PHASE II INVESTIGATION
AMPHENOL BOILER ROOM
SIDNEY, NEW YORK

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EXECUTIVE SUMMARY

Environmental Resources Management, Inc. has conducted a Phase II investigation in the Boiler Room area of Amphenol Corporation's Sidney New York manufacturing facility, to augment the findings of the Phase I investigation conducted in 1985. These investigations were conducted to address the potential effects on ground water by waste oil discovered during excavation of a below grade waste oil tank, in November 1984. Specifically, this Phase II investigation was designed to determine the source of chlorinated volatile organic compounds detected in the Boiler Room area, evaluate the horizontal and vertical distribution of these compounds, and to assess the potential for these compounds to impact off-site areas, including the Amphenol North Well and/or the Village of Sidney water supply wells.

The Phase II investigation included the installation of five additional shallow ground water monitoring wells to a maximum depth of 25 feet, and one deep ground water monitoring well to a depth of 100 feet. Subsequent to monitoring well installation, one complete round of ground water samples was collected from the entire monitoring well network (wells BR-1 through BR-11) followed by a second round of confirmatory samples collected from the Phase II wells (wells BR-6 through BR-11). Ground water sampling was followed by slug testing of select wells and an evaluation of the influence of the North Well on Boiler Room ground water by monitoring water levels in select wells for a period of 11 days.

The results of these investigations indicate that the Boiler Room ground water contains primarily TCE and related degradation products. Residual BTX compounds from the tank area have a sporadic distribution in ground water at concentrations generally less than 10 parts per billion.

The major conclusions of this investigation are as follows:

- The principal source area for the chlorinated volatile organics appears to be a former drum storage area which reportedly may have been present near the Boiler Room area.

- Ground water flows to the north and/or northwest in the area of the Boiler Room, ultimately discharging to the Susquehanna River. Ground water flow velocities range from 1 to 1.5 feet per day.
- Due to the nature of the lacustrine unit, vertically downward flow is minimal in the Boiler Room area.
- Pumping the North Well directly influences ground water in the deep flow system, but has only a limited influence on the shallow flow system in the Boiler Room area. However, closer to the North Well, vertical flow could be induced by the pumping. In fact, low concentrations of TCE degradation products detected in samples from the North Well indicate that the North Well pumping may be capturing a portion of the plume.
- There is no potential for significant human exposure to the compounds associated with the Boiler Room.
- On-site ground water quality exceeds the NYSDEC Ground Water Standards for TCE, and guidelines for other related volatile organics.
- Given the potential for migration of site-related compounds to the North Well and the exceeding of NYSDEC ground water standards, a program of ground water recovery and treatment should be established.

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SECTION 1
INTRODUCTION

1.1 Site Location and Background

Amphenol Corporation operates an electrical connector and component manufacturing facility in Sidney, New York. The town of Sidney is located approximately 40 miles northeast of the city of Binghamton, adjacent to the Susquehanna River on the western border of Delaware County, New York (Figure 1-1).

In the late 1960s, an underground storage tank was installed in the Boiler Room area of the Amphenol facility for the purpose of storing Number 6 fuel oil, which was used to fire the plant boiler in the adjacent Boiler Room. The tank was converted to a waste oil storage tank in 1981, periodically emptied, and its contents transported to a disposal facility. The tank was taken out of service in 1983.

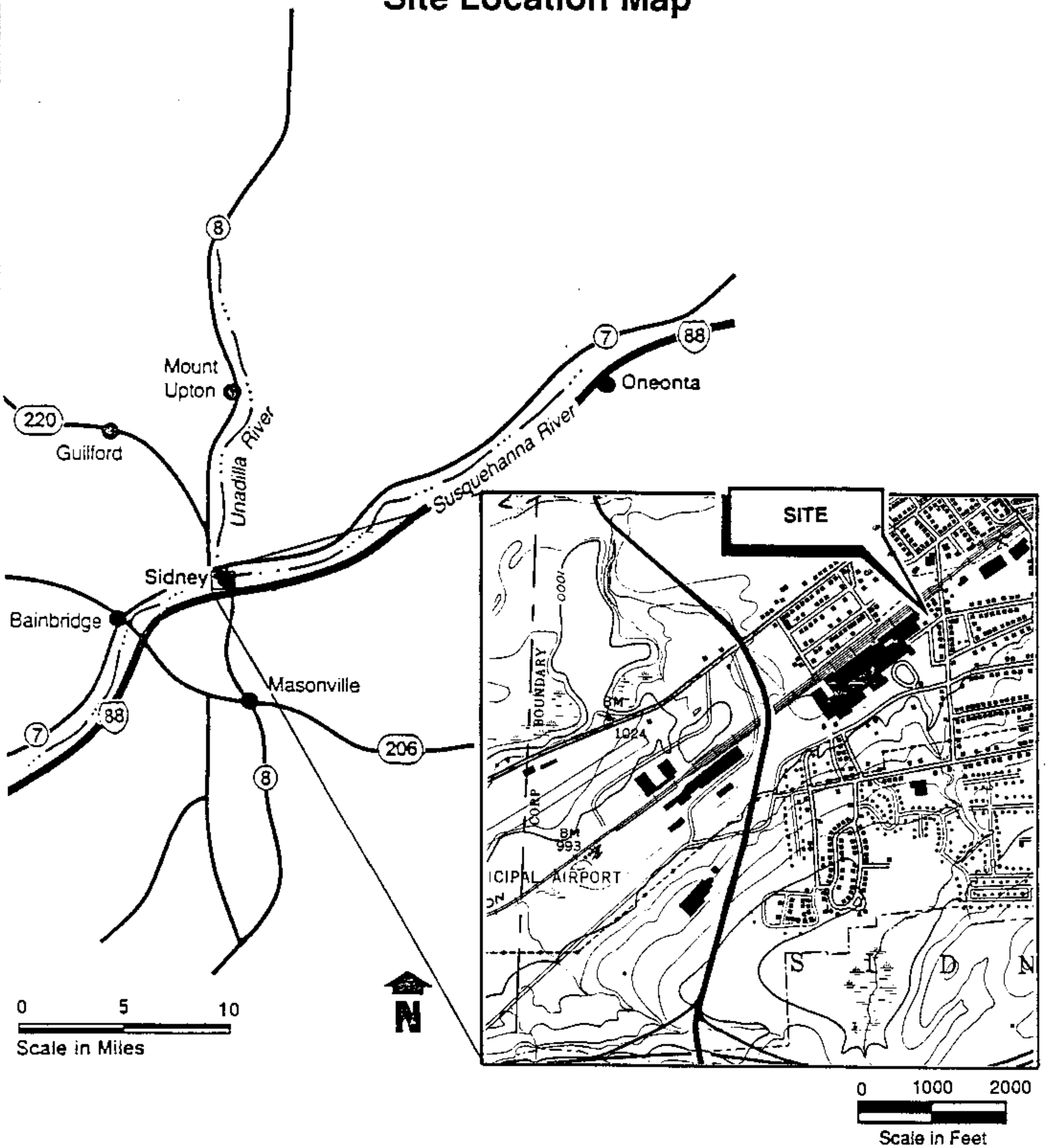
During the excavation and subsequent removal of the tank on 27 November 1984, oil was discovered in the subsurface soils surrounding the tank. Detailed inspection of the tank revealed no apparent leaks, which led to the conclusion that either small scale spillages over time or unidentified leaks in the tank piping were the probable source of the subsurface oil.

1.2 Environmental Setting

1.2.1 Geology

The town of Sidney lies within the glaciated northern portion of the Appalachian Plateaus Physiographic Province. Uplifted, nearly horizontal beds of siltstone, sandstone, shale, some limestone, and occasional seams of coal, through which rivers and streams have incised deep, narrow valleys, characterize the Appalachian Plateaus Province. Advances and subsequent retreats of Pleistocene Age glacial sheets widened and deepened many of these valleys, with glacial melt depositing till (a typically dense, unsorted deposit of boulders, cobbles, gravel, sand and silt), and glacial drift. Deposits of glacial drift are subdivided by origin into two categories: glaciofluvial deposits, which consist of sorted sands and gravels deposited by glacial melt waters; and

Figure 1-1
Site Location Map



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glaciolacustrine deposits, consisting of fine sand, silt, and clay deposited in glacial lakes created by the damming of rivers and streams by glacial ice and sediments.

The Amphenol Facility is located within an northeast-southwest trending section of the Susquehanna River Valley. Outcrops observed in the valley walls include three interbedded, yet distinct rock types: a dense, slightly fissile red and gray siltstone; a medium dense, gray sandstone; and a dense, fissile red shale containing occasional gray siltstone interbeds.

Within the valley, overburden deposits consisting of both glacial and alluvial sediments overlie the aforementioned bedrock lithologies. The composition of overburden deposits is variable with location, and may include some or all of the following:

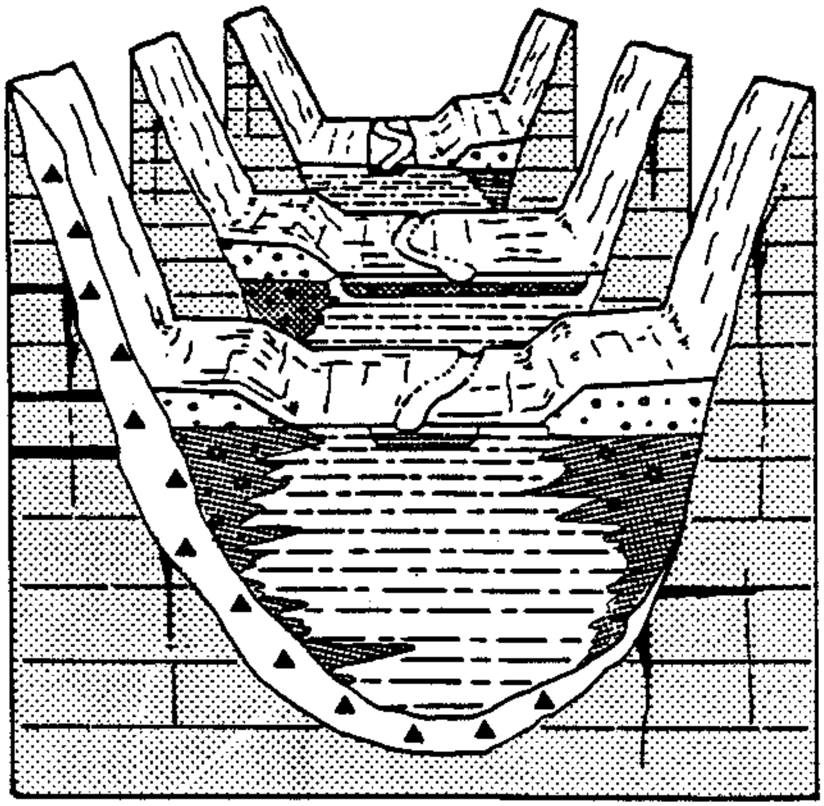
- Overbank river alluvial deposits consisting of brown silt and fine sand;
- Riverbed deposits consisting of permeable rounded sand and gravel;
- Glacial outwash consisting of permeable sand and gravel;
- Glacial till consisting of a mix of boulders, cobbles, gravel, sand, and silt, having a low permeability and which varies in density depending upon location; and
- Glaciolacustrine silts, sands, and/or clays, low permeability units deposited in glacial lake environments.

Overbank and riverbed deposits are generally found at the land surface adjacent to the Susquehanna River. Significant thicknesses of glacially derived sediments are present throughout the valley and can also be found covering large portions of the valley walls. The overburden deposits typically are interfingered, adding to both the geologic and hydrogeologic complexity of the area. The interrelationship of the overburden deposits and the underlying bedrock is presented in Figure 1-2.

1.2.2 Hydrogeology

Ground water within the Sidney area occurs in two aquifer systems: the unconfined overburden system and the underlying bedrock system.

Figure 1-2
Simplified Cross Section of the Susquehanna River Valley near Sidney, New York



LEGEND

- Sand and Gravel
- Lacustrine Silts, Clay, and Very Fine Sand
- Till
- Bedrock, with Fractures
- High-Yielding Aquifer Material
- Low-Yielding Aquifer Material

(Modified from MacNish and Randall, 1982)

Ground water movement within the bedrock system occurs through secondary porosity that is comprised primarily of joints, fractures, and bedding planes. Where these features intersect, ground water movement can occur in both a vertical and/or horizontal direction. According to MacNish (1982), water supply wells in the region that are completed in bedrock have yields that range from 20 to 60 gallons per minute (gpm).

The overburden can be subdivided into the glacial till and the glacial drift systems. Wells constructed within the glacial till generally yield less than 0.5 gpm as a result of its dense nature and quantity of fine material within the till (MacNish 1982). The glacial drift deposits, however, provide the most important aquifer in the Susquehanna River Valley region. In contrast to wells completed in the till, wells completed in the drift deposits produce variable yields that are dependant upon the quantity of fine sediments present. Wells completed in sand and gravel outwash units can yield quantities of water in excess of 1000 gpm.

1.3 Initial (Phase I) Boiler Room Investigation

The Phase I Boiler Room investigation began in January 1985 with the installation of five shallow monitoring wells, to an approximate depth of 25 feet. The wells were located to determine the presence of free-floating oil on the shallow ground water table, characterize ground water quality, and define the extent of migration of any associated dissolved organic compounds. Monitoring well locations for the Phase I Investigation are shown in Figure 1-3.

The following conclusions were drawn from the Phase I Investigation:

1. Ground water in the Boiler Room area occurs under unconfined conditions within unconsolidated, glacial sediments.

2. Variable amounts of seasonal recharge, interlayering of permeable and impermeable sediments, and shallow hydraulic gradients appear to contribute to changes in direction of ground water flow within the unconfined aquifer.

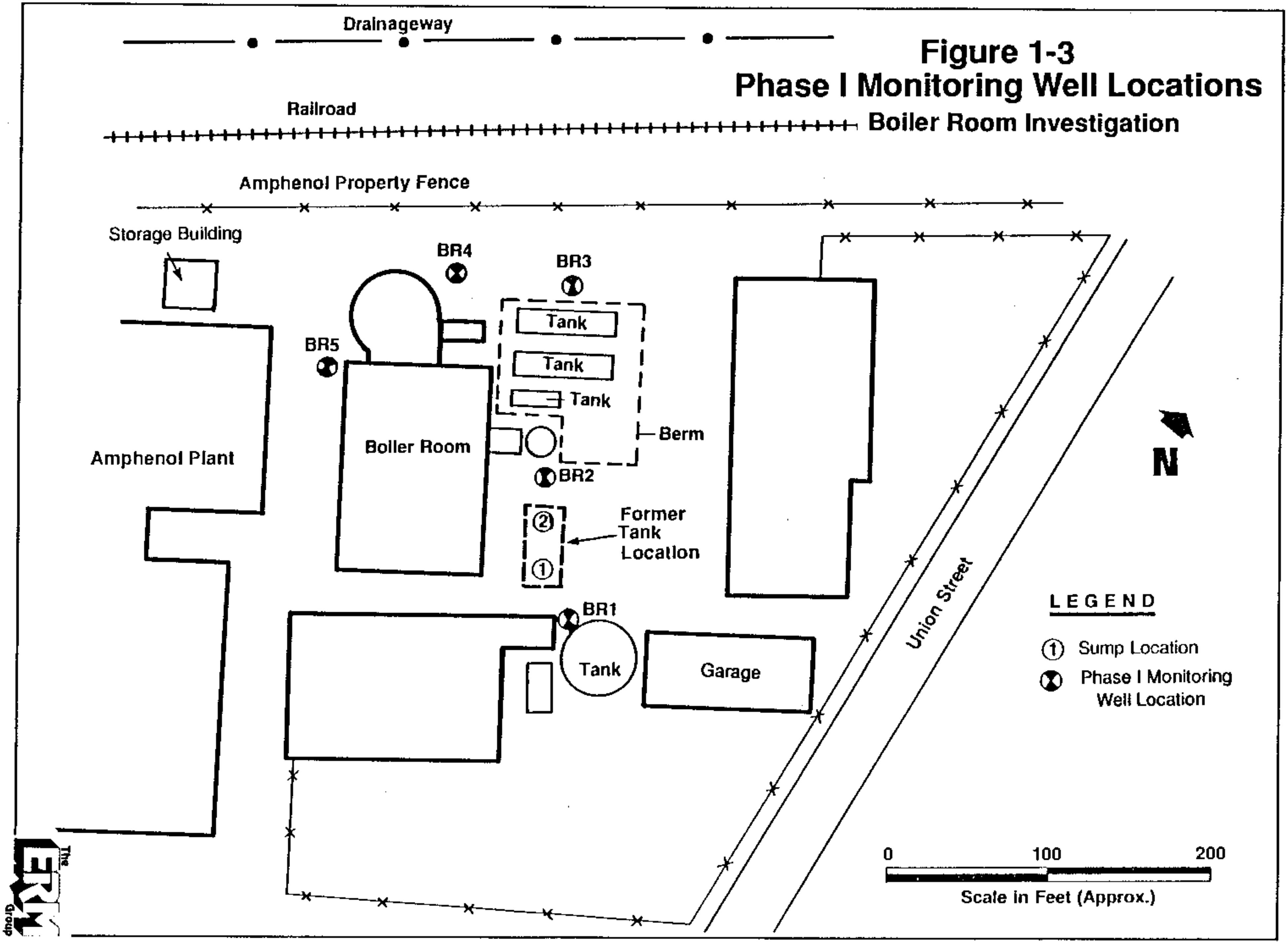


Figure 1-3
Phase I Monitoring Well Locations
Boiler Room Investigation

3. The high absorptive capacity of the sediments in the vicinity of the former underground storage tank prevented the occurrence of free-floating oil on the shallow ground water.
4. Dissolved benzene, toluene and xylene (BTX) compounds, which have migrated northward in the unconfined aquifer are the primary ground water quality concern in the Boiler Room area.
5. The limited source of oil, low ground water flow velocity and dilution served to limit the horizontal extent of dissolved BTX compounds within the ground water.
6. The downward vertical migration of dissolved BTX compounds into the unconfined aquifer is limited by their lighter-than-water density.

The Phase I Report also included a recommendation that additional ground water monitoring be conducted to verify ground water flow direction and to better define the extent of dissolved BTX compounds in the unconfined aquifer underlying the Boiler Room area.

1.4 Post Phase I Monitoring

Ground water monitoring subsequent to the Phase I Investigation indicated the presence of chlorinated volatile organic compounds (VOCs), including trichloroethene (TCE), trans 1,2-dichloroethene (Trans 1,2-DCE), 1,1-dichloroethene (DCE), vinyl chloride (VC), and tetrachloroethene (PCE), that did not appear to be related to the former waste tank. Ongoing monitoring has indicated that these compounds have been increasing in concentrations over time, while the BTX levels associated with the former waste tank have decreased in response to Amphenol's remedial actions when the tank was removed. Since no known on-site source exists for the other compounds, this suggested that they may have originated from an off-site source.

1.5 Purpose and Scope of the Phase II Investigation

The purpose of this Phase II Investigation is to further define the extent and source of the chlorinated VOCs in the Boiler Room area. This Phase II Investigation was authorized by the New York State Department of Environmental Conservation

(NYSDEC) by approval of Amphenol's Phase II Work Plan, dated 30 November 1988.

The Phase II Investigation was designed to:

- determine the source of the non-BTX related VOCs which have been detected in increasing concentrations in the Boiler Room area;
- evaluate the vertical and horizontal distribution of VOCs detected in the ground water beneath the Boiler Room area; and
- assess the potential for the ground water beneath the Boiler Room area to impact off-site areas, including the Amphenol North Well and/or the Village of Sidney water supply wells.

These issues were addressed by conducting field investigations which included the following:

- Soil Gas Survey - To identify areas of elevated VOC concentration to assist in placement of additional monitoring wells;
- Monitoring Well Installation - To assist in defining ground water movement;
- Ground Water Sampling and Analysis - To characterize on-site ground water quality; and
- Aquifer Characterization- To estimate the hydraulic conductivity of the subsurface materials and assess the effects of the North Well pumping on the flow systems at the Boiler Room area.

These activities are described in detail in the following sections.

SECTION 2
FIELD INVESTIGATION

2.1 Soil Gas Survey

A limited soil gas (SG) survey was conducted in the Boiler Room area in May, 1988 in an attempt to screen for areas of elevated VOC concentrations. The results of the SG Survey were used to assist in determining final locations for the monitoring wells installed during the Phase II investigation. The sampling points used are shown in Figure 2-1.

Soil gas samples were obtained by advancing one inch diameter soil gas borings using a gasoline powered, hand held auger to a depth of three to four feet. Soil types encountered were observed and recorded while advancing each borehole. After reaching total depth, the auger was withdrawn and a one-inch diameter PVC soil gas probe, as depicted in Figure 2-2, inserted into the borehole. The fit between the soil gas probe and the borehole was sufficiently tight to ensure that soil gas vapors were not diluted by ambient air. After the sample was collected, a second, deeper sample was collected in select borings by removing the PVC probe and driving a one-half-inch stainless steel probe to a depth of seven to eight feet. A Foxboro Model 128 Organic Vapor Analyzer (OVA) with a flame ionization detector (FID) was used for both extraction and analysis of samples for total VOC concentration.

In addition to total VOC concentration, soil gas samples were also analyzed for TCE and degradation by-products DCE and Trans 1,2-DCE, using a portable gas chromatograph (GC). Soil gas samples were collected for GC analysis by inserting a Hamilton® gas tight syringe through the Tygon tubing of the soil gas probe. Samples were subsequently injected into the column of a Photovac 10S50 portable GC which was equipped with a 5% SE 30 packed column to provide separation of TCE and associated degradation by-products.

Calibration standards were prepared, and the resultant calibration chromatograms compared with sample chromatograms to assess whether TCE or its associated degradation by-products were qualitatively present in the soil

Figure 2-1
Soil Gas Sampling Locations
Boiler Room Investigation

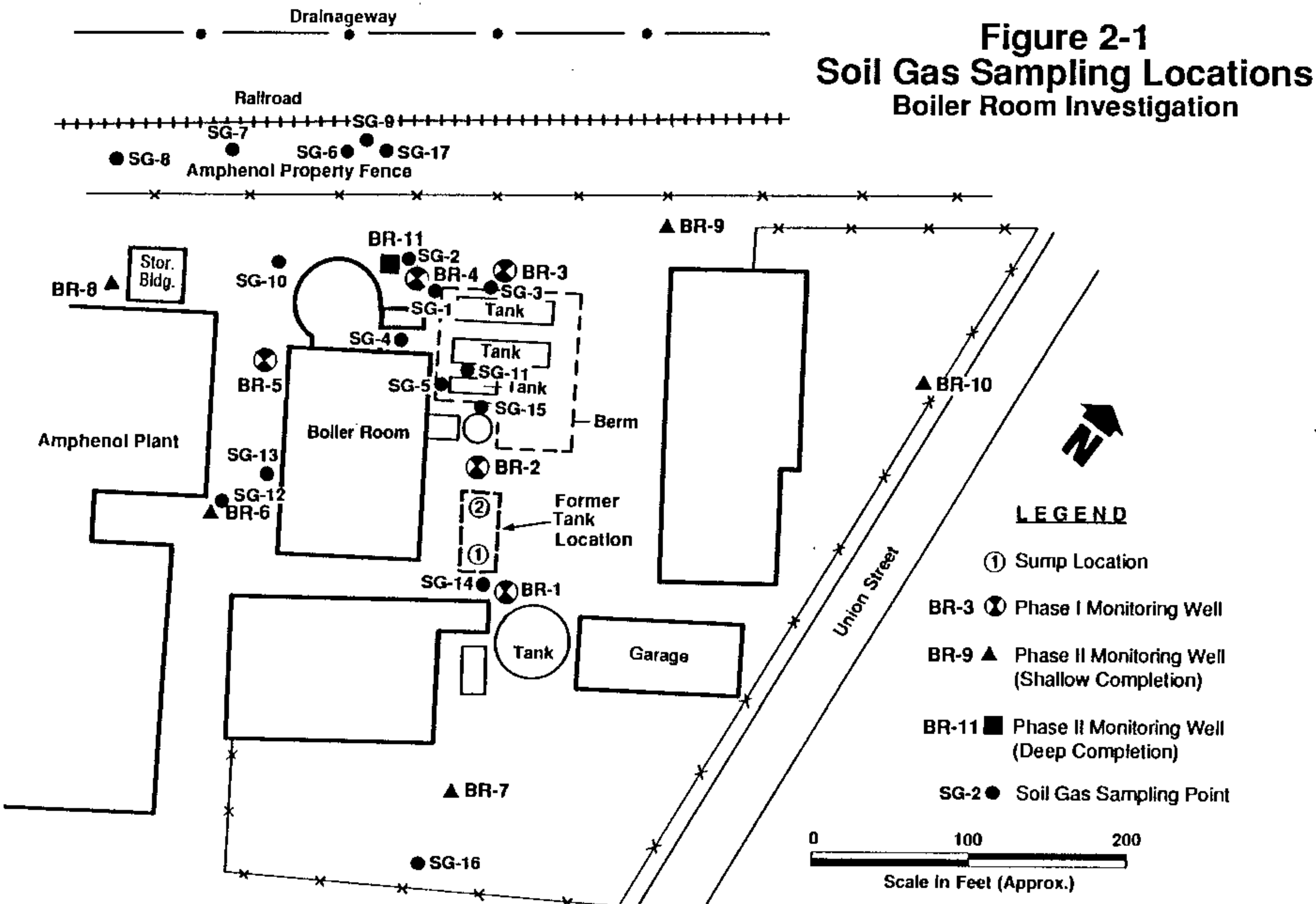


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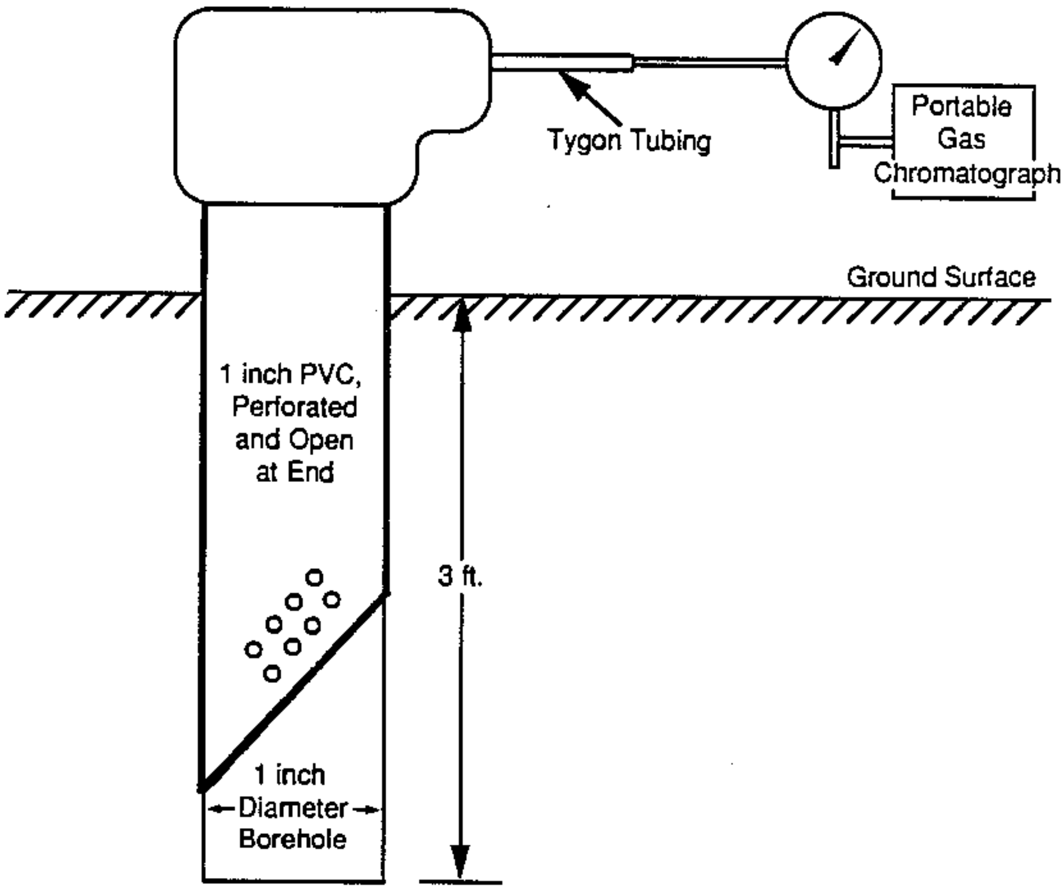
Figure 2-2
Soil Gas Probe Schematic



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gasses analyzed. Additional quality control was implemented by the analysis of deionized water blanks as necessary to allow for determination of carry-over, and syringe/instrument contamination.

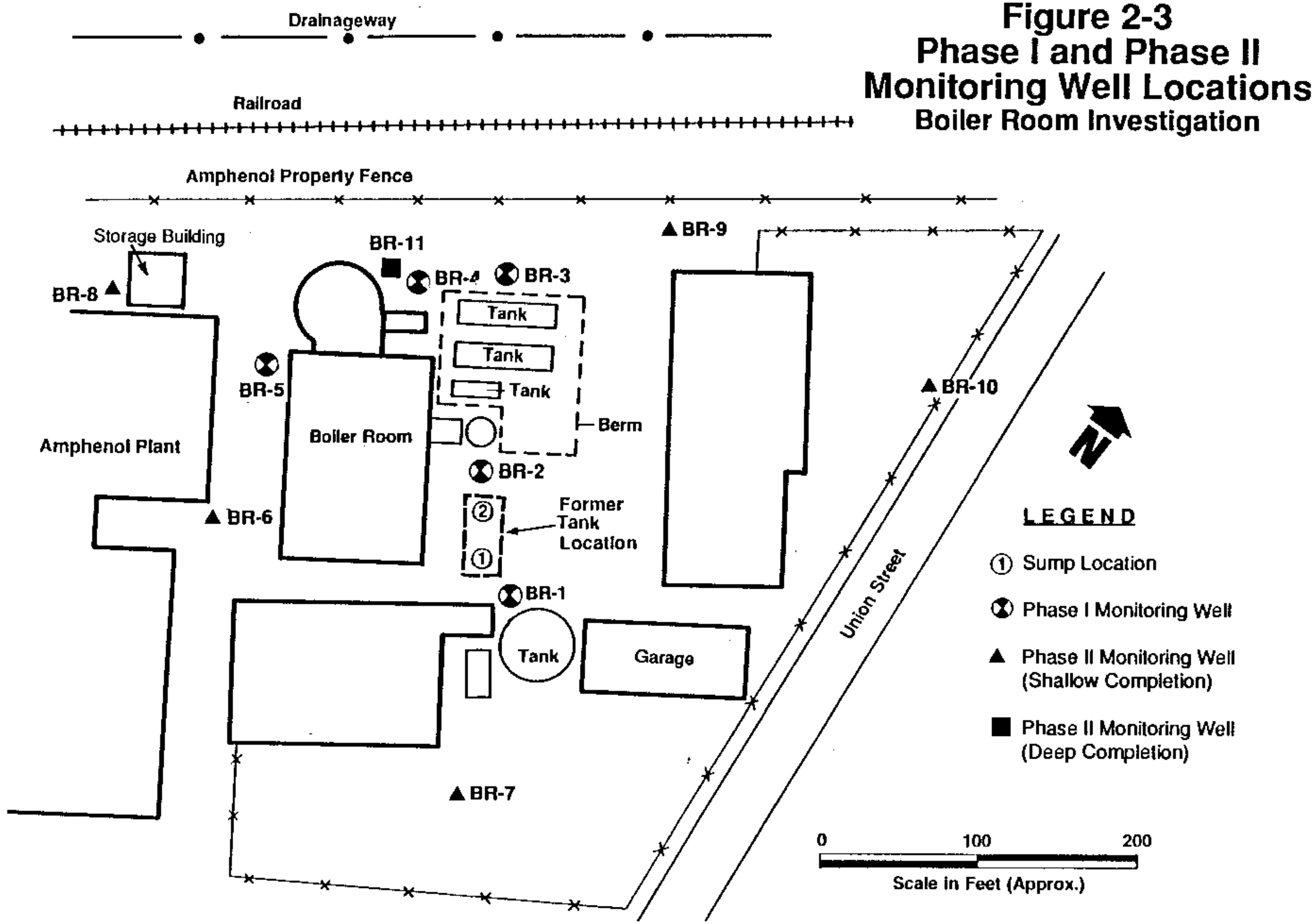
2.2 Monitoring Well Installations

Six wells were installed to augment the existing monitoring network within the Boiler Room area. Five new shallow wells (BR-6, BR-7, BR-8, BR-9, and BR-10) were installed to an approximate depth of 25 feet. One deep well (BR-11) was installed to an approximate depth of 100 feet. The rationale for each additional well location, presented in Figure 2-3, is as follows:

- Well BR-6 - This shallow well was located at the corner of the main plant building, where low level TCE was detected during the soil gas survey.
- Well BR-7 - This shallow well was located near the liquid propane gas tanks to the southeast of the Boiler Room, to serve as an upgradient background well near the Amphenol property line.
- Wells BR-8, BR-9 - These shallow wells were located near the northwestern fence line marking the Amphenol property boundary. These locations were selected to assist in the determination of the distribution and concentrations of VOCs potentially leaving or entering the site.
- Well BR-10 - This shallow well was located directly east of the Boiler Room area to serve as a background well near the eastern Amphenol property boundary.
- Well BR-11 - This deep well was installed adjacent to existing well BR-4 to provide information on the vertical distribution of VOCs beneath the Boiler Room area, and also to provide information regarding the nature and hydrogeologic characteristics of the aquifer materials at depth.

All wells were installed within a borehole advanced by 3-1/4-inch I.D. hollow stem augers driven by a truck-mounted auger rig. Subsurface materials were described from split spoon samples taken at five-foot intervals from 0 to 50 feet below land

Figure 2-3
Phase I and Phase II Monitoring Well Locations
Boiler Room Investigation



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surface (BLS), and 10 foot intervals from depths greater than 50 feet BLS.

All wells were constructed of two-inch I.D. schedule 40 PVC Number 10 slotted well screen and riser pipe. The shallow monitoring wells were constructed with approximately 15 feet of screen extending two to three feet above the water table. Each well was sand packed such that the sand extended a minimum of two feet above the well screen. The sand pack was sealed with two feet of bentonite pellets and the remaining annular space tremie-grouted with a cement/bentonite mixture to the surface. Flush mount protective well covers were used in traffic areas, while four-inch I.D. steel protective casings equipped with locking caps were cemented into place to ensure the integrity of those wells in non-traffic areas. A well construction schematic is presented in Figure 2-4; well construction details are given in Table 2-1.

The deep well (BR-11) was nested with existing well BR-4. The lower 10 feet of this well were screened to monitor the aquifer at depth. As with the shallow wells, the well screen was sand packed such that the sand extended approximately three feet above the well screen. The sand pack was sealed with two feet of bentonite pellets and the remaining annular space tremie grouted with a cement/bentonite mixture to the surface. This well was completed with a locking cap, and a protective casing cemented into place.

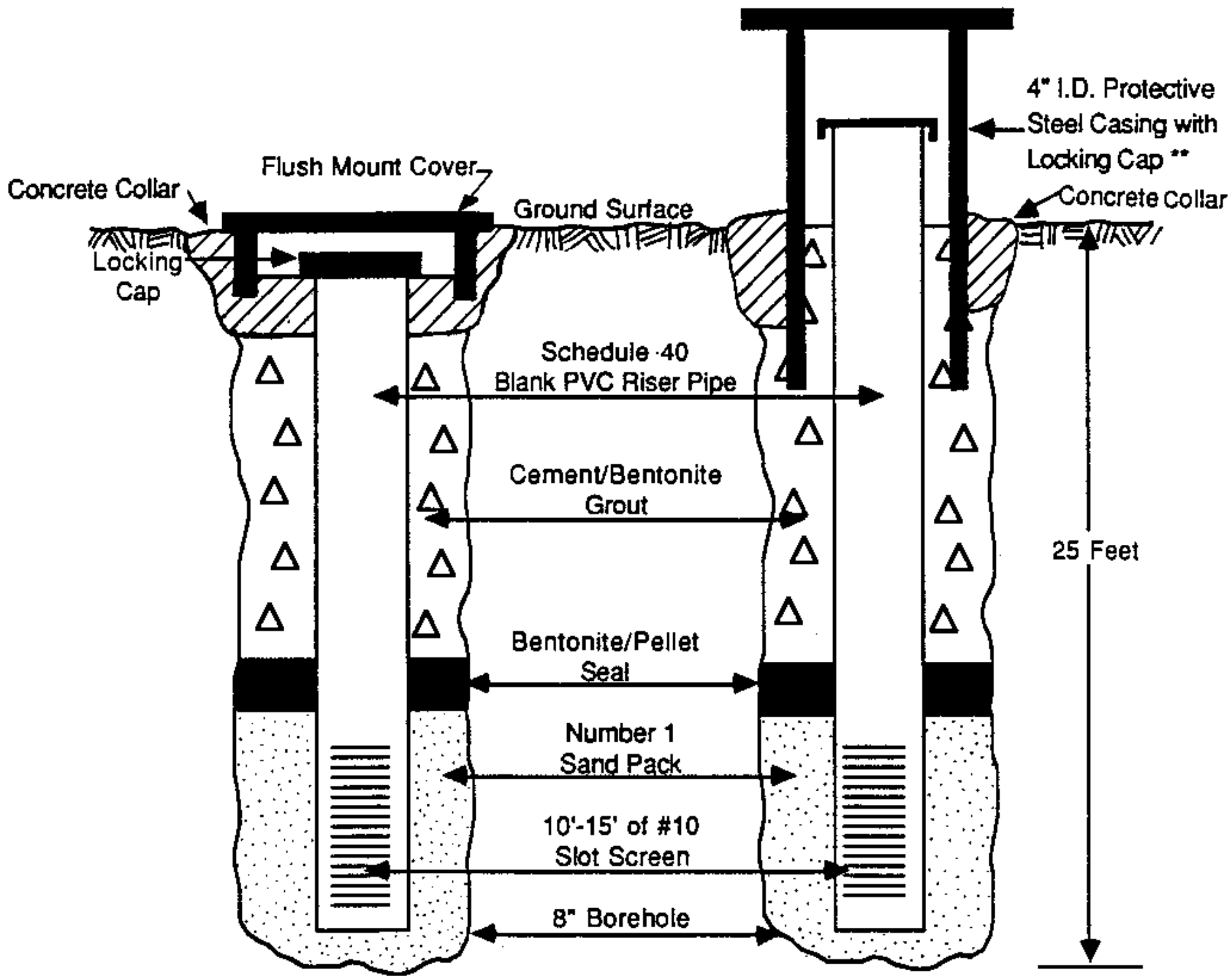
After monitoring well installation was completed, each monitoring well was developed by pumping until the water produced was relatively free of turbidity. Each PVC well riser was later surveyed for vertical control by a New York State - licensed surveyor.

All downhole tools, including augers, split spoons, and drill rods were steam-cleaned prior to the commencement of any drilling activities. Additionally, the back of the drill rig, including tires, drilling table, controls, and all associated tools were also steam-cleaned to prevent cross contamination between boreholes.

2.3 Ground Water Sampling and Analysis

Two sets of ground water samples were obtained as part of this Phase II investigation: one complete set, collected from both

Figure 2-4
Well Construction Schematic



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* Well BR-11 was Installed to a Depth of 100'.

** 4" Protective Steel Casing Extends Approximately 2' Above Ground Surface

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Table 2-1
Well Construction Details
Boiler Room Investigation

Well #	Elevation		Screened Interval*	Sand Packed Interval*	Bentonite Seal*	Type of Completion
	T.O.C.	Ground				
BR-1	987.01	985.00	25.0 - 10.0	25.0 - 9.0	9.0 - 7.0	Protective Steel
BR-2	987.79	985.75	25.0 - 10.0	25.0 - 9.0	9.0 - 7.0	Protective Steel
BR-3	986.77	984.94	25.0 - 10.0	25.0 - 9.0	9.0 - 7.0	Protective Steel
BR-4	986.44	984.43	25.0 - 10.0	25.0 - 9.0	9.0 - 7.0	Protective Steel
BR-5	984.39	984.97	25.0 - 10.0	25.0 - 9.0	9.0 - 7.0	Protective Steel
BR-6	983.93	984.39	24.0 - 9.0	24.0 - 7.0	7.0 - 4.0	Flush Mount
BR-7	988.26	986.06	25.0 - 10.0	25.0 - 8.0	8.0 - 5.0	Protective Steel
BR-8	983.69	983.97	24.5 - 9.5	24.5 - 8.0	8.0 - 5.0	Flush Mount
BR-9	984.98	985.10	25.0 - 10.0	25.0 - 8.0	8.0 - 5.0	Flush Mount
BR-10	987.40	985.12	24.0 - 9.0	24.0 - 7.0	7.0 - 4.0	Protective Steel
BR-11	986.48	984.57	100.0 - 90.0	100.0 - 86.5	86.5 - 84.5	Protective Steel

* Depth below land surface

Phase I and Phase II wells in March 1989, and a partial set collected from the Phase II wells in June 1989. Ground water sampling was conducted to characterize the ground water coming into and leaving the Boiler Room area. VOC analyses were conducted to allow for characterization of specific volatile organic compounds and their concentrations in ground water underlying the Boiler Room area.

Prior to the acquisition of any ground water samples, a complete round of depth-to-water measurements was obtained to provide a static ground water configuration and to assist in determining well volumes to be purged from each respective well. After purging three well volumes and allowing a minimum of 90 percent recovery, samples were obtained with dedicated PVC sampling bailers equipped with polypropylene string. Samples were collected in 40-milliliter laboratory-supplied zero headspace vials, with teflon septa. All samples were placed on ice immediately after collection to maintain a temperature of 4°C. ERM Chain-of-Custody and Traffic Report forms were completed for each sample, and all bottles were labeled with sampling information including; date, time of sampling, sampler's initials, Traffic Report number, analyses required and preservatives used.

All ground water samples were analyzed for VOCs by GC/MS by Lancaster Laboratories, of Lancaster, PA. All analytical work was conducted under United States Environmental Protection Agency protocols and procedures. A quality assurance (QA) Review was conducted by ERM Quality Assurance Chemists. The QA Review is included as Appendix A.

Prior to ground water sampling, PVC bailers underwent the following decontamination procedure:

1. Inside/outside scrub with a non-phosphate soap/hot tap water solution.
2. Hot tap water rinse inside/outside.
3. Triple distilled water rinse inside/outside.
4. Placement into dedicated "Bailer Bags".

Each dedicated bailer received a final rinse with distilled water prior to its insertion into a well. Additionally, the first bailer-full of sample from each well was discarded to ensure that the distilled water rinse would not dilute the sample submitted to the laboratory.

2.4 Aquifer Testing

After the completion of the newly installed wells the tops of the PVC casings were surveyed for elevation control, and water level measurements were taken to the nearest one-hundredth of a foot. Ground water contour maps were generated to define the direction of ground water movement and gradient. After ground water sampling was completed, the aquifer hydraulic conductivity was estimated from slug tests conducted on three of the shallow wells within the Boiler Room area, and the newly installed deep well. This information, in conjunction with ground water table mapping, allows for an estimation of the ground water flow velocity within the Boiler Room area.

Slug tests were conducted at wells BR-4, BR-6, BR-7, and BR-11 by causing an instantaneous displacement of the water level within the wells tested. Instantaneous displacement was accomplished by inserting a solid slug into the well, raising the water level. Hermit™ Data Loggers and pressure transducers were used to collect water level data during the recovery of the well to static conditions. After recovery, the displacement slug was removed, lowering the water level, with data collection continuing until recovery was complete. Slug test data were analyzed by the Bouwer and Rice Method to estimate the hydraulic conductivity of the glacial aquifer.

Finally, after well sampling and slug testing, Hermit™ Data Loggers were installed on wells BR-4, BR-6, BR-8 and BR-11 to record water levels for a period of eleven days. This information was obtained to assist in assessing the influence of the on-off cycling of the North Well, and possibly the Village of Sidney well, on the Boiler Room area.

SECTION 3
RESULTS OF INVESTIGATION

3.1 Soil Gas Survey

The intent of the soil gas survey was to assist in identifying areas in which to locate Phase II monitoring wells. In general, the soil gas concentrations of total VOCs did not exceed 420 parts per million (ppm). The highest peak reading of 420 ppm was detected in the sample obtained from SG-17, located north of the plant between the plant fence and the railroad tracks (Figure 2-1). In addition to analysis for total VOCs, a portable gas chromatograph (GC) was used to analyze for specific compounds including TCE and its associated degradation products. The GC identified TCE compounds in only two soil gas borings: SG-9 and SG-12 at respective concentrations of 16 and 41 ppb.

It is ERM's opinion that the soil gas survey results did not preclude the presence of TCE compounds and VOCs in soil pore spaces. Rather, the relatively "tight" nature of the shallow soil materials is such that the migration of interstitial soil gases was inhibited, and thus, the success of the soil gas survey in the types of soils present underlying the Boiler Room area may be limited. Although these results were not sufficient to provide delineation of TCE compound distribution in the subsurface, they were helpful in selecting monitoring well locations installed as part of the Phase II investigation.

The soil gas sampling results are presented in Table 3-1. Total soil gas concentrations (in ppm) were measured with a Flame Ionization Detector (FID) and include natural soil gases such as methane. These results contrast with those obtained by the field GC, (concentrations in ppb) which employed a Photo Ionization Detector (PID). The PID is only sensitive to a narrow range of ionization potentials, which excludes the detection of methane and many other gases that are detected by the FID. The FID and the PID also measure concentrations of gases in a different manner. Therefore results of the two methods are often dissimilar.

Despite the limited information obtained, the TCE detection at location SG-12 was used to select the location for well BR-6. It

Table 3-1
Soil Gas Survey Results
Boiler Room Investigation

Boring I.D.	Total VOC (ppm)			Gas Chromatographic Analyses Results (ppb)			
	Depth	Peak	Stable	trans-1,2-DCE	1,1-DCE	TCE	Unknowns
SG-1	3'	7	4	-	-	-	-
SG-2	3'	20	6	-	-	-	-
SG-3	5'	18	6	-	-	-	-
SG-3	10'	20	8	-	-	-	-
SG-4	4'	9	4	-	-	-	-
SG-5	4'	10	3	-	-	-	-
SG-6	4'	320	95	-	-	-	<1
SG-7	4'	20	NR	-	-	-	<1
SG-7	8'	3	2	-	-	-	<1
SG-8	4'	7	NR	-	-	-	<1
SG-9	4'	10	8	-	-	-	-
SG-9	8'	90	NR	-	-	16	4
SG-10	1.5'	6	6	-	-	-	<1
SG-11	4'	10	6	-	-	-	8
SG-12	1.5'	10	10	-	-	41	<1
SG-12	5'	4	2	-	-	-	-
SG-13	1.5'	4	3	-	-	-	-
SG-13	5'	10	6	-	-	-	-
SG-14	4.5'	20	16	-	-	-	8
SG-15	4.5'	8	5	-	-	-	-
SG-16	4.5'	6	6	-	-	-	<1
SG-17	4.5'	420	NR	-	-	-	-

NR - No Reading Recorded
\- - None Detected

was felt that the high total VOC hits at SG-6 and SG-17 may have been related to the nearby presence of a sewer line, since no TCE compounds were detected.

3.2 Site Geology

Well logs from both the Phase I and Phase II Boiler Room Investigations are included as Appendix B. The cross sections presented in Figures 3-1 and 3-2 were generated from the lithologic logs of the newly installed monitoring wells.

The Boiler Room area is underlain by four predominant lithologies: a disturbed till/outwash unit, a silt and clay unit, a weathered till unit, and a lacustrine silty fine sand unit.

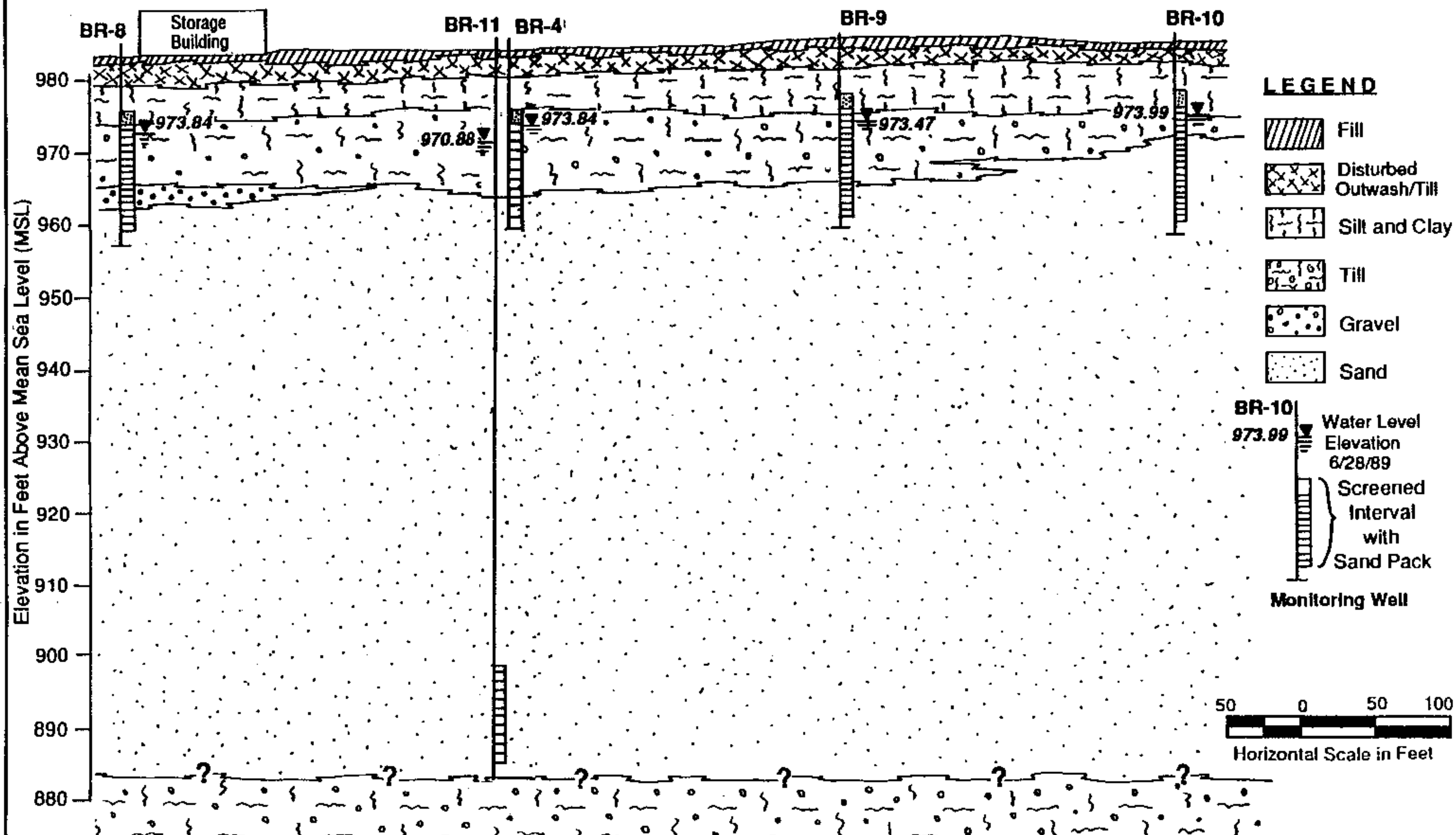
The disturbed till/outwash unit is composed of a loosely consolidated, poorly sorted mixture that ranges in size from silt to cobbles. This material is likely to be natural to the site but was probably re-worked and disturbed during plant construction. This material was typically encountered at a depth of one foot below land surface (BLS), extending to depths ranging from 2.5 to 6 feet BLS.

The disturbed till/outwash is underlain by silt and clay that is typically soft and wet. The upper surface was encountered from 2.5 to 6 feet BLS, extending to depths ranging from 8 to 15.5 feet BLS.

The silt and clay is underlain by till that is greenish grey in color and composed of a poorly sorted mixture that ranges from silt to cobbles. The matrix of this material is composed predominantly of silt except at well BR-6 where the matrix contains an abundance of medium grained sand. The upper surface of the till was encountered from 8 to 15.8 feet BLS, extending to depths ranging from 12.5 to 26 feet BLS. The till was present in all wells installed as part of the Phase II investigation. However, it is only two-tenths (0.2) of a foot in thickness in well BR-7, indicating a pinching out to the south of the Boiler Room area.

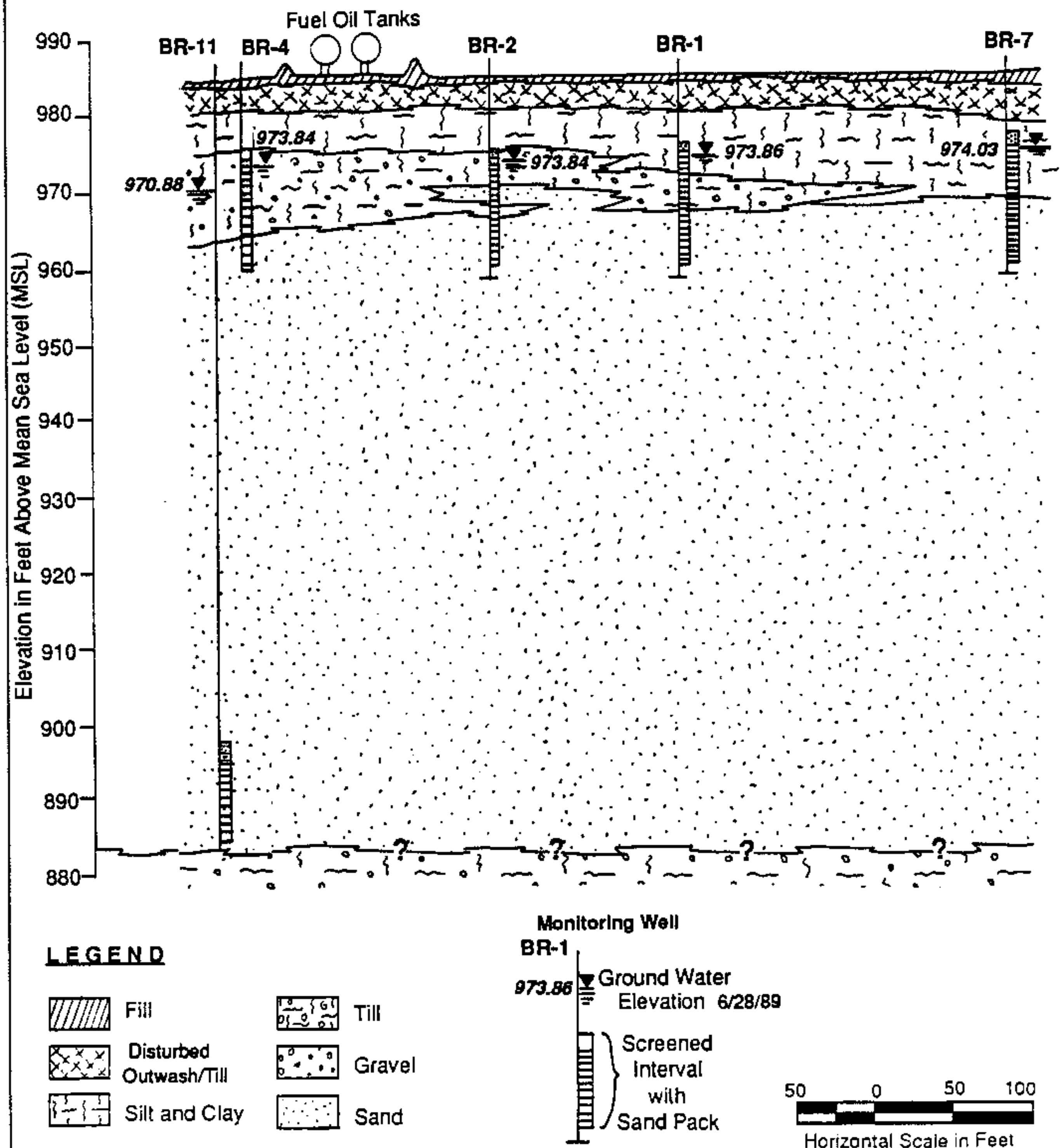
With exception of the well BR-8 area, the till is underlain by the fine sand. The sand, which comprises the greatest portion of the glacial aquifer beneath the site, is lacustrine in origin, and is very silty, fine-grained and well-sorted. The fine sand was encountered from 12.5 to 26 feet BLS, and extends to at least a depth of 101 feet BLS. Well BR-11 was the only well drilled to

Figure 3-1
East-West Cross Section
Boiler Room Investigation



WO# 30127	Drawn by / Date: D.L. 8/3/89	Checked by / Date: R.Hoose 8/3/89	Notes:	The ERM Group
	Revised by / Date: EJK 9/89	Checked by / Date: R. Hoose 9/89		

Figure 3-2
North-South Cross Section
Boiler Room Investigation



WO# 30127	Drawn by / Date: D.L. 8/3/89	Checked by / Date: R.Hoose 8/3/89	The ERM Group
	Revised by / Date: EJK 9/89	Checked by / Date: R. Hoose 9/89	

the bottom of this unit, and therefore a range of thickness cannot be ascertained. At depth, this sand is characterized by a cyclic layering that exhibits a fining-upward sequence, with grain sizes ranging from fine to very, very fine over a vertical distance of approximately two-tenths of a foot. At approximately 40 feet BLS, the sand changes from dark/greenish grey to reddish brown in color. Corresponding with this color change is a clay enriched zone that extends to approximately 50 feet BLS. In well BR-11, the sand was underlain by a dense, reddish brown till layer which, for the purposes of the Phase II Investigation, was used to identify the lower boundary of the unconsolidated aquifer.

A thin gravel stringer was encountered in well BR-8 between the till and fine sand. The gravel, which was present from 18 to 21 feet BLS consisted of medium grained gravel in a matrix of medium grained sand. It is likely that this material has a relatively high hydraulic conductivity, and may serve as a preferential flow path in the shallow ground water system.

3.3 Analytical Results

Both historical analytical results and those from the two rounds of Phase II ground water samples (March 1989 and June 1989) are presented in Table 3-2. Ground water analysis reports submitted from Lancaster Laboratories, and ERM's Quality Assurance reviews, are included in Appendix A.

The primary compounds detected in the ground water at the Boiler Room are TCE and its associated degradation products, which include trans-1,2-DCE, DCE and VC. PCE is also present, and can be either a parent compound for TCE, or a contaminant in industrial grade TCE. The degradation of PCE and TCE occurs by a process known as reductive dehalogenation. This process occurs when anaerobic microbes degrade the more chlorinated molecules by stripping off chlorine atoms. Thus, the breakdown sequence is:

		CIS 1, 2-DCE		
PCE -->	TCE -->	TRANS 1, 2-DCE -->	VC -->	Ethene
		1, 1-DCE		Chloride

TABLE 3-2
ANALYTICAL RESULTS
GROUND WATER SAMPLES COLLECTED AUGUST 1985 THROUGH JUNE 1989
BOILER ROOM INVESTIGATION

	Well BR-1								Well BR-2							
VOLATILE ORGANICS*	Aug-85	May-86	Nov-86	Feb-87	Apr-88	Sep-88	Mar-89	Jun-89	Aug-85	May-86	Nov-86	Feb-87	Apr-88	Sep-88	Mar-89	Jun-89
Benzene	5						1 J	NS	4	2	3	5	26	26	7	NS
Toluene								NS								NS
Ethylbenzene								NS								NS
Methylene Chloride								NS						B		NS
Chloroform								NS								NS
Vinyl Chloride								NS	45	25	25	27	47	65	64	NS
1,1-Dichloroethene								NS							2 J	NS
1,1-Dichloroethane								NS	9	6	4	6	6	8	6	NS
trans-1,2-Dichloroethene	4	4	3			3		NS	130	100	80	150	250	240	340	NS
1,2-Dichloroethane								NS								NS
1,1,1-Trichloroethane				4		2		NS								NS
Trichloroethene	3	2	4			4	2 J	NS	180	110	81	150	310	320	430	NS
Tetrachloroethene								NS					2	3	5 J	NS
Xylenes								NS								NS
Carbon disulfide								NS							6 J	NS
TOTAL VOLATILE ORGANICS	12	6	7	4		9	3 J	NS	368	243	193	338	641	662	860 J	NS

** Other VOC compounds were not detected by 601/602 analysis*

- All results in ug/l (ppb)
- Blank space indicates none detected
- NS indicates that well was not sampled
- J This result is a quantitative estimate
- B This compound was detected in a deionized water blank at a similar concentration

TABLE 3-2 (CONTINUED)
ANALYTICAL RESULTS
GROUND WATER SAMPLES COLLECTED AUGUST 1985 THROUGH JUNE 1989
BOILER ROOM INVESTIGATION

	WELL BR-3								WELL BR-4							
VOLATILE ORGANICS*	Aug-85	May-86	Nov-86	Feb-87	Apr-88	Sep-88	Mar-89	Jun-89	Aug-85	May-86	Nov-86	Feb-87	Apr-88	Sep-88	Mar-89	Jun-89
Benzene	2	1	7	5	7		3 J	NS		2		12	13		3 J	NS
Toluene								NS								NS
Ethylbenzene	1				1			NS								NS
Methylene Chloride								NS								NS
Chloroform						11		NS								NS
Vinyl Chloride	21	11	59		28	46	11	NS	16	43	23	60	63	70	26	NS
1,1-Dichloroethene			1					NS							1 J	NS
1,1-Dichloroethane	5	5	10	10	6	15	1 J	NS	4	8		16	11	20	5	NS
trans-1,2-Dichloroethene	70	53	260	170	180	270	67	NS	76	100	200	520	470	680	220	NS
1,2-Dichloroethane								NS			11					NS
1,1,1-Trichloroethane								NS								NS
Trichloroethene	100	54	260	150	150	290	100	NS	140	130	190	580	780	1100	360	NS
Tetrachloroethene	1		1				1 J	NS	5	3		5	9		6 J	NS
Xylenes				2	2			NS								NS
Carbon Disulfide								NS								NS
TOTAL VOLATILE ORGANICS	200	124	598	337	374	632	178 J	NS	241	286	424	1193	1346	1870	611 J	NS

** Other VOC compounds were not detected by 601/602 analysis*

- All results in ug/l (ppb)
- Blank space indicates none detected
- NS indicates that well was not sampled
- J This result is a quantitative estimate
- B This compound was detected in a deionized water blank at a similar concentration

TABLE 3-2 (CONTINUED)
ANALYTICAL RESULTS
GROUND WATER SAMPLES COLLECTED AUGUST 1985 THROUGH JUNE 1989
BOILER ROOM INVESTIGATION

VOLATILE ORGANICS*	WELL BR-5								WELL BR-6		WELL BR-7		WELL BR-8	
	Aug-85	May-86	Nov-86	Feb-87	Apr-88	Sep-88	Mar-89	Jun-89	Mar-89	Jun-89	Mar-89	Jun-89	Mar-89	Jun-89
Benzene							5	NS	1					
Toluene								NS						
Ethylbenzene								NS					1 J	
Methylene Chloride								NS						
Chloroform								NS						
Vinyl Chloride	8	16	20	30	90	76	96	NS	96	17			60	60
1,1-Dichloroethene				20			3 J	NS	3 J				3 J	1 J
1,1-Dichloroethane	2	7			30	13	10	NS	11				8	5
trans-1,2-Dichloroethene	52	110	155	400	810	630	410	NS	660	130			340	190
1,2-Dichloroethane								NS						
1,1,1-Trichloroethane								NS						
Trichloroethene	110	110	143	380	1200	920	460	NS	500	170			150	87
Tetrachloroethene	6	3				11	14	NS	17	3 J			7	4 J
Xylenes								NS					1 J	
Carbon Disulfide								NS					9 J	
TOTAL VOLATILE ORGANICS	178	246	318	830	2130	1650	995 J	NS	1288 J	320 J			565 J	342 J

** Other VOC compounds were not detected by 601/602 analysis*

- All results in ug/l (ppb)
- Blank space indicates none detected
- NS indicates that well was not sampled
- J This result is a quantitative estimate
- B This compound was detected in a deionized water blank at a similar concentration

TABLE 3-2 (CONTINUED)
ANALYTICAL RESULTS
GROUND WATER SAMPLES COLLECTED AUGUST 1985 THROUGH JUNE 1989
BOILER ROOM INVESTIGATION

	WELL BR-9		WELL BR-10		WELL BR-11		NORTH WELL
VOLATILE ORGANICS*	Mar-89	Jun-89	Mar-89	Jun-89	Mar-89	Jun-89	May-89
Benzene							
Toluene							
Ethylbenzene							
Methylene Chloride							
Chloroform							
Vinyl Chloride							
1,1-Dichloroethene							
1,1-Dichloroethane							1
trans-1,2-Dichloroethene					2 J		1
1,2-Dichloroethane							
1,1,1-Trichloroethane							
Trichloroethene					2 J		
Tetrachloroethene							
Xylenes							
Carbon Disulfide							
TOTAL VOLATILE ORGANICS					4 J		2

** Other VOC compounds were not detected by 601/602 analysis*

- All results in ug/l (ppb)
- Blank space indicates none detected
- NS indicates that well was not sampled
- J This result is a quantitative estimate
- B This compound was detected in a deionized water blank at a similar concentration

TABLE 3-2 (CONTINUED)
ANALYTICAL RESULTS
GROUND WATER SAMPLES COLLECTED AUGUST 1985 THROUGH JUNE 1989
BOILER ROOM INVESTIGATION

	Sump #1								Sump #2							
VOLATILE ORGANICS*	Aug-85	May-86	Nov-86	Feb-87	Apr-88	Sep-88	Mar-89	Jun-89	Aug-85	May-86	Nov-86	Feb-87	Apr-88	Sep-88	Mar-89	Jun-89
Benzene	NS	210		47	48	43	NS	NS	2			NS	1	2	NS	NS
Toluene	NS	19		5	13	10	NS	NS				NS			NS	NS
Ethylbenzene	NS	56			14	6	NS	NS				NS			NS	NS
Methylene Chloride	NS						NS	NS				NS			NS	NS
Chloroform	NS						NS	NS				NS			NS	NS
Vinyl Chloride	NS						NS	NS				NS			NS	NS
1,1-Dichloroethene	NS						NS	NS				NS			NS	NS
1,1-Dichloroethane	NS	1			1		NS	NS				NS	1	1	NS	NS
trans-1,2-Dichloroethene	NS	3					NS	NS				NS		2	NS	NS
1,2-Dichloroethane	NS						NS	NS				NS			NS	NS
1,1,1-Trichloroethane	NS						NS	NS				NS			NS	NS
Trichloroethene	NS	2					NS	NS	7			NS			NS	NS
Tetrachloroethene	NS						NS	NS				NS			NS	NS
Xylenes	NS			15	36		NS	NS				NS			NS	NS
Carbon Disulfide	NS						NS	NS				NS			NS	NS
TOTAL VOLATILE ORGANICS	NS	291		67	112	59	NS	NS	9			NS	2	5	NS	NS

** Other VOC compounds were not detected by 601/602 analysis*

- All results in ug/l (ppb)
- Blank space indicates none detected
- NS indicates that well was not sampled
- J This result is a quantitative estimate
- B This compound was detected in a deionized water blank at a similar concentration

Therefore, it can be seen that DCE compounds are an intermediate step in a process whereby TCE is degraded to VC and the VC to ethene and chloride ions.

For the purpose of an overall assessment of the migration of VOCs in the ground water beneath the Boiler Room Area, PCE, TCE and its associated degradation by-products are referred to as TCE compounds, while other VOCs are discussed separately.

Six of the eleven Boiler Room monitoring wells contained quantifiable concentrations of TCE compounds in March 1989. These concentrations ranged from 178 µg/L in well BR-3 to 1284 µg/L in well BR-6. Additionally, an estimated concentration of 2 µg/L was detected in well BR-1. Likewise, an estimated concentration of 4 µg/L of TCE compounds were detected in well BR-11. However, these were not detected in this well in the June confirmatory sampling.

Two additional compounds, carbon disulfide and benzene, were also detected in the Boiler Room ground water. Carbon disulfide was detected in wells BR-2 and BR-8 at estimated concentrations of 6 and 9 µg/L respectively. Benzene was detected in wells BR-2 and BR-5 at respective concentrations of 7 and 5 µg/L. An estimated Benzene concentration of 3 µg/L was detected in well BR-3. VOCs were not detected in samples from wells BR-7, BR-9, and BR-10.

A second round of ground water samples was collected from the Phase II wells in June, 1989 to confirm the results obtained from the March sampling. As with the March samples, the primary compounds detected in the ground water were TCE compounds. These were detected in wells BR-6 and BR-8 at quantifiable concentrations of 317 and 342 µg/L, respectively, significantly lower than the concentrations of 1284 and 565 µg/L (respectively) detected in the same wells in the March sampling. This is considered to be a dilutional effect caused by the above average precipitation over the northeast during the spring. As with the March sampling, non-detectable concentrations were reported for wells BR-7, BR-9, BR-10 and additionally, BR-11.

3.4 Site Hydrogeology

The three tasks undertaken to evaluate the unconsolidated aquifer underlying the Boiler Room Area included slug testing, developing water table maps, and observing the long term trends of water levels within the Boiler Room Area. The results are as follows.

3.4.1 Slug Test Results

The data obtained during slug testing were analyzed by the Bouwer and Rice method. In this method, the data for each respective well are transferred to a semi-logarithmic plot where water level displacement and subsequent recovery, are plotted on the logarithmic Y-axis while elapsed time is plotted on the arithmetic X-axis. A straight line is fit to the data and projected to intersect the logarithmic Y-axis. Three data points are obtained from the straight line fit; 1) initial instantaneous displacement (Y_o when time = 0), 2) the displacement (Y_t) at some later time (t), and 3) the time t (Figure 3-3). These data points (Y_o, Y_t, t) are used as input into a series of equations (included in Appendix C) that estimate the aquifer hydraulic conductivity (k).

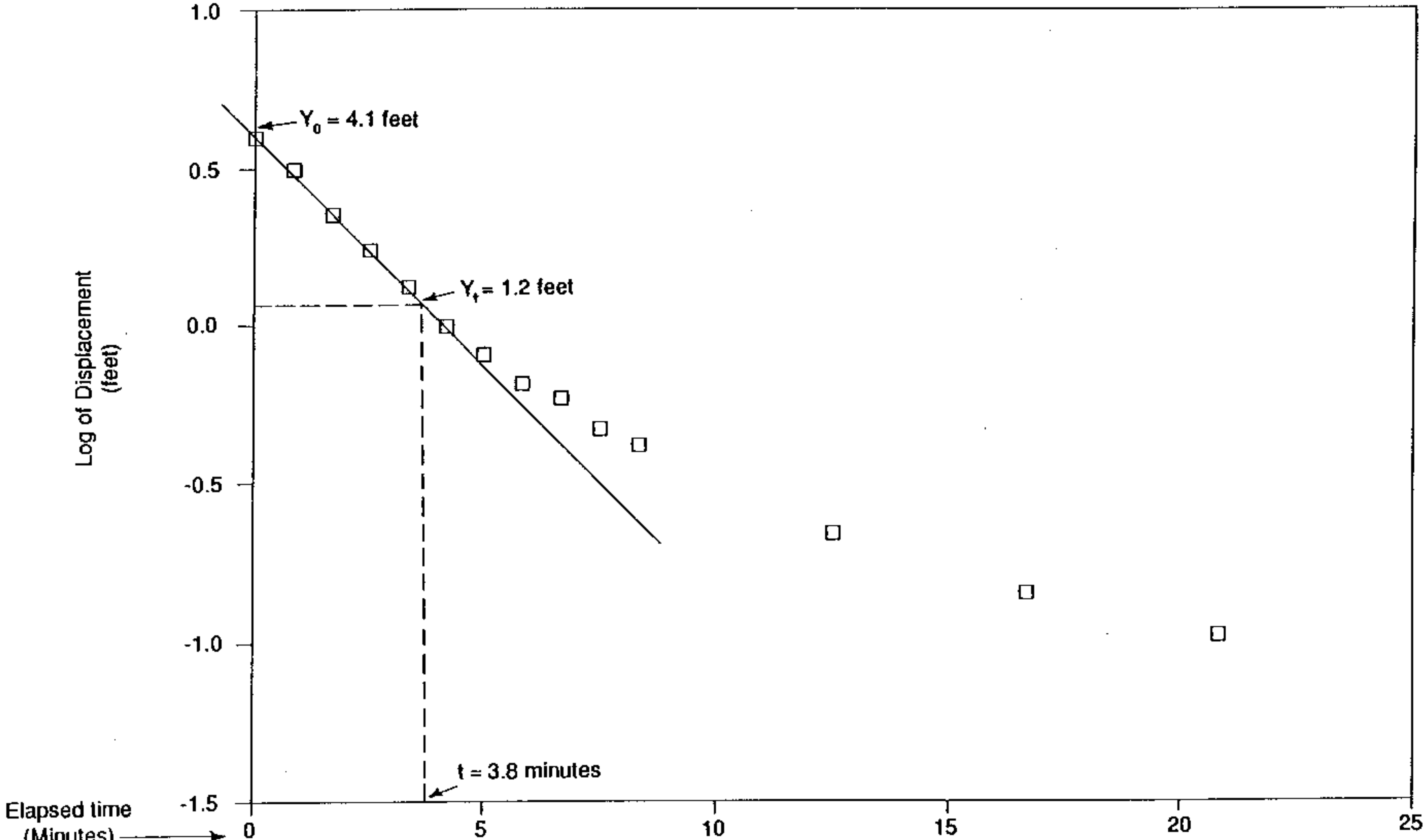
Table 3-3 presents the hydraulic conductivities in the Boiler Room area, as determined from the slug tests. The hydraulic conductivities ranged from 5 ft/day in well BR-7 to 98 ft/day in well BR-6. The high values in wells BR-4 and BR-6 indicate that the glacial till unit is highly weathered due to its near-surface location. The low value in well BR-7 is attributable to the pinching out of the till unit. The high value at deep well BR-11 is anomalous with that expected in the lacustrine unit. It is suspected by ERM that the well screen sand pack response may be represented. Data plots are included as part of Appendix C.

3.4.2 Ground Water Flow

3.4.2.1 Hydraulic Gradients

The depth-to-water measurements obtained prior to the March and June 1989 ground water sampling events, were converted into water table elevations (Table 3-4). Ground water contour maps, presented in Figures 3-4 and 3-5, were constructed.

Figure 3-3
Example Semi-Logarithmic Data Plot for Slug Test Analysis
Bouwer and Rice Method



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30127	Revised by / Date: E.M. 9.15.89	Checked by / Date: R. Hoose 9.15.89	

The ERM Group

Table 3-3
Hydraulic Conductivity Values
Boiler Room Investigation

Well Number	Hydraulic Conductivity
BR-4	64 feet/day
BR-6	98 feet/day
BR-7	5 feet/day
BR-11	61 feet/day

Table 3-4
Ground Water Elevations
28 March, 28 June 1989
Boiler Room Investigation

Well #	TOC Elevation	March 28, 1989		June 28, 1989	
		DTW	Elev.	DTW	Elev.
BR-1	987.01	16.28	970.73	13.15	973.86
BR-2	987.79	17.06	970.73	13.95	973.84
BR-3	986.77	16.02	970.75	12.95	973.82
BR-4	986.44	15.70	970.74	12.60	973.84
BR-5	984.39	13.66	970.73	10.54	973.85
BR-6	983.93	13.29	970.64	10.06	973.87
BR-7	988.26	17.81	970.45	14.23	974.03
BR-8	983.69	12.99	970.70	9.85	973.84
BR-9	984.98	14.76	970.22	11.51	973.47
BR-10	987.40	16.85	970.55	13.41	973.99
BR-11	986.48	17.24	969.24	15.60	970.88

Figure 3-4
Ground Water Configuration
28 March 1989
Boiler Room Investigation

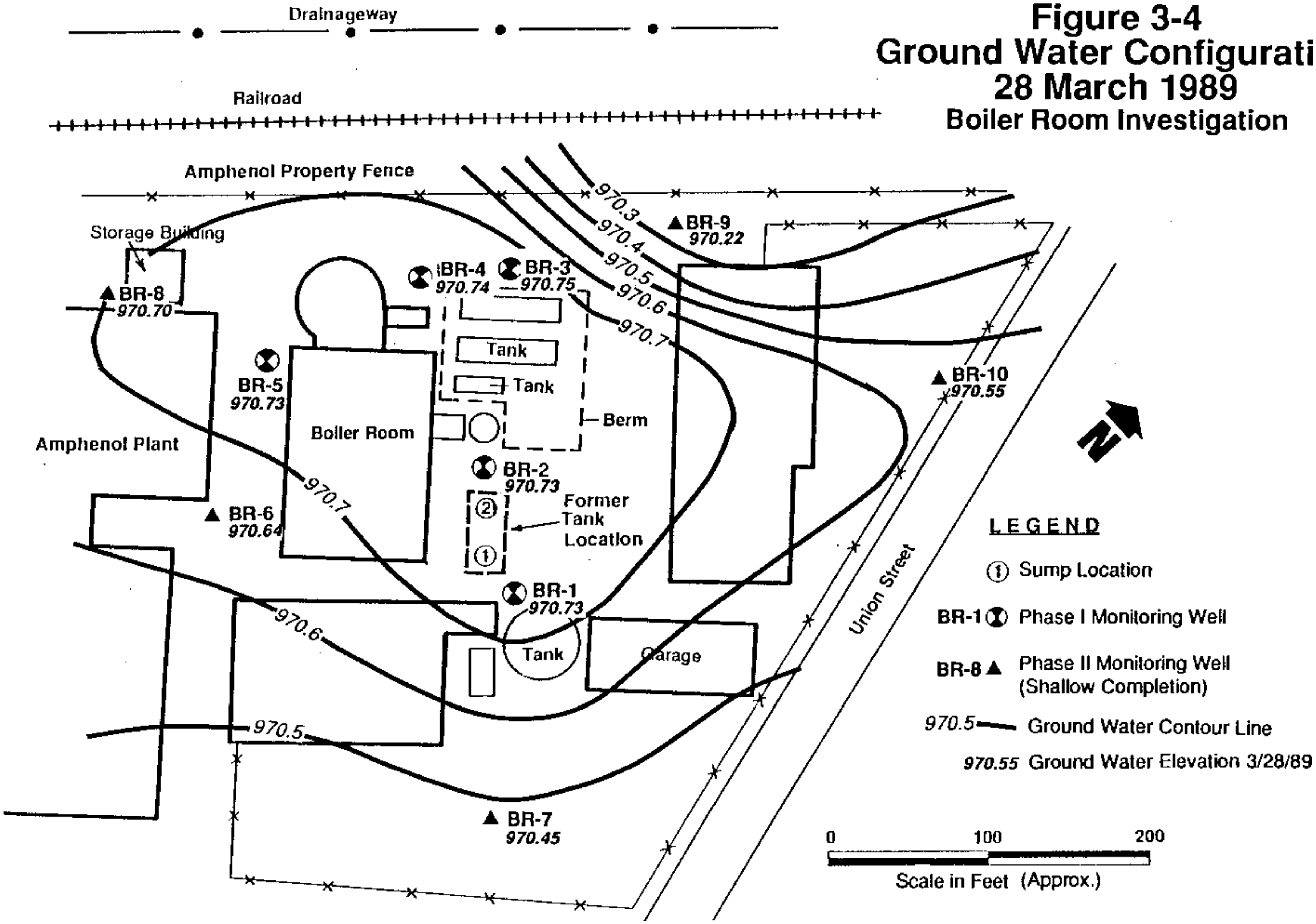

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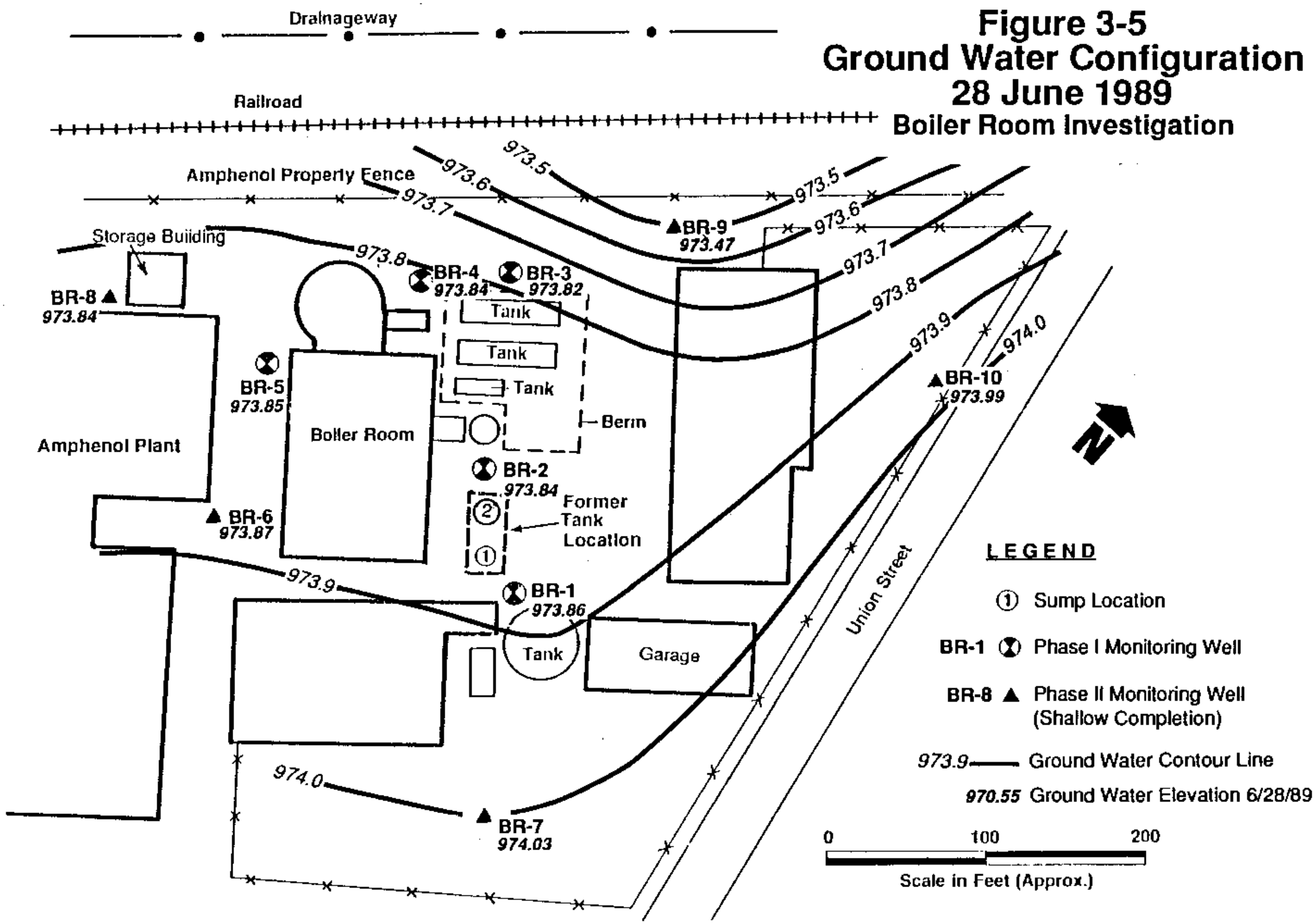
Figure 3-5
Ground Water Configuration
28 June 1989
Boiler Room Investigation



WO# 30127	Drawn by / Date: EJK 9/89	Checked by / Date: R. Hoose 9/89	Notes:	The ERM Group
	Revised by / Date:	Checked by / Date:		

The ground water contour map presented in Figure 3-4 suggests that a slight but distinct ground water mound existed beneath the Boiler Room area in March 1989. This mounding extended from the area formerly occupied by the underground fuel/waste oil tank to the present location of the above ground fuel oil tanks. Consequently, ground water should flow radially from the mound. Hydraulic gradients were very low, and range from 0.0003 on the west flank to 0.002 on the south flank. The hydraulic gradient on the east flank of the mound was 0.001. To the north the hydraulic gradient was 0.005, significantly steeper than that of the east, west, and south flanks of the ground water mound. At present, this steeper gradient cannot be explained by extraneous influences such as off-site pumping, differences in well construction, or interception by the well screen of a different lithologic unit or zone. However, the expected topographically controlled gradient would be north to northwest, toward the Susquehanna River Valley.

The ground water contour map presented in Figure 3-5 indicates north to northwest ground water flow in June 1989. Hydraulic gradients were very low (0.0006) across much of the Boiler Room area. However, as with the March 1989 ground water configuration, the hydraulic gradient on the north side of the Boiler Room was significantly steeper (0.004). Again, this order of magnitude increase in hydraulic gradient cannot be explained by extraneous influences.

Comparison of Figures 3-4 and 3-5 indicates that ground water conditions beneath the Boiler Room can be somewhat variable. The mounding effect observed during March 1988 is likely related to the sustained below average precipitation observed during 1988 and early 1989. However, a recharge source sufficient to produce this mounding effect has not been identified at this time. In contrast, the ground water configuration observed under the higher recharge conditions of June 1989 represents expected conditions, with ground water flowing generally from south to north through the site, and ultimately to the Susquehanna River.

In addition to horizontal ground water flow, a downward vertical gradient exists between wells BR-4 and BR-11. These two wells have a vertical sand packed-interval separation of 61.5 feet, and the head differential between these wells was 1.59 and 3.05 feet in a downward direction on 28 March and 28 June, 1989 respectively. Therefore, the downward gradients for these two dates were 0.026 and 0.05 respectively, an order of magnitude greater than the gradients defined in any horizontal direction.

3.4.2.2 Flow Velocities

Ground water flow velocity beneath the Boiler Room can be calculated through the relation:

$$\text{velocity } (v) = \frac{ki}{n_e}$$

Where:
- k = Hydraulic Conductivity (ft/d)
- i = Hydraulic Gradient
- n_e = Effective Aquifer Porosity

Based on the preceding equation, and assuming an effective aquifer porosity of 35 percent (Freeze and Cherry, 1979) and an average hydraulic conductivity of 87 ft/day in the glacial till, ground water flow from the Boiler Room area to the north, was at a rate approaching 1.5 feet per day during the March sampling. During the June sampling, ground water flow to the north from the Boiler Room area was at a rate of 1 foot per day. The vertical flow rate cannot be accurately determined as no data on vertical hydraulic conductivity are available. However, two significant observations can be made:

- in a sedimentary lacustrine sequence, hydraulic conductivity is always one or more orders of magnitude lower in the vertical direction than in the horizontal, and
- the absence of VOCs in the deep lacustrine sequence indicates that the downward flow component is minimal.

3.4.3 Long Term Water Levels

Water levels were monitored over a period of 11 days to assess the impact of pumping the North Well on the Boiler Room area, to identify any other pumping which may have an affect on the Boiler Room area, and to observe the trends in water levels over a sustained period of time. The dates monitored during this study were 25 May-to-5 June 1989. This time period encompassed a three-day plant shut-down over Memorial Day weekend, during which the North Well ceased operation on 26 May at 11:30 p.m., and resumed operation on 30 May at 7:40

a.m.. The data were gathered by Hermit™ data loggers and pressure transducers installed on wells BR-4, BR-6, BR-8 and BR-11.

The hydrographs presented in Figures 3-6 through 3-9 show the water table elevation trends in the wells monitored during the study. The hydrographs for the shallow wells (BR-4, BR-6, BR-8) indicate similar behavior, with two rates of water level decline readily apparent in each of those wells. Except for well BR-8, a natural decline is identified during the Memorial Day weekend and represented as a gently sloping line on the hydrographs. This represents a natural water level decline of approximately 0.02 feet/day where any observable effects due to pumping the North Well are not apparent. This decline was not apparent in well BR-8 where water levels showed a slight increase during North Well shutdown. An induced water level decline, approaching 0.08 feet/day, after the North Well was re-started on 30 May is represented as the sharply sloping line on each hydrograph.

In addition to the decline of the water table, abrupt upward changes in water table elevation on 27 May, 30 May and 4 June are apparent in the hydrographs. On 27 May, 0.27 inches of rainfall was recorded at the Bainbridge weather station (Table 3-5). Therefore, the abrupt upward change on this date can be attributed to infiltrating precipitation. The change observed on 29 May cannot be attributed to precipitation, as no precipitation was recorded on that date. However, this change may be related to fluctuations in barometric pressure. The upward change on 4 June likely represents the shut down of the North Well for the weekend.

The hydrograph for well BR-11 (Figure 3-9), screened from 90-to-100 feet BLS, indicates that the deep glacial system responds differently to pumping when compared to the shallow portion of the same system. Similar to the shallow well hydrographs, a natural decline in water level of approximately 0.02 feet/day is observed over the Memorial Day weekend. However, more prominent in this hydrograph is the conspicuous head differential of +1.3 feet that correlates almost precisely with shut down and subsequent re-start of the North Well over the long weekend. Additionally, a cyclic pattern is observed during the work week in which an unidentified well begins a pumping

Figure 3-6
Well BR-4
Long Term Water Level Study
Boiler Room Investigation

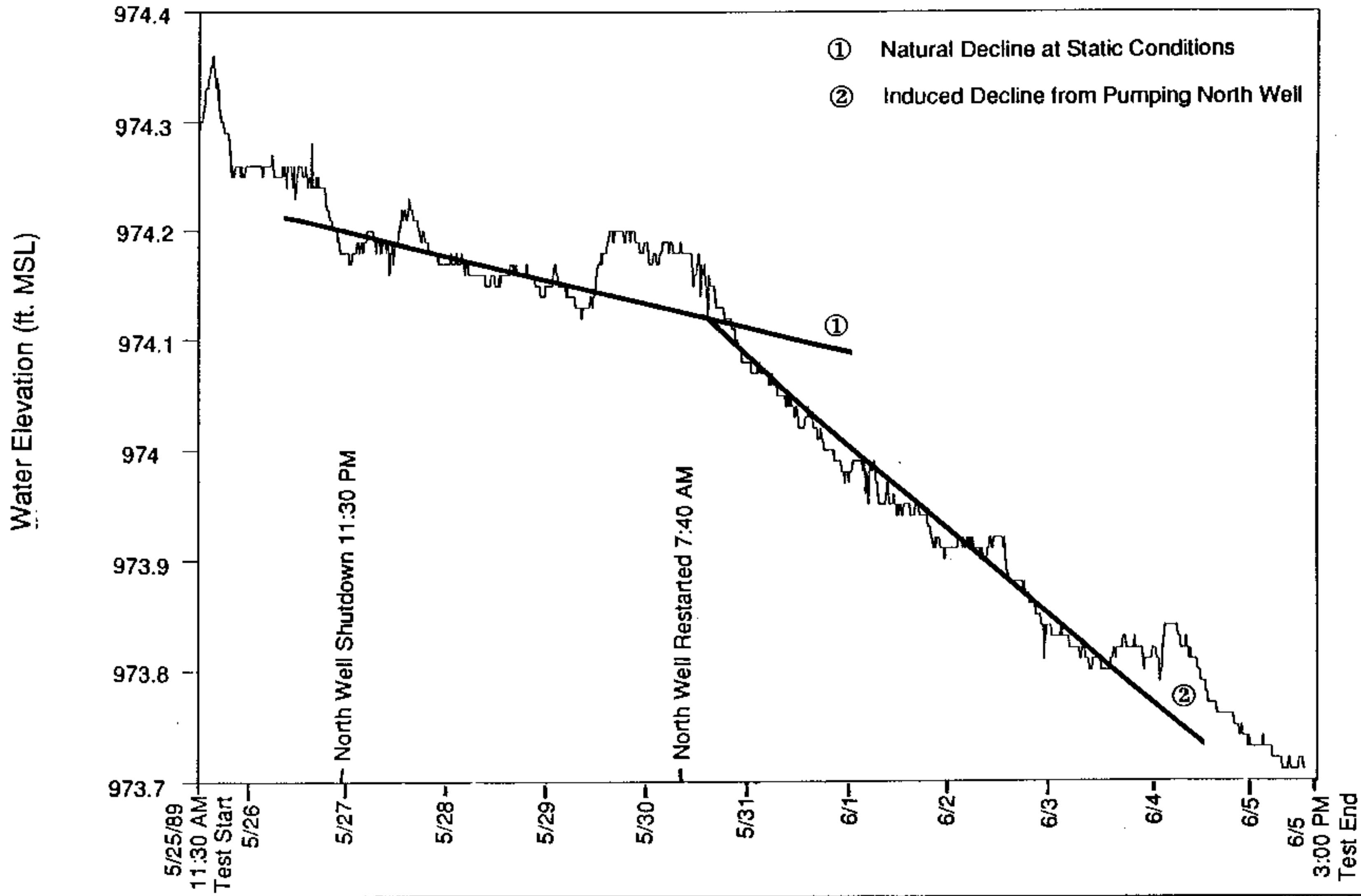


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Figure 3-7
Well BR-6
Long Term Water Level Study
Boiler Room Investigation

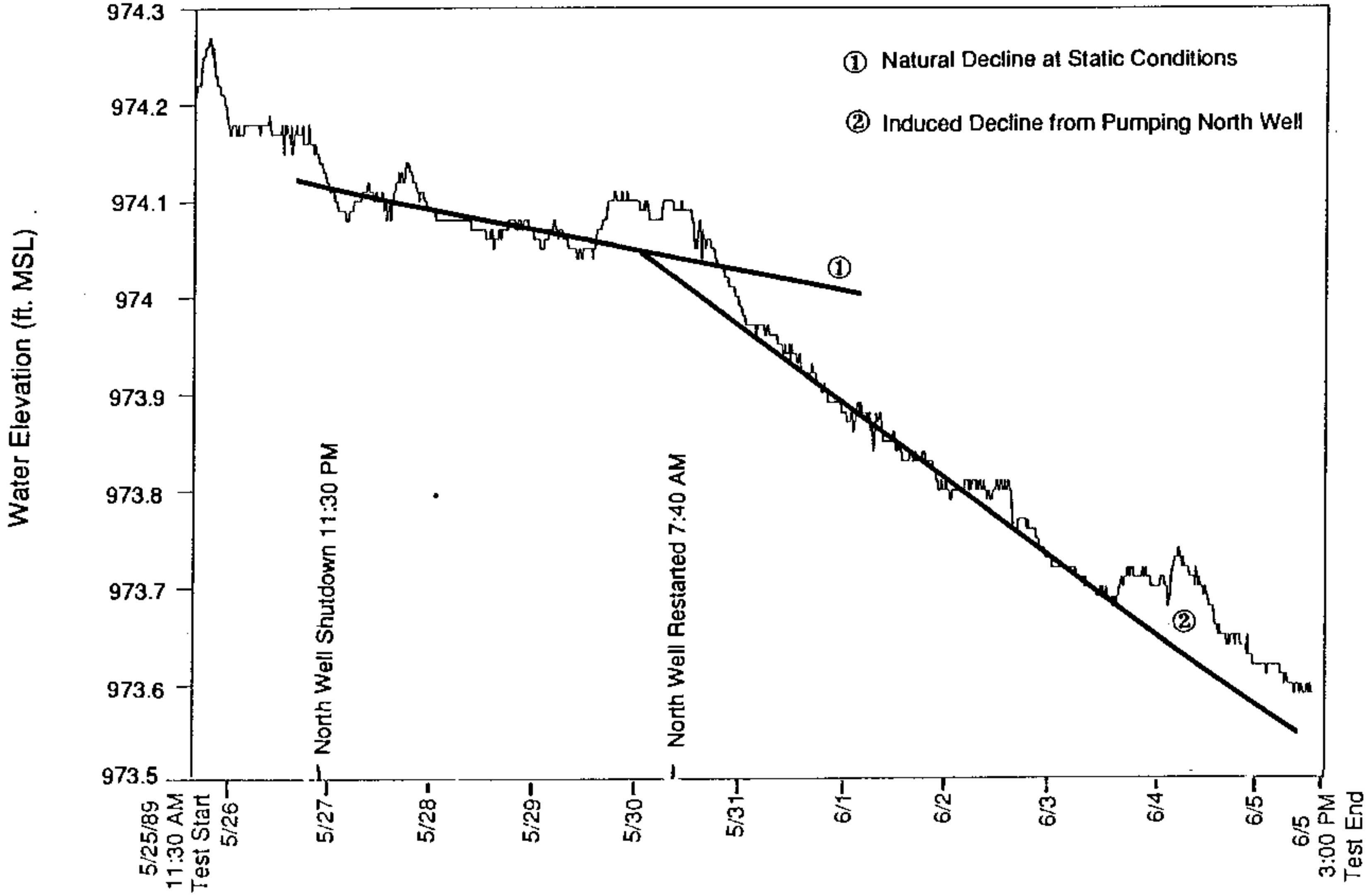

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Figure 3-8
Well BR-8
Long Term Water Level Study
Boiler Room Investigation

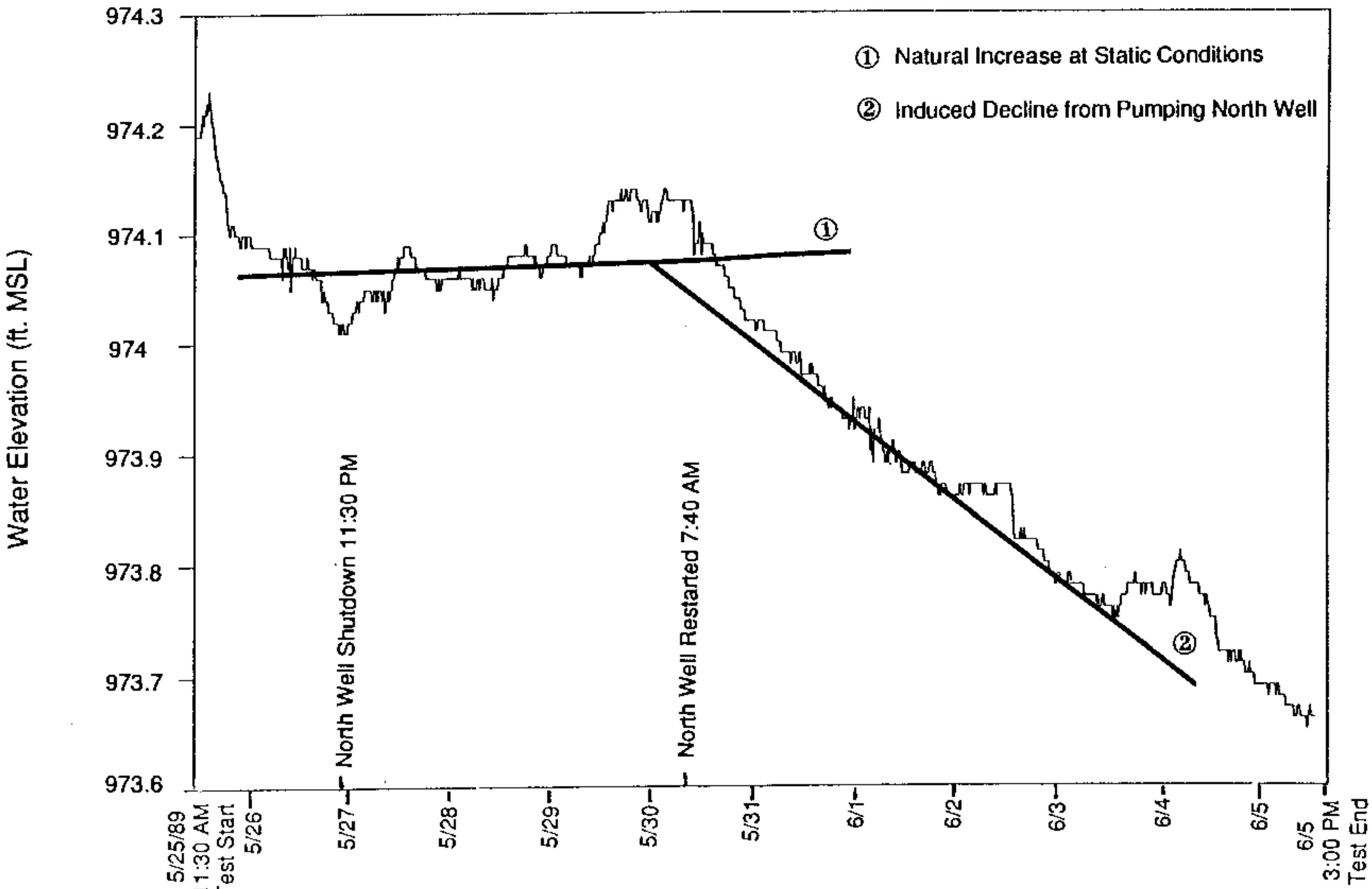

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Figure 3-9
Well BR-11
Long Term Water Level Study
Boiler Room Investigation

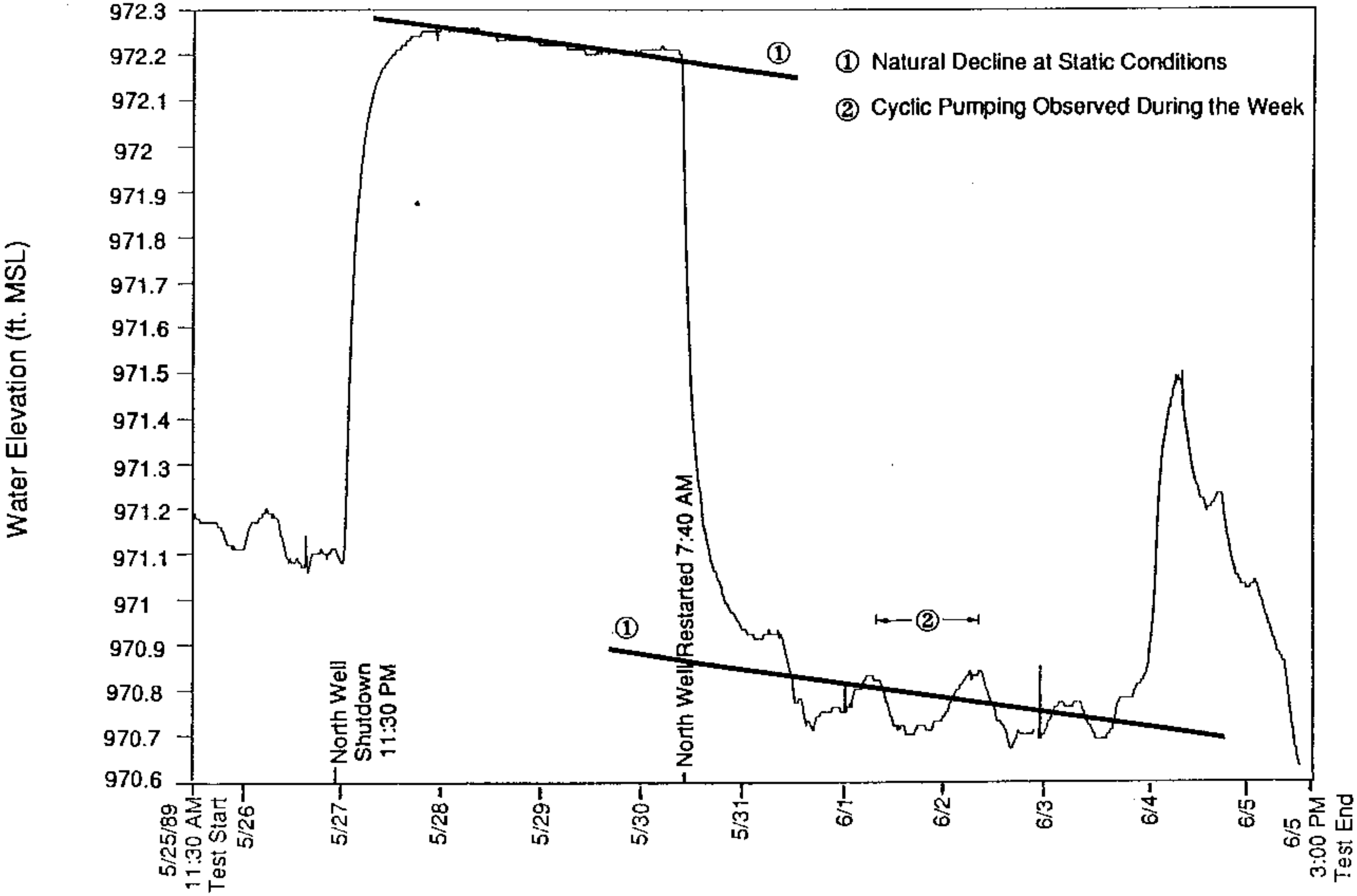

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Table 3-5
Precipitation Observed at the NOAA Weather Station at Bainbridge, New York During the Long Term Water Level Study Boiler Room Investigation

	Date	Precipitation (inches)
May	23	0.00
	24	0.47
test begin *	25	0.05
	26	0.04
	27	0.27
	28	0.05
	29	0.00
	30	0.00
	31	0.26
June	1	0.15
	2	0.05
	3	0.10
	4	0.17
test end **	5	0.10
	6	0.43
	7	0.05

* Test Began at 11:30 am
** Test Ended at 3:00 pm
Source: NOAA, 1989

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schedule sometime between 8:00 and 10:00 a.m. and ceases operation sometime between 5:00 and 9:00 p.m. daily. The source of this daily cyclic pumping is unknown at this time.

Nearly 1.3 feet of water level recovery in well BR-11 resulting from the shut-down of the North Well indicates that the downward vertical gradient observed between wells BR-4 and BR-11 is enhanced by the operation of the North Well. The vertical gradients between these two wells were 0.051 on May 26, just prior to North Well shutdown, and 0.033 on May 30, just prior to North Well restart, essentially under static conditions. Although this evidence suggests that the operation of the North Well has an impact on vertical flow in the Boiler Room area, the reduced vertical permeability of the lacustrine sand aquifer restricts the intercommunication between the shallow and deep flow systems.

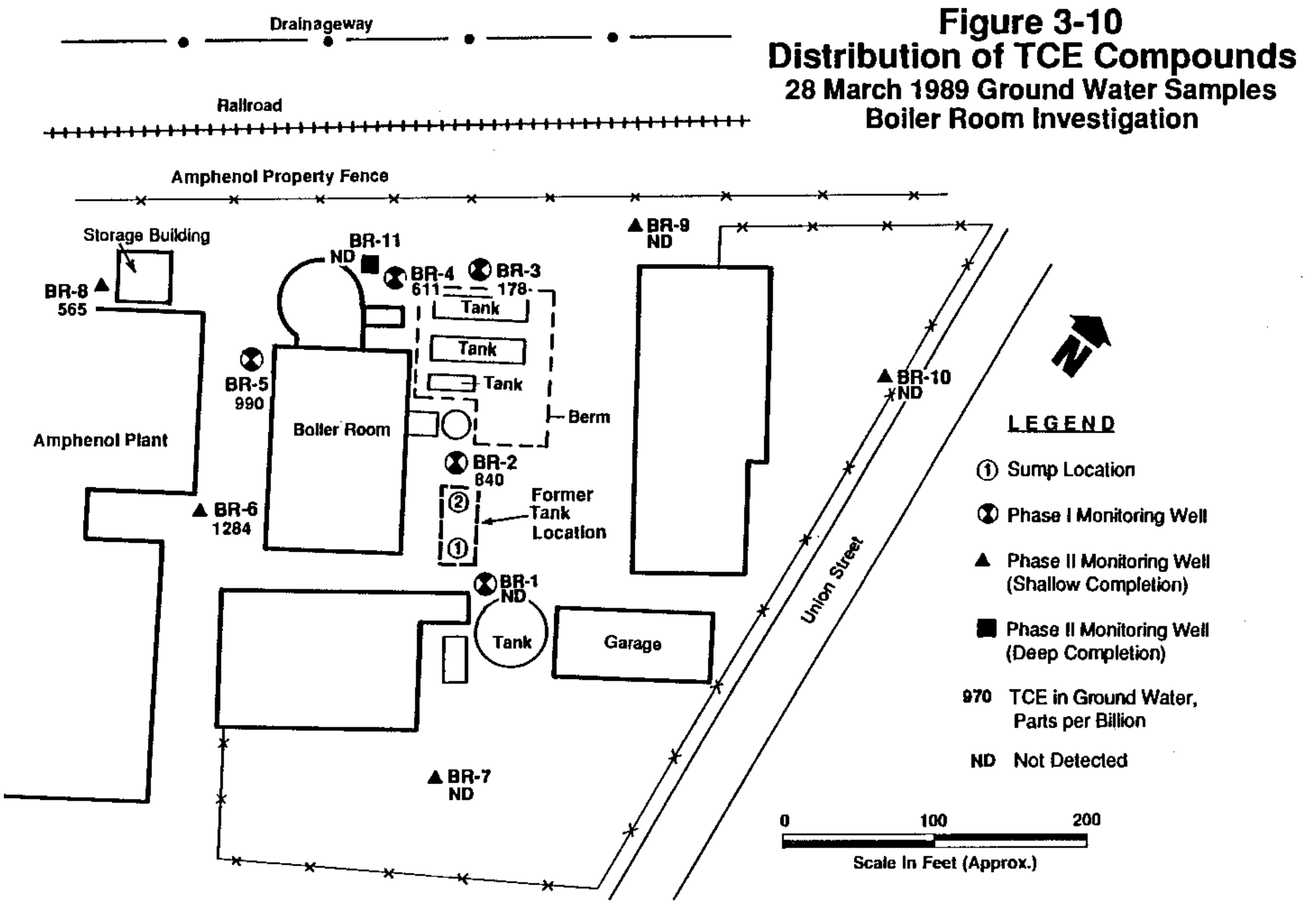
The pre-North Well shutdown period of the hydrographs also gives a good indication that hydraulic connection is very limited between the shallow and deep glacial system in the Boiler Room area. Two of the shallow wells showed no recovery, but rather a slight water level decline after North Well shutdown. This decline continued at a low rate until North Well restart, when the decline steepened in obvious response to the pumping. However, the actual effect of the pumping is very limited, and only served to steepen the natural decline somewhat. If a greater effect were present, the pre-shutdown levels would have been lower than the post-shutdown levels. Evidently, the decline prior to shutdown had been at a steeper trend, similar to the post-restart trend observed after May 30.

By contrast, the deep system head at well BR-11 responded to shutdown with a steep, immediate recovery, and to restart with a steep, immediate decline. Thus, the effects of North Well pumping on the shallow system are very limited in the Boiler Room area.

3.5 Dynamics and Extent of VOC Migration

The distribution of total VOCs in the ground water in the Boiler Room area is shown in Figure 3-10. This pattern suggests that a plume has migrated to the north from the area somewhere near well BR-6. The data collected during the early phases of the Boiler Room investigation indicated the presence of BTX

Figure 3-10
Distribution of TCE Compounds
28 March 1989 Ground Water Samples
Boiler Room Investigation



WO# 30127	Drawn by / Date: EJK 9/89	Checked by / Date: R. Hoose 9/89	Notes: * Concentrations do not include results with a "J" qualifier	The ERM Group
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compounds associated with the oil spillage at the former waste tank location. The data indicate that the BTX concentrations in the area have declined in response to the tank and soil removal action taken. The distribution of TCE compounds, by contrast, clearly suggests an alternate source area, somewhere nearer the vicinity of well BR-6. ERM understands that the area just south of well BR-6 may at one time have been a drum storage area, before the current plant building was constructed. This migration scenario is consistent with the ground water table configuration of June of 1989 (Figure 3-5). The presence of slightly higher-than-expected concentrations at well BR-2 suggests that the former waste tank area might have contributed some lesser concentrations of TCE compounds to the plume in that area.

The VOC plume distribution is inconsistent with the March 1989 water table map, shown in Figure 3-4, that indicates the presence of a ground water mound near the former waste tank area, with radial flow outward in all directions. The VOC distribution suggests that this mounding is not a major condition, it likely occurs only during very dry periods and does not control VOC migration to any significant degree.

An evaluation of the TCE/DCE/VC ratios to total TCE compounds is presented in Table 3-6. This data indicate that the highest ratios of TCE to total TCE compounds are found in wells BR-2, BR-3 and BR-4, located closest to the former waste tank area (Figure 3-11). Conversely, the lowest ratios of TCE to total TCE compounds are found in wells BR-6 and BR-8. Although the overall ratios are similar in all the wells, this distribution may reflect the effects of two source areas; the major one south of well BR-6, and a minor one at the former waste tank area.

The extent of the TCE plume migration downgradient in the shallow aquifer is not known at this time. The concentrations detected near the Amphenol property boundary in wells BR-4 and BR-8 indicate that some off-site migration may have occurred. The long term water level study indicates that the North Well pumping has an overall slight influence on hydraulic gradients in the Boiler Room area shallow system, but it does not appear likely that the overall northward gradient is deflected directly toward the North Well from the site. However, the presence of low level TCE Compounds in the North Well may

Table 3-6
TCE/DCE/VC to Total TCE Compound Ratios
March, 1989 and June, 1989 Sampling
Boiler Room Investigation

Date	TCE/Total TCE Compounds		DCE/Total TCE Compounds		VC/Total TCE Compounds	
Well Number	28-Mar	28-Jun	28-Mar	28-Jun	28-Mar	28-Jun
BR-1		*		*		*
BR-2	52	*	41	*	7	*
BR-3	56	*	38	*	6	*
BR-4	59	*	36	*	5	*
BR-5	48	*	42	*	10	*
BR-6	40	54	52	41	8	5
BR-7						
BR-8	28	27	62	56	10	17
BR-9						
BR-10						
BR-11						

All values represent percentages
Blank spaces indicate that TCE Compounds were not detected
* These wells were not sampled in June, 1989

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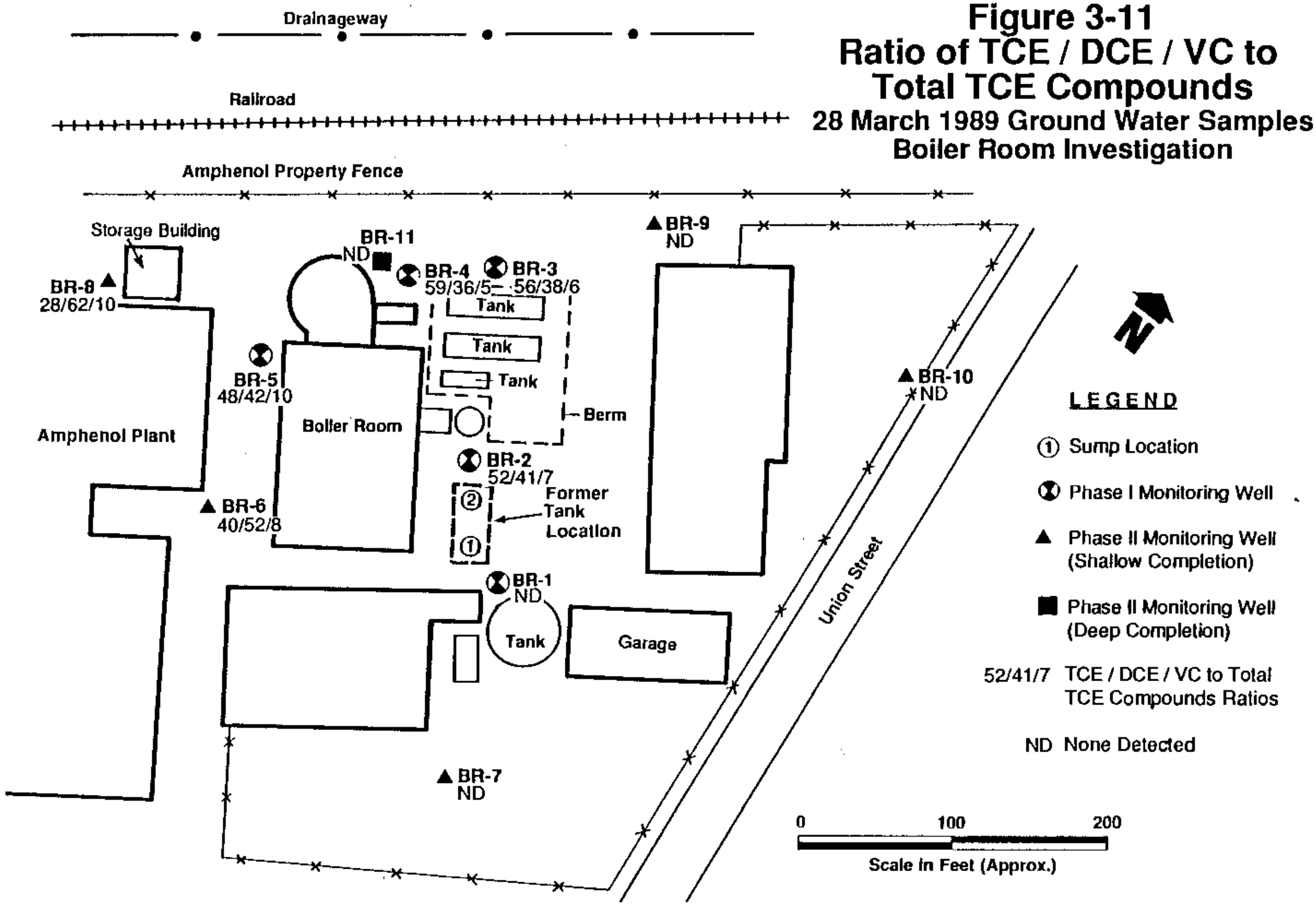
Figure 3-11
Ratio of TCE / DCE / VC to Total TCE Compounds
28 March 1989 Ground Water Samples
Boiler Room Investigation



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indicate that any off-site portion of the plume may be partially captured by the North Well due to increased vertical hydraulic gradients closer to the pumping well.

The conditions seen at Amphenol's West Well are analogous to those likely at the North Well. At the West Well, TCE compounds are drawn vertically downward through the lacustrine fine sands, silts and clays under the influence of the induced vertical gradients. This effect has restricted lateral downgradient migration of the shallow plume in the West Well area. If the Boiler Room area plume comes within an area of similar effect for the North Well, capture should be essentially complete; if not, continued lateral migration will occur. Given the plume distance from the North Well, total capture is not expected by ERM.

SECTION 4
SITE IMPACT ASSESSMENT/REMEDIAL ACTION REQUIREMENTS

4.1 Site Impact Assessment

To assess the need for remedial action at the Boiler Room site, two factors were considered:

- potential impact to humans by exposure to compounds of concern; and
- potential exceeding of regulatory standards, or in the absence of standards, comparison to guideline values, where available.

These assessments are discussed as follows.

4.1.1 Potential for Human Exposure

The potential for human exposure to the compounds associated with the Boiler Room area is limited by the nature of the problem. The only potential exposures might be:

- Dermal and/or inhalation exposure to contaminated source area materials - no such source area materials appear to be present exposed at the land surface, as the Amphenol plant building and/or paving apparently cover the source area.
- Exposure via use of affected ground water for potable uses - no private wells are used for water supply downgradient of the Boiler Room area, as determined by the NYS Department of Health during former investigations related to the Amphenol West Well area. The Amphenol North Well is located in the downgradient direction of ground water flow, but is not used for potable water supply. The Village of Sidney water supply wells are located downgradient approximately 1500 feet.
- Exposure via discharge of North Well water to Tributary 147 - North Well water is used in plant processes and for cooling water, and ultimately discharges via NPDES outfalls into Tributary 147, which flows to the Susquehanna River. However, the concentrations at the North Well are so low (a

few μg/L) as to have no practical impact at this time. Also, the volatile nature for the compounds in ground water would virtually assure their loss by volatization during water usage and discharge to Tributary 147. Therefore, no significant impacts are likely to occur.

Given the above, no current impacts are expected to be present from the Boiler Room area. However, as the plume migrates with time, the North Well concentrations could increase, and if the North Well plume capture is limited, the Village well(s) could be reached by the outer plume periphery. To examine the potential for impacts, ERM has performed preliminary analysis of the plume as it migrates toward those two potential receptors (See Section 4.2).

4.1.2 Comparison to Standards and Guidelines

The second criterion by which the Boiler Room area was assessed was a comparison to regulatory standards or guidelines where they existed. Based on the hydrogeologic investigations, the ground water pathway is the only significant pathway for potential exposure to the compounds identified. Table 4-1 shows the potentially applicable regulatory standards and guidelines for the compounds found in ground water at the site. It should be noted that only the New York State Ground Water Standards are enforceable criteria, as the federal MCLs are point of use standards for public water supplies. However, in the absence of standards for most site-related compounds in the ground water, available guidelines are also listed in Table 4-1 to allow for a more complete overview of site-related conditions.

4.2 Ground Water Impacts Assessment

4.2.1 Ground Water Flow and Quality

As presented in Section 3.4, ground water elevations indicate that predominant flow occurs to the north at velocities ranging from 1 to 1.5 feet per day. Vertical gradients indicate downward vertical flow; this flow is minor in comparison to the horizontal movement in the shallow flow system. The North Well exerts a pronounced influence on the water levels on the deep flow system, but very little on the shallow flow system in the Boiler Room area. However, the conditions found at the Amphenol

TABLE 4-1
APPLICABLE STANDARDS
FOR VOLATILE ORGANICS DETECTED IN GROUND WATER IN 1989
BOILER ROOM PHASE II INVESTIGATION

Compound	NYSDEC Ground Water Standard	US EPA Maximum Contaminant Level
Trichloroethene (TCE)	5	5
Trans-1,2-dichloroethene (DCE)	5	
Tetrachloroethene (PCE)	5	
1,1-dichloroethane (DCA)	5	
Vinyl chloride (VC)	2	2
Benzene	5	5
Carbon disulfide	50	

Note: All concentrations shown are in µg/L (ppb).

West Well suggest that the shallow system could be strongly influenced nearer the North Well, where the induced vertical gradients might be more substantial.

Ground water quality data have indicated that there are two potential source areas for the halogenated organics detected in the ground water. The highest concentration of these compounds are in well BR-6, near to a suspected former drum storage area. However, proportions of TCE to its degradation products indicate a possible minor additional source area in the vicinity of the former waste storage tank.

4.2.2 Long-Term Potential for Exposure

The long term potential effects of the VOCs in ground water at the Boiler Room area have been evaluated at two points of exposure, the North Well and near the Susquehanna River (which approximates the area of the Village of Sidney water supply wells). Each evaluation takes into account the fate of the waters and the dispersion of the VOCs throughout the process of transportation. For this analysis, a dispersion model was employed to determine the expected long-term concentrations of TCE, which was detected as the major species of concern, at the two receptors. The results of the dispersion modeling were then semi-quantitatively adjusted for dilution factors.

4.2.2.1 Description of Dispersion Model

The VOC dispersion model provides for the calculation of a VOC concentration at a receptor some distance away from the contaminant source. The model is conservative in that it assumes steady state conditions, an infinite supply at the contaminant source, and does not include other processes such as retardation, dilution or chemical or biological degradation. Additionally, concentrations calculated at potential receptors are based on "worst case" location, where the receptor well is located on the longitudinal axis of the plume. All of these assumptions result in extremely conservative estimates of long-term concentrations.

According to Anderson (1984), the ratio of longitudinal to transverse dispersion ranges from 10:1 to 100:1. This assumption is significant in that a plume will tend to spread and disperse more rapidly in a downgradient (longitudinal) direction in contrast to spreading in the transverse direction.

To facilitate the use of the model, values for several variables must be either known or assumed. These variables are as follows:

Y = Distance to receptor

X = Width of source area

Z = Thickness of source area

Co = Initial concentration of contaminant at source

Based on this information, the concentration to be expected at the nearest down-gradient receptor can be calculated by the relation:

$$Cr = Co \operatorname{erf}\left[\frac{Z}{2(D_t Y/v)^{1/2}}\right] \operatorname{erf}\left[\frac{X}{4(D_t Y/v)^{1/2}}\right] \quad \text{Equation \#1}$$

Where:
- Cr = Concentration at Receptor
- v = Ground water Velocity
- D_t = Transverse Dispersion Coefficient
- Y = Distance to Receptor
- erf = error function

The transverse dispersion coefficient (D_t) can be determined from Figure 4-1, which gives the longitudinal dispersivity (d_t) to be expected in several different types of porous media. In this study, the value used for dispersivity was 1/10 of the value determined from Figure 4-1.

From the dispersivity, the dispersion coefficient can be calculated through the relation:

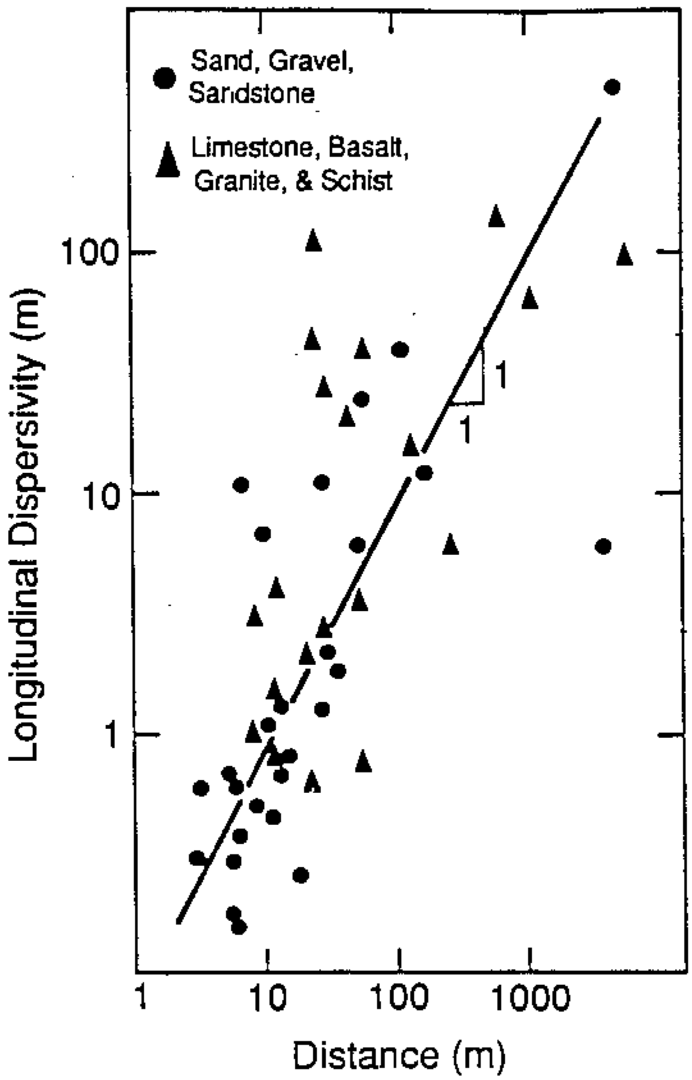
$$d_t = \frac{D_t}{v}$$

Where:
- d_t = dispersivity
- D_t = Dispersion coefficient
- v = ground water velocity

$$D_t = (d_t)(v)$$

Substitution of $(d_t)(v)$ into Equation 1 yields:

Figure 4-1
Graph Showing Variation of Dispersivity with Distance



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$$Cr = Co \; erf\left[\frac{Z}{2(d_tY)^{1/2}}\right] \; erf\left[\frac{W}{4(d_tY)^{1/2}}\right] \quad \text{Equation \#2}$$

This assumption is consistent with that of Anderson (1984).

This model was applied to each of the two potential receptor points, as discussed in the following subsection.

Two situations were modeled for each potential exposure point. The first situation entails solving the model for the concentration at the receptor (Cr) based on the concentration at the source area (Co). The second situation sets the concentration at the receptor to equal a standard (i.e. NYSDEC Ground Water Standard for TCE), and solves for the concentration required at the source area. This latter case estimates that condition following "clean up" that will result in exposures below standards at the receptor.

4.2.2.2 Model Application for Cr

Models of concentrations at the receptors based on present source area concentrations were based on the following input parameters:

Co	=	average of 1989 TCE concentrations at wells BR-4 and BR-8 along property line = 0.199 mg/L,
Z	=	thickness of shallow flow zone = 35 feet = 11 meters,
W	=	width of contaminated flow at source = distance between source areas at site (BR-6 to BR-3) = 250 feet = 76 meters,
Y	=	distance to receptors: North Well = 600 feet = 183 meters; Susquehanna River = 1500 feet = 457 meters, and
d_t	=	longitudinal dispersivity constant = 0.1 of value derived from Figure 4-1 based on distance to receptor: North Well = 1.75; Susquehanna River = 4.16.

Input of these variables into Equation 2 yields:

For North Well as receptor:

$$Cr = Co \quad erf\left[\frac{Z}{2*(d_tY)^{1/2}}\right] \quad erf\left[\frac{W}{4*(d_tY)^{1/2}}\right]$$

$$= 0.199\ g/m^3 * erf\left[\frac{11}{2(1.75)(183)^{1/2}} *\right] \quad erf\left[\frac{76}{4(1.75)(183)^{1/2}}\right]$$

$$= 0.199\ erf(0.307)\quad erf(1.062)$$

$$=0.056\ g/m^3 = 0.056\ mg/L = 56\ \mu g/L\ TCE$$

For Susquehanna River as receptor:

$$Cr = Co \quad erf\left[\frac{Z}{2(d_tY)^{1/2}}\right] \quad erf\left[\frac{W}{4\ (d_tY)^{1/2}}\right]$$

$$= 0.199\ g/m^3 * \quad erf\left[\frac{11}{2(4.16*457)^{1/2}}\right] \quad erf\left[\frac{76}{4(4.16*457)^{1/2}}\right]$$

$$= 0.199\ erf(0.126)\quad erf(0.436)$$

$$=0.013\ g/m^3 = 0.013\ mg/L = 13\ \mu g/L\ TCE$$

Therefore, based on this dispersion model, TCE with an initial concentration of 199 μg/L will be reduced to 56 μg/L over 600 feet and 13 μg/L over 1500 feet. Again, the reduction is attributed solely to dispersion; chemical, biological and dilution processes are neglected.

To put these numbers into better perspective, the following should be noted:

- Significant dilution from ground water recharge will occur. For example, at an average ground water flow velocity of approximately 1 foot per day, arrival at the North Well and Susquehanna River would occur in approximately 1 1/2 to 2 years, and 4 to 5 years, respectively. Assuming 1 foot per porosity of 0.35 over a 35 foot aquifer thickness, dilution would be approximately 8 percent per year. Therefore, at the North Well, concentrations would be reduced to 47 to 49 ppb, and at the river, to 8 to 9 ppb.

- The increase in the gravel aquifer saturated thickness near the river (to approximately 100 feet) would provide another 2 times dilution at that location, reducing concentrations to 2 to 3 ppb.
- Significant dilution will occur due to pumping contributions from unaffected areas at the North Well, and at the Village of Sidney well(s) near the river. This effect cannot be estimated, but would reduce the effective concentrations at the river to below 1 ppb. However, if the North Well dynamics are similar to those at the West Well, VOC concentrations might be detectable. This is consistent with the few ppb levels occasionally present in samples taken from the North Well.

In conclusion, the Boiler Room area is not expected to pose any potential exposure threat at the Village of Sidney water supply wells. The hydrogeologic investigation and the impact assessment do indicate, however, that potential exists for some effects at the North Well. The degree to which the concentrations might increase at that well cannot be estimated at this time, but the maximum is expected to be well below the 79 ppb dispersion model value.

4.2.2.3 Model Application for Co

Back calculation from the receptors to the source area were performed. In these calculations, the distances to the source area remained the same, but the Crs were assumed to be 5 μg/L, the NYSDEC Ground Water Standard for TCE. This exercise suggests that considering dispersion only, a source area with a TCE concentration of 18 μg/L could not impact the North Well area with a TCE concentration of over 5 μg/L. Likewise, a source area with a TCE concentration of 79 μg/L would not impact the Susquehanna River with a TCE concentration of over 5 μg/L. The actual values taking into account other variables as discussed previously will be higher, possibly twice as high, for the North Well, and well above the present levels for the river area.

4.2.3 Comparison With Standards and Guidelines

Table 4-2 presents the results of ground water analyses for the Boiler Room monitoring wells in March and June 1989, along with EPA Maximum Contaminant Levels (MCLs) and NYSDEC Ground Water Standards. As indicated on Table 4-2, NYSDEC standards are available for TCE, Trans 1,2-DCE, DCE, PCE and VC. MCLs exist for TCE, VC and benzene.

Data from wells BR-4 and BR-8 indicate that both NYSDEC standards and guidelines, as well as MCLs are most likely exceeded in off-site ground water north of the Boiler Room. Both of these wells are located just upgradient of the Amphenol property fence, and therefore represent concentrations that would be similar to those in off-site ground water just across the property line. Samples obtained from each of these two wells exceeded both the NYSDEC standard and the MCL for TCE. Of the remaining compounds, DCA exceeded the NYSDEC standard of 5 µg/L in well BR-8, and PCE, VC and DCE each exceeded all standards in both wells. Data from the North Well to date have not exceeded any standards.

No data is available regarding the presence or absence of TCE in the Susquehanna River. The modeled concentration of TCE at the Susquehanna River exposure point is slightly above both the NYSDEC Ground Water Standard and the MCL for TCE. It should be pointed out that this model is conservative and does not reduce the concentrations from the source to the receptor as a result of dilution, degradation or attenuation. The remainder of the contaminants detected in the Boiler Room area will decrease proportionally to the TCE reduction at each exposure point, and would therefore be expected to decrease below NYSDEC guidelines.

4.3 Remedial Action Requirements

Although the shallow ground water flow zone at the Boiler Room area is not used as a water supply, the modeled exposures indicate the potential for migration to the North Well. Given this, and since the concentrations beyond the Amphenol property boundary are inferred to exceed NYSDEC Ground Water Standards for the chlorinated organics, a program of ground water recovery and treatment should be established.

TABLE 4-2
COMPARISON OF MAXIMUM 1989 GROUND WATER CONCENTRATIONS WITH APPLICABLE STANDARDS FOR VOLATILE ORGANICS
BOILER ROOM PHASE II INVESTIGATION

Compound	Maximum 1989 Boiler Room Network Concentration	NYSDEC Ground Water Standard	US EPA Maximum Contaminant Level
Trichloroethene (TCE)	500	5	5
Trans-1,2-dichloroethene (DCE)	660	5	
Tetrachloroethene (PCE)	17	5	
1,1-dichloroethane (DCA)	11	5	
Vinyl chloride (VC)	100	2	2
Benzene	7	5	5
Carbon disulfide	9	50	

Note: All concentrations shown are in µg/L (ppb).

Ground water recovery and treatment for volatile organics typically consists of the recovery of the ground water via a pumping well and treatment via an air stripper. Such systems have been successfully installed and operated at the Amphenol West Well area and the former Amphenol Lagoons site. A similar type of system would be appropriate for the Amphenol Boiler Room area. The format of ground water recovery and treatment must be determined in a Feasibility Study and subsequent phases of design engineering.

SECTION 5
CONCLUSIONS

The Phase II Boiler Room Investigation has evaluated ground water in the shallow and deep flow zones, including:

- physical characteristics of ground water flow,
- ground water quality, and
- impacts of ground water quality and requirements for remediation.

Following review of the results of this investigation, ERM has drawn the following conclusions with respect to these items.

Physical Characteristics of Ground Water Flow

- Ground water table maps produced in this investigation indicate that ground water normally flows to the north and/or northwest in the area of the Boiler Room, ultimately discharging to the Susquehanna River
- Temporary ground water mounding occurs under the Boiler Room as a result of sustained periods of below average precipitation, and possibly, an unidentified recharge source that produces this mounding effect; this mound has shallow gradients to the east, west, north and south.
- Ground water flow velocities range from 1 to 1.5 feet per day to the north.
- A downward vertical gradient was measured between shallow and deep flow zones; however, due to the nature of the lacustrine unit, vertically downward flow is minimal in the Boiler Room area.
- Pumping the North Well directly influences ground water in the deep flow system, but has only a limited influence on the shallow flow system in the Boiler Room area. However, closer to the North Well, vertical flow could be induced by pumping.

Ground Water Quality

- TCE and related volatile organic compounds have been detected in the shallow ground water in the vicinity of the Boiler Room, but only at an estimated concentration of 4 μg/L in the deep ground water monitoring well in March 1989. However, this was not confirmed in the June 1989 sampling. This substantiates the conclusion that hydraulic connection is limited between the shallow and deep flow zones in the Boiler Room area.
- The principal source area for the chlorinated volatile organics appears to be a former drum storage area which reportedly may have been present near the Boiler Room area.
- The downgradient extent of the shallow ground water plume is undefined; the concentrations detected in wells BR-4 and BR-8 along the property boundary indicate that the plume has likely moved off site to the north.
- Low concentrations of TCE degradation products detected in samples from the North Well indicate that the North Well pumping may be capturing a portion of the plume.

Impact of Ground Water and Remedial Action Requirements

- There is no potential for significant human exposure to the compounds associated with the Boiler Room.
- On-site ground water quality exceeds the NYSDEC Ground Water Standards for TCE, and guidelines for other related volatile organics.
- Dispersion modeling of the source area concentrations, and consideration of the effects of dilution on off-site ground water quality predict concentrations of less than 50 μg/L at the North Well and non-detectable at the Susquehanna River.
- Given the potential for migration of site-related compounds to the North Well and the exceeding of NYSDEC ground water standards, a program of ground water recovery and treatment should be established.

- A Feasibility Study should be performed to evaluate remedial options, including several ground water recovery techniques and applicable treatment technologies.

REFERENCES

Bouwer, H., and R.C. Rice. 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially penetrating Wells. Water Resources Research 12 (3): 423-428.

Freeze, R.A., and J.A. Cherry. 1979. Groundwater. Prentice-Hall, Englewood Cliffs, New Jersey.

MacNish, R.D., and A.D. Randall. 1982. Stratified-Drift Aquifers in the Susquehanna River Basin, New York. New York State Department of Environmental Conservation Bulletin 75:68.

NOAA, 1989, Personal Communication to Randy Hoose, ERM, Inc., 26 June 1989.

ANALYTICAL QUALITY ASSURANCE REVIEW
AMPHENOL CORPORATION
BOILER ROOM GROUND WATER SAMPLES
COLLECTED ON 28 MARCH 1989

23 August 1989

Prepared For:

Ampenol Corporation
One Delaware Avenue
Sidney, New York 13838

Prepared By:

Environmental Resources Management, Inc
855 Springdale Drive
Exton, Pennsylvania 19341

File No: 301-27-00-01

SECTION 1
INTRODUCTION

The following analytical quality assurance report is based on the review of all data from the Boiler Room water samples collected on 28 March 1989 at the Amphenol Corporation Facility located in Sidney, New York. All samples included in this review are listed on Table 1-1. The analytical methods which were used in these analyses are summarized and referenced in Attachments 1 and 2, respectively. Data summary tables presenting the validated and qualified analytical results are attached at the end of this report.

All data for the analyses were reviewed for adherence to the specified analytical protocols. All results have been validated or qualified according to general guidance provided in the "Laboratory Data Validation Functonal Guidelines for Evaluating Organic Analyses" (US EPA).

TABLE 1-1
AMPHENOL BOILER ROOM
SUMMARY OF SAMPLE DATA REVIEWED

ERM SAMPLE NUMBER	SAMPLE LOCATION	DATE SAMPLED	LANCASTER LAB SAMPLE NUMBER	ANALYSIS PERFORMED
17777	BR-11	3/28/89	1373564	VOA by CLP
17778	BR-1	3/28/89	1373565	VOA by CLP
17779	BR-7	3/28/89	1373566	VOA by CLP
17780	BR-10	3/28/89	1373567	VOA by CLP
17781MS	BR-10	3/28/89	1373568	VOA by CLP
17782MSD	BR-10	3/28/89	1373569	VOA by CLP
17783	BR-9	3/28/89	1373570	VOA by CLP
17784	BR-2	3/28/89	1373571	VOA by CLP
17785	BR-3	3/28/89	1373572	VOA by CLP
17786	BR-24 (Duplicate of BR-3)	3/28/89	1373573	VOA by CLP
17787	BR-4	3/28/89	1373574	VOA by CLP
17788	BR-23 (Blind Equipment Blank)	3/28/89	1373575	VOA by CLP
17789	BR-5	3/28/89	1373576	VOA by CLP
17790	BR-6	3/28/89	1373577	VOA by CLP
17791	BR-8	3/28/89	1373578	VOA by CLP
17792	BR-25 (Blind Travel Blank)	3/28/89	1373579	VOA by CLP

SECTION 2
ORGANIC DATA

Eleven water samples, one travel blank, one equipment blank and one blind duplicate were analyzed by Lancaster Laboratories Inc. of Lancaster, Pennsylvania. All samples were analyzed for the Target Compound List (TCL) volatile organic compounds using US EPA Contract Laboratory Program (CLP) protocols. Tentatively identified compounds (TICs) were not requested to be reported for these samples.

The findings offered in this report are based on a detailed review of the following criteria reported according to the CLP deliverables format: chain-of-custody, holding times, blank analyses, surrogate compound recoveries, matrix spike compound recoveries and reproducibility, bromofluorobenzene (BFB) mass tuning results, internal standard areas, initial and continuing calibrations, quantitation of results, and qualitative mass spectral interpretation.

The organic analyses were performed acceptably, but require a few qualifying statements. It is recommended that the qualified results only be utilized appropriately as indicated in the following qualifying statements. Any data which are not qualified in this review are qualitatively and quantitatively valid, based on the criteria evaluated.

2.1 Organic Data Qualifiers

- As required by CLP protocols, all results for volatile organic compounds which were qualitatively identified at concentrations below the CLP contract required quantitation limits (CRQL) have been marked with "J" qualifiers to indicate that they are quantitative estimates.
- The reported results for carbon disulfide in the volatile analyses of water samples BR-2 and BR-8, and tetrachloroethene in samples BR-2 and BR-4, should be considered quantitative estimates. Poor response factor (RF) precision (>25% difference) was observed for these compound between the initial calibration curve average RF

and the continuing calibration standard RF associated with these samples. Poor continuing calibration RF precision indicates an instrument stability problem for this compound. The reported results for carbon disulfide and tetrachloroethene in these water samples have been qualified with a "J" on the data summary tables to indicate they are quantitative estimates.

- The detection limits for 2-butanone for all samples should be considered unreliable and may be higher than reported. The associated initial and continuing calibration standards response factors for 2-butanone were less than 0.05. These low response factors indicate a lack of instrument sensitivity for this compound.
- A blind duplicate sample labeled (BR-24) of monitoring well BR-3 was submitted for analysis. The relative percent difference (RPD) for the compounds detected in the duplicate analyses ranged from 0-3%, as summarized below. These low RPDs indicate good sampling and analytical precision.

	Concentration (µg/L)		
Compound	BR-3	BR-24	%RPD
Benzene	3	3	0
Vinyl Chloride	11	11	0
1,1-Dichloroethane	1	1	0
Tetrachloroethene	1	1	0
1,2-Dichloroethene (total)	67	69	3
Trichloroethene	100	100	0

SECTION 3
SUMMARY

All analyses for these samples were performed acceptably, but required a few qualifying statements. This analytical quality assurance review has identified all aspects of the analytical data which have required qualification. A support documentation package further detailing these findings has been filed with the Amphenol Boiler Room project.

Report Prepared By:

Melina A. Williams   23 August 1989

Melina A. Williams   Date
Quality Assurance Chemist

Approved By:

David R. Blye   23 August 1989

David R. Blye   Date
Quality Assurance Manager

ATTACHMENT 2

METHOD REFERENCES

Analyte	Reference
Volatiles	US EPA Contract Lab Program 10/86, Rev. 8/87.

ATTACHMENT 1

METHODOLOGY SUMMARY

Analysis for the TCL Volatiles by GC/MS

The sample is purged with helium and the volatile components are collected on a Tenax/Silica gel trap. The trap is desorbed onto the GC column where components of the sample are separated and detected by a mass spectrometer for quantitative and qualitative evaluation.

Amphenol Boiler Room
Ground Water Sample Results
Collected 28 March 1989
(all concentrations reported in μg/L)

Sample Location	BR-1	BR-2	BR-3	BR-24	BR-4	BR-5	BR-6	BR-7	BR-8	BR-9	BR-10	BR-11
Duplicates	-	-	-	Dup. of BR-3	-	-	-	-	-	-	-	-
Collection Date	3/28/89	3/28/89	3/28/89	3/28/89	3/28/89	3/28/89	3/28/89	3/28/89	3/28/89	3/28/89	3/28/89	3/28/89
Traffic Report #	17778	17784	17785	17786	17787	17789	17790	17791	17783	17780	17777	
Volatile Organics								ND		ND	ND	
Vinyl Chloride		84	11	11	28	98	88		60			
Carbon Disulfide		6 J							9 J			
1,1-Dichloroethene		2 J			1 J	3 J	3 J		3 J			
1,1-Dichloroethane		8	1 J	1 J	5	10	11		8			
1,2-Dichloroethene (total)		340	67	69	220	410	660		340			
Trichloroethene	2 J	430	100	100	360	460	500		150			2 J
Benzene	1 J	7	3 J	3 J	3 J	5	1 J					2 J
Tetrachloroethene		6 J	1 J	1 J	6 J	14	17		7			
Ethylbenzene									1 J			
Xylene (total)									1 J			

Qualifier Codes:
J-This result should be considered a quantitative estimate.
ND- None Detected.
Note: No concentration is entered for compounds which were not detected.

APPROVED FOR
RELEASE BY
QUALITY ASSURANCE
David R Blye 8-29-89
QA/QC MANAGER DATE

ANALYTICAL QUALITY ASSURANCE REVIEW
AMPHENOL CORPORATION
BOILER ROOM GROUND WATER SAMPLES
COLLECTED ON 28 JUNE 1989

14 September 1989

Prepared For:

Amphenol Corporation
One Delaware Avenue
Sidney, New York 13838

Prepared By:

Environmental Resources Management, Inc
855 Springdale Drive
Exton, Pennsylvania 19341

File No: 301-27-00-01

SECTION I
INTRODUCTION

The following analytical quality assurance report is based on the review of all data from the Boiler Room ground water samples collected on 28 June 1989 at the Amphenol Corporation Facility located in Sidney, New York. All samples included in this review are listed on Table 1-1. The analytical methods which were used in these analyses are summarized and referenced in Attachments 1 and 2, respectively. A data summary table presenting the validated and qualified analytical results is attached at the end of this report.

All data for the analyses were reviewed for adherence to the specified analytical protocols. All results have been validated or qualified according to general guidance provided in the "Laboratory Data Validation Functonal Guidelines for Evaluating Organic Analyses" (US EPA).

TABLE 1
AMPHENOL BOILER ROOM
SUMMARY OF SAMPLE DATA REVIEWED

ERM SAMPLE NUMBER	SAMPLE LOCATION	DATE SAMPLED	LANCASTER LAB SAMPLE NUMBER	ANALYSIS PERFORMED
19868	BR-11	6/28/89	1408148	VOA by CLP
19869	BR-7	6/28/89	1408149	VOA by CLP
19870	BR-10	6/28/89	1408150	VOA by CLP
19871	BR-9	6/28/89	1498151	VOA by CLP
19872	BR-6	6/28/89	1408152	VOA by CLP
19873	BR-8	6/28/89	1408153	VOA by CLP
19874 MS	BR-10	6/28/89	1408154	VOA by CLP
19875 MSD	BR-10	6/28/89	1408155	VOA by CLP
19876	BR-24 (Duplicate of BR-9)	6/28/89	1408157	VOA by CLP
19877	BR-23 (Equipment Blank)	6/28/89	1408158	VOA by CLP
19886	BR-25 (Travel Blank)	6/28/89	1408156	VOA by CLP

SECTION 2
ORGANIC DATA

Six water samples, one travel blank, one equipment blank and one blind duplicate were analyzed by Lancaster Laboratories Inc. of Lancaster, Pennsylvania. All samples were analyzed for the Target Compound List (TCL) volatile organic compounds using US EPA Contract Laboratory Program (CLP) protocols. Tentatively Identified Compounds (TICs) were not requested to be reported for these samples.

The findings offered in this report are based on a detailed review of the following criteria reported according to the CLP deliverables format: chain-of-custody, holding times, blank analyses, surrogate compound recoveries, matrix spike compound recoveries and reproducibility, bromofluorobenzene (BFB) mass tuning results, internal standard areas, initial and continuing calibrations, quantitation of results, and qualitative mass spectral interpretation of target compounds.

The organic analyses were performed acceptably, but require a few qualifying statements. It is recommended that the qualified results only be utilized appropriately as indicated in the following qualifying statements. Any data which are not qualified in this review are qualitatively and quantitatively valid, based on the criteria evaluated.

2.1 Organic Data Qualifiers

- All reported positive results for acetone and methylene chloride are qualitatively invalid due to the levels at which these compounds were present in the laboratory method blanks and/or travel blanks. EPA protocol requires positive sample results that are less than or equal to ten times the laboratory method blank or travel blank contamination level to be considered qualitatively invalid for methylene chloride and acetone (common laboratory contaminants). This has been indicated by placing a "B" qualifier next to the quantitative results on the data table.

- Review of the surrogate recovery data for water sample BR-24 (TR#19876) indicates that 1,2-dichloroethane-d4 was slightly above the acceptable surrogate QC criteria of 76-114% at 116%. Due to operator oversight, the reanalysis of this sample was not performed by the laboratory. Since no compounds were detected in the sample, there is no effect on the data presented due to the elevated 1,2-dichloroethane-d4 recovery.

- The volatile organic compounds quantitation limits and positive results for all samples may be slightly higher than reported. The laboratory entered the sample receipt dates incorrectly into the sample management system. This error resulted in the analyses to be performed one day in excess of the required fourteen day holding time for acid preserved samples. Comparison of these analyses to previous data indicate the results show only minor differences. Since the holding time was only exceeded by one day and the data compares well with previous data, the results have not been qualified.

- As required by CLP protocols, all results for volatile organic compounds which were qualitatively identified at concentrations below the CLP contract required quantitation limits (CRQL) have been marked with "J" qualifiers to indicate that they are quantitative estimates.

SECTION 3
SUMMARY

All analyses for these samples were performed acceptably, but required a few qualifying statements. This analytical quality assurance review has identified all aspects of the analytical data which have required qualification. A support documentation package further detailing these findings has been filed with the Amphenol Boiler Room project.

Report Prepared By:

Melina A. Williams — 14 September 1989

Melina A. Williams — Date
Quality Assurance Chemist

Approved By:

David R. Blye — 14 September 1989

David R. Blye — Date
Quality Assurance Manager

ATTACHMENT 1

METHODOLOGY SUMMARY

Analysis for the TCL Volatiles by GC/MS

The sample is purged with helium and the volatile components are collected on a Tenax/Silica gel trap. The trap is desorbed onto the GC column where components of the sample are separated and detected by a mass spectrometer for quantitative and qualitative evaluation.

ATTACHMENT 2

METHOD REFERENCES

<u>Analysis</u>	<u>Reference</u>
Volatiles	US EPA Contract Lab Program 10/86, Rev. 2/88.

Amphenol Boiler Room
Ground Water Sample Results
Collected 28 June 1989
(all concentrations reported in μg/L)

Sample Location	BR-6	BR-7	BR-8	BR-9	BR-24	BR-10	BR-11
Duplicates	-	-	-	-	Dup. of BR-9	-	-
Collection Date	6/28/89	6/28/89	6/28/89	6/28/89	6/28/89	6/28/89	6/28/89
Traffic Report #	19872	19869	19873	19871	19876	19870	19868
Volatile Organics							
Vinyl Chloride	17		60				
Methylene Chloride		3 B	1 B			4 B	2 B
Acetone	20 B	29 B	24 B	21 B	21 B	26 B	21 B
1,1-Dichloroethene			1 J				
1,1-Dichloroethane			5				
1,2-Dichloroethene (total)	130		190				
Trichloroethene	170		87				
Tetrachloroethene	3 J		4 J				

Qualifier Codes:
J-This result should be considered a quantitative estimate.
B-This result is qualitatively invalid since the compound was also detected in a blank at similar concentration.
Note: No concentration is entered for compounds which were not detected.

APPROVED FOR RELEASE BY QUALITY ASSURANCE

David R Blye 9-14-89

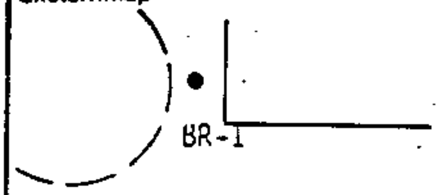
QA/QC MANAGER DATE

Environmental Resources Management

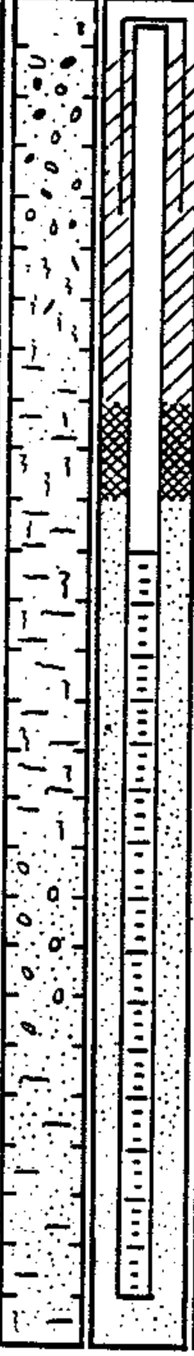
Drilling Log

Project: Bendix-Sidney
Owner:
Location: Boiler Room
W.O. Number: 3010510
Well Number: BR-1
Total Depth: 25.0'
Diameter: 2"
Surface Elevation:
Water Level: Initial:
24-hrs.:
Screen: Dia. 2"
Length: 15.0'
Slot Size: .01''
Casing: Dia. 2"
Length: 17.0'
Type: PVC Schedule 40
Drilling Company: Parratt Wolff, Inc
Drilling Method: Hollow stem auger
Driller: Butch Stevens
Log By: Bob Keating
Date Drilled: 1-24-85

Sketch Map



Notes: Grout mix 1-1 cement - sa
Screen packed with No.3 sand.

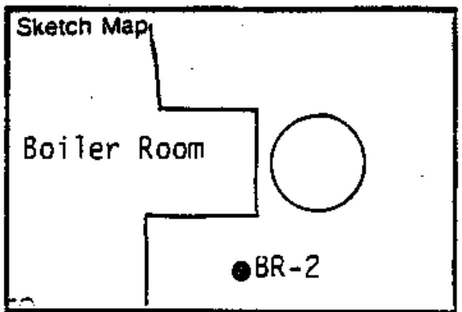


Depth (Feet)	Sample Number	Description/Soil Classification (Color, Texture, Structures)
0		Finished with 2.0' of 6" I.D. steel riser with locking cap.
	0-2'	Brown pea gravel and soil FILL, loose, dry, no odors.
2	2-4'	Same as above.
4	4-6'	Black organic - rich silty CLAY, with plant debris, soft, moist no odors.
6	6-8'	Grey SILT, little f. sand, trace clay, soft but dense, dry, no odors.
8	8-10'	(1') Dark brown organic - rich silty CLAY, soft but dense, moist, no odors. (1') Grey SILT, little f. sand, little clay, soft but dense, moist, no odors.
10	10-11.5'	Grey clayey SILT, trace f. sand, soft buta dry, moist, no odors
15	15-16.5'	(1') Same as above. (1') Green silty f. SAND and f/m subrounded GRAVEL, poorly sorted, dense, dry, no odors. -saturated conditions
20	20-21.5'	Red grey f. SAND, little silt, soft, saturated, no odors.
25	25-26.5'	Red grey f. SAND, little silt, trace clay, soft, saturated, no odors.

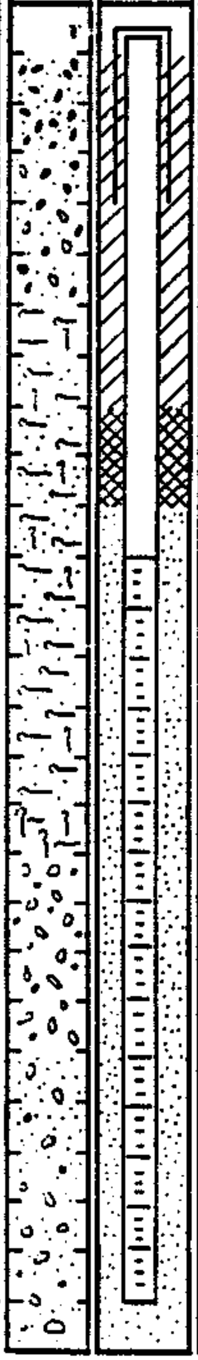
Environmental Resources Management | **Drilling Log**

Project: Bendix-Sidney | Owner:
Location: Boiler Room | W.O. Number: 3010510
Well Number: BR-2 | Total Depth: 25.0' | Diameter: 2"
Surface Elevation: | Water Level: Initial | 24-hrs.
Screen: Dia. 2" | Length: 15.0' | Slot Size: .01"
Casing: Dia. 2" | Length: 17.0' | Type: PVC Schedule
Drilling Company: Porratt Wolff, Inc | Drilling Method: Hollow stem auger
Driller: Butch Stevens | Log By: Bob Keating | Date Drilled: 1-24-85

Sketch Map



Notes
Grout 1-1 cement - sand, screen sand packed with No. sand.



Depth (Feet)	Sample Number	Description/Soil Classification (Color, Texture, Structures)
0		Finished with 20' of 6" I.D. steel riser with locking cap.
	0-2'	Black soil FILL, soft, dry, no odors.
2	2-4'	Orange and red subangular gravel and soil FILL, soft, dry, no odors.
4	4-6'	(1') Same as above, loose, saturated, no odors.
		(1') Grey clayey SILT, soft but dense, moist, no odors.
6	6-8'	Grey SILT, little f. sand, little clay, moist, soft, slight odor.
8	8-10'	Grey, with orange mottling, clayey SILT, little f. sand, moist, soft, no odors.
10	10-11.5'	Same as above.
15	15-16.5'	(1') Grey CLAY, little silt, soft, moist, no odors. (.5') Grey and red f. sandy subrounded to rounded GRAVEL, loose, saturated, slight odor.
20	20-21.5'	Green and red f/m/c SAND and f/m rounded GRAVEL, loose, saturated, slight odor.
25		Same as above, slight odor.

Environmental Resources Management

Drilling Log

Project: Bendix-Sidney Owner:

Location: Boiler Room W.O. Number: 3010510

Well Number: BR-3 Total Depth: 25.0' Diameter: 2"

Surface Elevation: Water Level: Initial   24-hrs.

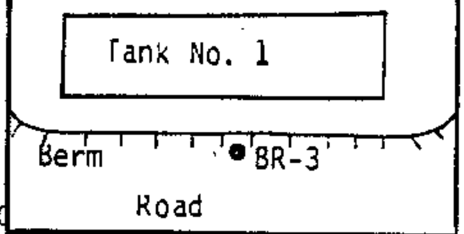
Screen: Dia. 2" Length: 15.0' Slot Size: .01"

Casing: Dia. 2" Length: 12.0' Type: PVC Schedule 40

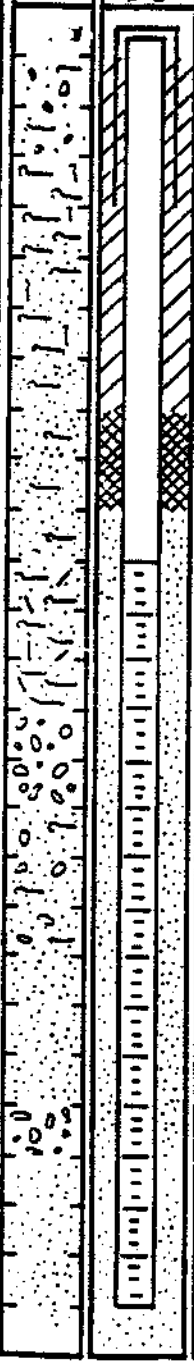
Drilling Company: Porratt Wolff, Inc. Drilling Method: Hollow Stem Auger

Driller: Butch Stevens Log By: Bob Keating Date Drilled: 1-23-85

Sketch Map



Notes:
Grout mix 1-1 cement sand.
Screen packed with No. 3 sa



Depth (Feet)	Sample Number	Description/Soil Classification (Color, Texture, Structures)
0		Finished with 2.0' of 6" I.D. steel riser with locking cap.
	0-2'	Red brown silty soil and gravel FILL, dense, dry, no odors.
2	2-4'	(1.5') Green and tan SILT, little clay, dense, dry, no odors.
		(.5') Black organic-rich SILT, little f. sand, dense, dry, no odo
4	4-6'	Grey with tan mottling silty f. sand, trace clay, soft but dense, moist, no odors.
6	6-8'	Grey with tan mottling f. SAND, little silt, soft but dense, moist, no odors.
8	8-10'	Grey f. SAND, little silt, soft but dense, moist, no odors.
10	10-11.5'	Grey f. sandy SILT, little clay, wood debris, soft but dense moist, no odors.
		---Gravel
15	15-16.5'	Grey blue f/m sandy f/m rounded GRAVEL, little silt, loose, moist to saturated, no odors.
		---Sand
20	20-21.5'	(1') Blue-grey m/SAND, well sorted, loose, saturated, no odors
		(1') Blue-grey f/m rounded GRAVEL, well sorted, loose, saturated no odors (gravel lens).
		(1') Blue-grey m/SAND, loose, saturated, no odors.
25	25-26.5')	(.5) Red-grey SILT to f. SAND, soft, saturated, no odors.

Environmental Resources Management

Drilling Log

Project: Bendix-Sidney Owner:

Location: Boiler Room W.O. Number: 3010510

Well Number: BR-4 Total Depth: 25.0' Diameter: 2"

Surface Elevation: Water Level: Initial: 24-hrs:

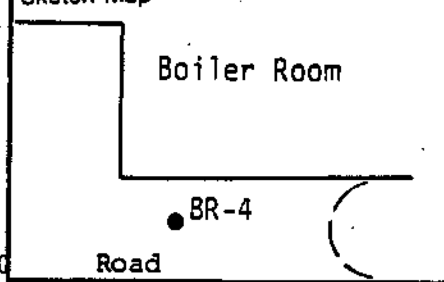
Screen: Dia. 2" Length: 15.0' Slot Size: .01"

Casing: Dia. 2" Length: 12.0' Type: PVC Schedule 40

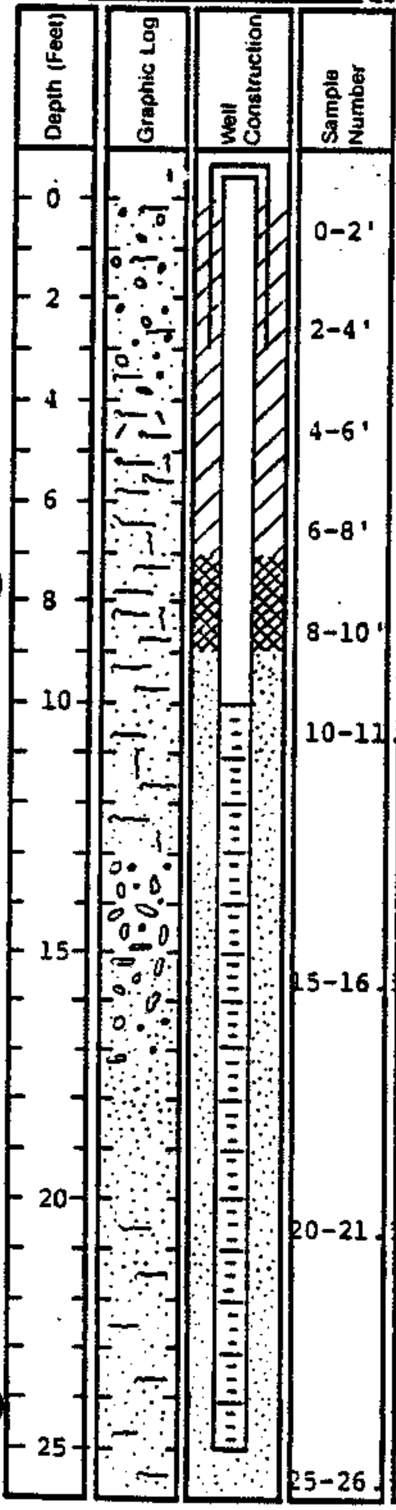
Drilling Company: Porratt Wolff, Inc. Drilling Method: Hollow Stem Auger

Driller: Butch Stevens Log By: Bob Keating Date Drilled: 1-23-84

Sketch Map



Notes
Grout mix 1-1 Cement sand,
Screen packed with No. 3 sand



Sample Number	Description/Soil Classification (Color, Texture, Structures)
0-2'	Finished with 2.0' of 6" I.D. Steel riser with locking cap Red-brown silty and gravelly FILL, dense, dry, no odors
2-4'	Same as above.
4-6'	(1') Black organic-rich SILT, wood debris, soft, dry, possible odor. (1') Grey SILT, little f/m sand, little clay, soft but dense, moist, no odors.
6-8'	Grey f. sandy SILT, little clay, soft but dense, moist, no odors.
8-10'	Same as above with thin layer of organic-rich black clay, no odors.
10-11.5'	Grey f. SAND, little silt, trace clay, soft but dense, saturated, no odors.
	-- Gravel
15-16.5'	Grey and red f/m sandy f/m rounded GRAVEL, loose, saturated, no odors.
	---M/Sand
	---M/Sand
20-21.5'	Red-grey f. SAND, little silt, soft, saturated, no odors.
25-26.5'	Red-grey, molted f. SAND, little silt, saturated, no odors.

Environmental Resources Management

Drilling Log

Project: Bendix-Sidney Owner:

Location: Boiler Room W.O. Number: 3010510

Well Number: BR-5 Total Depth: 25.0 Diameter: 2"

Surface Elevation: Water Level: Initial 24-hrs.

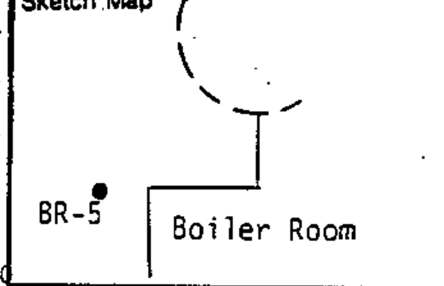
Screen: Dia. 2" Length: 15.0' Slot Size: .01"

Casing: Dia. 2" Length: 10.0' Type: PVC Schedule 40

Drilling Company: Porratt Wolff, Inc. Drilling Method: Hollow Stem Auger

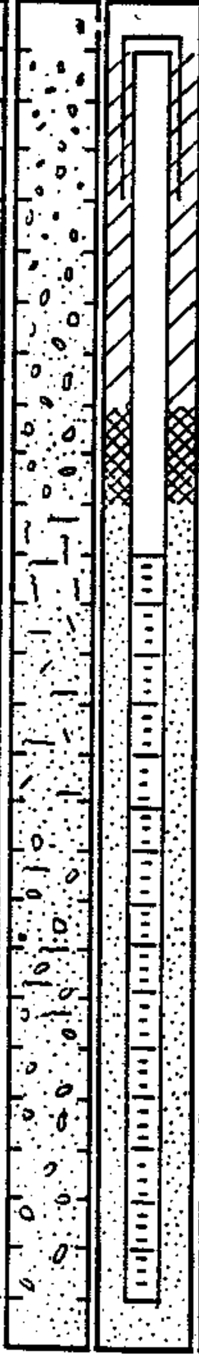
Driller: Butch Stevens Log By: Bob Keating Date Drilled: 1-24-85

Sketch Map



Notes
Grout mix 1-1 cement sand,
Screen sand packed with
4.3 sand

Graphic Log / Well Construction:



Depth (Feet)	Sample Number	Description/Soil Classification (Color, Texture, Structures)
0		Finished with steel gate box flush to grade.
	0-2'	Red soil and gravel FILL, dense, dry, no odors.
2	2-4'	Same as above.
4	4-6'	Brown m/c SAND and f/m rounded GRAVEL, loose, moist, no odors.
6	6-8'	No recovery.
8	8-10'	(1') Same as above, loose, saturated, no odors.
		(1') Grey silty CLAY, little f. sand, damp, soft but dense, no odors.
10	10-11.5'	(1') Same as above.
		(.5') Gray f/m SAND, little silt, wood debris, soft, damp, no odors.
		- Saturated conditions
15	15-16.5'	(.5') Same as above, soft, saturated, no odors.
		(1') Red and Green f/m/c SAND and f/m subrounded GRAVEL, little silt, loose, saturated, no odors.
20	20-21.5'	Green and Red f/m/c SAND and f/m rounded GRAVEL, little sand, loose, saturated, no odors.
25		(.5) Green m/c SAND, loose, saturated, no odors.
	25-26.5'	(1') Red grey f. SAND, little silt, soft, saturated, no odors

Environmental Resources Management

Drilling Log

Project: Boiler Room Owner: Amphenol Corp

Location: Sidney N.Y. W.O. Number: 30127-00-01

Well Number: BR-6 Total Depth: 24.0 Diameter:

Surface Elevation: Water Level: Initial 24-hrs.

Screen: Dia. 2" Length 15.0' Slot Size #10

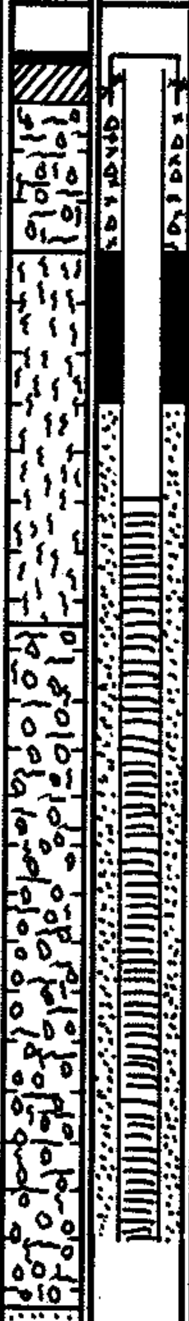
Casing: Dia. 2" Length 5.0' Type PVC Sch 40

Drilling Company: Parratt Wolff Drilling Method: H.S.A.

Driller: Mark Beck Log By: R. Hoose Date Drilled: 12/14/88

Sketch Map

Notes



Depth (Feet)	Sample Number	Description/Soil Classification (Color, Texture, Structures)
0		0-0.3' ASPHALT PAVING
		0.3'-1.0' STONE FILL, IN A DARK BROWN SILTY MATRIX
		1.0'-4.0' DISTURBED TILL/OUTWASH, Reddish brown with ABUNDANT COBBLES IN A SILTY MATRIX, DRY
5	SS-1 2, 4, 3, 4	4.0'-11.5' CLAY, grey, SOFT, WET
10	SS-2 5, 7, 10, 12	11.5'-26.0' TILL, greenish grey with ABUNDANT cobbles IN A SILTY CLAY MATRIX
15	SS-3 11, 15, 7, 7	26.0'-27.0' SAND, DARK grey, very FINE grained, well SORTED
20	SS-4 11, 15, 10, 9	
25	SS-5 5, 4, 3, 4	

Well Specifications

#10 SLOT SCREEN	24.0'-9.0'
#1 SAND PACK	24.0'-7.0'
BENTONITE PELLETS	7.0'-4.0'

CEMENT/BENTONITE GROUT TO SURFACE

Well COMPLETED WITH LOCKING CAP AND FLUSH MOUNT COVER

Environmental Resources Management

Drilling Log

Project: Boiler Room | Owner: Amphenol Corp.

Location: Sidney N.Y. | W.O. Number: 30127-00-01

Well Number: BR-7 | Total Depth: 25.0 | Diameter:

Surface Elevation: | Water Level: Initial | 24-hrs.

Screen: Dia. 2" | Length 15.0' | Slot Size #10

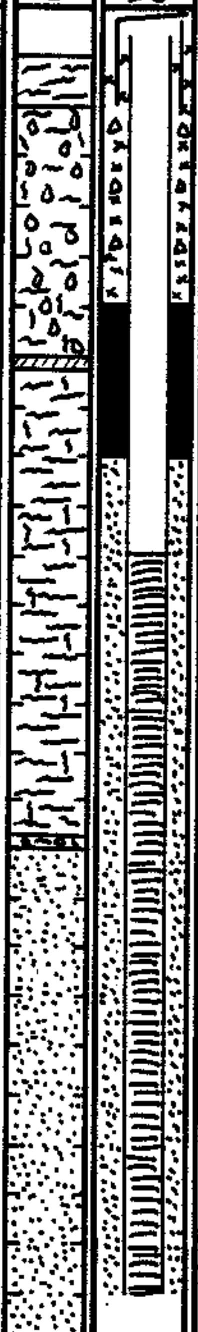
Casing: Dia. 2" | Length 5.0' | Type PVC Sch 40

Drilling Company: Parratt Wolff | Drilling Method: H.S.A.

Driller: Mark Beck | Log By: R. Hoose | Date Drilled: 12/16/88

Sketch Map

Notes



Depth (Feet)	Sample Number	Description/Soil Classification (Color, Texture, Structures)
0		0-1.0' SILT, Brown with trace fine gravel and roots.
		1.0'-6.0' DISTURBED TILL/OUTWASH, Reddish brown with abundant cobbles in a silty clay matrix
		6.0'-6.2' FILL, Black, cinder or ash fill
5	SS-1 2, 2, 2, 5	6.2'-15.8 CLAYEY SILT, grey, soft * becomes wet at ≈ 9.0'
10	SS-2 2, 2, 2, 2	
		15.8'-16.0' TILL, Brown to orangy brown with abundant cobbles in a silty clay matrix
15	SS-3 8, 13, 8, 10	16.0'-26.5' SAND, orangy brown to brown, very fine grained, well sorted * becomes reddish brown with depth
20	SS-4 7, 6, 4, 4	
25	SS-5 7, 7, X, X	

Well Specifications

#10 Slot Screen 25.0'-10.0'

#1 Sand Pack 25.0'-8.0'

Bentonite Pellets 8.0'-5.0'

Cement / Bentonite Grout to surface

Well completed with protective steel riser and locking cap

X = Spoon pushed with rig due to rope failure

Environmental Resources Management

Drilling Log

Project: Boiler Room Owner: Amphenol Corp

Location: Sidney N.Y. W.O. Number: 30127-00-01

Well Number: BR-8 Total Depth: 24.5 Diameter:

Surface Elevation: Water Level: Initial 24-hrs.

Screen: Dia. 2" Length: 15.0' Slot Size: #10

Casing: Dia. 2" Length: 5.0' Type: PVC Sch 40

Drilling Company: Parratt Wolff Drilling Method: H.S.A.

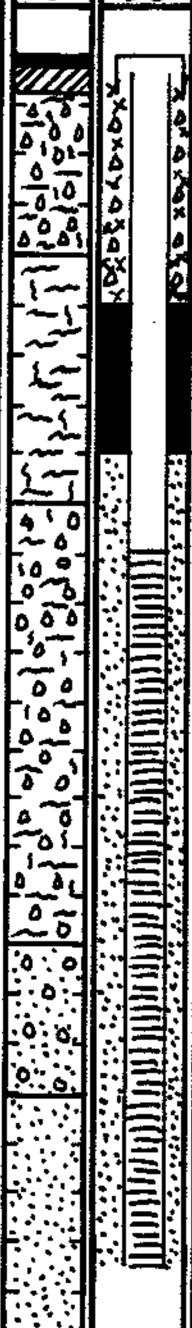
Driller: Mark Beck Log By: R. Hoose Date Drilled: 12/14/88

Sketch Map

Notes

Depth (Feet)	Sample Number
0	
5	SS-1 3, 4, 5, 6
10	SS-2 10, 10, 14, 17
15	SS-3 10, 8, 9, 6
20	SS-4 6, 8, 3, 3
25	SS-5 3, 3, 3, 3

Graphic Log / Well Construction



Description/Soil Classification (Color, Texture, Structures)

0-0.3' Asphalt Paving

0.3'-0.8' Stone Fill, light grey

0.8'-4.0' Disturbed Till/Outwash, dark brown with abundant cobbles in a silty matrix

4.0'-9.0' Clayey Silt, grey, stiff, damp

9.0'-18.0' Till, light greenish grey with abundant cobbles in a silty clay matrix

18.0'-21.1' Gravel, fine to medium grained in sandy matrix

21.1'-26.5' Sand, grey, very fine grained, well sorted

Well Specifications

#10 Slot Screen 24.5'-9.5'

#1 Sand Pack 24.5-8.0'

Bentonite Pellets 8.0'-5.0'

Cement/Bentonite grout to surface

Well completed with locking cap and flush mount cover

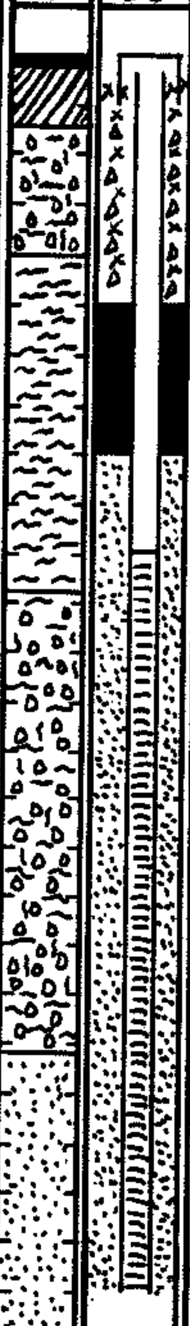
Environmental Resources Management

Drilling Log

Project	BOILER ROOM
Owner	AMPHENOL CORP
Location	SIDNEY N.Y.
W.O. Number	30127-00-01
Well Number	BR-9
Total Depth	25.0
Diameter	
Surface Elevation	
Water Level: Initial	
24-hrs.	
Screen: Dia.	2"
Length	15.0'
Slot Size	#10
Casing: Dia.	2"
Length	5.0'
Type	PVC SCH 40
Drilling Company	PARRATT WOLFF
Drilling Method	H.S.A.
Driller	MARK BECK
Log By	R. HOOSE
Date Drilled	12/13/88

Sketch Map

Notes



Depth (Feet)	Sample Number
5	SS-1 5,5, 8,5
10	SS-2 1,1, 5,10
15	SS-3 6,8, 6,5
20	SS-4 3,3, 3,7
25	SS-5 3,3, 4,4

Description/Soil Classification (Color, Texture, Structures)

0 - 0.3' ASPHALT PAVING

0.3' - 1.5' STONE FILL

1.5' - 4.0' DISTURBED TILL/OUTWASH, DARK BROWN WITH ABUNDANT COBBLES IN A SANDY SILT MATRIX

4.0' - 10.8' SILT, MOTTLED ORANGE BROWN, LIGHT grey and brown, SOFT, WET.

10.8' - 20.3' TILL, greenish grey WITH ABUNDANT Cobbles IN A SILTY CLAY MATRIX

20.3' - 26.5' SAND, grey, very FINE grained, well SORTED

* SOME well rounded cobbles PRESENT FROM 24.5-26.5

Well Specifications

#10 Slot Screen	25.0' - 10.0'
#1 SAND PACK	25.0' - 8.0'
BENTONITE PELLETS	8.0' - 5.0'

CEMENT/BENTONITE GROUT TO SURFACE

COMPLETED WITH LOCKING CAP AND FLUSH MOUNT COVER

Environmental Resources Management

Drilling Log

Project: Boiler Room Owner: AMPHENOL CORP.

Location: SIDNEY N.Y. W.O. Number: 30127-00-01

Well Number: BR-10 Total Depth: 24.0 Diameter:

Surface Elevation: Water Level: Initial 24-hrs.

Screen: Dia. 2" Length 15.0' Slot Size #10

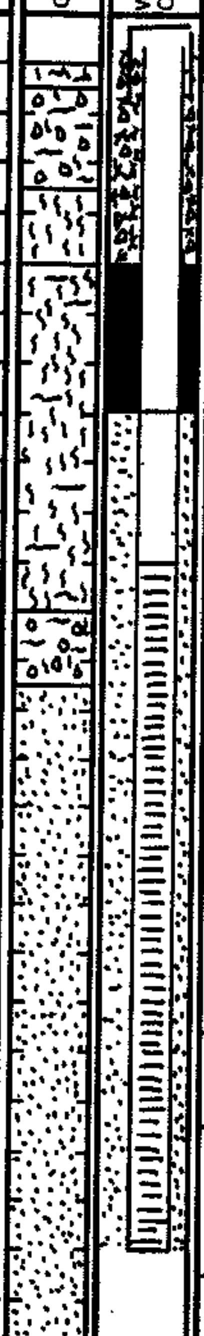
Casing: Dia. 2" Length 5.0' Type PVC Sch 40

Drilling Company: Parratt Wolff Drilling Method: H.S.A.

Driller: MARK BECK Log By: R. HOOSE Date Drilled: 12/13/88

Sketch Map

Notes



Depth (Feet)	Sample Number	Description/Soil Classification (Color, Texture, Structures)
0		0 - 0.5' SILTY CLAY, with abundant Roots AND ORGANIC MATERIAL
		0.5' - 2.5' Disturbed Till/outwash DARK brown with Abundant Pebbles in A silty matrix
		2.5' - 4.0' CLAY, orangy brown
5	SS-1 6, 8, 7, 8	4.0' - 11.0' CLAY, Silty, Light grey, Stiff * Clay becomes very soft AND wet at 8.0'
10	SS-2 23, 23, 25, 26	11.0' - 12.5' TILL, Variegated olive green, Red AND greenish grey with Abundant Cobbles in a silty clay Matrix
15	SS-3 3, 3, 2, 3	12.5' - 26.5' SAND, Reddish brown to grey, very Fine grained, well sorted. * Thin clay zone at 16.1'
20	SS-4 3, 8, 5, 4	
25	SS-5 3, 5, 7, 9	

Well Specifications

#10 Slot Screen 24.0' - 9.0'

#1 Sand Pack 24.0' - 7.0'

Bentonite Pellets 7.0' - 4.0'

Cement/Bentonite grout to surface

* well completed with protective steel Riser and locking cap.

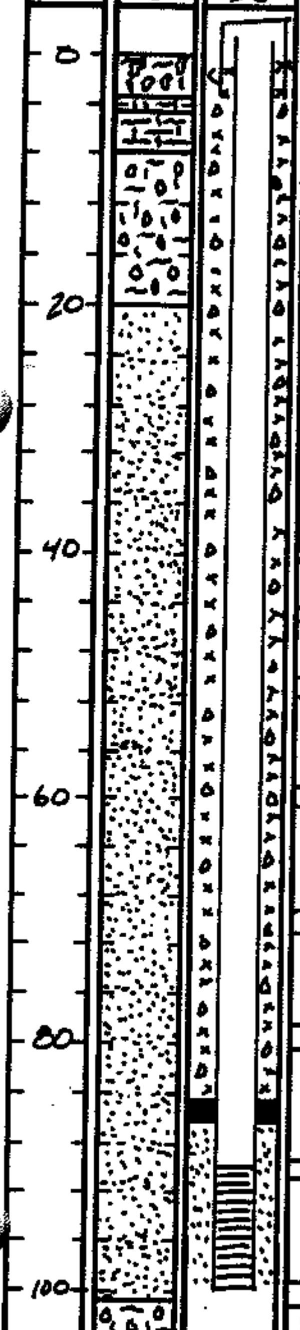
Environmental Resources Management

Drilling Log

Project: Boiler Room   Owner: Amphenol Corp.
Location: Sidney N.Y.   W.O. Number: 30127-00-01
Well Number: BR-11   Total Depth: 100.0'   Diameter:
Surface Elevation: Water Level: Initial   24-hrs.
Screen: Dia. 2"   Length 10.0'   Slot Size #10
Casing: Dia. 2"   Length 90.0'   Type PVC Sch 40
Drilling Company: Parratt Wolff   Drilling Method: H.S.A.
Driller: Mark Beck   Log By: R. Hoose   Date Drilled: 12/19/88

Sketch Map

Notes



Sample Number	Blow counts
SS-1	3,4, 3,5
SS-2	5,9, 9,10
SS-3	4,13, 11,10
SS-4	4,3, 4,7
SS-5	2,2, 4,7
SS-6	2,3, 5,6
SS-7	4,5, 7,9
SS-8	4,7, 9,11
SS-9	5,8, 15,16
SS-10	6,11, 12,22
SS-11	8,12, 17,22
SS-12	8,12, 15,17
SS-13	9,14, 19,22
SS-14	11,11, 12,13
SS-15	10,18, 18,14

Description/Soil Classification (Color, Texture, Structures)

0 - 3.5' DISTURBED TILL/OUTWASH, Reddish brown with abundant cobbles in a silty clay matrix.

3.5' - 5.0' SILTY CLAY, DARK BROWN, DAMP

5.0' - 8.0 CLAYEY SILT, light grey w/ rust color mottling.

8.0' - 20.5' TILL, variegated reddish brown and greenish grey with abundant cobbles in a silty clay matrix.

20.5' - 101.0 SAND, dark grey to greenish grey, very fine grained, well sorted
* Becomes reddish brown + clayey at 40.0'

101.0 - 101.5 TILL, Reddish brown with abundant cobbles in a silty clay matrix

WELL SPECIFICATIONS

#10 SLOT SCREEN 100.0' - 90.0'
#1 SAND PACK 100.0' - 86.5'
BENTONITE PELLETS 86.5' - 84.5'
CEMENT/BENTONITE GROUT TO SURFACE
* Well completed with protective steel riser and locking cap.

Bouwer and Rice Slug Test Calculations *

Case 2:
Gravel Pack K Assumed equal to Aquifer K

Well BR-4 Slug Removed

Definition Of Variables:

D : Saturated Aquifer Thickness
H : Depth of Water in the Well
H = Static Water Elev. - Elev. of Well Bottom
L : Length of Screen Below Water Table
Note: L = H if Water level is Below the Top of the Screen
A & B : Well Geometry Factors - from Bouwer & Rice, Figure 3
rc : Inner Radius of the Well casing
Yo : Water Level Displacement at time = 0
t : Arbitrary Time from Recovery vs Time Plot
Yt : Water Level Displacement at time = t

Determined Values for Variables:

D =	125	feet
H =	13	feet
L =	13	feet
A =	2.9	
B =	0.5	
rc =	0.083	feet
Yo =	1	feet
t =	0.042	minutes
Yt =	0.16	feet

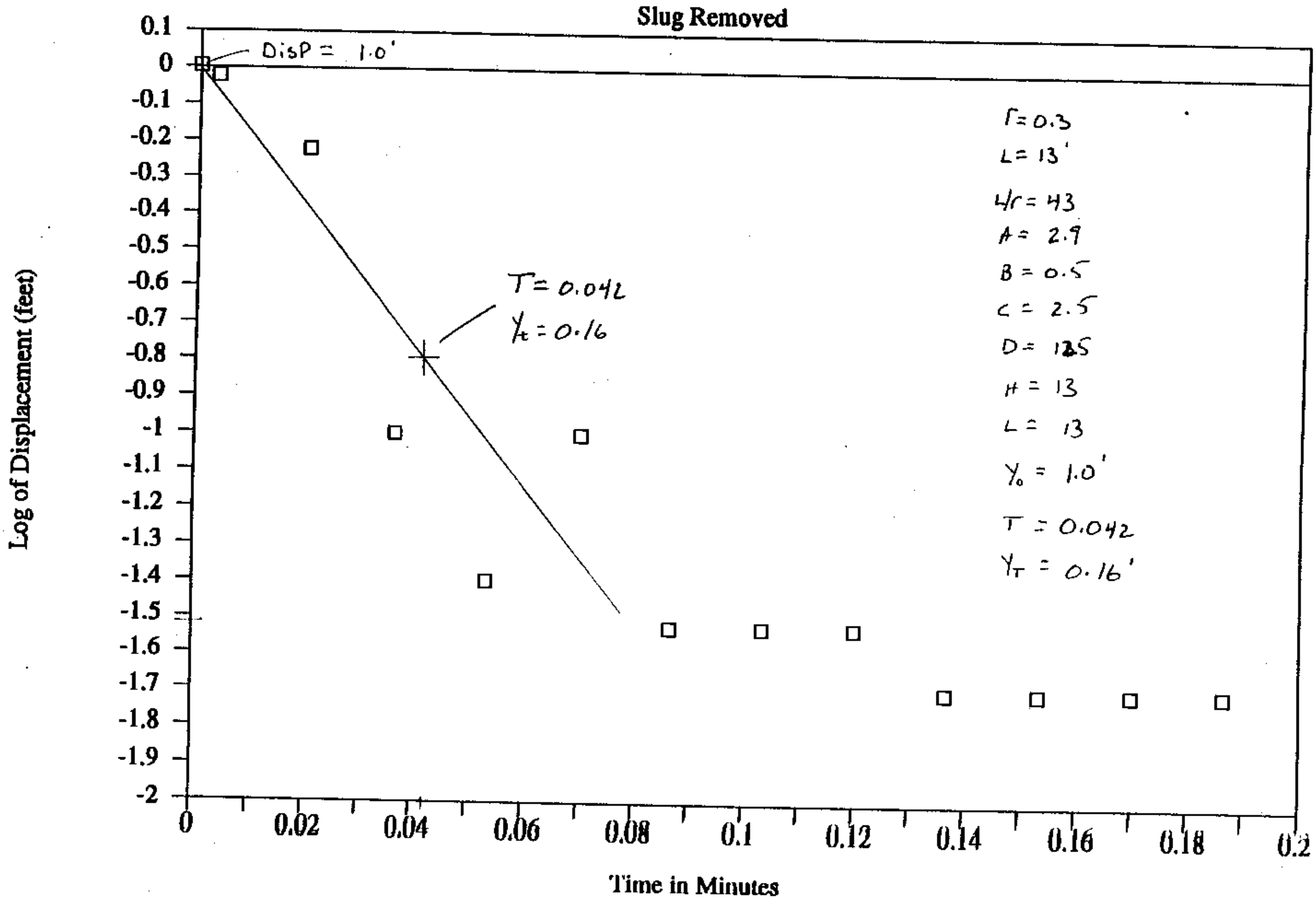
Calculate: (1/t)*ln(Yo/Yt)
= 43.63289

Calculate: ln(Re/rc) = 1/[(1.1/ln(H/rc)+(A+Bln((D-H)/rc)))/(L/rc)]
= 3.858338

Calculate: K = (rc*rc*ln(Re/rc)*(1/t)*ln(Yo/Yt))/(2L)
= 0.044606 feet/minute
= 64.23321 feet/day

* Reference: Bouwer,H and Rice,R.C, 1976: A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells: Water Res. Res. V.12. No. 3

Well BR-4


Slug Removed
Log of Displacement (feet)
Time in Minutes
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
-1.2
-1.3
-1.4
-1.5
-1.6
-1.7
-1.8
-1.9
-2
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
Disp = 1.0'
T = 0.042
Yt = 0.16
r = 0.3
L = 13'
L/r = 43
A = 2.9
B = 0.5
C = 2.5
D = 125
H = 13
L = 13
Yo = 1.0'
T = 0.042
YT = 0.16'

Bouwer and Rice Slug Test Calculations *

Case 2:
Gravel Pack K Assumed equal to Aquifer K

Well BR-6 Slug Removed

Definition Of Variables:
- D : Saturated Aquifer Thickness
- H : Depth of Water in the Well
  - H = Static Water Elev. - Elev. of Well Bottom
- L : Length of Screen Below Water Table
  - Note: L = H if Water level is Below the Top of the Screen
- A & B : Well Geometry Factors - from Bouwer & Rice, Figure 3
- rc : Inner Radius of the Well casing
- Yo : Water Level Displacement at time = 0
- t : Arbitrary Time from Recovery vs Time Plot
- Yt : Water Level Displacement at time = t

Determined Values for Variables:

D =	125	feet
H =	14	feet
L =	14	feet
A =	3	
B =	0.5	
rc =	0.083	feet
Yo =	1.8	feet
t =	0.03	minutes
Yt =	0.22	feet

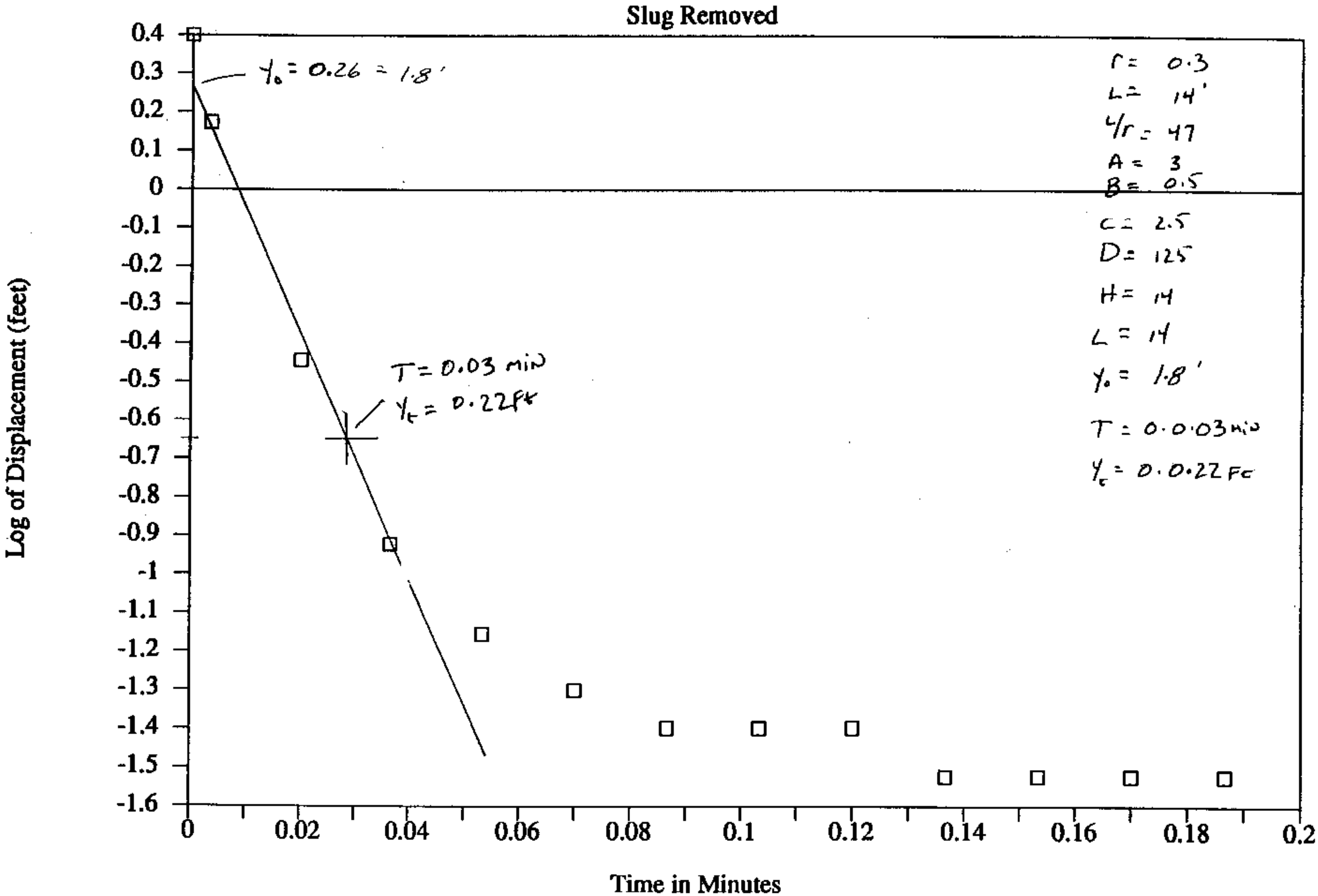
Calculate: (1/t)*ln(Yo/Yt)
= 70.06381

Calculate: ln(Re/rc) = 1/[(1.1/ln(H/rc)+(A+Bln((D-H)/rc)))/(L/rc)]
= 3.942693

Calculate: K = (rc*rc*ln(Re/rc)*(1/t)*ln(Yo/Yt))/(2L)
= 0.067964 feet/minute
= 97.86951 feet/day

* Reference: Bouwer,H and Rice,R.C, 1976: A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells: Water Res. Res. V.12. No. 3

Well BR-6



Slug Removed
Log of Displacement (feet)
Time in Minutes
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
-1.2
-1.3
-1.4
-1.5
-1.6
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
Y₀ = 0.26 = 1.8'
T = 0.03 min
Yt = 0.22ft
r = 0.3
L = 14'
L/r = 47
A = 3
B = 0.5
C = 2.5
D = 125
H = 14
L = 14
Y₀ = 1.8'
T = 0.0.03 min
Yt = 0.0.22 Ft

Bouwer and Rice Slug Test Calculations *

Case 2:
Gravel Pack K Assumed equal to Aquifer K

Well BR-7 Slug Removed

Definition Of Variables:

D : Saturated Aquifer Thickness
H : Depth of Water in the Well
H = Static Water Elev. - Elev. of Well Bottom
L : Length of Screen Below Water Table
Note: L = H if Water level is Below the Top of the Screen
A & B : Well Geometry Factors - from Bouwer & Rice, Figure 3
rc : Inner Radius of the Well casing
Yo : Water Level Displacement at time = 0
t : Arbitrary Time from Recovery vs Time Plot
Yt : Water Level Displacement at time = t

Determined Values for Variables:

D =	125	feet
H =	11	feet
L =	11	feet
A =	2.35	
B =	0.5	
rc =	0.083	feet
Yo =	1.91	feet
t =	0.53	minutes
Yt =	0.4	feet

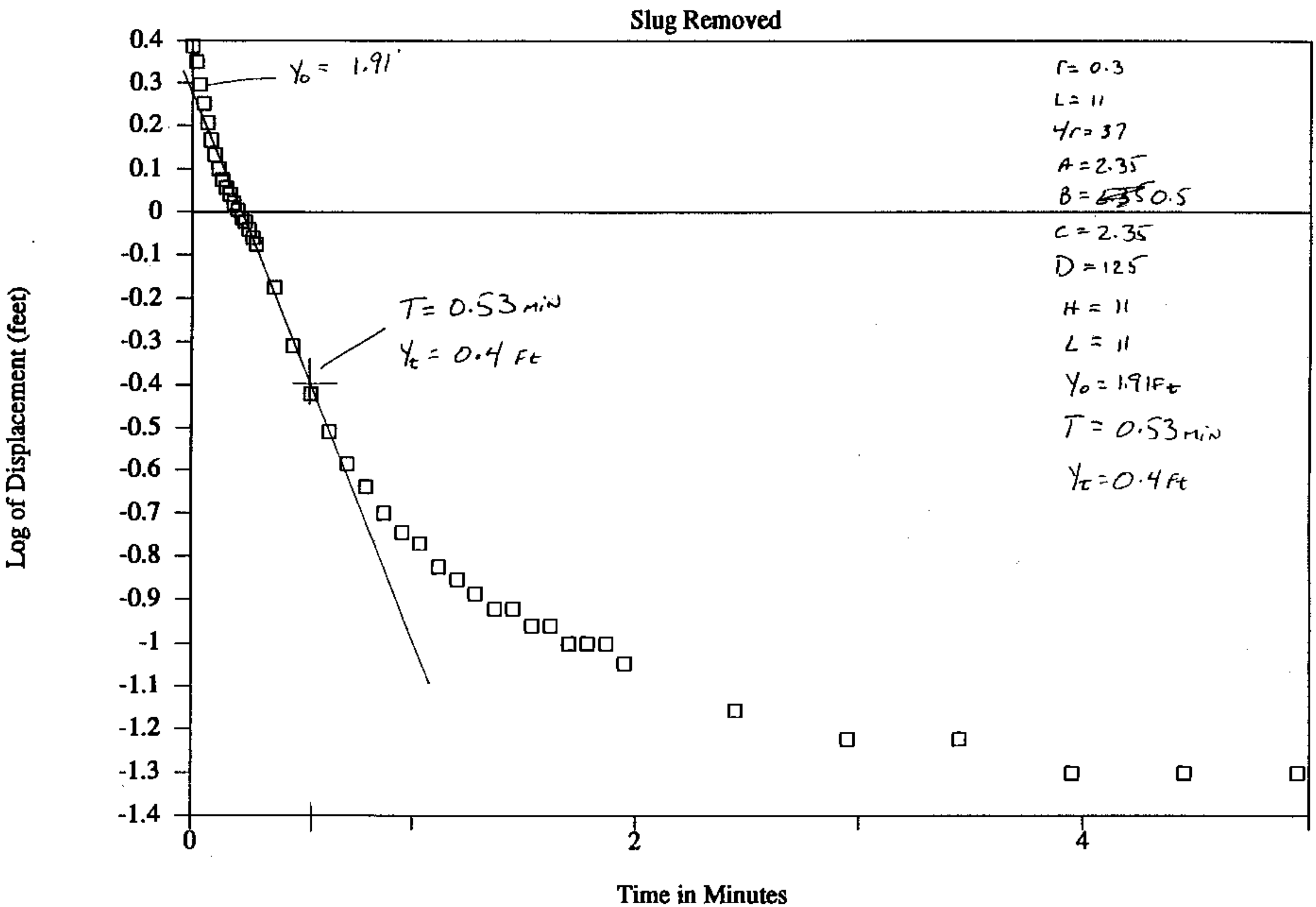
Calculate: (1/t)*ln(Yo/Yt)
= 2.949799

Calculate: ln(Re/rc) = 1/[(1.1/ln(H/rc)+(A+Bln((D-H)/rc)))/(L/rc)]
= 3.702525

Calculate: K = (rc*rc*ln(Re/rc)*(1/t)*ln(Yo/Yt))/(2L)
= 0.003419 feet/minute
= 4.924777 feet/day

* Reference: Bouwer,H and Rice,R.C, 1976: A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells: Water Res. Res. V.12. No. 3

Well BR-7


Slug Removed
Log of Displacement (feet)
Time in Minutes
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
-1.2
-1.3
-1.4
0
2
4
Y₀ = 1.91'
T = 0.53 MIN
Yt = 0.4 Ft
r = 0.3
L = 11
L/r = 37
A = 2.35
B = 0.5
C = 2.35
D = 125
H = 11
L = 11
Y₀ = 1.91 Ft
T = 0.53 MIN
Yt = 0.4 Ft

Bouwer and Rice Slug Test Calculations *

Case 2:
Gravel Pack K Assumed equal to Aquifer K

Well BR-11 Slug Removed

Definition Of Variables:
- D : Saturated Aquifer Thickness
- H : Depth of Water in the Well
  H = Static Water Elev. - Elev. of Well Bottom
- L : Length of Screen Below Water Table
  Note: L = H if Water level is Below the Top of the Screen
- A & B : Well Geometry Factors - from Bouwer & Rice, Figure 3
- rc : Inner Radius of the Well casing
- Yo : Water Level Displacement at time = 0
- t : Arbitrary Time from Recovery vs Time Plot
- Yt : Water Level Displacement at time = t

Determined Values for Variables:

D =	125	feet
H =	88	feet
L =	13.5	feet
A =	2.95	
B =	0.5	
rc =	0.083	feet
Yo =	2.5	feet
t =	0.1	minutes
Yt =	0.1	feet

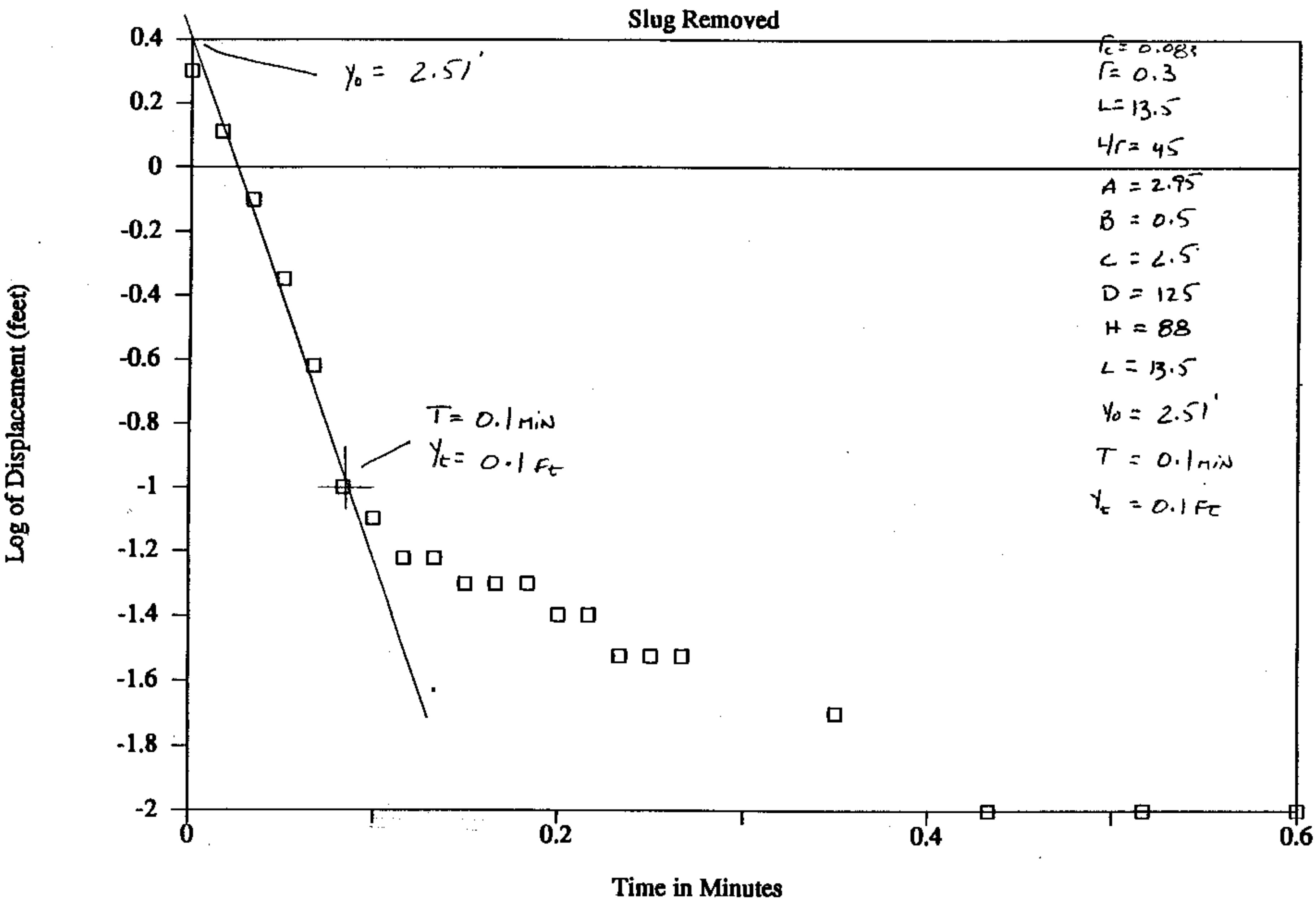
Calculate: (1/t)*ln(Yo/Yt)
= 32.18875

Calculate: ln(Re/rc) = 1/[(1.1/ln(H/rc)+(A+Bln((D-H)/rc)))/(L/rc)]
= 5.133667

Calculate: K = (rc*rc*ln(Re/rc)*(1/t)*ln(Yo/Yt))/(2L)
= 0.042162 feet/minute
= 60.71372 feet/day

* Reference: Bouwer,H and Rice,R.C, 1976: A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells: Water Res. Res. V.12. No. 3

Well BR-11



Slug Removed
Log of Displacement (feet)
Time in Minutes
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
0
0.2
0.4
0.6