Attachment III
Fred C. Hart Associates, Inc. Report
November 1984

and

Attachment IV
Fred C. Hart Associates, Inc. Report
April 10, 1986

Revised Sampling, Analysis
And Monitoring Plan

Including Revised Pump Test Plan

For
General Switch
Middletown, New York

November 18, 1991

Prepared By:

Jacobs Environmental, Inc.
7 Parlin Drive, Parlin, New Jersey

And

Shakti Consultants, Inc.
185 Gatzmer Avenue, Jamesburg, New Jersey

ATTACHMENT III

HYDROGEOLOGIC INVESTIGATION OF THE GENERAL SWITCH SITE

Prepared by:

Fred C. Hart Associates, Inc.
530 Fifth Avenue
New York, NY 10036

November 1984

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

Fred C. Hart Associates, Inc. (FCHA) was retained by the General Switch Corporation (GSC) to conduct a Hydrogeologic Investigation at the GSC plant in Middletown, New York. In compliance with the Consent Order Agreement between the Environmental Protection Agency (EPA) and General Switch, and with the approval of EPA, the investigation was designed to examine the shallow glacial till aquifer. This report contains the results of the field investigation that was carried out between August 1, 1984 and September 21, 1984.

A. Purpose of Phase I Hydrogeologic Investigation

Preliminary studies by EPA in the General Switch vicinity indicated that high levels of tetrachloroethylene (PCE) contamination were present in the bedrock aquifer close to the plant. It was believed that PCE spilled or disposed of near the site might migrate through the glacial till to the underlying bedrock aquifer. Therefore, the Hydrogeologic Investigation was primarily designed to provide information about the extent of PCE contamination in the glacial till. This plan included locating and defining the source of contamination as well as determining the mechanisms by which PCE migrated through the till.

B. Scope of Work

FCHA employed several methods to determine the source and extent of PCE contamination in the study area. The first method consisted of an OVA/M-Pacto probe survey to screen the study area for underlying soil contamination. The other methods were designed to locate both shallow and deep metal objects, such as drums, which might contain tetrachloroethylene. Shallow metal objects were located with a metal detector and deeply buried objects were located with a magnetometer. The results from these surveys were also used to select areas for further subsurface studies.

In order to more thoroughly study the hydrogeologic characteristics of the site, test pits and test borings were utilized. Soil samples were collected and analyzed from selected test pits and test borings to define the vertical and horizontal extent of PCE contamination in the glacial till. In addition, soil samples were taken for grain size and permeability measurements that would provide information on the potential for contaminant migration through the till. Lastly, monitor wells were installed in all the test borings to enable FCHA to analyze groundwater flow patterns and the amount of PCE in the groundwater.

C. Contents of Report

This report has been divided into five chapters. The first chapter contains introductory material pertaining to the purpose and scope of the investigation. The second chapter provides a summary of background material relating to the physical geology and setting of the GSC site as well as the history of the plant and its operations. An account of the field investigative methods and results is found in the third chapter. The fourth chapter contains a summary of the geology and hydrology of the site and the fifth chapter contains the interpretations and conclusions generated by the investigation. All of the grain size and permeability measurements geologic logs, and chemical analyses have been placed at the end of the report in the appendices.

CHAPTER II

BACKGROUND

A. Site Description

The GSC plant is located in Middletown, New York at the intersection of Highland Avenue and Industrial Place (Figure II-1). The natural topography at the site slopes to the southeast, although the area around the plant has been filled and graded. Consequently, there is a 5-15' elevation difference between the top and bottom banks of the parking lot (Figure II-2). The topography slopes to its lowest elevation near the southeastern edge of the GSC and Parella properties and then rises again in the area of Lubricants, Incorporated.

There are two geologic units in the study area: a lower shale bedrock unit and an overlying glacial till unit. The bedrock is comprised of an interbedded shale and siltstone/graywacke. This unit is highly fractured and weathered near the top, although at greater depths it is fairly fresh and dark gray in color. Most of the wells in the area tap the bedrock aquifer. Overlying the bedrock is an orange-brown to gray glacial till unit of variable thickness. This unit is comprised primarily of silt and clay with some boulders and has a very low permeability.

B. Site History

1. Past and Present Plant Operations

The GSC plant was built in 1958 and both the original parking lot and building were about half their present size (Figure II-2). At that time, the area adjacent to the parking lot was used for disposing of scrap metal and industrial waste generated by the plant. In 1963, the plant was enlarged to its present size and the old scrap metal was used as fill when the parking lot was expanded. Most of the scrap metal now generated by the plant is temporarily stored in dumpsters and then sold to a scrap metal company.

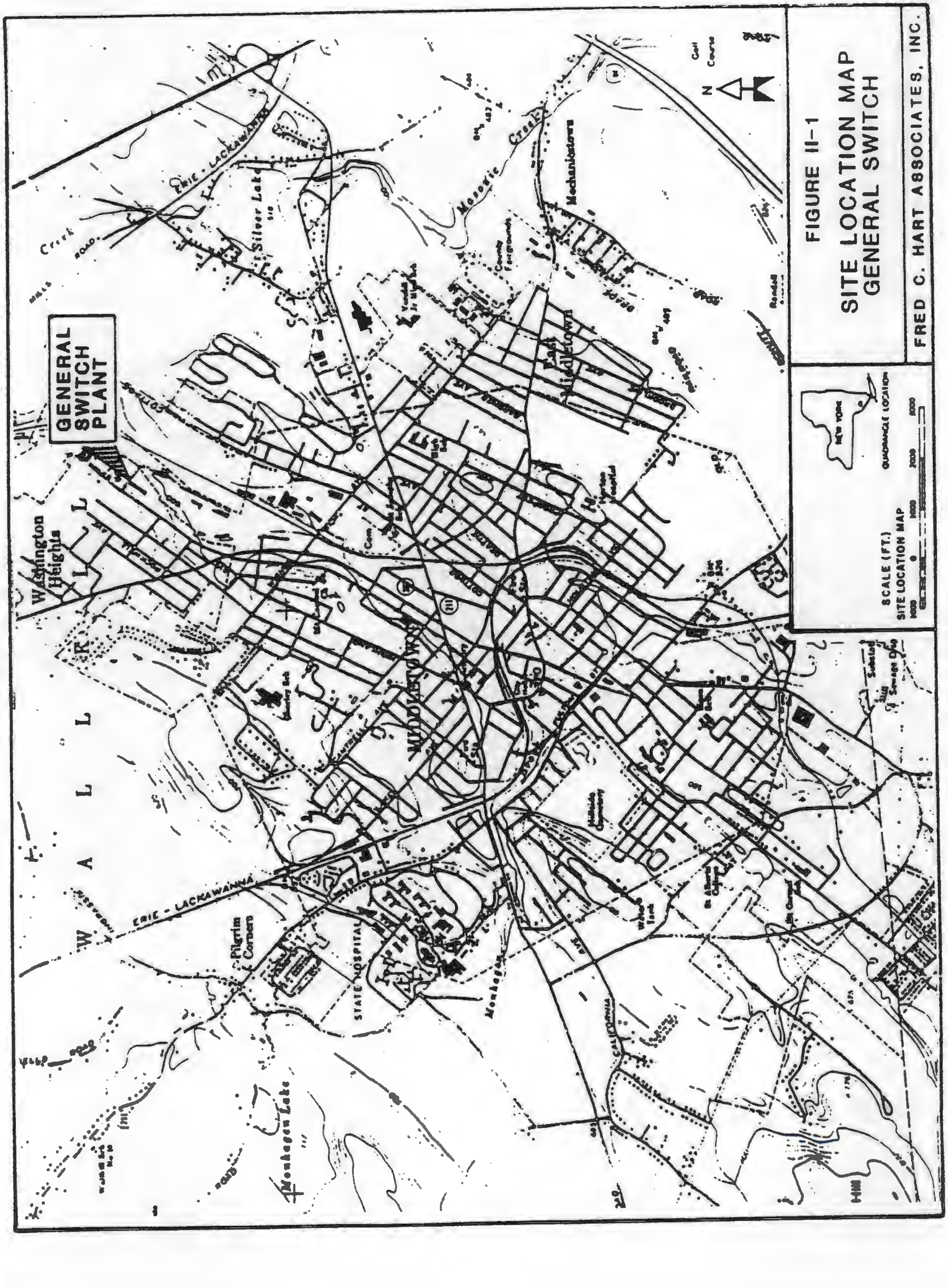


FIGURE II-1
SITE LOCATION MAP
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

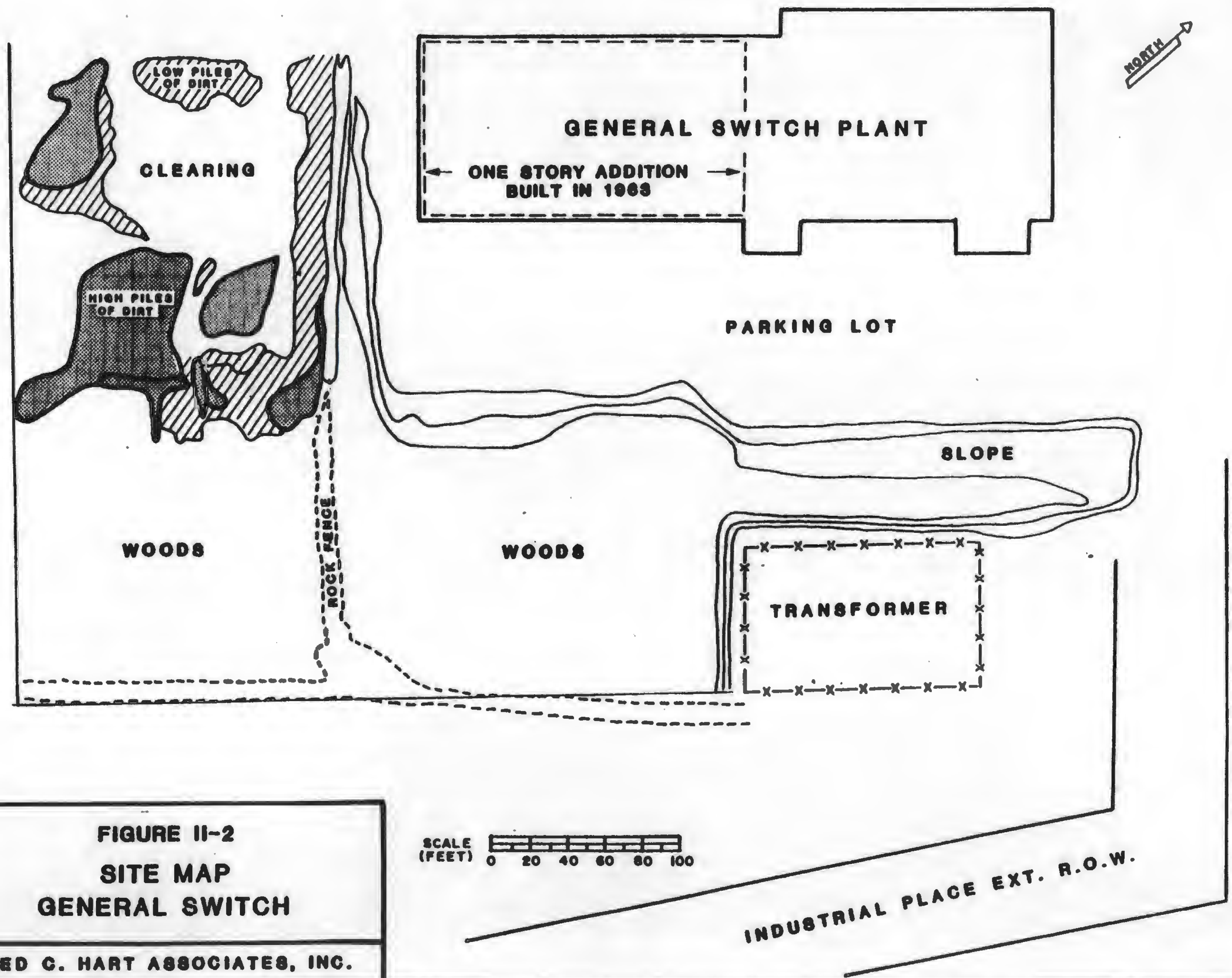


FIGURE II-2
SITE MAP
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

The plant manufactures and stores switch boxes and circuit breakers and uses tetrachloroethylene as a degreaser in the manufacturing process. The metal parts used in the switch boxes and circuit breakers are carried on a conveyor belt and dipped into a tank containing PCE to clean all the accumulated oil and grease. Tetrachloroethylene was originally stored inside the plant in a 500-gallon tank and the chemical was delivered by tank truck. Now, however, PCE is delivered and stored inside the plant in 55-gallon drums. The spent PCE goes through an on-site distillation process whose end product is a 50 percent PCE-oil mixture. The still bottoms are then sent to another facility to be reprocessed. General Switch has been using this distillation process for at least the last ten years.

2. Results of Past Investigations

EPA, in conjunction with the New York State Department of Conservation (NYSDEC), conducted several investigations at GSC. A brief summary of the results from their sampling program and pump test is presented in the following paragraphs.

In December 1983, the NYSDEC sampled soil from 0-2.5 feet at a site just south of the plant building. The results of the chemical analyses showed relatively low concentrations of PCE at the top and bottom of the hole and higher concentrations (100 ppm) at depths of one to two feet. A second round of soil samples was taken from within a 100 foot radius of the plant in March, 1984. The most contaminated sample (1,000 ppm PCE) was found on the northwest side of the plant. Two other samples from the southwestern corner of the plant contained 95 and 400 ppm PCE, while the other soil samples contained only 10 ppm.

From October 17, 1983 to March 16, 1984 water samples from potable wells within a one-mile radius of the GSC plant were analyzed for PCE. The data generated from over 300 ground water samples indicated that twenty wells on Highland and Watkins Avenues had detectable concentrations of PCE. Seven domestic wells and one industrial well (at GSC) contained concentrations of PCE that exceeded the NYSDOH maximum permissable concentration (50 ppb) for any single synthetic organic chemical. The contamination appeared to be distributed in a northeast-southwest line, with the most contaminated well (260,000 ppb) on the property adjacent to GSC. Lower concentrations of PCE (less than 50 ppb) were found in some wells along Watkins Avenue, and wells on Commonwealth Avenue appeared to be totally unaffected. The results also showed that the distribution of PCE changed little over the three month period of the investigation.

In order to extract PCE from the bedrock aquifer, the Technical Assistance Team (TAT) and USEPA pumped the Parella well from November 15 to December 26, 1983. Parella's well (the extraction well) was pumped at a rate of 0.5 to 4.0 gpm and an estimated 21 pounds of PCE were removed. In the process of pumping Parella's well, it was noted that the radius of influence was anisotropic and limited to 350 feet. TAT's conclusion was that the existing wells could be effectively used as extraction wells for removal of the contaminated water.

CHAPTER III

SUMMARY OF FIELD INVESTIGATIVE ACTIVITIES

A. Introduction

The FCHA work plan at GSC was designed to investigate PCE contamination in the area of the GSC plant and assess the potential for its migration in the glacial till overlying the bedrock aquifer. This chapter contains the purpose, procedures and results of all the field activities as well as the chemical data generated by these activities. The activities completed were:

1. OVA/M-Pacto Probe Survey
2. Magnetometry and Metal Detection Surveys
3. Test Pits
4. Test Borings
5. Soil Sampling and Chemical Analysis
6. Permeability Measurements
7. Monitor Well Installation
8. Casing Elevations and Water Level Measurements
9. Monitor Well Sampling and Chemical Analysis
10. Potable Well Sampling and Chemical Analysis

B. OVA/M-Pacto Probe Survey

1. Purpose

The OVA/M-Pacto Probe Survey was conducted to screen the General Switch study area for underlying soil contamination by volatile organic hydrocarbons. Although EPA had already collected and analyzed soil samples for PCE in the immediate area of the plant, this survey was designed to cover a much larger area. The area of interest included the Paralla property, the parking lot and the property below the parking lot southeast of the plant building. In addition, the results of the survey were used in conjunction with data from the magnetometry and metal detection surveys to help identify areas for further subsurface studies.

2. Procedures

Before the OVA, magnetometry or metal detection surveys could be started, a reference grid was constructed in the survey area. The grid system was used for all the surveys and made data correlation easier and more accurate.

The baselines for the grid were staked out by siting along two sides of the Orange and Rockland Utilties substation fenceline. Baseline A was sited along the northeast-southwest side of the fence and extended 400 feet in a southwest direction. The second baseline, line Ø, was sited along the southeast-northwest side of the fence and extended perpendicularly to baseline A in a northwest direction toward the plant.

Once the baselines were established, the entire grid was constructed (Figure III-1). Lines parallel to baseline A were identified by letters and paced out at 50 foot intervals. The intermediate lines at 25 foot intervals were designated D.5, E.5 and so on. Lines parallel to baseline Ø were identified by numbers. The numbers were positive (+50, +100) on the southwest side of baseline Ø and negative (-50, -100) on the northwest side of baseline Ø. The intersections between the northeast trending lines and the northwest trending lines were marked with flags and each flag was identified with the appropriate letter and number.

Once the reference grid was established, the OVA/M-Pacto probe survey was carried out. At each point on the reference grid, a 3/4" diameter probe with a drop hammer was driven approximately 1 to 2 ft into the ground. Immediately after the probe was withdrawn, the air was sampled and analyzed through the inlet port of Century Systems Model 128 Organic Vapor Analyzer (OVA). The OVA was operated in survey mode to provide a qualitative indication of total volatile organic hydrocarbons trapped in the interstitial air space between soil particles. The instrument response was calibrated to a methane standard and the data collected was reported in ppm volatile organic hydrocarbons.

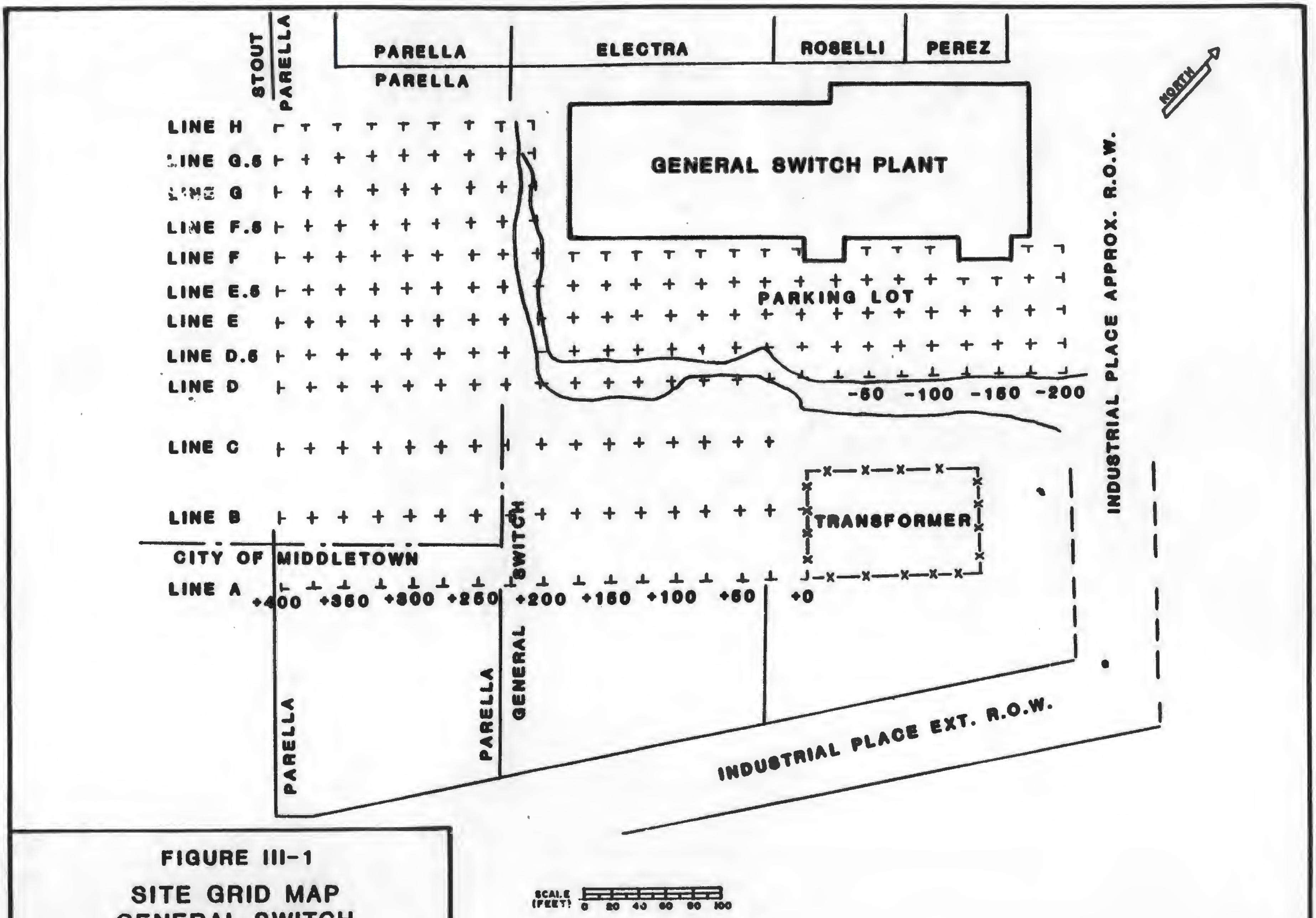


FIGURE III-1

SITE GRID MAP
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

3. Results

The results of the OVA/M-Pacto probe survey are shown on the contour map in Figure III-2. The contour map shows three areas where the air space in the soil pores contained volatile organic hydrocarbon concentrations of 1000 ppm or greater. All three of these areas are located within or near the GSC parking lot and locations 1 and 2 are in the general vicinity of the present loading dock. It should be noted that the process of transferring PCE from the tank truck into the 500 gallon storage tank inside the building could result in some minor leakage in the vicinity of the loading dock. There appears to be little volatile organic hydrocarbon contamination in the shallow soils on Parella's property or in the soils southeast of the plant. The background values in these areas range from 0 to 10 ppm, with a few isolated areas showing values of 20, 70 and 100 ppm.

C. Magnetometry and Metal Detection Surveys

1. Purpose

Magnetometry and metal detection surveys were conducted to determine the presence of buried metal objects, such as drums, in the study area. The metal detector is capable of locating objects at shallow depths, while the magnetometer provides data about metal objects at greater depths. The data generated by these two surveys was also used to identify locations for test borings and test pits.

2. Procedures

As in the case of the OVA survey, both of these survey techniques require the construction of a reference grid. The procedure for constructing a grid was discussed in Section IIIB-2.

Magnetometry. A proton magnetometer operates by detecting and measuring changes in the earth's magnetic field. These disturbances arise from local changes in magnetization caused by the presence of ferromagnetic

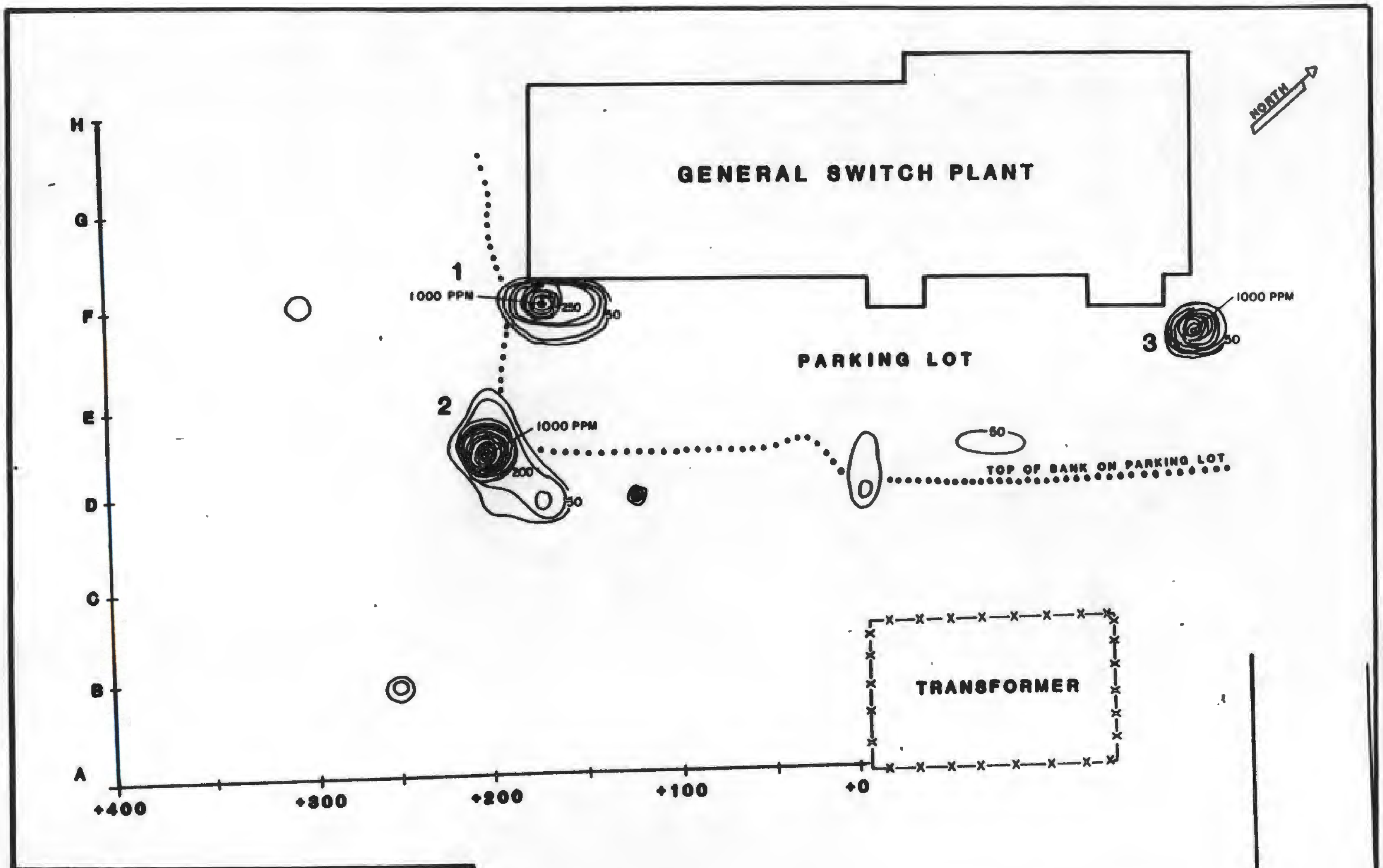


FIGURE III-2
OVA CONTOUR MAP
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

material. The magnetometer is calibrated in gammas and as long as the magnetic gradient is not too high, the instrument is accurate to one gamma. However, the presence of a high magnetic gradient produced by large concentrations of metal or electrical interference will reduce the maximum accuracy of the instrument to 100 gammas. The instrument used for the survey at General Switch was a Geometric G-846 Unimag II Proton Precession Magnetometer.

In order to calibrate the magnetometer, it was taken to the southeast corner of Parella's property near grid point A-385 (Figure III-3). This spot was considered to be free of any local disturbances and was also established as a reference point to record diurnal variations. The magnetometer was calibrated by consulting a map of the earth's magnetic field and adjusting the field intensity dial on the magnetometer to the appropriate setting.

The actual survey was conducted as a series of traverses along grid lines parallel to baseline A. Readings were taken at 25 foot intervals and after every traverse was finished, readings were taken at the reference point. The entire reference grid at General Switch was covered in this manner over the period of two days.

Metal Detection. The metal detector consists of a directional radio transmitter and receiver coupled together. The transmitter sends out a signal which induces an electromagnetic field on a target within range of the transmitter. This field is detected by the receiver and identified to the operator by an audio signal. Although the metal detector is easy to operate, it is limited to an effective depth of penetration of only 4 feet.

The instrument used at General Switch was a Fisher Model TW-5 M-Scope. The metal detector was calibrated by holding it over an area representative of background conditions and adjusting the appropriate knob for maximum sensitivity.

The General Switch parking lot was extensively surveyed with the metal detector. Instead of using the reference grid, the metal detector was left on and carried by hand in traverses that completely covered the parking lot.

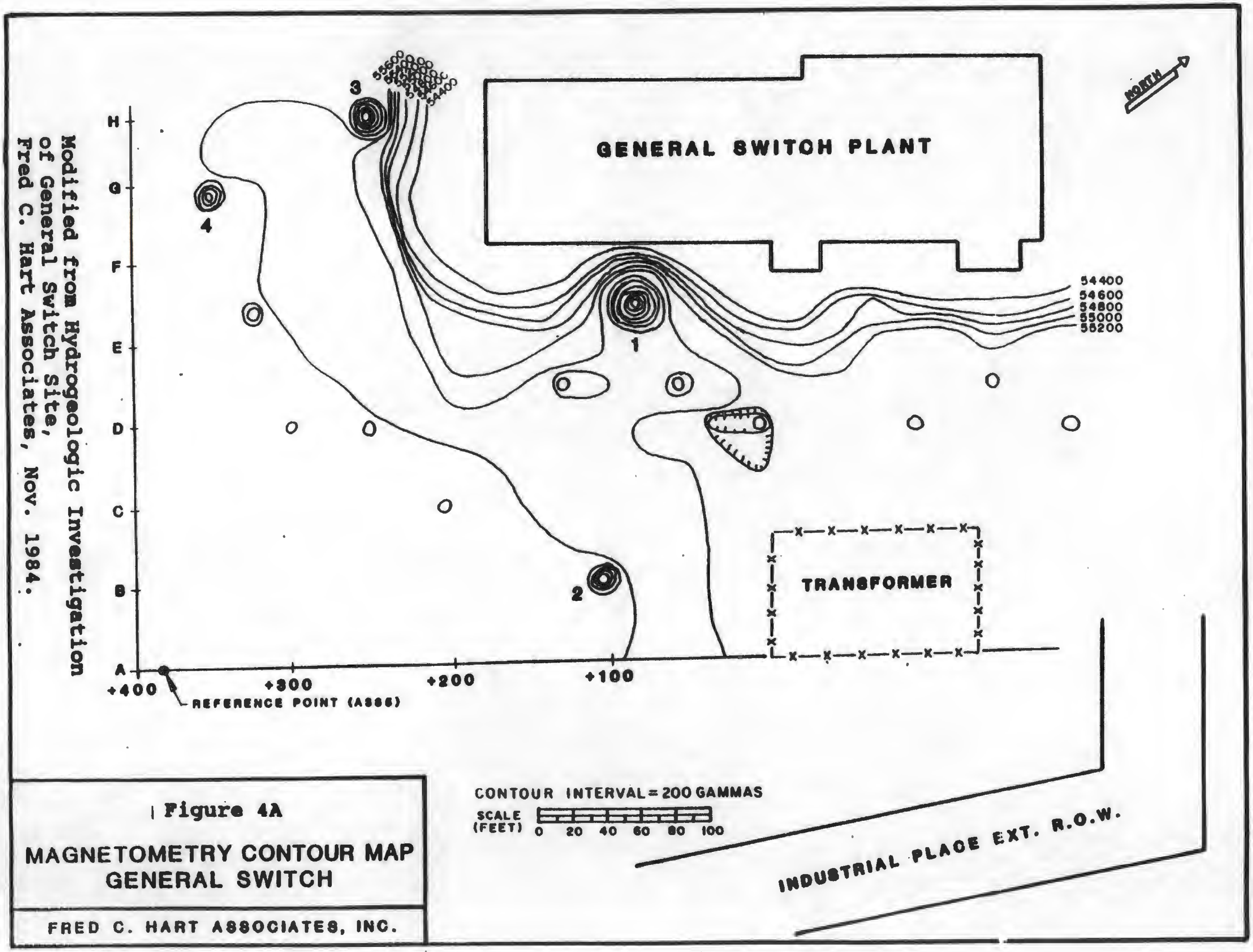


Figure 4A

MAGNETOMETRY CONTOUR MAP
GENERAL SWITCH

Modified from Hydrogeologic Investigation of General Switch Site, Fred C. Hart Associates, Nov. 1984.

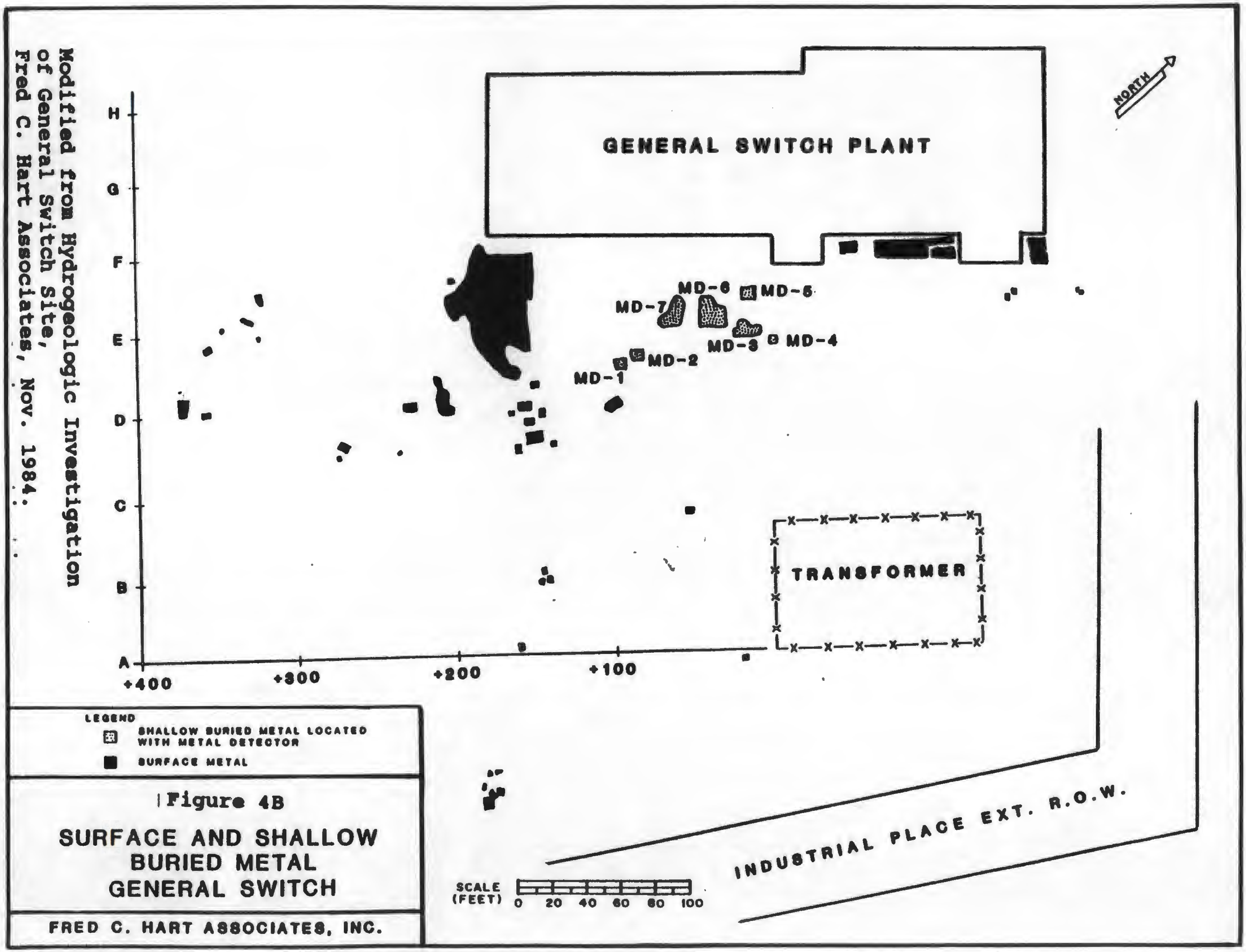
The rest of the study area was covered by traverses along the 25 foot interval grid lines. Particular attention was paid to areas where the magnetometer had shown anomalies, where surface metal was found or where the topography appeared unusually disturbed.

3. Results

Magnetometry. The contour map constructed from the magnetometric data collected in the field is shown in Figure III-3. The data was corrected for natural diurnal variations in the magnetic field that occurred during the survey. Magnetic anomalies that could be positively attributed to surface metal or electrical interference (i.e. the transformer) were removed from the contour map.

The magnetometric contour map (Figure III-3) shows four major magnetic anomalies as well as the magnetic gradient generated by the reinforced concrete wall of the plant. The largest anomaly, labeled 1, is located in the General Switch parking lot and anomalies 2, 3 and 4 are scattered around the study area. An attempt was made to model the burial depth and weight of each object that generated an anomaly, but the results were not entirely satisfactory. In the parking lot, ambient gradients produced by the concentrated layer of buried metal precluded accurate modeling. Anomalies mapped in other areas of the General Switch property may be due to the highly magnetic nature of glacial till. Test pits were dug in each of the four locations and metal objects were found in two of the pits. These results will be discussed further in the section on test pits.

Metal Detection. The only area where shallow buried metal was located with the metal detector was in the General Switch parking lot. The location of these sites (labeled MD1-MD7), as well as surface metal locations are shown in Figure III-4. Sites MD1-MD7 correspond to the area where scrap metal was found when the test pits were dug. The scrap metal layer is actually continuous in that part of the parking lot, but the metal detector only identified scrap metal that was 4 feet or shallower.



Modified from Hydrogeologic Investigation of General Switch Site, Fred C. Hart Associates, Nov. 1984.

Figure 4B

SURFACE AND SHALLOW BURIED METAL GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

Most of the surface metal found at the site was also in the vicinity of the parking lot. The large area of surface metal near the present loading dock consisted of trolleys, several old generators and a compressor. The scrap metal on the southeastern edge of the parking lot consisted of metal shelves, a refrigerator, some fence wire and several drum lids. Several empty paint cans and an empty drum were also found along the southwestern edge of Parella's property.

D. Test Pits

1. Purpose

A total of twelve test pits were dug to provide both visual and physical data about shallow subsurface conditions at the General Switch site. Samples were collected from each pit to provide data on grain size, permeability and the extent of PCE contamination. In addition, several test pits were located in areas where magnetometry or metal detection data indicated that buried metal might be present.

2. Procedure

A tractor-mounted backhoe and operator were provided by Kendrick Drilling. The operator excavated 10 to 12 foot pits at each of ten predetermined sites (Figure III-5). The sites were chosen on the basis of data gathered in the preceeding magnetometry, metal detector and OVA surveys. Areas where particularly high levels of volatile organics or metal were found or areas where the topography was unusually disturbed were chosen as sites for test pits. An additional two sites were also dug to collect bulk soil samples for permeability tests.

Before the backhoe operation began, an equipment decontamination (decon) and storage site was established. This site was used to prepare and clean trowels and equipment for sampling and as a storage area for the cooler and extra equipment. In this case, the trowels were the only equipment that needed cleaning. The procedure involved washing the trowels in detergent and rinsing them first in tap water, then distilled water and

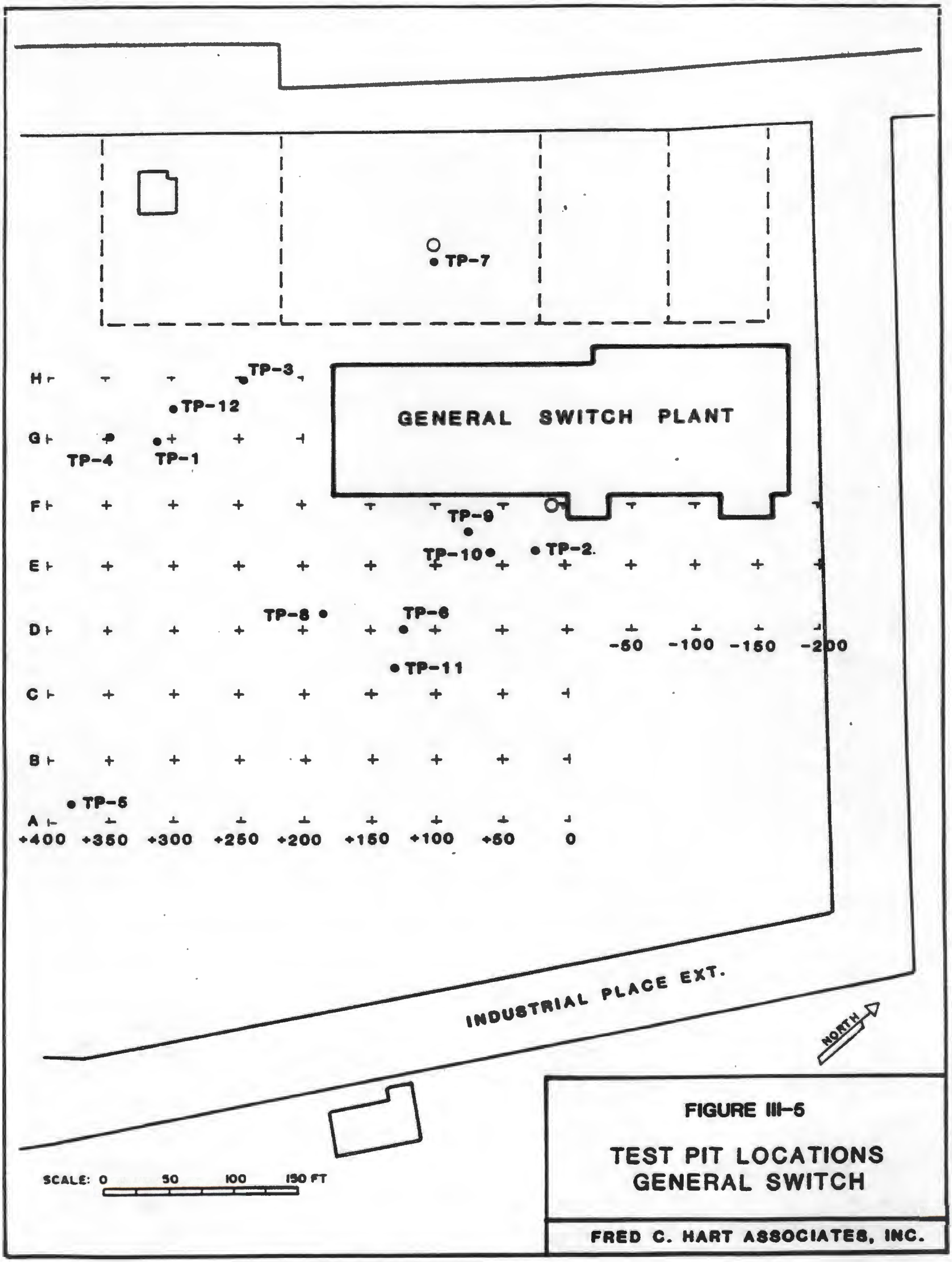


FIGURE III-5

TEST PIT LOCATIONS
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

finally, acetone. After air-drying, the trowels were wrapped in aluminum foil to keep them clean in storage. All of the necessary sampling equipment was assembled at the decon site and then taken to the test pit. For safety, an OVA was used to assess air quality above and within each test pit prior to sampling.

Once the test pit was completed, a geologist went down into the hole and took composite soil samples. A fiber tape was lowered from the top of the pit and samples were taken from within two-foot intervals on one wall of the pit and composited in the sample bottle. One trowel was used to fill each VOA vial and soil sample bottle collected from each interval. All the bottles and VOA vials were labeled with the date, the interval sampled and the test pit number. Once the entire pit was sampled, all the bottles and vials were removed and placed in a cooler, on ice. VOA headspace screenings and analyses were performed in the evening a maximum of twelve hours after the samples were collected. The chemical data from the headspace analyses is included in the section on soil samples and chemical analyses. All the pits were backfilled after sampling and test pit logs were completed.

3. Results

The test pit logs completed for all twelve test pits are contained in Appendix A. Although the soil and till thicknesses were somewhat variable, the units themselves were quite similar across the study area. The topsoil tended to be dry and brown in color and ranged in thickness from 5 inches in undisturbed areas to 5 feet in disturbed areas. Some of the top soil on the Parella property had been bulldozed into high piles (Figure II-2) that supported thick stands of vegetation. The till was gray to orange-brown in color and predominantly silt and clay-rich. There were occasional fine to medium sandy pockets, and abundant cobbles and boulders scattered throughout the till. The boulders were mostly shale in composition and tended to be quite angular. With the exception of one test pit in the parking lot (TP-2) and one test pit where bedrock was encountered (TP-5), all of the other test pits were terminated in the till. Test pit 5 was unusual in that bedrock was encountered at a depth of only 4-5 ft. Water was flowing through the fractured bedrock into TP-5 while it was sampled, and the air in the pit had a "chemical" odor. OVA measurements indicated that the air within this test pit contained approximately 100 ppm of volatile organic hydrocarbons.

In three of the four test pits dug in the parking lot (TP-2, TP-6 and TP-10), an extensive scrap metal and industrial waste layer was encountered. The OVA readings in these pits were some of the highest measured and it was frequently possible to smell a "chemical" odor. The industrial waste found in the test pits included: paint cans, drum lids, metal switch boxes, paint sludge, wire screens and wood. One empty drum was found in TP-2 and two drums, partially filled with gray paint sludge, were found in TP-10 at a depth of 5-6 ft. Neither of these drums had lids and the gray paint sludge was dried and crumbled. Test pit 6 was dug on the southeast side of the parking lot and also contained industrial waste. The "chemical" odor was strongest in this test pit which was located directly across from the loading dock. Test Pit 9 was the cleanest pit in the parking lot and contained mostly soil fill material rather than industrial waste. One half of a drum, with cleanly cut sides was found in the study area at TP-3. The drum was screened with the OVA which indicated that there were no volatile hydrocarbons present in the drum.

E. Soil Test Borings and Rock Coring

1. Purpose

The purpose of the test borings was to provide detailed geological data on the glacial till underneath the General Switch site. The test borings provided informaton on the extent and thickness of the glacial till, as well as the location and nature of the underlying bedrock surface. In addition, grain size and chemical analyses of split spoon samples provided information on the extent and possible paths of migration of PCE.

2. Procedure

A total of eight soil borings were completed by Kendrick Drilling Co., Monroe, N.Y. The borings were originally planned to be completed with a hollow stem auger. However, because of the hardness of the till and the

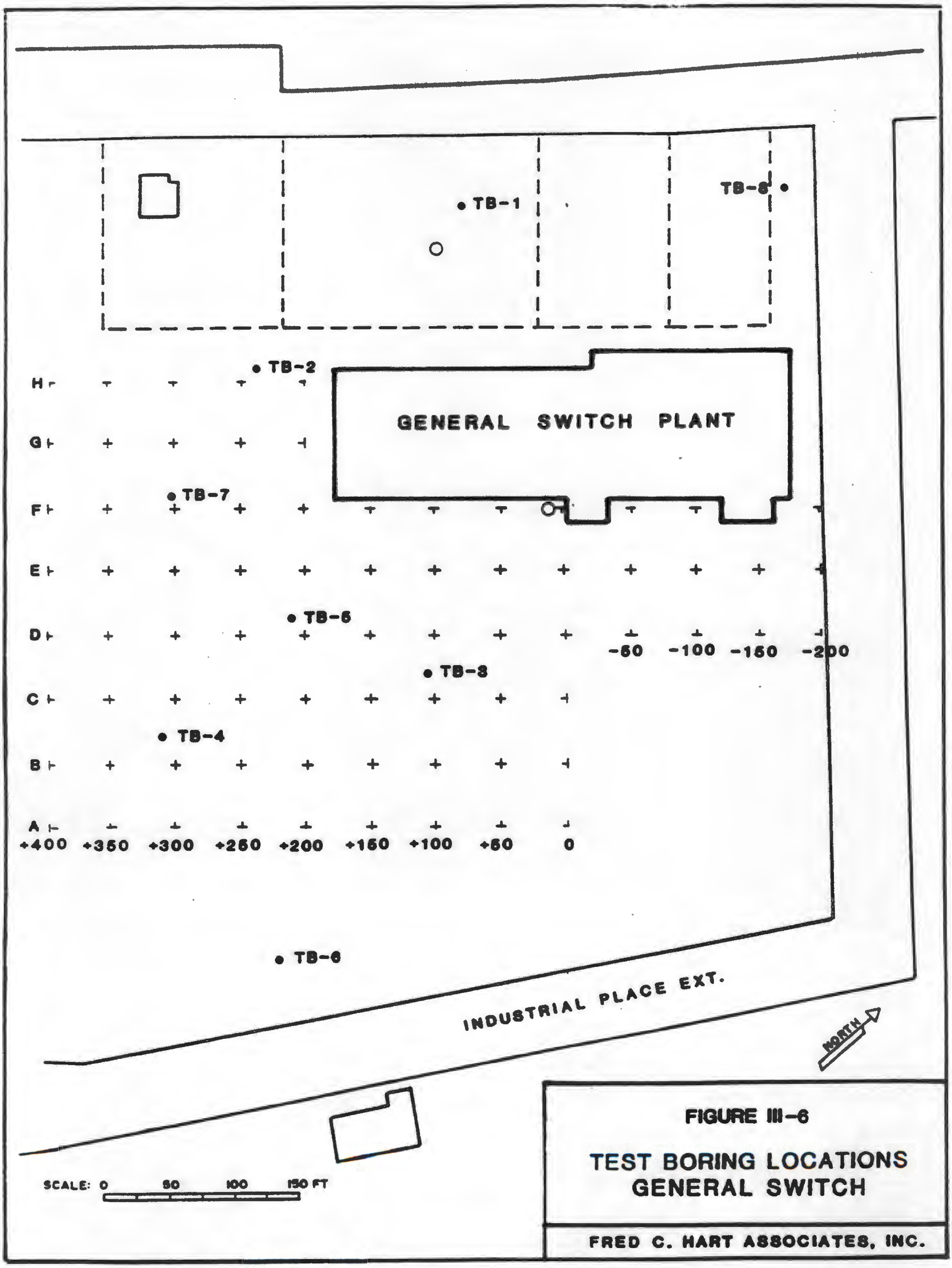


FIGURE III-6

TEST BORING LOCATIONS GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

abundance of boulders, a mud rotary set-up, using water as the drilling fluid, was required. The locations of the test borings (Figure III-6) were chosen based on chemical and geological data gathered in the test pit investigation. Two test borings (TB-1 and TB-8) were located at sites where no PCE contamination was expected, to check background levels in the groundwater. Two test borings (TB-3 and TB-5) were placed on either side of the parking lot to monitor groundwater in the vicinity and one was placed downgradient of the parking lot near the test pit where a "chemical" odor was discovered (TB-4). Two test borings were also placed on the northwestern side of the plant to investigate the possibility of contaminant migration between the General Switch property and the Parella property (TB-2 and TB-7).

All of the test borings were drilled and sampled continuously from the ground surface to bedrock. In all of the borings, at least five feet of rock was drilled or several feet of rock were cored to confirm the bedrock surface. Rock cores were taken from TB-1, TB-6 and TB-8 to allow a visual inspection of the rock type and degree of weathering and fracturing in the rock. All three rock cores were taken with a five foot long, 1 1/2" diameter core barrel supplied by Kendrick Drilling Co.

The soil was sampled with a 2 foot split spoon sampler and blow counts were recorded for each six inch interval. A standard 140 lb. drop hammer was used to drive the split spoon through the till. An attempt was made to drive the spoon the full 24 inches at each sampling interval, but the presence of cobbles and boulders frequently made this difficult.

The contents of each spoon were carefully described and logged and pictures were taken when time allowed. Portions of each sample were placed in a VOA vial and a sample bottle. The bottles were labeled and placed on ice as soon as possible. In some cases, the sample recovery was large enough so that a third sample could be taken for grain size analyses.

OVA headspace analyses were completed on all the VOA vials. This data is presented in the next section and aided in screening the soil samples that were sent to the laboratory for chemical analyses.

3. Results

The test boring logs compiled during drilling and sampling are found in Appendix B. The data from the test borings was used to generate the cross-sections found in Chapter IV.

The till in the General Switch area is fairly consistent in color and texture. Orange-brown till consisting of fine sand and silt is generally found near the top of the profile. The till tends to get slightly more clay-rich and the boulders increase in abundance further down in the profile. In some borings, a gray clay layer with abundant fractured shale fragments overlies the fractured shale bedrock. In all test borings, at least 1 to 2 feet of fractured shale were encountered on top of fresh, gray shale bedrock. The rock cores showed that the gray shale was frequently interfingered with a harder, slightly coarser siltstone or graywacke unit.

All the split spoon samples taken in the till were relatively dry. Samples from shallow depths tended to be very dry and those from deeper in the till were slightly moist. Moisture content increased with proximity to bedrock, but no saturated till sample was found in any test boring. The till in the study area ranges in thickness from 5 to 36 feet and generally thickens toward the west. A more thorough discussion of the geology will be presented in the next chapter.

F. Soil Sampling and Chemical Analyses

1. Purpose

Soil samples were collected and analyzed in order to determine the aerial and vertical extent of PCE contamination in the study area. Samples were selected for laboratory analysis based on an OVA qualitative pre-screening procedure conducted in the field.

2. Procedures

All of the soil sample bottles and VOA vials were prepared and supplied by Princeton Testing Laboratories, Princeton, New Jersey. As previously described, one sample bottle and one VOA vial was taken for each sampling interval in the test pits and the test borings. The samples were placed on ice and Organic Vapor Analyzer (OVA) prescreens were performed on all the samples within twelve hours of collection.

The OVA has two modes of operation, a survey mode and a gas chromatograph (GC) mode. The prescreening procedure utilizes the OVA in the survey mode to identify soil samples containing volatile organic hydrocarbons. The limits of detection on the OVA range from 1 ppm to 1000 ppm. The VOA vials were prepared for analysis by placing them in a constant temperature bath at 40-50°C to drive the volatiles into the air space (headspace) remaining in the vial. A 100 ul injection was taken from the head space in each vial and injected into the OVA.

Once the prescreens were finished, samples containing more than 10 ppm volatile organic hydrocarbons were analyzed on the OVA in the GC mode. These analyses provided positive confirmation of the presence of PCE in the soil. All OVA/GC analyses were performed using a T-8 column, enclosed in a portable isothermal pack (PIP). The PIP has a hollow core which may be filled with ice or hot water. By keeping the column at a constant temperature, the PIP provides for better separation of the components in the gas sample. A strip chart recorder was hooked up to the OVA to record each chromatogram. Ideally, each component in a gas sample can be identified by its characteristic elution times in a given chromatographic column.

Based on the OVA prescreens, samples were chosen for quantitative laboratory analyses. The samples were chosen to cover as much of the study area as possible, especially in areas around the parking lot where high readings on the OVA were found. Background samples were also chosen from TP-7, TB-1 and TB-8. Sixteen samples from the test pits and thirty-three samples from the test borings were analyzed. In addition, three samples were sent to the lab for volatile organic priority pollutant scans. All the samples were packed in ice and shipped in a sealed cooler to Princeton Testing. Three shipments were sent so that all of the samples were analyzed within a week of collection.

3. Results

OVA and Gas Chromatograph Analyses. The results of the OVA prescreens of the test pit samples are shown in Table III-1. The samples containing the highest levels of volatile organic hydrocarbons were found in TP-2, TP-6, TP-9 and TP-10. All of these pits are located in the parking lot area of GSC (Figure III-5). As previously mentioned, the source of this contamination may be spills or leaks from tank trucks. Although buried drums were found in TP-2 and TP-10, they were empty or only partially filled with paint sludge and no other containers were found that might hold liquid PCE. Some contaminated soil samples were also found in TP-5, on the southern edge of Parella's property. TP-5 was the only test pit where bedrock and flowing water was encountered. It was noted at the time of excavation that this particular pit had a "chemical" odor.

The results of OVA/GC analyses on the test pit samples were only qualitative and a summary of the elution times noted for each peak in each sample is shown in Table III-2. Copies of all the strip chart records are contained in Appendix E and Figure III-7 shows the GC peaks obtained from three of the samples. A sample of pure PCE was initially analyzed on the gas chromatograph to determine its elution time. The elution time was measured at 1 minute 45 seconds on 8-29-84, and 1 minute 54 seconds on 8-31-84; the variation was probably due to temperature differences in the PIP. All of the samples were run through the column for at least three minutes to insure that the OVA picked up all the PCE and then the column was backflushed for the same amount of time. The OVA/GC analyses of 19 of the test pit soil samples and the PCE from the plant indicated the presence of a peak eluting with the same retention time as the PCE standard (Table III-2). In addition, several other compounds were noted in samples 5E, 6F, $10D_2$ and the paint sludge in one of the drums from TP-10. About half of the samples analyzed contained an additional compound with an elution time (1 minute six seconds to 1 minute 18 seconds) similar to that found in the paint sludge.

TABLE III-1

OVA PRESCREEN OF TEST PIT SAMPLES
(Volatile Organic Hydrocarbon Values in ppm)

Sample No	OVA Reading	Sample No	OVA Reading	Sample NO	OVA Reading
1A	10	4A	9	7A	100
1B	11	4B	20	7B	1.5
1C	5	4C	2	7C	10
1D	4	4D	7	7D	10.5
$1E_1$	3	4E	100	7E	5
$1E_2$	10				
		5C	100	8A	11
$2A_1$	40	5D	10	8B	9
$2A_2$	200	5E	350	8C	11
2B	3.5				
2C	400	6A	1,000+	9A	5.4
		6B	100	9B	200
3A	0	6C	130	9C	20
$3B_2$	16	6D	730	9D	8.5
3C	1	6E	820	9E	5.5
3D	70	6F	1,000+		
3E	14			10A	100
3F	4			10B	20
3G	100			10C	11
				$10D_1$	700
				$10D_2$	1,000

TABLE III-2

OVA-GAS CHROMATOGRAPH PEAK RETENTION TIMES FOR TEST PIT SAMPLES
(Values are Elution Times in Minutes and Seconds)

Date	Sample	Peak 1	Peak 2	Peak 3	(PCE) Peak 4	Backflush+
8-29	$2A_2$	0:12		1:06	1:45	Clean
8-29	2C				1:45	Clean
8-29	3D				1:45	Clean
8-29	3G				1:45	Clean
8-29	4B				1:45	Clean
8-29	4E				1:45	Clean
8-29	5C				1:45	Clean
8-29	5E		0:37	1:10	1:45	Clean
8-29	6A				1:45	Clean
8-29	6B				1:45	Clean
8-29	6C				1:45	Clean
8-29	6D			1:06	1:45	Clean
8-29	6E			1:09	1:45	Clean
8-29	6F		0:36	1:06	1:45	Clean
8-31	7A				1:54	Clean
8-31	9B			1:15	1:54	Clean
8-31	10A			1:18	1:54	Clean
8-31	$10D_1$			1:18	1:54	Clean
8-31	$10D_2$	0:10	0:28	1:12	1:50	Shows Peaks*
8-31	PCE from Plant	0:15	0:48		1:54	Shows Peaks*
8-31	Drum Sludge			1:12	1:48	Clean

*Peaks indicate presence of compounds heavier than PCE.
+Clean backflush indicates that no compounds heavier than PCE are present in the sample.

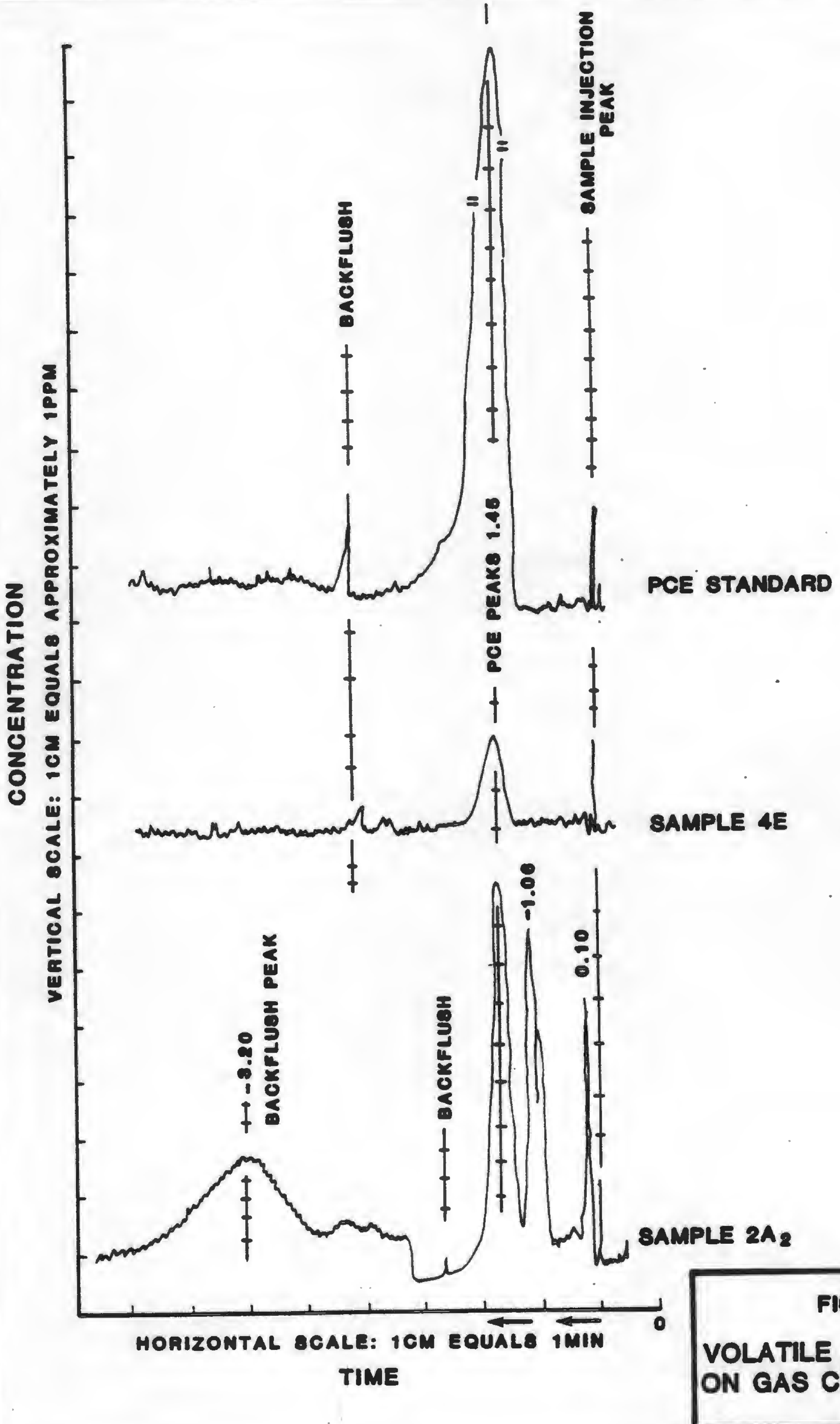


FIGURE III-7

VOLATILE ORGANIC PEAKS ON GAS CHROMATOGRAPH

FRED C. HART ASSOCIATES, INC.

None of the backflushes on these samples contained any peaks with the exception of $10D_2$ and the PCE from the plant. The presence of peaks in the backflush indicate that some heavier molecular weight compounds are present.

The data from the OVA prescreens of the test boring samples is shown in Table III-3. For the most part, the test boring samples contained low levels of volatile organics. Higher concentrations of volatile organics were found at depth in TB-3 and TB-5, both of which are located near the parking lot (Figure III-6). The contamination was usually highest in the till just above the bedrock, and little contamination was found near the surface in these test borings. The same is true in TB-4 which was located near the southern edge of Parella's property (near TP-5). In TB-4, volatile organic concentrations gradually increased until they reached their highest level in the till lying directly over the shale bedrock (Table III-3).

Since the majority of the samples from the test borings contained less than 10 ppm volatile organics and since GC work had previously confirmed the presence of PCE in the test pits, none of the samples from the test borings were analyzed on the OVA in the GC mode.

<u>Laboratory Analyses</u>. The results of the chemical analyses performed by Princeton Testing are shown in Tables III-4 and III-5. The limit of detection on tetrachloroethylene is 0.010 ppm. The values shown in these tables cannot be compared to the OVA prescreen data since the later did not use a quantitative methodology. However, the general trends indicated by the OVA prescreen data are confirmed by the laboratory analyses.

In Table III-4, the data from the test pit samples as well as the priority pollutant scans are listed. The most contaminated samples: $2A_2$, 2C, 6A, 6F, 9B, 10A, $10D_1$, and $10D_2$ are all from test pits located in the parking lot (Figure III-8). In general, the test pit samples from outside of the parking lot contain low levels of PCE. The priority pollutant scan showed that several other organic compounds are present in the study area. However, the only chemical that showed up in significant concentrations was 1,2 trans-dichloroethylene which was found in the paint sludge sample. This chemical is a common solvent and although it is listed as a priority

TABLE III-3

OVA PRESCREEN OF TEST BORING SAMPLES
(Volatile Organic Hydrocarbon Values in ppm)

Sample No.	OVA Reading	Sample No.	OVA Reading	Sample No.	OVA Reading
TB1-1	3.7	TB3-1	4.8	TB6-1A	2.4
TB1-2	1.6	TB3-2	3.9	TB6-1B	0.9
TB1-3	1.6	TB3-3	60.0	TB6-2	1.3
TB1-4	2.1	TB3-4	52.0	TB6-3	6.2
TB1-5	1.1	TB3-5	15.0	TB6-4	43
TB1-6	0.9	TB3-6	100.0		
TB1-7	0.9	TB3-7	3.6	TB7-1	0.4
TB1-8	2.3			TB7-2	2.1
TB1-9	1.3	TB4-1	3.4	TB7-3	No Sample*
TB1-10	1.7	TB4-2	5.2	TB7-4	0.6
TB1-11	0.8	TB4-3	9.4	TB7-5	1.8
		TB4-4	33.3	TB7-6	0.3
TB2-1	1.6	TB4-5	88	TB7-7	0.1
TB2-2	0.6	TB4-6	100	TB7-8	0.2
TB2-3	1.3	TB4-7	3.8	TB7-9	0.3
TB2-4	1.6			TB7-10	0.2
TB2-5	1.7	TB5-1	2.4	TB7-11	0.3
TB2-6	1.0	TB5-2	1.4	TB7-12	0.9
TB2-7	1.5	TB5-3	8.9		
TB2-8	0.8	TB5-4	6.4	TB8-1A	0.4
TB2-9	1.1	TB5-5	12	TB8-1B	0.3
TB2-10	0.9	TB5-6	25	TB8-2	0.2
TB2-11	1.2	TB5-7	320	TB8-3	0.2
TB2-12	1.2	TB5-8	9.3	TB8-4	0.2
TB2-13	0.8	TB5-9	2.8	TB8-5	No Sample*
TB2-14	1.0			TB8-6	0.4
				TB8-7	0.2
				TB8-8	0.1

*No sample was recovered from the split spoons.

TABLE III-4

PRINCETON TESTING ANALYSES
TEST PIT SAMPLES

Sample No.	Depth (ft.)	PCE (ppm)	Replicate (ppm)
2A$_2$	1-2	4.1	
2C	4-6	13.0	
3D	5-7	0.013	
3G	11-13	0.014	0.019
4E	7-8	0.017	
5C	1-2	0.15	
6A	0-2	2,200.0	
6F	10-12	1.5	
7A	0-2	0.009	
9B	2-4	0.840	
9E	8-10	0.045	
10A	0-2.5	0.620	
10D$_1$	6.5-7.5	0.670	
10D$_2$	7.5-8.5	5.50	

VOLATILE ORGANIC PRIORITY POLLUTANT SCAN
(Values in ppm)

	Limits of Detection	Drum Sludge	10D$_2$
Chloroform	0.020	ND*	1.20
Methylene Chloride	0.050	0.016	0.10
Tetrachloroethylene	0.020	13.0	5.5
1,2 Trans-dichloroethylene	0.010	11.0	ND*
Trichloroethylene	0.020	0.260	ND*

*Not detectable

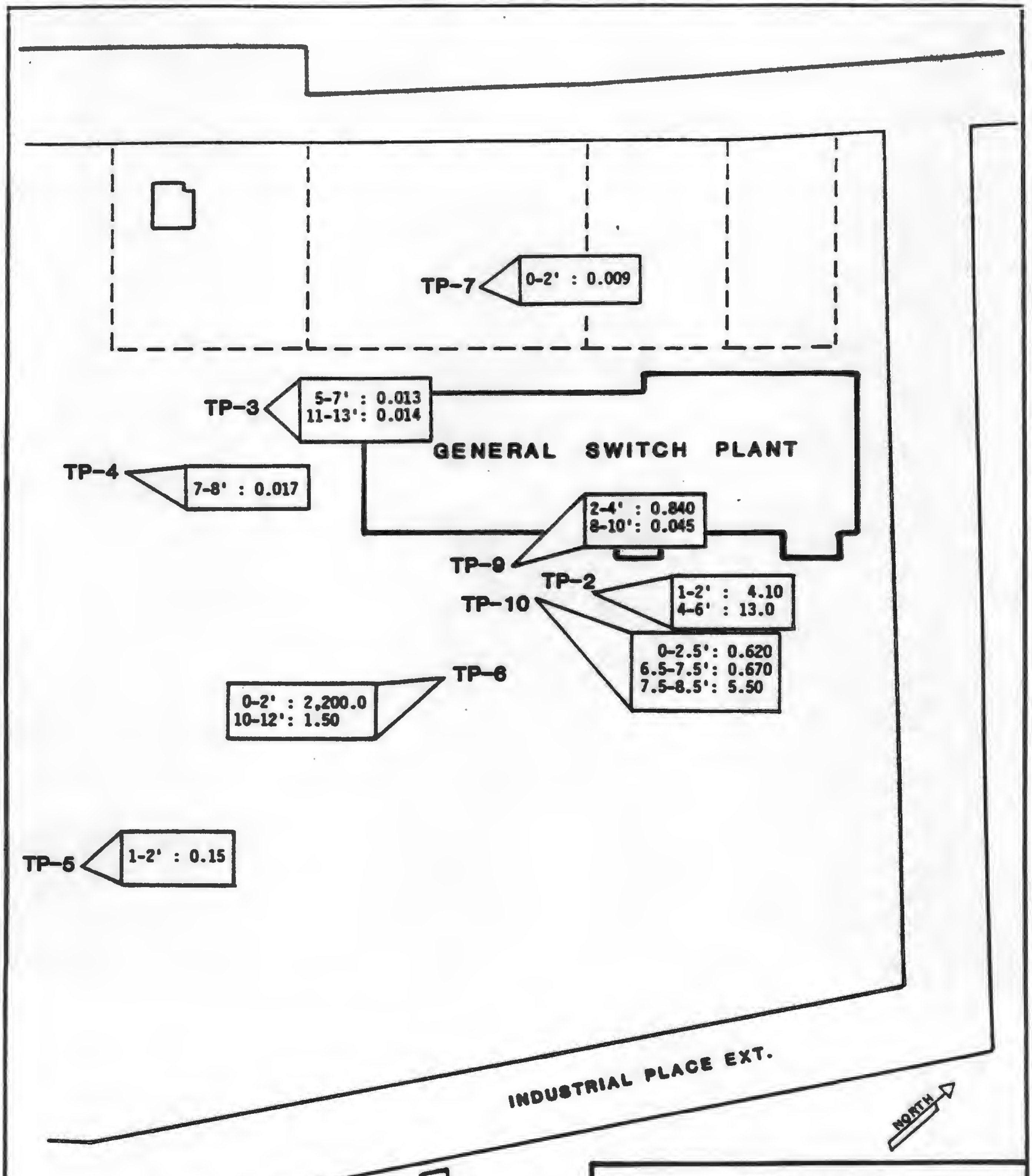


FIGURE III-8

CONCENTRATIONS OF PCE (IN PPM) IN TEST PITS GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

pollutant, there are no standards or regulations pertaining to acceptable exposure levels at the present time.

The results of the chemical analyses performed on the test boring samples are shown in Table III-5 and Figure III-9. With one exception, the concentrations of PCE in the test boring samples were all less than 1 ppm. Although the levels of PCE contamination are fairly low, it does appear to be consistently distributed through the soils in the area south and southeast of the plant. The samples containing the highest levels of PCE are TB-3, TB-4 and TB-5, all of which are located within 100-150 ft of the parking lot (Figure III-9). The PCE concentrations in TB-4 and TB-5 show small increases with depth, the highest reported PCE concentration was 3.2 ppm in TB-5 at a depth of 10-12 feet (Figure III-9). The low levels of PCE contamination were probably introduced into the subsurface soils during the drilling process. The drill rig picked up small amounts of PCE in the parking lot and through the drill rods transferred low levels of contamination into the soil. The area on the western side of the plant is generally free of PCE contamination with the exception of the surface sample from TB-2.

G. Permeability Measurements and Grain Size Analyses

1. Purpose

Three methods were used to evaluate the permeability of glacial till at the General Switch site. Direct measurements were made by tests on bulk soil samples and by slug tests. An indirect assessment of permeability was also made using grain size analyses. This information was essential to evaluate the potential for contaminant migration through the till.

2. Procedures

Grain Size Analyses. Soil samples were collected from five different test borings and one test pit for grain size analyses. Five samples from TB-8, six samples from TB-5, eleven samples from TB-2 and one sample each from TB-6, TB-7 and TP-5 were analyzed to determine whether the grain size distribution changed appreciably with depth or between test borings. Since

TABLE III-5

PRINCETON TESTING ANALYSES
TEST BORING SAMPLES

Sample No.	Depth (ft.)	PCE (ppm)	Replicate (ppm)
TB1-1	0-2	ND	
TB1-2	0-2	0.018	
TB1-6	8-10	ND	
TB1-11	18-20	LT 0.010	
TB2-3	2-4	0.140	
TB2-6	8-10	ND	LT 0.010
TB2-8	13-15	ND	
TB2-12	25.5-27.5	0.017	ND
TB3-1	0-2	0.330	
TB3-2	0-2	0.170	
TB3-3	2-4	0.430	
TB3-4	4-6	0.300	
TB3-5	6-8	0.320	
TB4-2	0-2	0.058	
TB4-3	2-4	0.120	
TB4-4	4-6	0.330	
TB4-5	6-8	0.560	
TB4-6	8-10	0.650	
TB5-3	2-4	0.078	
TB5-5	6-8	0.30	
TB5-6	8-10	0.70	0.50
TB5-7	10-12	3.2	
TB6-1A	0-2	0.090	
TB6-2	2-4	0.020	
TB6-3	4-6	0.055	
TB7-2	2-4	ND	
TB7-5	8-10	ND	
TB7-10	18-20	0.006	
TB8-2	2-4	ND	
TB8-10	14-16	ND	

LT = Less than
ND = Not Detectable

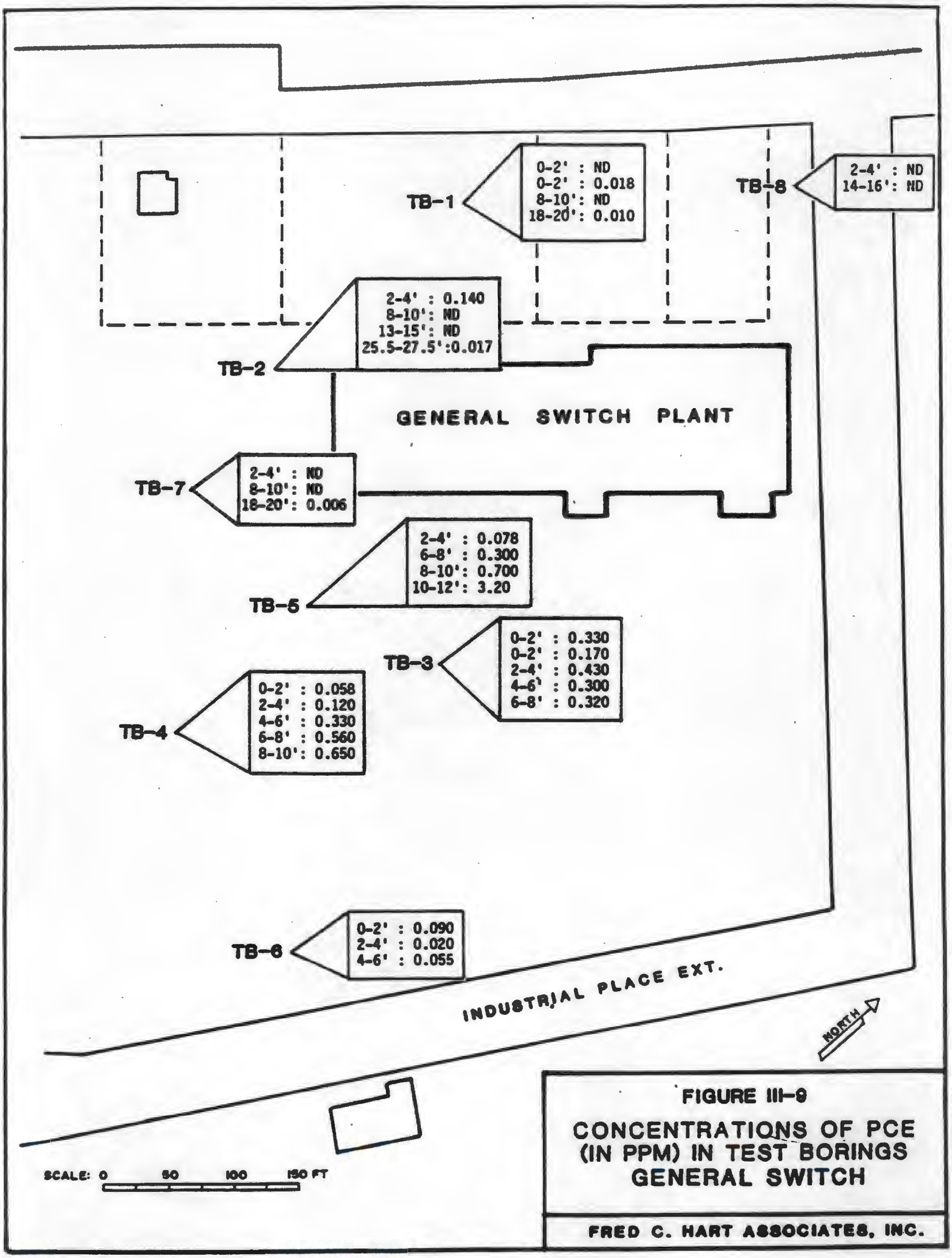


FIGURE III-9

CONCENTRATIONS OF PCE (IN PPM) IN TEST BORINGS GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

the glacial till appeared to be fairly uniform from boring to boring, only spot samples representative of the soils at these locations were taken from TB-6, TB-7 and test pit 5.

The samples were placed in driller's bottles and shipped in sealed boxes to J&L Testing Company, Bridgeville, Pennsylvania. The grain size analyses included seive and hydrometer testing according to the procedures outlined in ASTM D-422-63-72.

Bulk Soil Samples. The original work plan called for the collection of both Shelby tubes and bulk soil samples for permeability testing. Unfortunately, it was impossible to obtain Shelby tube samples because the till was too hard and contained too many cobbles and boulders. The Shelby tubes are constructed of thin walls that crumple when pushed into rocky material.

Two bulk soil samples were collected at the General Switch site from TP-11 and TP-12 (Figure III-5). Since most of the contamination found at the plant was in the vicinity of the parking lot, site TP-11 was chosen to determine the permeability of the geologic material underlying the parking lot. The permeability value would then allow an assessment of the potential for contaminant migration from the parking lot to the bedrock aquifer. The sample collected from TP-12 was taken at a depth and location representative of most of the glacial till underlying the General Switch plant.

In TP-11, the backhoe operater used the backhoe to collect a bulk sample from the gray clay layer found 2 feet from the surface. The sample was wrapped in cheese cloth and coated with melted wax to keep the sample intact and prevent it from drying out.

In TP-12, two bulk samples were recovered, one from about 8 feet and one from 10 feet. These samples were carved out of the bottom and side of the test pit by hand and were removed with a considerable effort to maintain sample integrity. Even at a depth of 10 feet, the soil was fairly dry and cracked easily. Both samples were brought to the surface, covered with cheese cloth and sealed with melted wax. In a further effort to protect the samples, they were also wrapped in aluminum foil and taped.

All three samples were delivered the following day to the Clifton Laboratory of Woodward-Clyde in Wayne, New Jersey. The samples were trimmed to the appropriate size and placed in a permeability cylinder for triaxial permeability tests. Ideally, natural conditions are reproduced as closely as possible in the cylinder with respect to sample orientation and confining pressure. All three axes of the sample were subjected to an effective confining stress of 5 to 7 psi which was chosen as representative of the pressure exerted on till at a depth of 8-10 feet. It was possible to orient sample 12A because it was removed from the pit by hand. However, sample 11 could not be oriented because the proper sample orientation was lost when the backhoe removed the sample from the pit. In addition, it was necessary to saturate the samples before the permeability test began because the till underneath General Switch was unsaturated.

<u>Slug Tests</u>. One, limited in-situ well slug test was performed. Monitoring well 5 was chosen for the slug test because it was a dry well and could not be sampled.

Slug tests may be conducted using either a falling head or a constant head method. In a falling head test, the well is filled with water and the time it takes for the water level to drop to the top of the screen is recorded. In a constant head test, the water level is kept constant by continually adding water and the amount of time it takes to add a certain volume of water is recorded. In order to accurately measure permeability by these methods, it is necessary for the gravel pack and the surrounding till to be saturated. Otherwise, when water is poured down the well, the rate at which it moves into the unsaturated soil pore space is a function of the amount of empty pore space rather than permeability. Unfortunately, the till and the gravel pack in well 5 were unsaturated and it was unfeasible to saturate them because of the low permeability of the till. Distilled water was used to avoid the chance of introducing any unknown contaminants into the groundwater. Initially, one gallon of distilled water at a time was poured in the well and the water level was measured. After 7 gallons of distilled water were added to the well, and the water level was at the top of the well, a falling head test was conducted. Constant head tests were conducted during the addition of the next 8 gallons of distilled water. In these tests, the water level was held constant at the top of the pipe and the length of time it took to add one gallon of water was recorded.

3. Results

Grain Size Analyses. The results of the grain size analyses are represented graphically in distribution curves contained in Appendix C. An examination of this data indicates changes in the grain size distribution with depth and some variability from test boring to test boring. In TB-8, all five samples ranging in depth from 2 to 14 feet contain approximately 50 percent clay, and there is only a small amount of variability with depth. In TB-5, the amount of clay in the samples ranges from 20-30 percent and there is more variability with depth in these samples than at other locations. However, the samples get slightly coarser with depth. In TB-2, where the samples range in depth from 0 to 32 feet, there is a considerable amount of variability in the grain size distribution. The amount of clay in the samples ranges from 12 to 70 percent with clay-rich samples coming from the intervals of 10-17 feet and 28-32 feet. In a general sense, the samples get slightly finer with depth.

Bulk Soil Samples. Only two of the three bulk soil samples collected for triaxial permeability tests could be used. All of the samples were of questionable quality because of the friable nature of the till and the cracks that had developed due to digging, handling and lab trimming. However, tests were run on sample 11 and sample 12A.

The results of the test indicated a permeability of 1.3×10^{-7} cm/sec in sample 11 and 6.4×10^{-7} in sample 12A. These values may be slightly high because the samples were first saturated and because of the small cracks and fractures that were artifically introduced into the till before the test was performed. The original data and summary sheets are contained in Appendix C. These values are fairly typical of glacial till in the northeastern United States, and the till may be described as having a very low permeability (Terzaghi and Peck, 1967).

<u>Slug Tests</u>. The data from the falling head and constant head tests is shown in Table III-6. Unfortunately, permeability values could not be calculated because the data indicates that the gravel pack and the till surrounding MW-5 remained unsaturated. The unsaturated nature of the till is shown by the fact that the length of time it took to add one gallon of water to the well consistently increased in the constant head tests. Furthermore, if the till had been saturated, the results of the falling head tests would have been more similar. The very low permeability of the till made it impossible to saturate the till or use the results of the slug test.

H. Monitor Well Installation and Development

1. Purpose

Monitor wells were installed in each of the eight test borings drilled by Kendrick Drilling. All of the wells were screened in the glacial till, just above the bedrock-till contact. The wells were installed to provide the necessary hydrological and chemical data to determine the groundwater flow direction and the extent of PCE migration in the glacial till.

2. Procedure

The locations of the monitoring wells are shown in Figure III-10. Seven of the wells were constructed of 5 ft, 10 slot, wire-wrapped stainless steel screens and 2" diameter galvanized steel riser pipe. In one test boring (TB-6), the depth to bedrock was so shallow that a 2'2", 20 slot wire-wrapped stainless steel screen was used instead. The galvanized steel riser pipe was joined by threaded flush joints and sealed with teflon tape. Stainless steel was used for all monitoring wells.

The procedure followed for well installation was the same in each test boring. Each bore hole was filled with several feet of bentonite pellets until the bedrock-till interface was reached. When the bentonite pellets come into contact with water, they expand to fill all available space and in the process create a seal. An inch or two of gravel (Morie No. 2) was poured on top of the bentonite to provide a base on which to set the screen.

TABLE III-6

RESULTS OF FALLING HEAD AND CONSTANT HEAD PERMEABILITY TESTS
FALLING HEAD TESTS

Test 1 (10:45 AM) Time (secs)	Test 1 Water Level Below TOC (ft)	Test 2 (11:15 AM) Time (secs)	Test 2 Water Level Below TOC (ft)
60	0.64	20	0.31
80	1.08	40	0.75
100	1.53	60	1.0
120	2.09	80	1.41
150	2.67	100	1.81
180	3.13	120	2.12
240	3.82	140	2.52
330	5.45	160	2.80
420	6.47	210	3.51
540	7.38	240	4.15
		270	4.64
		330	5.0
		390	5.80
		450	6.42
		510	6.97
		570	7.46
		630	7.82

CONSTANT HEAD TESTS

Volume of Water Added	Time (sec)
1 Gallon	200
1 Gallon	200
1 Gallon	220
1 Gallon	230
1 Gallon	240
1 Gallon	260

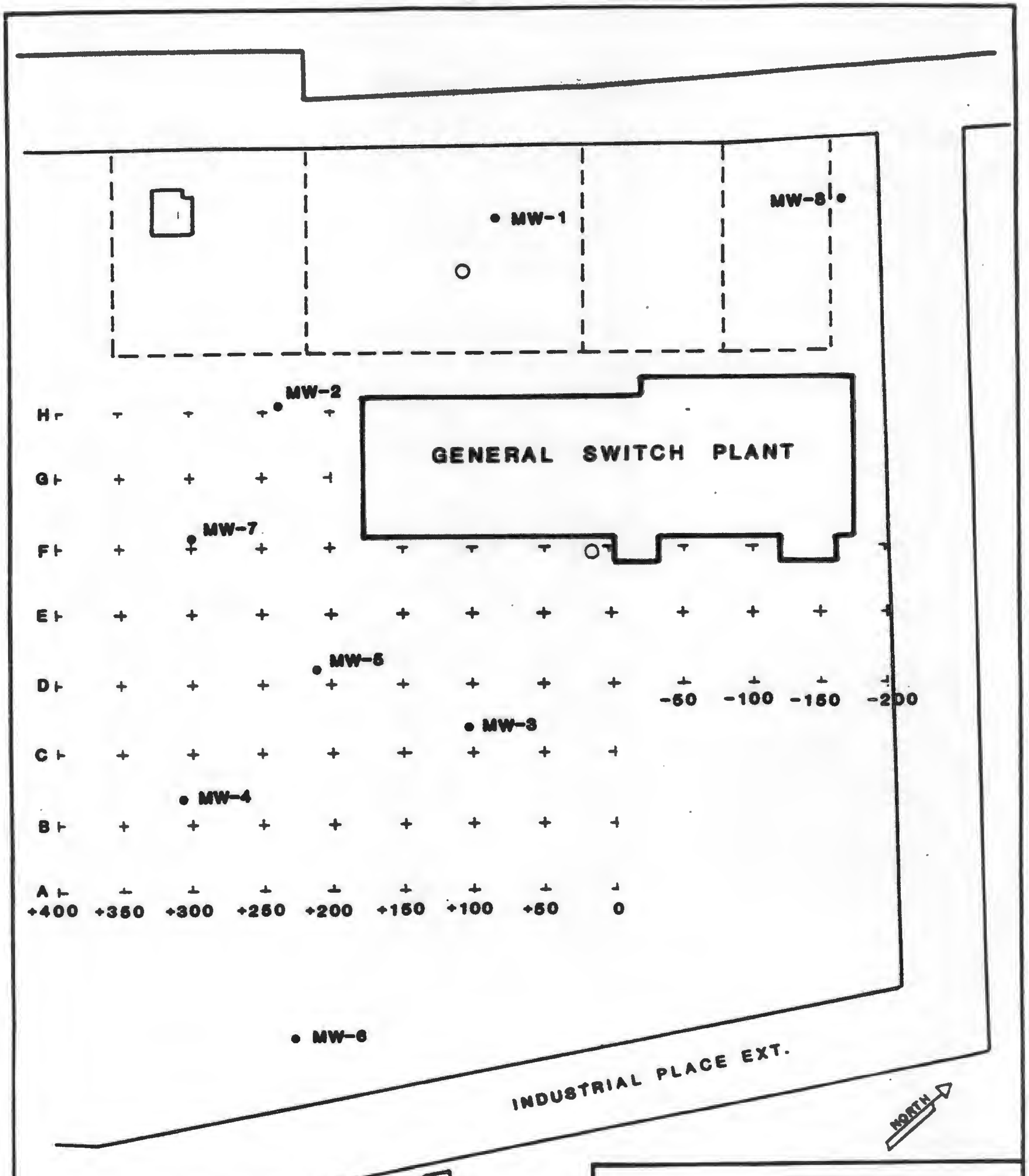


Figure 25

MONITOR WELL LOCATIONS
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

Modified from Hydrogeologic Investigation
of General Switch Site,
Fred C. Hart Associates, Nov. 1984.

A 2" diameter screen and riser pipe was then set in the hole and held in place while more gravel was poured in the annulus. The gravel pack extended the full five foot interval of the screen in each well and approximately 2 ft above that. A second 1-2 ft layer of bentonite pellets was added on top of the gravel pack to prevent grout materials from percolating through the gravel into the well.

A cement slurry mixture was poured on top of the bentonite layer to within 1-2 ft of the top of the bore hole. A 4" diameter, 5 ft long protective steel casing was then set into the hole and grouted in place with cement. A cement pad was also constructed outside of the casing to prevent any surface water from draining directly into the well. In seven of the wells, there was a 2-3 ft stick up on the riser pipe and the outer protective casing usually sat 2-3 inches above the top of the pipe. One of the wells (MW-8) was located in a parking lot and was therefore finished flush to the ground and covered with a manhole cover. All eight wells had locking caps and locks.

An attempt was made to develop all the wells with compressed air. The purpose of well development is to create a good hydraulic connection between the well and the aquifer in which it is screened. However, it was difficult to develop wells in the study area because water movement tended to be slow due to the very low permeability of the till.

It was initially assumed that most of the water in the wells was left over from drilling. An air compressor was used to blow water out of each well on September 13, 1984. Water level measurements were made prior to blowing out the well and immediately afterwards, and the water levels were monitored in all the wells for the next several days. Adequate recharge for development was only encountered in MW-2 and MW-7, and wells 5 and 8 were dry after the attempt to develop them. The movement of water around the rest of the wells was too slow for adequate development.

3. Results

Records were kept on all the well installation procedures. Well construction diagrams for MW-1 to MW-8 are shown in Figures III-11 to III-18.

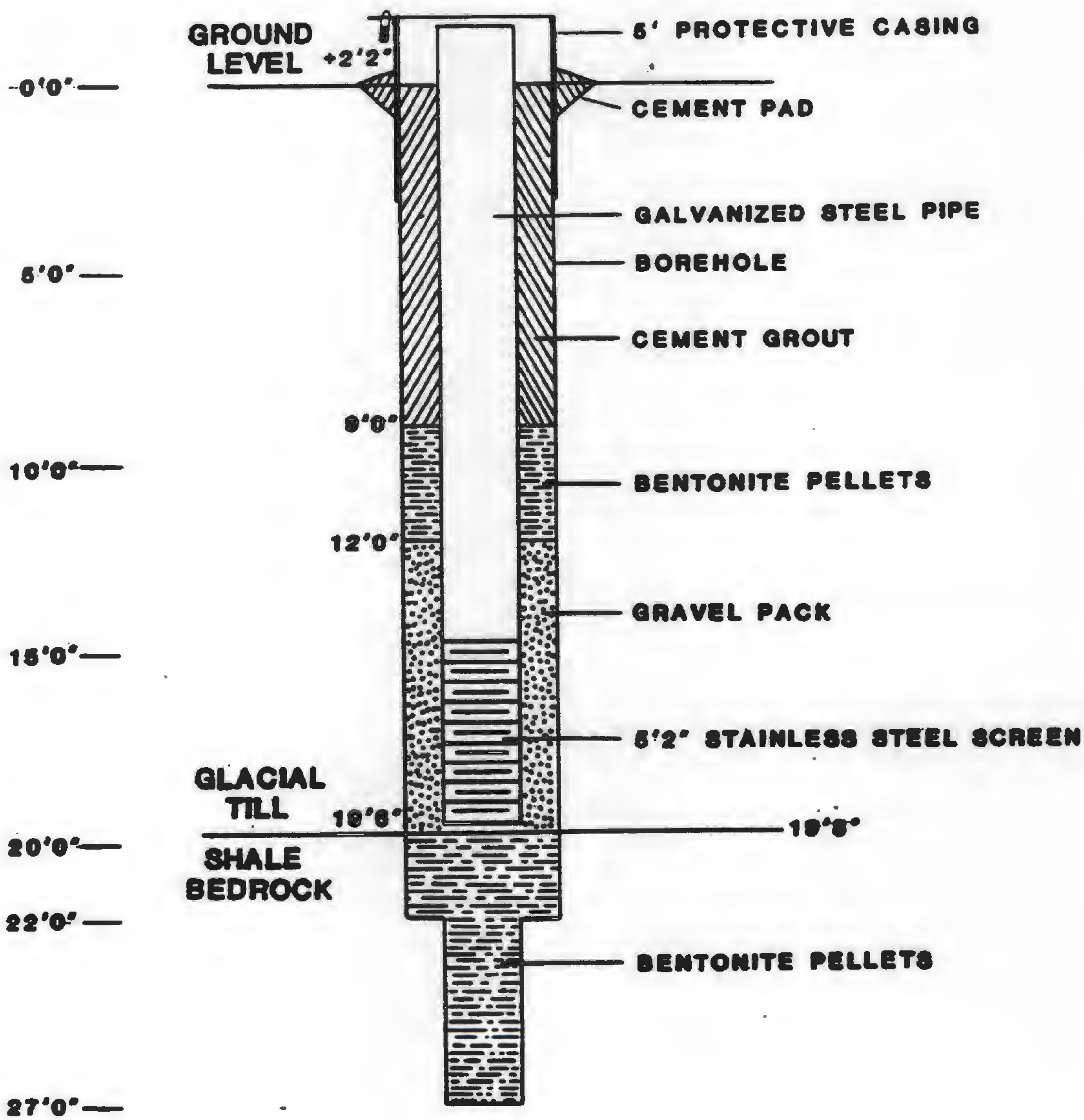


FIGURE III-11

WELL CONSTRUCTION
TEST BORING # 1
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

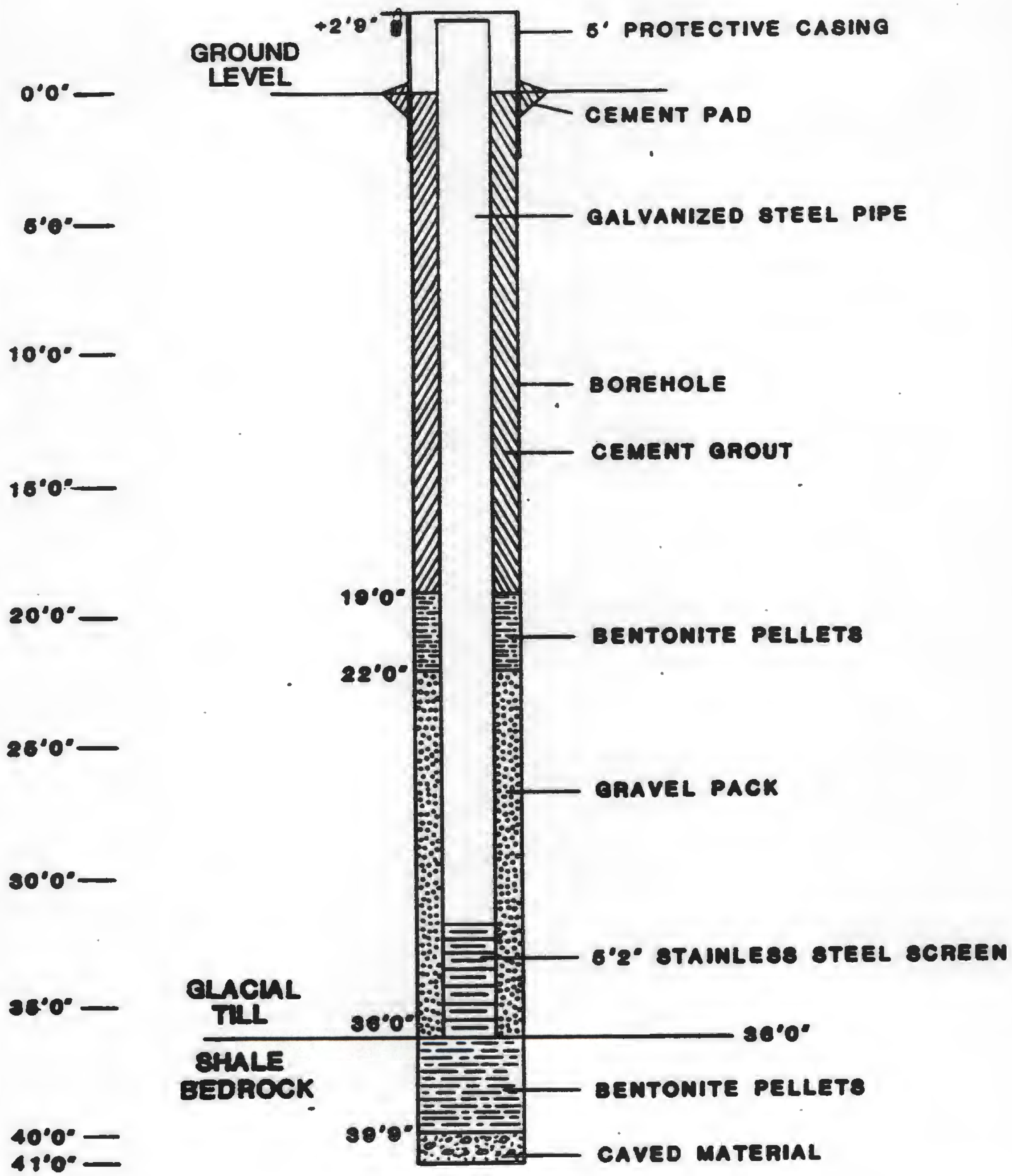


FIGURE III-12

WELL CONSTRUCTION
TEST BORING # 2
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

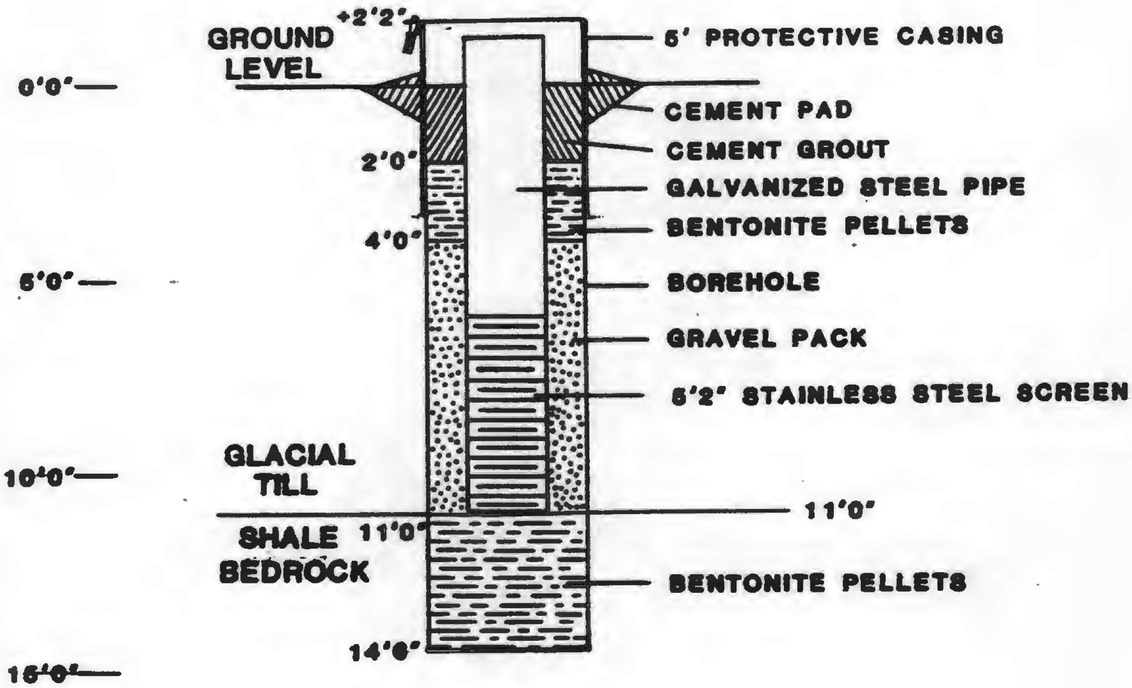


FIGURE III-13

WELL CONSTRUCTION
TEST BORING # 3
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

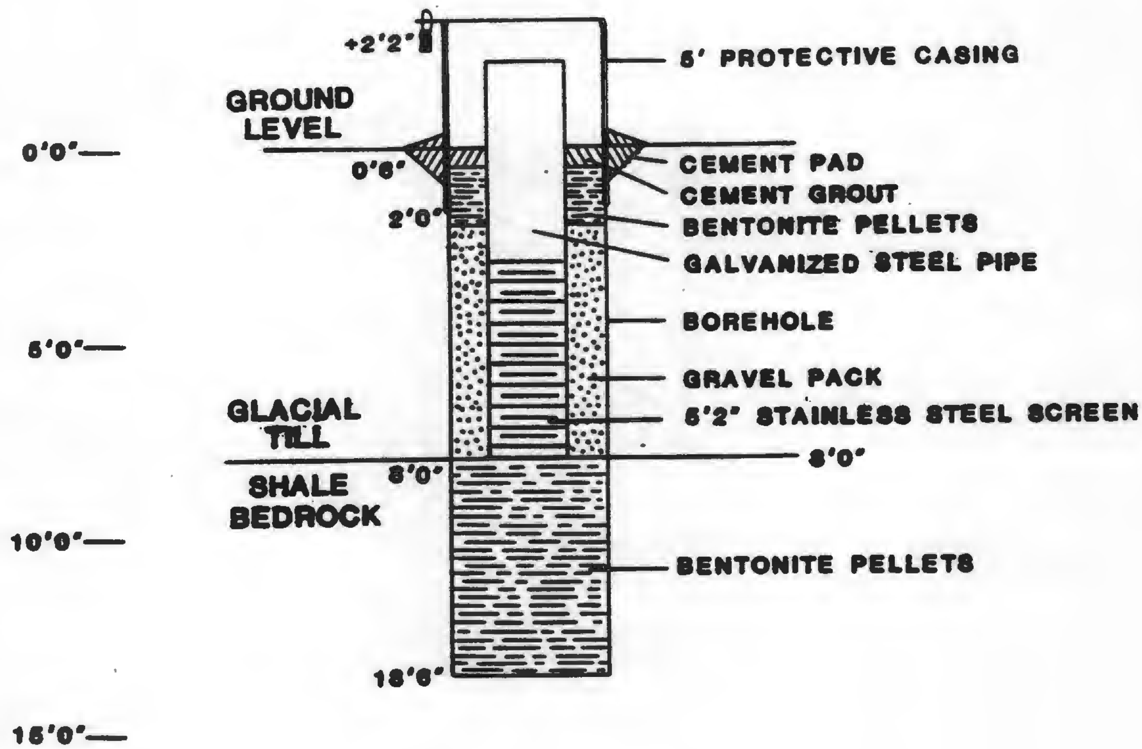


FIGURE III-14

WELL CONSTRUCTION
TEST BORING # 4
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

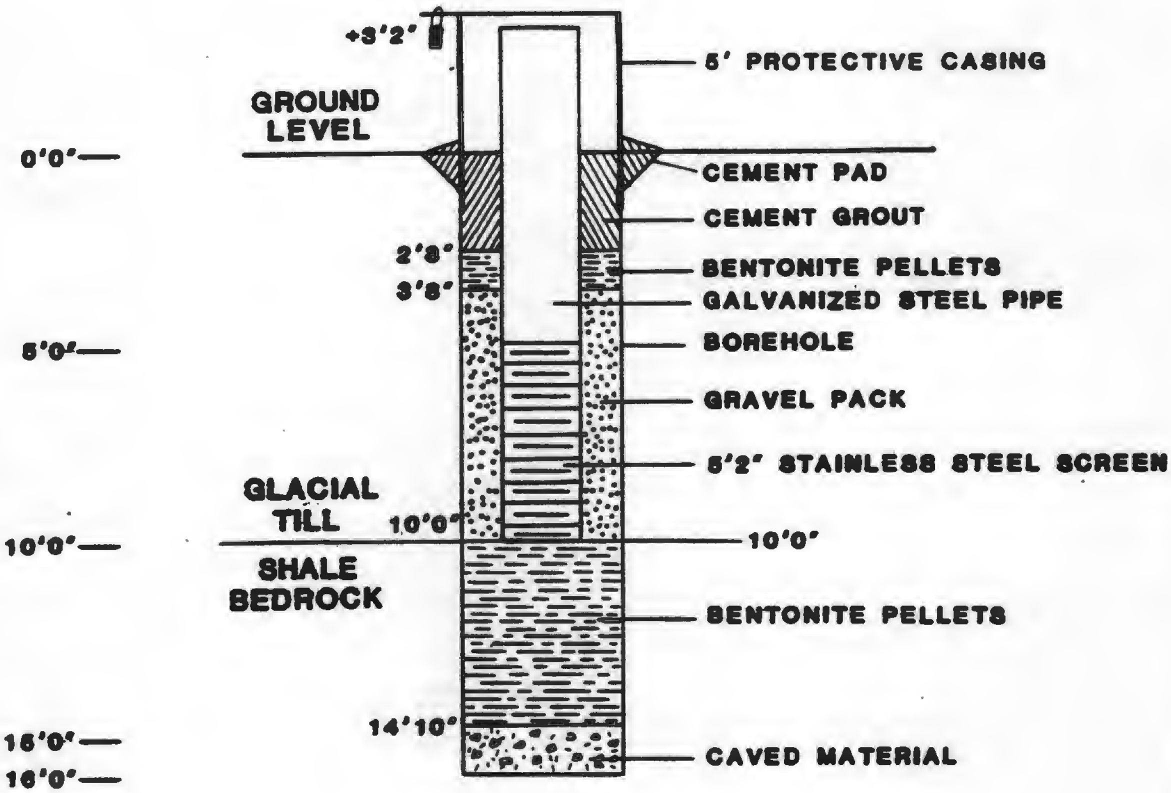


FIGURE III-15

WELL CONSTRUCTION
TEST BORING # 5
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

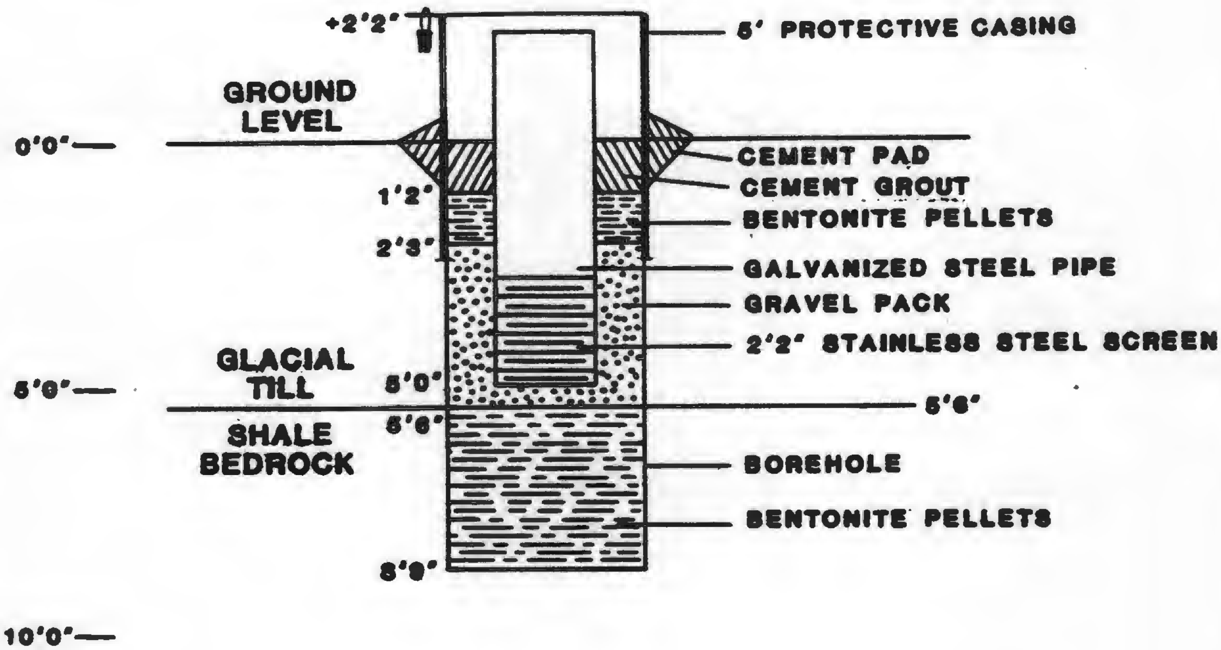


FIGURE III-16

WELL CONSTRUCTION
TEST BORING # 6
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

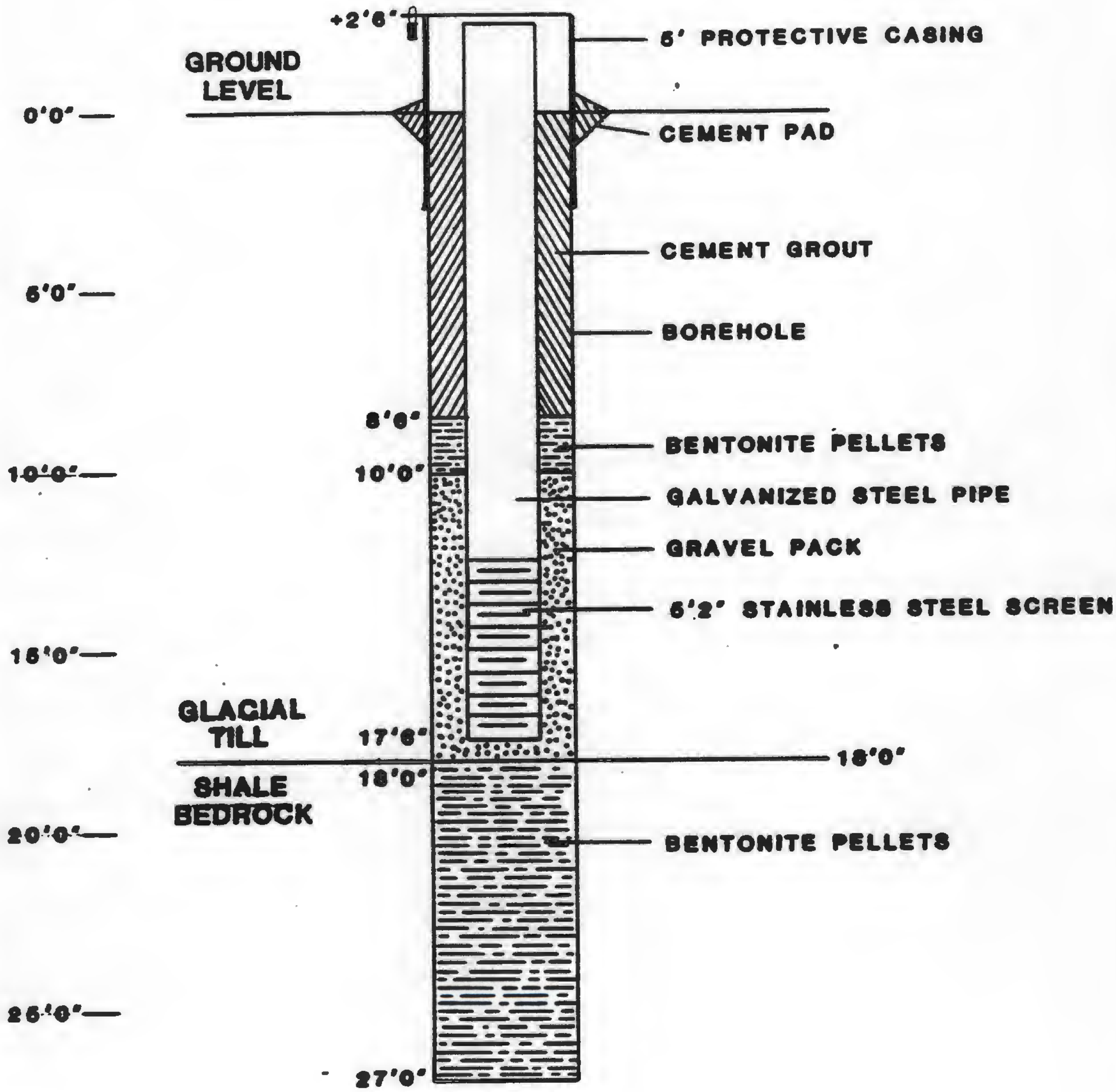


FIGURE III-17

WELL CONSTRUCTION
TEST BORING # 7
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

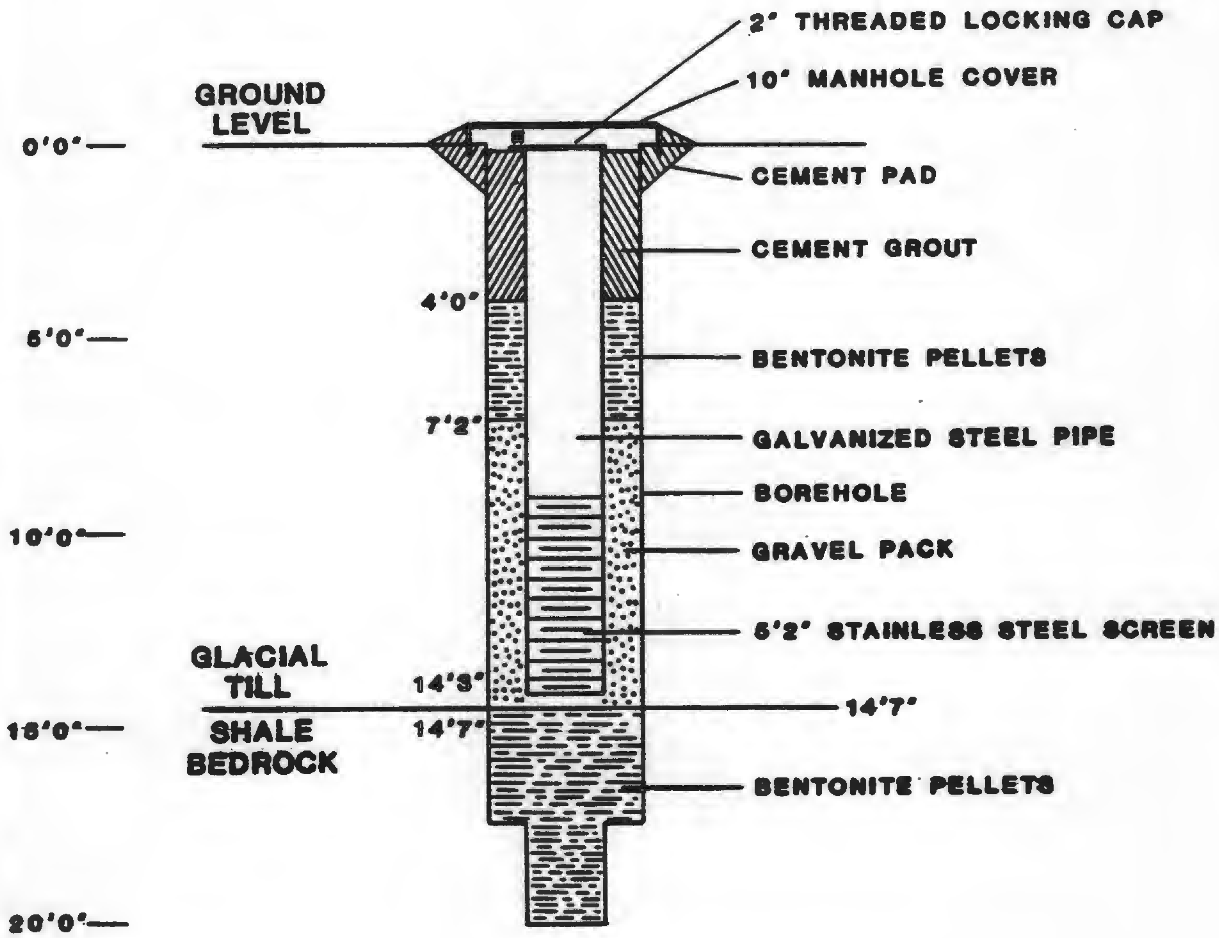


FIGURE III-18

WELL CONSTRUCTION
TEST BORING # 8
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

These diagrams contain information pertaining to depth to bedrock, placement of screens, thickness of bentonite seals, etc.

The water levels in most of the wells (excluding MW-5 and MW-8) slowly recovered after well development. This recovery indicates that either water is flowing horizontally through the till or water is leaking upwards from the bedrock into the well screen. The hydraulic heads in MW-2 and MW-7 are fairly high and it seems more likely that water is leaking from the bedrock. This mechanism will be discussed more fully in the next chapter.

Since MW-2 had enough recharge for well development, a decision was made to try and fully develop it on September 14, 1984. The air compressor was set up on the well for about two hours. At the end of this period, water coming from the well was fairly clear. Water level measurements taken on September 14, 1984 show the effect of pumping MW-2 on MW-7 (Table III-7). Apparently, MW-2 and MW-7 are in hydraulic connection and the cone of depression created by developing MW-2 extended to MW-7. The recovery of MW-7 was slow enough that the effect of pumping in the morning of September 14, 1984 could still be measured late in the afternoon.

I. Casing Elevations and Water Level Measurements

1. Purpose

In order to construct accurate water level maps, all the well casings were surveyed and water level measurements were taken twice a day for three days. The survey data was also essential for constructing a topographic map and a bedrock elevation map for the study area.

2. Procedures

Casing Survey. The casing survey was conducted with an auto-level by FCHA. The General Switch well was chosen as a benchmark and was included in both survey loops needed to cover the study area. At the conclusion of each loop, the first and last elevations measured were compared to evaluate the accuracy of the data. Both loops were closed within 0.01 foot. The distances between turning points and instrument points were either paced off or measured with a tape. All of the elevation data was then used to compile approximate topographic and bedrock elevation maps.

Water Level Measurements. The first complete round of water level measurements were taken at the General Switch site on September 13, 1984. An M-scope was lowered from the top of the casing down the well and when the electrode came into contact with water, an audio signal was emitted from the instrument. The M-scope was also used to sound the bottom of the well.

Water level measurements were made before and after well development on September 13, 1984, and twice on September 14, 1984. Another round of measurements were made on September 19, 1984 when the monitor wells were sampled.

3. Results

Casing Survey. The results of the casing survey are shown in Table III-7. The well elevations were taken from the top of the galvanized steel pipe in feet above mean sea level. In the proces of surveying the wells, enough elevations were collected from around the site to construct an approximate topographic map, shown in Figure III-19. An approximate bedrock elevation map was also constructed from the survey data and depth to bedrock data. This map (Figure III-20), is based upon contour mapping of 9 data points and suggests the presence of a shallow bedrock trough underneath the GSC plant which trends approximately northeast-southwest.

Water Level Measurements. The water levels measured in all eight monitoring wells from September 13, 1984 to September 19, 1984 are shown in Table III-7. Small changes were observed in the water level measurements during the study period. With the exception of the measurement in MW-7 on the afternoon of September 14, 1984, these levels reflect natural fluctuations in the water levels due to rain fall, evaporation or changes in humidity. An approximate water level contour map was constructed from the data gathered in the morning of September 14, 1984 (Figure III-21). The direction of flow is at right angles to the contours and is indicated by the arrows on Figure III-21. The flow directions probably reflect gradients in

TABLE III-7

WELL CASING ELEVATIONS AND WATER LEVEL MEASUREMENTS

Well No.	Casing Elevation (ft above MSL)	Depth (ft) to Bottom of Well	Water Level Measurements (ft)**				
				9-14-84		9-19-84	
			9-13-84	AM	PM	AM	PM
1	648.17	21.43	18.01	16.43	16.58	16.90	16.99
2	635.05	39.01	20.33	20.03	19.42	20.34	20.25
3	622.29	13.10	12.21	12.24	12.11	12.32	12.43
4	615.29	10.83	10.20	9.87	9.90	10.28	10.83
5	623.95	13.21	13.11	13.07	Dry	Dry	Dry
6	620.60	7.01	6.23	4.94	4.35	4.59	4.51
7	624.77	20.19	12.80	10.83	19.13	11.11	11.07
8	651.17	14.06	Dry	Dry	Dry	Dry	Dry

* Casing measurement point elevation
**Depth to wall as measured from casing measurement point

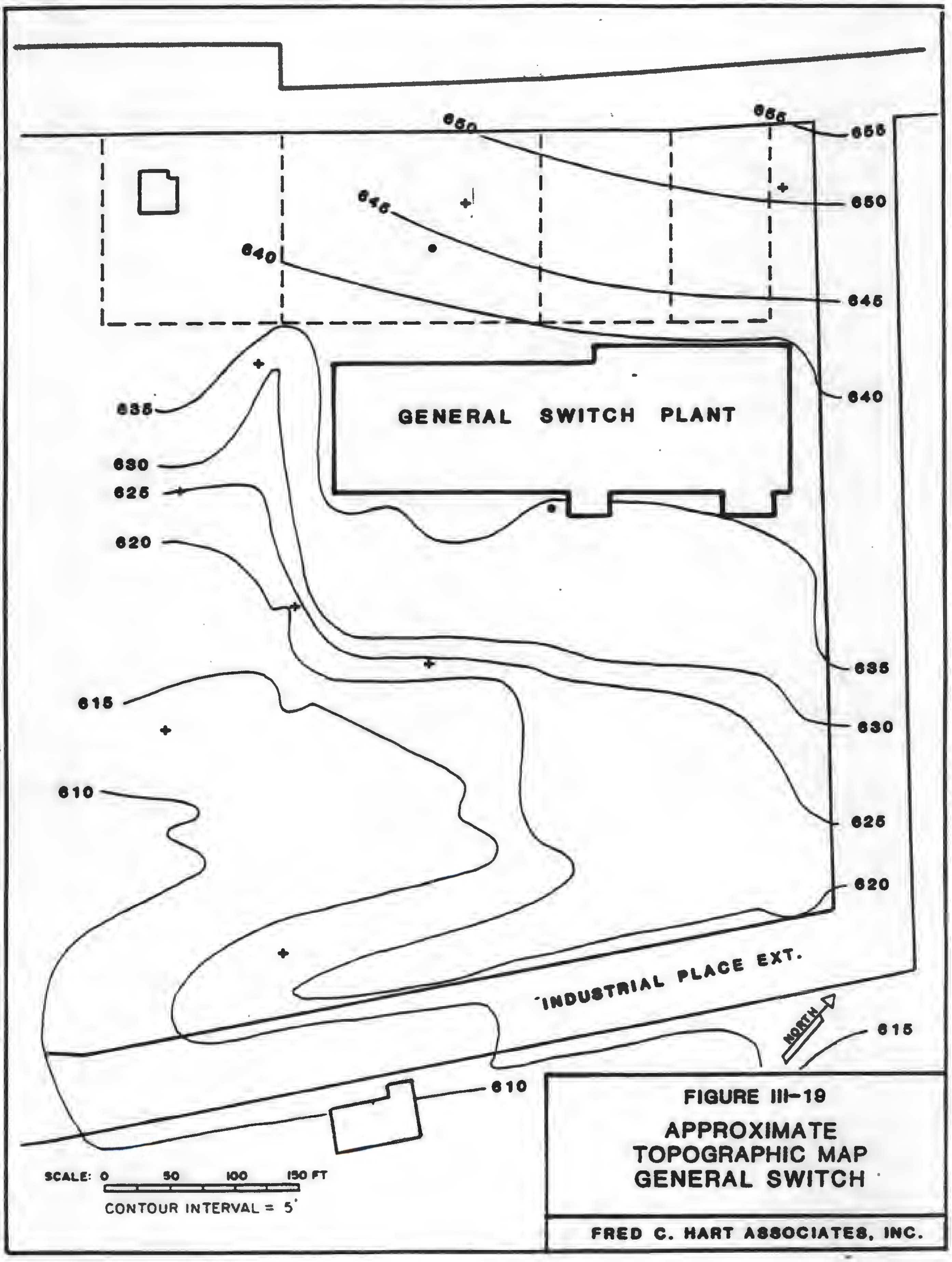


FIGURE III-19
APPROXIMATE TOPOGRAPHIC MAP GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

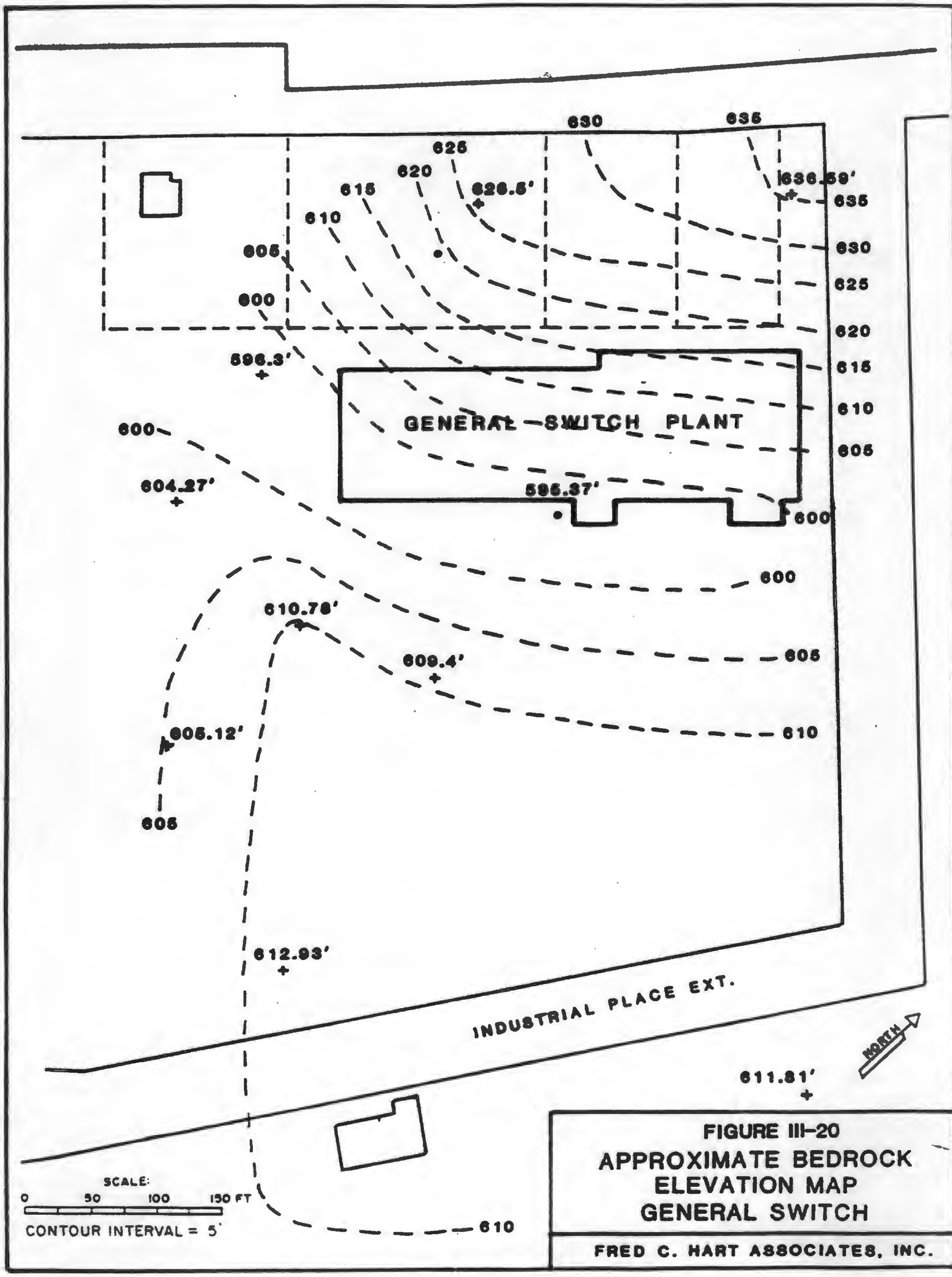
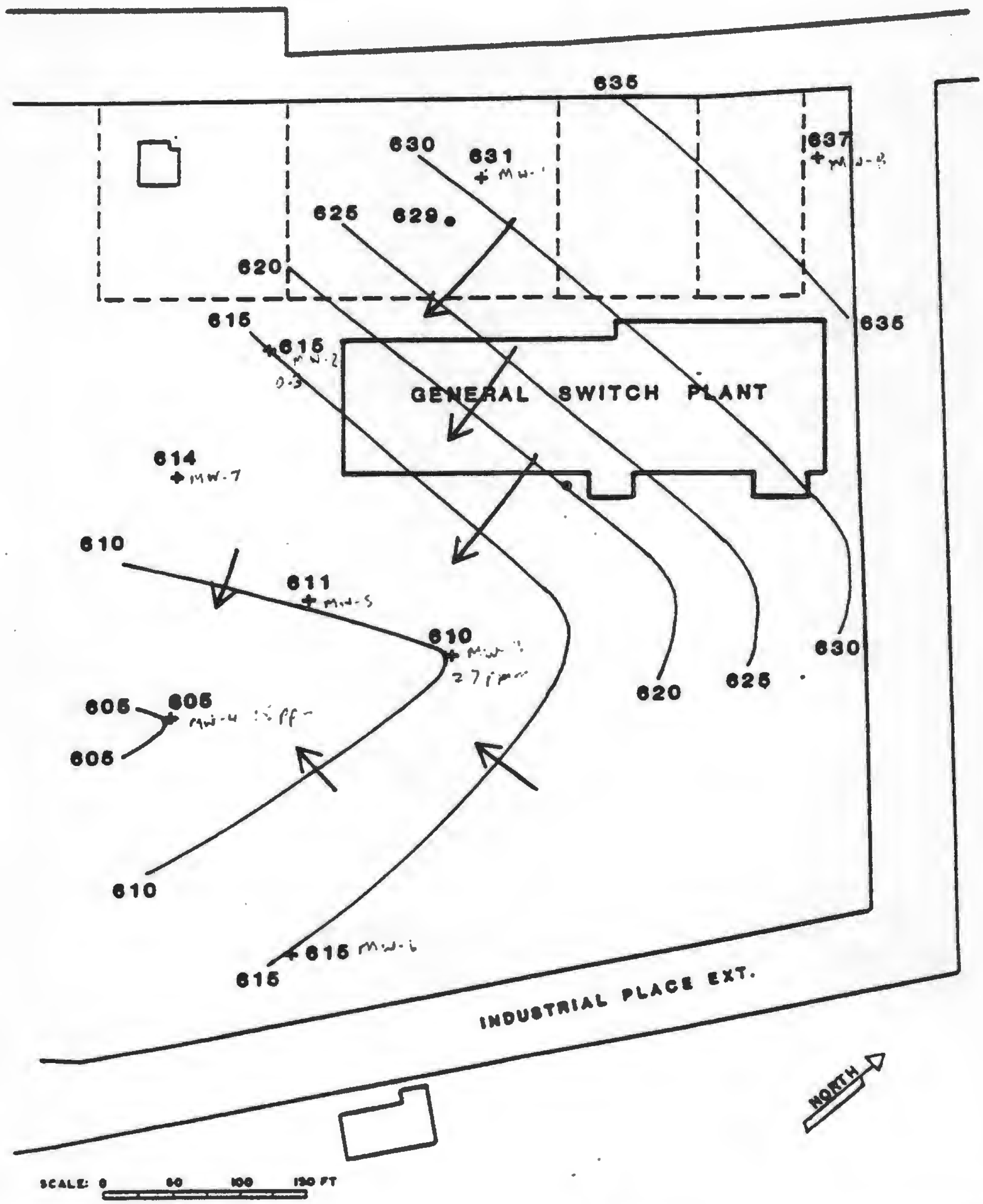


FIGURE III-20
APPROXIMATE BEDROCK
ELEVATION MAP
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.



LEGEND

• WATER LEVELS MEASURED IN WELLS OPEN TO BASE OF SHALLOW TILL AND TOP OF SHALLOW BEDROCK

610 ——— 610 CONTOUR OF WATER LEVELS MEASURED 9-14-84

———> POTENTIAL FLOW DIRECTION

CONTOUR INTERVAL = 5'

FIGURE III-21

CONTOUR MAP OF WATER LEVELS* GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

the hydrologic zone from the base of the till to shallow bedrock. Since the till was unsaturated, it appears that water from the bedrock aquifer leaked into the monitoring wells and produced the observed water levels. This mechanism will be discussed more fully in the chapter on geology and hydrology.

J. Monitor Well Sampling and Chemical Analyses

1. Purpose

At the General Switch site, only six of the eight monitoring wells contained water (TB-5 and TB-8 were dry) and only one of the six wells yielded enough water for adequate development and cleaning prior to sampling. Despite reservations pertaining to the quality of the data that might be collected from the wells, a sampling program was initiated. It was thought that the additional information might provide some insight into the distribution of contaminants in the subsurface environment.

2. Procedures

Prior to well sampling, eight bottom loading stainless steel bailers were disassembled, cleaned in detergent, rinsed twice in distilled water and once in acetone. The bailers were allowed to air dry, reassembled and then wrapped in aluminum foil. During the well sampling, the same sample bailer was used for bailing and sampling each well.

The same sampling procedure was followed at each well. A water level measurement was taken and the amount of water in the well, in gallons, was calculated. Then, the number of bails necessary to remove three standing well volumes of water was calculated and attempt was made to remove that amount of water. It is standard practice to remove three well volumes where possible to insure that the water sample will be from the geologic formation and not from standing water in the well. The wells at sites MW-1, MW-3, MW-4, MW-6 and MW-7 were bailed dry. Recovery was so slow that the wells were locked, with the bailers inside, to await recovery. No attempt was made to sample either MW-5 or MW-8 because these wells were dry. MW-7 was the only well where it was possible to bail three well volumes of standing water before sampling.

After all the wells were bailed, a second circuit was made to collect water samples. About 1½-2 hours elapsed between the time of bailing and the time of sampling, and that was sufficient for recovery of enough water for sampling in all of the wells. Two VOA vials (30 ml) were filled for each well and a separate bail was used to fill each vial. At MW-1, only one VOA vial was obtained because the teflon check valve on the bottom of the bailer was jammed open. All of the VOA vials were immediately labeled and placed on ice. They were delivered to the Princeton Testing Laboratory on September 20, 1984.

3. Results

The results of the shallow monitor well sampling as well as notes on the quality of development and recovery in each well are shown in Table III-8. As previously mentioned, the usefulness of this data may be limited by the fact that only one of the wells (MW-2) had adequate recharge for development and cleaning. It should be emphasized that these wells are probably receiving water from the already contaminated bedrock aquifer. The mechanism by which water leaked from the bedrock into these wells will be discussed more fully in the next chapter. The highest levels of PCE contamination are found in TB-3 and TB-4 which are both within about 100 feet of the parking lot. The levels decrease away from the parking lot, although the area to the south and southeast appears more contaminated than the area to the west. The general trends are very similar to those obtained from analyses of the test boring samples.

K. Potable Well Sampling

1. Purpose

Potable wells in the vicinity of General Switch were sampled monthly from June 1984 to September 1984 to monitor the concentrations and migration of PCE in the bedrock aquifer.

TABLE III-8

PRINCETON TESTING ANALYSES: MONITOR WELL SAMPLES
(PCE VALUES IN ppm)

Well	Concentration (9-19-84)	Quality of Development and Recovery in Well
MW-1	0.001	Limited development, Slow recovery
MW-2	0.350	Full development, Good recovery
MW-3	27.0	Poor development, Poor recovery
MW-4	15.0	Poor development, Poor recovery
MW-5	Dry	Poor development, No recovery
MW-6	0.076	Poor development, Slow recovery
MW-7	0.034	Limited development, Slow recovery
MW-8	Dry	Poor development, No recovery

2. Procedures

The potable wells were sampled according to procedures established by USEPA during their previous potable well sampling trips.

Ten to twenty-five potable wells were sampled on a monthly basis. At each house, the closest tap to the well head was run for 15 minutes to evacuate the well and water distribution system prior to sampling. The samples were collected directly from the tap in standard 40 ul VOA vials, and the vials were carefully capped to eliminate air bubbles in the samples. The samples were preserved on ice from the time of collection until arrival at the laboratory. One or two replicates, one trip blank and one field blank were included in each monthly round of sampling. Unfortunately, no trip blanks or water for field blanks were provided by the laboratory for potable well sampling on August 28, 1984.

3. Results

The results of the potable well sampling program as well as the range in PCE values in samples collected by EPA/NYSDOH are shown in Table III-9. During the four months of sampling the most contaminated wells encountered were at the homes of: Ruppert, Liska, Barry, Stout, Parella, General Switch and Lewis. With the exception of Liska and Lewis, all the other wells had previously been identified as contaminated with over 50 ppb of PCE (Table III-9). PCE concentrations in excess of 50 ppb were first noticed in the Lewis and Liska wells on July 17, 1984. Another set of samples were taken on August 28, 1984 to confirm the previous results. When the results of the August 28, 1984 sampling trip were received, the Liska and Lewis homes were put on alternate water. Aside from the wells mentioned above, all the other wells in the General Switch vicinity remained uncontaminated (Table III-9).

In general, the concentrations and distribution of PCE have changed very little since EPA's last samples were taken in March of 1984. The trend of PCE distribution has remained in a northwest-southeast orientation and the contamination found in the Liska and Lewis wells conforms to this pattern.

TABLE III-9

POTABLE WELL SAMPLING DATA
(PCE values in ug/liter)

Owner	Street	EPA/NYSDOH** 10-17-83- 4-19-84	FCHA Potable Well Sampling Trips 6-4-84- 6-5-84	7-17-84- 7-18-84	9-19-84- 8-28-84	9-20-84
Knapp	Highland	ND-12	24	15		7
Van Pelt	Electric	ND-LT1	ND		ND	
Ogden	Highland	ND-LT1	ND		ND	ND/0.1*
Seeley	Highland	ND-LT1	ND			ND
Gilbert	Highland	ND-LT1	ND		ND	0.2
Cornelius	Highland	NAR	ND/ND*			
Crooks	Highland	ND-28	LT 0.1	ND		
Tessler	Highland	ND	ND			
Petrizzo	Highland	ND	ND			
Fiore	Highland	ND-LT1	0.1	ND		
Heilfurth	Commonwealth	LT1	ND		ND	
McEntee	Commonwealth	ND-LT1	ND			
Ruppert	Commonwealth	ND-LT1	ND			
Caspe	Highland	NAR	ND			
Pitt	Highland	ND-165	ND			
Wegenroth	Watkins	NAR	ND			
Brinkerhoff	Commonwealth	LT1	ND		ND	
Palermo	Commonwealth	LT1	ND			
Berry	Commonwealth	LT1	ND			
Varga	Commonwealth	LT1	ND			
Prior King Press	Watkins	ND-2,3	1/ND*	2		
Holmes	Watkins	ND	ND			

TABLE III-9 (CONTINUED)

POTABLE WELL SAMPLING DATA
(PCE values in ug/liter)

Owner	Street	EPA/NYSDOH** 10-17-83-4-19-84	FCHA Potable Well Sampling Trips 6-4-84-6-5-84	7-17-84-7-18-84	9-19-84-8-28-84	9-20-84
Eckerson	Highland	ND	ND	ND		
Lopez	Commonwealth	LT1	ND			
Rasmussen	Watkins	ND-12	ND			
Liska	Highland	LT1-12		130	850/810*	
Nixdorf	Highland	ND		ND		
Barry	Highland	39-730		250		
Osborne	Highland	41-2400		34		
Bliven	Commonwealth	ND-LT1		ND		
Hoffman	Commonwealth	ND-LT1		ND		
Winner	Watkins	ND-1.1		ND		
Stout	Highland	2341-3500		3,500		
Lobb	Highland	39-2500		46		
Janiak	Highland	ND-17		ND		
Parella	Highland	1900-260,000		68,000/47,000*		
General Switch	Highland	1100-3877		1,400		
Lewis	Highland	ND-49		107	120	
Robanna	Highland	5-78		4		13
Radivoy	Highland	ND-4.5		2		
Muller	Commonwealth	ND-LT1		ND		
CosmoOptics New Well	Watkins	ND		2		

TABLE III-9 (CONTINUED)

POTABLE WELL SAMPLING DATA
(PCE values in ug/liter)

Owner	Street	EPA/NYSDOH** 10-17-83- 4-19-84	FCHA Potable Well Sampling Trips 6-4-84- 6-5-84	7-17-84- 7-18-84	9-19-84- 8-28-84	9-20-84
CosmoOptics Old Well	Watkins	ND-6 - failed QC		ND		
Smith	Highland	ND-LT1			ND	ND
Courteau	Highland	ND			ND	
Perry	Highland	ND			ND	
Reynolds	Commonwealth	ND-LT1			ND	ND
Kieran	Commonwealth	ND-LT1			ND	
Hawkins	Commonwealth	ND			ND	
Shattuck	Highland	ND				LT 0.1
Estrada	Highland	ND				ND
Gady	Highland	ND-LT1				0.1
Ward	Wilkins	ND-2				ND
Ebert	Park	ND				LT 0.1
Duco	Park	ND				LT 0.1
Ruppert	Highland	7,000-13,985		14,000/18,000*		
Trip Blanks		ND	ND		ND	
Field Blanks		ND	ND		ND	

* Represents replicate analysis.

**Column represents range in PCE values from EPA/NYSDOH sampling program.

LT = Less than.

NAR = No available range.

CHAPTER IV

GEOLOGY AND HYDROLOGY

A. Introduction

In order to assess the potential for contaminant migration from the General Switch property through the glacial till, it is necessary to understand the geology and hydrology of the area. The last chapter described the range of field investigations and laboratory analyses performed by FCHA as part of the work plan. The information obtained from that work provides the basis for the following discussions of regional and site geology and site hydrology.

B. Geology

1. Regional Geology

The Middletown area lies within the physiographic province known as the Valley and Ridge province. The area is underlain by alternating layers of hard sandstone and soft shale that were compressed and deformed by regional tectonic pressure exerted from the southeast. The deformation occurred during the Taconic Orogeny, approximately 450 million years ago. As a result of pressure from the southeast, the long axes of the folds in the rocks trend northeast-southwest.

The stratigraphic units underlying the northwestern section of Orange County are part of the Normanskill Shale unit. The lower member of the Normanskill is the Mt. Merino Shale, and the upper member is the Austin Glen Grit and Shale. The combined thickness of these two members is thought to be between 8,000 and 9,000 feet. Stratigraphically above the Normanskill Shale is the Snake Hill Shale.

Lithologically, the lower part of the Mt. Merino Shale is composed of medium-dark gray mudstone layers interfingered with layers of fine sand and silt. The upper part of the member is composed of thicker, more massive beds of laminated sandy siltstone and finer layers of mudstone. The overlying Austin Glen member is composed of interbedded, massive dirty sandstones or graywackes and thinly-bedded fissile shales. Graywacke sections of the Austin Glen are medium gray and typically weather to a buff color with a 1/2 to 1 inch rusty-brown rim that is slightly porous. The lithology of the Snake Hill Shale is similar to that of the Austin Glen, although the graywacke beds are not as thick, nor as numerous.

Ground moraine, or till, mantles most of the shale in the Orange County area. The till was deposited by southward moving glaciers during the Pleistocene epoch. As the glaciers moved over the shale bedrock, the ice eroded and picked up weathered rock. When the glaciers retreated, this material was redeposited on the bedrock as an unsorted, unstratified mixture of clay, silt, sand, gravel and boulders. The till in this area has been referred to as "hardpan" because the large boulders make drilling difficult. In general, till is considered to be a low permeability material, and is usually classified as more of an aquiclude than an aquifer. Published reports on till in southern New England show that hydraulic conductivity (permeability) values range from 4.3×10^{-6} to 9.6×10^{-3} cm/sec with a median value of 7.2×10^{-4} cm/sec (Wilson, et al., 1974).

2. Site Geology

The shale and siltstone bedrock in the General Switch area was tentatively identified as the Austin Glen Grit and Shale member of the Normanskill Shale. The bedrock outcrop on the southeastern side of the Industrial Place extension consists of massively bedded dirty siltstone that strikes approximately N63°E and dips 45 to 59°NW. None of the fissile shale layers were found at this outcrop. However, these layers are much less resistant to physical and chemical weathering than the massive siltstone. Sparse bedrock outcrops located in the Middletown vicinity (along 17M) contain interbedded layers of shale and siltstone and in most cases, the shale layers are highly weathered and fractured.

Rock cores recovered during the test drilling phase show alternating layers of shale and siltstone. The layers range in thickness from one inch to one foot and may alternate on a scale ranging from several inches to one foot. The rock core recovered from TB-1 consists predominantly of shale with minor siltstone layers (Appendix B). The core from TB-8 consists of about 60 percent shale with more numerous and thicker layers of siltstone. In contrast, the core from TB-6 consists almost entirely of siltstone. The driller at the General Switch site could frequently distinguish between the shale and the siltstone by changes in drilling rates and the color of drill chips. He noticed the alternating nature of shale and siltstone in most of the test borings.

The rock cores also show discrete fractures and some small fracture zones. The discrete fractures are predominantly horizontal and located parallel to and along bedding planes. Some of these fractures probably developed as a result of coring, and some of them may have formed as a result of regional deformation during the Taconic Orogeny or more recently during the glacial retreat. Since the rock cores are only five feet in length, it is difficult to determine how extensive the zone of fractured bedrock is. However, based on information from private wells it must be several hundred feet deep. The degree of fracturing probably decreases with depth until somewhere in the vicinity of 600 feet, when the occurrence of fractures is rare (Frimpter, 1972).

As previously mentioned in the report, an approximate bedrock elevation map was constructed from survey and test boring data. This map (Figure III-19) suggests that there is an apparent shallow trough below the General Switch plant, that is oriented in an northeast-southwest direction. The trough lies approximately parallel to the long axes of folds in the area, and may have originated as a structurally weak area that was subsequently traversed and scoured out by the glaciers. Because of insufficient data, it is difficult to determine the aerial extent of this trough.

Stratigraphically above the shale bedrock is a mantle of glacial till ranging in thickness from 5.5 feet in TB-6 to 36 feet in TB-2. The till is somewhat variable in color, ranging from gray to orange-brown. It is generally unsorted and unstratified and consists primarily of clay, silt and boulders. The permeability of the till is very low and the values range from 1.3 x 10^{-7} cm/sec to 6.4 x 10^{-7} cm/sec. During the test pit and test boring phases, it was noted that the shallow till was quite dry and became only slightly moist at depth.

The till in most of the test borings directly above the bedrock was gray in color and composed primarily of silt and clay. Abundant weathered shale fragments were usually found in this layer, and occasional pockets of coarse, orange-brown sand were also found. Twenty-three feet of this clay layer were found in TB-2, but only 2-4 feet were found in the other test borings. The gray clay was usually very dense and quite cohesive.

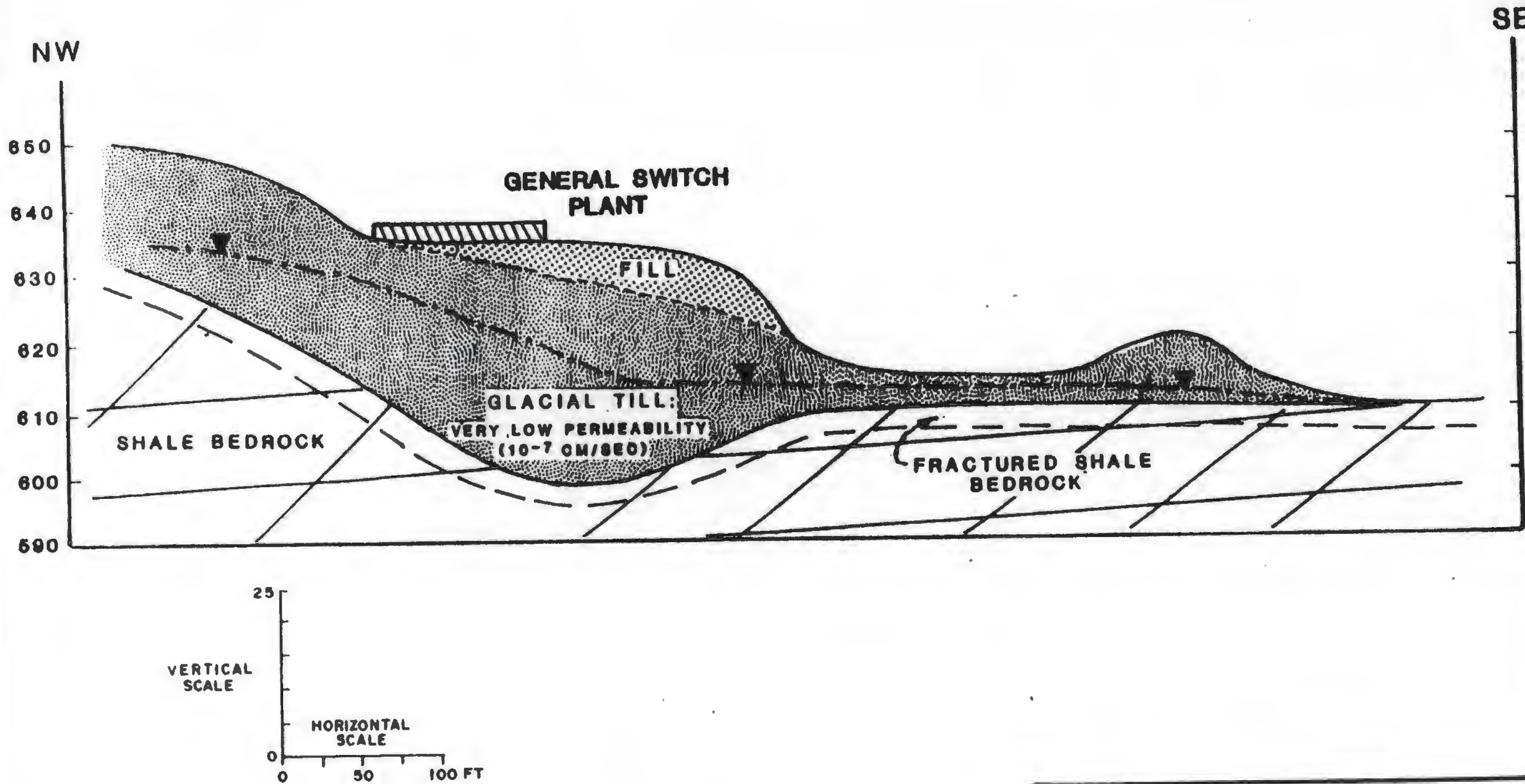
Orange-brown till lies above the gray till in all the test borings. The orange-brown till was usually composed of fine sand and silt with some rock fragments. Occasional pockets of gray clay surrounding some of the larger boulders in the orange-brown till were noticed in several test pits. The orange-brown till was generally slightly coarser grained than the gray till and not quite as dense or cohesive.

A generalized cross-section through the study area is presented in Figure IV-1. The cross-section is oriented in a northwest-southeast direction, approximately perpendicular to the trend of the apparent bedrock trough below General Switch. The till is thickest below and to the northwest of the General Switch plant and thins towards the southeast. As mentioned, bedrock outcrops are found to the southeast of the plant beyond the Industrial Place Extension. The boundary between fractured and unfractured bedrock is uncertain since the longest core was only 5' in length, but the density of fractures probably gradually decreases with depth.

C. Hydrology

1. Surface Water Drainage

During the time of the field investigation (August - September, 1984), no apparent surface streams drained the General Switch area. However, General Switch is situated on a southeasterly dipping slope and surface water must drain in that direction. Because of the low permeability of the till, most of the water probably travels as surface runoff. The surface



NOTE: DATA ON BEDROCK LIMITED TO FIVE FOOT CORE

FIGURE IV-1

GENERALIZED GEOLOGIC CROSS-SECTION GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

runoff probably collects in a low swampy area at the southeastern edge of the General Switch and Parella properties and may drain off to the southwest. There is about 5.5 feet of very low permeability till over bedrock in this area and it is unlikely that surface water could reach the bedrock aquifer even where the till is thinner here than under the plant.

2. Groundwater

In the General Switch area, the till is acting as a confining layer and there is no water table aquifer in the shallow till soils at the site. This conclusion is substantiated by several pieces of evidence. First, all of the split spoon samples taken in the till were dry. Secondly, the water level rose above the bedrock-till interface in every test boring, except TB-8. In TB-8, drill water was lost down the hole when bedrock was encountered and during the water level measurements, MW-8 was consistently dry. The fact that the water level rose above the till-bedrock interface indicates the till has such a low permeability that there is almost no hydraulic connection between the two units. Furthermore, the low permeability of the till retards the movement of any significant quantity of water in the till itself.

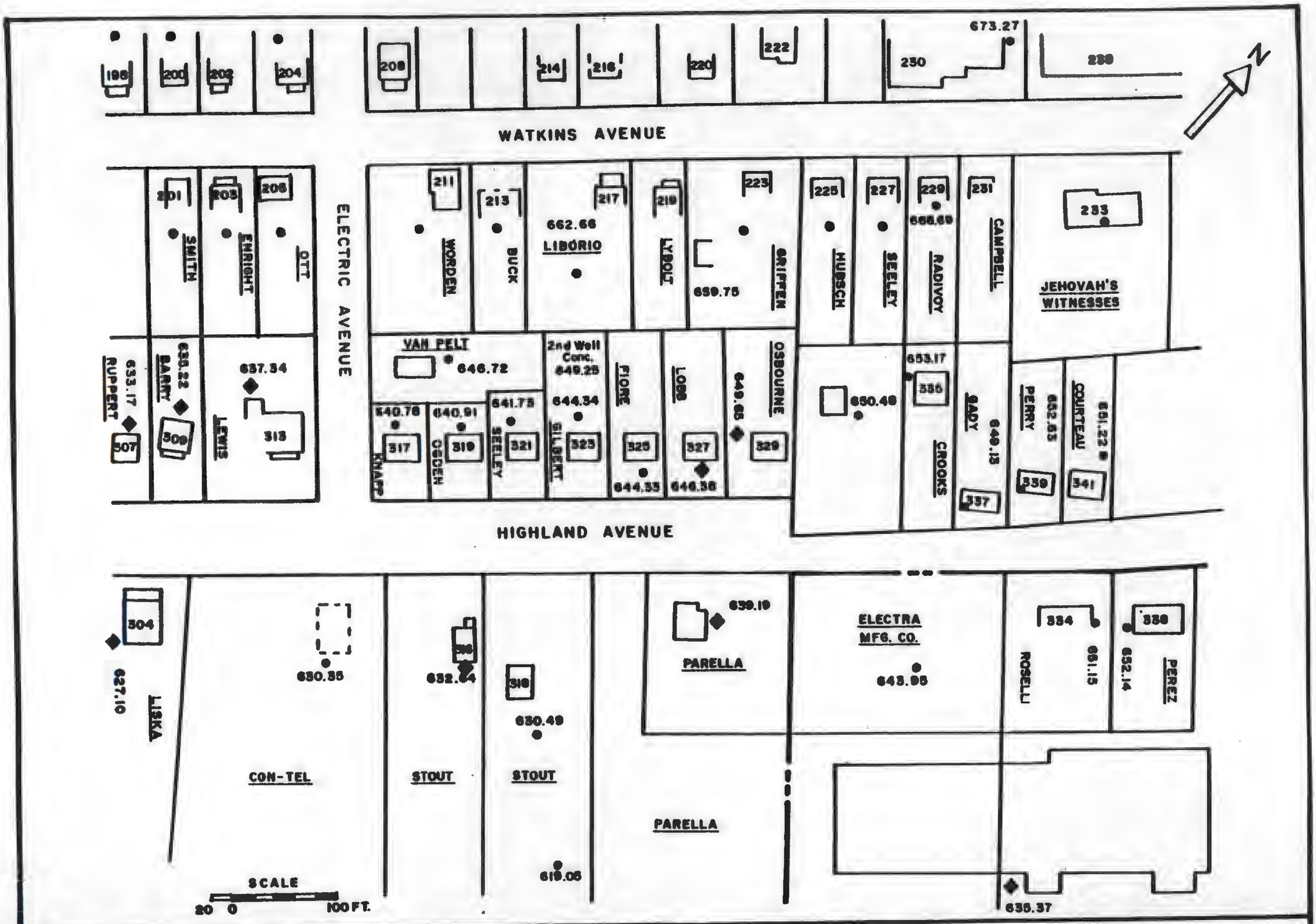
However, because the potentiometric surface is above the bedrock-till interface, an upward force is exerted by the water in the bedrock on the base of the till. As a result, some water appears to be pressed or leaked from the shallow bedrock aquifer into the base of the till. This mechanism accounts for the presence of water in the monitoring wells. When the wells were installed, the screens were placed as deep as possible to insure the collection of any water flowing through the till. However, at the time of installation, the hyraulic properties of this boundary were unknown. The presence of drilling water in the test borings made it difficult to observe water leaking from the bedrock aquifer into the till. It was not until the wells were evacuated and water level measurements were taken that the leakage became recognizable. Water leaking from the bedrock aquifer into the deep till and the monitoring wells is the predominant influence on all the groundwater and chemical data.

Flow Paths and Flow Directions. The permeability of the overlying till is so low that most of the rainwater falling on its surface will travel downgradient as surface run-off. The small component of water that penetrates the unsaturated till will travel in a predominantly vertical direction. However, since the till is a confining layer, there is almost no hydraulic connection between the till and the bedrock. Water traveling in the till-bedrock hydrologic zone appears to be flowing in a direction to the south and west (Figure III-21). Because of the upward hydraulic gradient, water is apparently leaking upward from the fractured bedrock aquifer into the base of the till. It should be noted, however, that the direction of groundwater flow at the present time may not necessarily be indicative of groundwater movement under all conditions. Pumping patterns in domestic wells have changed since the contamination was first discovered in October, 1983. In areas where domestic well productivity is low, such as in a fractured bedrock aquifer, pumping practices can have a significant influence on groundwater flow directions.

Groundwater Quality. Since there is no water table aquifer in the till, neither is there any groundwater contaminant plume in the till. Laboratory analyses of soil samples did, however, show the presence of low levels of PCE contamination in the soils around the General Switch plant. PCE spilled on the parking lot surface could be carried downgradient by surface runoff or introduced into the subsurface soils through the drilling process. Most of the contamination was found within a 100 foot radius of the plant indicating that it has not traveled very far either laterally or vertically.

Relatively high concentrations of PCE were found in some of the monitor well water samples (Table III-8). Since the monitor wells are receiving water from shallow bedrock, it is likely that most of the contamination in the wells originated in the bedrock aquifer. Apparently, at least some of the monitoring wells are in hydraulic connection with the already contaminated bedrock aquifer and the analyses indicate that the contaminant plume in the bedrock extends under the General Switch property.

Since groundwater flow directions may have changed as pumping practices changed, it is difficult to determine whether or not the PCE plume has always been present in the bedrock under the General Switch site. The contaminant plume at the present time extends from the houses on Highland Avenue southwest of the plant to the General Switch property (Figure IV-2). Based on the results of potable well sampling, the orientation of the plume has remained fairly stable in a northwest-southeast configuration since contamination was first found in October, 1983. This orientation is approximately parallel to the direction of the shallow trough located under the General Switch property. The trough may be evidence of some kind of fracture pattern that is restricting further movement of the PCE contaminant plume.



LEGEND
- ◆ WELLS CONTAINING GREATER THAN 50 PPB PCE
- ● UNCOMTAMINATED WELLS

FIGURE IV-2
LOCATION OF CONTAMINATED WELLS

FRED C. HART ASSOCIATES, INC.

CHAPTER V

CONCLUSIONS

The hydrogeologic study was designed to investigate the source and migration pathway of PCE in the glacial till at the General Switch site. Two very important conclusions were reached during the study:

- There is no known substantial source of PCE either above ground or buried at the General Switch site.
- There is a very low potential for contaminant migration either
  - (a) vertically from the ground surface to the underlying bedrock aquifer, or
  - (b) laterally from the parking lot downslope to an area where the bedrock is at or above ground surface.

Only one small, potential source of PCE contamination was located and that was under the present parking lot. The parking lot contained mostly scrap metal, some wood and other assorted types of industrial refuse. There was no evidence that any substantial quantity of containerized PCE has been deposited in the parking lot area either in the past or at the present time. The source of PCE found in the near surface soils of the parking lot was probably leaks and spills from tank trucks that previously delivered PCE to the plant. The highest level of PCE contamination was found on the surface, near the southeastern edge of the lot in one of the test pits. There may have been a concentrated pool of PCE left over from an old spill or leak. However, the samples taken in the soil underneath this spot showed substantially less PCE which indicates very little vertical migration. Furthermore, General Switch now receives all of their PCE in 55-gallon drums which should reduce the chance of spills or leaks occurring in the future.

Only low levels of PCE contamination were found in the subsurface soils around the General Switch site. With the exception of one sample which contained only 3.2 ppm, all the test boring samples analyzed had PCE concentrations of less than 0.70 ppm. The low level soil contamination is distributed somewhat more consistently downgradient from the parking lot than in an upgradient direction. However, the levels of PCE are not substantially higher downgradient and no significant concentration gradient exists. The lack of any significant concentration gradient indicates that there is no major quantity of PCE presently migrating laterally downgradient from the parking lot. Furthermore, there is no significant concentration gradient in a vertical direction anywhere on the site, which likewise indicates that PCE has not migrated in substantial quantities through the till to the bedrock.

The results of the field investigations indicate that there is only a very low potential for contaminant migration through the glacial till to the bedrock. A relatively thick wedge of unsaturated till ranging from 20-40 feet is present below the plant and the parking lot. The permeability of till in this area ranges from only 1.3×10^{-7} cm/sec to 6.4×10^{-7} cm/sec, values which indicate that the till has a very low permeability. Furthermore, the permeability is so low that no water table aquifer exists at the site and the till is acting as a confining layer. Since the till is confining water in the bedrock aquifer, water from the surface cannot penetrate the till in any significant quantity, nor can surface water reach the bedrock aquifer within the limits of the site. Therefore, as is characteristic of confining layers, there is no hydraulic connection between the surface and the bedrock aquifer. The upward hydraulic gradient created by the confining layer does, however, cause a small amount of water and PCE to leak from the bedrock into the base of the till.

Not only was it found that there is a low potential for PCE migration through the till, but water level measurements indicate that water flowing at the till-bedrock interface is presently moving in a southwesterly direction away from the plant. This flow direction is away from the contaminated potable wells on Highland Avenue and opposite from the groundwater flow direction previously reported. There are several reasons why the present flow direction may be different. Pumping patterns have probably changed since the contamination was identified in October, 1983. In an aquifer that does not produce a large supply of water, small shifts in pumping practices may have a significant effect on groundwater flow directions. On the other hand, the flow direction in the deeper parts of the bedrock aquifer may be different from ones in the shallow part of the bedrock aquifer. Despite the fact that flow directions appear to have changed in the bedrock aquifer, the contaminant plume has remained in a stable configuration since the contamination was first found last October.

In conclusion, no substantial source of PCE was located at the General Switch site and the data indicates that any PCE spilled or leaked on the site would be unlikely to migrate through the till to the bedrock aquifer. The fact that the till at the site was unsaturated and acted as a confining layer precluded the presence of any groundwater contaminant plume and therefore made it difficult to identify the source of the contamination. Likewise, since no source was identified and since the till is no longer a potential pathway, it was difficult to distinguish the mechanism by which PCE contamination entered the bedrock aquifer.

REFERENCES

Frimpter, M.H., 1972. Ground-Water Resources of Orange and Ulster Counties, New York, U.S. Geological Survey Water-Supply Paper 1985, U.S. Government Printing Office, Washington, D.C.

Terzaghi, K. and Peck, R. B., 1967. Soil Mechanics in Engineering Practice, John Wiley and Sons, Inc., New York, 2nd ed.

Wilson, W. E., Burke, E. L. and Thomas, L. E., 1974. Water Resources Inventory of Connecticut, Part 5, The Lower Housatonic River Basin, Connecticut Water Resources Bulletin no. 19.

APPENDICES

APPENDIX A

TEST PIT LOGS AND DRUM INVENTORIES

LOG OF TEST PIT

FRED C. HART ASSOCIATES, INC.

PROJECT NO. A0379

PROJECT NAME: General Switch		TEST PIT NO. 1
		COORDINATES: G, 310
LOCATION: Middletown, New York		EQUIPMENT OPERATOR: Lou
DATE: 8/28/84	GROUND SURFACE ELEVATION:	INSPECTOR: Morahan / Greuthier

DEPTH (FT.)		DESCRIPTION OF MATERIALS	REMARKS
0			no soil horizons or "topsoil" - may have been dozed off to form piles around edge of clearing
1	1A		
2			
3	1B	gray to orange-brown TILL; clay and boulders, trace medium sand	
4			
5	1C		
6			
7	1D		
8			
9	1E: 1E2 / 1E1		8.5' (on uphill side) pocket of olive-brown stratified fine to med. SAND that carries some H_2O
10			
11		pit terminated at 10' bgl	
12			
13			
14			
15			

FRED C. HART ASSOCIATES, INC.

PROJECT NO. A0376

PROJECT NAME: General Switch	TEST PIT NO. 2
	COORDINATES: E.25,+25
LOCATION: Middletown, New York	EQUIPMENT OPERATOR: Lou
DATE: 8/28/84 — GROUND SURFACE ELEVATION:	INSPECTOR: Horanan/Sweetheer

DEPTH (FT.)	sample no.	DESCRIPTION OF MATERIALS	REMARKS
0		FILL consisting of industrial waste (paint cans, drum lids, metal switch boxes, paint sludge, wire screens, exhaust pipe) with some sand and boulders	crushed stone fill darker OVA = 0 ppm
1	2A, soil		topsoil matrix 2A, OVA = 2 ppm
2	$2A_2$ paint sludge		
3	2B		reinforced concrete slab
4			less soil 2B, OVA = 1000 ppm
5	2C		no soil, metal only OVA = 1000 ppm
6			6.5' - found drum partially filled w/ paint sludge 2C, OVA = 1000 ppm
7		pit terminated at 7' bgl	
8			
9			
10			
11			
12			
13			
14			
15			

LOG OF TEST PIT

FRED C. HART ASSOCIATES, INC.

PROJECT NO. A0374

PROJECT NAME: General Switch	TEST PIT NO. 3
	COORDINATES: H,250
LOCATION: Middletown, New York	EQUIPMENT OPERATOR: Lou
DATE: 8/29/84 · GROUND SURFACE ELEVATION:	INSPECTOR: TM/LT

DEPTH (FT.)		DESCRIPTION OF MATERIALS	REMARKS
0			topsoil appears to have been backfilled based on drum and metal scraps found within OVA = 0ppm
1	3A (+3')		
2		black to orange-brown; dry TOPSOIL	
3	$3B_2$ (+1')		* found rusted out half of metal drum took sample of dirt from inside ($3B_2$) OVA = 0ppm
4	0 REF		
5	3C (-1')		
6	3D (-3')	light-brown TILL with gray clay plugs	
7			
8	3E (-5')	same as above with some sandy plugs that carry water	damp (slightly darker)
9			
10	3F (-7')		
11			
12	3G (-9')		
13			3G - water collecting in bottom of pit
14		pit terminated 9' below reference point (or 13' bgl)	
15			* backfilling operation uncovered syringe - saved in sample bottle labeled 3H

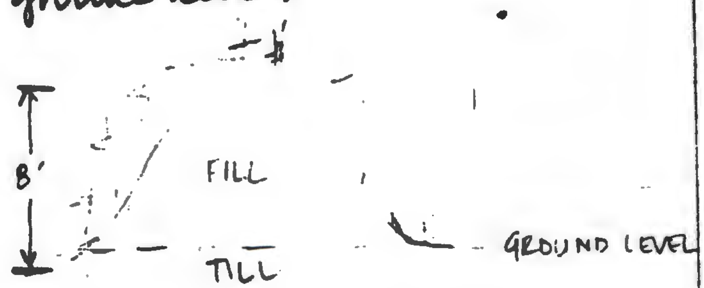
LOG OF TEST PIT

FRED C. HART ASSOCIATES, INC.

PROJECT NO. A0379

PROJECT NAME: General Switch	TEST PIT NO. 4
	COORDINATES: G, 350
LOCATION: Middletown, New York	EQUIPMENT OPERATOR: Lou
DATE: 8/29/84 — GROUND SURFACE ELEVATION:	INSPECTOR: Tauethuer/Horahan

DEPTH (FT.)		DESCRIPTION OF MATERIALS	REMARKS
0–2	4A	FILL consisting of brown-black topsoil; some roots in top 2'	
2–4	4B		
4–6	4C		
6–7	4D		
7–8	4E	light orange-brown TILL, boulders and clay, trace med sand	
8–15		pit terminated at 8' below top of piles (at approximately ground level)	



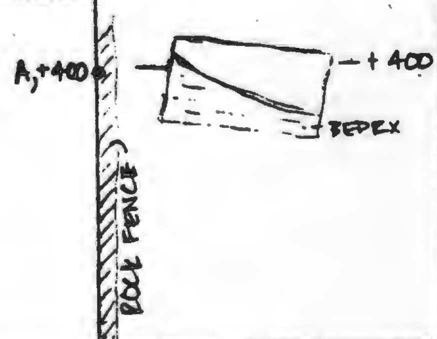
LOG OF TEST PIT

FRED C. HART ASSOCIATES, INC.

PROJECT NO. A037a

PROJECT NAME: General Switch	TEST PIT NO. 5
	COORDINATES: A.25, +385
LOCATION: Middletown, New York	EQUIPMENT OPERATOR: Lou
DATE: 8/29/84 — GROUND SURFACE ELEVATION:	INSPECTOR: Monahan/Imeltner

DEPTH (FT.)	DESCRIPTION OF MATERIALS	REMARKS
0–2	dry, brown TOPSOIL with organic material and roots	Samples 5C, 5D and 5E only.
2 — 5C; 5D; 3–4 (48")	light brown TILL consisting of tight clay and moderately fresh flat oblong shale cobbles	
4–10; 8–10 — 5E	Fresh, hard, moderately fractured, dark gray, SHALE	60" damp bedrock water running into pit from fractures at 7' bgl water level after 10-15 minutes = 8' original DTW = 9'
10–15	pit terminated at 10' bgl	



LOG OF TEST PIT

FRED C. HART ASSOCIATES, INC.

PROJECT NO. A037a

PROJECT NAME: General Smith	TEST PIT NO. 6
	COORDINATES: D, 125
LOCATION: Middletown, New York	EQUIPMENT OPERATOR: Lou
DATE: 8/29/84 — GROUND SURFACE ELEVATION:	INSPECTOR: Moranan/Guenthner

DEPTH (FT.)	Sample	DESCRIPTION OF MATERIALS	REMARKS
0–2	6A	FILL consisting of topsoil and industrial waste (wood, metal and some plastic)	topsoil and waste material is damp. OVA readings ranged from 40-70 ppm, with one or two high readings of 250 and 1000. Very strong smell of PCE.
2–4	6B		
4–6	6C		
6–8	6D		
8–10	6E		
10–12	6F	orange-brown TILL consisting of silt with some boulders and trace fine sand	
12–15			

LOG OF TEST PIT

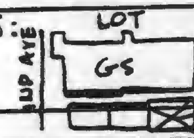
FRED C. HART ASSOCIATES, INC.

PROJECT NO. A037a

PROJECT NAME: General Switch

TEST PIT NO. 7

COORDINATES:



pit located in Middle of Electric Lot.

LOCATION: Middletown, New York

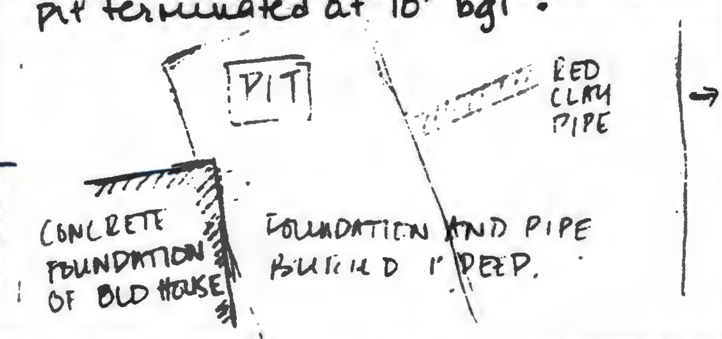
EQUIPMENT OPERATOR: Lou

DATE: 8/30/84

GROUND SURFACE ELEVATION:

INSPECTOR: Moorahan / Truettner

DEPTH (FT.)		DESCRIPTION OF MATERIALS	REMARKS
0–2	7A	dry, brown TOPSOIL with organic material and roots	
2–4	7B	orange-brown TILL consisting of boulders, cobbles, gravel, sand and clay	
4–6	7C	grey TILL consisting of same with orange stains	
6–8	7D		
8–10	7E		OVA = 0 P.PM
10–15	TO HIGHLAND AVE.	pit terminated at 10' bgl.	TO GS PLANT



LOG OF TEST PIT

FRED C. HART ASSOCIATES, INC.

PROJECT NO. A037a

PROJECT NAME: General Switch	TEST PIT NO. 8
	COORDINATES: D.25, 185
LOCATION: Middletown, New York	EQUIPMENT OPERATOR: Lou
DATE: 8/30/84 — GROUND SURFACE ELEVATION:	INSPECTOR: Morahan / Kruether

DEPTH (FT.)		DESCRIPTION OF MATERIALS	REMARKS
0		dark brown ORGANICS with some roots	
1–2	8A	FILL consisting of brown topsoil with some cobbles	soil is damp and OVA readings were generally low (4-6 ppm) - although initial OVA reading of 400 ppm at 4'
3–4	8B		
5–6	8C		
6–15		pit terminated at 6' below top of parking lot (approximately to ground level)	pit dug on side of parking lot through fill down to gl.

LOG OF TEST PIT

FRED C. HART ASSOCIATES, INC.

PROJECT NO. A037a

PROJECT NAME: General Switch	TEST PIT NO. 9
	COORDINATES: E.5, +75
LOCATION: Middletown, New York	EQUIPMENT OPERATOR: Lou
DATE: 8/30/84 — GROUND SURFACE ELEVATION:	INSPECTOR: Morahan / Gruethner

DEPTH (FT.)		DESCRIPTION OF MATERIALS	REMARKS
0–1	9A	FILL consisting of crushed stone	FILL #2 B
		gray FILL consisting of industrial waste	FILL #2 A
1–2	9A	FILL consisting of brown to light brown TILL composed of cobbles and sand	FILL #1
2–4	9B		
4–6	9C	dark brown to dark gray TILL composed of clay with some gravel	TILL (dry)
6–8	9D	orange-brown TILL composed of silt and sand, little gravel, trace cobbles	
8–10	9E		
10–15		pit terminated at 10' bgl	

LOG OF TEST PIT

FRED C. HART ASSOCIATES, INC.

PROJECT NO. [illegible]

PROJECT NAME: General Switch	TEST PIT NO. 10
	COORDINATES: E.25, +60
LOCATION: Middletown, New York	EQUIPMENT OPERATOR: Lou
DATE: 8/31/84 — GROUND SURFACE ELEVATION:	INSPECTOR: Monahan / Truettner

DEPTH (FT.)		DESCRIPTION OF MATERIALS	REMARKS
0			
1–3	10A	FILL consisting of gray-brown, med to fine sand and silt, some cobbles	top few inches capped with grey crushed stone ambient air ≤ 50 ppm (smells like PERC)
3–5	10B	FILL consisting of orange-brown fine sand and silt	hole is generally dry OVA readings: 1000+ spots
5–7	10C	FILL consisting of industrial waste (boards, drums, drum lids, drum bands, switch boxes, plastic)	Found 2 drums * IN THIS LAYER damp and rotting boards
7–8	10D 10D1	FILL consisting of wood and dark gray till composed of sand	OVA readings 200-300 ppm
8–9	10D2	orange-brown TILL consisting of sand and silt, little gravel, trace cobbles	
9		Pit terminated at 8.5' BGL	
10			* drums: 55 gal with no tops - partially filled with paint sludge waste
11			
12			
13			
14			
15			

LOG OF TEST PIT

FRED C. HART ASSOCIATES, INC.

PROJECT NO. [illegible]

PROJECT NAME: General Switch	TEST PIT NO. 11
	COORDINATES: SS MAINT. PARKING LOT TP11 → X • MW3
LOCATION: Middletown, New York	EQUIPMENT OPERATOR: Drew
DATE: 9-20-84 / GROUND SURFACE ELEVATION:	INSPECTOR: Truettner / Morahan

DEPTH (FT.)	DESCRIPTION OF MATERIALS	REMARKS
0 – 2	FILL consisting of rotting wood and scrap metal, some topsoil	
2 – 3 (11A)	gray CLAY	block sample taken for permeability testing
3 – 11	orange-brown TILL consisting of silt, some boulders, trace fine sand	
11	TB11 terminated at 11' BGL	

DEPTH scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

LOG OF TEST PIT

FRED C. HART ASSOCIATES, INC.

PROJECT NO. A0370

PROJECT NAME: General Smith	TEST PIT NO. 12
	COORDINATES: G.5, 300
LOCATION: Middletown, New York	EQUIPMENT OPERATOR: Drew
DATE: 9-20-84 / GROUND SURFACE ELEVATION:	INSPECTOR: Morahan / Truettner

DEPTH (FT.)	DESCRIPTION OF MATERIALS	REMARKS
0–8	orange-brown to gray TILL consisting of clay and boulders, trace medium sand	
8 12A		12A & B - block soil samples taken for permeability tests.
9		
10 12B		
11	TP 12 terminated at 11' BGL	
12		
13		
14		
15		

FRED C. HART ASSOCIATES

DRUM INVENTORY LOG

QUADRANT E.25+60 DRUM № 4

CONDITION: open bullet holes visible leakage
sealed bulged rusted

SIZE: 5 gal. 40 gal. 55 gal. 125 lb.
other NO TOP

CONTENTS: full 3/4 1/2 1/4 empty

PORTION BURIED: 3/4 1/2 1/4 none COMPLETELY (4ft)

ANGLE: 90° 60° 30° 0°

DIRECTION: Buried in 4 Ft of INDUSTRIAL TRASH FILL

RECCOMENDED SAMPLING: DRUM/RCRA COMPOSITE/RCRA OVA NONE

POSSIBLE CONTENTS Dried Paint Sludge Waste

200 ppm OVA

LABEL INFORMATION:
NONE

LOCATION OF DRUM IN QUADRANT PIT # 10

FRED C. HART ASSOCIATES

DRUM INVENTORY LOG

QUADRANT E. 25 + 60 DRUM № 3

CONDITION: open bullet holes visible leakage

sealed bulged rusted

SIZE: 5 gal. 40 gal. 55 gal 125 lb.

other NO TOP

CONTENTS: full 3/4 1/2 1/4 empty

PORTION BURIED: 3/4 1/2 1/4 none Completely (3-4 ft)

ANGLE: 90° 60° 30° 0°

DIRECTION: BURIED 3 - 4 ft BGL IN INDUSTRIAL TRASH FILL

RECCOMENDED SAMPLING: DRUM/RCRA COMPOSITE/RCRA OVA NONE

POSSIBLE CONTENTS Dried paint sludge waste

LABEL INFORMATION: NONE

LOCATION OF DRUM IN QUADRANT PIT # 10

FRED C. HART ASSOCIATES

DRUM INVENTORY LOG

QUADRANT H+250 DRUM № 2 (HALF DRUM)

* CONDITION: open bullet holes visible leakage

sealed bulged rusted

SIZE: 5 gal. 40 gal. 55 gal. 125 lb.

other Cut in half

CONTENTS: full 3/4 1/2 1/4 empty

PORTION BURIED: 3/4 1/2 1/4 none completely (3 Ft)

ANGLE: 90° 60° 30° 0°

DIRECTION: Buried in topsoil Fill

RECCOMENDED SAMPLING: DRUM/RCRA COMPOSITE/RCRA OVA NONE

POSSIBLE CONTENTS unknown

LABEL INFORMATION: see below

* DRUM CUT IN HALF AS WITH A BLOWTORCH

LOCATION OF DRUM IN QUADRANT TEST PIT # 3

FRED C. HART ASSOCIATES

DRUM INVENTORY LOG

QUADRANT E.25 + 40 DRUM № 1

CONDITION: open | bullet holes | visible leakage

sealed | bulged | rusted

SIZE: 5 gal. | 40 gal. | 55 gal. | 125 lb.

other NO TOP

CONTENTS: full | 3/4 | 1/2 | 1/4 | empty

PORTION BURIED: 3/4 | 1/2 | 1/4 | none | COMPLETELY (6.5 Ft)

ANGLE: 90° | 60° | 30° | 0°

DIRECTION: Completely buried in Industrial Trash FILL

RECCOMENDED SAMPLING: DRUM/RCRA | COMPOSITE/RCRA | OVA | NONE

POSSIBLE CONTENTS Dried Paint Sludge Waste

LABEL INFORMATION: NONE

LOCATION OF DRUM IN QUADRANT TEST PIT #2

APPENDIX B

TEST BORING LOGS AND ROCK CORE LOGS

550 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. [illegible]	BORING NO. TB 1
PROJECT [illegible]	LOCATION [illegible]
DRILLING CONTRACTOR Al [illegible]	DRILLING EQUIPMENT [illegible]
GEOLOGIST [illegible] / Morgan	DRILLER Tom 4 [illegible]
SIZE & TYPE OF BIT	DATE START 9-04-84 / DATE FINISH 9-04-84
CASING — HAMMER WT. — FALL —	SAMPLER split spoon / HAMMER WT. 140 lb / FALL 30"
WELL CASING galvanized steel pipe	SCREEN MAKE & TYPE Johnson water well screen / LENGTH 5' / SLOT 10
ELEVATION OF: GROUND SURFACE / WELL CASING / SCREEN / WATER / DATE	
REMARKS	

LOG OF BORING

CASING BLOWS/FT	DEPTH FT	SAMPLE NO.	TYPE	RECOVERY IN.	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		1			1	0-5" organic horizon		
		2	SS	16"	1 3 6	5-16" orange-brown TILL consisting of some gravel, trace cobbles		
		3	SS	20"	8 11 15 15	same		
		4	SS	19"	16 21 30 30	gray-brown TILL consisting of clay and pebbles		
		5	SS	20"	21 26 21 21	same		
		6	SS	20"	26 25 110	gray-brown TILL consisting of clay and shale cobbles	stopped at 9'6" to add casing and change to tricone roller bit.	
		7	SS	21"	37 8 90 81	gray-brown TILL consisting of silt and clay and some fine sand, some pebbles, trace pockets of fine sand in core.		
		8	SS	9"	42 100/4"	gray-brown TILL consisting of silt, some clay and some shattered rocks, trace pebbles	about 3½" of core was shattered RX	
	15	9	SS	6"	110	gray-brown TILL consisting of silt, some clay, some shattered shale		
		10	SS	6"	135/5"	gray-brown TILL consisting of silt and clay, some fresh shale pebbles, trace pockets of orange-brown silt		
		11	SS	9"	50 100/3"	gray TILL consisting of silt w. shale fragments, some clay		
	20	12	SS	–	–	gray SHALE	19'8" top of bedrock; drilled through 2'4" of shale	
						ROCK CORE gray SHALE bedrock	applied down pressure = 700 lbs	
						rock core		

LOG OF BORING

NO. BLOWS/ft.	DEPTH ft.	SAMPLE No.	TYPE	RECOVERY %	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC L[illegible]
						[illegible] GROUP [illegible]	[illegible] [illegible] GRAY [illegible] with some fractured zones at 5"-7", 38"-41" and 48"-52" (measurement from top of core) otherwise hairline fractures mostly horizontal in attitude	
						TEST BORING TERMINATED A[illegible] 2[illegible]		

550 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. [illegible]	BORING NO. TB2
PROJECT [illegible]	LOCATION [illegible]
DRILLING CONTRACTOR Kendrick [illegible]	DRILLING EQUIPMENT [illegible] rig
GEOLOGIST Morahan / Truettner	DRILLER Tom and Jimmy
SIZE & TYPE OF BIT	DATE START 9-05-84 / DATE FINISH 9-06-84
CASING — HAMMER WT. — FALL —	SAMPLER split spoon / HAMMER WT. 140 lb / FALL 30"
WELL CASING	SCREEN MAKE & TYPE Johnson water well screen / LENGTH 5' / SLOT .10
ELEVATION OF: GROUND SURFACE / WELL CASING	SCREEN / WATER / DATE
REMARKS	

LOG OF BORING

CASING BLOWS/FT	DEPTH FT	SAMPLE No.	TYPE	RECOVERY FT	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		1				0-5' loose FILL consisting of brown topsoil		
		2	SS	8"	1 2 5 15	5'-8" orange-brown TILL consisting of silt and clay, some cobbles		
		3	SS	10"	21 22 31 26	orange-brown TILL consisting of fine sand and silt, some shattered shale fragments	dry	
		4	SS	22"	26 32 29 19	orange-brown TILL consisting of fine sand and silt, some cobbles	dry	
		5	SS	20"	16 12 12 10	orange-brown TILL consisting of silt and clay, some cobbles, little medium sand, trace gray clay near top of core		
		6	SS	22"	11 26 40 43	orange-brown TILL consisting of silt and clay, some shale cobbles		
	10	7	SS	4"	100/4"	same as above	BOULDER 11'6" 12'3"	
		8	SS	21"	27 37 44 58	gray TILL consisting of clay, some cobbles, some shale fragments	dry	
	15	9	SS	3"	28 37 58 67	gray TILL consisting of clay and shale fragments (1-2" or greater) some coarse gravel	pushing shale fragment in plug	
		10	SS	8"	48 100/5"	same as above	18'3" BOULDER 19'0"	
	20	11	SS	6"	100/6"	gray TILL consisting of clay and silt, some fine to med sand, some shale fragments trace quartzite fragments	20'0" 20'7" 20'10" 21'3" 21'11" 22'10"	
			SS	0"	125/1.5"	WASH	23'4" 24'3" 24'6"	
	25							

LOG OF BORING

N Blows/ft.	Depth ft.	Sample No	Type	Recovery in	Penetration Resistance Blows/6"	Description	Remarks
		12	SS	23"	[illegible] 35 56 46	gray TILL [illegible] fragments	
		13	SS	19"	42 57 69 55	same as above	
	30	14	SS	11"	24 105/6"	gray <u>TILL</u> consisting of fine sand and silt, some clay, some shale fragments	large shale fragment in plug
			SS	0"	125/5"	WASH	split spoon pushing down on boulder 3 cobbles 33'9" 34'5"
	35		SS	0"	100/2"	TILL BEDROCK	36'0"
		15				gray <u>SHALE</u> bedrock	drill cuttings in sample TB2-15
		15				gray <u>SHALE</u> bedrock	
						TB2 terminated at 41' BGL.	

550 FIFTH AVENUE
NEW YORK, NEW YORK 10036

PAGE ____ OF ____

JOB NO. 1922	BORING NO. TB3
PROJECT [illegible]	LOCATION [illegible]
DRILLING CONTRACTOR [illegible]	DRILLING EQUIPMENT [illegible]
GEOLOGIST Morahan / Tillethier / Brown	DRILLER Tom & Jimmy
SIZE & TYPE OF BIT	DATE START 9-06-84 — DATE FINISH 9-07-84
CASING ____ HAMMER WT. ____ FALL ____	SAMPLER Split Spoon — HAMMER WT. 140 lbs — FALL 30"
WELL CASING 2" galvanized steel pipe	SCREEN MAKE & TYPE Johnson waterwell screen — LENGTH 5' — SLOT -10
ELEVATION OF: GROUND SURFACE — WELL CASING	SCREEN — WATER — DATE
REMARKS	

LOG OF BORING

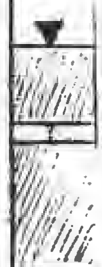
CASING BLOWS/FT	DEPTH FT	SAMPLE No.	TYPE	RECOVERY IN	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		1 2	SS	3"	3 4 5 6	0"-2" Loose FILL consisting of brown topsoil	plug contains 2" of orange-brown TILL; SS hit boulder and went in at angle	
		3	SS	16"	26 20 26 37	orange-brown TILL consisting of fine sand to silt and clay, some coarse gravel, some rock fragments	dry	
	5	4	SS	15"	32 30 44 58	same as above	dry	
		5	SS	2"	35 55 45 27	same as above (material is probably natural; problems with boulders and angle of split spoon)	dry boulder 8'0" 8'6"	
	10	6	SS	3"	50/1"	gray TILL consisting of clay and shale fragments (took sample of drill cuttings) TILL	welded casing - had to bore hole over due to angle of pipe 11'0"	
		7	SS		100/?"	dark gray-black SHALE BEDROCK	took sample of drill cuttings 14'6"	
	15					TEST BORING TERMINATED AT 14'6" BGL		
	20							
	25							

550 FIFTH AVENUE
NEW YORK, NEW YORK 10036

PAGE 1 OF ____

JOB NO. A0350	BORING NO. TB4
PROJECT [illegible]	LOCATION [illegible]
DRILLING CONTRACTOR Kendrick Drilling	DRILLING EQUIPMENT [illegible]
GEOLOGIST Trachtman / Brown / Monahan	DRILLER Tom and Jimmy
SIZE & TYPE OF BIT	DATE START 9-07-84 · DATE FINISH 9-07-84
CASING ____ HAMMER WT. ____ FALL ____	SAMPLER split spoon · HAMMER WT 140 lbs · FALL 30"
WELL CASING 2" galvanized steel pipe	SCREEN MAKE & TYPE Johnson water well screen · LENGTH 5' · SLOT .10
ELEVATION OF: GROUND SURFACE · WELL CASING	SCREEN · WATER · DATE
REMARKS	

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
						[illegible] topsoil consisting of fine sand and silt		
		1 2	SS	16"	3 5 7 7	dry orange-brown TILL consisting of fine sand some silt, some coarse gravel		
		3	SS	19"	17 14 16 28	orange-brown to gray TILL consisting of fine sand and silt, some coarse gravel		
	5	4	SS	21"	5 13 15 27	orange-brown TILL consisting of fine sand and silt, some coarse gravel, some rock fragments	Rock in plug	
		5	SS	20"	37 40 35 34	orange-brown TILL consisting of fine sand and silt, some rock fragments (weathered shale)	sample gets wetter toward bottom	
		6	SS	7"	27 50/4"	gray-black SHALE - very shattered, little orange-brown TILL consisting of med sand	wet sample - bedrock at 8'0" to 8'2". OVA scan of samples 5 & 6 showed nothing but inserted OVA down hole and got 40-50 ppm.	
	10	7	SS	4"	100/4"	dark gray SHALE, trace gray clay (took wash sample from split spoon)		
	15					test boring terminated at 13'6" BGL	NOTE: found lighter-gray, coarser textured (possibly graywacke) chips mixed with shale in drill cuttings. Driller also said harder rock was mixed in with shale so bedrock may be alternating layers of graywacke & shale	
	20							
	25							

530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

PAGE 1 OF 1

JOB NO. [illegible]	BORING NO. TBS
PROJECT [illegible]	LOCATION [illegible]
DRILLING CONTRACTOR Kendrick Drilling	DRILLING EQUIPMENT Rotary Rig
GEOLOGIST Treuthren / Monahan / Brown	DRILLER Tom and Jimmy
SIZE & TYPE OF BIT	DATE START 9-10-84 / DATE FINISH 9-10-84
CASING — HAMMER WT. — FALL —	SAMPLER split spoon HAMMER WT 140 Lbs FALL 30"
WELL CASING 2" galvanized steel pipe	SCREEN MAKE & TYPE Johnson watermark well screen LENGTH 5'2" SLOT 10
ELEVATION OF: GROUND SURFACE / WELL CASING / SCREEN / WATER / DATE	
REMARKS	

LOG OF BORING

CASING BLOWS/FT.	DEPTH FT	SAMPLE NO.	TYPE	RECOVERY IN.	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS
		1			2	0"-8" Loose brown FILL consisting of topsoil and till	
		2	SS	15"	5 7 13	orange-brown TILL consisting of silt, some fine sand, some cobbles	
		3	SS	22"	13 20 60 35	orange-brown TILL consisting of silt, some cobbles, trace clay	spoon damp
	5	4	SS	23"	30 28 80 50	orange-brown TILL consisting of silt, some cobbles, little clay, trace weathered graywacke rock fragments	gray clay in plug spoon damp
		5	SS	10"	75 29 100/5"	orange-brown TILL consisting of silt, some fine sand, some shale and some graywacke rock fragments	7'5"
		6	SS	18"	19 17 27 30	orange-brown TILL consisting of medium sand, some silt, some gravel	shale rx fragments in plug 10'0"
	10	7	SS	22"	47 47 69 92	highly fractured and weathered gray SHALE, little gray clay	
		8	SS	5"	100/5"	highly fractured and weathered dark gray SHALE	at 13'6" hit harder rocks
	15	9	SS			fresh, gray SHALE	drill cuttings. 16'0"
	20					TBS terminated at 16' BGL	

GRAPHIC LOG

530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. [illegible]		BORING NO. [illegible]	
PROJECT [illegible]		LOCATION [illegible]	
DRILLING CONTRACTOR Kendrick Drilling		DRILLING EQUIPMENT Rotary Rig	
GEOLOGIST Brown / Moynihan / Truethner		DRILLER Tom & Jimmy	
SIZE & TYPE OF BIT	DATE START 9-10-84	DATE FINISH 9-11-84	
CASING ___ HAMMER WT. ___ FALL ___	SAMPLER Split Spoon	HAMMER WT. 140 LBS	FALL 30"
WELL CASING 2" galvanized steel pipe	SCREEN MAKE & TYPE Johnson Watermark well screen	LENGTH 2'2"	SLOT .20
ELEVATION OF: GROUND SURFACE	WELL CASING	SCREEN	WATER / DATE
REMARKS			

LOG OF BORING

CASING BLOWS/FT	DEPTH FT	SAMPLE No.	TYPE	RECOVERY IN	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS
						0"-8" choc. brown-black TOPSOIL consisting of clay, little rock fragments, trace sand	
		1A 1B	SS	14"	1, 5, 9, 8	orange-brown TILL consisting of clay	
		2	SS	24"	8, 12, 15, 22	orange-brown TILL consisting of clay, little rock fragments, trace sand	bottom 6" of SS are damp
	5	3	SS	14.5"	15, 29, 100/5"	brown TILL consisting of silt and sand, some clay, little shale rock fragments	spoon wet
						gray to black SHALE and SILTSTONE (graywacke)	TB+ drill cuttings 5'6" from 5'6" to 6'0"
		ROCK CORE				dark gray SILTSTONE (graywacke) and SHALE	SOFT ZONE - 7'0" - 7'3"
					50/1"	same	7'4" - 8'3"
						TB6 terminated at 8'9" BGL	

DEPTH FT scale: 5, 10, 15, 20

GRAPHIC LOG

530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. AU: 70		BORING NO. TB7	
PROJECT General Smith		LOCATION Middletown, NY	
DRILLING CONTRACTOR Kendrick Drilling		DRILLING EQUIPMENT Rotary Rig	
GEOLOGIST Monahan / Truettner		DRILLER Tom & Jimmy	
SIZE & TYPE OF BIT	DATE START 9-11-84	DATE FINISH 9-12-84	
CASING —	HAMMER WT. —	FALL —	SAMPLER split spoon; HAMMER WT. 140 lbs; FALL 30"
WELL CASING 2" galvanized steel pipe	SCREEN MAKE & TYPE Johnson Watermark well screen	LENGTH 5'2"	SLOT 10
ELEVATION OF: GROUND SURFACE	WELL CASING	SCREEN	WATER / DATE
REMARKS			

LOG OF BORING

CASING BLOWS/FT.	DEPTH FT.	SAMPLE NO.	TYPE	RECOVERY IN.	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		1	SS	20.5"	7, 10, 18, 21	orange-brown TILL consisting of silt, some fine sand, some cobbles, trace weathered shale and graywacke rock fragments	top 5" are damp from rain last night	
		2	SS	15"	24, 35, 19, 22	brown TILL consisting of fine sand and silt, some cobbles, some rock fragments		
	5	3	SS	0"	22, 30, 34, 35	Rock in plug - no sample recovered		
		4	SS	22"	23, 28, 29, 25	orange-brown TILL consisting of clay and silt, some cobbles, little rock fragments		
		5	SS	24"	20, 25, 21, 24	same with more rock fragments, less cobbles		
	10	6	SS	21"	34, 50, 100/6"	same		
		7	SS	21"	31, 38, 77, 50/3"	orange-brown TILL consisting of silt and clay and weathered shale rock fragments		
	15	8	SS	22"	37, 43, 53, 88	orange-brown TILL consisting of silt, some rock fragments, little fine sand (2" near top of core), little clay	weathered shale in plug	▼
		9	SS	11"	29, 50/2"	orange-brown TILL consisting of clay and silt, some weathered shale rock fragments, trace gray clay found around large shale fragments		
		10	SS	5"	60, 75/4"	heavily fractured, weathered orange-brown to gray SHALE, some orange-brown clay and silt	18'0"	
	20	11	SS	7"	31, 50/2"	same	gray shale in plug	
		12	SS	14"	27, 35, 50/2"	same	fresh gray shale in plug	
	25	13	SS		—	dark gray fresh SHALE	[illegible] - took drill cuttings 24'0" to 24'3"	

LOG OF BORING

... NO BLOWS/ft.	DEPTH ft.	SAMPLE No.	TYPE	RECOVERY ft	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC L...
							[illegible]	
						TB7 terminated at 27' BGL		

530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

PAGE ___ OF ___

JOB NO. A0370	BORING NO. TBS
PROJECT [illegible]	LOCATION [illegible]
DRILLING CONTRACTOR Kendrick Drilling	DRILLING EQUIPMENT Rotary Rig
GEOLOGIST Tarrettees / Monahan	DRILLER Tom & Jimmy
SIZE & TYPE OF BIT	DATE START 9-12-84 — DATE FINISH 9-13-84
CASING ___ HAMMER WT. ___ FALL ___	SAMPLER Split Spoon HAMMER WT 140 lbs FALL 30"
WELL CASING 2" galvanized steel pipe	SCREEN MAKE & TYPE Johnson Watermark well screen LENGTH 5'2" SLOT 10
ELEVATION OF: GROUND SURFACE	WELL CASING — SCREEN — WATER — DATE
REMARKS	

LOG OF BORING

CASING BLOWS/FT.	DEPTH FT.	SAMPLE No.	TYPE	RECOVERY IN.	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
						0-5.5' FILL consisting of gravel and gray-brown topsoil		
		1A 1B	SS	16"	10 10 18 14	orange-brown TILL consisting of silt and fine sand, some gravel, trace cobbles	dry sample	
		2	SS	20.5"	15 38 86 37	orange-brown TILL consisting of silt and clay, little fine sand, little rock fragments, little cobbles	dry sample rock in plug	
		3	SS	19.5"	24 30 34 29	orange-brown TILL consisting of clay and silt, some cobbles, some rock fragments	clay in plug	
		4	SS	21"	24 26 37 43	same	rock in plug	
		5	SS	0"	75/2"		SS pushing boulder	
	10	6	SS	18"	21 46 50/3"	orange-brown TILL consisting of clay and silt, some coarse gravel, little weathered shale rock fragments		
		7	SS	17"	32 61 50/1"	same		
						orange-brown TILL consisting of fine sand and cobbles	lost H_2O at top of fractured shale (14'7")	14'7"
	15	8	SS	5"	31 50/1"	dark gray, fresh SHALE	fresh shale at 15'9"	15'9"
						15'9" to 16'6" sample of drill cuttings		
17'7"		ROCK CORE					lost water again at 17'7" when rock coring started	
20'1"	20					TBB terminated at 20'1" BGL		

FRED C. HART ASSOCIATES, INC.

LOG OF BORING TB5 SHEET 1 OF ____

JOB	GENERAL SWITCH
PROJECT NO.	A037A
LOCATION	MIDDLETOWN NY
DRILLING AGENCY	KENDRICKS DRILLING
DRILLING EQUIPMENT	ROCK CORE BARREL / ROTARY RIG
INSPECTOR	TRUETTNER

ROCK CORE DEPTH	DESCRIPTION	DEPTH, FEET	SAMPLE	REMARKS (DRILLING FLUID, DEPTH OF CASING, FLUID LOSS, ETC)	CASING BLOWS
0–2	GRAY SHALE				
2–3	SILTSTONE				
3–7	GRAY SHALE				
8	GRAY SILTSTONE				
10	GRAY SHALE				
12	GRAY SILTSTONE				
14–16	GRAY SHALE				
18	GRAY SILTSTONE				
19.5	GRAY SHALE				
20–22	GRAY SILTSTONE				
22–26	GRAY SHALE				

FRED C. HART ASSOCIATES, INC.

LOG OF BORING TB3 SHEET 2 OF 2

ROCK CORE DEPTH	DESCRIPTION	DEPTH, FEET	SAMPLE	REMARKS (DRILLING FLUID, DEPTH OF CASING, FLUID LOSS, ETC)	CASING BLOWS
	GRAY SHALE				
	GRAY SILTSTONE				
	GRAY SHALE				
30	GRAY SILTSTONE				
32	GRAY SHALE				
34	GRAY SILTSTONE				
	GRAY SHALE				
36	ROCK CORE TERMINATED AT 3'				

FRED C. HART ASSOCIATES, INC.

LOG OF BORING TB-6 SHEET 1 OF 1

[illegible]

PROJECT NO. A[illegible]

LOCATION: MIDDLETOWN NY

DRILLING AGENCY: KENDRICKS DRILLING

DRILLING EQUIPMENT: ROCK CORE BARREL / ROTARY RIG

INSPECTOR: TRUETTNER

ROCK CORE	DESCRIPTION	DEPTH, FEET	SAMPLE	REMARKS (DRILLING FLUID, DEPTH OF CASING, FLUID LOSS, ETC)	CASING BLOWS
	GRAY SHALE				
2					
4	GRAY SILTSTONE				
6					
8	CORE TERMINATED AT 8"				

FRED C. HART ASSOCIATES, INC.

LOG OF BORING TB-1 SHEET 1 OF 2

General Switch	A037A
MIDDLETOWN NEW YORK	
KENDRICKS DRILLING	
ROCK CORING BARREL / ROTARY RIG.	
	INSPECTOR: TRUETTNER

ROCK CORE	DESCRIPTION	DEPTH, FEET	SAMPLE	REMARKS (DRILLING FLUID, DEPTH OF CASING, FLUID LOSS, ETC)	CASING BLOWS
2					
4					
6					
8	GRAY SHALE				
10					
12					
14					
	SILTSTONE				
16					
18	GRAY SHALE				
20					
22	SILTSTONE				
24					
26					

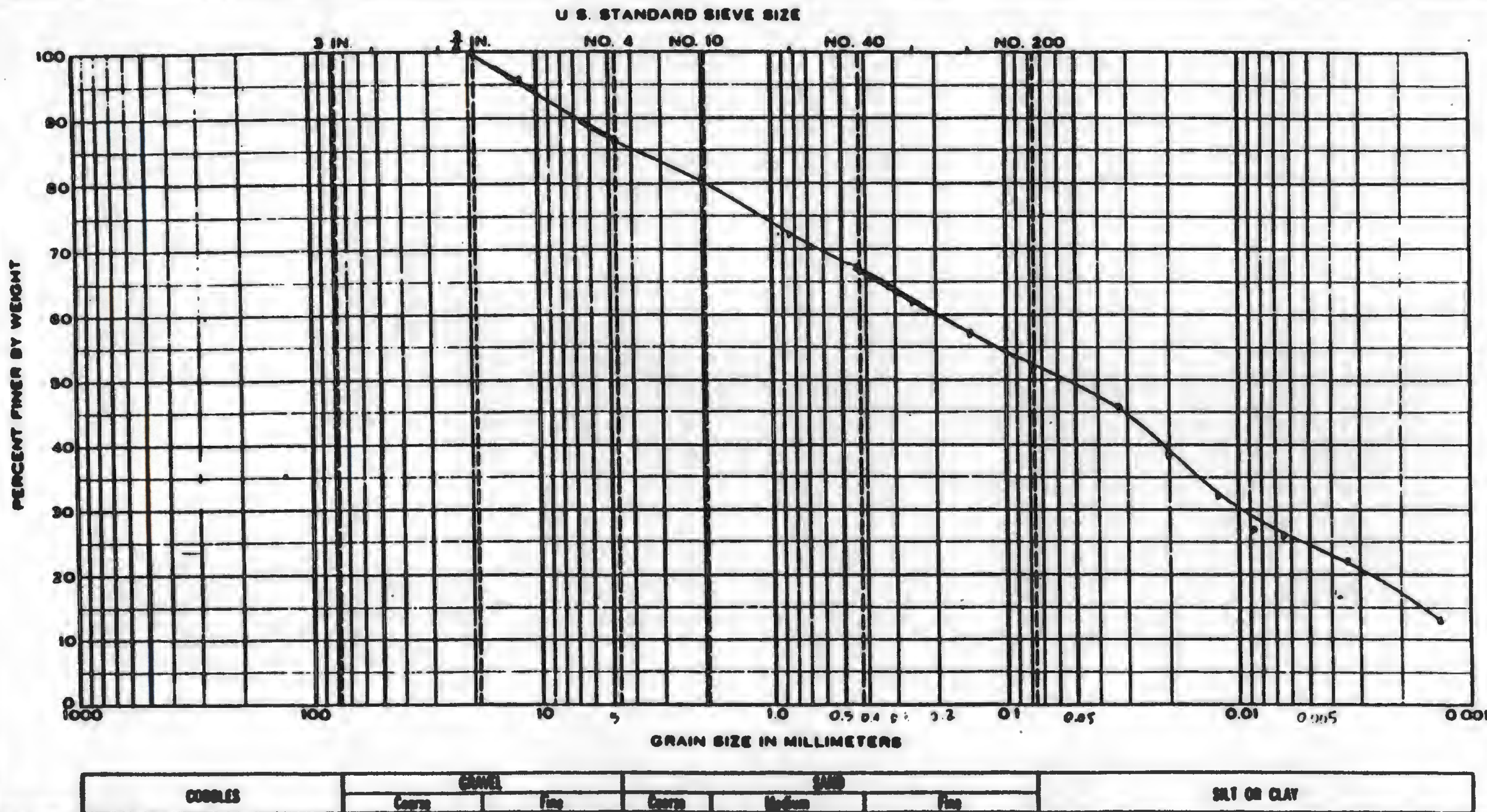
FRED C. HART ASSOCIATES, INC.

LOG OF BORING TB-1 SHEET 2 OF 2

ROCK CORE			DESCRIPTION	DEPTH, FEET	SAMPLE				REMARKS (DRILLING FLUID, DEPTH OF CASING, FLUID LOSS, ETC)	CASING BLOWS
			GRAY SHALE							
			SILTSTONE							
32			GRAY SHALE							
34										
36			SILTSTONE							
			GRAY SHALE							
42										
44										
46			SILTSTONE							
48			GRAY SHALE							
50										
			SILTSTONE							
			GRAY SHALE							
60										
62										

APPENDIX C

GRAIN SIZE DISTRIBUTION CURVES
AND
PERMEABILITY DATA

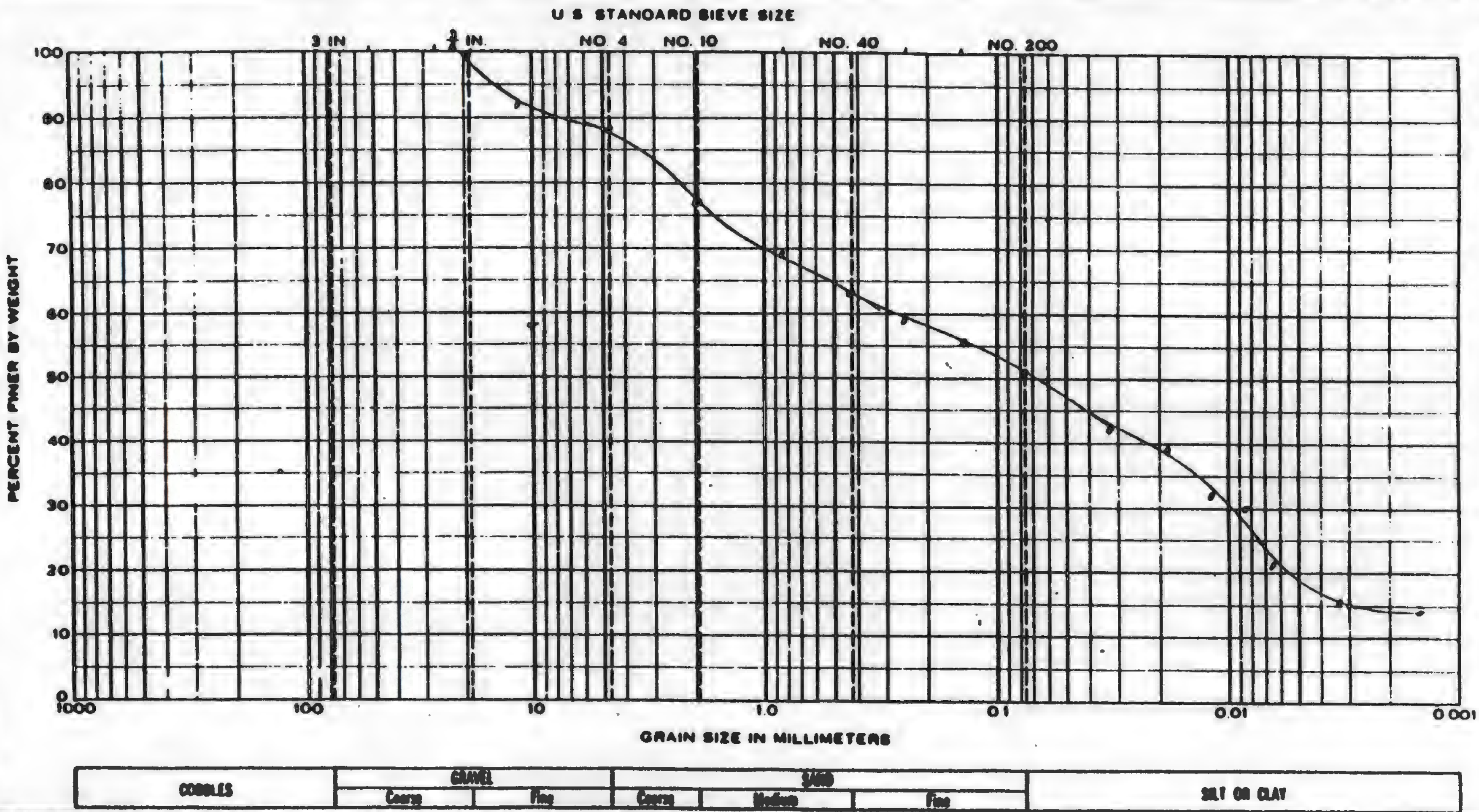


Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
TB-8 S-2	2-4						

Project Gen. Switch

Date 20 Sept 84 JOB No. 84B065-01

GRADATION CURVES

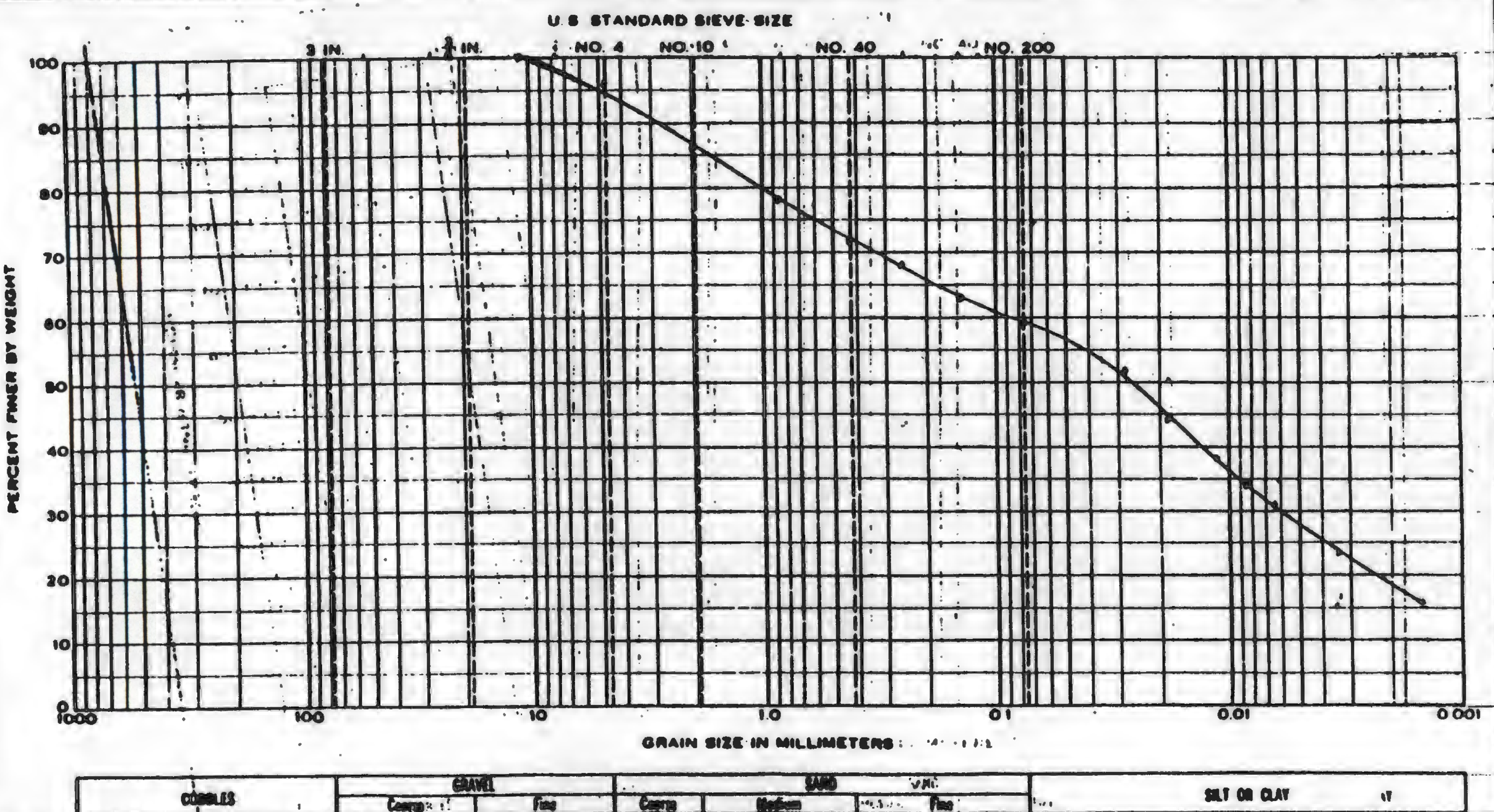


Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
TB-P S-3	4-6						

Project Gen Switch

GRADATION CURVES

Date 20 Sept 74 JOB No. 3460601

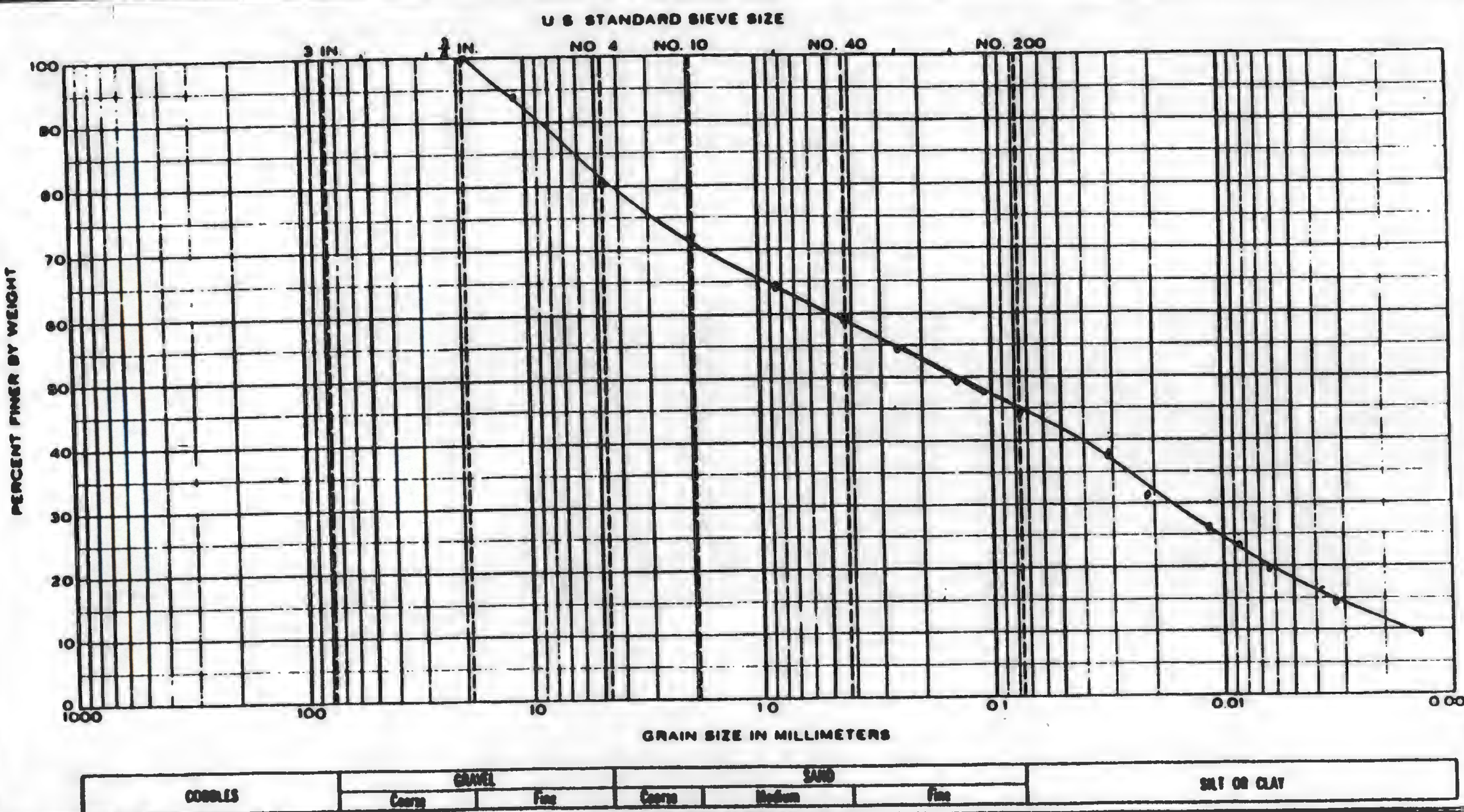


Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
TB-1 S-4	6-8						

Project Gen. Switch

GRADATION CURVES

Date 9/21/84 JOB No. 848065-01

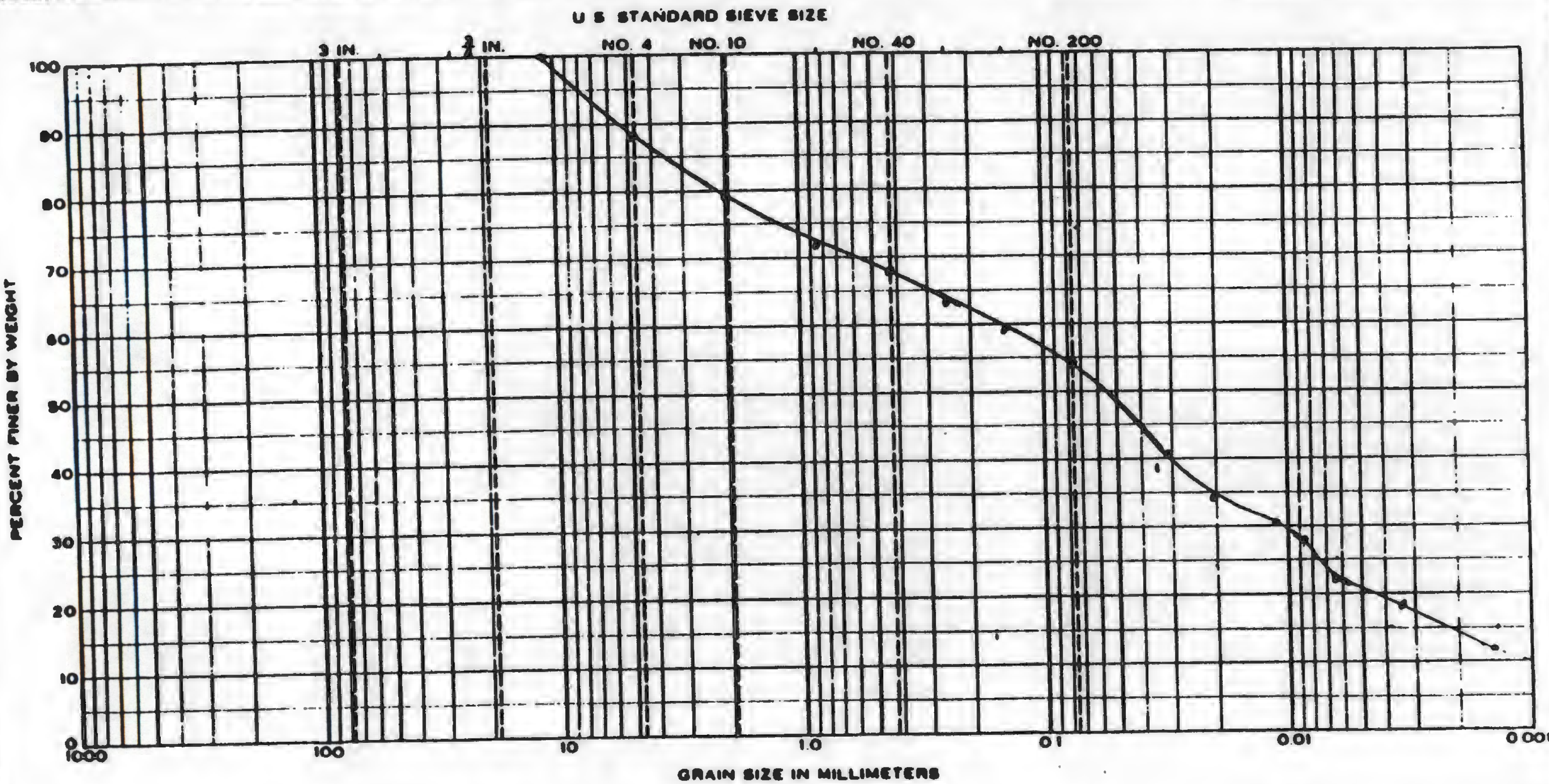


Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
TB-8 5-6	10-12					

GRADATION CURVES

Project General Switch

Date 9-22-84 JOB No. 84B065-01



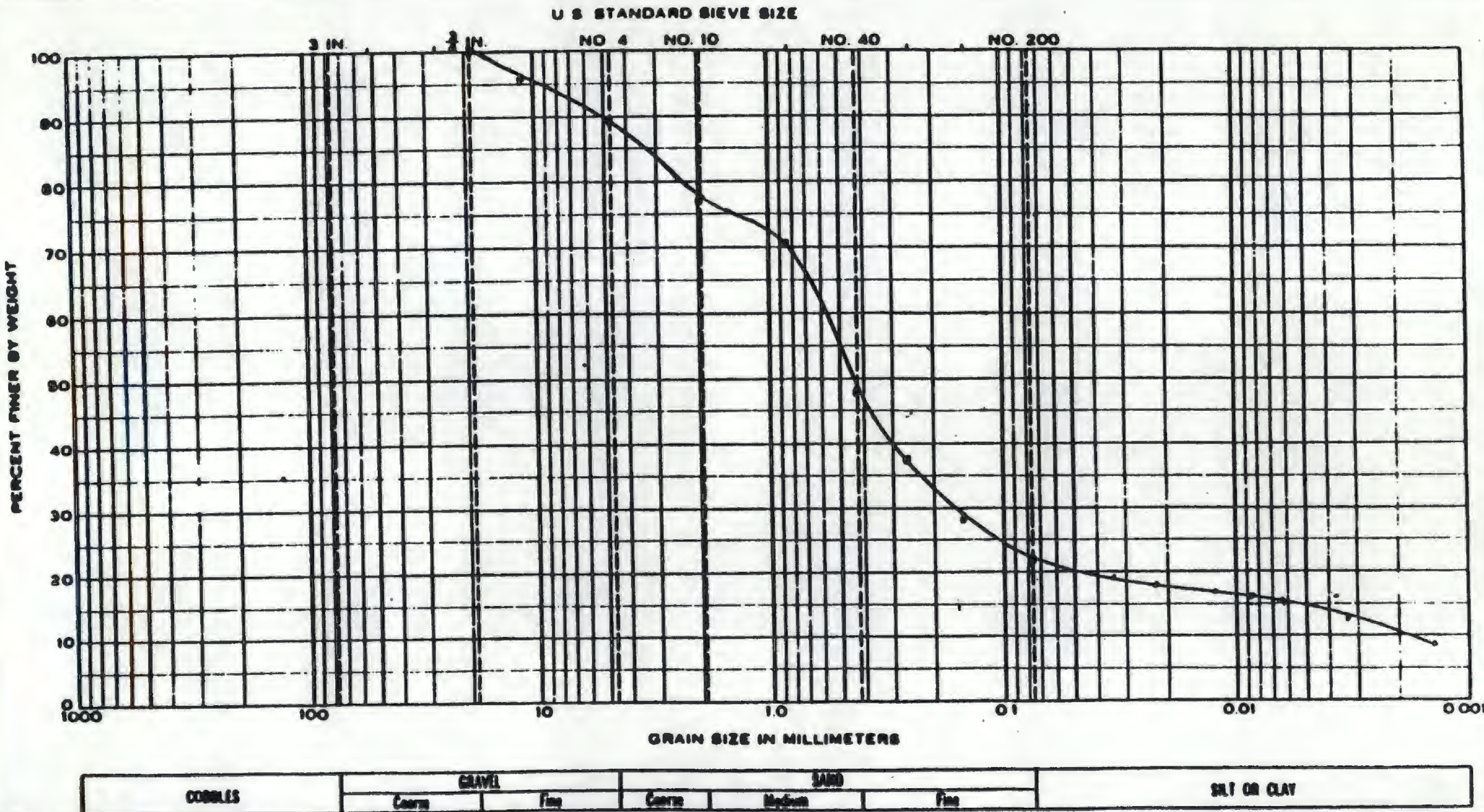
COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
TB-8 S-7	12-14						

Project General Switch

Date 9-22-84 JOB No. 846065-01

GRADATION CURVES

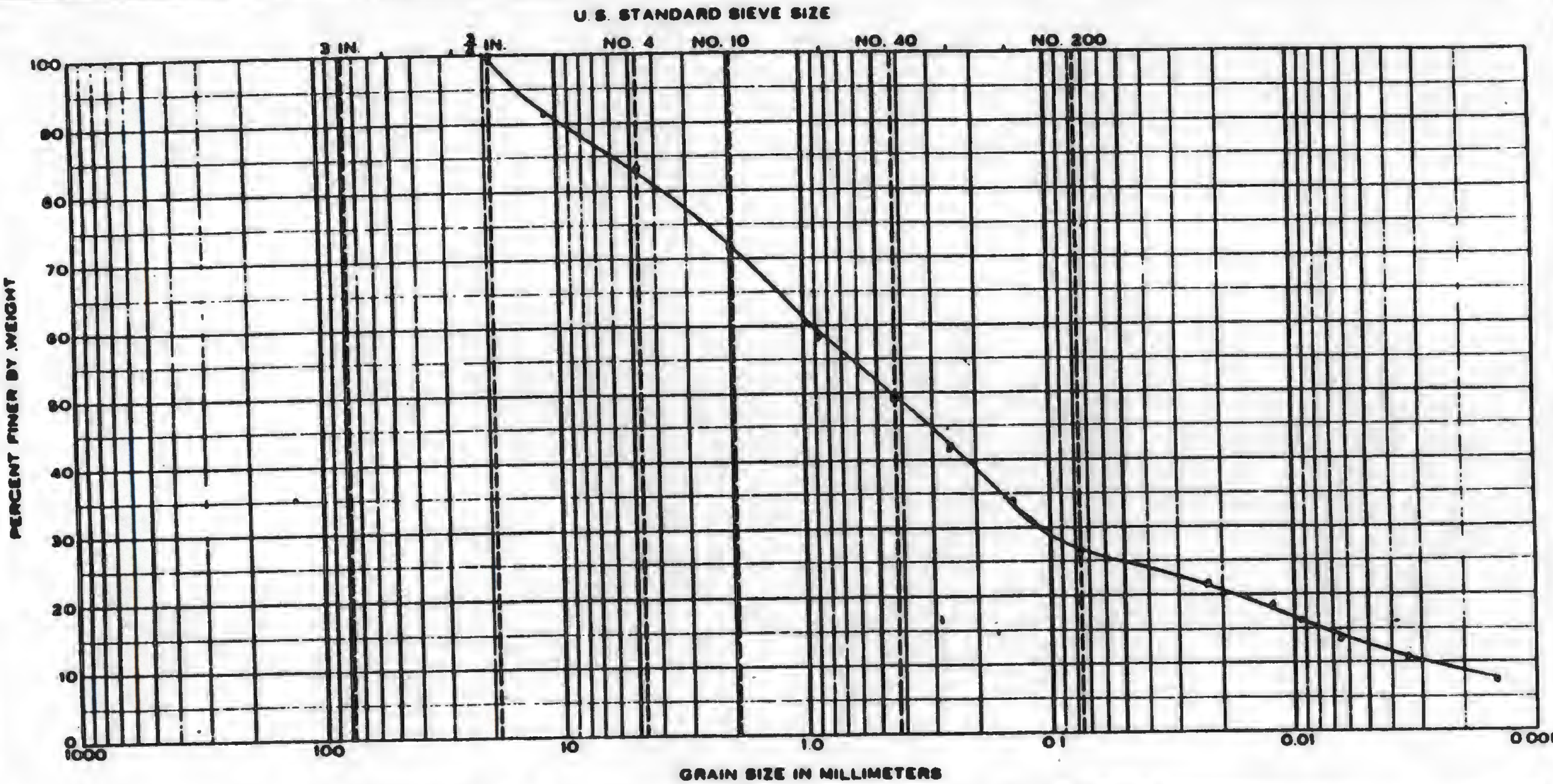


Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	
TB-2 S-1	0-2						

Project General/Switch

Date 9-22-89 JOB No. 84B065-01

GRADATION CURVES



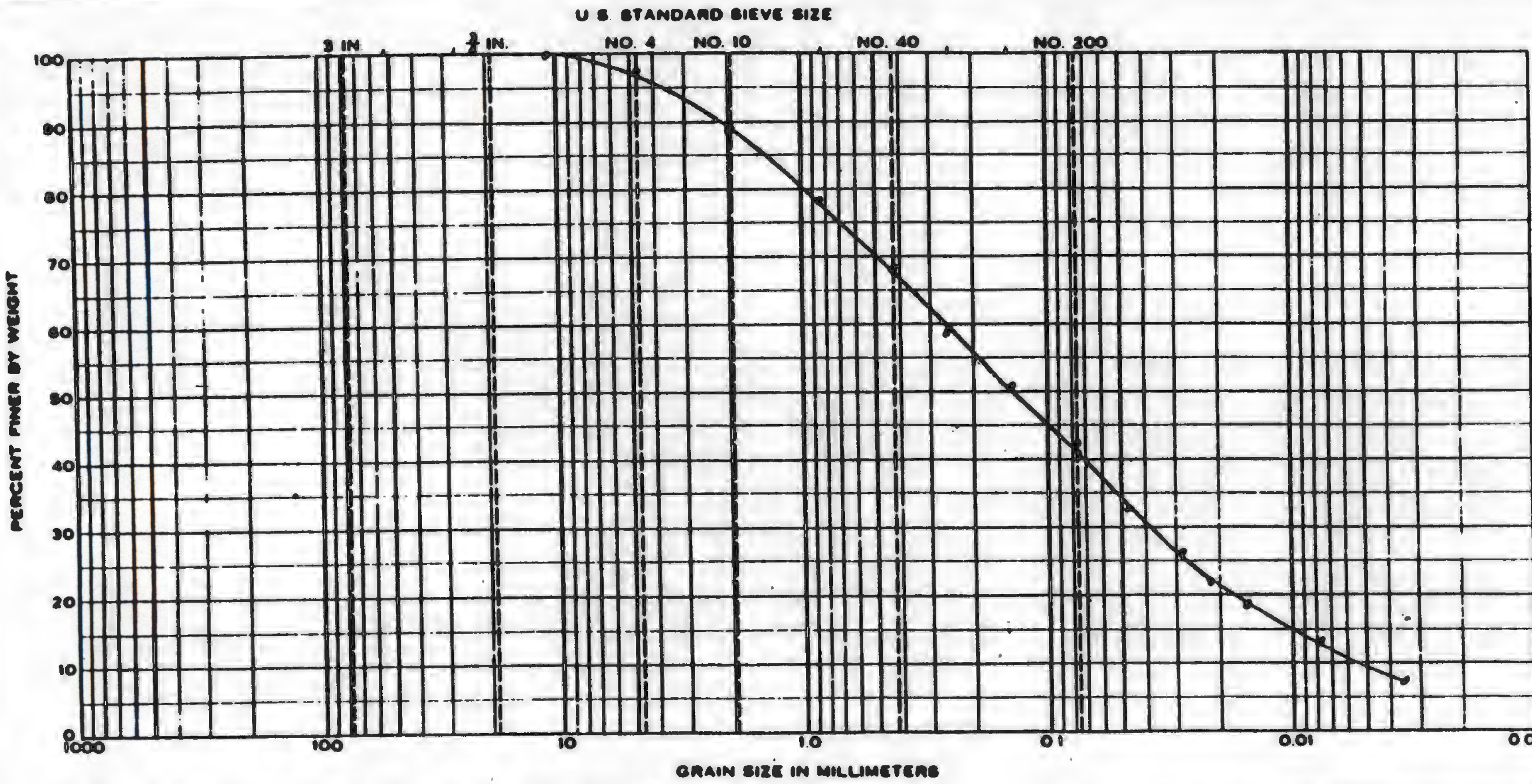
COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	
TB-2 S-4	4-6						

Project Gen. Switch

Date 9/21/84 JOB No. 848065-01

GRADATION CURVES



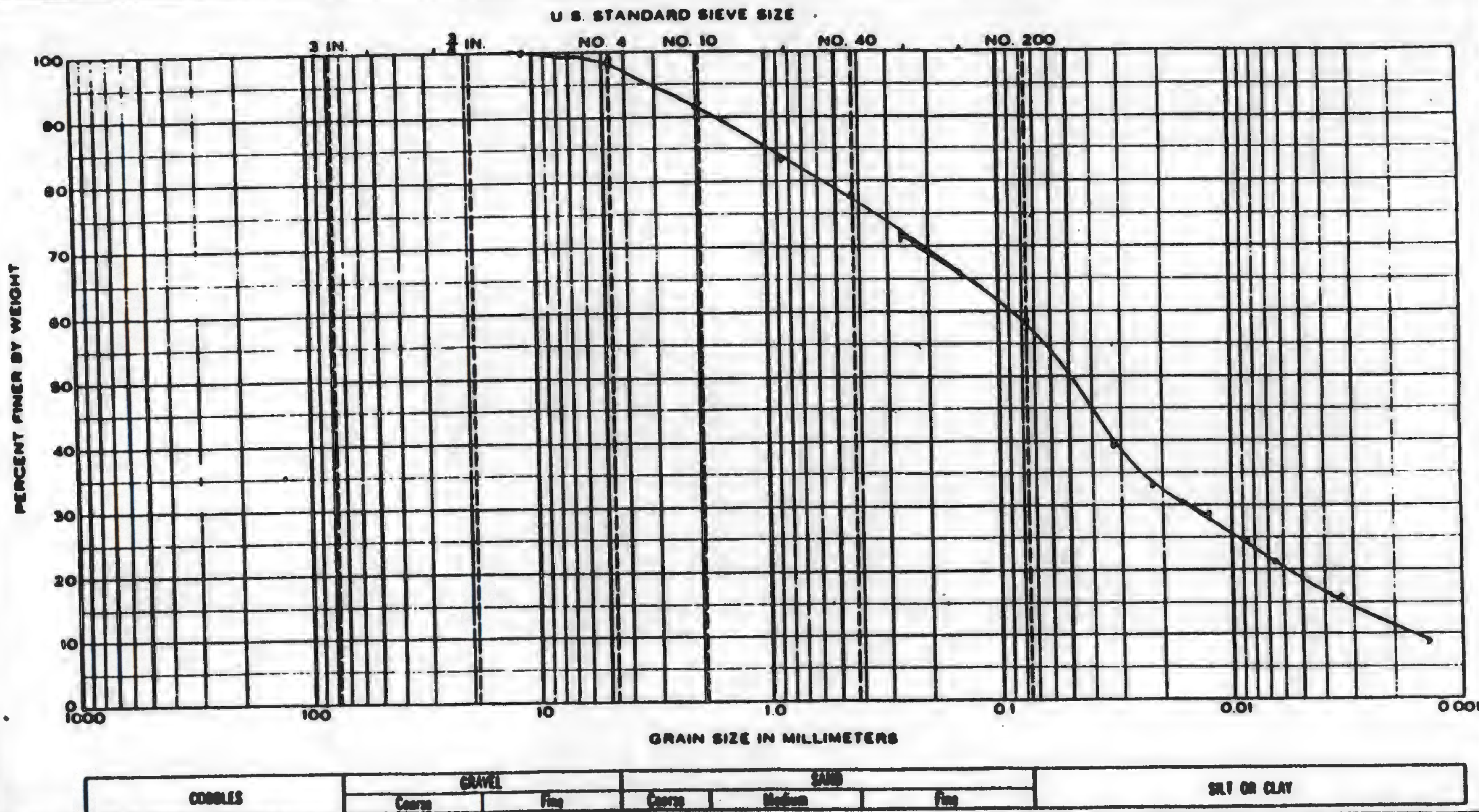
COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
TB-2 S-5	6-8						

Project Gen. Switch

GRADATION CURVES

Date 20 Sept 84 JOB No. 84B065-01

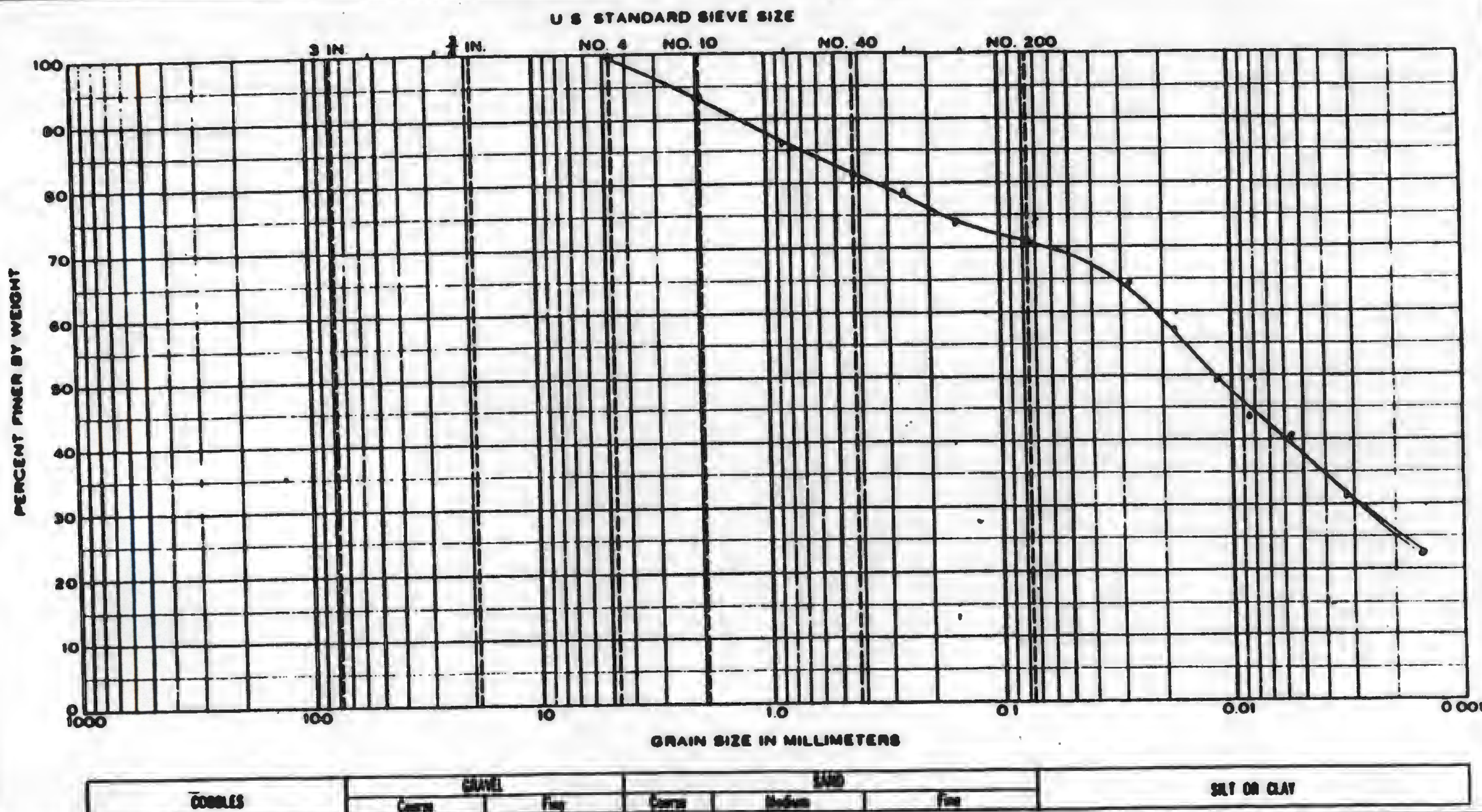


Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	
TB-2 S-7	10-12						

Project Gen. Switch

GRADATION CURVES

Date 9/21/84 JOB No. 84 B065-01

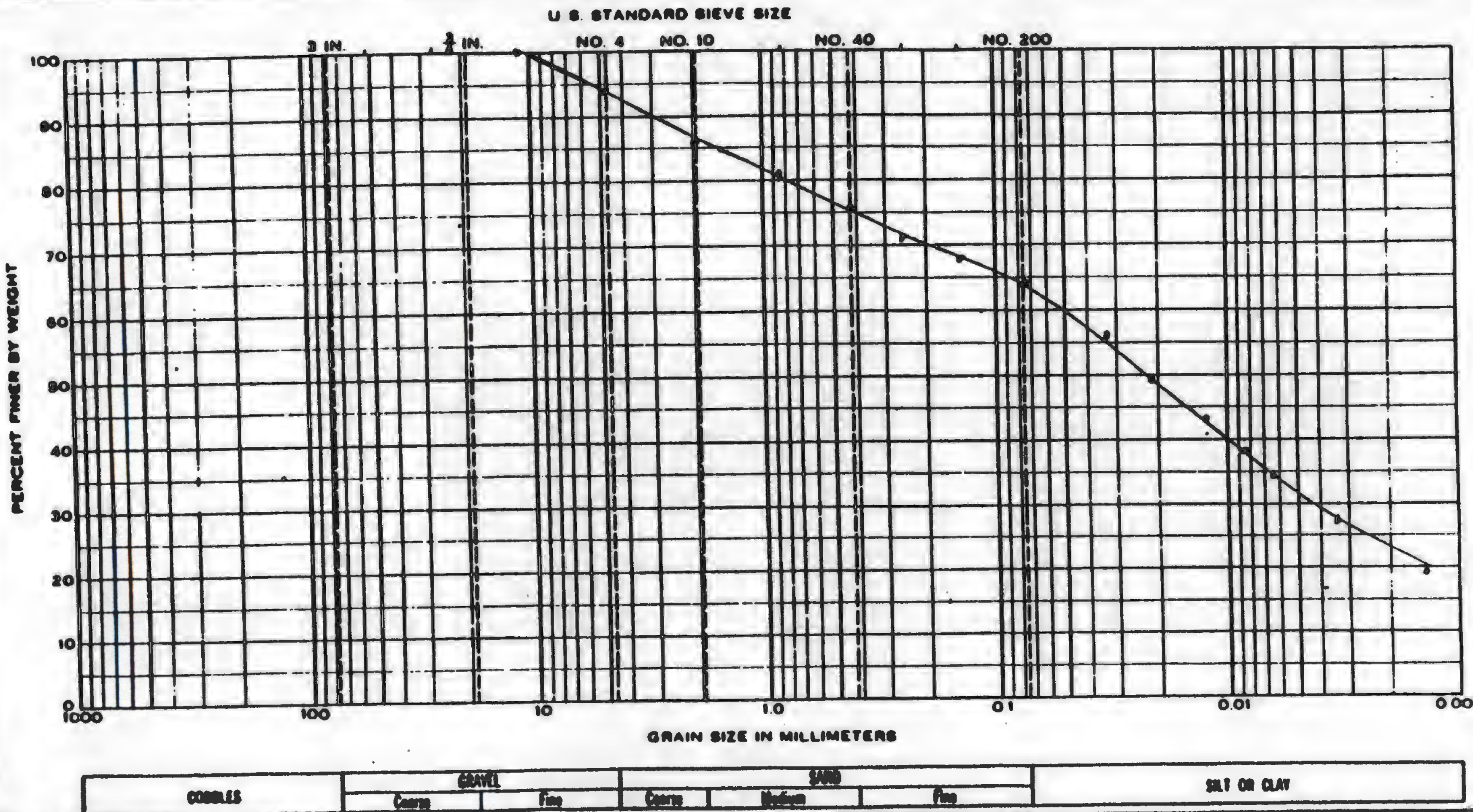


Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
TB-2 S-8	13-15						

Project Gen Switch

GRADATION CURVES

Date 9/21/89 JOB No. 848065-31

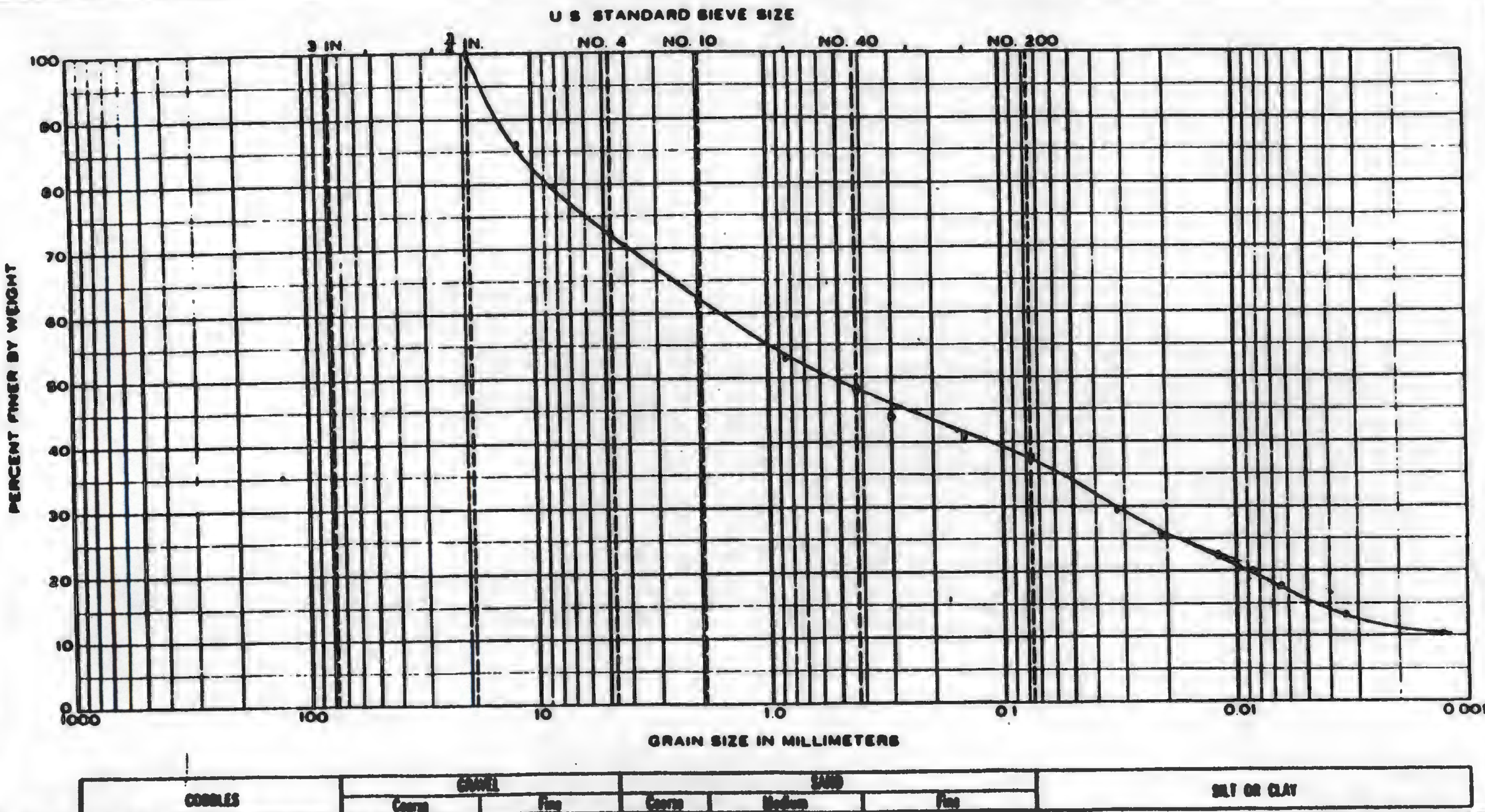


Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
TB-2 S-9	15-17						

Project Gen. Switch

GRADATION CURVES

Date 9-21-84 JOB No. 84B065-01

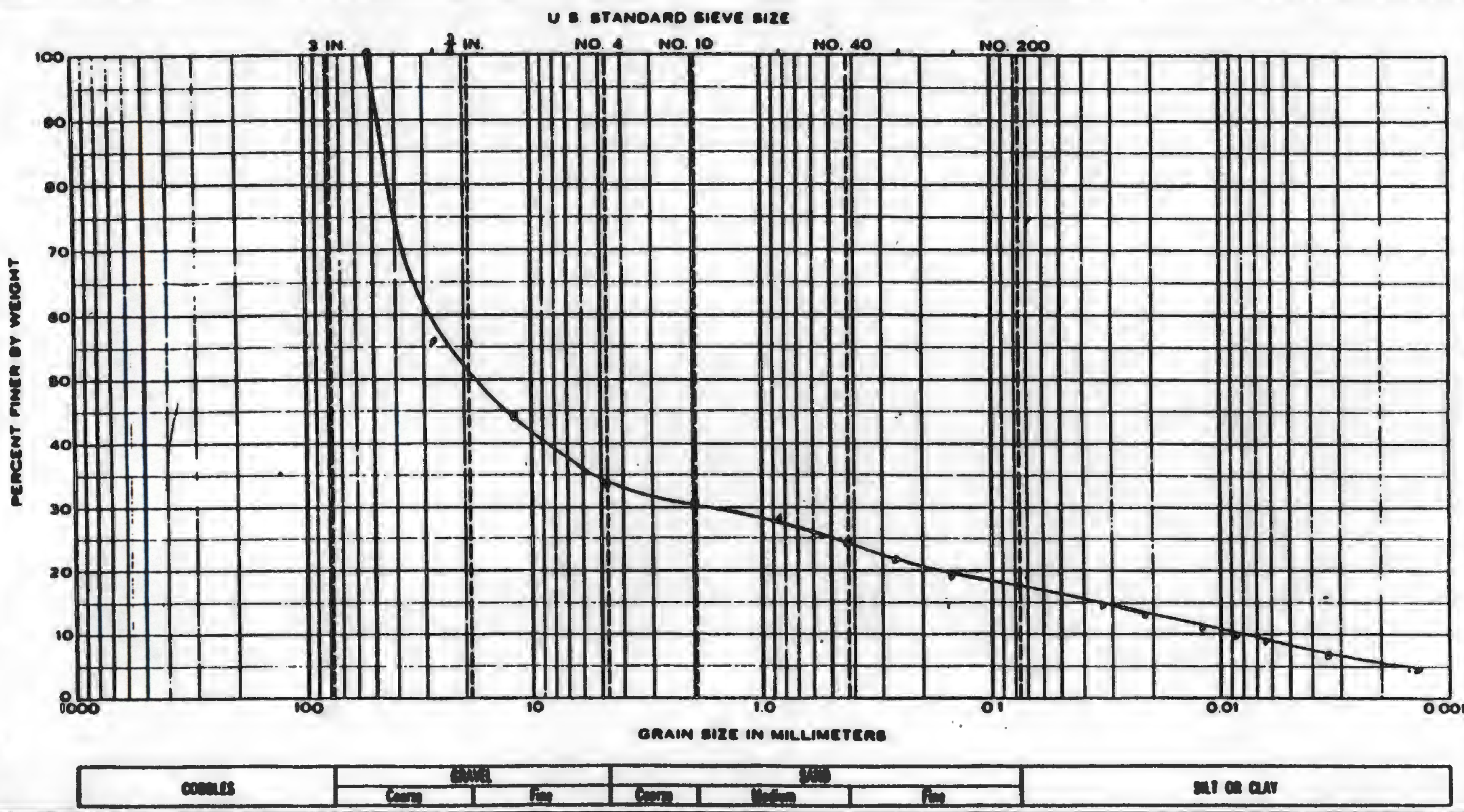


Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
TB-2 S-10	17-15					

Project General Switch

Date 9-22-84 JOB No. 84B065-01

GRADATION CURVES

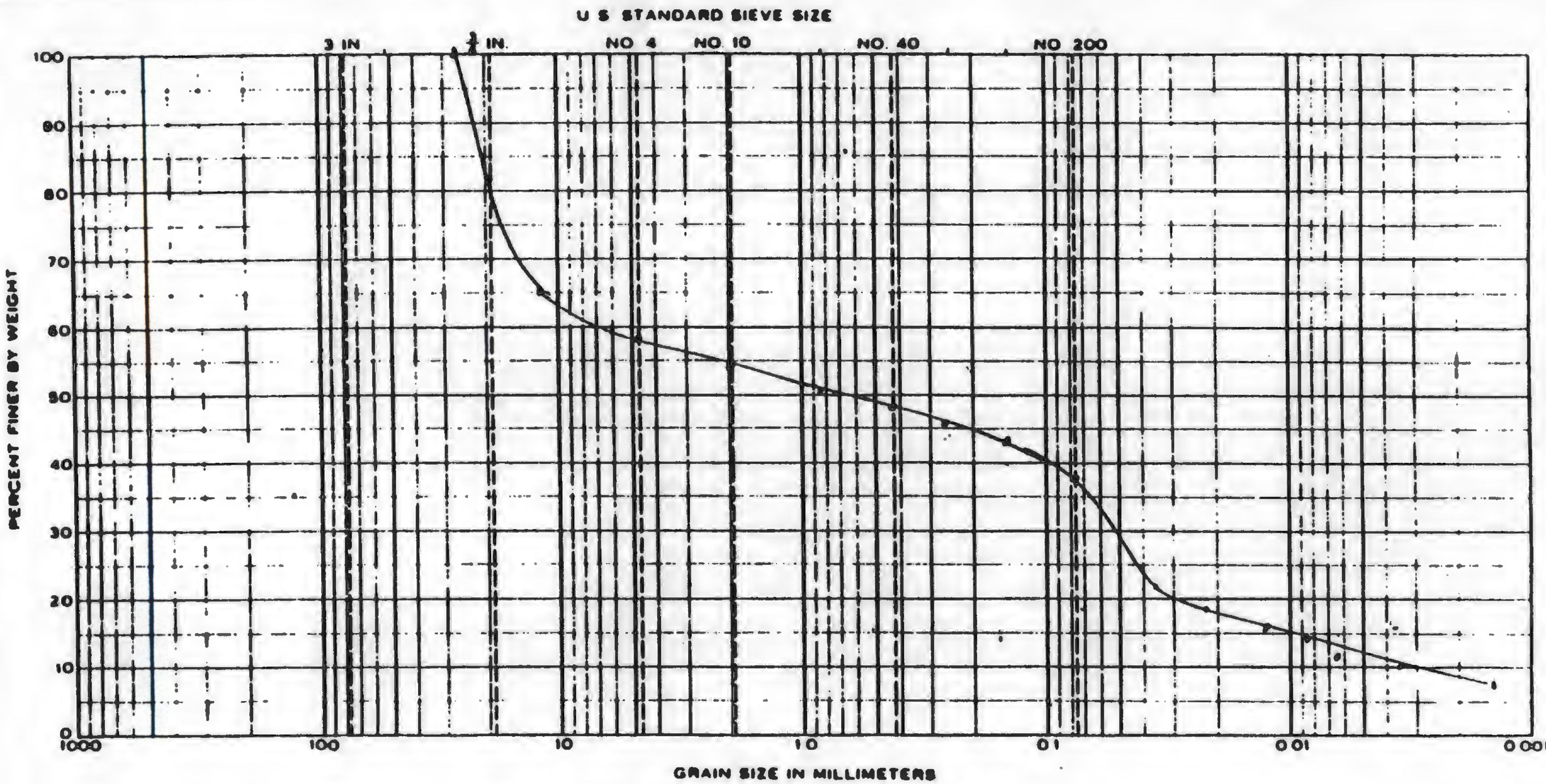


Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	
TB-2 S-11	19-21						

Project General/Switch

GRADATION CURVES

Date 9-22-88 JOB No. 88-B065-01



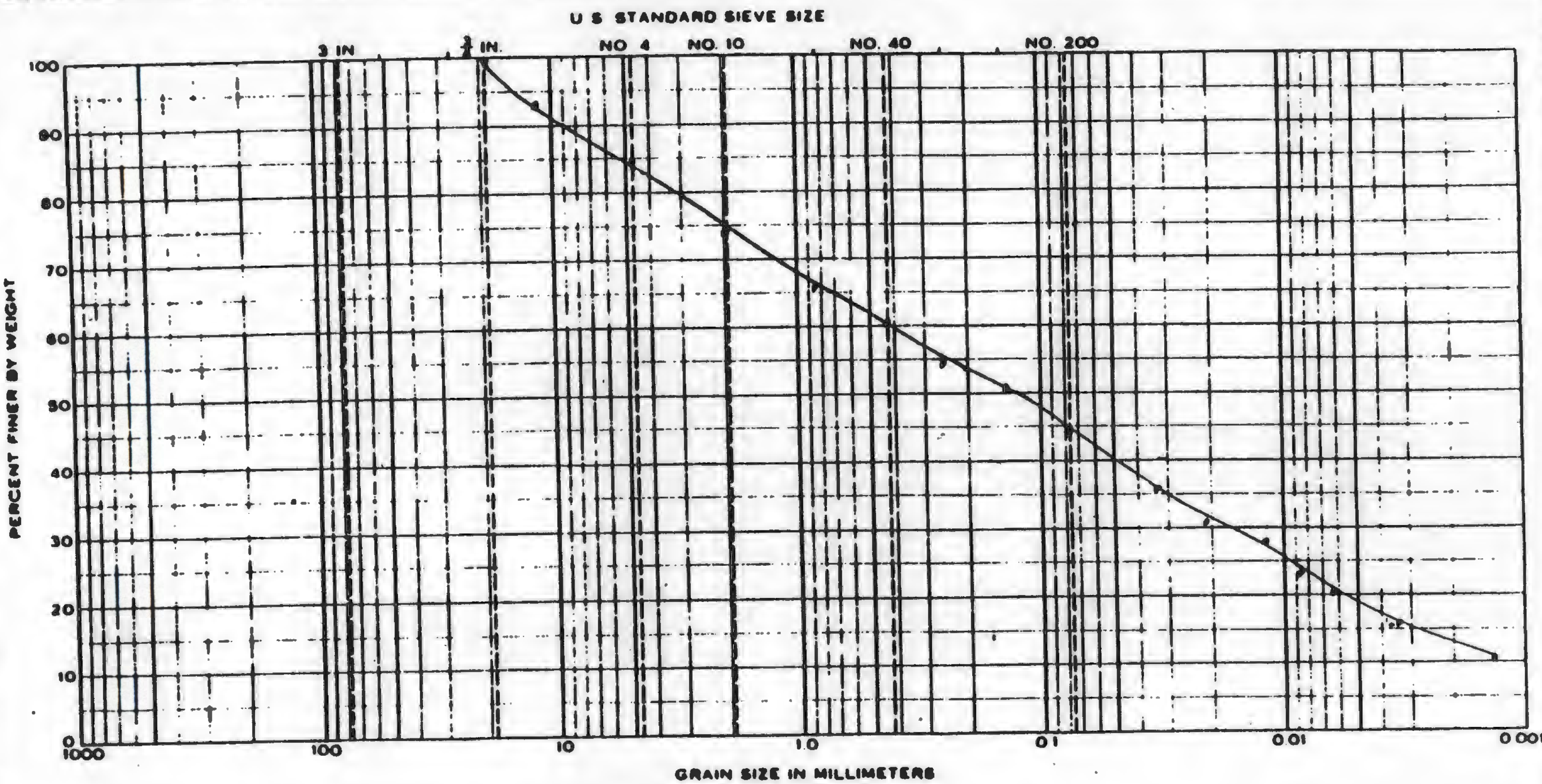
COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
1B-2 S-12	GSA						

Project General Servi[illegible]

GRADATION CURVES

Date [illegible] JOB No. 84E 5[illegible]



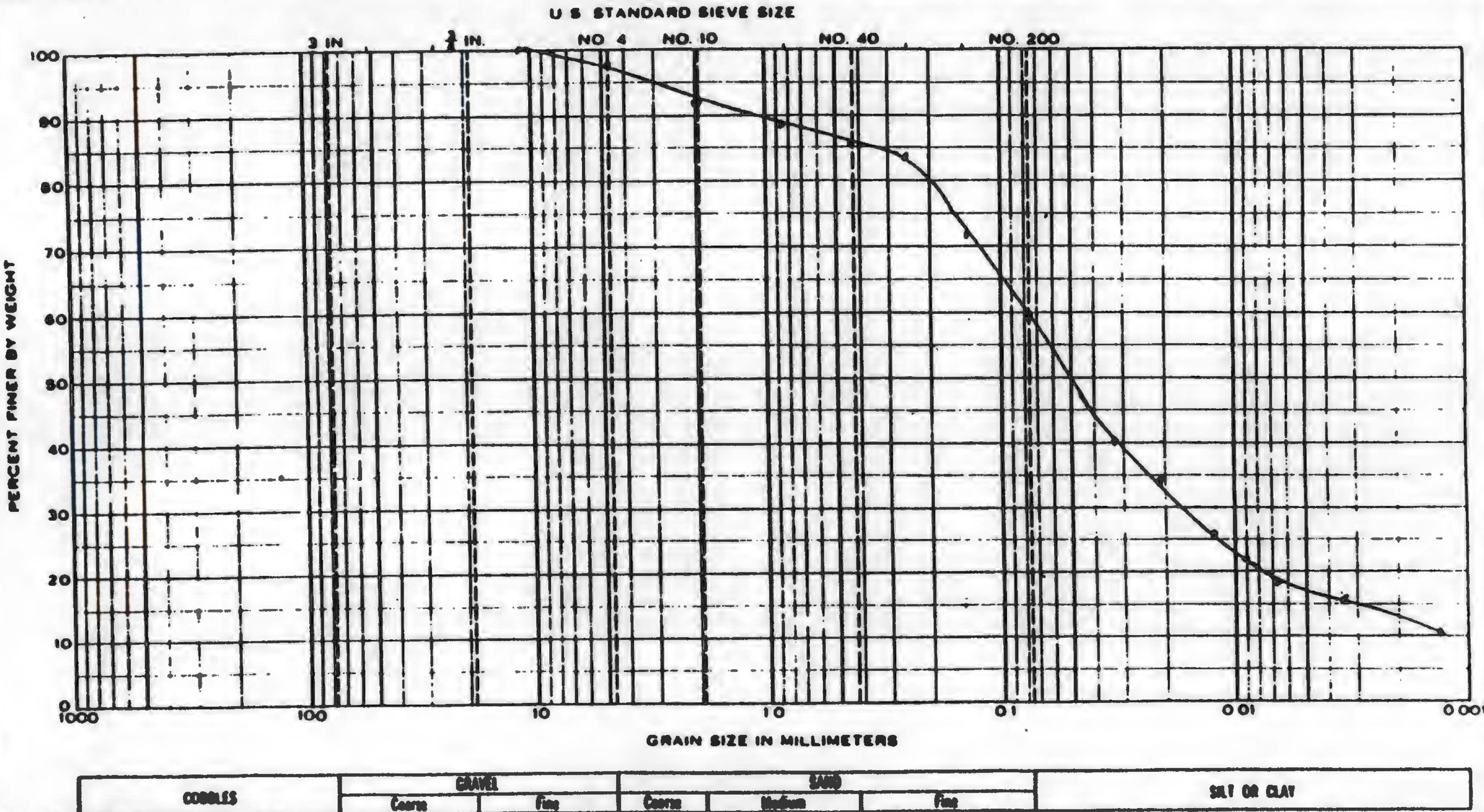
COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
TB-2 S13	GSA						

Project Gener[illegible]

Date 9-22-8[illegible] JOB No. 8[illegible]

GRADATION CURVES

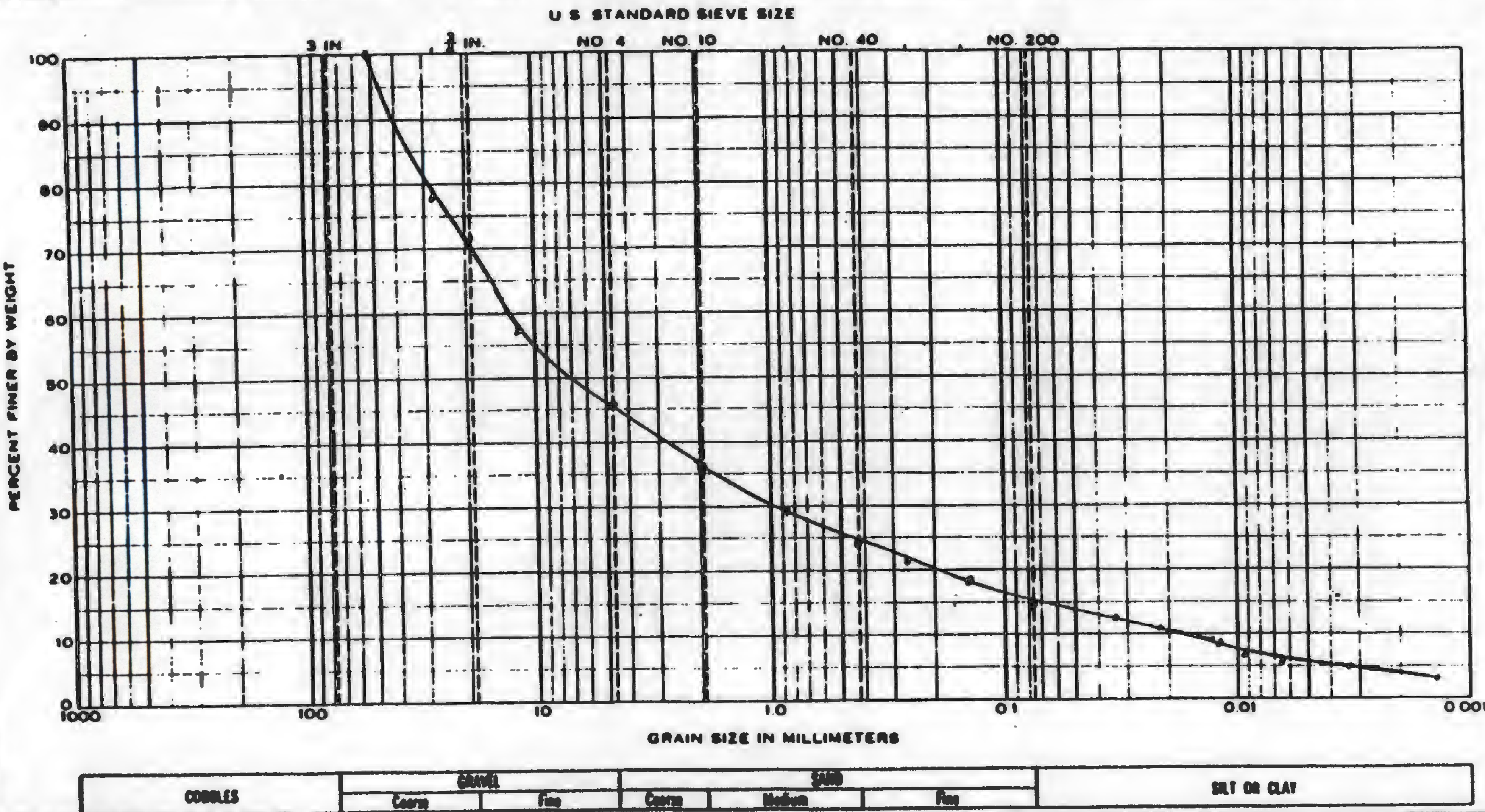


Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI
TB2 S-14	30-32					

Project General Switch

GRADATION CURVES

Date 9-22-87 JOB No. 848065-01



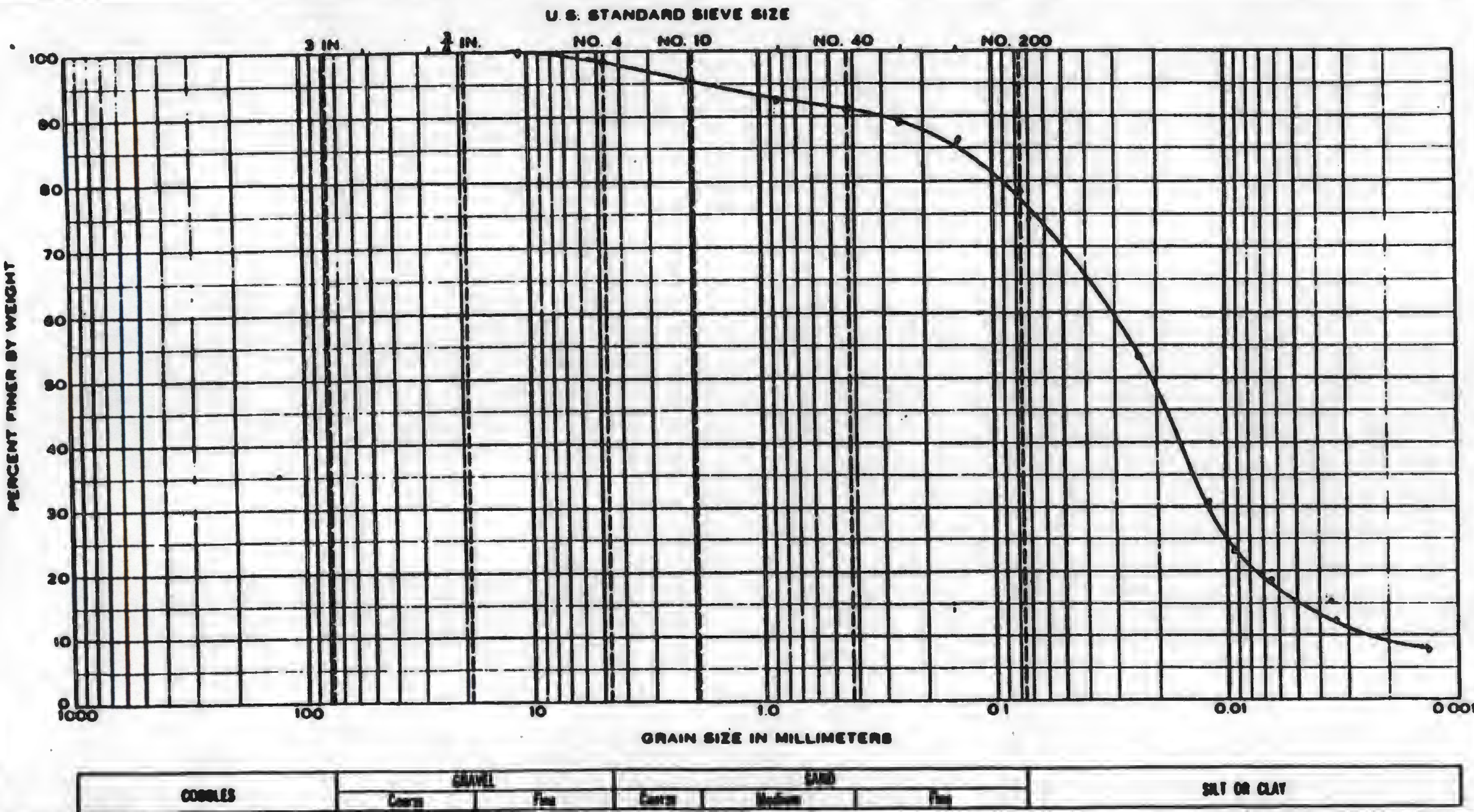
Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
TPS 5-D	2.5						

Project [illegible]

Date 9-22-84 JOB No. 846065-01

GRADATION CURVES

TEST PIT 5 - D

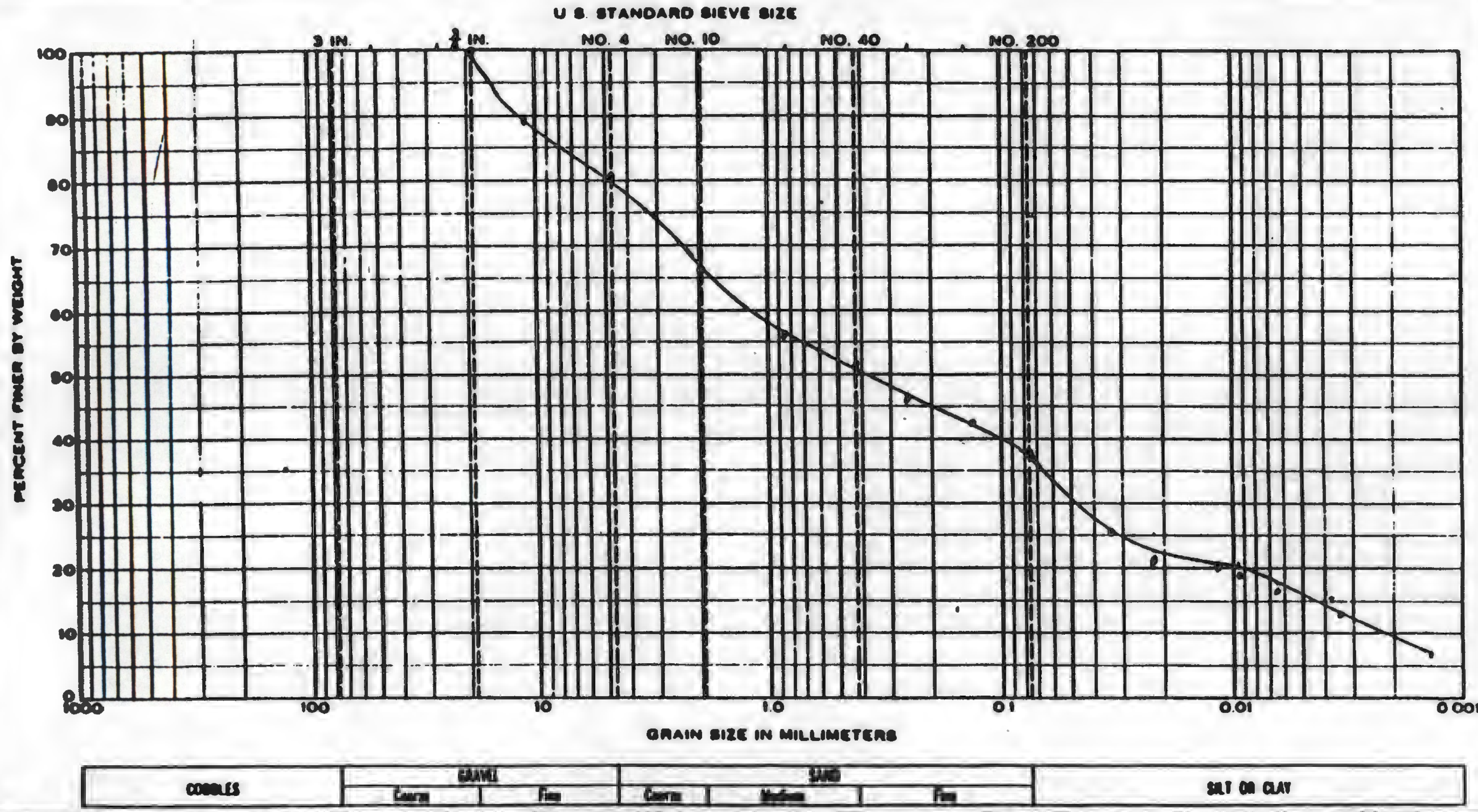


Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	
TBG S-2	GSA						

Project General Switch

GRADATION CURVES

Date 9-22-84 JOB No. 84B065-01

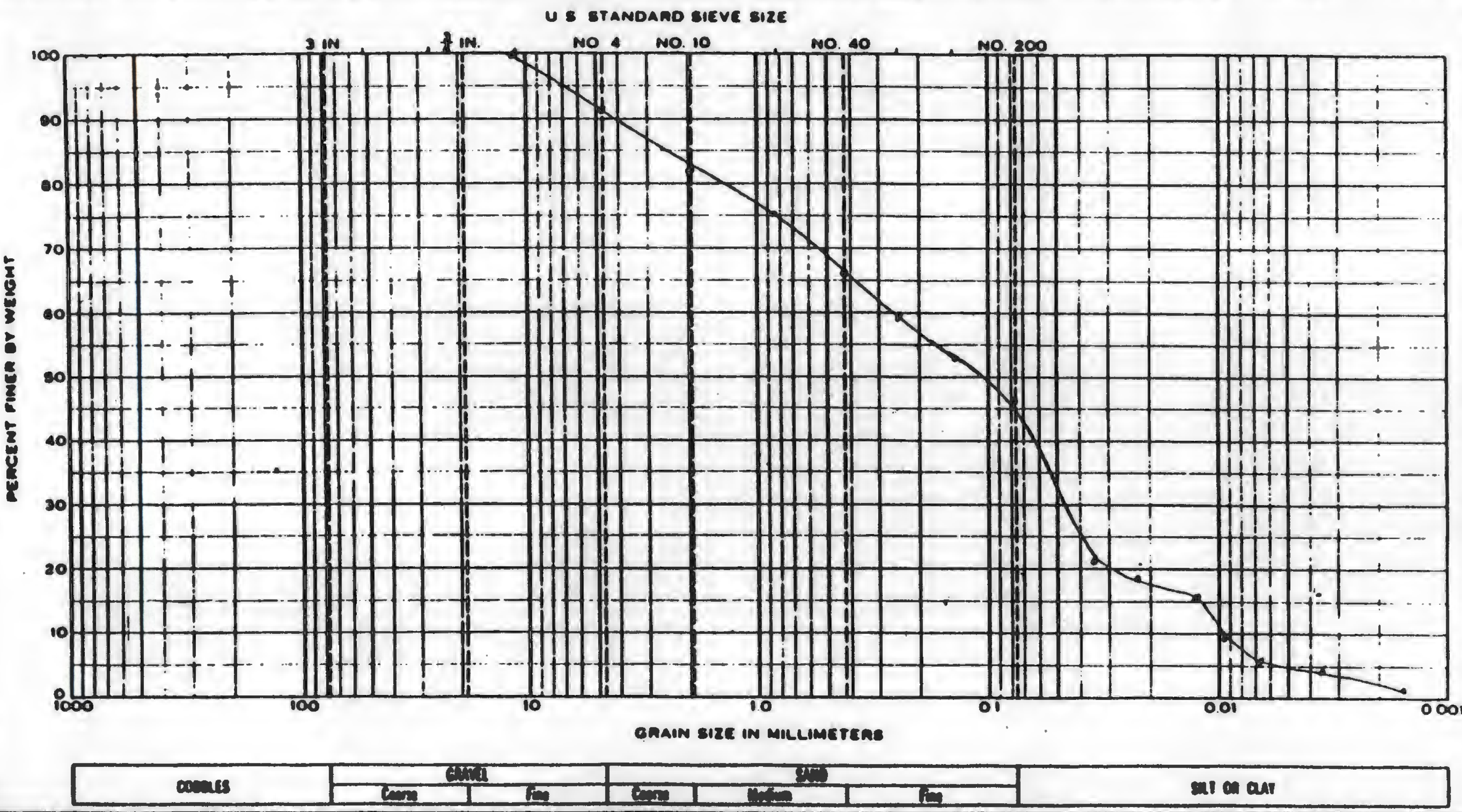


Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
TB-7 S-2	14-16						

Project Gen. Switch

Date 20 Sept 84 JOB No. 848065-01

GRADATION CURVES

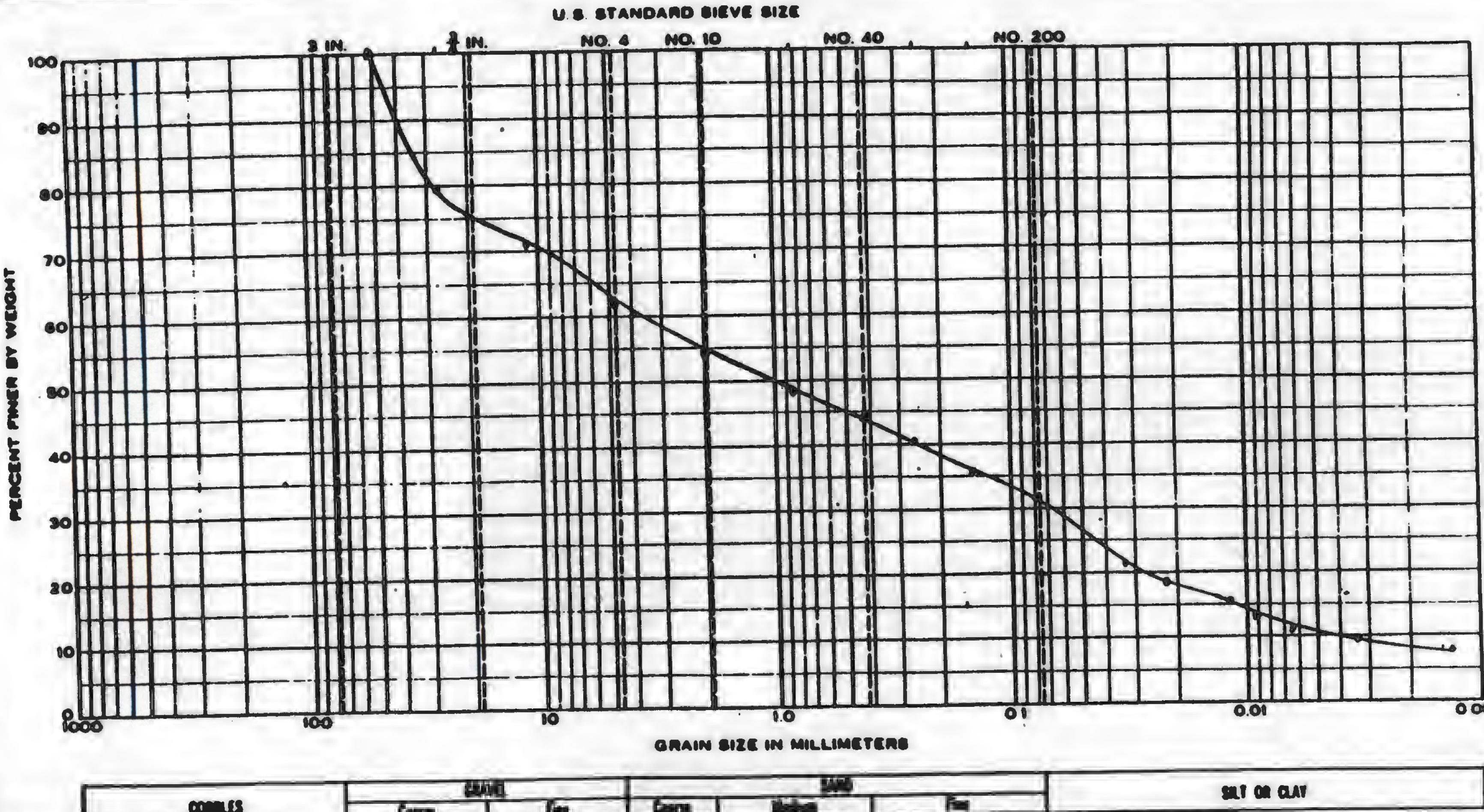


Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
TB-5 S-1	0-2						

Project [illegible]

Date 7-22-7[illegible] JOB No. 84[illegible]

GRADATION CURVES

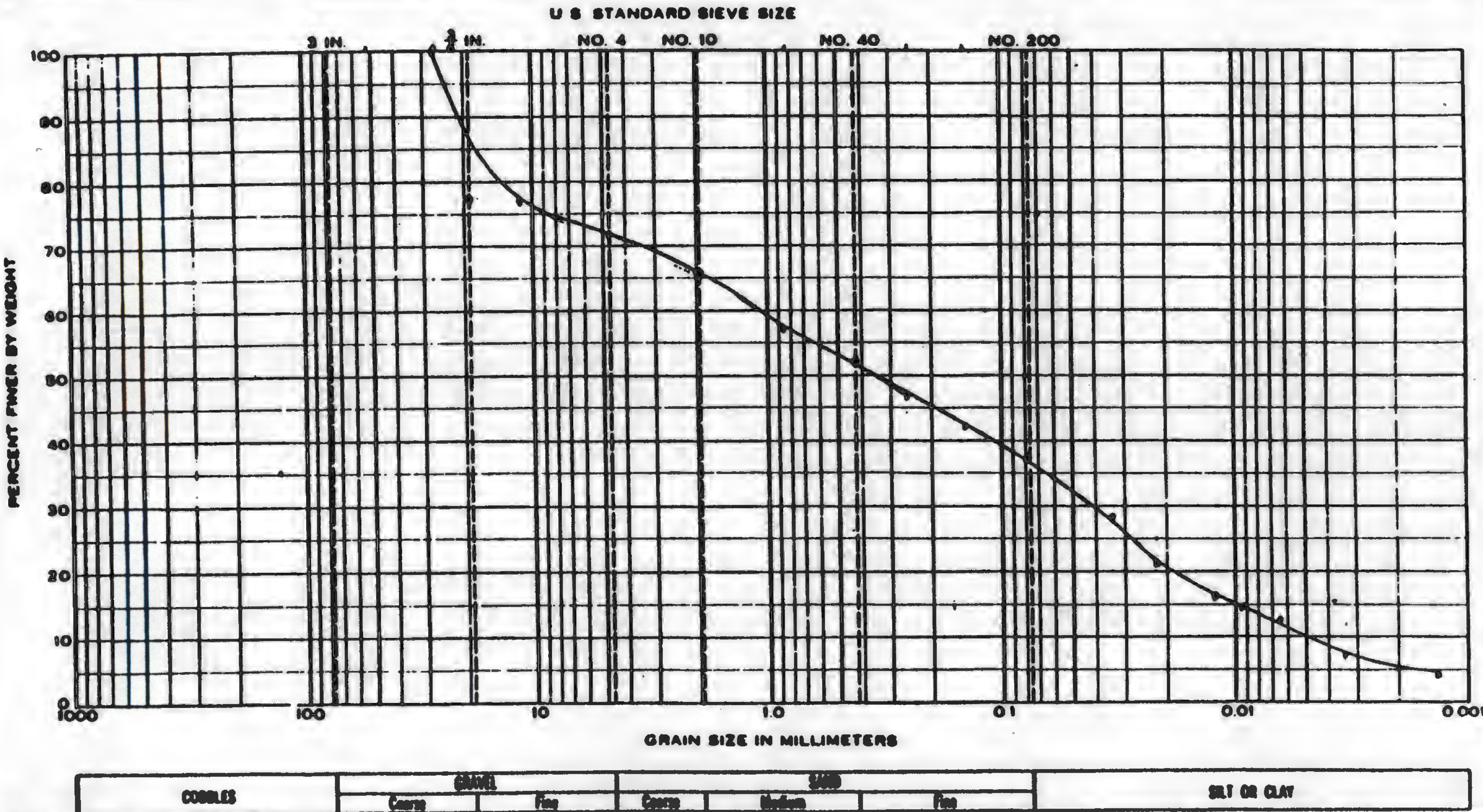


Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
18-5-52	0-2						

Project General Switch

Date 9-22-89   JOB No. 848065-01

GRADATION CURVES

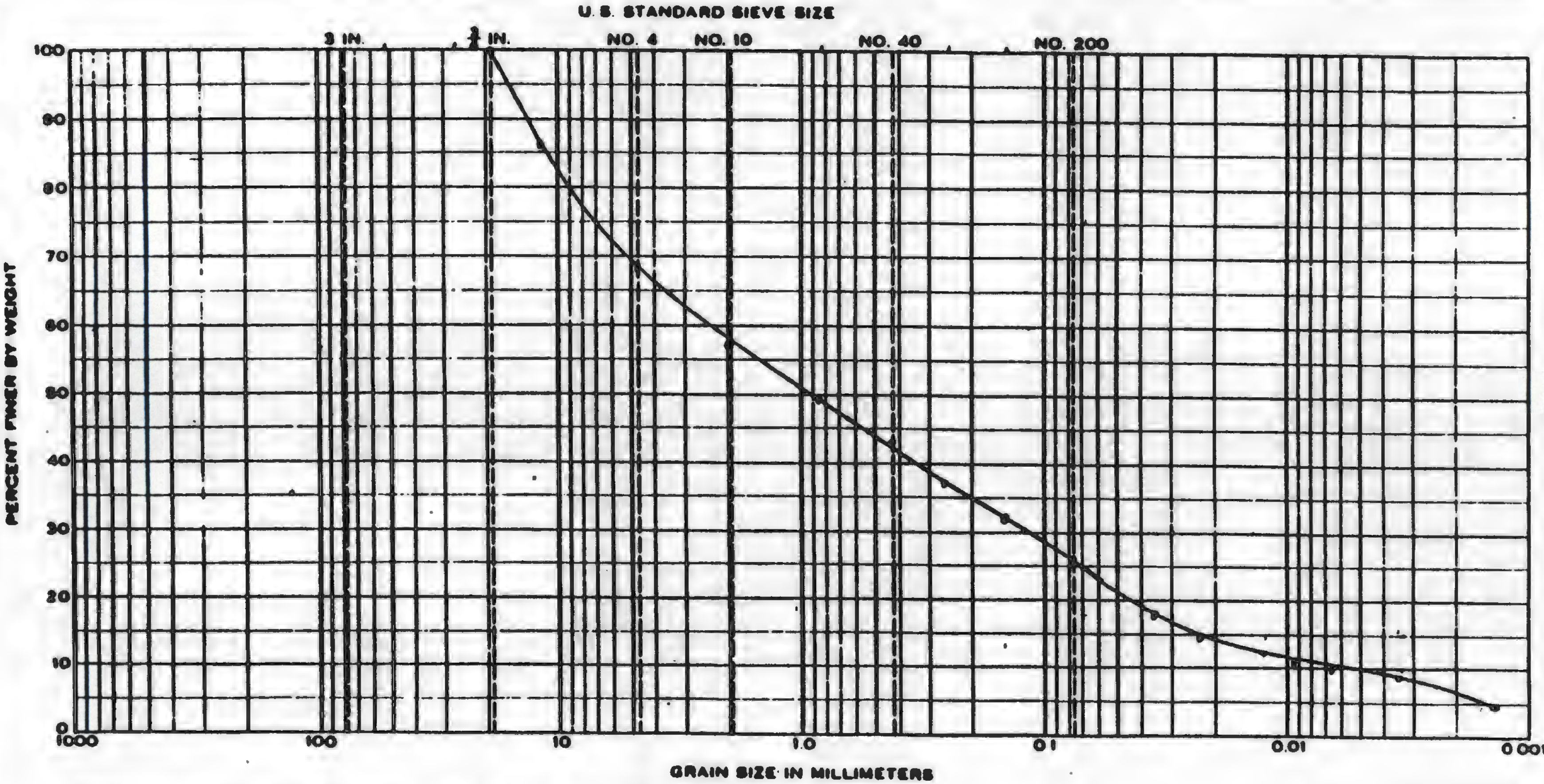


Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
TB-5 S-3	2-4						

Project Gen. Switch

GRADATION CURVES

Date 9/21/84 JOB No. 84B065-01



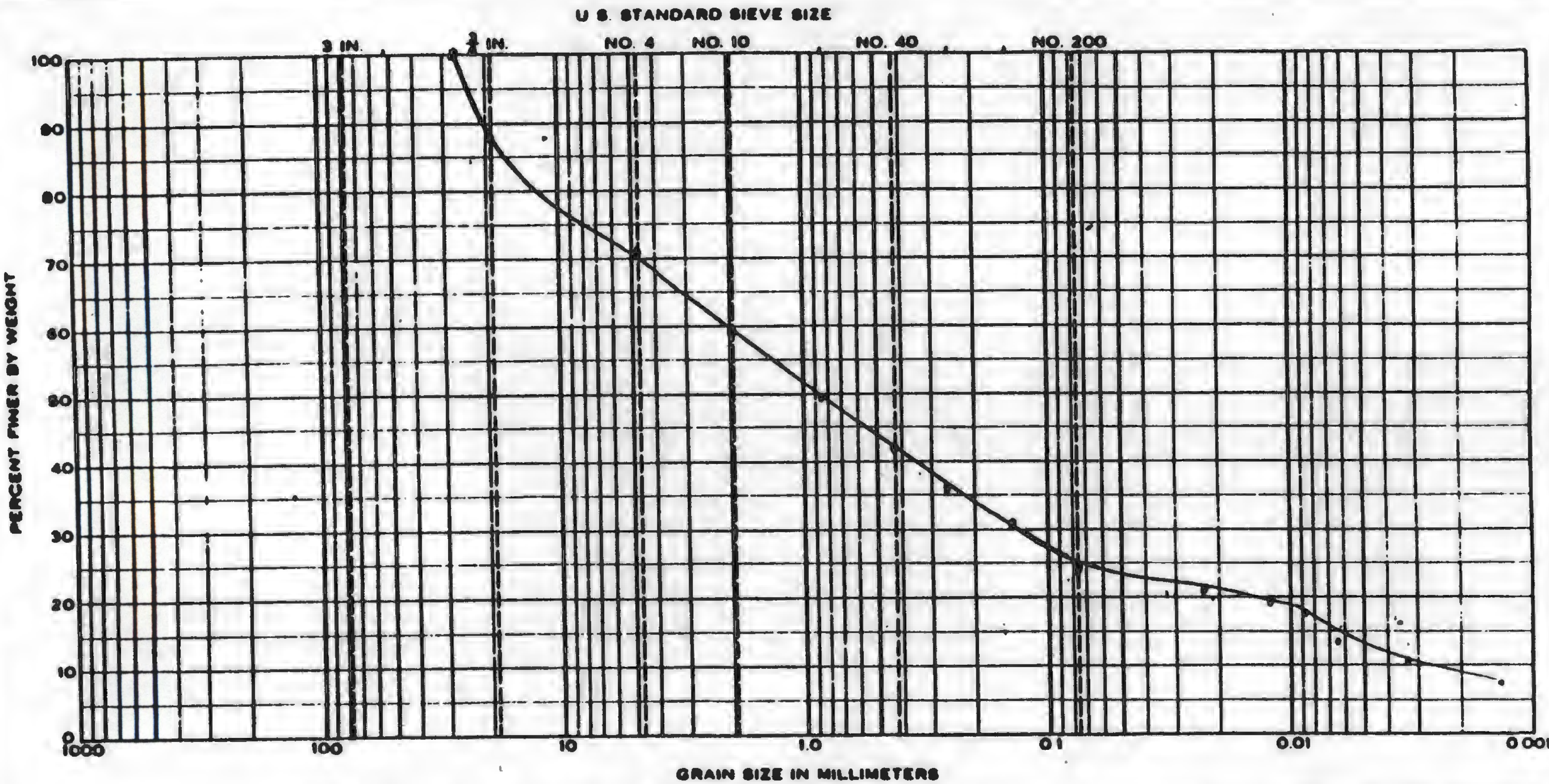
COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	
TB-5 S-4	4-6						

Project Gen. Switch

GRADATION CURVES

Date 9/21/84 JOB No. 84B065-01



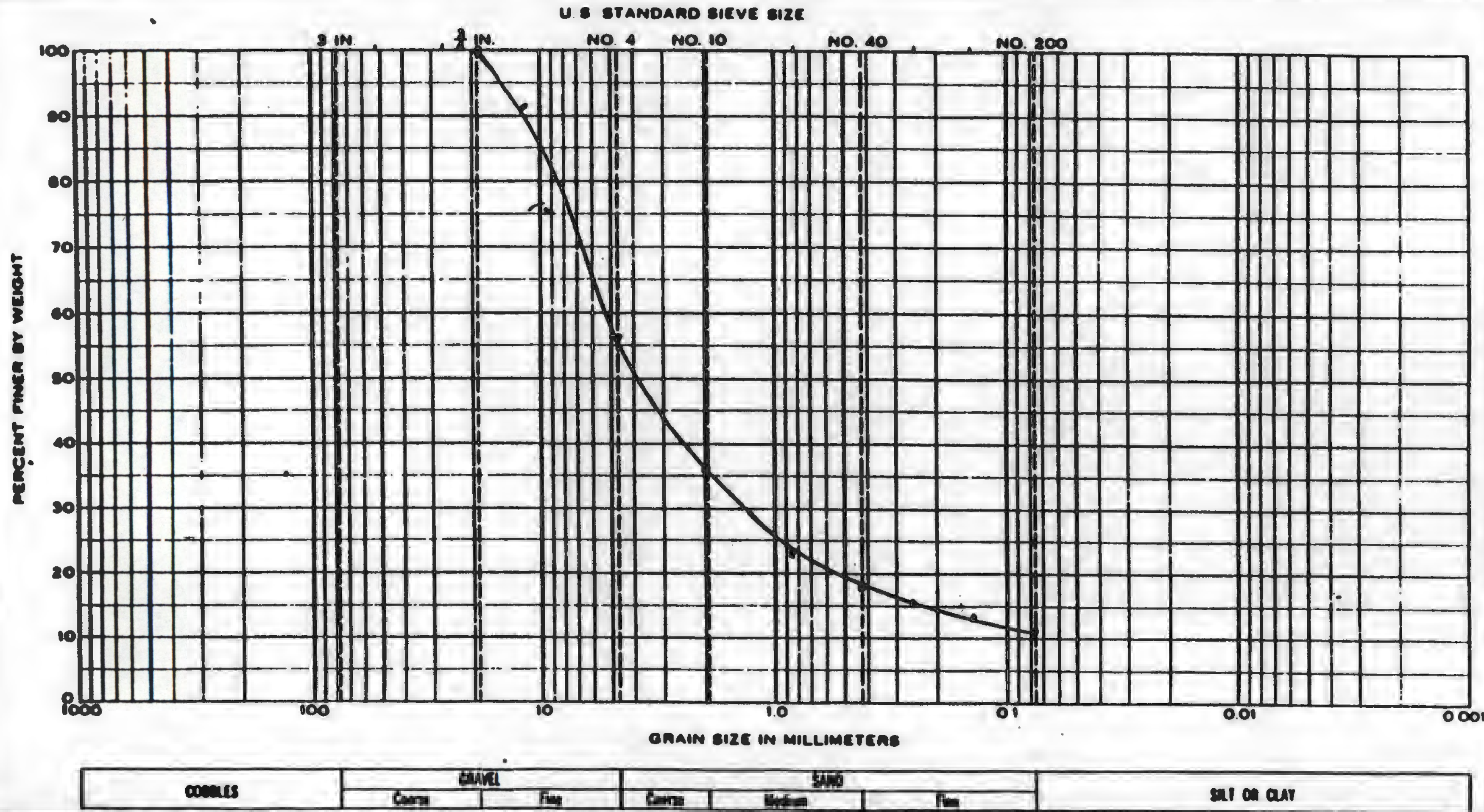
COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	
TB-5 S-6	8-10						

Project General Switch

GRADATION CURVES

Date 9-22-84 JOB No. 84-8065-01



Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	
TB-5 S-8	12-14						

Project General/Switch

GRADATION CURVES

Date 22Sept84 JOB No. 848065-01

LABORATORY TESTING ASSIGNMENT AND DATA SUMMARY

Reviewed By ~~O~~

Date 10/8/84

Project No. 84C4203 Project Engr P. Dutko Assigned By T. Marchane Date Assigned 9/84 Required ASAP

Results of Permeability Tests Performed Using Specimens trimmed from Block Samples

Boring No.	Block Sample No.	Depth (ft)	Direct. of Perm. data	W_L %	W_P %	% Fines (-200)			W Trim %	W_O %	W_C %	γ_{to} pcf	γ_{do} pcf	γ_{tc} pcf	γ_{dc} pcf		$\bar{\sigma}_c$ tsf	U_b tsf	Permeability (1) k @ 20°C cm/sec.			t days
	11		Unknown (No orientation data provided for block sample)	–	–	–			27.0	24.0	23.8	124.6	100.5	126.9	102.5		0.36	7.20	1.3×10^{-7}			o/n
	12A		Vert	–	–	–			13.4	12.7	13.3	139.5	123.6	141.2	124.7		1.36	7.20	6.4×10^{-7}			o/n
	12B		No Permeability test performed due to extensive fragmentation of block sample																			

* Indicate hold point o/n = overnight

L-202 (8/83)

SPECIMEN - (Set Up / Take Down)

Proj. No. 84-4203 Proj. Eng. HV Cell No. 2 Piston dia.: ☐ 3/8"; ☐ 1/2"

Type Test ______ File No ______

Loading Conditions: ☐ Cyclic ☐ Static	☐ Undrained ☐ Drained	☐ Compression ☐ Extension	☒ Constant Cell pressure ☐ Variable cell pressure

Type Consolidation: ☒ Isotropic ☐ Anisotropic ☐ K_o stress path ☐ 45° Stress path	Piston Screwed in: ☐ Yes; ☒ No

☐ Tube ☒ Block ☐ Reconstituted ☐ Impact ☐ Constant Effort

Boring No. 12A Composite No ______ ☐ Static ______ layers; ______ lb {Hammer / Tamp}

Sample No. ______ Specimen No ______ ☐ Kneading ______ Blows-Tamps/layer

Depth (ft) ______ Remarks ______ ☐ Tamping ☐ Undercompaction

☐ Ends capped with Castone; ☐ Geomarine Sample ☐ Other ______ layers; ______ Uni (%)

Water Content				Final
Location				Ave
Container No	654			385
Wgt Container + Wet Soil (gm)	621.10			406.80
Wgt Container + Dry Soil (gm)	568.90			381.95
Wgt. Container (gm)	178.60			194.84
Wgt Dry Soil (gm)				
WATER CONTENT (%)	13.37			13.28

☐ See attached data sheet(s) for additional water contents

Specimen Weight

Wet + Stone (etc): ______ gm

Stone (etc): ______ gm

Wet Initial: 937.61 gm

Wet Final: 942.32 gm

Excess Ovendry - Dish No ______

Wgt Dish + Dry Soil ______ gm

Wgt. Dish ______ gm

Wgt. Excess Dry Soil ______ gm

Dimentions of Specimen

	Height (in) Initial (L_o)	Final (L_f)		Diameter (in) or ______ Initial	Final
1	3.948		1-T	2.872	
2	3.957		2-M	2.871	
3	3.956		3-B	2.869	
4	3.944		1'-T	2.876	
5	3.950		2'-M	2.881	
Ave	3.9510		3'-B	2.877	
			Ave	2.8743	

$D_{ave} = (D_T + 2D_m + D_B)/4$

ΔL_c = ______ in

ΔL_f = ______ in

$\Sigma \Delta L$ = ______ in

$L_o - L_f$ = ______ in

$A_o = \pi D^2/4 = 6.4885$ in^2

$V_o = in^3 \cdot 16.3871 = 420.12$ cm^3

$A_{sm} = .54542(D^o)^2 =$ ______ 10^{-3} ft^2

Membrane {Thickness = ______ in; Circumference (C_m) = ______ in; $D_m = C_m/\pi$ = ______ in}

Filter Paper: Top + bottom: ☐ Yes; ☒ No

Filter Strips: ☐ Yes; ☒ No

______ Vertical at 1/4" - Whatman #54 or ______

______ Spiral at 1/4" - Whatman #1 or ______

Wgt top cap = ______ gm, ______ 10^{-3} lbs

Wgt (cap, dial + piston) = ______ gm, ______ 10^{-3} lbs

Preliminary

γ_{to} = ______ lb/ft^3 γ_{do} = ______ lb/ft^3

Failure Sketch

ε_a=20% →

Final Visual Classification: ☐ See more detailed sketch on attached sheet; ☐ Photo taken.

CL-ML brown, l-plastic clay silt

some c-f gravel c-f sand

Other Remarks: ______

Preliminary Cal. by HV Reviewed by [signature]

☒ Trimmed by HHC Setup by HHC Taken down by HHC

☐ Reconstituted Date 10/1/84 Date 10/1/84 Date 10/2/84

See back for Summary Calculations

SPECIMEN - SUMMARY CALCULATIONS

Type Test: ________ ☒ Undisturbed; ☐ Reconstituted - Specimen

☐ Cyclic e 1 Hz or ____ + sinusoidal or ______ ☐ Static e ______ %/hr.

Consolidation History Units: tsf or ____	Max. Induced Past Pressure Uncorr.	Corr.*	☐ Preshear (perm) ☐ Pre cy-loading Uncorr.	Corr.*	Preshear after Cy-loading Uncorr.	Corr.*
σ_{cell}		—	7.560	—		—
u		—	7.200	—		—
$\bar{\sigma}_v$			—			
$\bar{\sigma}_h$			0.360			
$\bar{\sigma}_p = (\bar{\sigma}_v + \bar{\sigma}_h)/2$			—			
$K_c = \bar{\sigma}_v/\bar{\sigma}_h$			1.0			
OCR			—			
Consol. Time	☐ Overnight ___ days ___ hours		☒ Overnight ___ days ___ hours		☐ Overnight ___ days ___ hours	

* Corrected for effects of membrane, filter strips, etc.

H_0 = 3.9570 in

A_0 = 6.4888 in²

V_0 = 420.12 cm³

D_{0d}/D_{0m} = ______

G_s = 2.72 ☒ Assumed ☐ Measured

P_f = ______ %

Area Corr. Factors: C

Undrained = ______

$C = \frac{1}{\epsilon_a}(1 - A_c/A_{sm})$

Drained = ______

$C = \frac{1}{\epsilon_a}\left[1 - \frac{A_c(1+\epsilon_{vt})}{A_{sm}}\right]$

Calculate Wgt. of Dry Soil	By Initial Water Content	By Final Water Content	By Total Ovendried Specimen
w_i (%)	13.37		
w_f (%)			
w_{ave} (%)		13.28	
Wgt. Wet Soil, W_T (gm)	937.61	942.32	
Partial Wgt. Dry Soil (gm)	ΔV_T (cm³) during test	(-) in; (+) out	
Wgt. Excess Ovendry Soil	Corr. Wet Wgt. = $W_T + \Delta V_T$		
Total Wgt. Oven Dry Soil, W_s (gm)	827.04	831.85	
W_s used:	Final = 831.85 gm		

Variations in Height and Volume During Consolidation	During Initial Consol. without back-pressure	During Back-Pressuring ΔV_b vol. in	After Backpressuring $\bar{\sigma}_h$ (psi) From 3.0 To 5.0	$\bar{\sigma}_h$ (psi) From ___ To ___	$\bar{\sigma}_h$ (psi) From ___ To ___
	Sign Convention: (-) ΔV in, (+) ΔV out, (-) ΔL up, (+) ΔL down				
ΔL (in)	.0023	.0067	~~.004~~		
ΔV_m (cm³)	1.70	-9.11	~~-0.30~~		
$\Delta V_c = 3V_0(\Delta H/H_0)$	0.734	2.137	1.276		
$R = \Delta V_m/\Delta V_c$	R_{used} = .236		.236		
Corrected $\Delta V_m = R \cdot \Delta V_c$	0.17	0.50			
Circle Selected Value	ΔV_1	ΔV_2	ΔV_3	ΔV_4	ΔV_5
ΔL_{eq} = ______ in	$\Delta V_{rebound} = \bar{\sigma}_{max}$ to $\bar{\sigma}_{test}$ = ______ cm³; ΔV_T (during drained loading) = ______ cm³				

Calculation of ΔV_c During Consolidation by Different Procedures	ΔV_c by Wgt Change $= W_0 - W_f - (\Delta V_b + \Delta V_T)$	ΔV_c by recorded/calculated volume changes = Σ selected ΔV	ΔV_c assuming S = 100% $V_F = (1/G_s + w_f)W_s/\gamma_w$
	ΔWgt. = -4.71 gm; $\Sigma(\Delta V_b + \Delta V_T)$ = 9.34 cm³; ∴ ΔV_c = 4.63 cm³	$\Delta V_c = \underset{\Delta V_1}{1.70} + \underset{\Delta V_2}{0.50} + \underset{\Delta V}{0.30} = 2.50$ cm³	Undrained: $\Delta V_c = V_0 - V_F$; Drained: $\Delta V_c = V_0 - (V_F + \Delta V_T)$; w_f = 13.28 %; V_F = 417.05 cm³; $V_F + \Delta V_T$ = ______ cm³; ∴ ΔV_c = 3.07 cm³

Conclusions:

ΔV_c used (ave ✓ values) = 3.56 cm³ ∴ V_c = 416.56 cm³; ΔL_c = 0.013 in; ∴ L_c = 3.9380 in

$A_c = V_c/L_c\,(cm^3/in)/16.3871$ = 6.455 in²; ÷ 0.144 = 44.827 ft² ×10⁻³; × 6.4516 = 41.646 cm²

ϵ_{ac} = 0.33 %; ϵ_{vc} = 0.85 %; $1 - \epsilon_v$ = ______ ϵ_f = ______; ϵ_{vc} = ______ (# not in percent.)

At max. induced past pressure: $\Delta V_{max} = \Delta V_c - \Delta V_{rebound}$ = ______ cm³; ΔL_{max} = ______ in

Summary	Height (in or cm)	Area (in² or cm² ft²×10⁻³)	Volume (cm³)	Water Content (%) (1)	Total / Dry Density (lb/ft³)	Saturation (%) (2)	
Initial	3.9570 / 10.036	41.863	420.12	12.71	139.38 / 123.62	93.1	
Pre-Test	3.9380 / 10.003	41.646	416.56	13.28 (13.22)	141.23 / 124.67	100.4 (G_s = 2.734 for S = 100%)	

(1) - ( ) indicates calculated value assuming S = 100%

(2) Approximate value especially if G_s is assumed.

Calculated by [signature] Reviewed by [signature]

$S = w G_s \gamma_d/(G_s \gamma_w - w\gamma_d)$ $\quad S = wG_s\gamma_d/(G_s\gamma_w - \gamma_d)$ $\quad \gamma_w$ = 1.20 (Steel) = 62.32 lb/ft³ = 0.9982 gm/cm³ (Salt) = 64.2 (lb/ft³)

G_s for S = 100% = $\gamma_d/(\gamma_w - w\gamma_d)$ $\quad$ = $G_s\gamma_w - \gamma_d$ / $G_s(\gamma_d - \gamma_w)$ $\quad G_s \gamma_d$ = ...

psi × 0.072 = tsf $\quad$ in² × 6.4516 = cm² $\quad$ w for S = 100% = $(G_s\gamma_w - \gamma_d)/G_s\gamma_d$

L-501
(9/83)

PERMEABILITY TEST: FALLING HEAD - CONSTANT VOLUME U-TUBE

Proj. No. 84C4203 Proj. Eng. RK Cell No. P2 Apparatus No. 2

Specimen-Apparatus Setup-Test Information	1) Specimen Tested in: Triaxial Cell or ☐ Compaction Mold or ________ with stones or ☐ Stones with filter paper or ☐ No. 200 screen reinforced with No. 10 screen or ________ top + bottom 2) Specimen orientation for Vertical or ☐ Horizontal permeability determination 3) During saturation: Water flushed up sides of specimen to remove air: No or ☐ Yes. 4) During consolidation: Top and bottom drainage or ☐ Top only or ☐ Bottom only 5) During permeation: Direction of permeant was: Up or ☐ Down 6) Permeant: Water (Demineralized or Distilled or Tap) or ☐ 0.01 N calcium sulfate or ________

Remarks: ________

Consol. Stage-Trial No.	Reading By	Date	Temp. °C	Time hr:min	Δt (min.)	Initial σ_c (psi)	Initial u_b (psi)	Initial Dial (in)	Mercury U-Tube Reading Right, h_r (cm)	Mercury U-Tube Reading Left h_l (cm)	Permeability (cm/sec.) Preliminary / Final @ 20°C
1	[illegible]	10/2/84	22.2	9:04	58	105	100.0	.5123	64.9	44.4	6.649×10^{-7}
1	HH		22.2	10:02					57.2	48.7	6.287×10^{-7}
	X	R_T = .947				σ_c = 0.36 tsf			h_0 = 25.8		
1	HH	10/2/84	22.2	9:05	~~34.75~~ 34.58				65.0	44.35	6.825×10^{-7}
		"	22.1	9:40					53.6	47.9	6.474×10^{-7}
2	X	R_T = .950				σ_c = 0.36 tsf			h_0 = 26.0		
1	HH	10/2/84	22.1	9:42	37.21				65.0	44.35	6.921×10^{-7}
			22.1	10:19	37.35				57.1	48.1	6.572×10^{-7}
3	X	R_T = .951				σ_c = 0.36 tsf			h_0 = 26.0		

L_c = 10.003 cm Remarks ________
A_c = 41.646 cm²

Calculated Using Prog. No. T.I-10E or ________

ave. $k_{@20°C}$ = 6.444×10^{-7} cm/sec
Calculated by HH
Reviewed by [signature]

Preliminary Length/Area Cal.

L_0 = 3.9510 in V_0 = 420.72 cm³
ΔL_c = 0.013 in $\Delta V_c = 3 \cdot V_0 \cdot \frac{\Delta L_c}{L_0}$ =
L_c = 3.9380 in = 4.147 cm³
= 10.003 cm V_c = 415.573 cm³
A_c = 41.585 cm²

Mercury Head Settings

1) ΔH_g in cm for 50% or ____ % σ_c
= 0.5 or ____ [σ_c (psi)/0.1784]
= ________ cm Hg

2) $i = \frac{h}{L} = \frac{\Delta H_g (cm)}{L_c (cm)} \times 12.572$ @ 21.7°C

Conversion 1 cm/sec = 1.969 ft/min = 2835 ft/day = 1.035×10^6 ft/yr = 14.73 (gal/min)/ft²
Factors: 1 cm of mercury in U-tube corrected for water h_g = 0.012544 kg/cm² = 0.1784 psi @ 21.7°C

L-501
(9/83)

(1) $$k = \frac{(a_1)(L)\left(\frac{1}{60}\right)}{A(\Delta T)(1+a_1/a_2)\left(\frac{\gamma Hg}{\gamma w}-1\right)} \ln\frac{ho}{hf}$$

where $ho = (hi)\left(\frac{\gamma Hg}{\gamma w}-1\right)$

$hf = (hi)\left(\frac{\gamma Hg}{\gamma w}-1\right) - (\Delta X)(1+a_1/a_2)\left(\frac{\gamma Hg}{\gamma w}-1\right)$

(K_T) — permeability of specimen at test temperature (cm/sec)

(a_1) — area of right tube in which initially the mercury is higher (cm^2) : Tail water

(a_2) — area of left tube in which initially the mercury is lower (cm^2) : Head water

(γ_{Hg}) — specific gravity of mercury at test temperature = 13.542 @ 71°F or 21.7°C

(γ_w) — specific gravity of water at test temperature = 0.9978 @ 71°F of 21.7°C

(hi) — difference in mercury levels at time zero (cm)

(ΔX) — drop in mercury in tube with area (a_1) during time ΔT (cm)

(ΔT) — elapsed time (minutes)

$$\left[\frac{(a_1)(1/60)}{(1+a_1/a_2)\left(\frac{\gamma Hg}{\gamma w}-1\right)}\right] = \text{apparatus constant}\left[(cm^2)\ \frac{(min.)}{sec.}\right]$$

$\left(\frac{L}{A}\right)$ — specimen constant $\left(\frac{1}{cm}\right)$ (L in cm and A in cm^2)

$(1+a_1/a_2)$ — tubes constant

$\left(\frac{\gamma Hg}{\gamma w}-1\right)$ — specific gravity constant = 12.572 at 71° F or 21.7° C

Therefore

$$k = \left[\frac{(\text{apparatus constant})\ (\text{specimen constant})}{(\Delta T)}\right] \ln\frac{ho}{hf}$$

$$= \left[\frac{\text{Test constant}\left(cm\ \frac{min}{sec.}\right)}{\Delta T(min)}\right] \ln\frac{ho}{hf}$$

Item	Apparatus 1	Apparatus 2	Apparatus 3
Apparatus Constant	7.598×10^{-5}	7.547×10^{-5}	7.556×10^{-5}
Tubes Constant	1.319	1.3175	1.316
	(4/26/73)	(4/26/73)	(4/26/73)

	4	5	6	7	8
Apparatus Constant ($\times 10^{-5}$)	7.7323	7.4779	7.6443	7.5202	7.8510
Tubes Constant	1.3133	1.3223	1.3196	1.3155	1.3507

WCC - L203
(11/75)

TRIAXIAL TEST
(Stage Back Pressuring/Consolidation)

Project No. 84C4203 Cell No. P-2 Test No. perm. Tested By [illegible]

Piston Screwed Into Top Cap : ☐ Yes ; ☒ No   Piston Weights Used: ☐ Yes ; ☒ No

Flow Into Specimen For: ☒ Increasing ; ☐ Decreasing Burrett Reading

Proving Ring No. —— Load Cell: No. —— Channel No. —— Vertical Dial No. ____

Stage No.	Date	Time	Elapsed Time (min)	Cell Pressure σ_c tsf/psi	Back Pressure U_b tsf/psi	Axial Load Div-lbs	Volume Change, CC Reading Δv	Volume Change, CC Reading Δv	Volume Change, CC Total Change	Vertical Dial (inch)	
1C	9/1/84	12:46	0	5.0	0		8.00			0.500	
			0.5				6.80			.502	
			2				6.72			.502	
			4				6.62			.502	
			11				6.48			.5022	
		14:15					6.30		1.70	.5023	
2B	9/1/84	14:17	0	3.0	0		6.30			.502	
			4		2		6.78			.503	
			8		5		7.73			.503	
			18	13.0	10		8.80			.5035	
			23		15		10.20			.504	
			27	23	20		11.11			.505	
			34		25		12.02			.506	
			43	33	30		12.70			.506	
			50		40		13.38			.507	
			56	53	50		13.93			.507	
			65		60		14.53			.507	
		15:30		73	70		14.88			.507	
		15:39			80		15.15			.508	
		15:50			90		15.35			.5085	
		16:00		103	100		15.41			.509	
		16:05					15.41		-9.11	.509	
3C	9/1/84	16:06	0	105.0	100		15.41			.509	
			0.5	$\bar{\sigma}_n = 5.0$ psi			15.15			.511	
			2				15.00			.5115	
			6				14.92			.511	
			17				14.89			.512	
		16:30					14.88		0.30	.512	
	10/2	7:38		105	100		15.11			.513	
		8:00					15.11		-0.23	.513	

Reviewed By [illegible]

SPECIMEN - (Set Up / Take Down) L-202 (8/83)

Proj. No. 3C4203 Proj. Eng. K.D. Cell No. 2 Piston dia.: ☐ 3/8"; ☐ 1/2"

Type Test [illegible] File No ______

Loading Conditions:	☐ Cyclic ☐ Static	☐ Undrained ☐ Drained	☐ Compression ☐ Extension	☒ Constant Cell pressure ☐ Variable cell pressure

Type Consolidation: ☒ Isotropic ☐ Anisotropic ☐ K_o stress path ☐ 45° Stress path

Piston Screwed in: ☐ Yes; ☒ No

☐ Tube ☒ Block ☐ Reconstituted

Boring No. ______ Composite No ______

Sample No 5-11 Specimen No ______

Depth (ft) ______ Remarks ______

☐ Ends capped with Containers; ☐ Geomarine Sample

☐ Impact ☐ Constant Effort

☐ Static ____ layers; ____ lb {Hammer Tamp.

☐ Kneading ____ Blows-Tamps/layer

☐ Tamping ☐ Undercompaction

☐ Other ____ layers; ____ Uni (%)

Water Content				Final
Location				Ave
Container No	641			645
Wgt Container + Wet Soil (gm)	625.80			417.07
Wgt Container + Dry Soil (gm)	545.30			372.15
Wgt. Container (gm)	178.51			183.14
Wgt Dry Soil (gm)				
WATER CONTENT (%)	21.95			23.77

☐ See attached data sheet(s) for additional water contents

Specimen Weight

Wet + Stone (etc): 878.10 gm

Stone (etc): 42.72 gm

Wet Initial: 835.38 gm

Wet Final: 834.15 gm

Excess Ovendry-Dish No ______

Wgt Dish + Dry Soil ______ gm

Wgt. Dish ______ gm

Wgt. Excess Dry Soil ______ gm

Dimensions of Specimen

	Height (in) Initial (L_o)	Final (L_f)		Diameter (in) Initial	Final
1	3.949		1-T	2.875	
2	3.944		2-M	2.877	
3	3.946		3-B	2.865	
4	3.940		1'-T	2.873	
5	3.944		2'-M	2.875	
Ave	3.9446		3'-B	2.863	
			Ave	2.8713	

$D_{ave} = (D_T + 2D_M + D_B)/4$

$\Delta L_c =$ ______ in

$\Delta L_f =$ ______ in

$\Sigma \Delta L =$ ______ in

$L_o - L_f =$ ______ in

$A_o = \pi D^2/4 =$ 6.4753 in²

$V_o =$ in³ · 16.3871 = 418.56 cm³

A_{sm} = .5454(D²)² = ______ 10^{-3} ft²

Membrane { Thickness ______ in; Circumference (in) = ______ in; Dia = Cu/π = ______ in

Filter Paper: Top + bottom: ☐ Yes; ☒ No

Filter Strips: ☐ Yes; ☒ No

____ Vertical at 1/4" - Whatman #54 or ____

____ Spiral at 1/4" - Whatman #1 or ____

Wgt top cap: ______ gm; ______ 10^{-3} lbs

Wgt (cap, dial + piston) = ______ gm, ______ 10^{-3} lbs

Preliminary

γ_{to} = 124.60 lb/ft³ γ_{do} = 102.17 lb/ft³

Failure Sketch

Final Visual Classification: ☐ See more detailed sketch on attached sheet; ☐ Photo Taken.

CL-ML gray S-plastic silty CLAY
Some gravel and c-f SAND

Other Remarks: CL-ML moist brown S-plastic silty
CLAY some c-f gravel & c-f sand

Preliminary Calc. by [signature] Reviewed by [signature]

☒ Trimmed ☐ Reconstituted by [signature] Date 9/28/84 Setup by [signature] Date 9/28/84 Taken down by [signature] Date 10/2/84

See back for Summary Calculations

Type Test: [illegible] ☒ Undisturbed; ☐ Reconstituted - Specimen
☐ Cyclic - c/Hz or ____ f sinusoidal or ____ ☐ Static e ____ %/hr.

Consolidation History Units: tsf or ____	Max. Induced Past Pressure Uncorr.	Corr.*	☐ Preshear/(ram) ☐ Pre cy-loading Uncorr.	Corr.*	Preshear after Cy-loading Uncorr.	Corr.*
σ_{cell}			7.560			
u			7.200			
$\bar{\sigma}_v$						
$\bar{\sigma}_h$			.360			
$\bar{\sigma}_p = (\bar{\sigma}_v + \bar{\sigma}_h)/2$						
$K_c = \bar{\sigma}_v/\bar{\sigma}_h$			1.0			
OCR						
Consol. Time	☐ Overnight days / hours		☐ Overnight days / hours		☐ Overnight days / hours	

* Corrected for effects of membrane, filter strips, etc.

H_o = 3.9446 in
A_o = 6.4753 in²
V_o = 418.56 cm³
Dex/Dsm = ____
G_s = 2.72 ☒ Assumed ☐ Measured
B_f = ____ %
Area Corr. Factors: C
Undrained = ____
$C = \frac{1}{\epsilon_f}(1 - A_c/A_{sm})$
Drained = ____
$C = \frac{1}{\epsilon_f}\left[1 - \frac{A_c(1+\epsilon_v)}{A_{sm}}\right]$

Calculate Wgt. of Dry Soil	By Initial Water Content	By Final Water Content	By Total Ovendried Specimen
w_i (%)	21.95		
w_s (%)			
w_{ave} (%)	-	23.77	
Wgt. Wet Soil, W_T (gm)	835.38	834.15	
Partial Wgt. Dry Soil (gm)	ΔV_T (cm³) during test	[illegible]	
Wgt. Excess Dry Soil	Corr. Wgt. [illegible] $W_s = W_T + \Delta V_T$		
Total Wgt. Dry Soil, W_s (gm)	685.02	673.95	
W_s used:	Final	= 673.95 gm	

Variations in Height and Volume During Consolidation	During Initial Consol. without back-pressure	During Back-Pressuring ΔV_b vol. in	After Backpressuring $\bar{\sigma}_h$(psi) From 2.0 To 5.0	$\bar{\sigma}_h$(psi) From ____ To ____	$\bar{\sigma}_h$(psi) From ____ To ____
Sign Convention: (+) ΔV^{in}, (-) ΔV^{out}, (-) ΔL^{up}, (+) ΔL^{down}					
ΔL (in)	-.046	.0009	.033		
ΔV_m (cm³)	4.61	-7.83	1.12		
$-\Delta V_c = 3V_c(\Delta H/H_o)$	5.093	2.285	2.547		
$R = \Delta V_m/\Delta V_c$	R_{used} = 0.440		0.440		
Corrected $\Delta V_m = R \cdot \Delta V_c$	2.24	1.26			
Circle Selected Value	ΔV_1	ΔV_2	ΔV_3	ΔV_4	ΔV_5

ΔL_{ave} = ____ ; $|\Delta V_{rebound}| = \bar{\sigma}_{max}$ to $\bar{\sigma}_{test}$ = ____ cm³
$|\Delta V_T$ (during drained loading)| = ____ cm³

Calculation of ΔV_c During Consolidation by Different Procedures	ΔV_c by Wgt. Change $= W_o - W_s - (\Delta V_b + \Delta V_T)$	ΔV_c by recorded/calculated volume changes $= \Sigma$ selected ΔV	ΔV_c assuming S = 100%; $V_F = (1/G_s + w_f)W_s/\gamma_w$
	ΔW_{gt} = 1.23 gm; $\Sigma(\Delta V_b + \Delta V_T)$ = 7.83 cm³; ∴ ΔV_c = 9.06 cm³	$\Delta V_c = \overset{\Delta V_1}{4.61} + \overset{\Delta V_2}{1.26} + \overset{\Delta V}{1.12}$ = 6.99 cm³	Undrained: $\Delta V_c = V_o - V_F$; Drained: $\Delta V_c = V_o - (V_F + \Delta V_T)$; w_f = 23.77 %; V_F = 408.71 cm³; $V_F + \Delta V_T$ = ____ cm³; ∴ ΔV_c = 9.85 cm³

Conclusions

ΔV_c used (ave ✓ values) = 8.03 cm³ ∴ V_c = 410.53 cm³; ΔL_c = 0.033 in; ∴ L_c = 3.9116 in
$A_c = V_c/L_c$ (cm³/in)/16.3871 = 6.405 in²; ÷ 0.144 = 44.776 ft² × 10⁻³; × 6.4516 = 41.320 cm²
ϵ_{ac} = 0.84 %; ϵ_{vc} = 1.92 %; $1-\epsilon_v$ = ____ ϵ_f = ____ ; ϵ_{vf} = ____ * not in percent.
At max. induced past pressure: $\Delta V_{max} = \Delta V_c - \Delta V_{rebound}$ = ____ cm³; ΔL_{max} = ____ in

Summary	Height (in or cm)	Area (in² or cm² ft²×10⁻³)	Volume (cm³)	Water Content (%) (1)	Total / Dry Density (lb/ft³)	Saturation (%) (2)
Initial	3.9446 / 10.019	44.776	418.56	23.95	124.6 / 100.5	94.9
Pre-Test	3.9116 / 9.935	44.320	410.53	23.77 (24.04)	126.85 / 102.49	98.7

G_s = 2.70 for S = 100%

(1) - ( ) indicates calculated value assuming S = 100%
(2) Approximate value especially if G_s is assumed.

Calculated by [illegible] Reviewed by ____

psi × 0.072 = tsf   in² × 6.4516 = cm² G_s for S = 100% = $\gamma_d/(\gamma_w - w\gamma_d)$ $S = w G_s \cdot \gamma_d/(G_s \cdot \gamma_w - \gamma_d)$
w for S = 100% = $(G_s \cdot \gamma_w - \gamma_d)/(G_s \cdot \gamma_d)$ $e = G_s \cdot \gamma_w/\gamma_d - 1$ ... γ_w = 62.32 lb/ft³ = 0.9982 gm/cm³ = 9.80 kN/m³

PERMEABILITY TEST: FALLING HEAD - CONSTANT VOLUME U-TUBE

Proj. No. 84C4203 Proj. Eng. RA Cell No. R-3 Apparatus No. 3

Specimen-Apparatus Setup-Test Information

1) Specimen Tested in: Triaxial Cell or ☐ Compaction Mold or ____ with stones or ☐ Stones with filter paper or ☐ No. 200 screen reinforced with No. 10 screen or ____ top + bottom
2) Specimen orientation for Vertical or ☐ Horizontal permeability determination
3) During saturation: Water flushed up sides of specimen to remove air: No or ☐ Yes.
4) During consolidation: Top and bottom drainage or ☐ Top only or ☐ Bottom only
5) During permeation, ~~Direction~~ of permeant was Up or ☐ Down
6) Permeant: Water (~~Demineralized~~ or Distilled or Tap) or ☐ 0.01 N calcium sulfate or ____

Remarks: ____

Consol. Stage-Trial No.	Readings By	Date	Temp. °C	Time hr:min	Δt (min.)	Initial σ_c (psi)	Initial u_b (psi)	Initial Dial. (in)	Mercury U-Tube Reading Right, h_r (cm)	Mercury U-Tube Reading Left h_l (cm)	Permeability (cm/sec.) Preliminary / Final @ 20°C
1 - 1	HK	10/2/84	22.4	8:05	62	105	100.4	.633	64.8	44.5	1.452 x10⁻⁷
			22.2	9:07					58.8	46.3	
		R_T = .947				$\bar{\sigma}_c$ = 0.36 tsf			L_o = 25.7		1.367 x10⁻⁷
1 - 2	HK	10/2/84	22.2	9:10	70.28				65.1	44.4	1.355 x10⁻⁷
			22.1	10:20	70.467				58.7	46.4	
		R_T = 0.950				$\bar{\sigma}_c$ = 0.36 tsf			L_o = 26.2		1.279 x10⁻⁷
1 - 3	HK	10/2/84	22.	10:23	63.96				65.1	44.4	1.233 x10⁻⁷
			22.	10:27	63.767				59.6	46.35	
		R_T = 0.951				$\bar{\sigma}_c$ = 0.36 tsf			L_o = 26.2		1.166 x10⁻⁷

L_c = 9.9355 cm Remarks ____
A_c = 41.320 cm²
Calculated Using Prog. No. TI-10E or ____

ave. $k_{@20°C}$ = 1.271 x10⁻⁷ cm/sec
Calculated by HK
Reviewed by [illegible]

Preliminary Length/Area Cal.

L_o = 3.9446 in V_o = 418.56 cm³
ΔL_c = .033 in $\Delta V_c = 3 \cdot V_o \cdot \frac{\Delta L_c}{L_o}$ = 10.505 cm³
L_c = 3.9116 in = 9.9355 cm V_c = 408.055 cm³
A_c = 41.070 cm²

Mercury Head Settings

1) ΔH_g in cm for 50% or ___ % $\bar{\sigma}_c$ = 0.5 or ___ [$\bar{\sigma}_c$(psi)/0.1784] = ___ cm Hg
2) $i = \frac{h}{L} = \frac{\Delta H_g (cm)}{L_c (cm)} \times 12.572$ @ 21.7°C

Conversion Factors: 1 cm/sec = 1.969 ft/min = 2835 ft/day = 1.035x10⁶ ft/yr = 14.73 (gal/min)/ft²
1 cm of mercury in U-tube corrected for water hg = 0.012544 kg/cm² = 0.1784 psi @ 21.7°C

TRIAXIAL TEST
(Stage Back Pressuring/Consolidation)

Project No. 84C4203 Cell No. 8-3 Test No. Perm Tested By [illegible]

Piston Screwed Into Top Cap: ☐ Yes ☒ No Piston Weights Used: ☐ Yes ☒ No

Flow Into Specimen For: ☒ Increasing ☐ Decreasing Burrett Reading

Proving Ring No. —— Load Cell: No. —— Channel No. —— Vertical Dial No. E-1-11

Stage No.	Date	Time	Elapsed Time (min)	Cell Pressure σ_c tsf/psi	Back Pressure U_b tsf/psi	Axial Load Div-lbs	Volume Change, CC Reading Δv	Reading Δv	Total Change	Vertical Dial (inch)
1 C	9/25/84	14:22	0	3.0	0		10.00			0.502
			0.5				9.07			.506
			4				8.58			.509
			38				7.34			.570
	10/1/84	7:30					5.40			.576
		8:46					5.39		4.61	.576
2 B	10/1/84	8:48	0	3.0	0		5.39			.576
			14		2		5.98			.576
			39		5		7.15			.577
			70	13.0	10		8.62			.578
		13:35			15		10.02			.5785
		13:47		23	20		10.50			.579
		13:55			25		11.00			.579
		14:03		33	30		11.32			.520
		14:18			40		11.88			.521
		14:26		53.0	50		12.22			.522
		14:35			60		12.53			.522
		14:45		73.0	70		12.75			.523
		14:52			80		12.92			.523
		15:00			90		13.08			.524
		15:12		103.0	100		13.20			.525
		15:24					13.22			.525
3 C	10/1/84	15:25	0	105.0	100		13.22			.525
			0.5	$\sigma_3 = 5.0$			13.05			.5265
			10				12.80			.528
		15:39					12.66			.528
		15:54					12.55			.5285
		16:06					12.47			.529
		16:30					12.40			.5295
	10/2	7:35		104.9	99.9		12.10			.533
		8:04		adj			12.10		1.12	.533

Reviewed By [illegible]

(1) $$k = \frac{(a_1)(L)(\frac{1}{60})}{A(\Delta T)(1 + a_1/a_2)\left(\frac{\gamma Hg}{\gamma w} - 1\right)} \ln \frac{ho}{hf}$$

where $ho = (hi)\left(\frac{\gamma Hg}{\gamma w} - 1\right)$

$hf = (hi)\left(\frac{\gamma Hg}{\gamma w} - 1\right) - (\Delta X)(1 + a_1/a_2)\left(\frac{\gamma Hg}{\gamma w} - 1\right)$

(K_T) – permeability of specimen at test temperature (cm/sec)

(a_1) – area of right tube in which initially the mercury is higher (cm^2) : Tail water

(a_2) – area of left tube in which initially the mercury is lower (cm^2) : Head water

(γ_{Hq}) – specific gravity of mercury at test temperature = 13.542 @ 71°F or 21.7°C

(γ_w) – specific gravity of water at test temperature = 0.9978 @ 71°F of 21.7°C

(hi) – difference in mercury levels at time zero (cm)

(ΔX) – drop in mercury in tube with area (a_1) during time ΔT (cm)

(ΔT) – elapsed time (minutes)

$$\left[\frac{(a_1)(1/60)}{(1 + a_1/a_2)\left(\frac{\gamma Hg}{\gamma w} - 1\right)}\right] = \text{apparatus constant} \left[(cm^2)\ \left(\frac{min.}{sec.}\right)\right]$$

($\frac{L}{A}$) – specimen constant ($\frac{1}{cm}$) (L in cm and A in cm^2)

($1 + a_1/a_2$) – tubes constant

$\left(\frac{\gamma Hg}{\gamma w} - 1\right)$ – specific gravity constant = 12.572 at 71° F or 21.7° C

Therefore

$$k = \left[\frac{(\text{apparatus constant})\ (\text{specimen constant})}{(\Delta T)}\right] \ln \frac{ho}{hf}$$

$$= \left[\frac{\text{Test constant}\left(cm\ \frac{min}{sec.}\right)}{\Delta T(min)}\right] \ln \frac{ho}{hf}$$

Item	Apparatus 1	Apparatus 2	Apparatus 3
Apparatus Constant	7.598×10^{-5}	7.547×10^{-5}	7.556×10^{-5}
Tubes Constant	1.319	1.3175	1.316
	(4/26/73)	(4/26/73)	(4/26/73)

	4	5	6	7	8
Apparatus Constant ($\times 10^{-5}$)	7.7323	7.4779	7.6443	7.5702	7.8510
Tubes Constant	1.3133	1.3223	1.3196	1.3155	1.3507

APPENDIX D

LABORATORY ANALYSES

POTABLE WELL ANALYSES

M E M O R A N D U M

TO: Dave Lipsky

FROM: Francie Barker FB

DATE: June 6, 1984

RE: General Switch Potable Well Sampling Trip

On June 4 and 5, 1984, Dale Webster and I sampled 24 potable wells in the vicinity of General Switch. In addition, two replicates, one field blank, and one trip blank were collected. The following provides a list of sample numbers and sampling locations:

Sample #	Owner	Address
PW-1	Knapp	317 Highland Ave.
PW-2	Van Pelt	31 Electric Ave.
PW-3	Ogden	319 Highland Ave.
PW-4	Seeley	321 Highland Ave.
PW-5	Gilbert	323 Highland Ave.
PW-6	Cornelius	331 Highland Ave.
PW-7	Cornelius (dup.)	331 Highland Ave.
PW-8	Crooks	335 Highland Ave.
PW-9	Tessler	287 Highland Ave.
PW-10	Petrizzo (Chaves)	292 Highland Ave.
PW-11	Fiore	325 Highland Ave.
PW-12	Heilfurth	233 Commonwealth Ave.
PW-13	McEntee	227 Commonwealth Ave.

testing laboratory

P.O. Box 5108 Princeton NJ 08540

Results of June 6 Sampling

DATE: June 28, 1984

JOB NO. 33542

AUTHORIZATION: verbal

SAMPLE: water - 28

TO:
Fred C. Hart Assoc.
530 Fifth Ave
New York NY 10036

ATT: B. Jaycot

REPORT OF ANALYSIS

COMPOUND NAME	DETECTION LIMIT	SAMPLE'S ID	SAMPLE ug/l
Tetrachloroethylene	0.1	PW-1	24
		PW-2	ND
		PW-3	ND
		PW-4	ND
		PW-5	ND
		PW-6	ND
		PW-7	ND
		PW-8	< 0.1[a]
		PW-9	ND
		PW-10	ND
		PW-11	0.1
		PW-12	ND
		PW-13	ND
		PW-14	ND
		PW-15	ND
		PW-16	ND
		PW-17	ND
		PW-18	ND
		PW-19	ND
		PW-20	ND
		PW-21	ND
		PW-22	1
		PW-23	ND
		PW-24	ND
		PW-25	ND
		PW-26	ND
		PW-27	ND
		PW-28	ND

a) Below method detection limit. Quantitation and/or identification may be uncertain at this point.
ND=not detected

Brian Janke, Manager
Organic Laboratory

William F. Pickup, Director

BJ:na

PW-14	Ruppert	229 Commonwealth Ave.
PW-15	Caspe (Perez)	338 Highland Ave.
PW-16	Pitt	355 Highland Ave.
PW-17	Wegenroth	168 Watkins Ave.
PW-18	Brinkerhoff	197 Commonwealth Ave.
PW-19	Palermo	183 Commonwealth Ave.
PW-20	Berry	210 Commonwealth Ave.
PW-21	Varga	220 Commonwealth Ave.
PW-22	Prior King Press	230 Watkins Ave.
PW-23	Prior King Press (dup.)	230 Watkins Ave.
PW-24	Field Blank	-
PW-25	Holmes	174 Watkins Ave.
PW-26	Eckerson	299 Highland Ave.
PW-27	Lopez	174 Commonwealth Ave.
PW-28	Trip Blank	-

The Liska and Janiak wells were not sampled because the owner's lawyers advised them not to have their wells sampled. The Schmick residence was not sampled, because they are on city water. The Holmes residence at 174 Watkins Ave. was sampled instead of the Holmes residence at 175 Watkins Ave., because the well at 175 Watkins Ave. is a 25 ft. deep dug well which does not draw water from the contaminated bedrock aquifer.

The samples were collected using the following procedures:

testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

Box 3108, Princeton, N.J. 08540

Analyst : TXL
Date : 10-17-84
Matrix Code DW

QUALITY CONTROL REPORT
B. DUPLICATE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run - 1 (D_1)	Run 2 (D_2)	
PW-1	Tetrachloroethylene	EPA 601	27	21	13

$$^{*}RPD = \frac{(D_1 - D_2)}{\left[(D_1 + D_2)/2\right]} \times 100$$

Matrix Codes:
Soil SO
Sludge SL
Drinking Water DW
Air Air
Plant Effluent/monitoring well PE/MW
Other

Job # 33542
Analyst TXL
Date 10-17-84
MATRIX CODE DW

princeton testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

P.O. Box 3105, Princeton, N.J. 08540

QUALITY CONTROL REPORT

A. MATRIX SPIKE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)			
Sample ID	COMPOUND NAME	METHOD	Sample Result (SR)	Spiked Sample Result (SSR)	Spike Added (SA)	% Recovery*
PW-3	Tetrachloroethylene	EPA 601	ND	46	49	94

Matrix Codes:
Soil SO
Sludge SL
Drinking water DW

*% Recovery = $\frac{(SSR - SR)}{(SA)}$ X 100

princeton testing laboratory
Box 3108, Princeton, N.J. 08540

Princeton Service Center
U.S. Route 1
609-452-9050

Job #: 33542
Analyst: TXL
Date: 10-17-84

QUALITY CONTROL REPORT
B. DUPLICATE ANALYSIS

MATRIX CODE DW

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run 1 (D_1)	Run 2 (D_2)	
PW-6	Tetrachloroethylene	EPA 601	ND	ND	0

$$\text{*RPD} = \frac{(D_1 - D_2)}{(D_1 + D_2)/2} \times 100$$

princeton testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

P.O. Box 3108, Princeton, N.J. 08540

Job # 33542
Analyst TXL
Date 10-17-84

MATRIX CODE DW

QUALITY CONTROL REPORT

A. MATRIX SPIKE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)			%
Sample ID	COMPOUND NAME	METHOD	Sample Result (SR)	Spiked Sample Result (SSR)	Spike Added (SA)	Recovery*
PW-9	Tetrachloroethylene	EPA 601	ND	53	54	98

*% Recovery = $\frac{(SSR - SR)}{(SA)}$ X 100

Matrix Codes:
Soil SO
Sludge SL
Drinking water DW
Air Air

princeton testing laboratory
P.O. Box 3108, Princeton, N.J. 08540
Princeton Service Center
U.S. Route 1
609-452-9050

Job # 53542
Analyst TXL
Date 10-17-84
MATRIX CODE DW

QUALITY CONTROL REPORT

A. MATRIX SPIKE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)			% Recovery*
Sample ID	COMPOUND NAME	METHOD	Sample Result (SR)	Spiked Sample Result (SSR)	Spike Added (SA)	
PW-18	Tetrachloroethylene	EPA 601	ND	53	49	108

Matrix Codes:
Soil SO
Sludge SL
Drinking water DW
Air Air

$$*\% \text{ Recovery} = \frac{(SSR - SR)}{(SA)} \times 100$$

princeton testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

Box 3108, Princeton, N.J. 08540

Job #: 33542
Analyst: TXL
Date: 10-17-84
Matrix Code: DW

QUALITY CONTROL REPORT

B. DUPLICATE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run 1 (D_1)	Run 2 (D_2)	
PW-21	Tetrachloroethylene	EPA 601	ND	ND	0

$$*RPD = \frac{(D_1 - D_2)}{\left[(D_1 + D_2)/2\right]} \times 100$$

Matrix Codes:
Soil SO
Sludge SL
Drinking Water DW
Air Air
Plant Effluent/monitoring well PE/MW

609-452-9350
TLX84-3492

testing
laboratory
P.O. Box 3308, Princeton, N.J. 08540

DATE: August 21, 1984

JOB NO. 34173

AUTHORIZATION: Verbal

SAMPLE: Water - 29

TO:
Fred C. Hart Associates
530 Fifth Avenue
New York, New York 10036
ATTN: B. Jaycot

REPORT OF ANALYSIS

Compound Name	Detection Limit	Sample IDs'		Sample ug/l
Tetrachloroethylene	0.1	PW-1	Eckerson	ND
		PW-2	Liske	130
		PW-3	Nixdorf	ND
		PW-4	Barry	250
		PW-5	Ruppert	140
		PW-6	Knapp	15
		PW-7	Rep	18000
		PW-8	Crooks	ND
		PW-9	~~Freze~~ FIORE	ND
		PW-10	Osborne	34
		PW-11	Bliven	ND
		PW-12	Hoffman	ND
		PW-13	Winner	ND
		PW-14	Rasmussen	ND
		PW-15	Stout	3500
		PW-16	Lobb	46
		PW-17	Laniak	ND
		PW-18	Parella	68000
		PW-19	Field Blank	ND
		PW-20	Replicate	47000
		PW-21	General Switch 11:37	1400
		PW-22	Lewis	107
		PW-23	Robama	4
		PW-24	Radivoy	2
		PW-25	Muller	ND
		PW-26	Prior King	2
		PW-27	CosmoOptics HW	2
		PW-28	CosmoOptics OW	ND
		PW-29	Trip Blank	ND

[signature] for
Brian Janke, Manager
Organic Laboratory

BJ/dds

princeton testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

Box 3108, Princeton, N.J. 08540

Analyst : TXL
Date : 8/21/84

QUALITY CONTROL REPORT

B. DUPLICATE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	Matrix Code PE/MW	Run - 1 (D_1)	Run 2 (D_2)	
PW-4	Tetrachloroethylene		280	210	29

$$*RPD = \frac{(D_1 - D_2)}{\left[(D_1 + D_2)/2\right]} \times 100$$

princeton testing laboratory
Princeton Service Center
U.S. Route 1
609-452-9050
Box 3108, Princeton, N.J. 08540

Analyst : TXL
Date : 8/21/84

QUALITY CONTROL REPORT

B. DUPLICATE ANALYSIS

COMPOUND (Including Surrogates)		CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME Matrix Code PE/MW	Run - 1 (D_1)	Run 2 (D_2)	
PW-7	Tetrachloroethylene	18000	17000	6

$$^*RPD = \frac{(D_1 - D_2)}{\left[(D_1 + D_2)/2\right]} \times 100$$

princeton testing laboratory
Princeton Service Center
U.S. Route 1
609-452-9050
Box 3108, Princeton, N.J. 08540

Analyst : TXL
Date : 8/21/84

QUALITY CONTROL REPORT

B. DUPLICATE ANALYSIS

COMPOUND (Including Surrogates) Sample ID	COMPOUND NAME Matrix Code PE/MW	CONCENTRATION (ug/l) Run - 1 (D_1)	Run 2 (D_2)	Relative Percent Difference (RPD)*
PW-10	Tetrachloroethylene	37	30	21

$$*RPD = \frac{(D_1 - D_2)}{\left[(D_1 + D_2)/2\right]} \times 100$$

princeton testing laboratory
Box 3108, Princeton, N.J. 08540

Princeton Service Center
U.S. Route 1
609-452-9050

Analyst : TXL
Date : 8/21/84

QUALITY CONTROL REPORT

B. DUPLICATE ANALYSIS

COMPOUND (Including Surrogates)		CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME Matrix Code PE/MW	Run - 1 (D_1)	Run 2 (D_2)	
PW-15	Tetrachloroethylene	3900	3100	23

$$*RPD = \frac{(D_1 - D_2)}{\left[(D_1 + D_2)/2\right]} \times 100$$

princeton testing laboratory
Box 3108, Princeton, N.J. 08540
Princeton Service Center
U.S. Route 1
609-452-9050

Analyst : TXL
Date : 8/21/84

QUALITY CONTROL REPORT

B. DUPLICATE ANALYSIS

COMPOUND (Including Surrogates)		CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME Matrix Code PE/MW	Run - 1 (D_1)	Run 2 (D_2)	
PW-21	Tetrachloroethylene	1500	1200	22

$$^{*}RPD = \frac{(D_1 - D_2)}{\left[(D_1 + D_2)/2\right]} \times 100$$

Testing Laboratory
Box 3108, Princeton, N.J. 08540
Princeton Service Center
U.S. Route 1
609-452-9050

Date : 8/21/84

QUALITY CONTROL REPORT
B. DUPLICATE ANALYSIS

COMPOUND (Including Surrogates)		CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME / Matrix Code PE/MW	Run - 1 (D_1)	Run 2 (D_2)	
PM-21	Tetrachloroethylene	1500	1200	22

$$^{*}RPD = \frac{(D_1 - D_2)}{[(D_1 + D_2)]} \times 100$$

princeton testing laboratory
Box 3108, Princeton, N.J. 08540
Princeton Service Center
U.S. Route 1
609-452-9050

Analyst : TXL
Date : 8/21/84

QUALITY CONTROL REPORT

B. DUPLICATE ANALYSIS

Matrix Code PE/MW

COMPOUND (Including Surrogates)		CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	Run - 1 (D_1)	Run 2 (D_2)	
PW-22	Tetrachloroethylene	109	104	5

$(D_1 - D_2)$ x 100

609-452-9050
TLX 843-492

testing laboratory

RECEIVED

DATE:	Aug 21, 1984
JOB NO.	34173 (corrected)
AUTHORIZATION:	verbal
SAMPLE:	water - 29

TO:

Fred C. Hart Associates
530 Fifth Ave
New York NY 10036

ATT: Dave Lipski

REPORT OF ANALYSIS

Sample ID	Tetrachloroethylene ug/l
Detection limit	0.1
PW-1 Eckerson	ND
PW-2 Liske	130
PW-3 Nixdorf	ND
PW-4 Barry	250
PW-5 Ruppert	14,000
PW-6 Knapp	15
PW-7 Rep	18,000
PW-8 Crooks	ND
PW-9 Froze	ND
PW-10 Osborne 1	34
PW-11 Bliven	ND
PW-12 Hoffman	ND
PW-13 Winner	ND
PW-14 Rasmussen	ND
PW-15 Stout	3,500
PW-16 Lobb	46
PW-17 Laniak	ND
PW-18 Parella	68,000
PW-19 Field Blank	ND
PW-20 Replicate	47,000
PW-21 General Switch 11:37	1,400
PW-22 Lewis	107
PW-23 Robama	4
PW-24 Radivoy	2
PW-25 Muller	ND
PW-26 Prior King	2
PW-27 CosmoOptics HW	2
PW-28 CosmoOptics OW	ND
PW-29 Trip Blank	ND

Brian Janke, Manager
Organic Laboratory

William F. Pickup, Director

BJ:na

< less than <. . ND element is less than the value given and not detected by the technique employed > greater than ND not detected

Princeton Service Center
U.S. Route 1
(609) 452-9050
Tlx-84-1942

princeton testing laboratory

P.O. Box ... Princeton, N.J. 08540

August 27, 1984

Mr. Dave Lipski
Fred C. Hart Associates
530 Fifth Ave
New York, New York 10036

Dear Mr. Lipski:

The purpose of this letter has two objectives, i.e., to confirm the error and corrected concentration of sample FW-5 and to brief you on steps we have taken to see that it does not happen again.

The concentration for FW-5 should have been 14000 ppb tetrachloroethylene instead of the 1400 reported. A corrected report is attached. We have repeated the analyses and although the samples have exceeded accepted storage time limits, the agreement between the latest analysis , 12,000 ppb, and the newly reported 14,000 confirms our earlier work. The error was caused by neglecting a dilution factor in the calculation. We checked all results and found no such error in any of the other calculations. It was simple preventable error that regrettably was not caught by us.

We have instituted additional Q C procedures to reduce and hopefully eliminate this type of error. First, the dilution factor will be written on each computer hard copy. Secondly, the dilution factor will be entered into the computer calculation so the factor will be taken into account automatically.

Parenthetically, it was shifting from manual calculations to computer calculations that led to the error cited here in the first place. Switch-overs like this do not excuse the mistake,but obviously does increase the likelyhood.

Thanks for your understanding. You can rest assured that your message was received loud and clear and while we cannot prevent errors absolutely, we will do everything we can.

Very truly yours,

Gene Dennison

Gene Dennison, PhD, Manager
Technical Director

GD:mm

PRINCETON SERVICE CENTER
U.S. Route 1
609-452-9050
TLX84-3492

princeton testing laboratory

P.O. Box 3108, Princeton, N.J. 08540

DATE: 9/14/84

JOB NO. 34914

AUTHORIZATION: verbal

SAMPLE: water - 4

TO:
Fred C. Hart Associates
530 Fifth Ave
New York NY 10036

ATT: B. Jaycot

REPORT OF ANALYSIS

	Tetrachloroethylene
Detection limit	0.1
PW-1 Smith Res.	ND
PW-2 Liska Res.	850
PW-3 Lewis Res.	120
PW-15 Replicate	810

ND=not detected

Brian Janke, Manager
Organic Laboratory

William F. Pickup, Director

BJ:na

< - less than <. . ND - element is less than the value given and not detected by the technique employed > - greater than ND - not detected

princeton testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

Box 3108, Princeton, N.J. 08540

Job #: 34914
Analyst: TXL
Date: 9-14-84

QUALITY CONTROL REPORT

B. DUPLICATE ANALYSIS

MATRIX CODE: PE/MW

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run - 1 (D_1)	Run 2 (D_2)	
PW-15					
replicate	Tetrachloroethylene	EPA 601	900	720	22

$$\frac{(D_1 - D_2)}{[(D_1 + D_2)]} \times 100$$

princeton testing laboratory
Princeton Service Center
U.S. Route 1
609-452-9050
Box 3108, Princeton, N.J. 08540

Job # 34914
Analyst TXL
Date 9-18-84

QUALITY CONTROL REPORT
B. DUPLICATE ANALYSIS

MATRIX CODE: PE/MW

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run - 1 (D_1)	Run 2 (D_2)	
PW-2					
Liska Res	Tetrochloroethylene	EPA 601	980	720	31

$(D_1 - D_2)$

testing laboratory

DATE: Sept 11, 1984

JOB NO. 34926

AUTHORIZATION: verbal

SAMPLE: water - 10

TO: Fred C. Hart Assoc.
530 Fifth Ave
New York NY 10036

ATT: Wayne Tusa

REPORT OF ANALYSIS

Compound Name	
Sample	Tetrachloroethylene
Detection limit	0.1
PW-4 Ogden Res	ND
PW-5 Gilbert Res	ND
PW-6 Courteau Res	ND
PW-7 Perry Res	ND
PW-8 Reynolds Res	ND
PW-9 Brinkerhoff Res	ND
PW-10 Kieran Res	ND
PW-11 Hawkins Res	ND
PW-13 Heilfurth Res	ND
PW-14 Van Peit Res	ND

Brian Janke, Manager
Organic Laboratory

AU37

William F. Pickup, Director

BJ:na

< - less than < . . ND - element is less than the value given and not detected by the technique employed > greater than ND not detected

princeton testing laboratory
P O Box 3106, Princeton, N.J. 08540
Princeton Service Center
U.S. Route 1
609-452-9050

Job # 34926
Analyst TXL
Date 9-11-84

QUALITY CONTROL REPORT

MATRIX CODE PF/MW

A. MATRIX SPIKE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)			% Recovery*
Sample ID	COMPOUND NAME	METHOD	Sample Result (SR)	Spiked Sample Result (SSR)	Spike Added (SA)	
PW-6						
Courteau						
Res.	Tetrachloroetnylene	EPA 601	ND	51	54	94

*% Recovery = $\frac{(SSR - SR)}{(SA)}$ X 100

princeton testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

Box 3108, Princeton, N.J. 08540

Job #: 34926
Analyst: TXL
Date: 9-11-84

QUALITY CONTROL REPORT
B. DUPLICATE ANALYSIS

MATRIX CODE PF/MW

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run 1 (D_1)	Run 2 (D_2)	
PW-13					
Heilfurth					
Res	Tetrachloroethylene	EPA 601	ND	ND	0

$$*RPD = \frac{(D_1 - D_2)}{[(D_1 + D_2)/2]} \times 100$$

testing laboratory

DATE: Oct 11, 1984

JOB NO. 35267

AUTHORIZATION: verbal

SAMPLE: water - 21

TO: Fred C. Hart Associates
530 Fifth Ave
New York NY 10036

REPORT OF ANALYSIS

	Tetrachloroethylene ug/1
Detection limit	0.1
PW-1 Shattuck Res.	< 0.1[a]
PW-2 Estrada Res.	ND
PW-3 Weedon (Smith) Res.	ND
PW-4 Robanna Res.	13
PW-5 Ogden Res.	ND
PW-6 Seely Res.	ND
PW-7 Gilbert Res.	0.2
PW-8 Gody Res.	0.1
PW-9 Knapp Res.	7
PW-11 Ward Res.	ND
PW-12 Ebert Res.	< 0.1[a]
PW-13 Duco Res.	< 0.1[a]
PW-14 Trip Blank	ND
PW-15 Field Blank	ND
PW-16 Replicate	0.1

a) Below detection limit. Quantitation and/or identification may be uncertain at this level.

Brain Janke, Manager
Organic Laboratory

William F. Pickup, Director
BJ:na

< less than <.. ND - element is less than the value given and not detected by the technique employed > greater than ND not detected

princeton testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

P.O. Box 3108, Princeton, N.J. 08540

Job # 35267
Analyst TXL
Date 10-11-84
MATRIX CODE PE/MW

QUALITY CONTROL REPORT

A. MATRIX SPIKE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)			
Sample ID	COMPOUND NAME	METHOD	Sample Result (SR)	Spiked Sample Result (SSR)	Spike Added (SA)	% Recovery*
PW-3	Tetrachloroethylene	EPA 601	ND	0.45	0.44	102

Matrix Codes:
Soil SO
Sludge SL
Drinking water DW

*% Recovery = $\frac{(SSR - SR)}{(SA)}$ X 100

testing laboratory

Box 3108, Princeton, N.J. 08540

Princeton Service Center
U.S. Route 1
609-452-9050

Analyst : TXL
Date : 10-11-84
Matrix Code PE/MW

QUALITY CONTROL REPORT
B. DUPLICATE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run - 1 (D_1)	Run 2 (D_2)	
PW-4	Robanna				
	Tetrachloroethylene	EPA 601	13	13	0

$$*RPD = \frac{(D_1 - D_2)}{\left[(D_1 + D_2)/2\right]} \times 100$$

Matrix Codes:
Soil SO
Sludge SL
Drinking Water DW
Air Air
Plant Effluent/monitoring well PE/NW

Princeton Testing Laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

Box 3108, Princeton, N.J. 08540

Job 35-[illegible]
Analyst TXL
Date 10-11-84
Matrix Code PE/MW

QUALITY CONTROL REPORT

B. DUPLICATE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run 1 (D_1)	Run 2 (D_2)	
PW-16	Replicate				
	Tetrachloroethylene	EPA 601	0.1	0.1	0

$$*RPD = \frac{(D_1 - D_2)}{\left[(D_1 + D_2)/2\right]} \times 100$$

Matrix Codes:
Soil SO
Sludge SL
Drinking Water DW
Air Air
Plant Effluent/monitoring well PE/MW

SOIL SAMPLE AND MONITOR WELL ANALYSES

testing
laboratory

5 1984

DATE: Oct 4, 1984

JOB NO. 35004

AUTHORIZATION: verbal

SAMPLE: soil

TO: Fred C. Hart Assoiciates Inc.
530 Fifth Ave
New York NY 10036

ATT: Tom Morahan

REPORT OF ANALYSIS

	Tetrachloroethylene ug/kg (wet)
Detection limit	10
$2A_2$	4,100
2C	13,000
3D	13
3G	14
5C	150
4E	17
6A	2,200,000
6F	1,500
7A	9
9B	840
9E	45
10A	620
10D	670
Replicate (3G)	19

Brian Janke, Manager
Organic Laboratory

William F. Pickup, Director

BJ:na

< less than < . . ND – element is less than the value given and not detected by the technique employed > – greater than ND not detected

princeton testing laboratory
Princeton Service Center
U.S. Route 1
609-452-9050
Box 3108, Princeton, N.J. 08540

Job # 3500
Analyst : TXL
Date : 10-4-84
Matrix Code: PE/MW

QUALITY CONTROL REPORT
B. DUPLICATE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/kg) (wet)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run 1 (D_1)	Run 2 (D_2)	
2A2	Tetrachloroethylene	EPA 5030	4500	3600	27

$$^{*}RPD = \frac{(D_1 - D_2)}{\left[(D_1 + D_2)/2\right]} \times 100$$

princeton testing laboratory

Princeton Service Center
US Route 1
609-452-9050

• P.O. Box 3108, Princeton, N.J. 08540

Analyst TXI
Date L) - 4-84

MATRIX CODE PE/MW

QUALITY CONTROL REPORT

A. MATRIX SPIKE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/kg) (wet)			
Sample ID	COMPOUND NAME	METHOD	Sample Result (SR)	Spiked Sample Result (SSR)	Spike Added (SA)	Rec...
3G	Tetrachloroethylene	EPA 5030	14	674	790	8[illegible]

*% Recovery = $\frac{(SSR - SR)}{(SA)}$ X 100

Matrix Codes:
Soil SO
Sludge SL
Drinking water DW
Air Air
Plant Effluent/Monitoring Well P...

princeton testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

• P.O. Box 3108, Princeton, N.J. 08540

Job # 35 04
Analyst XL
Date 10-4-84
MATRIX CODE PE/MW

QUALITY CONTROL REPORT

A. MATRIX SPIKE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/kg) (wet)			
Sample ID	COMPOUND NAME	METHOD	Sample Result (SR)	Spiked Sample Result (SSR)	Spike Added (SA)	% Recovery*
4E	Tetrachloroethylene	EPA 5030	17	1807	1910	94

*% Recovery = $\frac{(SSR - SR)}{(SA)}$ X 100

Matrix Codes:
Soil SO
Sludge SL
Drinking water DW
Air Air

princeton testing laboratory
Princeton Service Center
U.S. Route 1
609-452-9050
Box 3108, Princeton, N.J. 08540

Job #: 04
Analyst: TAL
Date: 10-4-84

QUALITY CONTROL REPORT
B. DUPLICATE ANALYSIS

MATRIX CODE: PE/MW

COMPOUND (Including Surrogates)			CONCENTRATION (ug/kg) (wet)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run - 1 (D_1)	Run 2 (D_2)	
6A	Tetrachloroethylene	EPA 5030	2.4×10^6	2.0×10^6	18

$$\text{*RPD} = \frac{(D_1 - D_2)}{\left[(D_1 + D_2)/2\right]} \times 100$$

princeton testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

Box 3108, Princeton, N.J. 08540

Job # 35004
Analyst TXL
Date 10-4-84

QUALITY CONTROL REPORT
B. DUPLICATE ANALYSIS

MATRIX CODE: PE/MW

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run - 1 (D_1)	Run 2 (D_2)	
9E	Tetrachloroethylene	EPA 601	47	43	9

$$*RPD = \frac{(D_1 - D_2)}{\left[(D_1 + D_2)/2\right]} \times 100$$

testing
laboratory

DATE: Oct 4, 1984

JOB NO. 35004

AUTHORIZATION: verbal

SAMPLE: soil - 17

TO: Fred C. Hart Associates Inc.
530 Fifth Ave
New York NY 10036

ATT: Tom Morahan

REPORT OF ANALYSIS

VOLATILE ORGANICS

	Detection Limit	Drum #3 (Drum #4) ug/kg (wet)	10D2	5E*
Acrolein	---	---	---	---
Acrylonitrile	---	---	---	---
Benzene	10	ND	ND	
Bis(chloromethyl) ether				
Bromoform	100	ND	ND	
Carbon Tetrachloride	20	ND	ND	
Chlorobenzene	10	ND	ND	
Chlorodibromomethane	20	ND	ND	
Chloroethane	20	ND	ND	
2-Chloroethylvinyl ether	50	ND	ND	
Chloroform	20	ND	1200	
Dichlorobromomethane	20	ND	ND	
Dichlorodifluoromethane	50	ND	ND	
1,1-Dichloroethane	10	ND	ND	
1,2-Dichloroethane	10	ND	ND	
1,1-Dichloroethylene	10	ND	ND	
1,2-Dichloropropane	10	ND	ND	
1,3-Dichloropropylene	50	ND	ND	
Ethylbenzene	10	ND	ND	
Methyl bromide	100	ND	ND	
Methyl chloride	20	ND	ND	
Methylene Chloride	50	16	100	
1,1,2,2-Tetrachloroethane	100	ND	ND	
Tetrachloroethylene	20	13000	5500	
Toluene	10	ND	ND	
1,2-Trans-dichloroethylene	10	11000	ND	
1,1,1-Trichloroethane	20	ND	ND	
1,1,2-Trichloroethane	50	ND	ND	
Trichloroethylene	20	260	ND	
Trichlorofluoromethane	50	ND	ND	
Vinyl Chloride	20	ND	ND	

*Sample comprised of large stones which are not applicable to this type of analysis.

Brian Janke, Manager
Organic Laboratory

BJ:na

testing laboratory

DATE.	Oct 5, 1984
JOB NO.	35100
AUTHORIZATION:	verbal
SAMPLE:	soil - 20

TO: Fred C. Hart Associates
530 Fifth Ave
New York NY 10036

ATT: B. Jaycot

REPORT OF ANALYSIS

	Tetrachloroethylene ug/kg (wet)
Detection limit	10
TB 1-1	ND
TB 1-2	18
TB 1-6	ND
TB 1-11	< 10
TB 2-3	140
TB 2-6	ND
TB 2-8	ND
TB 2-12	17
TB 3-1	330
TB 3-2	170
TB 3-3	430
TB 3-4	300
TB 3-5	320
TB 4-2	58
TB 4-3	120
TB 4-4	330
TB 4-5	560
TB 4-6	650
Replicate 1 TB2-6	< 10
Replicate 2 TB2-12	ND

Brian Janke, Manager
Organic Laboratory

William F. Pickup, Director

BJ:na

< less than   < ND amount is less than the value given and not detected by the technique employed   > greater than   ND not detected

princeton testing laboratory

Princeton Service Center
U S Route 1
609-452-9050

• P.O. Box 3108, Princeton N.J. 08540

Job ___
Analyst ___ TXL
Date ___ 0-5-81
MATRIX CODE ___ PE/MW

QUALITY CONTROL REPORT

A. MATRIX SPIKE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/kg (wet))			%
Sample ID	COMPOUND NAME	METHOD	Sample Result (SR)	Spiked Sample Result (SSR)	Spike Added (SA)	Recovery*
TB 1-1	Tetrachloroethylene	EPA 601	ND	13	15	87

Matrix Codes:
Soil SO
Sludge SL
Drinking water DW
Air Air

$$\text{*\% Recovery} = \frac{(SSR - SR)}{(SA)} \times 100$$

Job 516u
Analyst J
Date 10-5-84
MATRIX CODE PE/MW

princeton testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

• P.O. Box 3108, Princeton, N.J. 08540

QUALITY CONTROL REPORT

A. MATRIX SPIKE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/Kg)			%
Sample ID	COMPOUND NAME	METHOD	Sample Result (SR)	Spiked Sample Result (SSR)	Spike Added (SA)	Recovery*
TB 1-6	Tetrachloroethylene	EPA 601	ND	28	30	93

*% Recovery = $\frac{(SSR - SR)}{(SA)} \times 100$

Matrix Codes:
Soil SO
Sludge SL
Drinking water DW
Air Air

princeton testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

Box 3108, Princeton, N.J. 08540

Job #: [illegible]100
Analyst: L
Date: 10-5-84

QUALITY CONTROL REPORT
B. DUPLICATE ANALYSIS

MATRIX CODE: PE/MW

COMPOUND (Including Surrogates)			CONCENTRATION (ug/Kg)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run - 1 (D_1)	Run 2 (D_2)	
TB 3-4	Tetrachloroethylene	EPA 601	310	280	10

$$*RPD = \frac{(D_1 - D_2)}{(D_1 + D_2)/2} \times 100$$

princeton testing laboratory
Princeton Service Center
U.S. Route 1
609-452-9050
Box 3108, Princeton, N.J. 08540

Job # 3510^
Analyst : TX
Date 10-5-84

QUALITY CONTROL REPORT
B. DUPLICATE ANALYSIS

MATRIX CODE: PE/MW

COMPOUND (Including Surrogates)			CONCENTRATION (ug/kg)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run - 1 (D_1)	Run 2 (D_2)	
TB 3-5	Tetrachloroethylene		380	260	38

$$*RPD = \frac{(D_1 - D_2)}{(D_1 + D_2)/2} \times 100$$

princeton testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

Box 3108, Princeton, N.J. 08540

Job # 35100
Analyst : TXL
Date 10-5-84

QUALITY CONTROL REPORT

B. DUPLICATE ANALYSIS

MATRIX CODE: PE/MW

COMPOUND (Including Surrogates)		CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	Run - 1 (D_1)	Run 2 (D_2)	
TB 4-6	Tetrachloroethylene	680	620	9

$$^{*}RPD = \frac{(D_1 - D_2)}{(D_1 + D_2)/2} \times 100$$

testing laboratory

DATE: Oct 5, 1984

JOB NO. 35206

AUTHORIZATION: verbal

SAMPLE:

TO: Fred C. Hart Associates Inc.
530 Fifth Ave
New York NY 10036

ATT: Tom Morahan

REPORT OF ANALYSIS

	Tetrachloroethylene ug/kg (wet)
Detection limit	10
TB 6-1A	90
TB 6-2	20
TB 6-3	55
TB 7-2	ND
TB 7-5	ND
TB 7-10	6[a]
TB 5-3	78
TB 5-5	300
TB 5-7	3200
TB 5-6	700
Replicate 1	900
TB 8-2	ND
TB 8-6	ND

a) Below detection limit. Quantitation and/or identification may be uncertain at this level.

Brian Janke, Manager
Organic Laboratory

William F. Pickup, Director
BJ:na

< less than <. ND element is less than the value given and not detected by the technique employed > greater than ND not detected

princeton testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

Box 3108, Princeton, N.J. 08540

Job # 35200
Analyst :
Date 10-5-84

QUALITY CONTROL REPORT

B. DUPLICATE ANALYSIS

MATRIX CODE: PE/MW

COMPOUND (Including Surrogates)		CONCENTRATION (ug/kg) (wet)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME METHOD	Run - 1 (D_1)	Run 2 (D_2)	
TB 5-6	Tetrachloroethylene	710	690	3

$$*RPD = \frac{(D_1 - D_2)}{(D_1 + D_2)/2} \times 100$$

princeton testing laboratory

Box 3108, Princeton, N.J. 08540

Princeton Service Center
U.S. Route 1
609-452-9050

Job # 35206
Analyst : TXL
Date 10-5-84

QUALITY CONTROL REPORT
B. DUPLICATE ANALYSIS

MATRIX CODE: PE/MW

COMPOUND (Including Surrogates)			CONCENTRATION (ug/Kg)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run 1 (D_1)	Run 2 (D_2)	
TB 5-7	Tetrachloroethylene	EPA 601	3400	3000	13

$$*RPD = \frac{(D_1 - D_2)}{(D_1 + D_2)/2} \times 100$$

princeton testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

Box 3108, Princeton, N.J. 08540

Job # 35206
Analyst : TXL
Date 10-5-84

QUALITY CONTROL REPORT

B. DUPLICATE ANALYSIS

MATRIX CODE: PE/MW

COMPOUND (Including Surrogates)		CONCENTRATION (ug/kg)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME METHOD	Run - 1 (D_1)	Run 2 (D_2)	
Replicate	1			
	Tetrachloroehtylene	990	810	20

$$*RPD = \frac{(D_1 - D_2)}{\left[(D_1 + D_2)/2\right]} \times 100$$

princeton testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

• P.O. Box 3108, Princeton, N.J. 08540

Job 3_ _ _ 3

Analyst TXL

Date 10-5-84

MATRIX CODE PE/MW

QUALITY CONTROL REPORT

A. MATRIX SPIKE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/kg) (wet)			%
Sample ID	COMPOUND NAME	METHOD	Sample Result (SR)	Spiked Sample Result (SSR)	Spike Added (SA)	Recovery*
TB 8-2	Tetrachloroethylene	EPA 601	ND	35	49	71

Matrix Codes:
Soil SO
Sludge SL
Drinking water DW
Air Air

$$*\% \text{ Recovery} = \frac{(SSR - SR)}{(SA)} \times 100$$

testing laboratory

DATE: Oct 11, 1984

JOB NO. 35267

AUTHORIZATION: verbal

SAMPLE: water - 21

TO:

Fred C. Hart Associates
530 Fifth Ave
New York NY 10036

REPORT OF ANALYSIS

	Tetrachloroethylene ug/l
Detection limit	0.1
MW-1	1
MW-2	350
MW-3	27,000
MW-4	15,000
MW-6	76
MW-7	34

Brian Janke, Manager
Organic Laboratory

William F. Pickup, Director

BJ:na

< - less than   < . . ND - element is less than the value given and not detected by the technique employed   > - greater than   ND - not detected

testing laboratory

Princeton Service Cen.
U.S. Route 1
609-452-9050

Box 3108, Princeton, N.J. 08540

QUALITY CONTROL REPORT

B. DUPLICATE ANALYSIS

[illegible] # [illegible]

Date : 10-11-84

Matrix Code PE/MW

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run - 1 (D_1)	Run 2 (D_2)	
MW-2					
	Tetrachloroethylene	EPA 601	360	350	3

$$*RPD = \frac{(D_1 - D_2)}{\left[\frac{(D_1 + D_2)}{2}\right]} \times 100$$

Matrix Codes:
Soil SO
Sludge SL
Drinking Water DW
Air Air
Plant Effluent/monitoring well PE/MW
Other

testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

Box 3108, Princeton, N.J. 08540

Analyst: TXL
Date: 10-11-84
Matrix Code: PE/MW

QUALITY CONTROL REPORT
B. DUPLICATE ANALYSIS

COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run - 1 (D_1)	Run 2 (D_2)	
MW-7					
	Tetrachloroethylene	EPA 601	37	31	18

$$*RPD = \frac{(D_1 - D_2)}{\left[(D_1 + D_2)/2\right]} \times 100$$

Matrix Codes:
Soil SO
Sludge SL
Drinking Water DW
Air Air
[illegible]

testing laboratory

Princeton Service Center
U.S. Route 1
609-452-9050

Box 3108, Princeton, N.J. 08540

QUALITY CONTROL REPORT
B. DUPLICATE ANALYSIS

Analyst : TXL
Date : 10-11-84
Matrix Code PE/MW

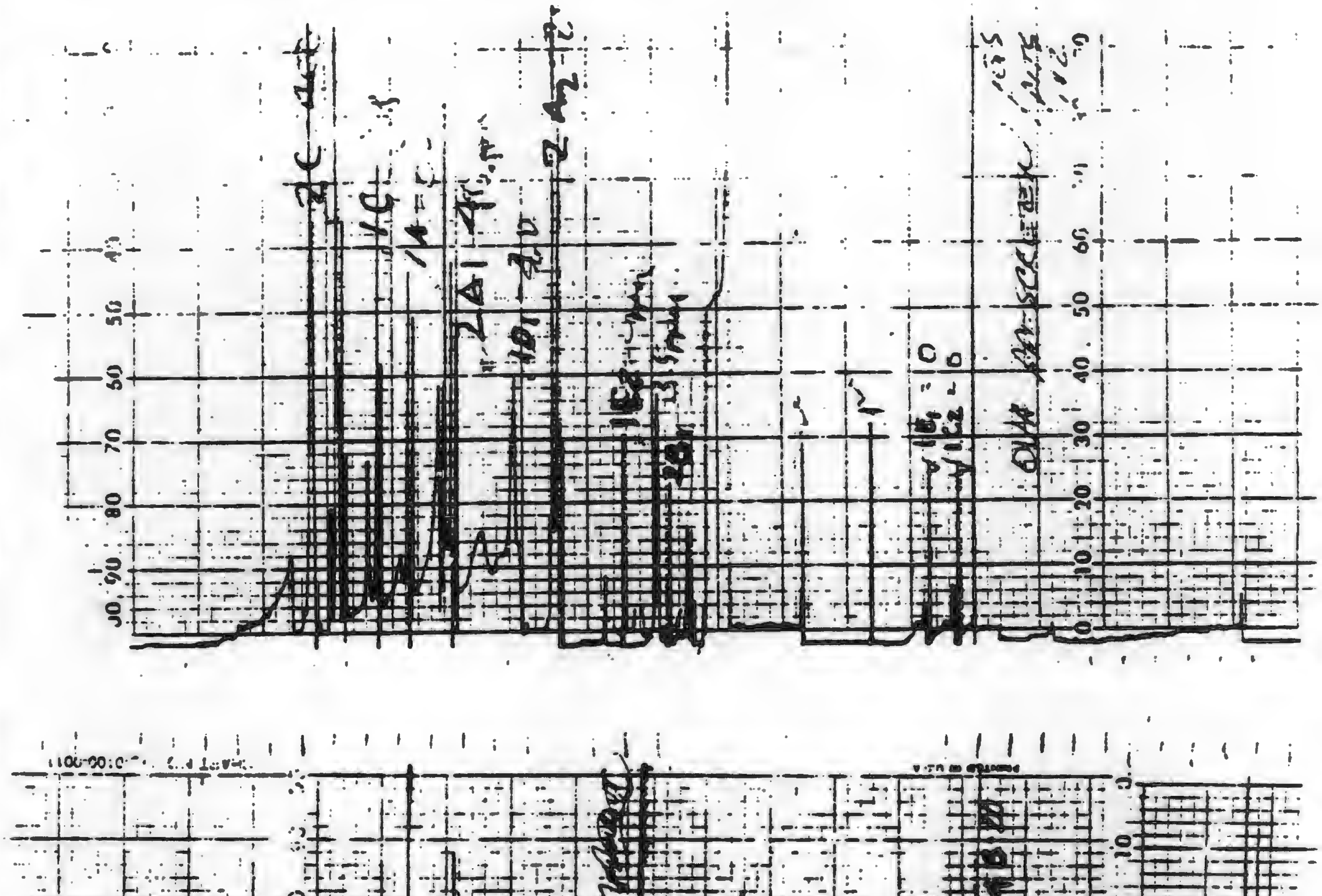
COMPOUND (Including Surrogates)			CONCENTRATION (ug/l)		Relative Percent Difference (RPD)*
Sample ID	COMPOUND NAME	METHOD	Run - 1 (D_1)	Run 2 (D_2)	
MW-3	Tetrachloroethylene	EPA 601	27000	26000	3.8

$$^*RPD = \frac{(D_1 - D_2)}{\left[\frac{(D_1 + D_2)}{2} \right]} \times 100$$

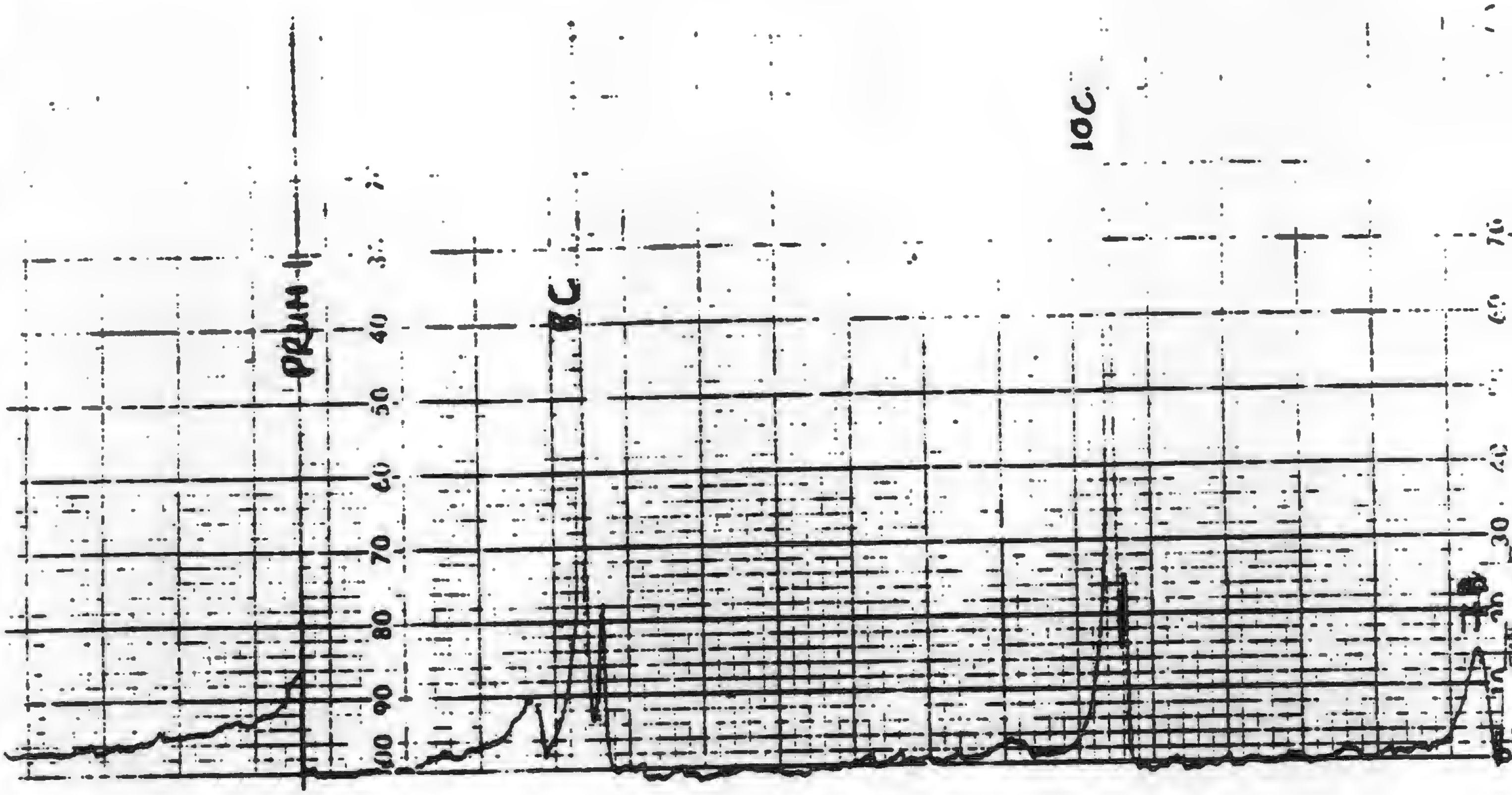
Matrix Codes:
Soil SO
Sludge SL
Drinking Water DW
Air Air

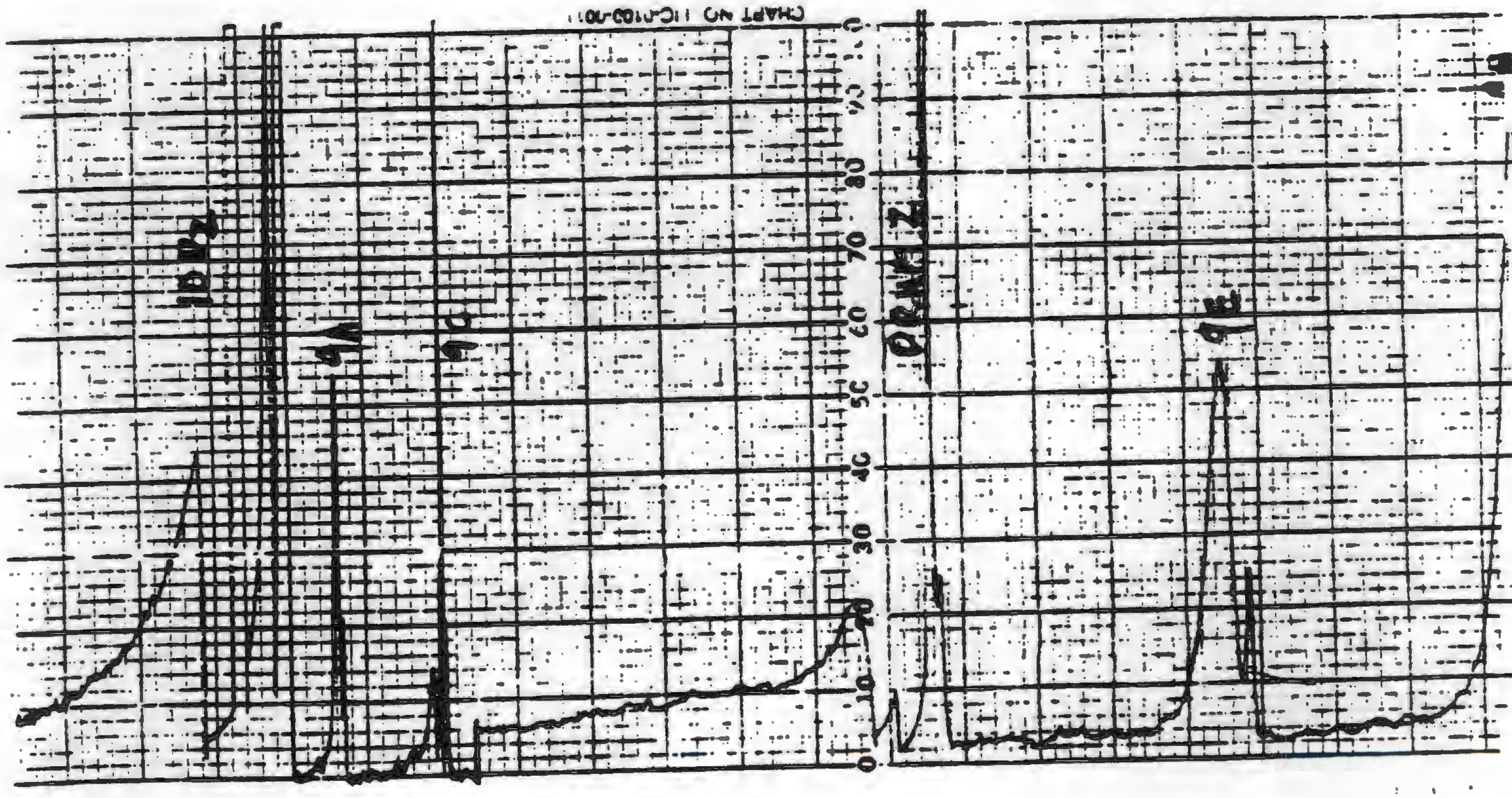
APPENDIX E

OVA PRESCREEN AND GAS-CHROMATOGRAPH STRIP CHARTS

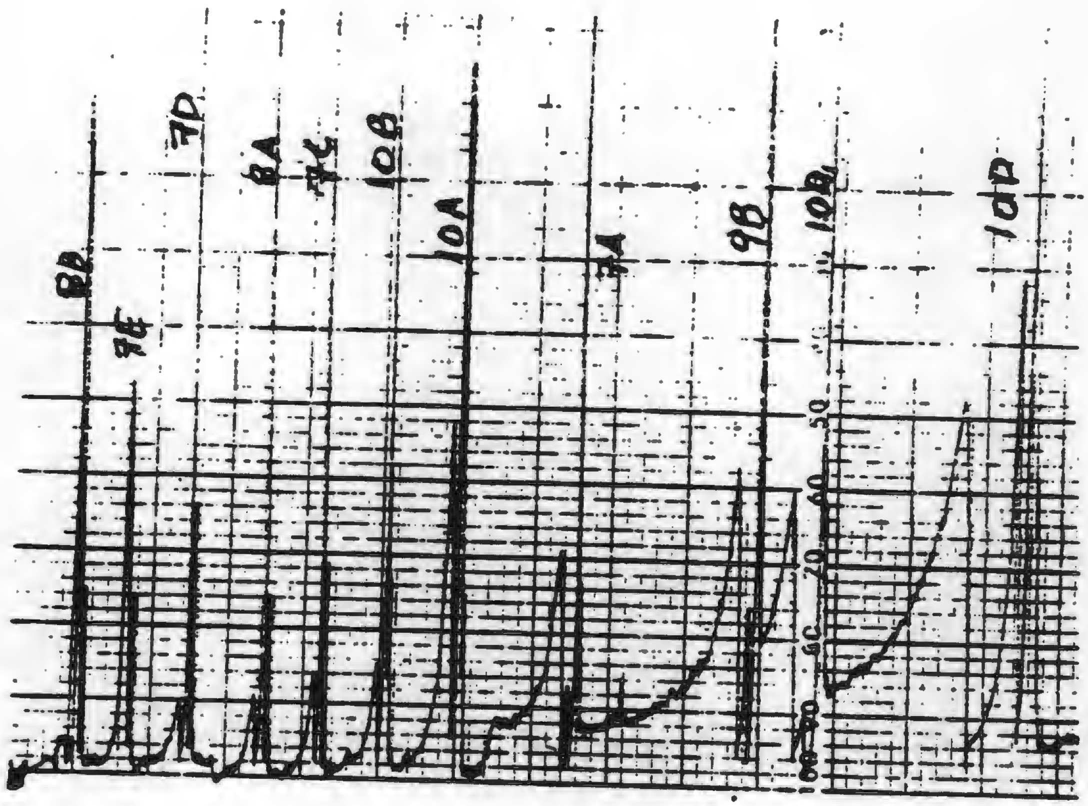


OVA prescreens

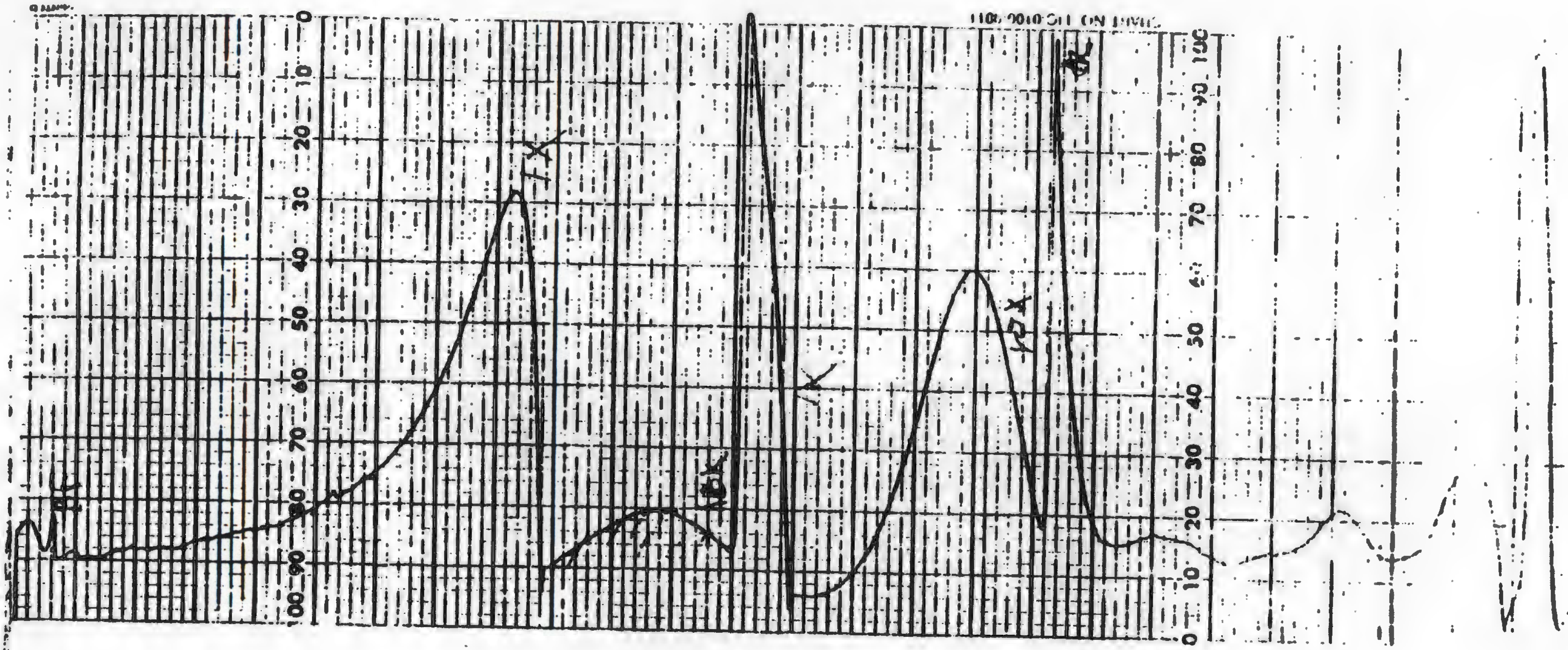


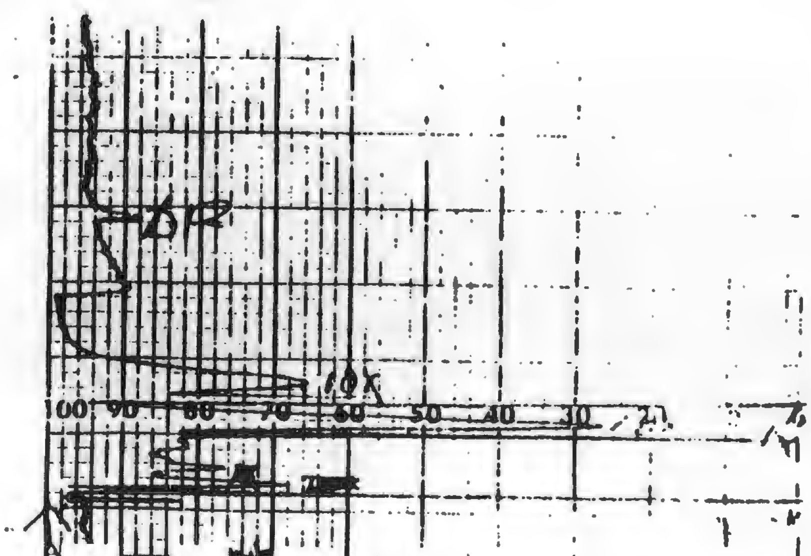


OVA prescreens

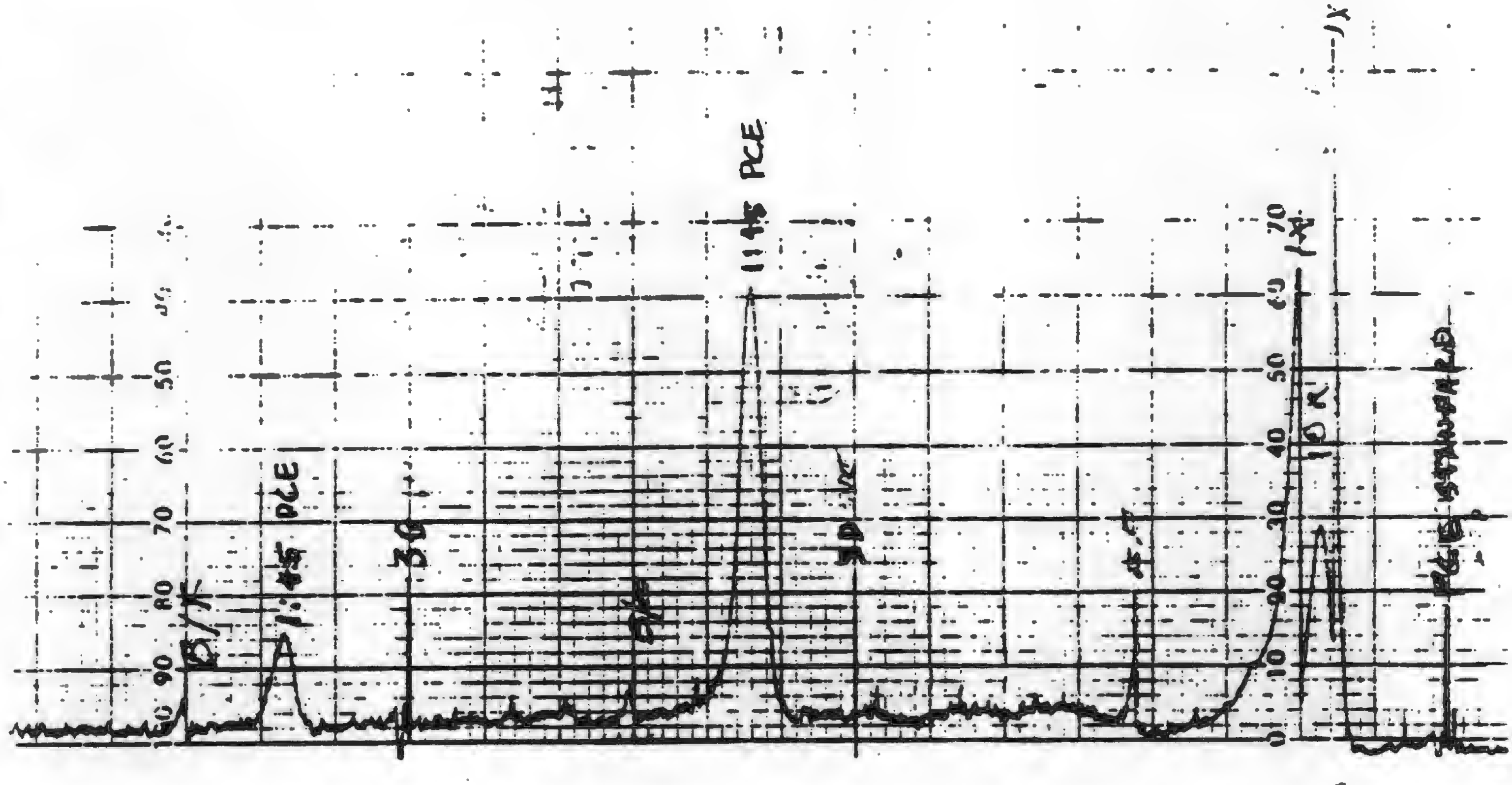


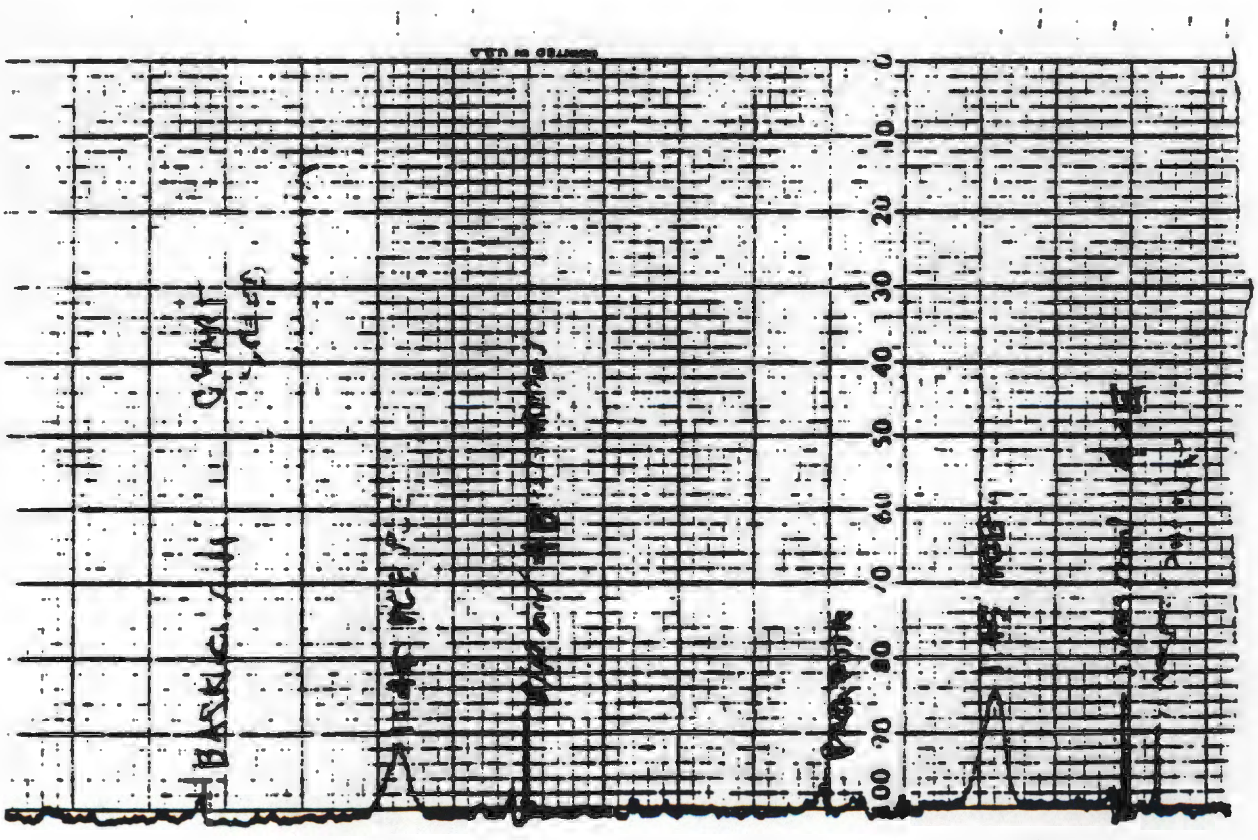
OVA prescreens





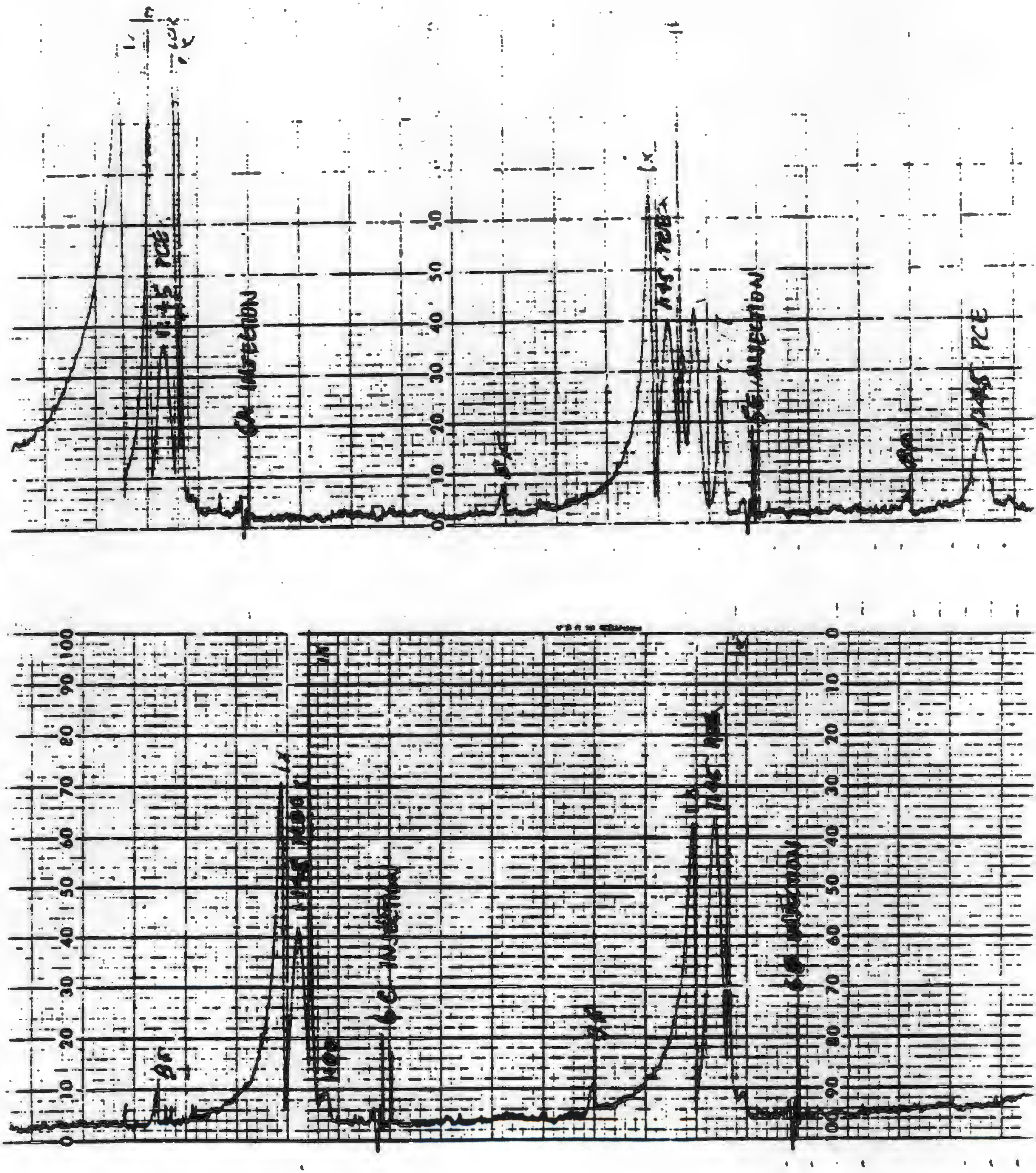
OVA- gas chromatograph mode



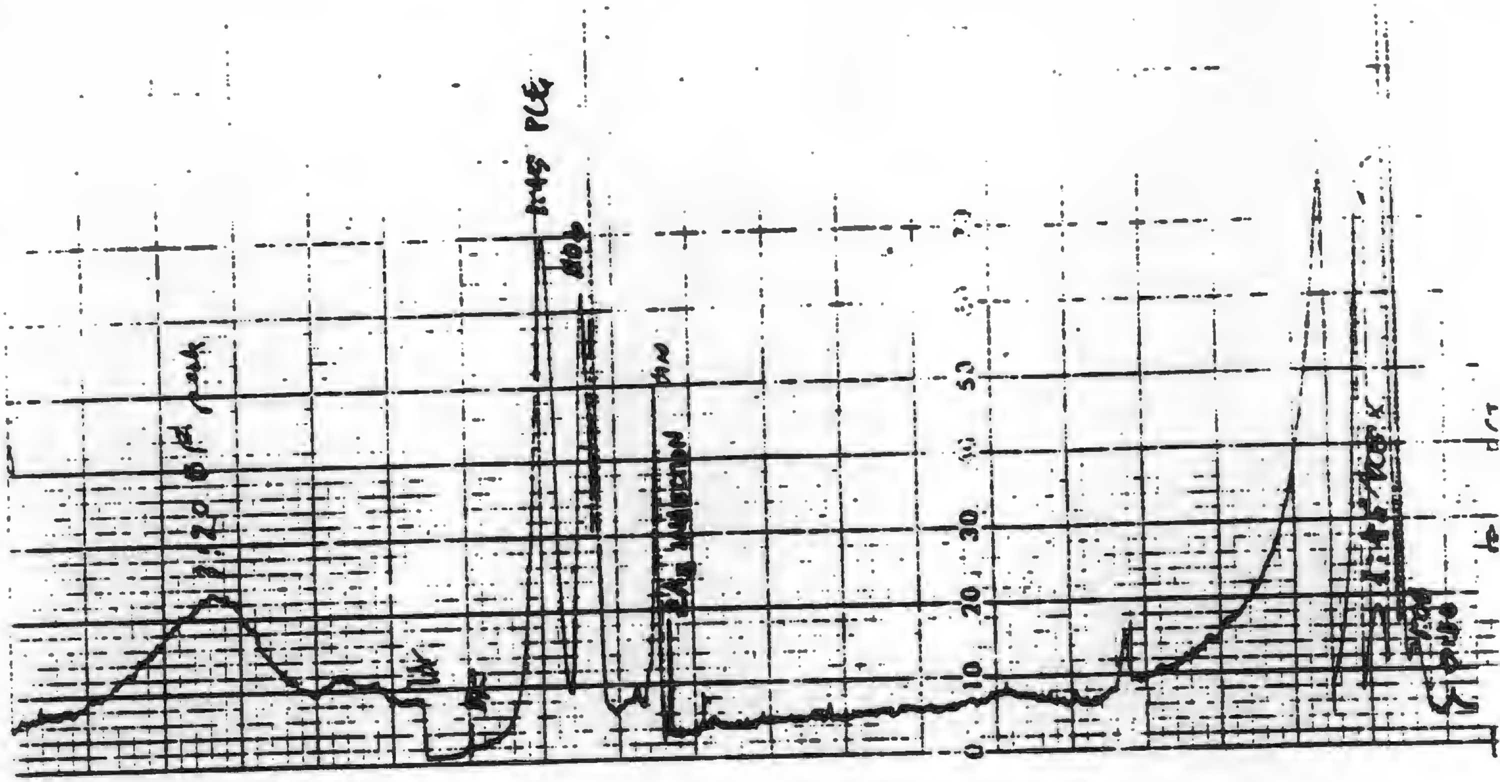


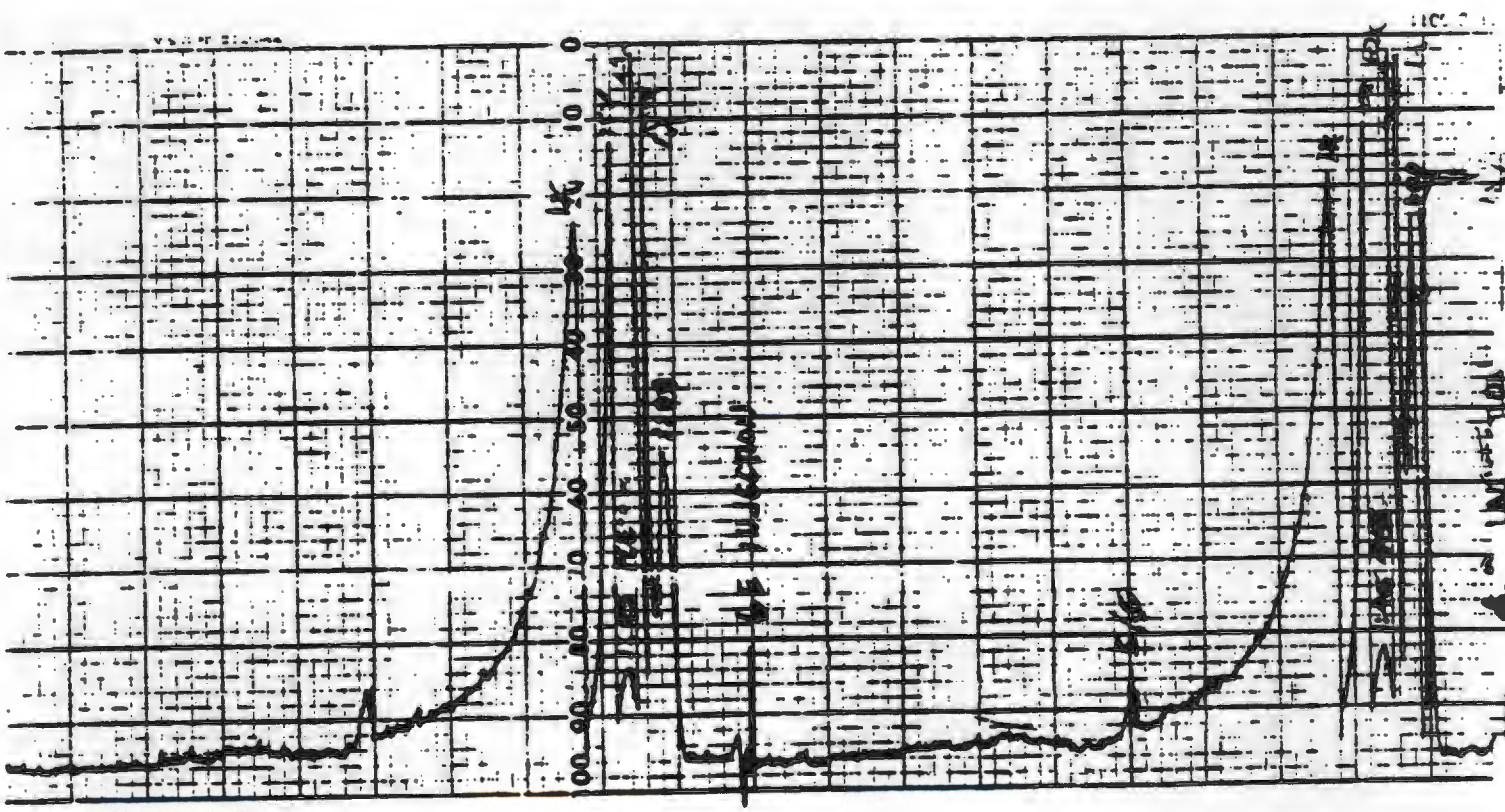
OVA- gas chromatograph mode

E-2

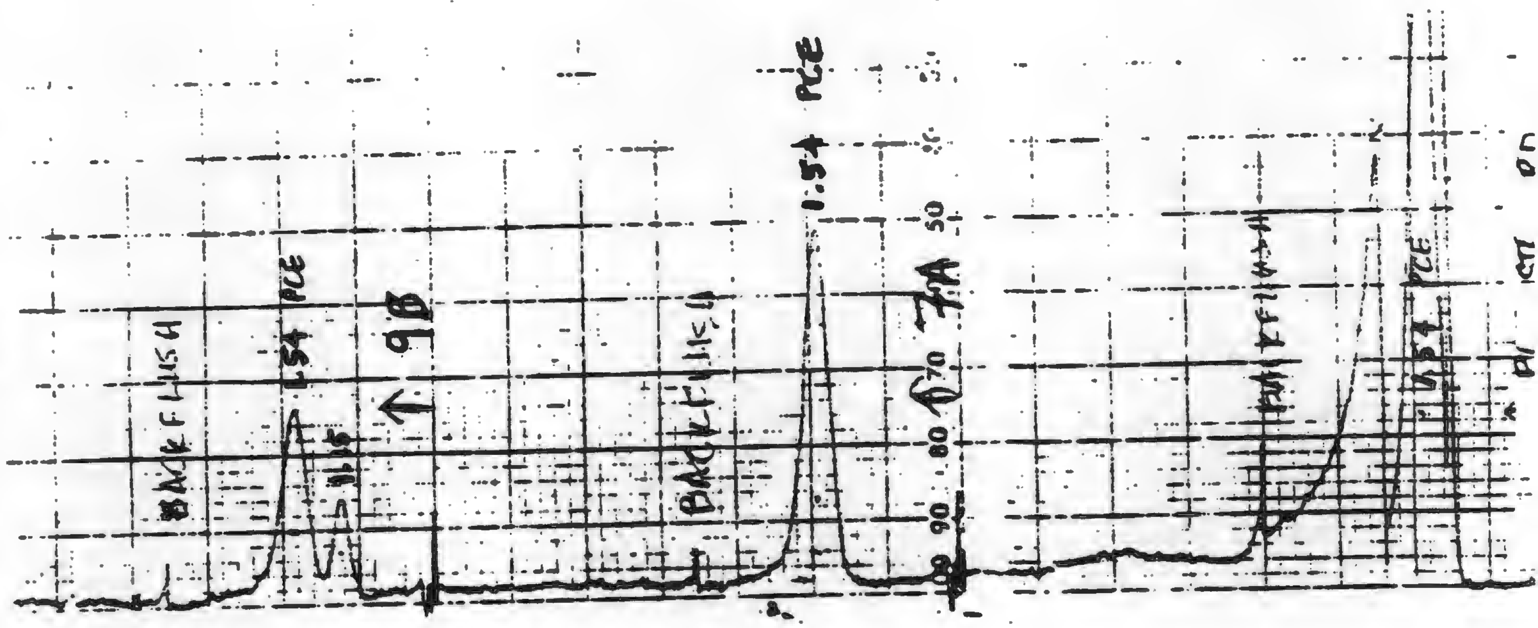


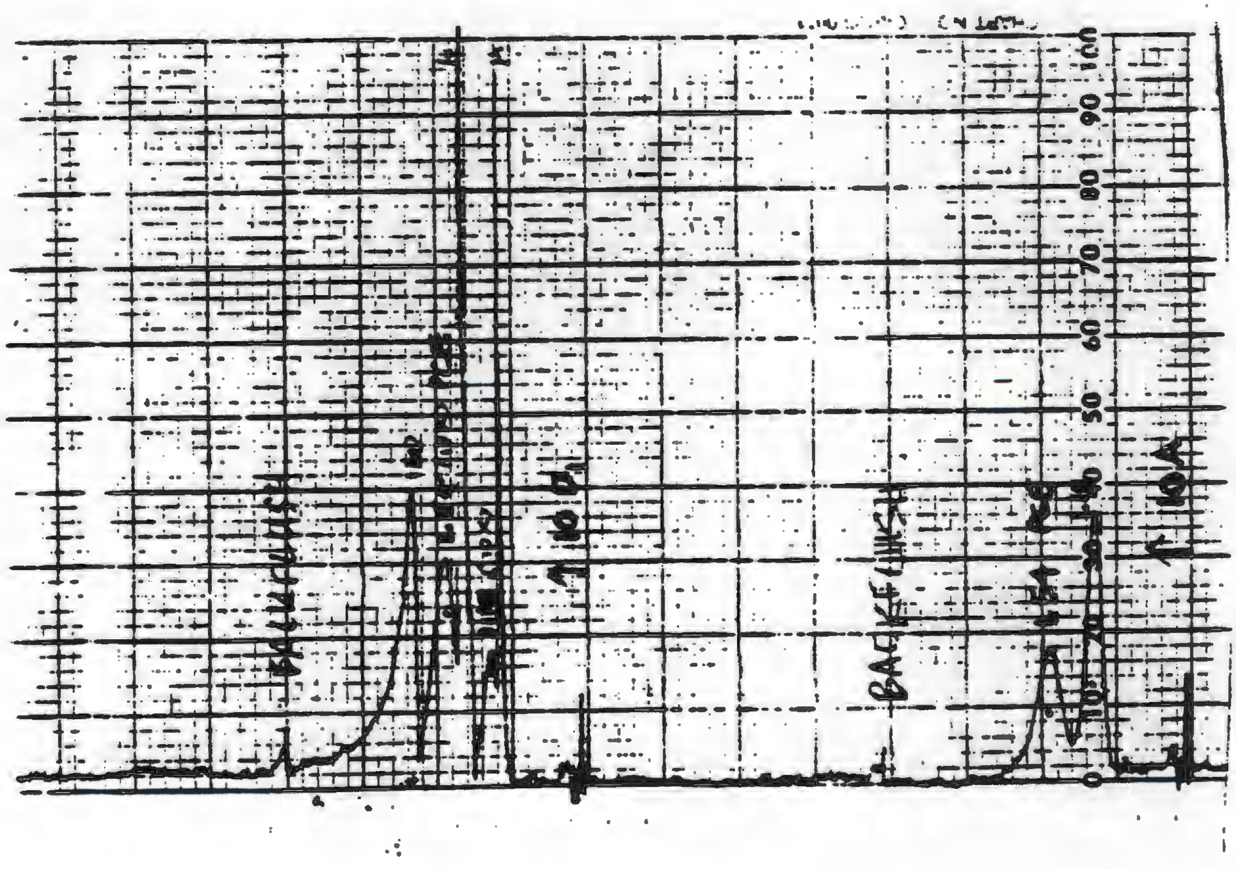
OVA- gas chromatograph mode



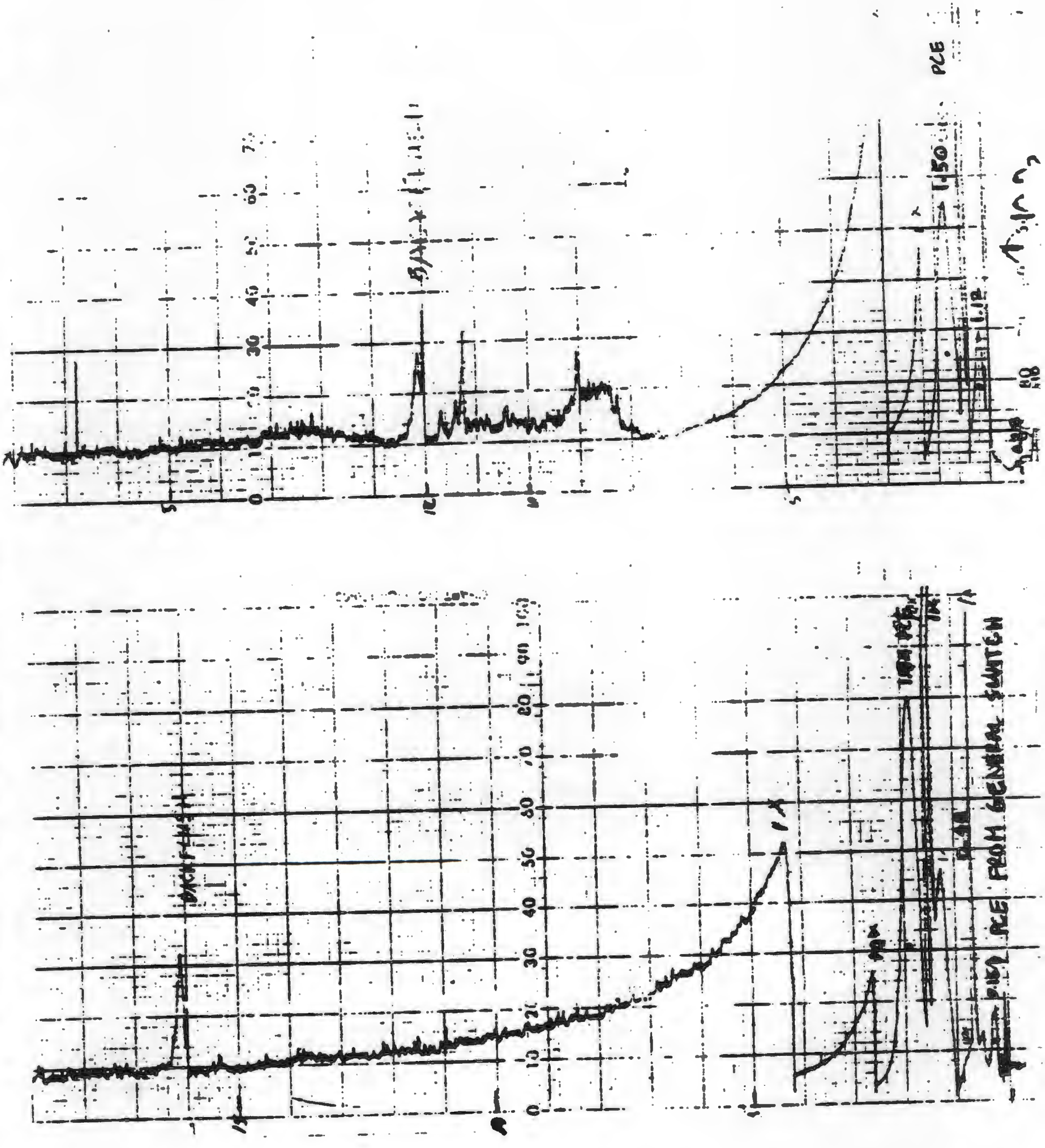


OVA- gas chromatograph mode

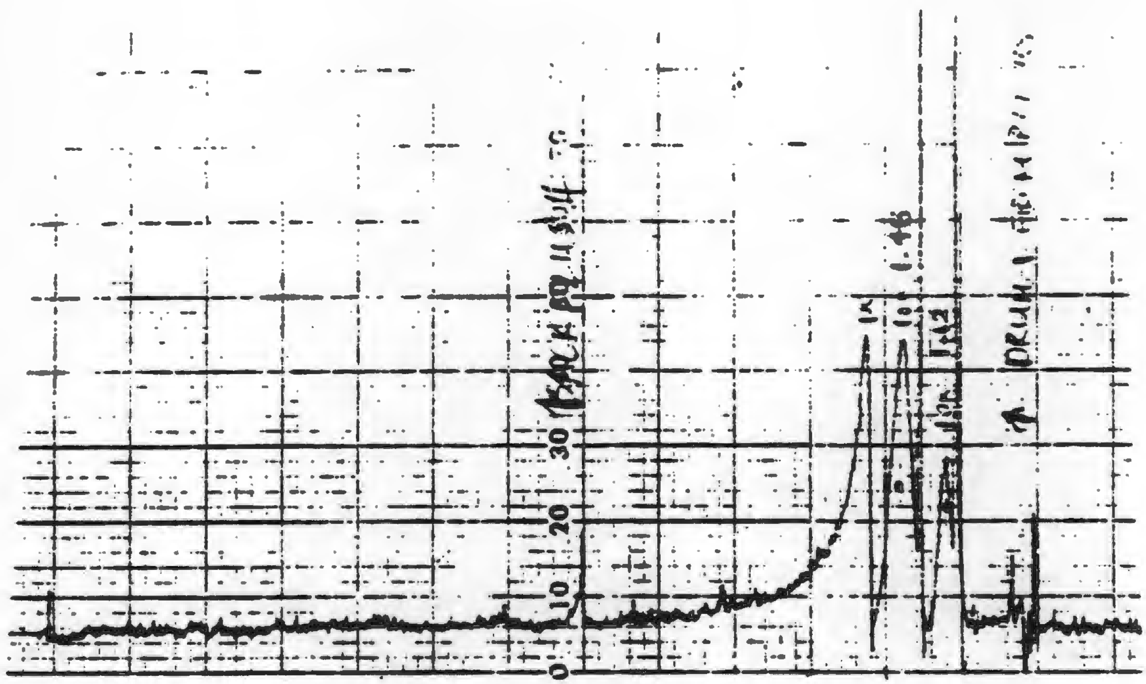




OVA- gas chromatograph mode



OVA-gas chromatograph mode



OVA-gas chromatograph mode

separate letter

2 alternatives

Caveat

encompass three alternative methods: 1) discharge directly to the sewer system; 2) treatment in the airstripper; and 3) use of tank trucks. This section must also provide that one in every ten samples will be analyzed by the lab.

4. The Pump Test Plan must include a description of what will be contained in a separate deliverable due within three weeks of the resubmittal of the Pump Test Plan (September 7, 1990). This separate document will be a plan to produce a Well Survey Report to determine which wells will be used in monitoring the Pump Test. This document should contain a schedule for completion of the well survey; it should also take into account the possibility that some of the wells may be in poor condition and therefore in need of renovation.

flag!!!

The well survey will precede the Pump Test itself. Therefore, the Pump Test Plan and the separate plan describing the well survey should indicate that the initiation of the Pump Test is the setting up of the datalogger and not the initiate of the well survey.

Comments on Sampling, Analysis and Monitoring Plan:

1. EPA expressed concern that the soil permeability of the site is not yet known.

2. The revised SAMP should include a section describing how the "percolation rate" will be calculated.

flag it

3. The revised SAMP should also give a general ideal of the timeframe for cleanup based on the calculation of the percolation rate.

flag it

This is the type of info that is part of an RI/DP plan or post sampling field work.

4. The EPA also expressed concern about the heterogeneity of the soil. Specifically, EPA wants the SAMP to address the possibility that there may be preferential flow paths through the soil and to suggest what will be done if that is true.

add

5. The revised SAMP should also address the issue of the extent of contamination by making provision for soil borings to trace the contours of the contamination out to nondetect levels.

STROOCK 7 HANOVER SQ TEL: 212-806-5798 Aug 9.90 10:05 No.001 P.05

ATTACHMENT IV

SOILS INVESTIGATION
TO DETERMINE
THE EXTENT OF PCE CONTAMINATION
AT THE
GENERAL SWITCH SITE

Prepared by

Fred C. Hart Associates, Inc.
296 Washington Avenue Extension
Albany, New York 12203

April 10,. 1986

TABLE OF CONTENTS

LIST OF FIGURES AND TABLE

1.0 Introduction

Fred C. Hart Associates, Inc. (HART) was retained by the General Switch Corporation (GSC) to conduct a soils investigation at the GSC site in Middletown, New York. This investigation was conducted to further examine on-site soils with respect to tetrachloroethylene (PCE) contamination and local geologic conditions. Specifically, the program was designed to estimate the lateral and vertical extent of PCE contamination in the soil at previously identified areas of significant contamination, and to provide additional information on the depth to undisturbed glacial till in these areas.

1.1 Scope of Work

A total of 20 soil borings were drilled in the areas previously identified as having significant PCE contamination in the soil. Split spoon samples were obtained from each boring and logged with respect to geologic conditions. In addition, samples from each spoon were retained for field and laboratory chemical analysis for PCE.

1.2 Contents of the Report

This report is divided into four sections. The first section presents introductory material pertaining to the purpose and scope of this investigation. The second section provides a brief summary of previous soil investigative activities at the site. Section three provides the detailed information on the purpose, procedures, and results of this investigation. The fourth section presents conclusions based on the results of this investigation. Test boring logs and laboratory analytical data are included as Appendices A and B, respectively.

2.0 SUMMARY OF PREVIOUS INVESTIGATIONS

2.1 HART Phase I Investigation

HART conducted a Phase I soil investigation at the GSC site in August and September, 1984. As part of this investigation an OVA/M-Pacto Probe survey was conducted and test pits were excavated. The results of this investigation indicated one isolated area of surficial PCE contamination in the soil at the GSC site. Test pit locations and analytical results are shown in Figure 2-1.

2.2 HART Soil Sampling Program

As a follow-up to the Phase I investigation, HART conducted a soil sampling program at the GSC site on April 8 and 10, 1985. This investigation was conducted in compliance with the Consent Order Agreement between the New York State Department of Environmental Conservation (NYSDEC) and GSC. This investigation was designed to further examine the shallow soils at the GSC site. As part of this investigation, an OVA/M-Pacto Probe survey was conducted and test pits were excavated. The results of this investigation indicated two areas of significant PCE contamination in the soil in addition to the area previously identified in the HART Phase I investigation. Test pit locations and analytical results are shown in Figure 2-2.

2.3 NYSDEC Investigation

The NYSDEC conducted a soil investigation at the GSC site in December, 1983 and March, 1984. As part of this investigation, soil was sampled at depths of from 0 to 2 feet around the GSC site. The results of this investigation indicated isolated areas of shallow PCE contamination in the soil at the GSC site.

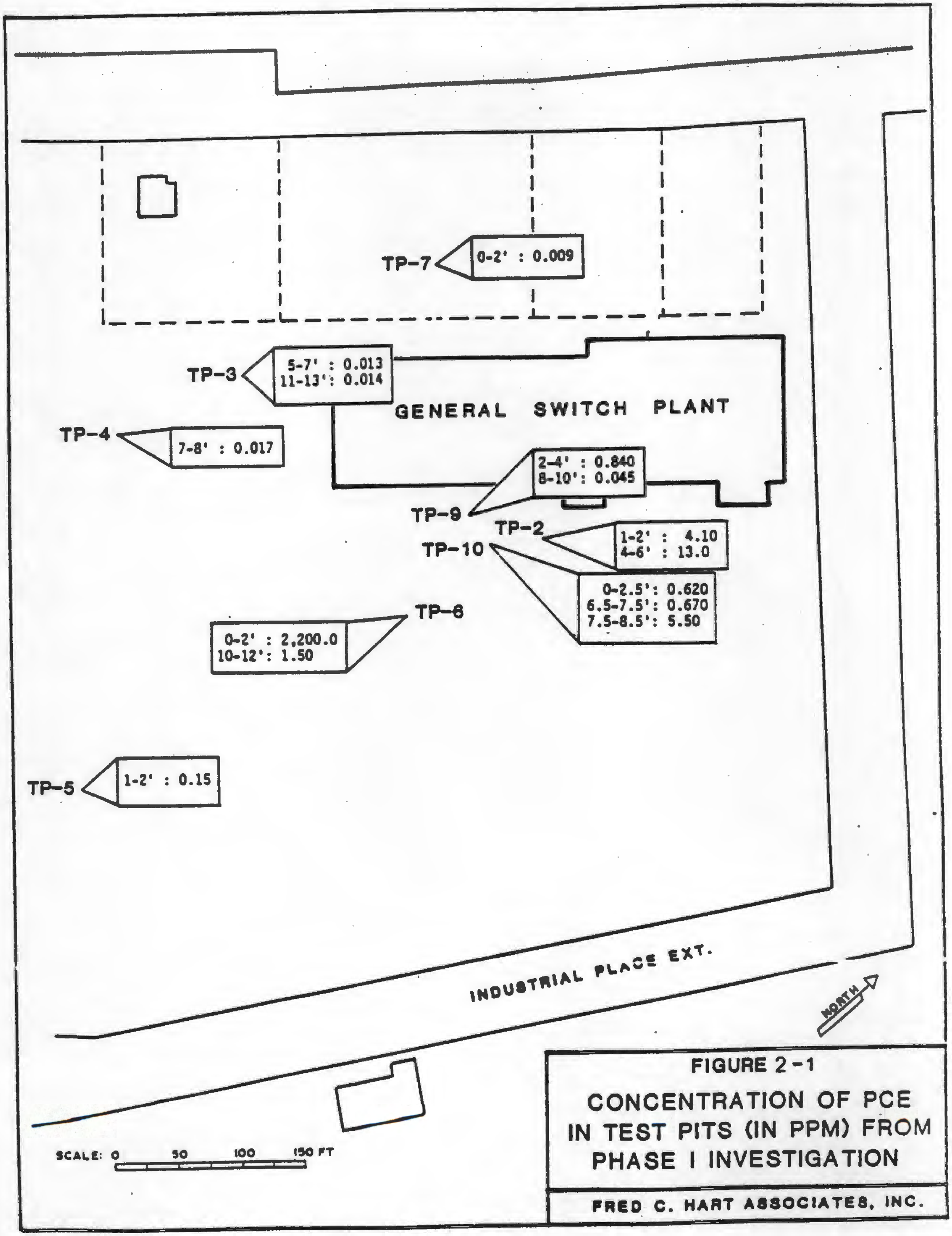


FIGURE 2-1

CONCENTRATION OF PCE IN TEST PITS (IN PPM) FROM PHASE I INVESTIGATION

FRED C. HART ASSOCIATES, INC.

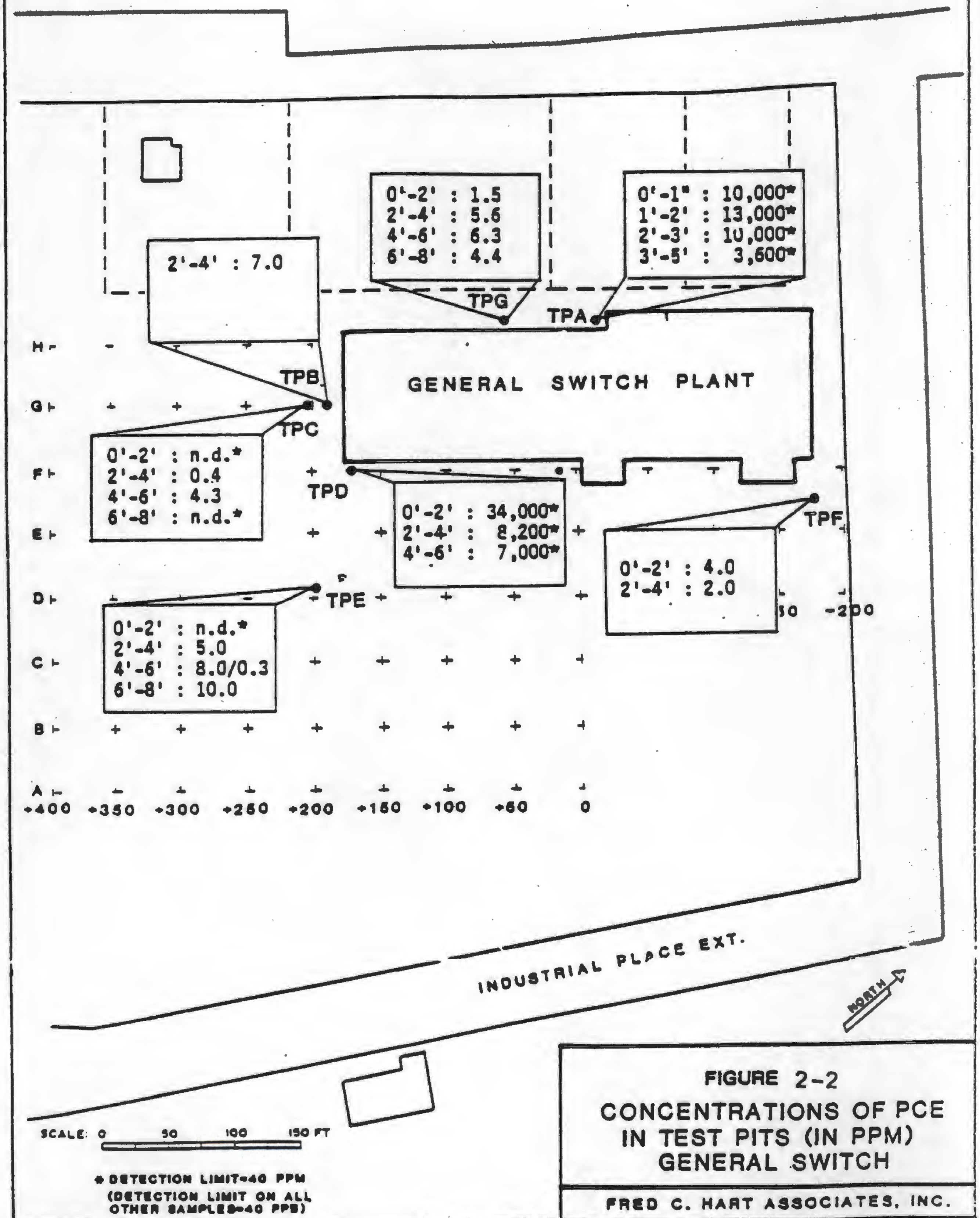


FIGURE 2-2
CONCENTRATIONS OF PCE IN TEST PITS (IN PPM)
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

3.0 SUMMARY OF INVESTIGATIVE ACTIVITIES

3.1 Introduction

This chapter presents the purpose, procedures, and results of the investigative activities conducted as part of this investigation. The section is divided into two parts. The first is a discussion of procedures and results with respect to site geology. The second addresses the procedures and results of the investigation pertaining to chemical (PCE) analyses.

3.2 Soil Borings Program

3.2.1 Purpose

The purpose of the soil borings program was to provide additional information on the site specific geologic conditions at the GSC facility, and to obtain samples of the soil at varying depths for chemical analyses.

3.2.2 Procedures

A total of 20 soil borings were completed as part of this investigation. Test Borings T-1 through T-14 were completed by Hardin-Huber Soil Testing Company of Crofton, Maryland. Due to access problems encountered using the Hardin-Huber rig, Test Borings T-15 through T-20 were completed by Kendrick Drilling Company of Monroe, New York. The locations of all test borings are shown in Figure 3-1.

The test borings were located based on the results of previous HART investigations indicating significant concentrations of PCE in these areas (Figures 2-1 and 2-2). A grid pattern locating the test borings was established at each of the three areas designated for investigation. This grid was dependent somewhat on rig accessibility.

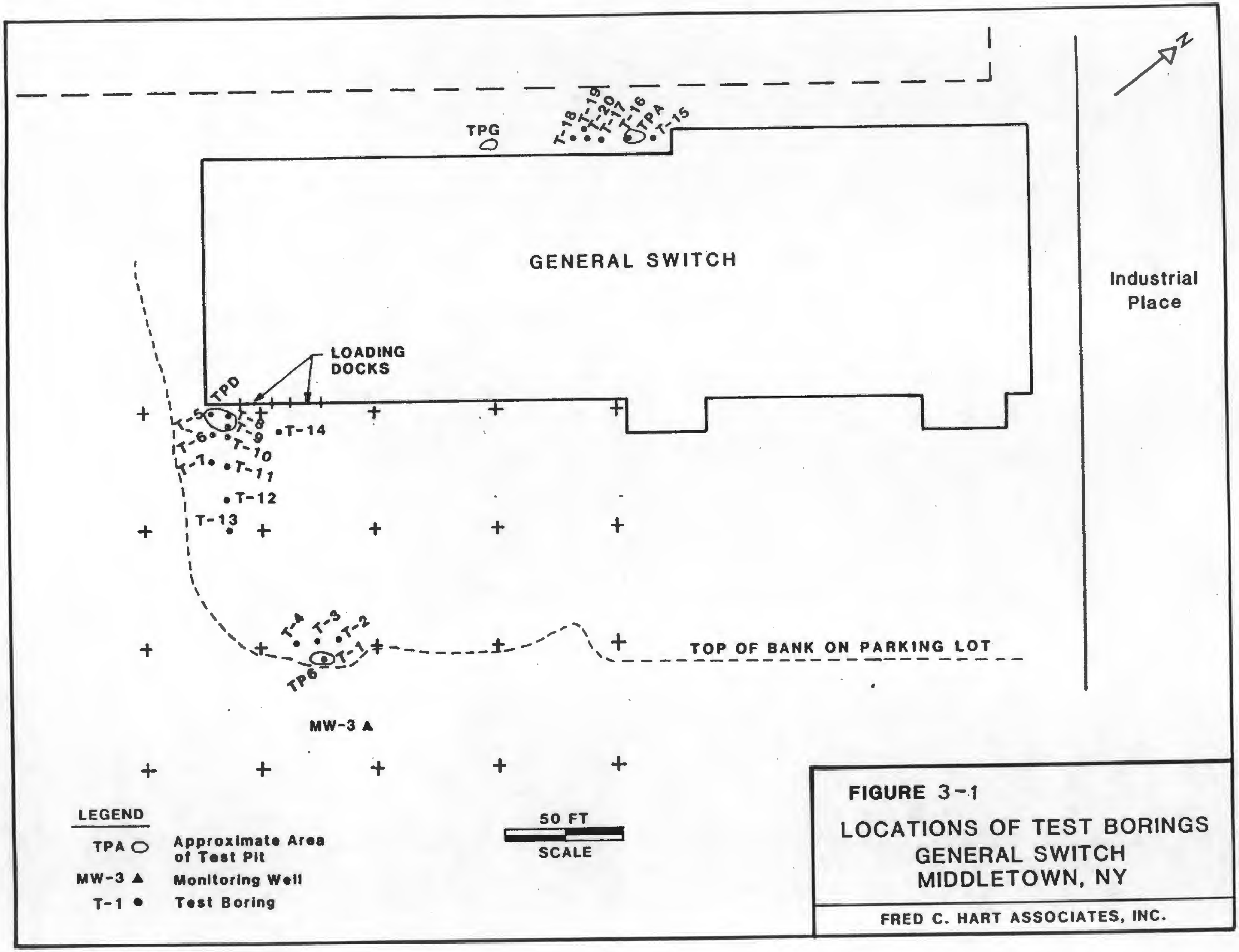


FIGURE 3-1
LOCATIONS OF TEST BORINGS
GENERAL SWITCH
MIDDLETOWN, NY

FRED C. HART ASSOCIATES, INC.

The Hardin-Huber test borings (T-1 through T-14) were completed using a hollow-stem auger rig. Split spoon samples were collected at the discretion of the HART geologist, generally at two-foot intervals. The borings were advanced into the undisturbed glacial till or until split spoon refusal was encountered.

Samples were collected with a two-foot split-spoon sampler and blow counts were recorded at six-inch intervals. A standard 140-pound drop hammer was used to drive the split spoons. The Kendrick test borings (T-15 through T-20) were completed with a mini-rig mounted on tracks equipped with a miniature derrick. The borings were advanced by percussion using a 130-pound drop hammer to drive the split spoon. This method allowed for continuous sampling of the soil (except in T-15). An attempt was made to drive the spoon the full 24 inches at each sampling interval, but due to the resistance of the fill material, this was not always possible.

The contents of each spoon were carefully described and logged. Portions of each sample were placed in a VOA vial for chemical analyses. An Organic Vapor Analyzer (OVA) was used to survey the split-spoon samples and the ambient air around the rigs during drilling operations.

3.2.3 Results

The test boring logs compiled during this investigation are given in Appendix A. A discussion of the geologic conditions encountered during this investigation is presented below.

Test Borings T-1 through T-4 were completed in the vicinity of TP6 (Figure 2-1) near the southeastern edge of the plant parking lot. A brown fill consisting of gravelly clay with sand and silt was found in this area to a depth of approximately 10 feet. Immediately underlying this material was light brown glacial till consisting of gravelly clay with sand. Deeper test borings completed at 15 to 17 feet indicated a change to a more orange-brown color and a higher percentage of sand. Black to gray shale, which may be indicative of bedrock or boulder, was also found at this depth.

Test Borings T-5 through T-14 were completed in the vicinity of TPD (Figure 2-2) near the loading dock at the southeastern corner of the plant building. These borings generally reflect geologic conditions encountered in T-1 through T-4, except that split-spoon samples taken between 7 and 10 feet indicated a gray till or pale soil horizon overlying the light brown gravelly clay till. This one to two foot layer is predominantly clay to sandy clay with local gravel.

Test Borings T-15 through T-20 were completed in the vicinity of TPA (Figure 2-2), on the northwest side of the building adjacent to Highland Avenue. Due to the limitations inherent in the use of the mini-rig, the maximum depth achieved in this area was approximately 13 feet in TB-17. These test borings apparently penetrated only fill material. The undisturbed glacial till was not encountered.

The fill material, while consisting mainly of glacially derived material, was probably deposited during the construction of the building. The fill consisted of brown, gravelly clay with sand and silt. A gray shale, probably a boulder, was encountered at 13.3 feet in test boring T-17.

3.3 Photovac and Laboratory Chemical Analyses

3.3.1 Purpose

The purpose of the Photovac and laboratory chemical analyses was to provide information regarding the lateral and vertical extent to PCE contamination in the soils at the three areas addressed in this investigation.

3.3.2 Procedures

This part of the investigation was conducted in two phases, a field analysis using the Photovac and a laboratory analysis which was used as a basis for correlating the Photovac results to actual PCE concentrations in the soil. As such, duplicate samples were retained in VOA vials from the split spoon samples, where possible. An attempt was made to ensure that equal volumes of soil were placed in the VOA vials so that a reasonable comparison of PCE contamination between samples could be made. The VOA vials were stored upside down on ice prior to the Photovac analysis, and prior to and during shipment for laboratory analysis.

The Photovac analysis was conducted using a Photovac Model 10S50 portable gas chromatograph (GC). The Photovac GC utilizes photoionization at ambient temperatures. A Model SE30 column with a packing material of silicon gum and a length of four feet was used.

As part of the field analytical procedure, the Photovac was calibrated with a PCE standard. The standard was used for qualitative analysis only. A 100 ul injection of the standard was introduced into the Photovac to obtain the retention time for PCE. For the purposes of this investigation, any sample peak with a retention time like that of the standard was assumed to be PCE. The PCE peak derived from the standard was arbitrarily labelled 1 ppm according to the peak size. All other PCE peaks obtained during the Photovac these samples were 21, 72, 1692, and 1871 ppm, respectively. The corresponding laboratory concentrations were 3.08, 4.68, 92.2, and 132.4 ppm, respectively. The results indicate that the concentrations of PCE in the headspace as identified through the Photovac analysis are approximately one order of magnitude greater than the actual concentration of PCE in the soil. Based on this correlation a conservative relationship between the Photovac analysis and the laboratory analysis can be established as follows:

Photovac Analysis (ppm)		Corresponding PCE Concentration in the Soil (ppm)
>1000	<-- significant contamination -->	>100
100-1000	<-- moderate contamination -->	10-100
1-10	<-- low contamination -->	<1

NOTE: Not all samples collected were analyzed with the Photovac. If the OVA scan of the split spoon indicated a high concentration of total volatile organics (greater than 1000 ppm) it was assumed that the sample was highly contaminated and a Photovac analysis was not performed. Based on the OVA results from this study and laboratory analytical results from previous studies, PCE concentrations in the soil around TPA and TPD are known to be higher than 200 ppm. The following discussion addresses only the Photovac results which, based on the laboratory correlation, showed concentrations of 200 ppm or less.

With the above relationship in mind, the following is a discussion of the findings of the chemical analyses of this soils investigation.

Soil samples taken from the area around TP6, which included Test Borings T-1 through T-4, showed PCE concentrations in the range of less than 1 to approximately 20 ppm.

With respect to contamination in the vertical direction, the higher concentrations were found at depths of 2 to 7 feet., as indicated in Test Borings T-2, T-3, and T-4. PCE contamination below a depth of 10 feet and extending to a depth of 17 feet was in the range of 1 to 5 ppm for all samples analyzed in this area.

With respect to the lateral extent of PCE contamination in this area, all four test borings generally showed the same degree of contamination. It appears that PCE contamination at concentrations of less than 20 ppm extends laterally beyond the area investigated with Test Borings T-1 through T-4.

Soil samples taken from the area around TPD, which included Test Borings T-5 through T-14, showed PCE contamination in the range of less than 1 ppm to approximately 200 ppm.

With respect to contamination in the vertical direction in this area, the higher concentrations were found at depths of 0 to 12 feet, with the highest concentrations generally at depths of less than 10 feet. Concentrations in samples taken at depths of 12 to 17 feet were in the range of approximately 5 to 15 ppm.

With respect to the lateral extent of PCE contamination in this area, the highest concentrations were found in Test Borings T-7, T-8, T-9, T-10 and T-11, at levels of up to approximately 200 ppm with the Photovac and greater than 1000 ppm with the OVA. The lowest concentrations were found in Test Borings T-5, T-6, T-12, T-13 and T-14, in a range of less than 1 ppm to approximately 20 ppm. It appears that these test borings roughly define the lateral extent of PCE contamination in this area.

Soil samples taken from the area around TPA, which included Test Borings T-15 through T-20, showed PCE contamination in a range of less than 1 ppm to approximately 200 ppm.

With respect to contamination in the vertical direction in this area, the analytical data generated is less conclusive than in the preceding two areas. Due to the liminations of the mini-rig, as previously discussed, we were unable to extend our borings through the heavily contaminated fill material into the undisturbed glacial till. It appears that there is significant contamination in the vertical direction in this area to at least a depth of 10 to 12 feet.

With respect to the lateral extent of PCE contamination in this area, the highest concentrations were found in Test Borings T-15, T-16, T-17, and T-20, at levels of up to approximately 200 ppm with the Photovac and greater than 1000 ppm with the OVA. However, Test Boring T-19 had a maximum concentration of approximately 5 ppm and all three concentrations in T-18 were less than 1 ppm. It appears that Test Boring T-19 roughly defines the lateral extent of PCE contamination parallel to the building in this area.

4.0 CONCLUSIONS

Based on the results of this and previous soil investigations conducted at the GSC site, the following conclusions may be drawn:

1. There is a layer of undisturbed glacial till at a depth of approximately 10 to 12 feet in the two areas investigated in the parking lot in the vicinity of TP6 and TPD. This layer is at least 5 feet thick based on borings taken to 17 feet in these areas. This till layer was not encountered in the area investigated around TPA to a depth of approximately 13 feet. The permeability of this till layer is on the order of 10^{-7} cm/sec., based on the results of two triaxial tests performed in a previous study on relatively undisturbed samples of this material.

2. It appears that this till layer is acting as a barrier to vertical migration of PCE contamination from the contaminated fill in the two areas investigated in the parking lot. The vertical extent of PCE contamination in these two areas is to a depth of 10 to 12 feet. Below this depth contamination is less than 5 ppm and in most cases less than 1 ppm.

3. The vertical extent of contamination around TPA was not defined. There appears to be significant contamination to a depth of at least 10 to 12 feet in this area. It is likely that the glacial till layer identified in previous borings extends underneath this area of contamination. If that is the case, it would also act as a barrier to vertical migration of PCE contamination in this area.

4. The lateral extent of PCE contamination in the area around TPD is roughly defined by Test Borings T-5, T-6, T-12, T-13, and T-14.

5. The lateral extent of contamination in the area around TPA is roughly defined by Test Boring T-19 and the GSC property line adjacent to this area.

6. The lateral extent of contamination in the area around TP6 was not defined. Maximum concentrations of PCE in this area ranged from approximately 10 to 20 ppm.

APPENDIX A

Test Boring Logs

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. AC371		BORING NO. T-1	
PROJECT General Switch		LOCATION Middletown, NY	
DRILLING CONTRACTOR Hardin - Huber		DRILLING EQUIPMENT Mobile Rig w/ H.S.A.	
GEOLOGIST J. Brown		DRILLER K. Shepard	
SIZE & TYPE OF BIT	DATE START 3-4-86	DATE FINISH 3-4-86	
CASING — HAMMER WT. — FALL —	SAMPLER Split Spoon	HAMMER WT #140	FALL 30"
WELL CASING	SCREEN MAKE & TYPE	LENGTH	SLOT
ELEVATION OF GROUND SURFACE	WELL CASING	SCREEN	WATER / DATE

REMARKS SS - Split Spoon; HSA - Hollow Stem Auger; T.D. - Total Depth

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
	0–2		HSA					
	2–4	S-1	SS	0.4	2.3 4.1	Med. brn FILL - gravel, silt & clay		
	4–5		HSA					
	5–7	S-2	SS	0.7	4.6 7.7	The SAME		
	7–10		HSA					
	10–10.5	S-3	SS	0.4	3.4 50/1"	Lt. brn. TILL(?) - GRAVELLY-CLAY		
						T.D. - 10.5 ft		

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

PAGE 1 OF 1

JOB NO. A037i

BORING NO. T-2

PROJECT General Switch

LOCATION Middletown, NY

DRILLING CONTRACTOR Hardin-Huber

DRILLING EQUIPMENT Mobile Rig with H.S.A

GEOLOGIST J. Brown

DRILLER K. Sheppard

SIZE & TYPE OF BIT

DATE START 3-4-86

DATE FINISH 3-4-86

CASING — HAMMER WT. — FALL —

SAMPLER Split Spoon HAMMER WT #140 FALL 30"

WELL CASING

SCREEN MAKE & TYPE

LENGTH

SLOT

ELEVATION OF GROUND SURFACE | WELL CASING | SCREEN | WATER | DATE

REMARKS See T-1

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft.	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		S-1	SS		24 51/3"			
			HSA					
		S-2	SS	1.2'	9-14 9-8	Med. brn. FILL - gravelly clay; silt and sand;		
	5		HSA					
		S-3	SS	0.4'	6-7 8-7	SAME		
			HSA					
	10	S-4	SS	0.7	11-28 21-16	Lt. brn. TILL (?) - gravelly clay; moist		
			HSA					
	15	S-5	SS	2.0	9-26 43-22	1.2 - Lt./orange/brn. CLAYEY SAND & GRAVEL; wet 0.8 Blk-gray SHALE/CLAY (Boulder?); Damp to dry		
	20					17 ft Total Depth		
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. A037i	BORING NO. T-3
PROJECT General Switch	LOCATION Middletown, NY
DRILLING CONTRACTOR Hardin-Huber	DRILLING EQUIPMENT Mobile Rig with HSA
GEOLOGIST J. Brown	DRILLER K. Sheppard
SIZE & TYPE OF BIT	DATE START 3-4-86 DATE FINISH 3-4-86
CASING — HAMMER WT. — FALL —	SAMPLER Split Spoon HAMMER WT #140 FALL 30"
WELL CASING	SCREEN MAKE & TYPE LENGTH SLOT
ELEVATION OF GROUND SURFACE	WELL CASING SCREEN WATER DATE
REMARKS See T-1	

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		S-1	SS	0.4	37	Brn. FILL; SAND, CLAY & GRAVEL		
			HSA		51/3"			
		S-2	SS	1.2	7-7 12-19	Brn. FILL; CLAYEY-GRAVEL & SAND; dry, damp.		
	5		HSA					
		S-3	SS	0.8	7-8 7-6	SAME; damp		
			HSA					
	10	S-4	SS	1.7	5-18 18-M	Lt. brn. TILL (?) GRAVELLY-CLAY & SANDY-CLAY; moist to damp.	Duplicate	
			HSA					
	15	S-5	SS	1.1	19-10 11-15	SAME		
	20							
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

BORING NO. T-4

JOB NO. A037i	
PROJECT General Switch	LOCATION Middletown, NY
DRILLING CONTRACTOR Hardin-Huber	DRILLING EQUIPMENT Mobile Rig with HSA
GEOLOGIST J. Brown	DRILLER K Sheppard
SIZE & TYPE OF BIT	DATE START 3-4-86 / DATE FINISH 3-4-86
CASING — HAMMER WT. — FALL —	SAMPLER Split Spoon HAMMER WT #140 FALL 30"
WELL CASING	SCREEN MAKE & TYPE LENGTH SLOT
ELEVATION OF GROUND SURFACE	WELL CASING SCREEN WATER DATE
REMARKS See T-1	

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft.	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
			HSA					
		S-1	SS	1.2	6-7 7-9	Brn. FILL; CLAYEY-GRAVEL, with SAND & SILT		
	5		HSA					
		S-2	SS	0.9	3-6 6-7	SAME		
			HSA					
	10	S-3	SS	1.2	2-10 43-22	Lt. brn. TILL GRAVELLY-CLAY; WITH SAND; damp.		
			HSA					
	15	S-4	SS	1.2	21-32 19-37	Orange-brn. CLAYEY-SAND & blk. to gry Shale (Shale = boulder?)		
						T.D. = 17'		
	20							
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. A037i	BORING NO. T-5
PROJECT General Switch	LOCATION Middletown, NY
DRILLING CONTRACTOR Hardin-Huber	DRILLING EQUIPMENT Mobile Rig with HSA
GEOLOGIST J. Brown	DRILLER K. Sheppard
SIZE & TYPE OF BIT	DATE START 3-4-86 / DATE FINISH 3-4-86
CASING — HAMMER WT. — FALL —	SAMPLER Split-Spoon HAMMER WT # 140 FALL 30"
WELL CASING	SCREEN MAKE & TYPE LENGTH SLOT
ELEVATION OF GROUND SURFACE / WELL CASING	SCREEN / WATER / DATE
REMARKS See T-1	

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
	0		HSA					
		S-1	SS	0.8	4-8 7-10	Brn. FILL: Gravelly CLAY; Sand; silt; damp to moist		
	5		HSA					
		S-2	SS	1.0	13-14 6-6	Brn. FILL; CLAYEY-SAND, with gravel; moist	Duplicate	
			HSA					
	10	S3	SS	0.9	30 5½"	Lt. Brn. TILL? (FILL?); sandy, gravelly CLAY		
	15						Unable to drill augers past 10.5 ft	
	20							
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. A037i	BORING NO. T-6
PROJECT General Switch	LOCATION Middletown, NY
DRILLING CONTRACTOR Hardin-Huber	DRILLING EQUIPMENT Mobile Rig with HSA
GEOLOGIST J. Brown	DRILLER K. Sheppard
SIZE & TYPE OF BIT	DATE START 3-5-86 / DATE FINISH 3-5-86
CASING — HAMMER WT. — FALL —	SAMPLER Split-Spoon / HAMMER WT #140 / FALL 30"
WELL CASING	SCREEN MAKE & TYPE / LENGTH / SLOT
ELEVATION OF GROUND SURFACE / WELL CASING / SCREEN / WATER / DATE	
REMARKS See T-1	

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft.	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		S-1	SS	0.7	4-13 14-7	Brn. FILL; GRAVELLY-CLAY; WITH Sand & Silt.		
			HSA					
		S-2	SS	1.3	3-6 4-13	SAME		
	5		HSA					
		S-3	SS	0.5	19-16 12-8	SAME		
			HSA					
	10	S4	SS	1.5	5-10 14-23	Lt. brn. TILL; abundant CLAY; SILTY CLAY; With GRAVEL; some with sand; damp; moist		
			HSA					
	15	S5	SS	0.9	12-37 16-14	Lt. brn. TILL; abundant CLAY & GRAVEL; Some sand; wet		
						T.D. 17ft.		
	20							
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. AC371	BORING NO. T-7
PROJECT General Switch	LOCATION Middletown, NY
DRILLING CONTRACTOR Hardin-Huber	DRILLING EQUIPMENT Mobile Rig w/ HSA
GEOLOGIST J. Brown	DRILLER K. Shepard
SIZE & TYPE OF BIT	DATE START 3-5-86 / DATE FINISH 3-5-86
CASING — HAMMER WT. — FALL —	SAMPLER Split Spoon HAMMER WT #140 FALL 30"
WELL CASING	SCREEN MAKE & TYPE / LENGTH / SLOT
ELEVATION OF GROUND SURFACE / WELL CASING / SCREEN / WATER / DATE	
REMARKS See T-1	

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		S-1	SS	1.5	7-8 10-8	Brn. FILL: CLAYEY-GRAVEL w/ SAND & SILT; damp-moist		
			HSA					
		S-2	SS	0.2	7-8 4-4	The SAME	Poor Recovery	
	5		HSA					
		S-3	SS	0.9	8-19 13-16	The SAME; damp	—Duplicate	
			HSA					
	10	S-4	SS	0.9	8-11 10-9	Lt. (Orange) brn TILL; SANDY-CLAY, w/Gravel; abndnt silt, dry to damp		
			HSA					
	15	S-5	SS	0.7	14-5½"	Brn TILL; SANDY-GRAVEL (Shale); w/ to some clay, silt; wet	—Auger Refusal at 14 ft. —near bedrock?	
	20							
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

BORING NO. T-8

JOB NO. A037i

PROJECT General Switch | LOCATION Middletown, NY

DRILLING CONTRACTOR Hardin-Huber | DRILLING EQUIPMENT Mobile Rig with HSA

GEOLOGIST T. Brown | DRILLER K. Sheppard

SIZE & TYPE OF BIT | DATE START 3-5-86 | DATE FINISH 3-5-86

CASING — HAMMER WT. — FALL — | SAMPLER Split-Spoon | HAMMER WT #140 | FALL 30"

WELL CASING | SCREEN MAKE & TYPE | LENGTH | SLOT

ELEVATION OF | GROUND SURFACE | WELL CASING | SCREEN | WATER | DATE

REMARKS See T-1

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		S-1	SS	0.6	1-2 1-1	Brn. FILL; CLAYEY-GRAVEL with sand, silt; wet		
			HSA					
		S-2	SS	0.25	1-2 2-1	SAME		
	5		HSA					
		S-3	SS	0.7	4-7 6-6	SAME	Duplicate	
			HSA					
	10	S-4	SS	1.7	11-13 14-9	Lt. brn. TILL; CLAY; with gravel; some silt, sand, damp to moist	8.5' Auger refusal no reading on OVA, but distinct odor 8.5': 60 ppm OVA Split-Spoon: (8.5 ft to 10.5 ft) 8 ppm OVA	
	15							
	20							
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. A037i		BORING NO. T-9	
PROJECT General Switch		LOCATION Middletown, NY	
DRILLING CONTRACTOR Hardin-Huber		DRILLING EQUIPMENT Mobile Rig with HSA	
GEOLOGIST J. Brown		DRILLER K Sheppard	
SIZE & TYPE OF BIT	DATE START 3-5-86	DATE FINISH 3-5-86	
CASING — HAMMER WT. — FALL —	SAMPLER Split Spoon	HAMMER WT #140	FALL 30"
WELL CASING	SCREEN MAKE & TYPE	LENGTH	SLOT
ELEVATION OF GROUND SURFACE	WELL CASING	SCREEN	WATER / DATE
REMARKS See T-1			

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft.	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		S-1	SS	0.7	1-2 1-2	Brn. TILL; Sandy, CLAYEY-GRAVEL with Silt; wet		
			HSA					
		S-2	SS	0.2	1-2 2-2	SAME; distinct odor; (no OVA change)		
	5		HSA					
		S-3	SS	0.9	2-4 5-9	SAME; distinct odor		
			HSA					
	10	S-4	SS	1.4	2-7 5-8	Lt. Brn. TILL; GRAVELLY-CLAY; with silt, some sand; damp to dry 1 ppm OVA		
			HSA					
		S-5	SS	0.2	51/5"	brn. GRAVEL; Poor Recovery No sample obtained	13.5' auger refusal	
	15							
	20							
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. A037i		BORING NO. T-10	
PROJECT General Switch		LOCATION Middletown, NY	
DRILLING CONTRACTOR Harain Huber		DRILLING EQUIPMENT Mobile Rig with HSA	
GEOLOGIST J. Brown		DRILLER K. Sheppard	
SIZE & TYPE OF BIT	DATE START 3-5-86	DATE FINISH 3-5-86	
CASING ___ HAMMER WT. ___ FALL ___	SAMPLER Split-Spoon	HAMMER WT #140	FALL 30"
WELL CASING	SCREEN MAKE & TYPE	LENGTH	SLOT
ELEVATION OF GROUND SURFACE	WELL CASING	SCREEN	WATER / DATE
REMARKS See T-1			

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		S-1	SS	0.3	5-8 13-15	Brn. FILL; CLAYEY, SANDY-GRAVEL		
			HSA					
		S-2	SS	1.2	7-9 11-13	SAME; distinct odor 30 ppm OVA		
	5		HSA					
		S-3	SS	1.4	11-12 18-12	SAME; distinct odor; ~10 ppm OVA		
			HSA					
	10	S-4	SS	0.4	51/6"	0.2 Gry-blk. CLAY; w/ roots; 0.2 Lt. brn. CLAY w/ sand, silt tr. f. gravel } TILL. No odor. No OVA reading	10' auger refusal	
	15					T.D. 10.5 ft.		
	20							
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. A037i	BORING NO. T-11
PROJECT General Switch	LOCATION Middletown, NY
DRILLING CONTRACTOR Hardin Huber	DRILLING EQUIPMENT Mobile rig w/ HSA
GEOLOGIST J. Brown	DRILLER K. Shepard
SIZE & TYPE OF BIT	DATE START 3-5-86 / DATE FINISH 3-5-86
CASING — HAMMER WT. — FALL —	SAMPLER Split Spoon HAMMER WT #140 FALL 30"
WELL CASING	SCREEN MAKE & TYPE LENGTH SLOT
ELEVATION OF GROUND SURFACE	WELL CASING SCREEN WATER DATE
REMARKS See T-1	

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		S-1	SS	0.8	5-11 11-12	Brn FILL: CLAYEY-SAND & GRAVEL; some silt, moist	OVA: "1ppm"	
			HSA				OVA: 25ppm	
		S-2	SS	0.9	9-5 6-5	The SAME		
	5		HSA					
		S-3	SS	1.1	8-16 19-21	The SAME; damp	OVA: 4ppm	
							" "	
		S-4	SS	—	4-8 10-7	Blk-gry TILL: CLAY w/ roots; some - tr. gravel, some silt, dry to damp	Auger Refusal at 7 ft.: 70 ppm - OVA probe out of augers at 7 ft.	
	10						"T.D." - 9 ft.	
	15							
	20							
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. P037i	BORING NO. T-12
PROJECT General Switch	LOCATION Middletown, NY
DRILLING CONTRACTOR Hardin-Huber	DRILLING EQUIPMENT Mobile Rig w/ H.S.A.
GEOLOGIST J. Brown	DRILLER K. Shepard
SIZE & TYPE OF BIT	DATE START 3-5-86 / DATE FINISH 3-5-86
CASING — HAMMER WT. — FALL —	SAMPLER Split Spoon HAMMER WT #140 FALL 30"
WELL CASING	SCREEN MAKE & TYPE / LENGTH / SLOT
ELEVATION OF GROUND SURFACE / WELL CASING / SCREEN / WATER	DATE
REMARKS See T-1	

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		S-1	SS	0.9	10-31/3	Brn. FILL - abndnt SAND, CLAY & GRAVEL; damp	distinct odor	
			HSA					
		S-2	SS	0.3	11-14 15-18	The SAME	No odor	
			HSA					
	5	S-3	SS	1.5	9-18 13-19	Brn FILL - GRAVELLY-CLAY: w/ sand, silt		
			HSA				Auger Refusal at 9 ft.	
	10	S-4	SS	1.3	20-3 4-4	Grn-gry TILL: abndnt SANDY-CLAY w/ GRAVEL, some silt, v. moist to wet: "gumbo" texture	"T.D." - 11 ft.	
	15							
	20							
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO A0371		BORING NO. T-13	
PROJECT General Switch		LOCATION Middletown, NY	
DRILLING CONTRACTOR Hardin - Huber		DRILLING EQUIPMENT Mobile rig w/ HSA	
GEOLOGIST J. Brown		DRILLER K. Shepard	
SIZE & TYPE OF BIT	DATE START 3-5-86	DATE FINISH 3-5-86	
CASING — HAMMER WT. — FALL —	SAMPLER Split Spoon	HAMMER WT #140	FALL 30"
WELL CASING	SCREEN MAKE & TYPE	LENGTH	SLOT
ELEVATION OF GROUND SURFACE	WELL CASING	SCREEN	WATER / DATE
REMARKS See T-1			

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		S-1	SS	1.1	12·11 14·15	Brn FILL: CLAYEY-SAND & GRAVEL; dry to damp	no noticeable odor	
			HSA					
		S-2	SS	0.5	12·11 11·17	The SAME; damp.		
	5		HSA					
		S-3	SS	1.1	5·7 6·4	The SAME; damp to moist		
			HSA					
	10	S-4	SS	1.2	2·3 17·18	0.8 Grn-Gry TILL: GRAVELLY-CLAY moist 0.4 Orange-brn TILL: SILTY-CLAY w/ Gravel, damp		
			HSA					
	15	S-5	SS	1.3	10·19 27·23	Orange-brn TILL: CLAYEY-GRAVEL abndnt Sand; w/ silt, wet	T.D.: 17 ft	
	20						~54 ft away from plant bldg.	
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

BORING NO. T-14

JOB NO. A037i	
PROJECT General Switch	LOCATION Middletown, NY
DRILLING CONTRACTOR Hardin-Huber	DRILLING EQUIPMENT Mobile rig w/ HSA
GEOLOGIST J. Brown	DRILLER K. Shepard
SIZE & TYPE OF BIT	DATE START 3-5-86 / DATE FINISH 3-5-86
CASING — HAMMER WT. — FALL —	SAMPLER Split Spoon HAMMER WT #140 FALL 30"
WELL CASING	SCREEN MAKE & TYPE / LENGTH / SLOT
ELEVATION OF GROUND SURFACE / WELL CASING / SCREEN / WATER / DATE	
REMARKS See T-1	

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft.	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
			HSA					
		S-1	SS	1.2	18-20 21-23	Brn FILL: CLAYEY-SAND & GRAVEL, w/ silt; damp to dry		
	5		HSA					
		S-2	SS	0.7	7-9 7-4	The SAME		
			HSA					
	10	S-3	SS	0.6	11-50/.1	Orange-brn TILL; Gravelly SILTY-CLAY w/ sand damp to moist	T.D. = 11 ft (Split Spoon and Auger Refusal)	
	15							
	20							
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO A037i	BORING NO. T-15
PROJECT General Switch	LOCATION Middletown, NY
DRILLING CONTRACTOR Kendrick	DRILLING EQUIPMENT Mini-Rig and Derrick
GEOLOGIST J. Brown	DRILLER Emmett
SIZE & TYPE OF BIT	DATE START 3-6-86 / DATE FINISH 3-6-86
CASING — HAMMER WT. — FALL —	SAMPLER Split Spoon HAMMER WT #130 FALL ~30"
WELL CASING	SCREEN MAKE & TYPE / LENGTH / SLOT
ELEVATION OF GROUND SURFACE / WELL CASING / SCREEN / WATER / DATE	
REMARKS Per. - Percussion hole expansion; See T-1 for other remarks	

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft.	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
	0	S-1	SS	0.9	1-17 12-18	Brn FILL: CLAY, some Gravel	Upper 0.1 ft w/ small metal frags. OVA: ~7ppm	
			Per.					
	5	S-2	SS	1.5	18-25 40-70	Lt. brn to choc. brn 'FILL': GRAVELLY-CLAY, w/ silt, damp	(TILL material)	
		S-3	SS	1.4	25-41 40-70	Brn. 'FILL' (TILL) - GRAVELLY CLAYEY-SAND, abndnt clay & sand	-Distinct odor at top of SS (OVA: 3ppm)	
		S-4	SS	—	100/5"	The SAME	Refusal at 9.5 ft.	
	10							
	15							
	20							
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. A037i			BORING NO. T-16
PROJECT General Switch		LOCATION Middletown, NY	
DRILLING CONTRACTOR Kendrick		DRILLING EQUIPMENT Mini-rig and derrick	
GEOLOGIST J. Brown		DRILLER Emmett	
SIZE & TYPE OF BIT	DATE START 3-6-86	DATE FINISH 3-6-86	
CASING — HAMMER WT. — FALL —	SAMPLER Split Spoon	HAMMER WT #130	FALL ~30"
WELL CASING	SCREEN MAKE & TYPE	LENGTH	SLOT
ELEVATION OF: GROUND SURFACE	WELL CASING	SCREEN	WATER / DATE
REMARKS See T-1			

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		S-1	SS	0.5	1 1 2 2	Brn & Blk FILL: abndnt CLAY & GRAVEL	abndnt small metal frags.: 0.1 ft	
		S-2	SS	1.0	5 13 10 7	Brn FILL: CLAYEY-SAND & GRAVEL, wet	distinct odor OVA: 20 ppm	
	5	S-3	SS	1.5	15 16 15 20	The SAME	OVA: 7 ppm	
		S-4	SS	0.7	23 24 26 27	Lt. brn, grn-gry "FILL" (TILL?): GRAVELLY-CLAY, some sand	OVA: 2 ppm	
		S-5	SS	0.9	36 56 100/3"	Brn "FILL" (TILL?): CLAYEY-SAND, w/ gravel	faint odor TD/Refusal: 9.2 ft	
	10							
	15							
	20							
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. A0371		BORING NO. T-17	
PROJECT General Switch		LOCATION Middletown, NY	
DRILLING CONTRACTOR Kendrick		DRILLING EQUIPMENT Mini rig and derrick	
GEOLOGIST J. Brown		DRILLER Emmett	
SIZE & TYPE OF BIT	DATE START 3-6-86	DATE FINISH 3-6-86	
CASING — HAMMER WT. — FALL —	SAMPLER Split Spoon	HAMMER WT #130	FALL ~30"
WELL CASING	SCREEN MAKE & TYPE	LENGTH	SLOT
ELEVATION OF GROUND SURFACE	WELL CASING	SCREEN	WATER / DATE
REMARKS See T-1			

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		S-1	SS	1.2	1 5 / 11 13	Brn FILL - GRAVELLY-CLAY, w/ sand wet	0.2 ft of Metal frags. at surface OVA: 6 ppm	
		S-2	SS	0.8	9 7 / 10 15	Lt. brn FILL - SANDY-CLAY w/ gravel, wet to moist	distinct odor OVA: 6 ppm	
	5	S-3	SS	1.0	31 20 / 19 21	Lt. (choc.) brn FILL - CLAYEY-SAND w/ gravel; loc. gry clay	OVA: 3 ppm	
		S-4	SS	1.2	18 20 / 20 23	The SAME; abndnt gravel	OVA: 9 ppm	
		S-5	SS	0.7	34 36 / 10 8	The SAME AS ABOVE	- distinct odor	
	10	S-6	SS	1.5	28 18 / 20 22	Lt. brn TILL?; GRAVELLY-CLAY w/ sand; damp to dry	- distinct odor	
		S-7	SS	1.2	55 32 / 100/4"	1.0 Brn. TILL?; SAND, w/ clay & gravel 0.2 Gry SHALE (BOULDER?)	- no odor T. Of Refusal: 13.3 ft.	
	15							
	20							
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. A0371	BORING NO. T-18
PROJECT General Switch	LOCATION Middletown, NY
DRILLING CONTRACTOR Kendrick	DRILLING EQUIPMENT Mini rig and derrick
GEOLOGIST J. Brown	DRILLER Emmett

SIZE & TYPE OF BIT	DATE START 3-6-86	DATE FINISH 3-6-86

CASING —	HAMMER WT. —	FALL —	SAMPLER Split Spoon	HAMMER WT #130	FALL ≈ 30"

WELL CASING	SCREEN MAKE & TYPE	LENGTH	SLOT

ELEVATION OF	GROUND SURFACE	WELL CASING	SCREEN	WATER	DATE

REMARKS

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		S-1	SS	1.6	1.5 6.10	0.3 Dk. gry CLAY (TOPSOIL) 1.3 Brn FILL - GRAVELLY-CLAY	No odor	
		S-2	SS	1.3	9.10 12.10	Brn FILL: CLAYEY-SAND w/ gravel moist	No odor	
	5	S-3	SS	1.2	25.22 29.34	The SAME; abndnt gravel		
		S-4	SS	0.9	16.16 17.19	0.4 The SAME 0.5 Lt. brn TILL?, laminated CLAY & GRAVELLY-SAND		
		S-5	SS	1.0	24.32 100/0.5"	Brn TILL?: CLAYEY-SAND, w/ gravel	No odor T.D./Refusal: 9 ft	
	10							
	15							
	20							
	25							

FRED C. HART ASSOCIATES, INC.
530 FIFTH AVENUE
NEW YORK, NEW YORK 10036

JOB NO. A037i	BORING NO. T-19
PROJECT General Switch	LOCATION Middletown, NY
DRILLING CONTRACTOR Kendrick	DRILLING EQUIPMENT Mini rig and derrick
GEOLOGIST J. Brown	DRILLER Emmett
SIZE & TYPE OF BIT	DATE START 3-6-86 / DATE FINISH 3-6-86
CASING — HAMMER WT. — FALL —	SAMPLER Split Spoon HAMMER WT #130 FALL ≈30"
WELL CASING	SCREEN MAKE & TYPE / LENGTH / SLOT
ELEVATION OF / GROUND SURFACE / WELL CASING	SCREEN / WATER / DATE
REMARKS	

LOG OF BORING

CASING BLOWS/ft	DEPTH ft	SAMPLE No.	TYPE	RECOVERY ft.	PENETRATION RESISTANCE blows/6"	DESCRIPTION	REMARKS	GRAPHIC LOG
		S-1	SS	1.5	1·3 6·7	0.6 Gry CLAY (TOP SOIL) 0.9 Orange brn CLAYEY-SAND w/ gravel		
		S-2	SS	1.4	16·37 52·47	The SAME		
	5	S-3	SS	1.1	59·62 59 100/3"	The SAME	Refusal/T.D. ≈6 ft	
	10							
	15							
	20							
	25							

Adirondack Environmental Services, Inc.®
P.O. Box 265
298 Riverside Avenue
Rensselaer, NY 12144
(518) 434-4546

LABORATORY REPORT

Client: Fred C. Hart Associate, Inc.
296 Washington Avenue Extension
Albany, NY 12203

Attention: Mr. Brian Jacot

No. Samples analyzed 4

Date Received: 3/13/86 Sample Taken By: A. Levy Matrix: Soil

Date Sampled: Location: Composite or Grab:

Methods are in accordance with STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, and METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES, (EPA), unless otherwise noted or attached.

PARAMETER(S)	Your sample ID	T-5	T-8	T-3	T-7		UNITS(1)	LABORATORY NOTE BOOK REFERENCE
	AES NUMBER	860313H01	860313H02	860313H03	860313H04			
Tetrachloro-ethylene		4680	132,400	3080	92,200		ug/kg	TF-B-34

(1)Units are expressed in mg/l unless otherwise stated.

NA = Not Applicable < = less than
ND = Not Detectable > = greater than

Approved by: Paul Batista
Date: 3/26/86

Specializing in Hazardous Waste and Petroleum Product Analyses