center Philadelphia, Pennsylvania	INSPECTOR John Hilton	HOLE NO. MW25 SHEET 3 OF 3 SHEETS

ELEV. a	DEPTH b	Blow Counts c	DESCRIPTION OF MATERIALS d	Field Screening Results e	Geotech Sample or Core Box No. f	Analytical Sample No. g	REMARKS h
			SAND w/ f gravel (SW)				
-8.2	29						
-9.2	30		End of Boring				
-10.2	31						
-11.2	32						
-12.2	33						
-13.2	34						
-14.2	35						
-15.2	36						
-16.2	37						
-17.2	38						
-18.2	39						
-19.2	40						
-20.2	41						
-21.2	42						
-22.2	43						
-23.2	44						
-24.2	45						
-25.2	46						

Appendix C
Monitoring Well Development Logs

Monitoring Well Development Log

Well No. MW-23

PROJECT NAME: Defense Personnel Support Center
PROJECT LOCATION: Philadelphia, Pennsylvania
PROJECT NUMBER: 0285-643
DATE: 6/27-28/1996
SAMPLER(S): DCL/JPH

A Total Casing and Screen Length (ft.) 25.55

B Casing Internal Diameter (in.) 4

C Water Level Below Top of Casing (ft.) 18.42

D Volume of Water in Casing (gal.) 4.7

$0.0408 (B)^2 x (A - C) = D$
$0.0408 (4)^2 x (25.55 - 18.42) = 4.7$ gal.

E Volume of Water in Annulus (porosity = 30 %) 8.2
$[(0.0408 (10.5)^2 - 0.66) x 0.30 x (25.70 - 18.49)=$

F Borehole Volume = Annulur Vol. + Casing Vol. = 12.9

Well I.D.	Vol. Gal./Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

PARAMETER	CUMULATIVE VOLUME PURGED										
Gallons	0	9	18								
Time	16:00	17:00	10:05								
Conductivity (mohm/cm)	0.776	0.789	0.829								
Dissolved Oxygen (ppm)	-	-	-								
Eh (mV)	-	-	-								
pH (S.U.s)	6.91	6.96	6.91								
Temp. (°C)	19.8	19.2	19.1								
Turbidity (NTUs)	>100	>100	>100								
Surge Block Used After Sample		X									
Petroleum Odor	X	X	X								
Petroleum Sheen	X	X	X								

COMMENTS:
Thick, silt-mud as initial purge, very slow recharge
Surge block 6/28 after well recharge to 18.44 '
Well recharge slow-moderate, total of 22 gallons purged as of 6/28

Monitoring Well Development Log

Well No. MW-24

PROJECT NAME:	Defense Personnel Support Center
PROJECT LOCATION:	Philadelphia, Pennsylvania
PROJECT NUMBER:	0285-643
DATE:	06/28/96
SAMPLER(S):	DCL/JPH

A Total Casing and Screen Length (ft.) 25.70

B Casing Internal Diameter (in.) 4

C Water Level Below Top of Casing (ft.) 18.49

D Volume of Water in Casing (gal.) 4.7

Well I.D.	Vol. Gal./Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

0.0408 $(B)^2$ x (A - C) = D
0.0408 $(4)^2$ x (25.7-18.49) = 4.7 gal.

E. Volume of Water in Annulus (porosity = 30 %) 8.3
[(0.0408 $(10.5)^2$ - 0.66) x 0.30 x (25.70 - 18.49)=

F Borehole Volume = Annulur Vol. + Casing Vol. = 13.0

PARAMETER	CUMULATIVE VOLUME PURGED										
Gallons	0	10	20	30	40	50					
Time	13:20	13:28	14:22	14:35	15:15	15:23					
Conductivity (mohm/cm)	0.936	0.923	0.988	0.987	0.979	0.963					
Dissolved Oxygen (ppm)	-	-	-	-	-	-					
Eh (mV)	-	-	-	-	-	-					
pH (S.U.s)	6.88	6.61	6.85	6.89	6.83	6.71					
Temp. (°C)	20.4	20.5	19.1	19.0	18.9	18.8					
Turbidity (NTUs)	>100	>100	>100	>100	>100	>100					
Surge Block Used After Sample		X		X							
Petroleum Odor	X	X	X	X	X	X					
Petroleum Sheen	X	X	X	X	X	X					

COMMENTS:

Prior to Development	LNAPL level = 18.49 ft below mp; Water = 18.51 below mp (top of PVC riser)
Following Development	Water level = 19.2 ft below mp; Bottom depth = 25.8 ft below mp
	Slight increase in petroleum product on purge water during development process

Monitoring Well Development Log

Well No. MW-25

PROJECT NAME: Defense Personnel Support Center
PROJECT LOCATION: Philadelphia, Pennsylvania
PROJECT NUMBER: 0285-643
DATE: 06/21/96
SAMPLER(S): DCL/JPH

A Total Casing and Screen Length (ft.) 25.35

B Casing Internal Diameter (in.) 6

C Water Level Below Top of Casing (ft.) 18.87

D Volume of Water in Casing (gal.) 9.5

Well I.D.	Vol. Gal./Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

0.0408 (B)^2 x (A - C) = D
0.0408 (6)^2 x (25.35 - 18.87) = 9.5 gal.

E Volume of Water in Annulus (porosity = 30 %) 8.5
[(0.0408 (12)^2 - 1.5) x 0.30 x (25.35 - 18.87)=

F Borehole Volume = Annulur Vol. + Casing Vol. = 18.0

PARAMETER	CUMULATIVE VOLUME PURGED										
Gallons											
Time											
Conductivity (mohm/cm)											
Dissolved Oxygen (ppm)											
Eh (mV)											
pH (S.U.s)											
Temp. (°C)											
Turbidity (NTUs)											
Surge Block Used After Sample											
Petroleum Odor											
Petroleum Sheen											

COMMENTS: Approximately 30 gallons of liquid removed
Approximately 20-25 gallons of NAPL
Development discontiued to avoid removal of excess NAPL

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Monitoring Well Development Log

Well No. CSX-MW3

PROJECT NAME: Defense Personnel Support Center
PROJECT LOCATION: Philadelphia, Pennsylvania
PROJECT NUMBER: 0285-643
DATE: 06/26/96
SAMPLER(S): DCL/JPH

A Total Casing and Screen Length (ft.) 51.60

B Casing Internal Diameter (in.) 2

C Water Level Below Top of Casing (ft.) 45.74

D Volume of Water in Casing (gal.) 1.0

0.0408 (B)² x (A - C) = D

0.0408 (2)² x (51.60 - 45.74) = 1.0 gal.

E Volume of Water in Annulus (porosity = 30 %) 4.9
[(0.0408 (8.5)² - 0.17) x 0.30 x (51.60 - 45.74)=

F Borehole Volume = Annulur Vol. + Casing Vol. = 5.8

Well I.D.	Vol. Gal./Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

PARAMETER	CUMULATIVE VOLUME PURGED										
Gallons	0	5	10	15	20	25	30				
Time	13:40	13:50	14:25	14:45	15:40	15:50	16:05				
Conductivity (mohm/cm)	1.406	1.422	1.291	1.292	1.243	1.253	1.244				
Dissolved Oxygen (ppm)	-	-	-	-	-	-	-				
Eh (mV)	-	-	-	-	-	-	-				
pH (S.U.s)	6.65	6.63	6.65	6.63	6.64	6.76	6.72				
Temp. (°C)	18.7	18.5	19.1	18.8	18.1	18.1	17.9				
Turbidity (NTUs)	>100	>100	>100	>100	>100	>100	>100				
Surge Block Used After Sample		X		X							
Petroleum Odor	X	X	X	X	X	X	X				
Petroleum Sheen	X	X	X	X	X	X	X				

COMMENTS:
Following Development Water level = 45.75 ft below mp; Bottom depth = 51.93 ft below mp

Monitoring Well Development Log

Well No. CSX-MW4

PROJECT NAME: Defense Personnel Support Center
PROJECT LOCATION: Philadelphia, Pennsylvania
PROJECT NUMBER: 0285-643
DATE: 06/26/96
SAMPLER(S): DCL/JPH

A Total Casing and Screen Length (ft.) 52.45

B Casing Internal Diameter (in.) 2

C Water Level Below Top of Casing (ft.) 45.33

D Volume of Water in Casing (gal.) 1.2

Well I.D.	Vol. Gal./Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

$0.0408 (B)^2 x (A - C) = D$

$0.0408 (2)^2 x (52.45 - 45.33) = 1.2$ gal.

E Volume of Water in Annulus (porosity = 30 %) 5.9
$[(0.0408 (8.5)^2 - 0.17) x 0.30 x (52.45 - 45.33)=$

F Borehole Volume = Annulur Vol. + Casing Vol. = 7.1

PARAMETER	CUMULATIVE VOLUME PURGED										
Gallons	0	5	10	15	20	25	30				
Time	16:40	16:50	17:20	17:35	18:10	18:25	18:33				
Conductivity (mohm/cm)	1.068	1.268	1.277	1.283	1.263	1.301	1.298				
Dissolved Oxygen (ppm)	-	-	-	-	-	-	-				
Eh (mV)	-	-	-	-	-	-	-				
pH (S.U.s)	6.87	6.72	6.75	6.72	6.76	6.70	6.66				
Temp. (°C)	19.2	18.8	19.0	18.7	18.4	18.2	18.1				
Turbidity (NTUs)	>100	>100	>100	>100	>100	>100	>100				
Surge Block Used After Sample		X		X							
Petroleum Odor	X	X	X	X	X	X	X				
Petroleum Sheen	X	X	X	X	X	X	X				

COMMENTS:
Following Development Water level = 45.4 ft below mp; Bottom depth = 52.6 ft below mp
Flammable vapors (100% LEL) at top of riser prior to, during, and subsequent to development
PID reading at top of PVC - 30-40 ppm; probe satuarted

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Monitoring Well Development Log

Well No. CSX-MW5

PROJECT NAME: Defense Personnel Support Center
PROJECT LOCATION: Philadelphia, Pennsylvania
PROJECT NUMBER: 0285-643
DATE: 06/27/96
SAMPLER(S): DCL/JPH

A Total Casing and Screen Length (ft.) 52.95

B Casing Internal Diameter (in.) 2

C Water Level Below Top of Casing (ft.) 44.87

D Volume of Water in Casing (gal.) 1.3

$0.0408 (B)^2 x (A - C) = D$

$0.0408 (2)^2 x (52.95 - 44.87) = 1.3$ gal.

E Volume of Water in Annulus (porosity = 30 %) 6.7
$[(0.0408 (8.5)^2 - 0.17) x 0.30 x (52.95 - 44.87)=$

F Borehole Volume = Annulur Vol. + Casing Vol. = 8.1

Well I.D.	Vol. Gal./Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

PARAMETER	CUMULATIVE VOLUME PURGED										
Gallons	0	5	10	15	20	25	30				
Time	09:05	09:15	09:50	10:05	11:00	11:15	11:25				
Conductivity (mohm/cm)	1.206	1.224	1.157	1.234	1.251	1.265	1.269				
Dissolved Oxygen (ppm)	-	-	-	-	-	-	-				
Eh (mV)	-	-	-	-	-	-	-				
pH (S.U.s)	7.08	7.11	7.08	7.16	7.02	6.96	7.05				
Temp. (°C)	18.4	16.9	16.9	17.8	18.2	18.2	17.8				
Turbidity (NTUs)	>100	>100	>100	>100	>100	>100	>100				
Surge Block Used After Sample		X		X							
Petroleum Odor	X	X	X	X	X	X	X				
Petroleum Sheen	X	X	X	X	X	X	X				

COMMENTS:

Following Development — Water level = 46.8 ft below mp; Bottom depth = 53.5 ft below mp
Petroleum sheen on purge water diminished during development process

Monitoring Well Development Log

Well No. CSX-MW6

PROJECT NAME: Defense Personnel Support Center
PROJECT LOCATION: Philadelphia, Pennsylvania
PROJECT NUMBER: 0285-643
DATE: 06/26/96
SAMPLER(S): DCL/JPH

A Total Casing and Screen Length (ft.) 51.50

B Casing Internal Diameter (in.) 2

C Water Level Below Top of Casing (ft.) 44.31

D Volume of Water in Casing (gal.) 1.2

Well I.D.	Vol. Gal./Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

$0.0408 (B)^2 x (A - C) = D$

$0.0408 (2)^2 x (51.5 - 44.31) = 1.2$ gal.

E Volume of Water in Annulus (porosity = 30 %) 6.0
$[(0.0408 (8.5)^2 - 0.17) x 0.30 x (51.5 - 44.31)=$

F Borehole Volume = Annulur Vol. + Casing Vol. = 7.2

PARAMETER	CUMULATIVE VOLUME PURGED										
Gallons	0	5	10	15	20	25	30				
Time	09:11	09:28	10:00	10:20	11:20	11:35	11:48				
Conductivity (mohm/cm)	1.344	1.310	1.317	1.312	1.353	1.328	1.335				
Dissolved Oxygen (ppm)	-	-	-	-	-	-	-				
Eh (mV)	-	-	-	-	-	-	-				
pH (S.U.s)	7.24	7.27	7.31	7.23	7.33	7.23	7.27				
Temp. (°C)	18.0	18.2	19.5	17.3	20.8	17.9	18.2				
Turbidity (NTUs)	>100	>100	>100	>100	>100	>100	>100				
Surge Block Used After Sample		X		X							
Petroleum Odor	X	X	X	X	X	X	X				
Petroleum Sheen	X	X	X	X	X	X	X				

COMMENTS:
Following Development Water level = 44.42 ft below mp; Bottom depth = 51.5 ft below mp

Monitoring Well Development Log

Well No. DPSSP-MWS-1

PROJECT NAME: Defense Personnel Support Center
PROJECT LOCATION: Philadelphia, Pennsylvania
PROJECT NUMBER: 0285-643
DATE: 08/29/96
SAMPLER(S): DCL/JPH

A Total Casing and Screen Length (ft.) 29.70

B Casing Internal Diameter (in.) 2

C Water Level Below Top of Casing (ft.) 22.08

D Volume of Water in Casing (gal.) 1.2

Well I.D.	Vol. Gal./Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

0.0408 (B)² x (A - C) = D

0.0408 (2)² x (29.70 - 22.08) = 1.2 gal.

E Volume of Water in Annulus (porosity = 30 %) 5.6
[(0.0408 (8)² - 0.17) x 0.30 x (29.70 - 22.08)=

F Borehole Volume = Annulur Vol. + Casing Vol. = 6.8

PARAMETER	CUMULATIVE VOLUME PURGED										
Gallons	0	5	10	15	20	25	30	35	40	45	50
Time	09:40	09:43	09:47	10:35	10:40	10:55	10:57	11:50	11:52	11:57	12:00
Conductivity (mohm/cm)	0.663	0.625	0.665	0.671	0.673	0.675	0.674	0.718	0.705	0.702	0.685
Dissolved Oxygen (ppm)	-	-	-	-	-	-	-	-	-	-	-
Eh (mV)	-	-	-	-	-	-	-	-	-	-	-
pH (S.U.s)	6.30	6.28	6.27	6.21	6.19	6.20	6.2	6.24	6.18	6.17	6.21
Temp. (°F)	68	65	66	67	66	66	66	70	67	67	67
Turbidity (NTUs)	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100
Surge Block Used After Sample			X		X		X				
Petroleum Odor	X	X	X	X	X	X	X	X	X	X	X
Petroleum Sheen	X	X	X	X	X	X	X	X	X	X	X

COMMENTS:
Following Development Water level = 22.14 ft below mp; Bottom depth = 29.94 ft below mp

Monitoring Well Development Log

Well No. DPSSP-MWS-2

PROJECT NAME: Defense Personnel Support Center
PROJECT LOCATION: Philadelphia, Pennsylvania
PROJECT NUMBER: 0285-643
DATE: 08/28/96
SAMPLER(S): DCL/JPH

A Total Casing and Screen Length (ft.) 25.40

B Casing Internal Diameter (in.) 2

C Water Level Below Top of Casing (ft.) 17.61

D Volume of Water in Casing (gal.) 1.3

Well I.D.	Vol. Gal./Ft
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

$0.0408 (B)^2 x (A - C) = D$

$0.0408 (2)^2 x (25.40 - 17.61) = 1.3$ gal.

E Volume of Water in Annulus (porosity = 30 %) 5.7
$[(0.0408 (8)^2 - 0.17) x 0.30 x (25.40 - 17.61)=$

F Borehole Volume = Annulur Vol. + Casing Vol. = 7.0

PARAMETER	CUMULATIVE VOLUME PURGED										
Gallons	0	5	10	15	20	25	30	35	40	45	50
Time	10:10	10:20	10:35	11:00	11:05	13:00	13:05	13:20	13:22	13:55	14:05
Conductivity (mohm/cm)	0.942	0.906	0.891	0.866	0.873	0.900	0.870	0.856	0.869	0.920	0.890
Dissolved Oxygen (ppm)	-	-	-	-	-	-	-	-	-	-	-
Eh (mV)	-	-	-	-	-	-	-	-	-	-	-
pH (S.U.s)	6.65	6.69	6.38	6.70	6.60	6.53	6.5	6.6	6.48	6.49	6.48
Temp. (°F)	68	68	68	66	66	68	66	65	66	69	68
Turbidity (NTUs)	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100
Surge Block Used After Sample			X		X		X				
Petroleum Odor	X	X	X	X	X	X	X	X	X	X	X
Petroleum Sheen	X	X	X	X	X	X	X	X	X	X	X

COMMENTS:
Following Development Water level = 17.62 ft below mp; Bottom depth = 27.4 ft below mp

Monitoring Well Development Log

Well No. DPSSP-MWS-3

PROJECT NAME: Defense Personnel Support Center
PROJECT LOCATION: Philadelphia, Pennsylvania
PROJECT NUMBER: 0285-643
DATE: 08/28/96
SAMPLER(S): DCL/JPH

A Total Casing and Screen Length (ft.) 20.70

B Casing Internal Diameter (in.) 2

C Water Level Below Top of Casing (ft.) 13.08

D Volume of Water in Casing (gal.) 1.2

Well I.D.	Vol. Gal./Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

$0.0408 (B)^2 x (A - C) = D$

$0.0408 (2)^2 x (20.70 - 13.08) = 1.2$ gal.

E Volume of Water in Annulus (porosity = 30 %) 5.6
$[(0.0408 (8)^2 - 0.17) x 0.30 x (20.70 - 13.08)=$

F Borehole Volume = Annulur Vol. + Casing Vol. = 6.8

PARAMETER	CUMULATIVE VOLUME PURGED										
Gallons	0	5	10	15	20	25	30	35	40	45	50
Time	14:40	14:45	14:50	15:45	15:50	16:00	16:05	16:40	16:43	16:46	16:50
Conductivity (mohm/cm)	0.833	0.740	0.746	0.739	0.754	0.710	0.753	0.736	0.707	0.704	0.710
Dissolved Oxygen (ppm)	-	-	-	-	-	-	-	-	-	-	-
Eh (mV)	-	-	-	-	-	-	-	-	-	-	-
pH (S.U.s)	6.44	6.47	6.52	6.53	6.42	6.45	6.36	6.47	6.41	6.46	6.48
Temp. (°F)	74	70	66	66	66	65	65	68	66	66	66
Turbidity (NTUs)	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100
Surge Block Used After Sample			X		X		X				
Petroleum Odor	X	X	X	X	X	X	X	X	X	X	X
Petroleum Sheen	X	X	X	X	X	X	X	X	X	X	X

COMMENTS:
Following Development Water level = 13.35 ft below mp; Bottom depth = 21.57 ft below mp

Monitoring Well Development Log

Well No. DPSSP-MWS-4

PROJECT NAME: Defense Personnel Support Center
PROJECT LOCATION: Philadelphia, Pennsylvania
PROJECT NUMBER: 0285-643
DATE: 8/28-29/1996
SAMPLER(S): DCL/JPH

A Total Casing and Screen Length (ft.) 23.00

B Casing Internal Diameter (in.) 2

C Water Level Below Top of Casing (ft.) 14.60

D Volume of Water in Casing (gal.) 1.4

Well I.D.	Vol. Gal./Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

$0.0408 (B)^2 x (A - C) = D$

$0.0408 (2)^2 x (23.00 - 14.60) = 1.4$ gal.

E Volume of Water in Annulus (porosity = 30 %) 6.2
$[(0.0408 (8)^2 - 0.17) x 0.30 x (23.00 - 14.60)=$

F Borehole Volume = Annulur Vol. + Casing Vol. = 7.5

PARAMETER	CUMULATIVE VOLUME PURGED										
						8/29/96					
Gallons	0	5	10	15	20	25	30	35	40	45	50
Time	17:20	17:25	17:30	17:45	17:50	7:55	8:00	8:15	8:20	9:10	9:15
Conductivity (mohm/cm)	0.930	0.815	0.740	0.753	0.720	0.792	0.761	0.717	0.675	0.700	0.740
Dissolved Oxygen (ppm)	-	-	-	-	-	-	-	-	-	-	-
Eh (mV)	-	-	-	-	-	-	-	-	-	-	-
pH (S.U.s)	6.20	6.24	6.31	6.27	6.31	6.21	6.23	6.22	6.24	6.22	6.21
Temp. (°F)	69	68	67	68	66	68	68	67	66	66	67
Turbidity (NTUs)	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100
Surge Block Used After Sample			X		X		X				
Petroleum Odor	X	X	X	X	X	X	X	X	X	X	X
Petroleum Sheen	X	X	X	X	X	X	X	X	X	X	X

COMMENTS:
Following Development Water level = 15.13 ft below mp; Bottom depth = 24.50 ft below mp

F:\P0285643\F\WELLLOGS\DEVMWS4.XLS

Monitoring Well Development Log

Well No. DPSSP-MWS-5

PROJECT NAME: Defense Personnel Support Center
PROJECT LOCATION: Philadelphia, Pennsylvania
PROJECT NUMBER: 0285-643
DATE: 8/29/1996
SAMPLER(S): DCL/JPH

A Total Casing and Screen Length (ft.) 26.80

B Casing Internal Diameter (in.) 2

C Water Level Below Top of Casing (ft.) 11.74

D Volume of Water in Casing (gal.) 2.5

Well I.D.	Vol. Gal./Ft.
1"	0.04
2"	0.17
3"	0.38
4"	0.66
5"	1.04
6"	1.50
8"	2.60

0.0408 (B)^2 x (A - C) = D

0.0408 (2)^2 x (26.80 - 11.74) = 1.4 gal.

E Volume of Water in Annulus (porosity = 30 %) 9.5
[(0.0408 (8)^2 - 0.17) x 0.30 x (13)=

F Borehole Volume = Annulur Vol. + Casing Vol. = 12.0

PARAMETER	CUMULATIVE VOLUME PURGED										
Gallons	0	5	10	20	25	35	45	50	55	60	
Time	13:25	13:27	13:30	13:45	14:10	14:30	15:00	15:15	15:20	15:25	
Conductivity (mohm/cm)	0.692	0.632	0.604	0.612	0.609	0.609	0.610	0.610	0.602	0.595	
Dissolved Oxygen (ppm)	-	-	-	-	-	-	-	-	-	-	
Eh (mV)	-	-	-	-	-	-	-	-	-	-	
pH (S.U.s)	6.67	6.63	6.62	6.60	6.70	6.68	6.71	6.73	6.7	6.69	
Temp. (°F)	70	66	65	68	66	67	66	66	66	65	
Turbidity (NTUs)	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	
Surge Block Used After Sample			X		X		X				
Petroleum Odor	X	X	X	X	X	X	X	X	X	X	
Petroleum Sheen	X	X	X	X	X	X	X	X	X	X	

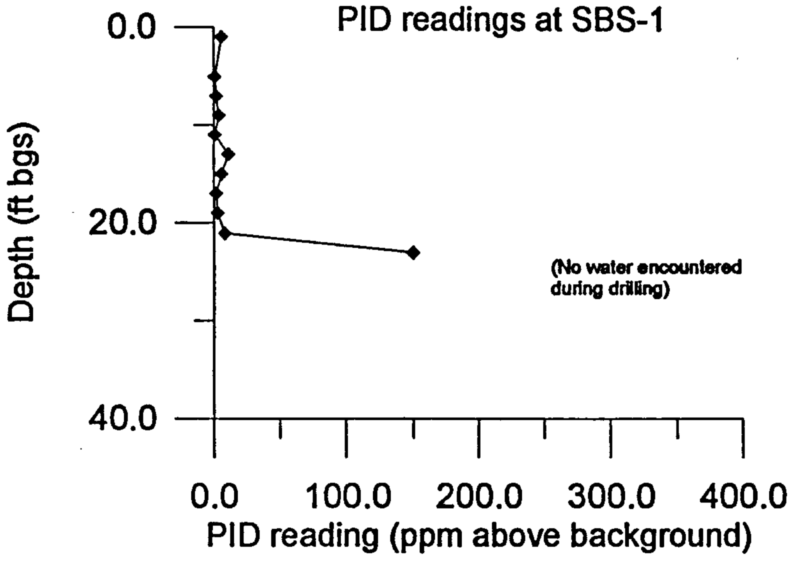
COMMENTS:
Following Development Water level = 12.27 ft below mp; Bottom depth = 27.72 ft below mp

F:\P0285643\F\WELLLOGS\DEVMWS5.XLS

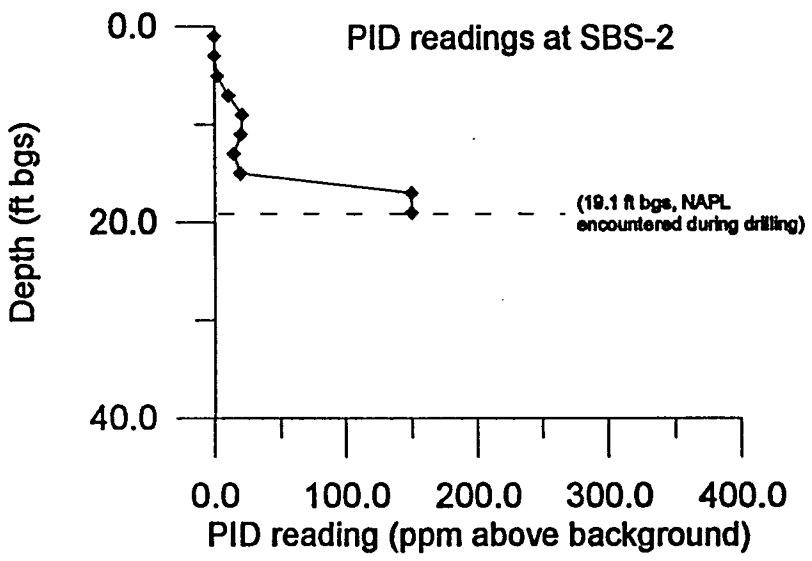
Appendix D
Graphs of PID Measurements Versus Depth

APPENDIX D
NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA

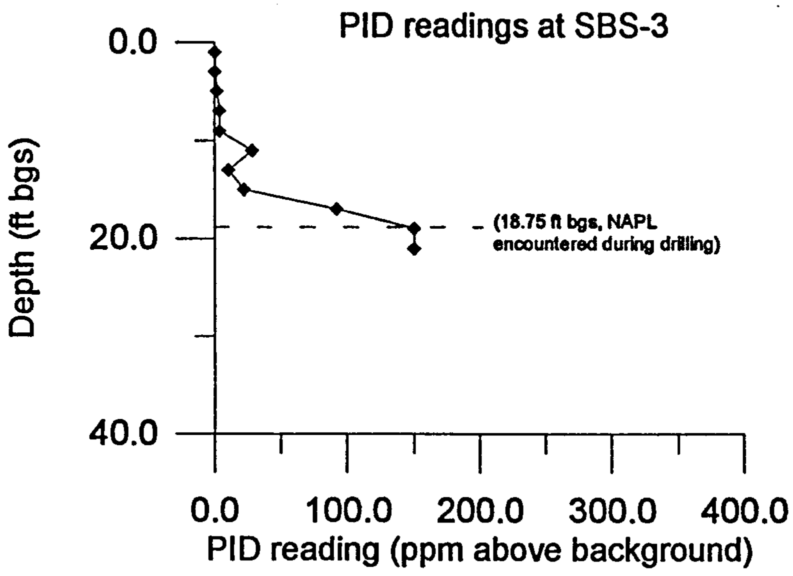
PID READINGS VERSUS DEPTH


PID readings at SBS-1

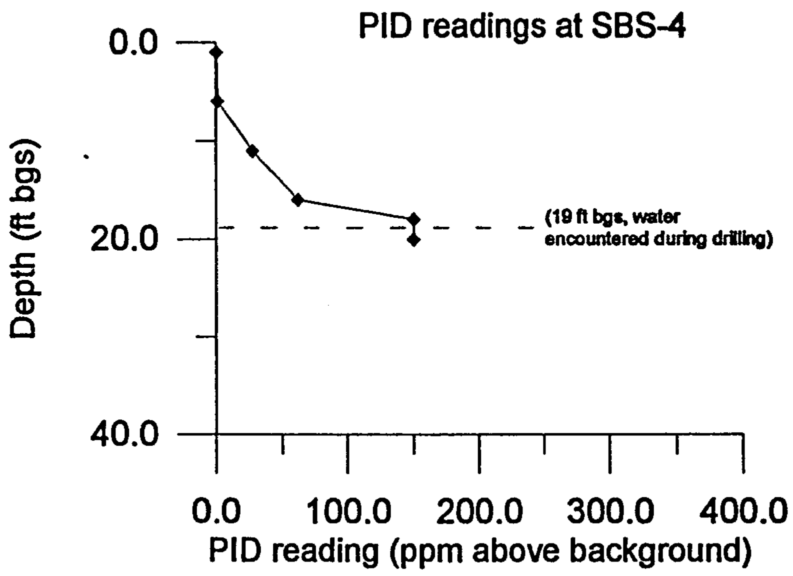
(No water encountered during drilling)


PID readings at SBS-2

(19.1 ft bgs, NAPL encountered during drilling)


PID readings at SBS-3

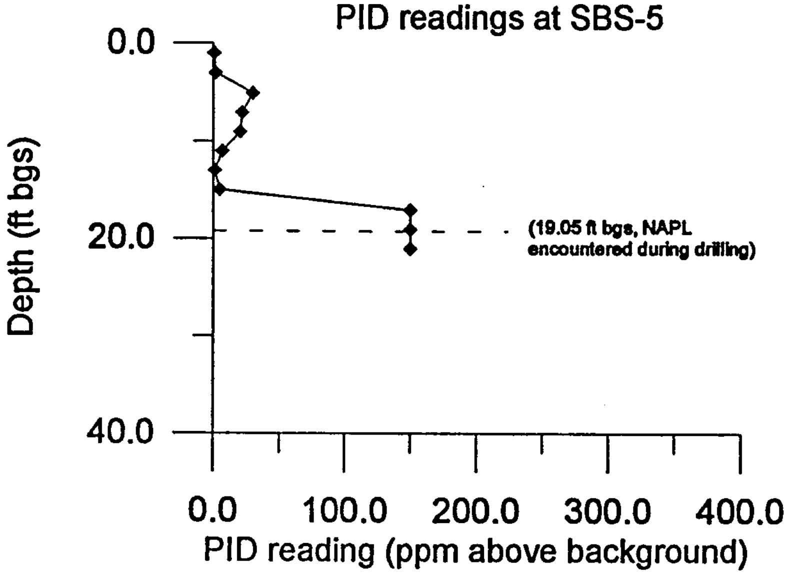
(18.75 ft bgs, NAPL encountered during drilling)


PID readings at SBS-4

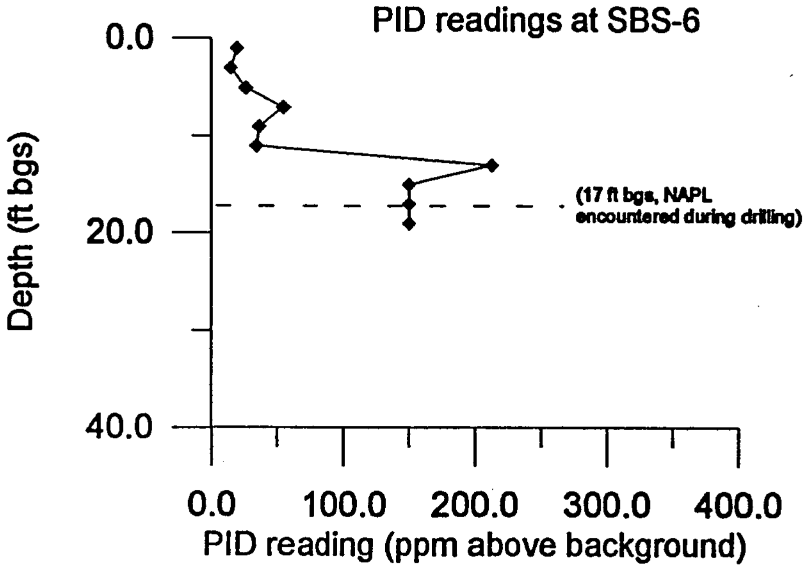
(19 ft bgs, water encountered during drilling)

APPENDIX D
NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA

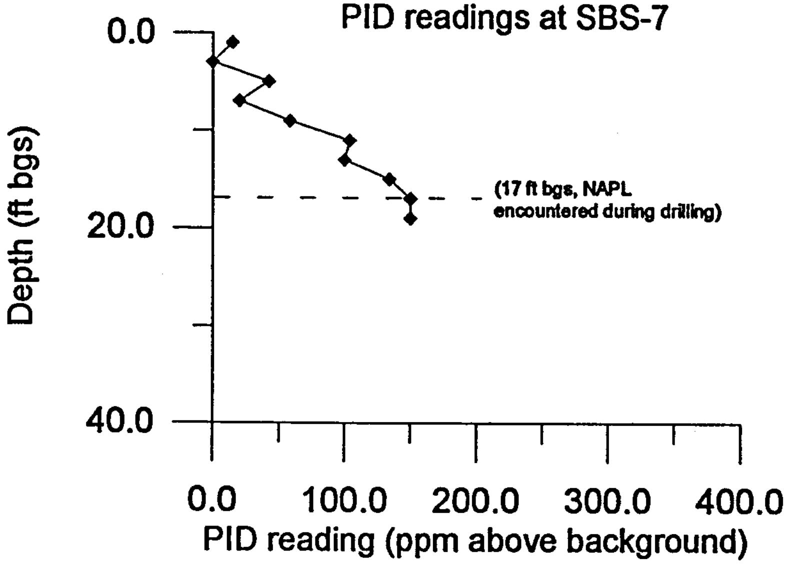
PID READINGS VERSUS DEPTH


PID readings at SBS-5

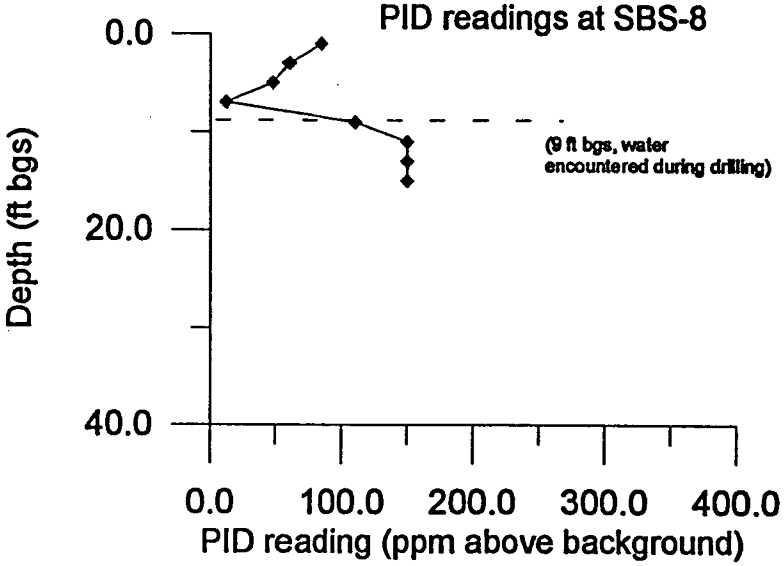
(19.05 ft bgs, NAPL encountered during drilling)


PID readings at SBS-6

(17 ft bgs, NAPL encountered during drilling)


PID readings at SBS-7

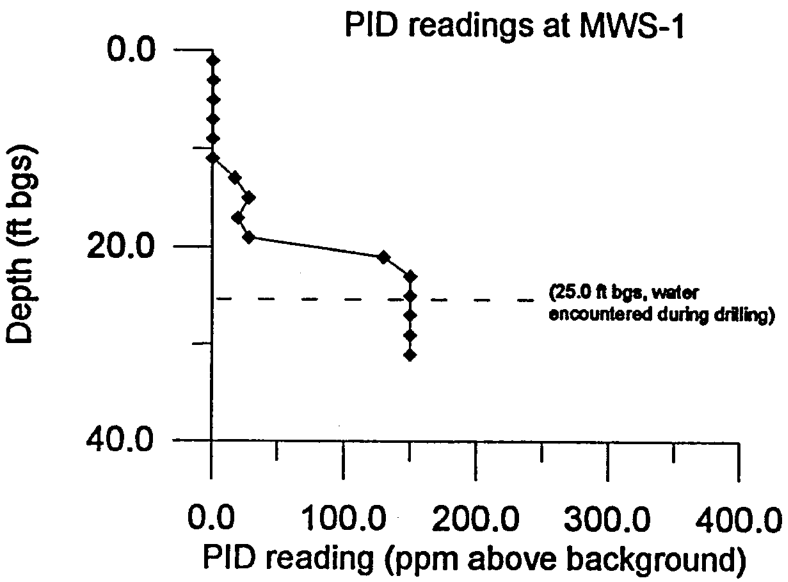
(17 ft bgs, NAPL encountered during drilling)

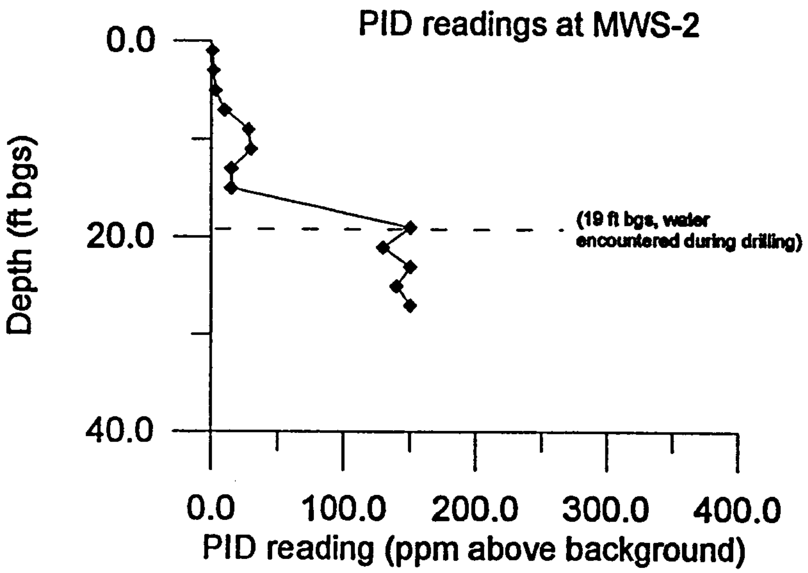

PID readings at SBS-8

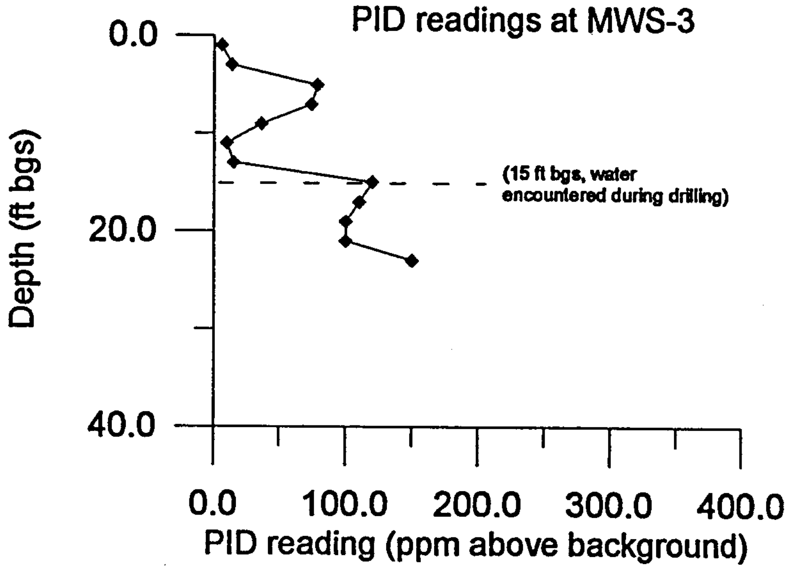
(9 ft bgs, water encountered during drilling)

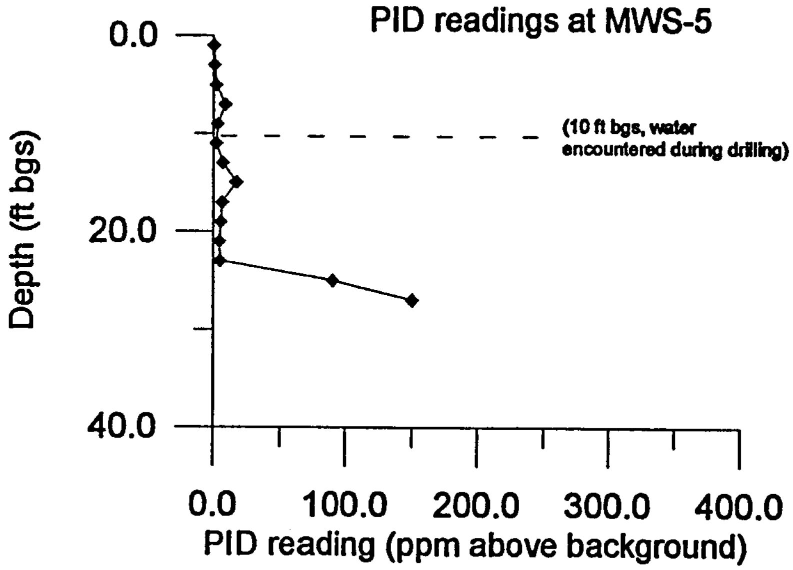
APPENDIX D
NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA

PID READINGS VERSUS DEPTH



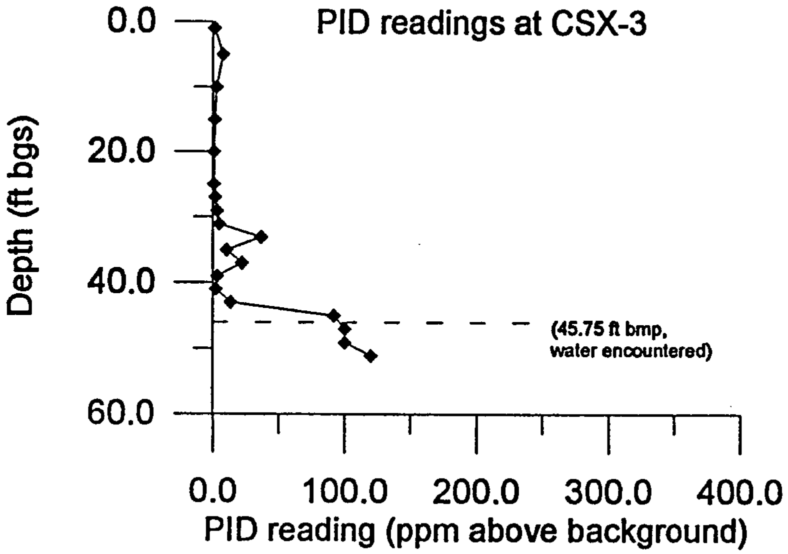


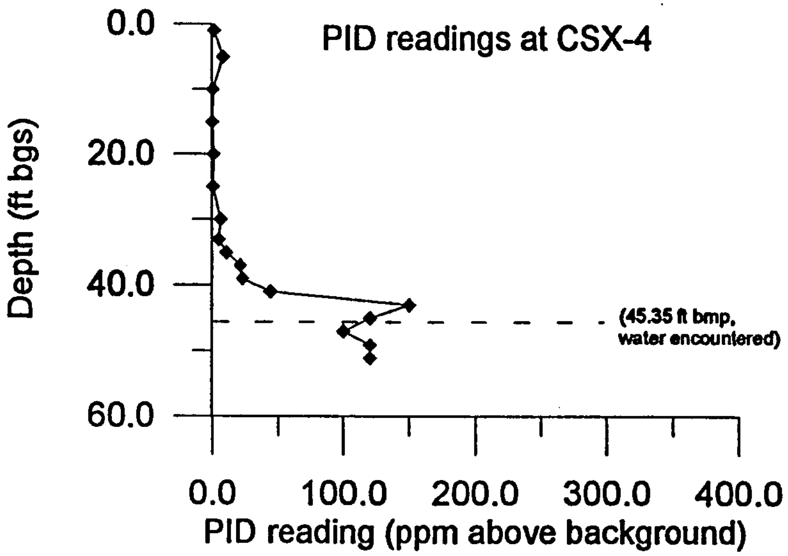


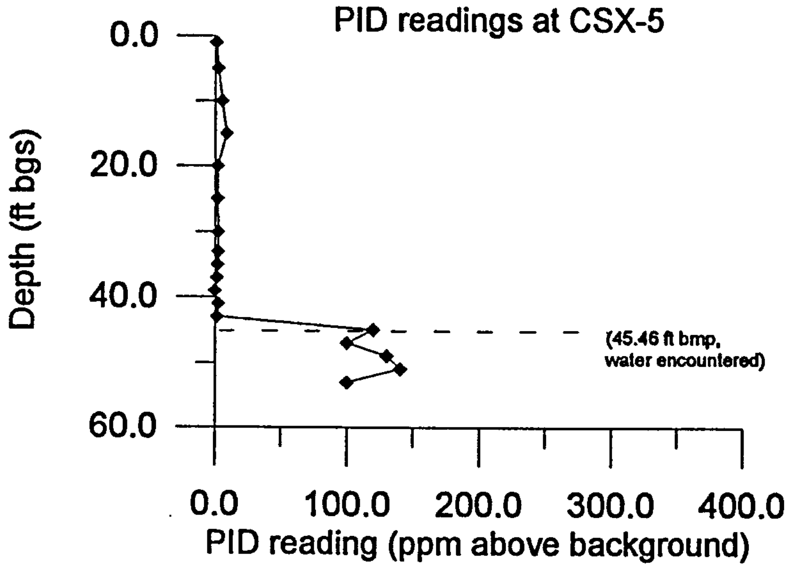


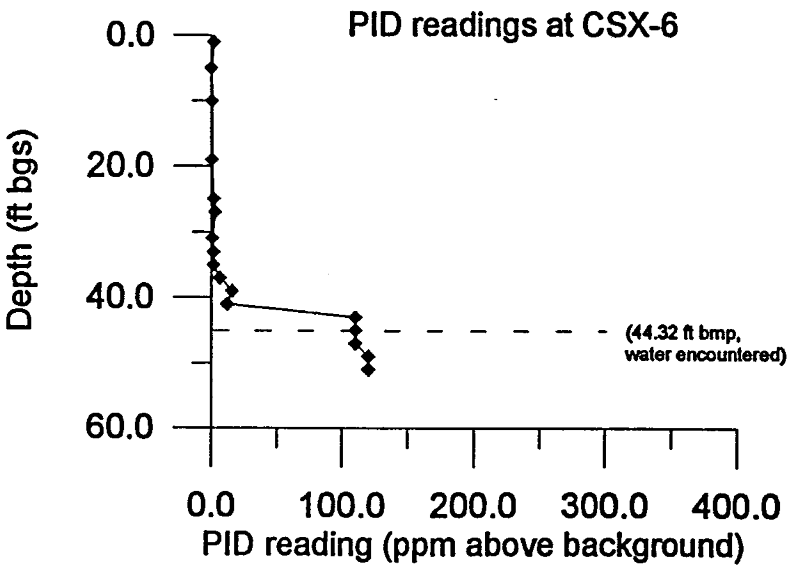
APPENDIX D
NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA

PID READINGS VERSUS DEPTH



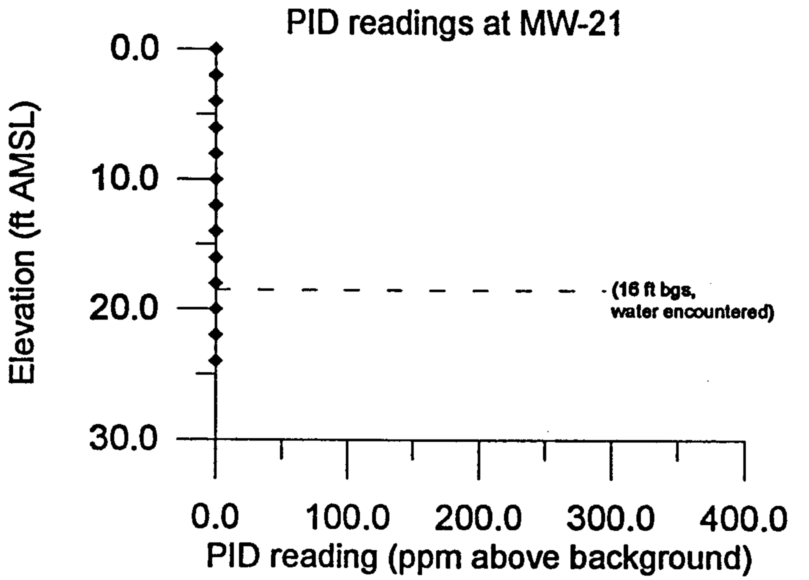


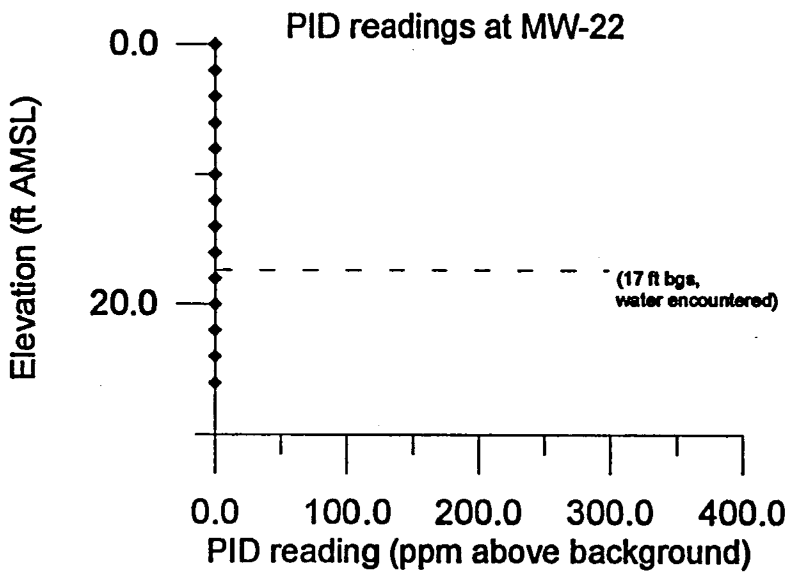


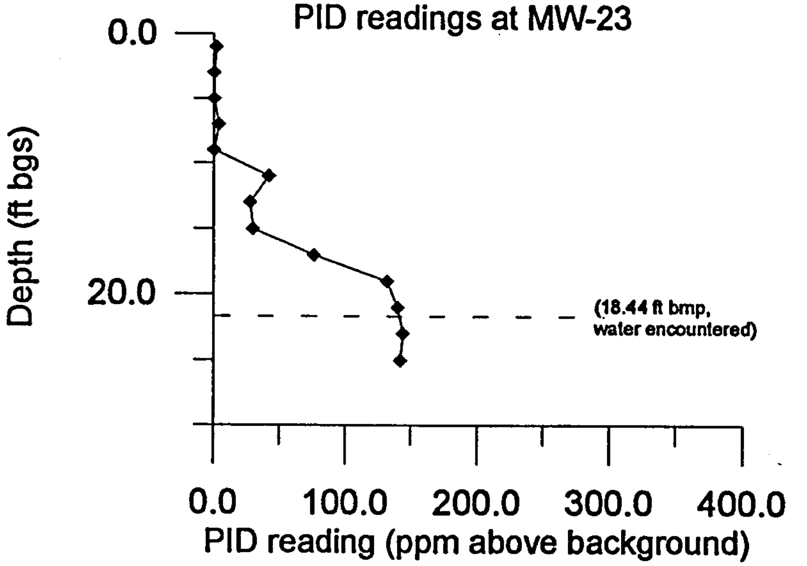


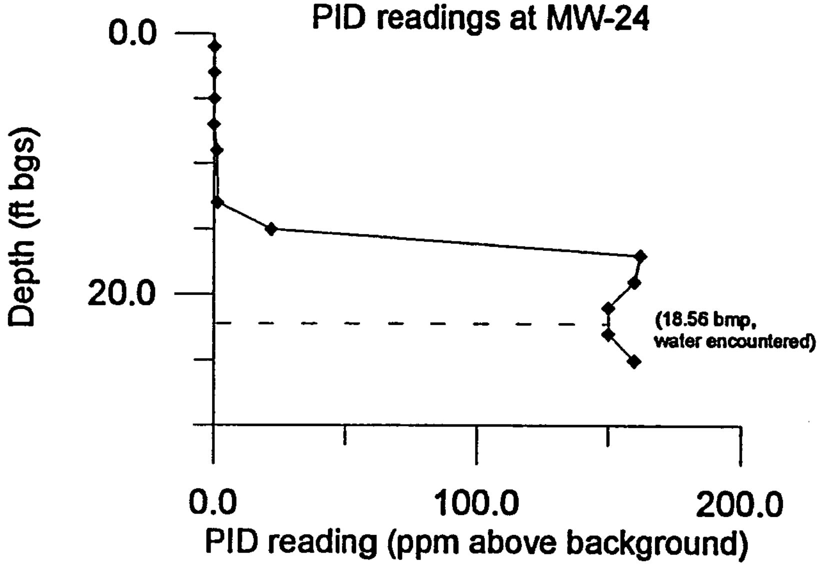
APPENDIX D
NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA

PID READINGS VERSUS DEPTH


PID readings at MW-21

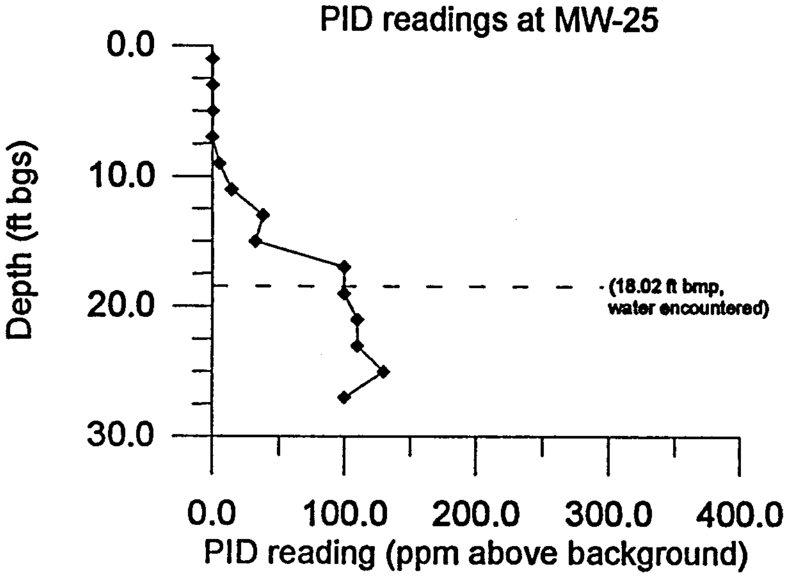

PID readings at MW-22


PID readings at MW-23


PID readings at MW-24

APPENDIX D
NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA

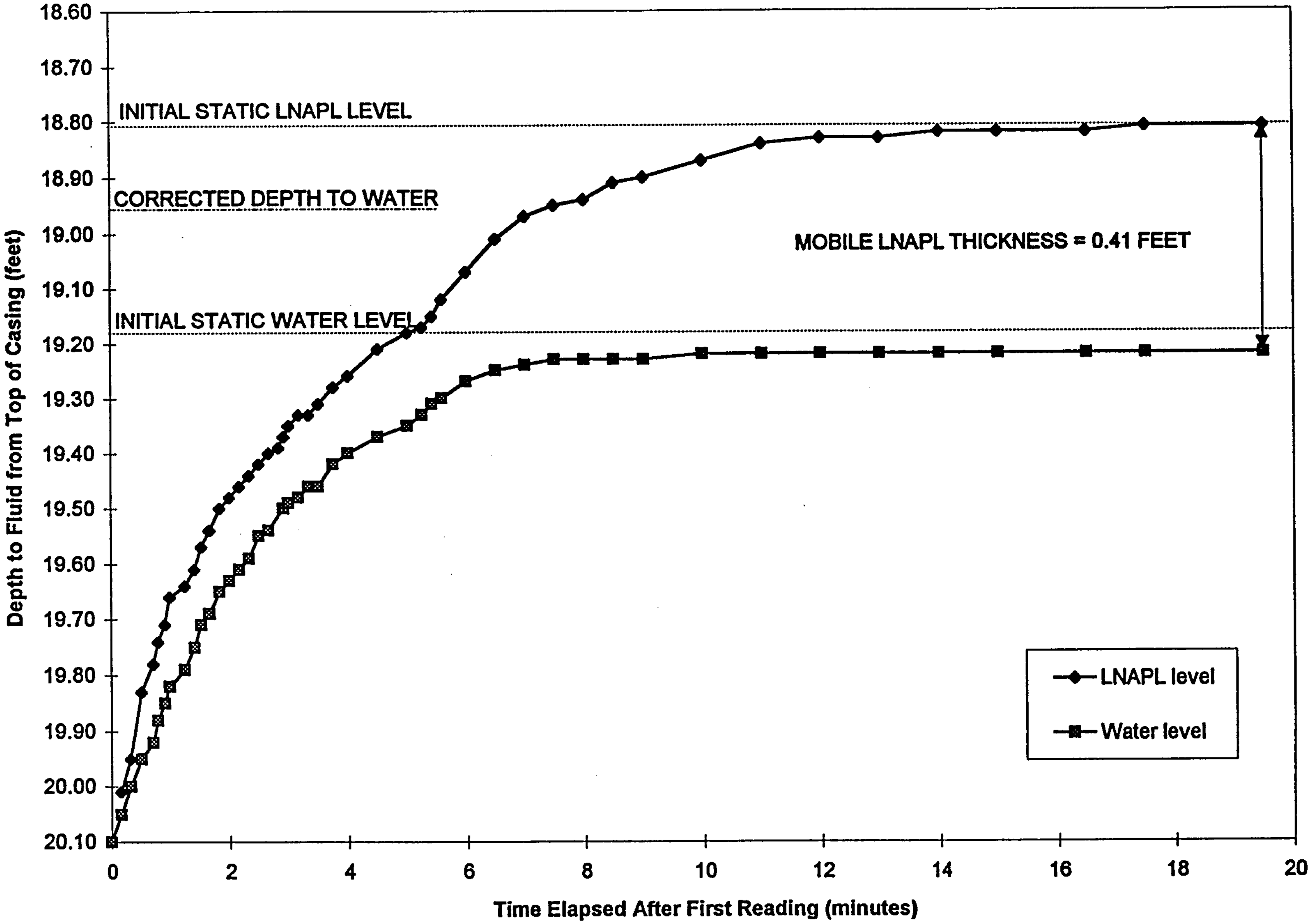
PID READINGS VERSUS DEPTH



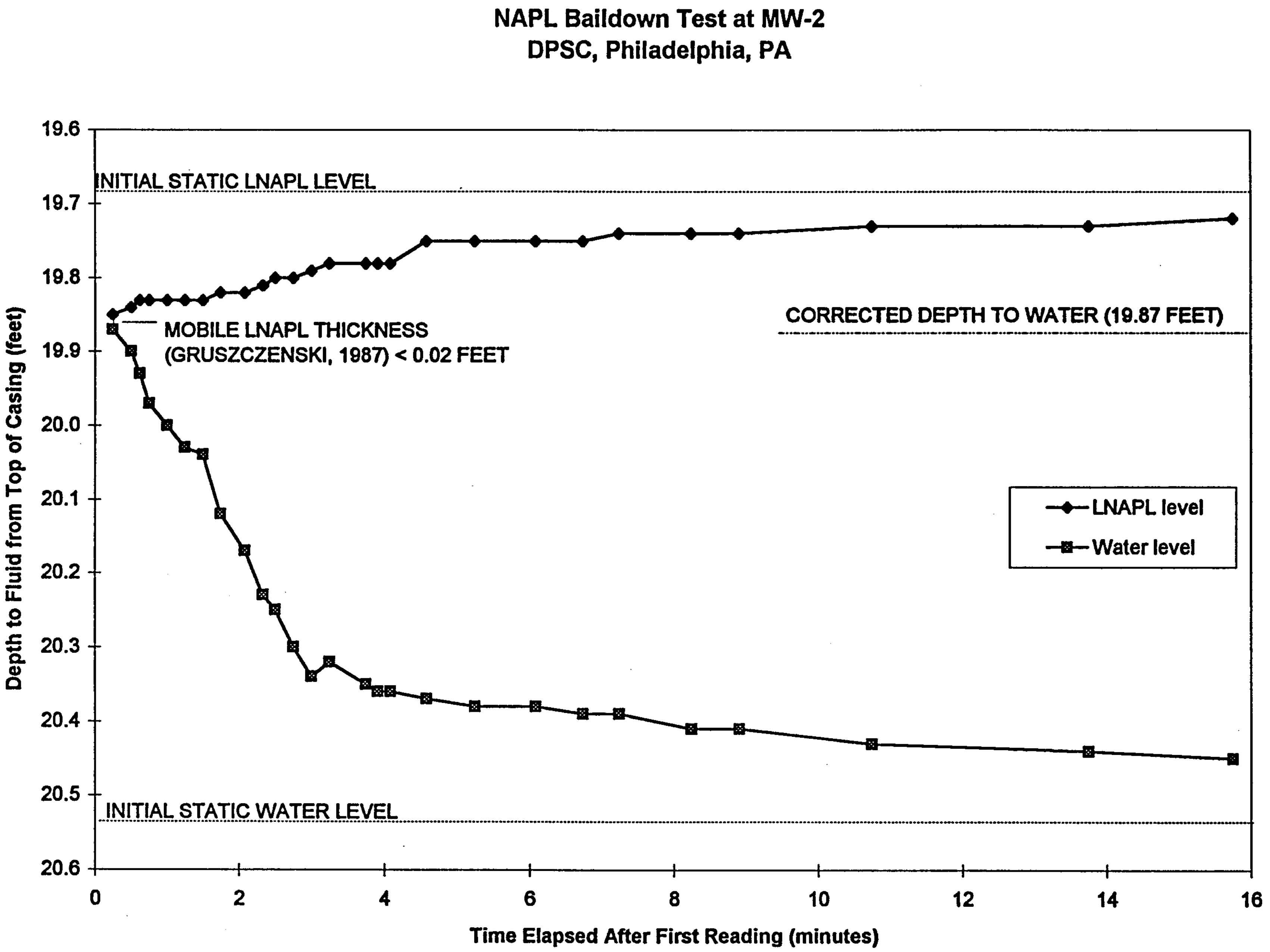
Appendix E

Graphs of NAPL Baildown/Recovery Test Data

NAPL Baildown Test at MW-1A
DPSC, Philadelphia, PA



f:\project\0285643\file\naplcalc\baildown\BD_TESTS.XLS!MW-1A chart



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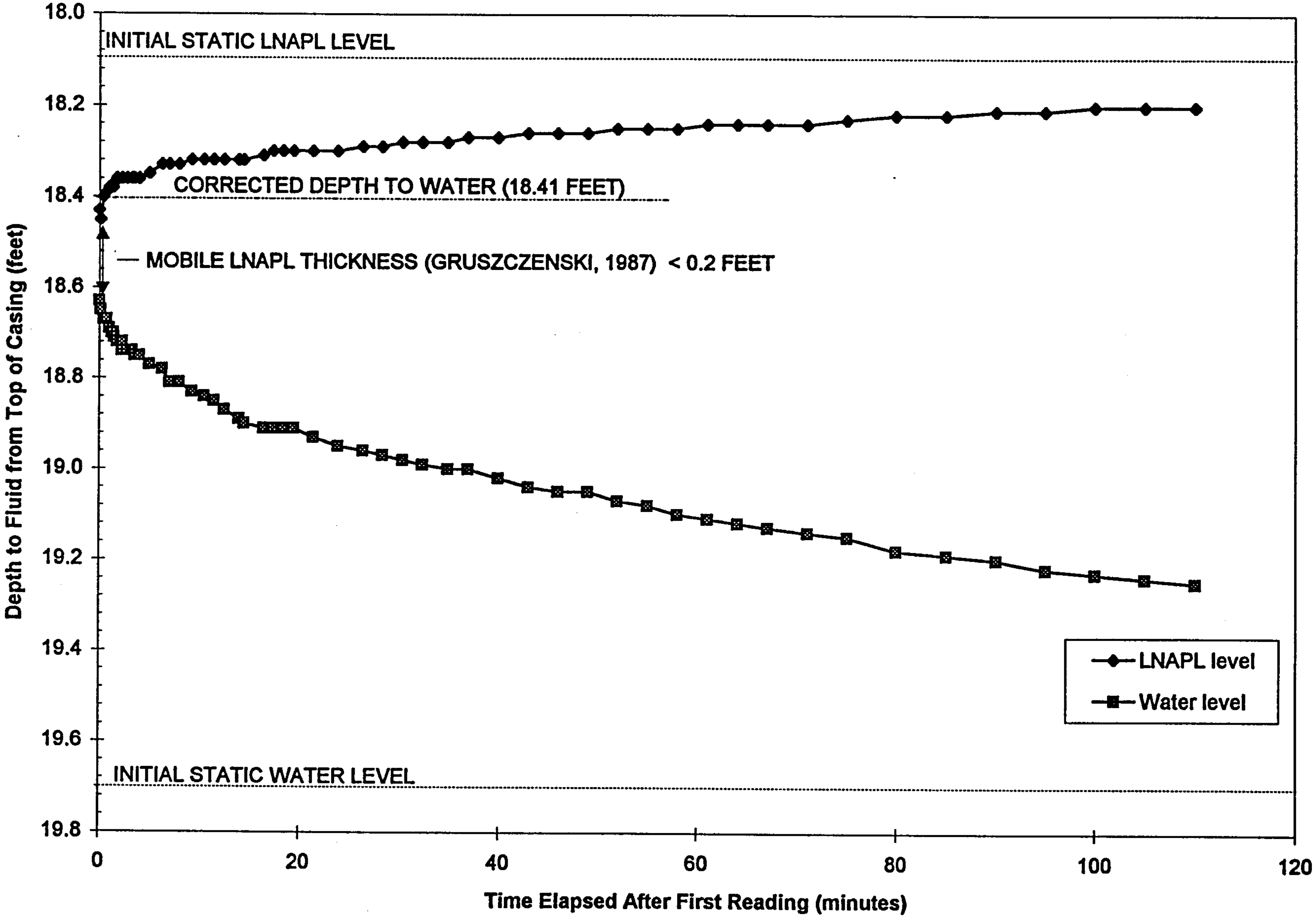
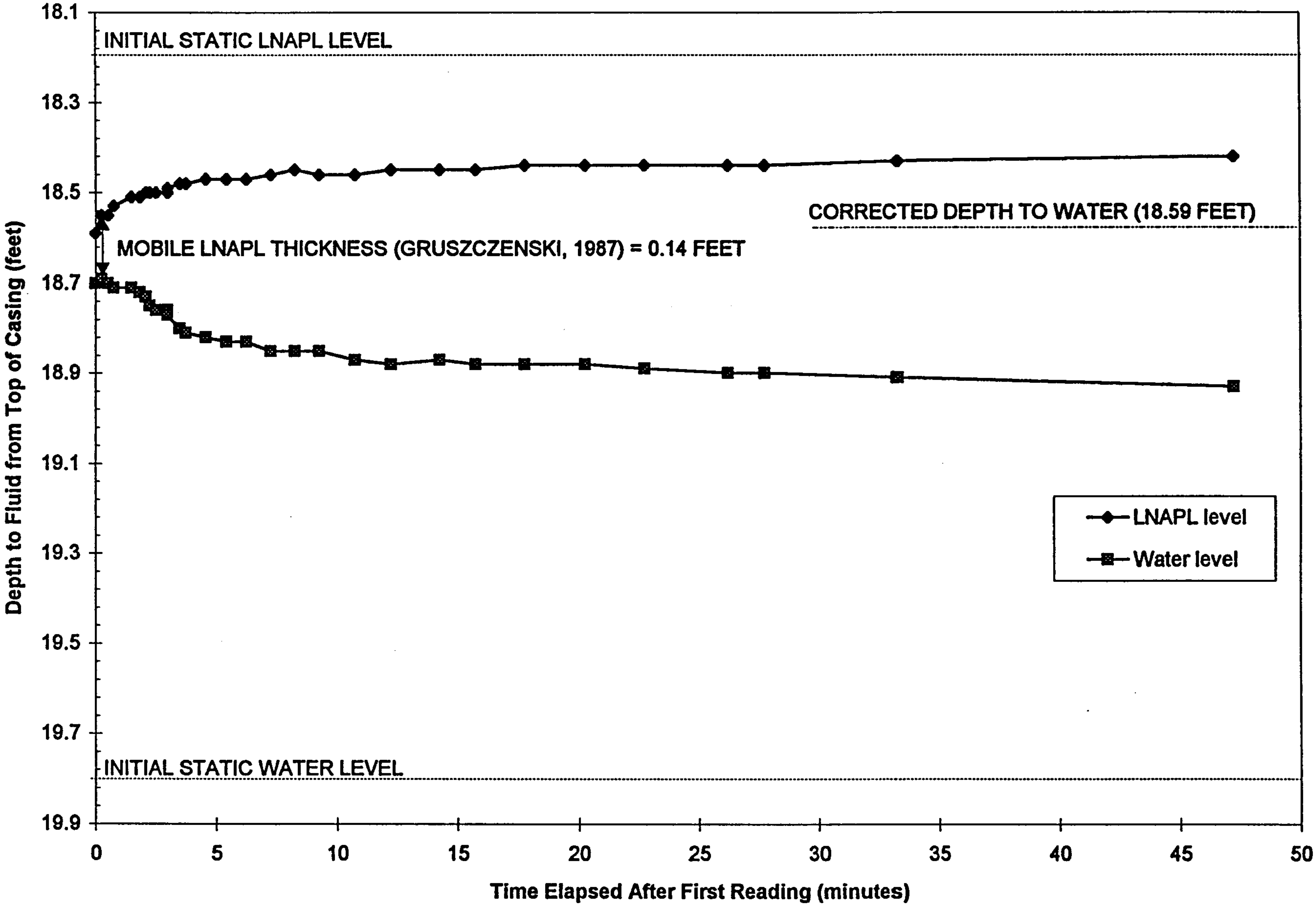
NAPL Baildown Test at MW-3
DPSC, Philadelphia, PA



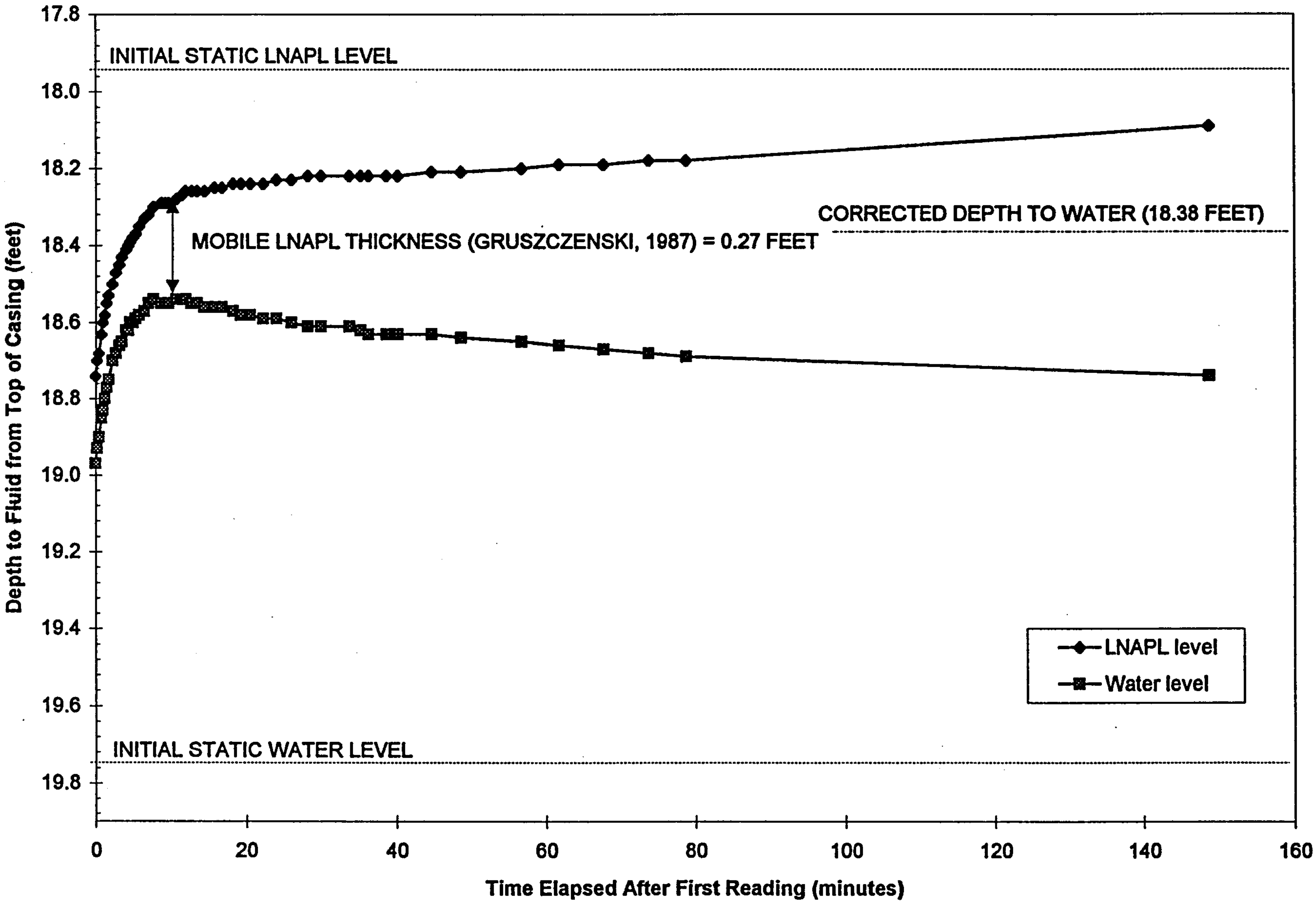
f:\project\0285643\file\naplcalc\baildown\BD_TESTS.XLS!MW-3 chart

NAPL Baildown Test at MW-4
DPSC, Philadelphia, PA



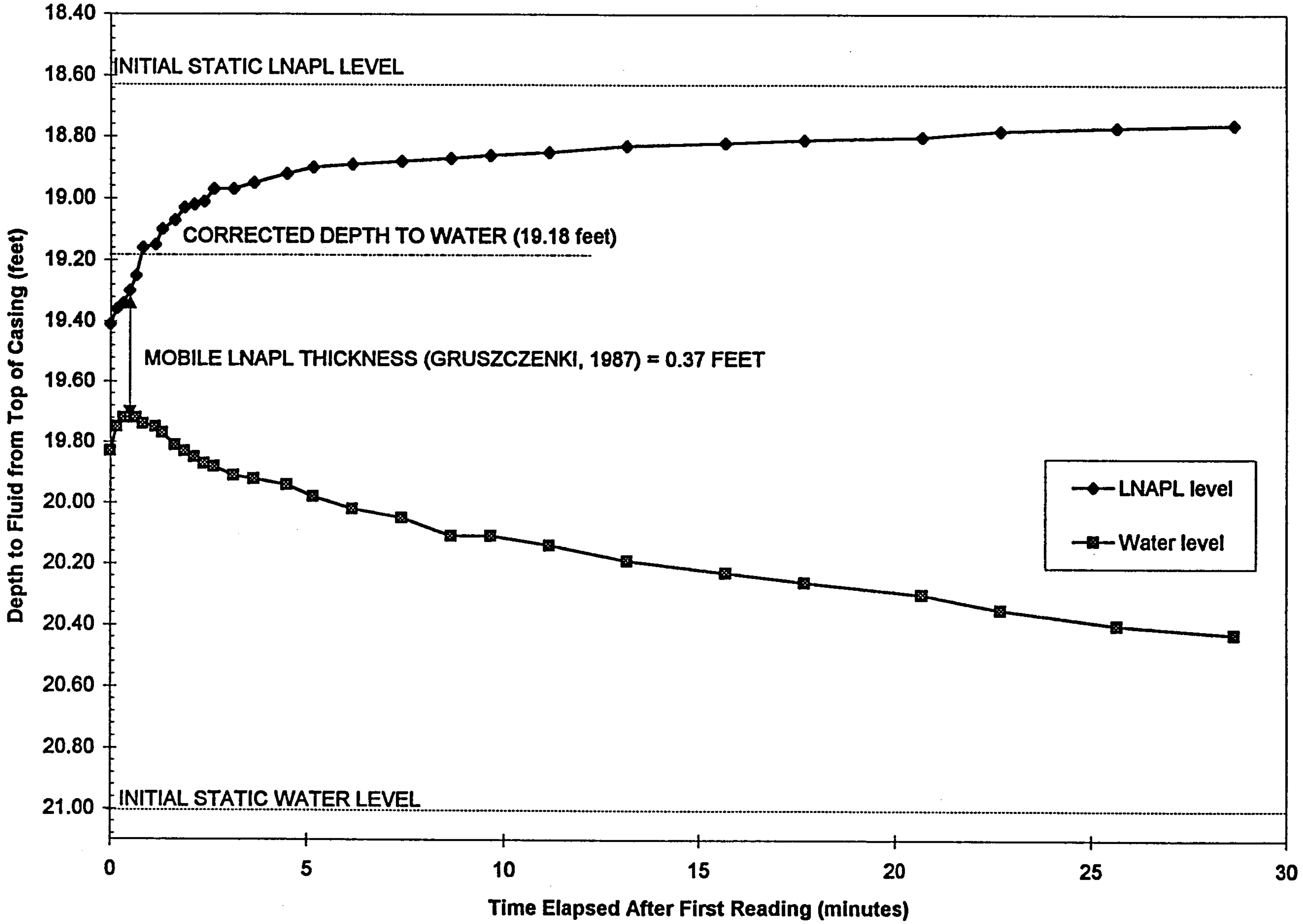
f:\project\0285643\file\napIcalc\baildown\BD_TESTS.XLS!MW-4 chart

NAPL Baildown Test at MW-5
DPSC, Philadelphia, PA



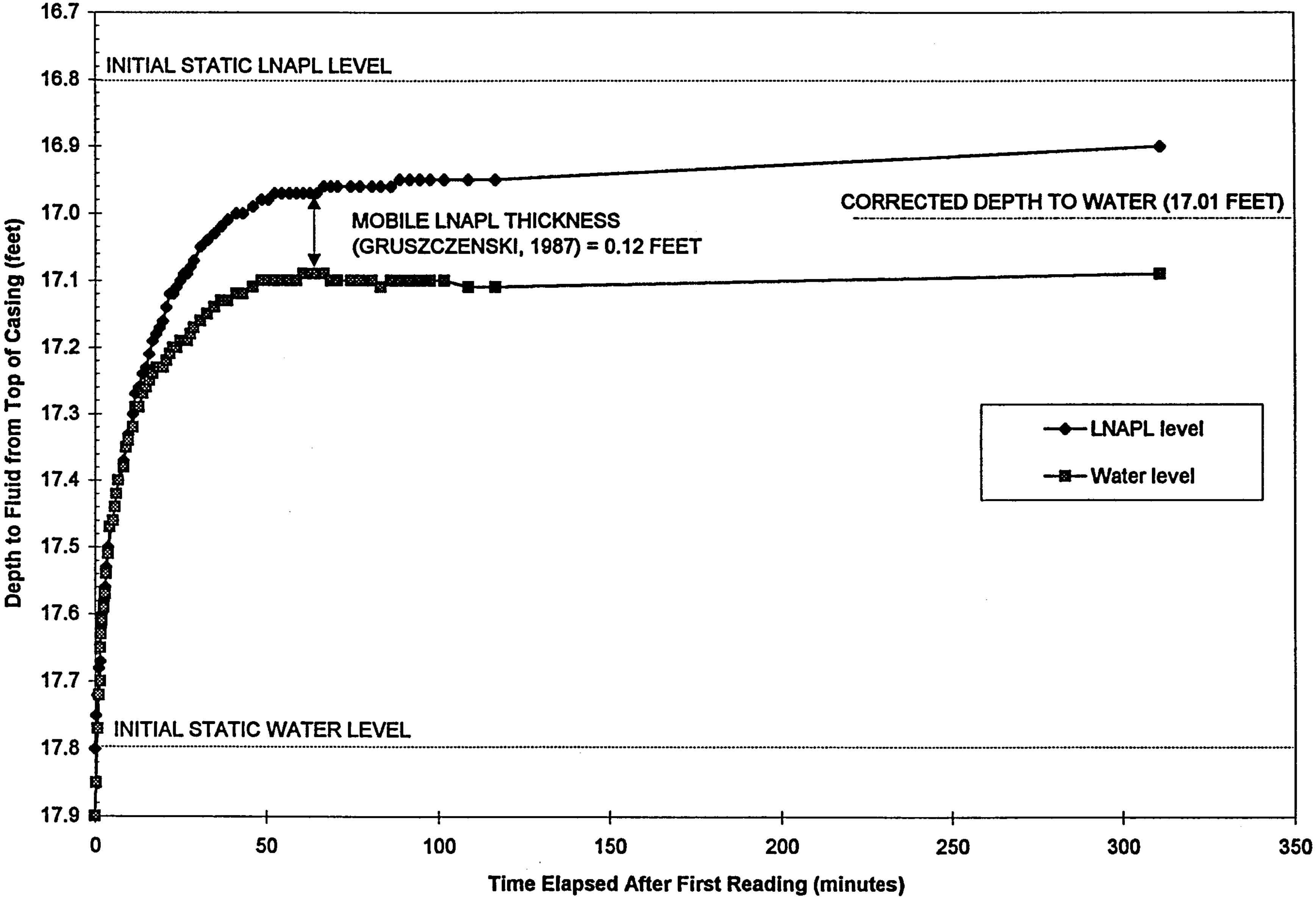
f:\project\0285643\file\naplcalc\baildown\BD_TESTS.XLS\MW-5 chart

NAPL Baildown Test at MW-6
DPSC, Philadelphia, PA



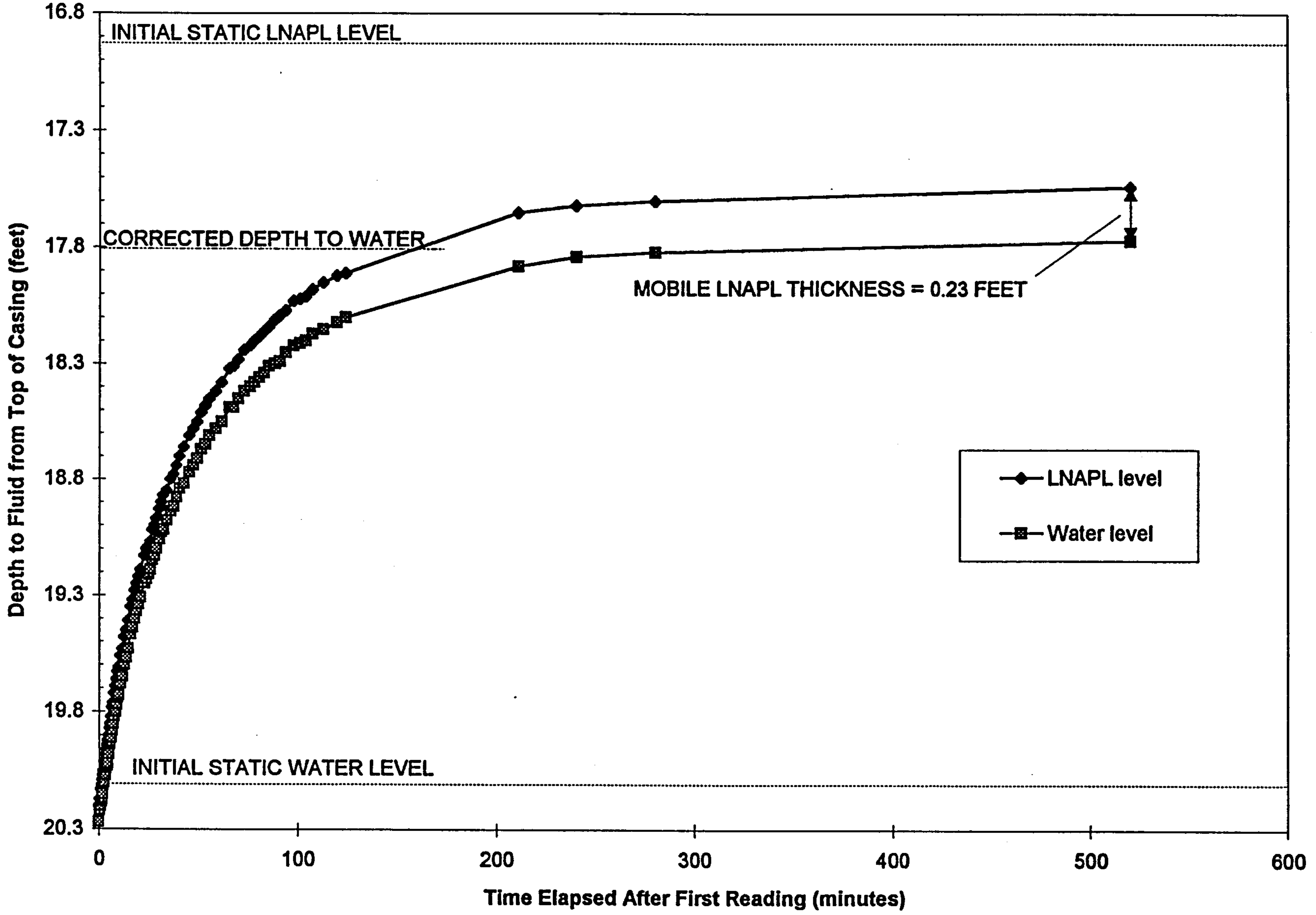
f:\project\0285643\file\naplcalc\baildown\BD_TESTS.XLS!MW-6B Chart

NAPL Baildown Test at MW-7
DPSC, Philadelphia, PA



f:\project\0285643\file\naplcalc\baildown\BD_TESTS.XLS!MW-7 chart

NAPL Baildown Test at MW-9
DPSC, Philadelphia, PA



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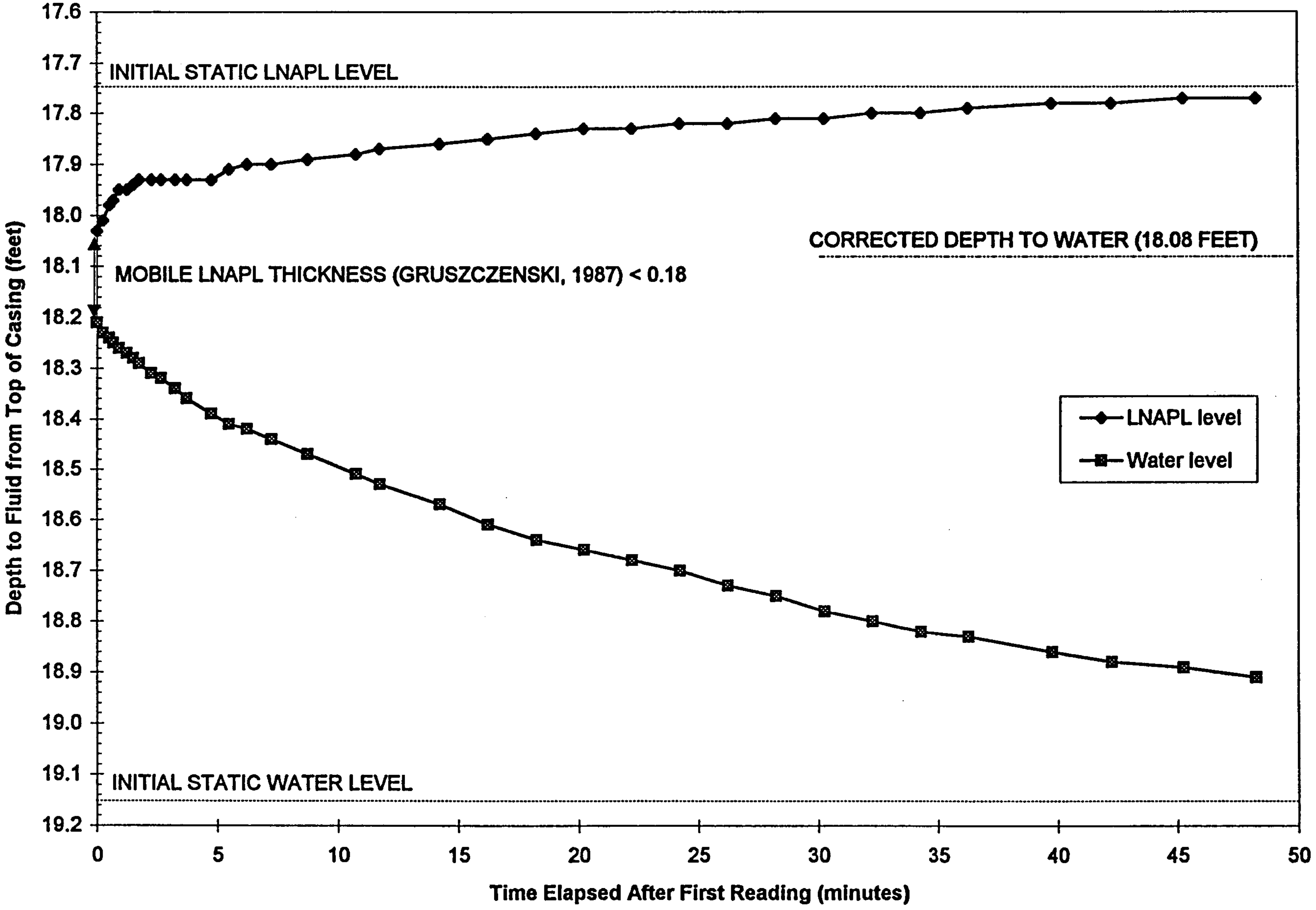
NAPL Baildown Test at MW-11
DPSC, Philadelphia, PA



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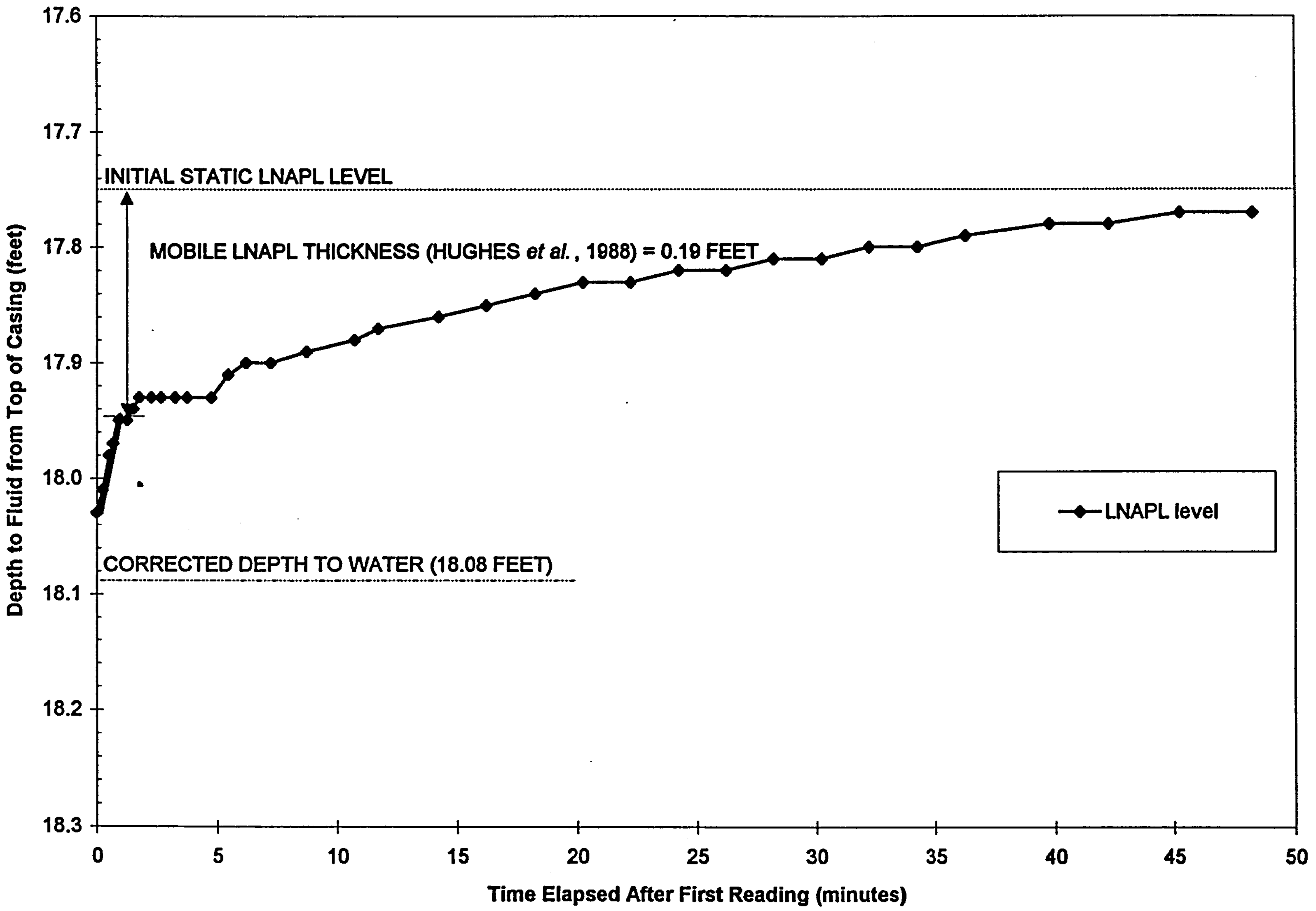
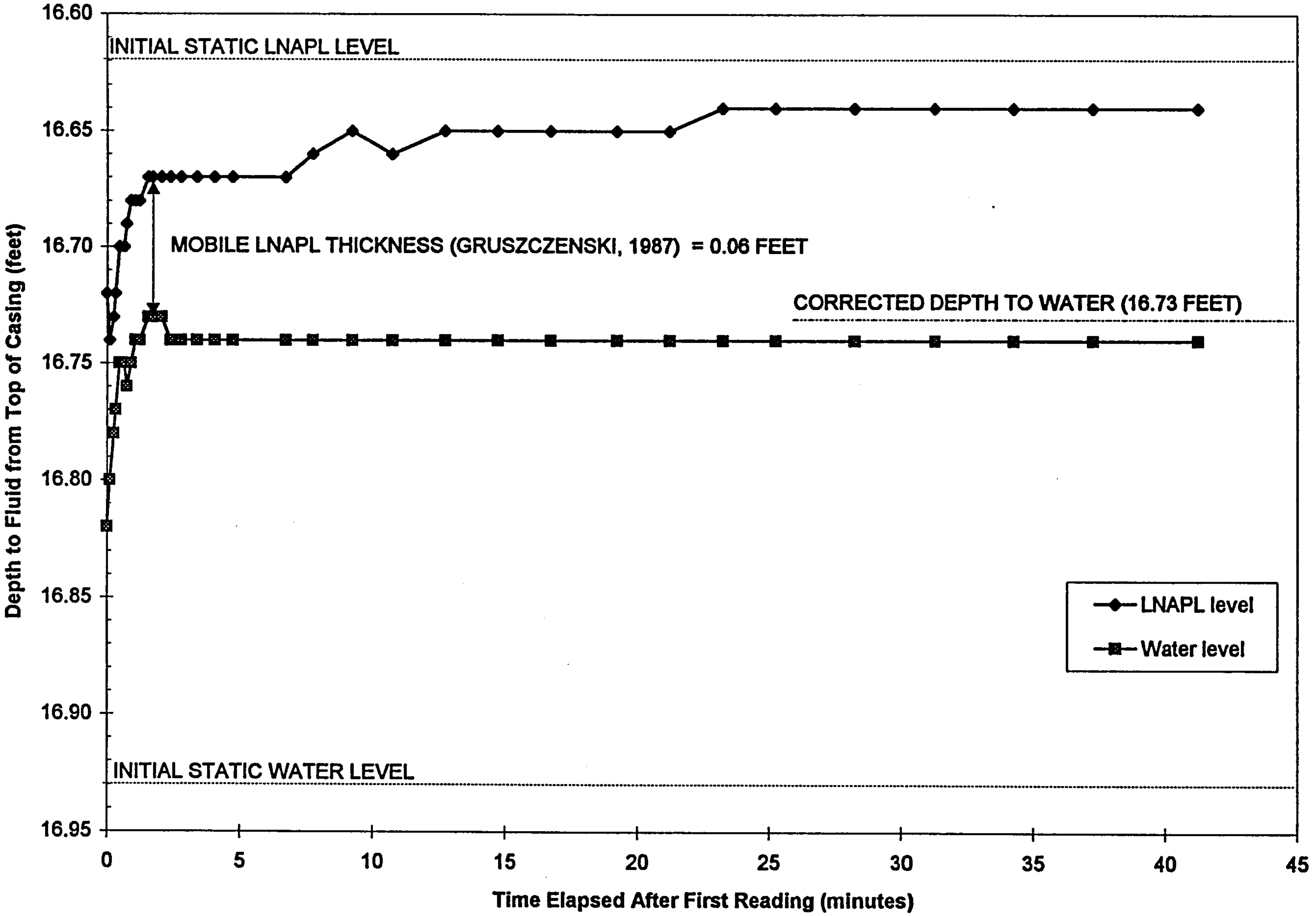
NAPL Baildown Test at MW-11
DPSC, Philadelphia, PA



f:\project\0285643\file\naplcalc\baildown\BD_TESTS.XLS!MW-11 chart (2)

NAPL Baildown Test at MW-12
DPSC, Philadelphia, PA



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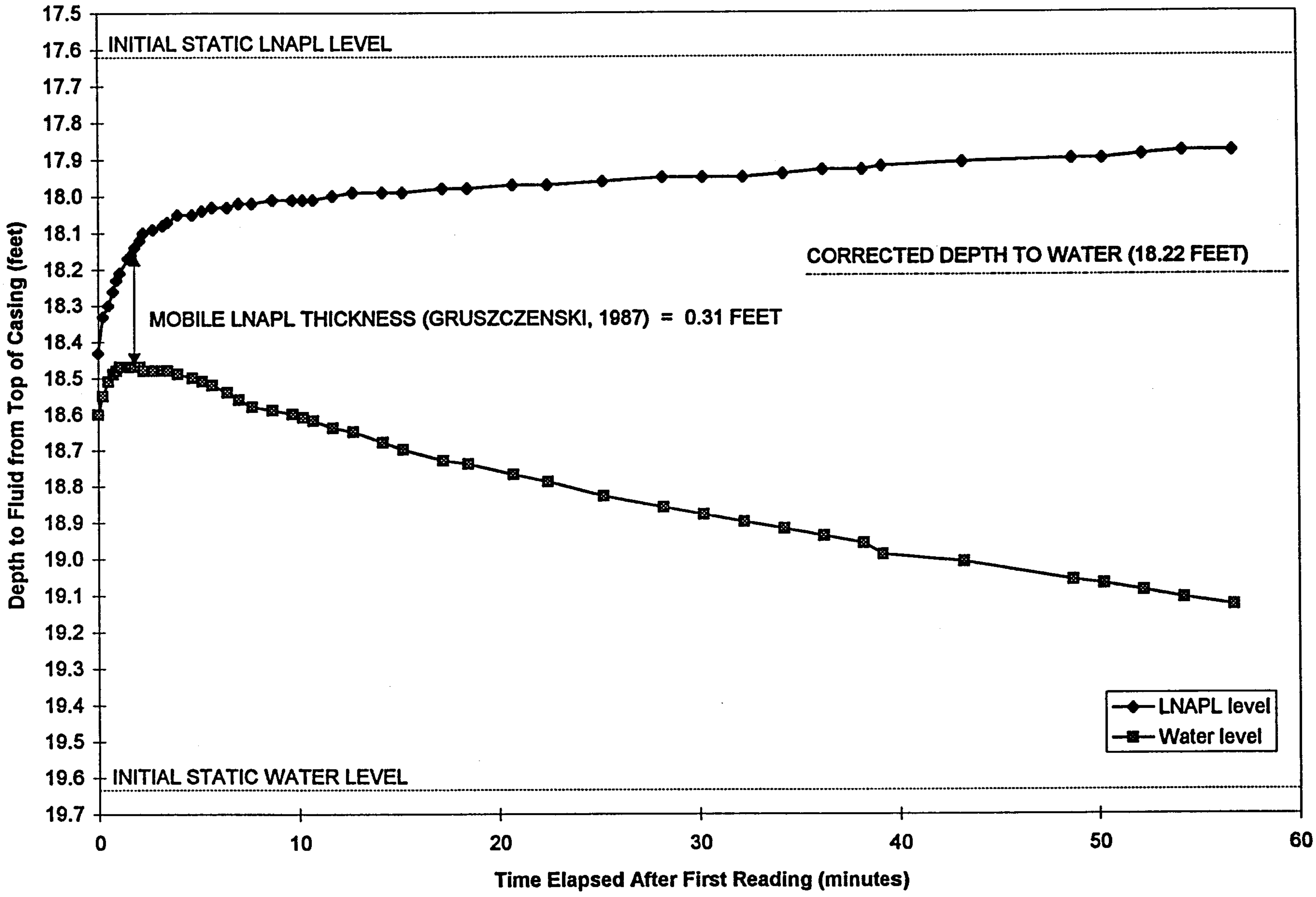
NAPL Baildown Test at MW-14
DPSC, Philadelphia, PA



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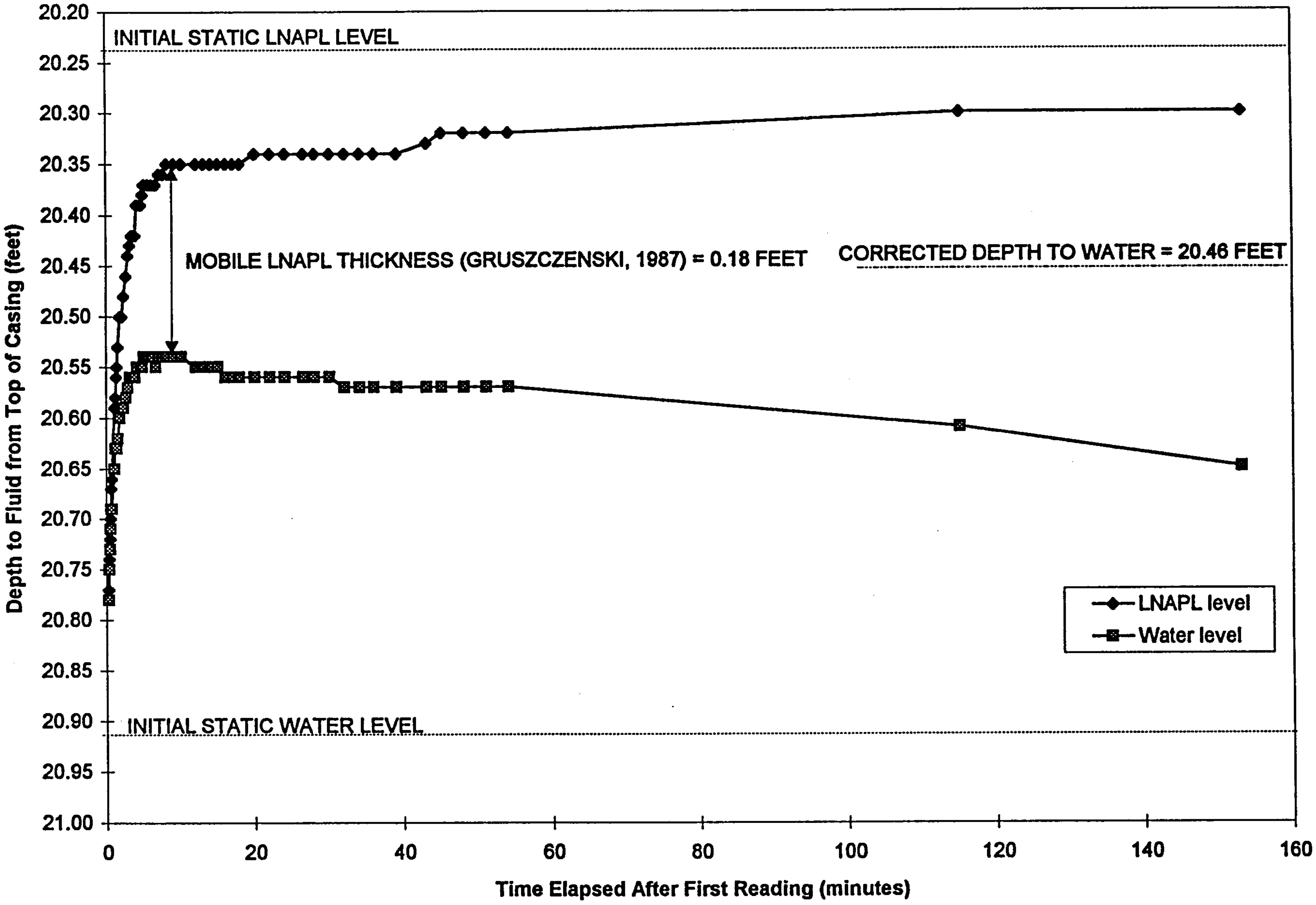
NAPL Baildown Test at MW-15
DPSC, Philadelphia, PA



f:\project\0285643\file\naplcalc\baildown\BD_TESTS.XLS!MW-15 chart

Appendix F

Environmental Risk Information and Imaging Services, Inc. Report

PERTAINING TO:

20TH STREET AND OREGON AVENUE
PHILADELPHIA, PA 19101

REPORT NUMBER:

120743A

PREPARED ON:

10/30/1996

ON BEHALF OF:

Malcolm Pirnie, Inc.
104 Corporate Park Dr.
Box 751
White Plains, NY 10602

If you have any questions or comments regarding this report, please contact ERIIS Customer Service at 1-800-989-0403, locally at 703-834-0600, or fax us at 703-834-0606. Thank you for your order.

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ERIIS REPORT OVERVIEW

The following features are available for an ERIIS report:

- * Database Report
    - * Statistical Profile
    - * Database Records
- * Related Maps
    - * Digital Custom Plotted Map
    - * Sanborn Fire Insurance Map(s)
    - * Topographical Map(s)

Statistical Profile

The statistical profile is an at-a-glance numeric summary of the databases searched for your ERIIS Report.

Database Records

The detailed federal and state database information indicates potential and actual environmental threats within the study radius. These records are sorted by their distance from the study site.

Digital Custom Map

The digital custom map is cross referenced with the database records. The cross-in-circle in the center of the map represents the study site. The red circles represent distances from the study site. The plottable sites in the report are distinguished on the map by symbols of different shape and color.

Historic Fire Insurance Maps

The ERIIS collection of historical Sanborn Fire Insurance Maps covers 14,000 cities and towns. These maps may indicate prior use of the study site. If no maps are available for the study site, a notice to that effect is included. This notice should serve as evidence of due diligence.

Topographical Map

USGS topographical maps show natural and man-made features as well as the shape and elevation of the terrain. The 7.5 minute quad maps are produced at a scale of 1:24,000, or one inch represents 2,000 feet.

If you have any questions about this report,
please contact ERIIS Customer Service at 1-800-989-0403

NPL
of Data: 05/01/1996
se Date: 05/13/1996
nvironmental Protection Agency
ice of Solid Waste and Emergency Response
703/603-8881

National Priorities List

The NPL Report, also known as the Superfund List, is an EPA listing of uncontrolled or abandoned hazardous waste sites. The list is primarily based upon a score which the site receives from the EPA's Hazardous Ranking System. These sites are targeted for possible long-term remedial action under the Superfund Act of 1980.

RCRIS_TS
Date of Data: 05/10/1996
Release Date: 06/10/1996
US Environmental Protection Agency
Office of Solid Waste and Emergency Response
202/260-4610

Resource Conservation and Recovery Information System - Treatment, Storage, And Disposal Facilities

The RCRIS_TS Report contains information pertaining to facilities which either treat, store, or dispose of EPA regulated hazardous waste. The following information is also included in the RCRIS_TS Report:
- Information pertaining to the status of facilities tracked by the RCRA Administrative Action Tracking System (RAATS)
- Inspections & evaluations conducted by federal and state agencies
- All reported facility violations, the environmental statute(s) violated, and any proposed & actual penalties
- Information pertaining to corrective actions undertaken by the facility or EPA
- A complete listing of EPA regulated hazardous wastes which are generated or stored on-site

CERCLIS
Date of Data: 05/01/1996
Release Date: 05/13/1996
US Environmental Protection Agency
Office of Solid Waste and Emergency Response
703/603-8730

Comprehensive Environmental Response, Compensation, and Liability Information System

The CERCLIS Database is a comprehensive listing of known or suspected uncontrolled or abandoned hazardous waste sites. These sites have either been investigated, or are currently under investigation by the U.S. EPA for the release, or threatened release of hazardous substances. Once a site is placed in CERCLIS, it may be subjected to several levels of review and evaluation, and ultimately placed on the National Priorities List (NPL). As of February 1995, CERCLIS sites designated "No Further Remedial Action Planned" (NFRAP) have been removed from the CERCLIS Database.

NFRAP
Date of Data: 05/01/1996
Release Date: 05/13/1996
Environmental Protection Agency
ce of Solid Waste and Emergency Response
/603-8881

No Further Remedial Action Planned Sites

The No Further Remedial Action Planned Report (NFRAP), also known as the CERCLIS Archive, contains information pertaining to sites which have been removed from the U.S. EPA's CERCLIS Database. NFRAP sites may be sites where, following an initial investigation, either no contamination was found, contamination was removed quickly without need for the site to be placed on the NPL, or the contamination was not serious enough to require federal Superfund action or NPL consideration.

RCRIS_LG
Date of Data: 05/10/1996
Release Date: 06/10/1996
US Environmental Protection Agency
Office of Solid Waste and Emergency Response
202/260-4610

Resource Conservation and Recovery Information System - Large Quantity Generators

The RCRIS_LG Report contains information pertaining to facilities which either generate more than 1000kg of EPA regulated hazardous waste per month, or meet other applicable requirements of the Resource Conservation And Recovery Act. The following information is also included in the RCRIS_LG Report:
- Information pertaining to the status of facilities tracked by the RCRA Administrative Action Tracking System (RAATS)
- Inspections & evaluations conducted by federal and state agencies
- All reported facility violations, the environmental statute(s) violated, and any proposed & actual penalties
- Information pertaining to corrective actions undertaken by the facility or EPA
- A complete listing of EPA regulated hazardous wastes which are generated or stored on-site

RCRIS_SG
Date of Data: 05/10/1996
Release Date: 06/10/1996
US Environmental Protection Agency
Office of Solid Waste and Emergency Response
202/260-4610

Resource Conservation and Recovery Information System - Small Quantity Generators

The RCRIS_SG Report contains information pertaining to facilities which either generate between 100kg and 1000kg of EPA regulated hazardous waste per month, or meet other applicable requirements of the Resource Conservation And Recovery Act. On advice of the U.S. EPA, ERIIS does not report so-called "RCRA Protective Filers." Protective Filers, commonly called Conditionally Exempt Small Quantity Generators (CESQG's), are facilities that have completed RCRA notification paperwork, but are not, in fact, subject to RCRA regulation. The determination of CESQG status is made by the U.S. EPA. The following information is also included in the RCRIS_SG Report:
- Information pertaining to the status of facilities tracked by the RCRA Administrative Action Tracking System (RAATS)
- Inspections & evaluations conducted by federal and state agencies
- All reported facility violations, the environmental statute(s) violated, and any proposed & actual penalties

- Information pertaining to corrective actions undertaken by the facility or EPA
- A complete listing of EPA regulated hazardous wastes which are generated or stored on-site

ERNS
Date of Data: 12/31/1995
Release Date: 03/18/1996
US Environmental Protection Agency
Office of Solid Waste and Emergency Response
202/260-2342

Emergency Response Notification System - 1995

ERNS is a national computer database system that is used to store information concerning the sudden and/or accidental release of hazardous substances, including petroleum, into the environment. The ERNS Reporting System contains preliminary information on specific releases, including the spill location, the substance released, and the responsible party. Please note that the information in the ERNS Report pertains only to those releases that occured between January 1, 1995 and December 31, 1995.

HWS
Date of Data: 06/06/1996
Release Date: 08/14/1996
PA Dept. of Environmental Protection
Bureau of Land Recycling & Waste Mgt.
717/783-7816

Pennsylvania Priority List of Hazardous Sites

The Pennsylvania Priority List of Hazardous Sites is a full-text description of facilities that are deemed potentially hazardous to the public health and welfare by the Pennsylvania Department of Environmental Resources.

LRST
Date of Data: 06/02/1995
Release Date: 07/03/1995
PA Dept. of Environmental Resources
Bureau of Water Quality Management
717/783-7816

Pennsylvania List of Confirmed Releases

The Pennsylvania List Of Confirmed Releases contains information pertaining to reported leaking underground storage tanks, spills, and tank overfills located within the Commonwealth of Pennsylvania.

SWF
Date of Data: 01/03/1996
Release Date: 01/16/1996
PA Dept. of Environmental Resources
Bureau of Solid Waste Management
717/787-7381

Pennsylvania Landfills List

The Pennsylvania Landfills List consists of six different types of solid waste facilities:

- Permitted Construction/Demolition Landfills
  06/01/93
- Permitted Residual Waste Landfills
  05/23/95
- Operating Municipal Waste Landfills
  05/23/95
- Facilities Approved For The Disposal Of Asbestos Containing Waste
  11/13/92
- Facilities Approved For The Disposal Of Virgin Fuel Contaminated Soils
  11/16/92
- Municipal Sur. App./Agriculture Utilization
  06/20/95

RST
Date of Data: 06/10/1996
Release Date: 07/02/1996
PA Dept. of Environmental Resources
Division of Storage Tanks
717/772-5599

Pennsylvania Underground Storage Tank Report

The Pennsylvania Underground Storage Tank Report is a comprehensive listing of all registered underground storage tanks located within the Commonwealth of Pennsylvania.

ERIIS ASTM STATISTICAL PROFILE
State: PA

ERIIS Report #120743A

Oct 28, 1996

Site:
20TH STREET AND OREGON AVENUE
PHILADELPHIA, PA 19101

Latitude: 39.915863
Longitude: -75.185708

Database	Radius (Mi)	Property Area**	Property-1/4	1/4-1/2	1/2-1	>1	TOTAL
NPL	1		0	0	0		0
RCRIS_TS	1		1	0	0		1
CERCLIS	.5		0	0			0
NFRAP	.5		1	0			1
RCRIS_LG	.25		0				0
RCRIS_SG	.25		0				0
ERNS	.05		0				0
HWS	1		0	0	0		0
LRST	.5		4	5			9
SWF	.5		0	0			0
RST	.25		6				6
			12	5	0	0	17

Radon Zone Level: 3

Zone 3 has a predicted average indoor screening level < 2 pCi/L

A Radon Zone should not be used to determine if individual homes need to be tested for radon. The EPA's Office of Radiation and Indoor Air (202/233-9320) recommends that all homes be tested for radon, regardless of geographic location or the zone designation in which the property is located.

` property is defined as a .02 mile buffer around the site's latitude and longitude.

A blank radius count indicates that the database was not searched by this radius per client instructions.

NR in a radius count indicates that the database cannot be reported by this search criteria due to insufficient and/or inaccurate addresses reported by a federal/state agency.

ERIIS SUMMARY OF PLOTTABLE SITES

ERIIS Report #120743A

Oct 28, 1996

ERIIS ID.	FACILITY/ADDRESS	DATABASE	DISTANCE FROM SITE	DIRECTION FROM SITE	MAP ID
	0 - 1/4 Miles				
42034006276	SEARS ROEBUCK & CO 2201 W OREGON AVE PHILADELPHIA, PA 19145-4191 COUNTY: PHILADELPHIA	LRST	0.140 Mi	NORTHEAST	6276
42010018031	LOCATION 957 2201 W OREGON AVE PHILADELPHIA, PA 19145-4111 COUNTY: PHILADELPHIA	RST	0.142 Mi	NORTHEAST	8031
42010017851	GETTY 67261 2101 W OREGON AVE PHILADELPHIA, PA 19145-4110 COUNTY: PHILADELPHIA	RST	0.172 Mi	NORTHEAST	7851
42010017554	SOUTH GARAGE S 20TH ST AT JOHNSTON ST PHILADELPHIA, PA 19145 COUNTY: PHILADELPHIA	RST	0.205 Mi	NORTHEAST	7554
42039000008	DEFENSE PERSONNEL SUPPORT 2800 S 20TH ST PHILADELPHIA, PA 19145-5001 COUNTY: PHILADELPHIA	NFRAP	0.208 Mi	NORTHEAST	8
42013000233	DEFENSE PERSONNEL SUPPORT CENTER 2800 S 20TH ST PHILADELPHIA, PA 19145-5001 COUNTY: PHILADELPHIA	RCRIS_TS	0.208 Mi	NORTHEAST	233
42034005872	DEFENSE PERSONNEL SUP CTR (SS) 2800 S 20TH ST PHILADELPHIA, PA 19145-5099 COUNTY: PHILADELPHIA	LRST	0.220 Mi	NORTHEAST	5872
42034005873	DEFENSE PERSONNEL SUP CTR-DEWITT ST 2800 S 20TH ST PHILADELPHIA, PA 19145-5001 COUNTY: PHILADELPHIA	LRST	0.220 Mi	NORTHEAST	5873
42034005874	DEFENSE PERSONNEL SUP CTR-OREGON 2800 S 20TH ST PHILADELPHIA, PA 19145-5099 COUNTY: PHILADELPHIA	LRST	0.220 Mi	NORTHEAST	5874
42010017804	DEFENSE PERSONNEL SUPPORT CENTER 2800 S 20TH ST PHILADELPHIA, PA 19145-5099 COUNTY: PHILADELPHIA	RST	0.220 Mi	NORTHEAST	7804
42010018448	PASSYUNK HOMES 3111 S 23RD ST PHILADELPHIA, PA 19145-5605 COUNTY: PHILADELPHIA	RST	0.242 Mi	SOUTHWEST	8448
42010018306	GEORGE YOUNG CO S 20TH ST AT W OREGON AVE PHILADELPHIA, PA 19145 COUNTY: PHILADELPHIA	RST	0.248 Mi	NORTHEAST	8306
	1/4 - 1/2 Miles				
42034005780	BEVERLEA ENTERPRISES INC 2149 PENROSE AVE PHILADELPHIA, PA 19145-5618 COUNTY: PHILADELPHIA	LRST	0.402 Mi	SOUTHWEST	5780
42034005816	CHECK CASH 2149 PENROSE AVE PHILADELPHIA, PA 19145-5618 COUNTY: PHILADELPHIA	LRST	0.402 Mi	SOUTHWEST	5816
42034006216	PHILADELPHIA SD - POE 2321 22ND & RITTNER ST PHILADELPHIA, PA COUNTY: PHILADELPHIA	LRST	0.416 Mi	NORTHEAST	6216
42034006032	LAIDLAW TRANSIT-RYDER LEASED PROP 3400 S 26TH ST PHILADELPHIA, PA 19145-5203 COUNTY: PHILADELPHIA	LRST	0.480 Mi	SOUTHWEST	6032
42034006262	RYDER TRUCK RENTAL LEASED PROPERTY 3400 S 26TH ST PHILADELPHIA, PA 19145-5203 COUNTY: PHILADELPHIA	LRST	0.480 Mi	SOUTHWEST	6262

ERIIS ENVIRONMENTAL DATA REPORT
RESOURCE CONSERVATION AND RECOVERY INFORMATION SYSTEM
RCRIS_TS - PLOTTABLE SITES - PAGE 1

ERIIS Report #120743A

Oct 28, 1996

ERIIS ID EPA ID	FACILITY	ADDRESS	RAATS ISSUE DATE RAATS ACTION/STATUS RAATS PENALTIES	DISTANCE FROM SITE	DIRECTION FROM SITE	MAP ID
42013000233 PA0971590005	DEFENSE PERSONNEL SUPPORT CENTER COUNTY: PHILADELPHIA	2800 S 20TH ST PHILADELPHIA, PA 19145-5001	09/28/90 ACTION CODE: NOTICE OF NON-COMPLIANCE STATUS: FEDERAL FACILITY PROPOSED : $ 0.00 FINAL: $0.00	0.208 MILES	NORTHEAST	233

FACILITY VIOLATIONS

	DATE DETERMINED:	DATE RESOLVED:	AREA OF VIOLATION:
1.	05/30/95	02/12/96	GENERATOR-ALL REQUIREMENTS
2.	10/05/92	01/15/93	GENERATOR-ALL REQUIREMENTS
3.	09/11/89	09/30/91	TSD-LAND BAN REQUIREMENTS
4.	09/11/89	09/30/91	GENERATOR-LAND BAN REQUIREMENTS
5.	09/11/89	09/30/91	TSD-OTHER REQUIREMENTS

FACILITY EVALUATIONS

	EVALUATION DATE:	EVALUATION AGENCY:	TYPE OF EVALUATION:	AREA(S) OF EVALUATION:
1.	09/11/89	EPA PERSONNEL	COMPLIANCE EVALUATION INSPECTION	TSD-LAND BAN REQUIREMENTS TSD-OTHER REQUIREMENTS GENERATOR-LAND BAN REQUIREMENTS
2.	12/14/89	EPA PERSONNEL	COMPLIANCE EVALUATION INSPECTION	TSD-LAND BAN REQUIREMENTS TSD-OTHER REQUIREMENTS GENERATOR-LAND BAN REQUIREMENTS
3.	10/05/92	STATE	COMPLIANCE EVALUATION INSPECTION	GENERATOR-ALL REQUIREMENTS GENERATOR-LAND BAN REQUIREMENTS
4.	05/30/95	STATE	COMPLIANCE EVALUATION INSPECTION	GENERATOR-ALL REQUIREMENTS GENERATOR-LAND BAN REQUIREMENTS

FACILITY ENFORCEMENTS

	ENFORCEMENT DATE:	ENFORCEMENT AGENCY:	TYPE OF ACTION:	PENALTY(S):
1.	09/28/1990	EPA	NOTICE OF NON-COMPLIANCE, INITIAL FORMAL ADMINISTRATIVE ACTION	
2.	12/31/1990	EPA	FEDERAL FACILITY COMPLIANCE AGREEMENT, FINAL FORMAL ADMINISTRATIVE ACTION	
3.	11/12/1992	STATE	WRITTEN, INFORMAL ADMINISTRATIVE ACTION	
4.	05/31/1995	STATE	WRITTEN, INFORMAL ADMINISTRATIVE ACTION	

CORRECTIVE ACTIONS

	EVENT ACTUAL DATE:	SITE EVENT:
1.	05/28/93	CA PRIORITIZATION--FACILITY ASSIGNED A LOW CORRECTIVE ACTION PRIORITY
2.	09/30/93	REFERRED TO A NON-RCRA FEDERAL AUTHORITY--FACILITY REFERRED TO CERCLA

HAZARDOUS WASTES

	WASTE CODE:	AMOUNT OF WASTE:	SOURCE OF INFO:
1.	P090	.00000	NOTIFICATION
2.	P120	.00000	NOTIFICATION
3.	P122	.00000	NOTIFICATION

ERIIS ENVIRONMENTAL DATA REPORT
RESOURCE CONSERVATION AND RECOVERY INFORMATION SYSTEM
RCRIS_TS - PLOTTABLE SITES - PAGE 2

ERIIS Report #120743A

Oct 28, 1996

ERIIS ID EPA ID	FACILITY	ADDRESS	RAATS ISSUE DATE RAATS ACTION/STATUS RAATS PENALTIES	DISTANCE FROM SITE	DIRECTION FROM SITE	MAP ID

	WASTE CODE:	AMOUNT OF WASTE:	SOURCE OF INFO:
4.	U002	.00000	NOTIFICATION
5.	U003	.00000	NOTIFICATION
6.	U006	.00000	NOTIFICATION
7.	U013	.00000	NOTIFICATION
8.	U031	.00000	NOTIFICATION
9.	U036	.00000	NOTIFICATION
10.	U044	.00000	NOTIFICATION
11.	U056	.00000	NOTIFICATION
12.	U057	.00000	NOTIFICATION
13.	U076	.00000	NOTIFICATION
14.	U122	.00000	NOTIFICATION
15.	U123	.00000	NOTIFICATION
16.	U140	.00000	NOTIFICATION
17.	U154	.00000	NOTIFICATION
18.	U159	.00000	NOTIFICATION
19.	U188	.00000	NOTIFICATION
20.	U209	.00000	NOTIFICATION
21.	U210	.00000	NOTIFICATION
22.	U220	.00000	NOTIFICATION
23.	U226	.00000	NOTIFICATION
24.	U239	.00000	NOTIFICATION
25.	U002	179.82400 POUNDS	PART A
26.	U003	9.97800 POUNDS	PART A
27.	U006	9.97800 POUNDS	PART A
28.	U031	9.97800 POUNDS	PART A
29.	U044	1548.63400 POUNDS	PART A
30.	U056	9.97800 POUNDS	PART A
31.	U057	9.97800 POUNDS	PART A
32.	U076	9.97800 POUNDS	PART A
33.	U122	9.97800 POUNDS	PART A
34.	U140	9.97800 POUNDS	PART A
35.	U154	49.95600 POUNDS	PART A
36.	U159	79.91200 POUNDS	PART A
37.	U188	9.97800 POUNDS	PART A
38.	U209	19.97800 POUNDS	PART A
39.	U220	109.89000 POUNDS	PART A
40.	U226	154.84600 POUNDS	PART A
41.	U210	99.91200 POUNDS	PART A
42.	U239	34.95600 POUNDS	PART A

ERIIS ENVIRONMENTAL DATA REPORT
CERCLIS NO FURTHER REMEDIAL ACTION PLANNED SITES
NFRAP - PLOTTABLE SITES - PAGE 1

ERIIS Report #120743A

Oct 28, 1996

ERIIS ID EPA ID	FACILITY	FACILITY ADDRESS	DISTANCE FROM SITE	DIRECTION FROM SITE	MAP II
42039000008 PA0971590005	DEFENSE PERSONNEL SUPPORT COUNTY: PHILADELPHIA	2800 S 20TH ST PHILADELPHIA, PA 19145-5001	0.208 MILES	NORTHEAST	8

SITE EVENT(S)	COMPLETE DATE
REMOVAL ACTION	03/01/95
REMOVAL ACTION	04/03/95
DISCOVERY	09/19/89
PRELIMINARY ASSESSMENT	02/07/92

ERIIS ENVIRONMENTAL DATA REPORT
PENNSYLVANIA UNDERGROUND STORAGE TANKS
RST - PLOTTABLE SITES - PAGE 1

ERIIS Report #120743A

Oct 28, 1996

ERIIS ID FACILITY ID	FACILITY ADDRESS	OWNER OWNER ADDRESS TELEPHONE	DISTANCE FROM SITE	DIRECTION FROM SITE	MAP ID
42010018031 51-31732	LOCATION 957 2201 W OREGON AVE PHILADELPHIA, PA 19145-4111 COUNTY: PHILADELPHIA	KAHN JOINT VENTURE 1516 LOCUST ST PHILADELPHIA, PA 19102 (215) 735-9800	0.142 MILES	NORTHEAST	8031

TANK ID	TANK SEQUENCE	CAPACITY(GAL)	SUBSTANCE	DATE INSTALLED
50357	001	00010000	HEATING OIL	12/01/1953

42010017851 51-23930	GETTY 67261 2101 W OREGON AVE PHILADELPHIA, PA 19145-4110 COUNTY: PHILADELPHIA	GETTY PETROLEUM CORP 86 DOREMUS AVE NEWARK, NJ 07105-1099 (201) 344-7860	0.172 MILES	NORTHEAST	7851

TANK ID	TANK SEQUENCE	CAPACITY(GAL)	SUBSTANCE	DATE INSTALLED
75843	001	00006000	GASOLINE	06/01/1979
75844	002	00006000	GASOLINE	06/01/1979
75845	003	00006000	GASOLINE	06/01/1979

42010017554 51-07489	SOUTH GARAGE S 20TH ST AT JOHNSTON ST PHILADELPHIA, PA 19145 COUNTY: PHILADELPHIA	SEPTA 1234 MARKET ST PHILADELPHIA, PA 19107 (215) 580-7911	0.205 MILES	NORTHEAST	7554

TANK ID	TANK SEQUENCE	CAPACITY(GAL)	SUBSTANCE	DATE INSTALLED
86305	001	00010000	DIESEL	01/01/1979
86307	003	00005000	NEW MOTOR OIL	01/01/1979
86308	004	00006000	GASOLINE	01/01/1979
86309	005	00001000	MIXTURE	01/01/1979
86310	006	00000550	MIXTURE	01/01/1979
86311	007	00000285	MIXTURE	01/01/1979
86312	008	00000550	MIXTURE	01/01/1979
86313	009	00000550	MIXTURE	01/01/1979

42010017804 51-20699	DEFENSE PERSONNEL SUPPORT CENTER 2800 S 20TH ST PHILADELPHIA, PA 19145-5099 COUNTY: PHILADELPHIA	DEFENSE PERSONNEL SUPPORT CTR DPSC XE PHILADELPHIA, PA 19101-8419 (215) 737-5883	0.220 MILES	NORTHEAST	7804

TANK ID	TANK SEQUENCE	CAPACITY(GAL)	SUBSTANCE	DATE INSTALLED
131660	004A	00002000	DIESEL	07/01/1994
131661	005A	00004000	GASOLINE	07/01/1994

42010018448 51-43174	PASSYUNK HOMES 3111 S 23RD ST PHILADELPHIA, PA 19145-5605 COUNTY: PHILADELPHIA	PHILADELPHIA HOUSING DEVELOPMENT 1234 MARKET ST PHILADELPHIA, PA 19107 (215) 684-5820	0.242 MILES	SOUTHWEST	8448

TANK ID	TANK SEQUENCE	CAPACITY(GAL)	SUBSTANCE	DATE INSTALLED
82402	001	00000550	GASOLINE	01/01/1942

42010018306 51-41929	GEORGE YOUNG CO S 20TH ST AT W OREGON AVE PHILADELPHIA, PA 19145 COUNTY: PHILADELPHIA	GEORGE YOUNG CO SW COR 20TH ST & OREGON AVE PHILADELPHIA, PA 19145 (215) 467-2200	0.248 MILES	NORTHEAST	8306

TANK ID	TANK SEQUENCE	CAPACITY(GAL)	SUBSTANCE	DATE INSTALLED
72261	001	00001000	GASOLINE	04/01/1972
72262	002	00004000	DIESEL	09/01/1975
72263	003	00006000	HEATING OIL	08/01/1973

ERIIS ENVIRONMENTAL DATA REPORT
PENNSYLVANIA CONFIRMED RELEASES
LRST - PLOTTABLE SITES - PAGE 1

ERIIS Report #120743A

Oct 28, 1996

ERIIS ID	FACILITY	ADDRESS	TYPE OF TANK	SUBSTANCE(S) RELEASED	MAP ID
42034006276	SEARS ROEBUCK & CO DISTANCE FROM SITE: 0.140 MILES DIRECTION FROM SITE: NORTHEAST	2201 W OREGON AVE PHILADELPHIA, PA 19145-4191 COUNTY: PHILADELPHIA	UNDERGROUND	WASTE OIL	6276
42034005872	DEFENSE PERSONNEL SUP CTR (SS) DISTANCE FROM SITE: 0.220 MILES DIRECTION FROM SITE: NORTHEAST	2800 S 20TH ST PHILADELPHIA, PA 19145-5099 COUNTY: PHILADELPHIA	UNDERGROUND	LEADED GASOLINE	5872
42034005873	DEFENSE PERSONNEL SUP CTR-DEWITT ST DISTANCE FROM SITE: 0.220 MILES DIRECTION FROM SITE: NORTHEAST	2800 S 20TH ST PHILADELPHIA, PA 19145-5001 COUNTY: PHILADELPHIA	UNDERGROUND	OTHER	5873
42034005874	DEFENSE PERSONNEL SUP CTR-OREGON DISTANCE FROM SITE: 0.220 MILES DIRECTION FROM SITE: NORTHEAST	2800 S 20TH ST PHILADELPHIA, PA 19145-5099 COUNTY: PHILADELPHIA	UNDERGROUND	MEDIUM DIESEL FUEL (NO 2-D)	5874
42034005780	BEVERLEA ENTERPRISES INC DISTANCE FROM SITE: 0.402 MILES DIRECTION FROM SITE: SOUTHWEST	2149 PENROSE AVE PHILADELPHIA, PA 19145-5618 COUNTY: PHILADELPHIA	UNDERGROUND	UNLEADED GASOLINE	5780
42034005816	CHECK CASH DISTANCE FROM SITE: 0.402 MILES DIRECTION FROM SITE: SOUTHWEST	2149 PENROSE AVE PHILADELPHIA, PA 19145-5618 COUNTY: PHILADELPHIA	UNDERGROUND	UNLEADED GASOLINE	5816
42034006216	PHILADELPHIA SD - POE 2321 DISTANCE FROM SITE: 0.416 MILES DIRECTION FROM SITE: NORTHEAST	22ND & RITTNER ST PHILADELPHIA, PA COUNTY: PHILADELPHIA	UNDERGROUND	HEATING OIL (NO 2)	6216
42034006032	LAIDLAW TRANSIT-RYDER LEASED PROP DISTANCE FROM SITE: 0.480 MILES DIRECTION FROM SITE: SOUTHWEST	3400 S 26TH ST PHILADELPHIA, PA 19145-5203 COUNTY: PHILADELPHIA	UNDERGROUND	UNLEADED GASOLINE	6032
42034006262	RYDER TRUCK RENTAL LEASED PROPERTY DISTANCE FROM SITE: 0.480 MILES DIRECTION FROM SITE: SOUTHWEST	3400 S 26TH ST PHILADELPHIA, PA 19145-5203 COUNTY: PHILADELPHIA	UNDERGROUND	UNLEADED GASOLINE	6262

Unplottable Sites

The remaining report pages list additional environmental sites that have been selected based on geographic criteria unique to your study site. They are classified as "unplottable sites" and require further investigation to assess their potential impact on your site.

How to Evaluate Unplottable Sites

Step 1

Streets Within the Radius: the following page is an alphabetical index of all streets that intersect or are contained within the largest study radius (usually one mile).

Step 2

Cross-Reference: use the "Streets Within the Radius" index to cross-reference the unplottable sites. For example, if Maple Avenue and Oak Avenue are listed in the street index, then any unplottable sites with a Maple Avenue or Oak Avenue address should be checked for possible impact on study site.

Questions on ERIIS' Proprietary Geocoding?

We're happy to answer any questions you might have about our data processing and **point-geocoding** (assigning a latitude and longitude to each address). Just give us a call on our toll-free number at (800) 989-0402 and let us know what state you're calling from. Our customer service staff is available from 8 a.m. to 8 p.m. (EST).

The ASTM Standard Practice For Environmental Site Assessments

As stated in the recently published **Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process** (E1527) by the American Society for Testing and Materials (ASTM):

> "For large databases with numerous facility records (such as RCRA hazardous waste generators and registered underground storage tanks), the records are not practically reviewable unless they can be obtained from the source agency in the smaller geographic area of ZIP code (3.3.24)."

Therefore, this Report contains information available by latitude/longitude or by ZIP code. If your research requires environmental records for which only city or county information is available (i.e., no valid street or ZIP code) ERIIS will include this data at no extra charge.

ERIIS LIST OF STREETS IN THE RADIUS

ERIIS Report #120743A Oct 28, 1996

STREET NAME
S 12th St
S 13th St
S 15th St
S 16th St
S 17th St
S 18st St
S 18th St
19th St
S 19th St
20th St
S 20th St
S 21st St
S 22nd St
23rd Ter
S 23rd St
24th
S 24th St
S 25th St
S 26th St
S 27th St
S 28th St
S 29th St
Aylwan Dr
Aylwyn Dr
Bailey Ter
S Bambrey St
S Bancroft St
Barbara St
Bastian Ter
S Beechwood St
Bigler Ter
Boise Pl
Bonsall Ter
S Bonsall St
S Bouvier St
Broad St Ramp
S Broad St
Buck Lane
Bucknell Ter
S Bucknell St
Burke Dr
S Camac St
Cantrell St
S Carlisle St
Cassin Pl
S Chadwick St
S Clarion St
S Cleveland St
S Colorado St
Creed Ct
Croatan Pl
Cronskey Ter
Croskey Ter
N Croskey St
S Croskey St
Curt St
Curtin Ter
Daly Ter
Denfield Pl
Dorrance St
N Dover St
Dudley St
Durfor St
Emily St
Ernest St
Etting Ter
S Etting St
Fitzgerald St
Forrestal St
S Garnet St
Geary Ter
Gladstone St
Halsey Pl
Hartranft St
Hemberger Ter
S Hemberger St
S Hicks St
Hoffman St
S Hollywood St
Homestead St
Houseman Ter
Hoyt Ter
Hulseman Ter
I 76 RAMP
I- 76
S Iseminger St
Jackson St
Jardin Ter
Johnston St
S Juniper St
Kirwin Pl
Kirwyn Pl
S Lambert St
Lanvale Pl
Leyte Pl
Marston Ter
S Marvine St
Mc Clellan St
Mc Kean St
S Mc Kean St
Mercy St

ERIIS LIST OF STREETS IN THE RADIUS

STREET NAME

Mifflin St
S Mole St
Mollbore Ter
Moore St
W Moyamensing Ave
Navy Yard Access Hwy
S Newkirk St
S Norwood St
Olympia Pl
S Opal St
Oregon Ave
Packer Ter
W Passyunk Ave
Pattison Ave
Penrose Ave
Penrose Av Ramp
Penrose Ferry Road
Pepper Ter
Pierce St
Point Breeze Ave
Pollock Ter
Porter St
W Porter St
Rambo Ter
S Ringgold St
Ritner St
Roseberry St
S Rosewood St
S Sartain St
Schley St
Schuylkill Ave
Schuylkill Exwy Ramp
Sheaff Lane
Shunk St
Sigel St
S Smedley St
Snyder Ave
Stocker St
Sydenham Pl
S Sydenham St
Taney Ter
Taylor Ter
S Taylor St
Tree Ter
S Uber St
Vare Ave
Walter St
Watkins St
S Watts St
Winton St
Wolf St
S Woodstock St

ERIIS SUMMARY OF UNPLOTTABLE SITES
(Facilities sorted alphabetically within ZIP Code)

RIIS Report #120743A Oct 28, 1996

ERIIS ID.	FACILITY/STREET	CITY/STATE/ZIP/COUNTY	DATABASE
4[illegible]002269	60TH AND ESSINGTON AVENUE 60TH AND ESSINGTON AVE.	PHILADELPHIA, PA 19101 COUNTY: PHILADELPHIA	NFRAP
42039002246	BRIDGE STREET CHEMICAL SPILL 95 SOUTHBOUND BRIDGE STREET OF	PHILADELPHIA, PA 19101 COUNTY: PHILADELPHIA	NFRAP
42039001073	CHEVRON USA INC SRTF 70TH ESSINGTON AVE	PHILADELPHIA, PA 19101 COUNTY: PHILADELPHIA	NFRAP
42034005823	CHEVRON USA INC PO BOX 7408	PHILADELPHIA, PA 19101-7408 COUNTY: PHILADELPHIA	LRST
42010018620	CHEVRON USA PHILADELPHIA REFINERY	PHILADELPHIA, PA 19101 COUNTY: PHILADELPHIA	RST
42008000989	PECO ENERGY CO CORPORATE HQ PO BOX 8699	PHILADELPHIA, PA 19101-8699 COUNTY: PHILADELPHIA	RCRIS_SG
42039001149	RICHMOND TOWN GAS W DELAWARE AVE & N VERANGOST	PHILADELPHIA, PA 19101 COUNTY: PHILADELPHIA	NFRAP
42002001217	ARAMINGO AVE IN THE FRANKFORT SECTION	PHILADELPHIA, PA 19101 COUNTY: PHILADELPHIA	ERNS
42002001348	ARAMINGO AVE IN THE FRANKFORD SECTION	PHILADELPHIA, PA 19101 COUNTY: PHILADELPHIA	ERNS

ERIIS ENVIRONMENTAL DATA REPORT
CERCLIS NO FURTHER REMEDIAL ACTION PLANNED SITES
NFRAP - UNPLOTTABLE SITES

ERIIS Report #120743A

Oct 28, 1996

ERIIS ID EPA ID	FACILITY	FACILITY ADDRESS
42039001073 PAD980555312	CHEVRON USA INC SRTF COUNTY: PHILADELPHIA	70TH ESSINGTON AVE PHILADELPHIA, PA 19101

SITE EVENT(S)	COMPLETE DATE
DISCOVERY	09/23/88
PRELIMINARY ASSESSMENT	06/13/89

ERIIS ID EPA ID	FACILITY	FACILITY ADDRESS
42039001149 PAD980707038	RICHMOND TOWN GAS COUNTY: PHILADELPHIA	W DELAWARE AVE & N VERANGOST PHILADELPHIA, PA 19101

SITE EVENT(S)	COMPLETE DATE
DISCOVERY	10/01/82
PRELIMINARY ASSESSMENT	08/28/86

ERIIS ID EPA ID	FACILITY	FACILITY ADDRESS
42039002246 PAD987327152	BRIDGE STREET CHEMICAL SPILL COUNTY: PHILADELPHIA	95 SOUTHBOUND BRIDGE STREET OF PHILADELPHIA, PA 19101

SITE EVENT(S)	COMPLETE DATE
DISCOVERY	10/04/90
PRELIMINARY ASSESSMENT	04/16/92

ERIIS ID EPA ID	FACILITY	FACILITY ADDRESS
42039002269 PAD987339710	60TH AND ESSINGTON AVENUE COUNTY: PHILADELPHIA	60TH AND ESSINGTON AVE. PHILADELPHIA, PA 19101

SITE EVENT(S)	COMPLETE DATE
DISCOVERY	05/23/91
PRELIMINARY ASSESSMENT	04/16/92

ERIIS ENVIRONMENTAL DATA REPORT
RESOURCE CONSERVATION AND RECOVERY INFORMATION SYSTEM
RCRIS_SG - UNPLOTTABLE SITES

ERIIS Report #120743A

Oct 28, 1996

ERIIS ID EPA ID	FACILITY	ADDRESS	RAATS ISSUE DATE RAATS ACTION/STATUS RAATS PENALTIES
42008000989 PAD007914468	PECO ENERGY CO CORPORATE HQ COUNTY: PHILADELPHIA	PO BOX 8699 PHILADELPHIA, PA 19101-8699	FACILITY NOT REPORTED IN RAATS

HAZARDOUS WASTES

	WASTE CODE:	AMOUNT OF WASTE:	SOURCE OF INFO:
1.	D000	.00000	NOTIFICATION
2.	D001	.00000	NOTIFICATION
3.	D002	.00000	NOTIFICATION
4.	D003	.00000	NOTIFICATION
5.	F001	.00000	NOTIFICATION
6.	F002	.00000	NOTIFICATION
7.	U226	.00000	NOTIFICATION

ERIIS ENVIRONMENTAL DATA REPORT
EMERGENCY RESPONSE NOTIFICATION SYSTEM
ERNS - UNPLOTTABLE SITES

ERIIS ID REPORT NUMBER SOURCE AGENCY	SPILL CITY, STATE, ZIP CODE SPILL COUNTY	DISCHARGER NAME ORGANIZATION ADDRESS	MEDIA AFFECTED LAND	WATER	AIR	GRND WATER	FACILITY	SPILL DATE WATER WAY AFFECTED
42002001217 304937 NATL. RESPONSE CTR	PHILADELPHIA, PA 19101 PHILADELPHIA	CONSOLIDATED RAIL CORP 2001 MARKET STREET PHILADELPHIA, PA 19101	Y	N	N	N	N	08/22/1995 SOIL

LOCATION: ARAMINGO AVE IN THE FRANKFORT SECTION
DESCRIPTION: LOCAMOTIVE FUEL TANK / RUPTURED
MATERIAL SPILLED: OIL: DIESEL QTY: 1200 GAL LBS: 8400 QTY IN WATER: 0 NON
ACTION TAKEN: LEAK IS SECURED / MATERIAL IS CONTAINED / CONTRACTORS EN ROUTE

42002001348 304937 EPA REGION	PHILADELPHIA, PA 19101 PHILADELPHIA	CONSOLIDATED RAIL CORP 2001 MARKET STREET PHILADELPHIA, PA 19101	N	N	Y	N	N	08/22/1995 NONE

LOCATION: ARAMINGO AVE IN THE FRANKFORD SECTION
DESCRIPTION: LOCOMOTIVE FUEL TANK / RUPTURED
MATERIAL SPILLED: OIL: DIESEL QTY: 1200 GAL LBS: 8400 QTY IN WATER: 0 UNK
ACTION TAKEN: LEAK IS SECURED / MATERIAL IS CONTAINED / CONTRACTORS EN ROUTE
MISCELLANEOUS: PHILA POLICE RADIO STATED THAT SOMEONE FROM EPA (NAMED "CHIQUITA") HAD ALREADYCALLED REQUESTING PATCH THROUGH TO FIRE DEPT HAZMAT TO DISPATCH A TEAM TO THE SCENE. THIS CALL OCCURRED SOMETIME JUST BEFORE I CALLED. VZ

ERIIS ENVIRONMENTAL DATA REPORT
PENNSYLVANIA CONFIRMED RELEASES
LRST - UNPLOTTABLE SITES

ERIIS Report #120743A

Oct 28, 1996

ERIIS ID	FACILITY	ADDRESS	TYPE OF TANK	SUBSTANCE(S) RELEASED
42034005823	CHEVRON USA INC	PO BOX 7408 PHILADELPHIA, PA 19101-7408 COUNTY: PHILADELPHIA	UNDERGROUND	UNLEADED GASOLINE

ERIIS ENVIRONMENTAL DATA REPORT
PENNSYLVANIA UNDERGROUND STORAGE TANKS
RST - UNPLOTTABLE SITES

ERIIS Report #120743A

Oct 28, 1996

ERIIS ID FACILITY ID	FACILITY ADDRESS	OWNER OWNER ADDRESS TELEPHONE
42010018620 51-44351	CHEVRON USA PHILADELPHIA REFINERY PHILADELPHIA, PA 19101 COUNTY: PHILADELPHIA	PETROLITE CORP 4TH & SAVILLE AVE EDDYSTONE, PA 19022 (610) 876-2200

TANK ID	TANK SEQUENCE	CAPACITY(GAL)	SUBSTANCE	DATE INSTALLED
93883	001A	00004000	HAZARDOUS SUBSTANCE	06/01/1982

EPA HAZARDOUS WASTE NUMBERS -- HAZARDOUS WASTE DESCRIPTION

D001 -- A solid waste that exhibits the characteristic of ignitability, but is not listed as a hazardous waste in Subpart D.

D002 -- A solid waste that exhibits the characteristic of corrosivity, but is not listed as a hazardous waste in Subpart D.

D003 -- A solid waste that exhibits the characteristic of reactivity, but is not listed as a hazardous waste in Subpart D.

EPA HW #	CAS #	COMMON CHEMICAL NAME
D004	7740-38-2	ARSENIC
D005	7740-39-3	BARIUM
D006	7440-43-9	CADMIUM
D007	7440-47-3	CHROMIUM
D008	7439-92-1	LEAD
D009	7439-97-6	MERCURY
D010	7782-49-2	SELENIUM
D011	7440-22-4	SILVER
D012	72-20-8	ENDRIN
D013	58-89-9	LINDANE
D014	72-43-5	METHOXYCHLOR
D015	8001-35-2	TOXAPHENE
D016	94-75-7	2,4-D
D017	93-72-1	2,4,5-TP(SILVEX)
D018	71-39-2	BENZENE
D019	56-23-5	CARBON TETRACHLORIDE
D020	57-74-9	CHLORDANE
D021	108-90-7	CHLOROBENZENE
D022	67-66-3	CHLOROFORM
D023	95-48-7	O-CRESOL
D024	108-39-4	M-CRESOL
D025	106-44-5	P-CRESOL
D026		CRESOL
D027	106-46-7	1,4-DICHLOROBENZENE
D028	107-06-2	1,2-DICHLOROETHANE
D029	75-35-4	1,1-DICHLOROETHYLENE
D030	121-14-2	2,4-DINITROTOLUENE
D031	76-44-8	HEPTACHLOR (AND ITS EPOXIDE)
D032	118-74-1	HEXACHLOROBENZENE
D033	87-68-3	HEXACHLOROBUTADIENE
D034	67-72-1	HEXACHLOROETHANE
D035	78-93-3	METHYL ETHYL KETONE
D036	98-95-3	NITROBENZENE
D037	87-86-5	PENTACHLOROPHENOL
D038	110-86-1	PYRIDINE
D039	127-18-4	TETRACHLOROETHYLENE
D040	79-01-6	TRICHLOROETHYLENE
D041	95-95-4	2,4,5-TRICHLOROPHENOL
D042	88-06-2	2,4,6-TRICHLOROPHENOL
D043	75-01-4	VINYL CHLORIDE

EPA HAZARDOUS WASTE NUMBERS -- HAZARDOUS WASTE DESCRIPTION

F001 -- The following spent halogenated solvents used in degreasing: Tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F002 -- The following spent halogenated solvents: Tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those listed in F001, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F003 -- The following spent non-halogenated solvents: Xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixtures/blends containing, before use, one or more of the above non-halogenated solvents, and, a total of ten percent or more (by volume) of one or more of those solvents listed in F001, F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F004 -- The following spent non-halogenated solvents: Cresols and cresylic acid, and nitrobenzene: all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogentaed solvents or those solvents listed in FOO1, FOO2, and FOO5; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F005 -- The following spent non-halogenated solvents: Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in FOO1, F002, or FOO4; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F006 -- Wastewater treatment sludges from electroplating operations except from the following processes: (1) Sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis) on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum.

F007 -- Spent cyanide plating bath solutions from electroplating operations.

F008 -- Plating bath residues from the bottom of plating baths from electroplating operations where cyanides are used in the process.

EPA HAZARDOUS WASTE NUMBERS -- HAZARDOUS WASTE DESCRIPTION

F009 -- Spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process.

F010 -- Quenching bath residue from oil baths from metal heat treating operations where cyanides are used in the process.

F011 -- Spent cyanide solutions from salt bath pot cleaning from metal heat treating operations.

F012 -- Quenching wastewater treatment sludges from metal heat treating operations where cyanides are used in the process.

F019 -- Wastewater treatment sludges from the chemical conversion coating of aluminum.

F020 -- Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri- or tetrachlorophenol, or of intermediates used to produce their pesticide derivatives. (This listing does not include wastes from the production of hexachlorophene from highly purified 2,4,5-trichlorophenol.)

F021 -- Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of pentachlorophenol, or of intermediates used to produce its derivatives.

F022 -- Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzenes under alkaline conditions.

F023 -- Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri- and tetrachlorophenols. (This listing does not include wastes from equipment used only for the production or use of hexachlorophene from highly purified 2,4,5- trichlorophenol.)

F024 -- Wastes, including but not limited to, distillation residues, heavy ends, tars, and reactor clean-out wastes from the production of chlorinated aliphatic hydrocarbons, having carbon content from one to five, utilizing free radical catalyzed processes. (This listing does not include light ends, spent filters and filter aids, spent dessicants, wastewater, wastewater treatment sludges, spend catalysts, and wastes listed in §261.32.)

F026 -- Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzene under alkaline conditions.

F027 -- Discarded unused formulations containing tri-, tetra-, or pentachlorophenol or discarded unused formulations containing compounds derived from these chlorophenols. (This listing does not include formulations containing hexachlorophene synthesized from prepurified 2,4,5-trichlorophenol as the sole component.)

EPA HAZARDOUS WASTE NUMBERS -- HAZARDOUS WASTE DESCRIPTION

F028 -- Residues resulting from the incineration or thermal treatment of soil contaminated with EPA Hazardous Waste Nos. FO20, FO21, FO22, FO23, FO26, and FO27.

K001 -- Bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote and/or pentachlorophenol.

K002 -- Wastewater treatment sludge from the production of chrome yellow and orange pigments.

K003 -- Wastewater treatment sludge from the production of molybdate orange pigments.

K004 -- Wastewater treatment sludge from the production of zinc yellow pigments.

K005 -- Wastewater treatment sludge from the production of chrome green pigments.

K006 -- Wastewater treatment sludge from the production of chrome oxide greenpigments (anhydrous and hydrated).

K007 -- Wastewater treatment sludge from the production of iron blue pigments.

K008 -- Oven residue from the production of chrome oxide green pigments.

K009 -- Distillation bottoms from the production of acetaldehyde from ethylene.

K010 -- Distillation side cuts from the production of acetaldehyde from ethylene.

K011 -- Bottom stream from the wastewater stripper in the production of acrylonitrile.

K013 -- Bottom stream from the acetonitrile column in the production of acrylonitrile.

K014 -- Bottoms from the acetonitrile purification column in the production of acrylonitrile.

K015 -- Still bottoms from the distillation of benzyl chloride.

K016 -- Heavy ends or distillation residues from the production of carbon tetrachloride.

K017 -- Heavy ends (still bottoms) from the purification column in the production of epichlorohydrin.

K018 -- Heavy ends from the fractionation colummn in ethyl chloride production.

K019 -- Heavy ends from the distillation of ethylene dichloride in ethylene dichloride production.

K020 -- Heavy ends from the distillation of vinly chloride in vinly chloride monomer production.

K021 -- Aqueous spend antimony catalyst waste from fluoromethane production.

K022 -- Distillation bottom tars from the production of phenol/acetone from cumene.

K023 -- Distillation light ends from the production of phthalic anhydride from naphthalene.

EPA HAZARDOUS WASTE NUMBERS -- HAZARDOUS WASTE DESCRIPTION

K024 -- Distillation bottoms from the production of phthalic anhydride from naphthalene.

K025 -- Distillation bottoms from the production of nitrobenxene by the nitration of benzene.

K026 -- Stripping still tails from the production of methyl ethyl pyridines.

K027 -- Centrifuge and distillation residues from toluene diisocyanate production.

K028 -- Spent catalyst from the hydrochlorinator reactor in the production of 1,1,1-trichloroethane.

K029 -- Wastes from the product steam stripper in the production of 1,1,1-trichloroethane.

K030 -- Column bottoms or heavy ends from the combined production of trichloroethtlene and perchloroethtlene.

K031 -- By-product salts generated in the production of MSMA and cacodylic acid.

K032 -- Wastewater treatment sludge from the production of chlordane.

K033 -- Wastewater and scrub water from the chlorination of cyclopentadiene in the production of chlordane.

K034 -- Filter solids from the filtration of hexachlorocyclopentadiene in the prodution of chlordane.

K035 -- Wastewater treatment sludges generated in the production of creosote.

K036 -- Still bottoms from toluene reclamation distillation in the production of disulfoton.

K037 -- Wastewater treatment sludges from the production of disulfoton,

K038 -- Wastewater from the washing and stripping of phorate production.

K039 -- Filter cake from the filtration of diethylphosphorodithioic acid in the productionof phorate.

K040 -- Wastewater treatment sludge from the production of phorate.

K041 -- Wastewater treatment sludge from the production of toxaphene.

K071 -- Brine purification muds from the mercury cell process in chlorine production, where separatelty prepurified brine is not used.

K073 -- Chlorinated hydrocarbon waste from the purification step of the diaphragm cell process using graphite anodes in chlorine production.

K083 -- Distillation bottoms from aniline production.

EPA HAZARDOUS WASTE NUMBERS -- HAZARDOUS WASTE DESCRIPTION

K085 -- Distillation or fractionation column bottoms from the production of chlorobenzenes.

K093 -- Distillation light ends from the production of phthalic anhydride from ortho-xylene.

K095 -- Distillation bottoms from the production of 1,1,1-trichloroethane.

K096 -- Heavy ends from the heavy ends column from the production of 1,1,1-trichloroethane.

K097 -- Vacuum stripper discharge from the chlordane chlorinator in the production of chlordane.

K098 -- Untreated process wastewater from the production of toxaphene.

K103 -- Process residues from aniline extraction from the production of aniline.

K104 -- Combined wastewater streams generated from nitrobenzene/aniline production,

K105 -- Separated aqueous stream from the reactor product washing step in the production of chlorobenzenes.

K106 - Wastewater treatment sludge from the mercury cell process in chlorine production.

K111 - Product washwaters from the production of dinitrotoluene via nitration of toluene.

K112 -- Reaction by-product water from the drying column in the production of toluenediamine via hydrogenation of dinitrotoluene.

K113 -- Condensed liquid light ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene.

K114 -- Vicinals from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene.

K115 -- Heavy ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene.

K116 -- Organic condensate from the solvent recovery column in the production of toluene diisocyanate via phosgenation of toluenediamine.

K117 -- Wastewater from the reactor vent gas scrubber in the production of ethylene dibromide via bromination of ethene.

K118 -- Spent absorbent solids from purification of ethylene dibromide in the production of ethylene dibromide via bromination of ethene.

K136 -- Still bottoms from the purification of ethylene dibromide in the production of ethylene dibromide via bromination of ethene.

EPA HAZARDOUS WASTE NUMBERS -- COMMON CHEMICAL NAME

EPA HW #	CAS #	COMMON CHEMICAL NAME
F027	88-06-2	2,4,6-TRICHLOROPHENOL
F027	58-90-2	2,3,4,6-TETRACHLOROPHENOL
F027	95-95-4	2,4,5-TRICHLOROPHENOL
F027	87-86-5	PENTACHLOROPHENOL
F027	93-76-5	2,4,5-TRICHLOROPHENOXYACETIC ACID
F027	93-72-1	SILVEX
P002	591-08-28	1-ACETYL-2-THIOUREA
P003	107-02-88	ACROLEIN
P001	81-81-2	WARFARIN
P004	309-00-28	ALDRIN
P005	107-18-68	ALLYL ALCOHOL
P006	20859-73-8	ALUMINUM PHOSPHIDE
P007	2763-96-4	MUSCIMOL
P008	504-24-58	PYRIDINE, 4-AMINO
P010	7778-39-4	ARSENIC ACID
P011	1303-28-2	ARSENIC PENTOXIDE, SOLID
P012	1327-53-3	ARSENIC TRIOXIDE, SOLID
P013	542-62-18	BARIUM CYANIDE, SOLID
P014	108-98-58	PHENYL MERCAPTAN
P015	7440-41-7	BERYLLIUM
P016	542-88-18	BIS(CHLOROMETHYL)ETHER
P017	598-31-28	BROMOACETONE
P018	357-57-38	BRUCINE
P020	88-85-7	DINOSEB
P021	592-01-88	CALCIUM CYANIDE, SOLID
P022	75-15-0	CARBON DISULFIDE
P023	107-20-08	CHLOROACETALDEHYDE
P024	106-47-88	P-CHLOROANILINE
P026	5344-82-1	1-(0-CHLOROPHENYL) THIOUREA
P027	542-76-78	3-CHLOROPROPIONITRILE
P028	100-44-78	BENZYL CHLORIDE
P029	544-92-38	CUPROUS CYANIDE
P030	57-12-5	CYANIDES (SOLUBLE SALTS AND COMPLEXES)
P031	460-19-58	CYANOGEN
P033	506-77-48	CYANOGEN CHLORIDE, INHIBITED
P034	131-89-58	4,6-DINITRO-0-CYCLOHEXYLPHENOL
P036	696-28-68	DICHLOROPHENYLARSINE
P037	60-57-1	DIELDRIN
P038	692-42-28	DIETHYLARSINE
P039	298-04-48	DISULFOTON
P040	297-97-28	THIONAZIN
P041	311-45-58	DIETHYL P-NITROPHENYL PHOSPHATE
P042	51-43-4	EPINEPHRINE
P043	55-91-4	ISOFLUROPHATE
P044	60-51-5	DIMETHOATE
P045	39196-18-4	THIOFANOX
P046	122-09-88	ALPHA, ALPHA-DIMETHYLPHENETHYLAMINE
P047	534-52-18	DINITRO-ORTHO-CRESOL

EPA HAZARDOUS WASTE NUMBERS -- COMMON CHEMICAL NAME

EPA HW #	CAS #	COMMON CHEMICAL NAME
P048	51-28-5	2,4-DINITROPHENOL
P049	541-53-78	2,4-DITHIOBIURET
P050	115-29-78	ENDOSULFAN
P051	72-20-8	ENDRIN
P054	151-56-48	ETHYLENEIMINE
P056	7782-41-4	FLUORINE
P057	640-19-78	FLUORACETAMIDE
P058	62-74-8	SODIUM FLUOROACETATE
P059	76-44-8	HEPTACHLOR
P060	465-73-68	ISODRIN
P062	757-58-48	HEXAETHYL TETRAPHOSPHATE
P063	74-90-8	HYDROGEN CYANIDE, ANHYDROUS, STABILIZED
P064	624-83-98	METHYL ISOCYANATE
P065	628-86-48	MERCURY FULMINATE
P066	16752-77-5	METHOMYL
P067	75-55-8	PROPYLENE IMINE
P068	60-34-4	METHYL HYDRAZINE
P069	75-86-5	ACETONE CYANOHYDRIN
P071	298-00-08	METHYL PARATHION
P072	86-88-4	THIOUREA, 1-NAPHTHALENYL-(ANTU)
P073	13463-39-3	NICKEL CARBONYL
P074	557-19-78	NICKEL CYANIDE
P075	54-11-5	NICOTINE
P076	10102-43-9	NITRIC OXIDE
P077	100-01-68	P-NITROANILINE
P078	10102-44-0	NITROGEN DIOXIDE
P081	55-63-0	NITROGLYCERIN
P082	62-75-9	N-NITROSODIMETHYLAMINE
P084	4549-40-0	N-NITROSOMETHYLVINYLAMINE
P085	152-16-98	SCHRADAN
P087	20816-12-0	OSMIUM TETROXIDE
P088	145-73-38	ENDOTHAL
P089	56-38-2	PARATHION
P092	62-38-4	PHENYLMERCURIC ACETATE
P093	103-85-58	PHENYLTHIOUREA
P094	298-02-28	PHORATE
P095	75-44-5	PHOSGENE
P096	7803-51-2	PHOSPHINE
P097	52-85-7	FAMPHUR
P098	151-50-88	POTASSIUM CYANIDE
P099	506-61-68	POTASSIUM SILVER CYANIDE
P100	107-12-08	ETHYL CYANIDE
P101	107-12-08	PROPIONITRILE
P102	107-19-78	PROPARGYL ALCOHOL
P103	630-10-48	SELENOUREA
P104	506-64-98	SILVER CYANIDE
P105	26628-22-8	SODIUM AZIDE (NA(N3))

EPA HAZARDOUS WASTE NUMBERS -- COMMON CHEMICAL NAME

EPA HW #	CAS #	COMMON CHEMICAL NAME
P106	143-33-98	SODIUM CYANIDE (NA(CN))
P108	57-24-9	STRYCHNINE
P109	3689-24-5	SULFOTEP
P110	78-00-2	TETRAETHYL LEAD
P111	107-49-38	TETRAETHYL PYROPHOSPHATE
P112	509-14-88	TETRANITROMETHANE
P113	1314-32-5	THALLIC OXIDE
P114	12039-52-0	SELENIOUS ACID, DITHALLIUM(1 +) SALT
P115	7446-18-6	THALLOUS SULFATE
P116	79-19-6	THIOSEMICARBAZIDE
P119	7803-55-6	AMMONIUM METAVANADATE
P120	1314-62-1	VANADIUM PENTOXIDE
P121	557-21-18	ZINC CYANIDE
P122	1314-84-7	ZINC PHOSPHIDE
P123	8001-35-2	TOXAPHENE
U001	75-07-0	ACETALDEHYDE
U002	67-64-1	ACETONE
U003	75-05-8	ACETONITRILE
U004	98-86-2	ACETOPHENONE
U005	53-96-3	2-ACETYLAMINOFLUORENE
U006	75-36-5	ACETYL CHLORIDE
U007	79-06-1	ACRYLAMIDE
U008	79-10-7	ACRYLIC ACID
U009	107-13-18	ACRYLONITRILE, INHIBITED
U010	50-07-7	MITOMYCIN C
U011	61-82-5	AMITROLE
U012	62-53-3	ANILINE
U014	492-80-88	C.I. SOLVENT YELLOW 34
U015	115-02-68	AZASERINE
U016	225-51-48	BENZ[C]ACRIDINE
U017	98-87-3	BENZAL CHLORIDE
U018	56-55-3	BENZ[A]ANTHRACENE
U019	71-43-2	BENZENE
U020	98-09-9	BENZENESULFONYL CHLORIDE
U021	92-87-5	BENZIDINE
U022	50-32-8	BENZO[A]PYRENE
U023	98-07-7	BENZOIC TRICHLORIDE
U024	111-91-18	BIS(2-CHLOROETHOXY)METHANE
U025	111-44-48	2,2'-DICHLOROETHYL ETHER
U026	494-03-18	CHLORNAPHAZINE
U027	108-60-18	BIS(2-CHLOROISOPROPYL)ETHER
U028	117-81-78	DI-(2-ETHYLHEXYL)PHTHALATE
U029	74-83-9	METHYL BROMIDE
U030	101-55-38	4-BROMOPHENYL PHENYL ETHER
U031	71-36-3	N-BUTYL ALCOHOL
U032	13765-19-0	CALCIUM CHROMATE
U033	353-50-48	CARBONIC DIFLUORIDE
U034	75-87-6	ACETALDEHYDE, TRICHLORO-

EPA HAZARDOUS WASTE NUMBERS -- COMMON CHEMICAL NAME

EPA HW #	CAS #	COMMON CHEMICAL NAME
U035	305-03-38	CHLORAMBUCIL
U036	57-74-9	CHLORDANE
U037	108-90-78	CHLOROBENZENE
U038	510-15-68	CHLOROBENZILATE
U039	59-50-7	4-CHLORO-M-CRESOL
U041	106-89-88	EPICHLOROHYDRIN
U042	110-75-88	2-CHLOROETHYL VINYL ETHER
U043	75-01-4	VINYL CHLORIDE
U044	67-66-3	CHLOROFORM
U045	74-87-3	METHYL CHLORIDE
U046	107-30-28	CHLOROMETHYL METHYL ETHER
U047	91-58-7	BETA-CHLORONAPHTHALENE
U048	95-57-8	0-CHLOROPHENOL
U049	3165-93-3	4-CHLORO-O-TOLUIDINE HYDROCHLORIDE
U050	218-01-98	1,2-BENZPHENANTHRENE
U051	8021-39-4	WOOD CREOSOTE
U052	1319-77-3	CRESOL
U053	4170-30-3	CROTONALDEHYDE
U055	98-82-8	CUMENE
U056	110-82-78	CYCLOHEXANE
U057	108-94-18	CYCLOHEXANONE
U058	50-18-0	CYCLOPHOSPHAMIDE
U059	20830-81-3	DAUNOMYCIN
U060	72-54-8	1,1-DICHLORO-2,2-BIS (P-CHLOROPHENYL)ETHANE
U061	50-29-3	DICHLORODIPHENYLTRICHLOROETHANE
U062	2303-16-4	DIALLATE
U063	53-70-3	DIBENZ(A,H)ANTHRACENE
U064	189-55-98	DIBENZO(A,I)PYRENE
U066	96-12-8	1,2-DIBROMO-3-CHLOROPROPANE
U067	106-93-48	ETHYLENE DIBROMIDE
U068	74-95-3	METHYLENE BROMIDE
U069	84-74-2	DIBUTYL PHTHALATE
U070	95-50-1	0-DICHLOROBENZENE, LIQUID
U071	541-73-18	M-DICHLOROBENZENE
U072	106-46-78	P-DICHLOROBENZENE
U073	91-94-1	3,3'-DICHLOROBENZIDINE
U074	764-41-08	1,4-DICHLORO-2-BUTENE (I,T)
U075	75-71-8	DICHLORODIFLUOROMETHANE
U076	75-34-3	1,1-DICHLOROETHANE
U077	107-06-28	ETHYLENE DICHLORIDE
U078	75-35-4	VINYLIDENE CHLORIDE
U079	156-60-58	TRANS-1,2-DICHLOROETHYLENE
U080	75-09-2	DICHLOROMETHANE
U081	120-83-28	2,4-DICHLOROPHENOL
U082	87-65-0	2,6-DICHLOROPHENOL
U083	78-87-5	PROPYLENE DICHLORIDE
U084	542-75-68	1,3-DICHLOROPHENOL

EPA HAZARDOUS WASTE NUMBERS -- COMMON CHEMICAL NAME

EPA HW #	CAS #	COMMON CHEMICAL NAME
U085	1464-53-5	2,2-BIOXIRANE
U086	1615-80-1	1,2-DIETHYLHYDRAZINE
U087	3288-58-2	0,0-DIETHYL S-METHYL DITHIOPHOSPHATE
U088	84-66-2	DIETHYL PHTHALATE
U089	56-53-1	DIETHYLSTILBESTROL
U090	94-58-6	DIHYDROSAFROLE
U091	119-90-48	3,3'-DIMETHOXYBENZIDINE
U092	124-40-38	DIMETHYLAMINE, ANHYDROUS
U093	60-11-7	4-DIMETHYLAMINOAZOBENZENE
U094	57-97-6	7,12-DIMETHYLBENZ(A)ANTHRACENE
U095	119-93-78	3,3'-DIMETHYLBENZIDINE
U096	80-15-9	CUMENE HYDROPEROXIDE
U097	79-44-7	DIMETHYLCARBAMOYL CHLORIDE
U099	540-73-88	1,2-DIMETHYLHYDRAZINE
U101	105-67-98	2,4-XYLENOL
U102	131-11-38	DIMETHYL PHTHALATE
U103	77-78-1	DIMETHYL SULFATE
U105	121-14-28	2,4-DINITROTOLUENE
U106	606-20-28	2,6-DINITROTOLUENE
U107	117-84-08	DIOCTYL PHTHALATE
U108	123-91-18	1,4-DIOXANE
U109	122-66-78	1,2-DIPHENYLHYDRAZINE
U110	142-84-78	DIPROPYLAMINE
U111	621-64-78	N-NITROSODI-N-PROPYLAMINE
U112	141-78-68	ETHYL ACETATE
U113	140-88-58	ETHYL ACRYLATE
U114	111-54-68	ETHYLENEBIS(DITHIOCARBAMIC ACID)
U115	75-21-8	ETHYLENE OXIDE
U116	96-45-7	ETHYLENE THIOUREA
U117	60-29-7	ETHYL ETHER
U118	97-63-2	ETHYL METHACRYLATE
U119	62-50-0	ETHYL METHANESULFONATE
U120	206-44-08	FLUORANTHENE
U121	75-69-4	FLUOROTRICHLOROMETHANE
U122	50-00-0	FORMALDEHYDE GAS
U123	64-18-6	FORMIC ACID
U124	110-00-98	FURAN
U125	98-01-1	FURFURAL
U126	765-34-48	GLYCIDALDEHYDE
U127	118-74-18	HEXACHLOROBENZENE
U128	87-68-3	HEXACHLOROBUTADIENE
U129	58-89-9	LINDANE
U130	77-47-4	HEXACHLOROCYCLOPENTADIENE
U131	67-72-1	HEXACHLOROETHANE
U132	70-30-4	HEXACHLOROPHENE
U133	302-01-28	HYDRAZINE, ANHYDROUS

EPA HAZARDOUS WASTE NUMBERS -- COMMON CHEMICAL NAME

EPA HW #	CAS #	COMMON CHEMICAL NAME
U134	7664-39-3	HYDROGEN FLUORIDE SOLUTION
U134	7664-39-3	HYDROGEN FLUORIDE
U135	7783-06-4	HYDROGEN SULFIDE
U136	75-60-5	CACODYLIC ACID
U137	193-39-58	INDENO(1,2,3-CD)PYRENE
U138	74-88-4	METHYL IODIDE
U139	9004-66-4	IRON DEXTRAN COMPLEX
U140	78-83-1	ISOBUTYL ALCOHOL
U141	120-58-18	ISOSAFROLE
U142	143-50-08	CHLORDECONE
U143	303-34-48	LASIOCARPINE
U144	301-04-28	LEAD ACETATE
U145	7446-27-7	LEAD PHOSPHATE
U146	1335-32-6	LEAD SUBACETATE
U147	108-31-68	MALEIC ANHYDRIDE
U148	123-33-18	MALEIC HYDRAZIDE
U149	109-77-38	MALONONITRILE
U150	148-82-38	MELPHALAN
U151	7439-97-6	MERCURY
U152	126-98-78	METHACRYLONITRILE
U153	74-93-1	METHYL MERCAPTAN
U154	67-56-1	METHYL ALCOHOL
U155	91-80-5	METHAPYRILENE
U156	79-22-1	METHYL CHLOROFORMATE
U157	56-49-5	3-METHYLCHOLANTHRENE
U158	101-14-48	4,4'-METHYLENEBIS(2-CHLOROBENZENAMINE)
U159	78-93-3	METHYL ETHYL KETONE
U160	1338-23-4	2-BUTANONE PEROXIDE
U161	108-10-18	METHYL ISOBUTYL KETONE
U162	80-62-6	METHYL METHACRYLATE, INHIBITED
U163	70-25-7	N-METHYL-N'-NITRO-N-NITROSOGUANIDINE
U164	56-04-2	METHYLTHIOURACIL
U165	91-20-3	NAPHTHALENE
U166	130-15-48	1,4-NAPHTHOQUINONE
U167	134-32-78	ALPHA-NAPHTHYLAMINE
U168	91-59-8	BETA-NAPHTHYLAMINE
U169	98-95-3	NITROBENZENE, LIQUID
U170	100-02-78	P-NITROPHENOL
U171	79-46-9	2-NITROPROPANE
U172	924-16-38	N-NITROSODI-N-BUTYLAMINE
U173	1116-54-7	N-NITROSODIETHANOLAMINE
U174	55-18-5	ETHANAMINE,N-ETHYL-N-NITROSO-
U176	759-73-98	N-NITROSO-N-ETHYLUREA
U177	684-93-58	N-NITROSO-N-METHYLUREA
U178	615-53-28	N-NITRO-N-METHYLURETHANE
U179	100-75-48	N-NITROSOPIPERIDINE
U180	930-55-28	N-NITROSOPYRROLIDINE
U181	99-55-8	5-NITRO-O-TOLUIDINE

EPA HAZARDOUS WASTE NUMBERS -- COMMON CHEMICAL NAME

EPA HW #	CAS #	COMMON CHEMICAL NAME
U182	123-63-78	PARALDEHYDE
U183	608-93-58	PENTACHLOROBENZENE
U184	76-01-7	PENTACHLOROETHANE
U185	82-68-8	PENTACHLORONITROBENZENE
U186	504-60-98	1,3-PENTADIENE
U187	62-44-2	PHENACETIN
U188	108-95-28	PHENOL
U189	1314-80-3	PHOSPHOROUS PENTASULFIDE
U190	85-44-9	PHTHALIC ANHYDRIDE
U191	109-06-88	2-PICOLINE
U192	23950-58-5	PRONAMIDE
U193	1120-71-4	PROPANE SULTONE
U194	107-10-88	PROPYLAMINE
U196	110-86-18	PYRIDINE
U197	106-51-48	QUINONE
U200	50-55-5	RESERPINE
U201	108-46-38	RESORCINOL
U202	81-07-2	SACCHARIN
U203	94-59-7	SAFROLE
U204	7783-00-8	SELENIOUS ACID
U205	7488-56-4	SELENIUM DISULFIDE
U206	18883-66-4	STREPTOZOTOCIN
U207	95-94-3	1,2,4,5-TETRACHLOROBENZENE
U208	630-20-68	1,1,1,2-TETRACHLOROETHANE
U209	79-34-5	1,1,2,2-TETRACHLOROETHANE
U210	127-18-48	TETRACHLOROETHYLENE
U211	56-23-5	CARBON TETRACHLORIDE
U212	58-90-2	2,3,4,6-TETRACHLOROPHENOL
U213	109-99-98	TETRAHYDROFURAN
U214	563-68-88	THALLIUM ACETATE
U215	6533-73-9	THALLOUS CARBONATE
U216	7791-12-0	THALLIUM CHLORIDE
U217	10102-45-1	THALLIUM NITRATE
U218	62-55-5	THIOACETAMIDE
U219	62-56-6	THIOUREA
U220	108-88-38	TOLUENE
U221	25376-45-8	TOLUENEDIAMINE
U222	636-21-58	O-TOLUIDINE HYDROCHLORIDE
U223	26471-62-5	TOLUENE DIISOCYANATE (MIXED ISOMERS)
U225	75-25-2	BROMOFORM
U226	71-55-6	METHYL CHLOROFORM
U227	79-00-5	1,1,2-TRICHLOROETHANE
U228	79-01-6	TRICHLOROETHYLENE
U230	88-06-2	2,4,6-TRICHLOROPHENOL
U232	93-76-5	2,4,5-T ACID
U233	93-72-1	SILVEX (2,4,5-TP)
U234	99-35-4	1,3,5-TRINITROBENZENE

EPA HAZARDOUS WASTE NUMBERS -- COMMON CHEMICAL NAME

EPA HW #	CAS #	COMMON CHEMICAL NAME
U235	126-72-78	TRIS
U236	72-57-1	TRYPAN BLUE
U237	66-75-1	URACIL MUSTARD
U238	51-79-6	URETHANE
U239	95-47-6	O-XYLENE
U239	106-42-38	P-XYLENE
U239	108-38-38	M-XYLENE
U239	1330-20-7	XYLENE (MIXED ISOMERS)
U239	95-47-6	BENZENE, O-DIMETHYL-
U239	106-42-38	BENZENE, P-DIMETHYL-
U239	108-38-38	BENZENE, M-DIMETHYL-
U240	94-75-7	2,4-DICHLOROPHENOXYACETIC ACID
U242	87-86-5	PENTACHLOROPHENOL
U243	1888-71-7	HEXACHLOROPROPENE
U244	137-26-88	THIRAM
U246	506-68-38	CYANOGEN BROMIDE
U247	72-43-5	METHOXYCHLOR
U248	506-68-38	CYANOGEN BROMIDE
U249	1314-84-7	ZINC PHOSPHIDE (CONC.< =10%)
U328	95-53-4	O-YOLUIDINE
U353	106-49-08	P-TOLUIDINE
U359	110-80-58	2-ETHOXYETHANOL

ENVIRONMENTAL RISK INFORMATION & IMAGING SERVICES
AERIAL PHOTOGRAPH SEARCH REPORT

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ERIIS Report #120743A

Oct 28, 1996
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VENDOR NAME	STREET	STATE	ZIP	PHONE
AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE	AERAIL PHOTOGRAPHY FIELD OFFICE P O BOX 30010	UT	84130-0010	(801) 975-3503

DATE OF COVERAGE	SENSOR CLASS	PROJECT CODE	SCALE	FOCAL LENGTH	FILM TYPE	CLOUD COVER	QUADRANGLE COVERAGE	REMARKS
1982 APR	VERTICAL CARTO (IMPLIES STEREO)	NHAP	58000	8.25in OR 210mm	COLOR	0%	100%	HIGH ALT PRGM

SOIL CONSERVATION SERVICE AERIAL PHOTOGRPAHY FIELD OFFICE	P O BOX 30010	UT	84130-0010	(801) 975-3503

DATE OF COVERAGE	SENSOR CLASS	PROJECT CODE	SCALE	FOCAL LENGTH	FILM TYPE	CLOUD COVER	QUADRANGLE COVERAGE	REMARKS
1970	VERTICAL CARTO (IMPLIES STEREO)	EWY	38000	6.00in OR 152mm	B&W	0%	90%	

NATIONAL OCEAN SERVICE NOAA/COAST AND GEODETIC SURVEY SUPPORT	OAA/COAST AND GEODETIC SURVEY S	MD	20910-3282	(301) 713-2692

DATE OF COVERAGE	SENSOR CLASS	PROJECT CODE	SCALE	FOCAL LENGTH	FILM TYPE	CLOUD COVER	QUADRANGLE COVERAGE	REMARKS
1944 AUG 09	VERTICAL CARTO (IMPLIES STEREO)	44C-9	20000	3.46in OR 88mm	B&W	0%	20%	133CNE 2828-2832
1946 MAR 01	VERTICAL CARTO (IMPLIES STEREO)	46D	16000	6.00in OR 152mm	B&W	0%	20%	133-C 1637-1653
1946 MAR 01	VERTICAL CARTO (IMPLIES STEREO)	46D	16000	6.00in OR 152mm	B&W	0%	30%	133-C 1696-1705
1946 MAR 01	VERTICAL CARTO (IMPLIES STEREO)	46D	16000	6.00in OR 152mm	B&W	0%	30%	133-C 1711-1723
1946 MAR 01	VERTICAL CARTO (IMPLIES STEREO)	46D	16000	6.00in OR 152mm	B&W	0%	50%	133-C 1671-1685
1946 MAR 01	VERTICAL CARTO (IMPLIES STEREO)	46D-2	16000	6.00in OR 152mm	B&W	0%	30%	133-C 1734-1742
1957 AUG 23	VERTICAL CARTO (IMPLIES STEREO)	57W-2	20000	6.00in OR 152mm	B&W	0%	20%	133CN4 6616-6620
1960 MAY 06	VERTICAL CARTO (IMPLIES STEREO)	60S	20000	6.00in OR 152mm	B&W	0%	40%	133-C 3162-3170
1960 MAY 06	VERTICAL CARTO (IMPLIES STEREO)	60S	36000	6.00in OR 152mm	B&W	0%	20%	133-C 2952-2965
1960 MAY 06	VERTICAL CARTO (IMPLIES STEREO)	60S	36000	6.00in OR 152mm	B&W	0%	30%	133-C 2972-2990
1960 MAY 06	VERTICAL CARTO (IMPLIES STEREO)	60S-1	20000	6.00in OR 152mm	B&W	0%	50%	133-C 3137-3147
1960 MAY 06	VERTICAL CARTO (IMPLIES STEREO)	60S-2	20000	6.00in OR 152mm	B&W	0%	50%	133-C 3149-3158
1960 MAY 06	VERTICAL CARTO (IMPLIES STEREO)	60S-2	36000	6.00in OR 152mm	B&W	0%	50%	133-C 3021-3025
1960 JUL 24	VERTICAL CARTO (IMPLIES STEREO)	60S	37000	6.00in OR 152mm	B&W	0%	60%	133-C 8790-8796
1962 NOV 19	VERTICAL CARTO (IMPLIES STEREO)	62W	36000	6.00in OR 152mm	B&W	0%	70%	133-C 2511-2516
1965 JUN 13	VERTICAL CARTO (IMPLIES STEREO)	65S	30000	6.00in OR 152mm	B&W	0%	30%	133CN6 4689-4697
1965 JUN 25	VERTICAL CARTO (IMPLIES STEREO)	65S-1	30000	6.00in OR 152mm	B&W	0%	20%	133CN6 4967-4970
1965 JUN 25	VERTICAL CARTO (IMPLIES STEREO)	65S-2	30000	6.00in OR 152mm	B&W	0%	30%	133CN6 4925-4936
1965 JUN 25	VERTICAL CARTO (IMPLIES STEREO)	65S-6	30000	6.00in OR 152mm	B&W	0%	40%	133CN6 4952-4963
1968 APR 02	VERTICAL CARTO (IMPLIES STEREO)	68E-2	30000	6.00in OR 152mm	B&W	0%	20%	133CN6 3111-3117
1970 SEP 02	VERTICAL CARTO (IMPLIES STEREO)	70L	30000	6.00in OR 152mm	B&W	0%	20%	133CN6 8033-8034
1972 APR 26	VERTICAL CARTO (IMPLIES STEREO)	72E-1	20000	6.00in OR 152mm	COLOR	0%	20%	133CNE 1811-1816
1973 JUN 15	VERTICAL CARTO (IMPLIES STEREO)	73L-1	36000	6.00in OR 152mm	B&W	0%	20%	133CN6 5999-6002
1973 JUN 15	VERTICAL CARTO (IMPLIES STEREO)	73L-2	36000	6.00in OR 152mm	B&W	0%	20%	133CN6 5946-5956
1973 JUN 15	VERTICAL CARTO (IMPLIES STEREO)	73L-3	36000	6.00in OR 152mm	B&W	0%	50%	133CN6 6013-6026
1973 SEP 19	VERTICAL CARTO (IMPLIES STEREO)	73L-1	36000	6.00in OR 152mm	B&W	0%	30%	133CN6 8195-8201
1975 APR 01	VERTICAL CARTO (IMPLIES STEREO)	75C-1	60000	3.46in OR 88mm	COLOR	0%	80%	133-CD 5699-5713
1975 APR 01	VERTICAL CARTO (IMPLIES STEREO)	75C-1	60000	3.46in OR 88mm	COLOR	0%	80%	133D-3 5699-5705
1975 AUG 28	VERTICAL CARTO (IMPLIES STEREO)	75B	20000	6.00in OR 152mm	COLOR	0%	20%	133-CD 4878-4887
1975 AUG 28	VERTICAL CARTO (IMPLIES STEREO)	75B	20000	6.00in OR 152mm	COLOR	0%	20%	133D-3 4889-4897
1975 AUG 28	VERTICAL CARTO (IMPLIES STEREO)	75B	20000	6.00in OR 152mm	COLOR	0%	30%	133D-3 4878-4887
1975 AUG 28	VERTICAL CARTO (IMPLIES STEREO)	75B	20000	6.00in OR 152mm	COLOR	0%	40%	133-CD 4889-4897
1975 AUG 28	VERTICAL CARTO (IMPLIES STEREO)	75B-14	20000	6.00in OR 152mm	COLOR	0%	20%	133D-3 4839-4842
1975 AUG 28	VERTICAL CARTO (IMPLIES STEREO)	75B-15	20000	6.00in OR 152mm	COLOR	0%	30%	133D-3 4843-4848
1975 AUG 28	VERTICAL CARTO (IMPLIES STEREO)	75B-6	20000	6.00in OR 152mm	COLOR	0%	30%	133-CD 4812-4819

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VENDOR NAME | STREET | STATE | ZIP | PHONE

DATE OF COVERAGE	SENSOR CLASS	PROJECT CODE	SCALE	FOCAL LENGTH	FILM TYPE	CLOUD COVER	QUADRANGLE COVERAGE	REMARKS
1975 AUG 28	VERTICAL CARTO (IMPLIES STEREO)	75B-8	20000	6.00in OR 152mm	COLOR	0%	50%	133-CD 4839-4848
1977 JUN 04	VERTICAL CARTO (IMPLIES STEREO)	77B-2	36000	6.00in OR 152mm	B&W	0%	30%	133CD9 5555-5561
1977 JUN 04	VERTICAL CARTO (IMPLIES STEREO)	77B-3	36000	6.00in OR 152mm	B&W	0%	50%	133CD9 5563-5565
1977 JUN 22	VERTICAL CARTO (IMPLIES STEREO)	77B	36000	6.00in OR 152mm	B&W	0%	20%	133CD9 5697-5705

U S AIR FORCE DEPT OF THE AIR FORCE EDC (800) USA-MAPS

DATE OF COVERAGE	SENSOR CLASS	PROJECT CODE	SCALE	FOCAL LENGTH	FILM TYPE	CLOUD COVER	QUADRANGLE COVERAGE	REMARKS
1960 JAN 01	VERTICAL CARTO (IMPLIES STEREO)	59035	60000	UNKOWN	B&W	0%	100%	1 0950102

U S ARMY DEPT OF THE ARMY EDC (800) USA-MAPS

DATE OF COVERAGE	SENSOR CLASS	PROJECT CODE	SCALE	FOCAL LENGTH	FILM TYPE	CLOUD COVER	QUADRANGLE COVERAGE	REMARKS
1957 APR 30	VERTICAL CARTO (IMPLIES STEREO)	550	60000	UNKOWN	B&W	0%	100%	1 520940834

U S GEOLOGICAL SURVEY RESTON ESIC 507 NATIONAL CENTER VA 22092 (703) 648-5920

DATE OF COVERAGE	SENSOR CLASS	PROJECT CODE	SCALE	FOCAL LENGTH	FILM TYPE	CLOUD COVER	QUADRANGLE COVERAGE	REMARKS
1965 APR 17	VERTICAL CARTO (IMPLIES STEREO)	VBEM	24045	OTHER	B&W	0%	100%	
1973 MAR 27	VERTICAL CARTO (IMPLIES STEREO)	VDFM	24037	OTHER	B&W	0%	100%	
1981 APR 10	VERTICAL RECONNAISSANCE	CITY	58000	OTHER	COLOR	0%	100%	
1981 APR 10	VERTICAL RECONNAISSANCE	CITY	59694	OTHER	COLOR	0%	100%	
1990 MAR 08	VERTICAL CARTO (IMPLIES STEREO)	VFNDC	24000	OTHER	COLOR	0%	100%	
1967 OCT 20	VERTICAL CARTO (IMPLIES STEREO)	PUHS	24142	OTHER	B&W	0%	100%	
1982 APR 01	VERTICAL CARTO (IMPLIES STEREO)	N3975	58000	OTHER	COLOR	0%	100%	
1983 MAR 01	VERTICAL CARTO (IMPLIES STEREO)	N3975	80000	OTHER	B&W	0%	100%	
1988 JUN	SLAR	RADWIL	0250000	OTHER	B&W	UNK	100%	WILMINGTON W
1991	VERTICAL CARTO (IMPLIES STEREO)	NP9067	0040000	6.00in OR 152mm	COLOR	0%	100%	NAPP-LEAF OFF
1987	VERTICAL CARTO (IMPLIES STEREO)	NP8707	0040000	6.00in OR 152mm	COLOR	0%	100%	NAPP-LEAF ON

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, AMES RESEARCH CNTR CONTACT U S GEOLOGICAL SURVEY ESIC OFFICES (800) USA-MAPS

DATE OF COVERAGE	SENSOR CLASS	PROJECT CODE	SCALE	FOCAL LENGTH	FILM TYPE	CLOUD COVER	QUADRANGLE COVERAGE	REMARKS
1972 DEC 03	VERTICAL RECONNAISSANCE	00848	127000	6.00in OR 152mm	COLOR	10%	100%	572000848 6768 6
1974 FEB 05	VERTICAL RECONNAISSANCE	01603	131000	6.00in OR 152mm	COLOR	0%	100%	574001603 5900 5
1975 OCT 22	VERTICAL RECONNAISSANCE	02260	126857	1.97in OR 50mm	COLOR	0%	100%	575002260 8902 8
1982 NOV 16	VERTICAL RECONNAISSANCE	03155	125000	1.97in OR 50mm	COLOR	10%	50%	582003155 1750 1
1988 NOV 01	VERTICAL RECONNAISSANCE	03806	64923	12.00in OR	COLOR	0%	100%	588003806 4424 4
1989 JUL 02	VERTICAL RECONNAISSANCE	03880	65000	12.00in OR	COLOR	20%	70%	589003880 8805 8
1989 JUL 02	VERTICAL RECONNAISSANCE	03880	65000	12.00in OR	COLOR	30%	70%	589003880 8799 8
1989 JUL 09	VERTICAL RECONNAISSANCE	03883	65000	12.00in OR	COLOR	0%	60%	589003883 9281 9
1989 JUL 09	VERTICAL RECONNAISSANCE	03883	65000	12.00in OR	COLOR	10%	100%	589003883 9283 9
1989 JUL 09	VERTICAL RECONNAISSANCE	03883	65000	12.00in OR	COLOR	20%	70%	589003883 9284 9

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, JS JOHNSON SPACE CENTER (800) USA-MPAS

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AERIAL PHOTOGRAPH SEARCH REPORT

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For site-specific photo availablity and ordering, please call the individual source agency or call
AIC at 1-800-945-9509 or fax this page to AIC at 512-478-5215.

VENDOR NAME	STREET	STATE	ZIP	PHONE

DATE OF COVERAGE	SENSOR CLASS	PROJECT CODE	SCALE	FOCAL LENGTH	FILM TYPE	CLOUD COVER	QUADRANGLE COVERAGE	REMARKS
1969 SEP 14	VERTICAL RECONNAISSANCE	1030	65469	12.00in OR	COLOR	0%	20%	61030008C 0140 0
1969 SEP 14	VERTICAL RECONNAISSANCE	1030	120427	6.00in OR 152mm	COLOR	0%	30%	61030007A 6263 6
1969 SEP 14	VERTICAL RECONNAISSANCE	1030	122158	6.00in OR 152mm	COLOR	0%	30%	61030009B 6589 6
1969 SEP 14	VERTICAL RECONNAISSANCE	1030	122501	6.00in OR 152mm	COLOR	0%	30%	61030007A 6273 6
1969 SEP 14	VERTICAL RECONNAISSANCE	1030	122704	6.00in OR 152mm	COLOR	0%	70%	61030009B 6600 6
1969 SEP 14	VERTICAL RECONNAISSANCE	1030	124697	6.00in OR 152mm	COLOR	0%	80%	61030007A 6279 6
1970 SEP 22	VERTICAL RECONNAISSANCE	1440	121845	6.00in OR 152mm	COLOR	0%	100%	614400100 7036 7
1970 SEP 23	VERTICAL RECONNAISSANCE	1440	64753	6.00in OR 152mm	COLOR	0%	60%	614400210 0308 0
1970 SEP 23	VERTICAL RECONNAISSANCE	1440	64938	6.00in OR 152mm	COLOR	0%	50%	614400210 0358 0
1970 SEP 23	VERTICAL RECONNAISSANCE	1440	65028	6.00in OR 152mm	COLOR	0%	30%	614400210 0434 0
1970 SEP 23	VERTICAL RECONNAISSANCE	1440	121704	6.00in OR 152mm	COLOR	0%	20%	614400190 7198 7
1970 SEP 23	VERTICAL RECONNAISSANCE	1440	121964	6.00in OR 152mm	COLOR	0%	100%	614400190 7193 7
1970 SEP 23	VERTICAL RECONNAISSANCE	1440	122176	6.00in OR 152mm	COLOR	10%	100%	614400200 6870 6
1970 SEP 23	VERTICAL RECONNAISSANCE	1440	122515	6.00in OR 152mm	COLOR	0%	100%	614400200 6841 6
1970 SEP 23	VERTICAL RECONNAISSANCE	1440	123862	6.00in OR 152mm	COLOR	0%	100%	614400190 7220 7
1970 SEP 23	VERTICAL RECONNAISSANCE	1440	124583	6.00in OR 152mm	COLOR	0%	100%	614400190 7258 7
1970 SEP 23	VERTICAL RECONNAISSANCE	1440	124910	6.00in OR 152mm	COLOR	0%	80%	614400200 6903 6
1970 SEP 23	VERTICAL RECONNAISSANCE	1440	124955	6.00in OR 152mm	COLOR	0%	40%	614400200 6845 6
1970 SEP 25	VERTICAL RECONNAISSANCE	1440	66968	12.00in OR	COLOR	10%	20%	614400390 0005 0
1970 SEP 25	VERTICAL RECONNAISSANCE	1440	66968	12.00in OR	COLOR	20%	70%	614400390 0009 0
1970 SEP 25	VERTICAL RECONNAISSANCE	1440	122053	6.00in OR 152mm	COLOR	30%	100%	614400370 7501 7
1970 SEP 25	VERTICAL RECONNAISSANCE	1440	123244	6.00in OR 152mm	COLOR	10%	50%	614400380 7153 7
1970 SEP 25	VERTICAL RECONNAISSANCE	1440	123702	6.00in OR 152mm	COLOR	30%	100%	614400380 7149 7
1970 SEP 25	VERTICAL RECONNAISSANCE	1440	125334	6.00in OR 152mm	COLOR	10%	50%	614400370 7505 7
1971 MAY 19	VERTICAL RECONNAISSANCE	1660	118338	6.00in OR 152mm	COLOR	0%	60%	616600330 5728 5
1971 MAY 19	VERTICAL RECONNAISSANCE	1660	118391	6.00in OR 152mm	COLOR	0%	50%	616600350 8729 8
1971 MAY 19	VERTICAL RECONNAISSANCE	1660	119039	6.00in OR 152mm	COLOR	0%	100%	616600350 8735 8
1971 MAY 19	VERTICAL RECONNAISSANCE	1660	119489	6.00in OR 152mm	COLOR	0%	100%	616600330 5734 5
1973 MAY 14	VERTICAL RECONNAISSANCE	2380	20480	6.00in OR 152mm	COLOR	0%	20%	623800010 0169 0
1975 APR 17	VERTICAL RECONNAISSANCE	3060	58000	12.00in OR	COLOR	0%	50%	630600620 0001 0
1975 APR 17	VERTICAL RECONNAISSANCE	3060	58000	12.00in OR	COLOR	0%	50%	630600610 0001 0
1975 AUG 28	VERTICAL RECONNAISSANCE	3170	57000	12.00in OR	COLOR	0%	70%	631700090 0051 0
1975 AUG 28	VERTICAL RECONNAISSANCE	3170	57000	12.00in OR	COLOR	0%	70%	631700080 0051 0

NEW JERSEY DEPT OF TRANSPORTATION GRAPHICS, CARTOGRAPHY AND GIS	1035 PARKWAY AVE CN600	NJ	08625	(609) 530-2845

DATE OF COVERAGE	SENSOR CLASS	PROJECT CODE	SCALE	FOCAL LENGTH	FILM TYPE	CLOUD COVER	QUADRANGLE COVERAGE	REMARKS
1972	VERTICAL CARTO (IMPLIES STEREO)		24000	6.00in OR 152mm	B&W	UNK	100%	

NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION AND ENERGY	9 EWING ST CN 401	NJ	08625	(609) 633-7369

DATE OF COVERAGE	SENSOR CLASS	PROJECT CODE	SCALE	FOCAL LENGTH	FILM TYPE	CLOUD COVER	QUADRANGLE COVERAGE	REMARKS
1978 JUL	VERTICAL CARTO (IMPLIES STEREO)		12000	6.00in OR 152mm	COLOR	0%	30%	TD057
1978 JUL	VERTICAL CARTO (IMPLIES STEREO)		12000	6.00in OR 152mm	COLOR	0%	30%	TD057
1972 JUL	VERTICAL CARTO (IMPLIES STEREO)		12000	6.00in OR 152mm	COLOR	0%	40%	
1972 JUL	VERTICAL CARTO (IMPLIES STEREO)		12000	6.00in OR 152mm	COLOR	0%	60%	

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AIC at 1-800-945-9509 or fax this page to AIC at 512-478-5215.

ERIIS Report #120743A

Oct 28, 1996

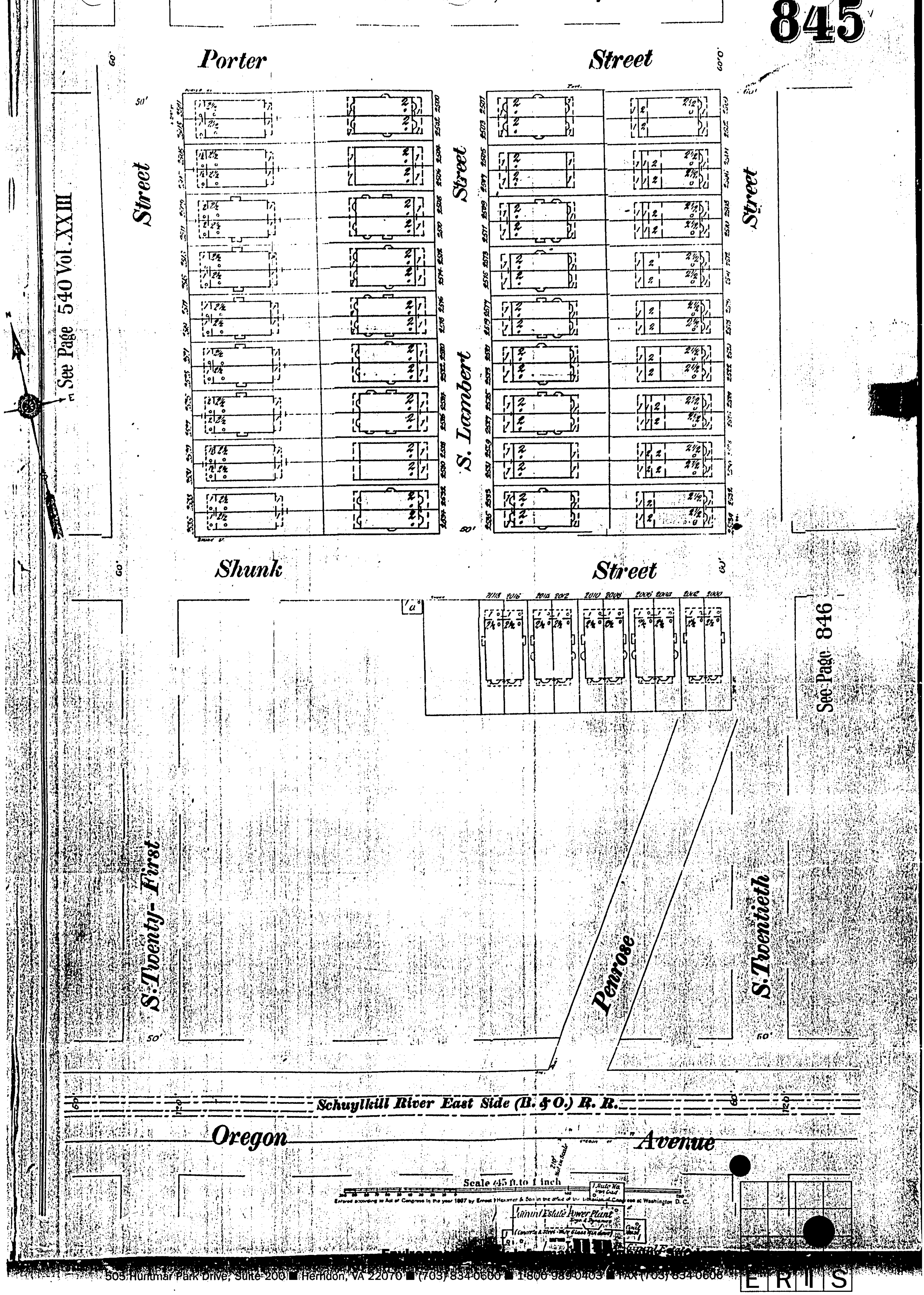
VENDOR NAME	STREET	STATE	ZIP	PHONE
KEYSTONE AERIAL SURVEYS INC NORTHEAST PHILADELPHIA AIRPORT	P O BOX 21059	PA	19114	(215) 677-3119

DATE OF COVERAGE	SENSOR CLASS	PROJECT CODE	SCALE	FOCAL LENGTH	FILM TYPE	CLOUD COVER	QUADRANGLE COVERAGE	REMARKS
1973 JUN	VERTICAL CARTO (IMPLIES STEREO)		12000	6.00in OR 152mm	COLOR	0%	90%	SPRING COVERAGE

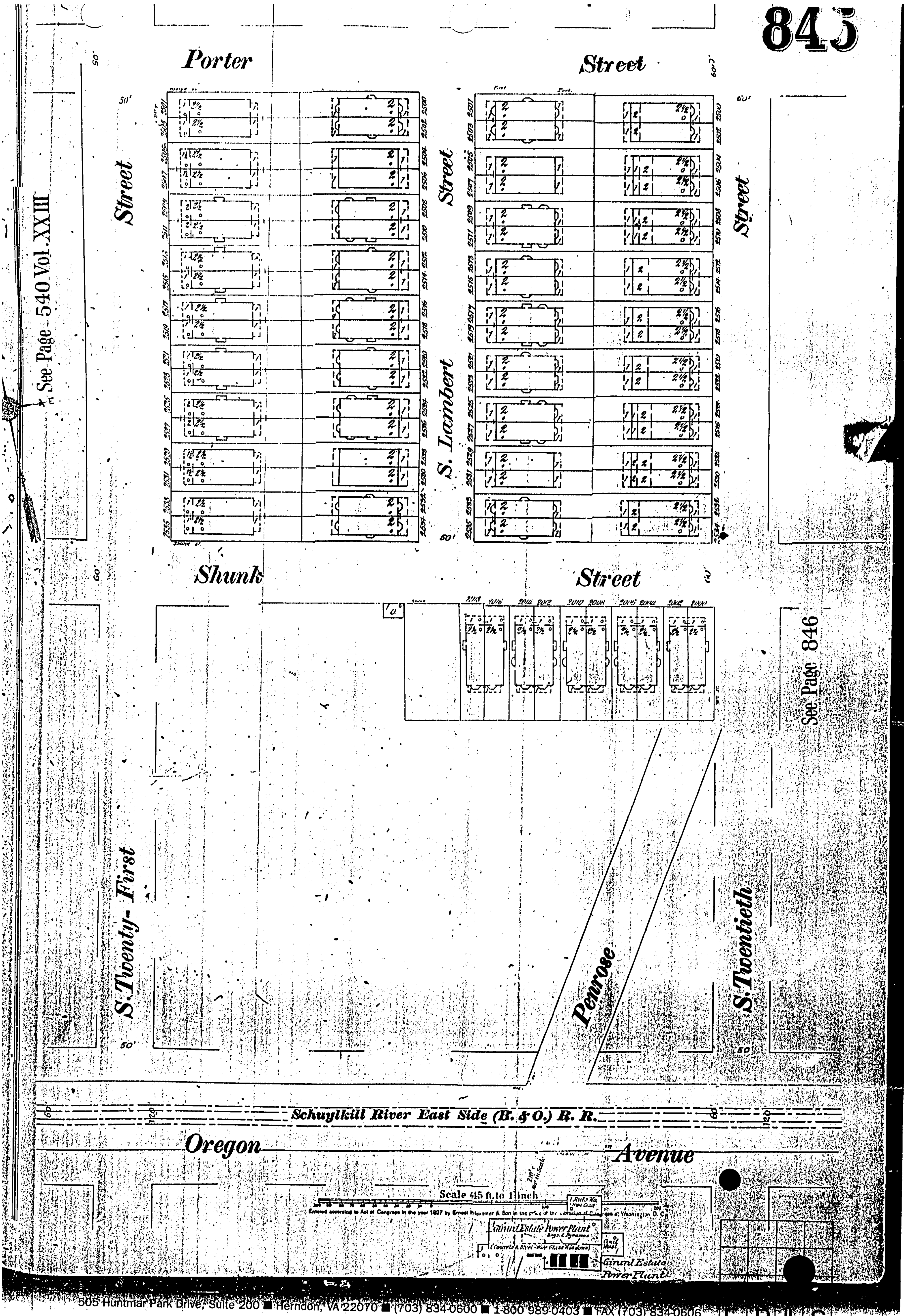
VENDOR NAME	STREET	STATE	ZIP	PHONE
AERIAL VIEWPOINT	10200 RICHMOND AVE SUITE 140	TX	77042	(713) 784-5801

DATE OF COVERAGE	SENSOR CLASS	PROJECT CODE	SCALE	FOCAL LENGTH	FILM TYPE	CLOUD COVER	QUADRANGLE COVERAGE	REMARKS
1965	VERTICAL CARTO (IMPLIES STEREO)		24000	UNKOWN	B&W	0%	90%	PHILADELPHIALOPA
1970	VERTICAL CARTO (IMPLIES STEREO)		24000	UNKOWN	B&W	0%	90%	PHILADELPHIACOPA
1975	VERTICAL CARTO (IMPLIES STEREO)		24000	UNKOWN	B&W	0%	90%	PHILADELPHIACOPA

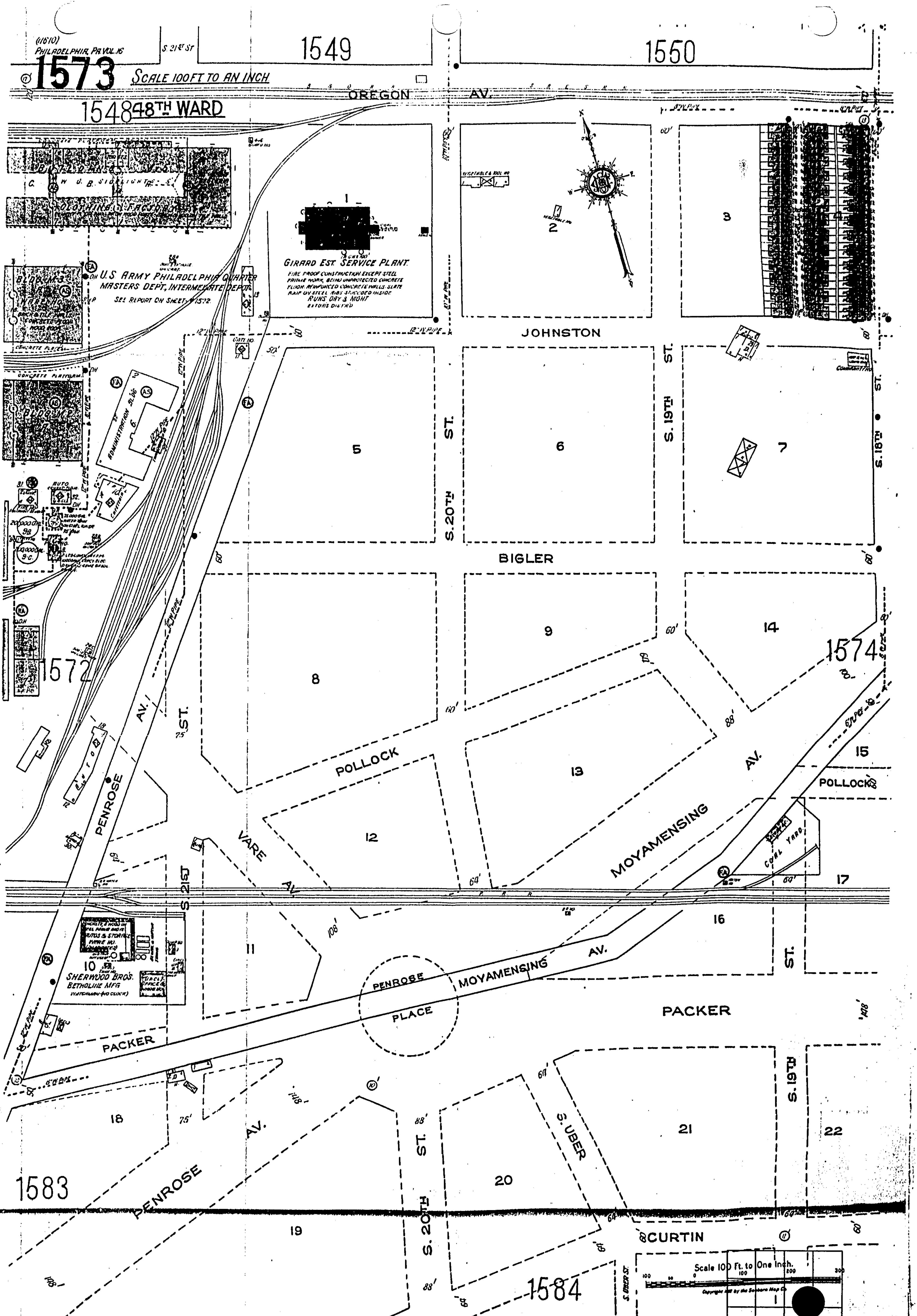
Continued below, to the left



HEXAMER 1919



HEXAMER 1920



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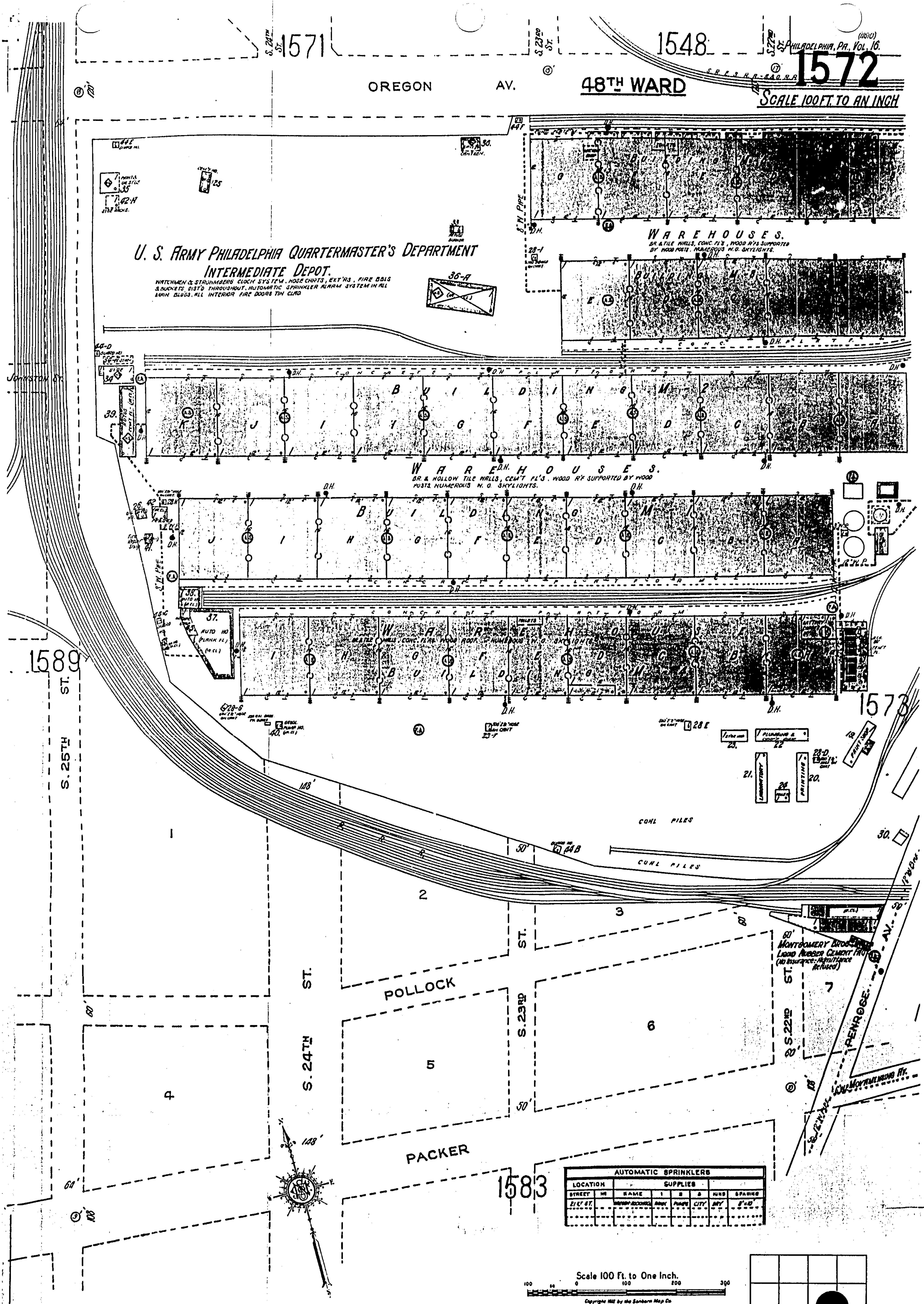
505 Huntmar Park Drive, Suite 200 ■ Herndon, VA 22070 ■ (703) 834-0600 ■ 1-800-989-0403 ■ FAX (703) 834-0606

ERIS

SANBORN 1922



AUTOMATIC SPRINKLERS							
LOCATION		SUPPLIES					
STREET	NO.	NAME	1	2	3	KIND	SPACING
21ST ST.		[illegible]	TANK	PUMPS	CITY	DRY	8'x10'

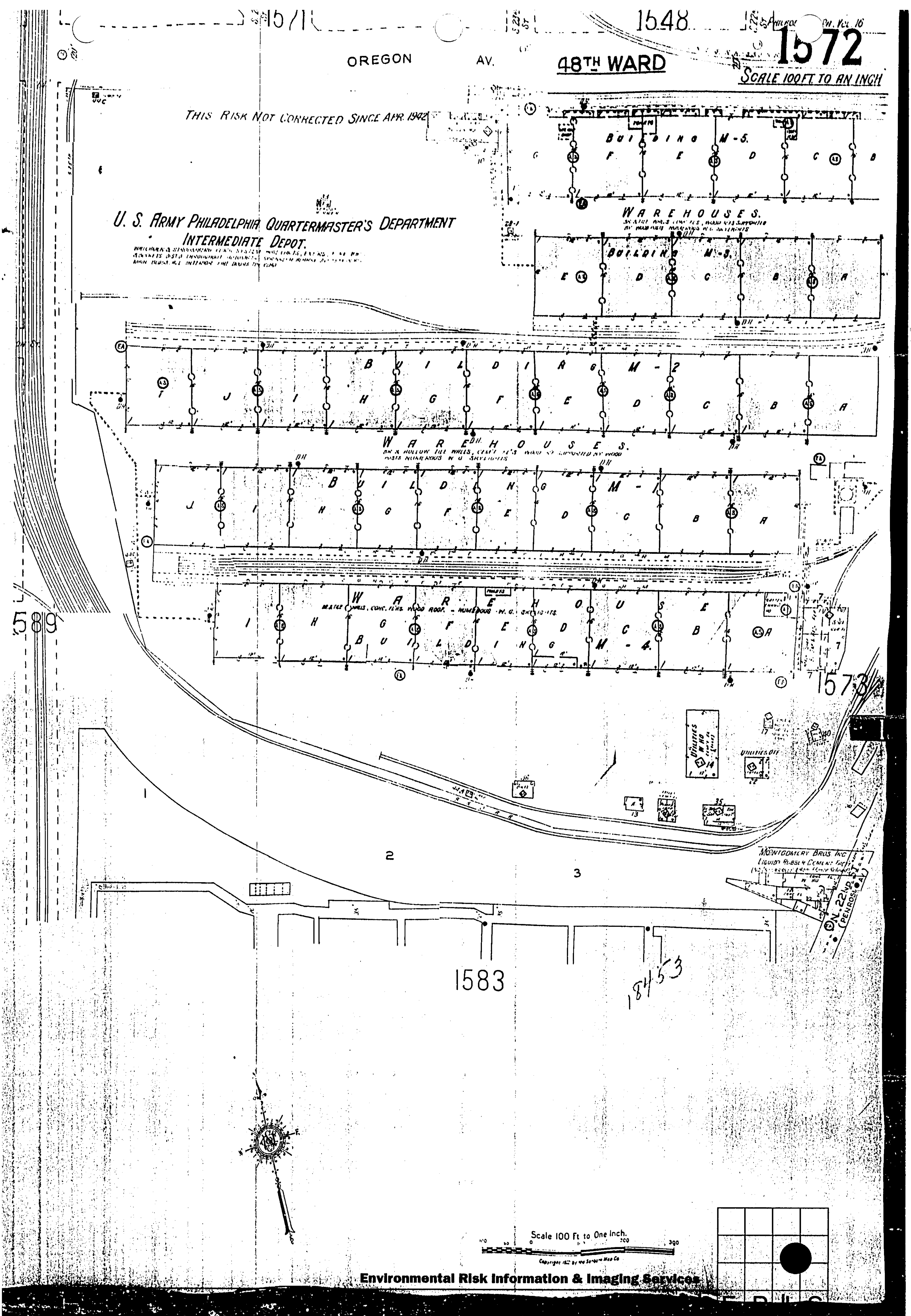
Environmental Risk Information & Imaging Services

505 Huntmar Park Drive, Suite 200 ■ Herndon, VA 22070 ■ (703) 834-0600 ■ 1-800-989-0403 ■ Fax (703) [illegible]

E R I I S

[illegible] IN ACCORDANCE WITH [illegible] OF AN AGREEMENT BETWEEN ENVIRONMENTAL RISK INFORMATION & IMAGING SERVICES AND SANBORN MAPPING & GEOGRAPHIC INFORMATION SERVICE DATED AUGUST 1, 1991. THE MANUFACTURERS' MUTUAL MAPS ARE THE PROPERTY OF THE EDISON INSTITUTE, DEARBORN, MICHIGAN, AND MAY NOT BE FURTHER REPRODUCED WITHOUT PERMISSION.

SANBORN 1922



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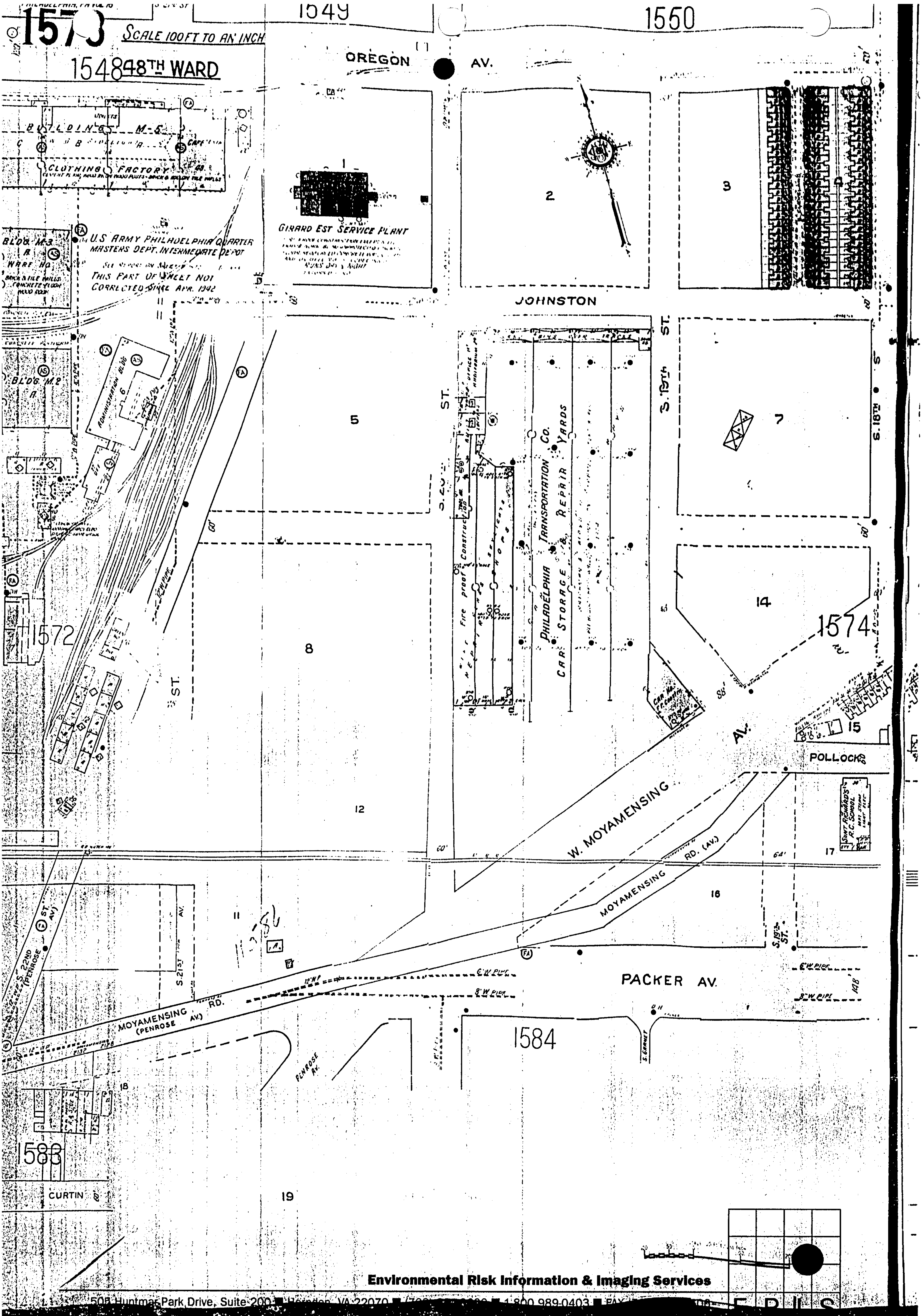

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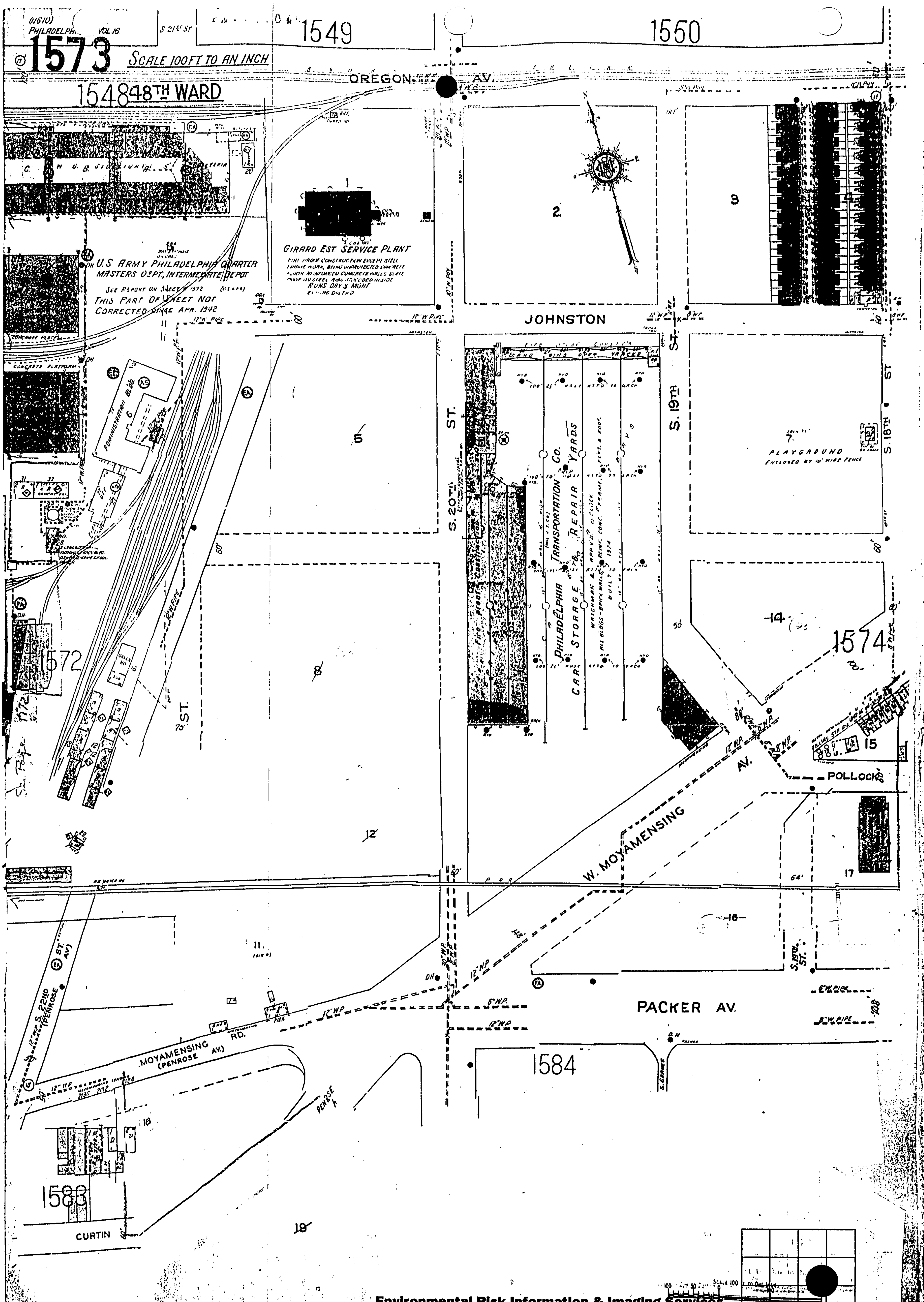
E R I I S

SANBORN 1947



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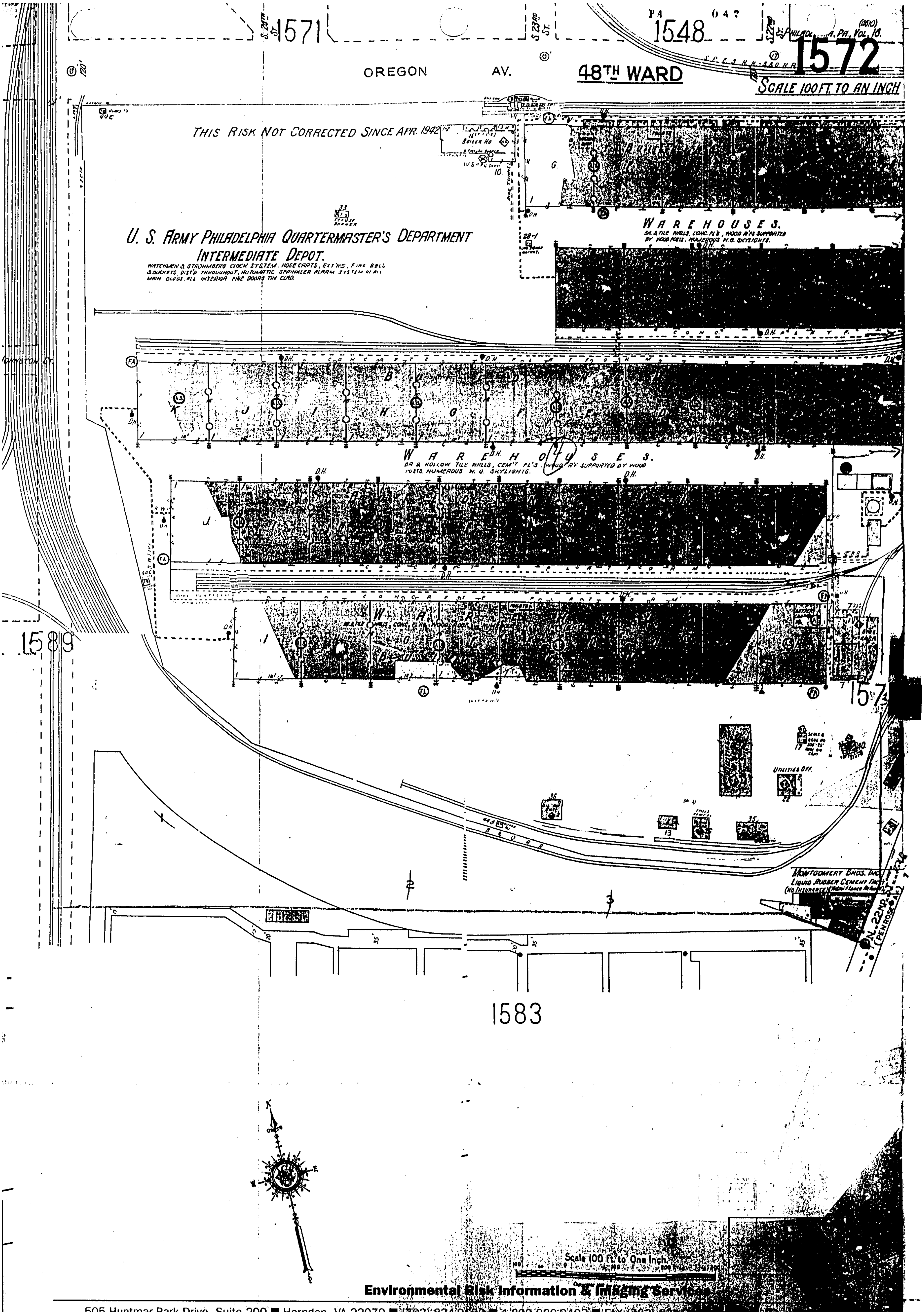
E R I S

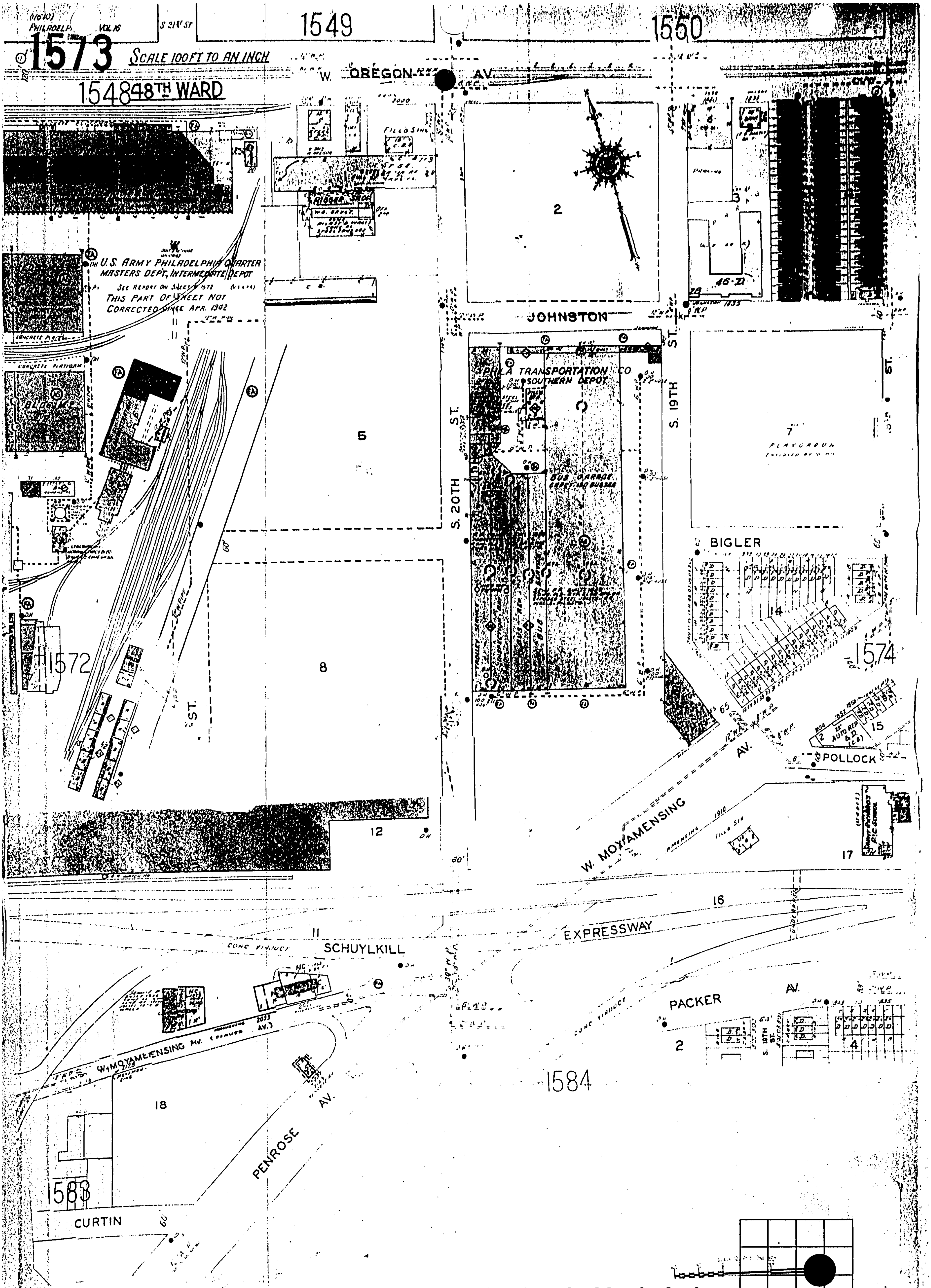
1951



Environmental Risk Information & Imaging Services

505 Huntmar Park Drive, Suite 200 ■ Herndon, VA 22070 ■ (703) 834-0600 ■ 1-800-989-0403 ■ FAX (703) 83

1951



Environmental Risk Information & Imaging Services

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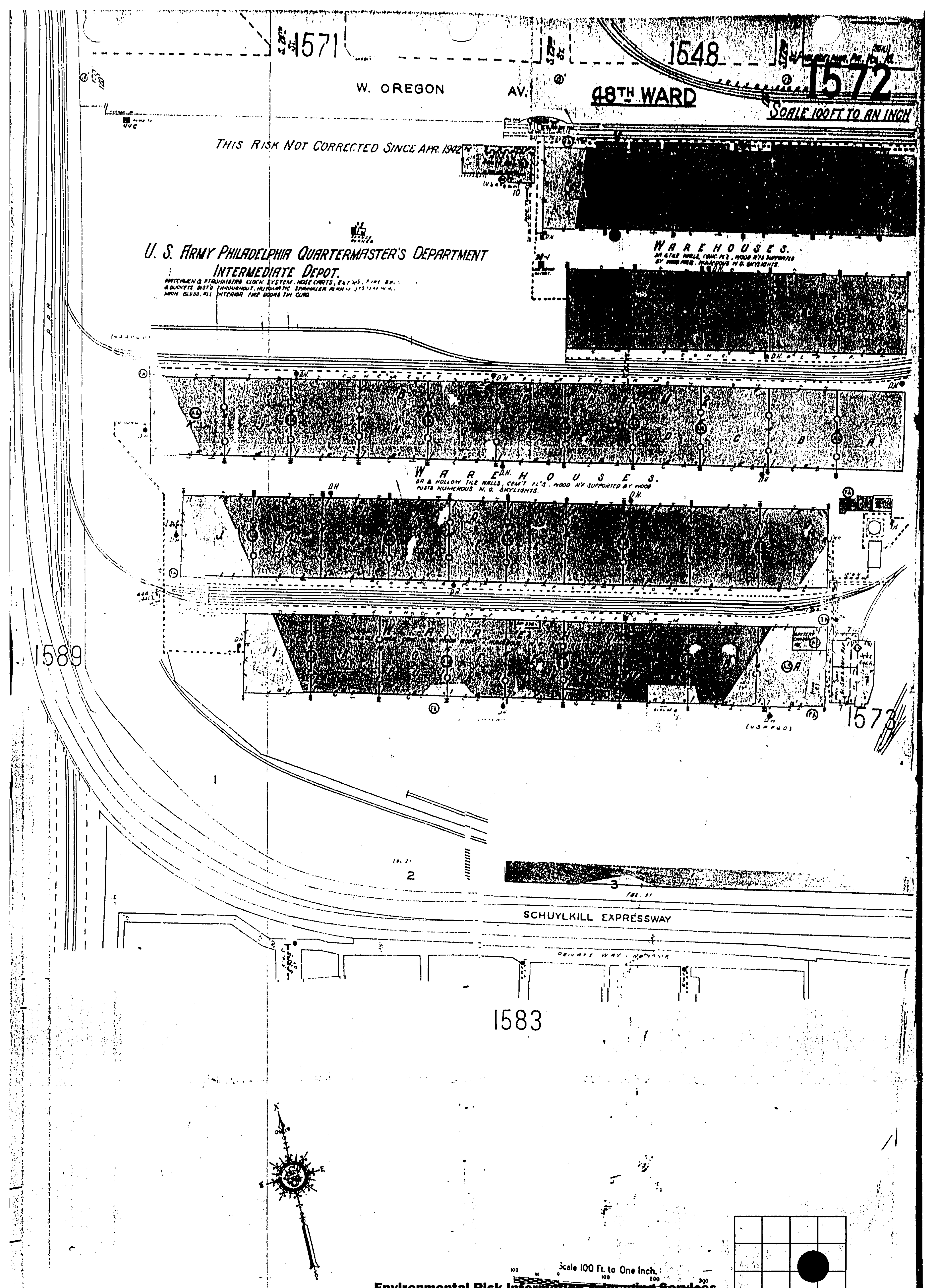
E R I S

SANBORN 1975



Environmental Risk Information & Imaging Services

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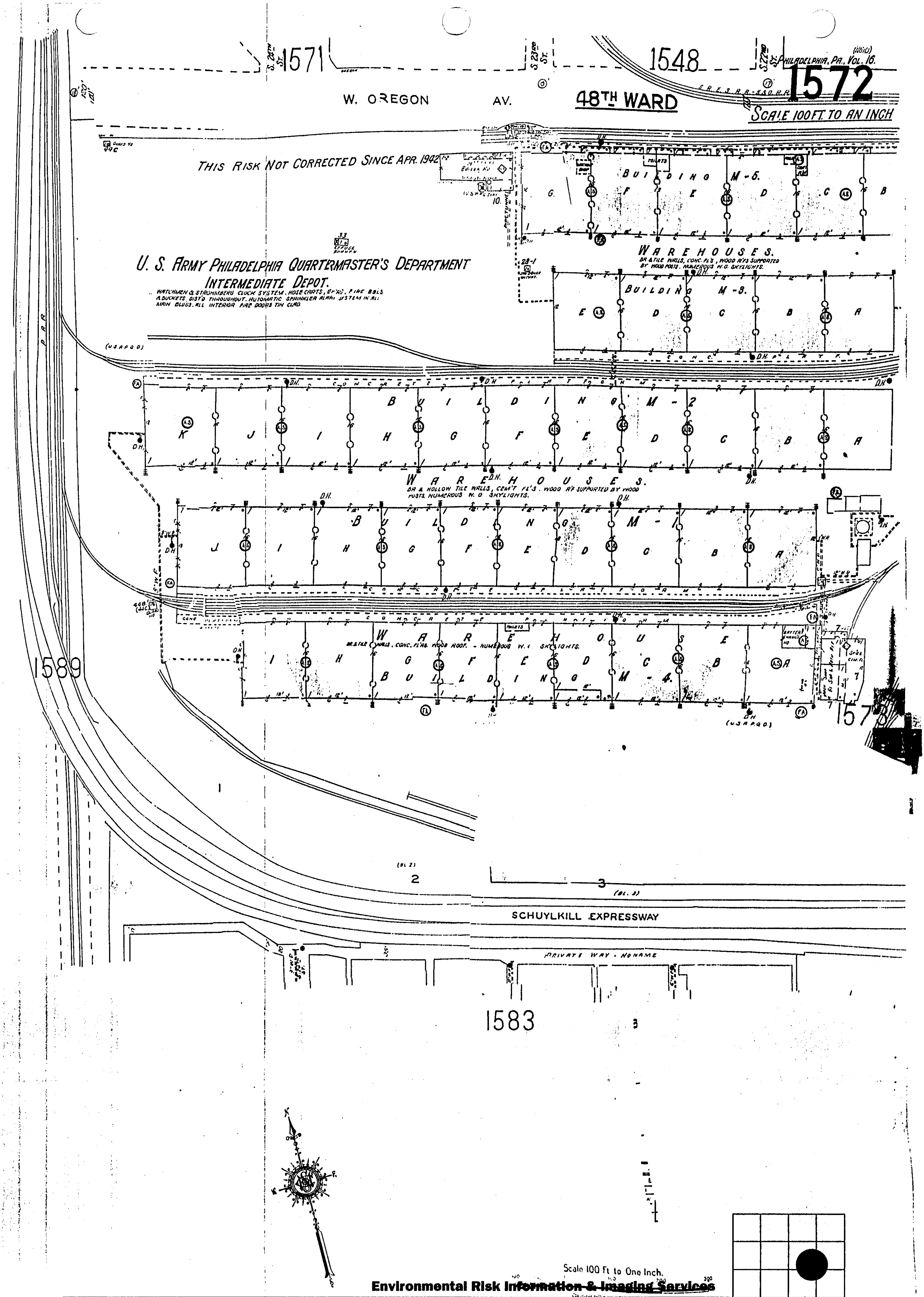
E R I I S

SANBORN 1975



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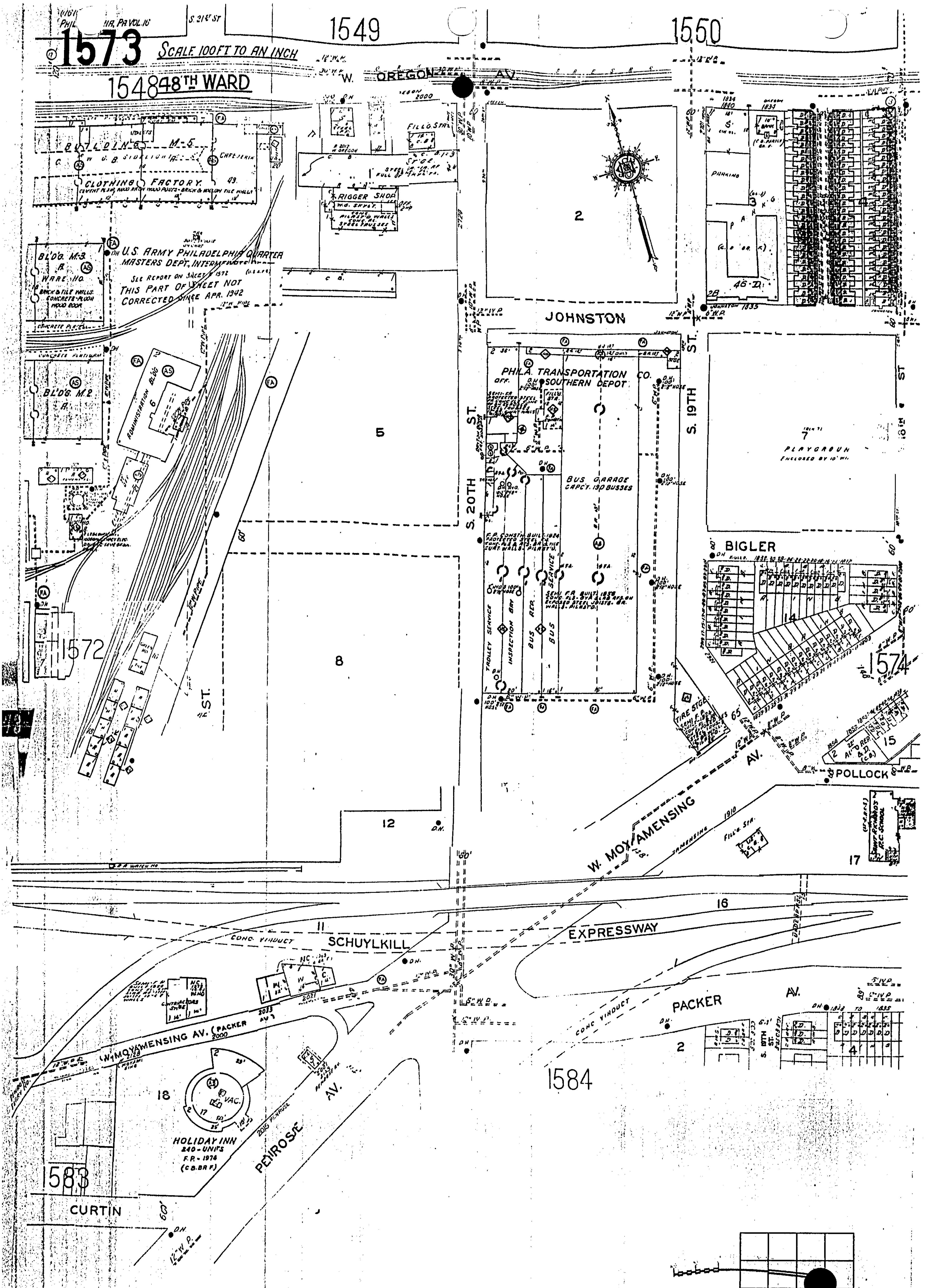
E R II S

1978



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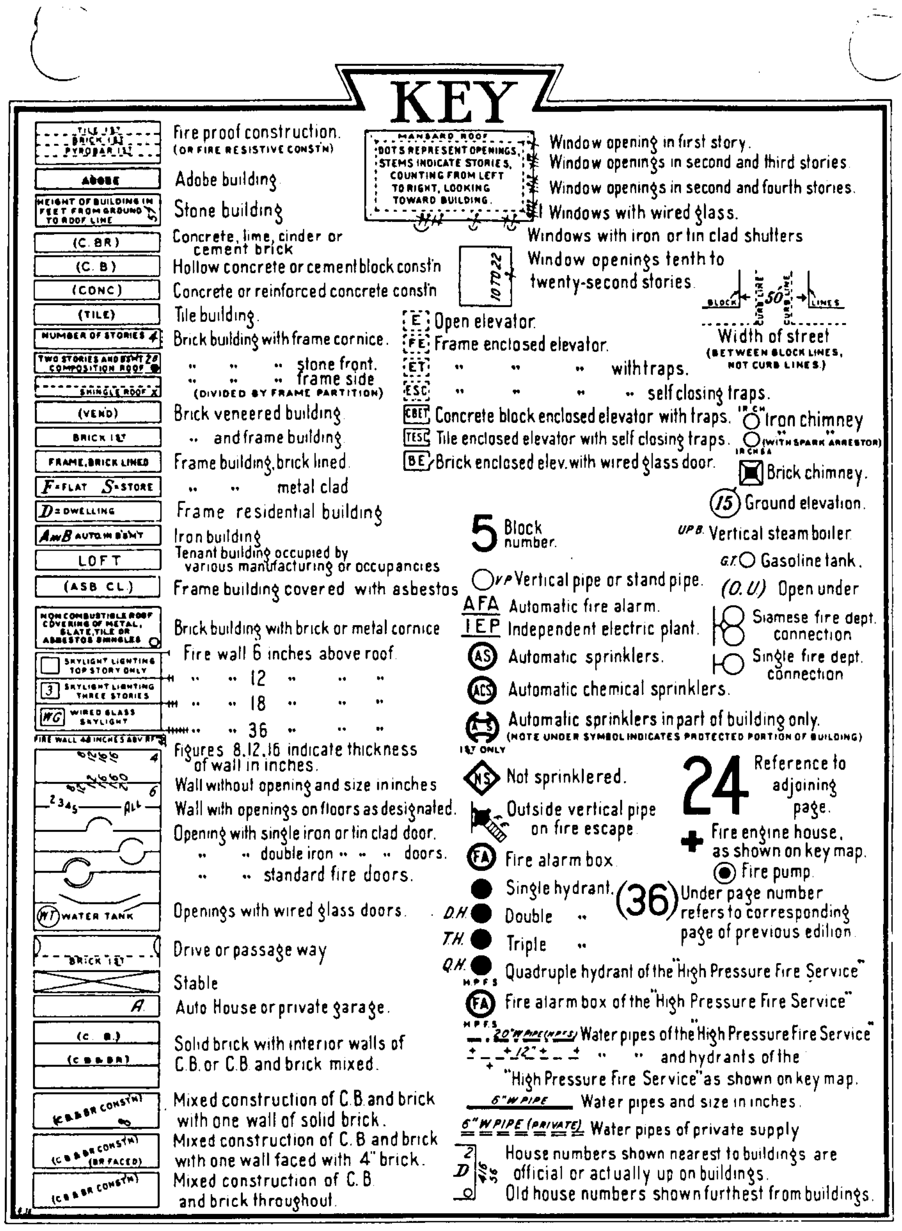
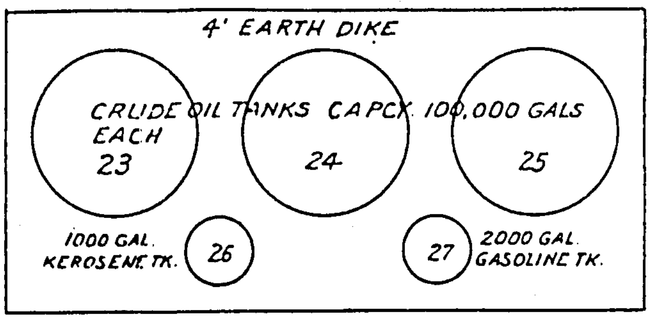
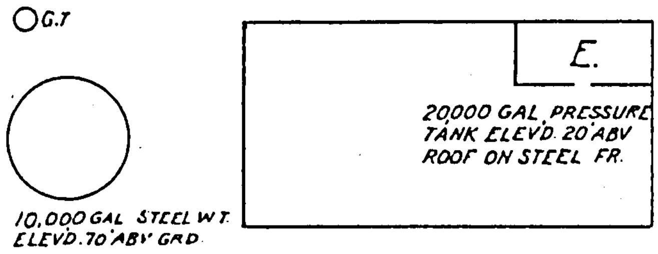
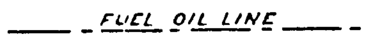
SANBORN 1978



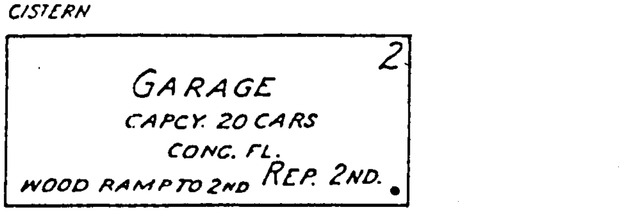
TANKS G.T. O Gasoline Tank

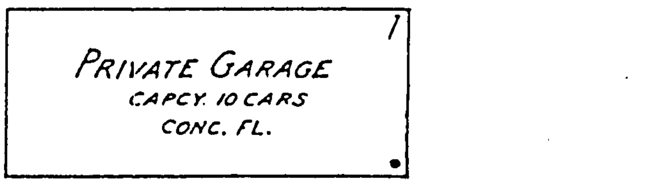






Fire Cistern





CODING OF STRUCTURAL UNITS FOR FIREPROOF AND NON-COMBUSTIBLE BUILDINGS

FRAMING

CODE	STRUCTURAL UNIT
A.	Reinforced Concrete Frame.
B.	Reinforced Concrete Joists, Columns, Beams, Trusses, Arches, Masonry Piers.
C.	Protected Steel Frame.
D.	Individually Protected Steel Joists, Columns, Beams, Trusses, Arches.
E.	Indirectly Protected Steel Frame.
F.	Indirectly Protected Steel Joists, Columns, Beams, Trusses, Arches.
G.	Unprotected Steel Frame.
H.	Unprotected Steel Joists, Columns, Beams, Trusses, Arches.
O.	Masonry Bearing Walls.

FLOORS

CODE	STRUCTURAL UNIT
1.	Reinforced Concrete. Reinforced Concrete with Masonry Units. Pre-cast Concrete or Gypsum Slabs or Planks.
2.	Concrete on Metal Lath, Incombustible Form Boards, Paper-backed Wire Fabric, Steel Deck, and Cellular, Ribbed or Corrugated Steel Units.
3.	Open Steel Deck or Grating.

LAND USE CODE APPLICABLE TO CHANGES DIAGRAMMED AFTER 5/69

R	RESIDENTIAL	M	MANUFACTURING
RT	RESIDENTIAL - TRANSIENT	P	PUBLIC OR INSTITUTIONAL
C	COMMERCIAL	U	UTILITY
W	WAREHOUSE	T	TRANSPORTATION

NUMERICAL PREFIX INDICATES THE NUMBER OF ESTABLISHMENTS IN EACH CATEGORY

ROOF

CODE	STRUCTURAL UNIT
a.	Reinforced Concrete. Reinforced Concrete with Masonry Units. Reinforced Gypsum Concrete. Pre-cast Concrete or Gypsum Slabs or Planks.
b.	Concrete or Gypsum on Metal Lath, Incombustible Form Boards, Paper-backed Wire Fabric, Steel Deck, and Cellular, Ribbed or Corrugated Steel Units.
c.	Incombustible Composition Boards with or without Insulation. Masonry or Metal Tiles.
d.	Steel Deck, Corrugated Metal or Asbestos Protected Metal with or without Insulation.

The coding for framing, floor and roof structural units as shown above is used in describing the construction of fire-resistive buildings. In addition, reports for fire-resistive buildings will show the date built and wall construction when other than brick.

F P buildings have masonry floors and roof; concrete and/or directly or indirectly protected steel framing; and clay brick, stone or poured concrete walls.

F P X buildings are F P buildings with inferior walls such as concrete block, cement brick, metal or glass panels, etc.

N C buildings have unprotected steel framing and fire-resistive but non-masonry floors and roof.

FP-1962
(CONC.)
A-1-a

A fire-resistive building built in 1962 with concrete walls and reinforced concrete frame, floors and roof.

FPX-1962
(METAL PANELS)
E-2-b
NONCOMB CEIL'G

A fire-resistive building built in 1962 with metal panel walls, indirectly protected steel frame, concrete floors and roof on metal lath, noncombustible ceilings.

NC-1962
(C. B.)
H-2-d

A noncombustible building built in 1962 with concrete block walls; unprotected steel columns and beams; concrete floors on metal lath and steel deck roof.

SANBORN MAP LEGEND

CODING OF FIRE-RESISTIVE STRUCTURAL UNITS FOR FIREPROOF AND NON-COMBUSTIBLE BUILDINGS

FRAMING

CODE	STRUCTURAL UNIT
A.	Reinforced Concrete Frame.
B.	Reinforced Concrete Joists, Columns, Beams, Trusses, Arches, Masonry Piers.
C.	Protected Steel Frame.
D.	Individually Protected Steel Joists, Columns, Beams, Trusses, Arches.
E.	Indirectly Protected Steel Frame.
F.	Indirectly Protected Steel Joists, Columns, Beams, Trusses, Arches.
G.	Unprotected Steel Frame.
H.	Unprotected Steel Joists, Columns, Beams, Trusses, Arches.
O.	Masonry Bearing Walls only.

FLOORS

CODE	STRUCTURAL UNIT
1.	Reinforced Concrete. Reinforced Concrete with Masonry Units. Pre-cast Concrete or Gypsum Slabs or Planks.
2.	Concrete on Metal Lath, Incombustible Form Boards, Paper-backed Wire Fabric, Steel Deck, or Cellular, Ribbed or Corrugated Steel Units.
3.	Open Steel Deck or Grating.

ROOF

CODE	STRUCTURAL UNIT
a.	Reinforced Concrete. Reinforced Concrete with Masonry Units. Reinforced Gypsum Concrete. Pre-cast Concrete or Gypsum Slabs or Planks.
b.	Concrete or Gypsum on Metal Lath, Incombustible Form Boards, Paper-backed Wire Fabric, Steel Deck, or Cellular, Ribbed or Corrugated Steel Units.
c.	Incombustible Composition Boards with or without Insulation. Masonry or Metal Tiles.
d.	Steel Deck, Corrugated Metal or Asbestos Protected Metal with or without Insulation.

The coding to left, for framing, floor and roof structural units is used in describing the construction of fire-resistive buildings. In addition, reports for fire-resistive buildings will show the date built, wall construction other than brick, and ceilings.

FP - 1962 (CONC.) A - 1 - a	A fireproof building built in 1962 with concrete walls and reinforced concrete frame, floors and roof.
FPX - 1962 (METAL PANELS) B - 2 - a (NONCOMB CEIL'GS)	A fireproof building built in 1962 with metal panel walls, reinforced concrete columns and beams, concrete floors on metal lath and gypsum slab roof; non-combustible ceilings.
NC - 1962 (C. B.) H - 2 - d	A noncombustible building built in 1962 with concrete block walls; unprotected steel columns, beams and joists; concrete floors on metal lath and steel deck roof.

MASONRY CONSTRUCTION

Important interior and all exterior masonry walls of all non-residential buildings and residential buildings of five or more dwelling units are shown with weighted (▬) lines.

Masonry walls of residential buildings of four dwelling units or less are shown with a standard line and the construction is noted on all buildings diagramed after July, 1963.

WALLS

8 8	8" Brick
12 (CONC.)	12" Concrete
18 (STONE) 20	18" & 20" Stone
(TILE)	12" & 8" Hollow Tile Wall Thicknesses Placed Relative to Respective Floors
(C. BR)	Cinder, Concrete or Cement Brick
(C. B) PILASTD	Hollow Cinder or Concrete Blocks, Pilastered
CBBRF	Mixed Construction of Concrete Blocks, Brick Faced
CB & BK	Mixed Construction of Concrete Blocks & Brick
METAL F.	Masonry Walls, Metal Faced
ADOBE	Adobe
C B	Hollow Cinder or Concrete Block Interior Wall Basement to Roof
TILE	Tile Interior Wall Basement to Roof
C. BR	Cement Brick End Wall

PARTITIONS

	Frame
TILE TO CEILING	Tile from Foundation to Top Ceiling only
CONC 1ST	Concrete 1st Floor only
C.B. 1ST	Hollow Cinder or Concrete Block 1st Floor only
BR. 2ND	Brick 2nd Floor only
TILE 1 & 3	Tile 1st & 3rd Floors only

OPENINGS

(Interior)

	Wall with No Openings
1	Wall with Double Standard Fire Doors 1st Floor
B	Wall with Standard Fire Door Basement
13	Wall with Substandard Fire Doors 1st & 3rd Floors
ALL	Wall with Metal & Wired Glass Fire Doors all Floors
123 4	Wall with Substandard Fire Doors 1st, 2nd & 3rd Floors & Unprotected Opening 4th Floor
ALL FLRS	Wall with Small Unprotected Openings only
ALL	Wall with Unprotected Openings all Floors

(Exterior)

	1st Floor
	1st & 2nd Floors
	3rd Floor
	1st & 4th Fl. with Metal Shutter 1st.
10 & 22	10th & 22nd only
10 to 22	10th to 22nd Fl.
G. BL	Glass Block
	Wired Glass in Metal Sash 2nd & 3rd Fl.

NON-MASONRY CONSTRUCTION

Non-masonry walls are shown with fine (———) lines.
(Wall construction other than wood and stucco on wood frame is noted)

	Wood & Stucco & Cement Plaster, Etc. on Wood Frame
(VEN'D)	Brick Veneered on Wood Frame (Other Types of Veneered on Wood Frame Specifically Noted)
C.B. TILE	Mixed Masonry & Non-Masonry (Type of Masonry Specifically Noted)
(BR FILLED)	Wood, Brick Lined, Br. Filled or Brick Nogged
WOOD & GLASS	Wood Sash & Glass
IR & GLASS	Metal Sash & Glass
(IR. CL.)	Metal Clad on Wood Frame
(IRON)	Iron Building
(IR) WOOD RF.	Iron Building with Wood Roof. (Location of Extensive Wood Areas Specifically noted)
(ASB CL)	Asbestos Clad on Wood Frame, Noted in Non-Residential Structures only.
(CB 9' GLASS ABV)	Mixed Wall--9' of CB With Metal Sash Above
(METAL PANELS)	Metal Panels
(C B 5')	Apron Walls With Wood Sash and Glass
(M L & P) STEEL FR.	Stucco, Cement Plaster, Etc. on Steel Frame
(GUNITE) STEEL FR.	Gunite on Steel Frame
(A.P.M.) STEEL FR.	Asphalt and/or Asbestos Protected Metal on Steel Frame
(A.P.M.) WOOD FR.	Asphalt and/or Asbestos Protected Metal on Wood Frame
(GLASS PANELS)	Glass Panels

GLOSSARY

A - B LINES An arbitrary boundary between adjoining sheets.
A. Private garage.
ABV. Above.
A. F. A. Equipped with fire detecting devices which automatically signal a central fire department.
AIR COND. Air cooling system employing ducts through floors.
APRON WALL A masonry wall extending 5' or less above foundation.
ASSOC. RISK Risk not underwritten by Stock Fire Ins. Companies.
BASEMENT A story having its floor below ground & its ceiling at least 4' above ground.
Cook County, Ill.: A floor of a building next below the first floor. Shown by the symbol B following story height. Sub-basements or sub-cellars, (stories below the 1st basement), are shown by the symbol SB following basement symbol.
CHIMNEYS (Applicable to maps in Rocky Mountain & Pacific Coast States)
- BC. Brick, stone, concrete brick & concrete chimneys.
- C. BL. C. Concrete block chimney.
- C. C. Non-standard concrete chimney.
- T. C. Tile chimney.
- P. C. Patent chimney.
- IR. CH. Iron chimneys.
- S. P. Stove pipe.
- S. P. V. Stove pipe with patent ventilator.

RESIDENTIAL OCCUPANCY SYMBOLS
- D. Single family unit or as qualified by a numeral.
- E. - APTS. A multi-family residential building corresponding with local Rating Bureau definition in family units per floor, story height, & separation of entrance.
- ROOM'G. A residential building normally occupied by a single family but with 10 or more rooms rented for lodging purposes.
  - EXCEPTIONS: 6 rooms in Arizona, California, Nevada, Utah & Montana; 5 rooms in Oregon & Washington; 4 rooms in Idaho & Hawaii.

FIRE RESISTIVE CONSTRUCTION SYMBOLS
- F. P. Approved masonry walls, floors & roof, interior supports of approved masonry, concrete, and/or protected steel.
- F. P. X. F. P. qualifications except inferior or sub-standard walls.
- N. C. Fire resistive with unprotected structural steel units.

HOLLOW WALL A bonded masonry wall having a continuous air space within.
I. E. P. Independent Electric Plant.
IMPASSABLE Not traversable due to condition of terrain.
LEDGED WALL A masonry bearing wall with extended ledges to support floors.
LOFT Tenanted by industrial occupancies.
M. L. & P. Concrete or plaster applied to metal lath on wood studdings.
M. S. & G. Metal sash & glass.
NOT OPEN Streets appearing on records but not open on ground.
O. L. Windows overlooking the roof above the corresponding floor of an adjoining building.
O. U. Open between ground and first floor.
PILAST'D. Masonry reinforcing columns in walls.
SKYTS. Skylights.
SL. CL. Slate attached to wood siding.
SM. HO. Smoke House.
STABLE Shown by crossing diagonal lines on diagram.
SUSP'D. Suspended ceilings below floor and/or roof beams.
SYST. System.
TRANSF. Transformer.
WD. Wood.

LAND USE CODE APPLICABLE TO CHANGES DIAGRAMMED AFTER [illegible]

R	RESIDENTIAL	M	MANUFACTURING
RT	RESIDENTIAL - TRANSIENT	P	PUBLIC OR INSTITUTIONAL
C	COMMERCIAL	U	UTILITY
W	WAREHOUSE	T	TRANSPORTATION

NUMERICAL PREFIX INDICATES THE NUMBER OF ESTABLISHMENTS IN EACH CATEGORY

FIRE PROTECTION

	Fire Department Connection
(AS) THRU-OUT	Automatic Sprinklers throughout contiguous sections of single risk
(AS)	Automatic Sprinklers all floors of building
(AS) 1ST ONLY	Automatic Sprinklers in part of building only (Note under Symbol indicates protected portion of building)
NS	Not Sprinklered
(ACS)	Automatic Chemical Sprinklers
(ACS)	Chemical Sprinklers in part of building only (Note under Symbol indicates protected portion of building)
VP ○ HYD. ○	Vertical Pipe or Stand Pipe
AFA	Automatic Fire Alarm
(WT)	Water Tank
FE	Outside Vertical Pipe on fire escape
(FA)	Fire Alarm Box Noted "HPFS" on High Pressure Fire Service

●	Single Hydrant
D.H. ●	Double Hydrant
T.H. ●	Triple Hydrant
Q.H. ● H.P.F.S.	Quadruple Hydrant of the High Pressure Service
20" W.P. (H.P.F.S.)	Water Pipes of the High Pressure Service
+ 12" +	Water Pipes of the High Pressure Service as Shown on Key Map
6" W.P. 4" W.P.	Public Water Service
6" W.P. (PRIV.)	Private Water Service

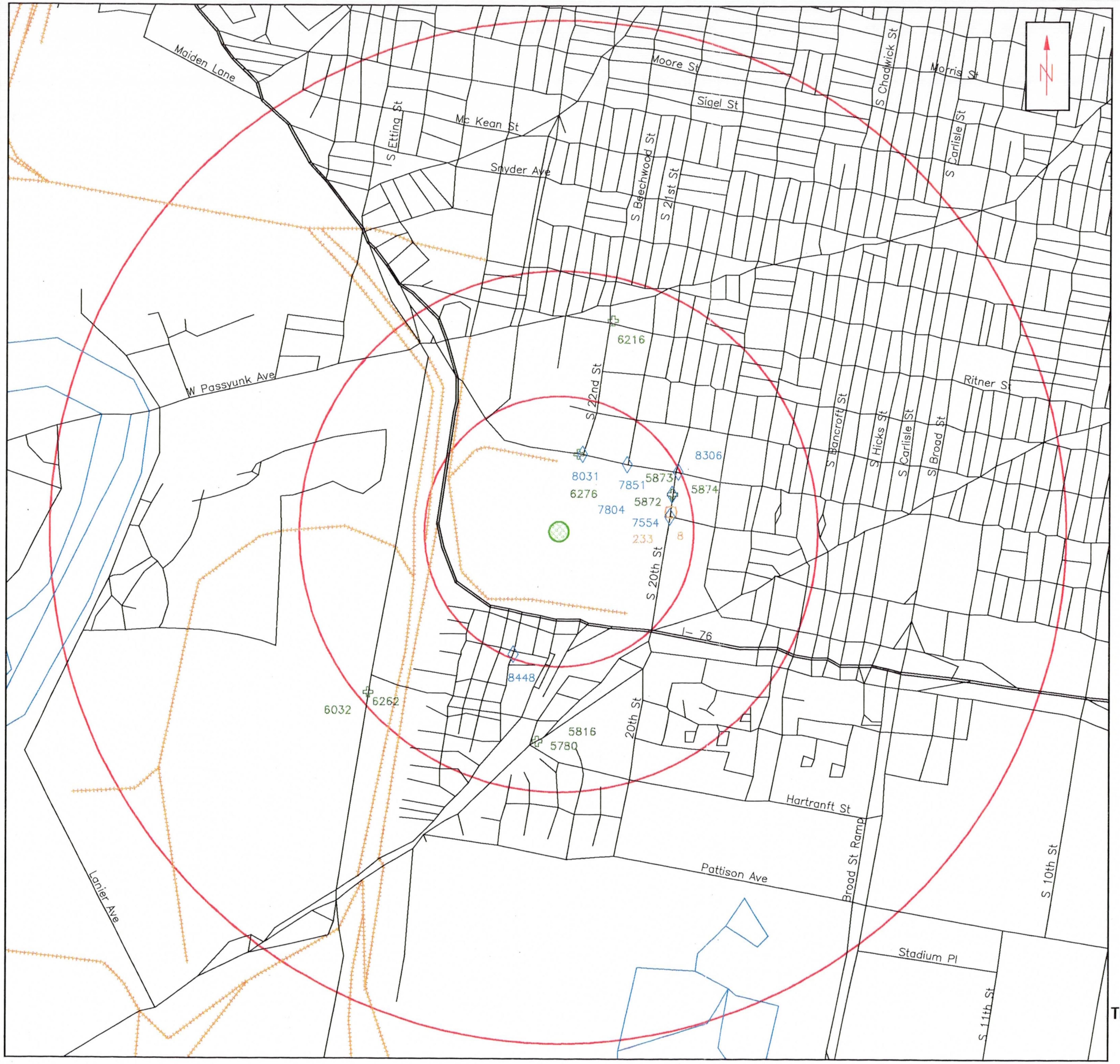
VERTICAL OPENINGS

☐	Skylight lighting top story only
3	Skylight lighting 3 stories
WG	Skylight with Wired Glass in Metal Sash
E	Open Elevator
FE	Frame Enclosed Elevator
ET	Frame Enclosed Elevator with Traps
ESC	Frame Enclosed Elevator with Self Closing Traps
CBET	Concrete Block Enclosed Elevator with Traps
TESC	Tile Enclosed Elevator with Self Closing Traps
BE	Brick Enclosed Elevator with Wired Glass Door
H	Open Hoist
HT	Hoist with Traps
H B TO 1	Open Hoist Basement to 1st
STAIRS	Stairs

MISCELLANEOUS

MANSARD ROOF	Number of Stories Height in Feet Composition Roof Covering
	Parapet 6" above Roof Frame Cornice Parapet 12" above Roof
W. HO.	Parapet 24" above Roof Occupied by Warehouse Metal, Slate, Tile or Asbestos Shingle Roof Covering Parapet 48" above Roof
S. 2B 2-D. A IN B BR 1ST	2 Stories & Basement 1st Floor Occupied by Store 2 Residential Units above 1st Auto in Basement Drive or Passageway Wood Shingle Roof
○ IR. CH.	Iron Chimney
○ IR. CH. S.A.	Iron Chimney (with Spark Arrestor)
● UPB	Vertical Steam Boiler
▬	Horizontal Steam Boiler
▣	Brick Chimney
G.T. ○	Gasoline Tank
◉	Fire Pump
CURB LINE 50' CURB LINE	Width of Street between Block Lines, not Curb Lines
(15)	Ground Elevation
56 416 2 D	House numbers nearest to Buildings are Official or Actually up on Buildings. Old House Numbers are Farthest from Buildings
24	Reference to Adjoining Page
5	Block Number
✚	Fire Department as shown on Key Map

Vac. or V. - Vacant
Vac. & Op. or V.-O. - Vacant & Open



ERIIS

505 Huntmar Park Dr, Suite 200
Herndon, VA 22070
(703)834-0600 (800)989-0402
FAX: (703)834-0606

SITE INFORMATION

20th St And Oregon Ave
Philadelphia, PA
Philadelphia County
Job Number: 120743A
Map Plotted: Oct 28, 1996

MAP LEGEND

- 🟩 Property Area
- □ Radii .25, .5, 1 Mi
- — Hydrography
- -+- Railroads
- — Roads
- ═ Highways
- ★ NPL 0 Sites
- □ RCRIS_TS 1 Site
- ● CERCLIS 0 Sites
- ○ NFRAP 1 Site
- □ RCRIS_LG 0 Sites
- □ RCRIS_SG 0 Sites
- ☆ ERNS 0 Sites
- ○ HWS 0 Sites
- ✚ LRST 9 Sites
- △ SWF 0 Sites
- ◇ RST 6 Sites

Miles

0 0.25 0.5

The Information on this map is subject to the ERIIS Disclaimer

Appendix G

Summary of Fluid-Level Measurements (June 1991 - November 1996)

APPENDIX G
NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA
NAPL AND WATER-LEVEL DATA

Well ID	Measuring Point Elevation (ft AMSL)	June 10, 1991						
		Apparent NAPL Thickness (feet)	NAPL Elevation (ft AMSL)	Depth to NAPL (ft BMP)	Depth to Water (ft BMP)	Apparent Water table Elevation (ft AMSL)	NAPL Specific Gravity	Corrected Water table Elevation (ft AMSL)
MW-1	20.78				19.11	1.67		1.67
MW-1A	21.33							
MW-2	21.83	0.68	1.15	20.68	21.36	0.47	0.763	0.99
MW-2A	21.13							
MW-3	20.34	1.71	1.27	19.07	20.78	-0.44	0.770	0.88
MW-4	20.60	1.48	1.21	19.39	20.87	-0.27	0.765	0.86
MW-5	20.32	1.74	1.31	19.01	20.75	-0.43	0.774	0.92
MW-6	21.18	1.85	1.29	19.89	21.74	-0.56	0.765	0.86
MW-6D	21.45							
MW-7	19.30	1.69	1.31	17.99	19.68	-0.38	0.796	0.97
MW-9	20.08							
MW-10	16.56							
MW-11	20.21							
MW-12	19.54							
MW-13	20.38							
MW-14	20.27							
MW-15	22.58							
MW-16	20.36							
MW-17	22.25							
MW-18	17.93							
MW-19	23.12							
MW-20	25.66							
MW-20D	25.80							
MW-21	20.18							
MW-22	21.70							
MW-23	20.72							
MW-24	20.95							
MW-25	20.36							
CSX-MW-1	51.32							
CSX-MW-2	46.70							
CSX-MW-3	48.12							
CSX-MW-4	47.15							
CSX-MW-5	49.76							
CSX-MW-6	45.92							
DPSSP-MWS-1	24.01							
DPSSP-MWS-2	19.97							
DPSSP-MWS-3	16.06							
DPSSP-MWS-4	17.54							
DPSSP-MWS-5	15.20							
SMW-1	18.55							
SMW-2	17.81							
SMW-3	17.82							
SMW-4	18.00							

NOTES:
NAPL - Light Non-Aqueous Phase Liquid
AMSL - Above Mean Sea Level
BMP - Below Measuring Point
Blank cells indicate no fluid level measured

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NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA

NAPL AND WATER-LEVEL DATA

Well ID	Measuring Point Elevation (ft AMSL)	September 25,1992						
		Apparent NAPL Thickness (feet)	NAPL Elevation (ft AMSL)	Depth to NAPL (ft BMP)	Depth to Water (ft BMP)	Apparent Water table Elevation (ft AMSL)	NAPL Specific Gravity	Corrected Water table Elevation (ft AMSL)
MW-1	20.78							
MW-1A	21.33							
MW-2	21.83							
MW-2A	21.13							
MW-3	20.34	1.78	0.76	19.58	21.36	-1.02	0.770	0.35
MW-4	20.60	2.48	0.87	19.73	22.21	-1.61	0.765	0.29
MW-5	20.32							
MW-6	21.18	1.79	0.73	20.45	22.24	-1.06	0.765	0.31
MW-6D	21.45							
MW-7	19.30	1.96	0.84	18.46	20.42	-1.12	0.796	0.44
MW-9	20.08							
MW-10	16.56							
MW-11	20.21							
MW-12	19.54							
MW-13	20.38							
MW-14	20.27							
MW-15	22.58							
MW-16	20.36							
MW-17	22.25							
MW-18	17.93							
MW-19	23.12							
MW-20	25.66							
MW-20D	25.80							
MW-21	20.18							
MW-22	21.70							
MW-23	20.72							
MW-24	20.95							
MW-25	20.36							
CSX-MW-1	51.32							
CSX-MW-2	46.70							
CSX-MW-3	48.12							
CSX-MW-4	47.15							
CSX-MW-5	49.76							
CSX-MW-6	45.92							
DPSSP-MWS-1	24.01							
DPSSP-MWS-2	19.97							
DPSSP-MWS-3	16.06							
DPSSP-MWS-4	17.54							
DPSSP-MWS-5	15.20							
SMW-1	18.55							
SMW-2	17.81							
SMW-3	17.82							
SMW-4	18.00							

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PHILADELPHIA, PENNSYLVANIA

NAPL AND WATER-LEVEL DATA

Well ID	Measuring Point Elevation (ft AMSL)	October 21,1994						
		Apparent NAPL Thickness (feet)	NAPL Elevation (ft AMSL)	Depth to NAPL (ft BMP)	Depth to Water (ft BMP)	Apparent Water table Elevation (ft AMSL)	NAPL Specific Gravity	Corrected Water table Elevation (ft AMSL)
MW-1	20.78				18.65	2.13		2.13
MW-1A	21.33	0.43	1.98	19.35	19.78	1.55	0.798	1.89
MW-2	21.83	0.75	1.43	20.40	21.15	0.68	0.763	1.25
MW-2A	21.13				18.8	2.33		2.33
MW-3	20.34	1.95	1.69	18.65	20.6	-0.26	0.770	1.24
MW-4	20.60	1.56	1.62	18.98	20.54	0.06	0.765	1.25
MW-5	20.32	1.27	1.45	18.87	20.14	0.18	0.774	1.16
MW-6	21.18	1.15	1.55	19.63	20.78	0.40	0.765	1.28
MW-6D	21.45							
MW-7	19.30	1.86	1.88	17.42	19.28	0.02	0.796	1.50
MW-9	20.08							
MW-10	16.56							
MW-11	20.21							
MW-12	19.54							
MW-13	20.38							
MW-14	20.27							
MW-15	22.58							
MW-16	20.36							
MW-17	22.25							
MW-18	17.93							
MW-19	23.12							
MW-20	25.66							
MW-20D	25.80							
MW-21	20.18							
MW-22	21.70							
MW-23	20.72							
MW-24	20.95							
MW-25	20.36							
CSX-MW-1	51.32							
CSX-MW-2	46.70							
CSX-MW-3	48.12							
CSX-MW-4	47.15							
CSX-MW-5	49.76							
CSX-MW-6	45.92							
DPSSP-MWS-1	24.01							
DPSSP-MWS-2	19.97							
DPSSP-MWS-3	16.06							
DPSSP-MWS-4	17.54							
DPSSP-MWS-5	15.20							
SMW-1	18.55							
SMW-2	17.81							
SMW-3	17.82							
SMW-4	18.00							

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NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA

NAPL AND WATER-LEVEL DATA

Well ID	Measuring Point Elevation (ft AMSL)	December 14,1994						
		Apparent NAPL Thickness (feet)	NAPL Elevation (ft AMSL)	Depth to NAPL (ft BMP)	Depth to Water (ft BMP)	Apparent Water table Elevation (ft AMSL)	NAPL Specific Gravity	Corrected Water table Elevation (ft AMSL)
MW-1	20.78				19.3	1.48		1.48
MW-1A	21.33	0.49	1.27	20.06	20.55	0.78	0.798	1.17
MW-2	21.83	1.92	1.80	20.03	21.95	-0.12	0.763	1.34
MW-2A	21.13				19.05	2.08		2.08
MW-3	20.34	1.90	1.04	19.30	21.2	-0.86	0.770	0.60
MW-4	20.60	1.63	0.94	19.66	21.29	-0.69	0.765	0.56
MW-5	20.32	1.41	0.95	19.37	20.78	-0.46	0.774	0.63
MW-6	21.18	1.05	0.78	20.40	21.45	-0.27	0.765	0.53
MW-6D	21.45							
MW-7	19.30	2.16	1.22	18.08	20.24	-0.94	0.796	0.78
MW-9	20.08							
MW-10	16.56							
MW-11	20.21							
MW-12	19.54							
MW-13	20.38							
MW-14	20.27							
MW-15	22.58							
MW-16	20.36							
MW-17	22.25							
MW-18	17.93							
MW-19	23.12							
MW-20	25.66							
MW-20D	25.80							
MW-21	20.18							
MW-22	21.70							
MW-23	20.72							
MW-24	20.95							
MW-25	20.36							
CSX-MW-1	51.32							
CSX-MW-2	46.70							
CSX-MW-3	48.12							
CSX-MW-4	47.15							
CSX-MW-5	49.76							
CSX-MW-6	45.92							
DPSSP-MWS-1	24.01							
DPSSP-MWS-2	19.97							
DPSSP-MWS-3	16.06							
DPSSP-MWS-4	17.54							
DPSSP-MWS-5	15.20							
SMW-1	18.55							
SMW-2	17.81							
SMW-3	17.82							
SMW-4	18.00							

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PHILADELPHIA, PENNSYLVANIA

NAPL AND WATER-LEVEL DATA

Well ID	Measuring Point Elevation (ft AMSL)	March 1-2, 1995						
		Apparent NAPL Thickness (feet)	NAPL Elevation (ft AMSL)	Depth to NAPL (ft BMP)	Depth to Water (ft BMP)	Apparent Water table Elevation (ft AMSL)	NAPL Specific Gravity	Corrected Water table Elevation (ft AMSL)
MW-1	20.78				19.29	1.49		1.49
MW-1A	21.33	0.28	1.27	20.06	20.34	0.99	0.798	1.21
MW-2	21.83	0.95	0.94	20.89	21.84	-0.01	0.763	0.71
MW-2A	21.13				19.12	2.01		2.01
MW-3	20.34	1.96	1.28	19.06	21.02	-0.68	0.770	0.83
MW-4	20.60	1.66	1.26	19.34	21.00	-0.40	0.765	0.87
MW-5	20.32	1.99	1.55	18.77	20.76	-0.44	0.774	1.10
MW-6	21.18	1.71	1.18	20.00	21.71	-0.53	0.765	0.78
MW-6D	21.45				20.76	0.69		0.69
MW-7	19.30	1.93	1.26	18.04	19.97	-0.67	0.796	0.87
MW-9	20.08	0.04	0.96	19.12	19.16	0.92	0.779	0.95
MW-10	16.56				15.01	1.55		1.55
MW-11	20.21	1.67	1.29	18.92	20.59	-0.38	0.780	0.92
MW-12	19.54				17.85	1.69	0.831	1.69
MW-13	20.38				18.69	1.69		1.69
MW-14	20.27	1.57	1.44	18.83	20.40	-0.13	0.770	1.08
MW-15	22.58	1.15	1.30	21.28	22.43	0.15	0.779	1.05
MW-16	20.36				18.78	1.58		1.58
MW-17	22.25				19.91	2.34		2.34
MW-18	17.93				15.92	2.01		2.01
MW-19	23.12				18.00	5.12		5.12
MW-20	25.66				20.50	5.16		5.16
MW-20D	25.80				24.56	1.24		1.24
MW-21	20.18							
MW-22	21.70							
MW-23	20.72							
MW-24	20.95							
MW-25	20.36							
CSX-MW-1	51.32				45.73	5.59		5.59
CSX-MW-2	46.70				46.31	0.39		0.39
CSX-MW-3	48.12							
CSX-MW-4	47.15							
CSX-MW-5	49.76							
CSX-MW-6	45.92							
DPSSP-MWS-1	24.01							
DPSSP-MWS-2	19.97							
DPSSP-MWS-3	16.06							
DPSSP-MWS-4	17.54							
DPSSP-MWS-5	15.20							
SMW-1	18.55							
SMW-2	17.81							
SMW-3	17.82							
SMW-4	18.00							

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NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA

NAPL AND WATER-LEVEL DATA

Well ID	Measuring Point Elevation (ft AMSL)	April 8,1996						
		Apparent NAPL Thickness (feet)	NAPL Elevation (ft AMSL)	Depth to NAPL (ft BMP)	Depth to Water (ft BMP)	Apparent Water table Elevation (ft AMSL)	NAPL Specific Gravity	Corrected Water table Elevation (ft AMSL)
MW-1	20.78				18.03	2.75		2.75
MW-1A	21.33	0.39	2.47	18.86	19.25	2.08	0.798	2.39
MW-2	21.83	0.72	2.14	19.69	20.41	1.42	0.763	1.97
MW-2A	21.13							
MW-3	20.34	1.46	2.29	18.05	19.51	0.83	0.770	1.95
MW-4	20.60	1.62	2.41	18.19	19.81	0.79	0.765	2.03
MW-5	20.32	1.72	2.37	17.95	19.67	0.65	0.774	1.98
MW-6	21.18	2.33	2.58	18.60	20.93	0.25	0.765	2.03
MW-6D	21.45				19.6	1.85		1.85
MW-7	19.30	1.00	2.54	16.76	17.76	1.54	0.796	2.34
MW-9	20.08	3.15	3.06	17.02	20.17	-0.09	0.779	2.36
MW-10	16.56				13.82	2.74		2.74
MW-11	20.21	1.28	2.45	17.76	19.04	1.17	0.780	2.17
MW-12	19.54	0.32	2.89	16.65	16.97	2.57	0.831	2.84
MW-13	20.38				17.51	2.87		2.87
MW-14	20.27	1.86	2.51	17.76	19.62	0.65	0.770	2.08
MW-15	22.58	0.66	2.28	20.30	20.96	1.62	0.779	2.13
MW-16	20.36							
MW-17	22.25							
MW-18	17.93							
MW-19	23.12							
MW-20	25.66							
MW-20D	25.80							
MW-21	20.18							
MW-22	21.70							
MW-23	20.72							
MW-24	20.95							
MW-25	20.36							
CSX-MW-1	51.32							
CSX-MW-2	46.70							
CSX-MW-3	48.12							
CSX-MW-4	47.15							
CSX-MW-5	49.76							
CSX-MW-6	45.92							
DPSSP-MWS-1	24.01							
DPSSP-MWS-2	19.97							
DPSSP-MWS-3	16.06							
DPSSP-MWS-4	17.54							
DPSSP-MWS-5	15.20							
SMW-1	18.55							
SMW-2	17.81							
SMW-3	17.82							
SMW-4	18.00							

NOTES:
NAPL - Light Non-Aqueous Phase Liquid
AMSL - Above Mean Sea Level
BMP - Below Measuring Point
Blank cells indicate no fluid level measured

APPENDIX G
NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA

NAPL AND WATER-LEVEL DATA

Well ID	Measuring Point Elevation (ft AMSL)	July 12,1996						
		Apparent NAPL Thickness (feet)	NAPL Elevation (ft AMSL)	Depth to NAPL (ft BMP)	Depth to Water (ft BMP)	Apparent Water table Elevation (ft AMSL)	NAPL Specific Gravity	Corrected Water table Elevation (ft AMSL)
MW-1	20.78				18.22	2.56		2.56
MW-1A	21.33	0.56	2.37	18.96	19.52	1.81	0.798	2.26
MW-2	21.83	0.73	1.95	19.88	20.61	1.22	0.763	1.78
MW-2A	21.13							
MW-3	20.34	1.69	2.13	18.21	19.9	0.44	0.770	1.74
MW-4	20.60						0.765	
MW-5	20.32	1.40	2.16	18.16	19.56	0.76	0.774	1.84
MW-6	21.18	1.60	2.19	18.99	20.59	0.59	0.765	1.81
MW-6D	21.45				19.79	1.66		1.66
MW-7	19.30						0.796	
MW-9	20.08	0.68	1.96	18.12	18.8	1.28	0.779	1.81
MW-10	16.56	0.04	2.39	14.17	14.21	2.35	0.780	2.38
MW-11	20.21	1.55	2.30	17.91	19.46	0.75	0.780	1.96
MW-12	19.54	0.17	2.83	16.71	16.88	2.66	0.831	2.80
MW-13	20.38				17.55	2.83		2.83
MW-14	20.27	1.87	2.39	17.88	19.75	0.52	0.770	1.96
MW-15	22.58	0.99	2.16	20.42	21.41	1.17	0.779	1.94
MW-16	20.36				17.74	2.62		2.62
MW-17	22.25				18.9	3.35		3.35
MW-18	17.93				14.46	3.47		3.47
MW-19	23.12				18.08	5.04		5.04
MW-20	25.66				20.01	5.65		5.65
MW-20D	25.80				23.88	1.92		1.92
MW-21	20.18				16.1	4.08		4.08
MW-22	21.70				17.87	3.83		3.83
MW-23	20.72				18.55	2.17		2.17
MW-24	20.95				18.59	2.36		2.36
MW-25	20.36	2.50	2.25	18.11	20.61	-0.25	0.775	1.69
CSX-MW-1	51.32							
CSX-MW-2	46.70				45.17	1.53		1.53
CSX-MW-3	48.12				45.81	2.31		2.31
CSX-MW-4	47.15				45.42	1.73		1.73
CSX-MW-5	49.76				45.22	4.54		4.54
CSX-MW-6	45.92				44.36	1.56		1.56
DPSSP-MWS-1	24.01							
DPSSP-MWS-2	19.97							
DPSSP-MWS-3	16.06							
DPSSP-MWS-4	17.54							
DPSSP-MWS-5	15.20							
SMW-1	18.55							
SMW-2	17.81							
SMW-3	17.82							
SMW-4	18.00							

NOTES:
NAPL - Light Non-Aqueous Phase Liquid
AMSL - Above Mean Sea Level
BMP - Below Measuring Point
Blank cells indicate no fluid level measured

APPENDIX G
NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA

NAPL AND WATER-LEVEL DATA

Well ID	Measuring Point Elevation (ft AMSL)	October 16,1996						
		Apparent NAPL Thickness (feet)	NAPL Elevation (ft AMSL)	Depth to NAPL (ft BMP)	Depth to Water (ft BMP)	Apparent Water table Elevation (ft AMSL)	NAPL Specific Gravity	Corrected Water table Elevation (ft AMSL)
MW-1	20.78				17.72	3.06		3.06
MW-1A	21.33	0.06	2.82	18.51	18.57	2.76	0.798	2.81
MW-2	21.83	0.73	2.43	19.40	20.13	1.70	0.763	2.26
MW-2A	21.13				17.56	3.57		3.57
MW-3	20.34	1.64	2.64	17.70	19.34	1.00	0.770	2.26
MW-4	20.60	1.58	2.65	17.95	19.53	1.07	0.765	2.28
MW-5	20.32	1.63	2.70	17.62	19.25	1.07	0.774	2.33
MW-6	21.18	2.10	2.78	18.40	20.50	0.68	0.765	2.29
MW-6D	21.45				19.27	2.18		2.18
MW-7	19.30	1.15	2.77	16.53	17.68	1.62	0.796	2.54
MW-9	20.08	0.74	2.72	17.36	18.10	1.98	0.779	2.56
MW-10	16.56	0.03	2.86	13.70	13.73	2.83	0.780	2.85
MW-11	20.21	1.38	2.82	17.39	18.77	1.44	0.780	2.52
MW-12	19.54	0.06	3.29	16.25	16.31	3.23	0.831	3.28
MW-13	20.38				17.10	3.28		3.28
MW-14	20.27	1.85	2.92	17.35	19.20	1.07	0.770	2.49
MW-15	22.58	0.85	2.65	19.93	20.78	1.80	0.779	2.46
MW-16	20.36				17.28	3.08		3.08
MW-17	22.25				18.44	3.81		3.81
MW-18	17.93				12.33	5.60		5.60
MW-19	23.12				17.79	5.33		5.33
MW-20	25.66				19.83	5.83		5.83
MW-20D	25.80				23.30	2.50		2.50
MW-21	20.18				15.70	4.48		4.48
MW-22	21.70				17.48	4.22		4.22
MW-23	20.72				18.02	2.70		2.70
MW-24	20.95				18.09	2.86		2.86
MW-25	20.36	2.53	2.84	17.52	20.05	0.31	0.775	2.27
CSX-MW-1	51.32				43.28	8.04		8.04
CSX-MW-2	46.70				44.64	2.06		2.06
CSX-MW-3	48.12				45.36	2.76		2.76
CSX-MW-4	47.15				44.96	2.19		2.19
CSX-MW-5	49.76				44.91	4.85		4.85
CSX-MW-6	45.92				43.91	2.01		2.01
DPSSP-MWS-1	24.01	0.04	1.92	22.09	22.13	1.88	0.760	1.91
DPSSP-MWS-2	19.97				17.65	2.32		2.32
DPSSP-MWS-3	16.06				13.37	2.69		2.69
DPSSP-MWS-4	17.54				14.82	2.72		2.72
DPSSP-MWS-5	15.20				12.80	2.40		2.40
SMW-1	18.55				16.64	1.91		1.91
SMW-2	17.81				16.01	1.80		1.80
SMW-3	17.82				15.97	1.85		1.85
SMW-4	18.00				16.40	1.60		1.60

NOTES:

Specific gravity for MWS-1 and MW-10 estimated by interpolation

NAPL - Light Non-Aqueous Phase Liquid
AMSL - Above Mean Sea Level
BMP - Below Measuring Point
Blank cells indicate no fluid level measured

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APPENDIX G
NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA

NAPL AND WATER-LEVEL DATA

Well ID	Measuring Point Elevation (ft AMSL)	November 15,1996						
		Apparent NAPL Thickness (feet)	NAPL Elevation (ft AMSL)	Depth to NAPL (ft BMP)	Depth to Water (ft BMP)	Apparent Water table Elevation (ft AMSL)	NAPL Specific Gravity	Corrected Water table Elevation (ft AMSL)
MW-1	20.78				17.92	2.86		2.86
MW-1A	21.33	0.09	2.59	18.74	18.83	2.50	0.798	2.57
MW-2	21.83	0.62	2.19	19.64	20.26	1.57	0.763	2.04
MW-2A	21.13				17.71	3.42		3.42
MW-3	20.34	1.69	2.44	17.90	19.59	0.75	0.770	2.05
MW-4	20.60	1.49	2.39	18.21	19.70	0.90	0.765	2.04
MW-5	20.32	1.18	2.33	17.99	19.17	1.15	0.774	2.06
MW-6	21.18	1.68	2.44	18.74	20.42	0.76	0.765	2.05
MW-6D	21.45				19.53	1.92		1.92
MW-7	19.30	1.14	2.51	16.79	17.93	1.37	0.796	2.28
MW-9	20.08	0.90	2.28	17.80	18.70	1.38	0.779	2.08
MW-10	16.56	0.02	2.44	14.12	14.14	2.42	0.780	2.44
MW-11	20.21	1.54	2.56	17.65	19.19	1.02	0.780	2.22
MW-12	19.54	0.08	3.09	16.45	16.53	3.01	0.831	3.08
MW-13	20.38				17.28	3.10		3.10
MW-14	20.27	1.82	2.62	17.65	19.47	0.80	0.770	2.20
MW-15	22.58	0.83	2.44	20.14	20.97	1.61	0.779	2.26
MW-16	20.36				17.42	2.94		2.94
MW-17	22.25				18.55	3.70		3.70
MW-18	17.93				12.31	5.62		5.62
MW-19	23.12				17.96	5.16		5.16
MW-20	25.66				19.96	5.70		5.70
MW-20D	25.80				23.47	2.33		2.33
MW-21	20.18				15.83	4.35		4.35
MW-22	21.70				17.61	4.09		4.09
MW-23	20.72				18.23	2.49		2.49
MW-24	20.95	0.01	2.67	18.28	18.29	2.66	0.790	2.67
MW-25	20.36	2.45	2.60	17.76	20.21	0.15	0.775	2.05
CSX-MW-1	51.32				42.38	8.94		8.94
CSX-MW-2	46.70				44.86	1.84		1.84
CSX-MW-3	48.12				45.59	2.53		2.53
CSX-MW-4	47.15				45.20	1.95		1.95
CSX-MW-5	49.76				45.07	4.69		4.69
CSX-MW-6	45.92				44.12	1.80		1.80
DPSSP-MWS-1	24.01	0.05	1.68	22.33	22.38	1.63	0.760	1.67
DPSSP-MWS-2	19.97	0.05	2.09	17.88	17.93	2.04	0.760	2.08
DPSSP-MWS-3	16.06				13.61	2.45		2.45
DPSSP-MWS-4	17.54				15.14	2.40		2.40
DPSSP-MWS-5	15.20				13.11	2.09		2.09
SMW-1	18.55				16.84	1.71		1.71
SMW-2	17.81				16.20	1.61		1.61
SMW-3	17.82				16.15	1.67		1.67
SMW-4	18.00	0.02	3.34	14.66	14.68	3.32	0.780	3.34

NOTES:
NAPL - Light Non-Aqueous Phase Liquid
AMSL - Above Mean Sea Level
BMP - Below Measuring Point
Blank cells indicate no fluid level measured

Specific gravity for MWS-1, MWS-2, SMW-4, MW-24 and MW-10 estimated by interpolation

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APPENDIX H

NAPL Plume Volume, Residual NAPL Volume, and NAPL Plume Migration Velocity Estimates: Calculations and Parameters

APPENDIX H

NAPL PLUME VOLUME, RESIDUAL NAPL VOLUME, AND NAPL PLUME MIGRATION VELOCITY ESTIMATES: CALCULATIONS AND PARAMETERS

NAPL PLUME VOLUME ESTIMATE

In order to interpolate apparent NAPL thickness at any location from the apparent NAPL thickness measurements of November 15, 1996, a finite element grid was utilized. A grid consisting of 56 cells, each 200 feet by 200 feet was superimposed on the apparent NAPL thickness contour map (Figure H-1). At each node a NAPL thickness was estimated by linearly interpolating between isopach contour lines. The apparent NAPL thickness assigned to each cell was calculated by averaging the interpolated apparent NAPL thickness values at the nodes surrounding the cell.

The average apparent NAPL thickness for each cell was converted into the specific NAPL volume for the cell using the three-phase van Genuchten capillary method (Parker, et al., 1994). This method first calculates capillary pressures which are used to calculate water and NAPL saturations. The NAPL saturation is used to calculate NAPL volumes per unit area, which allows the calculation of the NAPL volume.

Using a range of 0.3 to 0.4 for soil porosity based on geotechnical analyses, the average equivalent thickness of NAPL across the entire finite element grid was approximately 0.04 to 0.055 feet. Multiplying these values by the area encompassed by the finite element grid, 2,240,000 ft^2, results in an estimated NAPL volume range of 690,000 to 920,000 gallons.

The van Genuchten capillary method relies on various soil and fluid properties, a representative distribution of which was not available for this NAPL volume estimate. Some of the model input parameters were generated from in-well testing and represent conditions at relatively small radii around the tested well. For example, the parameter, S_m, the

LEGEND

—1.0— ISOCONTOUR LINE, APPARENT NAPL THICKNESS (FT.)

0.04 APPARENT NAPL THICKNESS (FT.)

● MONITORING WELL LOCATION

0.7 INTERPOLATED APPARENT NAPL THICKNESS (FT.) AT NODE

0.17 AVERAGE APPARENT NAPL THICKNESS (FT.)

SCALE IN FEET
0 100 200 400

US Army Corps of Engineers

DEFENSE PERSONNEL SUPPORT CENTER
USACE CONTRACT NO. DACA31-94-D-0017

GRID USED FOR NAPL PLUME VOLUME ESTIMATE

MALCOLM PIRNIE, INC.

FIGURE H-1

4871 : 0285657900\I:\ACAD\PROJ\02856439\643-79 SCALE: 1:1 08/06, 1997 at 10:03

XREF: X643-01

"irreducible" water saturation of 0.215 in the RI Report (Kemron/Versar, 1995) appears to be based on a single measurement. Literature values for similar soils (Farr, et al., 1990) vary significantly, to as low as 0.08. Thus, due to the use of constant or average input parameters, the range of NAPL volumes reported above inherently contains multiple sources of uncertainty.

The source of each property incorporated in the model and the value assigned to that property are described below.

Z_u, Z_{ow}, and Z_{ao} are fluid interface elevations specific to each cell. Z_u is the upper elevation of the capillary fringe, the highest elevation with any NAPL (oil) content. Z_{ow} is the elevation of the oil-water interface, at which oil-water capillary pressure is zero. Z_{ao} is the elevation of the air-oil interface. Each calculation is performed at a discrete elevation, Z, with a discrete thickness, dz, within the NAPL-bearing soil. Values of Z between monitoring wells were interpolated and dz has been set at 0.05 feet in order to provide a sufficient resolution for calculations. The value of dz has been chosen based upon sensitivity analysis.

H_{ow} is the oil-water capillary pressure calculated from Z, Z_{ao}, and the specific gravity of the product, ρ_{ro}. The specific gravity of the product in twelve monitoring wells across the DPSC facility was determined by laboratory analysis, as discussed in Section 4 of this document. A specific gravity for the product in each cell was assigned by linear interpolation and linear extrapolation based on the specific gravities measured in the laboratory. H_{ao}, the air-oil capillary pressure, is calculated from Z, Z_{ow}, and ρ_{ro}. These pressures vary at each elevation and cell according to the NAPL thickness above and below the discrete elevation, Z.

$$H_{ao} = \rho_{ro}(Z - Z_{ao})$$

$$H_{ow} = (1 - \rho_{ro})(Z - Z_{ao})$$

S_w is the water saturation at a specific elevation, calculated from the given oil-water capillary pressure H_{ow} at that elevation. S_{of} is the free oil saturation at an elevation based on the air-oil capillary pressure, H_{ao}, at that elevation. S_m is the "irreducible" water saturation for a soil based on its grain-size distribution. A value of 0.215 was assigned to S_m, based on geotechnical results provided in Appendix H of the RI Report (Kemron/Versar, 1995).

$$S_w = (1 - S_m)\ (1+(\alpha\ H_{ow})^n)^{-m}) + S_m$$

$$S_{of} = (1 - S_m)\ (1+(\alpha\ B_{ao}\ H_{ao})^n)^{-m}) + S_m - S_w$$

α, m and n are van Genuchten parameters for soil. α, the van Genuchten soil/water parameter, was estimated by employing a correlation with saturated hydraulic conductivity. In-situ hydraulic conductivity tests were conducted during the RI (Kemron/Versar, 1995). The geometric mean of hydraulic conductivity values estimated from tests in wells which intersected the NAPL plume is 3.4 feet per day (ft/d). This value was used in the following equation:

$$\alpha = A\ K_{sw}^{1/2}$$

A, a parameter based primarily on laboratory analyses of vertical conductivities has been estimated as 1.5 $ft^{-3/2}$, which results in an α of 2.77 ft^{-1}.

n, the pore size distribution exponent, was estimated as 1.446. This value for n was determined based on geotechnical analyses of soil samples (Kemron/Versar, 1995). The value of m, a calculation coefficient based on n ($m = 1 - (1/n)$), was estimated at 0.308.

B_{ao} and B_{aw} are scaling factors based on surface tensions. B_{ao} is the ratio of water surface tension to NAPL surface tension. The surface tension of a NAPL sample collected from MW-25 was measured in a laboratory to be 24.5 dynes/cm. The surface tension of water is 72.8 dynes/cm. The ratio B_{ao} is 2.97. B_{aw} is the ratio of water surface tension to NAPL-water interfacial tension. The laboratory measured value of NAPL-water interfacial tension for a NAPL sample collected from MW-25 was reported as 29.2 mN/m. B_{aw} is 2.49.

The porosity of the soil, ϕ, was assumed to be 0.3 to 0.4 based on geotechnical analysis.

The volume of NAPL per unit area per interval $dz = \phi\ S_{of}\ dz$

Therefore, the volume of NAPL per unit area (V_{of}) = Σ (ϕ S_{of} dz) for all z.

The total volume of NAPL beneath DPSC equals the volume of NAPL per unit area by the area encompassed by the finite element grid. The total volume calculated was approximately 690,000 to 920,000 gallons, based on the 0.3 to 0.4 range of porosities.

RESIDUAL NAPL VOLUME ESTIMATE

The volumetric product content of soil, Θ_o, was estimated from soil bulk density, oil (NAPL) density, and the reported concentrations of TPH in soil samples (Parker et al., 1994).

$$\Theta_o = (\rho_b)(TPH) / (10^6 \rho_o)$$

The soil bulk density, ρ_b, is calculated from the assumed porosity, 0.3, and the soil particle density, assumed to be 2.65 g/cm^3. The NAPL density, $\rho_{o,}$ was previously estimated as 0.75 g/cm^3 (Kemron/Versar, 1995).

The volume of soil above the air-NAPL and air-water interface, inside the 500 ppm TPH contour, and in the 15 to 30 foot depth interval was calculated to be 7,440,000 ft^3. The area enclosed by the 500 ppm contour is 1,882,000 ft^2. The average thickness of soil above the air-NAPL and air-water interface, inside the 500 ppm TPH contour, and in the 15 to 30 foot depth interval is 3.95 feet. Using the estimated volumetric oil (NAPL) content of the soil, 0.0063, the residual volume of NAPL in the soil was conservatively estimated to be 351,000 gallons. The calculation likely overestimates the volume of residual NAPL because the soil samples for TPH analysis were preferentially submitted from the lower portions of the 15 to 30 feet interval. Thus, the portion of this interval which is used in this estimate, an average of the upper 3.95 feet, is likely to, as an average, contain lower concentrations of TPH than the lower portion of this interval.

NAPL PLUME MIGRATION VELOCITY ESTIMATE

The migration rates of NAPL plumes can be estimated based upon the hydraulic gradient of the water table and a mobility factor relating soil and fluid parameters (Parker, et al., 1994). Because of its proximity to the southern downgradient edge of the plume, values determined during tests performed on monitoring well MW-6 are used.

These estimated values inherently contain uncertainties as evidenced by the estimated ranges of required input parameters. Several of these variables, including hydraulic conductivity and hydraulic gradient, are spatial parameters and therefore represent conditions specific to a certain area. The parameters used for these NAPL velocity estimates are specific to the area in the vicinity of MW-6. Not only are there significant uncertainties associated with these NAPL velocities, but applying these estimates to other areas within the study area would compound these uncertainties and result in non-representative NAPL migration velocities. It should also be noted that monitoring wells in which no NAPL is present have been installed to the south of the plume. These monitoring wells are periodically monitored for the presence of NAPL so that further possible migration of the NAPL plume will be identified.

The majority of values used to calculate the mobility factor are lab or field measured values. The density of the product, ρ_{ro}, was determined by lab analysis to be 0.765 g/cm^3. The hydraulic conductivity of the soil, K_{sw}, was estimated at 0.83 ft/day from slug tests performed in MW-6 during the Remedial Investigation. The irreducible water saturation of the soil, S_m, was determined to be 0.215 by lab analyses performed as part of the Remedial Investigation.

η_{ro}, the ratio of the dynamic viscosity of oil (NAPL) to the dynamic viscosity of water, was calculated based upon literature values (Oak Ridge National Laboratories, 1989). The dynamic viscosity of JP-4, μ_o, was estimated at 0.829 centipoise (cp). The dynamic viscosity of water, μ_w, is 1 cp at 20 C. The ratio of these two values, η_{ro}, is 0.829. The porosity of the soil, ϕ, was estimated at between 0.3 to 0.4, also based upon literature values.

The maximum mobility factor M_0^{max} is computed as:

$$M_0^{max} = (\rho_{ro} K_{sw}) / (\eta_{ro} \phi (1-S_m))$$

M_0^{max} = 2.44 ft/day to 3.26 ft/day (based upon a range of porosities)

The gradient of the corrected water table, dZ_{aw}/dx, is very shallow and has been conservatively estimated at 0.001 ft/ft.

The maximum NAPL plume velocity, v_0^{max}, is calculated as:

$v_0^{max} = (M_0^{max})\ (dZ_{aw}/dx)$

v_0^{max} = 0.0024 ft/day to 0.0033 ft/day (based upon a range of porosities)

In order to attain the maximum NAPL plume velocity, v_0^{max}, an apparent thickness greater than that observed at DPSC is required. At the thicknesses observed at DPSC, the relative oil mobility may be as little as half of the maximum value. Because the apparent product thickness at MW-6 is near the minimum apparent thickness seen in soils of this type due to capillary exclusion, the NAPL plume velocities in the vicinity of MW-6 can be estimated at approximately half of the maximum NAPL plume velocity. This velocity ranges between approximately 0.0012 ft/day and 0.0033 ft/day based upon both the relative oil mobility factor and the estimated range of porosities.

APPENDIX I

Friedman & Bruya, Inc. Analytical Report

Nature of Petroleum Material Present in the Vicinity of the Defense Personnel Support Center in Philadelphia, Pennsylvania.

Prepared for
Malcolm Pirnie, Inc.

by
James E. Bruya, Ph.D.
Friedman & Bruya, Inc.
October 31, 1996

Table of Contents

INTRODUCTION

A large amount of petroleum hydrocarbon material has been discovered in the subsurface at the Defense Personnel Support Center (DPSC) in Philadelphia, Pennsylvania. Hydrocarbon material has contaminated soil and is also found as a light non-aqueous phase liquid (LNAPL) floating on groundwater. The origin of the LNAPL is of particular concern due to its widespread distribution at the DPSC facility.

A number of petroleum hydrocarbon products were reported to have been used or stored at the DPSC facility. A summary of these potential on-site sources has been compiled by Louis Berger & Associates and Malcolm Pirnie, Inc. in a report titled "Phase II Expanded Site Investigation Report, 1996." There is concern, however, that some or all of the contamination at the DPSC facility is from off-site sources. One potential off-site source is a refinery located to the west adjacent to the DPSC facility. A number of tanks used for the storage of finished and intermediate petroleum hydrocarbon products are situated on the refinery property.

Soil, LNAPL, and water samples were collected on and adjacent to the DPSC facility in an attempt to characterize the nature of the material present and to pinpoint its origin. Samples were analyzed using a variety of tests depending on the location and type of sample. In general, an infrared (IR or FTIR) scan and capillary GC analysis were performed on most samples. These tests provided information as to the potential presence of hydrocarbon materials and the boiling range of any material that was present. Other tests were performed based on the project requirements and included tests for ethers, alcohols, organic lead, selected metals, volatile organic compounds, semi-volatile compounds, dyes, specific gravity, viscosity, flash point and pH. This report summarizes the important findings.

DEFINITION OF TERMS

The following provides a definition of some of the technical terms that are used in this report.

Naphtha is a generic term that can refer to a number of different low boiling materials. Naphtha can refer to hydrocarbon solvents or to a number of intermediate refinery products. These products are generally characterized as having very low flash points and relatively low distillation end points. The composition and boiling range of each naphtha will vary depending on the intended use of the product.

Kerosene is a generic term that refers to a number of different refined petroleum distillate products. These products are generally characterized as having moderate flash points and moderate distillation end points.

JP-4 is a turbine fuel that was widely used in the past to power jet aircraft used by the US Military Services. This fuel was typically made from a straight run petroleum distillate or naphtha.

JP-5 is a turbine fuel that was widely used in the past by the US Navy to power jet aircraft. This fuel was typically made from a straight run petroleum distillate or kerosene.

JP-8 is a turbine fuel that is currently used by all branches of the US Military to power jet aircraft. This fuel is typically made from a straight run petroleum distillate or kerosene. Its chemical composition is similar to that of JP-5.

Jet A is a turbine fuel that is widely used throughout the world to power civilian jet aircraft. This fuel is typically made from a straight run petroleum distillate or kerosene. Its chemical composition is similar to that of JP-5 and JP-8.

Diesel refers to one of several different grades of fuel that are used to power diesel engines. These fuels are typically made from a straight run petroleum distillate. Diesel #1 is designed for use in high speed engines that are subjected to frequent and relatively wide variations in loads and speeds and for use where low ambient temperatures are encountered. Diesel #2 is designed for use in high speed engines that are subjected to relatively constant loads and uniform speeds. Diesel #4 is designed for use in low and medium speed engines that are subjected to sustained loads and constant speeds.

Fuel oil is a generic term used to describe various products that can be utilized for heating purposes. Fuel oil #1 is typically made of a light distillate and is intended for use in burners which vaporize the fuel as it enters the combustion chamber. Fuel oil #2 is typically made of a heavier distillate than fuel oil #1 and is intended for use in burners that atomize the fuel as it enters the combustion chamber. Fuel oil #2 is typically used in domestic burners and medium capacity commercial-industrial burners. The ease of handling overcomes the higher cost relative to residual fuels. Fuel oil #4 is typically made of a light residual or heavy distillate and is intended for use in pressure-atomizing commercial-industrial burners. Fuel oil #5 is typically made of a residual material that may or may not require preheating. Fuel oil #6 is typically made of a residual material that generally requires heating during storage and transport.

BACKGROUND

A number of different petroleum hydrocarbon products were used and stored at the DPSC facility. Bulk petroleum products used included gasoline, diesel, and a number of different fuel oils. Products used in smaller amounts included lubricating oils such as motor oil, and solvents associated with cleaning and painting activities.

DPSC is located in the Coastal Plain Physiographic Province and is underlain by unconsolidated Pleistocene and Cretaceous sediments which overlie crystalline bedrock. The site is reported to be characterized by varying thicknesses of fill which overlie a silt unit which is up to approximately 15 thick. The silt unit is underlain by undifferentiated sand and gravel in which the water table is present. The water table is present at approximately 15 to 20 feet below ground surface. The NAPL is present within the sand and gravel unit, on top of the water table. DPSC is underlain by a single unconfined aquifer, although regionally confining units are present which define two aquifers.

POTENTIAL SOURCES OF PETROLEUM CONTAMINATION AT DPSC

There are a number of potential sources for the material present at the DPSC facility. Products known to have been present at the DPSC facility include gasoline, diesel, fuel oil, and various lubricating oils and solvents as reported by Malcolm Pirnie/Louis Berger, 1996.

A number of underground storage tanks (USTs) and associated piping were located near Building 28 beginning around 1941. This is the location of an automotive and locomotive fueling facility. Three USTs were installed in 1941, replaced in 1971, and retrofitted in 1987-1988. The USTs contained gasoline and diesel. A supply pipe was found leaking in the 1987-1988 investigation. In 1994, suspected pipe leaks were noted in the area of the pump island during further upgrades to the facility.

Another fueling facility was located near Building 9. This facility was reported to have been a relatively old operation (pre-1941). Tanks at this location were reported to have been placed inside a vault and were likely removed during the construction of Building 9. These tanks were reported to have contained gasoline.

There are several active underground and above ground tanks located near Building 18. The tanks were reported to have contained fuel oil #6. There were also several USTs near Oregon Avenue that were reported to have been installed in 1922. These tanks supplied fuel to a demolished boiler plant and the tanks went out of service in 1940.

A 550 gallon waste oil storage tank was installed in Building 8 in 1973. Prior to the tank installation, waste oil was stored in 55 gallon drums. The waste oil tank was removed in May of 1995.

IDENTIFICATION OF MATERIAL AT THE DPSC FACILITY

Based on the testing results, there appears to be several products present at the DPSC facility. Present on top of the groundwater is a LNAPL. This material is a relatively undegraded light naphtha similar to that expected for a JP-4. The LNAPL was fairly consistent in its composition throughout the site where free product was encountered. The exceptions to this were the LNAPL samples collected from MW7 and MW12 where the LNAPL appeared to contain a degraded naphtha. The soil present near the groundwater beneath the DPSC facility in the area of the LNAPL appeared to be impacted with degraded and undegraded naphtha depending on the location from which the samples were collected. In the soil beneath the DPSC facility but above the zone impacted by the groundwater, there appears to be evidence of gasoline, fuel oil and waste oil at what appears to be isolated locations.

The LNAPL is characterized as a low boiling or light naphtha that has a boiling range from below 200°F to approximately 600°F. The undegraded material displays an inverse relationship between the amount of material and its molecular weight. The undegraded material also shows a pattern of *n*-alkanes that is characteristic of a straight run naphtha. Since degradation processes generally result in a loss of the highly volatile compounds and *n*-alkanes, the presence of these constituents indicates that the LNAPL is a relatively undegraded naphtha. Undegraded naphtha is the dominant material present in LNAPL collected from locations MW1A, MW2, MW3, MW4, MW5, MW6, MW9, MW11, MW14, MW15 and MW25.

The LNAPL collected from MW7 was slightly different and consisted of a degraded naphtha. The material at MW7 is characteristic of a low boiling naphtha that has a boiling range from below 200°F to approximately 600°F. It did not show any evidence of the *n*-alkanes characteristic of an undegraded naphtha. The loss of the *n*-alkanes indicates that this naphtha has undergone extensive biological degradation. The extent of the degradation indicates that this material was likely released many years prior to the undegraded naphtha discussed above.

Present at low levels in several LNAPL samples was what appeared to be a degraded naphtha similar to that found in MW7. A mixture of degraded and undegraded naphtha was present at locations MW1A, MW9 and MW11. The degraded naphtha is likely from a release that is many years old and the undegraded naphtha from a fairly recent release.

The LNAPL collected from location MW12 was different than that from the other sampling locations. This material is characteristic of a kerosene with a boiling point range from approximately 300°F to 600°F. The material from MW12 showed an absence of *n*-alkanes which is characteristic of a biologically degraded naphtha. MW12 also showed an absence of the highly volatile compounds that were present in all of the other LNAPL samples.

The absence of the highly volatile compounds in MW12 may indicate that the volatile compounds have been lost by evaporative processes. Due to the fact that a low boiling naphtha is found in all of the other LNAPL samples, it is likely that the material at MW12 is a low boiling naphtha that has undergone more evaporative weathering than the other LNAPL samples. The greater extent of evaporative weathering may indicate that this material is located near the edge of the old naphtha plume. It is also possible that this is not a naphtha but rather a kerosene.

Organic lead was found at low levels in several of the LNAPL samples. Only tetramethyl lead and tetraethyl lead were present in the LNAPL. The relative ratios of these two lead species suggests that the lead is the result of more than one lead release. The presence of the adjacent refinery complicates the possible origin of the organic lead since it may come from the release of a leaded gasoline package that is blended into gasoline stock to make leaded gasoline rather than from the release of leaded gasoline.

Isooctane was also found in several of the LNAPL samples. Generally, isooctane is found in gasoline or in various refinery streams used to make gasoline. The presence of isooctane is generally not associated with naphtha.

The presence of both organic lead and isooctane indicate that the LNAPL contains low levels of leaded gasoline. The lead levels in the LNAPL vary from a high of 0.28 to less than 0.01 grams of lead per gallon. Due to the low level of lead generally present in the LNAPL, the lead and gasoline constituents have most likely been distributed throughout the site by the naphtha. To determine the actual proportion of leaded gasoline in the LNAPL one would need to determine the distribution of lead based on the quantity of LNAPL found throughout the site, the approximate level of lead in the gasoline when it was released, and the effect of weathering processes on the lead concentration. At this point, we have not attempted to make these determinations.

Soil samples were analyzed at varying depths within the LNAPL impacted zone at locations MW23, MW24 and MW25. Soil samples from MW23 collected at 18-20, 20-22 and 24-26 feet showed evidence of a highly degraded naphtha similar to that present at MW7. Soil samples from MW24 collected at depths of 16-18, 18-20 and 20-22 feet showed evidence of a relatively undegraded naphtha. Soil samples from MW25 collected at depths of 18-20, 20-22 and 24-26 feet showed a mixture of degraded and undegraded naphtha. The sample collected at 18-20 feet displayed a dominant pattern of *n*-alkanes which is characteristic of an undegraded naphtha. The sample collected at 20-22 feet showed evidence of a mixture of a degraded and undegraded naphtha. Finally the sample collected at 24-26 feet lacked the *n*-alkanes and is characteristic of a degraded naphtha.

Material was found in the soils above the smear zone created by the LNAPL as it moves vertically through the soil during groundwater fluctuatations. Highly evaporated gasoline was found near Building 28. Motor oil or other lubricating oil was also found in the soil near Building 28. Finally, a fuel oil was found near the Oregon Avenue USTs. None of these materials are similar to the degraded or undegraded naphtha that makes up the vast majority of the LNAPL.

ORIGIN OF CONTAMINATION AT THE DPSC FACILITY

In determining the origin of the contamination at the DPSC facility, the boiling range and general chemical composition of material provided the primary information source. Specific chemical composition analyses were used for identification of gasoline components. The volume of material and the expected groundwater flows have not been factored into this analysis of the potential sources of the LNAPL.

Both on and off-site sources were evaluated to determine if they were likely origins of the three different materials that make up the LNAPL present at the DPSC facility. The three components are an undegraded naphtha, a degraded naphtha and a gasoline or gasoline precursor. The possibility that the LNAPL originated with a subsurface release was considered because of the high proportion of volatile compounds.

The general composition of the LNAPL does not correspond to any of the products reported to have been stored and used at the DPSC facility. The LNAPL is not a motor oil, lube oil, or solvent. The boiling range of the LNAPL is not what one would expect for motor oil, lube oil, or solvent.

The LNAPL is not a fuel oil or boiler fuel. The expected flash point of the LNAPL is very low and would represent a safety hazard if used as a fuel oil. The high ratio of low to high boiling compounds in the LNAPL is not characteristic of fuel oils. Fuel oils are generally low cost fuels, and as such, contain higher proportions of high boiling (less valuable) compounds than low boiling compounds.

The LNAPL is not a diesel. The boiling range of the LNAPL is not what one would expect for a diesel. The expected flash point of the LNAPL is very low and would represent a safety hazard if used as a diesel. The absence of the higher boiling material found in diesel indicates that this is not a diesel. The power associated with a diesel fuel is linked with these high boiling compounds.

The LNAPL may contain small amounts of gasoline but is not primarily gasoline. The boiling range of the LNAPL extends beyond that of gasoline. The typical constituents of gasoline, namely the high octane aromatic hydrocarbons, are not present at the levels characteristic of gasoline. The level of *n*-alkanes present in the LNAPL greatly exceeds that found in gasoline. The wide distribution of low levels of organic lead throughout the LNAPL suggests that the naphtha was the likely carrier for the organic lead, and not gasoline.

The LNAPL is not a mixture of gasoline and diesel. The typical constituents of gasoline, namely the high octane aromatic hydrocarbons, are not present at the levels which are characteristic of gasoline. The level of the low octane *n*-alkanes present in the LNAPL greatly exceeds that found in gasoline. The absence of the higher boiling material found in diesel would eliminate the components that are responsible for the power of this fuel.

The LNAPL contains low levels of leaded gasoline and possibly some unleaded gasoline. The highest concentration of gasoline in the LNAPL does not correspond to any known gasoline storage location. This suggests that the gasoline has been moved to its current location by the naphtha that makes up the bulk of the LNAPL.

Because there is no known on-site source of the naphtha component of the LNAPL, off-site sources were considered. The boiling range of the degraded and undegraded naphtha that makes up the majority of the LNAPL best matches JP-4. Because of this, the LNAPL was analyzed to determine if the JP-4 icing inhibitor, ethylene glycol monomethyl ether, was present. Although none was found, production and shipment of JP-4 without this additive is not uncommon. Additionally, this additive may have been present at the time of release and has since degraded in the environment.

Due to the presence of the adjacent refinery to the west of the DPSC facility, the naphtha may also be the result of a release of a refinery intermediate or light crude oil. Although the boiling range of this material is not typical of a current refinery naphtha, the composition of refinery naphtha can change depending on refinery operating conditions. Likewise, the composition of crude oil feed stocks is unknown and one or more may, at some time, have been similar to that seen for the naphtha. Because of these uncertainties, it is not possible to rule out a refinery intermediate or crude oil as the LNAPL source.

Sampling activities were conducted to the west of Schuylkill Expressway to determine the extent of the LNAPL. The borings were reported to have been advanced east of any refinery tanks or pipelines. Analyses showed the presence of a highly degraded petroleum products. A degraded gasoline was present at boring CSX-MW5. Degraded naphtha was found in borings CSX-MW3, CSX-MW4, CSX-MW5 and CSX-MW6. There was no evidence of an undegraded naphtha.

A series of borings were also advanced south of the DPSC facility in the vicinity of a sewer line. Gasoline was present at locations MWS-1 and MWS-2. An undegraded naphtha appeared to be present at locations MWS-1, MWS-2, SBS-2, SBS-5 and SBS-6. A degraded naphtha appeared to be present at locations MWS-1, MWS-2, MWS-3, MWS-5, MWS-7, SBS-5, SBS-6 and SBS-8.

These findings suggest that the refinery is a likely source of the degraded naphtha and some, if not all of the gasoline that is present in the LNAPL at the DPSC facility. The refinery is also the likely source of the undegraded naphtha, as well.

SUMMARY

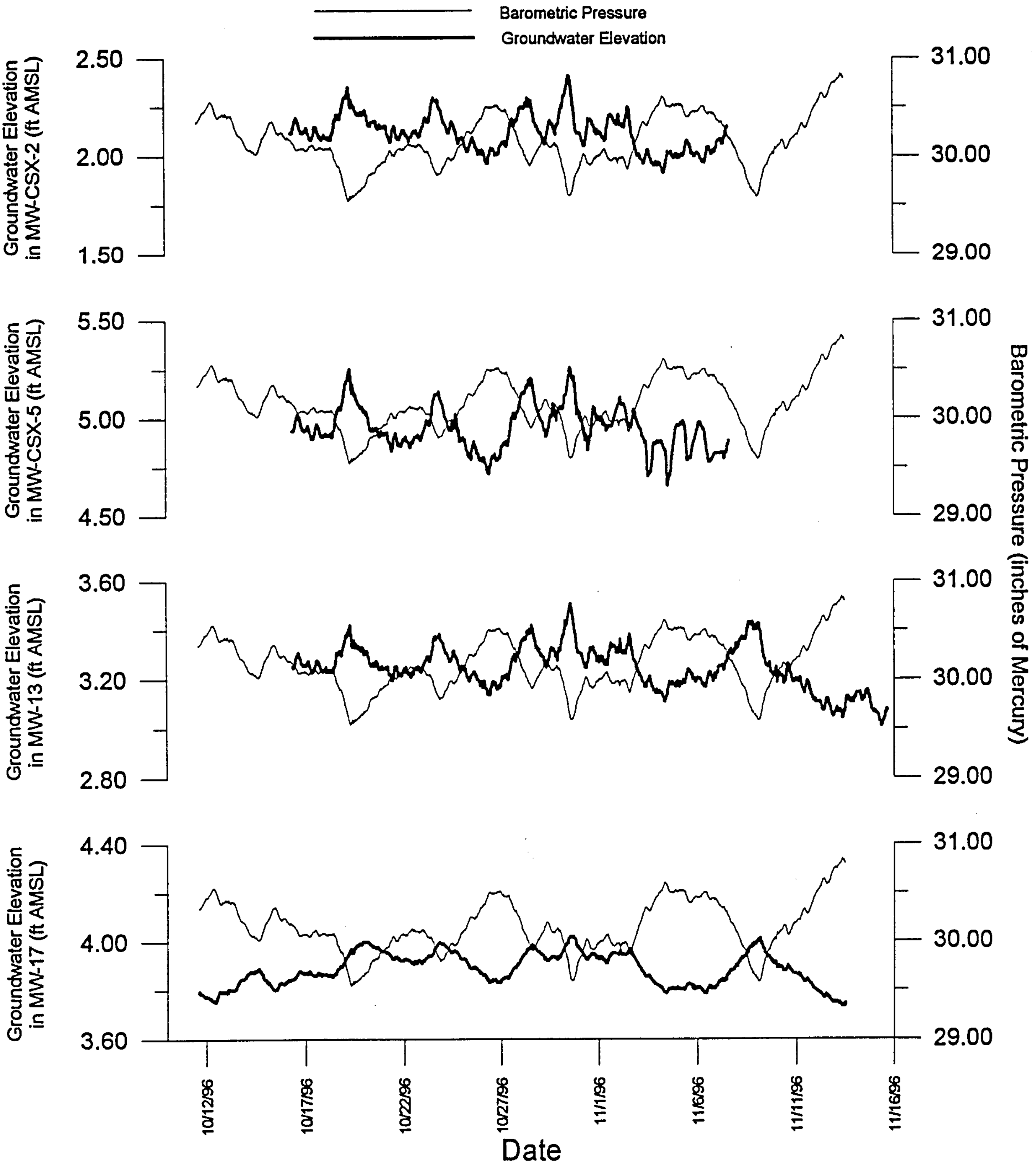
The identity of the material that makes up the LNAPL at the DPSC facility is not due to the release of products stored at the DPSC facility except for the possible release of some gasoline. The LNAPL is unusual and is characteristic of JP-4, a refinery naphtha or a light crude oil.

Clearly, there appears to have been at least two releases of naphtha that now make up the LNAPL. One naphtha is highly degraded and is found throughout the DPSC facility, as well as to the west and south. The other naphtha is relatively undegraded and is found generally in the southwestern portion of the DPSC facility.

Gasoline presents a minor component of the LNAPL. It may be due to the release of a gasoline at the DPSC facility but may also come from the same source as does the naphtha, i.e., the refinery.

Appendix J
Graphs of Long-Term Water-Level Monitoring Data

APPENDIX J
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA
LONG-TERM WATER-LEVEL DATA 10/12/96-11/16/96



Appendix K
Summary of DPSC Storage Tanks

APPENDIX K
NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA

SUMMARY OF DPSC STORAGE TANKS

PADEP TANK NO. (see note C)	BRAC TANK NO. (see note D)	CAPACITY (gallons)	CONTENTS	LOCATION	PRESENT USE	DATE INSTALLED	TANK CONDITION (see note B)	CONTAMINATION	COMMENTS	POTENTIAL IMPLICATIONS OF TANK
UST's:										
001 through 005	7 through 11	25,000(2,3,12) each tank	#6 Fuel Oil(3,11,12)	Bldg. 18 tank farm (Bet. Bldg. 18 & ASTs)	Active(2,3,12)	Jan - 1942(2,3)	Cleaned and precision tested in Fall 1994 - Tested tight (3)	Several releases of fuel oil have been documented in the vicinity of Bldg. 18. (12)	In operation 1942-present. (12) Tanks encased in concrete (3,14); connected to 2 ASTs and pump-house (Bldg. 18); Supplies fuel to Bldg. 8 boiler as backup power supply (3)	No. 6 Fuel Oil is highly viscous, and must be heated to be pumped. Its physical properties greatly limit its mobility and potential to flow through soils.
006	4	each 10,000(1,2,3,5,12,18) tanks have 8' φ(18)	Unleaded gas(1)	So.of Bldg. 28 (Gas Station) Top of each tank is 3' bgs(18)	Removed 5/94 (1,2)	1942(10,14) Jan - 1971(1,2,3)	All in "good condition"(1)	Removed 20 cy of contaminated soil - additional contaminated soil left in place (1) Removed 50 cy(3)	'In operation 1971-1994(12) Used for on-site automotive consumption; Replaced with one 2,000 gal. tank and one 4,000 gal. tank. (ASTs Nos. 004A & 005A, respectively) (16)	Tanks are located within limits of NAPL plume. Tanks tested tight, with only minor limited soil contamination documented.
007	5		Unleaded gas(1)				All tanks and piping tightness tested in 1988-no leaks (3,9)			
008	6	10,000(1,2,3,5,12,18) tank has 8' φ(18)	Diesel(1,3,5,12)				Leak in Tank 008 fuel line discovered and repaired 10/87(9)			
009	17	30,000(1,2,3,4,12,18) 10'6" φ x 46'6" lg.(18)	Diesel / #2 Fuel Oil(3,4), Diesel (12)	Rogers St. bet. Bldgs. 1&8. Top of tank is 3' bgs(18)	Removed 2/95(12)	Jan -1971(3) Jan-1973(1,2,4,12) early 1970s (14)	Intact; no evidence of leakage from tank or piping(1)	No VOC or TPH contam. observed beneath tank.(1,3)	In operation 1973-1993(12) Supplied fuel to Bldg. 8 standby emergency diesel generators (1,3); out of service for 10 years.(3)	Tank is slightly upgradient of the NAPL plume. No evidence of contamination is documented.
010	18	550(1,2,3,4,5,12,18) 4' φ x 6' lg.(18)	Waste Oil(5,12) (Used Motor Oil)(1,4)	Courtyard of Bldg. 8 (center of site)	Removed 5/94(2,12)	Jan-1973(1,2,3,4,12	Intact; no holes or evidence of leakage in tanks or piping during removal(1)	Minor release beneath tank (TPH = 1200 ppm)(3) No contaminated soil found during tank removal (1)	Exact contents of this tank are unknown. In operation 1973-1992 (12) "Waste oil tank for two standby emergency diesel generators in Bldg. 8" (1)	Tank is slightly upgradient of the NAPL plume. Only minor evidence of contamination is documented.
011 012	14 15	each 6,000(2,3,5,6,16)	Diesel or #2 Fuel(3) #4 Fuel Oil (1,4) Heating oil (12)	Along Oregon Ave., North of Bldg. 46	Removed 7/94(2,12)	Jan-1922(1,2,4,12)	Intact; no holes or evidence of leakage(1)	Contam. beneath 1 tank: TPH = 9800 ppm at 14' bgs(3) Soil around and under tanks observed as contaminated.(1) No release from the USTs has been identified. (12)	In operation 1922-1941. Exact contents are unknown(12) Out of service since 1940's.(3) Fuel storage for former Bldg 10 boiler plant (demolished) Filled with sand previously. (1) Tanks were cut up during removal - exact capacity not confirmed. (16)	Tanks are located far outside of the limits of NAPL plume. Extent of contamination is unknown - contractor performed excavation work without independent inspection.(16)

APPENDIX K
NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA

SUMMARY OF DPSC STORAGE TANKS

PADEP TANK NO. (see note C)	BRAC TANK NO. (see note D)	CAPACITY (gallons)	CONTENTS	LOCATION	PRESENT USE	DATE INSTALLED	TANK CONDITION (see note B)	CONTAMINATION	COMMENTS	POTENTIAL IMPLICATIONS OF TANK
013 014	1 2	10,000 (1,2,3,5,12,19) 8' ϕ x 27'5" l. (19)	DDT & other contaminants (2,5) DDT (1,3) Pesticide (12)	So. of Bldg. 9 (DeWitt St.) Top of tank is 3' bgs (19)	Removed 7/95 (1)	Jan-1942 (1,2)	intact with no sign of leakage (1,8)	High DDT contam; TPH = 242ppm, VOC = 10ppb xylene (3)	Filled w/ sand in 1983. (3) Supplied chemicals to mixing room in Bldg. 9. (1,3) In operation 1942-1973. (12) Over 1.4 million pounds of contam. soil, liquids, solids, and debris was removed from the site (8)	Tanks formerly contained DDT/pesticides - no historical record of petroleum products stored in these tanks.
015	16	each 10,000 (1,2,4,5,7,12,16)	Heating oil (12) Diesel or #2 Fuel (3) Fuel Oil #4 (1,4)	Along Oregon Ave north of Bldg 46.	Closed in place 2/95 (1,12)	Unknown (1,2,4) 1922 (12)	1/2" hole in bottom of tank (1)	Visible soil contamination encountered (3,16)	Exact contents are unknown (12) Discovered during removal of two adj. tanks; Fuel storage for Bldg. 10 boilers demolished in mid-1900's (piping also demolished) (1) Filled with foam. (1) In operation 1922-1941 (12)	Tank is located far outside of the limits of NAPL plume. Extent of contamination is unknown - contractor performed excavation work without independent inspection.(16)
NR1 NR2	12 13	unknown (12)	unknown (12)	East end of Bldg 46	Inactive (12)	unknown (12) Prior to May 1935 (17)	unknown	No release from Bldg 46 has been documented (12)	The existence of these tanks has not been confirmed. (12)	Tanks are located far outside of the limits of NAPL plume
NR3	19	1,440 (13) unknown (12)	waste oils and solvents (12, 13)	Within Bldg. 30 on north side	Inactive (12)	unknown (12)	unknown	unknown	Oil water separator; Exact contents are unknown (12) Bldg. 30 used as vehicle maintenance facility 1960s - 1980s (13) early 1970s - early 1980s (12)	Tanks are located within limits of NAPL plume.
NR4-a through NR4-e	22	unknown (12) 5 tanks with total capacity of 10,500 (17)	Gasoline (12)	Bash St. between Bldgs 6,9, & 14	Inactive (12)	unknown (12) Prior to May 1935 (17)	unknown	unknown	Tanks supplied fuel to former gasoline station. (12) The capacity of each individual tank is unknown (17)	Tanks are located within limits of NAPL plume.
NR5	-	unknown but believed to be 600 (13)	unknown (13)	Within Bldg. 30	unknown (13)	unknown (13)	unknown	unknown	2000 gal.of liquid pumped from tank, but contents could not be depleted (13) pH was low upon initial pumping of liquid, became neutral over time (16)	Tank is located within limits of NAPL plume.
<u>AST's</u> 001A	3	600 (13) or 500 (2,5,12)	Waste oil (12) Used Motor Oil (5)	Southwestern exterior wall of Bldg. 30 (12)	Removed 1991 (2) 1992 (12)	Jan -1950 (2)	unknown	unknown	In operation 1950 - 1992 (12) No tank closure report available.	Tank is located within limits of NAPL plume.

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NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA

SUMMARY OF DPSC STORAGE TANKS

PADEP TANK NO. (see note C)	BRAC TANK NO. (see note D)	CAPACITY (gallons)	CONTENTS	LOCATION	PRESENT USE	DATE INSTALLED	TANK CONDITION (see note B)	CONTAMINATION	COMMENTS	POTENTIAL IMPLICATIONS OF TANK
002A 003A	20 21	each 200,000(2,12)	#6 Fuel(3,11,12)	SW corner of site, South of Bldg. 18	Active(2,3,12)	Jan -1942(2,12)	unknown	unknown	Supplies fuel to boiler in Bldg.8 as backup power system. In operation 1942 - present (12)	No. 6 Fuel Oil is highly viscous, and must be heated to be pumped. Its physical properties greatly limit its mobility and potential to flow through soils.
004A	-	2,000(2,5,16)11'3" l x 8' w x 6' h(18)	Diesel(5,16,18)	So. of Bldg. 28	Active(2)	Jul -1994(2)	unknown	unknown	These two ASTs replaced three USTs which were removed in May, 1994.	The NAPL plume was detected prior to the installation of these two tanks
005A	-	4,000(2,5,16) 17'7-1/2" l x 8'1/2" w x 6'5-3/4" h(18)	Unleaded gas(5,16)							
NR6A NR7A	- -	each 200,000 (15)	Water (16)	East of Bldg. 1, beneath present location of Bldg 6.	Removed (16)	unknown	unknown	unknown	Water storage tanks used in former Boiler House to supply steam lines. Tank NR8A was a water tower(10,16)	Tanks were used for water storage - could not contribute to NAPL plume.
NR8A	-	75,000								

Notes:

A. All tanks are fabricated of steel.
B. Observations on tank condition were generally obtained from Tank Closure Reports. The reports do not specify whether any testing or analysis (e.g. pressure testing) was performed to confirm the observations.
C. Tank numbers as designated on sources (1), (2) and (4). Tanks designated as "NR_" are additional tanks discovered, which are not included on the PADER tank registration forms.
D. Tank numbers as designated on source (12)
E. Physical Tank dimensions are unknown.

Sources of Information:

(1) UST Closure Report Form
(2) Registration of Storage Tanks
(3) Final Phase 1 RI/FS Report, prepared by Kemron/Versar
(4) UST Closure Notification Form
(5) DLA letter to PADER re: Registration of Storage Tanks 7/12/94
(6) UST Sampling at Oregon Avenue, Figure 2, prepared by Versar, Inc. 5/19/94
(7) "Plan View of 10,000 Gallon Storage Tank Located along Oregon Avenue", Drawing No. L9407101, prepared by Versar, Inc.
(8) DPSC Tank Closure Report, prepared by Rollins Environmental Site Services, June 30, 1995.
(9) Draft Feasibility Report for Replacement of USTs at DPSC, prepared by Baker Environmental, Inc. Dec, 1992.
(10) Installation Assessment of DPSC, prepared by Chemical Systems Laboratory, September 1992.
(11) Final Engineering Report for DPSC, prepared by Environmental Science & Engineering, Inc., Nov. 1991.
(12) BRAC Cleanup Plan for DPSC, Final Report, Update 01, prepared by Defense Logistics Agency, June 15, 1995.
(13) Preliminary Screening Assessment, Buildings 30 & 44, DPSC, prepared by ENSR Consulting and Engineering, September 1991.
(14) Installation Assessment of DPSC, Report No. 193, prepared by Chemical Systems Laboratory, September 1982.
(15) "Location of Main Steam Supply and Return Lines," Drawing No. 6214-172, dated July 16, 1918.
(16) DPSC Personnel
(17) "General Plan Showing City Water Main, Domestic Water Lines and Fire Protection Mains," Drawing No. P.D.M. 145, dated May 28, 1935.
(18) "Underground Storage Tank Removals and Gas Station Tank Replacement," Drawing No. 1088001, sheets 1 thru 7 of 7, dated 6/15/93.
(19) "PQMD-Building No. 9 Sponging Plant, Liquid Handling Equipment with Equipment Room and Piping," Drawing No. PQMD 34-51-?, dated 3/5/51.

Appendix L

Summary of Multi-Tiered Analytical Sequence and Supplemental Quality Assurance/Quality Control Measures

APPENDIX L

SUMMARY OF MULTI-TIERED ANALYTICAL SEQUENCE AND SUPPLEMENTAL QUALITY ASSURANCE/QUALITY CONTROL MEASURES

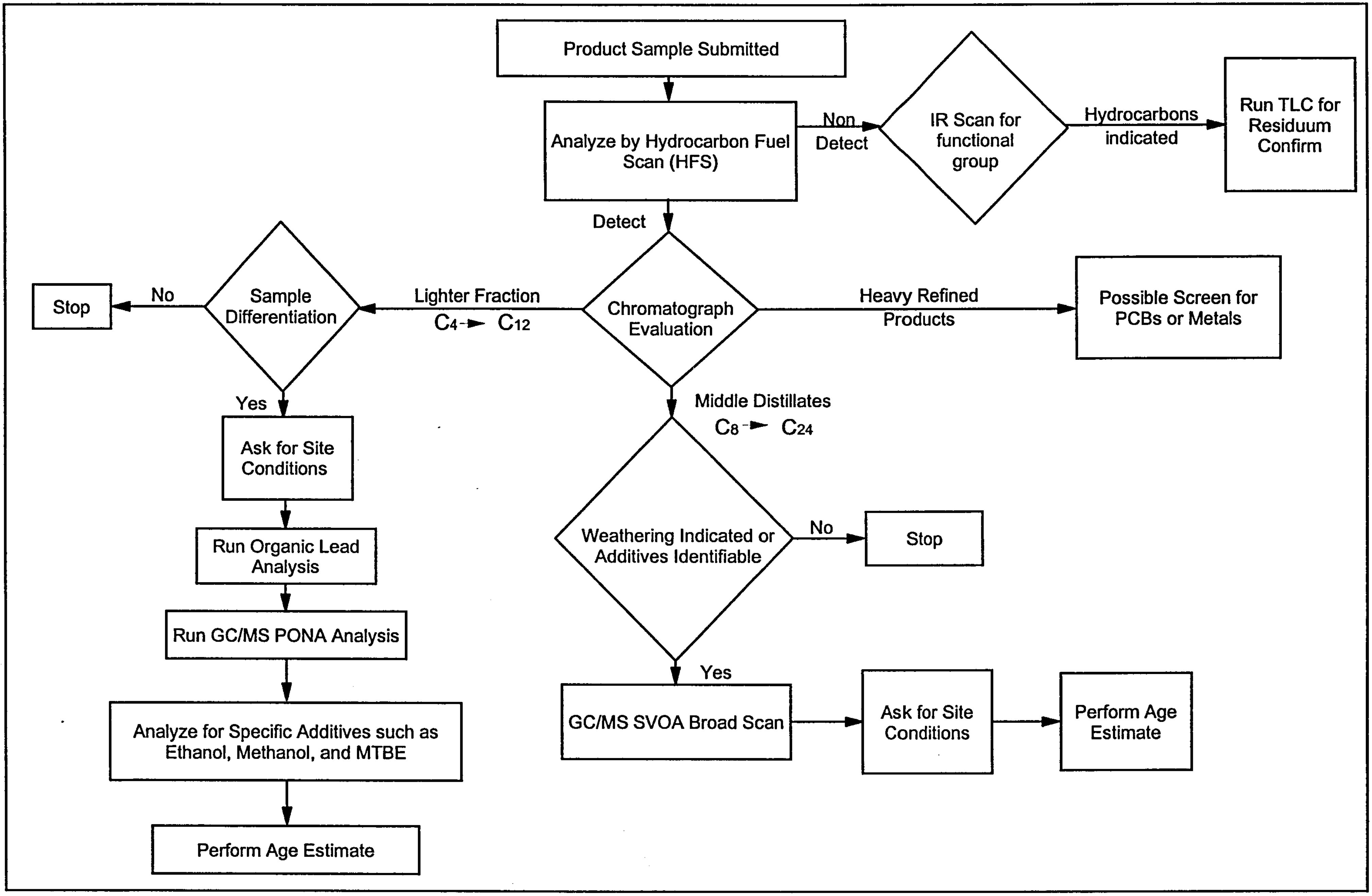
ANALYTICAL PROCEDURES FOLLOWED TO ASSESS SAMPLECOMPOSITION

Prior to collection of field samples under this investigation, Friedman & Bruya and Malcolm Pirnie developed a tiered analytical sequence to identify particular constituents commonly found in petroleum material; and this tiered analytical sequence of testing was titled “The Multi-Tiered Analytical Sequence”. This is a typical analytical scheme which was followed to determine the unknown composition of the samples entering the Laboratory. During the course of analysis, information may be revealed which would enable the analyst to modify the analytical protocol. A flow chart of the Multi-Tiered Analytical Sequence is provided in Figure L-1, and a brief description of the tiered sequence is outlined below.

The initial step in the process is to screen the samples using a gas chromatograph (GC) equipped with a hydrogen flame ionization detector (GC/FID) and an Electron Capture Detector (ECD). This analytical procedure is termed a Hydrocarbon Fuel Scan (HFS). In the HFS process, a 20 ul aliquot (measured portion) of sample is mixed with a solvent (carbon disulfide) and is injected into a GC equipped with a capillary column. This screening test provides an initial characterization of the sample which includes the molecular weights and boiling points of compounds present. After the analysis is performed, a detect or non-detect result determines the next step in the analytical approach.

If the HFS shows no compound detection, the sample is then prepared and tested for Total Recoverable Petroleum Hydrocarbons (TRPH) using Infrared Spectroscopy (IR). This TRPH analysis is performed to rule out the presence of asphalt, and to detect and identify possible functional groups presents within the sample. For samples that consist of a tar-like matrix (e.g., asphalt), the aliquot injected into the GC during the HFS step may not adequately vaporize, mostly remaining in the injection port. To remedy this condition, the

FIGURE L-1
NAPL PLUME STUDY
DEFENSE PERSONNEL SUPPORT CENTER
PHILADELPHIA, PENNSYLVANIA
MULTI-TIERED ANALYTICAL SEQUENCE



TRPH-IR scan is run. This analysis assists the analyst in assessing the sample and in determining what additional tests may be performed to identify the material. If the presence of hydrocarbons is detected by the TRPH-IR scan, a Thin Layer Chromatography (TLC) for residuum compounds is performed. This analysis detects the presence or absence of compound types such as alkanes, aromatics, and polar compounds.

If the HFS test results in a detection, then the analyst evaluates the chromatogram. The chromatogram provides information relative to the nature of the petroleum compounds in the sample, by visually identifying the peak patterns and peak locations on the horizontal axis (time in minutes). Based on these results, the chromatogram is assessed as originating from light, medium, or heavy refined products.

If the sample exhibits characteristics of the lighter fraction compounds as identified by the FID and ECD detectors, between carbon ranges of C4 to C12 (such as gasoline), or a combination of lighter fraction compounds, then additional information would be used to assess the sample. This information includes site conditions such as hydrogeology and geologic information, and site history information. This information is useful if lighter fractions such as gasoline, are present in the fuel sample. Gasolines are the only fuel products to which organic lead was added. The ECD chromatogram would be reviewed for the presence of tetramethyl lead, tetraethyl lead, ethylenedichloride (EDC), and ethylenedibromide (EDB). If tetraethyl and tetramethyl lead are detected, the sample would be diluted and analyzed for organic lead via ICP. This aspect of the analysis is critical in determining the amount of lead present, which can indicate the time frame or date of manufacture.

The next proposed test for the lighter fractions would be a GC/MS analysis for PONA (Paraffin, Olefin, Naphthene, and Aromatics) constituents. The PONA analysis would provide two additional pieces of information: a screening for oxygenates and additional information in the C3 to C6 region of the material. This additional information would be useful in providing a more detailed description of the evaporative losses which are part of the degradation and aging processes. A Library Search will be performed which could identify specific additives such as Ethanol, Methanol, and MTBE, which are key constituents in gasoline fuels.

If, after the HFS analysis, it is determined that the fuel sample carbon range falls within the middle distillate fraction (C8 to C24), a different set of tests is performed. The chromatogram is assessed for any indications of weathering in the sample (e.g., peak shapes, ratios). A GC/MS broad scan for semivolatiles is also performed. The sample undergoes a solvent extraction and sample clean-up prior to direct injection into the GC/MS.

If, following the HFS analysis, the sample exhibits the chromatography typical of heavy refined product (e.g., transformer oil) the sample is analyzed for PCBs and/or metals. Following sample analysis, the data produced is evaluated by an expert in the field of petroleum identification, such as Dr. James Bruya. This initial step in the evaluation is a qualitative examination of the screening chromatograms produced by the HFS. The sample chromatograms are compared to the chromatograms of reference hydrocarbon fuel products. The product of this evaluation is a preliminary assessment of the types of petroleum and petroleum mixtures present in the samples analyzed.

After the preliminary qualitative evaluation is completed, the data is examined in a more quantitative manner. Components identified during GC/MS and other subsequent analyses is evaluated.

Not all samples collected at DPSC were analyzed for all the parameters required under the Multi-Tiered Analytical Sequence. Test results from the HFS screening process were sufficient to warrant sample identification. However, a limited number of samples were chosen for analysis of every parameter associated with the Full Multi-Tiered Analytical Sequence. The results for tests performed supported the screening results of the HFS analysis. The subsequent testing provided additional information such as lead content indicating possible presence of leaded gasoline. There were no instances where the subsequent testing performed contradicted the initial screening results of the HFS.

QUALITY ASSURANCE AND QUALITY CONTROL

Proper Quality Assurance/Quality Control (QA/QC) measures followed during field sample collection and laboratory sample analysis helps to ensure sample integrity and the level of confidence in the data generated. Malcolm Pirnie, Inc. instituted various precautionary measures so that data was generated with a high level of confidence and values reported were considered the highest quality achievable. Although the following QA/QC measures are not requirements stipulated by USACE, Malcolm Pirnie designed and implemented these controls to obtain the most accurate and dependable results possible for this project.

Quality Assurance and Quality Control Instituted by Malcolm Pirnie, Inc.

To ensure accuracy and provide confidence in field sample collection techniques, precautionary measures were established for the proper collection procedures and to maintain integrity of each sample as not to jeopardize its representation value from the time of sample collection until sample shipment. To ensure and maintain a high degree of confidence in the sample collection activities, Malcolm Pirnie, Inc. instituted the following measures:

- Malcolm Pirnie sample manager was assigned to this investigation and provided oversight during all field sampling activities, especially, the sample collection process. The responsibilities of the sample manager were to ensure proper sample collection techniques, proper preparation of all documentation associated with sample collection (with an emphasis on the proper completion of the Chain-of-Custody Record), appropriate packaging of samples to prevent breakage, and that all samples and coolers sent to the contracting laboratories were custody sealed to confirm that no sample tampering had occurred between the field and laboratory analysis. Additionally, each sample was packaged in such a way that cross-contamination between samples during transport to the laboratory, should leakage or breakage occur, would not jeopardize the integrity of the entire batch of samples packed in that particular cooler.

- For all NAPL related sampling events at DPSC, Malcolm Pirnie purchased and used certified analyte-free water to rinse sample equipment between decontamination events to minimize contamination during field sample collection activities. This measure was put in place because laboratory supplied deionized water provided no documentation listing the type and concentrations of constituents that are normally present in laboratory supplied deionized water.

- Sample jars, certified pre-cleaned by the manufacturer, were also purchased and used to collect samples for all field activities to ensure that bottles collected for samples at the DPSC facility were not contaminated prior to sample collection. This measure was put in place because laboratory supplied bottle-ware provided no documentation listing the types and concentrations of constituents within each container. Note: Laboratory supplied bottle-ware is usually contaminant-free; however, bottles purchased from the manufacturer were certified clean (in accordance with their documentation) to verify that bottles were contaminant-free.

- Trip blank (TB) samples were sent with each cooler and analyzed for parameters similar to the parameters requested of the associated field samples. TB samples normally accompany aqueous volatile samples to measure possible cross-contamination between samples in the same cooler during shipment to the laboratory. The majority of samples collected for this project were not analyzed for volatile organic compounds. However, due to the high potential petroleum concentration in the samples, TB samples were sent with each sample cooler to detect possible cross- contamination.

- On a daily basis, the project Quality Assurance Officer (QAO) was in contact with the laboratory which performed analyses. Any problems with sample shipment, broken custody seals, excessive sample cooler temperatures recorded, analysis problems, or limited sample volumes were identified immediately and corrective measures were implemented so that the data quality objectives outlined for this investigation were not compromised.

Quality Assurance and Quality Control in the Field

QA/QC was also instituted during field sampling to maintain a high level of confidence in the integrity of the sample and its sample identification to that location. To achieve this end, blind duplicates were collected to monitor precision of field sample collection techniques. These samples were collected at a rate of 10% per matrix of the samples collected at DPSC.

Samples collected on September 18, 1996, were rejected during the validation process due to a discrepancy in the laboratory analyses reported between field sample and blind duplicate results.

Quality assurance is also maintained through the collection of split samples for laboratory analysis at the USACE QA laboratory. The QA laboratory was sent samples and given the opportunity to perform sample analysis; however, samples were returned to Malcolm Pirnie, Inc. due to the special nature of the analytical testing required.

Quality Assurance and Quality Control in the Laboratory

Based on the QA/QC measures, the laboratory performed proper laboratory procedures during sample analysis. One of the QC measures taken for all analyses performed was method or extraction blank analysis. A method blank sample is analyzed for each day field samples are analyzed. An extraction blank is a sample analysis performed upon laboratory deionized water and subject to all of the solvent and extraction procedures that would be performed on field samples. The purpose of the blank samples are to monitor common laboratory contamination and/or reported values which are considered instrument artifacts. These values are qualified during the validation process to determine whether they are present in the sample. All of the blank samples performed by Friedman & Bruya, Inc. during sample analysis were free of petroleum compounds indicative of petroleum products. However, the broad scan semivolatile analysis performed detected some phthalate constituents. Phthalate compounds are common laboratory constituents detected in laboratory analysis. They are considered unavoidable because the equipment used to prepare the sample extractions contains some plastics which inevitably contribute to phthalate constituents being present in the associated sample batch.

Where applicable, blank spike samples are also analyzed with the field samples. A blank spike sample is one consisting of deionized water with spiking compounds and is designed to monitor the efficiency of the digestion or distillation procedure. The blank spike sample is analyzed for each matrix using the same sample preparations, analytical methods, and QA/QC procedures. When the blank spike was reported in this project, it was reviewed for contractual compliance and no qualifications were applied to the associated sample data. The matrix spike is an aliquot of a matrix (water sample or soil sample) fortified (spiked) with known quantities of specific compounds and analyzed. Measuring recovery of the spiked compounds demonstrates method efficiency. The spike recovery is expressed in percent and defined as the amount of material found in the spiked sample divided by the amount spiked into the sample prior to the analysis, multiplied by 100. The matrix spike duplicate is a replicate matrix spike which is used to determine method precision.

The laboratory duplicate analysis requires two aliquots of the same sample which are separately carried through all steps of sample preparation and measurement procedures. The results are used as indicators of the precision of results of samples analyzed at the same time by the same instrument. Poor precision may result due to non-homogeneity, method defects, or laboratory technique. One laboratory duplicate is performed for each batch, each matrix, and each instrument used such that the precision results can be applied to all the samples in the associated batch.

Surrogates are a measure of extraction, cleanup (if necessary), and analytical system efficiency. Surrogates are added to every blank, sample, matrix spike, matrix spike duplicate, and standards during instrument calibration. These compounds are brominated, fluorinated, isotopically labeled, or deuterated compounds that mimic the class of compounds analyzed. These compounds are not expected to be detected in environmental media. They are added to the samples prior to the extraction process to provide information concerning the extraction efficiency of the analyst's technique and adherence to the standard method, as well as information regarding the matrix of the sample spiked. Surrogates can also provide information on instrument performance. "Poor" injections of the sample into the instrument during analysis can provide recoveries of less than 10%. Less than 10% surrogate recovery for extractable analyses, such as Semivolatiles, may also indicate that a problem occurred during the extraction procedure. The methodologies of SW-846 allow each laboratory to establish their own upper and lower control limits based on historical performance of instrument and analyst operations.

Quality assurance checks, which are similar to internal standard or surrogate compounds, are added during the sample extraction procedure and introduced into the GC with the sample. The purpose for the addition of these compounds is to determine if any interferences affecting recovery are caused by the matrix of the sample being analyzed. These compounds also serve to monitor the introduction of the sample into the GC. The compound pentacosane is added to the sample and detected by the FID detector; and the compound dibutyl chlorendate is added to the sample and detected by the ECD detector. Since these analytical tests are qualitative and not quantitative, the HFS chromatograms were visually inspected for recovery of the quality assurance check compounds. Based on visual examination of the chromatograms submitted, there is no evidence to suggest that there were problems associated with sample introduction into the GC for DPSC sample analyses.

Sensitivity was also evaluated by the review of Internal Standards for GC/MS. Internal standards were added to the sample prior to introduction into the GC and provided information on instrument performance as well as matrix interferences. A drop or increase in internal standard area counts reflects a change in instrument sensitivity. This change in sensitivity can be caused by a matrix effect or can reflect a change in the mass selective detector (MSD). The validators reviewed the data and compared the internal standard area criteria to that established by the EPA Region III guidelines. These guidelines stipulate that area counts outside of - 50% or + 100% of the associated continuing calibration standard are qualified. Qualifications were applied to compounds associated with internal areas that recovered below established limits; the compounds reported were qualified "J" as estimated with a high bias associated with the data, or "R" as rejected due to an extreme low recovery indicative of poor sensivity for those compounds. Each Validation Report identifies qualifications applied to the data regarding non-compliant internal standard areas.

Appendix M

Analytical Results of Samples Collected During Phase II ESI

Appendix N

Historical Groundwater Flow Maps

ATTACHMENT A

Company Confidential

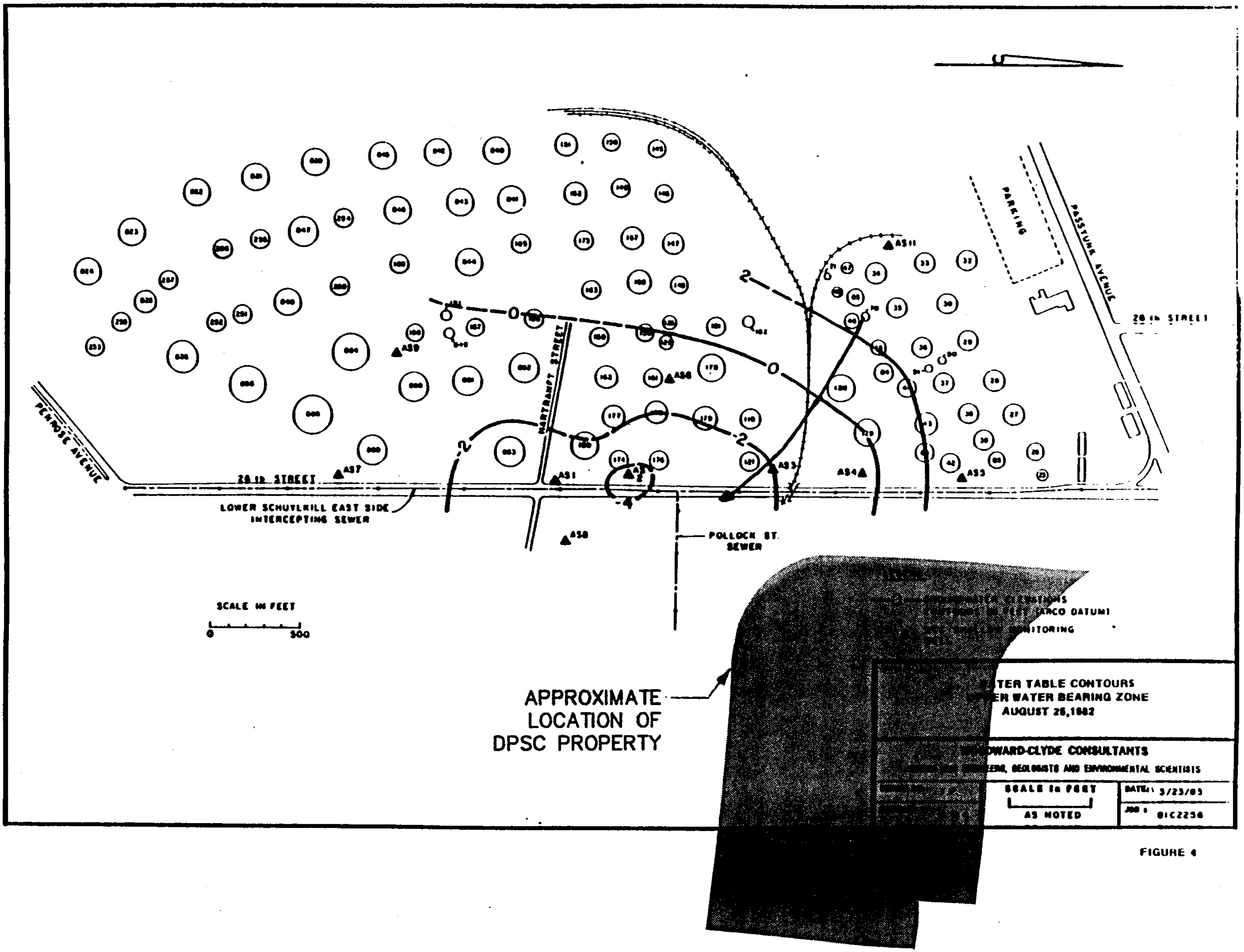
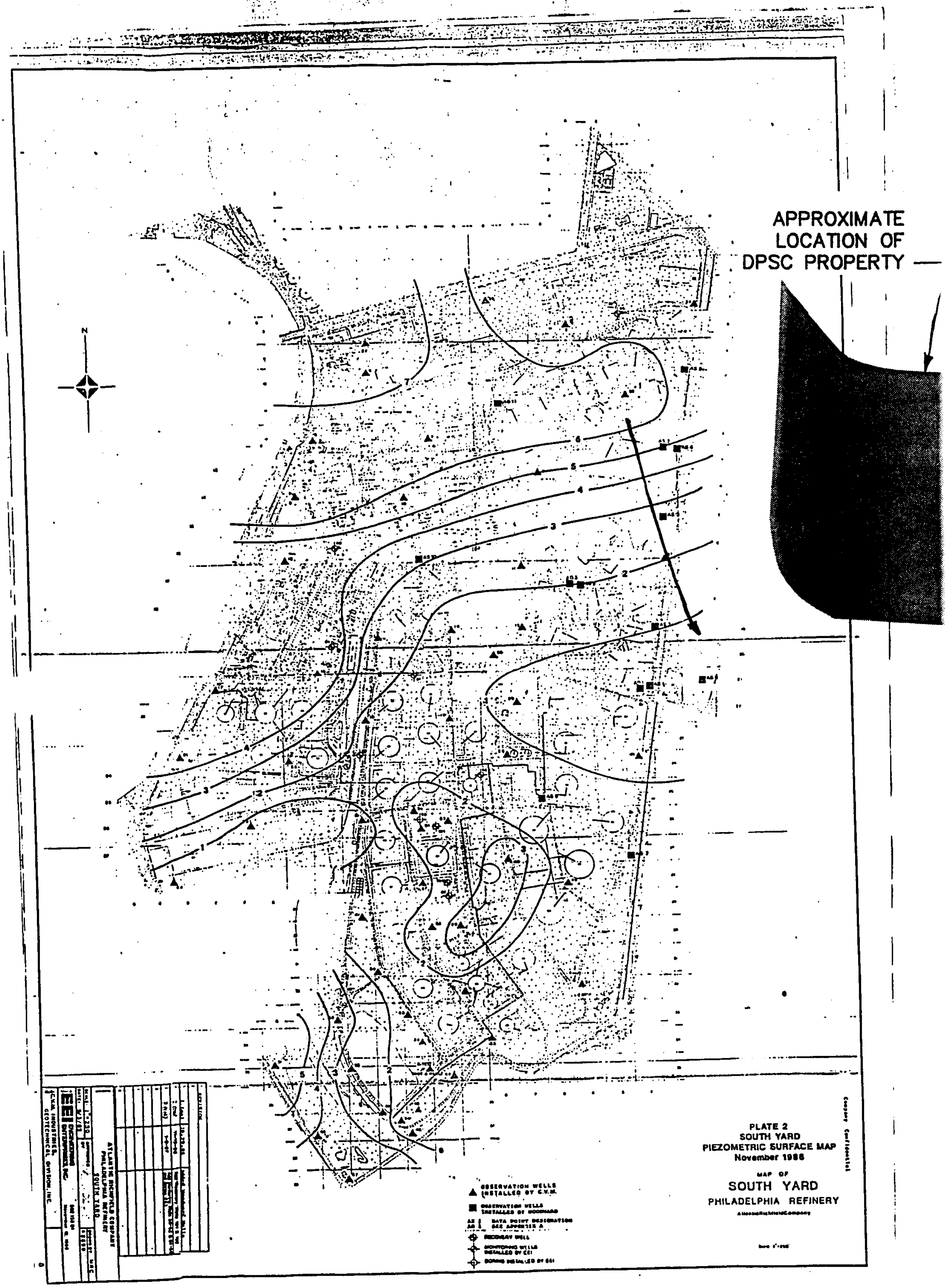


FIGURE 4

ATTACHMENT B

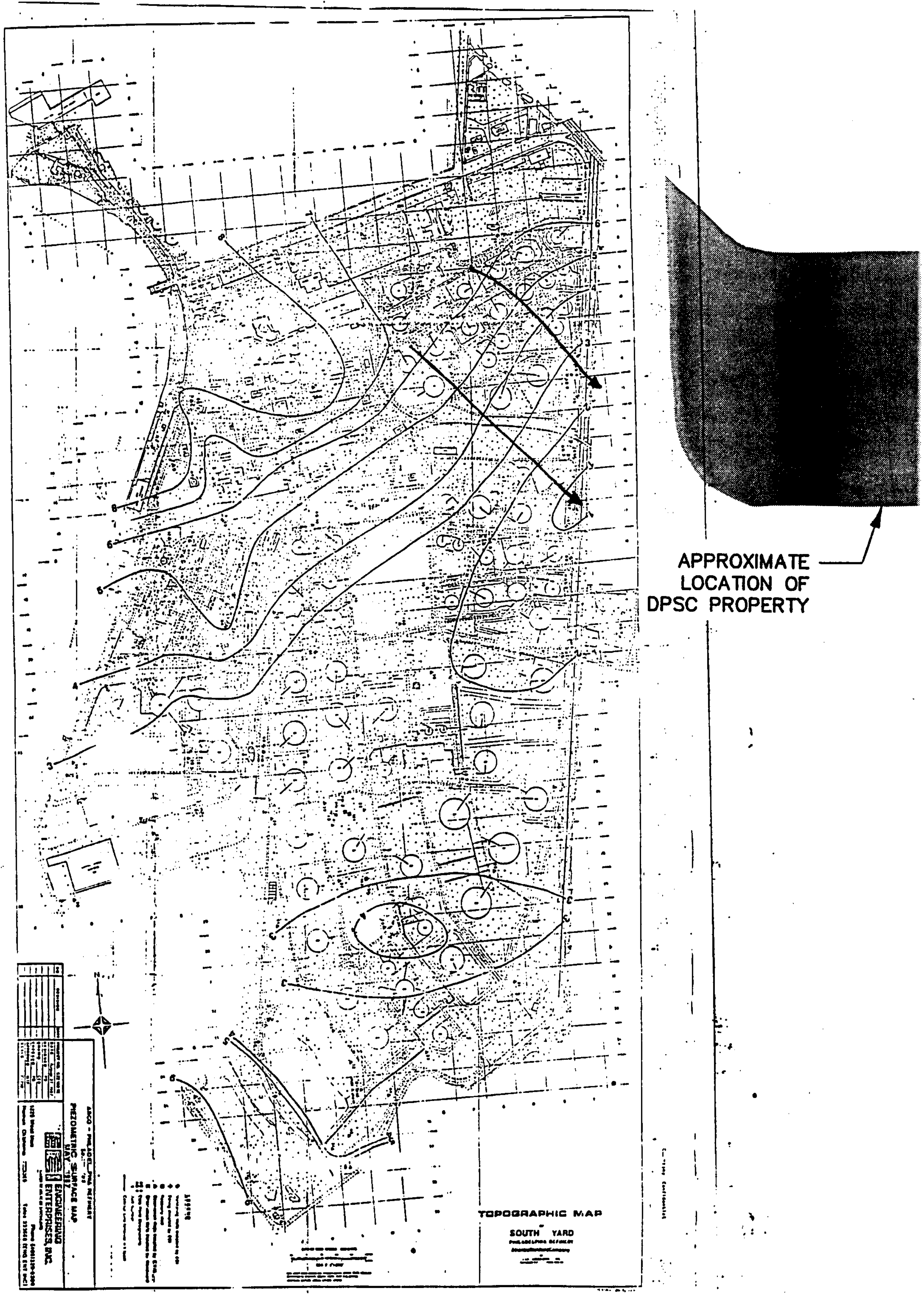


APPROXIMATE LOCATION OF DPSC PROPERTY

PLATE 2
SOUTH YARD
PIEZOMETRIC SURFACE MAP
November 1986

MAP OF
SOUTH YARD
PHILADELPHIA REFINERY
AtlanticRichfieldCompany

ATTACHMENT C



APPROXIMATE LOCATION OF DPSC PROPERTY

ATTACHMENT D

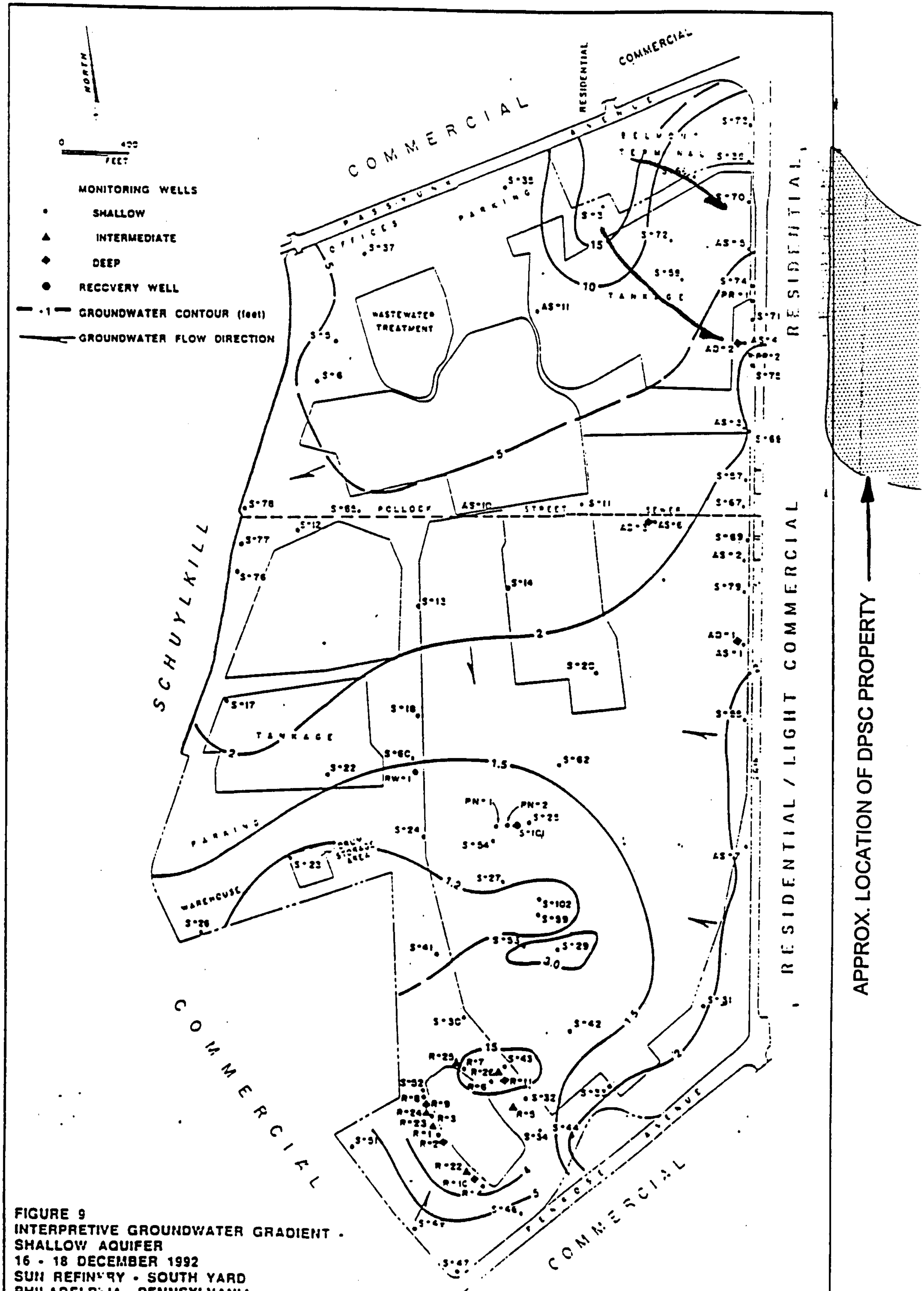
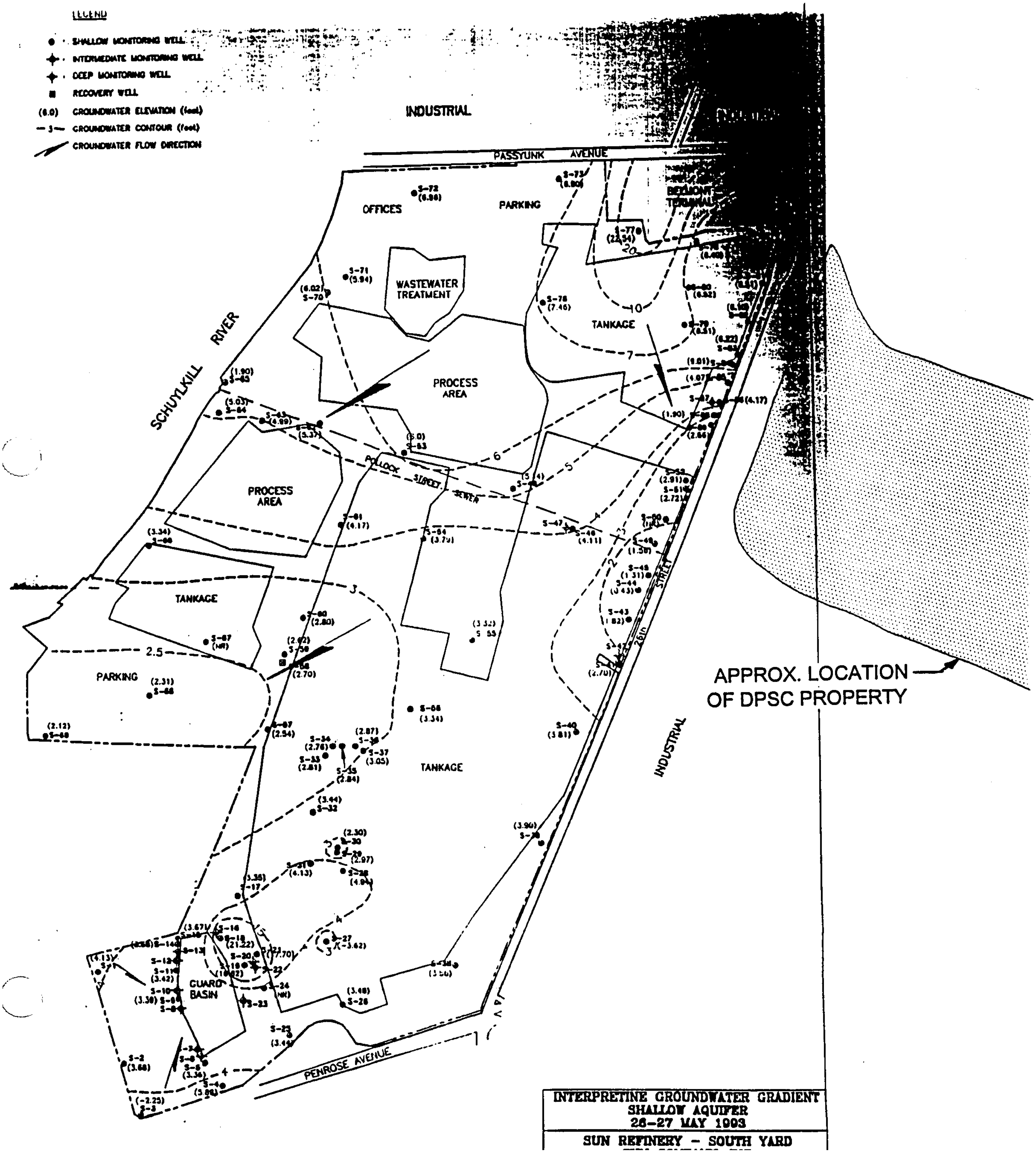


FIGURE 9
INTERPRETIVE GROUNDWATER GRADIENT - SHALLOW AQUIFER
16 - 18 DECEMBER 1992
SUN REFINERY - SOUTH YARD
PHILADELPHIA, PENNSYLVANIA

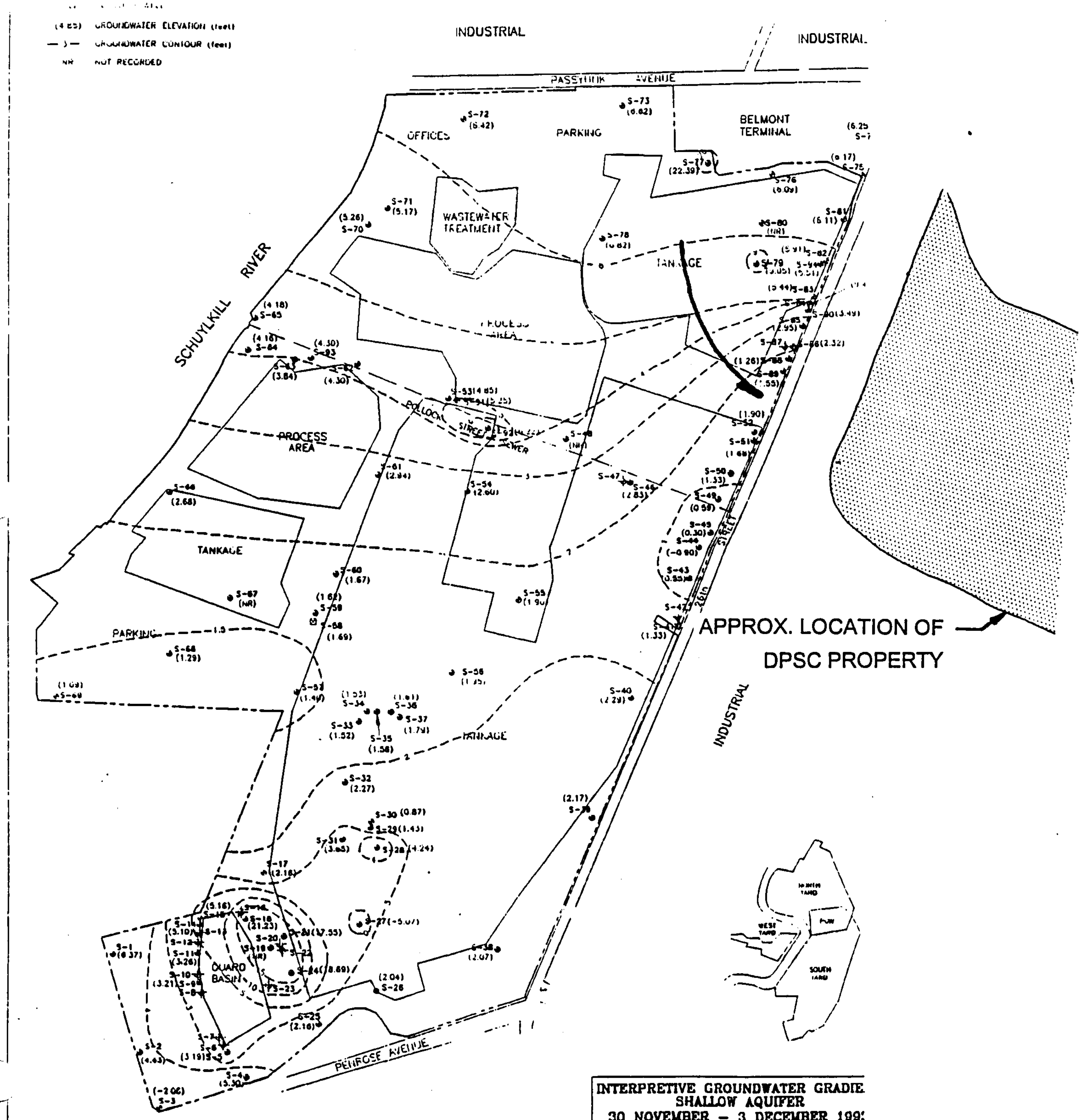
ATTACHMENT E



INTERPRETINE GROUNDWATER GRADIENT
SHALLOW AQUIFER
26-27 MAY 1993

SUN REFINERY - SOUTH YARD

ATTACHMENT F



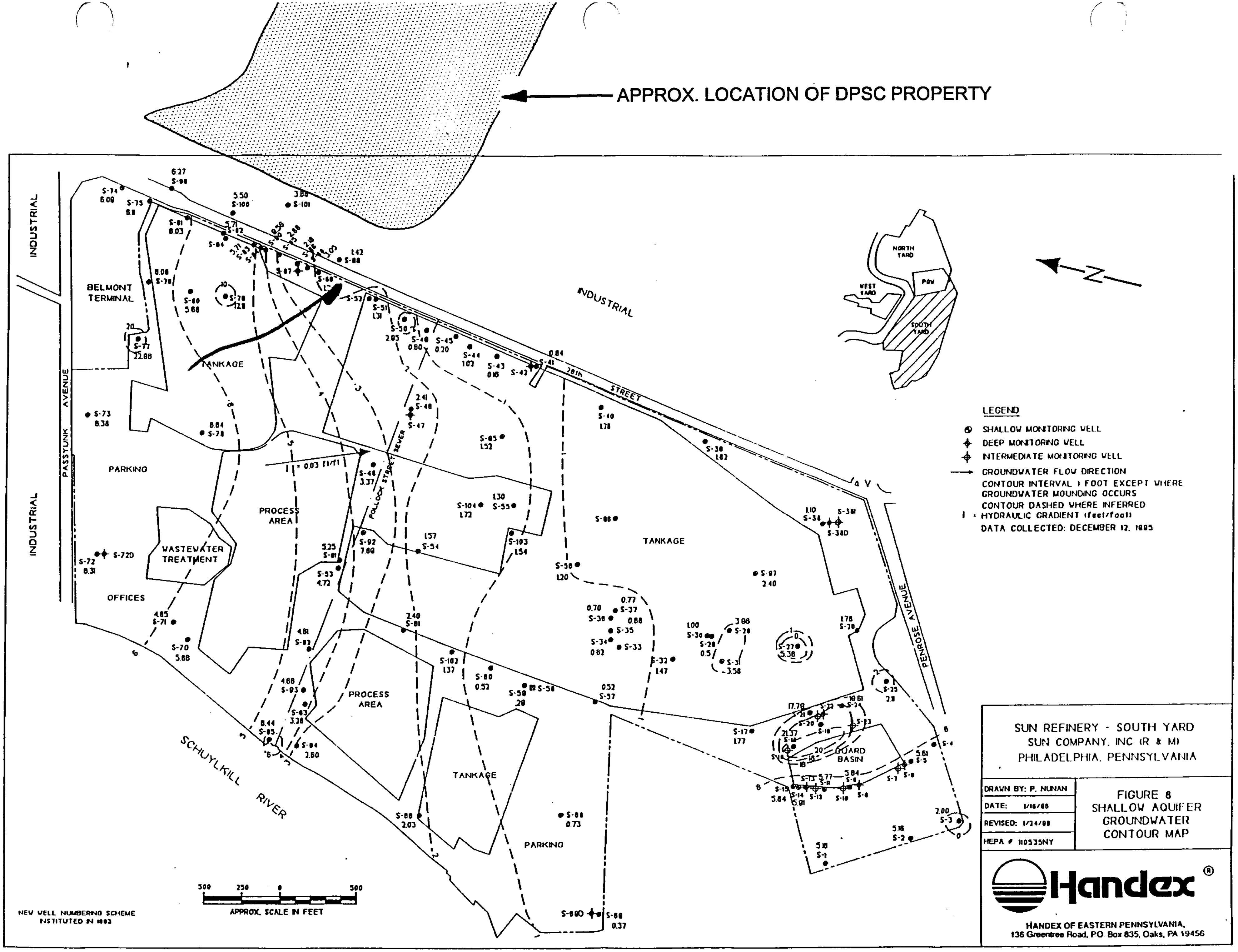
INTERPRETIVE GROUNDWATER GRADIE
SHALLOW AQUIFER
30 NOVEMBER – 3 DECEMBER 199

SUN REFINERY – SOUTH YARD
SUN COMPANY, INC. (R & M)
PHILADELPHIA, PENNSYLVANIA

NORTH	DATE: 14JAN94	CK: SR	APP
	BY: MLB	REV: GW-S-	
	SCALE IN FEET	FIGURE	

NEW WELLNUMBERING SCHEME INSTITUTED IN 1993

ATTACHMENT G



LEGEND

- ⊕ SHALLOW MONITORING WELL
- ◆ DEEP MONITORING WELL
- ⊕ INTERMEDIATE MONITORING WELL
- → GROUNDWATER FLOW DIRECTION

CONTOUR INTERVAL 1 FOOT EXCEPT WHERE GROUNDWATER MOUNDING OCCURS
CONTOUR DASHED WHERE INFERRED
I = HYDRAULIC GRADIENT (feet/foot)
DATA COLLECTED: DECEMBER 12, 1995

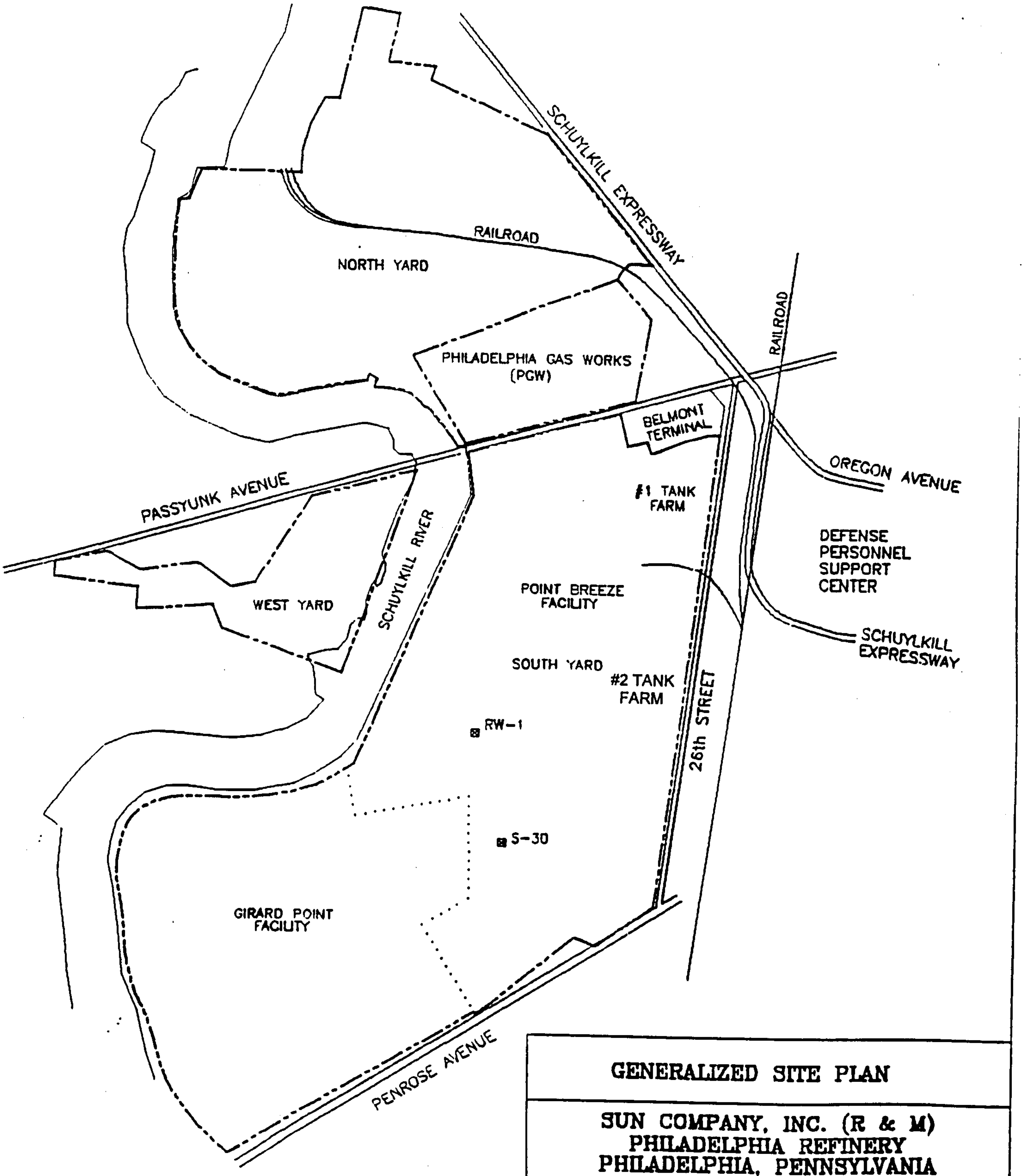
SUN REFINERY - SOUTH YARD
SUN COMPANY, INC (R & M)
PHILADELPHIA, PENNSYLVANIA

DRAWN BY: P. NUNAN	FIGURE 8 SHALLOW AQUIFER GROUNDWATER CONTOUR MAP
DATE: 1/16/96	
REVISED: 1/24/96	
HEPA # 110535NY	

Handex®

HANDEX OF EASTERN PENNSYLVANIA,
136 Greentree Road, P.O. Box 835, Oaks, PA 19456

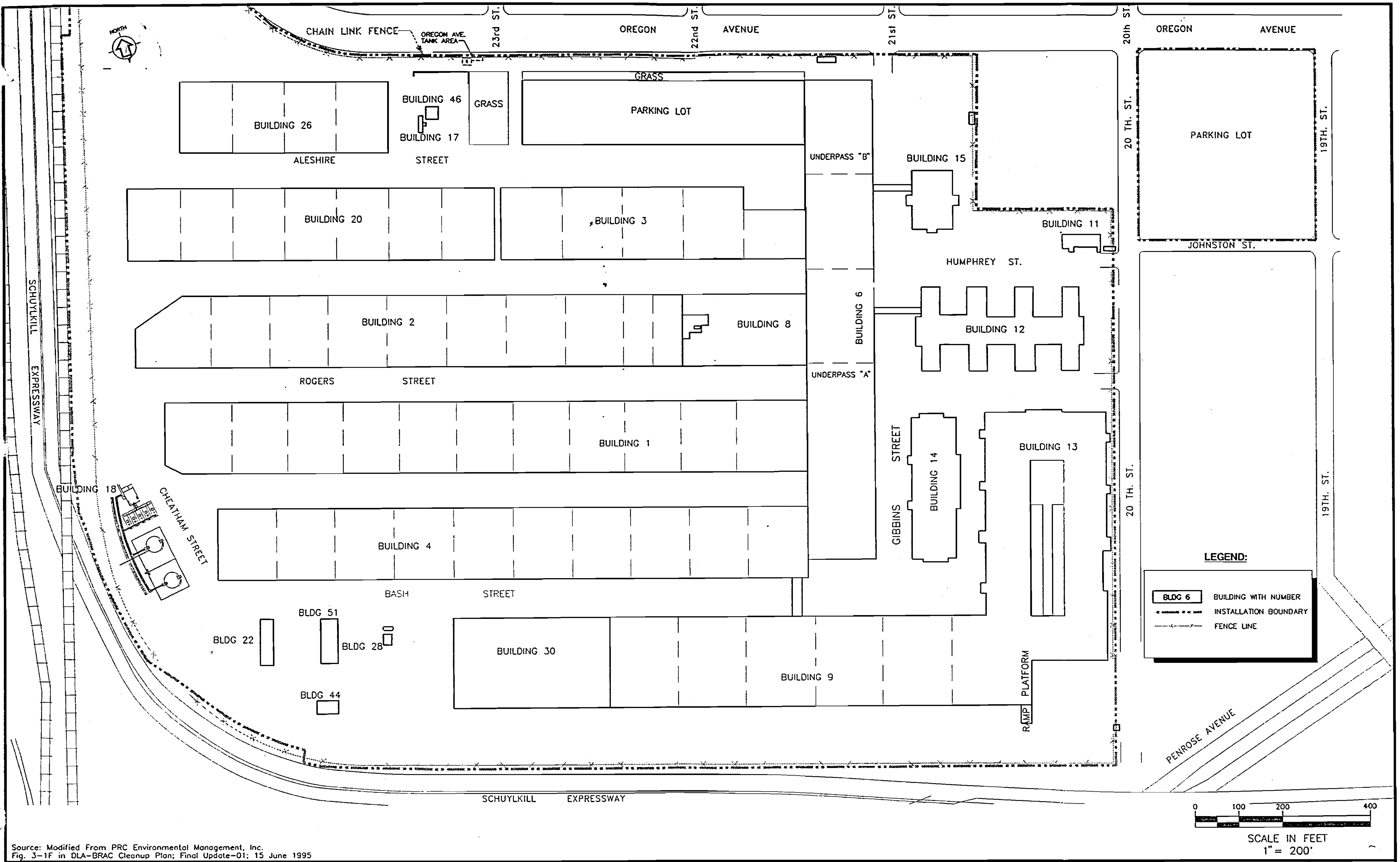
ATTACHMENT H



GENERALIZED SITE PLAN

SUN COMPANY, INC. (R & M)
PHILADELPHIA REFINERY
PHILADELPHIA, PENNSYLVANIA

NORTH	DWG: YARD01	CK: SR	APPV: RD
	BY: MLB	REV:	
	SCALE IN FEET 0 1500	FIGURE 1	



Source: Modified From PRC Environmental Management, Inc.
Fig. 3-1F in DLA-BRAC Cleanup Plan; Final Update-01; 15 June 1995

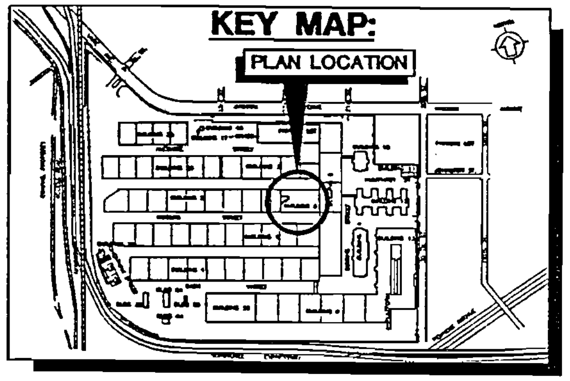
U.S. Army Corps
of Engineers

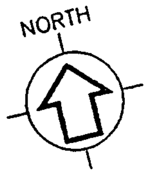
DEFENSE PERSONNEL SUPPORT CENTER – PHILADELPHIA, PENNSYLVANIA

FACILITY LAYOUT

USACE CONTRACT No. DACA31-94-D-0017

FIGURE M-1





BUILDING 8 - WASTE OIL TANK DETECTED COMPOUNDS

Analyte		Boring No.	08-01	08-01	08-01	08-02	08-03	08-03
		Sample ID:	08WOT-01-01-08	08WOT-01-03-12	08WOT-01-04-16	08WOT-02-03-10	08WOT-03-03-10	08WOT-03-04-12
		Sampling Date:	7/20/96	7/20/96	7/20/96	7/20/96	6/7/96	7/20/96
	PADEP CRITERIA •		Result	Result	Result	Result	Result	Result
	Non-Residential	Soil - GW						
Diesel Range Organics (mg/Kg)	500		2.5	3.3	2.7	1.5	50	110
GC/MS SEMIVOLATILE RESULTS (ug/Kg)								
bis (2-ethylhexyl)phthalate	400000	400000	NA	NA	NA	878	NA	NA

NOTES:

U - The analyte was analyzed for, but was not detected above the sample quantitation limit.

N/E - Criteria not established for this constituent

D - This qualifier identifies all compounds identified in an analysis at a secondary dilution

ALL Field Sample ID labels contain the prefix DPSC on the Chain Of Custody forms.

• Criteria based on PADEP Land Recycling Program Technical Guidance Manual 7/18/95

Sample ID consists of location boring number-sequential number-depth (eg. 08wot-01-01-08)

BUILDING 8 - WASTE OIL TANK DETECTED METALS

Analyte	Boring No.	08-01·	08-02	08-02	08-03
	Sample ID:	08WOT-01-02-10	08WOT-02-01-06	08WOT-02-02-06	08WOT-03-06-16
	Sampling Date	7/20/96	7/20/96	7/20/96	7/20/96
	PADEP CRITERIA •	Result	Result	Result	Result
TAL METALS (mg/Kg)					
MS		08WOT-01-02-10-MS	08WOT-01-02-10-MS	08WOT-01-02-10-MS	08WOT-01-02-10-MS
MSD		08WOT-01-02-10-MS	08WOT-01-02-10-MS	08WOT-01-02-10-MS	08WOT-01-02-10-MS
Aluminum	N/E	11100	15700	14000	10200
Arsenic	N/E	3.19	11.7	11.2	2.22
Barium	N/E	36.6	49.2	49	39.9
Beryllium	N/E	0.473	0.53	0.5	0.36
Cadmium	N/E	5.51	6.12	4.96	5.58
Calcium	N/E	1010	1390	1400	316
Chromium	N/E	18.5	23.7	20.7	21.1
Cobalt	N/E	4.75	5.92	5.98	6.83
Copper	N/E	10.5	11.9	11.5	12.9
Iron	N/E	17900	18800	15700	18100
Lead	600	7.79	5.81	6.14	6.72
Magnesium	N/E	1630	2340	2310	1950
Manganese	N/E	128	150	136	84.6
Nickel	N/E	8.61	9.92	9.51	11.3
Potassium	N/E	852	1310	1210	619
Sodium	N/E	93.8	115	106	85.1
Thallium	N/E	0.307 U	0.307 U	0.43	0.307 U
Vanadium	N/E	21.7	30.2	26.4	21.3
Zinc	N/E	28.4	40.1	41.3	32.8

NOTES:

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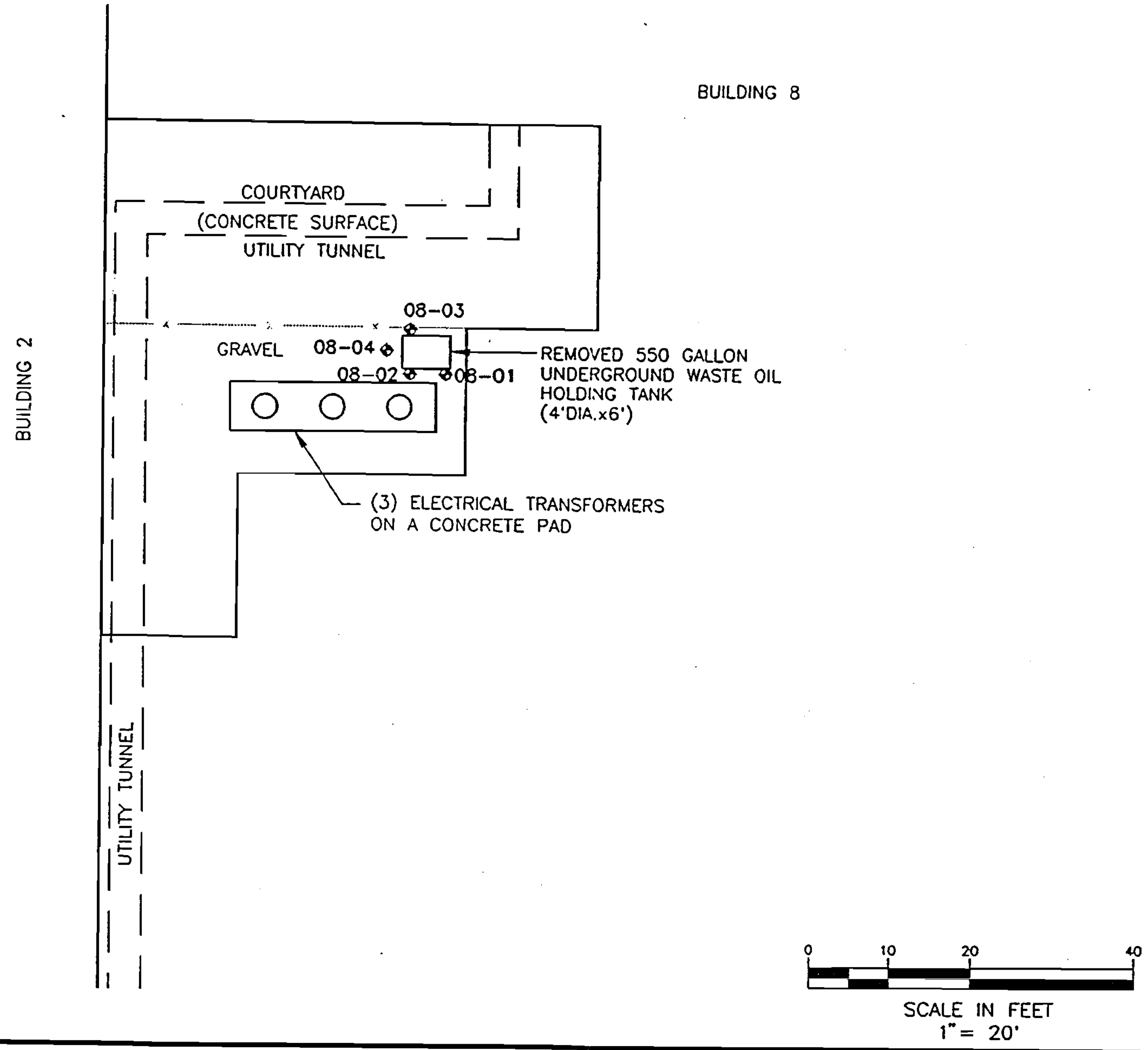
• Criteria based on PADEP Land Recycling Program Technical Guidance Manual 7/18/95

Sample ID consists of location boring number-sequential number-depth (eg. 08WOT-01-01-08)

LEGEND:

⊕ SOIL BORING



Source: Geophysical Survey Report, ENSA INC., 1996

U.S. Army Corps of Engineers

DEFENSE PERSONNEL SUPPORT CENTER - PHILADELPHIA, PENNSYLVANIA

DRILLING LOCATIONS & SOIL ANALYTICAL RESULTS - BUILDING 8 UST

USACE CONTRACT No. DACA31-94-D-0017

FIGURE M-2

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D
Beth M. Albertson, M.S.
Bradley T. Benson
Kelley D. Wilt

3012 16th Avenue West
Seattle, WA 98119-2029
TEL: (206) 285-8282
FAX: (206) 283-5044

July 30, 1996

RECEIVED
AUG 1 1996

Carole Tomlins, Project Manager
Malcolm Pirnie
104 Corporate Park Drive, Box 751
White Plains, NY 10602

Dear Ms. Tomlins:

Enclosed are the results from the testing of material submitted on July 24, 1996 from your DPSC, PO #0285-642-200 project.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Kelley Wilt

Kelley Wilt
Chemist

keh
Enclosures
MPI0730R.DOC

RECEIVED
1

RI MAN & BRUYA, INC.
12 16th Avenue West
Seattle, WA 98119-2029
06) 285-8282

07·24·96
10:00

SAMPLE CHAIN OF CUSTODY

nd Report To:
mpany MALCOLM PIRNIE INC. Contact CAROLE TOMLINS
ddress 104 CORPORATE PARK DRIVE
y, State, Zip WHITE PLAINS, NEW YORK 10602
one # 914- 694- 2100 Date 7-20-96

ITE NO.	PROJECT NAME	PURCHASE ORDER #
0285-642	DPSC	0285-642-200

SAMPLERS (signature)	PROJECT LOCATION
/MPI	PHILADELPHIA, PA

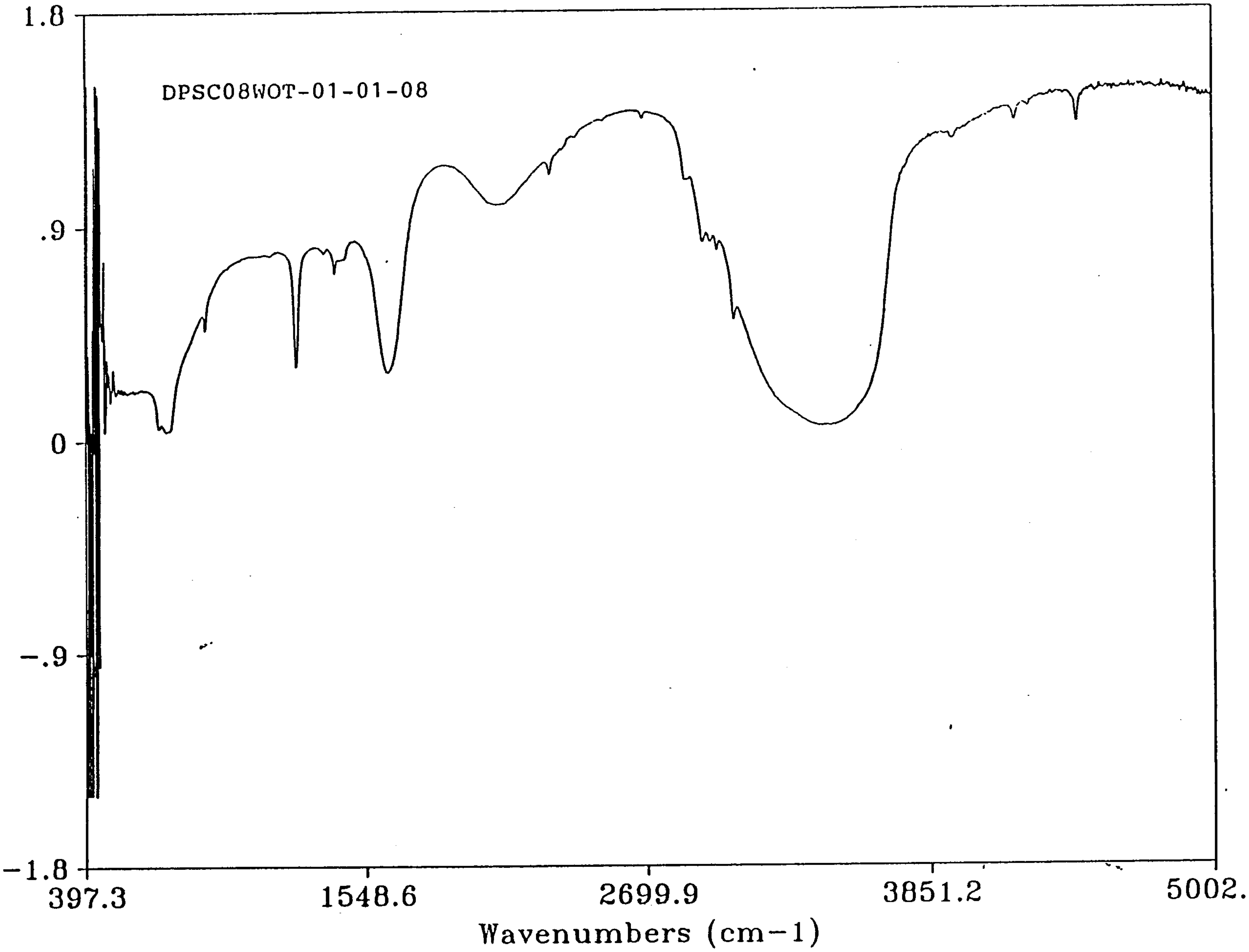
EMARKS
SAMPLES COLLECTED BY LBA FOR MPI

SAMPLE DISPOSAL INFORMATION
☐ Dispose after 30 days
☐ Return Samples
☐ Call for Instructions

Sample #	Date/Time Sampled	Type of Sample	# of Jars	Lab Sample #	Analyses Requested
PSC08WOT-01-01-08	7/20/96 / 1004	GRAB	1	71033	IR SCAN
C08WOT-01-03-12	" / 1020	"	1	71034	"
PSC08WOT-01-04-16	" / 1035	"	1	71035	"
WOT-02-03-10	" / 1110	"	1	71036	"
C08WOT-02-04-16	" / 1135	"	1	~~71038~~ 71037	"
PSC08WOT-03-03-10	" / 1305	"	1	71038	"
C08WOT-03-04-12	" / 1310	"	1	~~71040~~ 71039	"
SC08WOT-03-05-12	" / 1310	"	1	71040	"
C08WOT-03-06-16	" / 1320	"	1	~~71042~~ 71041	"
PSC08WOT-04-02-08	" / 1350	"	1	~~71043~~ 71042	"
C08WOT-04-04-16	" / 1415	"	1	~~71044~~ 71043	"
~~C08~~ DPSCFB072096	" / 1100	"	2	71044 - 71045	"

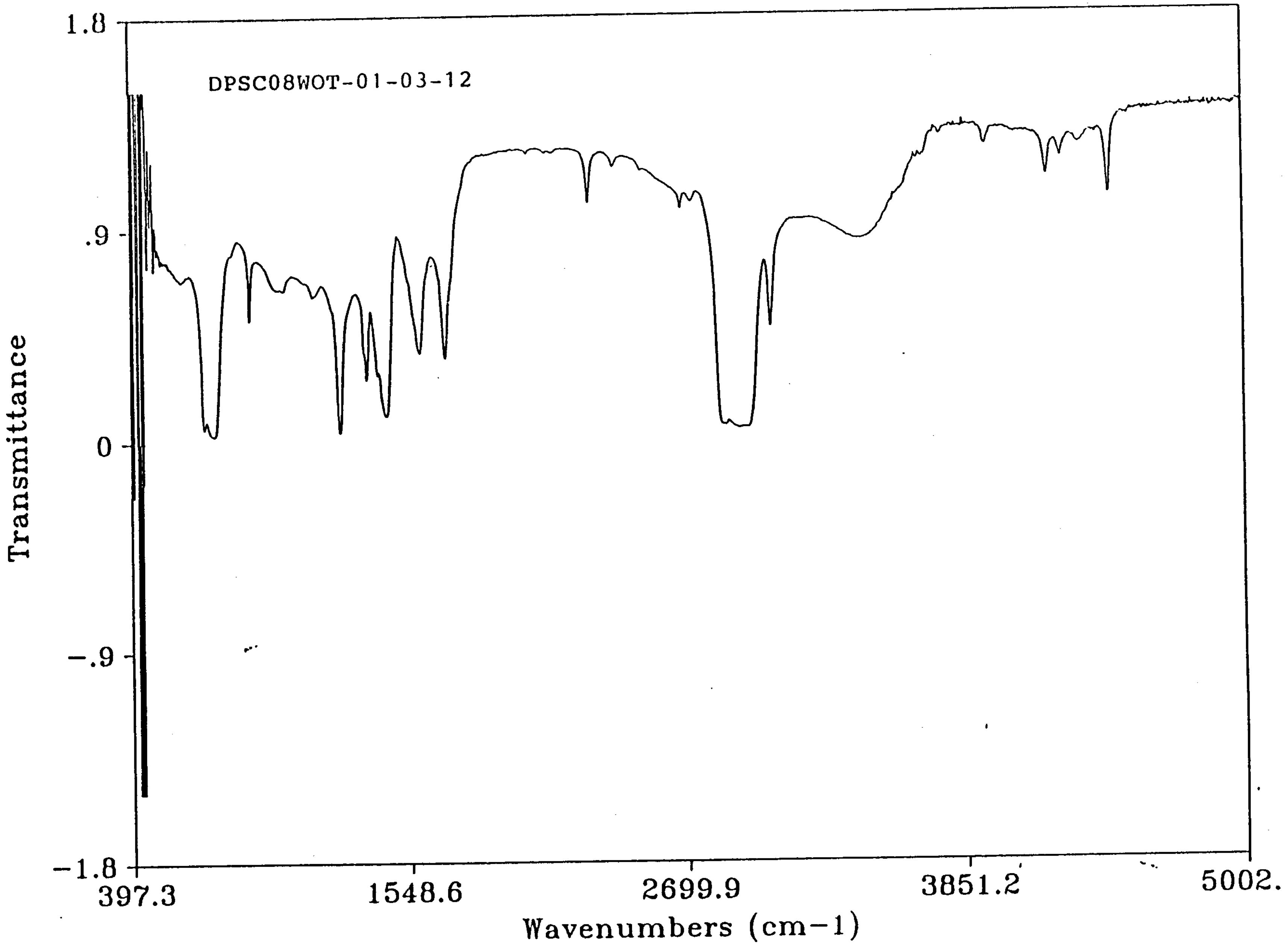
GNATURE	PRINT NAME	COMPANY	Date	Time
inquished by: /MPI	JOHN ARCHIBALD	MALCOLM PIRNIE	7/23/96	1500
ived by: Tom Russell	TOM RUSSELL	FBI	07·24·96	09:45
Relinquished by:				
eived by:				

FORMS/COC 09/19/94



UPR Res= 4 07/26/96 11:10

71033; TRANSMITTANCE

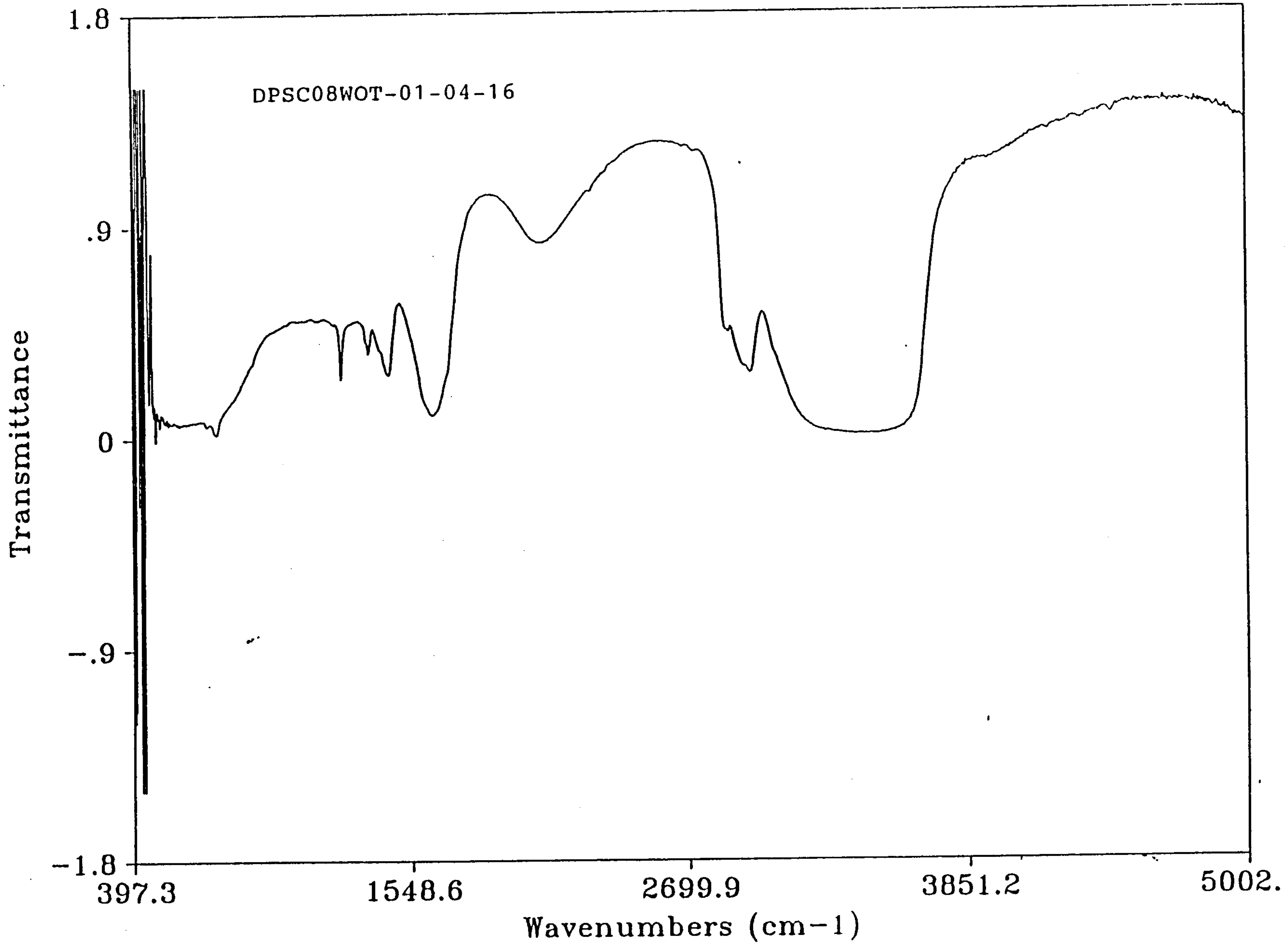


SCA

Res= 4

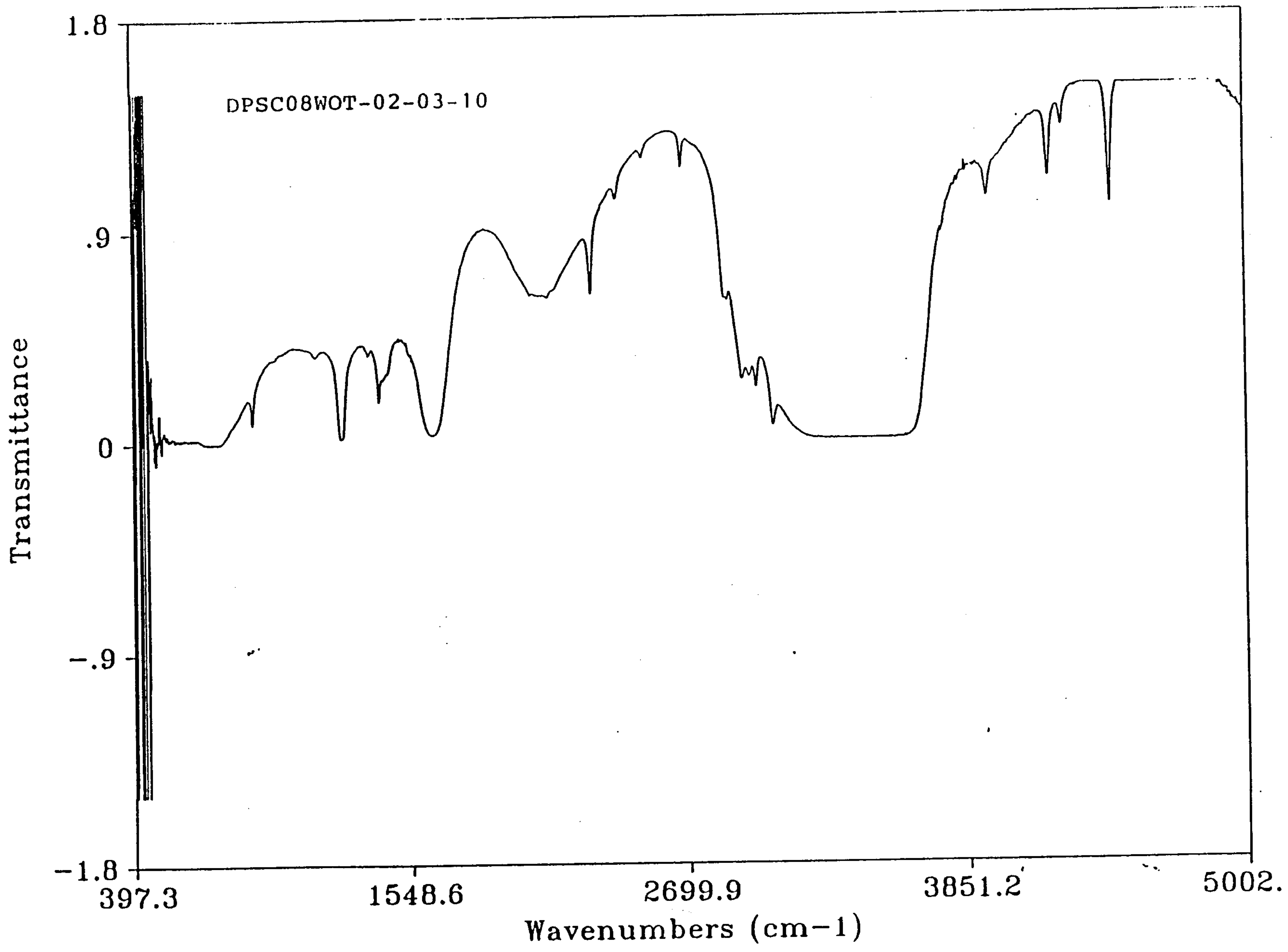
07/26/96 11:24

7[illegible]034; TRANSMITTANCE



DYO　　Res= 4　　07/26/96 11:11

71035; TRANSMITTANCE

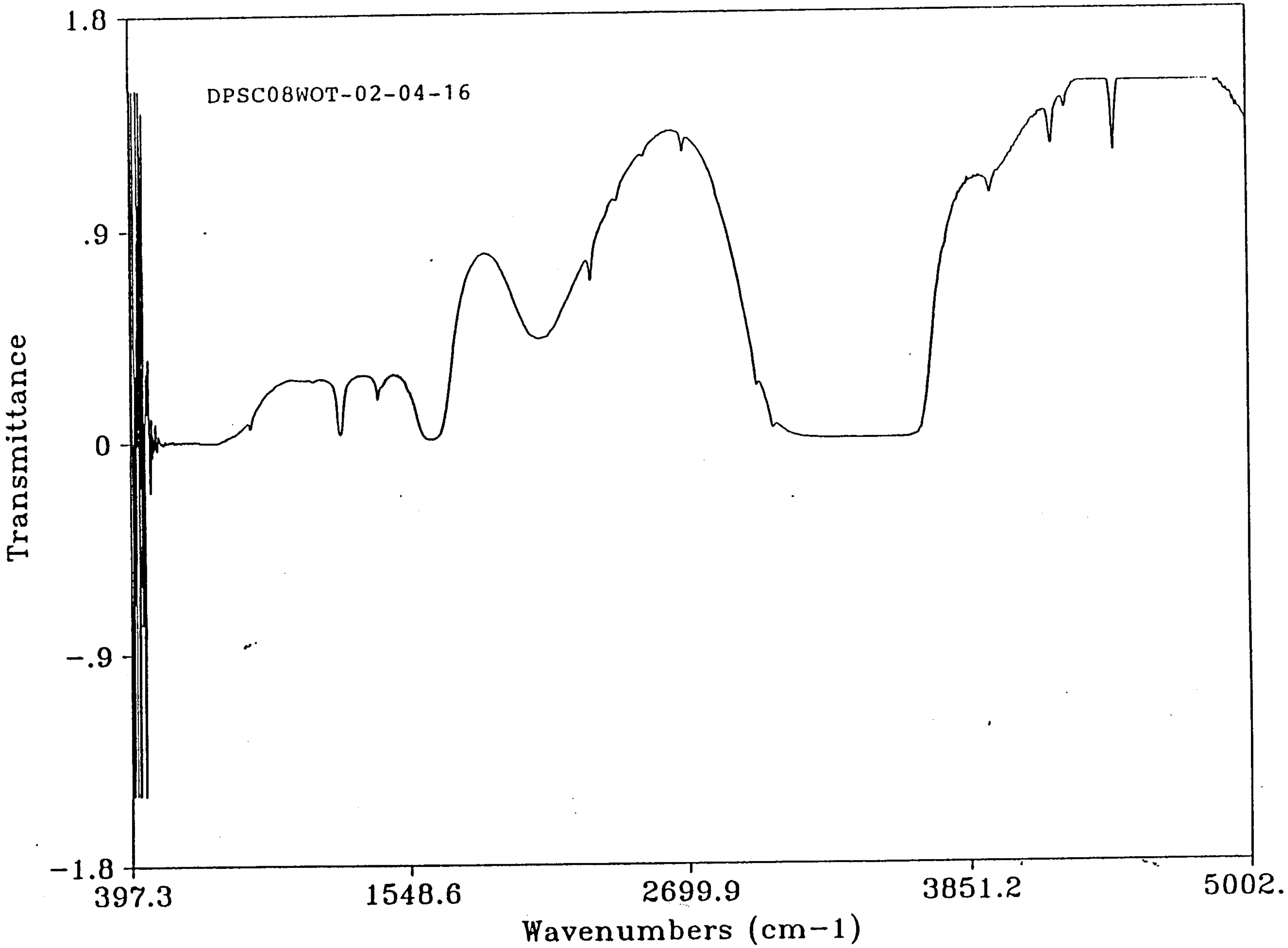


UED

Res= 4

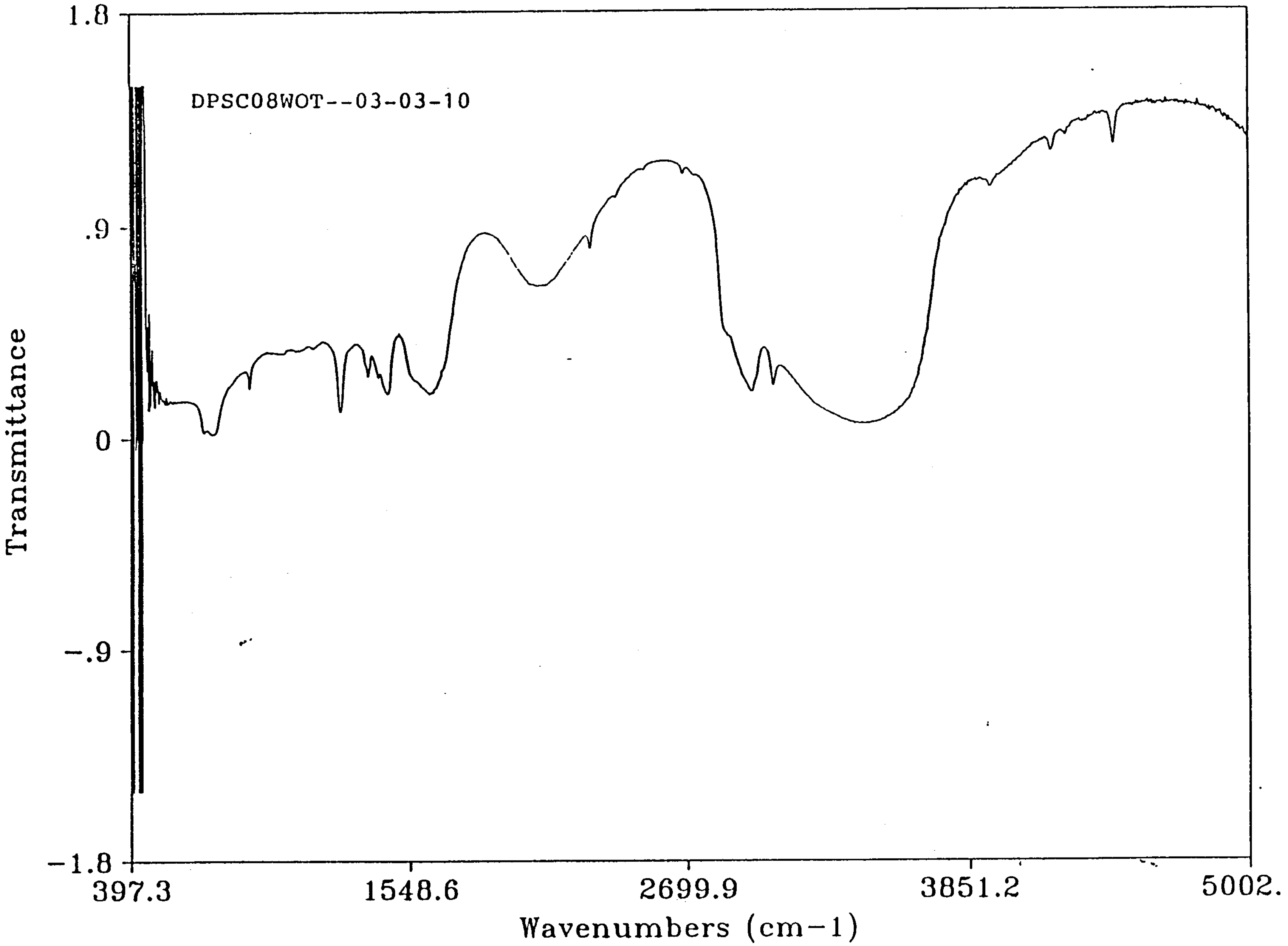
07/26/96 11:12

71036; TRANSMITTANCE



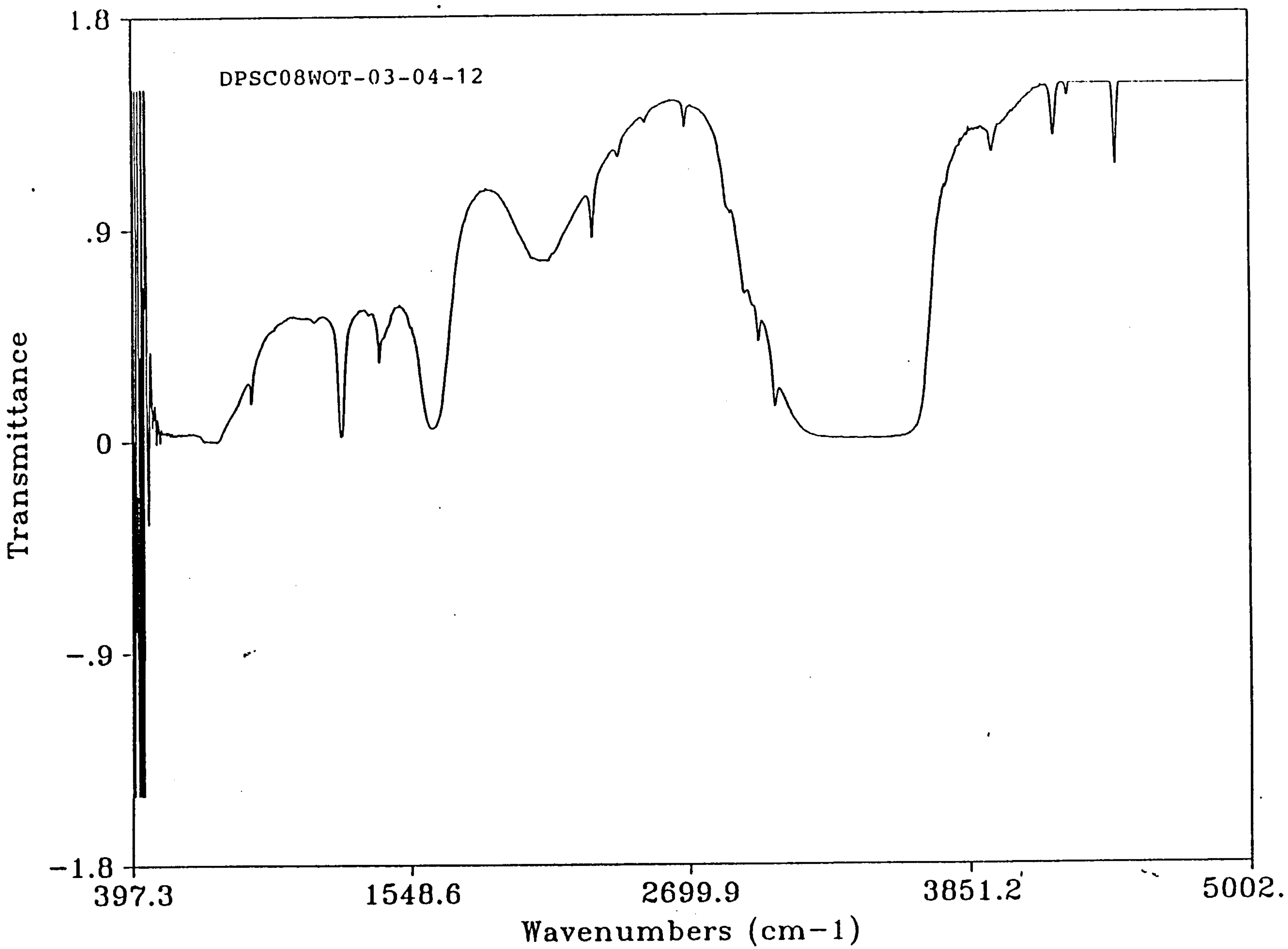
NEV Res= 4 07/26/96 11:14

71037; TRANSMITTANCE



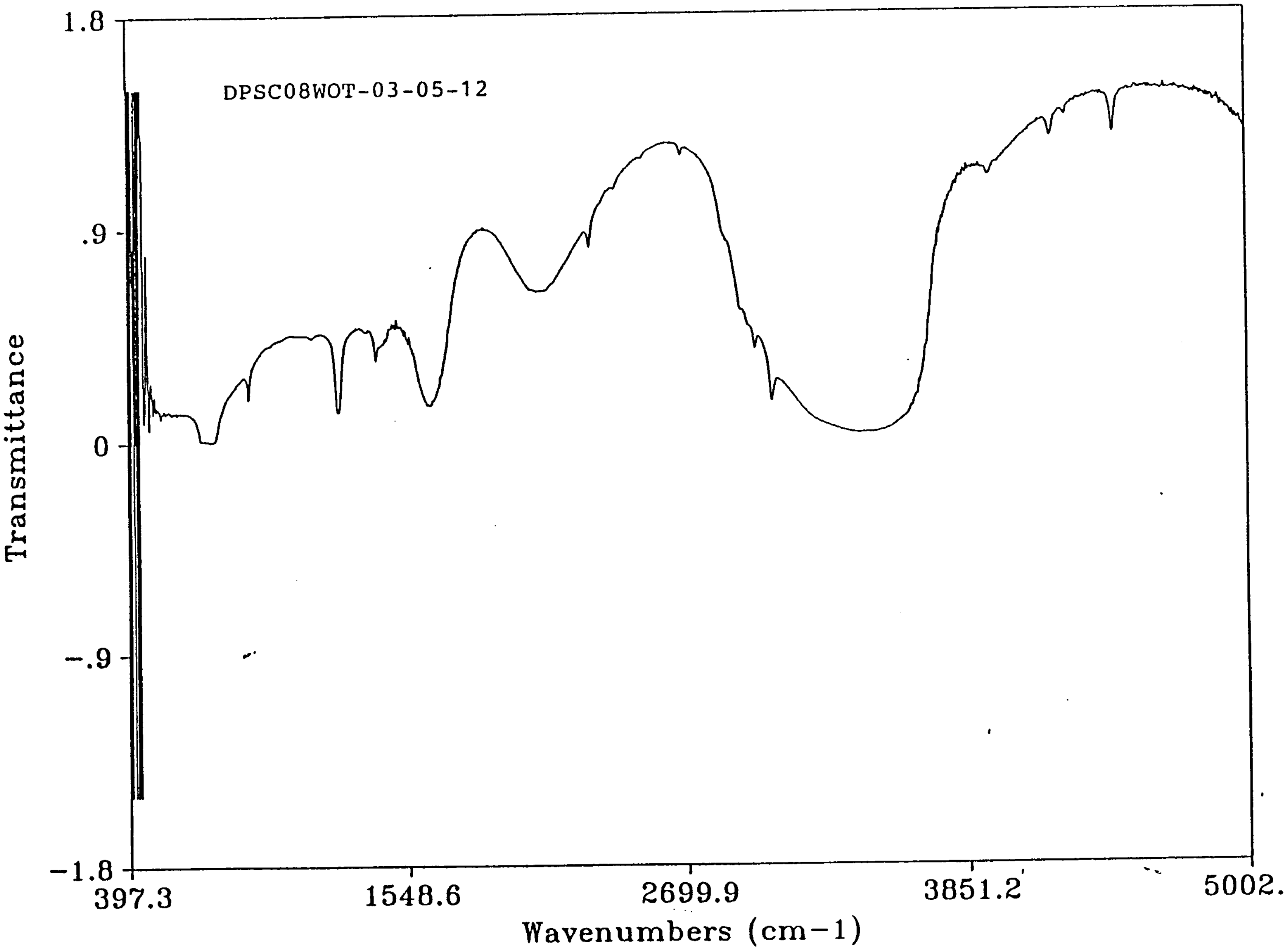
ERS Res= 4 07/26/96 11:15

71038; TRANSMITTANCE



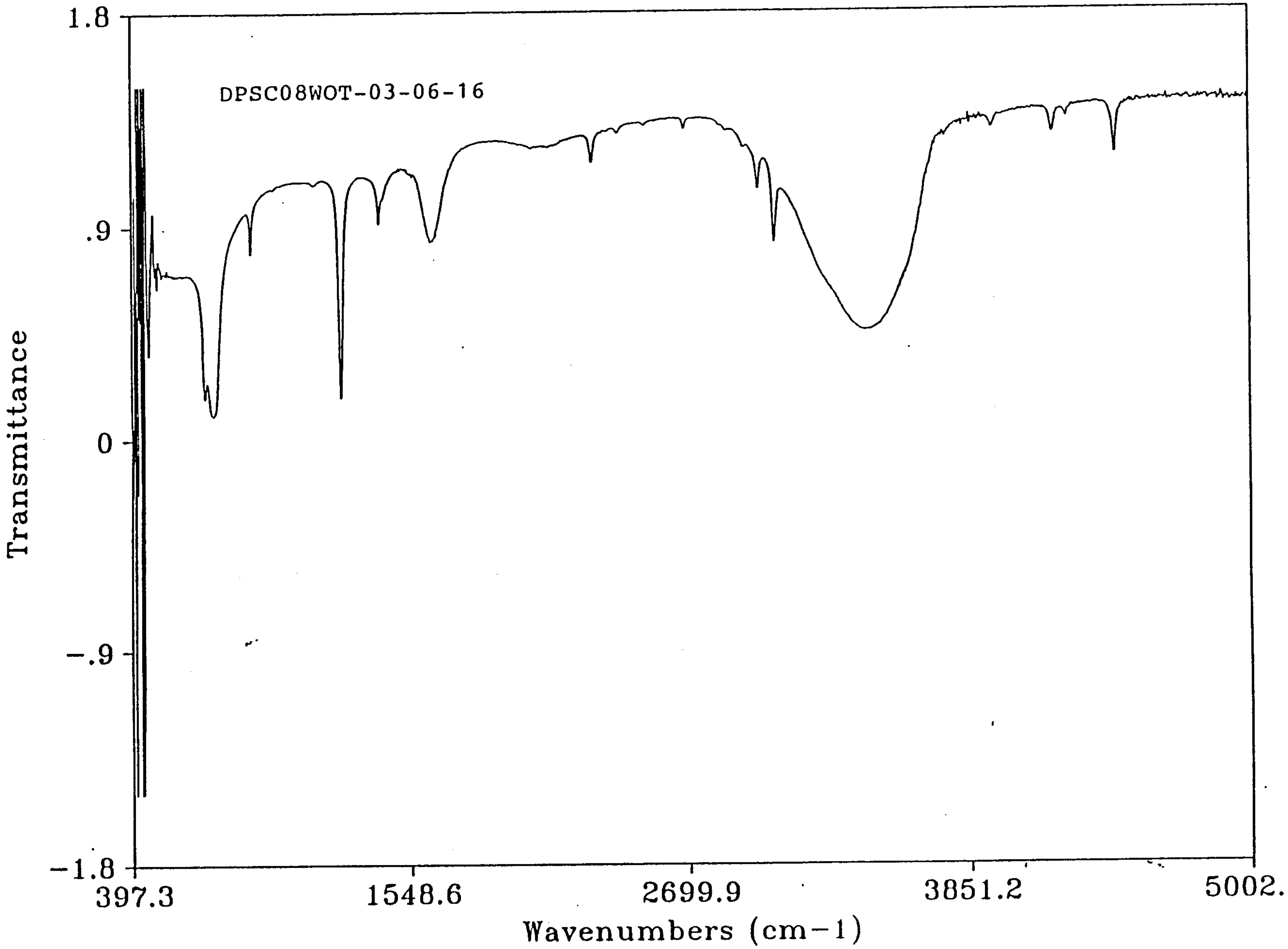
EET Res= 4 07/26/96 11:17

71039; TRANSMITTANCE



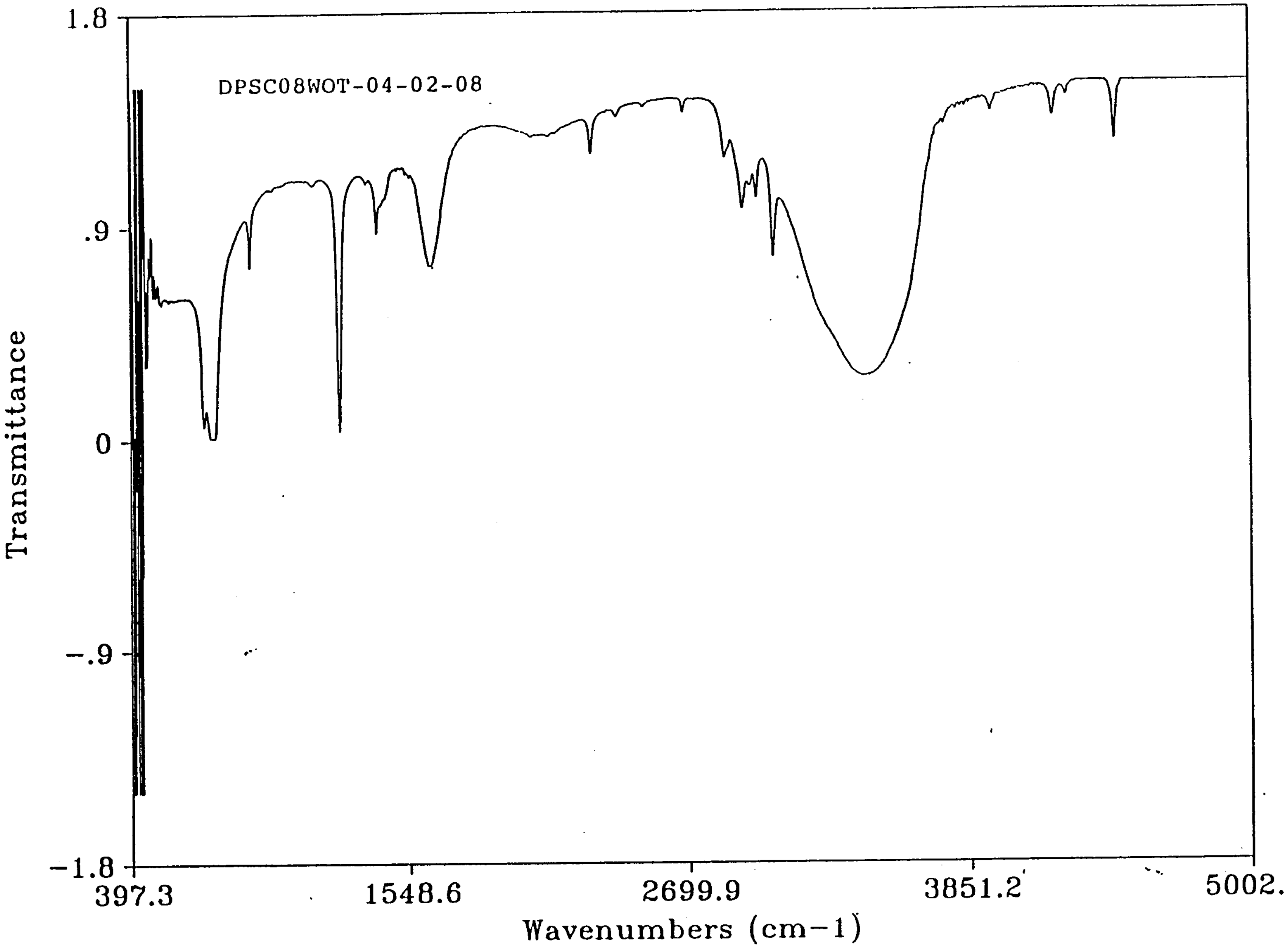
HED Res= 4 07/26/96 11:18

71040; TRANSMITTANCE



EME Res= 4 07/26/96 11:06

71041; TRANSMITTANCE

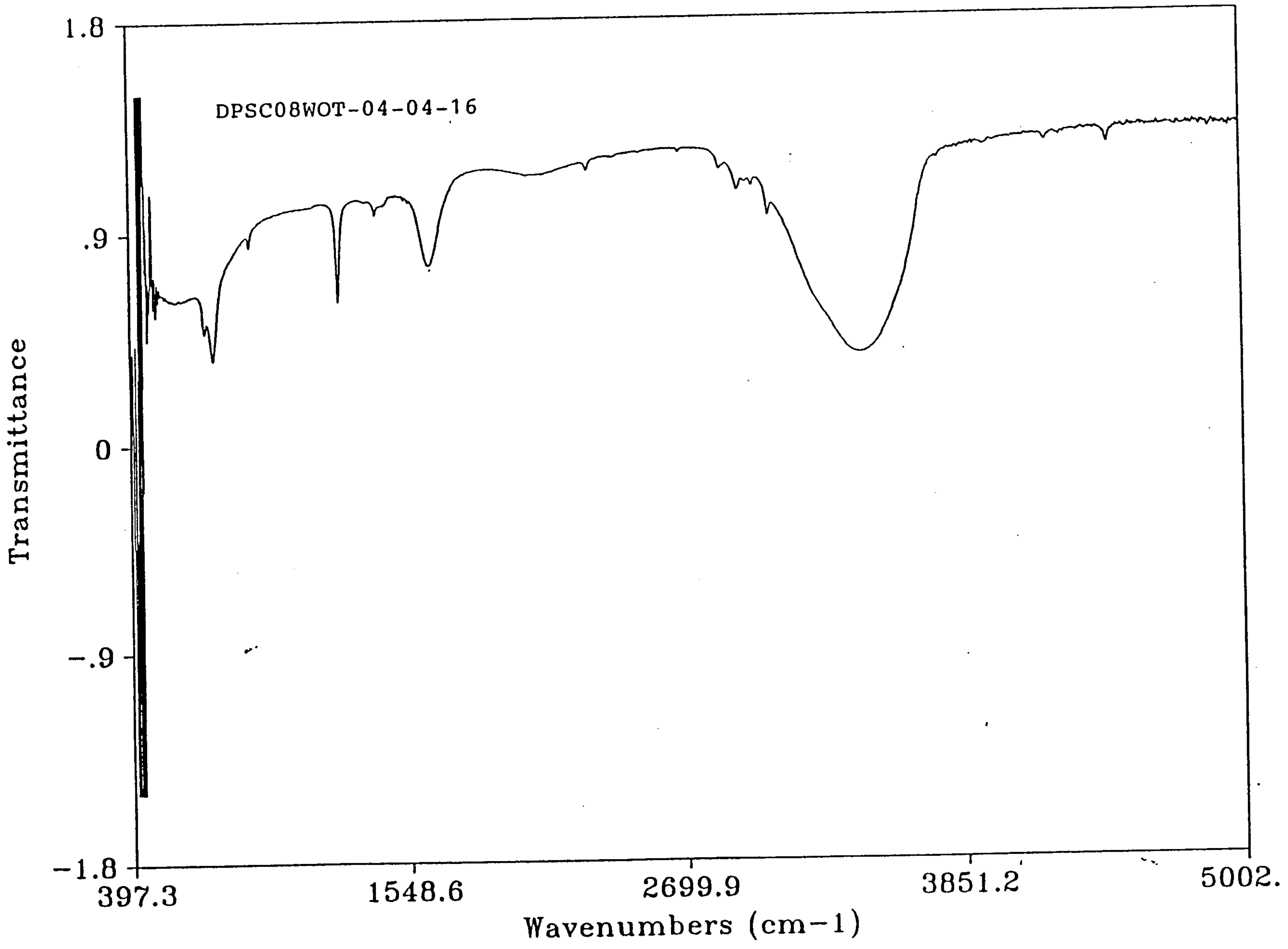


MBE

Res= 4

07/26/96 11:07

71042; TRANSMITTANCE

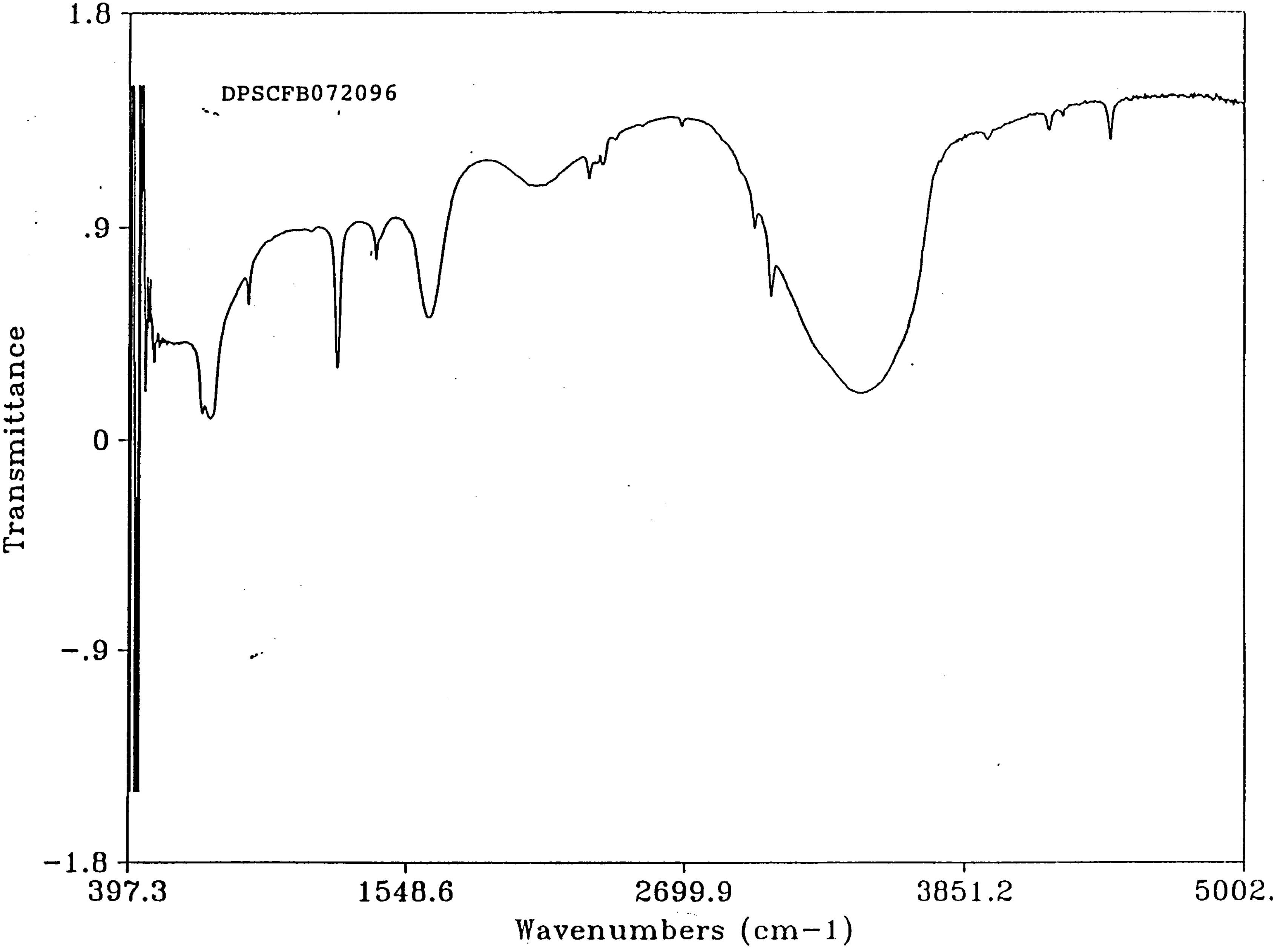


RWH

Res= 4

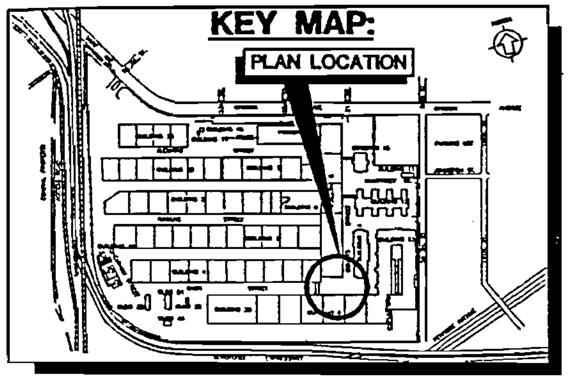
07/26/96 11:08

71043; TRANSMITTANCE



ENY Res= 4 07/26/96 11:09

71044; TRANSMITTANCE



BUILDING 9 (BASH STREET) GAS STATION DETECTED COMPOUNDS

	BORING NO.		09-01	09-02	09-02	09-03	09-03	09-04	09-04	09-04	09-04
	SAMPLE ID:		GSUST 01-04-12	GSUST 02-01-10	GSUST 02-03-16	GSUST 03-01-10	GSUST 03-02-12	GSUST 04-02-08	GSUST 04-03-08	GSUST 04-05-12	GSUST 04-06-16
	SAMPLING DATE:		6/26/96	6/27/96	6/27/96	6/27/96	6/27/96	6/27/96	6/27/96	6/27/96	6/27/96
	PADEP CRITERIA *		Result	Result	Result	Result	Result	Result	Result	Result	Result
ANALYTE	Non-Residential	Soil - GW									
Gasoline Range Organics (ug/Kg)	500,000		NA	5600	3800	2100	NA	5800	7300	20000	1100U
Lead (mg/Kg)	600		7.84	146	8.66		15.3	38.3	NA	NA	3.69

NOTES:

U – The analyte was analyzed for, but was not detected above the sample quantitation limit.

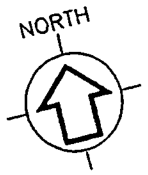
N/E – Criteria not established for this constituent

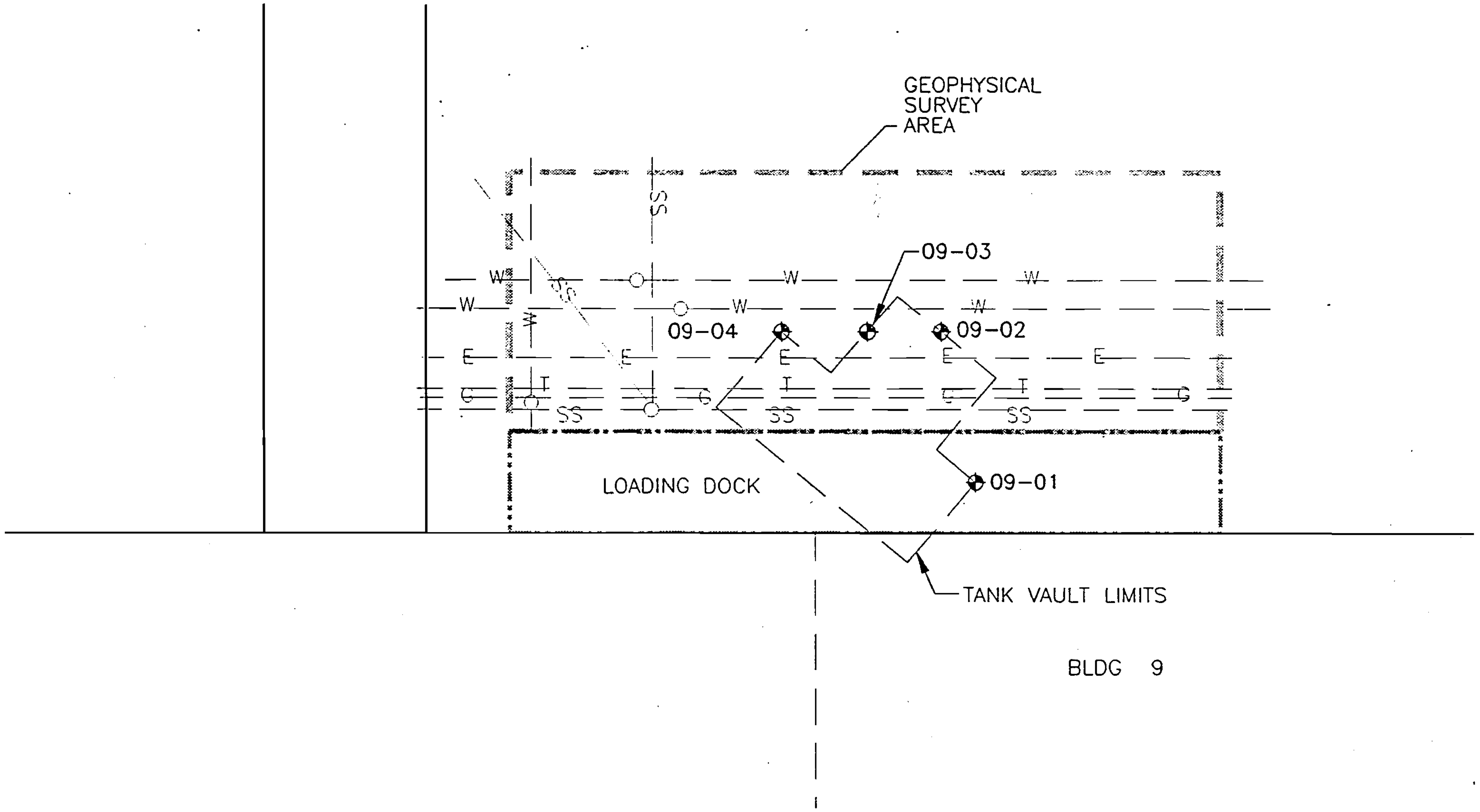
D – This qualifier identifies all compounds identified in an analysis at a secondary dilution

ALL Field Sample ID labels contain the prefix DPSC on the Chain Of Custody forms.

* Criteria based on PADEP LAND Recycling Program Technical Guidance Manual 7/18/95

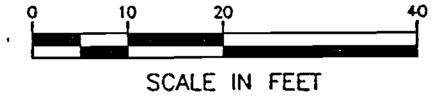
Sample number consists of: Location Boring–Sequential Number–Depth (eg. GSUST-02-01-10)





LEGEND:

⊕ SOIL BORING



SCALE IN FEET
1"= 20'

Source: Geophysical Survey Report, ENSA INC., 1996

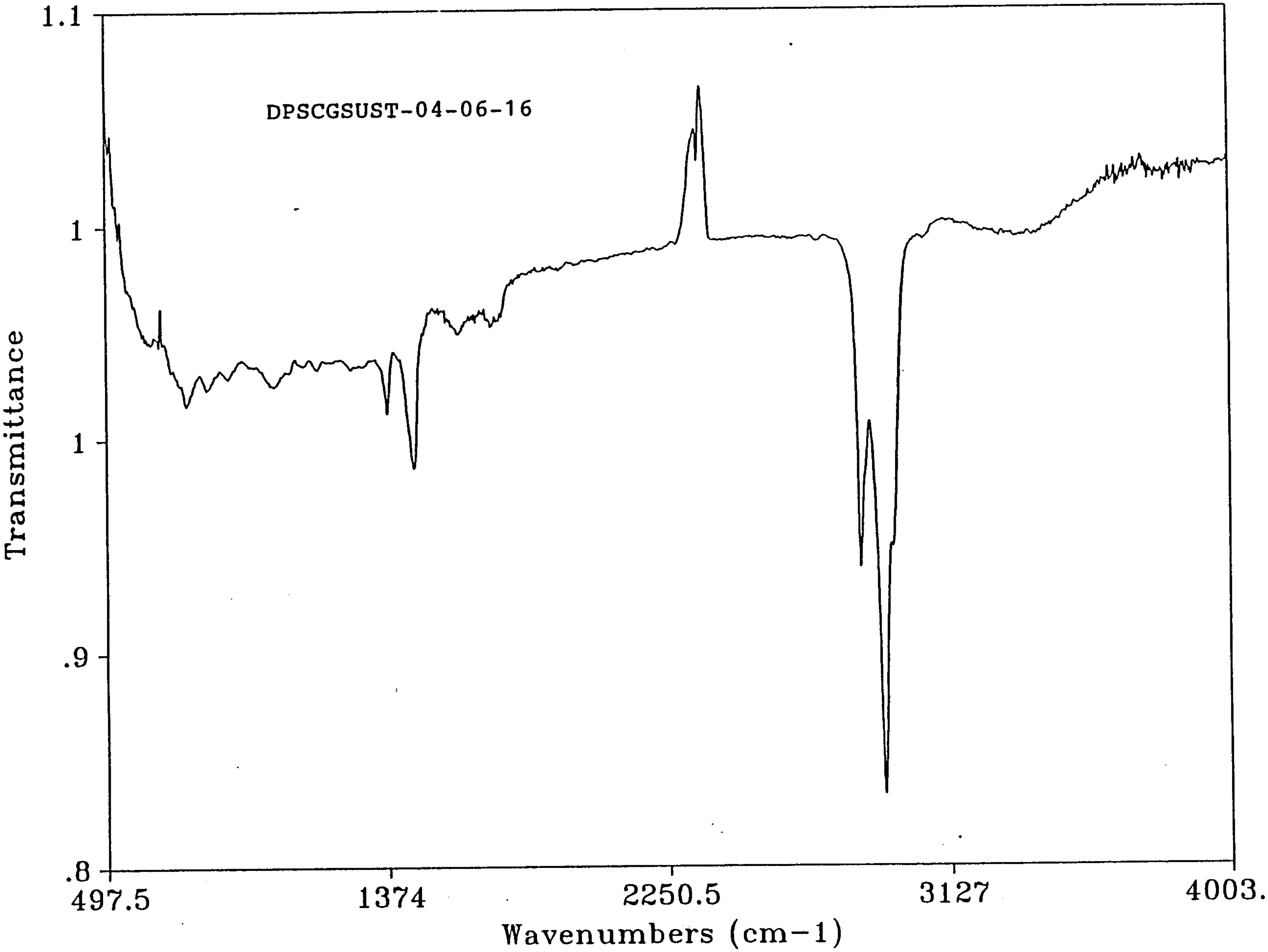
U.S. Army Corps of Engineers

DEFENSE PERSONNEL SUPPORT CENTER – PHILADELPHIA, PENNSYLVANIA

DRILLING LOCATIONS & SOIL ANALYTICAL RESULTS - BUILDING 9 (BASH ST.) GAS STATION USTs

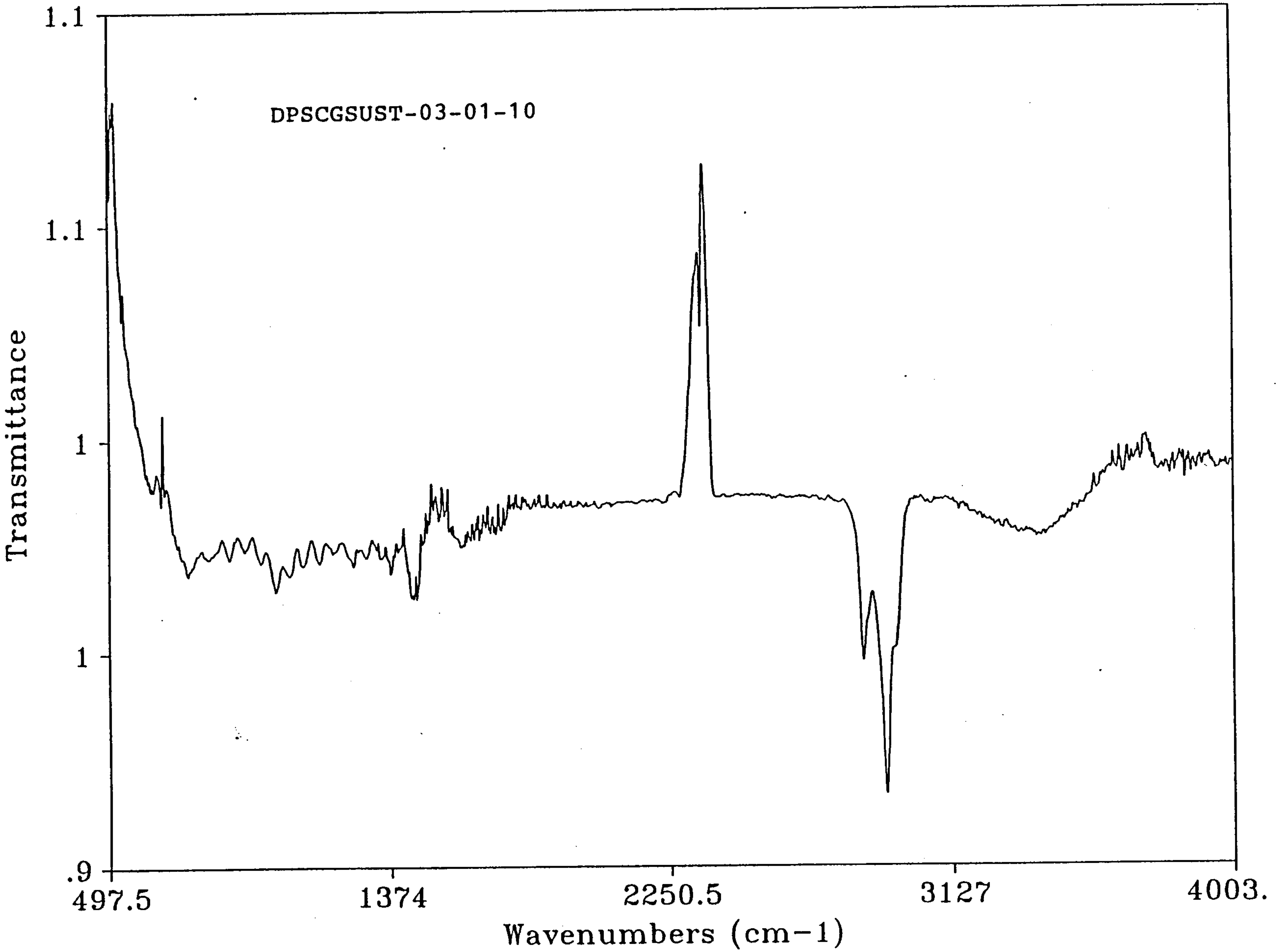
USACE CONTRACT No. DACA31-94-D-0017

FIGURE M-3



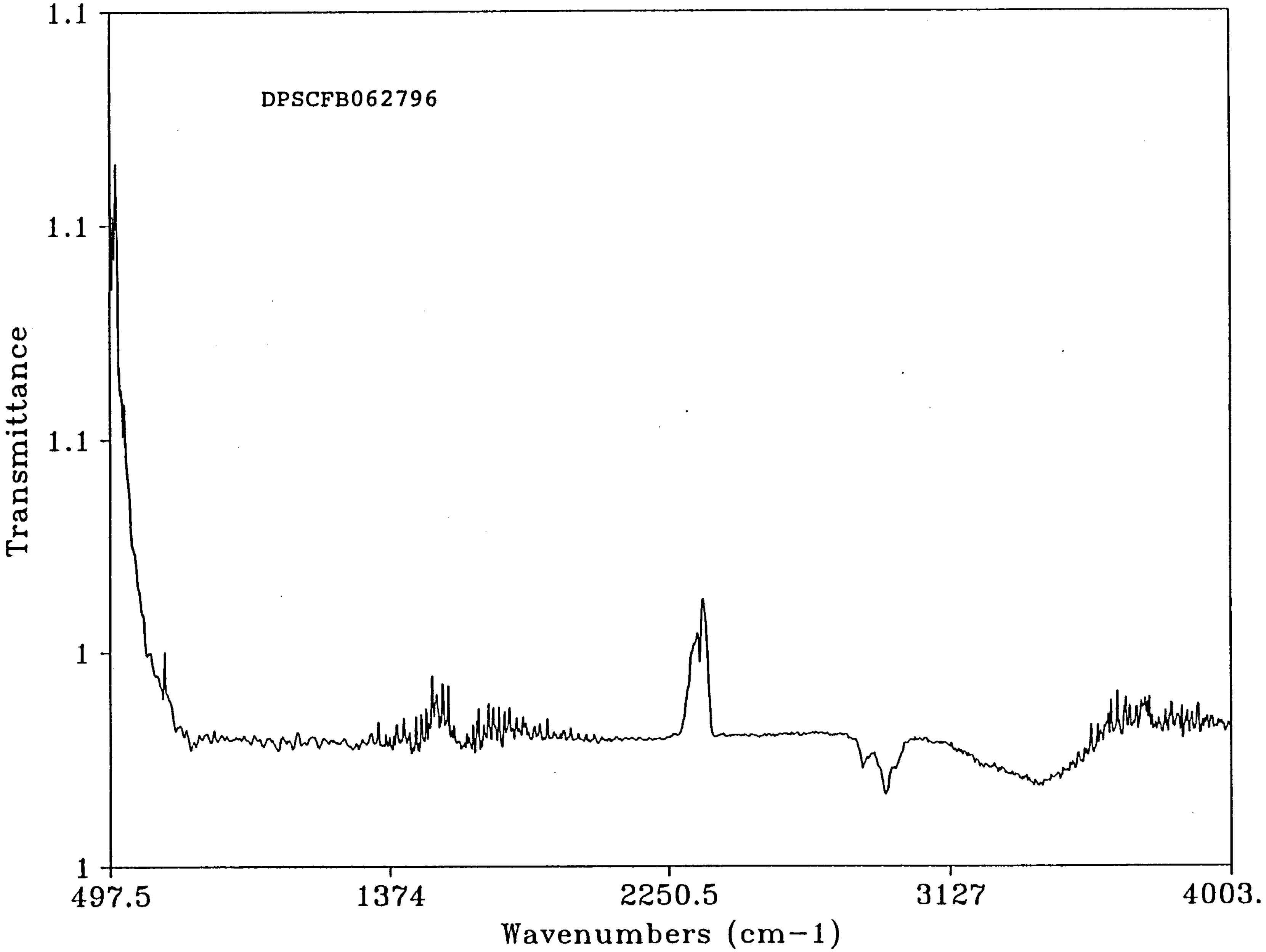
SCH Res= 4 07/03/96 13:55

70330 RN2; TRANSMITTANCE



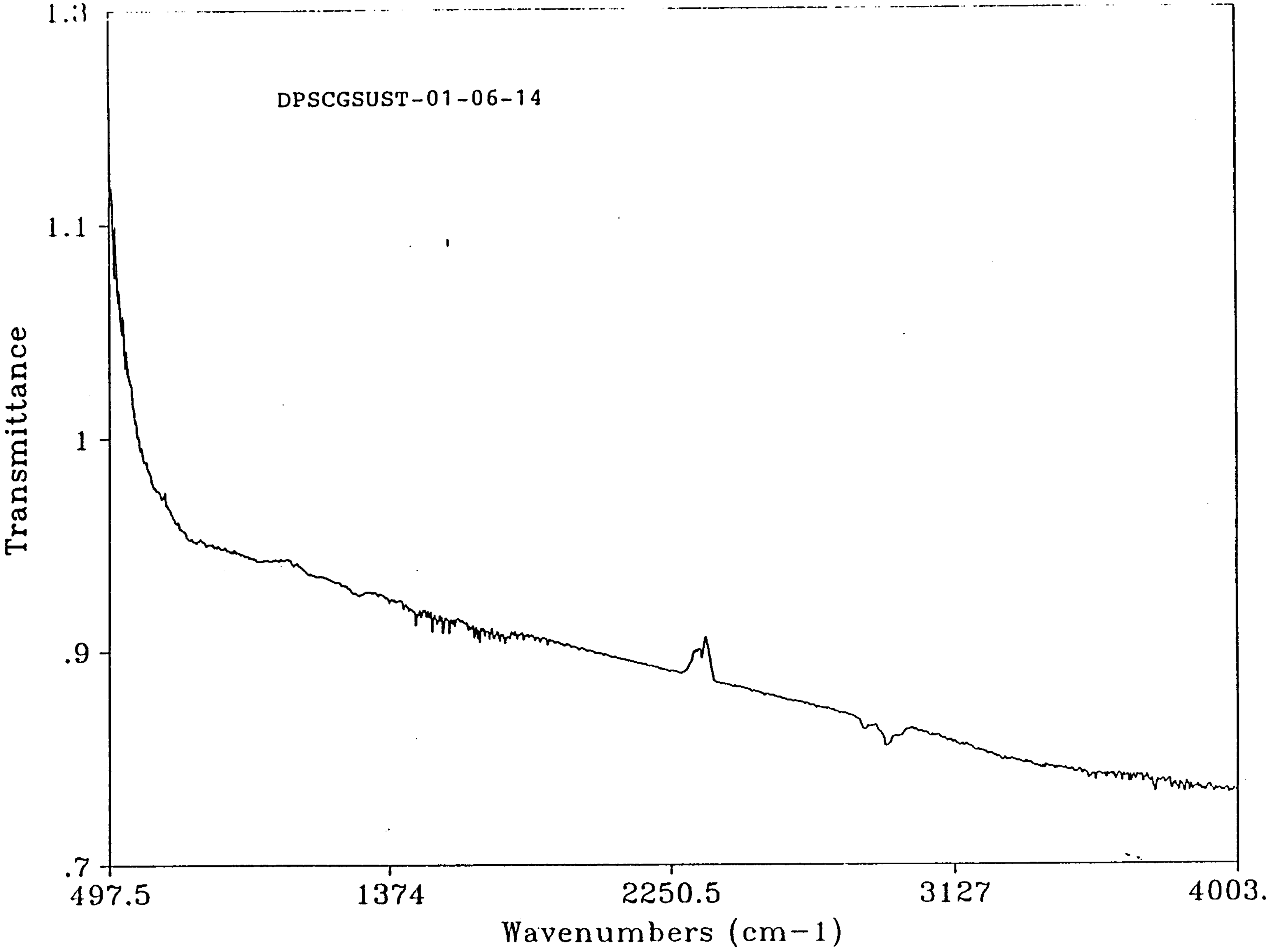
SCI Res= 4 07/03/96 13:56

70331 RN2; TRANSMITTANCE



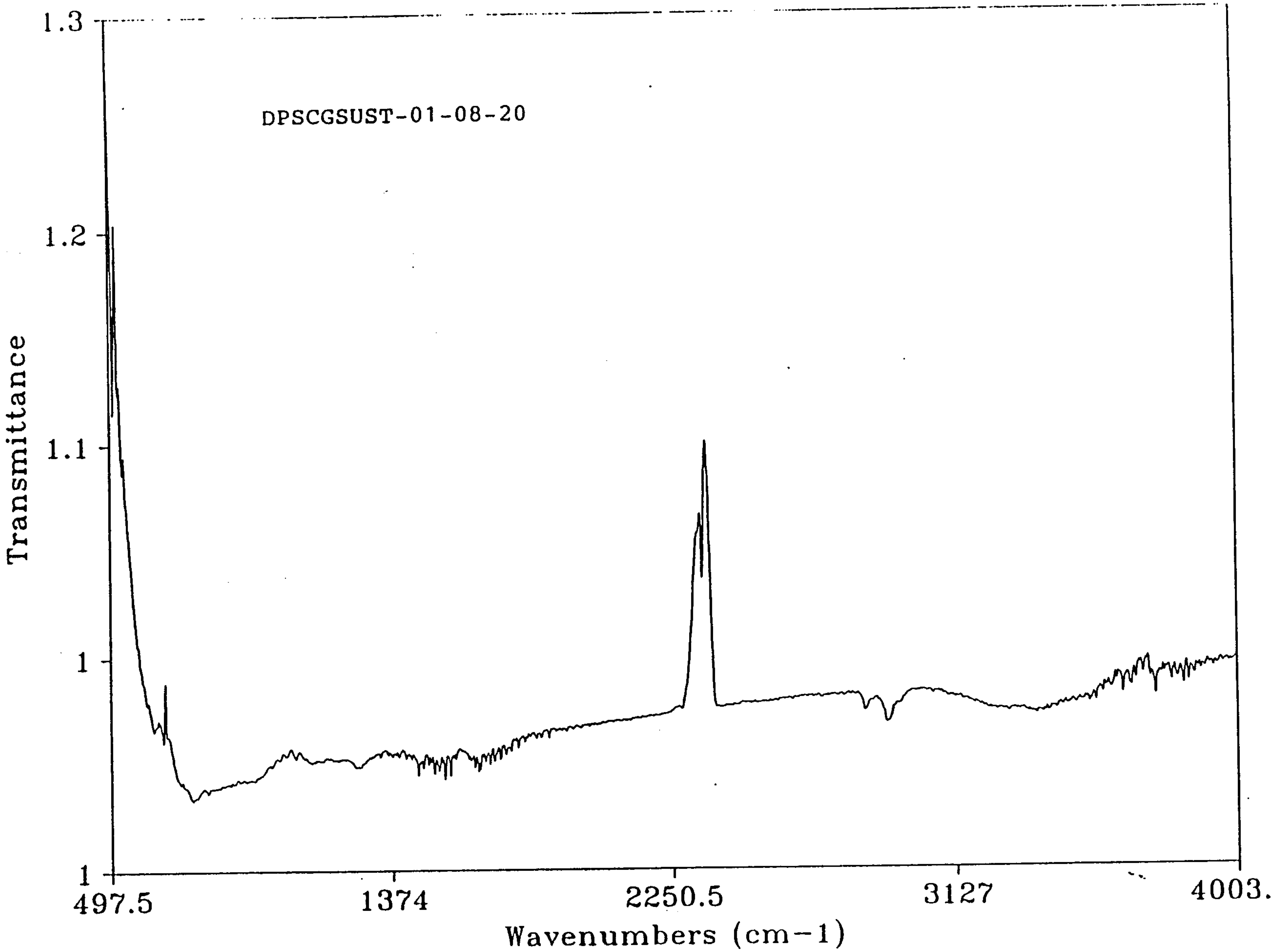
SCJ Res= 4 07/03/96 13:57

70332 RN2; TRANSMITTANCE



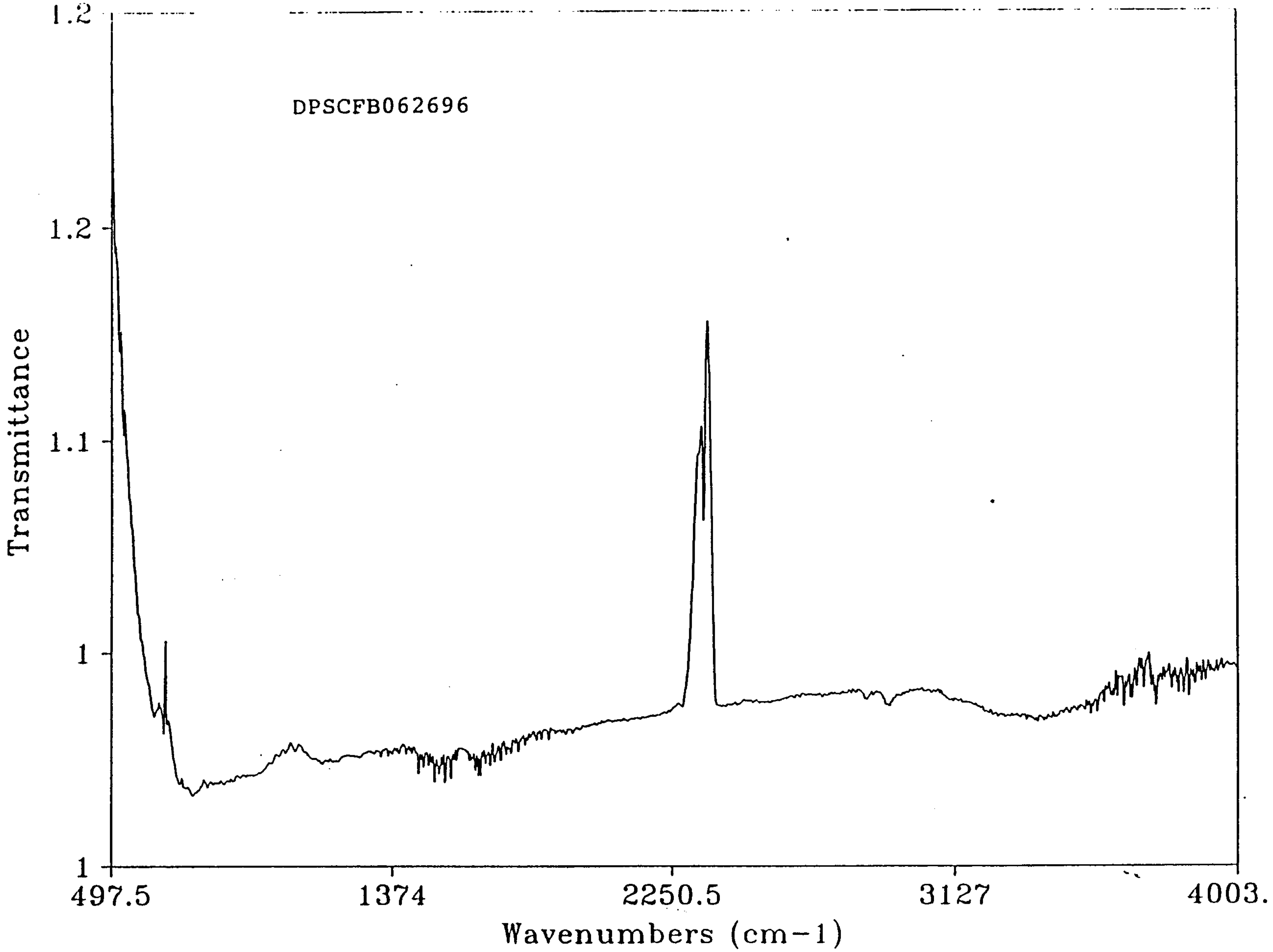
SCI Res= 4 07/02/96 10:53

70308; TRANSMITTANCE



SCJ Res= 4 07/02/96 10:54

70309; TRANSMITTANCE



SCK Res= 4 07/02/96 10:55

70310; TRANSMITTANCE

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D
Beth M. Albertson, M.S.
Bradley T. Benson
Kelley D. Wilt

3012 16th Avenue West
Seattle, WA 98119-2029
TEL: (206) 285-8282
FAX: (206) 283-5044

July 11, 1996

RECEIVED
JUL 12 1996

Carole Tomlins, Project Manager
Malcolm Pirnie
104 Corporate Park Drive, Box 751
White Plains, NY 10602

Dear Ms. Tomlins:

Enclosed are the results from the testing of material submitted on July 1, 1996 from your DPSC project.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Kelley Wilt

Kelley Wilt
Chemist

RECEIVED
JUL 15 1996

keh
Enclosures
FAX: (914) 641-2456
MPI0711R.DOC

FRIEDMAN & BRUYA, INC.
3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282

KW AO
7.1.96
8:25

SAMPLE CHAIN OF CUSTODY

Send Report To:
Company Malcolm Pirnie Contact: Carole Tomlins
Address 104 Corporate Park Drive
City, State, Zip White Plains New York 10602-0751
Phone # 914 694 2100 Date 6/28/96

SITE NO	PROJECT NAME	PURCHASE ORDER #
0285-642	DPSC	

SAMPLERS (signature)
1 John Archibald

PROJECT LOCATION
Philadelphia

REMARKS

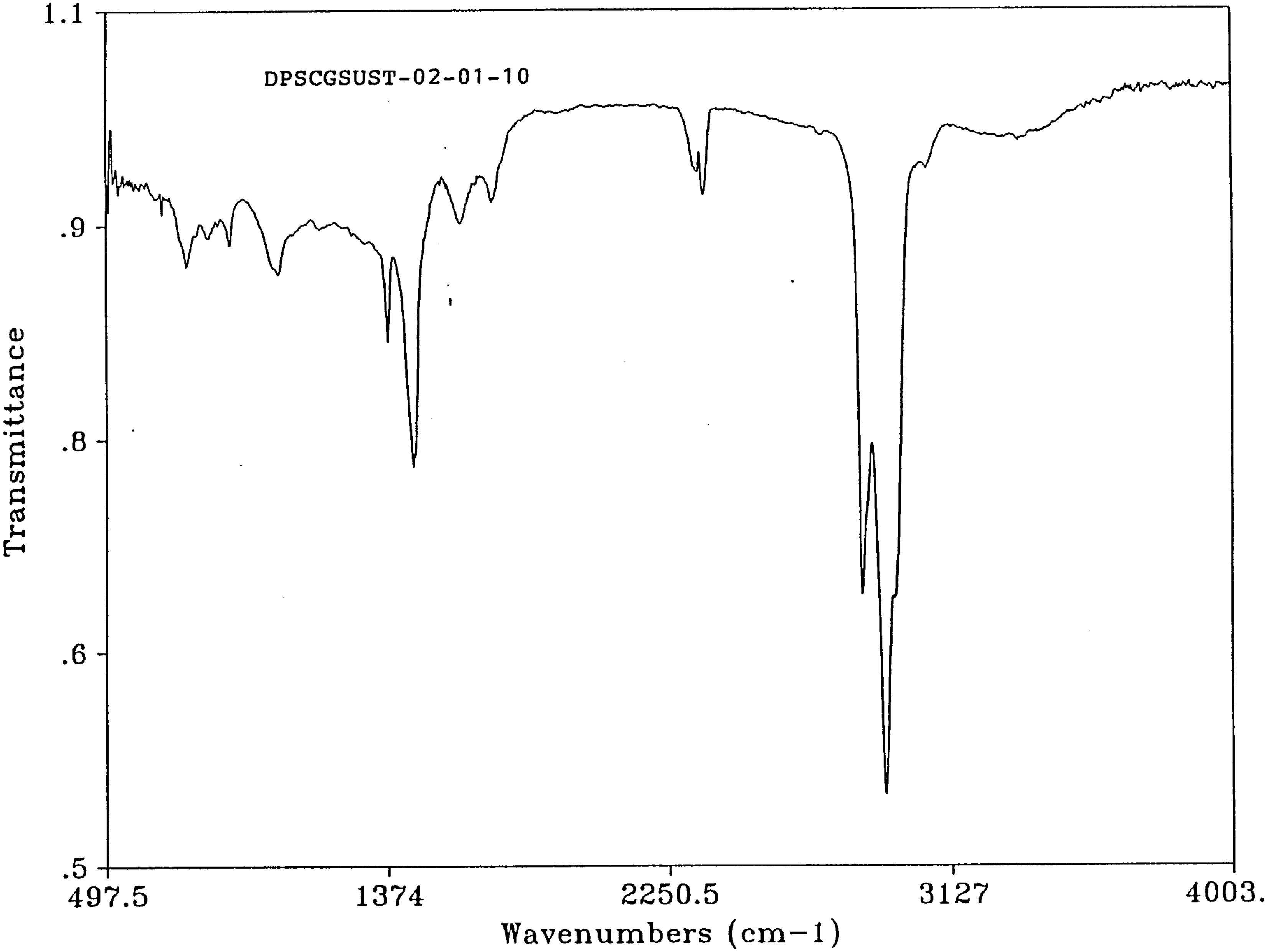
SAMPLE DISPOSAL INFORMATION
☐ Dispose after 30 days
☐ Return Samples
☐ Call for Instructions

Sample #	Date/Time Sampled	Type of Sample	# of Jars	Lab Sample #	Analyses Requested
DPSCGSUST-02-01-10	6/27/96 / 1315	GRAB SOIL	1 ✓	70325	IR SCAN
DPSCGSUST-02-03-16	6/27/96 / 1330	" "	1 ✓	70326	" "
PSCGS UST-04-01-06	6/27/96 / 1150	" "	1 ✓	70327	" "
DPSC28UST-28-01-14	6/27/96 / 1616	" "	1 ✓	70328	" "
DPSC28UST-26-01-06	6/26/96 / 1320	" "	1 ✓	70329	" "
DPSCGSUST-04-06-16	6/27/96 / 1215	" "	1 ✓	70330	" "
DPSCGSUST-03-01-10	6/27/96 / 1116	" "	1 ✓	70331	" "
DPSCFB062796	6/27/96 / 1520	" WATER	2	70332-33	IR SCAN

SIGNATURE	PRINT NAME	COMPANY	Date	Time
Relinquished by: John Archibald	JOHN ARCHIBALD	MALCOLM PIRNIE	6/28/96	1400
Received by: Thomas S. Wilke	Tom Wilkes	Malcolm Pirnie	6/28/96	1400
Relinquished by: Thomas S. Wilke	Thomas G. Wilkes	Malcolm Pirnie	6/28/96	1700
Received by: Cathy Downing	CAthy DowNING	F&BI	7/1/96	7.30

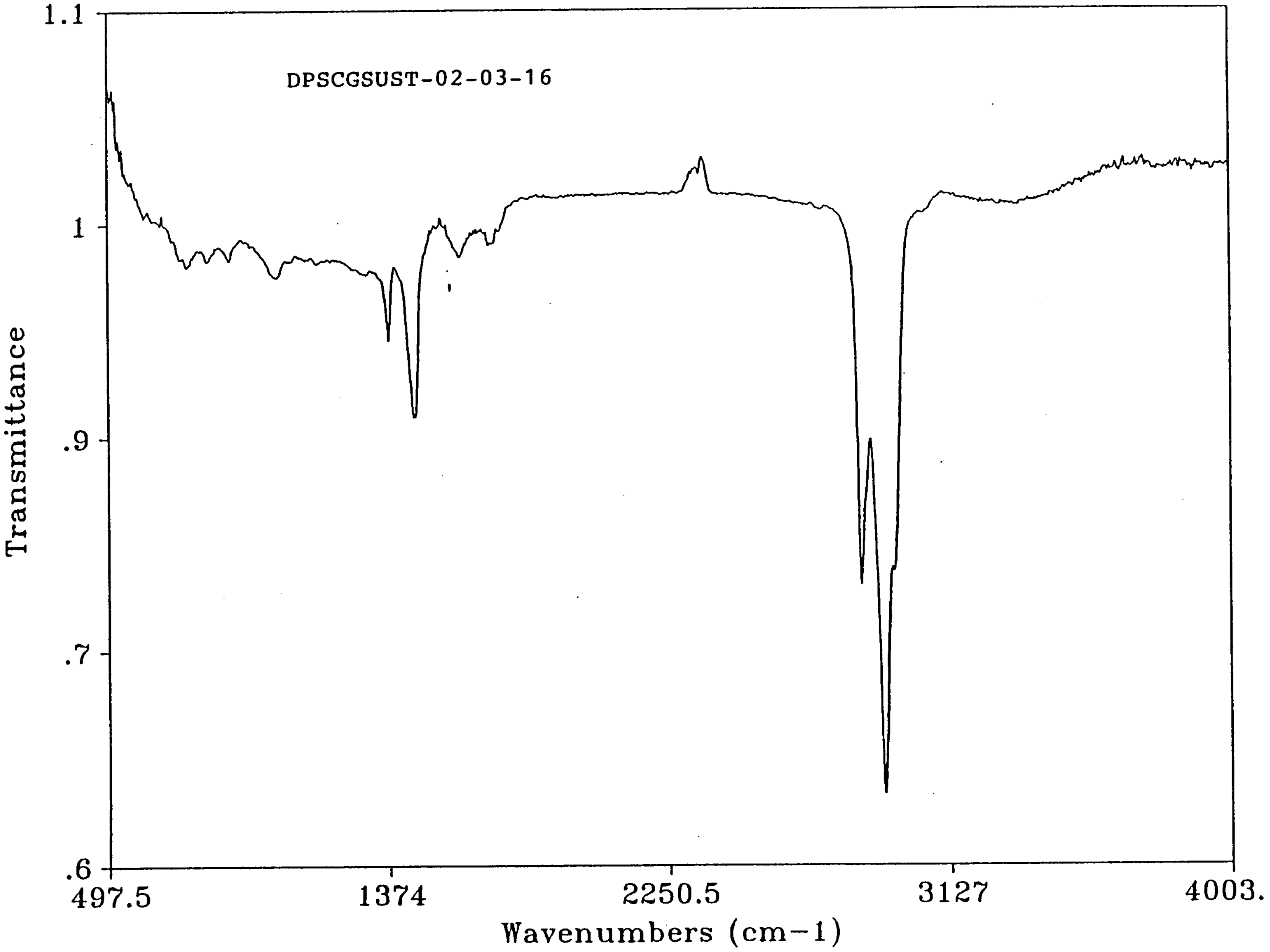
FORMS/COC

09/19/9



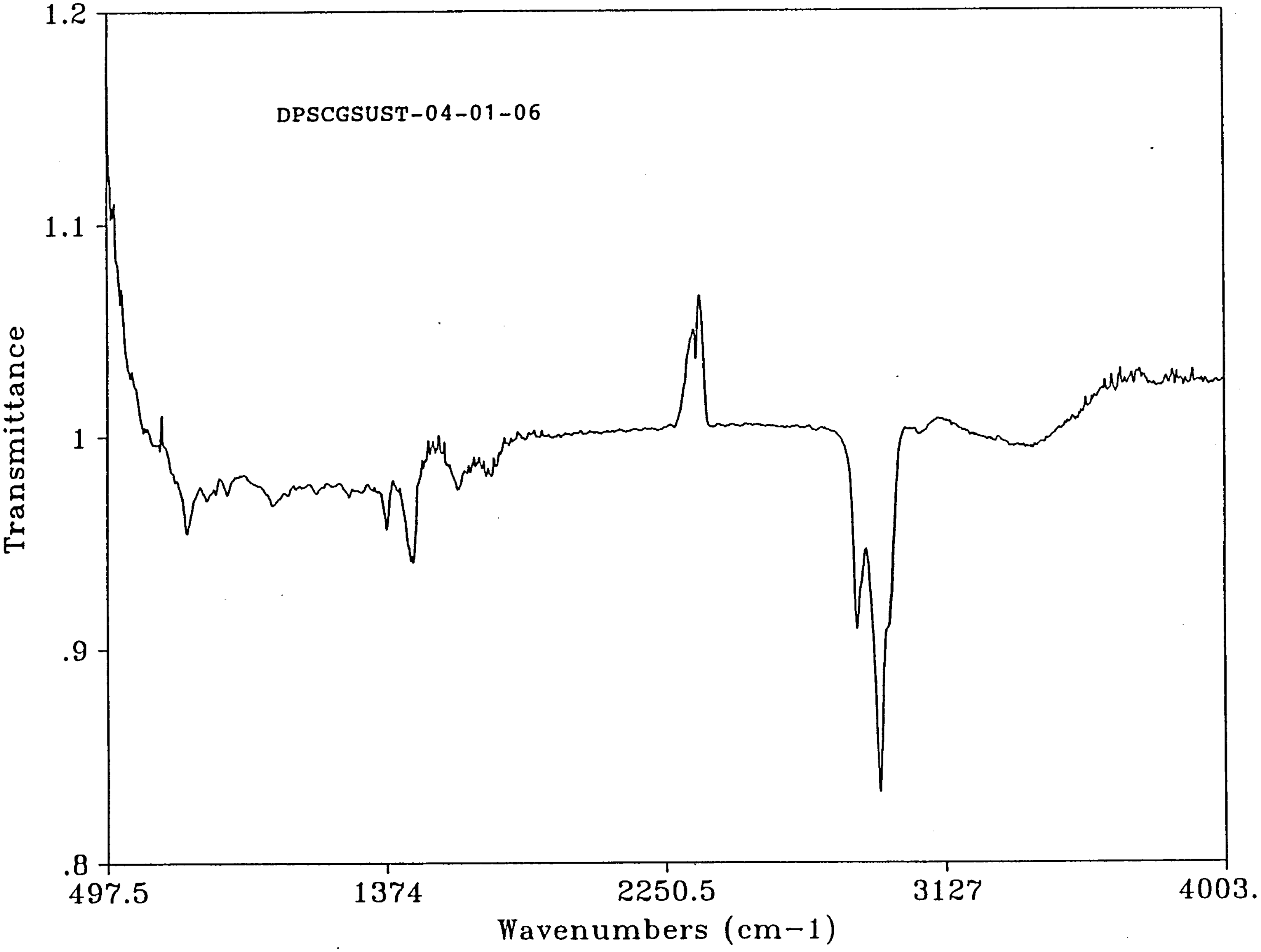
SCB Res= 4 07/03/96 13:49

70325; TRANSMITTANCE



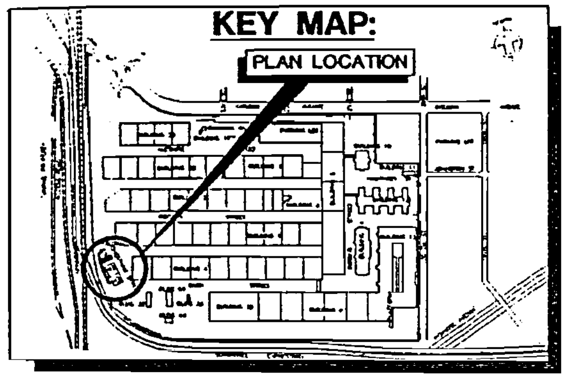
SCD Res= 4 07/03/96 13:51

70326 RN2; TRANSMITTANCE



SCE Res= 4 07/03/96 13:52

70327 RN2; TRANSMITTANCE



BULK FUEL STORAGE AREA - DETECTED COMPOUNDS

	BORING NO.:		BSOL-01	BSOL-01	BSOL-01	BSOL-01	BSOL-02	BSOL-02	BSOL-03	BSOL-03	BSOL-04
	SAMPLE ID:		BSUT 01-01-08	BSUT 01-02-08	BSUT 01-03-14	BSUT 01-04-14	BSUT 02-01-08	BSUT 02-03-12	BSUT 03-03-10	BSUT 03-04-12	BSUT 04-03-08
	SAMPLING DATE:		6/13/96	6/13/96	6/13/96	6/13/96	6/13/96	6/13/96	6/18/96	6/18/96	6/18/96
	PADEP CRITERIA *		Result	Result	Result	Result	Result	Result	Result	Result	Result
ANALYTE	Non-Residential	Soil - GW									
Diesel Range Organics (mg/Kg)	500		300	280	NA	NA	600 K	NA	1.2	NA	2.7
GC/MS SEMIVOLATILE (ug/Kg)											
Acenaphthene	60,000,000	30,000	NA	NA	360 U	360 U	NA	558	NA	400 U	NA
Anthracene	300,000,000	1,000,000	NA	NA	360 U	360 U	NA	1550	NA	400 U	NA
Benzo (a) anthracene	8,000	500,000	NA	NA	720 U	720 U	NA	311	NA	800 U	NA
bis (2-ethylhexyl)phthalate	400,000	400,000	NA	NA	141	89.7	NA	327	NA	862	NA
Chrysene	780,000	300,000	NA	NA	360 U	360 U	NA	401	NA	400 U	NA
Fluoranthene	40,000,000	400,000	NA	NA	360 U	360 U	NA	1450	NA	400 U	NA
Fluorene	80,000,000	100,000	NA	NA	360 U	360 U	NA	739	NA	400 U	NA
N-Nitrosodiphenylamine	N/E	N/E	NA	NA	360 U	360 U	NA	2870	NA	400 U	NA
Phenanthrene	N/E	80,000	NA	NA	360 U	360 U	NA	1480	NA	400 U	NA
Pyrene	30,000,000	300,000	NA	NA	360 U	360 U	NA	712	NA	400 U	NA

NOTES:

U - The analyte was analyzed for, but was not detected abovesthe sample quantitation limit.

N/E - Criteria not established for this constituent

D - This qualifier identifies all compounds identified in an analysis at a secondary dilution

ALL Field Sample ID labels contain the prefix DPSC on the Chain Of Custody forms.

* Criteria based on PADEP Land Recyciling Program Technical Guidance Manual 7/18/95

Sample ID consists of: Location Boring-Sequential Number-Depui (eg. BSUT-01-01-08)

	BORING NO.:		BSAST-01	BSAST-01	BSAST-02	BSAST-02	BSAST-04	BSAST-05	BSAST-06	BSAST-06
	SAMPLE ID:		BSAST 01 - 0.5	BSAST 01 - 2.6	BSAST 02 - 0.5	BSAST 02 - 05	BSAST 04-01-05	BSAST 05-01-0.5	BSAST 06-01-0.5	BSAST 06-03-0.5
	SAMPLE DATE:		6/7/96	6/7/96	6/7/96	6/7/96	6/26/96	6/26/96	6/26/96	6/26/96
	PADEP CRITERIA *		Result	Result	Result	Result	Result	Result	Result	Result
ANALYTE	Non-Residential	Soil - GW								
Diesel Range Organics (mg/Kg)	500		NA	0.98 U	NA	2.4	3.4		NA	NA
GC/MS SEMIVOLATILE RESULTS (ug/Kg)										
Fluoranthene	40,000,000	400,000	NA	370 U	NA	NA	778	NA	NA	NA
Phenanthrene	N/E	80,000	NA	370 U	NA	NA	449	NA	NA	NA
Pyrene	30,000,000	300,000	NA	568	NA	NA	440 U	NA	NA	NA
METALS										
Lead (mg/Kg)	600		829		275			217	109	32.1

NOTES:

U - The analyte was analyzed for, but was not detected above the sample quantitation limit.

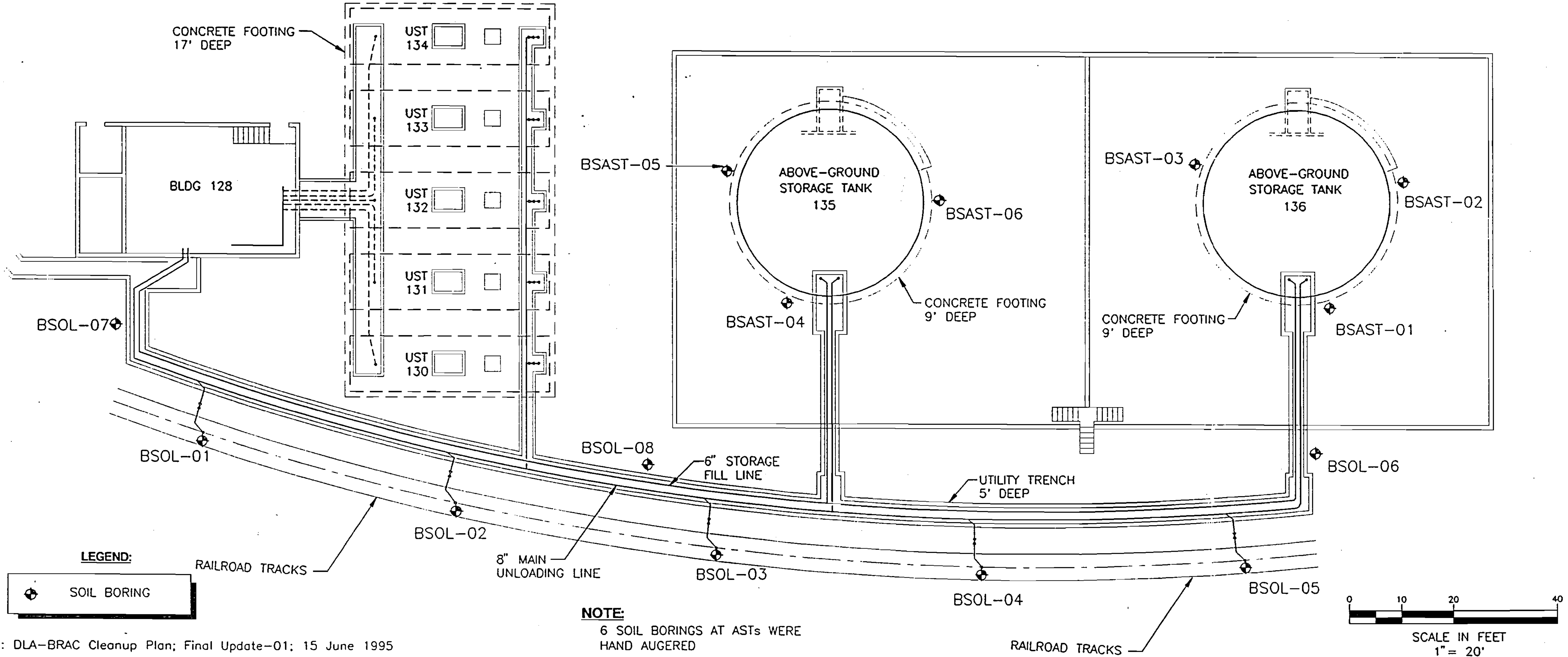
N/E - Criteria not established for this constituent

D - This qualifier identifies all compounds identified in an analysis at a secondary dilution

ALL Field Sample ID labels contain the prefix DPSC on the Chain Of Custody forms.

* Criteria based on PADEP Land Recycling Program Technical Guidance Manual 7/18/95

Sample ID consists of: Location Boring-Sequential Number-Depth
(eg. BSAST-01 THROUGH 02 (eg. BCAST-02-0.5)
: Location Boring No.-Sequential Number-Depth (eg. BSAST-04-01-05)



NOTE:
6 SOIL BORINGS AT ASTs WERE HAND AUGERED

Source: DLA-BRAC Cleanup Plan; Final Update-01; 15 June 1995

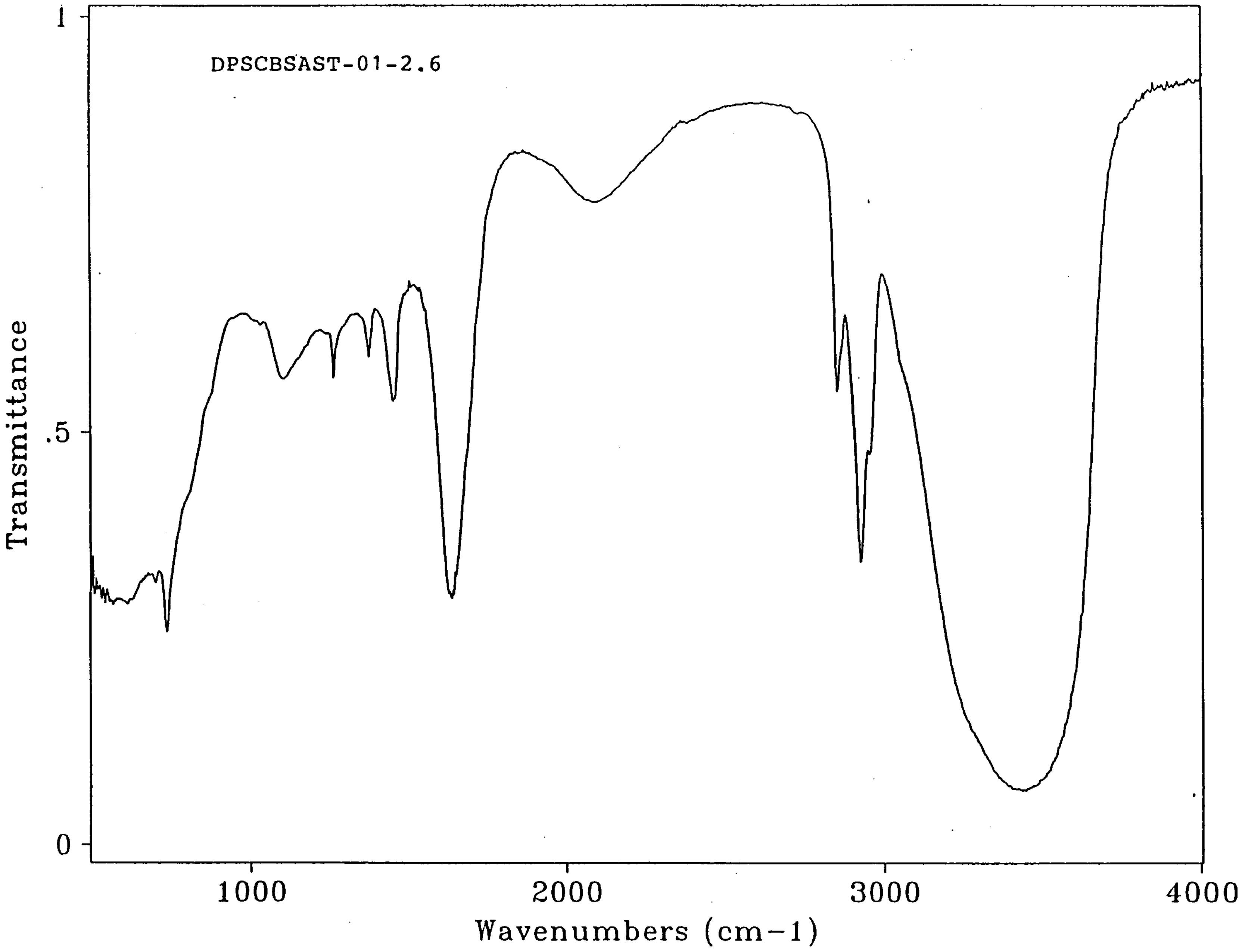
U.S. Army Corps of Engineers

DEFENSE PERSONNEL SUPPORT CENTER - PHILADELPHIA, PENNSYLVANIA

DRILLING LOCATIONS & SOIL ANALYTICAL RESULTS - BULK STORAGE ASTs/UTILITY TRENCH

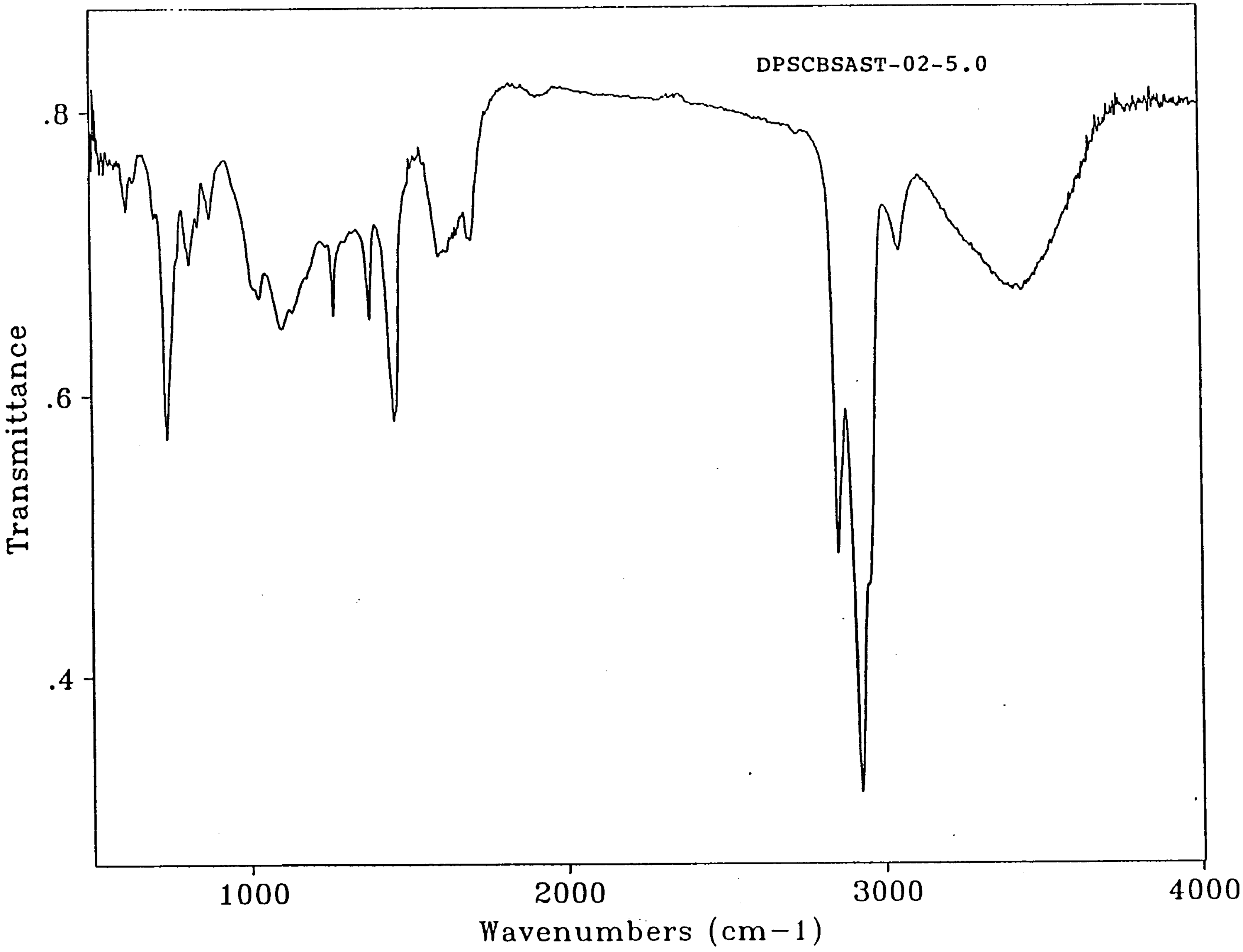
USACE CONTRACT No. DACA31-94-D-0017

FIGURE M-4



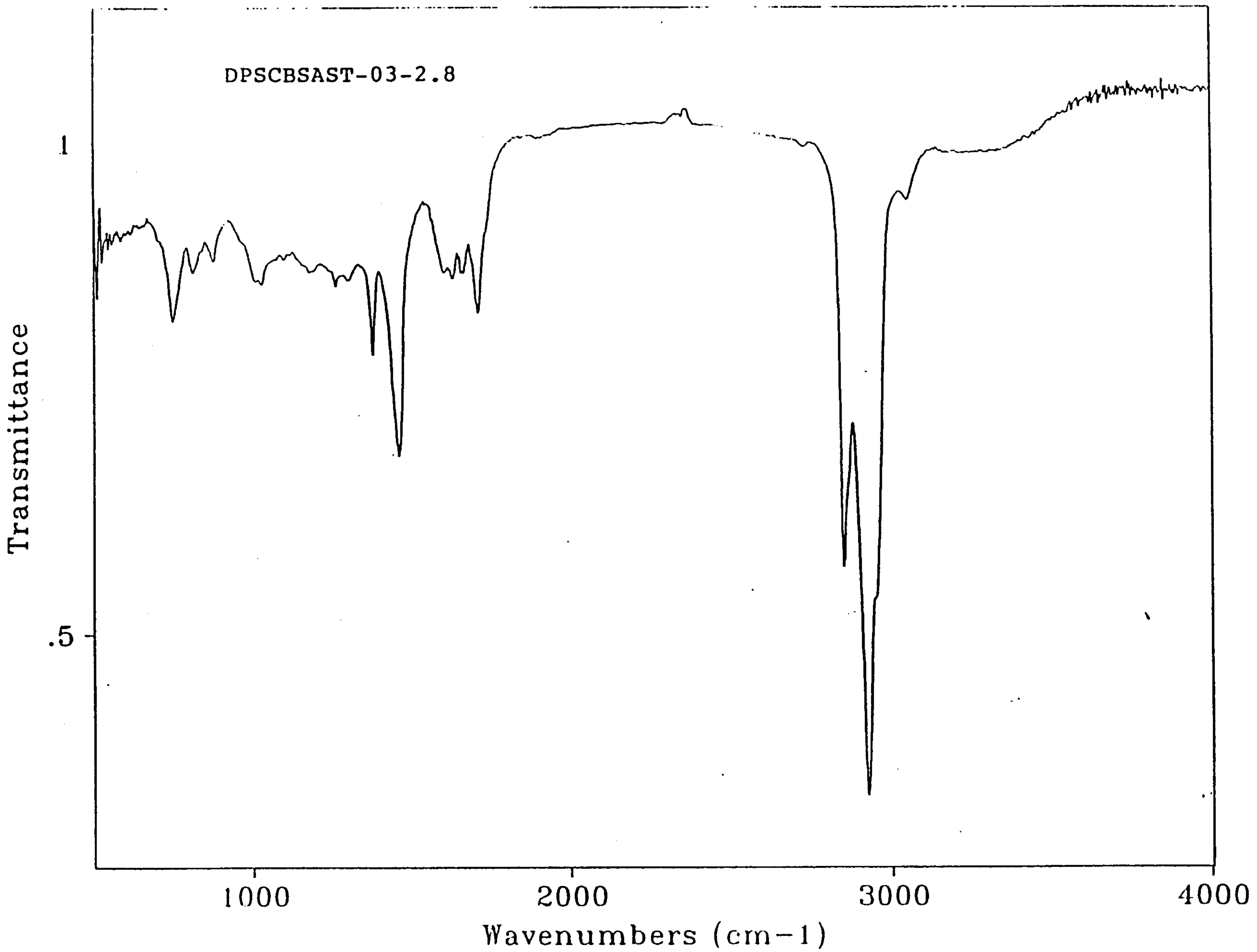
SCN Res= 4 06/18/96 16:42

69672; TRANSMITTANCE



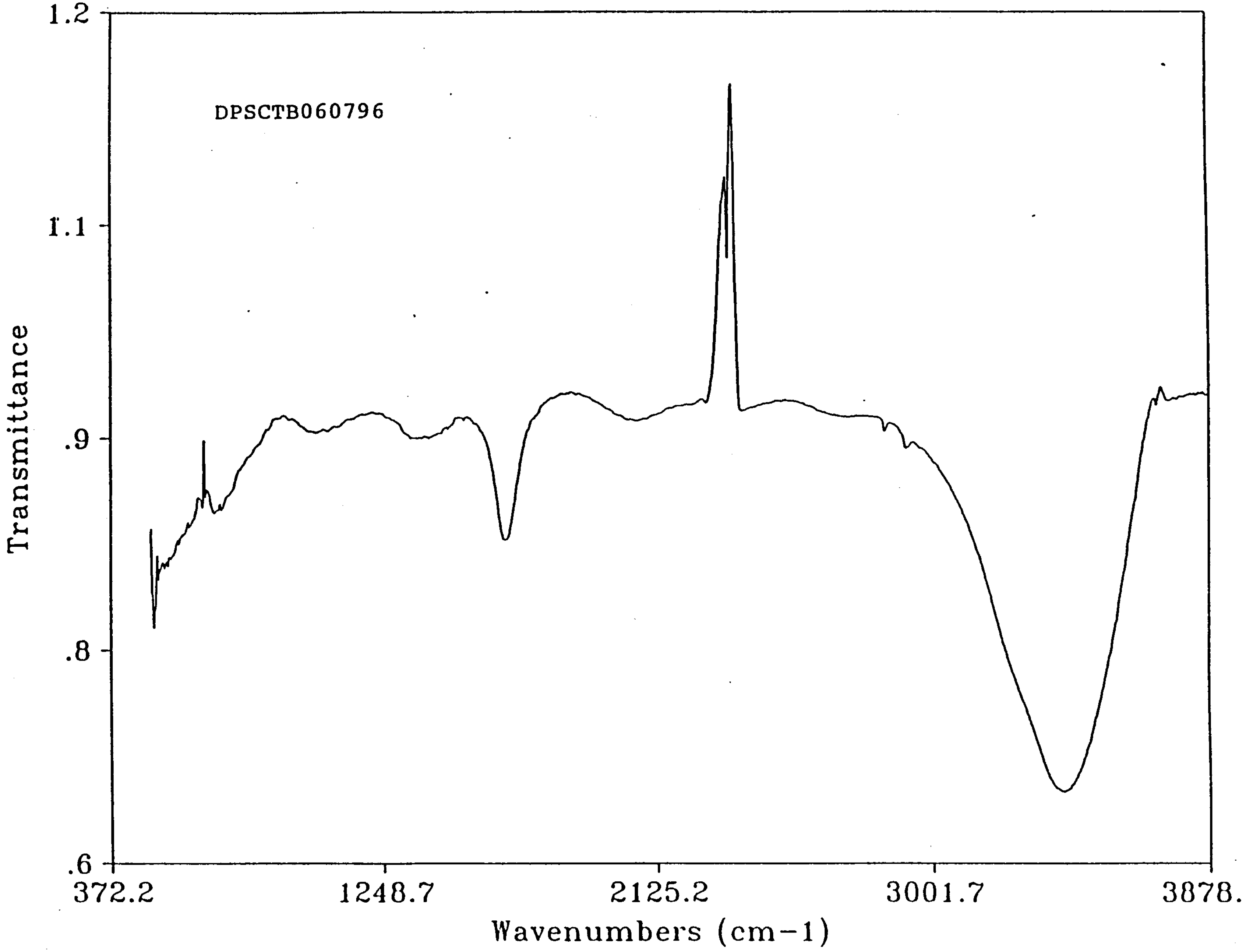
SCO Res= 4 06/18/96 16:43

69673; TRANSMITTANCE



SCG Res= 4 06/18/96 16:21

69674: TRANSMITTANCE



SCB Res= 4 06/19/96 14:19

69675; TRANSMITTANCE

N & BRUYA, INC.
Avenue West
WA 98119-2029
285-8282

NW AL
6.10.96
9:16

SAMPLE CHAIN OF CUSTODY

Send Report To:
Company MALCOLM PIRNIE Contact CAROLE TOMLINS
Address 104 CORPORATE PARK DRIVE
City, State, Zip WHITE PLAINS, NEW YORK 10602-5751
Phone # 914-694-2100 Date 6-7-96

SITE NO	PROJECT NAME	PURCHASE ORDER #
0285-612	DPSC	

SAMPLERS (signature)	PROJECT LOCATION
	PHILADELPHIA, PA

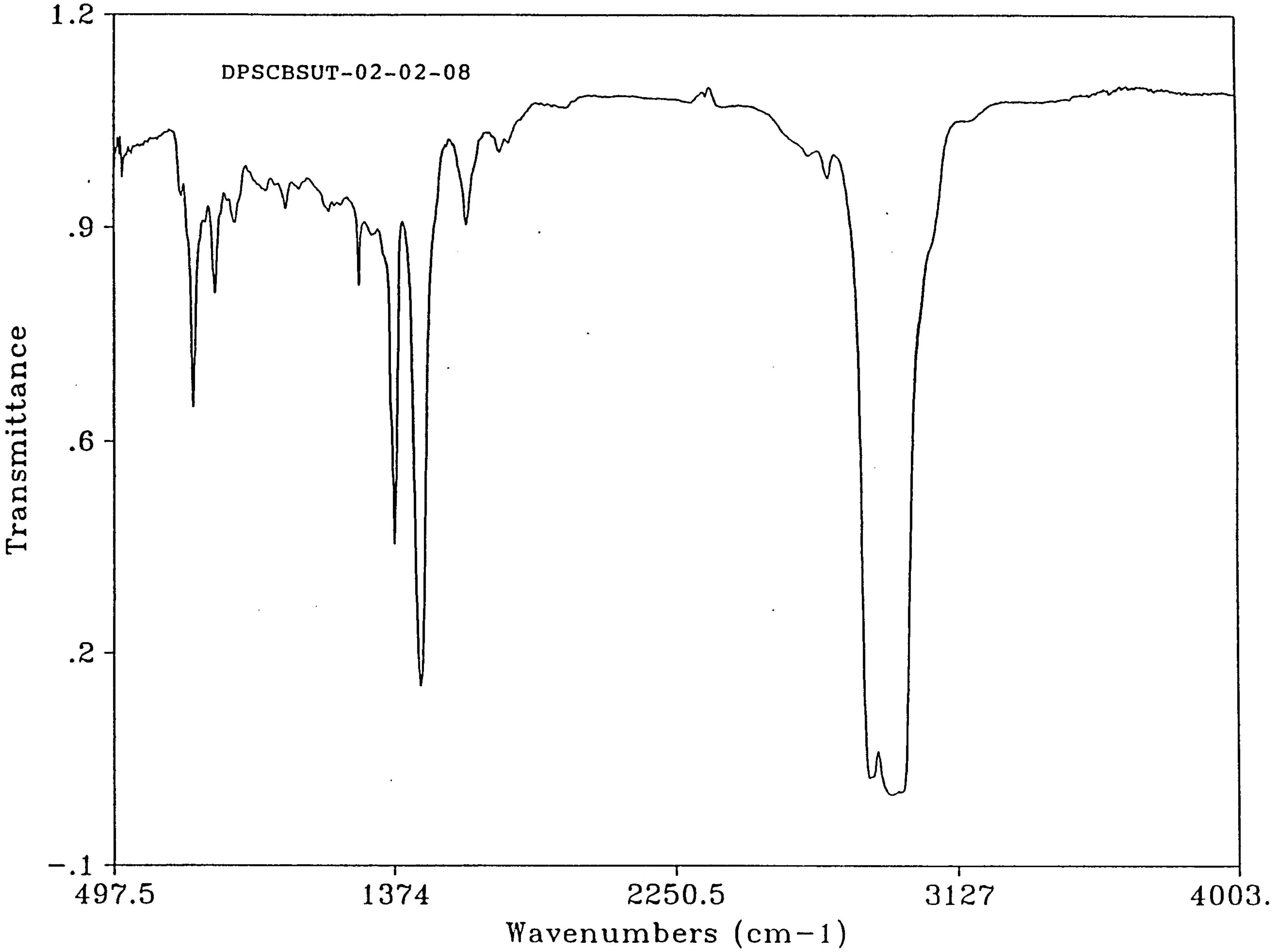
REMARKS
SAMPLES COLLECTED BY [illegible] STAFF OF LOUIS BERGER + ASSOCIATES, INC

SAMPLE DISPOSAL INFORMATION
☐ Dispose after 30 days
☐ Return Samples
☐ Call for Instructions

Sample #	Date/Time Sampled	Type of Sample	# of Jars	Lab Sample #	Analyses Requested
DPSC 46UST-01-2.0	6/7/96 1425	Soil	1	69664	IR SCAN
46UST-02-12	" 1507	"	1	69665	IR SCAN
PSC 46UST-03-14	1515		1	69666	IR SCAN
DPSC 46UST-04-16	1520		1	69667	IR SCAN
46UST-05-20	1535		1	69668	IR SCAN
DPSC 46UST-06-8.5	1600		1	69669	IR SCAN
PSC 46UST-07-12	1610		1	69670	IR SCAN
DPSC 46UST-08-16	1635		1	69671	IR SCAN
PSC BSAST-01-2.6	1115	\	1	69672	IR SCAN
PSC BSAST-02-5.0	1220			69673	IR SCAN
PSC BSAST-03-2.9	1305			69674	IR SCAN
PSC FB060796	1700	WATER	2	69675-76	IR SCAN
DPSC TB060796	1730	WATER	1	69647	TCL VOA

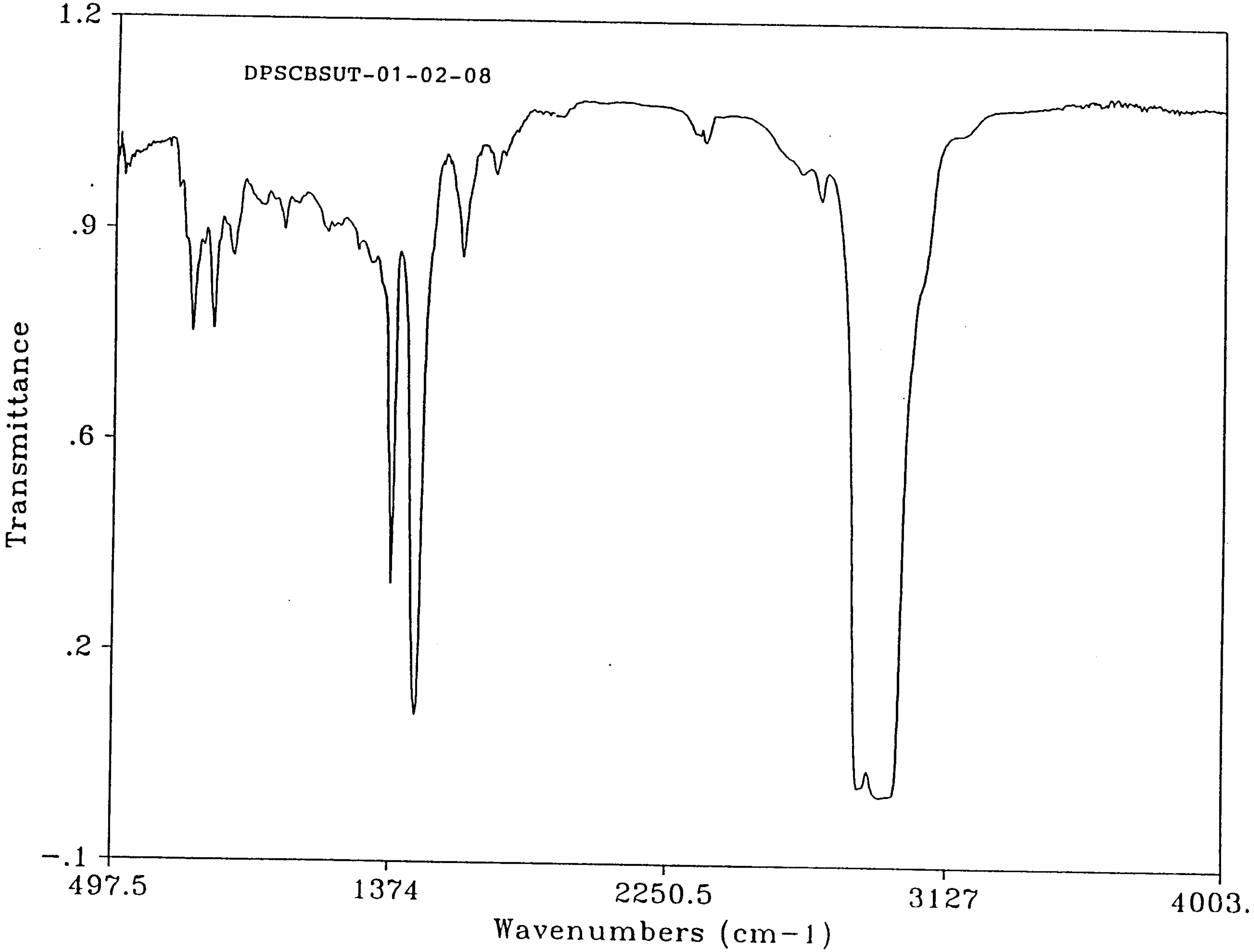
SIGNATURE	PRINT NAME	COMPANY	Date	Time
linquished by:	JOHN C [illegible]	MALCOLM PIRNIE INC	6-7-96	2000
ceived by: Cathy Downing	CATHY DOWNING	F&BI	6/10/96	8:30
Relinquished by:				
ceived by:				

RMS/COC 09/19/94



SCF' Res= 4 06/20/96 14:41

69851; TRANSMITTANCE

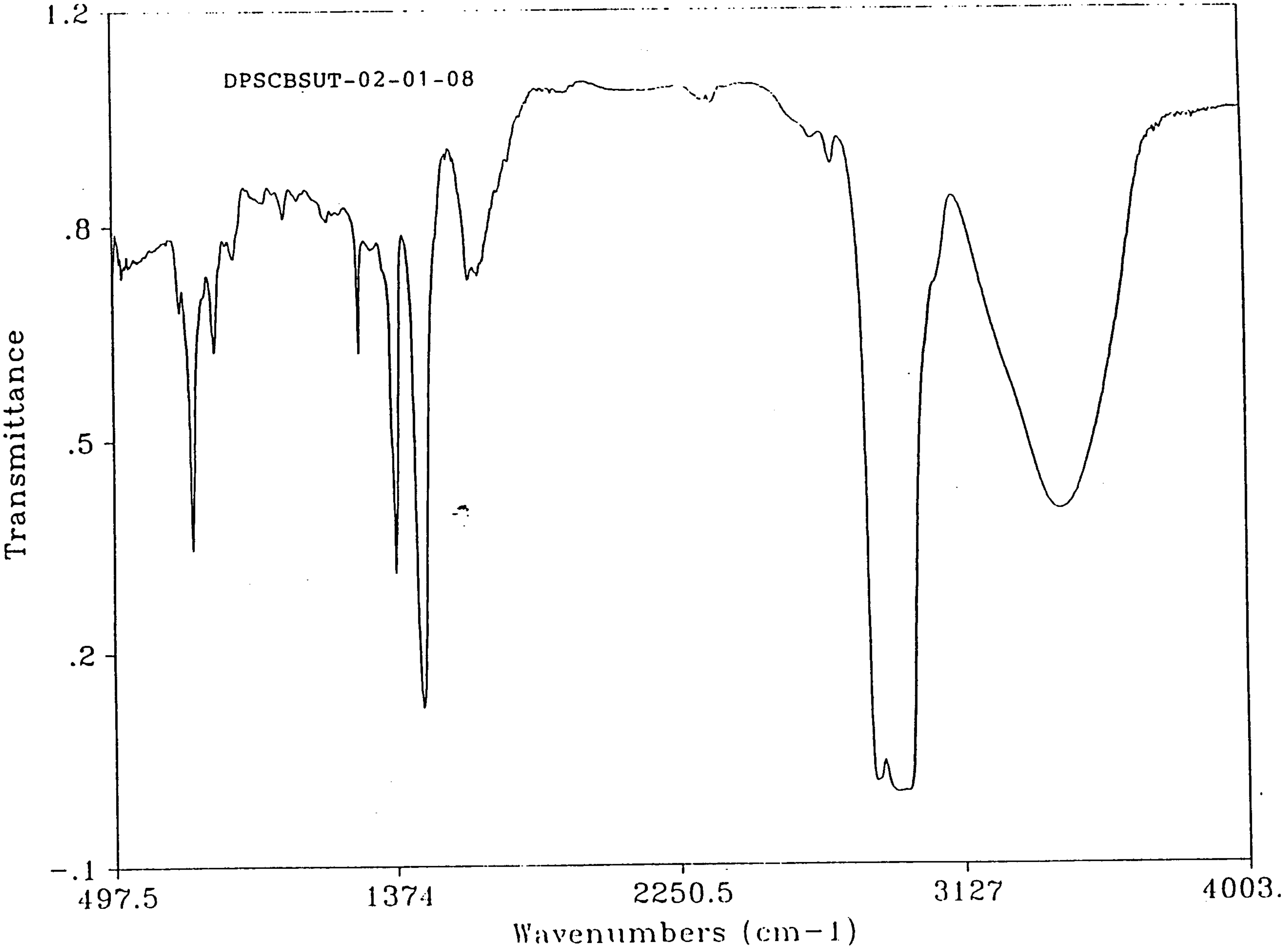


SCG

Res= 4

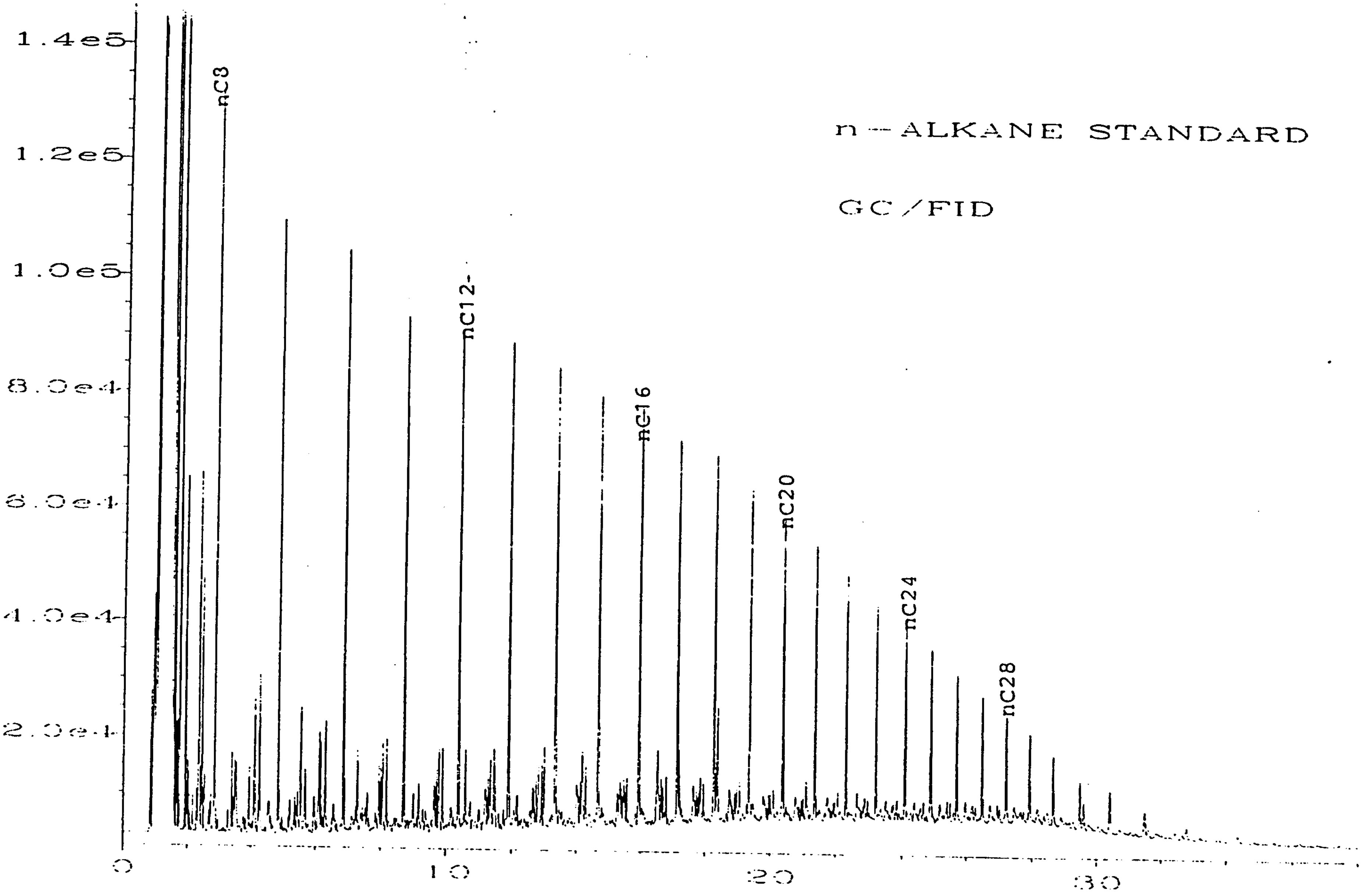
06/20/96 14:44

69850; TRANSMITTANCE

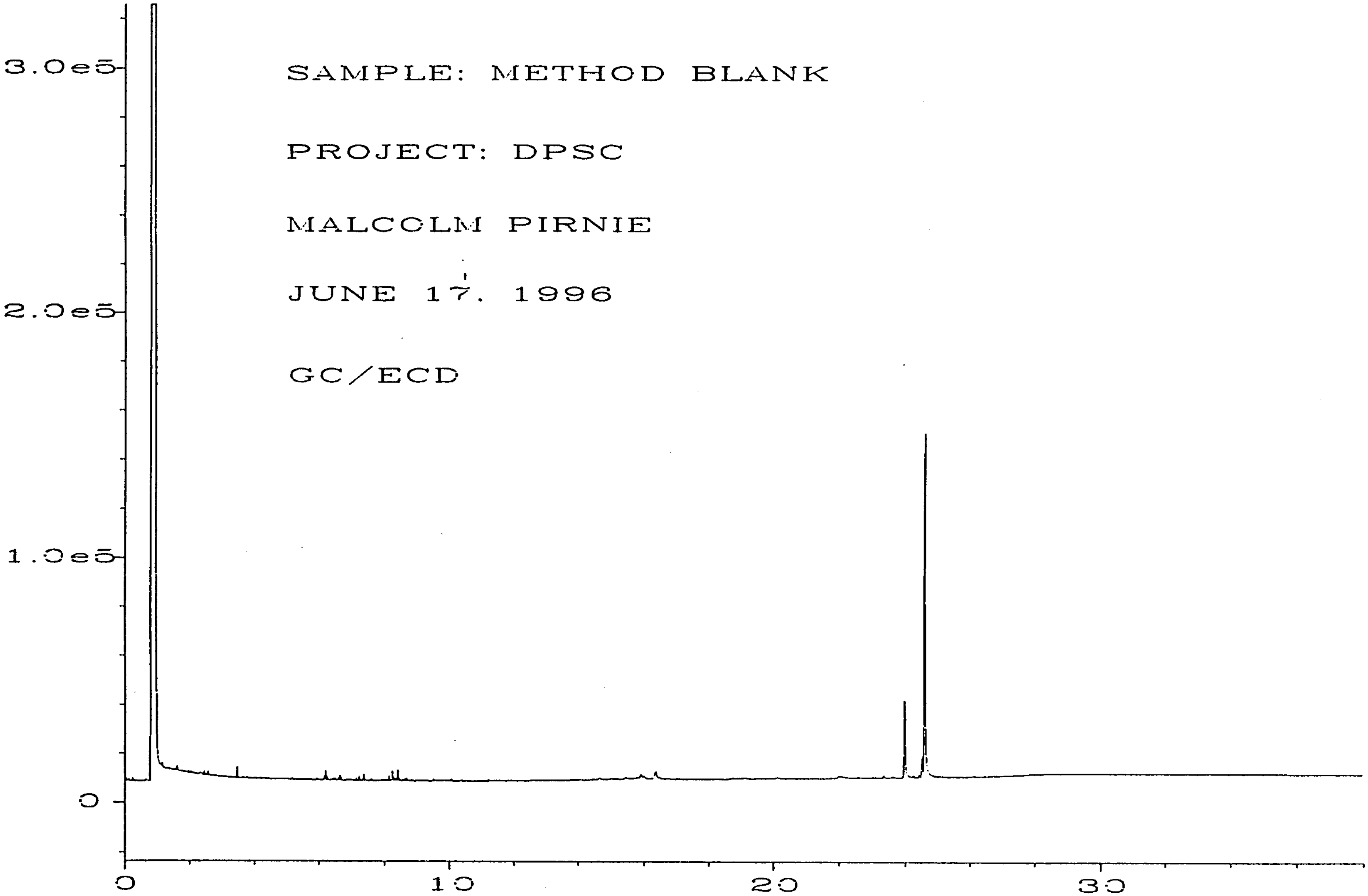


SCH Res= 4 06/20/96 14:59

69849; TRANSMITTANCE



Sig. 1 in C: HPCHEM 4 DATA 08 17 96 0097F0501 D



SAMPLE: METHOD BLANK

PROJECT: DPSC

MALCOLM PIRNIE

JUNE 17. 1996

GC/ECD

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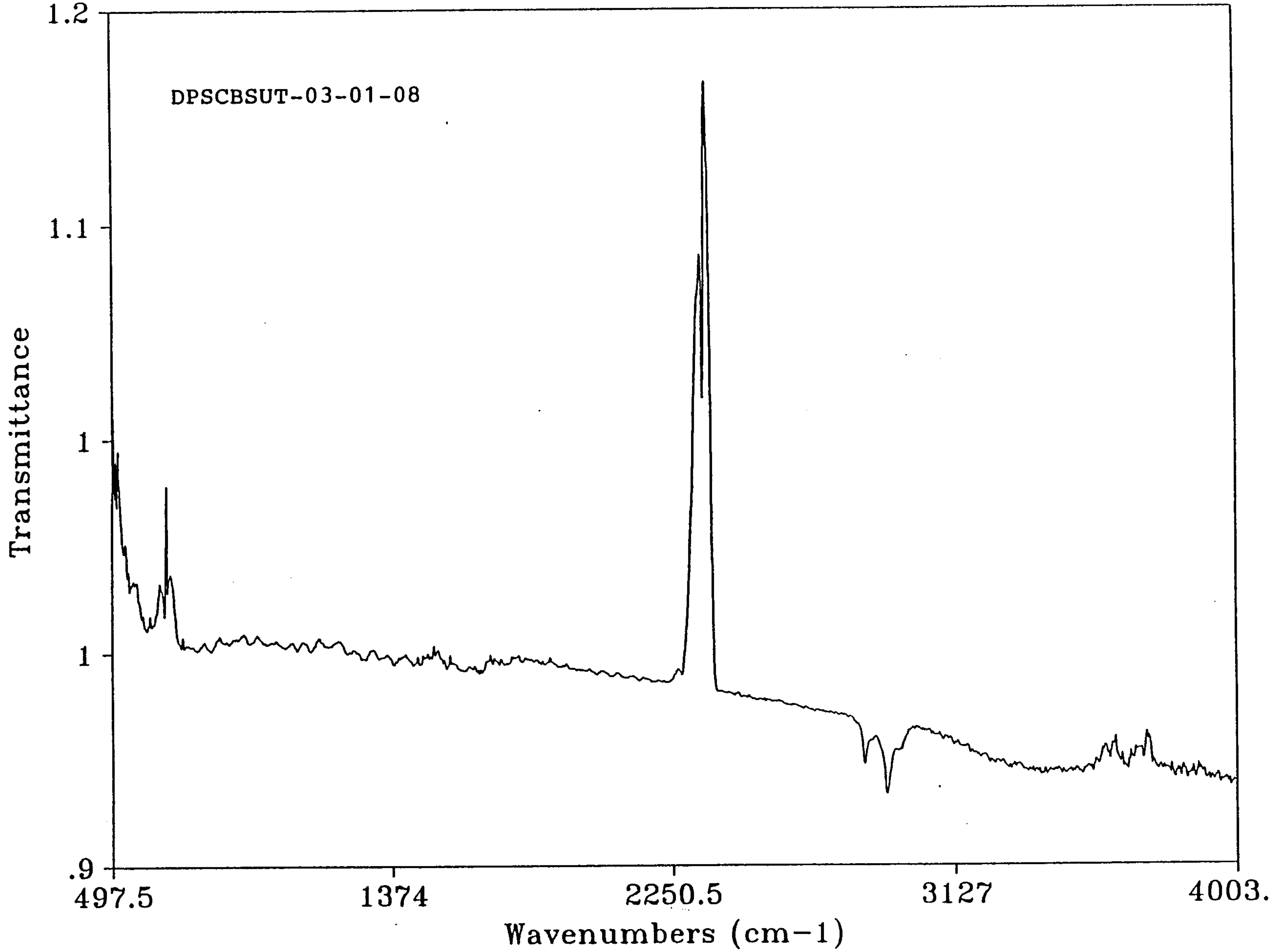

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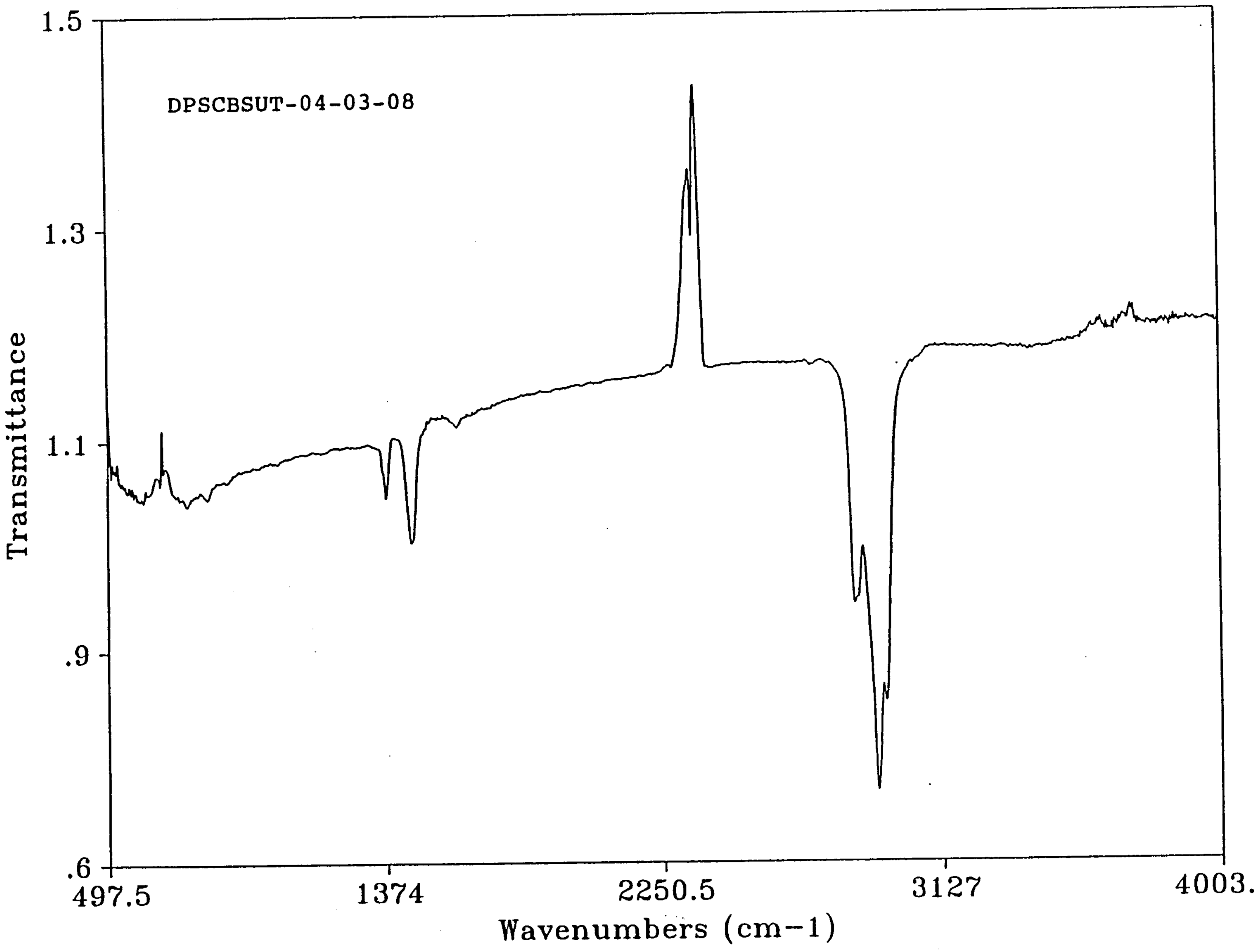

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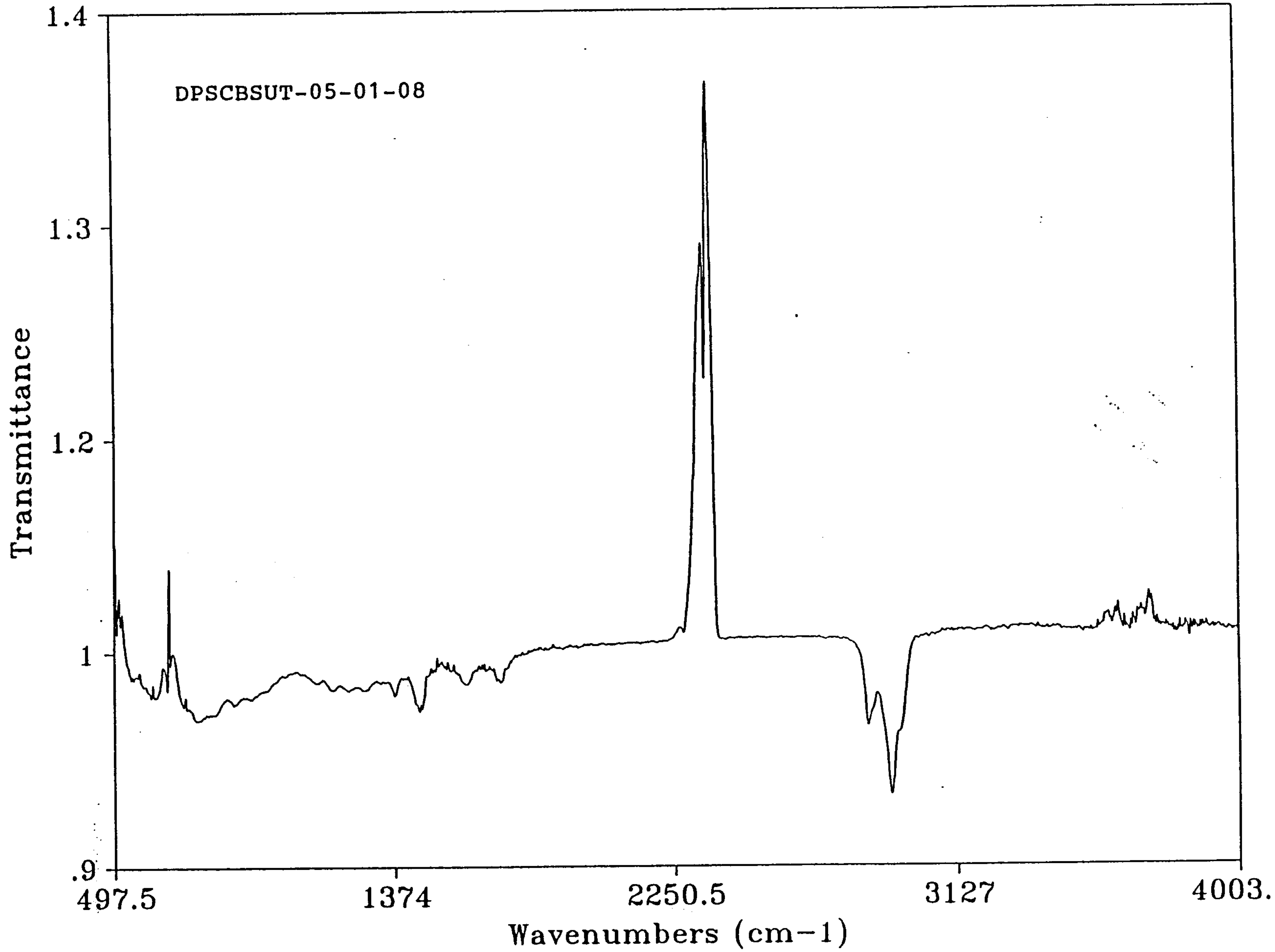

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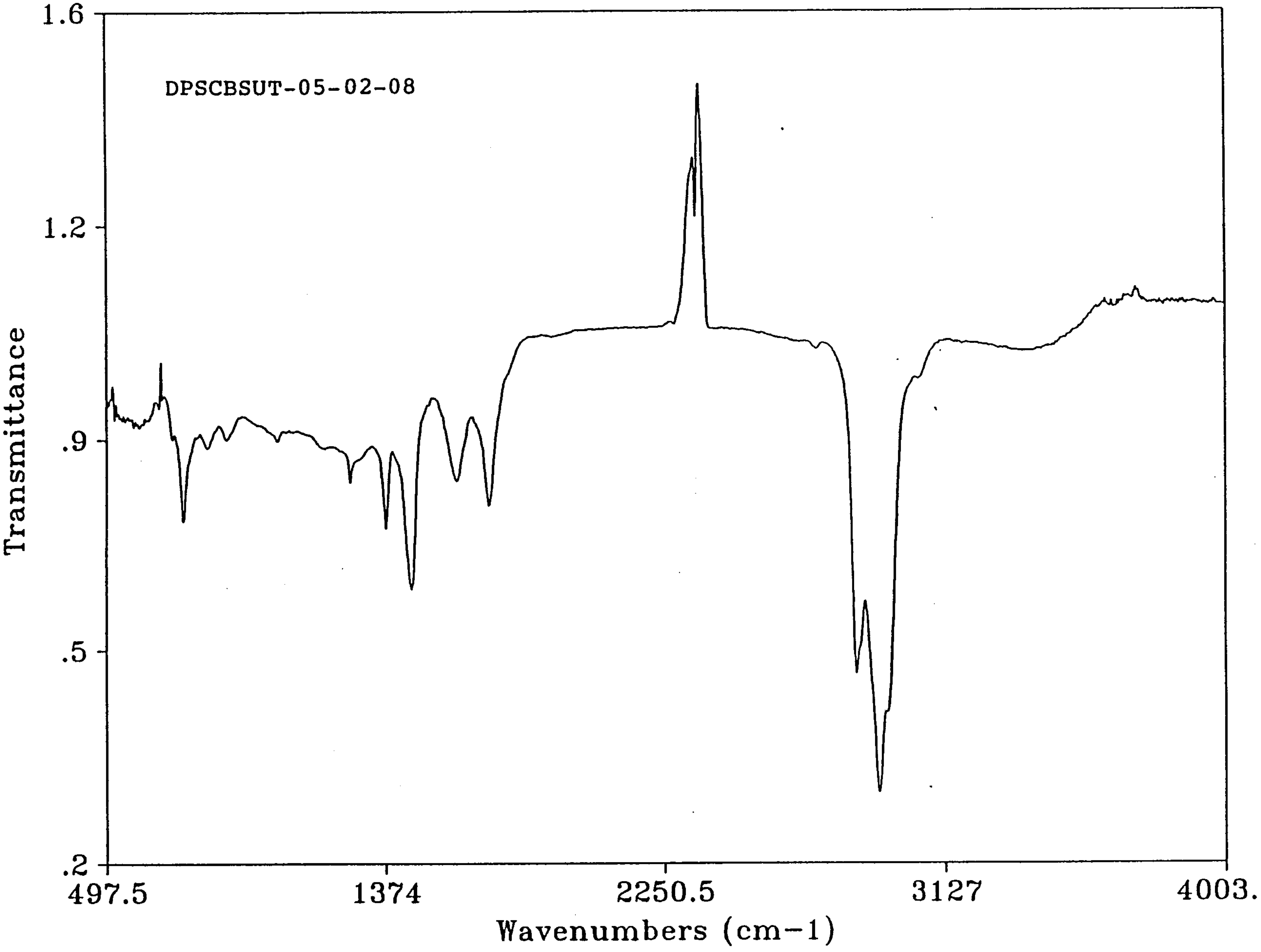

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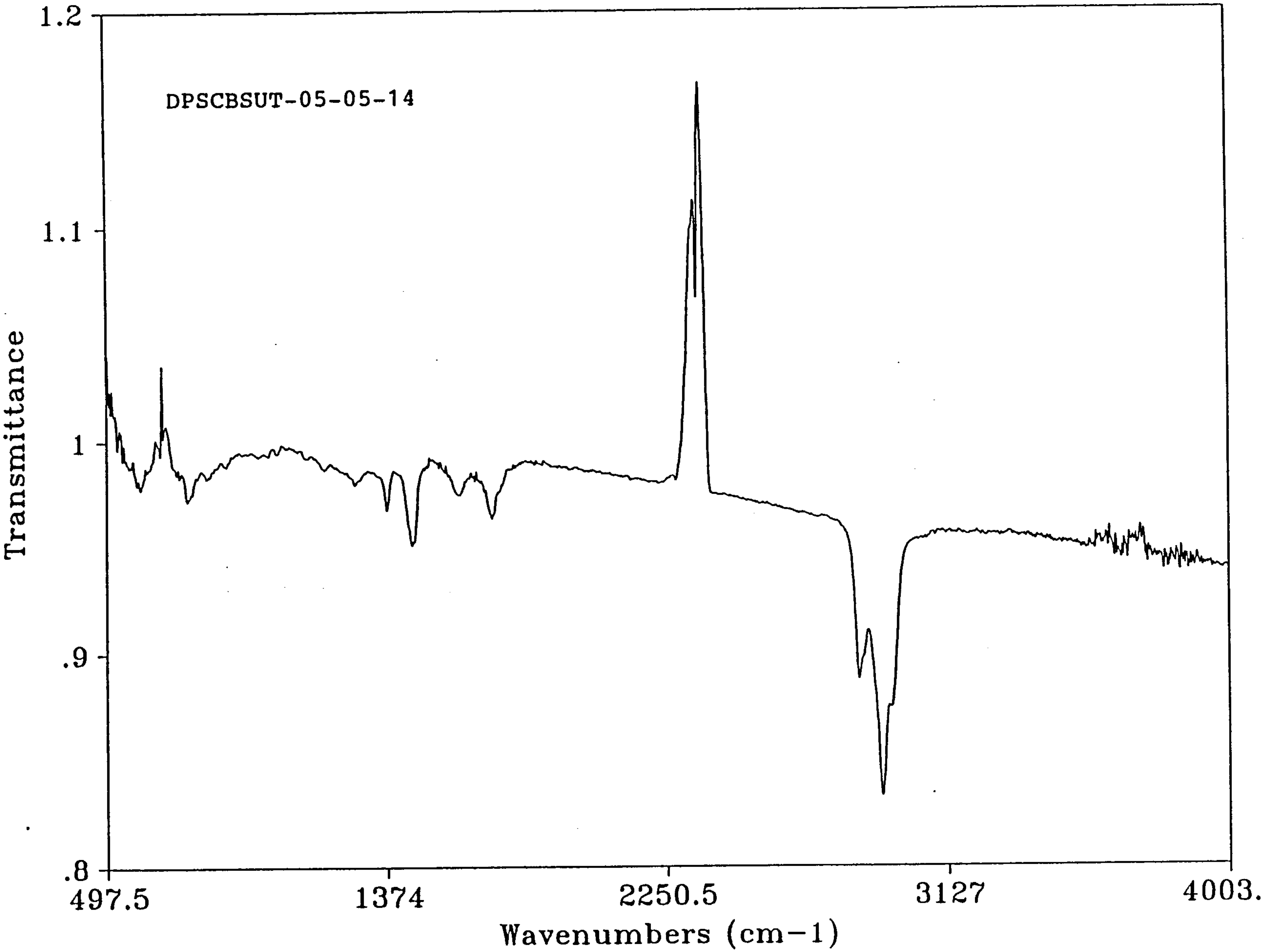

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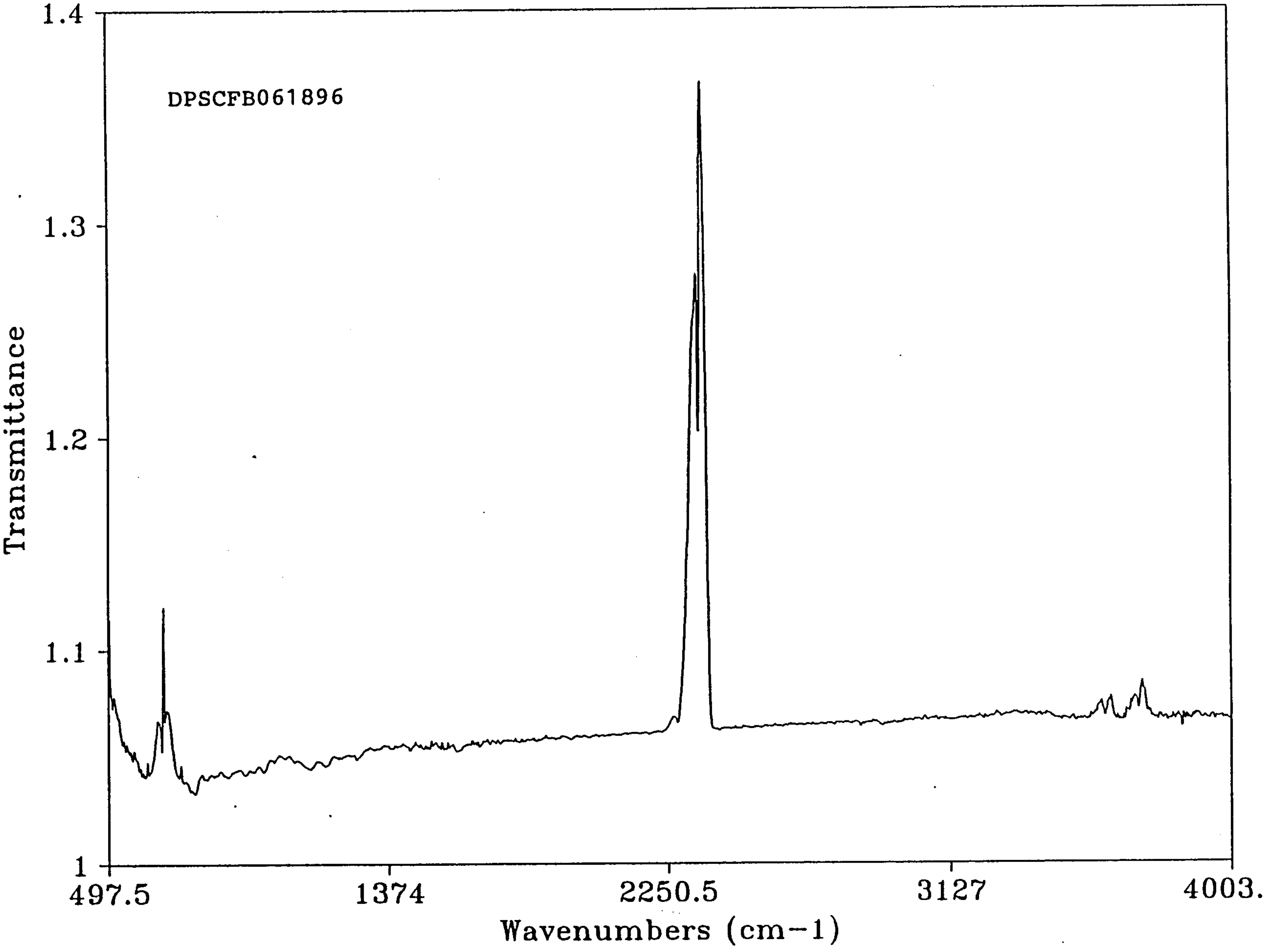

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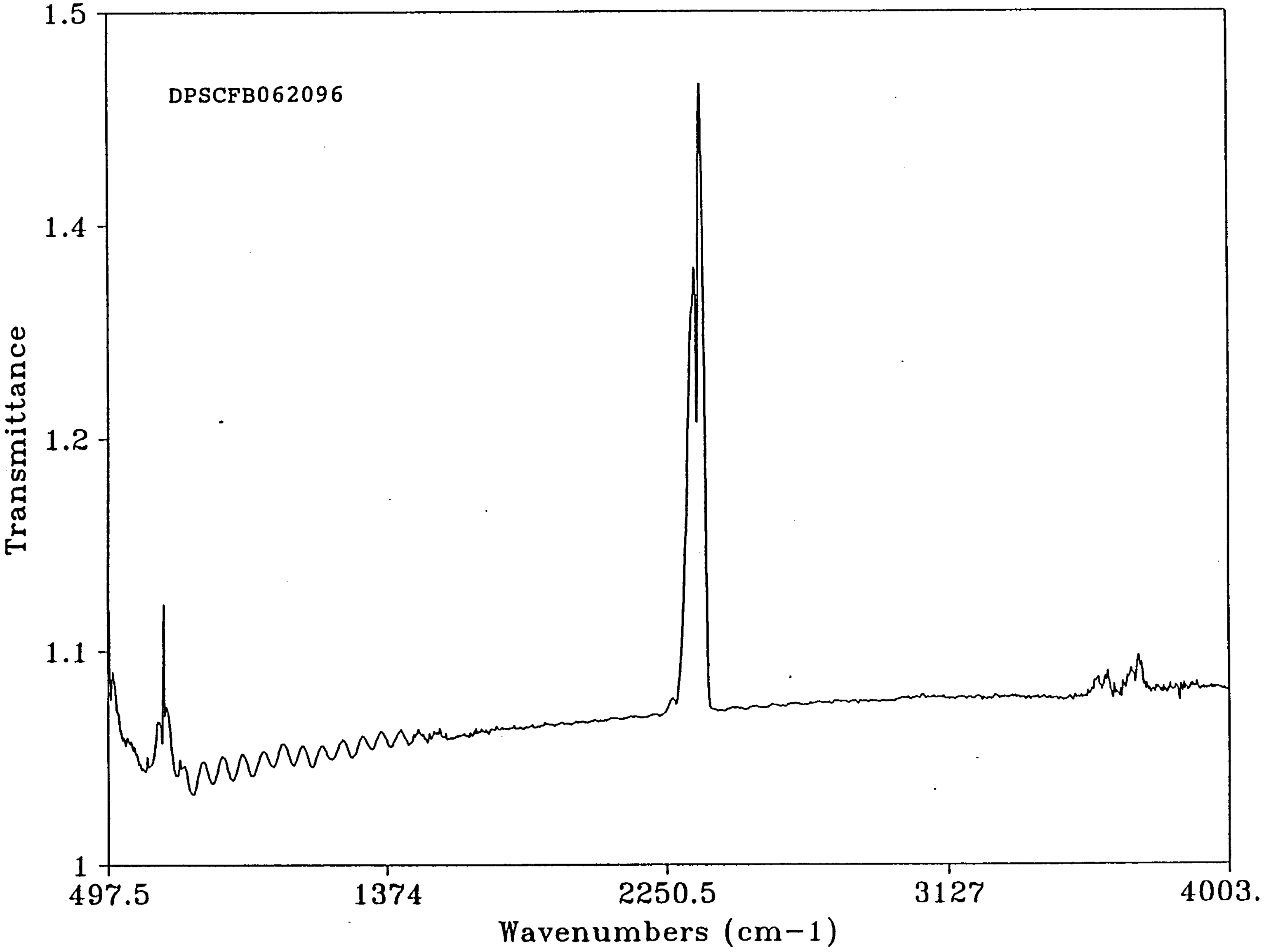
69989; TRANSMITTANCE



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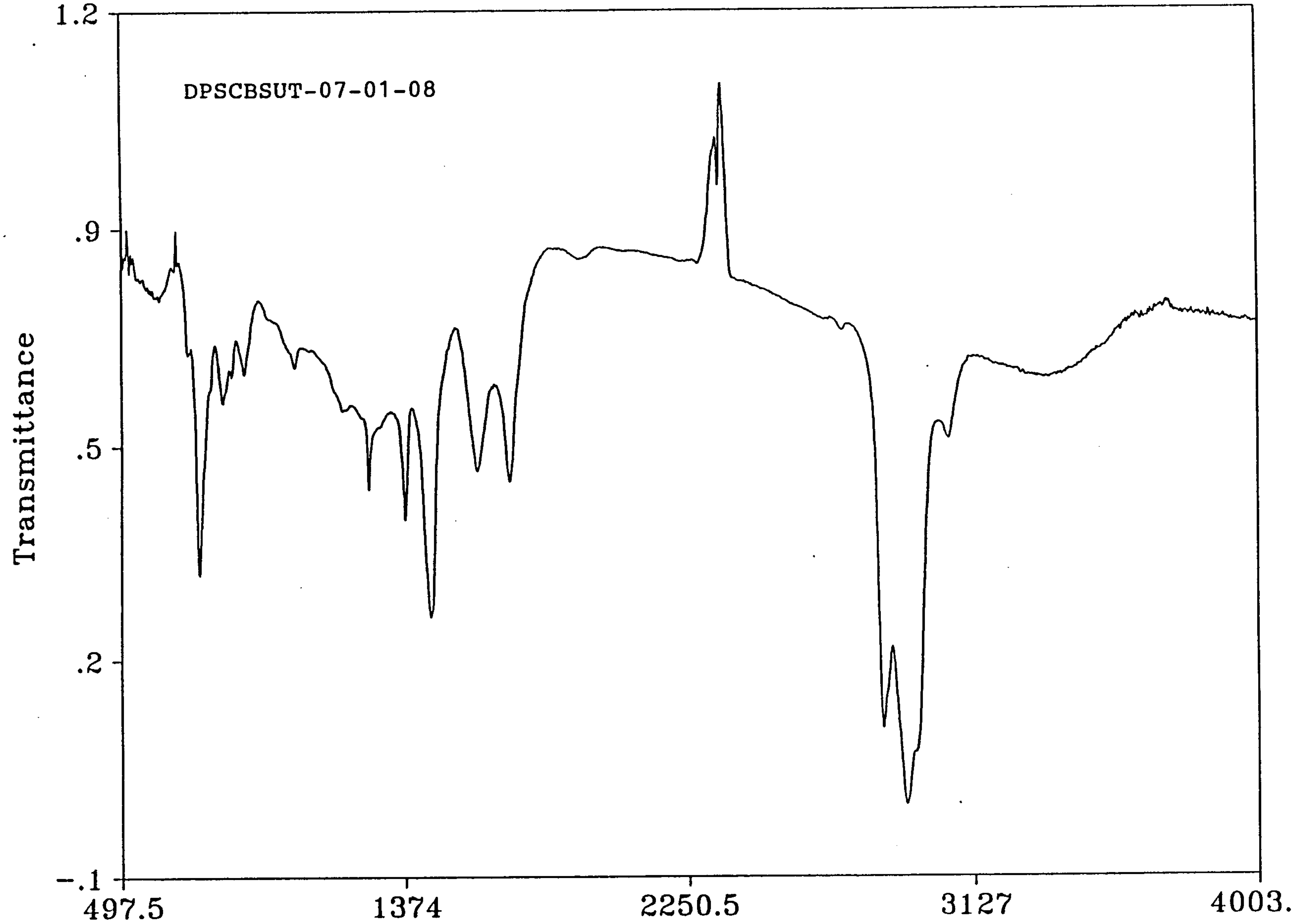

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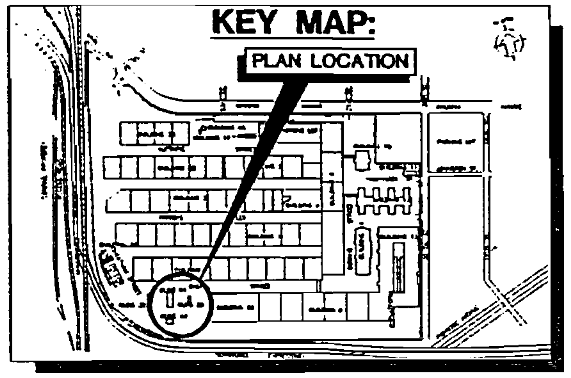
KEY MAP:



BUILDING 28 - DETECTED COMPOUNDS

	Boring No:		28-03	28-04	28-05	28-06	28-06	28-07	28-07	28-08	28-09	28-10	28-12	28-13	28-16	28-17	28-23	28-24	28TP-05	28TP-07	28TP-07	28TP-08	28TP-09
	Test Pit:		28UST-03	28UST-04	28UST-05	28UST-06	28UST-06	28UST-07	28UST-07	28UST-08	28UST-09	28UST-10	28UST-12	28UST-13	28UST-16	28UST-17	28UST-23	28UST-24	28TP-05	28TP-07	28TP-07	28TP-08	28TP-09
	Sample ID:		03-02-14	04-01-08	05-02-14	06-01-08	06-03-16	07-01-08	07-02-08	08-02-16	09-01-06	10-01-08	12-01-08	13-01-16	16-01-8.5	17-01-08	23-01-08	24-01-16	05-04-04	07-01-3.9	07-02-3.9	08-01-3.2	09-01-04
	Sampling Date:		6/19/96	6/20/96	6/20/96	6/20/96	6/20/96	6/20/96	6/20/96	6/20/96	6/20/96	6/21/96	6/21/96	6/24/96	6/24/96	6/24/96	6/25/96	6/25/96	6/20/96	6/21/96	6/21/96	6/21/96	6/21/96
	PADEP CRITERIA *		Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
ANALYTE	Non-Residential	Soil - GW																					
Gasoline Range Organics (ug/Kg)	500,000	N/E	1500	5400	110,000	45,000	8900	2900	1900	1400	5900	3100	18,000	2200	17,000	27,000	1400	3600	NA	3200	13000	66000	9400
Diesel Range Organics (mg/Kg)	500	N/E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	15	NA	NA	NA	NA

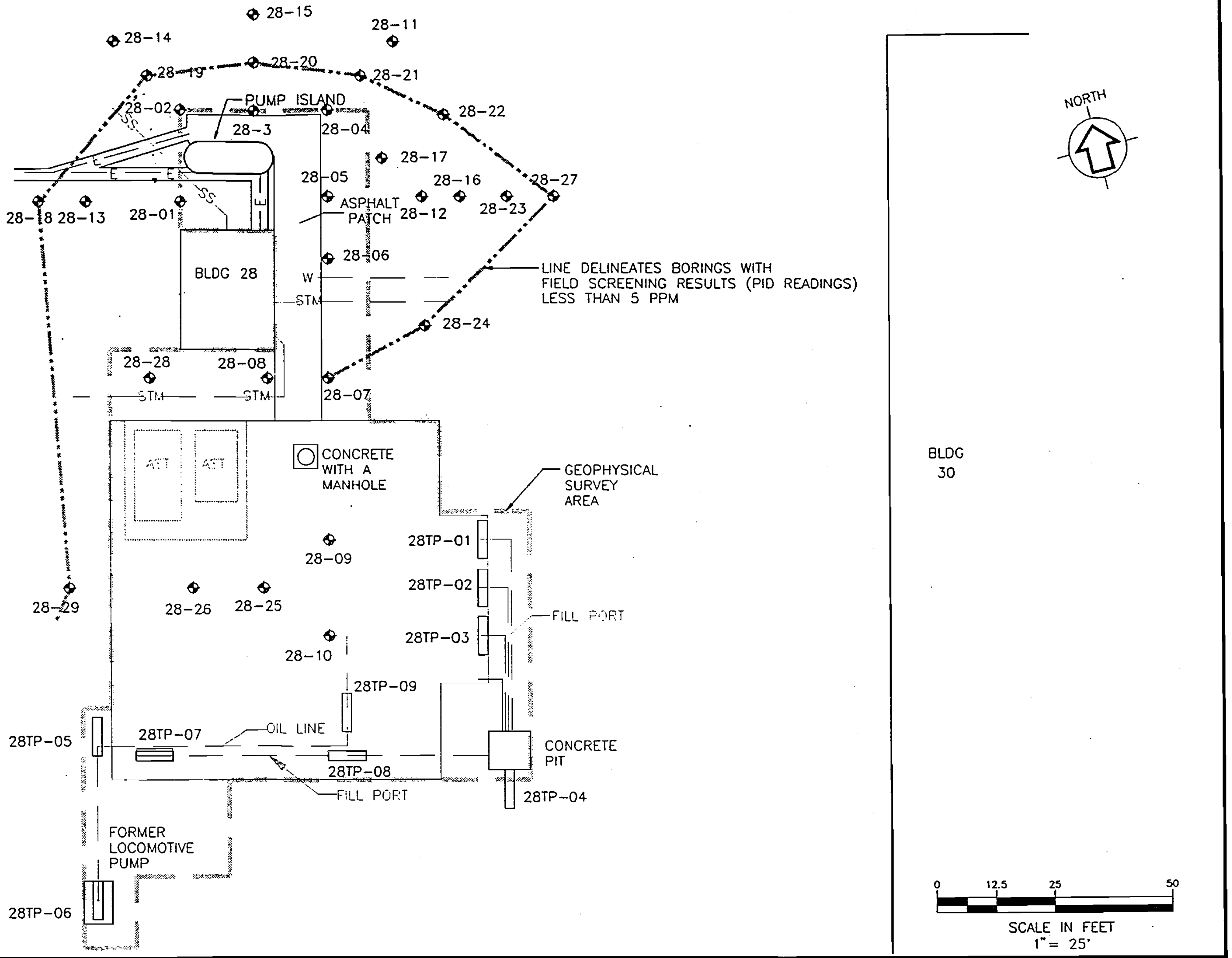
NOTES:

U	–	The analyte was analyzed for, but was not detected above the sample quantitation limit.
N/E	–	Criteria not established for this constituent
D	–	This qualifier identifies all compounds identified in an analysis at a secondary dilution

ALL Field Sample ID labels contain the prefix DPSC on the Chain Of Custody forms.

• Criteria based on PADEP LAND Recycling Program Technical Guidance Manual 7/18/95

Sample ID consists of: Location Boring-Sequential Number-Depth
(eg. 28UST-06-01-08)



LEGEND:

⊕	SOIL BORING
▭	TEST PIT

Source: Geophysical Survey Report, ENSA INC., 1996

U.S. Army Corps of Engineers

DEFENSE PERSONNEL SUPPORT CENTER – PHILADELPHIA, PENNSYLVANIA

DRILLING LOCATIONS & SOIL ANALYTICAL RESULTS - BUILDING 28 USTs/PIPING

USACE CONTRACT No. DACA31-94-D-0017

FIGURE M-5

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: July 8, 1996
Date Received: June 24, 1996
Project: DPSC

RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR FINGERPRINT CHARACTERIZATION BY CAPILLARY GAS CHROMATOGRAPHY USING A FLAME IONIZATION DETECTOR (FID) AND ELECTRON CAPTURE DETECTOR (ECD)

Sample ID	GC Characterization
CSX-MW6 (50-52)	The GC trace using the flame ionization detector (FID) showed the presence of low boiling compounds. The patterns displayed by these peaks are indicative of a light naphtha, such as JP-4 or crude oil. The low boiling compounds appeared as a ragged pattern of peaks eluting from n-C_6 to n-C_{25} showing a maximum near n-C_6. The low boiling product appears to have undergone degradation by evaporative processes. The low boiling product also appears to have undergone chemical or biological degradation. A dominant pattern of n-alkanes was not seen for this material. The large peak seen near 25 minutes on the GC/FID trace is pentacosane, added as a quality assurance check for this GC analysis. There is a second internal standard peak seen on the GC/ECD trace at about 26 minutes which is dibutyl chlorendate.
DPSC28UST-09-02-16	The GC trace using the flame ionization detector (FID) showed the presence of low boiling compounds. The patterns displayed by these peaks are indicative of gasoline. The low boiling compounds appeared as a ragged pattern of peaks eluting from n-C_6 to n-C_{14} showing a maximum near n-C_{12}. The GC/FID trace showed the presence of peaks that appeared to be indicative of C_3-benzenes. These compounds are characteristic of the constituents commonly found in gasoline. The low boiling product appears to have undergone degradation by evaporative processes. The low boiling product appears to have undergone chemical or biological degradation. The large peak seen near 25 minutes on the GC/FID trace is pentacosane, added as a quality assurance check for this GC analysis. There is a second internal standard peak seen on the GC/ECD trace at about 26 minutes which is dibutyl chlorendate.

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D
Beth M. Albertson, M.S.
Bradley T. Benson
Kelley D. Wilt

3012 16th Avenue West
Seattle, WA 98119-2029
TEL: (206) 285-8282
FAX: (206) 283-5044

RECEIVED

July 8, 1996

Carole Tomlins, Project Manager
Malcolm Pirnie
104 Corporate Park Drive, Box 751
White Plains, NY 10602

Dear Ms. Tomlins:

Enclosed are the results from the testing of material submitted on June 25, 1996 from your DPSC, PO #0285-6420 project.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Kelley Wilt

Kelley Wilt
Chemist

keh
Enclosures
FAX: (914) ~~694~~ 641-2455
MPI0708R.DOC

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: July 8, 1996
Date Received: June 25, 1996
Project: DPSC, PO #0285-6420
Date Samples Extracted: June 26, 1996

RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR FINGERPRINT CHARACTERIZATION BY CAPILLARY GAS CHROMATOGRAPHY USING A FLAME IONIZATION DETECTOR (FID) AND ELECTRON CAPTURE DETECTOR (ECD)

Sample ID	GC Characterization
DPSC28TP-03-03-03	The GC trace using the flame ionization detector (FID) showed the presence of high boiling compounds. The patterns displayed by these peaks are indicative of biogenic compounds or a high boiling material like asphalt. The high boiling compounds appeared as a hump eluting from n-C_{16} to beyond n-C_{36} showing a maximum near n-C_{29}. The large peak seen near 25 minutes on the GC/FID trace is pentacosane, added as a quality assurance check for this GC analysis. There is a second internal standard peak seen on the GC/ECD trace at about 26 minutes which is dibutyl chlorendate.
DPSC28TP-03-04-03	The GC trace using the flame ionization detector (FID) showed the presence of high boiling compounds. The patterns displayed by these peaks are indicative of biogenic compounds or a high boiling material like asphalt. The high boiling compounds appeared as a humpeluting from n-C_{16} to beyond n-C_{36} showing a maximum near n-C_{29}. The large peak seen near 25 minutes on the GC/FID trace is pentacosane, added as a quality assurance check for this GC analysis. There is a second internal standard peak seen on the GC/ECD trace at about 26 minutes which is dibutyl chlorendate.

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: July 8, 1996
Date Received: June 25, 1996
Project: DPSC, PO #0285-6420
Date Samples Extracted: June 26, 1996

RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR FINGERPRINT CHARACTERIZATION BY CAPILLARY GAS CHROMATOGRAPHY USING A FLAME IONIZATION DETECTOR (FID) AND ELECTRON CAPTURE DETECTOR (ECD)

Sample ID	GC Characterization
DPSC28TP-05-02-04	The GC trace using the flame ionization detector (FID) showed the presence of low, medium and high boiling compounds. The patterns displayed by these peaks are indicative of low boiling material transported by the soil gas, degraded naphtha, and a lubricating fluid such as motor oil or hydraulic fluid. The low boiling material appears as a pattern of peaks from n-C_6 to beyond n-C_7. Low boiling hydrocarbons are present in the soil gas and can come from a JP-4 or other light distillate found nearby. The medium boiling material is indicative of a naphtha, perhaps a weathered JP-4. It appears heavily evaporated and biodegraded as well as being present at low concentrations. The boiling point range for the material is from about n-C_7 to n-C_{18}. The heavy boiling material elutes as a hump from n-C_{18} to beyond n-C_{36} with a maximum at n-C_{29}. This material is indicative of a lubricant such as motor oil or hydraulic fluid. The large peak seen near 25 minutes on the GC/FID trace is pentacosane, added as a quality assurance check for this GC analysis. There is a second internal standard peak seen on the GC/ECD trace at about 26 minutes which is dibutyl chlorendate.

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: July 8, 1996
Date Received: June 25, 1996
Project: DPSC, PO #0285-6420
Date Samples Extracted: June 26, 1996

RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR FINGERPRINT CHARACTERIZATION BY CAPILLARY GAS CHROMATOGRAPHY USING A FLAME IONIZATION DETECTOR (FID) AND ELECTRON CAPTURE DETECTOR (ECD)

Sample ID	GC Characterization
DPSC28TP-05-03-04	The GC trace using the flame ionization detector (FID) showed the presence of low, medium and high boiling compounds. The patterns displayed by these peaks are indicative of low boiling material transported by the soil gas, degraded naphtha, and a lubricating fluid such as motor oil or hydraulic fluid. The low boiling material appears as a pattern of peaks from *n*-C_6 to beyond *n*-C_7. Low boiling hydrocarbons are present in the soil gas and can come from a JP-4 or other light distillate found nearby. The medium boiling material is indicative of a naphtha, perhaps a weathered JP-4. It appears heavily evaporated and biodegraded as well as being present at low concentrations. The boiling point range for the material is from about *n*-C_7 to *n*-C_{18}. The heavy boiling material elutes as a hump from *n*-C_{18} to beyond *n*-C_{36} with a maximum at *n*-C_{29}. This material is indicative of a lubricant such as motor oil or hydraulic fluid. The large peak seen near 25 minutes on the GC/FID trace is pentacosane, added as a quality assurance check for this GC analysis. There is a second internal standard peak seen on the GC/ECD trace at about 26 minutes which is dibutyl chlorendate.

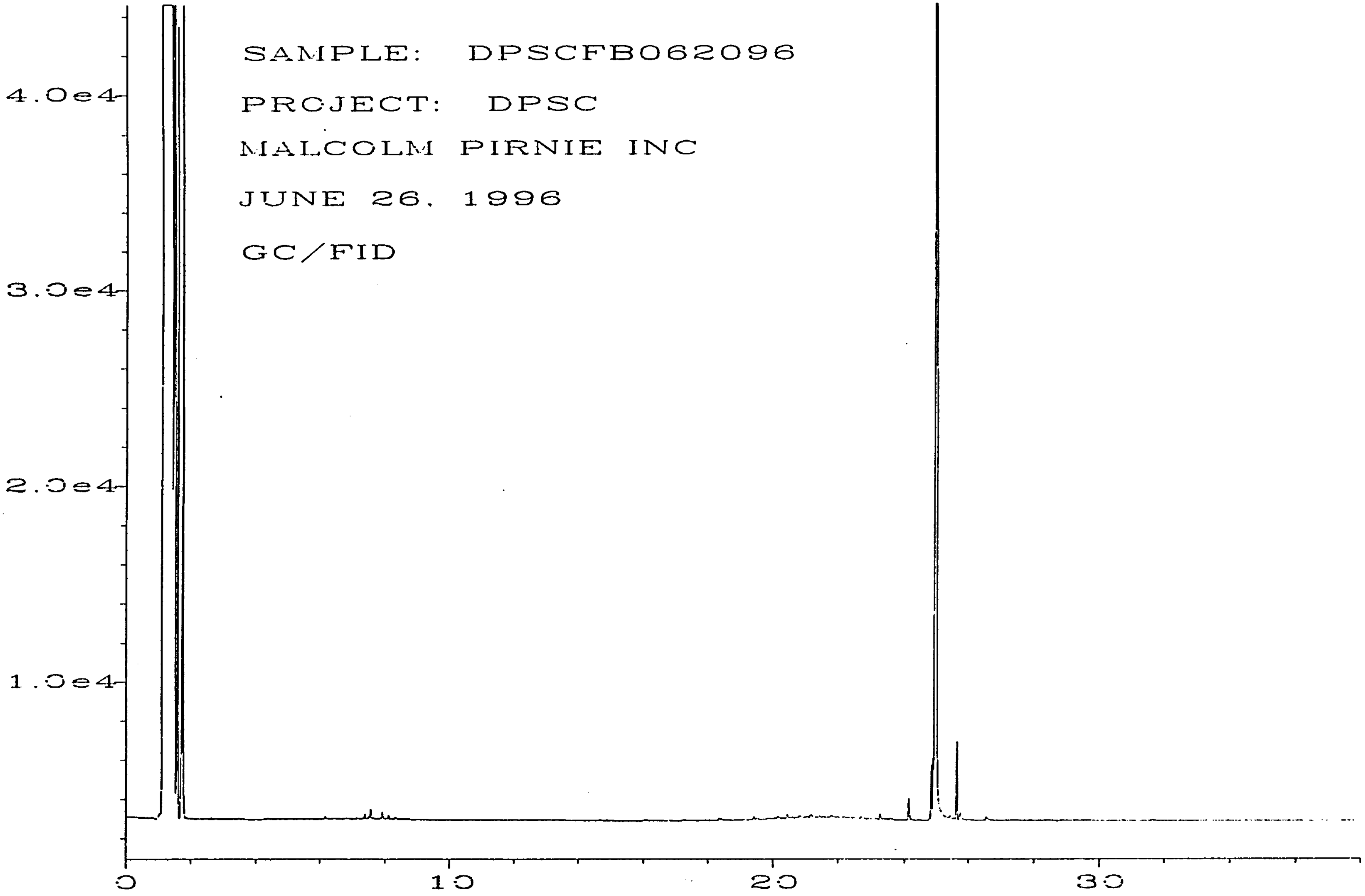
FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: July 8, 1996
Date Received: June 25, 1996
Project: DPSC, PO #0285-6420
Date Samples Extracted: June 26, 1996

RESULTS FROM THE ANALYSIS OF THE WATER SAMPLE FOR FINGERPRINT CHARACTERIZATION BY CAPILLARY GAS CHROMATOGRAPHY USING A FLAME IONIZATION DETECTOR (FID) AND ELECTRON CAPTURE DETECTOR (ECD)

Sample ID	GC Characterization
DPSCFB062196	The GC trace using the flame ionization detector (FID) and the GC electron capture detector (ECD) trace showed an absence of volatile and semi-volatile compounds. The large peak seen near 25 minutes on the GC/FID trace is pentacosane, added as a quality assurance check for this GC analysis. There is a second internal standard peak seen on the GC/ECD trace at about 26 minutes which is dibutyl chlorendate.



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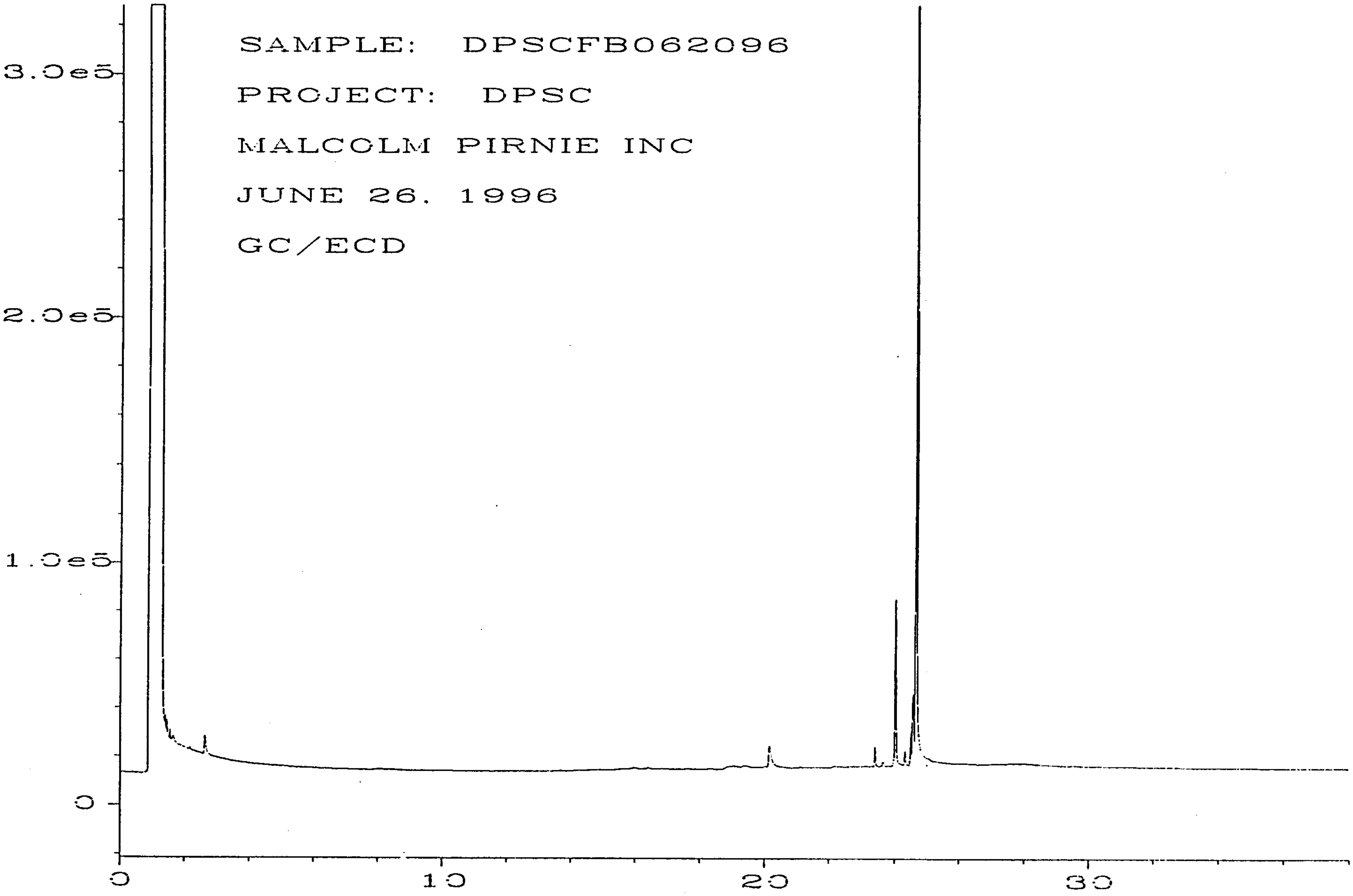

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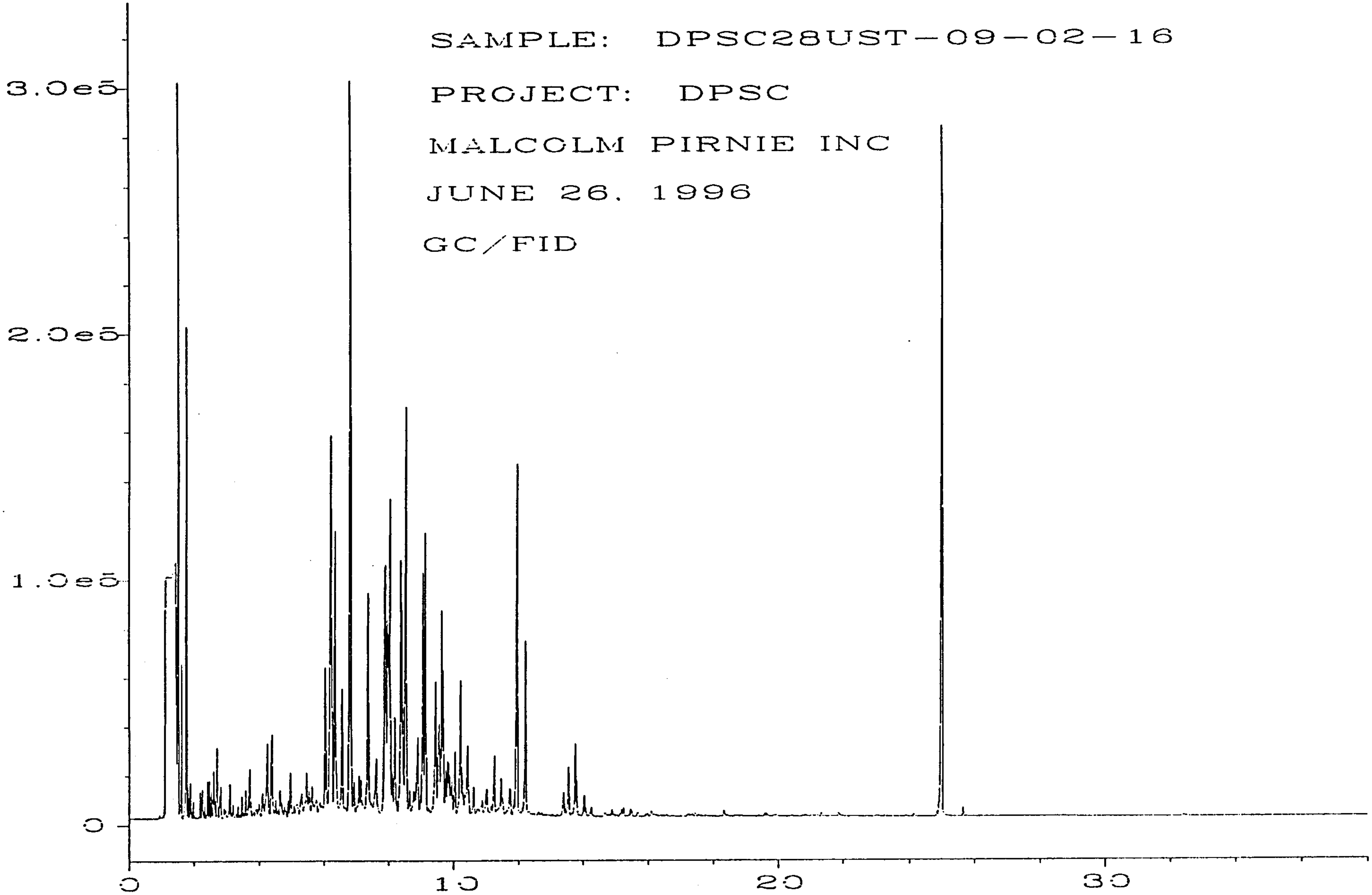

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PROJECT: DPSC

MALCOLM PIRNIE INC

JUNE 26, 1996

GC/FID

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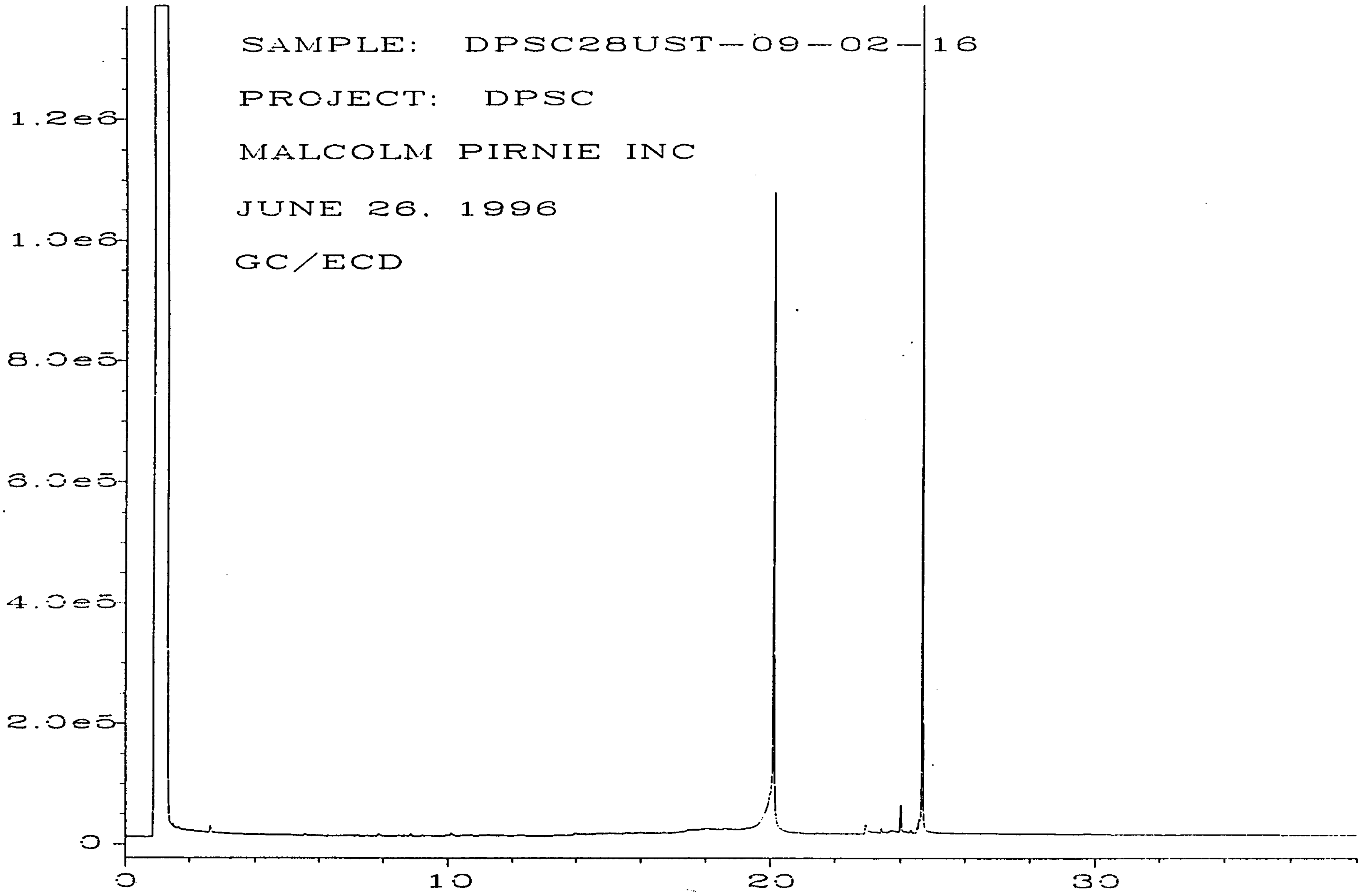

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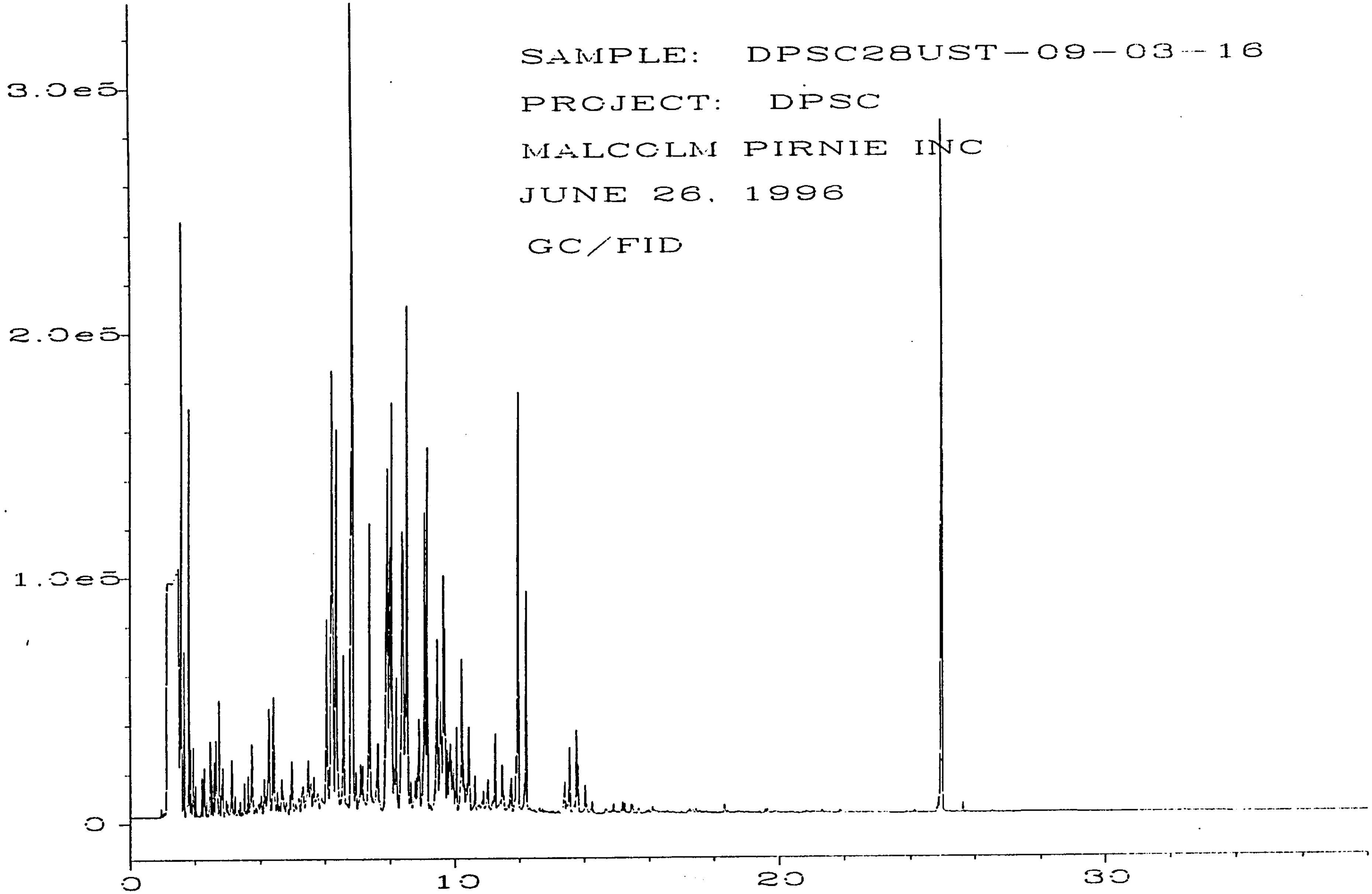

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PROJECT: DPSC
MALCOLM PIRNIE INC
JUNE 26, 1996
GC/FID

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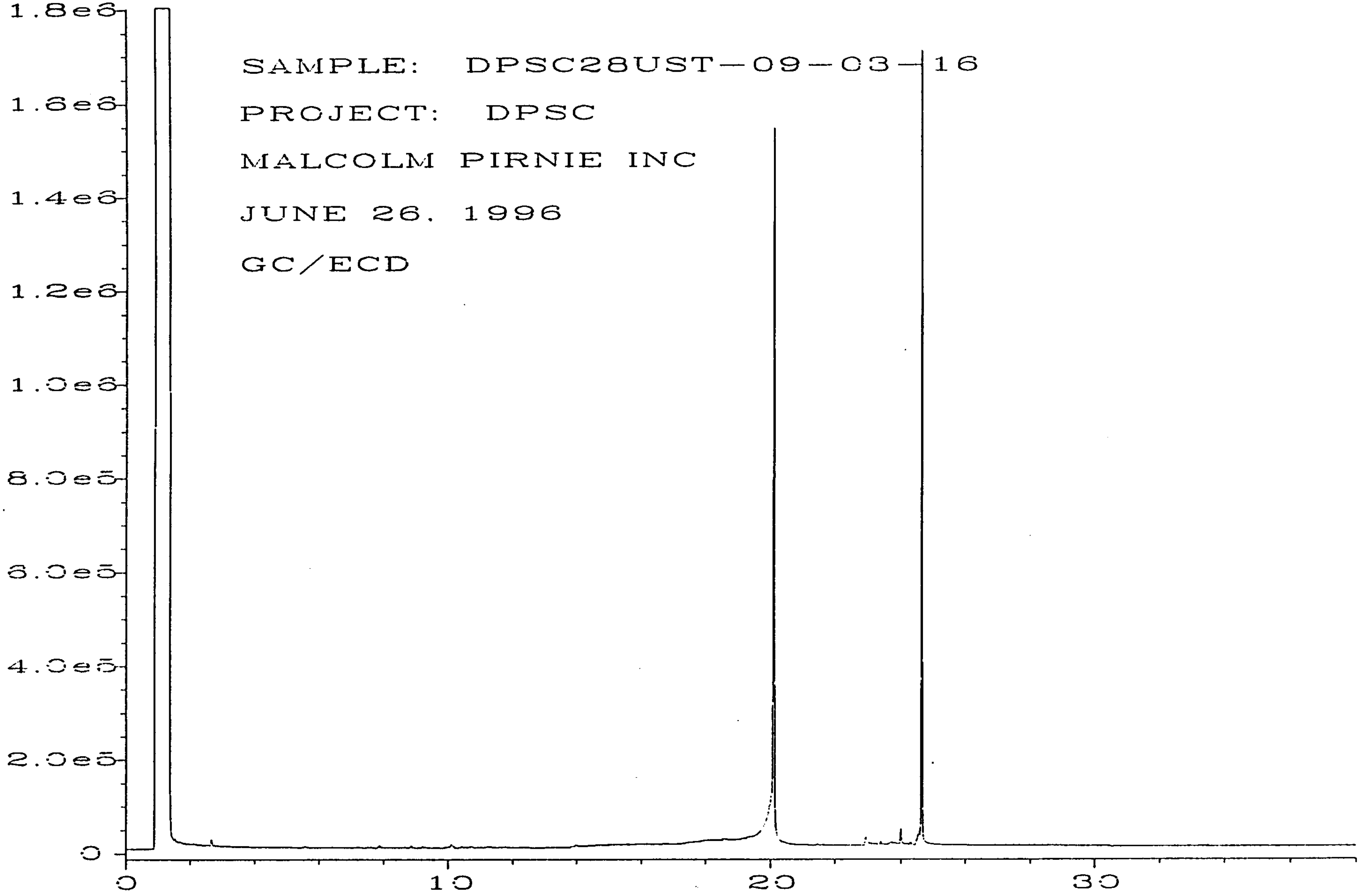

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PROJECT: DPSC

MALCOLM PIRNIE INC

JUNE 26, 1996

GC/ECD

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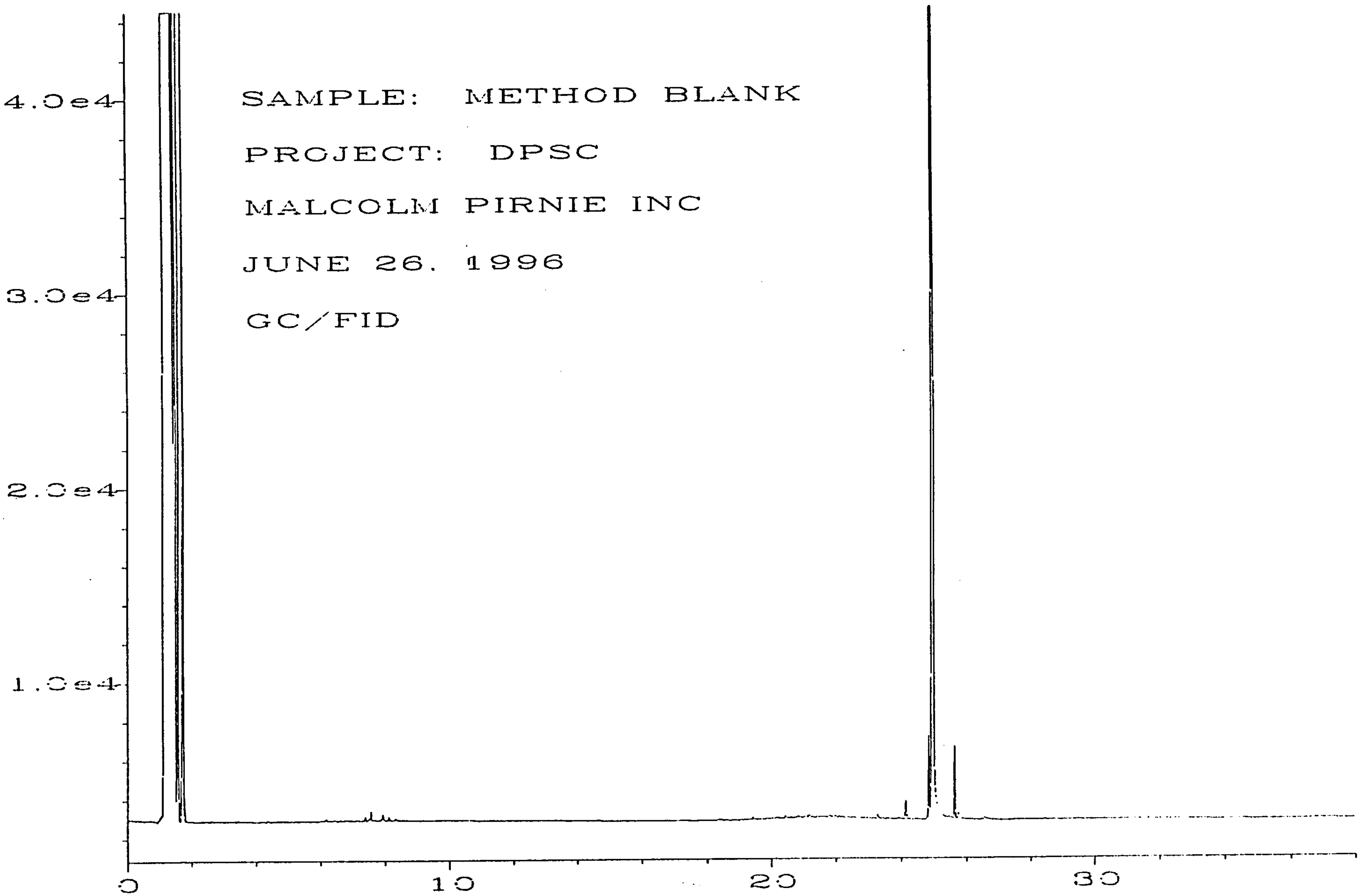

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PROJECT: DPSC

MALCOLM PIRNIE INC

JUNE 26, 1996

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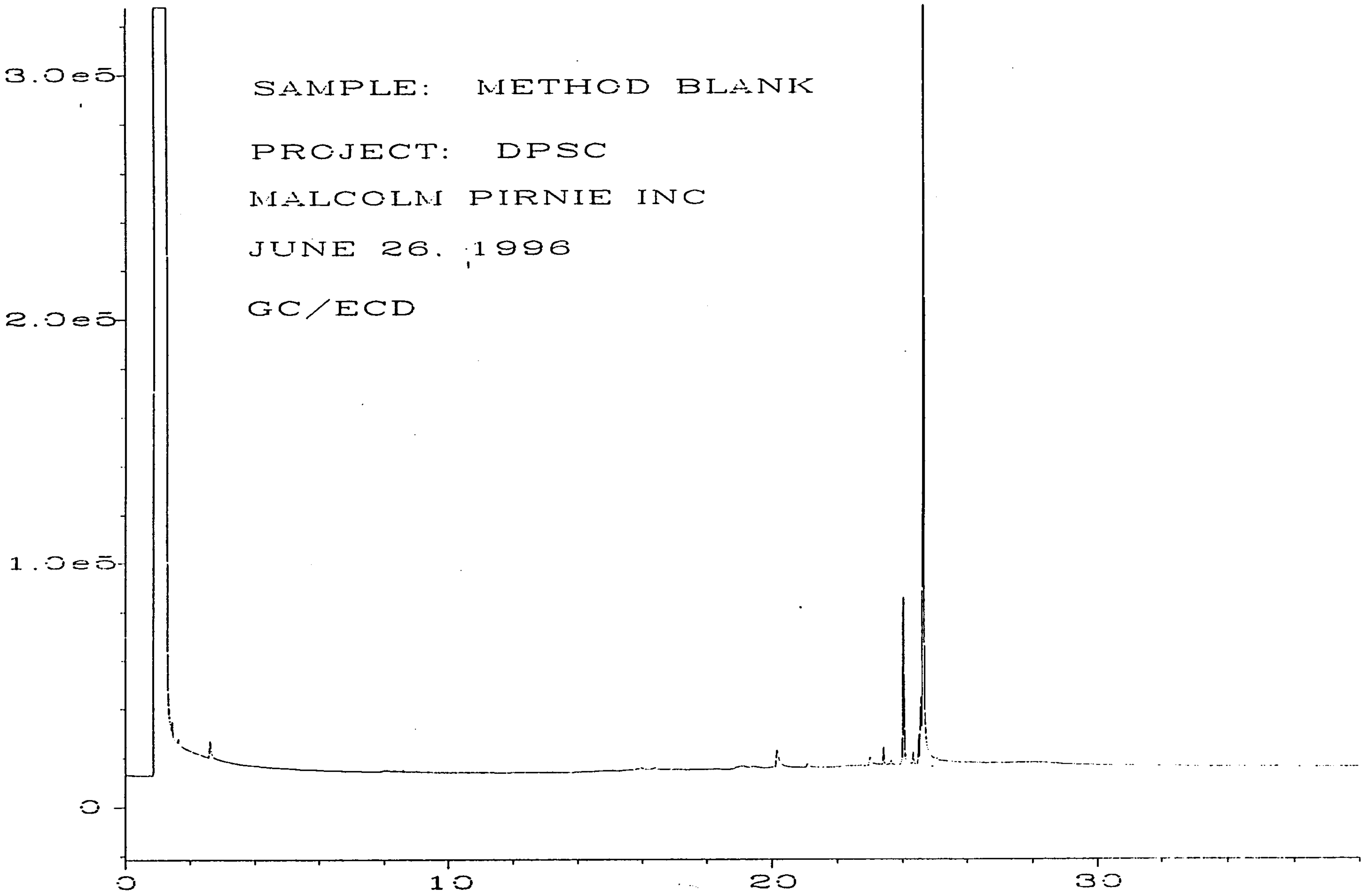

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PROJECT: DPSC

MALCOLM PIRNIE INC

JUNE 26, 1996

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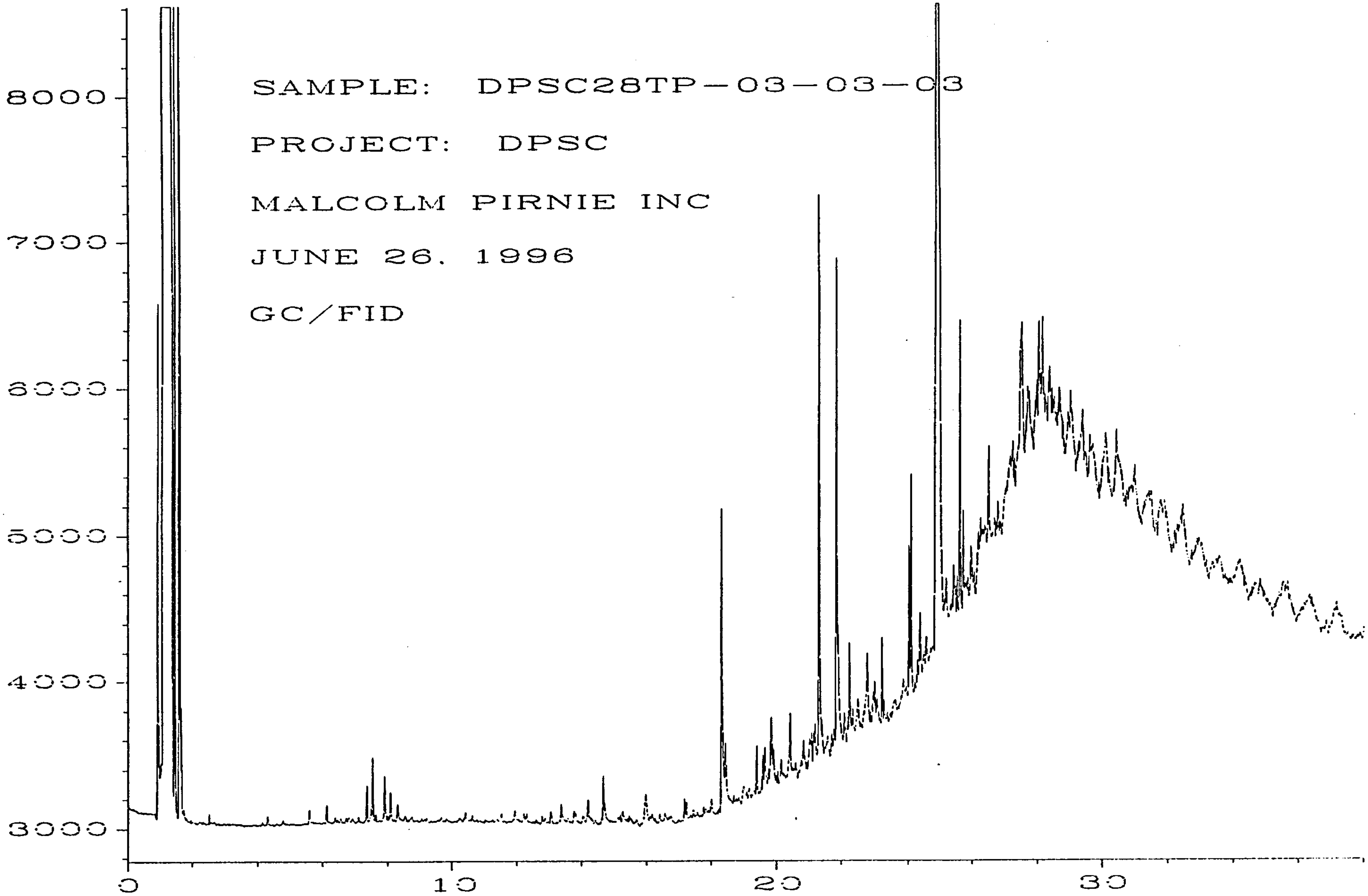

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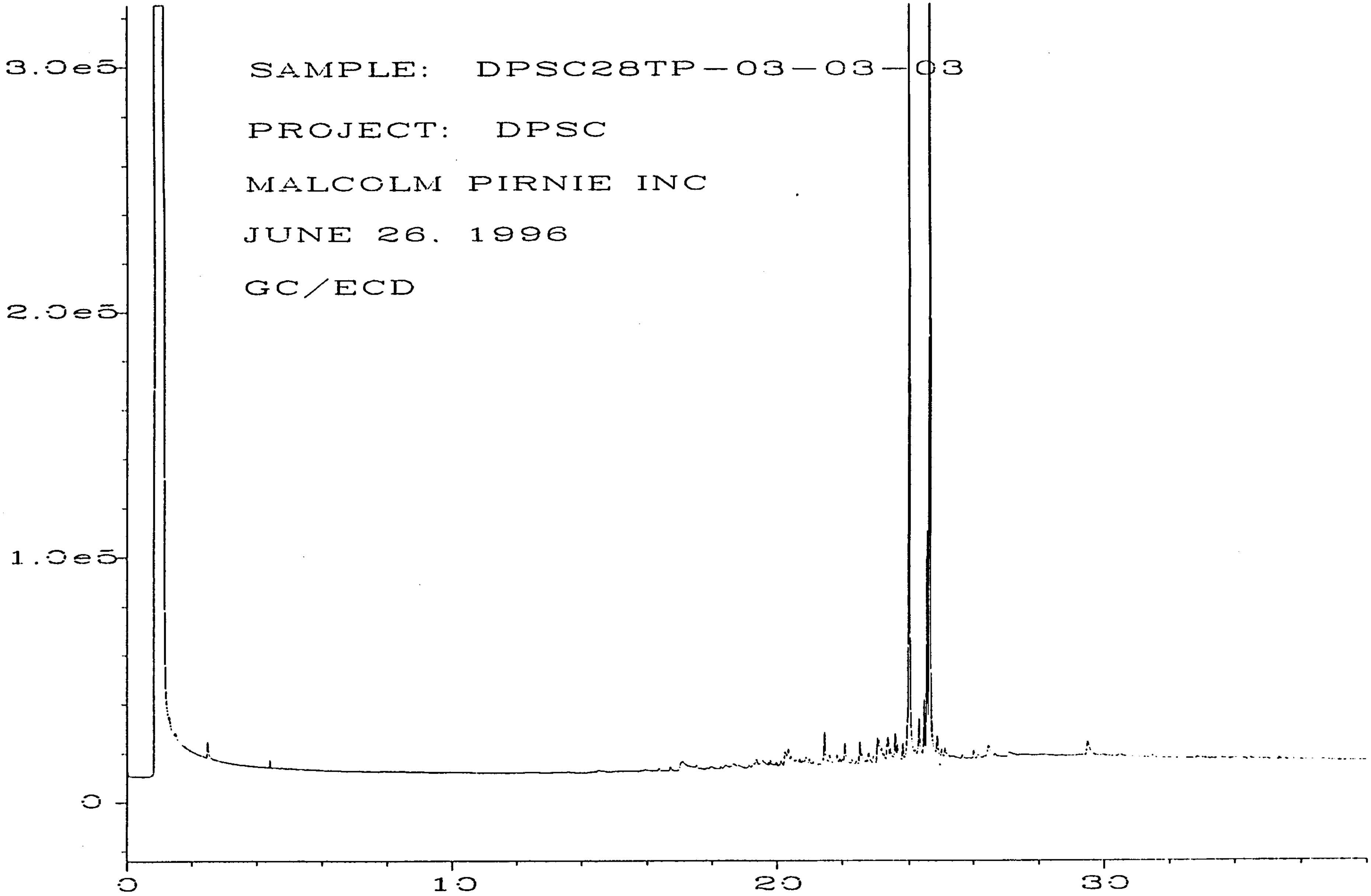

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PROJECT: DPSC

MALCOLM PIRNIE INC

JUNE 26, 1996

GC/ECD

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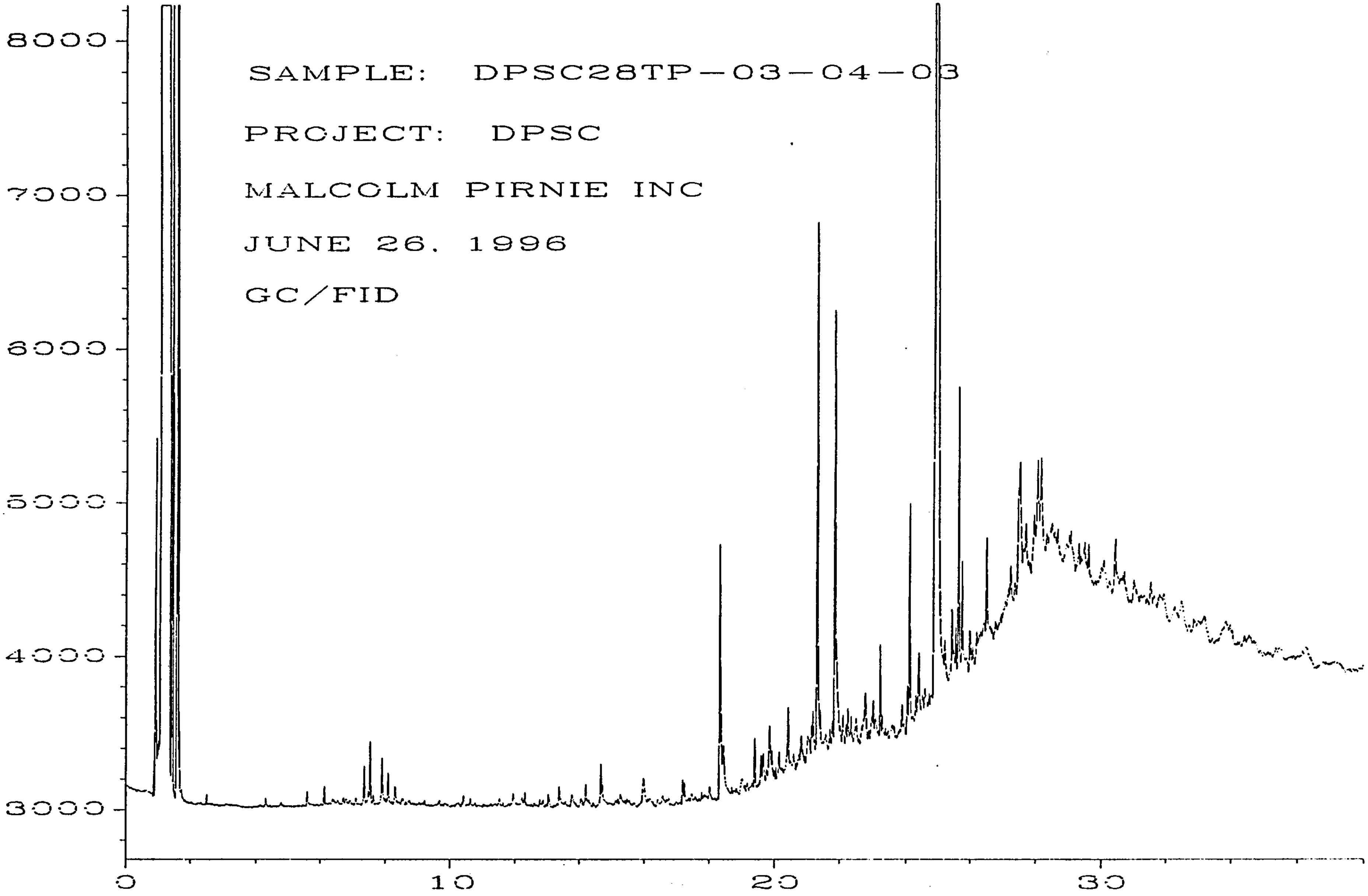

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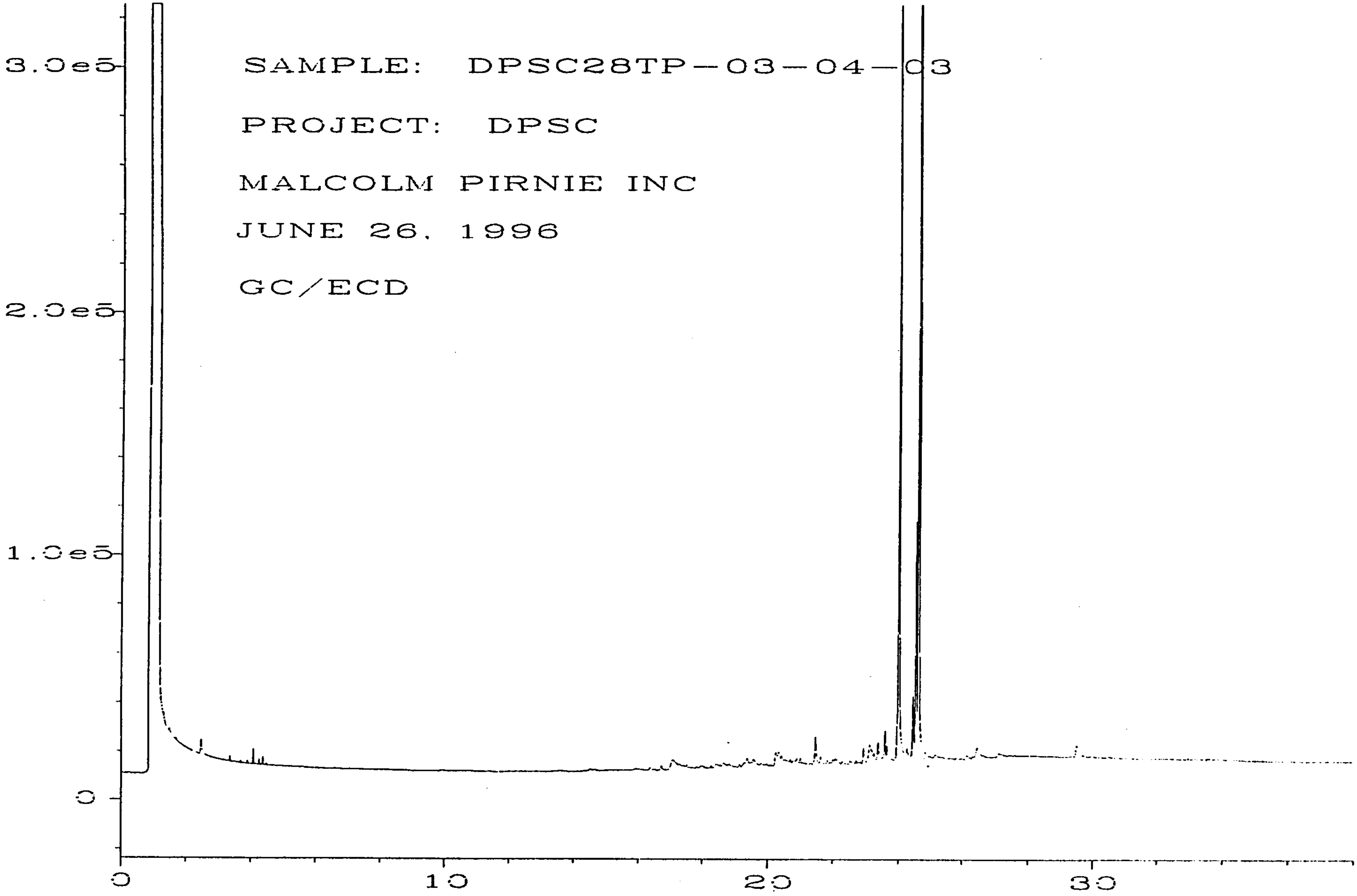

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PROJECT: DPSC

MALCOLM PIRNIE INC

JUNE 26, 1996

GC/ECD

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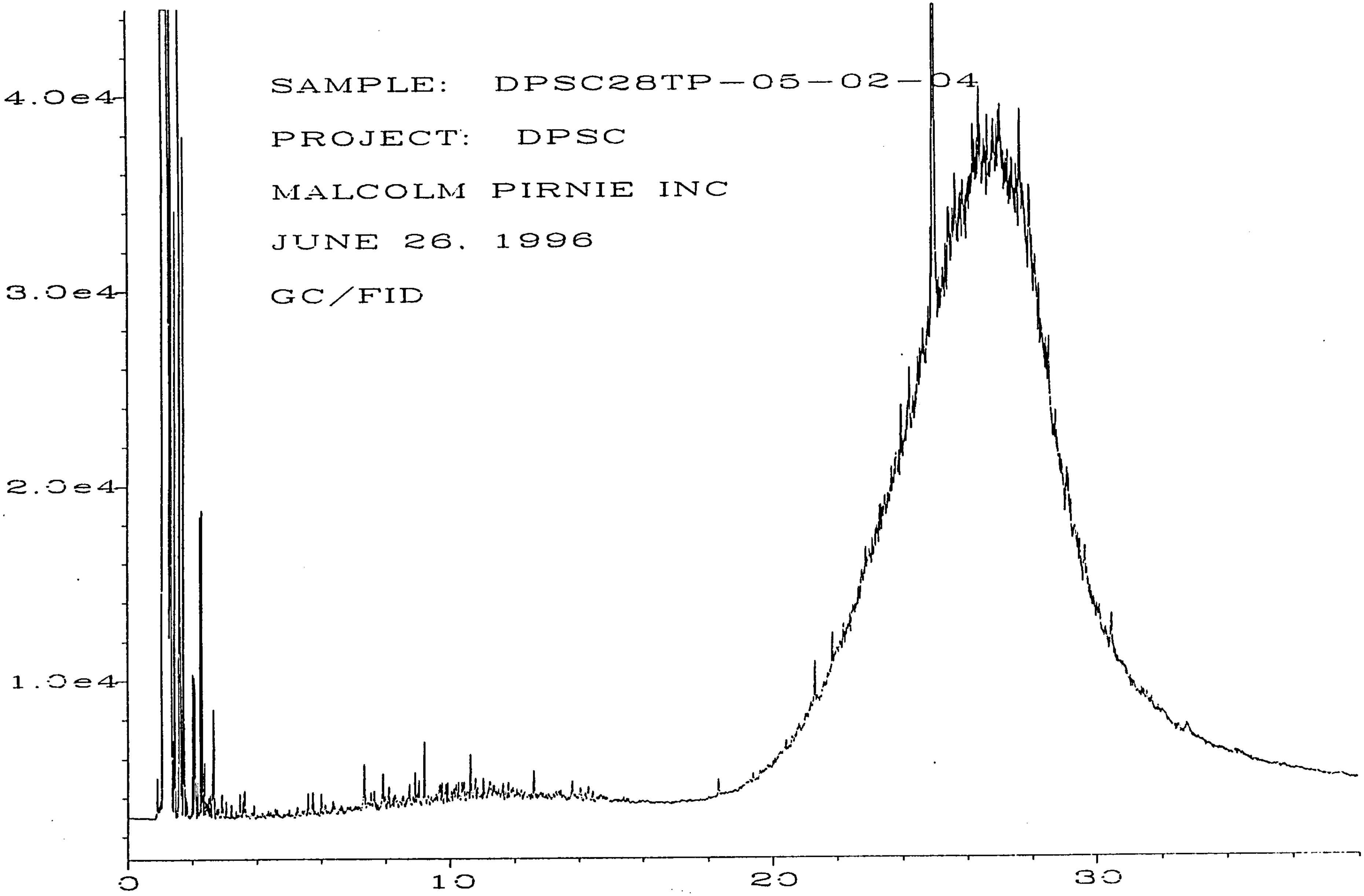

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MALCOLM PIRNIE INC
JUNE 26, 1996
GC/FID

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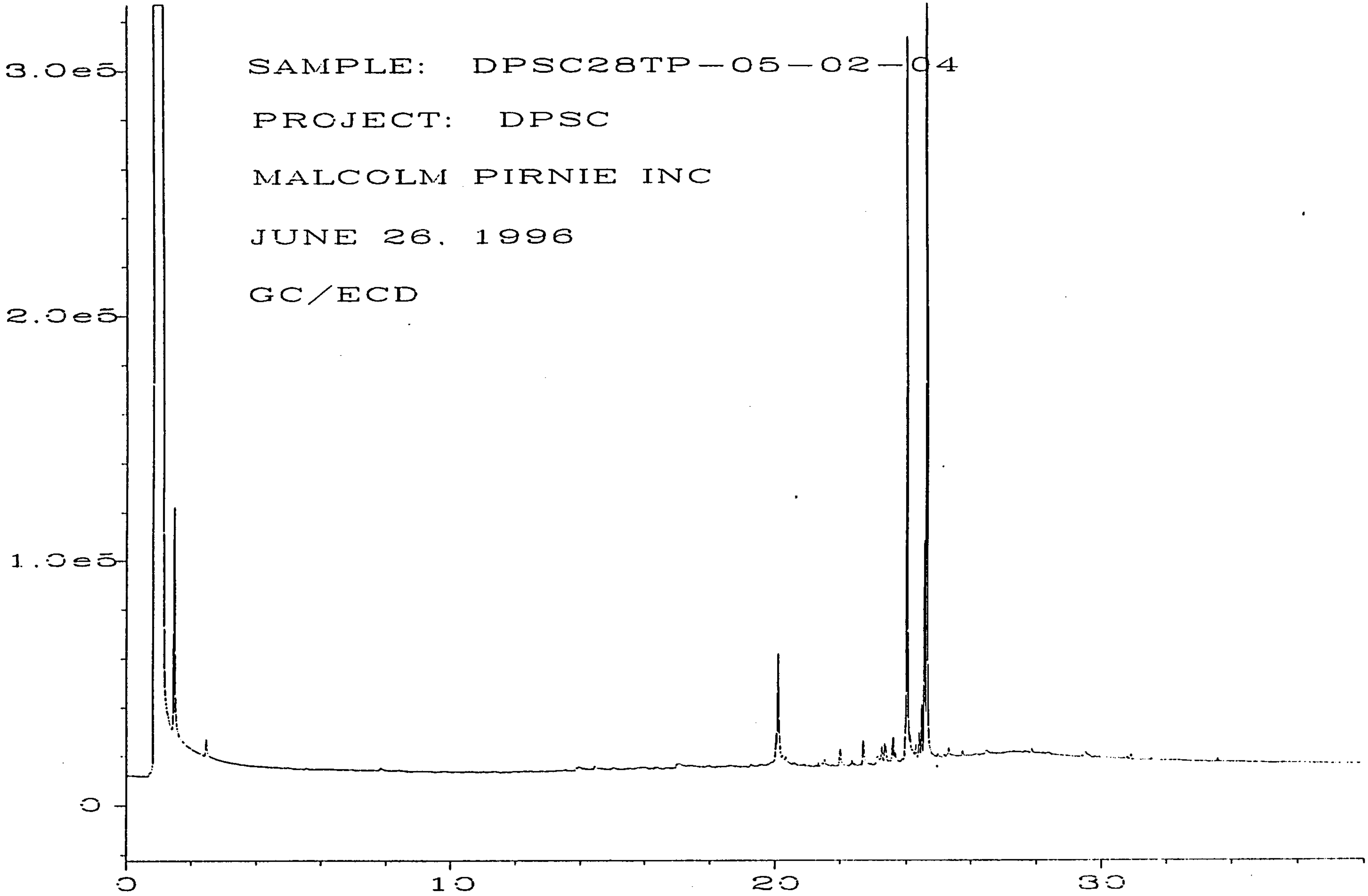

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PROJECT: DPSC

MALCOLM PIRNIE INC

JUNE 26, 1996

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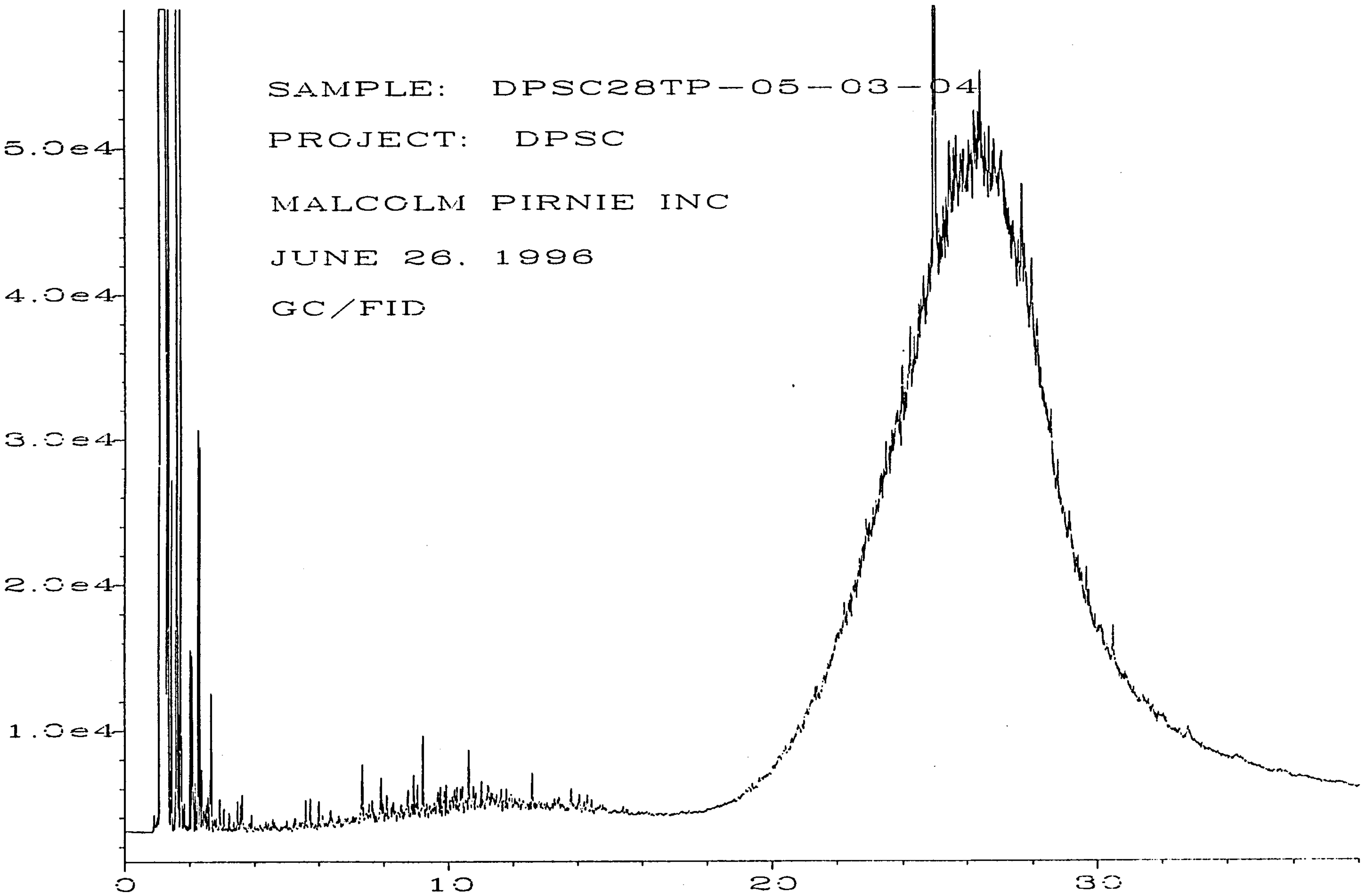

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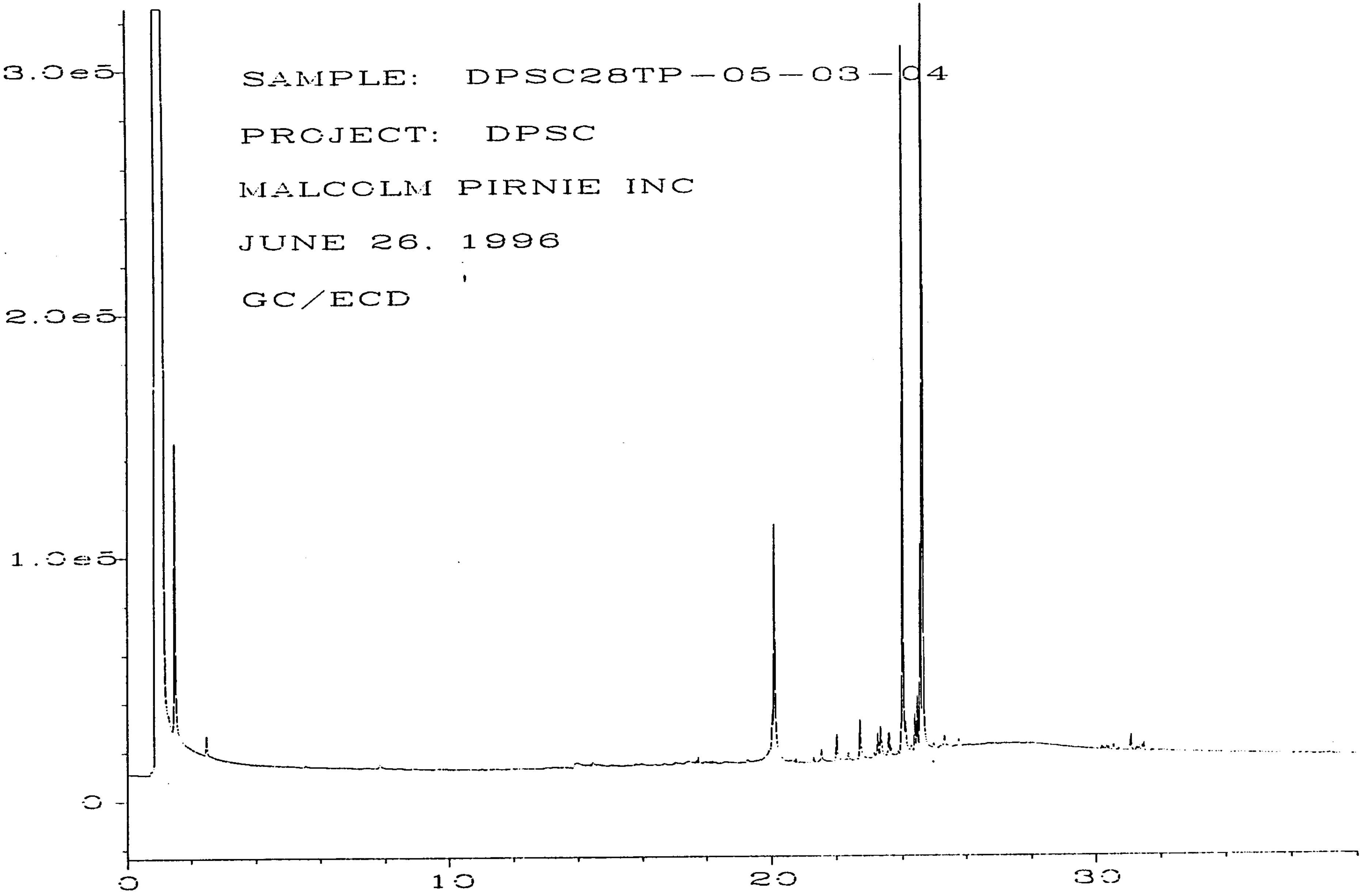

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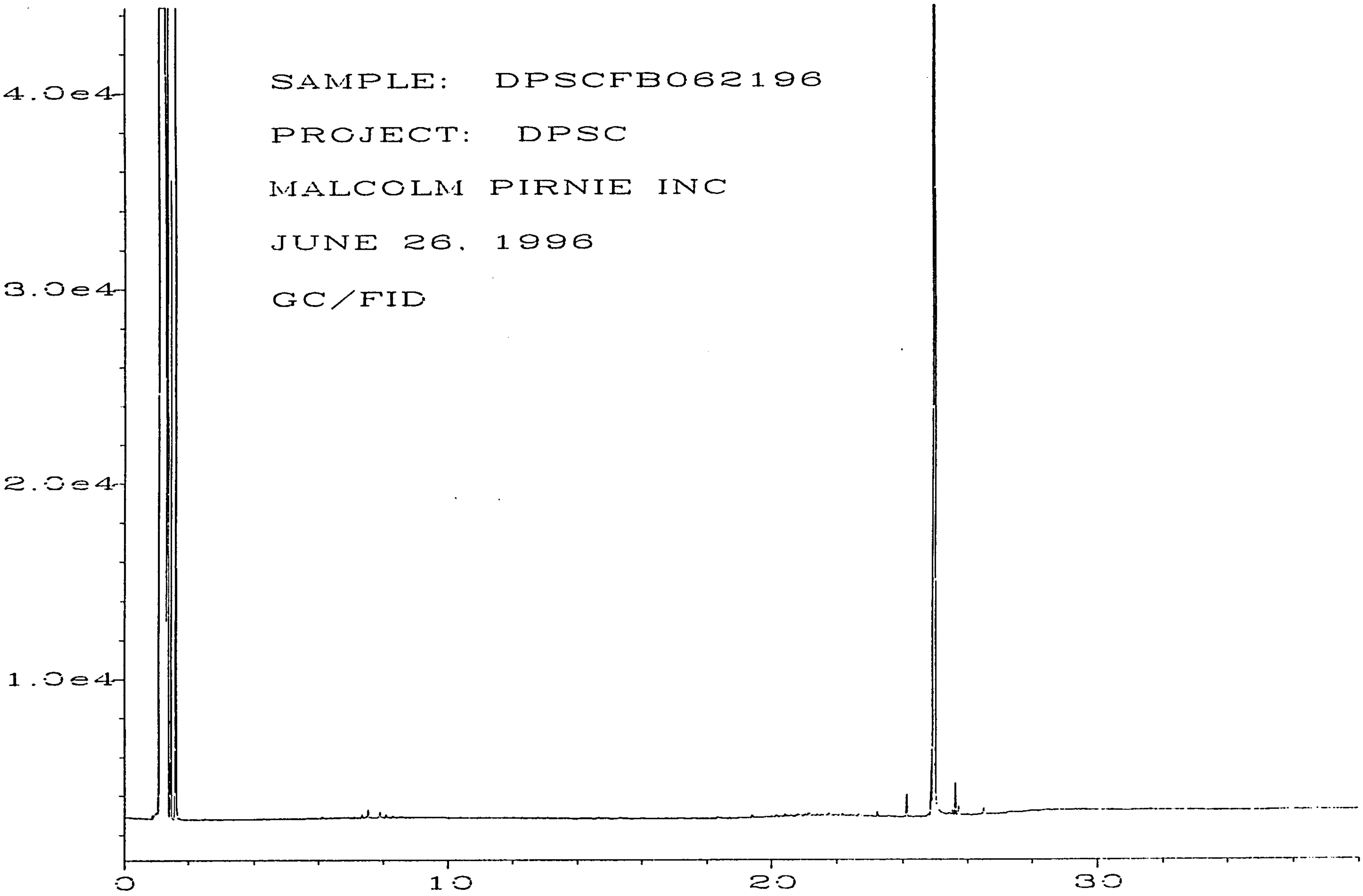

SAMPLE: DPSCFB062196

PROJECT: DPSC

MALCOLM PIRNIE INC

JUNE 26, 1996

GC/FID

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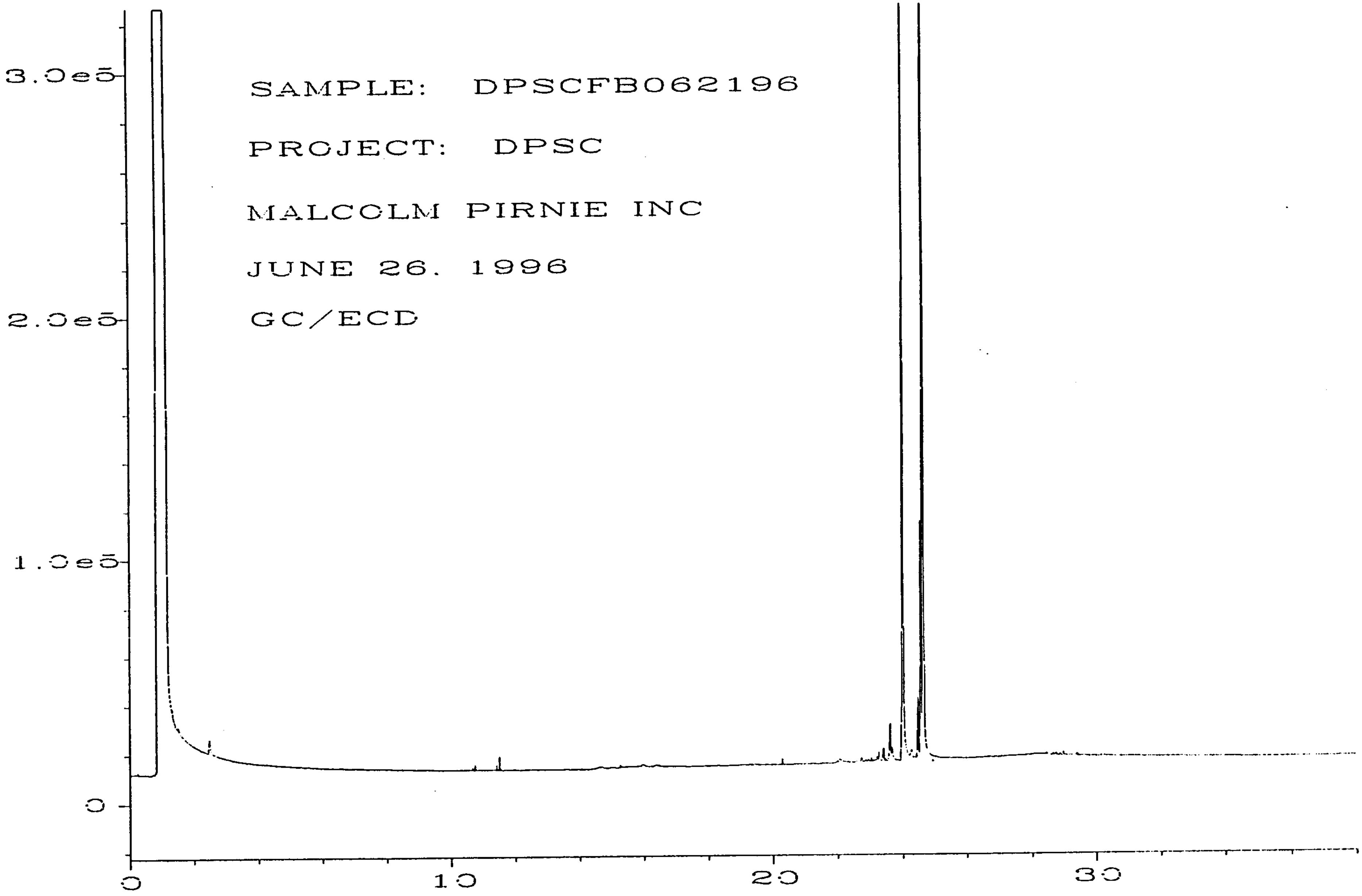

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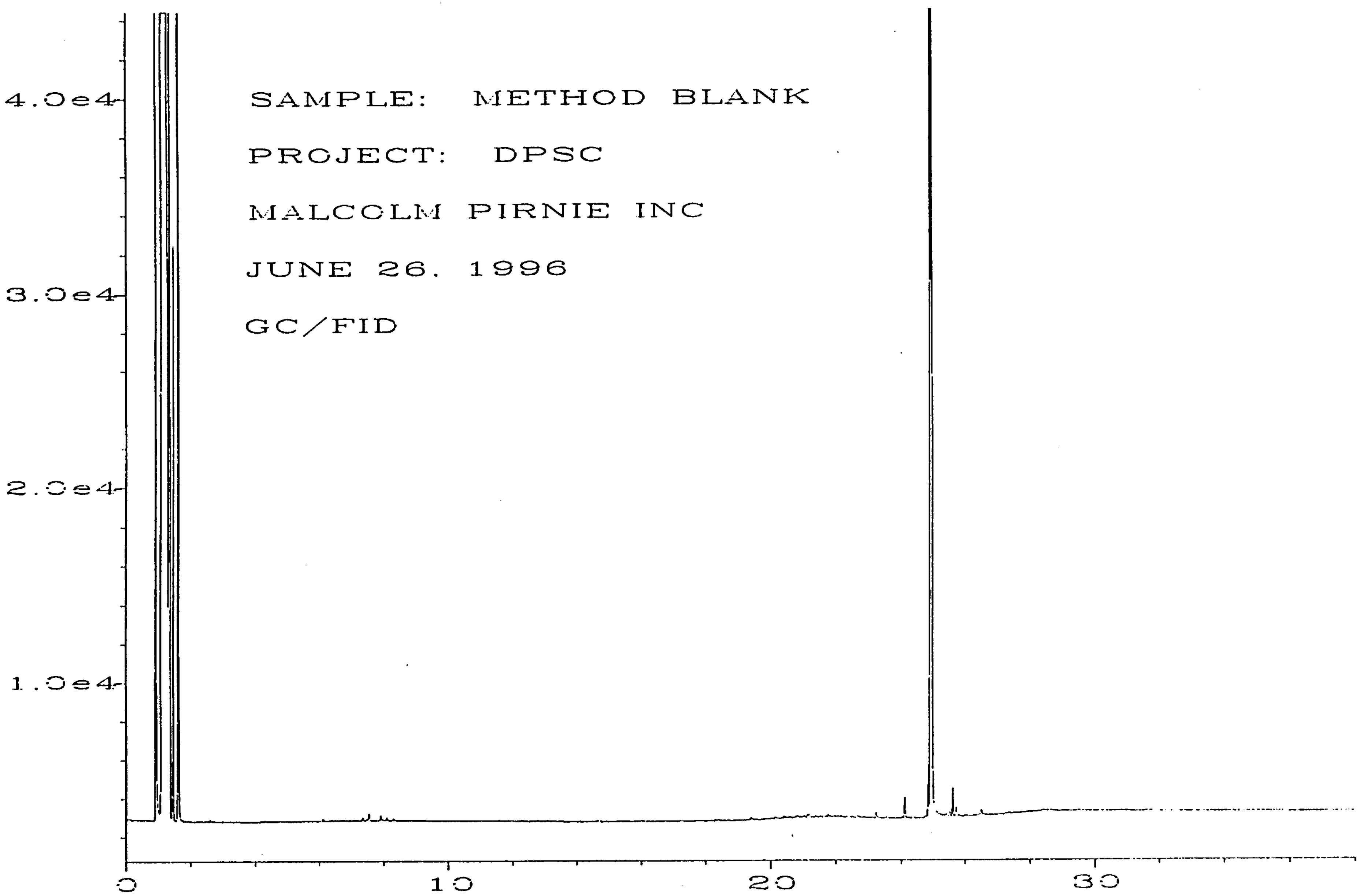

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PROJECT: DPSC

MALCOLM PIRNIE INC

JUNE 26, 1996

GC/FID

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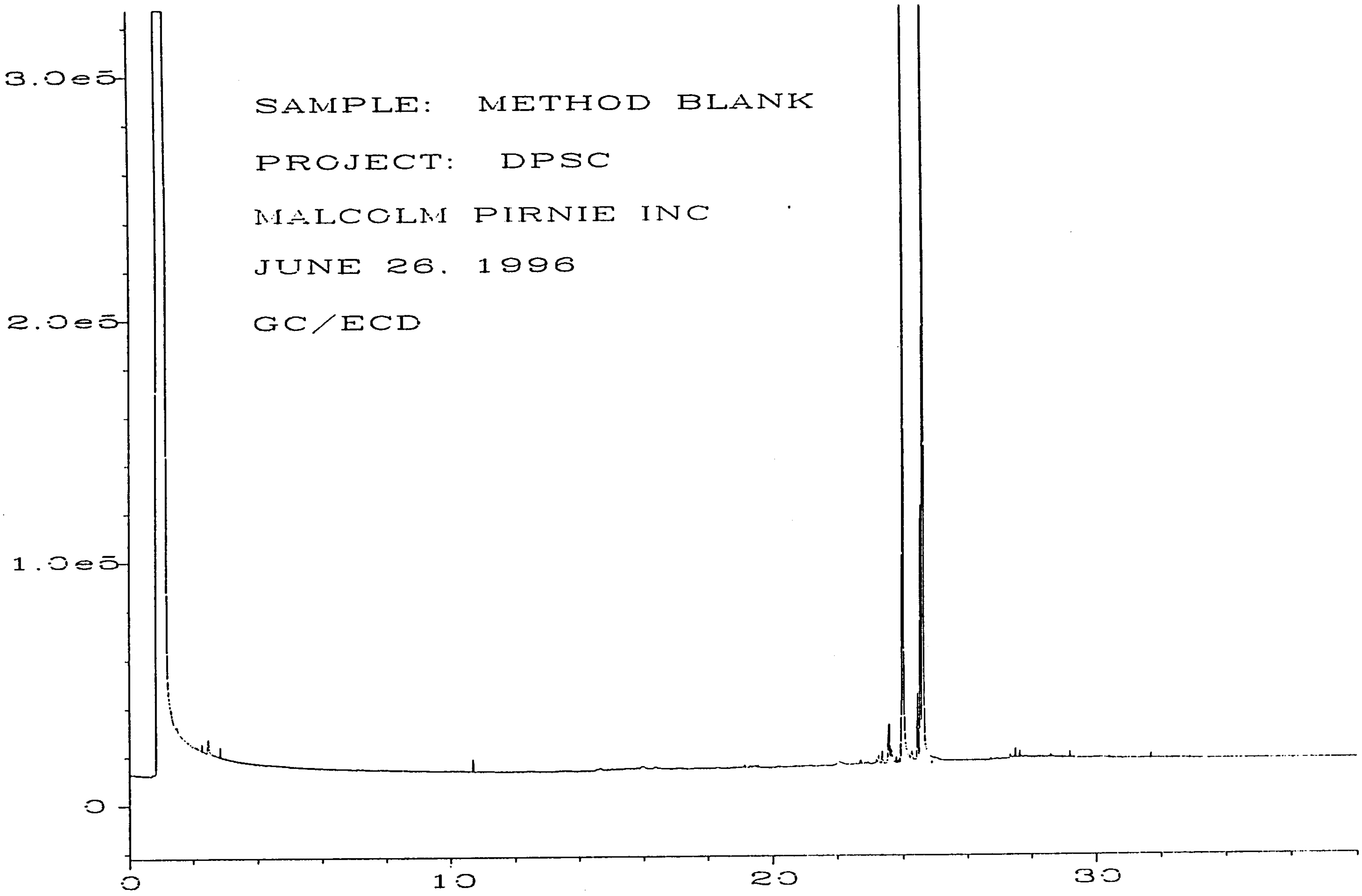

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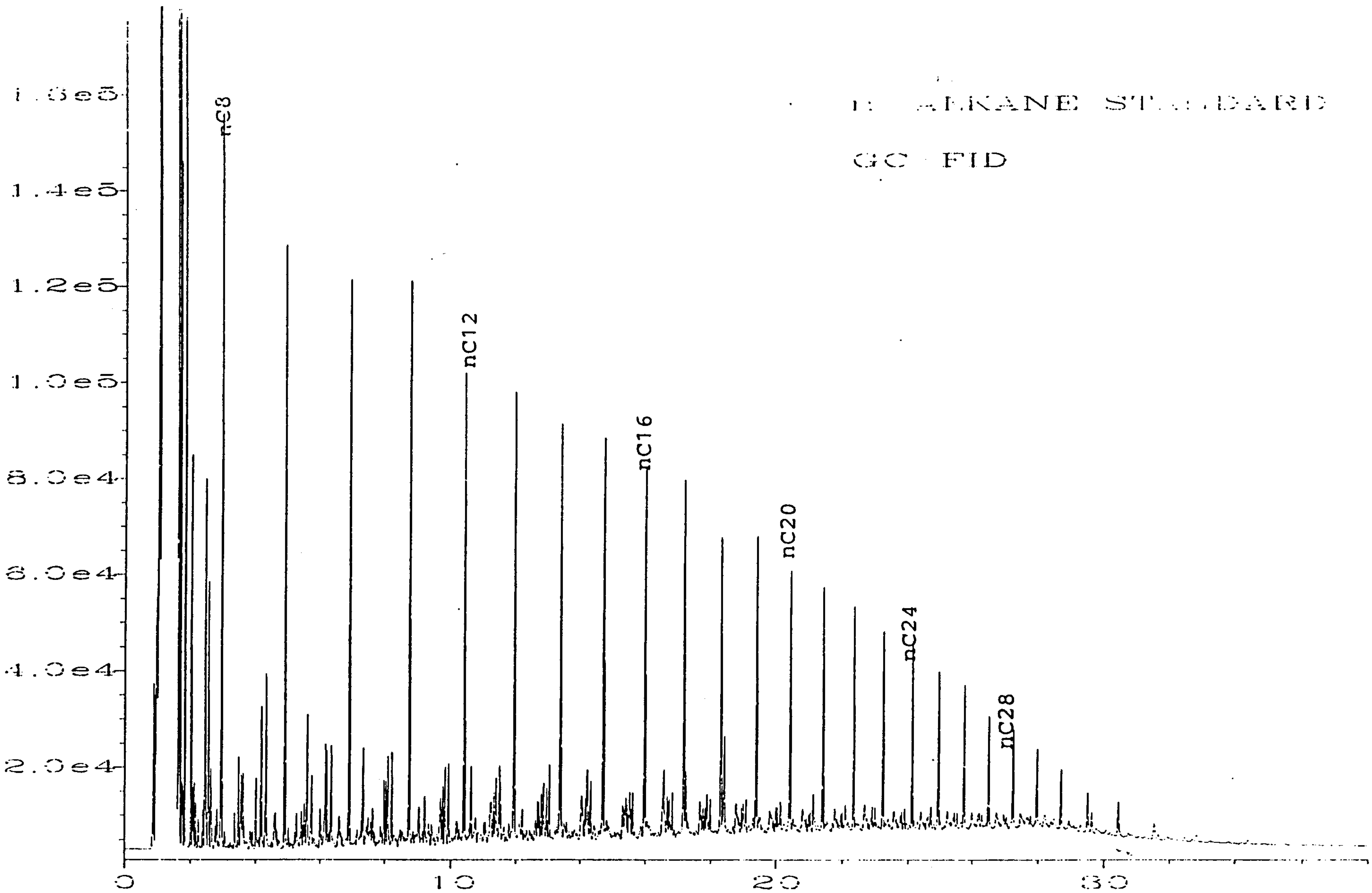

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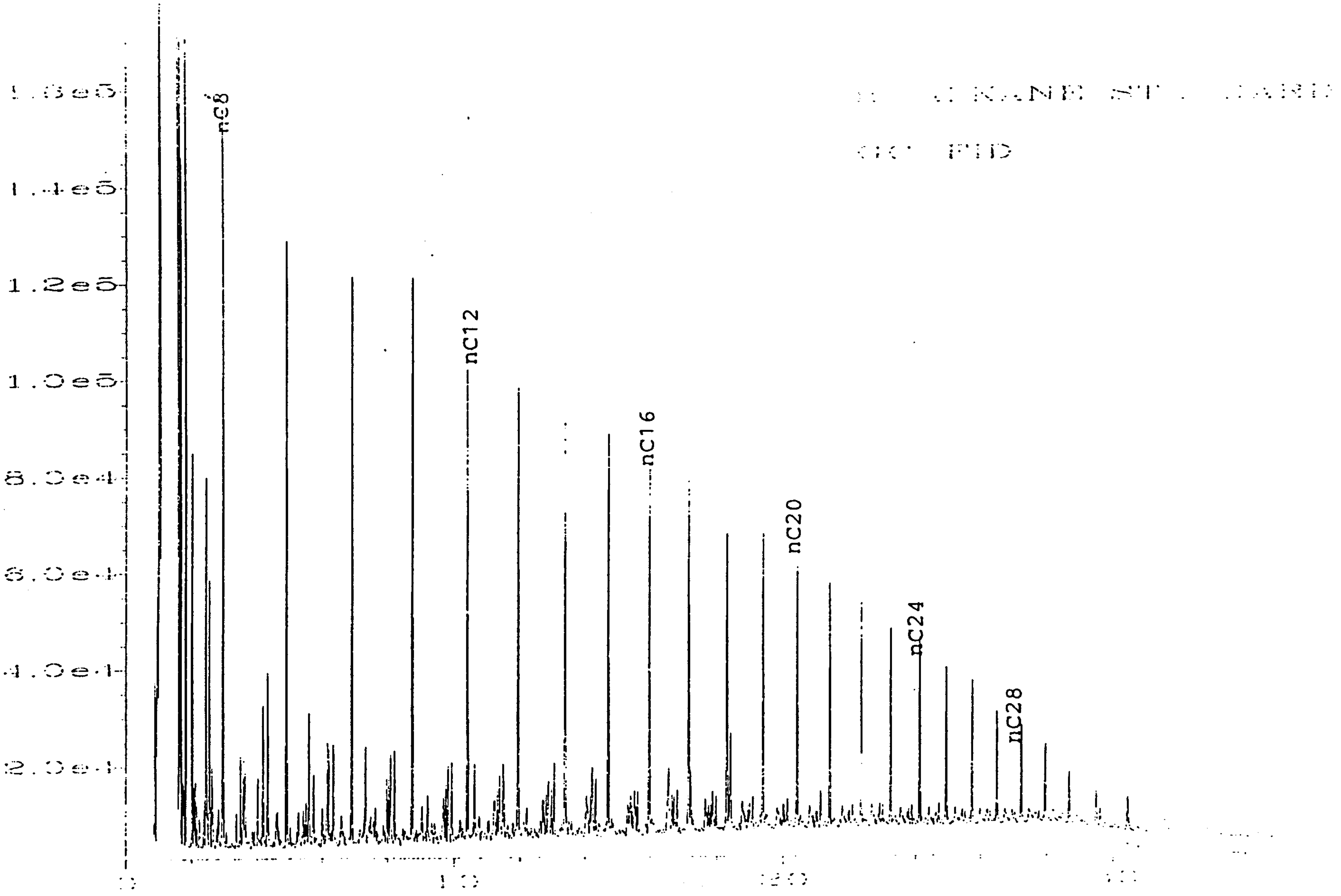
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8.0e4
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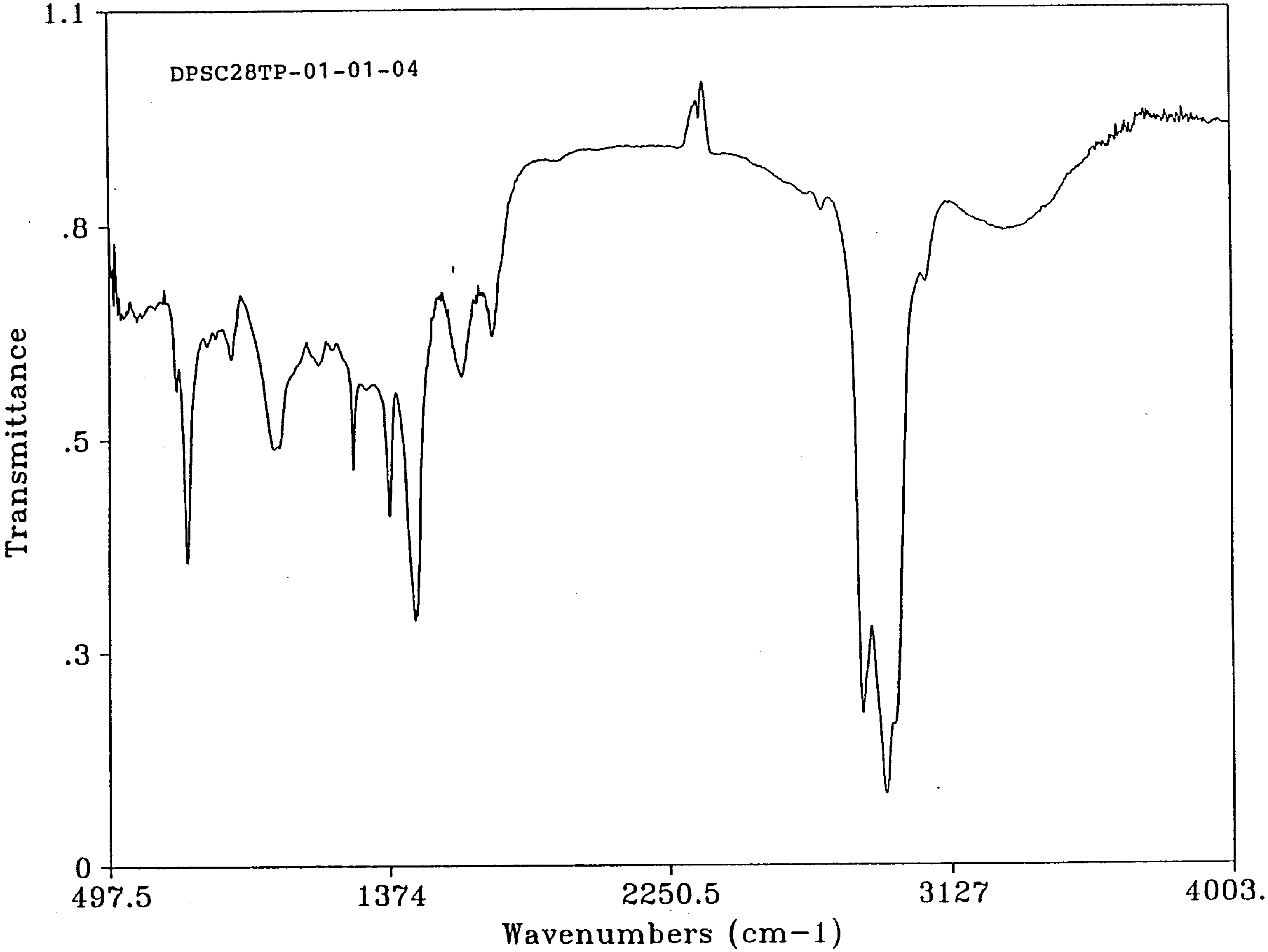

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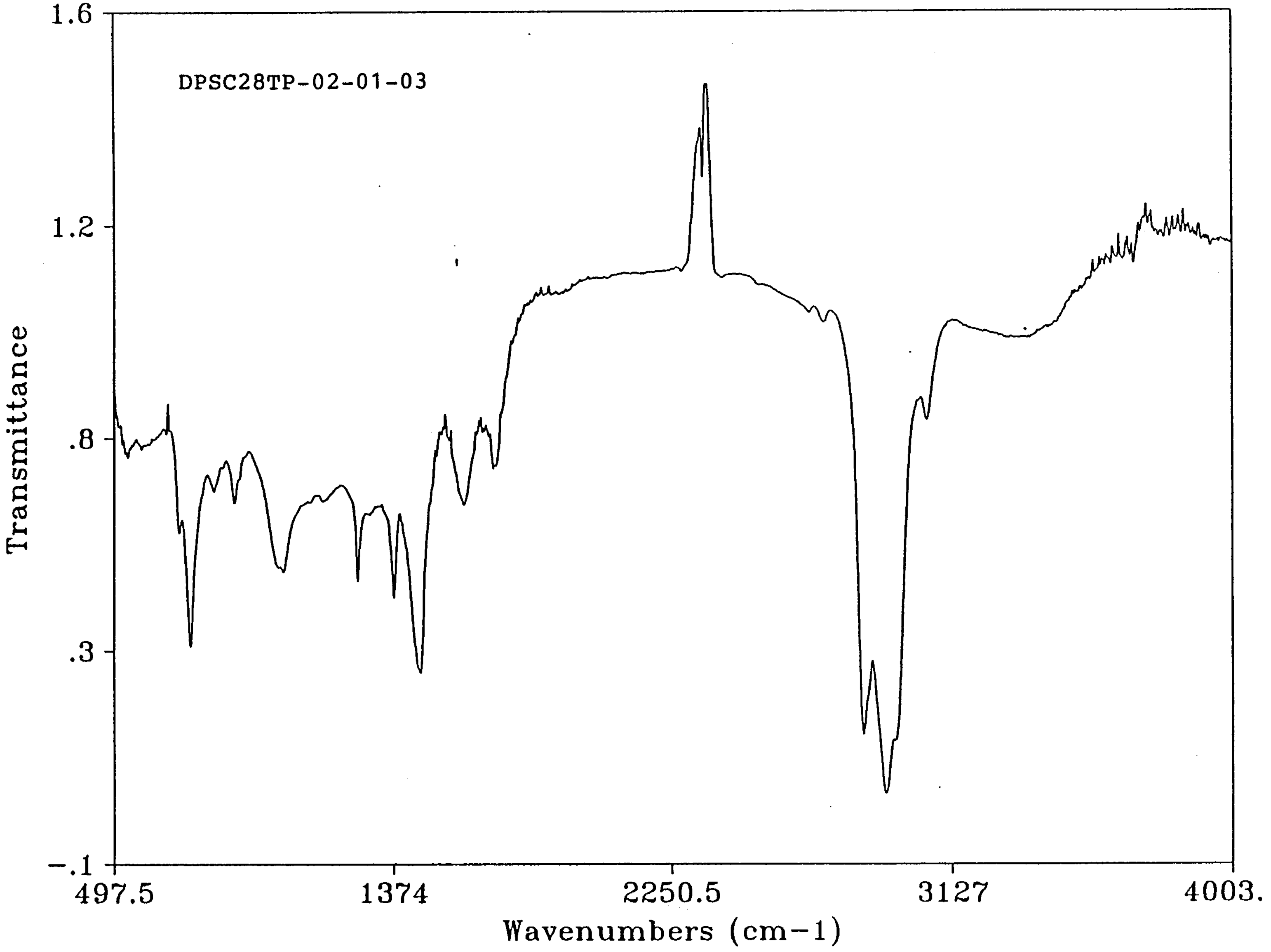

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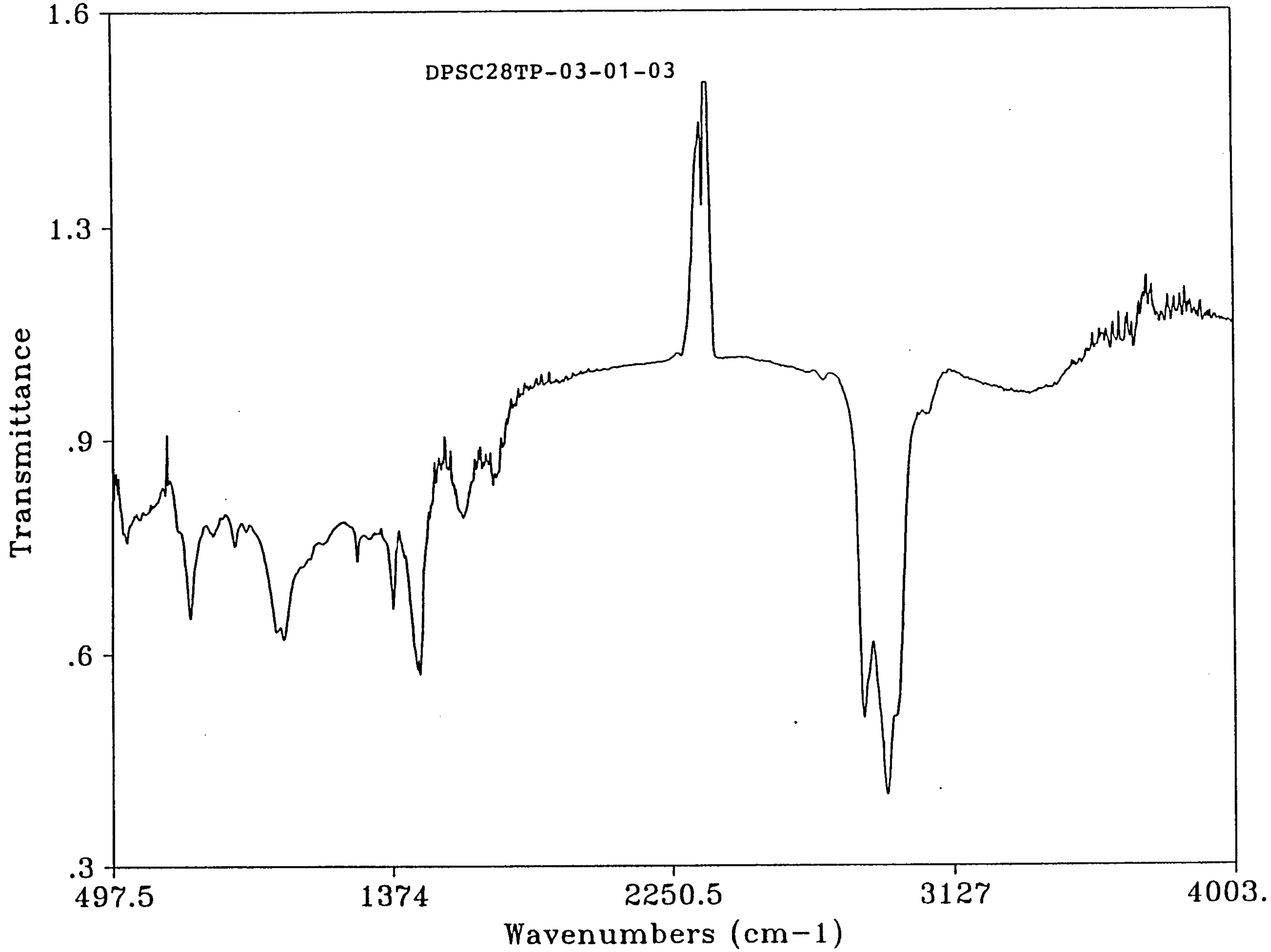

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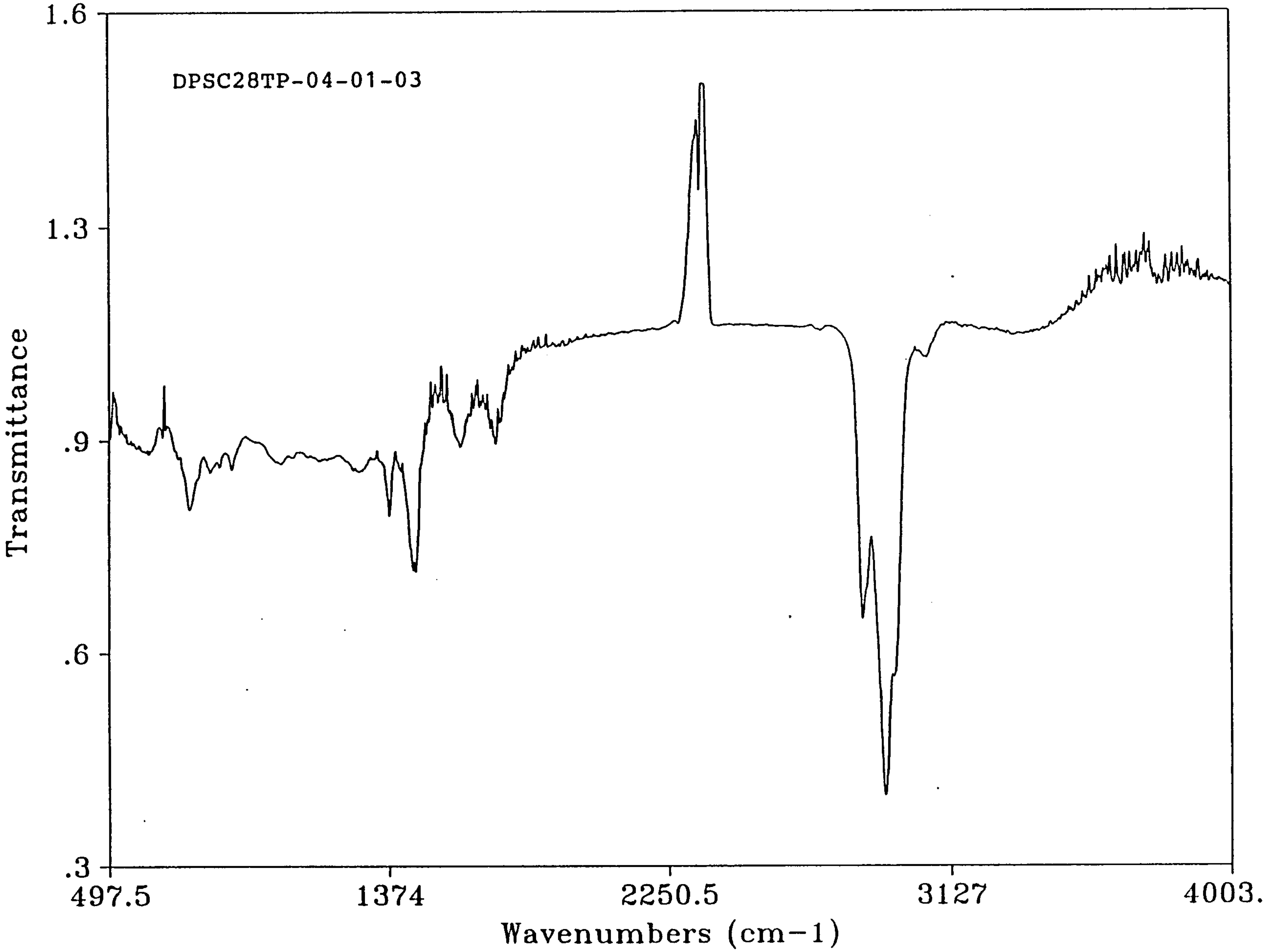

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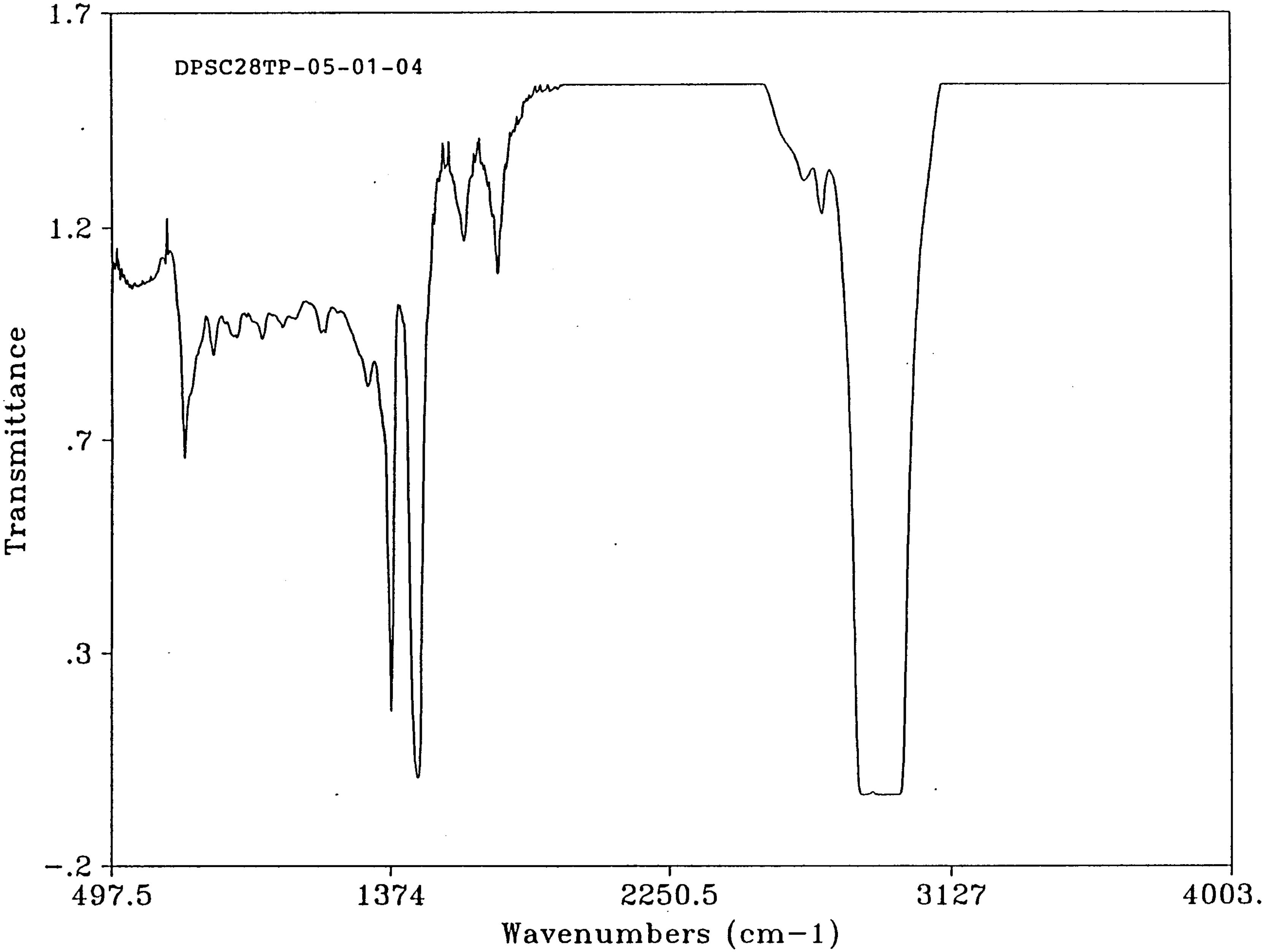

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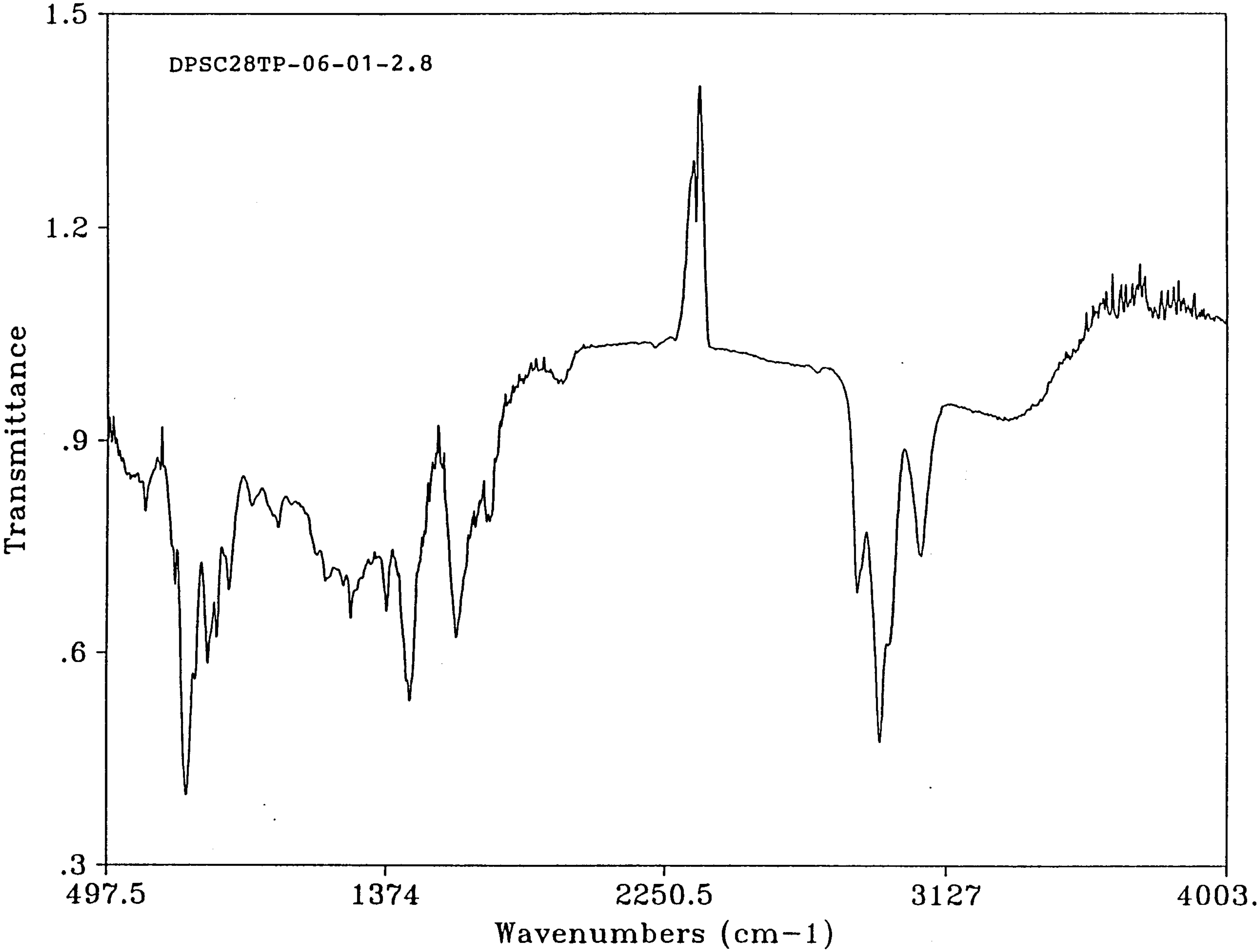

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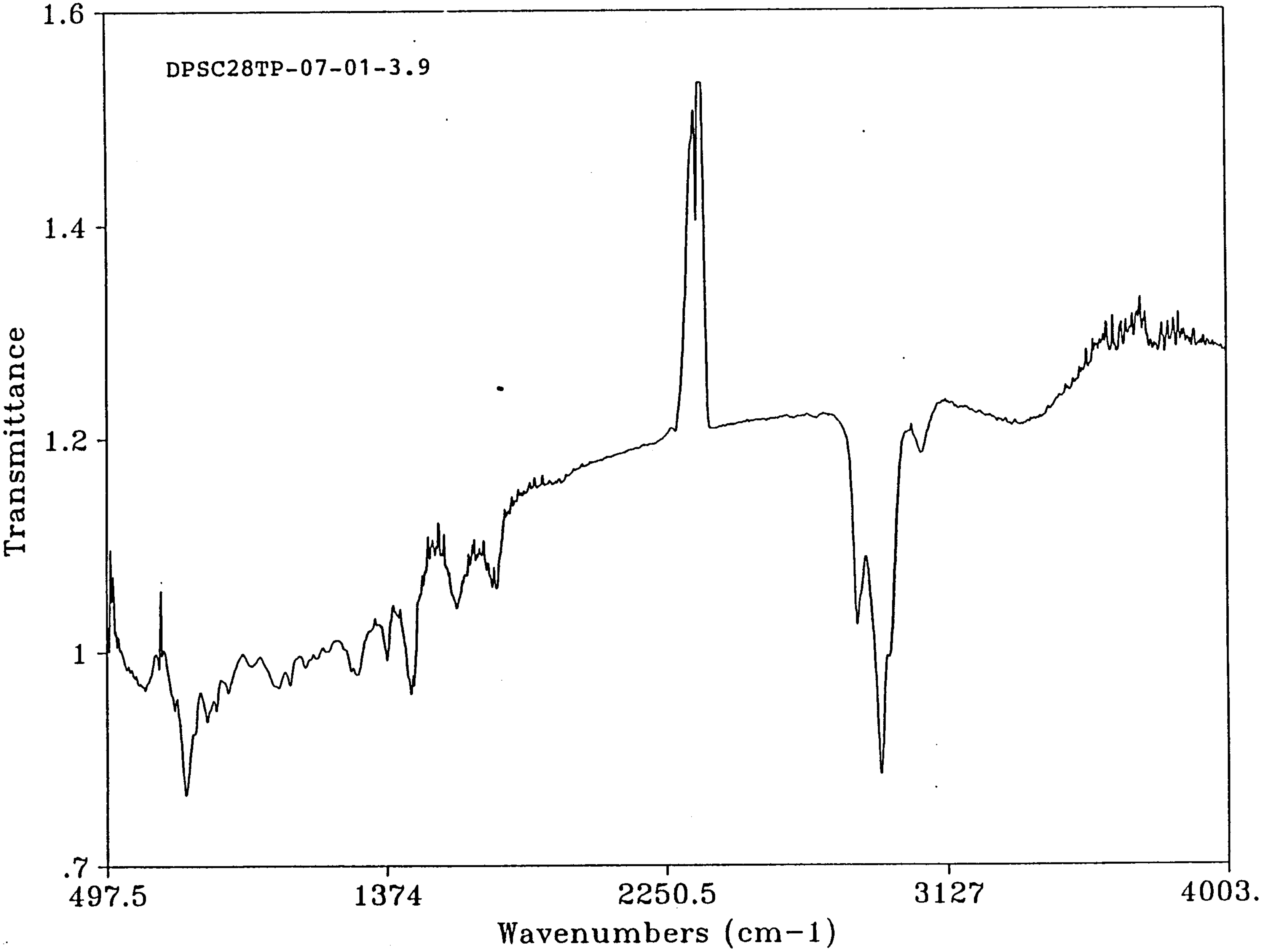

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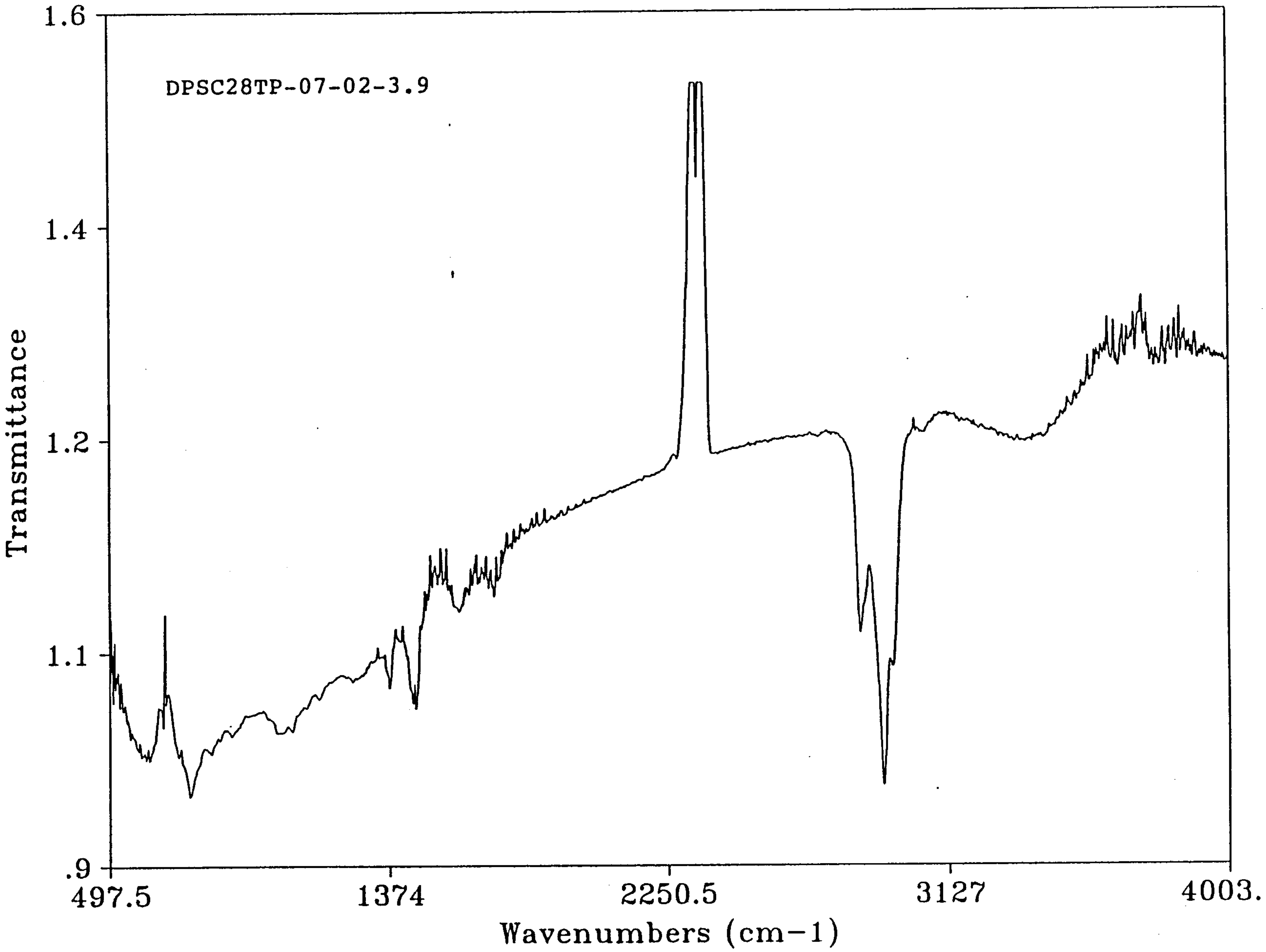

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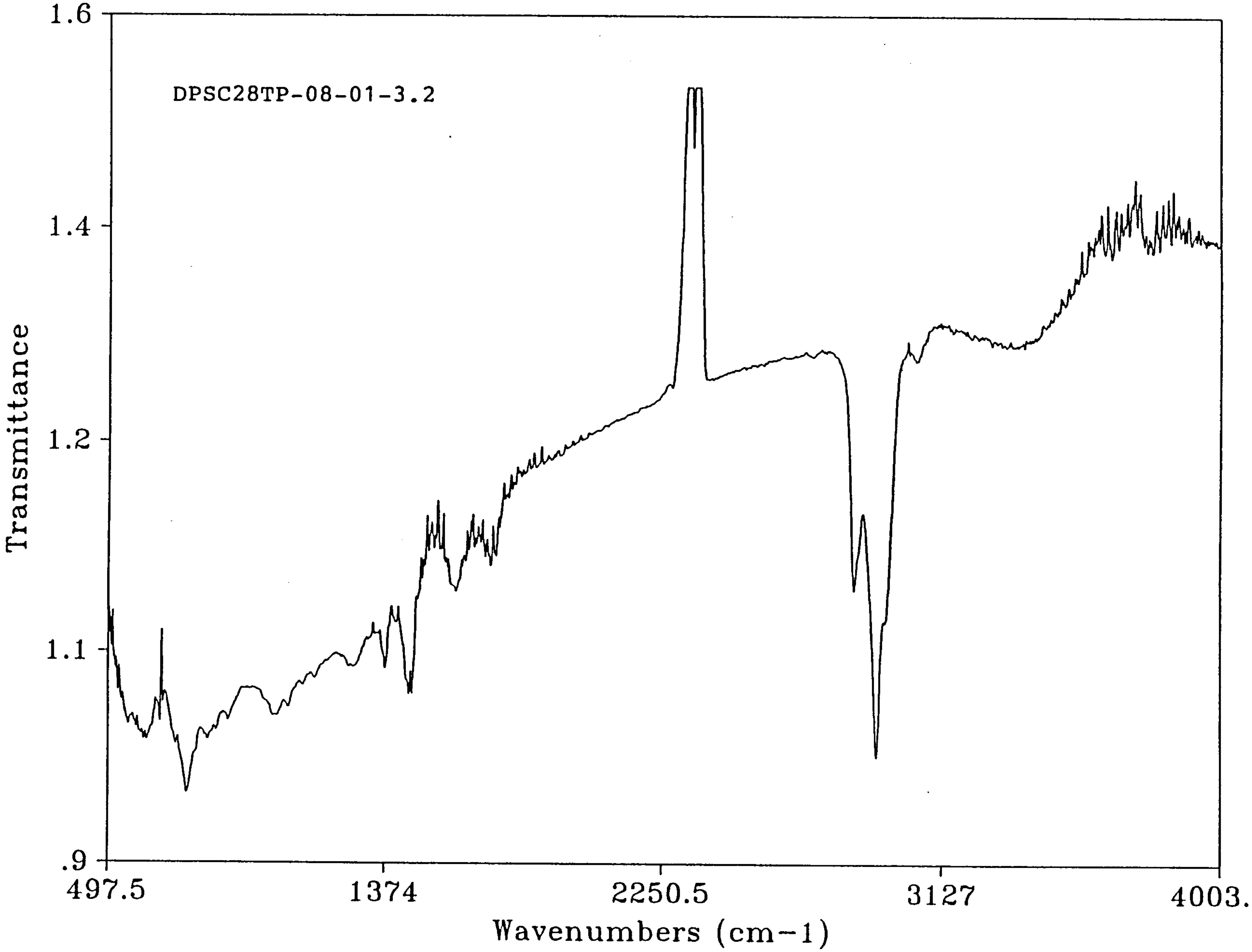

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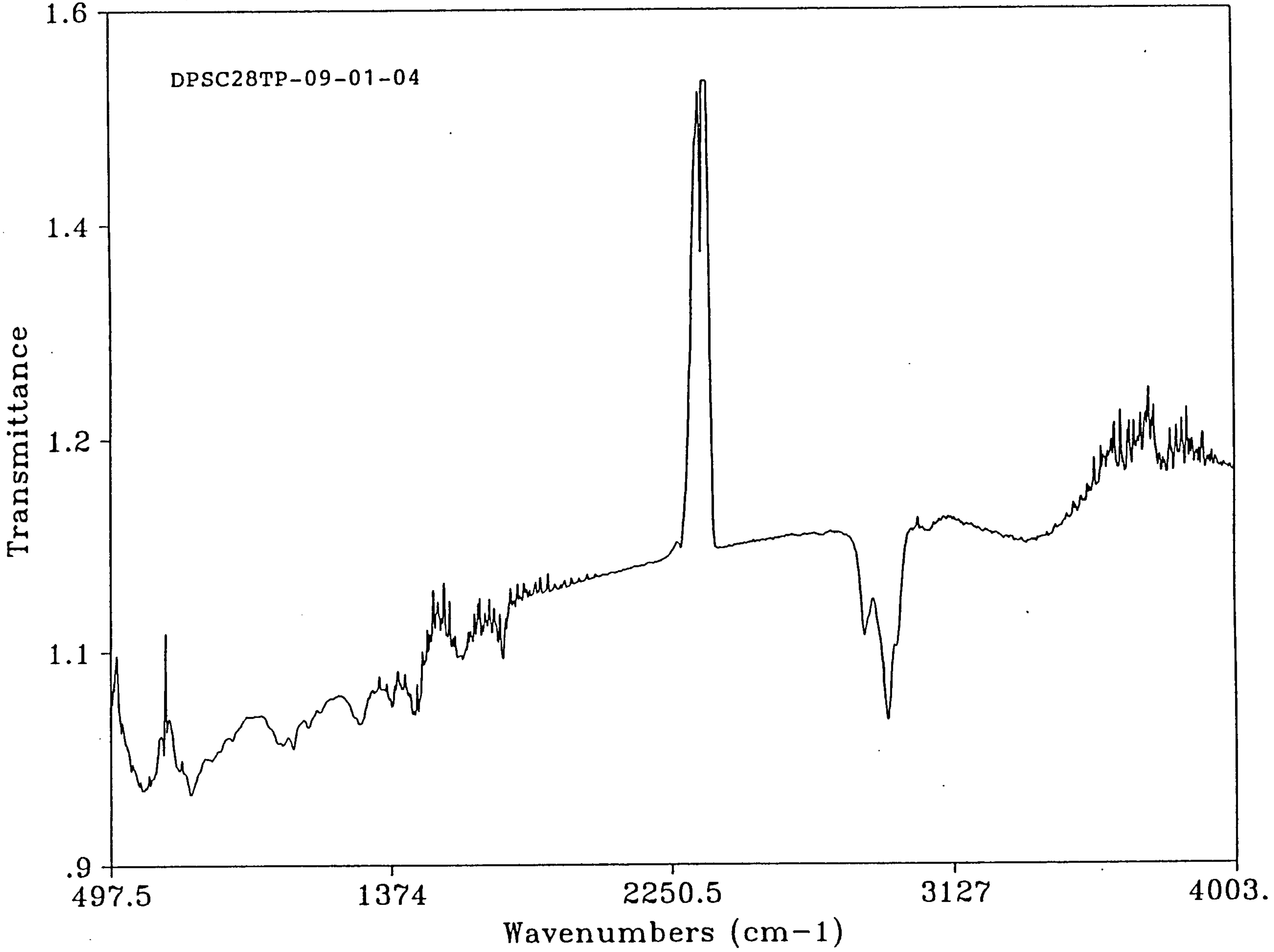

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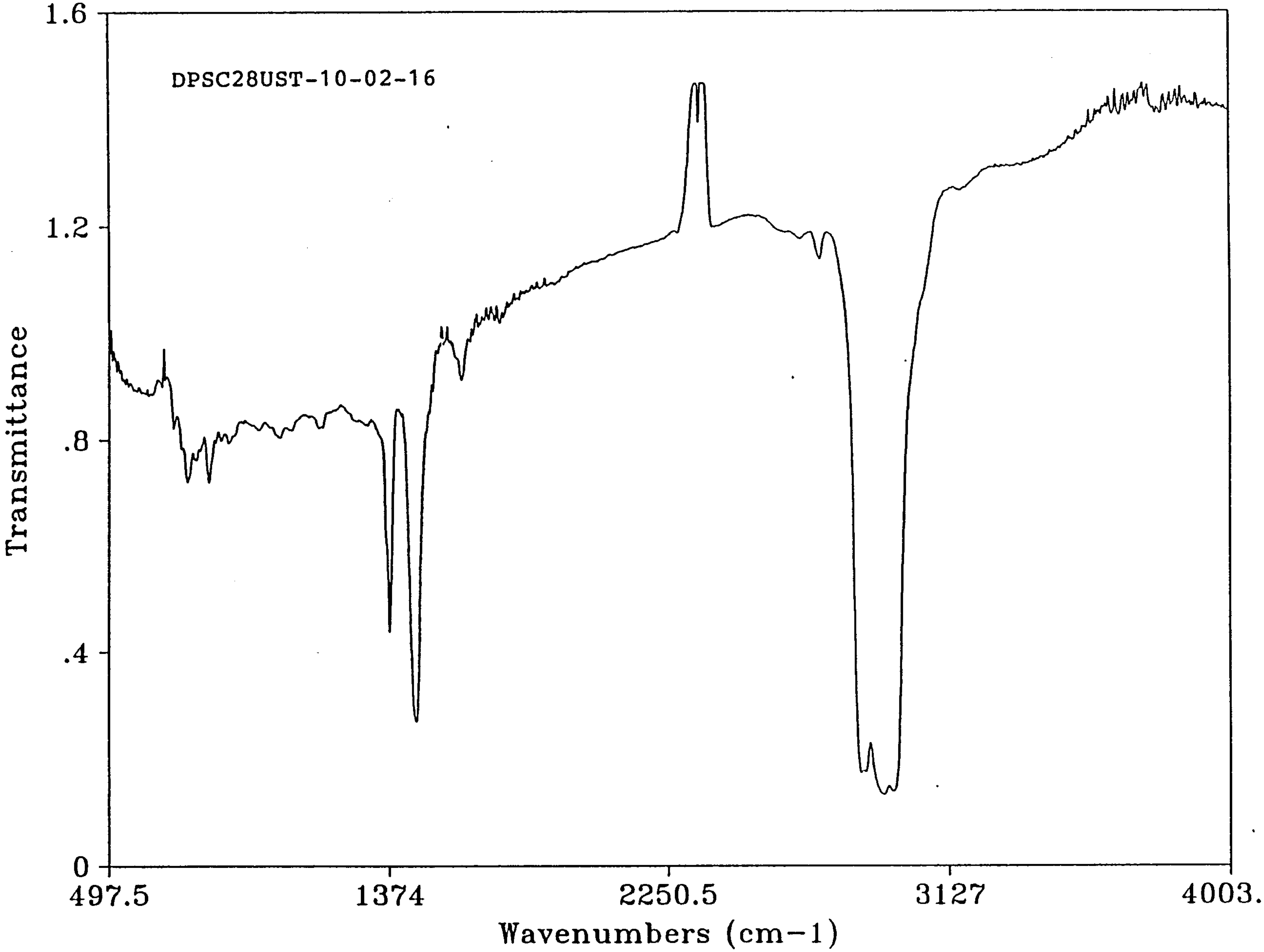

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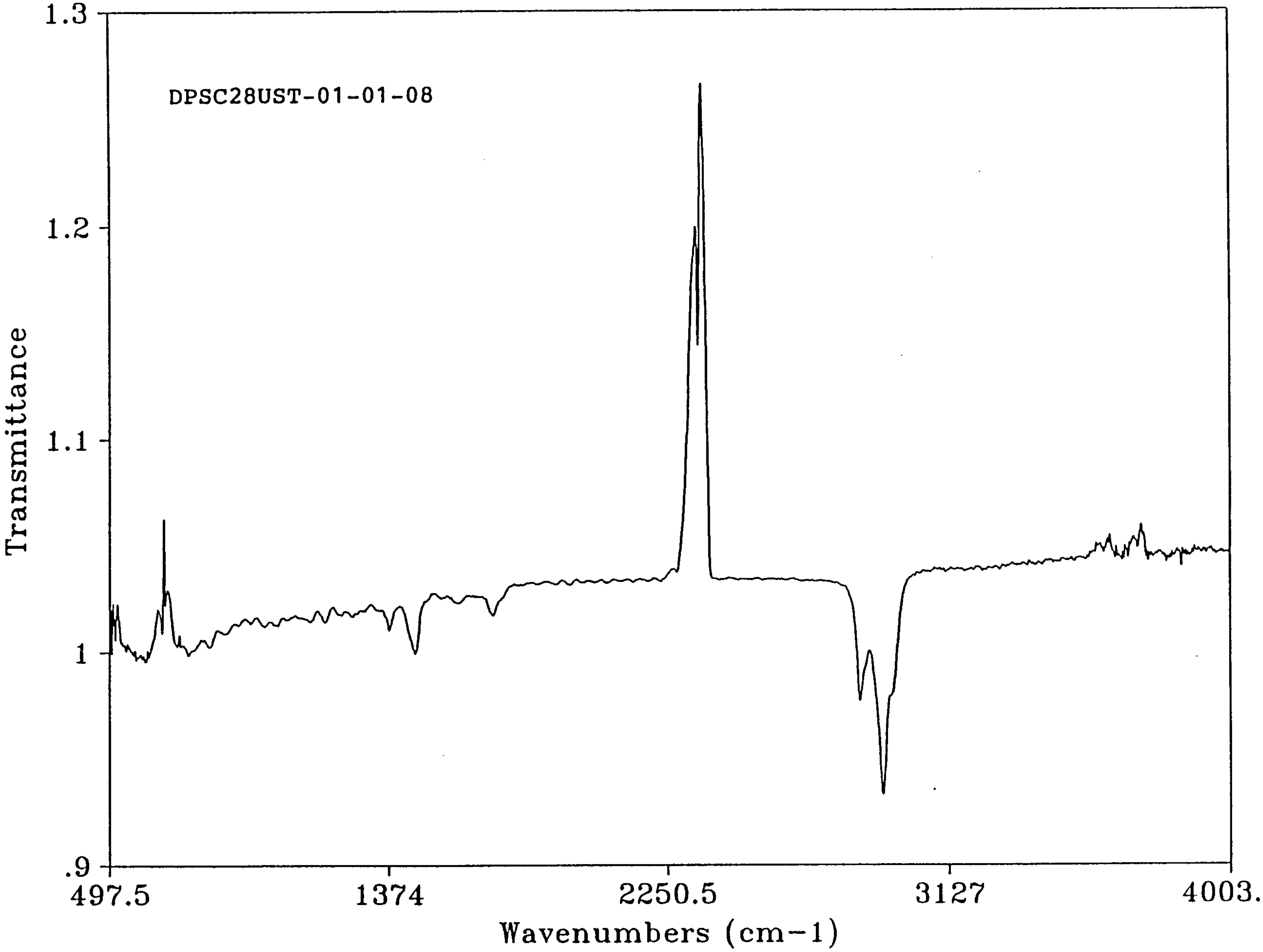

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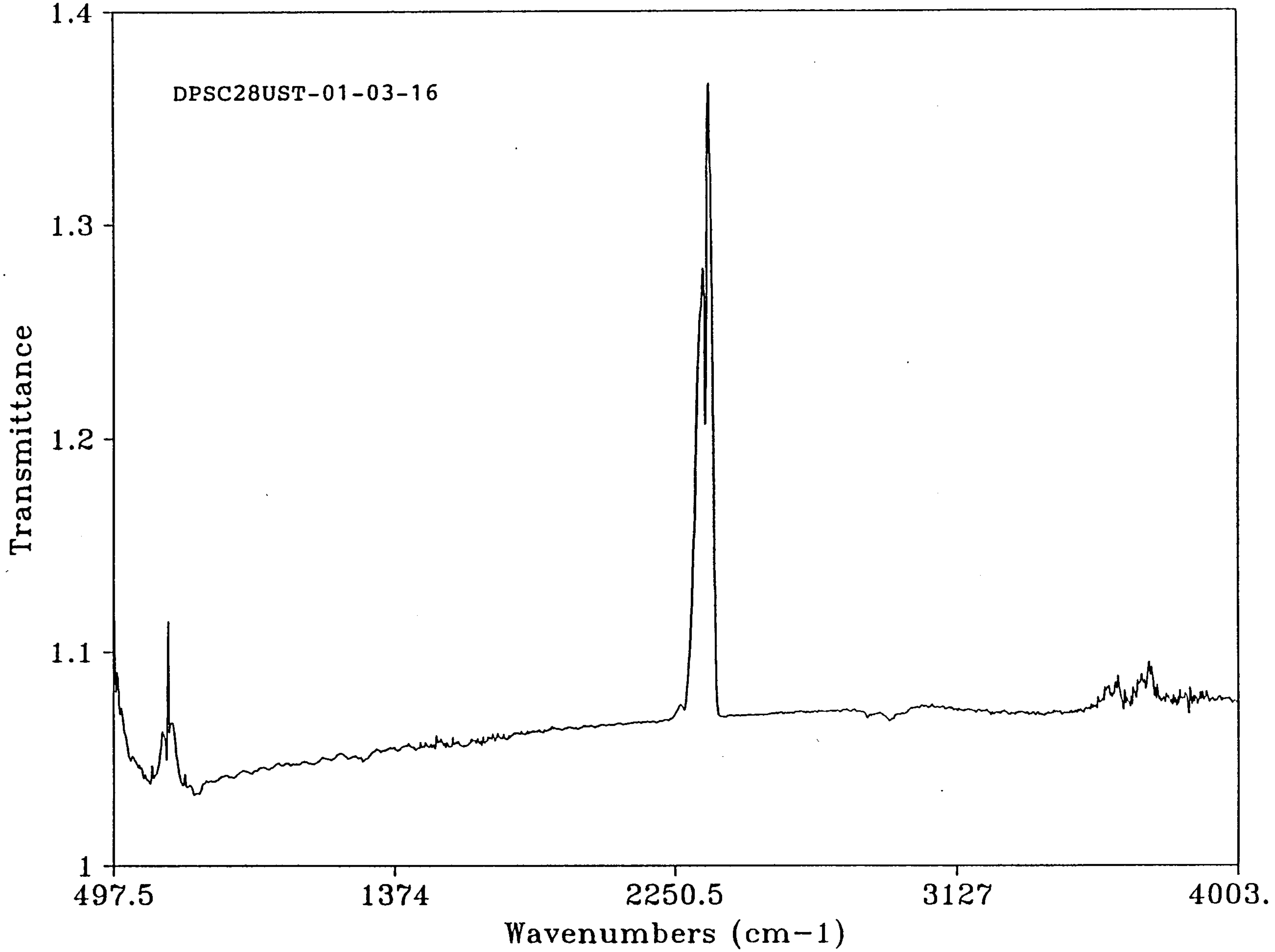

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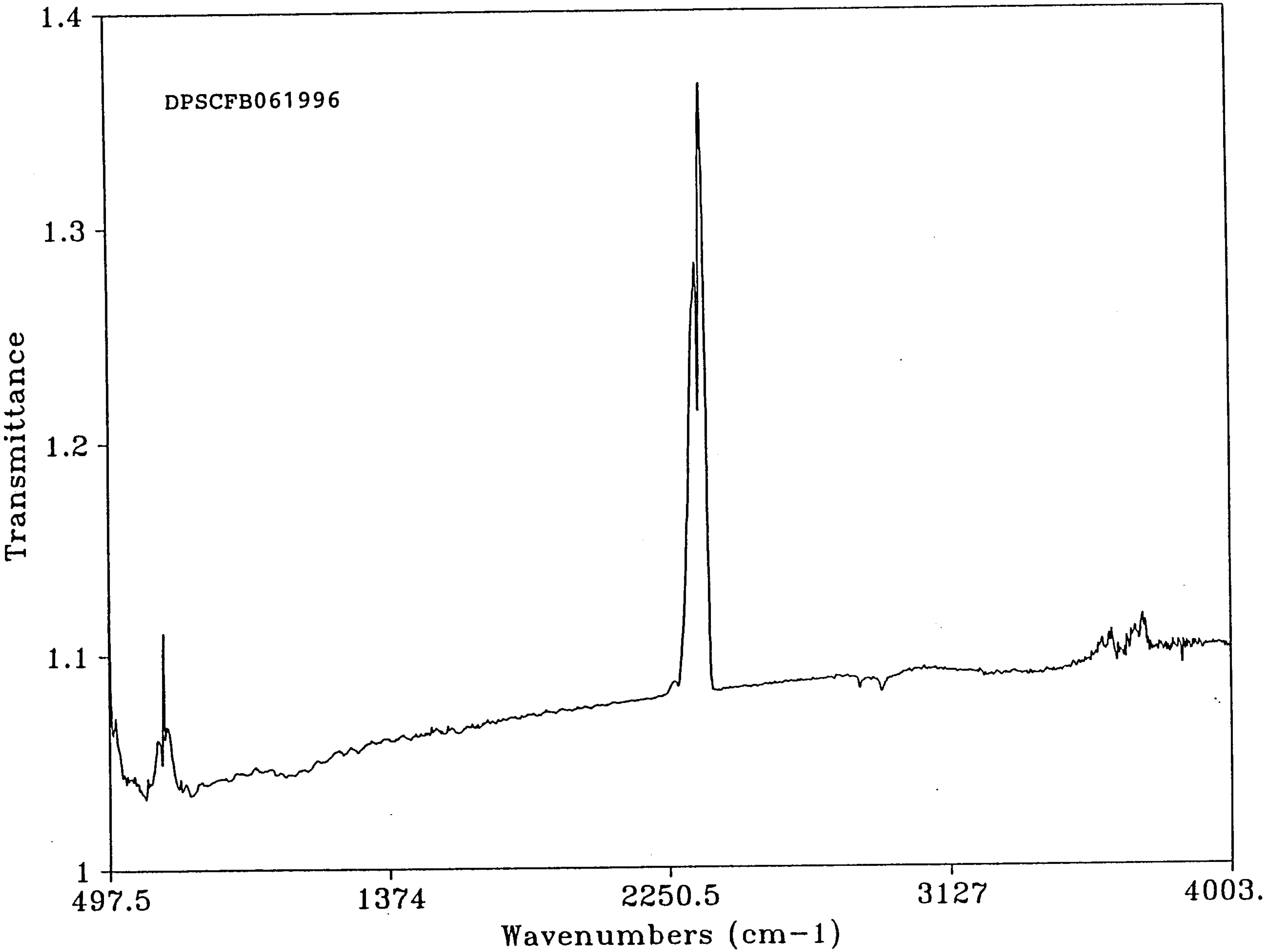

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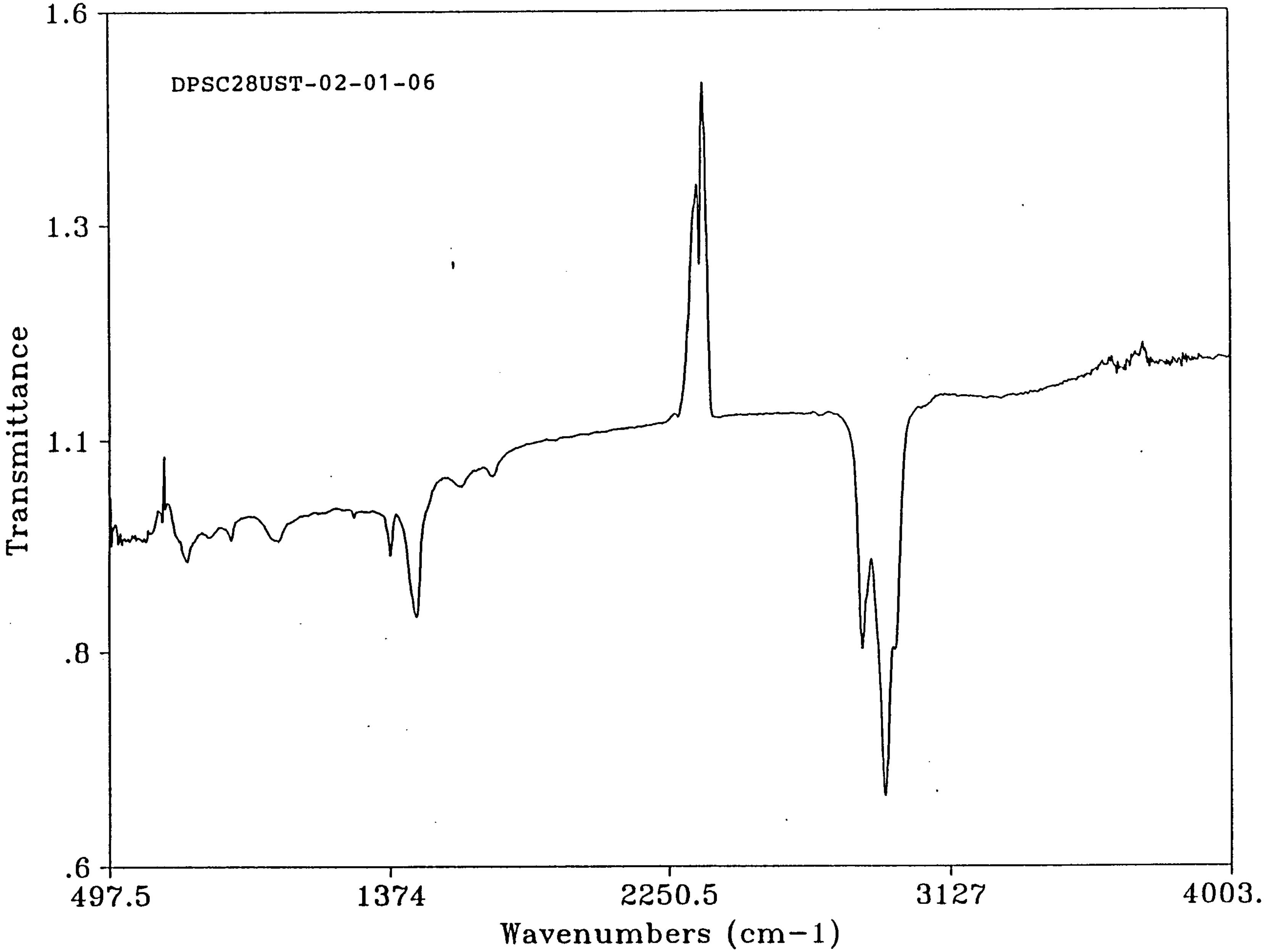

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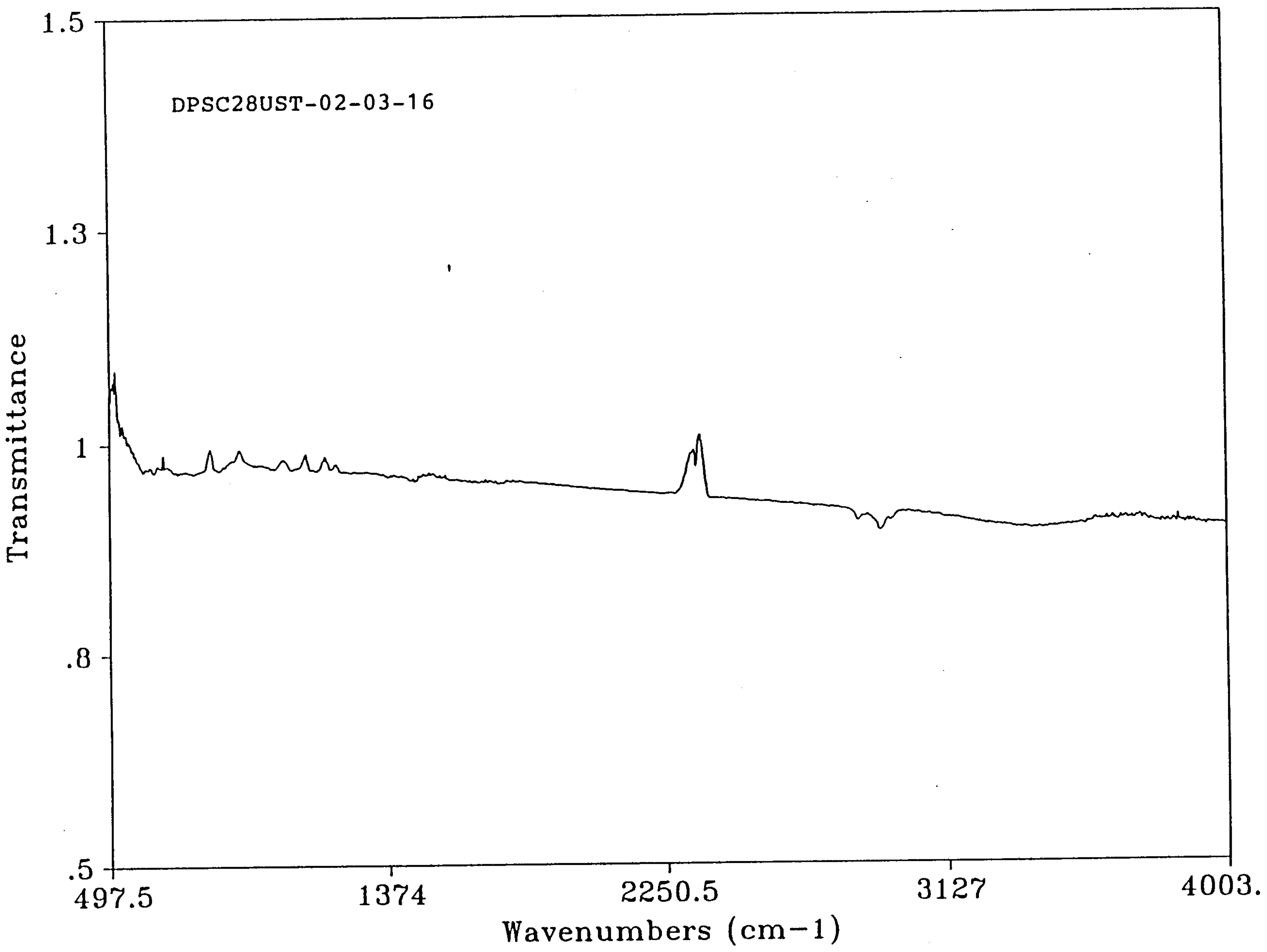
70000 TRANSMITTANCE



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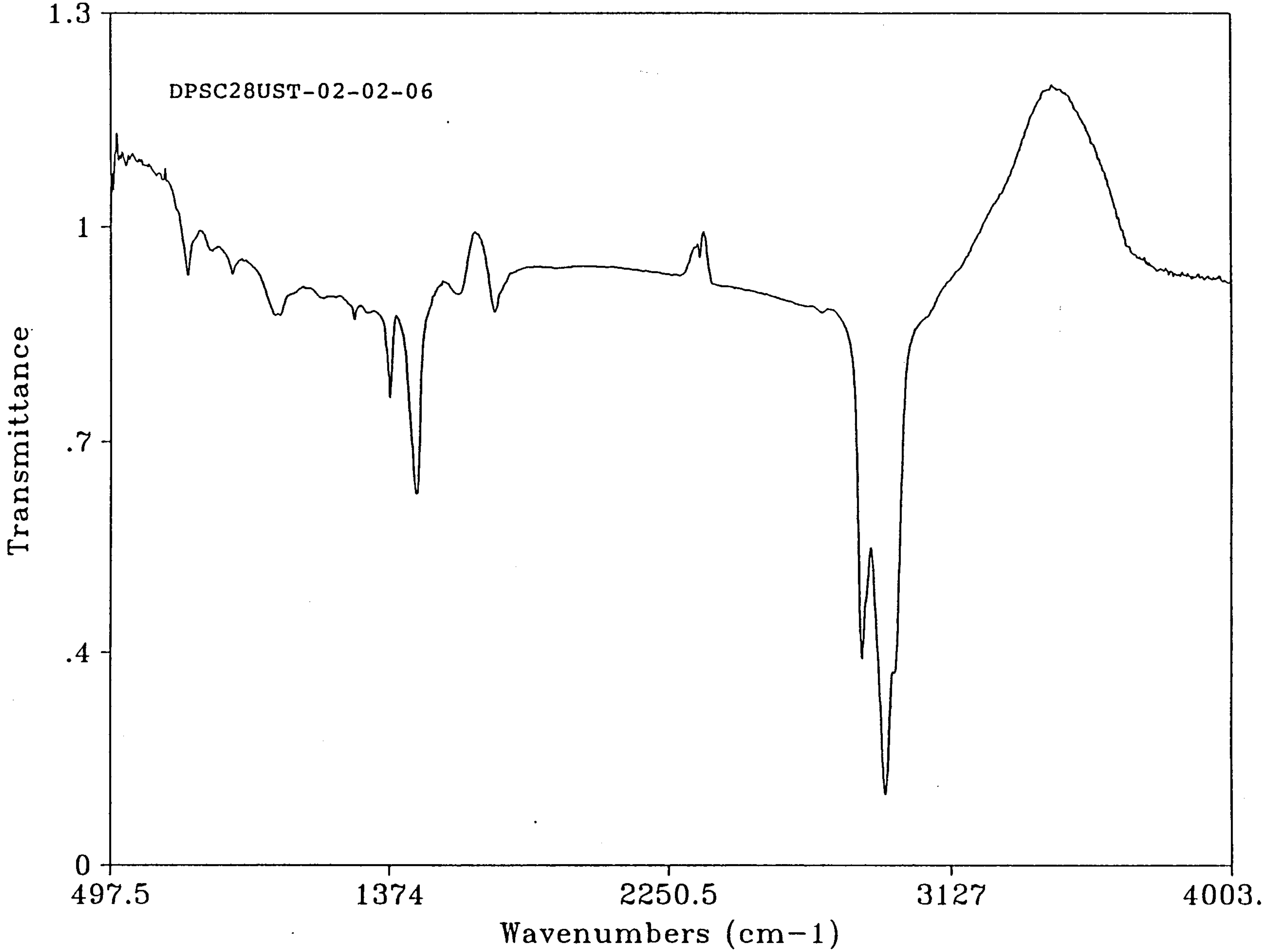

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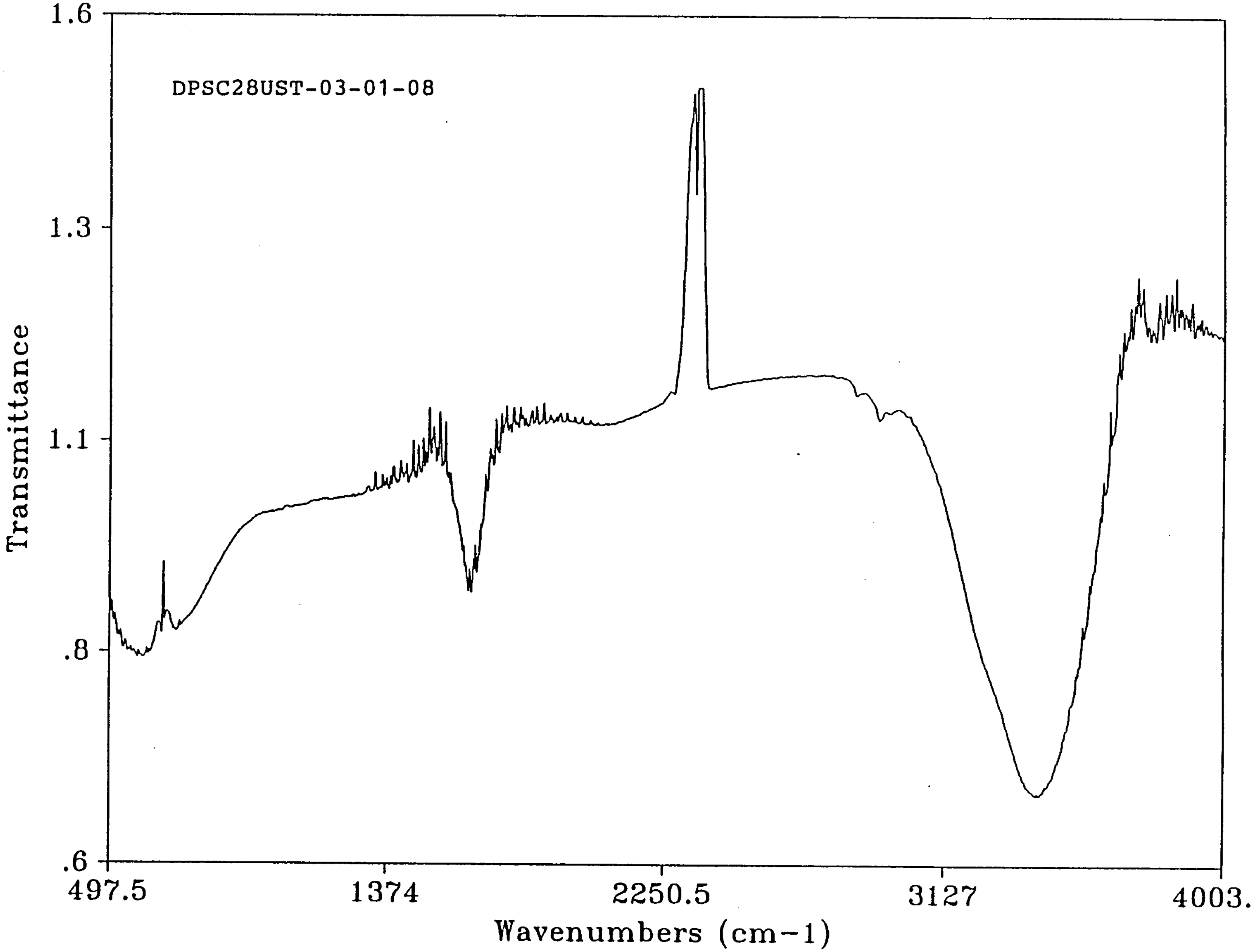

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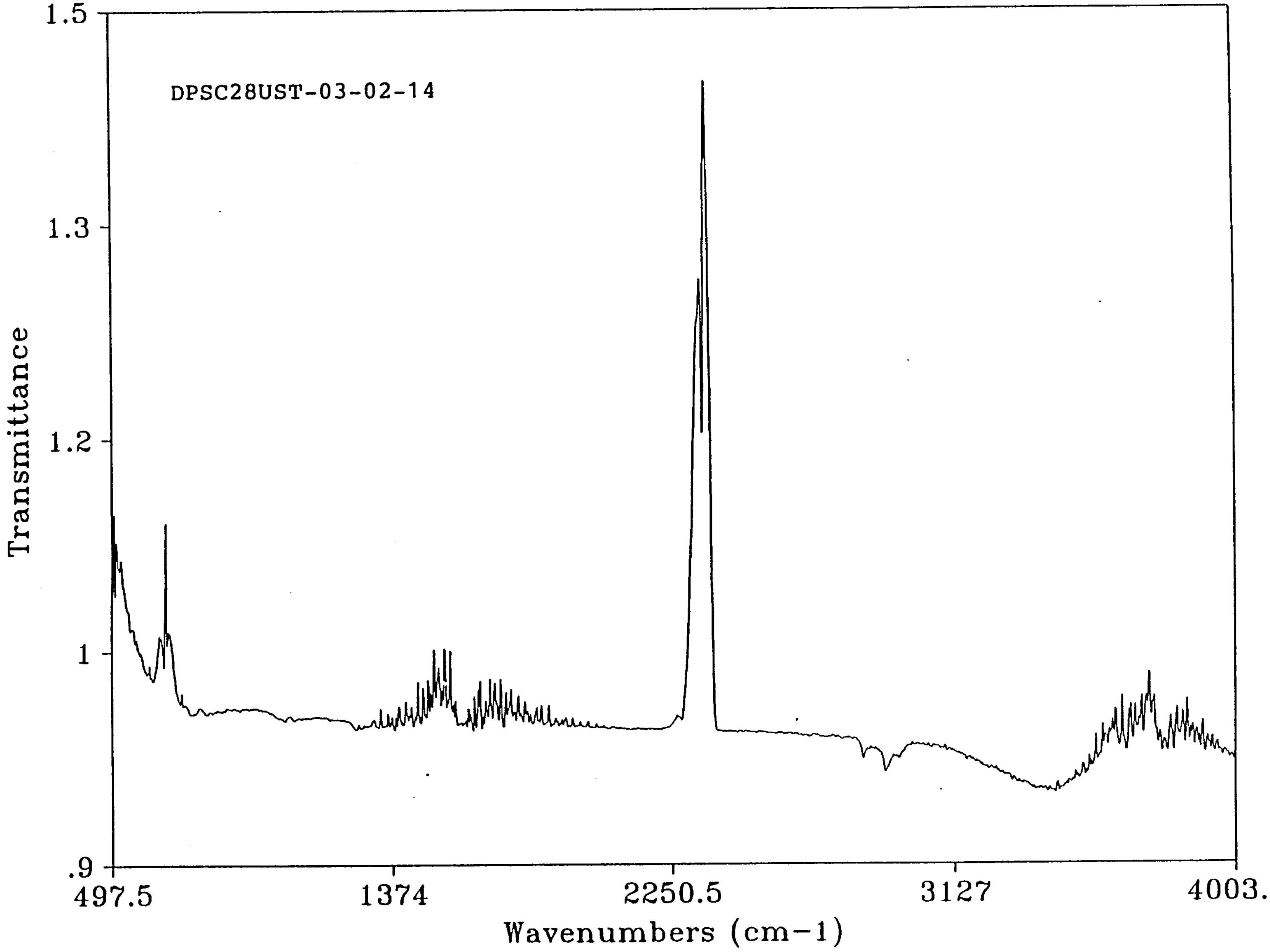

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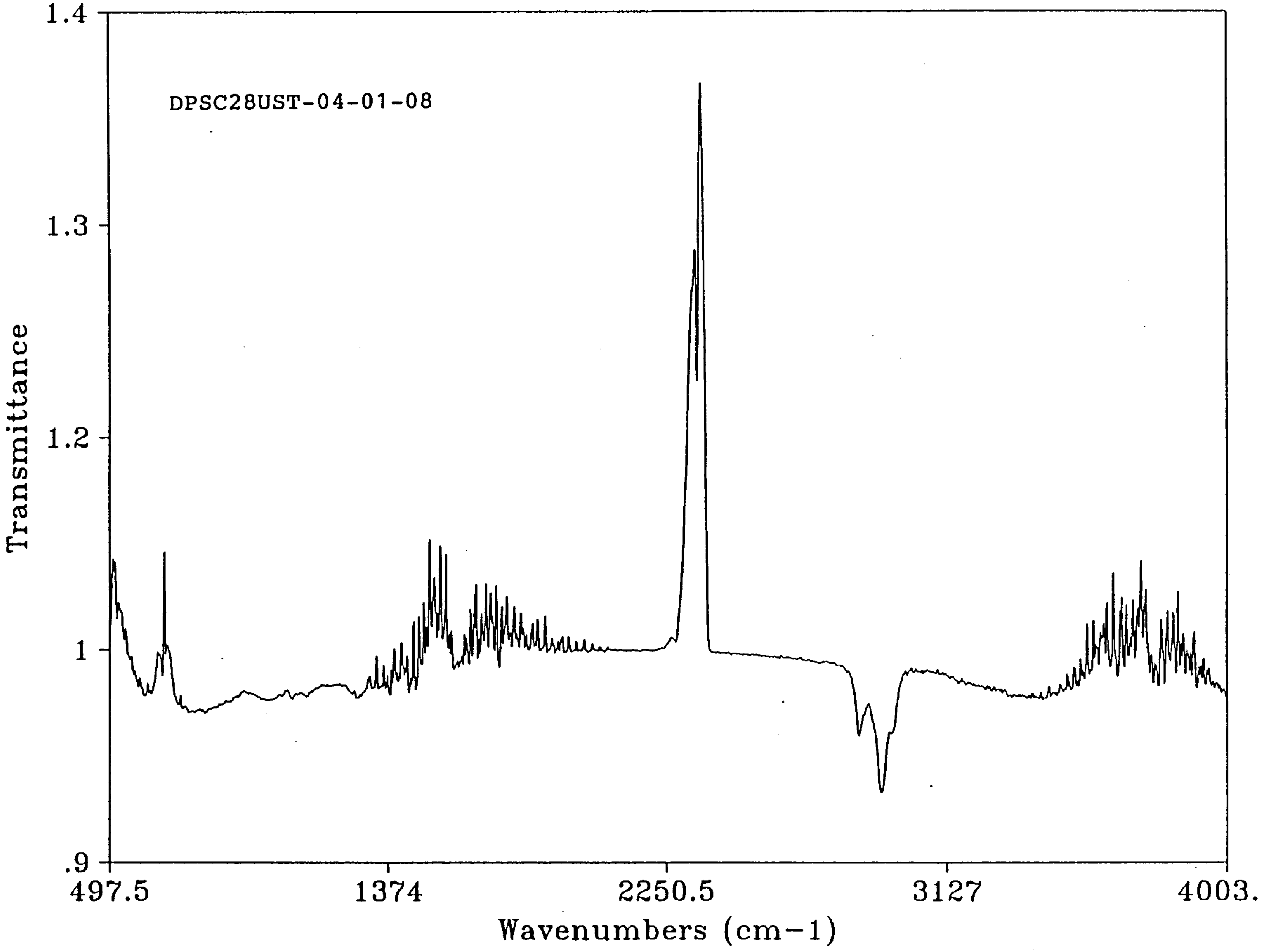

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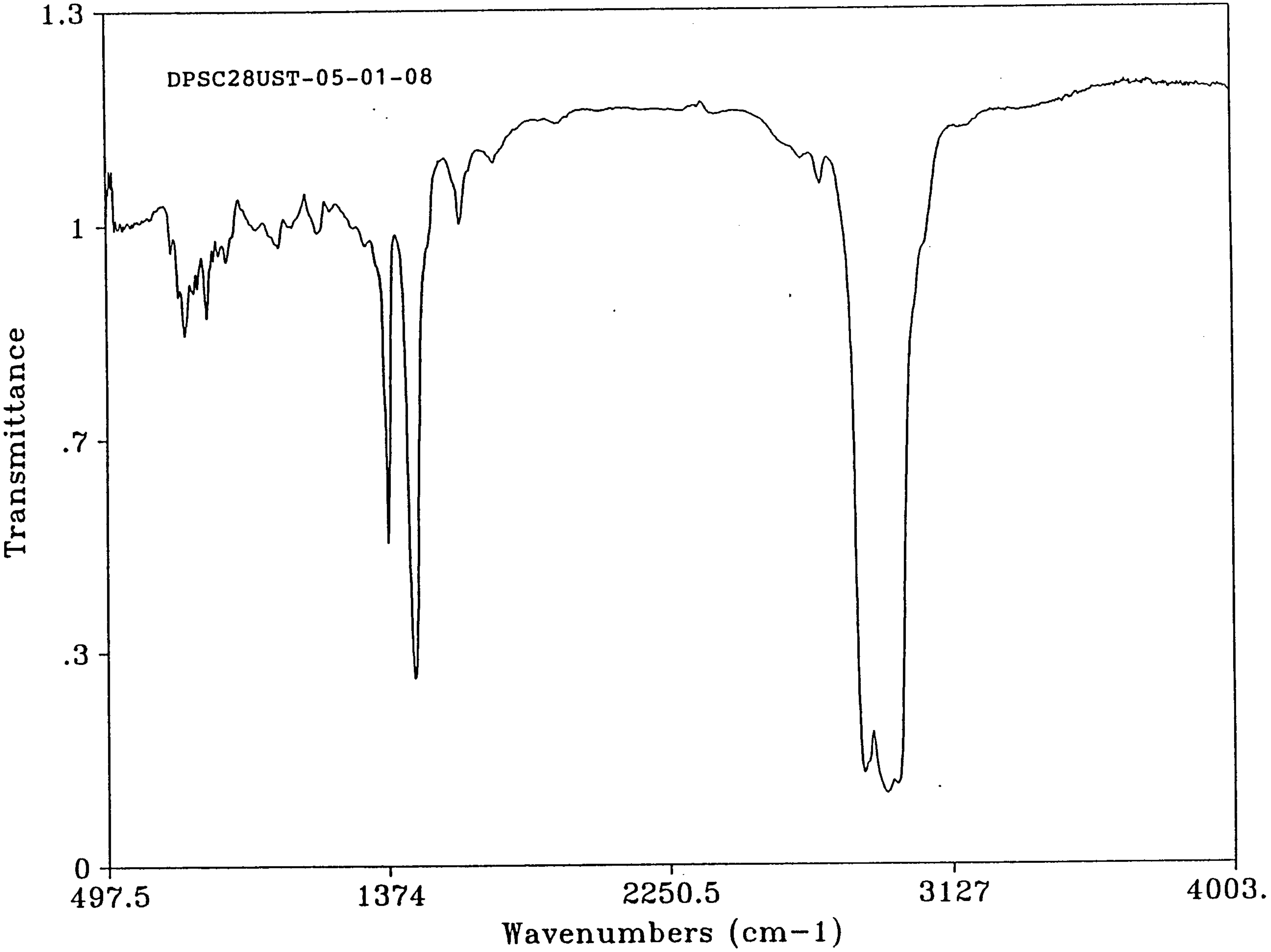

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Res= 4

06/27/96 16:12

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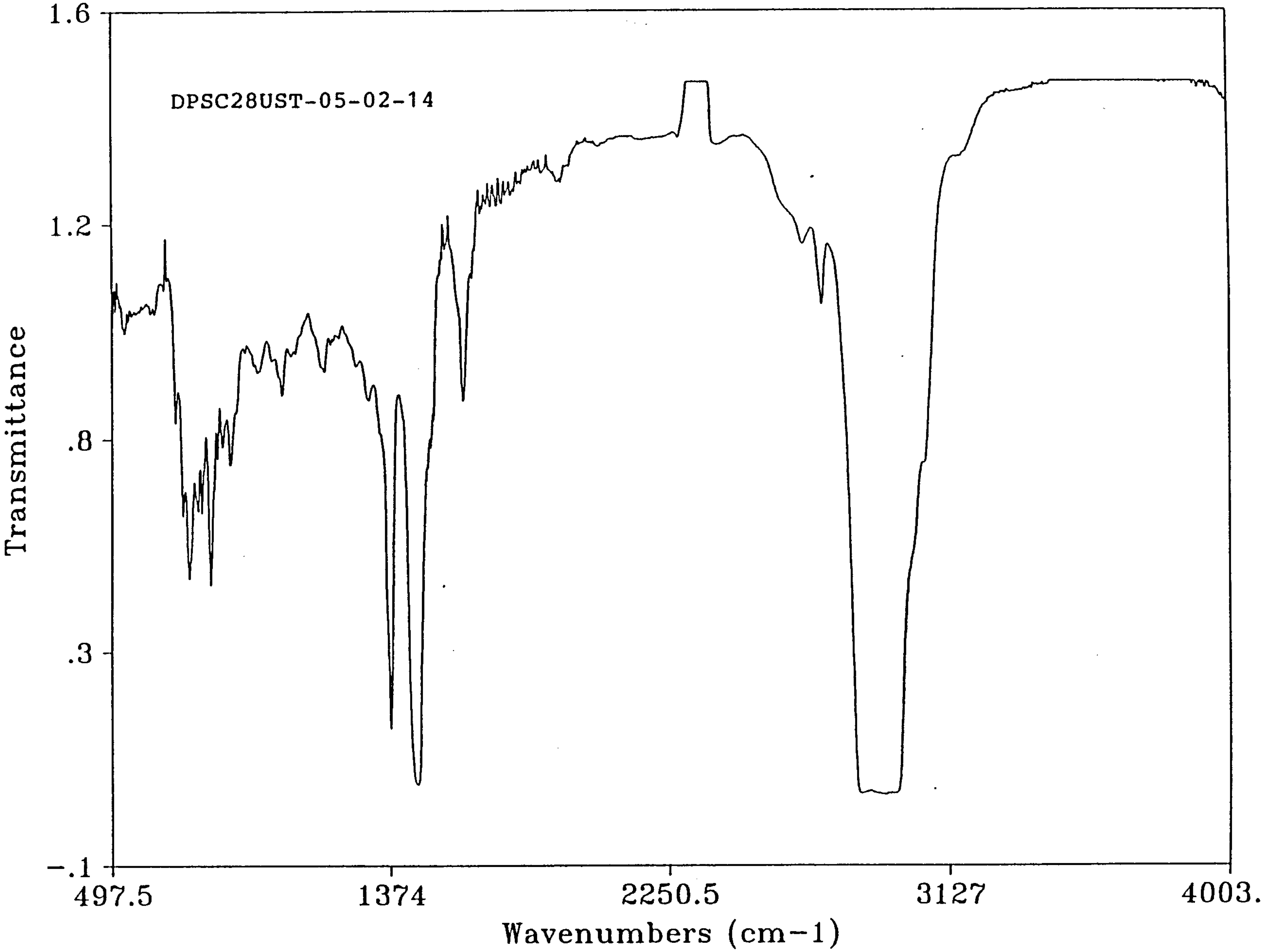

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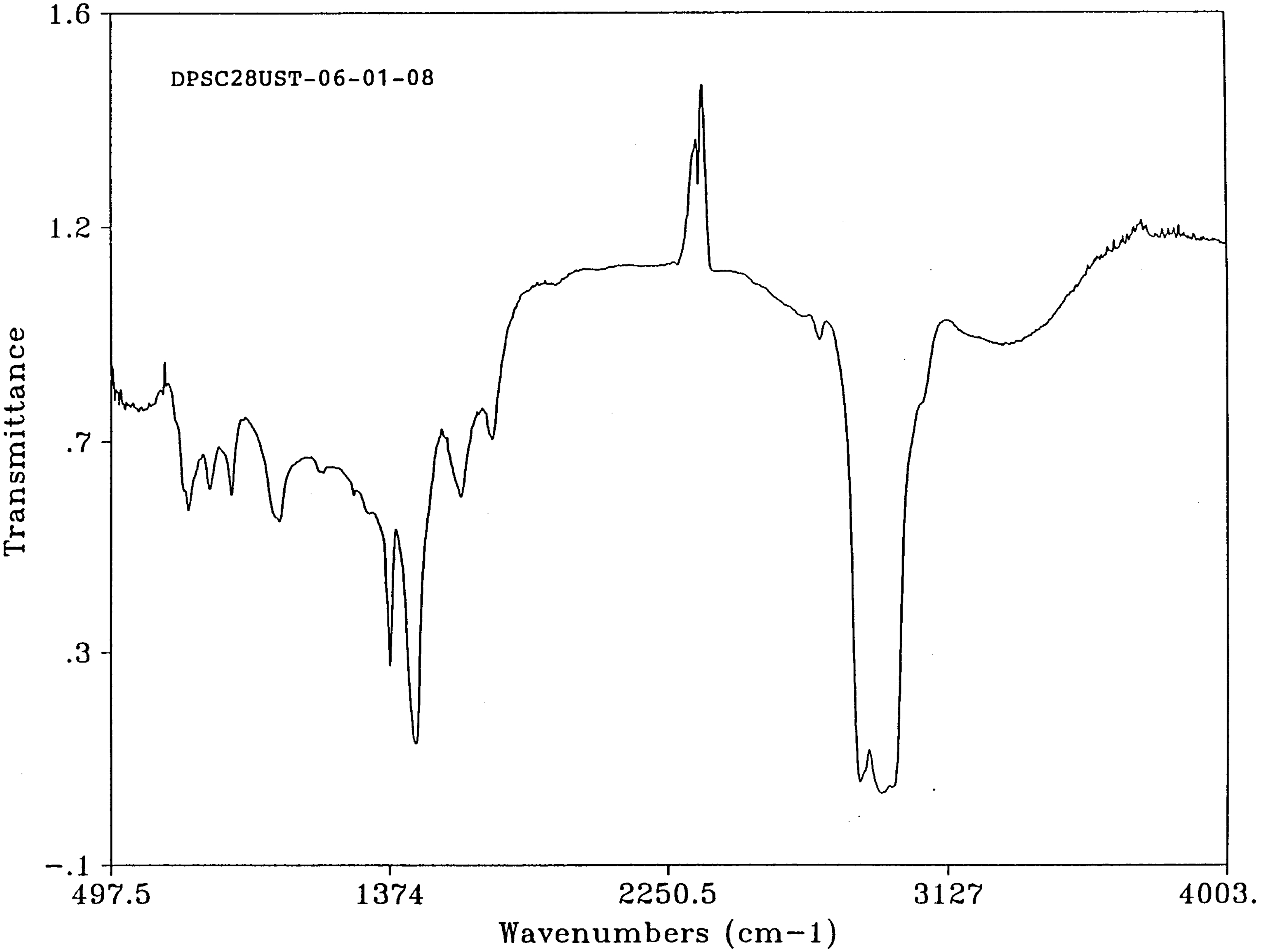

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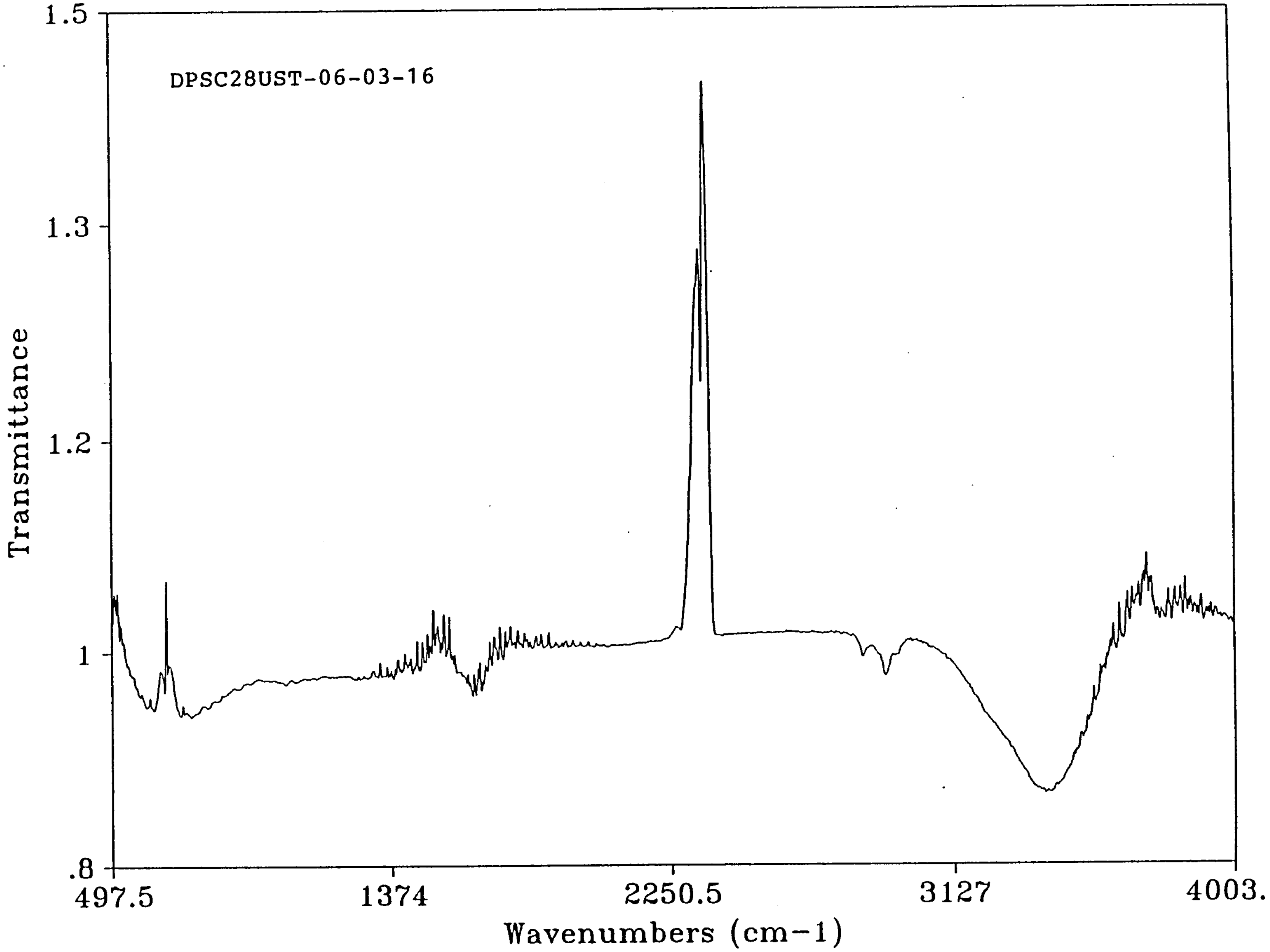

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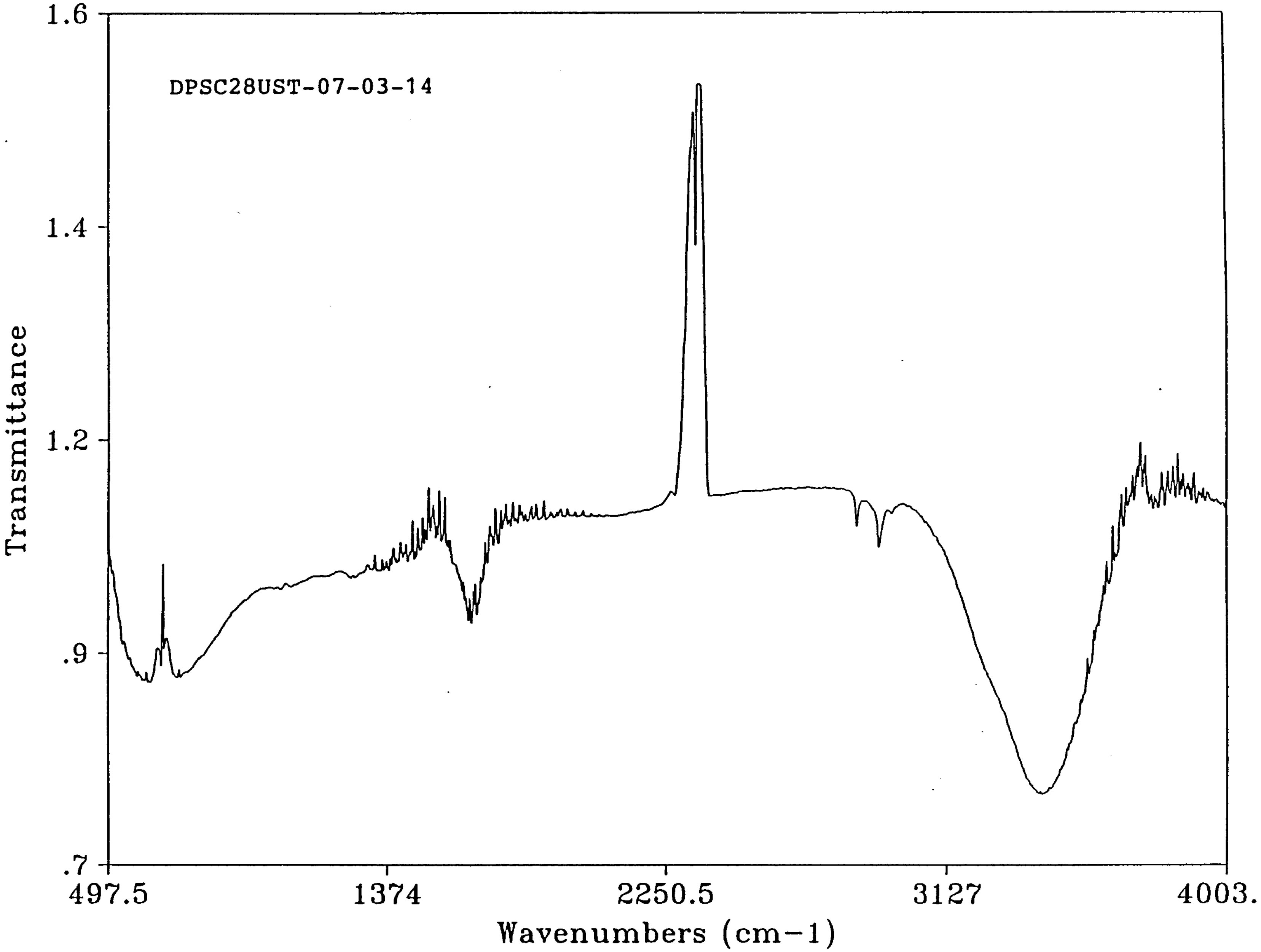

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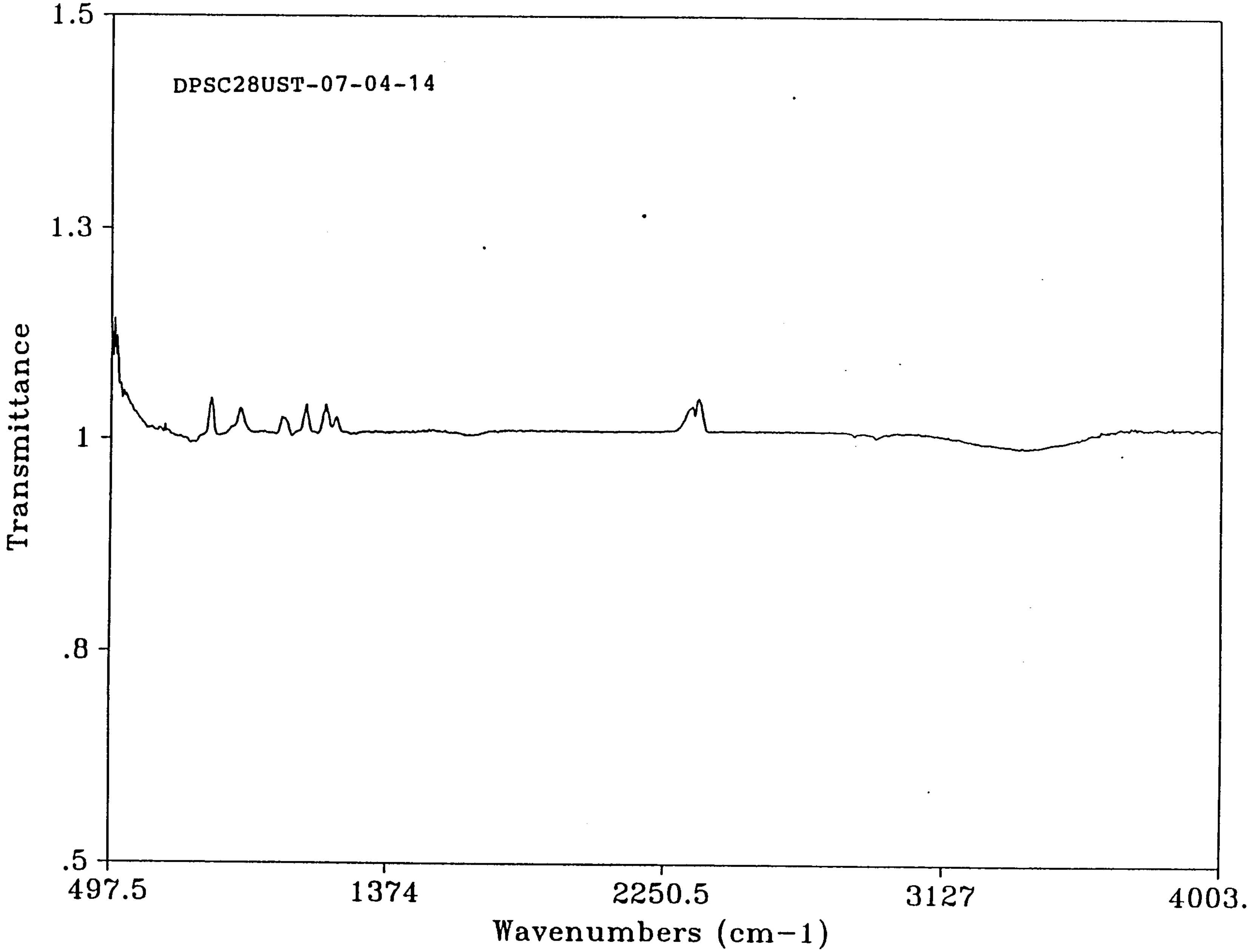

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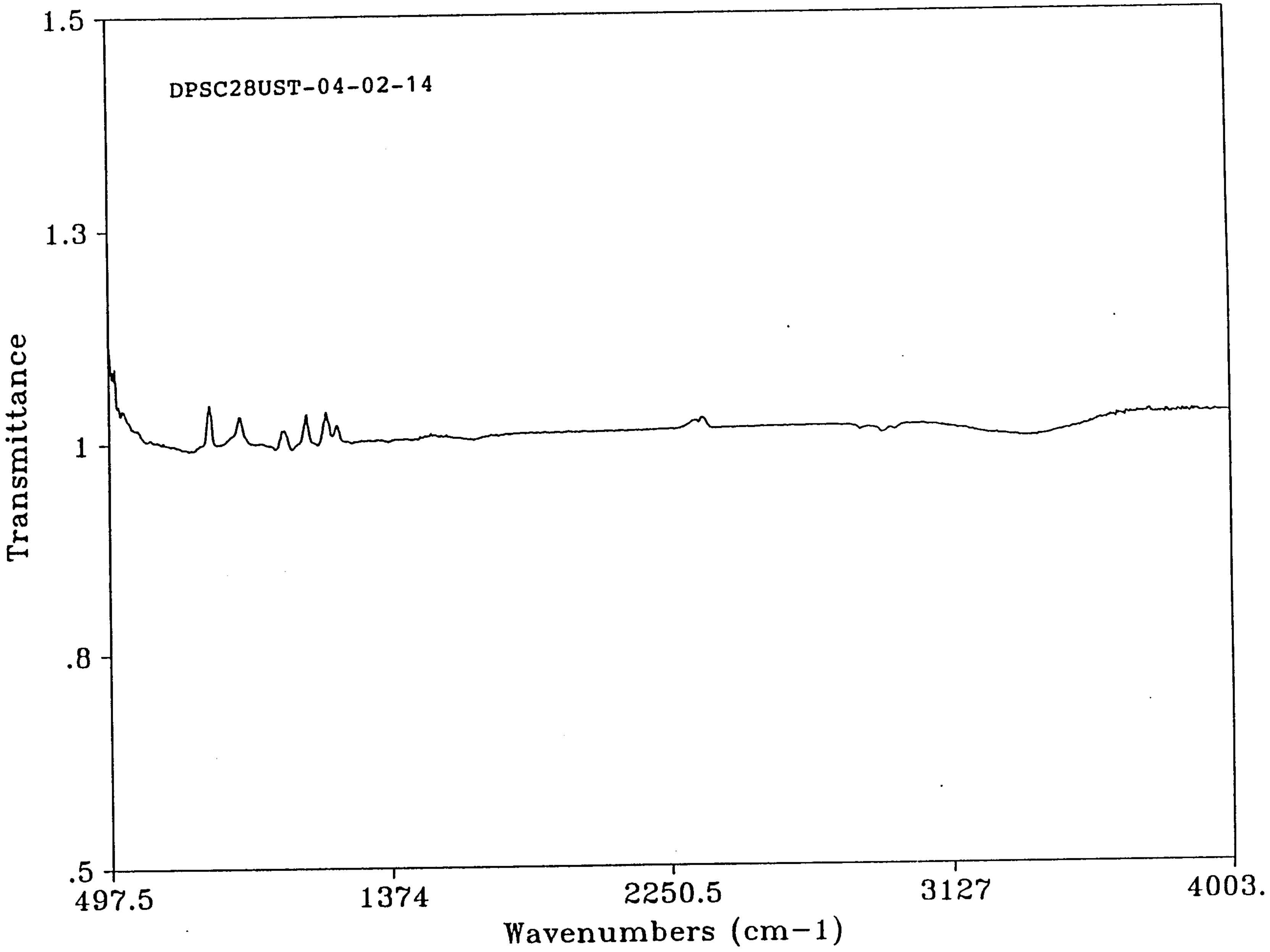

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Res= 4

06/28/96 09:51

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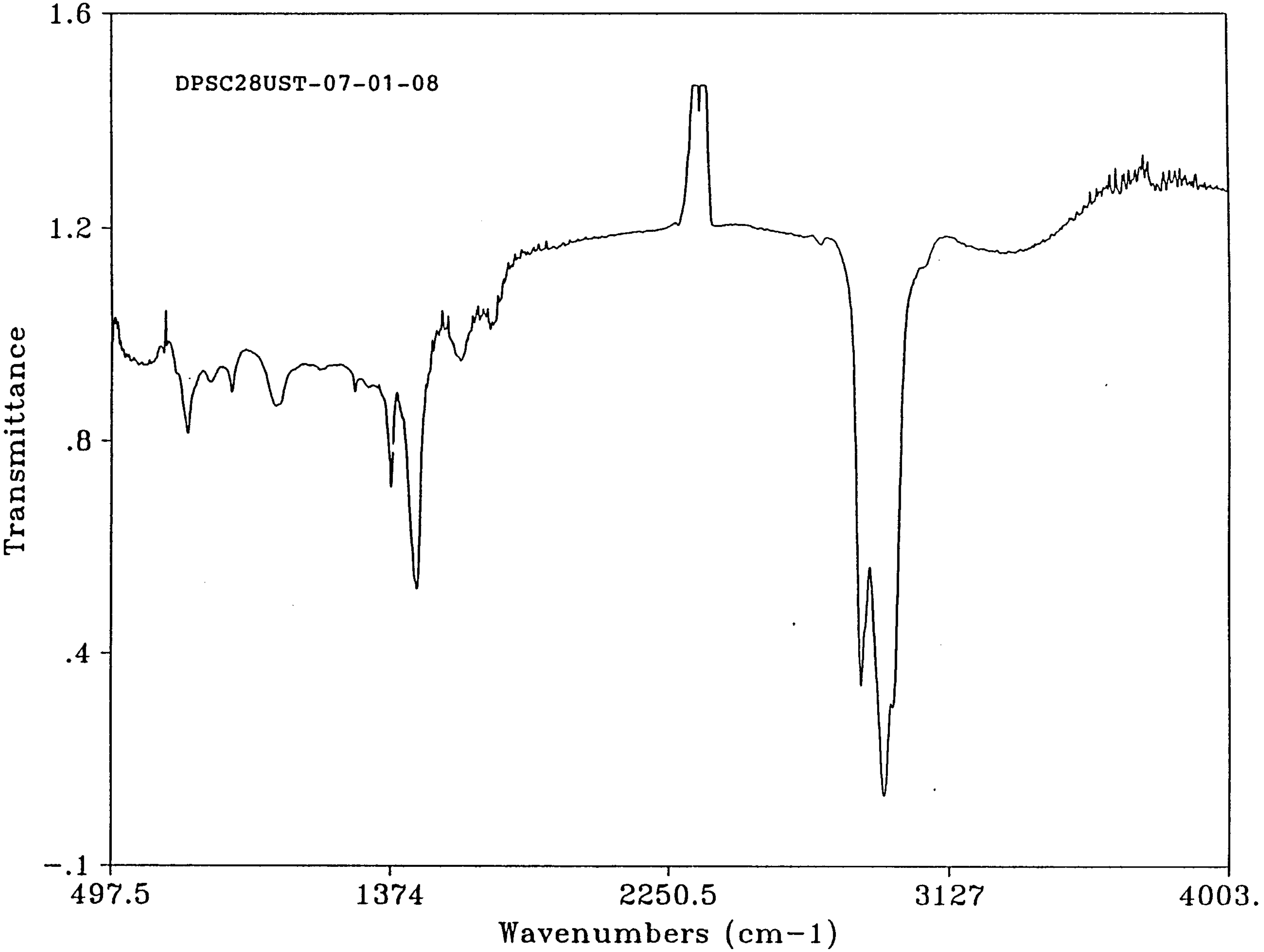

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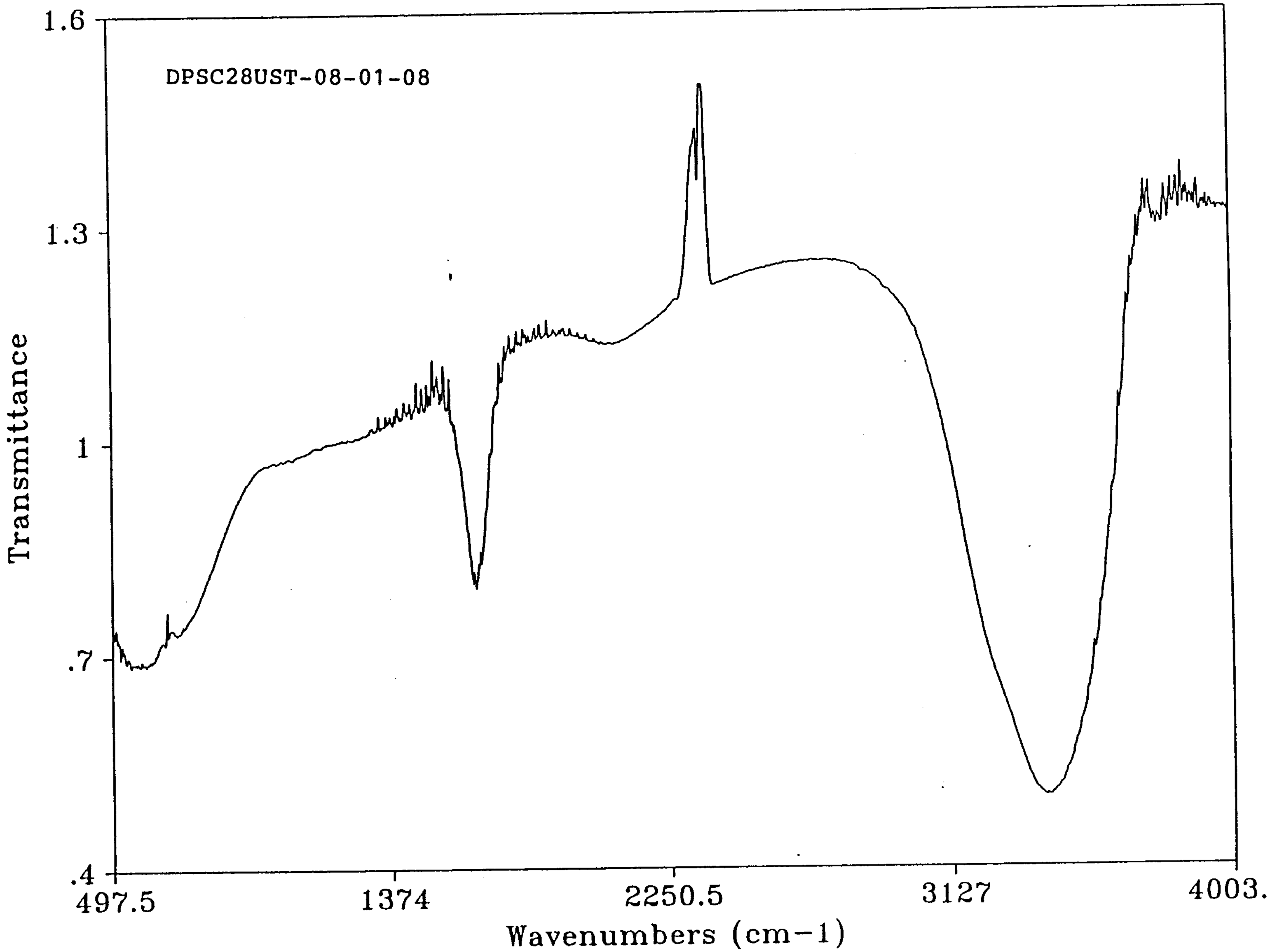

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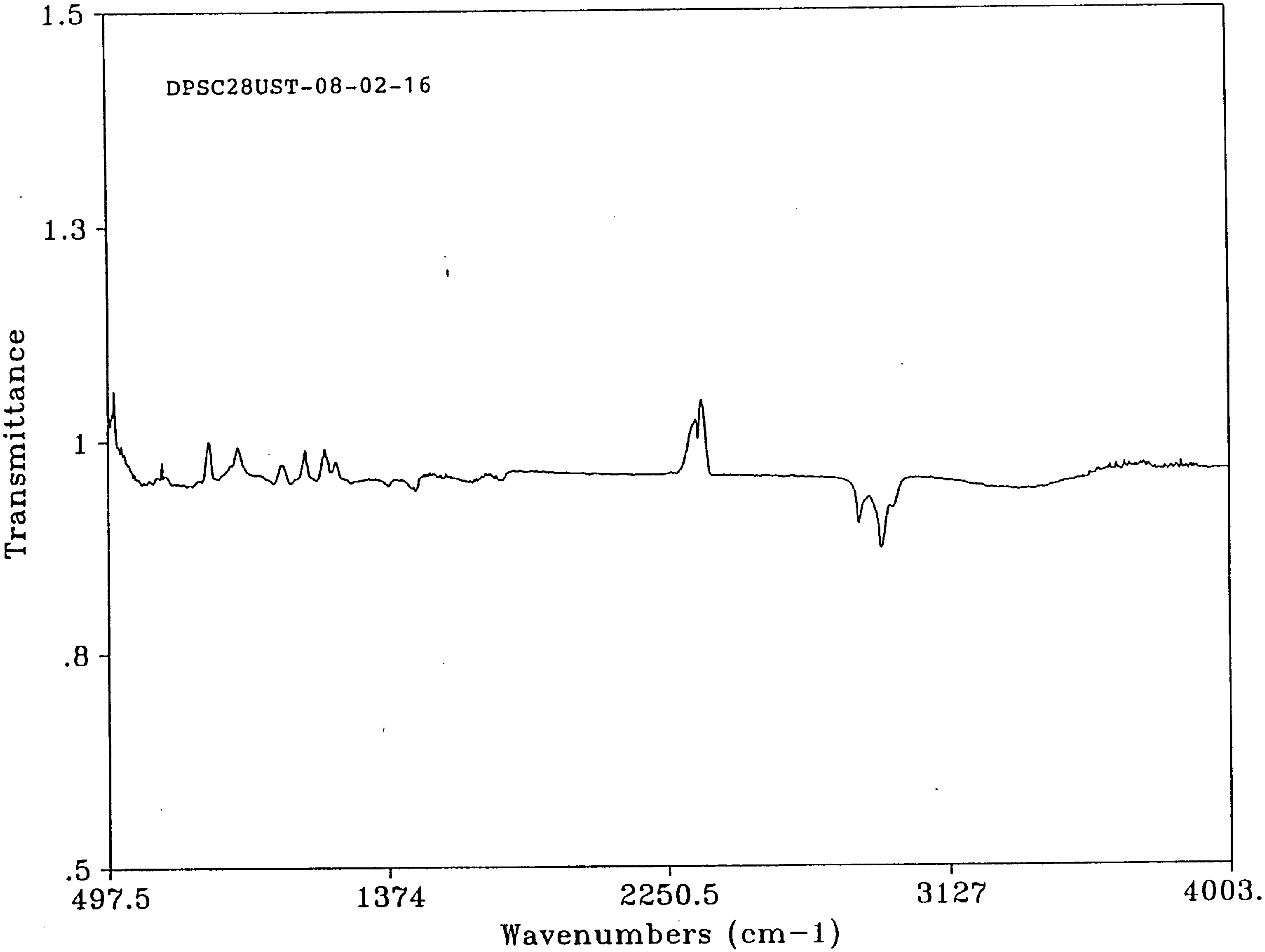

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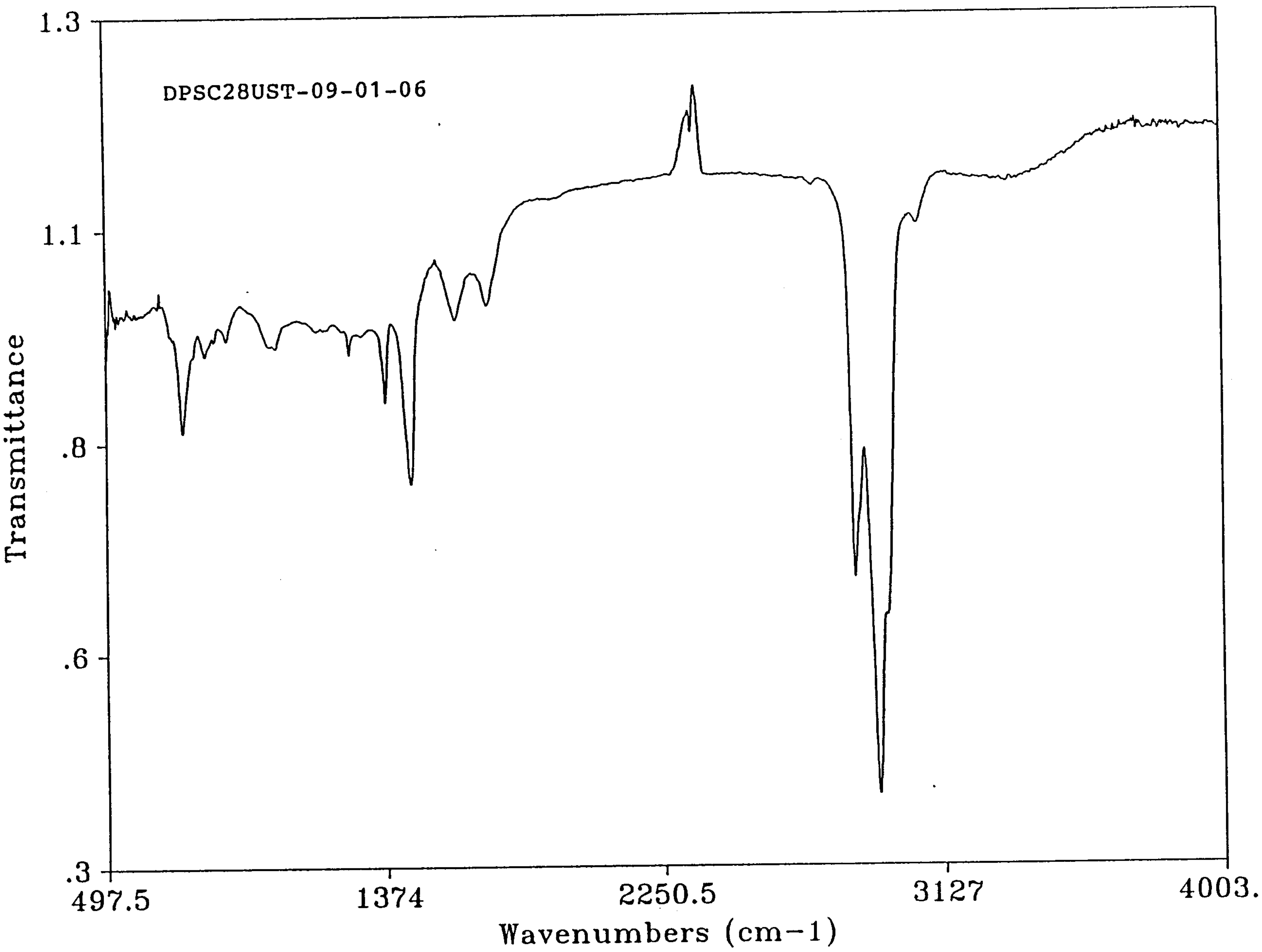

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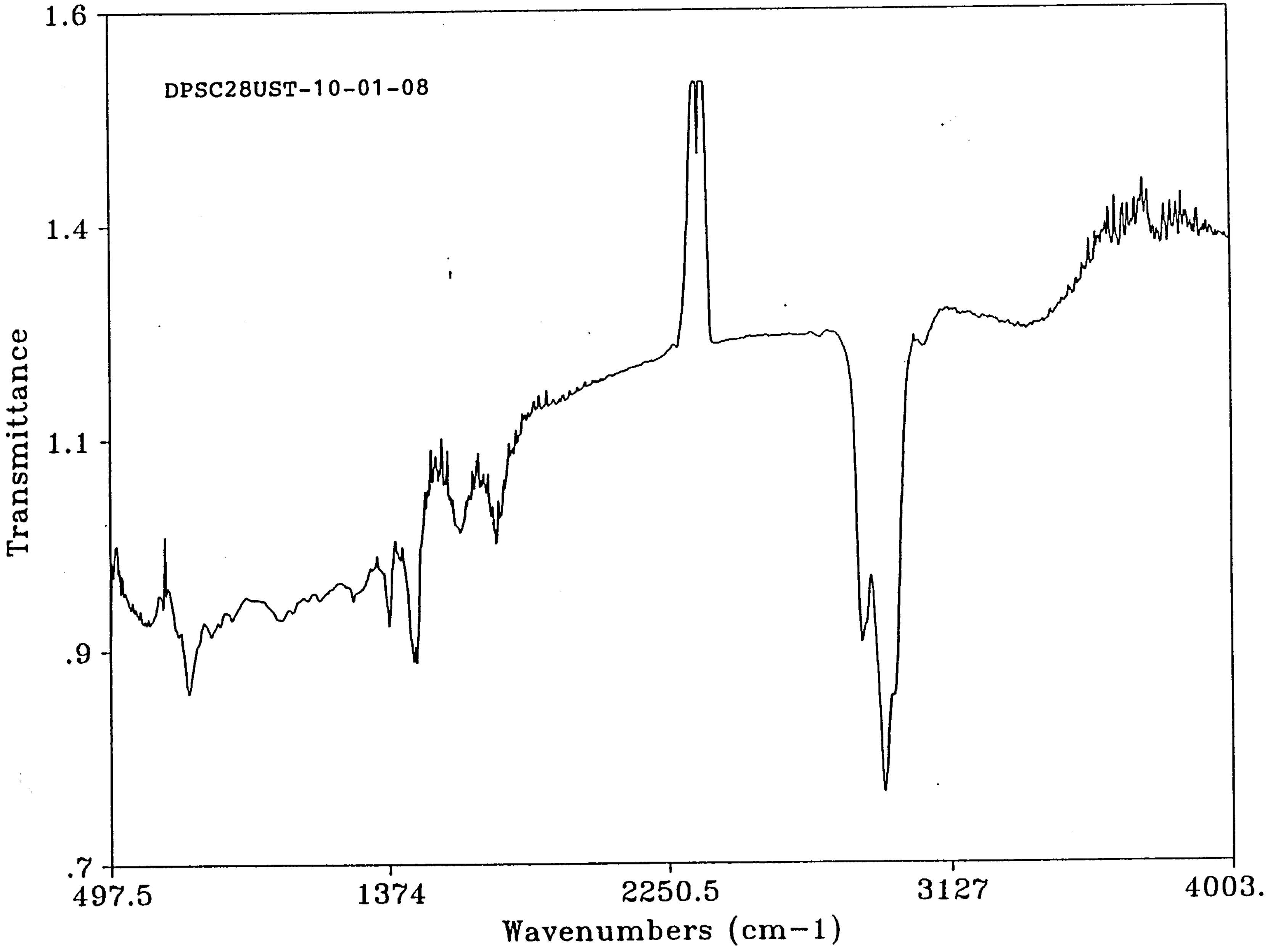

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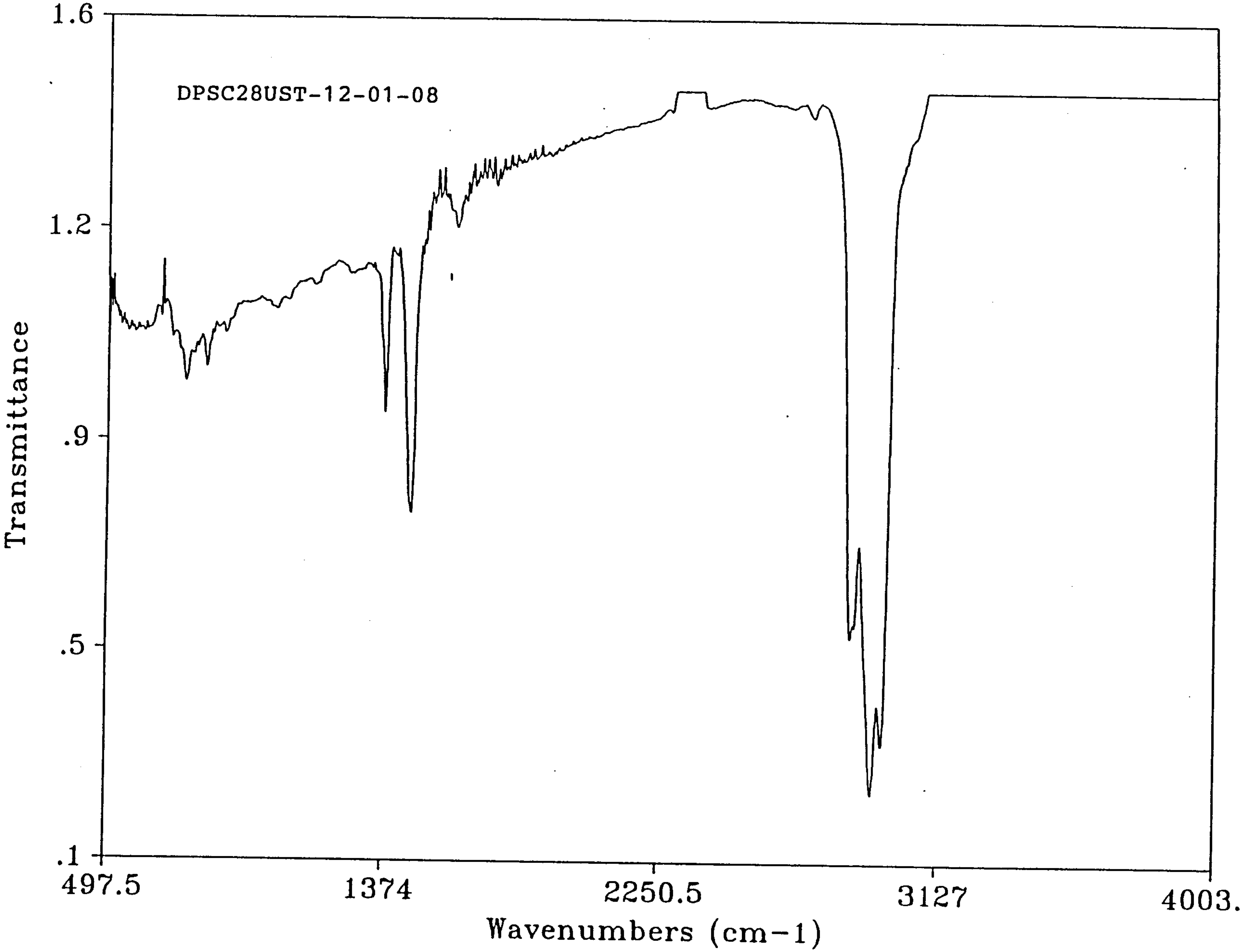

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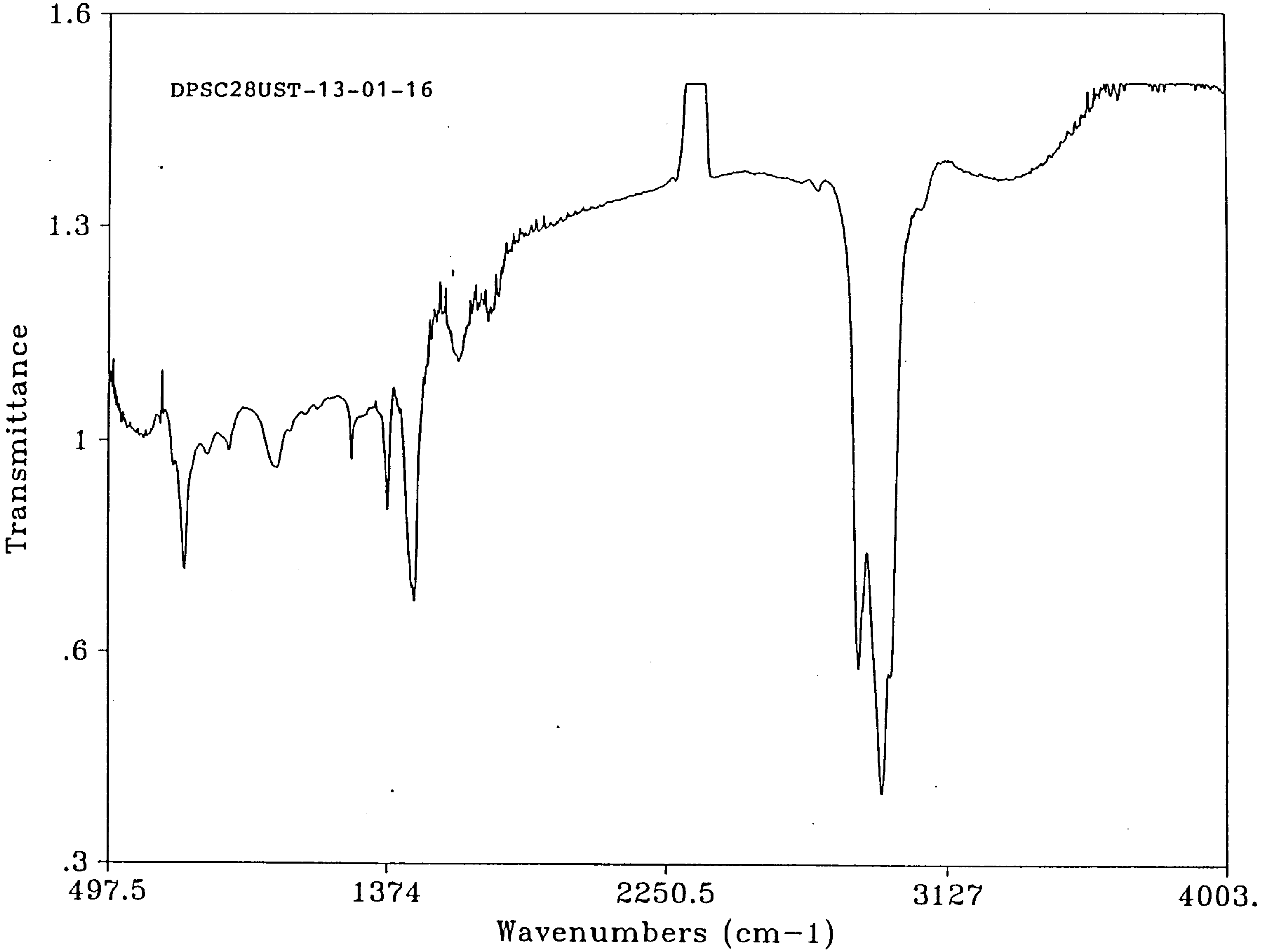

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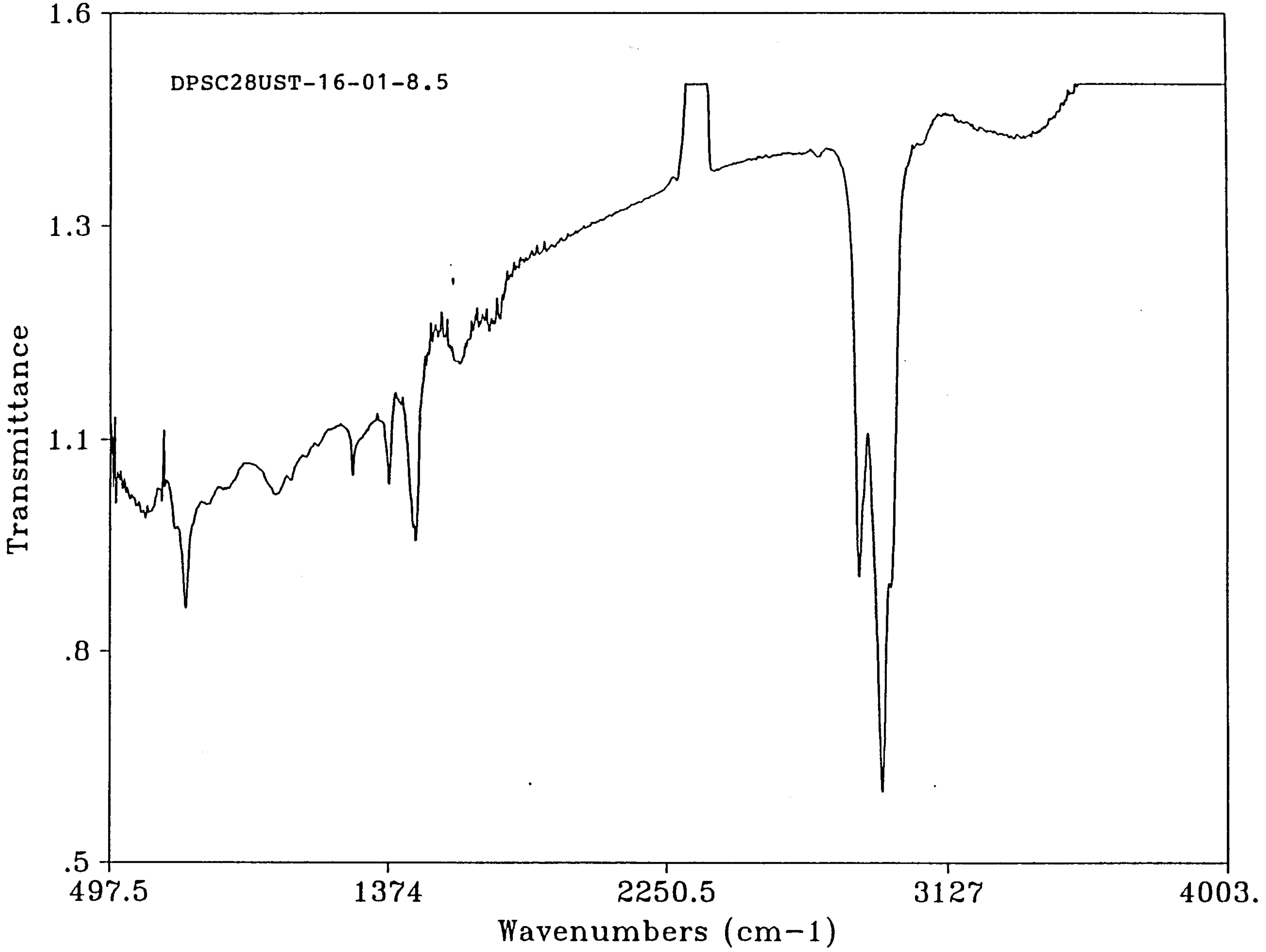

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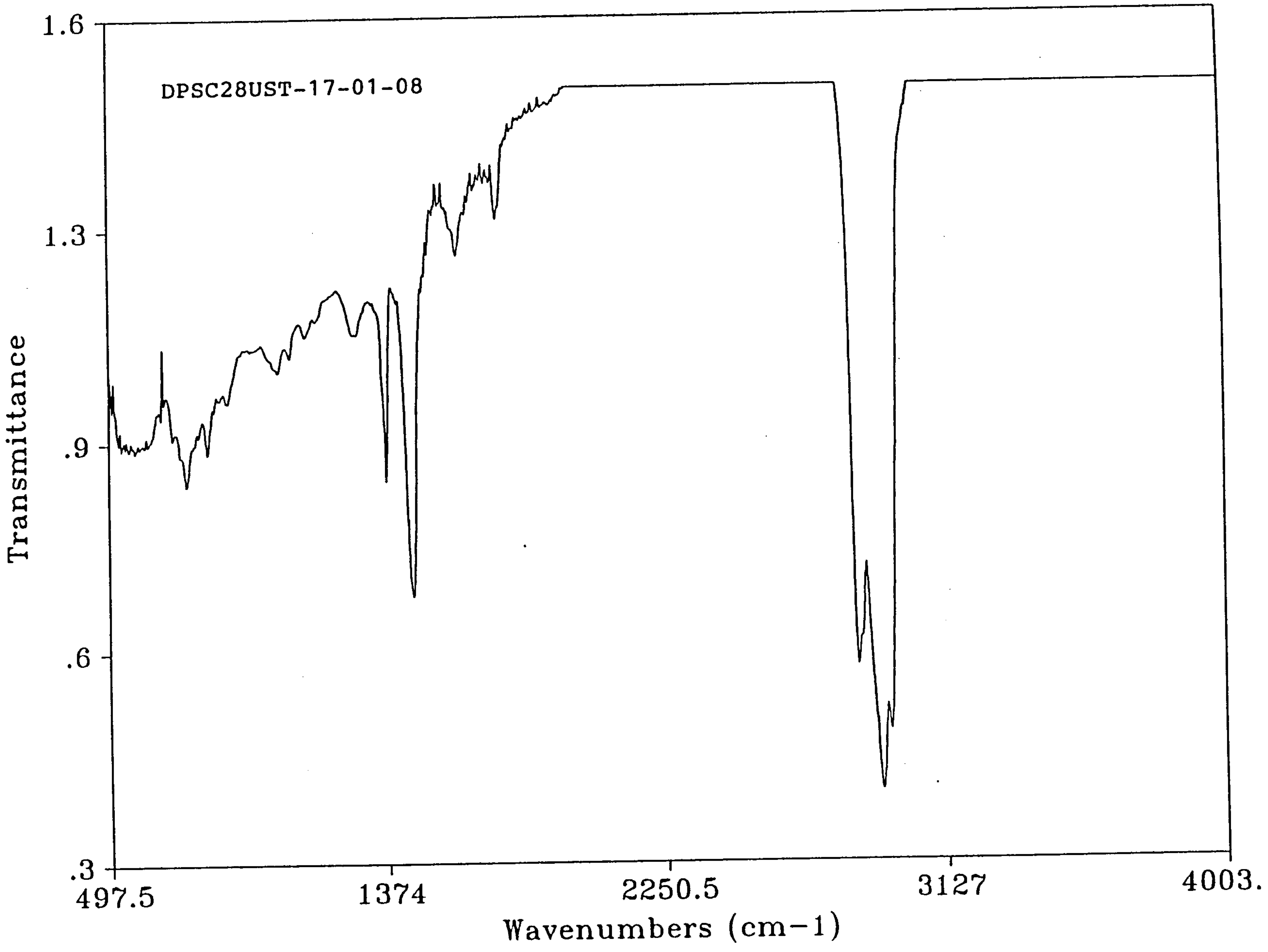

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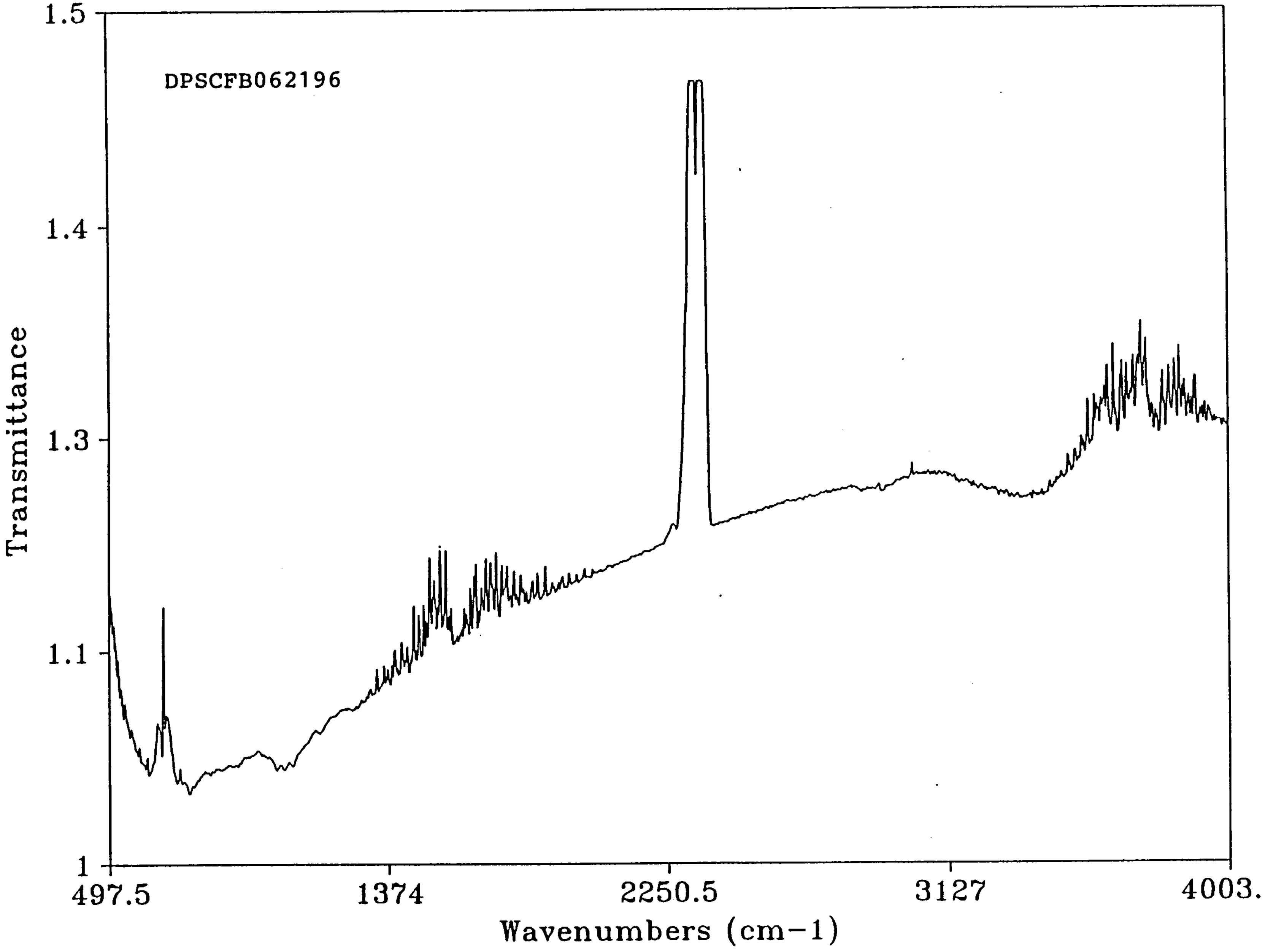

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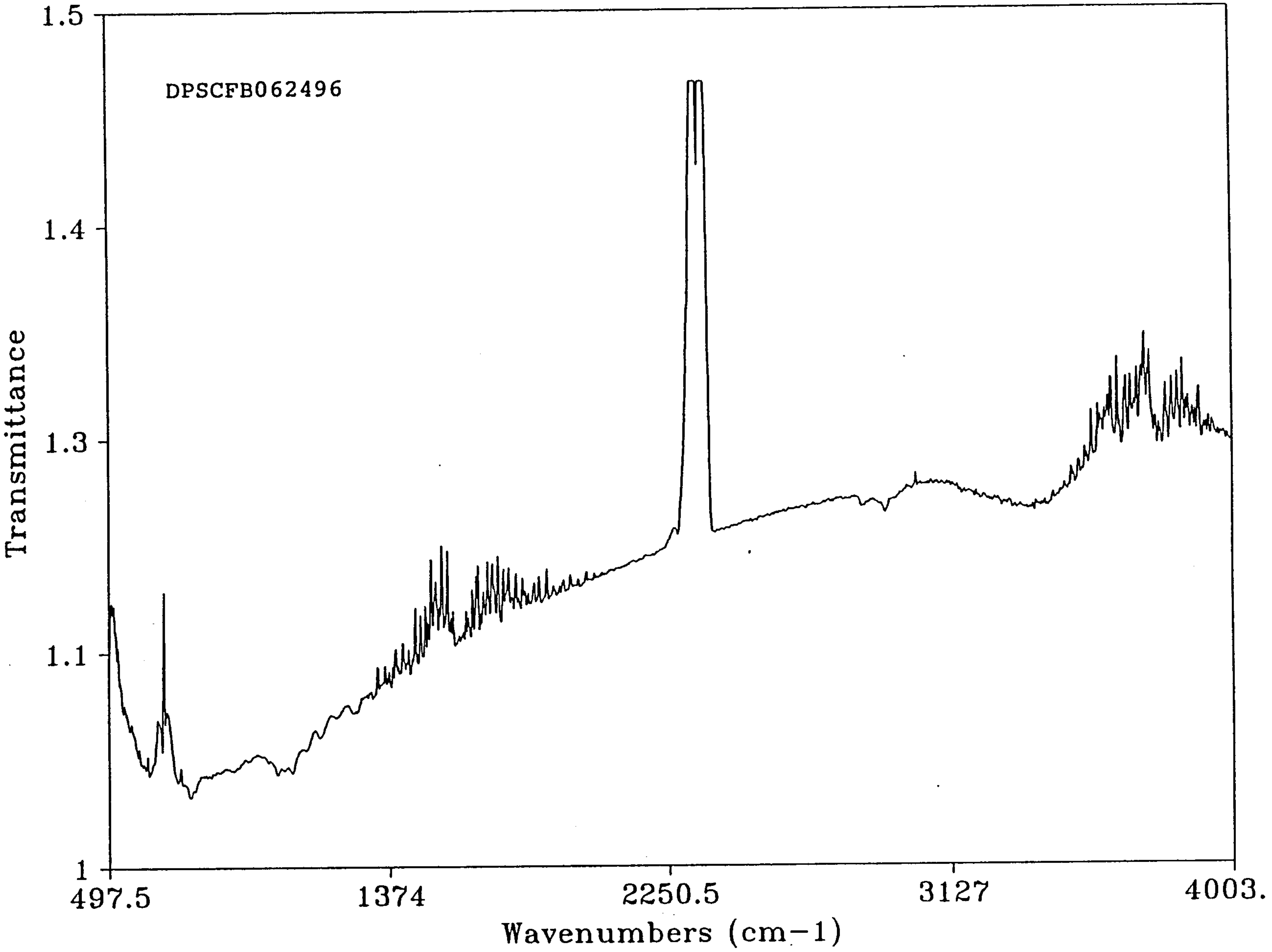

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70174; TRANSMITTANCE

TV1

KW HO
6.25.96.
11:30

PAGE 1 o

FRIED AN & BRUYA, INC.
3012 16 Avenue West
Seattle, A 98119-2029
(206) 2 3282

SAMPLE CHAIN OF CUSTODY

Send R To: Comp MALCOLM PIRNIE INC. Contact CAROLE TOMUNS
Address 104 CORPORATE PARK DRIVE
City, S Zip WHITE PLAINS, NEW YORK 10602
Phone 914-694-2100 Date 6/24/96

SITE N	PROJECT NAME	PURCHASE ORDER #
285-642	DPSC	0285-642.2

SAMP S (signature) / MPI

PROJECT LOCATION: PHILADELPHIA, PA

REMA
L COLLECTED SAMPLES FOR MPI

SAMPLE DISPOSAL INFORMATIC
☐ Dispose after 30 days
☐ Return Samples
☐ Call for Instructions

mple #	Date/Time Sampled	Type of Sample	# of Jars	Lab Sample #	Analyses Requested
DPSC2 -01-01-04	6/20/96 / 0915		1 ✓	70150	IR SCAN
DPSC TP-02-01-03	6/20/96 / 1015		1 ✓	70151	" "
DPSC TP-03-01-03	6/20/96 / 1115		1 ✓	70152	" "
P-03-03-03	6/20/96 / 1115		1 ✓	70153	HFS
DPSC P-03-04-03	6/20/96 / 1115		1 ✓	70154	HFS
DPSC P-04-01-03	6/20/96 / 1430		1 ✓	70155	IR SCAN
~~DPSC -05-04-04~~	~~6/20/96 / 1600~~	6/24/96			
DPSC2 -05-01-04	6/20/96 / 1600		1 ✓	70156	IR SCAN
DPSC P-05-02-04	6/20/96 / 1600		1 ✓	70157	HFS
DPSC P-05-03-04	6/20/96 / 1600		1 ✓	70158	HFS
DPSC TP-06-01-2.8	6/21/96 / 1230		1 ✓	70159	IR SCAN
DPSC TP07-01-3.9	6/21/96 / 1040		1 ✓	70160	" "
DPSC TP-07-02-3.9	6/21/96 / 1045		1 ✓	70161	" "
DPSC P-~~08~~-01-3.2	6/21/96 / 1120		1 ✓	70162	" "
DPSC P-~~09~~-01-04	6/21/96 / 1240		1 ✓	70163	" "

SIGN RE	PRINT NAME	COMPANY	Date	Ti
Rein by:	JOHN ARCHIBALD	MALCOLM PIRNIE	6/24/96	20
Rece Ky Lowring	CATHY DOWNING	FABI	6/25/96 ~~6/27/96~~	10.
Relinc by:				
eiv				

FOR

09/

KW NU
6.25.96
11:30

PAGE 2 OF

FRIEDMAN & BRUYA, INC.
3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282

SAMPLE CHAIN OF CUSTODY

Send Report To:
Company SEE PAGE
Contact 1 OF
Address
City, State, Zip
Phone #
Date

SITE NO.	PROJECT NAME	PURCHASE ORDER #

SAMPLERS (signature) MPI

PROJECT LOCATION

REMARKS
LBA COLLECTED SAMPLES FOR MPI

SAMPLE DISPOSAL INFORMATIC
☐ Dispose after 30 days
☐ Return Samples
☐ Call for Instructions

Sample #	Date/Time Sampled	Type of Sample	# of Jars	Lab Sample #	Analyses Requested
DPSC28UST-10-02-16	6/21/96 / 0925	GRAB / SOIL	1 ✓	70164	IR SCAN
DPSC28UST-10-01-08	6/21/96 / 0905	" "	1 ✓	70165	" "
DPSC28UST-12-01-08	6/21/96 / 1540	" "	1 ✓	70166	" "
D 28UST-13-01-16	6/24/96 / 1125	" "	1 ✓	70167	" "
DPSC28UST-16-01-8.5	6/24/96 / 1523	" "	1 ✓	70168	" "
DPSC28UST-17-01-08	6/24/96 / 1620	" "	1 ✓	70169	" "
DPSCFB062196	6/21/96 / 1515	" WATER	2 ✓	70170-71	" "
DPSCFB062196	6/21/96 / 1515	" "	2 ✓	70172-73	HFS
~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~		~~[illegible]~~
DPSCFB062496	6/24/96 / 1150	" "	2 ✓	70174-75	IR SCAN

SIGNATURE	PRINT NAME	COMPANY	Date	Time
Relinquished by:	JOHN ARCHIBALD	MALCOLM PIRNIE	6/24/96	203
Received by:		F+BI	~~6/24/96~~ 6/25/96	10:4
Relinquished by:				
Received by:				

FORMS/COC

09/19

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D
Beth M. Albertson, M.S.
Bradley T. Benson
Kelley D. Wilt

3012 16th Avenue West
Seattle, WA 98119-2029
TEL: (206) 285-8282
FAX: (206) 283-5044

July 10, 1996

RECEIVED
JUL 12 1995

Carole Tomlins, Project Manager
Malcolm Pirnie
104 Corporate Park Drive, Box 751
White Plains, NY 10602

Dear Ms. Tomlins:

Enclosed are the results from the testing of material submitted on July 28, 1996 from your DPSC, PO #0285-642-200 project.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

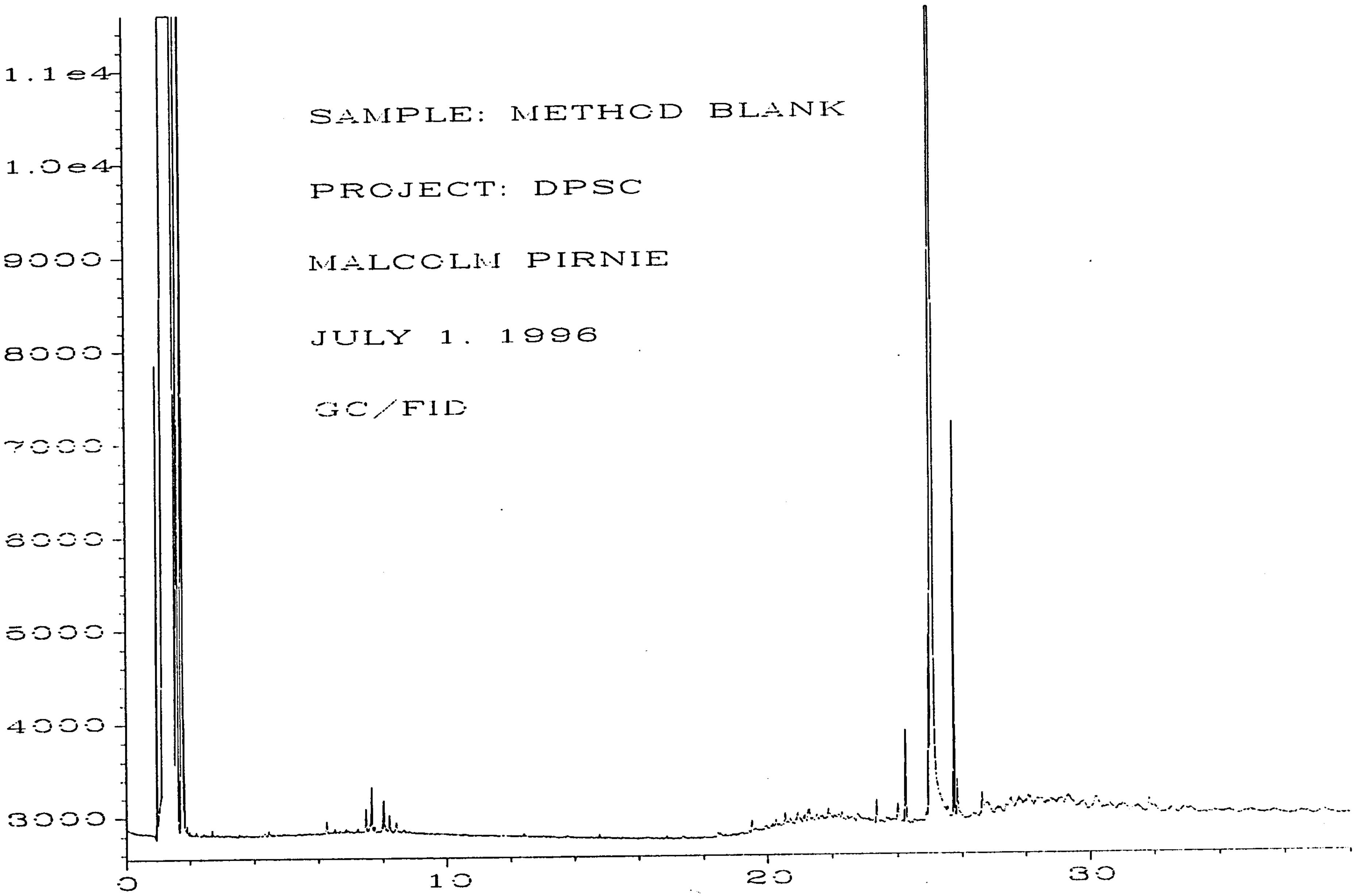
FRIEDMAN & BRUYA, INC.

Kelley Wilt

Kelley Wilt
Chemist

RECEIVED

keh
Enclosures
FAX: (914) 641-2455
MPI0710R.DOC



SAMPLE: METHOD BLANK

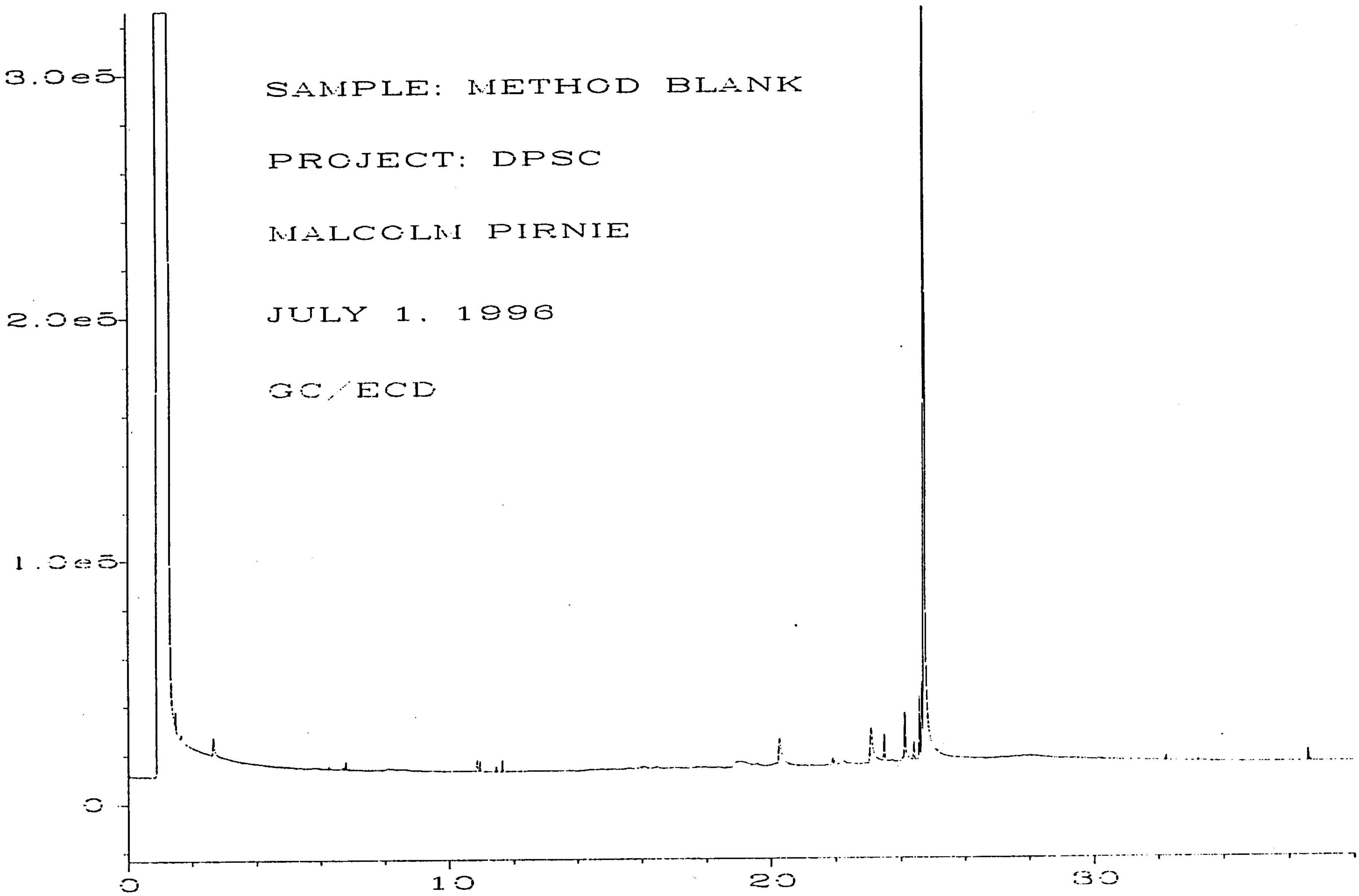
PROJECT: DPSC

MALCOLM PIRNIE

JULY 1. 1996

GC/FID

Sig. 1 in C:\HPCHEM\4\DATA\07-01-96\009F0601.D



SAMPLE: METHOD BLANK

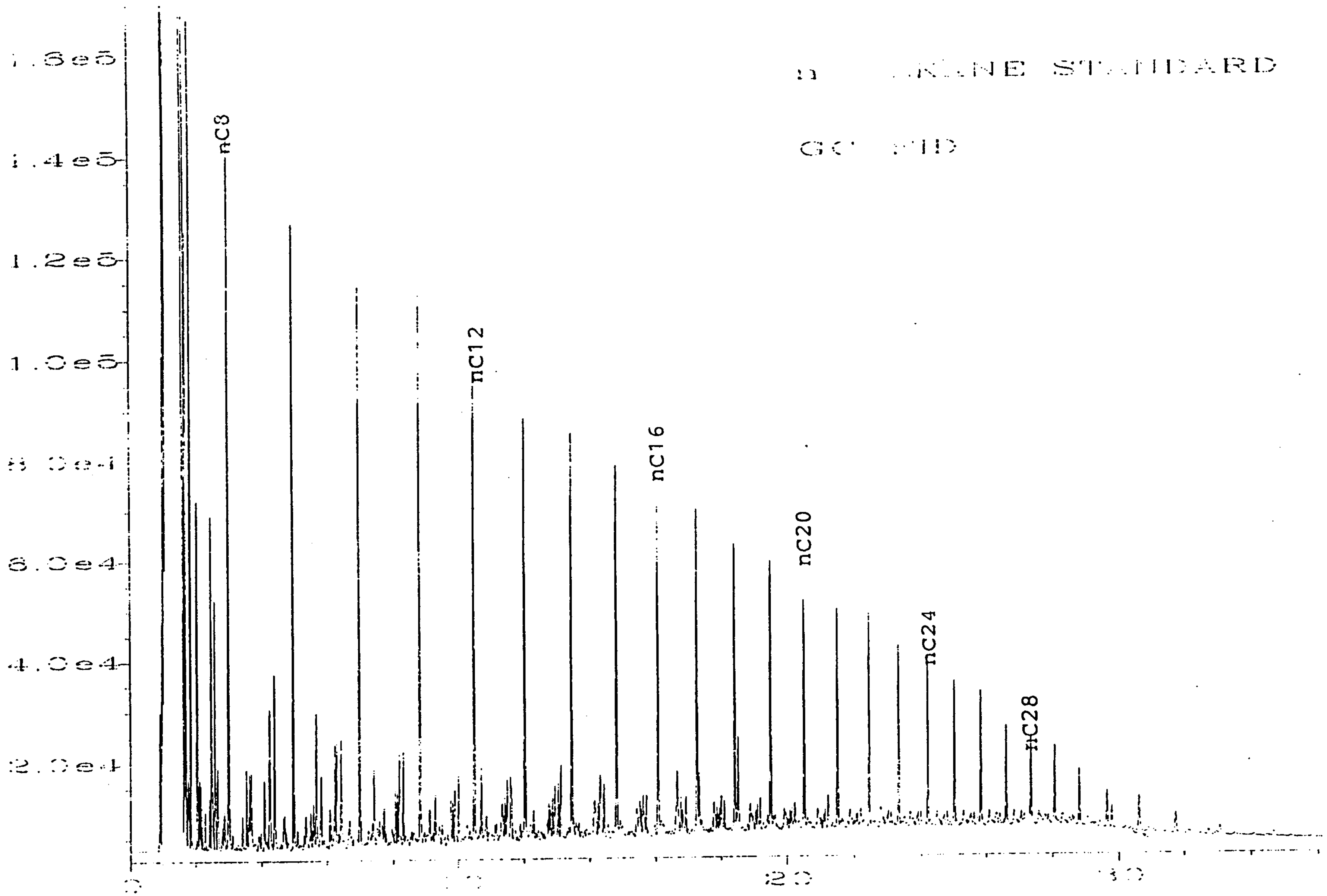
PROJECT: DPSC

MALCOLM PIRNIE

JULY 1, 1996

GC/ECD

Sig. 2 in C:\HPCHEM\4\DATA\07-01-96\009R0601.D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GC-FID
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1.0e5
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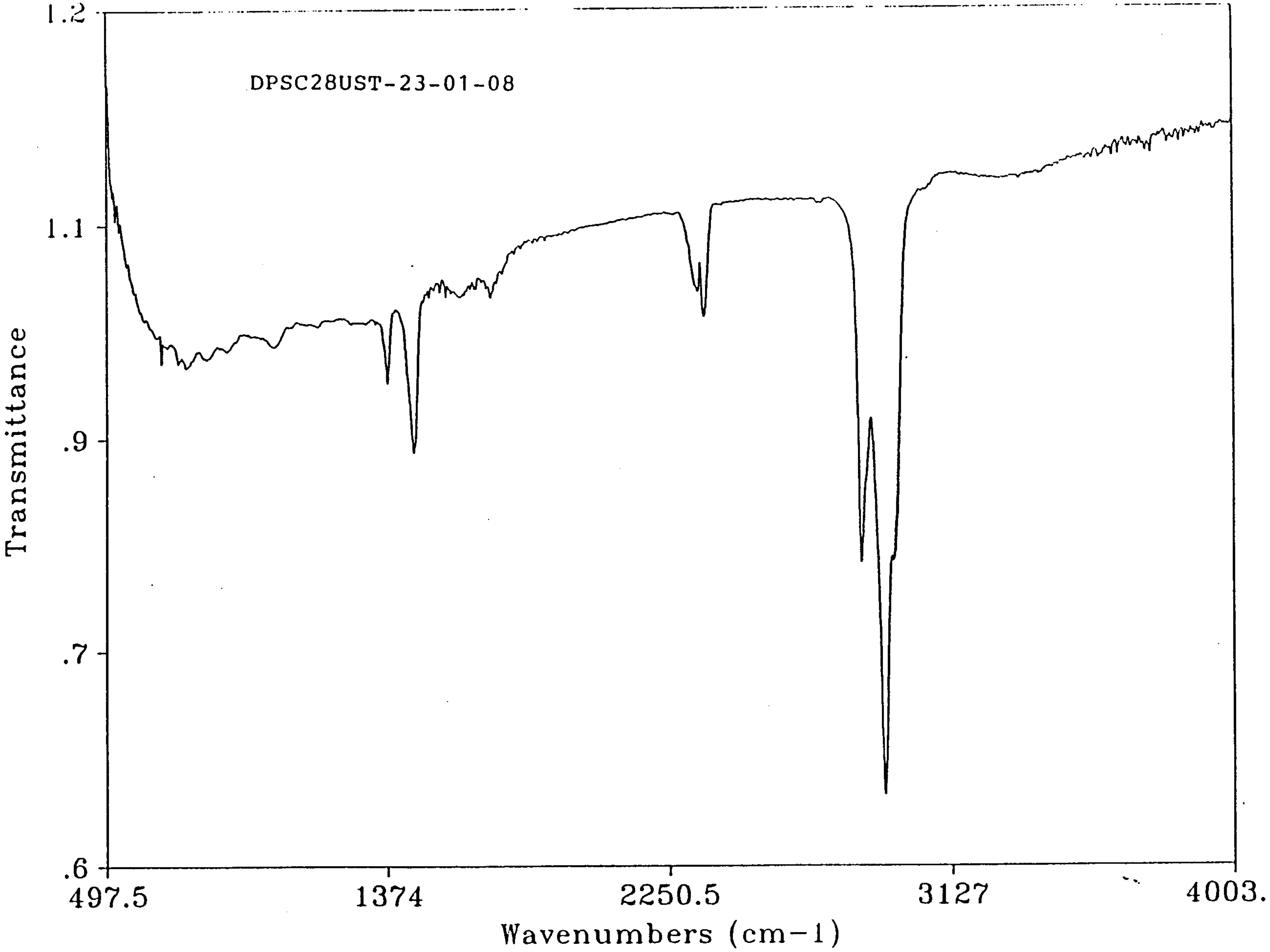

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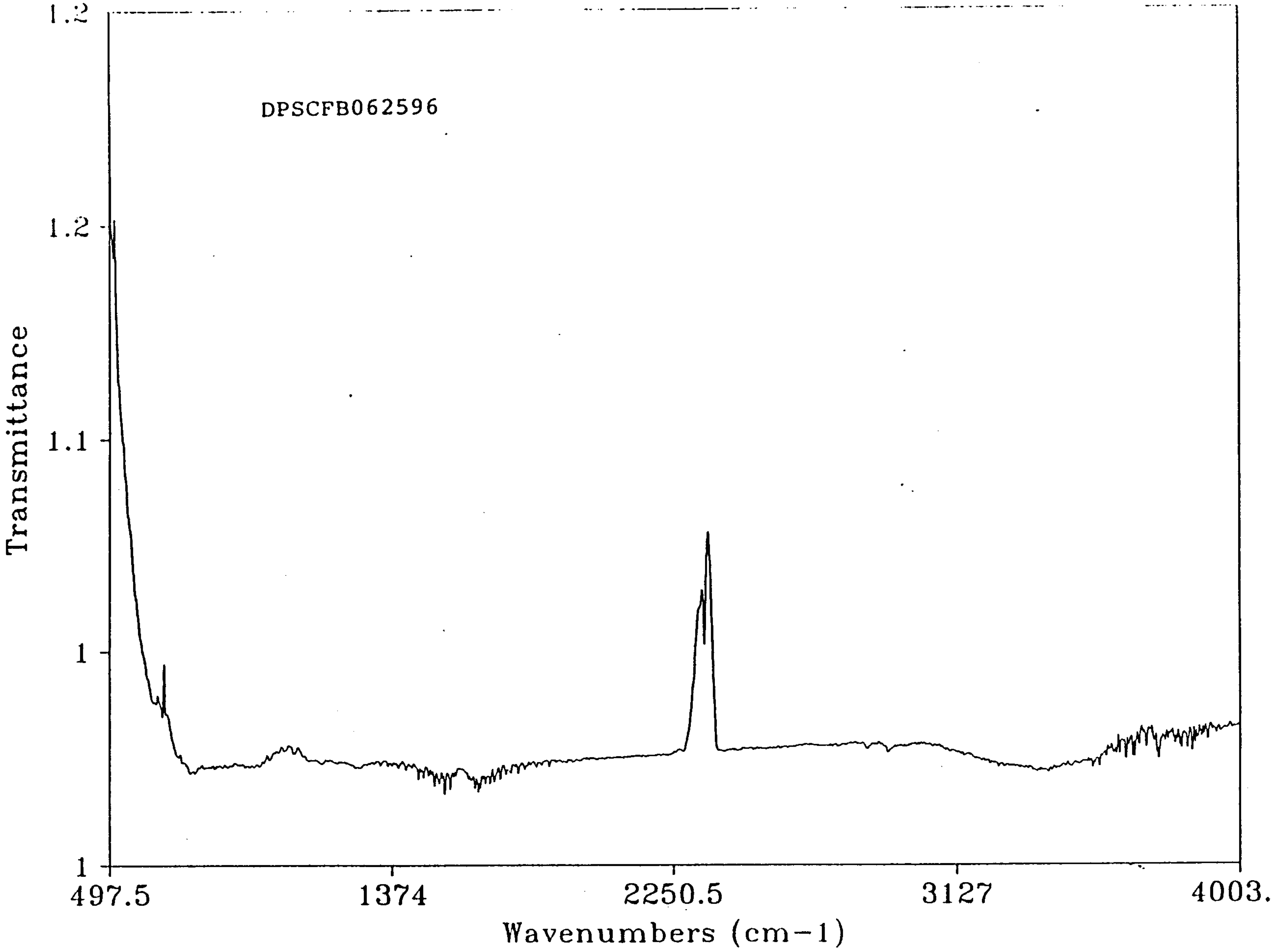

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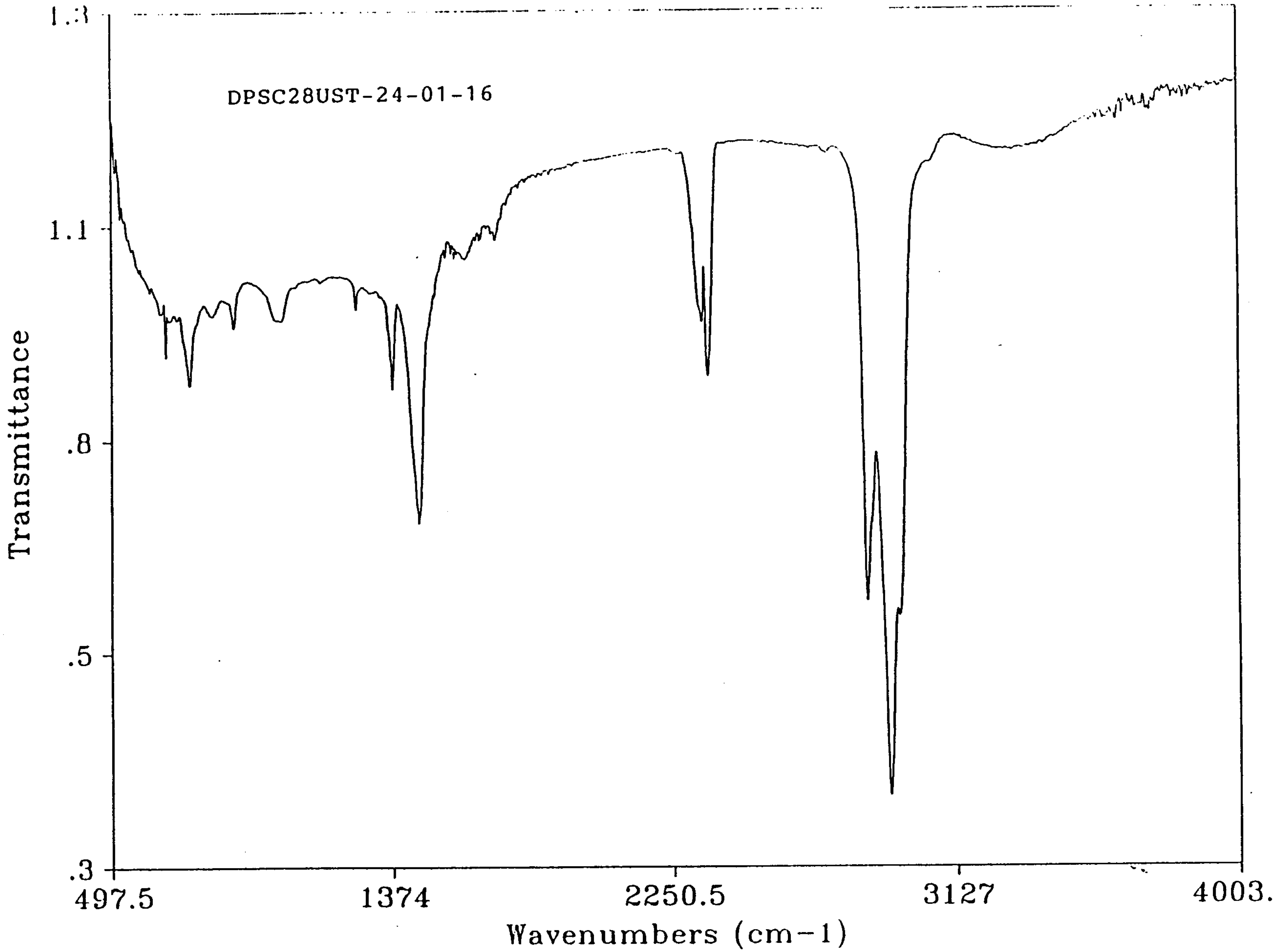

SCH Res= 4 07/02/96 10:52

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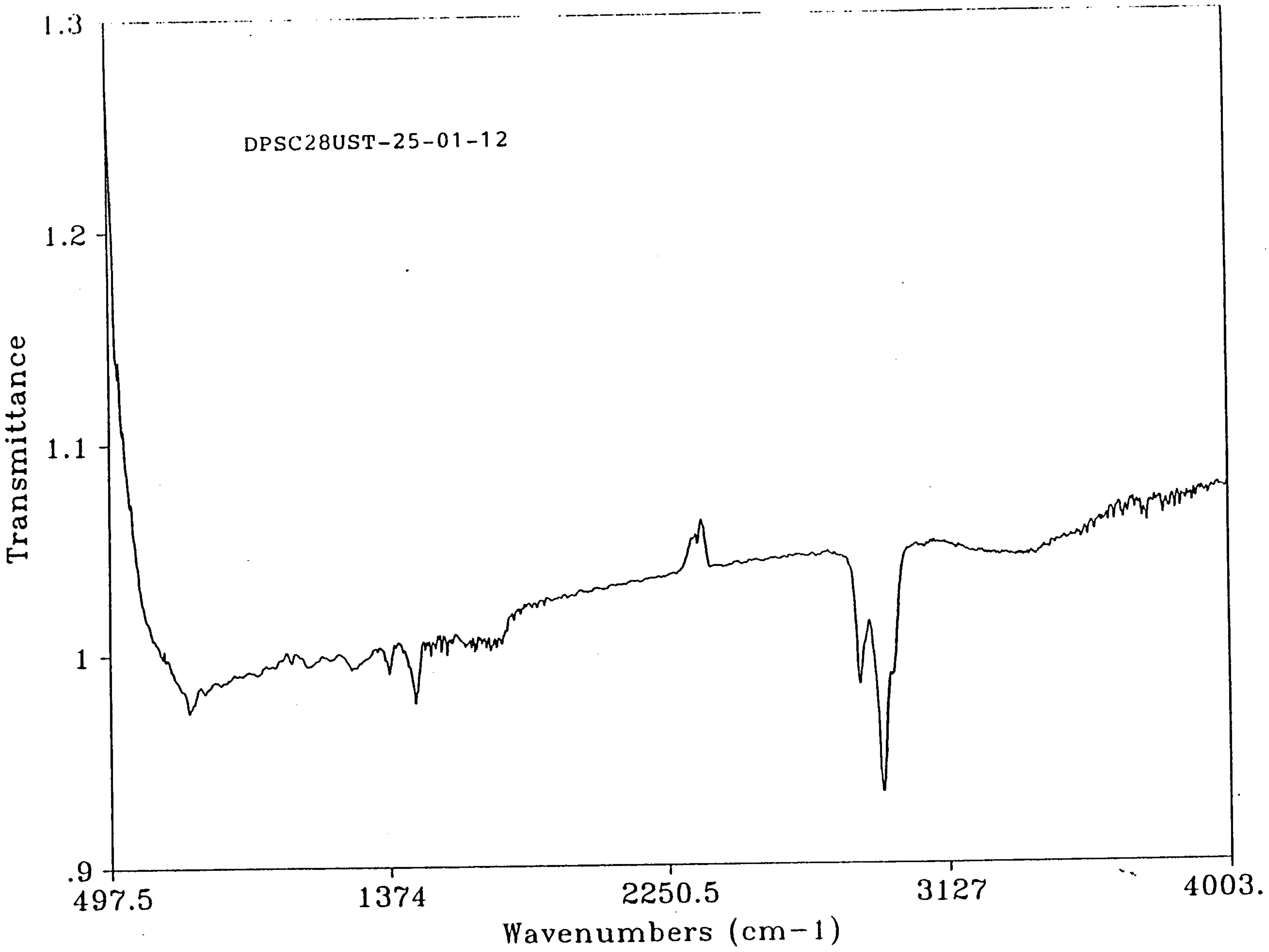
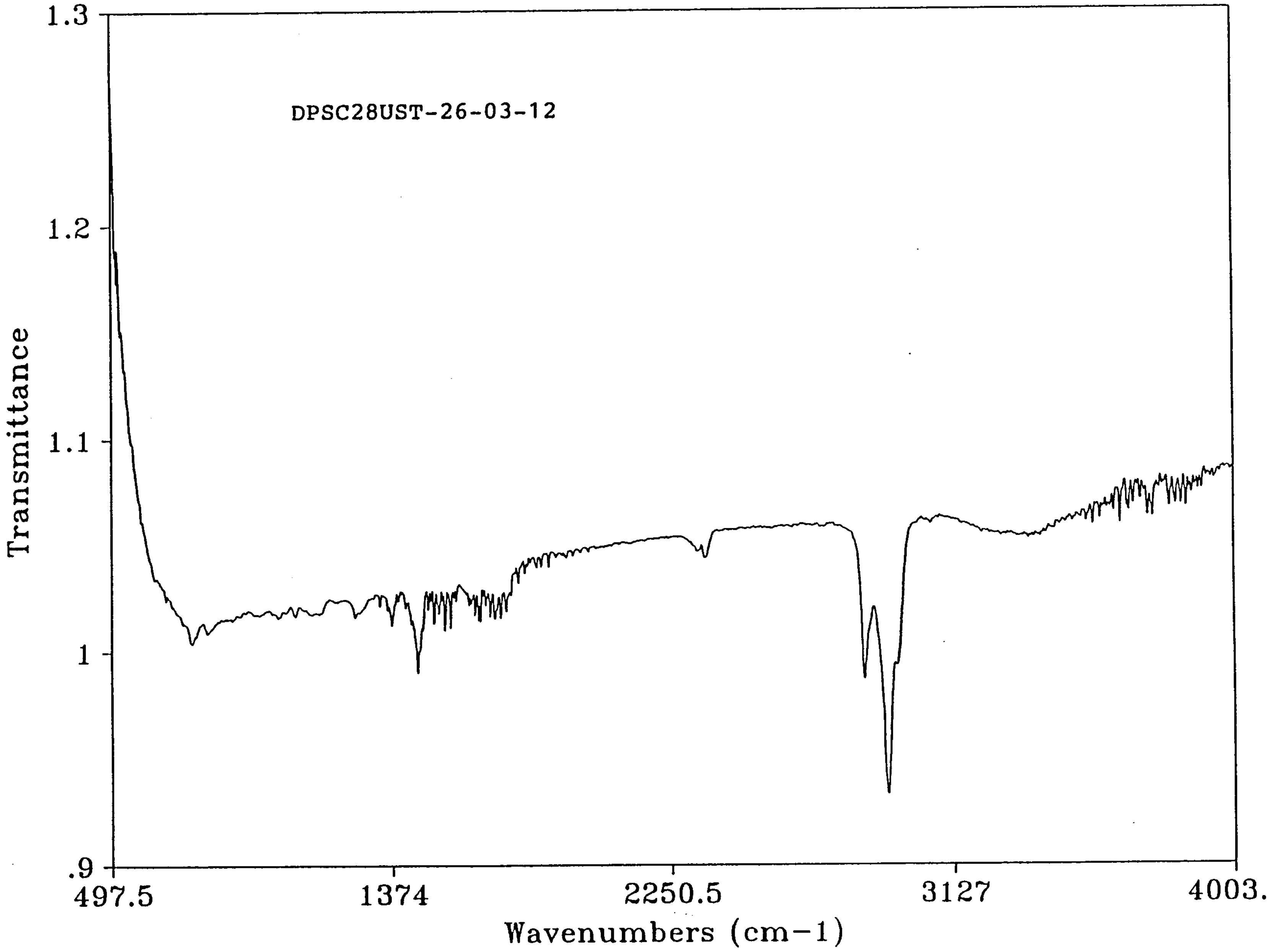


SCA

Res= 4

07/02/96 10:58

70312; TRANSMITTANCE



SCB Res= 4 07/02/96 10:59

70313; TRANSMITTANCE

FRIEDMAN & BRUYA, INC.
3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282

KW AO
6.28.96
10:20

SAMPLE CHAIN OF CUSTODY

Send Report To:
Company MALCOLM PIRNIE Contact CAROLE TOMLIN
Address 104 CORPORATE PARK DRIVE
City, State, Zip WHITE PLAINS, NEW YORK 10602-0751
Phone # 914-694-2100 Date 6/27/96

SITE NO.	PROJECT NAME	PURCHASE ORDER #
0285-642	DPSC	0285-642-200

SAMPLERS (signature)

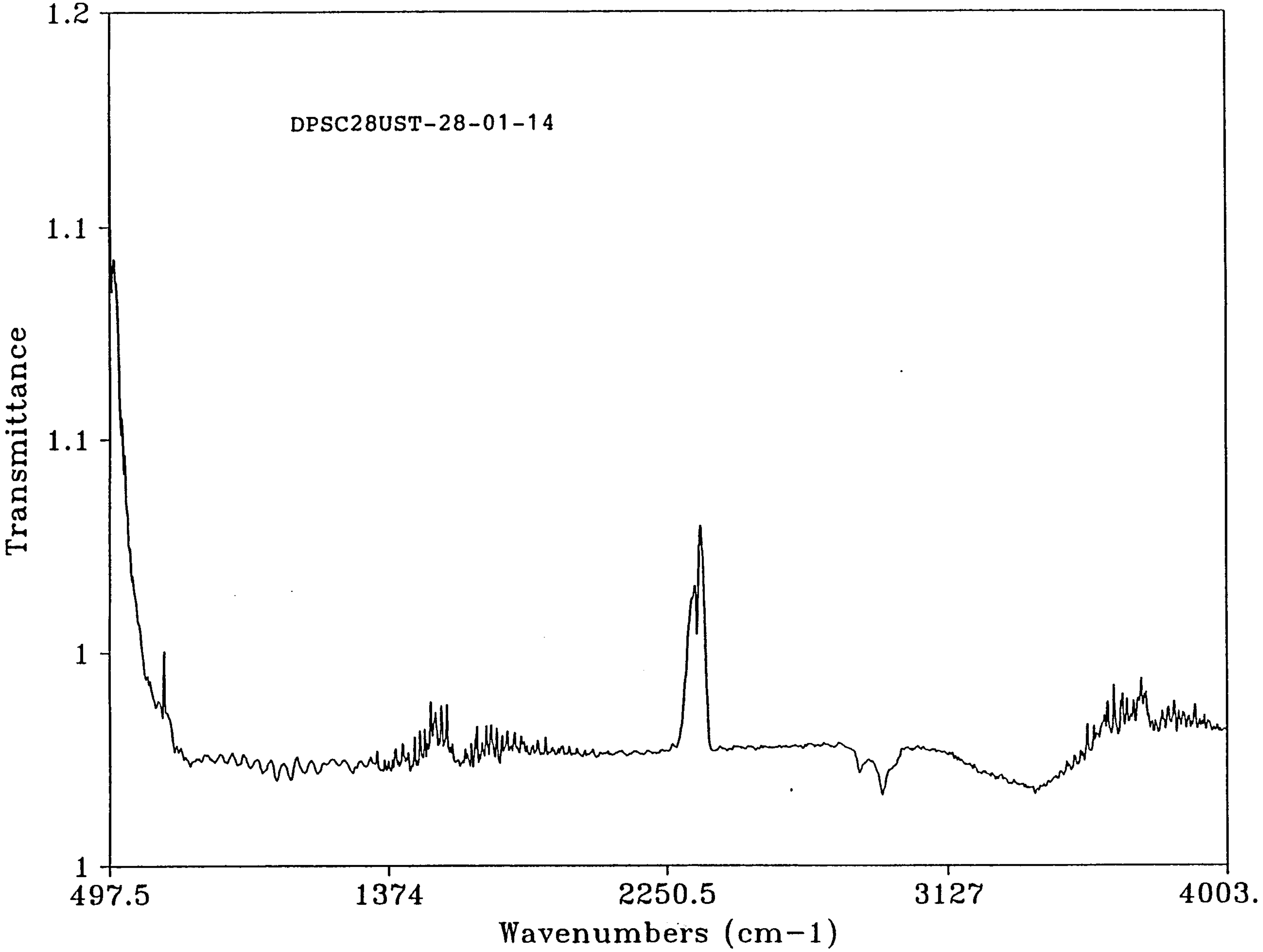
PROJECT LOCATION
PHILADELPHIA, PA

REMARKS
SAMPLES COLLECTED BY LBA FOR MPI

SAMPLE DISPOSAL INFORMATION
☐ Dispose after 30 days
☐ Return Samples
☐ Call for Instructions

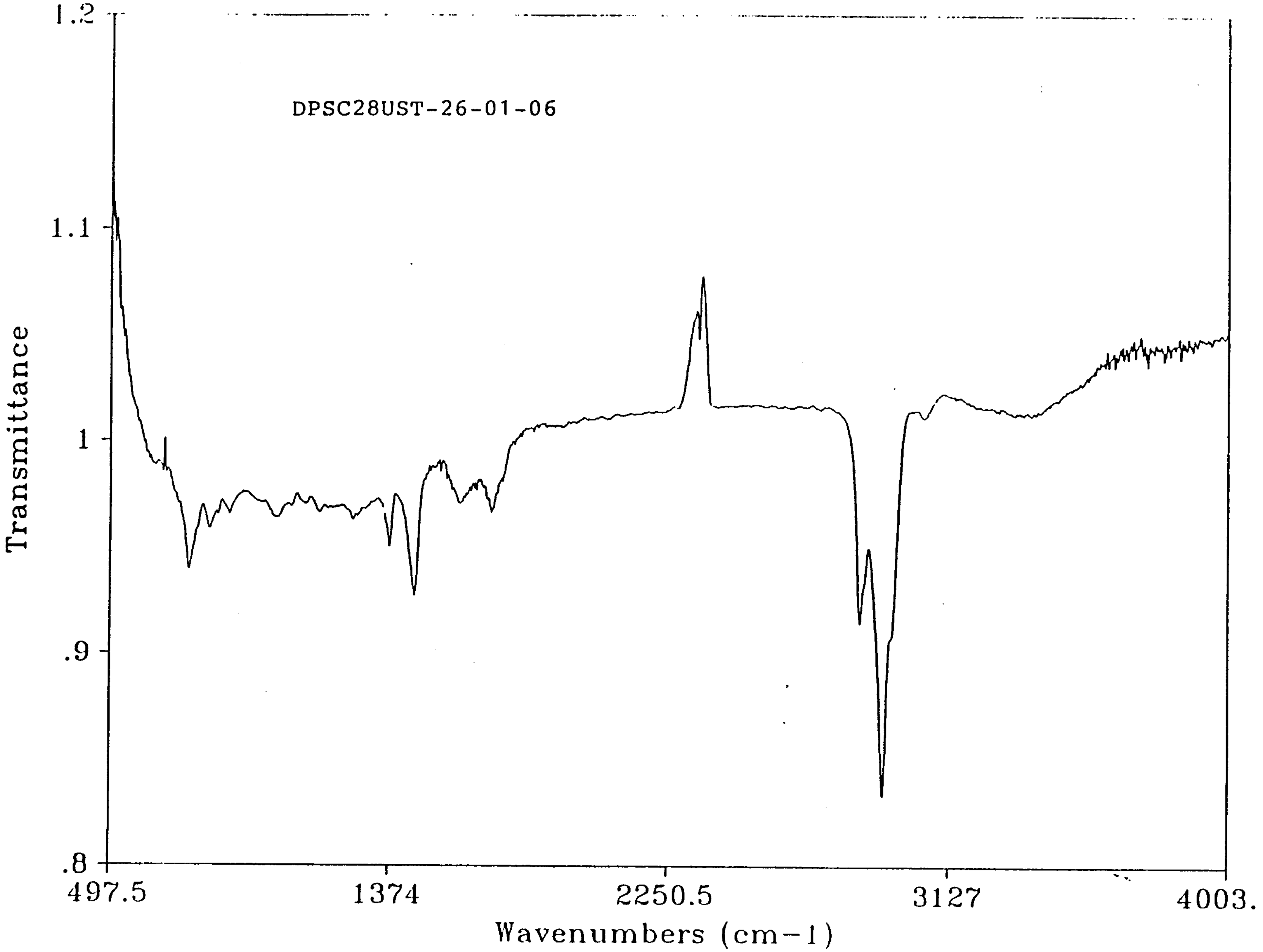
Sample #	Date/Time Sampled	Type of Sample	# of Jars	Lab Sample #	Analyses Requested
CSX-MW5 (44-46)	6/25/96/0830	GRAB SOIL	1 ✓	70301	HFS, IR SCAN
CSX-MW5 (48-50)	6/25/96/0845	" "	1 ✓	70302	" "
SX-MW5 (52-54)	6/25/96/0915	" "	1 ✓	70303	" "
UPSC28UST-23-01-08	6/25/96/1500	" "	1 ✓	70304	IR SCAN
DPSCFB062596	6/25/96/1515	GRAB WATER	2 ✓	70305-06	" "
DPSC28UST-24-01-16	6/25/96/1620	" SOIL	1 ✓	70307	" "
DPSCGSUST-01-06-14	6/26/96/0945	" "	1 ✓	70308	" "
DPSCGSUST-01-08-20	6/26/96/1000	" "	1 ✓	70309	" "
DPSCFB062696	6/26/96/1445	GRAB WATER	2 ✓	70310-11	" "
DPSC28UST-25-01-12	6/26/96/1255	" SOIL	1 ✓	70312	" "
DPSC28UST-26-03-12	6/26/96/1350	" "	1 ✓	70313	" "

SIGNATURE	PRINT NAME	COMPANY	Date	Time
Relinquished by:	JOHN ARCHIBALD	MALCOLM PIRNIE	6/27/96	2130
Received by: Cathy Downing	CAthy DowNiNG	F&BI	6/28/96	9:30
Relinquished by:				
Received by:				



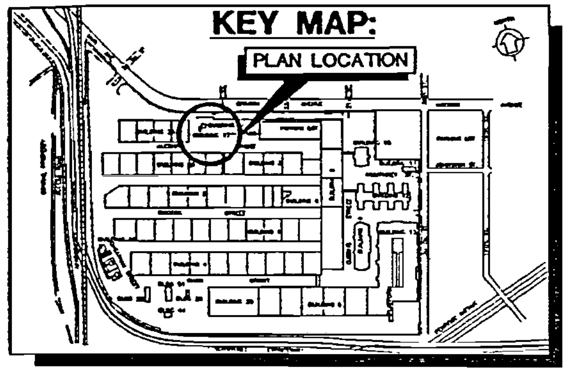
SCF Res= 4 07/03/96 13:53

70328 RN2; TRANSMITTANCE



SCG Res= 4 07/03/96 13:54

70329 RN2; TRANSMITTANCE



BUILDING 46 - DETECTED COMPOUNDS

ANALYTE	PADEP CRITERIA * Non-Residential	Soil - GW	46-01	46-01	46-01	46-01	46-02	46-02	46-02	46-02
	Boring No.:		46-01	46-01	46-01	46-01	46-02	46-02	46-02	46-02
	Sampe ID:		46UST 01 - 2.0	46UST 02 - 12	46UST 03 - 14	46UST 04 - 16	46UST 05 - 2.0	46UST 06 - 8.0	46UST 07 - 12	46UST 08 - 16
	Sampling Date:		6/7/96	6/7/96	6/7/96	6/7/96	6/7/96	6/7/96	6/7/96	6/7/96
			Result	Result	Result	Result	Result	Result	Result	Result
Diesel Range Organics (mg/Kg)	500		5	0.85 U	0.84 U	0.86 U	8.2	0.94	0.89 U	0.85 U
Methyl-tert-butyl ether (ug/Kg) MTBE	5,000,000	200	0.54 U	0.53 U	0.53 U	0.54 U	0.58	0.59 U	0.56 U	0.53 U
METALS										
Lead (mg/Kg)	600		72.7	6.84	7.7	7.4	37	20.5	11.9	6.43

NOTES:

U – The analyte was analyzed for, but was not detected above the sample quantitation limit.

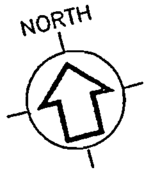
N/E – Criteria not established for this constituent

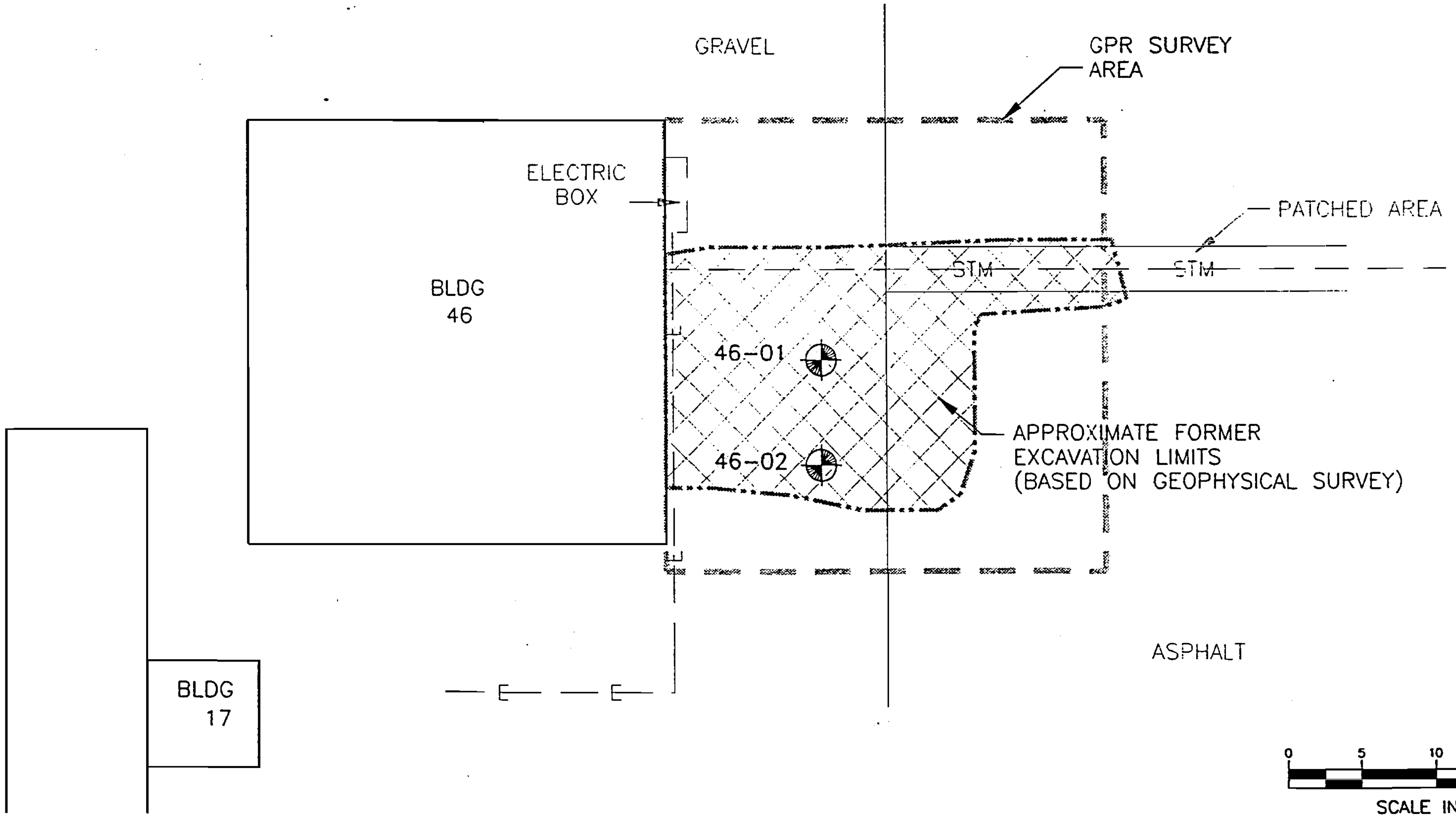
D – This qualifier identifies all compounds identified in an analysis at a secondary dilution

ALL Field Sample ID labels contain the prefix DPSC on the Chain Of Custody forms.

* Criteria based on PADEP LAND Recycling Program Technical Guidance Manual 7/18/95

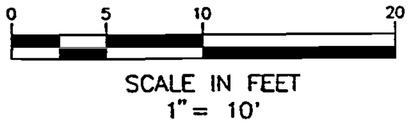
Sample ID consists of: Location Boring-Sequential Number-Depth (eg. 46UST-01-2.0)





LEGEND:

⊕ SOIL BORING



Source: Geophysical Survey Report, ENSA, Inc. 1996

U.S. Army Corps of Engineers

DEFENSE PERSONNEL SUPPORT CENTER – PHILADELPHIA, PENNSYLVANIA

DRILLING LOCATIONS & SOIL ANALYTICAL RESULTS - BUILDING 46 USTs

USACE CONTRACT No. DACA31-94-D-0017

FIGURE M-6

ES-AB46/12AUG96

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Andrew John Friedman
James E. Bruya, Ph.D.
(206) 285-8282

3012 16th Avenue West
Seattle, WA 98119-2029
FAX: (206) 283-5044

June 20, 1996

RECEIVED
JUL - 9 1996

Carole Tomlins, Project Manager
Malcolm Pirnie
104 Corporate Park Drive
White Plains, NY 10602-0751

Dear Ms. Tomlins:

Enclosed are the results from the testing of material submitted on June 10, 1996 from your DPSC project.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

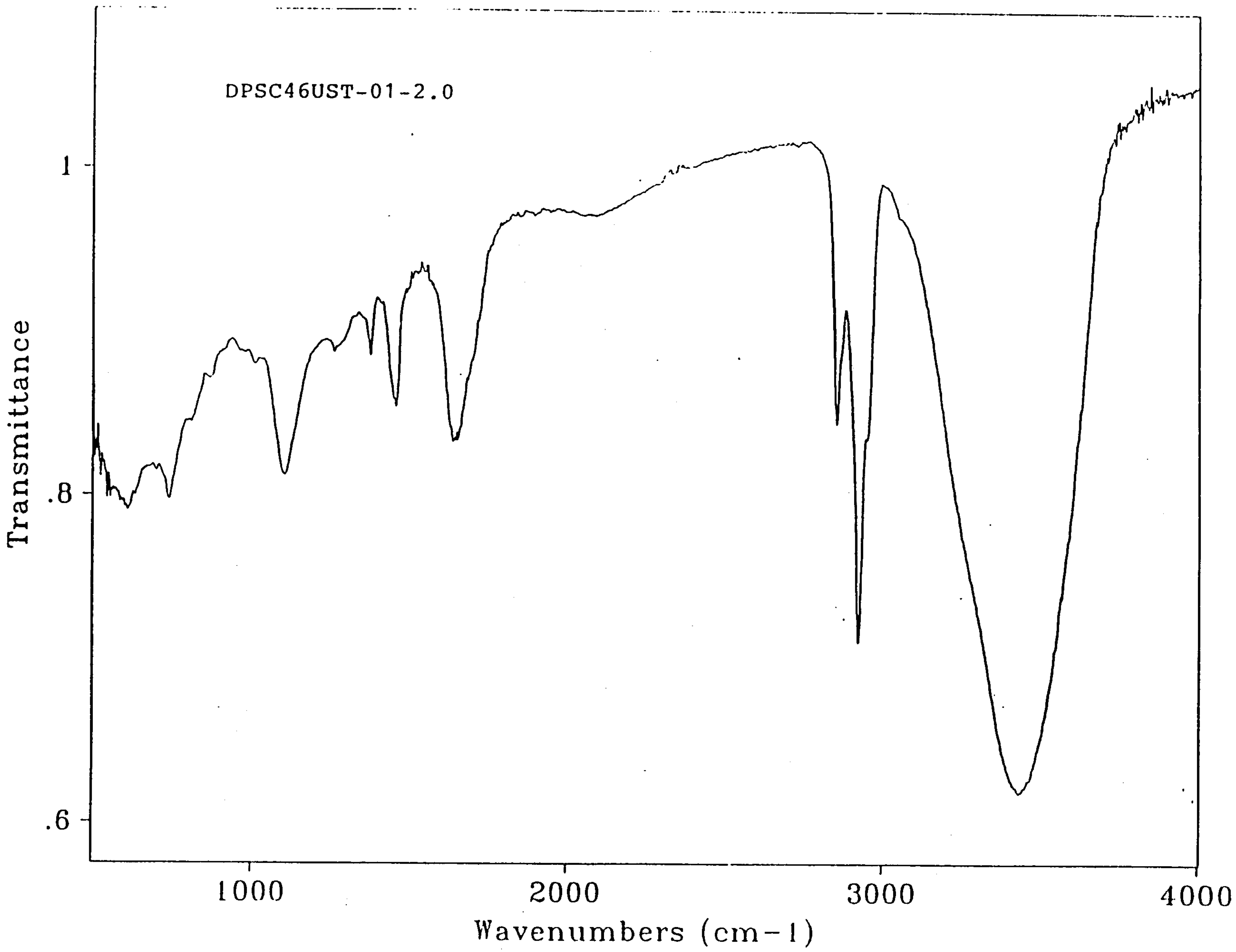
Sincerely,

FRIEDMAN & BRUYA, INC.

Kelley Wilt

Kelley Wilt
Chemist

keh
Enclosures
FAX: (914) 641-~~5422~~ 2455
NAA0620R.DOC



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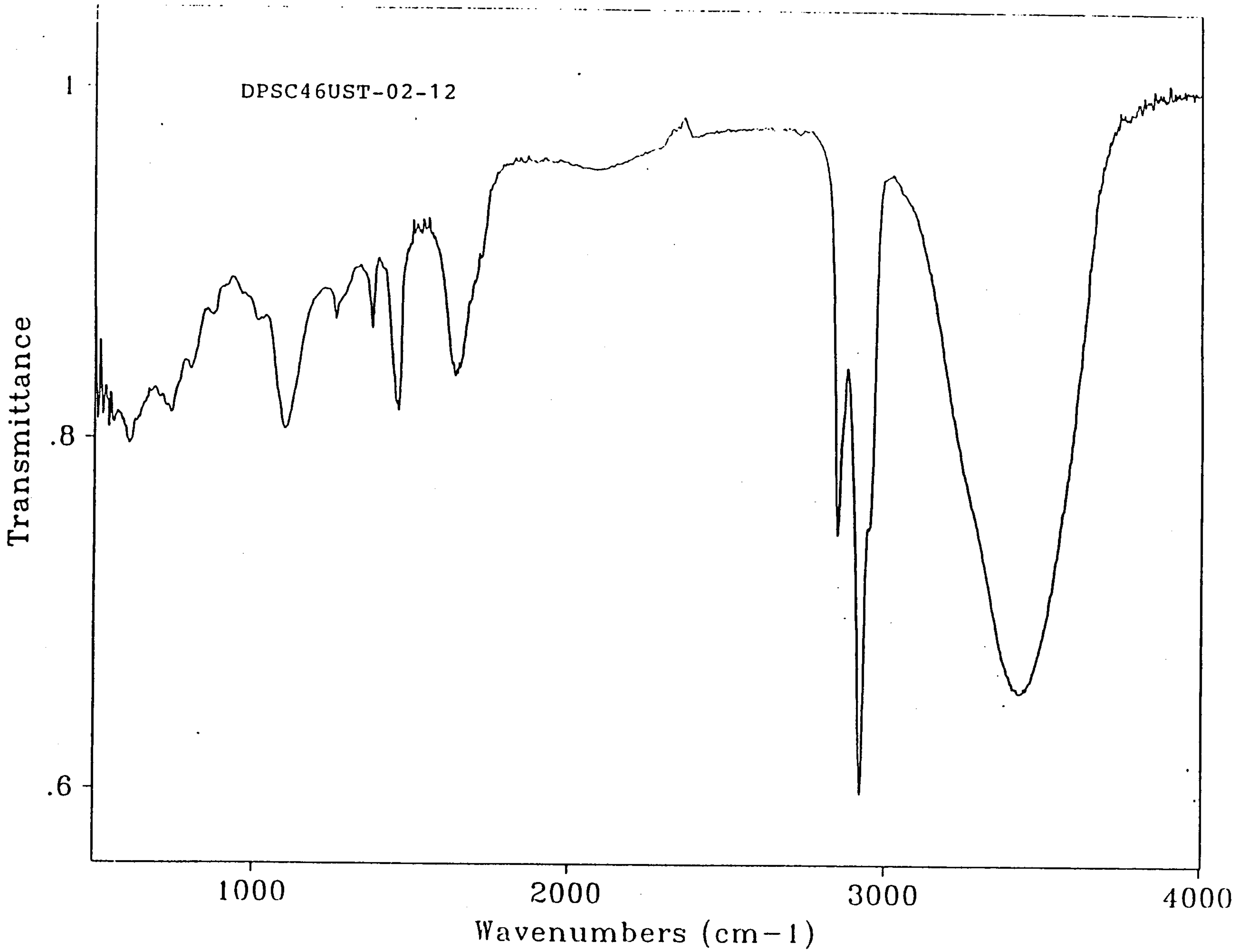
69664: TRANSMITTANCE



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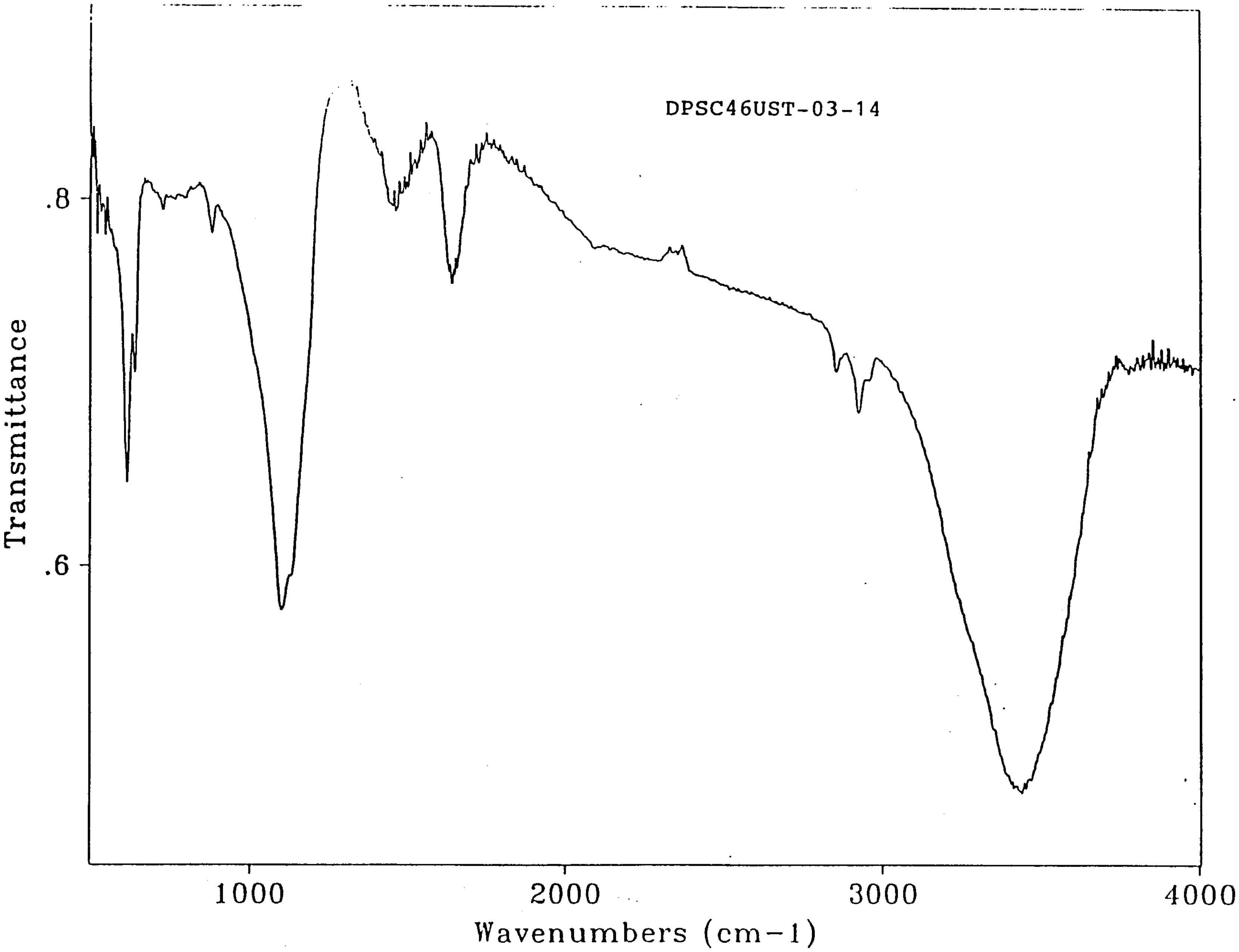
69[illegible]5; TRANSMITTANCE



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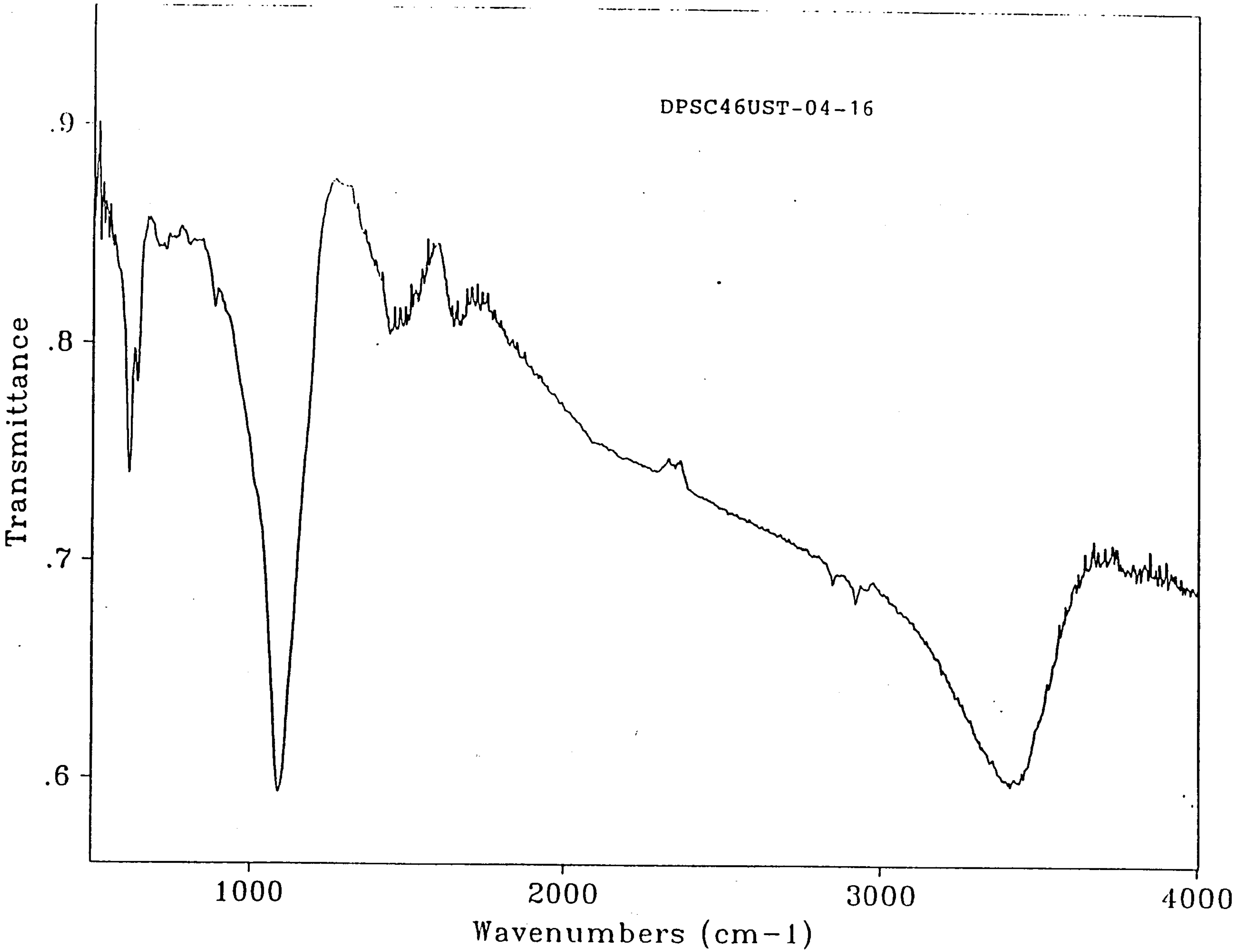

SCB Res= 4 06/18/96 16:49

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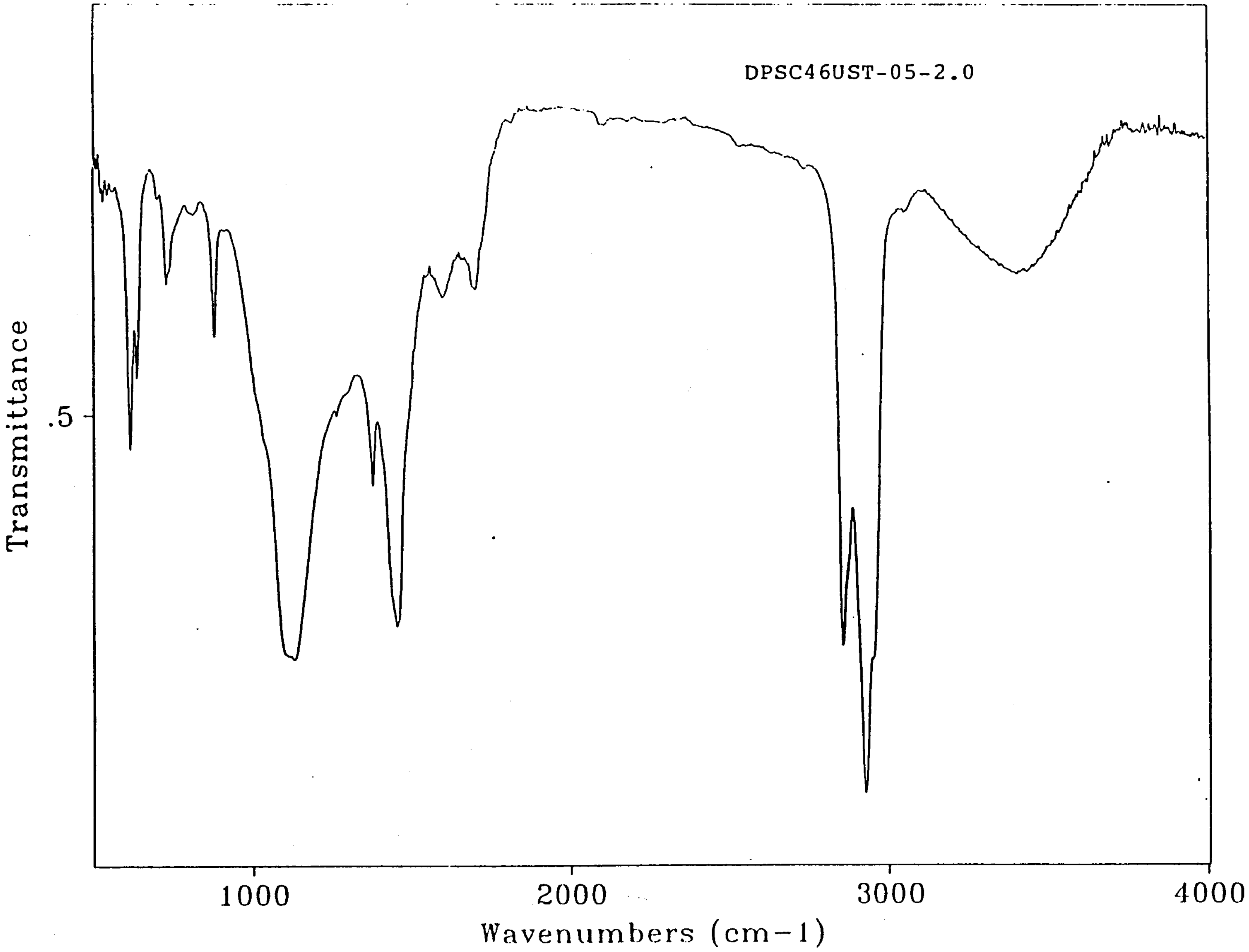

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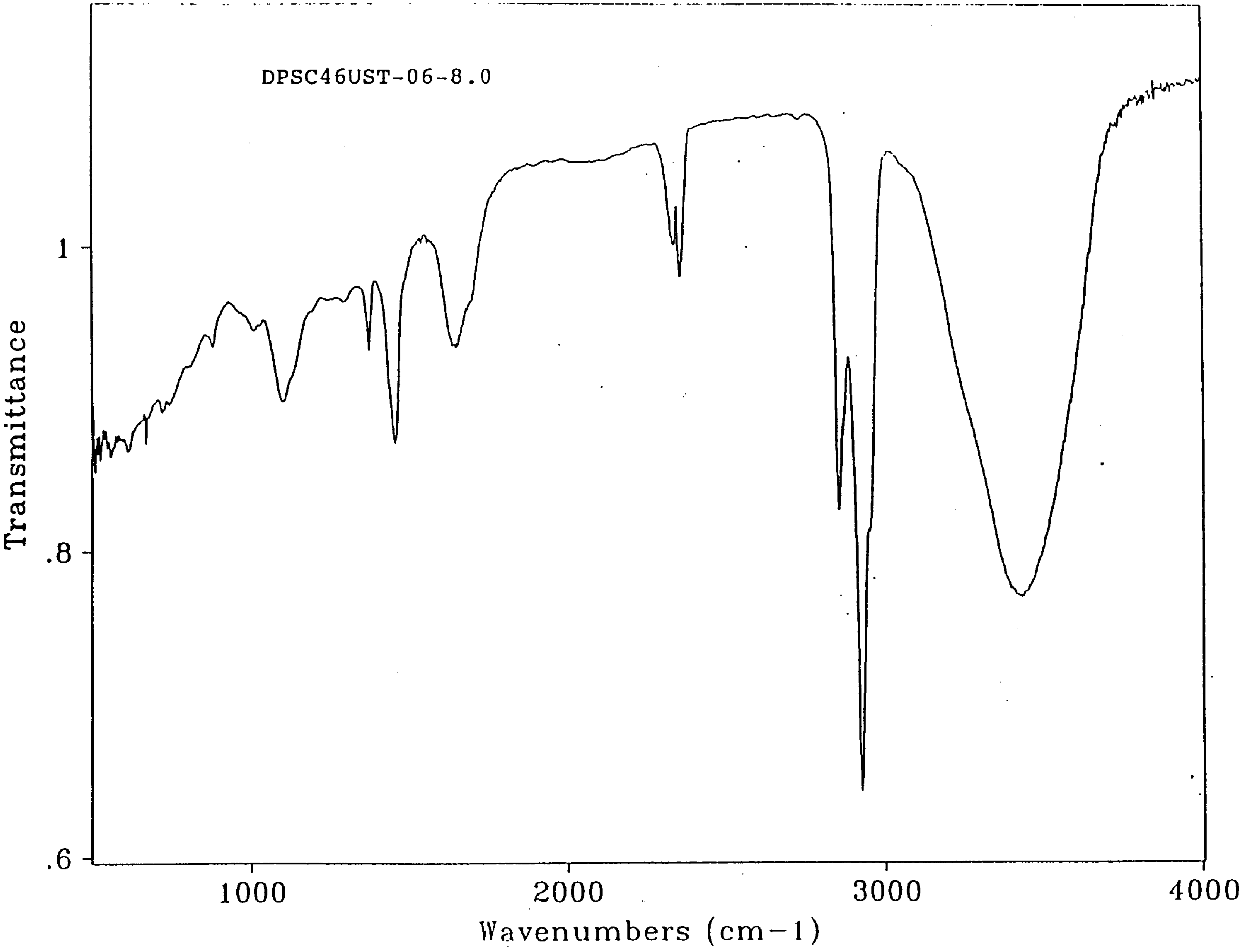
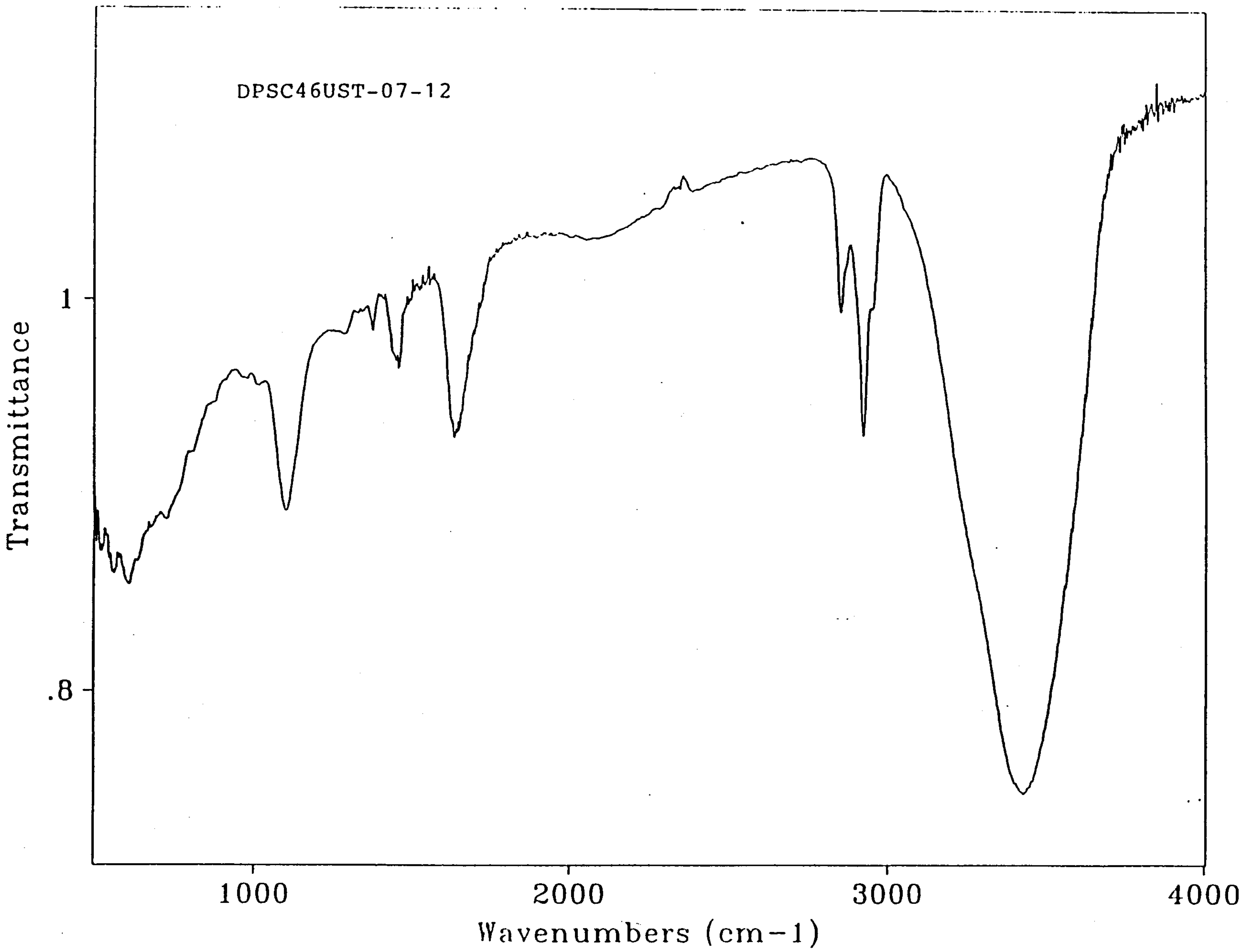


SCJ Res= 4 06/18/96 16:32

6[illegible]39; TRANSMITTANCE



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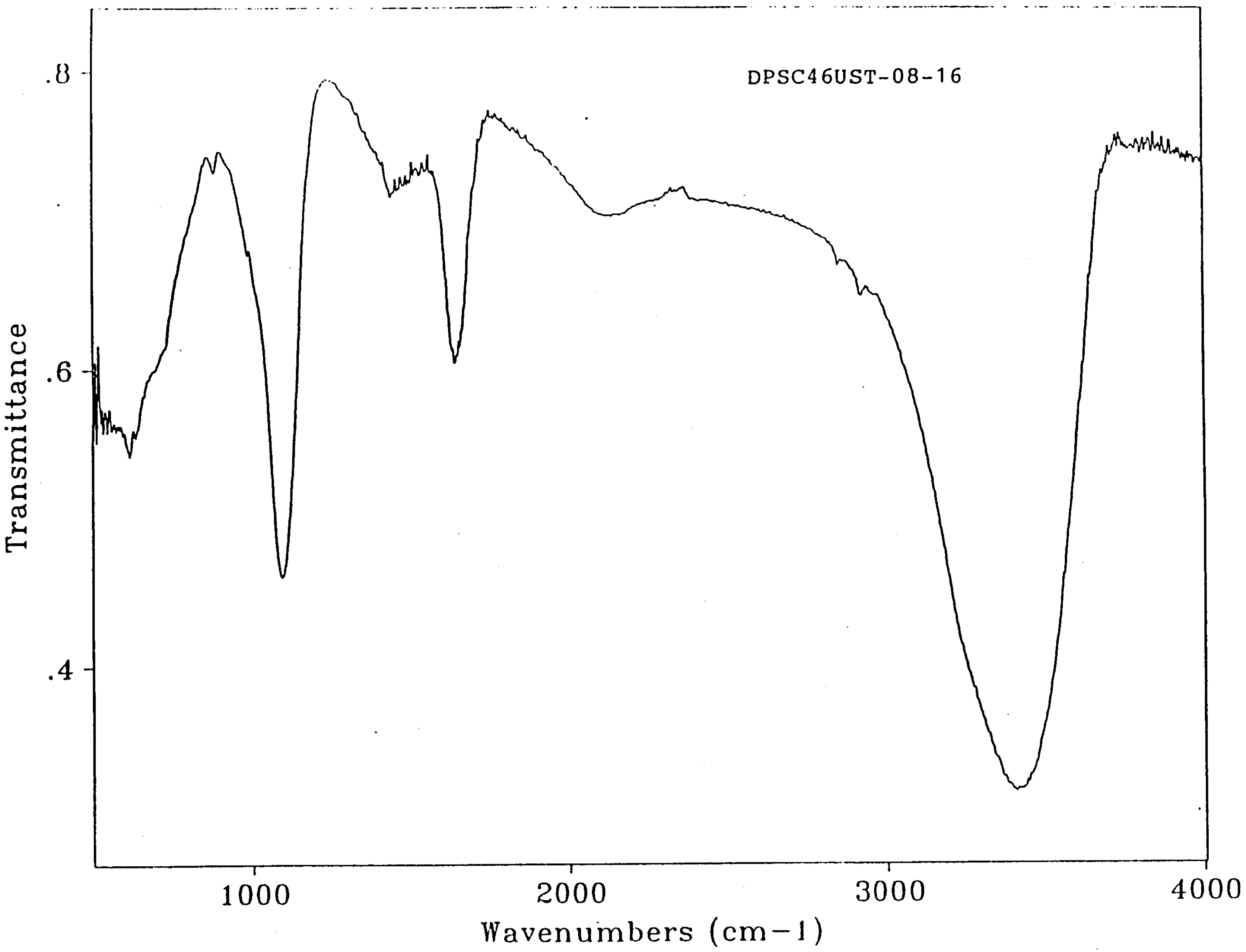
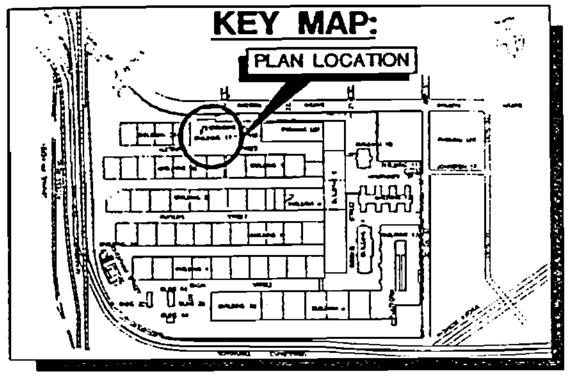
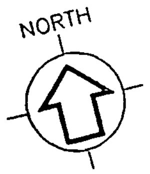


SCA Res= 4 06/18/96 16:48

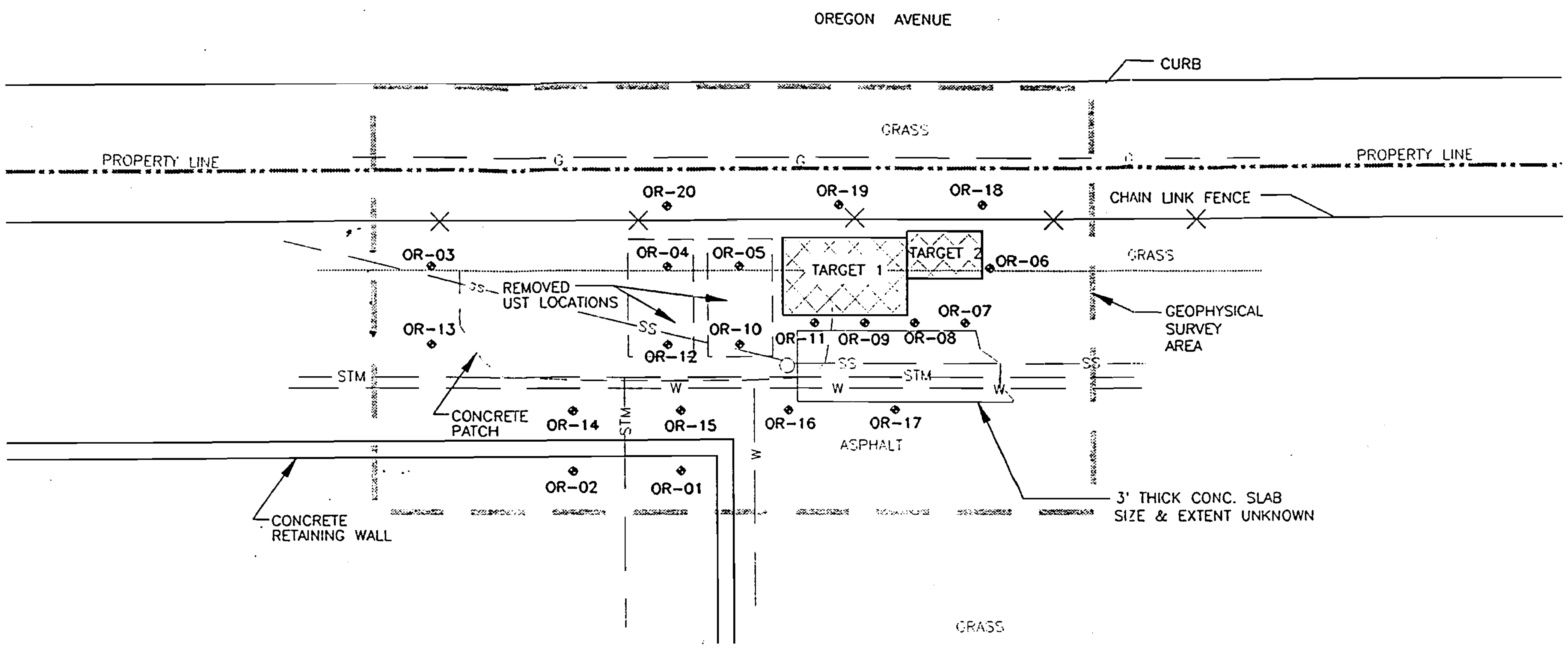
69671; TRANSMITTANCE





LEGEND:

⊕ SOIL BORING



NOTES:

U – The analyte was analyzed for, but was not detected above the sample quantitation limit.

N/E – Criteria not established for this constituent

D – This qualifier identifies all compounds identified in an analysis at a secondary dilution

ALL Field Sample ID labels contain the prefix DPSC on the Chain Of Custody forms.

• Criteria based on PADEP LAND Recycling Program Technical Guidance Manual 7/18/95

Sample ID consists of: Location Boring–Sequential Number–Depth (eg. OTUST–01–02–20)

OREGON AVENUE TANKS - DETECTED COMPOUNDS

		BORING No.	OR-01	OR-04	OR-04	OR-05	OR-05	OR-05	OR-06	OR-06	OR-07	OR-09	OR-10	OR-10	OR-11	OR-11	OR-11	OR-12	OR-12	OR-12	OR-13	OR-14	OR-14	OR-16	OR-16	OR-16	OR-16	OR-17	OR-18	OR-18	OR-18	OR-18	OR-19	OR-19	OR-20	OR-20
		SAMPLE ID:	OTUST 01-02-20	OTUST 04-01-12	OTUST 04-02-16	OTUST 05-01-12	OTUST 05-02-16	OTUST 05-03-16	OTUST 06-01-08	OTUST 06-02-12	OTUST 07-01-12	OTUST 09-01-13	OTUST 10-01-12	OTUST 10-02-16	OTUST 11-01-10	OTUST 11-02-14	OTUST 11-03-16	OTUST 12/1/08	OTUST 12/2/16	OTUST 12/3/16	OTUST 13-02-12	OTUST 14-02-10	OTUST 14-04-16	OTUST 16-01-10	OTUST 16-02-10	OTUST 16-03-16	OTUST 16-04-16	OTUST 17-02-10	OTUST 18-03-12	OTUST 18-04-16	OTUST 18-05-16	OTUST 18-06-20	OTUST 19-02-14	OTUST 19-03-18	OTUST 20-02-12	OTUST 20-03-20
		SAMPLING DATE:	6/10/96	6/10/96	6/10/96	6/10/96	6/10/96	6/10/96	6/11/96	6/11/96	6/11/96	6/11/96	6/11/96	6/11/96	6/11/96	6/11/96	6/11/96	6/12/96	6/12/96	6/12/96	6/12/96	6/12/96	6/12/96	6/12/96	6/12/96	6/12/96	6/12/96	6/12/96	6/13/96	6/13/96	6/13/96	6/13/96	6/13/96	6/13/96	6/13/96	6/13/96
ANALYTE	PADEP CRITERIA •		Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
	Non-Residential	Soil - GW																																		
Diesel Range Organics (mg/Kg)	500	N/E	0.89 U	4	150	8.7	170 K	160 K	750	610	13 K	580	34	950 D	51	14	NA	130	110	100	91	17	32	28	27	2.4	2.5	1.1	3300	750	1900	NA	2400	8.5	170	0.89
GC/MS VOLATILE (ug/Kg)																																				
Ethyl Benzene	N/E	N/E	NA	NA	2 U	NA	25.7	24	1230	NA	NA	10 U	NA	NA	NA	NA	10 U	2 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	35.6	NA	NA	NA	NA
Toluene	525,000	2,000	NA	NA	7.8	NA	11.3	10 U	20 U	NA	NA	10 U	NA	NA	NA	NA	10 U	2 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	20 U	NA	NA	NA	NA
Total Xylenes	4,000,000,000	10,000	NA	NA	50.8	NA	112	101	4610	NA	NA	10 U	NA	NA	NA	NA	57.2	2 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	132	NA	NA	NA	NA
GC/MS SEMIVOLATILE (ug/Kg)																																				
Pyrene	30000000	300000	568	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
METALS																																				
Lead (mg/Kg)	600	N/E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

0 10 20 40

SCALE IN FEET
1" = 20'

Source: Geophysical Survey Report, ENSA Inc., 1996.

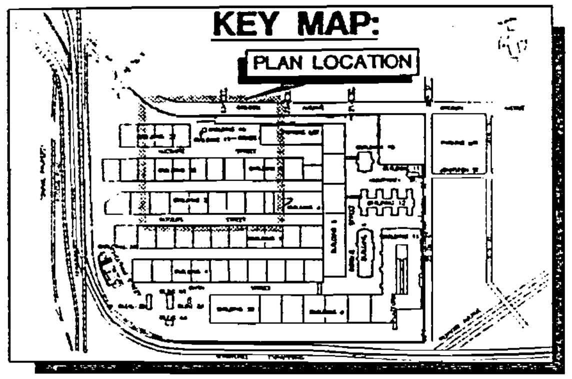
U.S. Army Corps
of Engineers

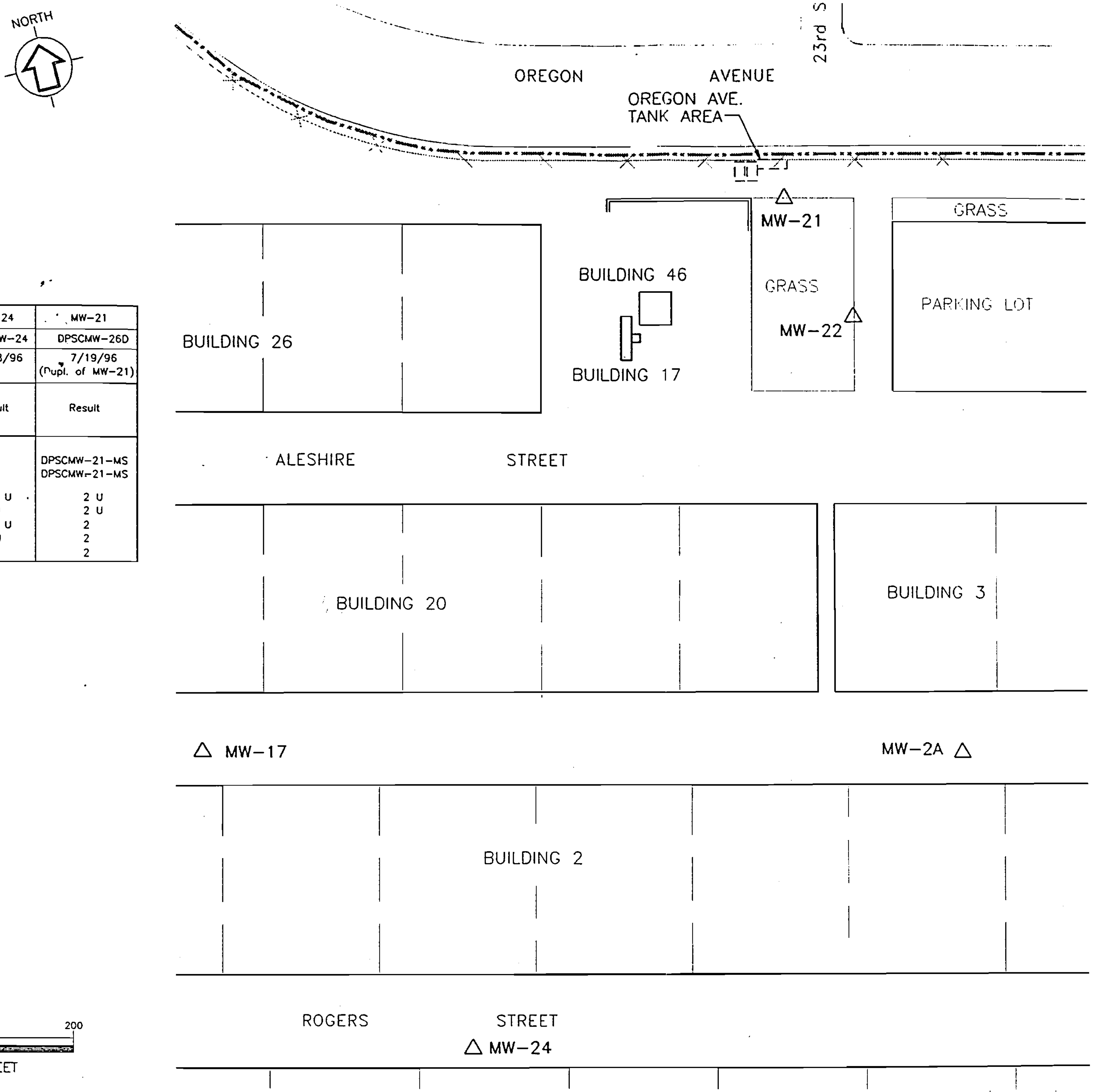
DEFENSE PERSONNEL SUPPORT CENTER – PHILADELPHIA, PENNSYLVANIA

DRILLING LOCATIONS & SOIL ANALYTICAL RESULTS - OREGON AVENUE USTs

USACE CONTRACT No. DACA31-94-D-0017

FIGURE M-7





GROUNDWATER SAMPLES DETECTED COMPOUNDS

	Well No.	MW-2A	MW-17	MW-21	MW-22	MW-24	MW-21
	Sample ID:	DPSCMW-2A	DPSCMW-17	DPSCMW-21	DPSCMW-22	DPSCMW-24	DPSCMW-26D
	Sampling Date:	7/18/96	7/18/96	7/19/96	7/19/96	7/18/96	7/19/96 (Dupl. of MW-21)
Analyte	PADEP CRITERIA • Aquifer Ingestion < 2500 TDS	Result	Result	Result	Result	Result	Result
GC/MS VOLATILE RESULTS (ug/L)							
MS				DPSCMW-21-MS	DPSCMW-21-MS		DPSCMW-21-MS
MSD				DPSCMW-21-MS	DPSCMW-21-MS		DPSCMW-21-MS
Chloroform	100 ••	2 U	9	2 U	2 U	2 U	2 U
Ethyl Benzene	70	2 U	2 U	2 U	2 U	379	2 U
Tetrachloroethene	5	5.8	2 U	2 U	2 U	2 U	2
Toluene	1,000	2 U	2 U	2 U	2 U	33.9	2
Total Xylenes	10,000	2 U	2 U	2 U	2 U	401	2

NOTES:

U The analyte was analyzed for, but was not detected above the sample quantitation limit.

• Criteria based on PADEP Land Recycling Program Technical Guidance Manual, 7/18/95

•• Individual criteria not established. Criteria specified under Total Trihalomethanes

Sample ID consists of location and monitoring well number (eg. DPSCMW-2A)

LEGEND:

△ MONITORING WELL

0 50 100 200

SCALE IN FEET
1" = 100'

Source: Modified From PRC Environmental Management, Inc.
Fig. 3-1F in DLA-BRAC Cleanup Plan; Final Update-01; 15 June 1995

U.S. Army Corps
of Engineers

DEFENSE PERSONNEL SUPPORT CENTER – PHILADELPHIA, PENNSYLVANIA

MONITORING WELL LOCATIONS & GROUNDWATER ANALYTICAL RESULTS

USACE CONTRACT No. DACA31-94-D-0017

FIGURE M-8

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D
Beth M. Albertson, M.S.
Bradley T. Benson
Kelley D. Wilt

3012 16th Avenue West
Seattle, WA 98119-2029
TEL: (206) 285-8282
FAX: (206) 283-5044

RECEIVED
JUL - 9 1996

June 24, 1996

Carole Tomlins, Project Manager
Malcolm Pirnie
104 Corporate Park Drive, Box 751
White Plains, NY 10602

Dear Ms. Tomlins:

Enclosed are the results from the testing of material submitted on June 18, 1996 from your DPSC project.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Kelley Wilt

Kelley Wilt
Chemist

keh
Enclosures
MPI0624R.DOC

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: June 24, 1996
Date Received: June 18, 1996
Project: DPSC
Date Samples Extracted: June 19, 1996

RESULTS FROM THE ANALYSIS OF THE SOIL SAMPLE FOR FINGERPRINT CHARACTERIZATION BY CAPILLARY GAS CHROMATOGRAPHY USING A FLAME IONIZATION DETECTOR (FID) AND ELECTRON CAPTURE DETECTOR (ECD)

Sample ID	GC Characterization
DPSCOTUST-18-01-10	The GC trace using the flame ionization detector (FID) showed the presence of medium boiling compounds. The patterns displayed by these peaks are typical of a catalytically cracked fuel oil. The medium boiling compounds appeared as a ragged pattern of peaks eluting from n-C_8 to n-C_{34} showing a maximum near n-C_{20}. A dominant pattern of n-alkanes was not seen for this material. The GC/ECD trace showed the possible presence of PCBs. The large peak seen near 25 minutes on the GC/FID trace is pentacosane, added as a quality assurance check for this GC analysis. There is a second internal standard peak seen on the GC/ECD trace at about 26 minutes which is dibutyl chlorendate.

RIEDMAN & BRUYA, INC.
012 16th Avenue West
, WA 98119-2029
285-8282

KW BO
6.18.96
10:25

T 60624-3

SAMPLE CHAIN OF CUSTODY

Send Report To:
Company: MALCOLM PIRNIE
Address: 104 CORPORATE PARK DRIVE
City, State, Zip: WHITE PLAINS, NY 10602-0751
Phone #: 914-694-2100
Contact: CAROLE TOMLINS
Date: 6-13-96

SITE NO	PROJECT NAME	PURCHASE ORDER #
0285-642-200	DPSC	

SAMPLERS (signature) MPI

PROJECT LOCATION: PHILADELPHIA, PA

REMARKS: SAMPLES COLLECTED BY RICHARD HARDING OF LOUIS BERGER & ASSOCIATES, INC.

SAMPLE DISPOSAL INFORMATION
☐ Dispose after 30 days
☐ Return Samples
☐ Call for Instructions

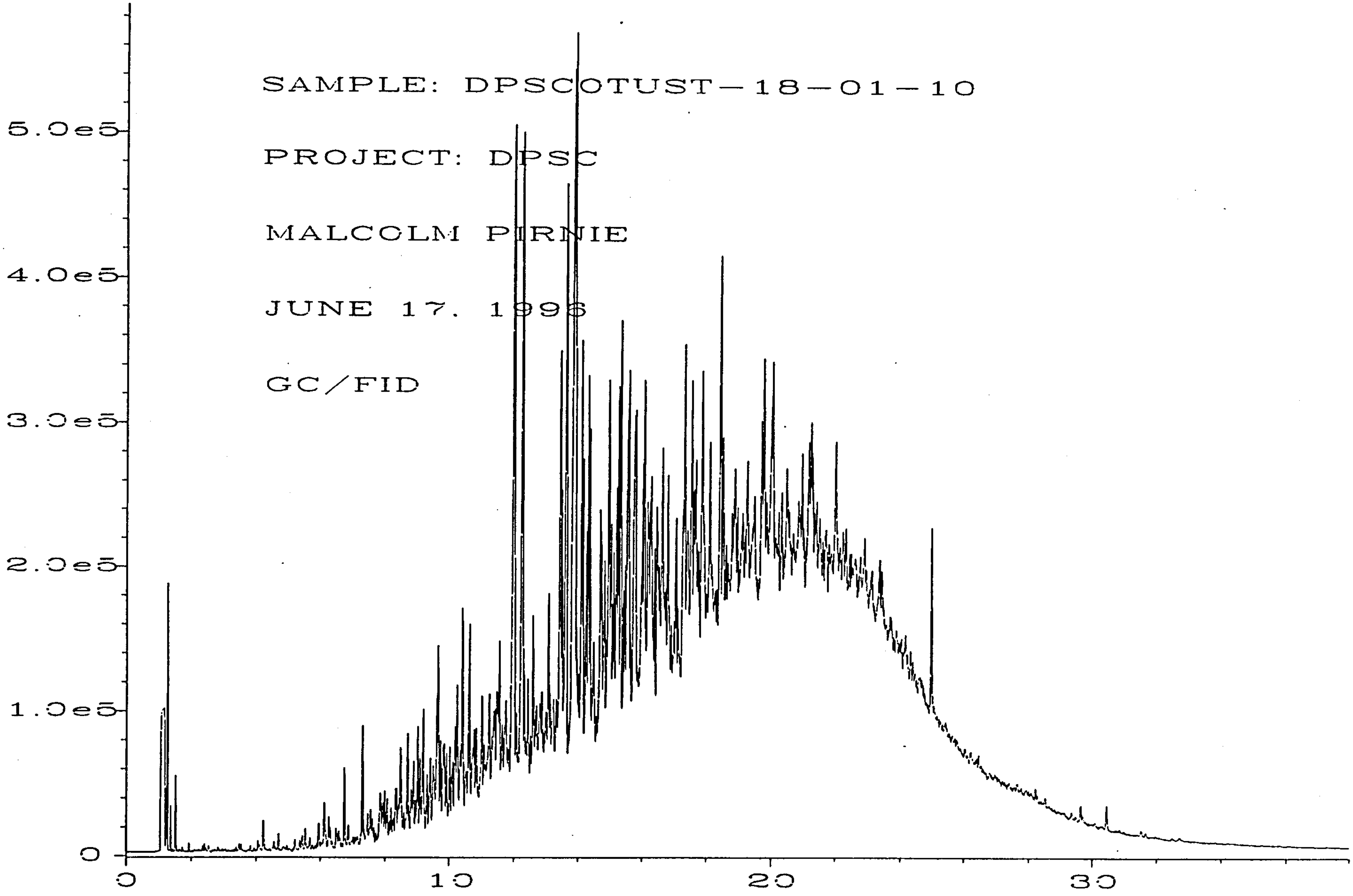
Sample #	Date/Time Sampled	Type of Sample	# of Jars	Lab Sample #	Analyses Requested
PSCOTUST-18-01-10	6/13/96 / 0920	SOIL	1	69848	HFS
P BSUT-02-01-08	6/13/96 / 1625	SOIL	1	69849	IR SCAN
BSUT-01-02-08	6/13/96 / 1520	SOIL	1	69850	IR SCAN
PSC BSUT-02-02-08	6/13/96 / 1625	SOIL	1	69851	IR SCAN

SIGNATURE	PRINT NAME	COMPANY	Date	Time
Relinquished by:	JOHN ARCHIBALD	MALCOLM PIRNIE	6-14-96	1700
Received by:				
Relinquished by:				
Received by:			6-15-96	10:40

Relinquished by: K. Dag K. DAGGUMATTI VRL 6/17/96 1500

Recvd By Cathy Downing CATHY DOWNING F&B I 6/18/96

FORMS/COC 091191 1304



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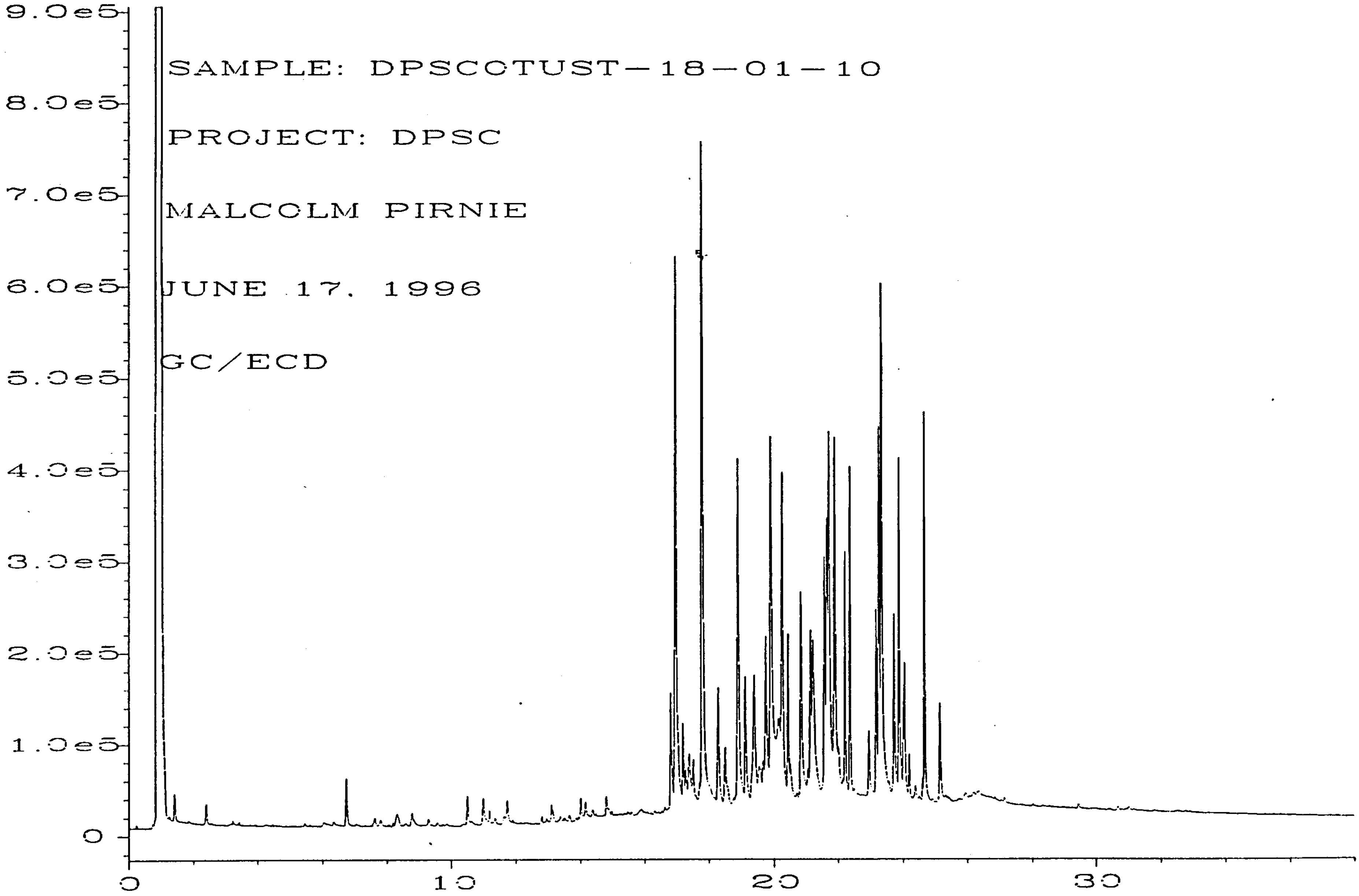

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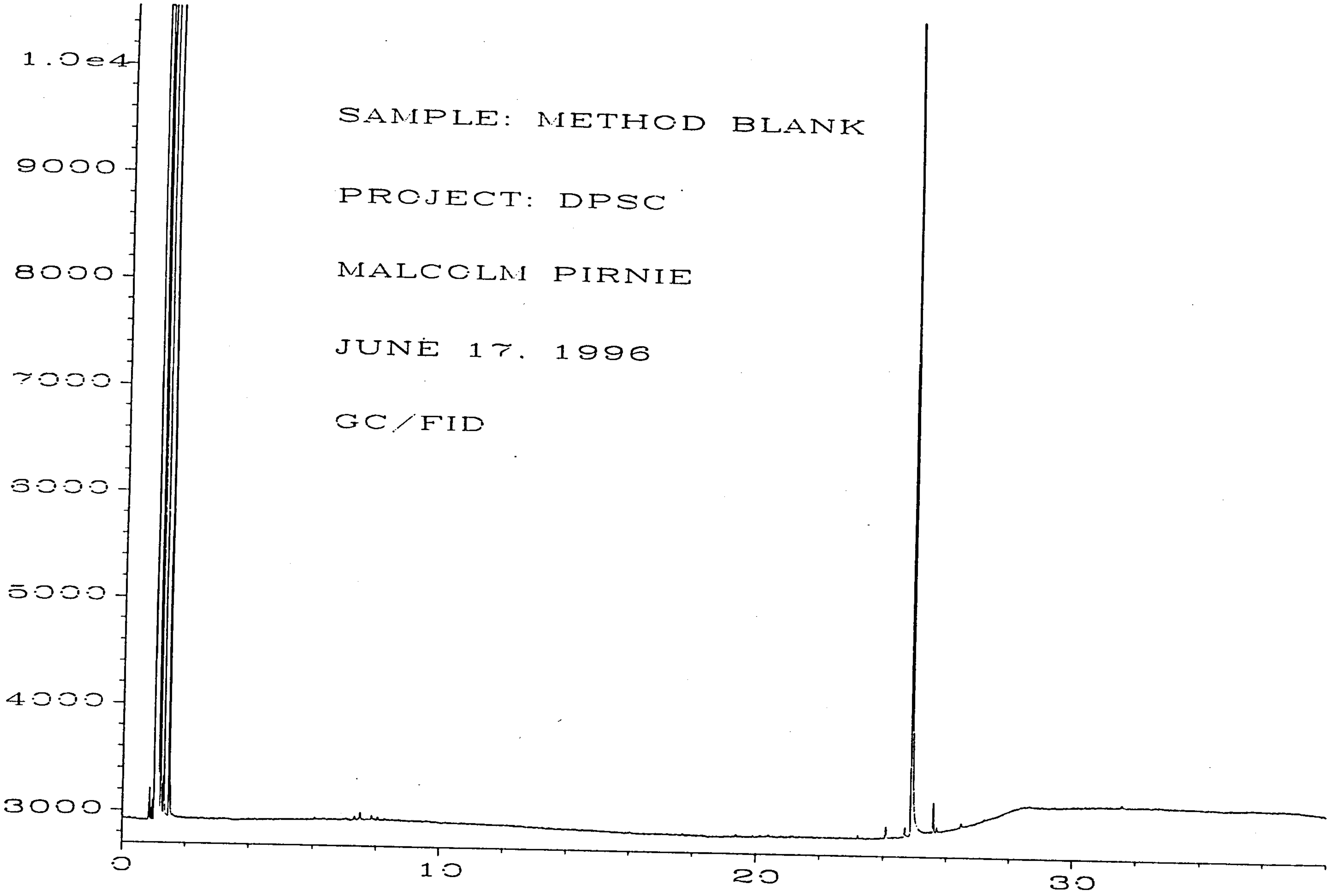

SAMPLE: METHOD BLANK

PROJECT: DPSC

MALCOLM PIRNIE

JUNE 17, 1996

GC/FID

Sig. 1 in C:\HPCHEM\4\DATA\06-17-96\077F3201.D

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

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RECEIVED

June 24, 1996

Carole Tomlins, Project Manager
Malcolm Pirnie
104 Corporate Park Drive, Box 751
White Plains, NY 10602

Dear Ms. Tomlins:

Enclosed are the results from the testing of material submitted on June 12, 1996 from your DPSC, PO #0285-643 project.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Kelley Wilt

Kelley Wilt
Chemist

keh
Enclosures
FAX: (914) ~~694~~-2455
MPI0624R.DOC 641

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: June 24, 1996
Date Received: June 12, 1996
Project: DPSC, PO #0285-643
Date Samples Extracted: June 13, 1996

RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR FINGERPRINT CHARACTERIZATION BY CAPILLARY GAS CHROMATOGRAPHY USING A FLAME IONIZATION DETECTOR (FID) AND ELECTRON CAPTURE DETECTOR (ECD)

Sample ID	GC Characterization
DP505-MW23 (24-26)	The GC trace using the flame ionization detector (FID) showed the presence of low and medium boiling compounds. The patterns displayed by these peaks are indicative of naphtha or light crude oil. The low and medium boiling compounds appeared as a ragged pattern of peaks eluting from n-C_6 to n-C_{20} showing a maximum near n-C_6. The low and medium boiling product appears to have undergone chemical or biological degradation. A dominant pattern of n-alkanes was not seen for this material. The large peak seen near 25 minutes on the GC/FID trace is pentacosane, added as a quality assurance check for this GC analysis. There is a second internal standard peak seen on the GC/ECD trace at about 26 minutes which is dibutyl chlorendate.
DPSCOTUST-10-02-16	The GC trace using the flame ionization detector (FID) showed the presence of medium boiling compounds. The patterns displayed by these peaks are typical of catalytically cracked fuel oil. The medium boiling compounds appeared as a broad hump of peaks eluting from n-C_9 to n-C_{34} showing a maximum near n-C_{20}. A dominant pattern of n-alkanes was not seen for this material. Peaks are seen on the GC/ECD trace indicative of halogenated or oxidized hydrocarbons. The large peak seen near 25 minutes on the GC/FID trace is pentacosane, added as a quality assurance check for this GC analysis. There is a second internal standard peak seen on the GC/ECD trace at about 26 minutes which is dibutyl chlorendate.

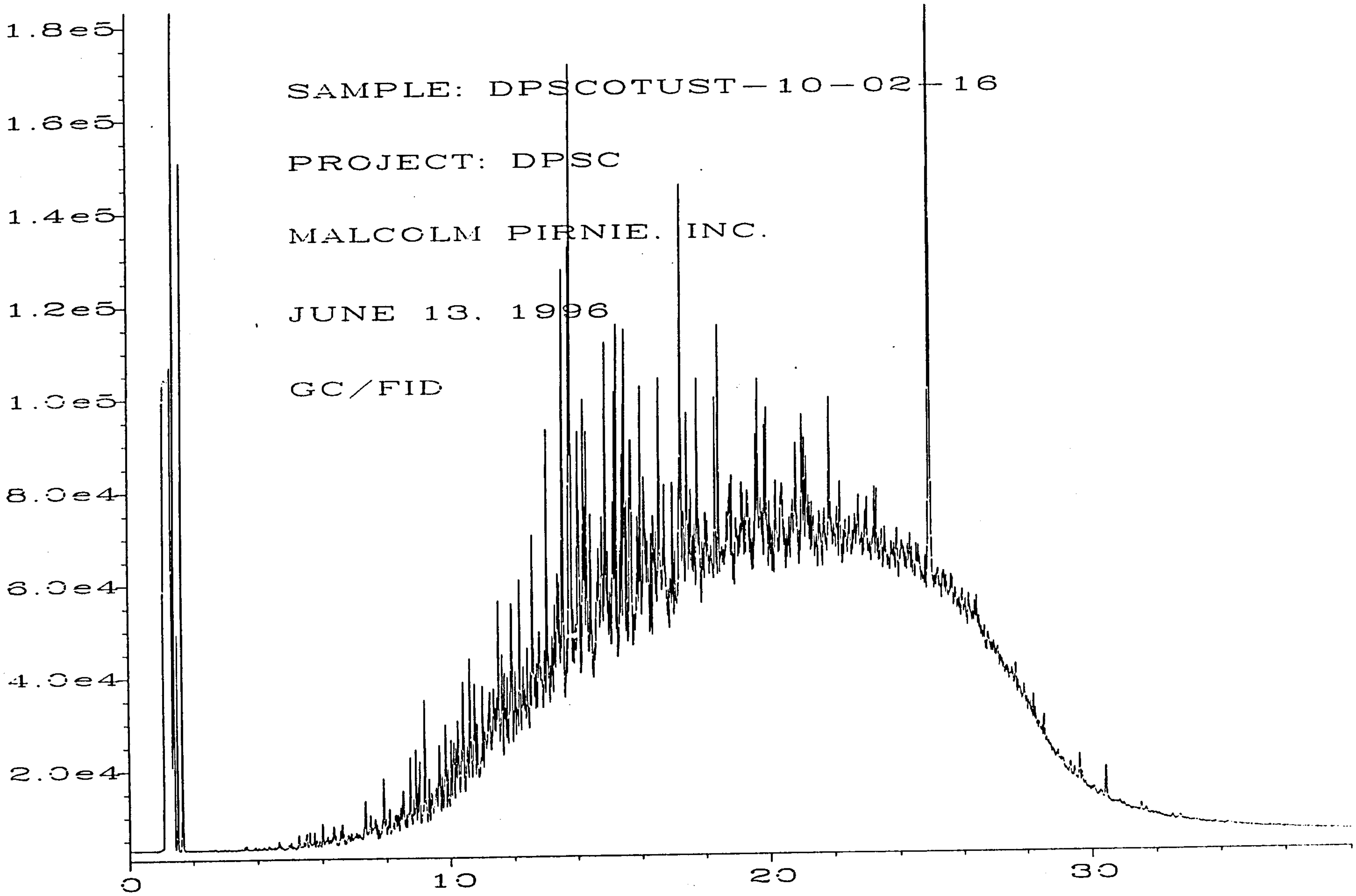
FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: June 24, 1996
Date Received: June 12, 1996
Project: DPSC, PO #0285-643
Date Samples Extracted: June 13, 1996

RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR FINGERPRINT CHARACTERIZATION BY CAPILLARY GAS CHROMATOGRAPHY USING A FLAME IONIZATION DETECTOR (FID) AND ELECTRON CAPTURE DETECTOR (ECD)

Sample ID	GC Characterization
DPSCTB061196	The GC trace using the flame ionization detector (FID) and the GC electron capture detector (ECD) trace showed an absence of volatile and semi-volatile compounds. The large peak seen near 25 minutes on the GC/FID trace is pentacosane, added as a quality assurance check for this GC analysis. There is a second internal standard peak seen on the GC/ECD trace at about 26 minutes which is dibutyl chlorendate.



SAMPLE: DPSCOTUST-10-02-16

PROJECT: DPSC

MALCOLM PIRNIE, INC.

JUNE 13, 1996

GC/FID

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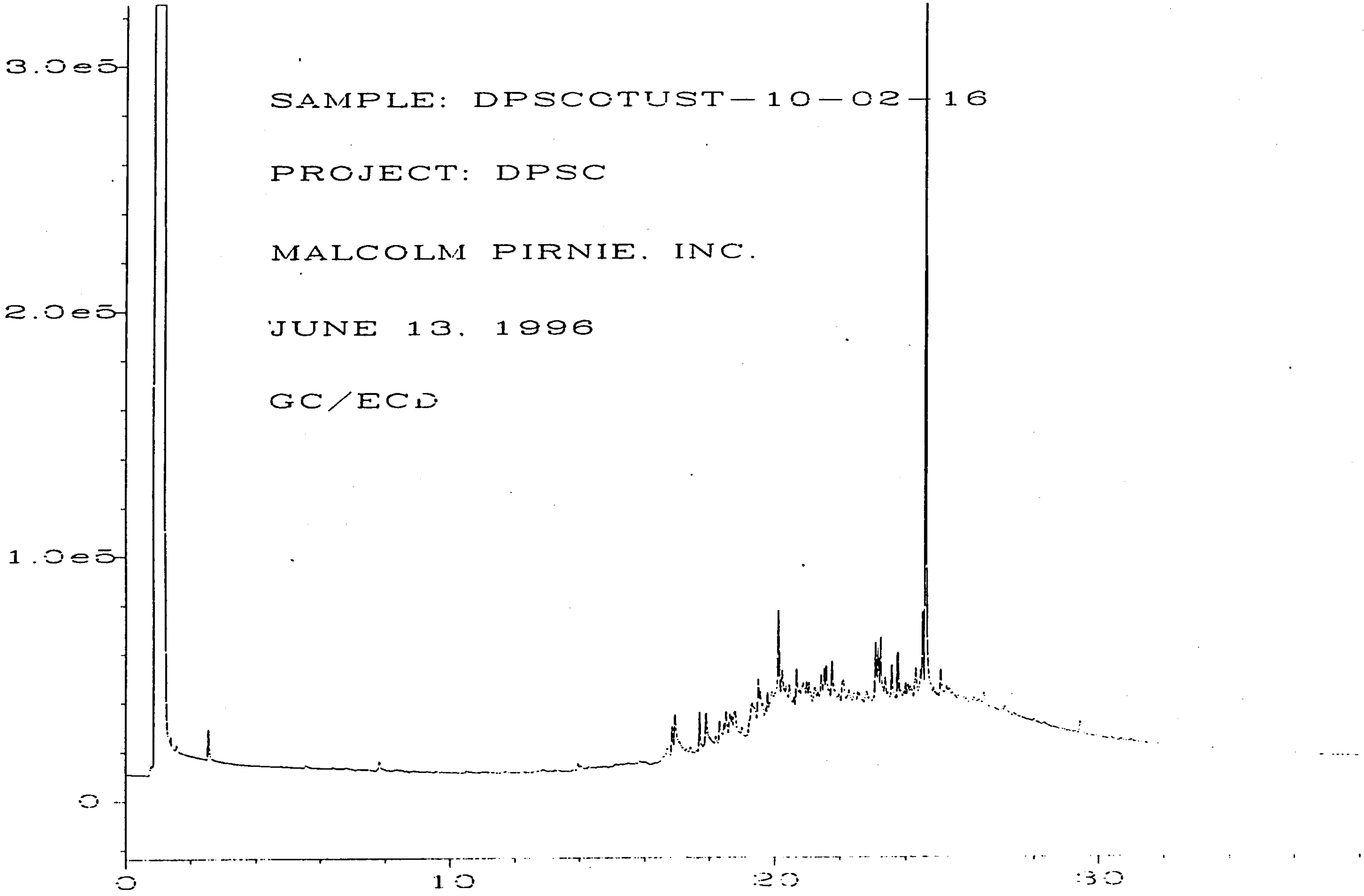

SAMPLE: DPSCOTUST-10-02-16

PROJECT: DPSC

MALCOLM PIRNIE, INC.

JUNE 13, 1996

GC/ECD

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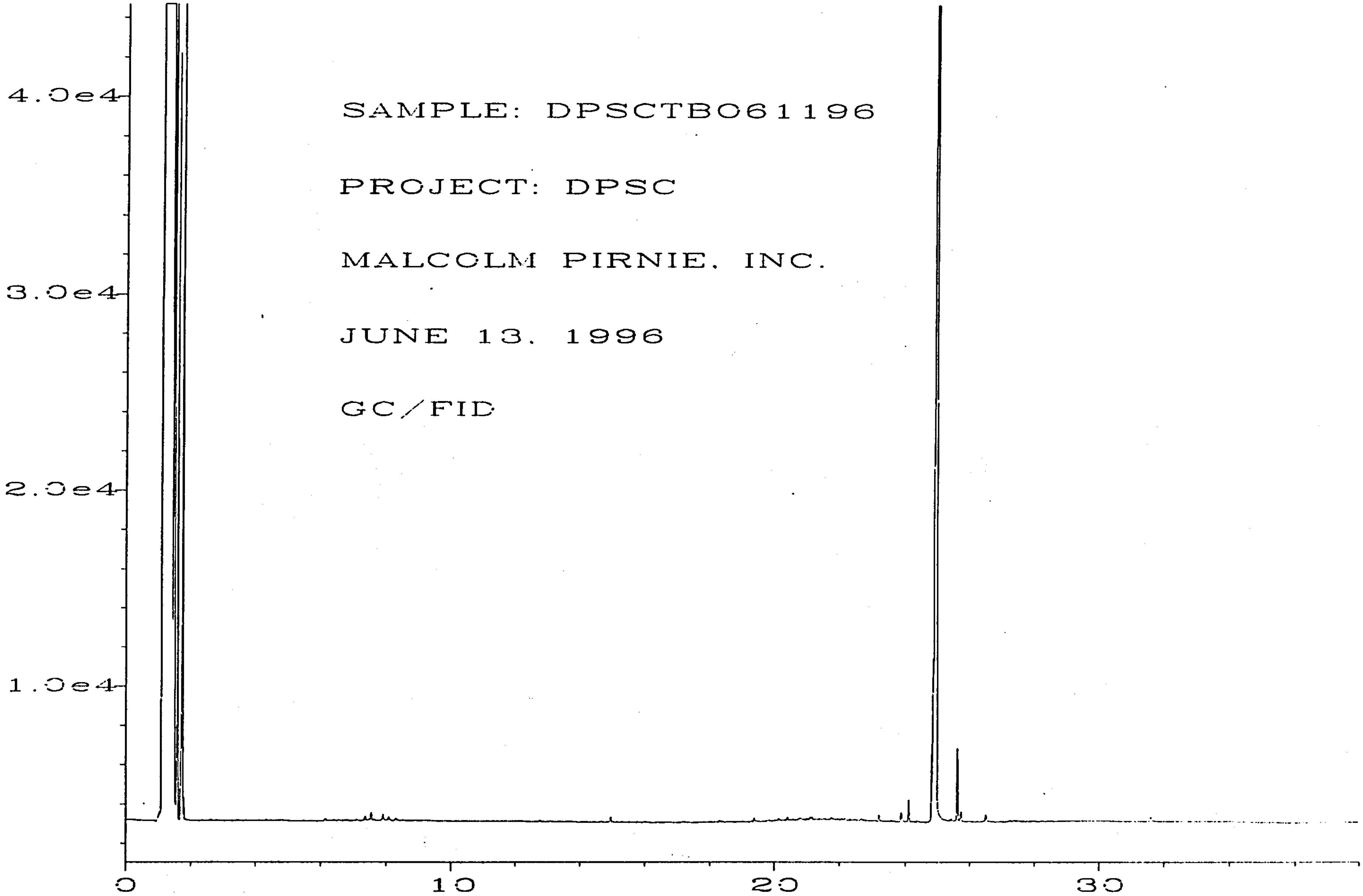

SAMPLE: DPSCTB061196

PROJECT: DPSC

MALCOLM PIRNIE, INC.

JUNE 13, 1996

GC/FID

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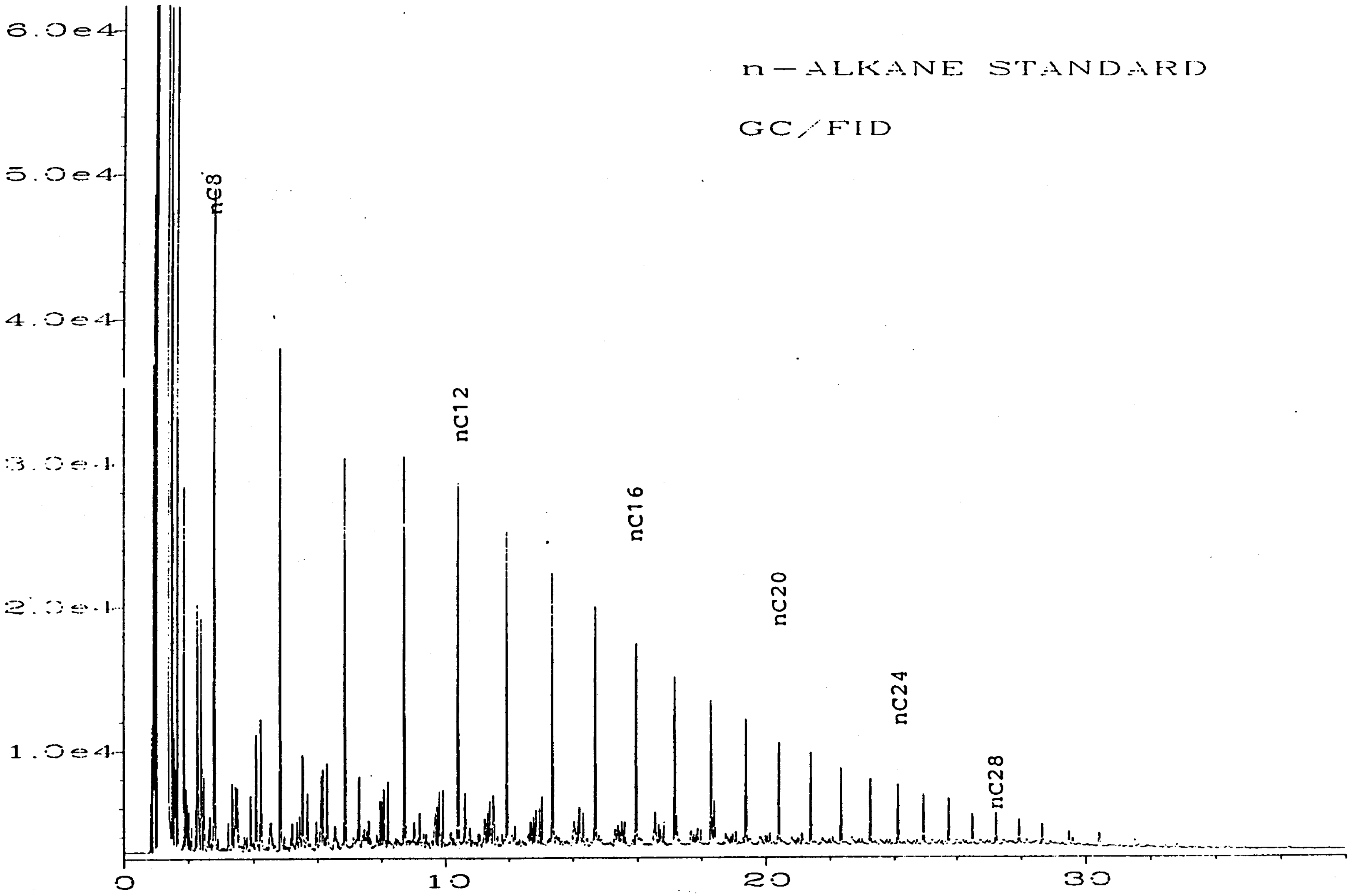

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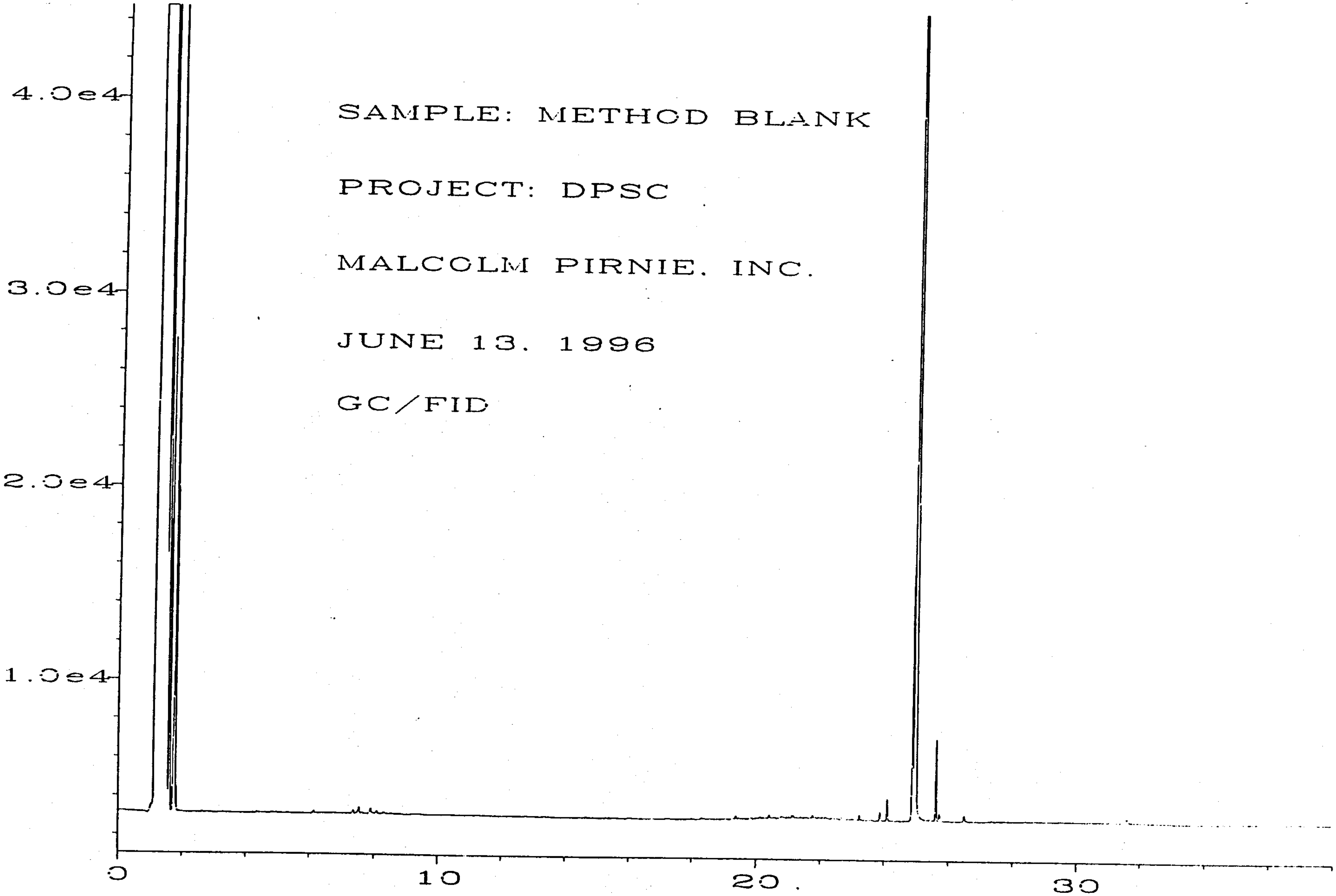

SAMPLE: METHOD BLANK

PROJECT: DPSC

MALCOLM PIRNIE, INC.

JUNE 13, 1996

GC/FID

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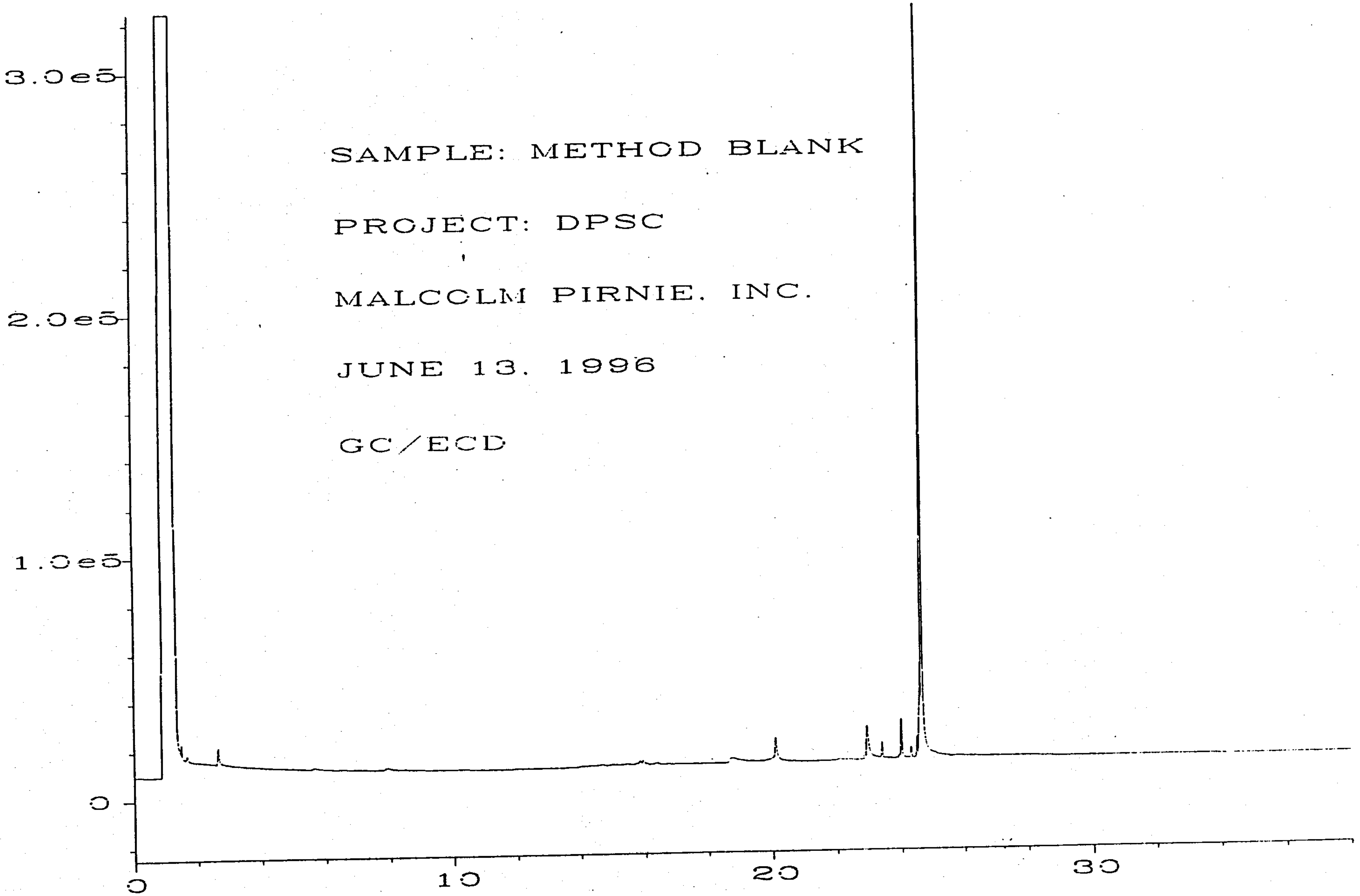

SAMPLE: METHOD BLANK

PROJECT: DPSC

MALCOLM PIRNIE. INC.

JUNE 13. 1996

GC/ECD

Sig. 2 in C:\HPCHEM\4\DATA\06-13-96\038R1701.D