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August 24, 1990

Mr Walter Stern
General Switch Co.
Middletown, New York 10940

Martin Baker, Esq. and Gregory Belcamino
Stroock, Stroock and Lavan
Seven Hanover Square
New York, New York 10004

RE: United States v General Switch Corporation
S.D.N.Y. (87 Civ. 8789)

Dear Mr. Martin Baker and Gregory Belcamino,

Attached is the Revised Sampling, Analysis and Monitoring Plan for General Switch Corporation. Note that this Sampling Plan includes a Quality Assurance/Quality Control Plan, a Health and Safety Plan and a Combined Overall Site Management Plan and Operations and Maintenance Plan.

Please provide a covering letter from Laurwal to the USEPA.

Sincerely,

John Bee

John Bee
President, Shakti Consultants, Inc.
Certified Professional Geologist # 6173
American Institute of Professional Geologists

SHAKTI CONSULTANTS INC.

185, Gatzmer Avenue
Jamesburg, NJ 08831
(201) 521-2322

August 24, 1990

Allison Hess
USEPA Project Coordinator
Wallkill Wellfield Site
26 Federal Plaza
New York, New York 10278

RE: United States v General Switch Corporation
<u>S.D.N.Y. (87 Civ. 8789)</u>

Dear Ms Hess,

Attached is the Revised Sampling, Analysis and Monitoring Plan for General Switch Corporation. Note that this Sampling Plan includes a Quality Assurance/Quality Control Plan, a Health and Safety Plan and a Combined Overall Site Management Plan and Operations and Maintenance Plan, and as Appendices the two reports of previous sampling conducted by Fred C. Hart.

Laurwal is to provide a covering letter to the USEPA.

Sincerely,

John Bee

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President, Shakti Consultants, Inc.
Certified Professional Geologist # 6173
American Institute of Professional Geologists

TABLE 1

ADMINISTRATIVE CHECKLIST FOR SAMPLING PLANS

Facility Name General Switch

Client	1.	Submittal signed by owner /operator.
Completed	2.	Table of contents and number pages
Completed	3.	Location map
Completed	4.	Scaled site map
		Environmental Setting
Completed	5.	Historical site use detailed or referenced
Completed	6.	Soil descriptions
Completed	7.	Topography/drainage descriptions
Completed	8.	Hydrogeologic description
Completed	9.	Geologic description
		Areas of Potential Environmental Concern
Completed	11.	Each area discussed separately
Completed	12.	Summary table (locations, sampling depth, analysis)
Completed	13.	Scaled sampling map
		Quality Assurance/Quality Control
Completed	14.	Sampling equipment and methods
Completed	15.	Equipment decontamination
Completed	16.	Names and address of contract laboratory
Completed	17.	Analytical methods with minimum detection limit by parameter and matrix
Completed	18.	Health and Safety Plan
Completed	19.	O & M plan
Completed	20.	Scheduling Includes notification, reporting dates

SAMPLING PLAN

ENVIRONMENTAL ENGINEERING
AND TECHNOLOGY SERVICES

PHASE 2 - SAMPLING PLAN

(SAMPLING, ANALYSIS AND MONITORING PLAN or SAMP)

GENERAL SWITCH
MIDDLETOWN, NEW YORK

AUGUST, 1990

ENGINEERING AND TECHNOLOGY SERVICES
SHAKTI CONSULTANTS, INC.
CHARLESTON, WEST VIRGINIA & JAMESBURG, NEW JERSEY

John Bee
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GENERAL SWITCH, MIDDLETOWN, NEW YORK
SAMPLING, ANALYSIS & MONITORING PLAN

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APPENDIX
Standard Operating Procedures:
- A. Soil Sampling
  - Excavation and Post-Excavation Sampling
  - Photovac Headspace Analysis for Soil & Water
- B. Groundwater Sampling
- C. Air Sampling
  - Activated Carbon and Photovac

GENERAL SWITCH, MIDDLETOWN, NEW YORK
SAMPLING, ANALYSIS & MONITORING PLAN

INTRODUCTION

Project Description

A contaminant plume of tetrachloroethylene has been identified in the groundwater in the Washington Heights Section of Wallkill (Site Map Figure 1) during the USEPA/Technical Assistance Team response in 1983-84. The highest levels of contamination have been noted in the Parella well, Robaina, Rupert, Barry, Lewis, Stout, Liska, Knapp, Lobb, Osbourne, Crooks and General Switch wells along Highland Avenue (Figure 14) and in the sewer line along Industrial Place as noted in the report "Wallkill, New York, Tetrachloroethylene Sample Results" presented in the Appendix.

Soil contaminated with Tetrachloroethylene was detected on the General Switch property in the attached Fred C. Hart 1984 report "Hydrologic Investigation of the General Switch Site" and the later report in 1986 the "Soils Investigation to Determine the Extent of PCE Contamination at the General Switch Site".

The majority of the residents in the immediate vicinity (within 1/4 mile) of General Switch and the Parella well are supplied with municipal drinking water supply along Industrial Place, Highland Avenue, Electric Avenue, Watkins Avenue and Commonwealth Avenue. Municipal drinking water supply is available to all the residents along Highland Avenue in that a city water line has been installed running down the street. Five home owners on Highland Avenue adjacent to the site have chosen not to use the available municipal supply. These are Ogden (now Wood), Seeley, Gilbert, Stout and Ernest (Figure 14 and Appendix D Table: Wallkill Well Data and well sample results). Stout uses the well for the garden and pool.

This sampling plan is a description of sampling activities to address the plume and soil contamination to be conducted under the Consent Order between USEPA and General Switch now Laurwal Holdings: United States v General Switch Corporation, S.D.N.Y. (87 Civ. 8789). The document provides a summary of background information and the areas of potential environmental concern. The proposed sampling is detailed in terms of their number and the method of sample collection and analysis. Additional reports required under the consent order include the Quality Assurance/Quality Control Plan; the Health and Safety Plan; Community Wells Survey Plan and Report, Operation and Maintenance Plan and the Schedule of Activities.

1.0. BACKGROUND INFORMATION

1.1. Site Location

The site is located on the border of Middletown and Wallkill, New York and includes the General Switch property and the affected wells on Highland Avenue. A pump test is required for the Parella well, now owned by Fluoro Cuison, at 320 Highland Avenue (see site plan, Figure 1-4) under the Consent Decree entered in US v. General Switch Corporation, 87 Civ 8789 (RJW). The Parella well that has shown the highest Tetrachloroethylene concentration in the groundwater is 200 feet east of the eastern corner of the General Switch building.

1.2. Site Hydrogeology

The stratigraphy of the site is a silty glacial till overlaying a sandstone and shale formation: the Austin Glen Series. The building of General Switch sits upon fill and the parking lot to the south east of the facility is composed of fill that contains some metal objects and is in part reworked till that contains cobbles. A magnetometer survey conducted by Fred C. Hart Associates in 1984 identified four major magnetic anomalies in the fill of the parking lot. Test pits were dug in each of the four locations and metal objects were found in two of the pits. The metal objects buried in the parking lot were trolleys, several old generators, and a compressor (Figure 4A and 4B, See also Reference 1: Hydrogeologic Investigation of General Switch Site, Fred C. Hart Associates, Nov. 1984).

There is approximately 40 feet of unconsolidated material under the building (Reference 1). As indicated by the soil borings completed by Fred C. Hart, there is an apparent shallow trough below the General Switch plant, that is oriented in a northeast-southwest direction. The trough lies approximately parallel to the long axes of folds in the area, and may have originated as a structurally weak area that was subsequently traversed and scoured out by the glaciers. The bedrock in general slopes down to the northwest (Figure 2 and 5). In the area, there are several exposures of the glacial soils and underlying shale to be found near the Parella well (320 Highland Avenue). A massive sandstone and shale is found to outcrop at the surface on the northern end of Watkins Avenue and near Lubricants, Inc. on Industrial Place, 450 feet southeast of the General Switch building. It is noted that in these outcrops the degree of fracturing of the bedrock is visible along with the regional fracture pattern that has a significant influence upon the available avenues of groundwater flow and site hydrogeology.

Glacial Till

From profiles of the soils at these locations, it can be noted that the soil horizons of the Washington Heights section of the Town of Wallkill belong to the Mardin gravelly silt loam series (Reference 3: Orange County Soil Survey). The Mardin soils are formed from a gravelly, sandy silt glacial till which in turn is derived from the sandstone, shale and slate of the bedrock of this area. The till lies unconformably on the Austin Glen Grit and Shales.

Permeability in the upper soil zones formed from the till is described in the literature as moderate in the surficial layer and upper part of the subsoil and is slow or very slow in the underlying substratum. The till below the upper soil zones is generally unsorted and unstratified and consists primarily of clay, silt and boulders. The permeability of this till is very low and the values range from 1.3 x 10^{-7} cm/sec to 6.4 x 10^{-7} cm/sec. (Reference 3: Orange County Soil Survey and 4: Frimpter, M.H. Groundwater Resources of Orange and Ulster Counties, NY, U.S. Geological Survey Paper - 1985.)

Available water capacity in the till is low and runoff is slow to medium. A perched water table has been observed in the months of November, December and January in the till. This perched water table was noted in the till that is tapped by poorly yielding dug wells: on the Continental Telephone property (abandoned), on the Stout Property (abandoned), and at 208 Watkins Ave (used for watering vegetables). When the Technical Assistance Team first arrived on-site on October 15, 1983, a survey of wells near the Parella Well was made by John Bee. Two shallow dug wells were noted on the property belonging to Janice Stout (Stout Lot #4). The two wells were 11 feet and 16 feet deep, were dug into the glacial till soils, and were dry to the bottom. Following a major storm event, the water levels were measured on December 16, 1983. Water, within a 2 day period, had reached to within 1 foot of the ground surface. The water levels in these wells then continued to hold a level within 2 feet of the surface through November, December and January. Water was found consistently through these winter months to be close to the ground surface in the shallow dug wells on Commonwealth, Watkins and Highland Avenues as well as in sumps and depressions along Industrial Place Extension. This perched water was noted filling the dug wells in the winter. The water levels in these dug wells were observed to fall through the summer months. The adjacent deep wells, between 40 and 250 feet, tapping the shale aquifer had water levels between ten to twenty feet below the perched water levels in the till in the shallow dug wells as reported in the Pump Test Tables 1, 2 and 3 and in the Summary of Water Level Measurements, 11/15/83 to 2/3/84.

Transmission of water and contaminants through the glacial till is likely to be retarded by the slow percolation rate operating in the surficial till.

The water in the glacial till is found in the soil pores between the unconsolidated soil grains. Contouring of the water table elevations in the till in 1984 indicated a flow direction in the till from north to south, generally following the ground level elevations (Figure 3).

As we propose to infiltrate treated groundwater through the till to flush out the Tetrachloroethylene in the glacial overburden at General Switch, the planned pump test must prove that the water will infiltrate through the contaminated soil and that the Parella well will capture the leachate so produced.

From the plot of water table levels in shallow dug wells (Figure 3) and in depressions throughout the site area, the water table contours in the till follow the topography of the site and intersect the topography at approximately the 600 foot piezometric contour, with groundwater issuing out at the base of the hill as a spring line and forming a wetlands in the valley bottom as noted on Figure 3. The general lateral direction of groundwater flow in the till was from north to south in contrast to the groundwater flow direction in the shale that was influenced in 1983-84 by the overpumping of the groundwater reserves on Highland Avenue, described in detail in Figure 6. Fred C. Hart has provided water contours in the glacial till specifically on the General Switch property (Figure 4). It may be noted that Figures 3 and 4 do not coincide precisely. This is because Figure 3 is a plot of the piezometric head in shallow dug wells less than 10 feet deep measured in January 16, 1984 and Figure 4 is a plot of the piezometric head in the glacial till measured in monitor wells in September 14, 1984.

Austin Glen Grit and Shale

The Austin Glen Grit and Shale consists of interbedded massive sandstones grading with increasing micaceous minerals through to thinly-bedded fissile shales (Ref: Frimpter, M.H. Groundwater Resources of Orange and Ulster Counties, NY, U.S. Geological Survey Paper - 1985.) As noted in outcrops on Industrial Place to the south of General Switch there is no primary porosity in the massive sandstone and shale exposed.

The fissile weathered shale is observed along the railroad grade to the east of General Switch while the more massive sandstone, fractured with regional fissures, is seen immediately to the southeast at Lubricants, Inc. The trend of the regional fissures at this outcrop is predominantly northeast-southwest. The strike of bedding for the Austin Glen Series is northeast-southwest as can be seen from the Goshen Quadrangle Map (Figure 5) and the regional dip is 26-40° NW. From the cross section included with the quadrangle, the site is located on the northeast limb of a major anticline.

Shale Aquifer

A second aquifer is found beneath the till in the Austin Glen Series sandstone and shale. This is a confined bedrock aquifer in that the bedrock is covered with 25 feet of dense glacial till under General Switch and water levels in wells cased into the shale are observed to have risen to elevations ten feet into the glacial till. For instance, the water levels were noted in December 1983 and January 1984 in the General Switch well at or about 623 feet MSL, 12 feet below ground and 13 feet into the till. Following weathering and erosion of the overlying soil and rock, there has been a pressure release in the Austin Glen Series and fissures in the rock have opened as the overburden (the amount of rock above) has been reduced. In addition, earth movements have caused faults to develop in the sandstone and shale formation. These fault lines observed in the outcrops cut across all the regional structures of bedding planes and fissures and these fractures have a major influence on the flow of groundwater in the confined aquifer. Thus, in the sandstone and shale, the groundwater is <u>not</u> found between the mineral grains but is found in the secondary fissures and fractures cutting through the rock. These secondary fissures and fractures influence the abundance and direction of flow of the groundwater under the motive force of the difference in potentiometric head from one point to another. Groundwater will pass more slowly through rock with tight joints. Permeability and well yields in the Austin Glen Series can vary greatly within a short distance. This is determined in part by the degree of fracturing and openness of the joints and also by the interconnection of fractures.

The groundwater in the shale is contained in this fractured bedrock aquifer. The following data obtained in 1984 is presented to indicate how the fractured bedrock aquifer responds to pumping. The potentiometric pressures in the shale represented by the composite groundwater contours plotted for the shale in 1984 indicated drawdown due to overpumping along Highland Avenue, a groundwater divide between Highland and Watkins Avenue and a groundwater mound in the vicinity of the Electra Manufacturing, General Switch and Pitt properties from which water moves away in a radial pattern westward to Cosmo Optic, southeastward along Highland Avenue and southward towards Guild Molders (Figure 6, a blue line drawing that represents the best available figure, now six years old).

Between November 15, 1983 and February 3, 1984 water levels were taken by John Bee of the Technical Assistance Team in wells that supplied residents with drinking water in the Washington Heights section of the Town of Wallkill and from Industrial Place in the City of Middletown.

Water levels were taken under the following conditions: Water levels used for plotting the regional groundwater flow pattern were taken only when whole streets and city blocks had stopped pumping their wells for at least 12 hours. The highest elevation of the groundwater found in the wells was taken as that most nearly approaching static. These water levels were contoured and plotted on February 18, 1983 and represented the static water levels of the Washington Heights section for the confined aquifer in the shale during a period of aquifer use for drinking water (Ref: Wallkill New York, Table, Summary of Water Level Measurements). We note that indeed 12 hours may not be sufficient time for some of these wells to recover to static levels. However, this limiting condition was presented above in order to judge the limits of accuracy of the data, imposed by daily need for the homeowners to use this aquifer.

Composite static groundwater levels: The composite water levels plotted for this site are taken from wells open along a large portion of their saturated profile. Note that this composite water level may differ from the true water level if the well penetrates a zone of rock in which the hydraulic potential changes with depth. The term composite is used to denote this difference. (Ref: Errors in Interpretation of Groundwater Level Data GWMR, Spring 1981, p56). The resultant water level is a function of the head differential, the permeabilities and the rate of recharge to the system. The true groundwater table can be determined by constructing piezometers screened no more than 5 feet in length and penetrating the aquifer only sufficiently to be below the dry season water level. In interpreting the water contour map attached, it should be noted that in a recharge area, a deep open hole will show an anomolously lower water level reading than that found in a shallower comparable borehole. It is only in areas of lateral flow that data from deep and shallow holes, and open and cased holes (piezometers) can be plotted on the same groundwater level map.

Any contaminants located in the shale near General Switch would tend to move towards the Parella well if a suitable fissure was available. The force moving the contaminants would be the difference in head between the General Switch well 624.77′ (static) and the Parella well 615.61′ (static). Note that even moderate (4 gpm) pumping of wells in the shale causes large drawdowns as much as 50 feet in the Parella well and 77 feet in the Pitt well. The General Switch well had not been pumped since it was drilled because it was such a poor yielding well, as reported by John Braghirol, the Plant Engineer. Thus, the potentiometric head around General Switch would maintain its elevated position. Pumping of the surrounding wells such as Osbourne, Lobb, Parella and Pitt greatly change the potentiometric contours as shown in the pump tests conducted at the site, greatly increasing the potentiometric head difference between the General Switch Well and the pumped wells.

Since 1962, when municipal sewers were constructed, until 1986, when municipal water was supplied to Highland Avenue, the discharge of well water pumped from this aquifer into the municipal treatment plants reduced the overall potentiometric head in the shale by about 20 feet throughout the area, according to local well drillers. There appears to be correlation between areas of extensive pumping and long-term drawdown of water wells. Although the water levels plotted for 1984 are static conditions for individual wells, the groundwater elevations in the shale show long-term drawdown anomalies where extensive pumping has occurred. There has been extensive pumping of water from the aquifer under Highland Avenue. Thus, in the 1984 plot of groundwater levels, the 620 and 610 feet groundwater contours crossing Highland Avenue between the Knapp (317 Highland Avenue) and Merle (331 Highland Avenue) residences show drawdown of the water levels in this location. As indicated by the composite groundwater contour map (Figure 6), groundwater was moving away from the groundwater mound near Electra Manufacturing properties and curving to the south, running along the line of Highland Avenue. A groundwater divide was located in the vicinity of Van Pelt and Gilbert where potentiometric head decreased to the east towards Highland Avenue and west towards the 590 foot contour observed along Watkins and Commonwealth Avenues. Little water is extracted from the aquifer along most portions of Watkins Avenue; many residences in 1984 were provided with municipal water supply. In general, groundwater flowed from Watkins Avenue towards Commonwealth Avenue in a north-westerly direction under residences located north of Electric Avenue (between numbers 208-251 on Watkins and numbers 200-244 on Commonwealth).

The tight concentric contours centered on the Morse and Perry residences reflected local drawdown in the potentiometric surface by overpumping of these two wells in a formation that is of limited extraction capacity and limited communication with major fractures. These wells did not recover to static levels within 12 hours. This fact alone indicates that the well does not yield much water and is isolated from the major water bearing fractures in the shale and from significant recharge. While groundwater data is scarce in the area immediately northwest of the Industrial Place Extension, the potentiometric head difference between General Switch elevation (624.77 feet) and Guild Molders (594.81 feet) would mean that groundwater would tend to flow from General Switch towards Guild Molders.

The pumping of individual wells has a great effect upon potentiometric heads in the shale and hence groundwater movements. While pumping of the Parella, Stout, Lobb and Osbourne wells will tend to increase the potential for groundwater flow from the Electra Manufacturing/General Switch groundwater mound, the fact that the well at Guild Molders had not been extensively used, according to information supplied by the facility, would tend to minimize the flow of groundwater from General Switch to Guild Molders. The mobilizing force for the groundwater flow would have been the difference in static head between the wells.

Since 1986 many of the wells have been abandoned and it is expected that the regional water levels along Highland Avenue have recovered. The proposed measurement of static water levels taken prior to the pump test in wells along Highland Avenue will provide the new regional direction of groundwater flow.

This discussion of hydrogeology in the shale aquifer is based upon data acquired during 1983-1984 by the author, John Bee, a certified professional geologist, and is the only site-specific data available concerning the shale aquifer collected by any of the parties. These were original observations during well sampling and water level measurement and are reported in the table " Wallkill Well Data" and in sampling report "Wallkill New York, Summary of Water Level Measurements" submitted to the USEPA in March 1984.

At this time, as we have previously noted, many of the residences and commercial facilities used well water. As previously noted many of the residences and facilities have converted to municipal water supply and have abandoned their individual wells. The discussion of groundwater flow characteristics based on 1986 data may have little relevance to the flow patterns at present. This is why we have proposed to take groundwater level readings during the well survey before the pump test and contour the data to determine the present groundwater gradients in the shale.

1.3. **Previous Pumping Tests**

Pumping of the Parella Well

Between November 15 and December 26, 1983, the Parella well at 320 Highland Avenue, was pumped at between 1/2 to 4 gpm. The Parella well was the most contaminated well at that time and was employed as an extraction well to remove contaminants from the bedrock aquifer, in an attempt to limit the spread of the plume and to prevent the contamination of clean wells in the vicinity of the Parella well.

From the plot of concentration of the Parella well water pumped between November 15 and December 26, there is an indication that pumping at 1/2 gpm to 1 gpm recovered the most contaminated groundwater of that pumped from the Parella well by the USEPA, Figure 7. We note that this is an indication and not a conclusion that pumping the well at 1/2 gpm to 1 gpm recovered the most contaminated groundwater during the 3 months of pumping by the USEPA.

There seemed to be a general lowering of tetrachloroethylene levels with time in the water being recovered, after a peak of 260 ppm on November 15, 1983. The concentration of tetrachloroethylene from the Parella well pumping at 4 gpm after 3 months was at 95 ppm. There also appears to be a recovery and increase in concentration of tetrachloroethylene in samples taken during pumping after the well was rested, without pumping for one day as observed on November 26, 1983. The concentration of Tetrachloroethylene increases towards the end of the pumping from 61.4 ppm to 95 ppm as the pumping rate was increased from 1 to 4 gpm. The graph depicted in Figure 7 represents information obtained during three months of pumping of the Parella well during which time highly contaminated groundwater was recovered from the aquifer and indicates that the Parella well was a good choice as a pumping and recovery well. No other findings seem warranted by the limited data.

Pumping the Parella well from November 15 to December 25, 1983, extracted 33,400 gallons of contaminated water from the bedrock aquifer. At an average of 74.5 ppm tetrachloroethylene, this recovered 20.75 lbs. of tetrachloroethylene or 1.55 gallons of pure product extracted during the pumping.

Parella Well Pump Test #1

The following data is presented to indicate how the Parella well operates and is interconnected to some of the nearby wells. On December 21, 1983, a pump test was conducted on the Parella well. The well had not been pumped for the previous 30 hours. At 1445 hours, a static level was taken in the Osbourne, Lobb, Fiore, Electra Manufacturing and Continental Telephone wells. At that time, these wells were abandoned: the residences were either supplied by a temporary municipal water line or the wells were previously abandoned.

It was assumed after 30 hours that the water levels in the shale had time to return to the static conditions. At 1500 hours, the Parella well was pumped at 12 gpm. At 1505 hours, the pump rate was reduced to 6 gpm as the well was losing suction. At 1535 hours, the pump rate was further cut back and held at 4 gpm for the remainder of the test.

Figure 8 and Table 1 presents a summary of the data collected during the pump test. From the data plotted, the effect that pumping the Parella well had on other wells can be observed. The water level in the Parella well was pulled down an estimated 50 feet, and the water levels in three of the surrounding wells belonging to the Osbourne, Lobb and Fiore families were pulled down appreciably.

The water level in the Lobb well after approximately 2.5 hours was pulled down 23.19 ft., Fiore 11.7 ft., and Osbourne over 7.61 ft. Thus the Lobb, Fiore, and Osbourne wells appear to be in intimate hydraulic connection with the Parella well, probably being fed by the same fissure in the shale. However, it should be noted that the Lobb and Osbourne wells are highly contaminated, but that the Fiore well contains only a trace of tetrachloroethylene contamination. The drawdown in the Fiore well may have been the result of homeowner water withdrawal during the pump test. This apparent contradiction may be answered during the planned pump test. A time/concentration pump test for the Fiore well was not completed. The abandoned well at Electra Manufacturing did not respond in this 2.5 hour pump test and is judged not be in direct and intimate connection with the Parella well fissure system. The Continental Telephone well water level dropped .18 feet during this test.

Thus, the zone of influence of pumping the Parella well does not propagate in all directions equally, but follows preferred flow paths through fissures in the shale. This zone has a general effective radius of influence of 350 ft. (based on .18 ft. drop at a distance of 350 ft. for the Continental Telephone Well). It is understood that this test was taken after pumping the Parella well since October 17 at rates between 1/2 to 1 gpm for the recovery of tetrachloroethylene-contaminated groundwater and that the pump test was taken in non-equilibrium conditions. The pump test was to determine if pumping the Parella well had an effect on the surrounding wells under these conditions.

General Switch Pump Test #1

The General Switch well is not a candidate for a groundwater recovery well. On February 2, 1984, the General Switch well was pumped at 2 gpm. At or before 1213 hours, a static water level was taken in the General Switch well and neighboring wells which had been rested for at least 12 hours. After 1 hour 40 minutes of pumping at 2 gpm the drawdown in the General Switch well was measured at more than 286′ below the static water level, deeper than the 300′ maximum depth from ground surface that could be measured using an M-scope water indicator. The specific capacity (gallons per minute/foot of drawdown) of the General Switch well is very small (less than 2gpm/300 feet = 0.0067) in that pumping at 2 gpm for a period of 100 minutes during the initial drawdown pulled the water table down to 300 feet+.

The General Switch well yields very little water. It is estimated that the General Switch well delivers only 1/2 gpm, although it is 480 feet deep. During the pumping test, water levels in nearby wells were recorded. There appears from the test to be hydraulic connection between the Parella and Osbourne wells and the General Switch well (Table 2).

During the pump test of the General Switch well the water levels in the Parella and Osbourne wells fell significantly. The Guild Molders, Perez and Pitt wells were unaffected. Water levels in the Electra Manufacturing, Perry and Wand wells rose during the test.

Ruppert Well Pump Test #1

The Ruppert well was pumped on February 3, 1984, the day after the General Switch pump test. The well was pumped at a flow rate of 11 gpm. This flow rate was sufficient after one hour to break suction on the pump set at 180′ depth (147′ below the static water level). One hour into the test the pump lost suction at 11 gpm and was then throttled back to 6 gpm. The pump again lost suction 1 hr. 23 minutes into the test at 6 gpm. At this point the pump was throttled back to 2 gpm and drawdown continued in the Barry (neighbor's) well. The drawdown in neighboring wells during 3 hours of pumping the Ruppert well is noted in Table 3.

Pumping the Ruppert well drew down the water levels appreciably in the Ruppert and Barry wells. Water levels in the Knapp, Van Pelt, Morse, Winner and Palermo wells rose during the test indicating that the wells were recovering to static level during the test and that these wells were not in intimate hydraulic connection with the Ruppert well, and any drawdown due to pumping was masked by this recovery.

The pumping data generated during the initial well contamination period is subject to interference from individual well use during the test. However, there is indication that pumping the Parella well will have a substantial effect of plume capture and intercept the flow of contaminated groundwater flowing to downgradient wells.

It is this hypothesis that the proposed pump test is intended to further investigate. Now that few wells are still being used, the possibility is more remote that pumping of the observation wells by a homeowner during the pump tests will influence the useful data. If the Parella well is to be used to capture the plume, the pumping of the Parella well will pull down the water levels in the surrounding wells on Highland Avenue and in monitor wells on the General Switch property, indicating its ability to intercept the groundwater from the area of soil contamination.

1.4. Wallkill Well Data

A survey of wells within 1/4 mile of the site was completed for the USEPA by John Bee, a certified professional geologist, between October 1983 and February 1984. The data presented in a tabular form was updated with marginal notes in September 1989. (See Appendix D, Table "Wallkill Well Data"). We propose to update this information and use it to confirm the number and location of wells to be monitored during the Pump Test.

1.5. Extent of Soil Contamination and the Resulting Plume

Contamination of soils with solvents including tetrachloroethylene has been detected in three locations: TP6 and TPD in soils in the facility yard and at TPA, a remote cul-de-sac at the northern side of the plant, Figures 9-13 and Reference: Soils Investigation to Determine the Extent of PCE Contamination at the General Switch Site, Fred C. Hart Associates, 1986.

In December 1983, the NYSDEC sampled soil from 0-2.5 feet at a site just south of the plant building. The results of the chemical analyses showed relatively low concentrations of tetrachloroethylene at the top and bottom of the hole and higher concentrations (100 ppm) at depths of one to two feet. A second round of soil samples was taken from within a 100 foot radius of the plant in March, 1984.

The most contaminated sample (1,000 ppm tetrachloroethylene) was found on the northwest side of the plant. Two other samples from the southwestern corner of the plant contained 95 and 400 ppm tetrachloroethylene, while the other soil samples contained only 10 ppm.

The Fred C. Hart reports define the extent of contamination and contaminant transport in the unconsolidated soils on the General Switch property as shown in Figures 9, 10, 11, 12 and 13.

Fred C. Hart has conducted a program to define the lateral and vertical extent of contamination of the unconsolidated soils and fill material at General Switch.

A correlation was developed between the laboratory data compared to data produced using a Photovac, a portable gas chromatograph with a photoionization detector and data generated using the portable OVA, a gas chromatograph using a flame ionization detector. It appears that the instruments were not calibrated to the same standards.

The results indicated that the concentrations of tetrachloroethylene in the headspace as identified through the Photovac analysis was approximately one order of magnitude greater than the actual concentration of tetrachloroethylene in the soil as identified by the standard laboratory method. This is consistent with our experience of use of the Photovac as a sensitive field method. It is from sampling results obtained by laboratory analysis that all USEPA and State environmental quality criteria are derived.

The OVA data produced poor correlation with soil laboratory data except to indicate high-level soil contamination. When the OVA scan of the split spoon indicated a high concentration of total volatile organics (greater than 1000 ppm) it was assumed that the sample was highly contaminated and a Photovac analysis was not performed. Based on the OVA results from this study and laboratory analytical results from previous studies, tetrachloroethylene concentrations in the soil around TPA and TPD are known to be higher than 200 ppm.

The Photovac results are the most numerous and we have used this data along with the OVA data to establish the horizontal and vertical extent of soil that requires treatment.

The following discussion addresses only the Photovac results which, based on the laboratory correlation, showed concentrations of 200 ppm or less. There are three areas of soil contamination indicated by previous investigations that are displayed in Figure 9: Soil around TP6, TPA and TPD.

TP6

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

With respect to contamination in the vertical direction, the higher concentrations were found at depths of 2 to 7 feet, as indicated in Test Borings T-2, T-3, and T-4. The tetrachloroethylene contamination that was found below a depth of 10 feet extends to a depth of 17 feet at the range of 1 to 5 ppm for all samples analyzed in this area. If the soil solidification alternative is adopted, soil will be treated to 4 feet depth in this area as defined by Cross Section A-A'.

With respect to the lateral extent of tetrachloroethylene contamination in this area, all four test borings generally showed the same degree of contamination. It appears that tetrachloroethylene contamination at concentrations of less than 20 ppm extends laterally beyond the area investigated with Test Borings T-1 through T-4. It is proposed to treat the area detailed on Figures 10-13 that include locations T-1, T-4 and TP6.

TPD

Soil samples taken from the area around TPD, which included Test Borings T-5 through T-11, showed tetrachloroethylene contamination in the range of less than 1 ppm to approximately 200 ppm.

With respect to contamination in the vertical direction in this area, the higher concentrations were found at depths of 0 to 12 feet, with the highest concentrations generally at depths of less than 10 feet. Concentrations in samples taken at depths of 12 to 17 feet were in the range of approximately 5 to 16 ppm.

With respect to the lateral extent of tetrachloroethylene contamination in this area, the highest concentrations were found in Test Borings T-7, T-8, T-9, T-10 and T-11, at levels of up to approximately 200 ppm with the Photovac and greater than 1000 ppm with the OVA. The lowest concentrations were found in Test Borings T-5, T-8, T-12, T-13 and T-11, in a range of less than 1 ppm to approximately 20 ppm. It appears that these test borings roughly define the lateral extent of tetrachloroethylene contamination in this area. For the solidification alternative, soil will be treated to 4 feet depth in T-5, T-6, to 6 feet depth near T-7, T-8, T-9 and T-10 and 2 feet near T-12, T-13.

TPA

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

It appears that there is significant contamination in the vertical direction in this area to at least a depth of 10 to 12 feet. The highest concentrations were found in Test Borings T-15, T-18, T-17, and T-20, at levels of up to approximately 200 ppm with the Photovac and greater than 1000 ppm with the OVA. However, Test Boring T-19 had a maximum concentration of approximately 5 ppm and all three concentrations in T-18 were less than 1 ppm. It appears that Test Boring T-19 roughly defines the lateral extent of tetrachloroethylene contamination parallel to the building in this area. The area at the side of the General Switch building is a cul-de-sac, a depression that is lower than the neighboring slope from Highland Avenue and is bounded on the north by a property boundary. For the soil solidification alternative the depth of soil treatment in this area will be to 6 feet and extend from T-15 to T20, bounded by the property boundary. The foundations of the building will be undermined if excavation proceeds below the footings.

Groundwater Contamination

From October 17, 1983 to March 16, 1984 water samples from potable wells within a one-mile radius of the General Switch plant were analyzed for tetrachloroethylene. The data generated from over 300 groundwater samples indicated that twenty wells on Highland and Watkins Avenues had detectable concentrations of tetrachloroethylene.

Seven domestic wells and one industrial well (at General Switch) contained concentrations of tetrachloroethylene that exceeded the NYSDOH 1984 maximum permissible concentration (50 ppb) for any single synthetic organic chemical as shown on Figure 14.

In 1984, the tetrachloroethylene contamination of wells in the Washington Heights Section of the Town of Wallkill was restricted to wells drawing water from the Austin Glen Series and not in the shallow dug wells in the area. Permeability in this formation is determined by the degree of fracturing, openness of joints and bedding planes, and the interconnection of joints. The distribution of contaminants in the area indicate transmission of the contaminants are along regional fractures. Those wells that obtain the highest level of contaminant concentration are on a regional fracture that connects to the source of contaminants.

Many of the residences on Highland Avenue have been supplied with municipal water, as noted in Figure 14, and have abandoned their wells, including all those residences with greater than 50 ug/l tetrachloroethylene.

As of July 1988, the nearest residences to General Switch that use the aquifer as a drinking water source are: The Perry residence that has historically been unaffected by the groundwater contamination and the Ogden (now Wood), Seeley and Gilbert residences at 319, 321 and 323 Highland Avenue. These wells in November 1983 to April 1984 received 1 ppb to non-detected concentrations of tetrachloroethylene, indicating that these wells were not on a significant fissure carrying the contaminants.

In November 1983 to April 1984 the residences on Watkins Avenue that were supplied from wells were Hammerquist, Wegenroth, Rassmussen, Morse, Winner, Prior King Press, Cosmo Optics, Radivoy, Campbell, Jehovahs Witness, Wand and Saxton. All the other residences on Watkins Avenue were supplied with municipal water from Middletown. In November 1983 to April 1984 all the wells on Watkins Avenue were free from tetrachloroethylene contamination except Prior King Press (ND, 2 and 3 ug/l), Winner (ND and 1.1 ug/l), Rassmussen (12 ug/l and ND), Morse (4 ug/l and ND) and Wand (2 ug/l and ND).

All the wells tested in 1983-1984 on Commonwealth Avenue were <1 ug/l or non-detected for tetrachloroethylene.

Water well testing was conducted by Fred C. Hart between June and September 1984. The results of potable water analysis are presented in the Appendix. During the four months of sampling by Fred C. Hart, the most contaminated wells encountered were at the homes of: Ruppert, Liska, Barry, Stout, Parella, General Switch and Lewis. With the exception of Liska and Lewis, all the other wells had previously been identified as contaminated with over 50 ug/l of tetrachloroethylene. Tetrachloroethylene concentrations in excess of 50 ug/l were first noticed in the Lewis and Liska wells on July 17, 1984. Another set of samples were taken on August 28, 1984 to confirm the previous results. This increase in these wells downgradient in terms of groundwater flow from the Parella well occurred after the Parella and Stout residences were provided with city water and ceased to pump their wells.

When the results of the August 28, 1984 sampling trip were received, the Liska and Lewis homes were put on alternate water. Aside from the wells mentioned above, all the other wells in the General Switch vicinity remained uncontaminated.

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

The additional data from the Technical Assistance Team studies fills a gap in the knowledge of the hydrogeology of the area and the nature and extent of groundwater contamination in the shale.

Retesting of selected wells during cleanup is included in the Sampling Plan along with a commitment by General Switch to provide municipal water to any residence impacted by the site with a well containing more than the Safe Drinking Water Act MCL.

We have begun the survey of wells adjacent to General Switch. The Wood well, identified in August 1989 as being used for private supply, was sampled on August 17, 1989 along with other neighboring wells of households, such as Stout, on city water.

Owner	Volatile Organics (Method 624)		
Ernest	353 Highland Avenue		ND
Seeley	321 Highland Avenue	Toluene	3.5 ug/l
Gilbert	323 Highland Avenue	Toluene	3.1 ug/l
Stout	316 Highland Avenue	Tetrachloroethylene	1300 ug/l
		Trichloroethylene	190 ug/l
Wood	319 Highland Avenue	ND	
Guild Molders	Industrial Place	1,1-Dichloroethane	44 ug/l
		1,1,1 Trichloroethane	12 ug/l

Following this review of the contaminated soil on General Switch property and the plume of tetrachloroethylene found in the shale, it would appear that the Parella well is the well to choose as the pumping well for plume capture. This assumption will be tested by the Pump Test Plan.

1.6. Consideration of ARARs During the Site Investigation and Cleanup

As part of the Cleanup, federal and state regulations will be evaluated to determine whether they are applicable or relevant and appropriate requirements (ARARs).

This section provides a preliminary determination of the federal and state environmental and public health requirements that are applicable or relevant and appropriate to General Switch. In addition, this section identifies other federal and state criteria, advisories, and guidance to be considered that could be used for evaluating the effectiveness of the remedial program.

o Definition of ARARs

The preliminary ARARs identified below have been categorized as "applicable or relevant and appropriate" requirements and "to be considered" requirements (TBCs), based on EPA's post-SARA interim guidance that addresses the development and utilization or ARARs (52 Federal Register 32496, August 27, 1987 and OSWER Directives USEPA 1986a, USEPA 1987b, USEPA 1988a, and USEPA 1988b). The SARA law defines ARAR as:

- Any standard, requirement, criteria, or limitation under any federal environmental law
- Any promulgated standard, requirement, criteria, or limitation under a state environmental or facility siting law that is more stringent than any equivalent federal standard, requirement, criteria, or limitation

The purpose of this definition is to provide that this cleanup is consistent with both federal and state environmental requirements.

Within these jurisdictional boundaries, ARARs are further defined according to the activity, contaminants, or location they are expected to affect. ARARs that address the level of pollutant allowed are called contaminant-specific; ARARs addressing a specific, geographic area are called location-specific; and ARARs that relate to a method of remedial response are called action-specific.

When ARARs do not exist for a particular chemical or remedial activity or when the existing ARARs do not protect human health or the environment, other non-promulgated criteria, advisories, and TBCs may be useful in designing and selecting a remedial alternative.

ARARs have been considered at the following intervals during the Investigation and Cleanup.

- Scope of the Work Plan. Identify preliminary chemical-specific and location-specific ARARs to plan the site characterization sampling locations, and analytical data quality objectives (DQOs) including those required for special analytical methods.
- Site characterization and risk assessment phases of the site investigation determining the site contaminant levels in relation to the chemical-specific ARARs and TBCs and location-specific ARARs in order to select the cleanup goals.
- Development of remedial alternatives identifying action-specific ARARs for each or the proposed alternatives.
- Detailed evaluation of alternatives to examine all the ARARs and TBCs for each alternative as a package to determine what is needed to comply with laws and regulations and whether or not compliance is feasible.
- Selection of remedy to attain all ARARs.
- Remedial design to ensure that the technical specifications of remedial construction attain the levels and standards of control set in the ARARs.

As the Cleanup continues, additional TBCs may be included, particularly as guidances are issued by the USEPA and State of New York.

The ARARs were used to guide the scope and development of the sampling approach, to aid in determining the appropriate extent of site cleanup, to evaluate and select proposed remedial alternatives, and to govern the implementation and operation of the selected action. Primary consideration was given to remedial alternatives that attain or exceed the requirements found in ARAR regulations. In drafting the Sampling Plan the ARARs were identified and utilized by considering the following:

- Contaminants suspected to be at the site
- Chemical analyses to be performed
- Types of media to be sampled
- Geology and other site characteristics
- Use of the resource/medium
- Level of exposure and risk
- Potential transport mechanism
- Purpose and application of the potential ARARs
- Remedial alternatives that is being applied at the site

The federal and state regulatory requirements presented below are potential ARARs for the site:

1) Contaminant Specific

Federal:

- RCRA Groundwater Protection Standards and Maximum Concentration Limits (40 CFR 264, Subpart F)
- Clean Water Act, Water Quality Criteria (Section 304) (May 1, 1987 - Gold Book)
- Safe Drinking Water Act, Maximum Contaminant Levels (MCLs) (40 CFR Part 141 Subpart B, 141.11141.16)

New York

- New York Groundwater Quality Standards
- New York Safe Drinking Water Act Maximum Contaminant Levels (MCLs) for hazardous contaminants
- New York Surface Water Standards
- NYPDES Toxic Effluent Limitations

2) Location Specific

Federal

- National Historic Preservation Act (16 USC 470) Section 106 et seq. (36 CFR 800) - Not applicable
- RCRA Location Requirements (RCRA Sec. 3004(o)7)
- Flood Control Act

3) Federal

- RCRA Subtitle C Hazardous Waste Treatment Facility Design and Operating Standards for Treatment and Disposal Systems, (i.e., landfill, incinerators, tanks, containers, etc.) (40 CFR 264 and 265) (Minimum Technology Requirements)
- RCRA Subtitle C Closure and Post Closure Standards (40 CFR 264, Subpart G)
- RCRA Groundwater Monitoring and Protection Standards (40 CFR 264, Subpart F)

- RCRA Generator Requirements for Manifesting Waste for Off-site Disposal (40 CFR 263)
- RCRA Transporter Requirements for Off-Site Disposal (40 CFR 270)
- RCRA Land Disposal Restrictions (40 CFR 268) (On and off-site disposal of excavated soil)
- Clean Water Act - NPDES Permitting Requirements for Discharge of Treatment System Effluent (40 CFR 122-125)
- DOT Rules for Hazardous Materials Transport (49 CFR 107, 171.1-171.500)
- Occupational Safety and Health Standards for Hazardous Responses and General Construction Activities (29 CFR 1904, 1910, 1926)

New York

- New York RCRA Standards for the Design and Operation of Hazardous Waste Treatment Facilities (i.e., landfills, air strippers, tanks, containers, etc.) Minimum Technology Requirements
- New York RCRA Closure and Post-Closure Standards (Clean Closure and Waste-In-Place Closure)
- New York RCRA Groundwater Protection and Monitoring Standards
- New York Pollution Discharge Elimination System (NYPDES) and Effluent Limitations
- New York Air Emissions Standards

o **Potential TBCs**

When ARARs do not exist for a particular chemical or remedial activity or when the existing ARARs do not protect human health or the environment, other criteria, advisories, and guidance may be useful in designing and selecting a remedial alternative. The following criteria, advisories, and guidance were developed by the EPA and other federal and state agencies.

1) Federal

- Safe Drinking Water Act National Primary Drinking Water Regulations, Maximum Contaminant Level Goals (MCLGs)
- Proposed Maximum Contaminant Levels (MCLs) and Proposed Maximum Contaminant Level Goals (MCLGs) (Federal Register August 24, 1988 and May 22, 1989)
- USEPA Drinking Water Health Advisories
- USEPA Health Effects Assessment (HEAs)
- Toxicological Profiles, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service
- Policy for the Development of Water-Quality-Based Permit Limitations for Toxic Pollutants (49 Federal Register 9016)
- Cancer Assessment Group (National Academy of Science) Guidance
- Groundwater Classification Guidelines
- Groundwater Protection Strategy

Preliminary Scope of ARAR Impacts

Key ARARs affecting cleanup address clean-up levels and standards of control that need to be attained

The groundwater under General Switch and the Highland Avenue area is a regional drinking water source. Therefore, the ability of cleanup to attain drinking water standards is a critical element in assessing the success of cleanup.

ARARs that limit the applicability of cleanup methods at General Switch include the RCRA Land Disposal Restrictions. Onsite disposal of contaminated materials will be affected by the land disposal regulations.

- **Applicable and Relevant Standards**

It is EPA policy that, in selecting remedial actions, primary consideration be given to remedies that attain applicable or relevant Federal environmental and public health standards (ARARs). The ARARs are presented in the section addressing exposure assessment.

State standards that are more stringent than Federal standards may form the basis for a remedy only if the standards have been promulgated and the result is consistent with the cost-effective remedy based on Federal standards.

In developing the Consent Order consideration was given to those remedies that attain or exceed applicable or relevant Federal public health and environmental standards.

An on-site alternative may be accepted that does not attain applicable or relevant standards in one or more of the circumstances discussed below.

- The selected alternative is not the final or total remedy and will become part of a more comprehensive remedy;

  Soil treatment is not the total remedy for the site but will reduce soil contamination and is complemented by the groundwater interception at the Parella well.

- Technical impracticability - that it is technically impracticable from an engineering perspective to achieve the standard at the specific site in question;

  It is technically impractical to remove all the tetrachloroethylene from the soil. Alternatives are presented that will mitigate the environmental impact of the product remaining in the soil.

- Unacceptable environmental impacts - All alternatives that attain or exceed standards would cause unacceptable damage to the environment; Not Applicable

  It is unlikely that the Hazardous Response Trust Fund will be available for this site. Now that the municipal drinking water supply has been provided to the community, there is not the drinking water exposure to the community that would trigger a high exposure score and inclusion in the National Priority List.

- **Standards Analysis**

There is an existing federal MCL for Tetrachloroethylene of 5 ug/1

The end of cleanup will be:

- When the soil contaminated to above 50 ppm of Tetrachloroethylene on the General Switch property is excavated and treated to reduce concentration by 95-99.99% and disposed of on site in a satisfactory method.
- Restoration of the aquifer underlying the site to a stabilized concentration of less than 5 ppb Tetrachloroethylene by pumping groundwater from an interceptor well(s). When the groundwater, sampled at the interceptor well, each month for a period of three months contains less than 5 ppb of Tetrachloroethylene, the USEPA may authorize temporary cesssation of operation of the Groundwater Remedy.
- The influent water from the interceptor well will be sampled for at least 8 consecutive quarters to assure there is no rebound of contaminant concentrations above 5 ppb Tetrachloroethylene.

TABLE 1

Applicable or Relevant Requirements	Other Criteria, Advisories and Guidance

HUMAN HEALTH CRITERIA
DRINKING WATER STANDARDS - TABLE I

ALL VALUES ARE IN ug/l UNLESS NOTED OTHERWISE	SAFE DRINKING WATER ACT MCL		PROPOSED WATER QUALITY CRITERIA INITIAL CANCER RISK		FINAL CANCER RISK		EPA SNARLS			NAS SNARLS (mg/l)			NAS ADI (mg/kg)	NEW YORK STATE
MATERIAL OR CHARACTERISTIC	PRIM.	SEC.	10-6	TOX	10-6	TOX	1-DAY	10-DAY	CHRON	1-DAY	7-DAY	CHRON	/DAY)	GWS
1,2-Dichloroethane (P)			0.7		0.94									
Tetrachloroethylene (P)	5		.2		.8		2300	175	20	172	24.5			
Trichloroethylene (P)			2.1		2.7		2000	200	75	105	15			10
Vinyl Chloride (P)			51.7		2.0									5

CRITERIA LEVELS - TETRACHLOROETHYLENE

WATER	5 ppb	MCL TETRACHLOROETHYLENE, DRINKING WATER STANDARD. MEANS EXTENDED GROUNDWATER TREATMENT
	0.67 ppb	HEALTH BASED STANDARD FOR CLEAN-UP. CARCINOGENIC ASSESSMENT GROUP - EPA WASHINGTON
		TECHNICAL OPERATING GUIDANCE -NY STATE (TOGS) NOT ARARs
SOIL	50 ppb	PROPOSED - EPA REGION II.
	200 ppb	HEALTH BASED STANDARD FOR CLEAN-UP. CARCINOGENIC ASSESSMENT GROUP - EPA WASHINGTON

1.7 Institutional Requirements

Regulations under the the Resource Conservation and Recovery Act (RCRA), the Safe Drinking Water Act (SDWA), and the Federal Water Pollution Control Act (Clean Water Act or CWA), have the broadest applications to the remedial action. These regulations, advisories, and guidance were considered in developing the remedies.

Results of the institutional analysis are presented, in the feasibility study as part of the non-cost criteria analysis of the remedial action alternatives.

o **Permits**

Permits that may be required for this site include:

- Injection into an underground formation requires an Underground Injection Control permit. This may be needed if groundwater is returned to the Shale once it is treated
- Transportation of hazardous waste to an off-site treatment, storage, or disposal facility (TSDF) requires RCRA manifests and TSDF permits.
- Discharge of pollutants or contaminants from a point source into U.S. waters requires a National Pollutant Discharge Elimination System (NPDES) permit pursuant to CWA section 402.
- Discharge of pollutant contaminants into a publicly owned treatment works (POTW) may require permits issued by the local POTW.
- Emissions of pollutants to the air may require Clean Air Act (CAA) permits, depending on the substance emitted, its quantity, and the classification of the area.

- **Applicable Laws and Regulations**

Regulations under the the Resource Conservation and Recovery Act (RCRA), the Safe Drinking Water Act (SDWA), and the Federal Water Pollution Control Act (Clean Water Act or CWA), and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) have the broadest applications to remedial actions.

- **Permits**

Federal programs such as the Clean Water Act, the Clean Air Act and various Resource Conservation and Recovery Act programs have been authorized by the USEPA to be administered by New York State. Various State regulations may apply to the site cleanup operations.

New York State Permits and Regulations

For Federally supervised sites and for sites that produce plumes from hazardous waste disposal sites, NY State supervision is conducted by the Division of Hazardous Waste Remediation. The Regional Engineer for Environmental Quality, Harry Agarawal for the NY State DEC, has responsibility for administering both the Water and Hazardous Waste regulation and is the point of contact in obtaining a decision on the required State permits. Harry Agarawal reports to Al Klauss, the Regional Director of Environmental Quality Engineering. Ronald Pergardia, in Albany, has special responsibility for sites involving PRPs (Potentially Responsible Parties). The Regional Air Pollution Engineer, Neil Isabel, also reports to Al Klauss. The NYSDEC lawyer for this site is Lou Evans. Permits that may be required for this site include:

- NPDES Permits

Discharge of pollutants or contaminants from a point source into U.S. waters requires a National Pollutant Discharge Elimination System (NPDES) permit pursuant to CWA section 402.

- Local Permission

Discharge of pollutant contaminants into sewer on Highland Avenue belonging to the Wallkill publicly owned treatment works (POTW) will require permission of the POTW. This alternative will be used during the Pump Test. A verbal agreement was obtained in 1989 with Dennis Cosgrove, the recently retired Supervisor of Wallkill. A formal agreement needs to be obtained with the present Supervisor, Robert Brennan, and the POTW.

- Groundwater Reinjection Permit, NYSDEC: Division of Water:

The injection of treated water from the Parella Well into an underground formation may require a Groundwater Reinjection Permit under the NPDES program administered by Caesar Manfredi of the NYSDEC, Division of Water. The reinjection of treated groundwater as a means of site cleanup is an acceptable policy of the NY State DEC detailed in two documents: Groundwater Policy Statements on the Reinjection of Groundwater. The Division of Hazardous Waste Remediation has the choice of administering NY State regulations either through a Division of Water Permit or through an Administrative Order.

According to Caesar Manfredi, because the site is being administered under CERCLA, the discharge of treated water into the ground may not require a permit but will have to meet the conditions of a permit (NYC Regulation Part 750). According to NY State regulations, under a permit, the discharge will meet the NY State Groundwater Quality Standard that is now 5 ppb for tetrachloroethylene, except in an area of containment such as a slurry wall or injection into a drawdown cone of recovery wells. In a decision on the appropriate groundwater requirements, the Division of Hazardous Waste Remediation will contact the Division of Water.

Caesar Manfredi has agreed to allow us to discharge the water to the ground during a pump test provided that we demonstrate to his satisfaction that the effluent criteria will be met. This demonstration may be in the form of a description of the air stripper operation in terms of discharge rate and time and anticipated effluent concentration. Whereupon Caesar Manfredi will issue a letter of temporary authorization to conduct the pump test.

- Clean Air Act Permits

Air Emissions: Regarding the air emission levels from site activity, General Switch has agreed to meet air emission levels permitted by existing permits granted by the State of New York. The air stripper will be located on the General Switch property and not at the Parella well. The water will be pumped out of the Parella well for treatment by the stripper on the General Switch site and the treated water discharged in the excavated holes formed during soil cleanup at the three hot spots.

According to the USEPA, a permit may not be required for such on-site remedial activity although the NY State air criteria will be observed.

According to Neil Isabel, NYSDEC Regional Air Pollution Engineer, emissions of pollutants to the air from the air stripper will require a New York State Air Permit (Air Resource Regulations 211.13 & 211-14). The criteria exhaust levels that will be permitted depend on the substance emitted, its quantity, and the air quality classification of the area. The NYSDEC will assess the impact of the exhaust. Based on past experience Neil Isabel does not envisage any problems in permitting the air stripper. The stripper must be separated from the exhaust from other manufacturing process operations.

Section 6 NYC RR 212 details the regulations for process and exhaust systems and the method of granting a permit to operate. An Air 100 Form will need to be completed that details the geographic location and chemical emissions from the site along with the emission rate potential (the emission rate without any controls) and the emission rate with controls. Neil Isabel stated on April 24, 1989 that we do not need a temporary air permit to conduct the pump test. We can conduct the pump test with the air stripper to provide hard data on the air emissions for the Air 100 Permit and he anticipates no problems in permitting the system. The regulations, according to Neil, specify the technology to be used (an air stripper) and as we propose to use the appropriate technology should not encounter a problem in applying for an operations permit supported by engineering drawings and data from the pump test. The engineering drawings will be certified by an engineer licensed to practice in New York State.

Soil Treatment

Neil Isabel requires an estimate of the rate of emission of solvent from the soil during soil treatment. New York State DEC reviewed hydrocarbon emissions from sites because of the ozone exceedences experienced in the State in the summer of 1989. It is noted that Orange County is in attainment for ambient ozone levels. John Davis of the Bureau of Source Control (518) 457-5618 is reviewing policy in regard to air strippers and will probably define the rate of emissions from a site above which controls are required. This policy may ask for an evaluation of the anticipated air emissions from the soil treatment and may either prevent the application of rotor tilling and evaporation of hydrocarbons as a remedial measure for spill sites without the control of these emissions

Neil Isabel requires an estimate of the rate of emission of solvent from the soil during soil treatment by rotor tilling. He has informed Shakti Consultants that this rate will most likely be acceptable.

- RCRA Program Permits

Transportation of hazardous waste to an off-site treatment, storage, or disposal facility (TSDF) requires RCRA manifests and TSDF permits but will not be required for on-site treatment.

2.0 SCOPE OF THE SAMPLING PLAN

This section of the report identifies which steps are indicated by the background information, sampling results, and the requirements to monitor the cleanup. We are to use the sample results to guide and verify the cleanup. The goal of the sampling program is to provide analyses of the levels of volatile organics in the soil, groundwater, surface water, sewer lines and air at the site during cleanup at General Switch. In the consent order General Switch agreed to excavate soils at locations greater than 50 parts per million and treat them until the tetrachloroethylene (PCE) concentration is reduced to 95 - 99.99% of its initial concentration and agreed to restore the aquifer underlying the site to a stabilized concentration of less than 5 parts per billion of tetrachloroethylene. The purpose of the Sampling Plan is to direct this effort, detect the soil and groundwater concentrations of tetrachloroethylene and other trace volatile contaminants and confirm that the cleanup goals have been achieved. The SAMP provides detailed procedures for each field activity and includes a Quality Assurance Plan, standard operating procedures (SOPs) for field sampling and details of the required analysis. The SAMP also describes site control procedures, field investigation activities and responsibilities (site operations), and the corresponding field operations schedule. The last section includes a schedule for field activities, data assessment and report writing. The plan includes

- Sampling objectives
- Number, locations, and types of samples and sample designation
- Details of the analyses for each sample
- Routine and special analytical procedures
- Data assessment procedures
- Chain-of-custody procedures
- Sample custody packaging and shipment procedures
- Decontamination procedures
- Quality assurance objectives
- Quality assurance/Quality control (QA/QC) of field sampling and procedures for field changes and corrective action
- Standard operating procedures (SOPs) for field investigations including sampling, monitoring, and field instrument calibration procedures
- Responsibilities of site personnel

The Site Operations and Maintenance Plan includes a project organization chart and delineates the responsibilities of key field and office team members. The HSP includes site-specific information, hazard assessment, monitoring procedures for site operations, safety procedures, disposal and decontamination procedures, and other sections required by EPA. The HSP also includes a contingency plan that addresses site-specific conditions that may be encountered.

2.1. Overview of the Problem

The Highland Avenue area of Wallkill is a residential community of one family homes that include the streets of Highland Avenue, Watkins Avenue and Commonwealth Avenue. There is a demonstrated plume of Tetrachloroethylene and other volatile organics at trace concentrations in the Shale Aquifer under Highland Avenue in the vicinity of the Parella well. This community was originally vacation cottages and each of the cottages originally had a dug well to supply water that was less than 20 feet deep. (Ref: Wallkill Well Data) These homes were subsequently used year round and other residential houses were built along Watkins and Commonwealth. While many of the residences along Watkins Avenue were supplied with public water many of the residences along Highlands Avenue were supplied by their individual wells (Wallkill Well Data). In 1983 the Parella well was identified as being contaminated with Tetrachloroethylene and subsequent investigations by the USEPA and NYSDEC identified wells that contained Tetrachloroethylene.

Subsequently, in 1984-86, Fred C. Hart and NYDEC identified Tetrachloroethylene-contaminated soils on the General Switch property, a distance of 200 feet from the Parella well.

The goal of our effort at Wallkill and the goal of the Consent Decree is the cleanup the aquifer under this portion of Wallkill and the removal of the potential source of the problem on the General Switch property. The goal of the overall program is to determine the present extent of the groundwater and soil contamination on the General Switch property to direct and monitor the proposed cleanup methods to determine that they are successful.

To assess that we have the right approach to the problem, a Pump Test Plan was developed. The Parella well was selected as the pumping well in the Pump Test because this well in 1983 and 1984 consistently demonstrated the highest concentrations of tetrachloroethylene observed in homeowners, wells. During the long-term pump test of the Parella well, water levels will be taken in the observation wells on Highland Avenue and on the General Switch property to assess the degree of interconnection of these wells in the glacial till and bedrock aquifer with the Parella well and the effectiveness of pumping the Parella well in capturing the Tetrachloroethylene plume in the surrounding bedrock and perched aquifer.

2.2. Data Quality Objectives

The objectives of the General Switch Sampling Plan were developed following a review of background information, consideration of the ARARs and permit requirement and identified to address quality control of the proposed remedial actions.

In order that the data generated during the cleanup process can direct the site remediation, a clear definition of the objectives and procedures for collecting data is required. This goal is facilitated through the development of data quality objectives (DQOs). DQOs relate the end use of the data to the extent and quality of the data to be gathered. DQOs are based on the concept that different data uses may require different levels of data quality. DQOs are set such that the level of uncertainty associated with data measurement is compatible with the level of uncertainty that can be acceptable in the decisions or conclusions derived from data interpretation.

Data quality objectives are qualitative and quantitative goals for precision, accuracy, reproducibility, comparability, and completeness, specified for each data set. DQOs are defined with respect to the types numbers, and locations of samples that will be collected, and the QA levels associated with the analysis. The guidance, "Data Quality Objectives: Remedial Guidance for the Uncontrolled Hazardous Waste Site. For Remedial Response Activities" (USEPA, 1987a), was used in determining the analytical levels needed to obtain the confidence levels for the intended data use. The analytical levels required for specific data uses and the types of analyses needed to achieve an analytical level are presented in DQ-1. Where data have multiple uses, the uses were prioritized and assigned the highest analytical level for a particular use.

The General Switch Remedial Action will generate Levels 1, 2, 4, and 5 analytical data. Level 3 analyses are not planned during the Remedial Action.

Data Quality Levels

Level 1 data are typically not suitable to support risk assessment and direct choices in remedial alternatives.
The Level 1 data to be generated at General Switch include any Field screening OVA or HNU readings gathered during field activities. Field measurements of parameters such as pH, temperature, and specific conductance of water samples are also examples of Level 1 data. These types of data will be used to monitor the health and safety of field personnel and assist in evaluating the adequacy of well development and purging procedures.

Level 2 analytical data may be used in directing remedial choices when accompanied with appropriate QA/QC procedures. Soil gas analyses and onsite field analysis of soil, water and air samples with the Photovac 10S50 calibrated against laboratory-supplied standards will yield semi-quantitative results of Level 2 quality.

Level 3 analytical data is laboratory data generated by non-Contract Laboratory procedures and require QA/QC review before assigning valid status. The laboratory analyses of soil and water, supported by QA/QC samples analyses gathered during previous investigations will be assumed to be Level 3 data including the analysis of the residential wells by the USEPA in 1983-84 and by Fred C. Hart in 1985-86. There is no validation information on these data, although qualifers are indicated on the laboratory data sheets. In addition, QA/QC samples were collected and analyzed as part of the sampling efforts.

The Level 4 and 5 analytical data will have detection limits that will allow comparison with ARARs for soils and groundwater and support risk assessment and remedial evaluation.

Laboratory analyses of samples from General Switch will be performed to obtain Level 4 and 5 data. These analyses will include the routine analyses by Methods 624 and SW846 provided by the contract Laboratory. Level 4 data have to meet standard detection limits and documentation suitable to support risk assessment, direct remedial actions and to support cost recovery.

Level 5 data include all analysis performed for special analytical needs. Level 5 data will include Method 524.2 analyses for VOCs in water samples to obtain detection limits to evaluate drinking water purity in the range of 1 to 2 ppb for comparison to ARARs.

During the remedial program, the sampling effort will continue the sampling effort begun with the Pump Test of the Parella well by determining the effectiveness of the air stripper and assessing improvements in the water quality in the aquifer. In addition, we will be excavating and treating Tetrachloroethylene-contaminated soils during the soil cleanup . The SAMP details those samples and field observations required to direct the soil cleanup.

Table DQ-1. Summary of Analytical Levels Appropriate to Various Data Uses

Data Use	Analytical Level	Type of Analysis	Method
Site Characterization Monitoring for Health and Safety	Level 1 Screening	Total organic vapor detection	Hnu/Ova meters in scan mode
Field Test Kit		pH Conductivity, temperature	Hach Kits and Conductivity meters
Well Pumping Rates		Flow rate	bucket/stopwatch, Flow gauge/totalizer
Site Characterization Soil, Water & Air Engineering decisions Monitoring of Treatment Equipment Decision to Allow Discharge to Sewer	Level 2 Field Analysis	Volatile organic	Photovac 10S50 analysis Region 1 Lab Protocol Detection Limit to low ppb range Calibrated against lab standards Duplicates 1 in 10 to lab
Water Level Measurements		Groundwater Level	Steel tape/Electropiezometer
Risk Assesement Site Characterization Evaluation of Alternatives Engineering Design	Level 3 Engineering	Specific volatile analysis EPA Procedures used by EPA laboratories other than CLP protocol	Method 601 specific volatiles in water
Risk Assessment PRP Determination Evaluation of Alternatives Engineering Design Assessment of Final Groundwater Cleanup	Level 4 Confirmational	TCL volatile organics by GC/MS Low ppb detection limit	Method 624 Water GC/MS Method SW846 Soil GC/MS
Risk Assessment Drinking water wells Assessment of Final Groundwater Cleanup	Level 5 Non standard	Volatile Nonconventional Used for wells where the detection limit must be able to see <5 ppb PCE	Method 524.2 Water

Source USEPA, 1987

The Data Quality Objectives for the sampling activities at General Switch are detailed in this section.

Groundwater Quality and Aquifer Characteristics

DQ1 Short-term pump tests are proposed to first determine that the observation wells selected to monitor the efficiency of the Parella well are the right choices. Initial short-term pump tests will be completed lasting 12 hours during which the performance characteristics of each well will be determined. The wells selected for observation wells will be those that demonstrated communication with the major fractures of the shale aquifer by showing a significant inflow of water into the well at rates approaching 2 gpm during the short term pump tests and a demonstrated effect in drawing down neighboring wells including the Parella well.

During the long-term pumping of the Parella well, water levels will be taken in the Parella well and observation wells to assess that the Parella well continues to demonstrate that the cone of depression encompasses all previously contaminated wells and has a significant impact upon groundwater flow in the area downgradient from General Switch.

Hydraulic characteristics of the unconsolidated materials and bedrock at the site will be obtained during the Pump Test. This information will be used to describe groundwater flow directions and rates and to evaluate the method of groundwater capture.

Data concerning the observation wells will be obtained that include the depth and condition of each well in the community well survey and the static water levels along Highland Avenue immediately prior to the pump test. The yield of individual wells provisionally selected as observation wells will be determined in order to assess the degree of connection these wells have to the regional fractured bedrock aquifer. Poorly yielding wells will be rejected as observation wells in a program of short-term pump tests prior to the pump test of the Parella well.

An attempt will be made to limit the use of nearby wells during the pump test as interferences and additional drawdown will result from any use of nearby wells. There are only five wells on Highland Avenue at present used for drinking water supply.

The drawdown of the pumping well under the optimum sustainable pumping rate will be observed along with the response in terms of drawdown in neighboring wells. This optimum sustainable pumping rate is that rate of groundwater pumping that the well can provide for the period of the pump test without drawing the well down to uncover the pump intake. It will be the pumping rate that removes most groundwater from the shale aquifer and has the most extensive impact on the water resources surrounding the well. We will report data comparing the pumping rate and the concentration of solvent withdrawn at that pumping rate. It is noted that the pump test is not a substitute for extended well pumping and that the initial optimum pumping rate may differ later in the groundwater recovery process.

Downgradient wells [illegible]

DQ2 Under the SAMP, groundwater samples will be taken to determine if the cone of influence of the Parella well encompasses the tetrachloroethylene plume observed in homeowners wells and if the water quality in the aquifer beneath Highlands Avenue is improving. Following on from the initial two sampling rounds of wells on Highland Avenue, Watkins Avenue, Electric Avenue and Commonwealth Avenue called for under the Pump Test Plan, further sampling rounds each quarter under the SAMP will be targeted to sample those wells that were contaminated in the first two sample rounds and to confirm that those wells immediately downgradient in terms of groundwater flow from the contaminated wells remain non-detected for volatiles.

DQ3 The types, concentrations and extent of onsite groundwater contamination. This information will be needed to assess the risks to receptors and evaluate the effectiveness of the groundwater cleanup. The monitor wells on the General Switch property will be sampled in the quarterly round of wells. Once the water quality throughout the Highland Avenue vicinity is established in a minimum of four quarterly sample rounds, provision will be made to reduce the number of wells in the sample round and cull out the wells that have demonstrated a pure water quality for 2 consecutive sample rounds and to conduct the sample rounds every 6 months for one year and then every year during the remainder of the cleanup.

DQ4 The stratigraphy and bedrock structure at the site has been defined by the soil borings drilled by Fred C. Hart and the well data from the community well survey. Additional well logs produced by local drillers will be obtained to further establish the geology and describe the contaminant migration pathways.

DQ5 Groundwater flow directions, both horizontal and vertical at the site. This information will be needed to evaluate contaminant migration pathways. Water levels will be taken at each quarterly sample round.

DQ6 The extent and migration of the contaminant plume will be defined by the well sampling program.

Groundwater Treatment

DQ7 We will monitor the effectiveness of the groundwater recovery at the Parella well. The effectiveness of the groundwater plume capture will be assessed by sampling the concentration of the influent water quality of the pumping well analyzed for volatile organics according to the attached sampling program. This will allow us to determine how much of the Tetrachloroethylene and trace volatiles are being removed from the aquifer by pumping the Parella well. By sampling the groundwater pumped into the air stripper and comparing it to the effluent discharge concentration from the air stripper, we will obtain information on the effectiveness of the air stripper in treating the groundwater recovered from the Parella well. This information will be presented in graphs of concentration plotted against time since the beginning of pumping to ascertain any trends in groundwater concentration and treatment efficiency.

This data will be used in order to justify the long-term authorization from the NYSDEC and the Town of Wallkill to discharge the effluent treated groundwater during groundwater cleanup.

DQ8 The rate and amount of groundwater withdrawal and treatment will be monitored with periodic reading of the pumping rate gauge and totalizer fitted to the discharge of the Parella well. The operating parameters of the Parella pumping well will be reported in terms actual pumping rate as compared to the optimum pumping rate, yield and specific capacity of the well. The well pump will be fitted with a water level control to maintain a selected drawdown to produce the optimum pumping rate.

DQ9 The pump test report will present details of the depth and condition of the pumping well that will include: static depth to water, well volume, depth of pump, pump capacity, power supply and pump control devices.

Soil Excavation and Flushing

DQ10 The locations and general extent of potential soil contamination source areas (Hot Spots) at the site has been determined by the Fred C. Hart investigations. No other geophysical surveys are envisaged. Additional information is needed to estimate the actual horizontal and vertical extent of contamination at these source areas and their effect on groundwater quality, estimate health risks, and the extent of soil removal and treatment. The types, concentrations, and lateral extent of surface soil contamination in known source areas will be determined during excavation. This information will be used to evaluate the extent to which subsurface soils could leach contaminants to groundwater and affect the cleanup.

The SAMP will assess and direct the cleanup of the hot spots identified on the General Switch property. Soil samples will be taken for analysis with the Photovac to direct the extent of the excavation during the removal of soil at the three hot spots that have more than 50 ppm tetrachloroethylene detailed in Figure 9. One in ten samples will be submitted for laboratory analysis.

DQ11 Part of the proposed remedial action involves flushing contamination from the hot-spots of soil contamination through the glacial till to the bedrock aquifer. The pump test plan includes monitoring of wells installed by Fred C. Hart in the glacial drift to determine if pumping the Parella well and drawing water from the bedrock aquifer will draw the water levels down in the wells screened in the glacial till. In this way, we will evaluate the degree of interconnection between the till and the fractured bedrock aquifer.

DQ12 The remedial plan involves flushing the treated groundwater from the Parella well through the hot-spots of soil contamination on the General Switch property after the soil that is contaminated to above 50 ppm Tetrachloroethylene has been removed and treated. We need to ascertain that the injected water that will form leachate by dissolving the residual Tetrachloroethylene in the soil will be captured by the cone of depression from the Parella well. To this end we will monitor the wells installed by Fred C. Hart for water level and groundwater quality in those wells downgradient and upgradient from the hot spots at General Switch.

The physical and geotechnical characteristics of unconsolidated materials has been determined by Fred C. Hart studies presented as an appendix to the SAMP. This information is needed to support the evaluation of contaminant migration pathways and evaluation of the rate of percolation of water leaching through the soil hot spots and determine if channelling through the soil is likely.

Air

DQ13 Determine the potential effects of the site on ambient air. This information is needed to assess the health risks associated with this pathway. We will analyze the air quality of the exhaust passing through activated carbon from the air stripper cleaning the water drawn from the Parella well. This data will be presented to the Air Branch of the NYDEC to justify their authorization to discharge the exhaust during groundwater cleanup. We will sample the air to monitor respiratory exposure during the soil tilling.

Soil Tilling

DQ14 The treatment method proposed to clean the soil is rotor tilling. Soil samples to verify that the soil has been cleaned will be taken before and after rotor tilling. Air samples to determine the ambient air concentrations of Tetrachloroethylene will be taken during soil disturbance.

DQ15 Estimate the public health and environmental risks associated with site contamination and cleanup. As there was no evidence of spillage on the residential properties, we do not need to define the types, concentrations, and lateral extent of possible surface soil contamination on neighboring residential properties.

Contaminant Migration: Surface Water/Sewer

DQ16 The SAMP will determine the types, concentrations, and extent of contaminants in surface waters and sediments in the topographic depression below the site along Industrial Place and the potential for migration to offsite surface water bodies. This information will be used to further assess the migration pathways, the risks to receptors and to evaluate cleanup measures. Site topography and drainage will be used to assess surface runoff patterns.

Fracture Tracing

DQ17 The SAMP will determine if any obvious regional fractures can be observed running through the site and report on the degree of bedrock fracturing and jointing.

Treatability

DQ18 Soil treatability studies are planned as part of this work plan. The first 20 cu yd volume of contaminated soil excavated will be treated and monitored to assess the efficiency of the soil treatment method proposed.

Maps and Figures

DW19 The various maps and figures used to present data will be updated and improved with the assistance of a surveyor licensed in New York State.

Observation Wells

Based on the information concerning the hydrogeology of the aquifers at General Switch and the data quality objectives presented above, we are to conduct a pump test in the vicinity of General Switch where the Parella well is the pumping well and the observation wells are ten other wells along Highland Avenue and on the General Switch property and eight monitor wells in the glacial till. These observation wells will continue to be monitored during groundwater cleanup.

For the observation wells, we will seek to use 10 abandoned wells in the shale of Barry, Rupert, Robaina, Stout, Osbourne and Lobb, Wood (now Ogden) or Lewis, Crooks, Electra Manufacturing, Roselli or Perez (Figure 24) and eight monitor wells installed by Fred C. Hart: MW1 through MW-8 (Figures 25 through 33). One shallow dug well on the Stout property may be used if it contains water. The observation wells along Highland Avenue that are provisionally selected have been the wells adjacent to the Parella well that have historically demonstrated tetrachloroethylene contamination and drawdown during the prior pumping of the Parella well and are adjacent to General Switch. The wells in the shale are supplemented with monitor wells screened in the glacial till above the shale in order to evaluate the interconnection of groundwater removal in the shale and drawdown in the till above.

Well flow (discharge) is a combination of water pumped from the standing column of water in a well (the well storage contribution) and the water flowing into the well from the aquifer (the aquifer contribution). In the evaluation of any well provisionally selected as a recovery well, such as the Parella Well, it is necessary to recognize that the well acts as a water storage chamber. Water is taken from well storage during peak demand times and gradually replenished during off-peak times. The impact of these two contributions was observed in the the wells in Wallkill drawing water from the shale. In those wells sampled that tapped few regional fractures, the aquifer contribution was low: less than 1 gpm. These wells were quickly exhausted once the well storage volume had been removed and had to be rested for a period of more than 1 hour before any significant well recovery was observed and the well could be pumped again. These wells will be rejected as observation wells.

SAMPLING TASKS

2.3 Mobilization and Demobilization

This subtask will consist of utility map procurement, field personnel orientation, procurement of a site trailer to be located adjacent to the main gate, and equipment mobilization and demobilization. The Middletown Underground Location Services will be contacted at least one week before the site work is begun to mark public utilities at the site and residential properties. During sampling on residential properties, the home owner will be asked to indicate private utilities such as sewer line, water line, septic or oil tanks, and others. General Switch will obtian access to residential and other properties and will inform the residents of the schedule to sample on their properties so that they are available to indicate private utilities at the time of sampling.

As part of this task, each field team member will attend an orientation meeting to become familiar with the history of the site, health and safety requirements, and field procedures. Health and Safety briefings will also be given before each level of effort. Equipment mobilization will entail the ordering, purchase of such items as zero grade air, safety tyvec suits, and analysis standards needed for the field investigation. An inventory of equipment, will be reviewed prior to the project and any additional equipment required will be secured. A field office trailer will be set up and necessary utility hookups obtained as part of the mobilization effort. The trailer will be at the site for the duration of the cleanup.

Locations for the soil excavations, surface soil samples, and groundwater monitoring wells will be located and staked at the start of the site operations. These locations will be measured from existing landmarks and baseline grids established for the geophysical and soil gas surveys.

Equipment will be demobilized at the completion of this these of field activities as necessary. Equipment demobilization will include, but will not be limited to sampling equipment, excavator equipment, health and safety equipment, decontamination equipment, and field office trailer and utility hookups.

The site work will generate several waste materials including development water, discarded protective equipment, decontamination wastes, and others. All wastes will be segregated by waste and drummed, and drums will be numbered with indelible paint. A log of drum contents, location from where the drums originated, and associated soil and groundwater samples will be maintained in the site notebook. Drums will be stored at the site at an EPA designsted area until EPA determines whether they should be labeled as hazardous or non-hazardous wastes. EPA may determine how to classify the drummed wastes after the results of the sampling are available.

Classification of drum contents, labeling (e.g., hazardous versus nonhazardous) and disposal are not included in the scope. The drums will be stored in a secured area noted on the site map attached. Public concern arise if waste is stored that is visible to the residents. The area will be provided with closed dumpsters.

2.4 Base Map and Topographic Map

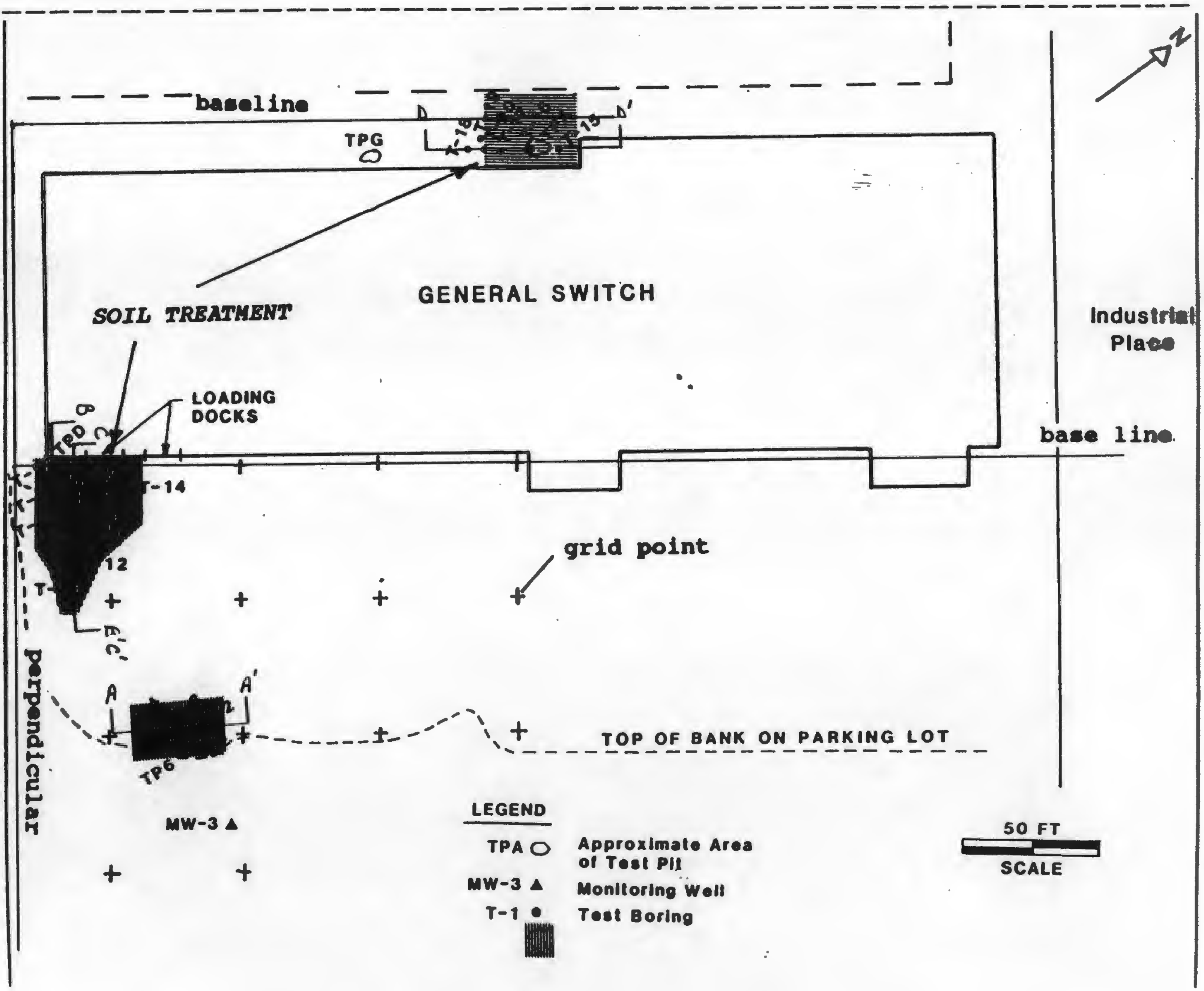
Topographic surveying and surveying of the elevations of the monitor wells was completed as part of the Fred C. Hart investigations. A topographic base map of the General Switch property was prepared during the USEPA/TAT Response Action and during the Fred C. Hart investigation. The elevation of the drinking water wells were surveyed in during the USEPA/TAT response, including the General Switch well and of the wells distributed throughout the Highland Avenue, Watkins Avenue and Commonwealth Avenue community. This data is included in the Wallkill Well Data table. The horizontal locations and vertical elevations for each monitor well were surveyed. Vertical elevations were surveyed to an accuracy of 0.01 foot. All well locations were tied to a National Geodetic Vertical Datum (NGVD) benchmark. Mylars of these maps and the appropriate control information will be obtained to upgrade the maps and figures at present available. Bearings, distances, and coordinates of the major structures on the General Switch Property will be shown.

The topographic base map will be compared to aerial photographs taken during a low level fly-over of the site. The topographic base map, at a scale of 1 inch to 100 feet with contour intervals every 5 feet, will be used to plot the surface water/sediment sample locations, the geophysical/soil gas and surface soil sampling grids, and the surveyed locations of wells and to estimate soil volumes for remediation. Fences extend along the borders of the General Switch property. These fences are assumed to constitute the site borders. The topographic base map and well locations will be compiled under the direction of a New York-licensed surveyor.

Three base lines will be surveyed on the General Switch property to help field crews in locating sampling locations. The two base lines and the topographic map production are proposed as part of the Phase I activities. The two common base lines are to locate the previous and future surface soil sampling grids. Two of the base lines will be established parallel to the General Switch manufacturing facility. The other base line will be perpendicular to the first two lines. Auxiliary grid points will be established at the site at each soil hot spot. The geophysical, soil gas, and surface soil sampling grids will be measured in the field from the two base lines. Baseline node locations will be measured every 40 feet and also tied to a surveyed benchmark. Incorporation of the base lines onto the topographic base map will allow accurate location of grid points onto the map for each activity (see attached Figure).

Shakti Consultants, Inc.

Figure Base map



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2.5 Fracture Trace and Structure Survey

A fracture trace survey is planned to determine areas within the bedrock where increased groundwater flow and subsequent contaminant migration may occur. The survey will consist of the following tasks: a photographic fracture trace analysis, review of aerial photographs (infrared and color aerial stereo pairs) and topographic maps and ground truthing of aerial photo survey and surface mesoscopic structures. The fracture trace and infrared photography interpretation are proposed as part of the Phase I activities.

To find areas within the bedrock where increased groundwater flow and subsequent contaminant migration may occur, a fracture trace survey will be performed. The survey will consist of two main parts:

1. Photogeologic fracture trace analyses of aerial photographs and topographic maps.
2. Ground truthing of aerial photo survey and surface mesoscopic structure study.

In the first portion of the study, existing aerial photographs and maps will be obtained from Keystone Aerial (Toms River, NJ), Robinson Aerial (Philadelphia, PA) or Aero Services (Dallas TX). The photographs will be examined to detect linear features to assist the location and trace orientation of a fracture within the subsurface. On aerial photographs and topographic sheets, these features are represented by topographic lineations such as straight valley segments, straight stream segments, abrupt changes in valley alignment, in ridges, gully development, and aligned holes. In addition to the topographic criteria, soil tonal alignments, localized vegetation differences, and localized spring or diffuse seepage areas will be noted to delineate fracture traces.

To refine the analysis, color infrared aerial photographs (Scale 1:58,000) will be obtained from the United States Geological Survey (USGS) National High Altitude Program (NHAP) in Sioux Falls, South Dakota. In addition, color, aerial stereo pairs (Scale 1:2,000) will be ordered from a commercial vendor. Both types of photographs offer advantages for detecting regional and localized fracture trace trends.

Upon completion of the aerial photo fracture trace survey, fracture traces affecting the site will be confirmed in the field. The main objective of this portion of the study is to confirm that lineations defined on aerial photographs are not man-made structures such as roads, paths, telephone or electric lines and irrigation ditches.

A second portion of this phase of the survey will consist of measuring mesoscopic structures (bedding, cleavage, joints, faults, veins, etc.) from outcrops within a 1-mile radius of the site. The adjacent rail line represents an excellent opportunity to describe and measure structures that affect the movement of groundwater beneath the site. Other outcrops will be selected according to size, orientation, and position within the 1-mile radius to assure unbiased sampling of each fracture orientation and frequency. Individual fractures will be described by orientation, width, degree of weathering, length and frequency.

Measurement of actual fracture surfaces provides a third dimension that cannot be described by the aerial photo survey. In addition, although parallelism is recognized between fracture trace orientation and fracture type structures (bedding, joints, faults, cleavage) in flat lying, relatively undeformed rock (Lattman and Nickelson, 1958), fracture trends may differ in deformed rocks (Keim, 1961).

Fracture traces from aerial photographs confirmed in the field will be plotted on rosette diagrams for orientation, and histograms for width and length. Mesocopic structures from the outcrop survey will be plotted on stereograms for orientation and histograms for fracture width. Results of the fracture trace and mesoscopic structure survey will be compared and analyzed to discern major and minor fracture orientations, in regards to fracture width, of weathering, spacing, and density.

2.6 Geophysical Survey

Geophysical surveys have been conducted to find buried metal at the site that might have been sources of contamination. The geophysical survey was performed by Fred C. Hart, see Appendix.

The results of the geophysical survey have been used to refine the soil gas and soil boring locations and surface soil sample locations in potential source areas at the site.

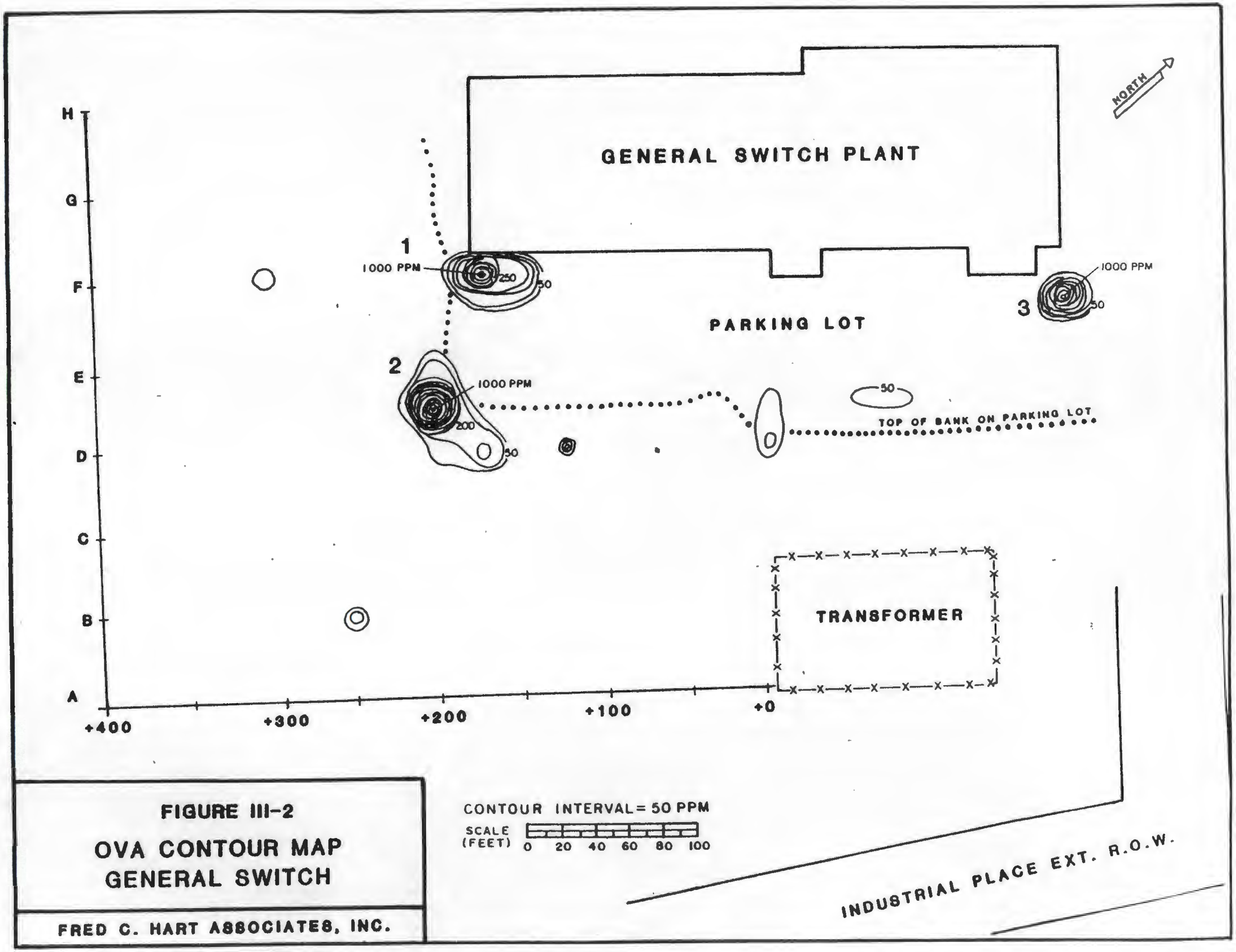

FIGURE III-2

OVA CONTOUR MAP GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

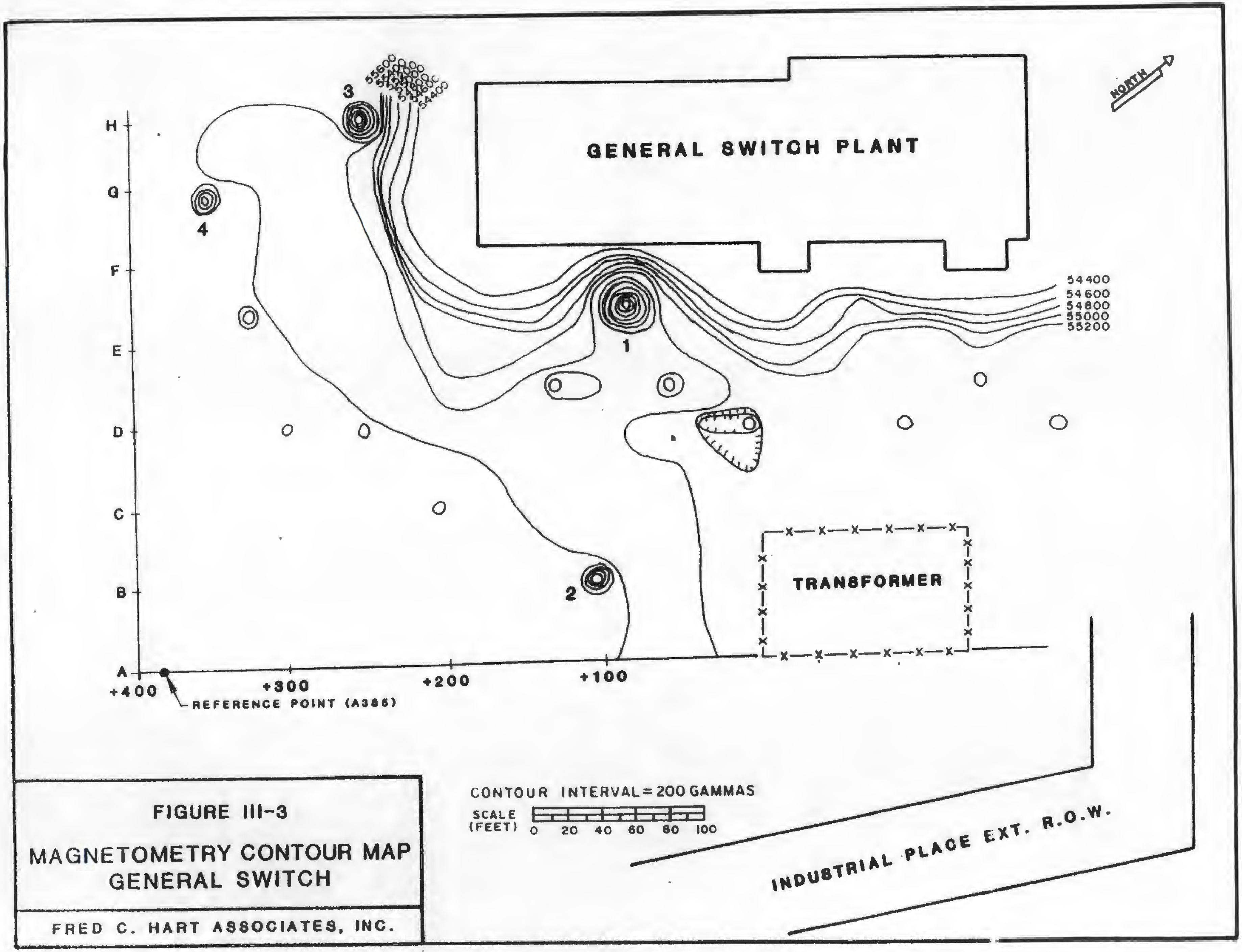

FIGURE III-3

MAGNETOMETRY CONTOUR MAP
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

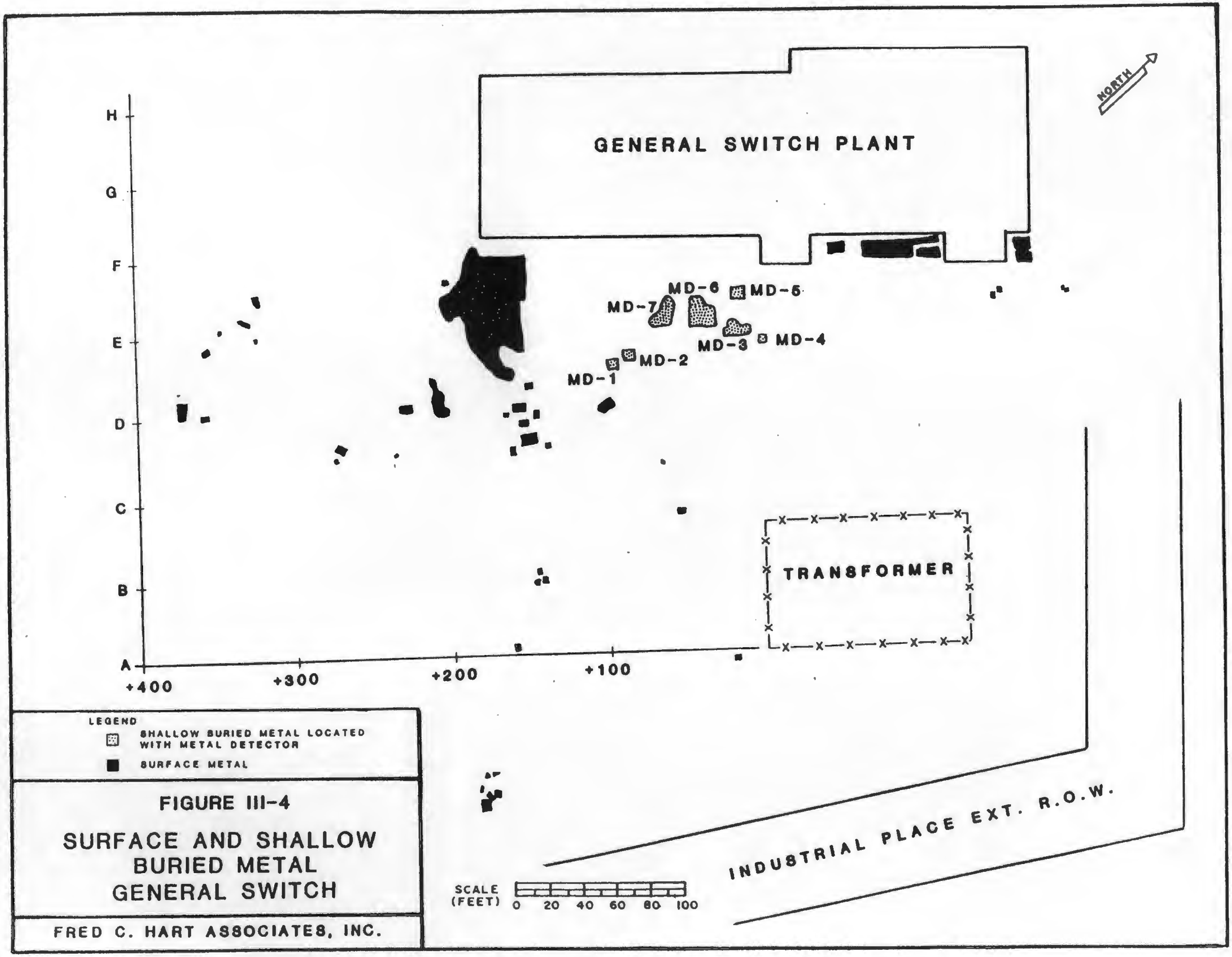

FIGURE III-4

SURFACE AND SHALLOW BURIED METAL GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

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Soil Boring/Subsurface Soil Sampling

Summary of Previous Soils Investigations

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

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

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

Soil Borings Program

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

A total of 20 soil borings were completed as part of this investigation. The locations of all test borings are shown in Figure 3-1. The test borings were located based on the results of previous Fred C. Hart investigations indicating significant concentrations of PCE in these areas (Figures 2-1 and 2-2). A grid pattern locating the test borings was established at each of the three areas designated for investigation. The results are discussed in Section 1: Background Information. In general:

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

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

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

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

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

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

Soil Boring/Subsurface Soil Sampling

Upon close examination of the data developed by Fred C. Hart, there are two location at General Switch where the volatile content of the soils was greater than 500 ppm as measured with the OVA gas chromatograph and where there is no deeper samples to define the extent of the contamination. These locations are adjacent to the General Switch loading dock at TPD in soil borings T-8, T-9, T-10 and T-11 and at TPA adjacent to the rear door of the plant in borings T-15, T-16 and T-20. In these locations we may expect to excavate to the limit of the trackhoe unless the building footings are undermined.

2.8 Excavation and Post-Excavation Samples

Soil samples will be taken during soil excavation and treatment: In the soil cleanup, we propose to be guided by the soil sampling data presented in Figures 9 through 14 that generally illustrate the location and the vertical and horizontal extent of contamination in the three Hot Spots on the General Switch Property.

The contaminated soils inside the limits of the contaminated soil areas at the three hot spots, TPA, TPD and TP6 will be excavated. As agreed to in the Order, we propose to excavate and treat soil contaminated with more than 50 ppm of tetrachloroethylene in the Hot Spots.

To supplement site information regarding the extent of contamination, in accordance with the Consent Order, the Photovac will screen all soil samples during the soil excavation according to the protocol in Appendix A. Field decisions will be made regarding the depth of the excavation based on Photovac analysis of the soil and footing foundation security. The decision will be made jointly by the Project-Coordinators of the USEPA and Shakti Consultants once the depth of the footings in areas TPA and TPD are exposed in the two areas adjacent to the building. In any regard, the excavation may only expose a slope that is 45 degrees from the horizontal sloping away from the base of the footings.

The excavations will be dug with a trackhoe with a 25 feet arm and 3 cu yd bucket. The excavator will remove the highly contaminated soils that will be stockpiled on a concrete pad indicated in Figures 9 and 23 and under 8 mil plastic and tarpaulins.

According to the Order, the Sampling Plan includes provision to demonstrate to USEPA's satisfaction that the required soil treatment has been attained. Samples of soil will be screened using the Photovac as the soil is removed from the excavation: to determine the solvent content of the soil taken out. A composite sample will screened with the Photovac for every 20 cu yds of soil removed. A minimum of one in ten of all soil samples will be analyzed by the contract laboratory. In addition, one composite sample will be taken for every 20 cubic yards of soil after treatment to demonstrate that treatment has been attained.

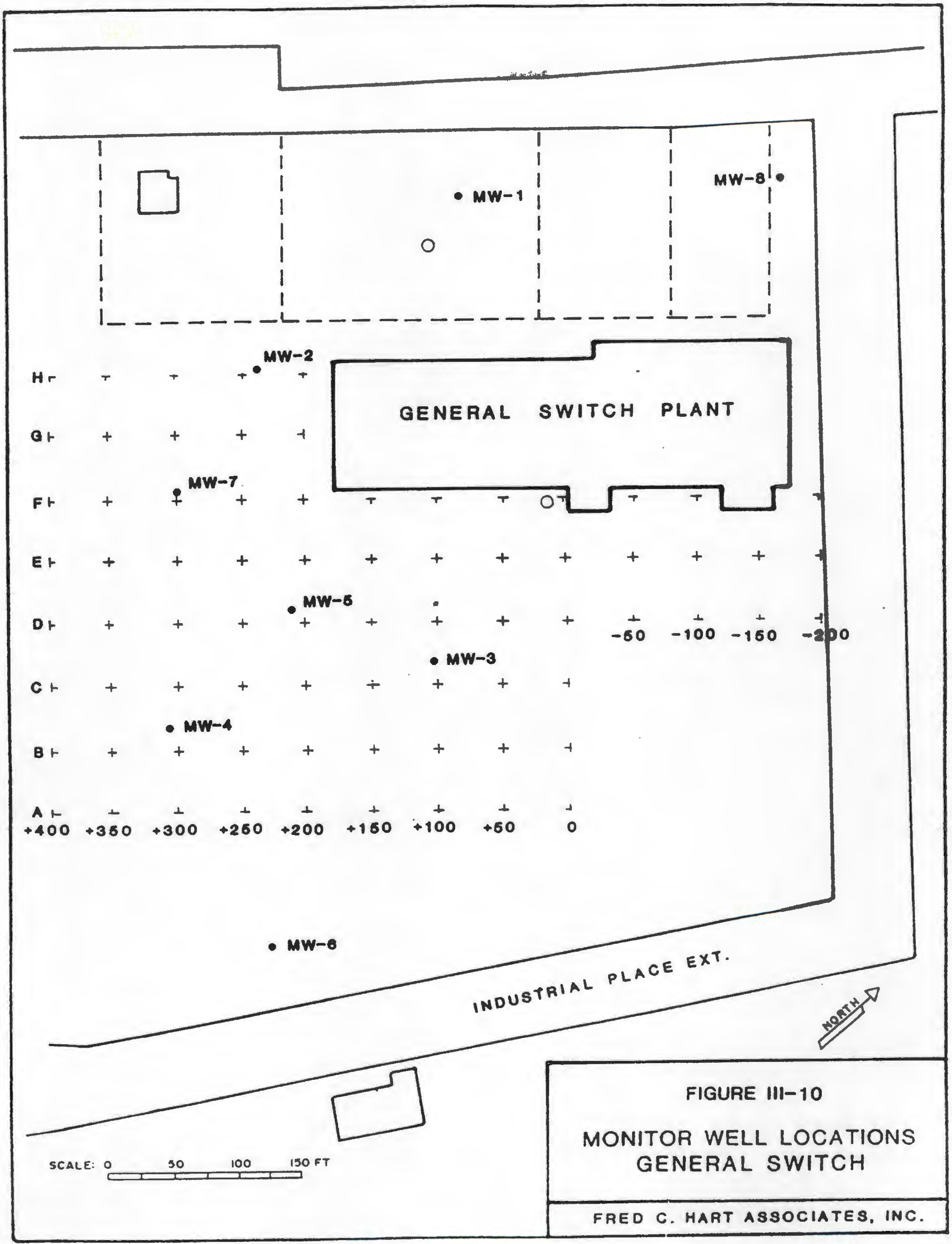


FIGURE III-10

MONITOR WELL LOCATIONS
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

The sample locations will be defined in a lateral dimension by measurement from the sampling grid and offset from the General Switch manufacturing building and in a vertical sense by measurement from the ground surface. The excavation will proceed out from the most contaminated location in each hot spot to a limit of soil contamination less than 50 ppm. The trackhoe will expose the buried waste materials at the site. The locations of the excavations indicated by cross hatching in Figure 9 were determined based on the results of the surface geophysics, soil gas survey and soil sampling conducted by Fred C. Hart.

Post-excavation samples will be taken immediately after the completion of the excavation, at the sides and ends of the excavation, and along the center line in the bottom of each excavation; a minimum of five samples per excavation, all of which will be analyzed by USEPA Method SW846 for volatile organics. Soil at concentrations less than 50 ppm Tetrachloroethylene will be left in place.

At TPD, if the Photovac indicates levels of soil contamination above 50 ppm Tetrachloroethylene, the soil will be excavated to at least 7 feet depth at the loading dock area unless the USEPA determines that excavation to four feet combined with flushing will be an adequate alternative. At TPD the excavation will include an area 5-feet in radius surrounding soil boring locations T-7, T-8, T-9, T-10 and T-11. These radii will combine to remove the highly contaminated soils indicated in these soil borings.

At TPD, if soil is encountered in the bottom of the excavation at a concentration more than 50 ppm, an underground drain system may be placed into the excavation at this location and used to infiltrate treated groundwater into the till, to flush the remaining tetrachloroethylene to the recovery well. The piping system may also be used for vapor extraction. This excavation next to the loading dock, will be backfilled with clean consolidated soil to allow for truck loading and unloading.

Area TPA is at the rear of the building in a natural depression adjacent to the building footings, sandwiched between the building and the property fence. At this hot spot, high-level contamination of the soil will be excavated to at least 7 feet in depth, provided the building foundations are not undermined. The highly contaminated soil appears to be in an area 5 feet in radius surrounding soil boring locations T-20, T-17, T-16 and T-15, where soil contamination is expected to be above 50 ppm tetrachloroethylene. If during the time of the cleanup, the foundation adjacent to TPA is threatened with collapse, an under drain for infiltration of treated groundwater or vapor extraction similar to area TPD may be installed.

TP6: Soil will be excavated at TP6 to a depth of at least 4 feet.

The methods of taking the soil samples and maintaining the required chain of custody is detailed in the standard procedures presented in the Quality Assurance and Quality Control Plan.

2.9 Post Soil-Treatment Samples

The contaminated soil removed from the excavation will be treated by rotor tilling the soil, and evaporation of the solvent. One sample of soil will be taken for every 20 cu yd of soil excavated during the soil tilling operation and screened with the Photovac. These results will be compared to samples of soil taken for each 20 cu yd of soil treated.

With this information, a determination will be made by the USEPA that the treatment has reduced the volatile concentration of tetrachloroethylene in the soil by 95-99.9% in accordance with the guidance " Interim Treatment Levels for Soil and Debris" June 1, 1988 USEPA Office of Emergency and Remedial Response. Upon obtaining satisfactory soil sample results as measured with the Photovac, one in ten samples will be taken in duplicate as confirmatory soil samples that will be analyzed in the laboratory by USEPA Method SW846 (Method 624 modified for soils analysis).

After the soil is rotor tilled and reduced to the required residual tetrachloroethylene concentration, the soil will then be stockpiled, covered with plastic and tarpaulins while the soil flushing is complete.

Disposition of the Treated Soils: After soil rotor tilling is completed and after completion of groundwater treatment, at the discretion of the USEPA, the treated soil that was stockpiled will be placed into the excavations at TPA and TP6 in 8" lifts. The soil lifts will be spread across the floor of the excavation and compacted.

The contaminated soil areas will be closed in a manner that minimizes the need for further maintenance and controls. The finished closure of stabilized soil at TP6 to the south of the truck yard and at TPA will be seeded to minimize erosion. The truck area will be covered with a concrete pad.

There will be a final quality control inspection and certification by an Professional Engineer or certified Professional Geologist.

The operation of the system used for aeration will be in accordance with all laws and regulations applicable to air emissions.

2.10 Groundwater Sampling

Air Stripper

The discharge from the Parella Well will be treated to <5 ppb Tetrachloroethylene, <5 ppb Trichloroethylene, <5 ppb Dichloroethylene and <2 ppb Vinyl Chloride volatile components by pumping the water recovered during the pump test through a full-scale air stripper. The air stripper will be housed in a trailer on site. The air stripper will be sized to take additional well discharges if necessary. The air exhaust will be piped through activated carbon. Samples will be taken of the air after passing through activated carbon. The Pump Test will be used to monitor the effectiveness of the air stripper.

Imbiber Beads

During the Pump Test, the groundwater discharge from the air stripper will be piped through a bed of imbiber beads and into two 4000 gallon tanker trucks on site. The imbiber beads are polystyrene beads marketed under the name of Expandbeads that are effective in adsorping petroleum fuels and solvents. Details of the beads are attached in Appendix F.

The drawdown water level will be stabilized close to the bottom of the pumping well, five to ten feet above the pump in order to stress the aquifer. We will:

- Monitor any changes in the surrounding wells with a dual system of readings: by hand measurements of water level as well as by recording the data on the data logger.

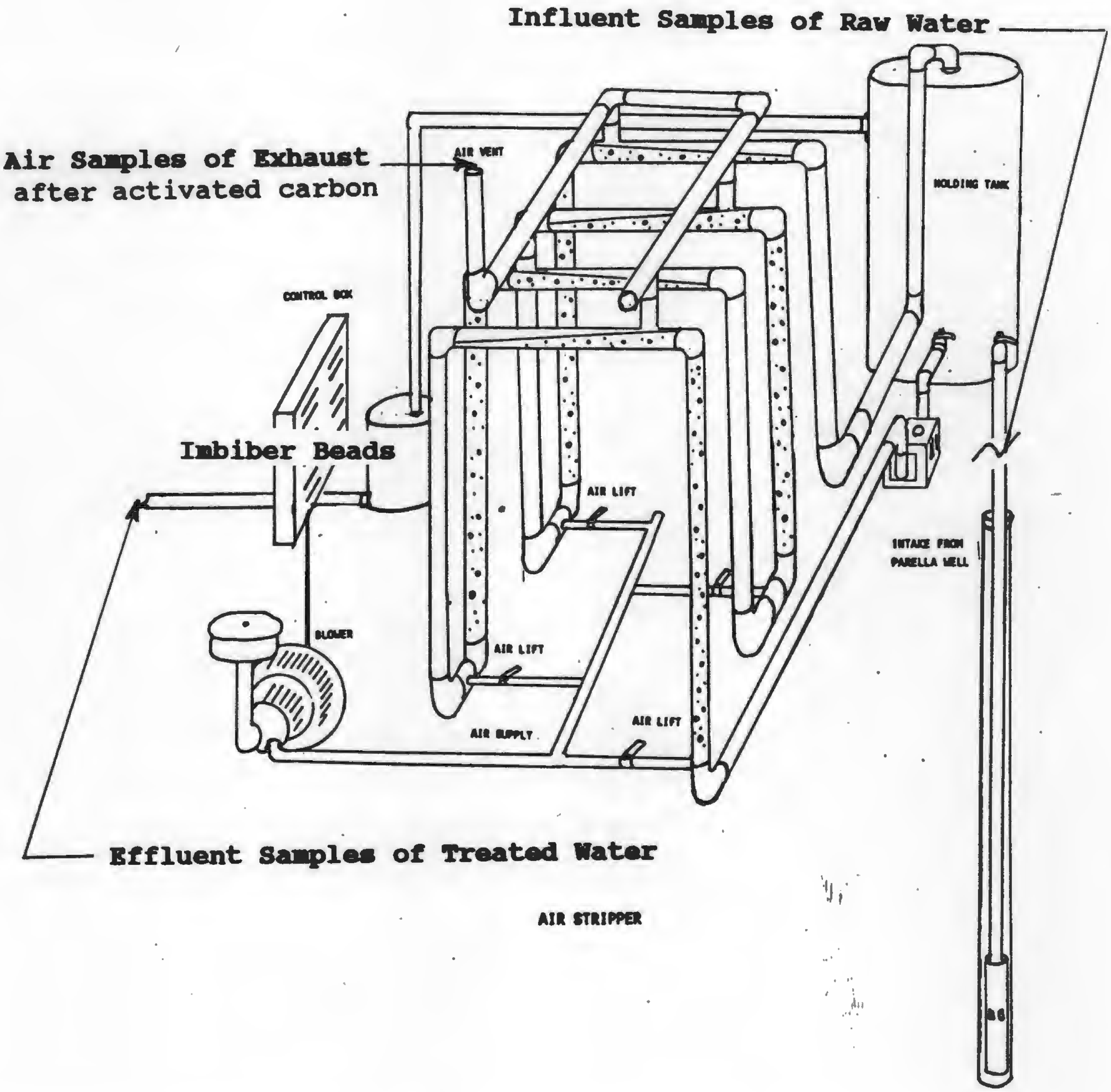
- Discharge the treated water provided the effluent is below 5 ppb of tetrachloroethylene.

Sampling Plan for the Pump Test and Subsequent Long-Term Operation

The Pump Test Plan includes provision for the following chemical analyses:

- **Groundwater Samples from the Short-Term Pump Tests**

Samples of the pumped water will be collected at the end of the pumping period of each increment of 2, 4, 6 and 10 gpm and tested on the Photovac to analyze the concentration of groundwater contamination in the well effluent at each rate. One sample in ten will be analyzed in the laboratory by USEPA Method 624 for priority pollutant volatile organics.



Influent Samples of Raw Water

Air Samples of Exhaust after activated carbon

Imbiber Beads

Effluent Samples of Treated Water

Figure 21. Merry-Go-Round Air Stripper

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185 Gatzmer Avenue
Jamesburg, NJ 08831

- **Groundwater Samples Before and After the Pump Test**

To determine if the cone of influence of the Parella well encompasses the tetrachloroethylene plume observed in homeowners wells, these wells will be sampled prior to and after the pump test. It is anticipated that this sampling will identify a circle of clean wells outside the affected wells. The sampling round of wells will include all the existing wells on Industrial Place, Highlands Avenue, Electric Avenue and Watkins Avenue including the observation wells surrounding the Parella well. The samples will be analyzed for volatile organics by USEPA Method 524.2. A round of samples will be taken after the pumping to assess the water quality changes caused by the pumping.

One month after the sample results of the wells are made available to the USEPA, we will submit a plan to identify a circle of clean wells around any contaminated well that is above 5 ppb Tetrachloroethylene that will be added to the sampling round. The results will be portrayed in a table and will include a map depicting the location of such wells.

- **Influent Samples of Raw Water from the Parella Well**

Each day of the pump test, the effectiveness of the groundwater plume capture will be assessed by sampling the concentration of the influent water quality of the pumping well. The samples will be analyzed for volatile organics.

- **Effluent Samples of Treated Water from the Air Stripper**

A minimum of 2 water samples of the pumped water will be collected each day after treatment by the air stripper at the discharge of the storage tanks into the sewer during the 3-day operation of the air stripper during the Pump Test and analyzed with the Photovac 10S50 calibrated against standards supplied by the Laboratory.

A minimum of 1 duplicate effluent discharge sample per day will be analyzed during the Pump Test by Method 524.2 on a one-day turnaround. Verbal results will be provide to the Project Coordinator and Wallkill POTW to enable a decision on the release of the stored pump-test water.

The laboratory will determine in one day if any volatiles are present in the discharge with one day turnaround to a detection limit of 5 ppb by Method 524.2. The QA/QC data will probably be available in 28 days. Samples from the first day of the Pump Test will be hand delivered to the laboratory personnel who will have the equipment calibrated in advance.

Duplicate samples will be analyzed with the Photovac 10S50 gas chromatograph. The Photovac will be calibrated against standards of known concentration supplied by the laboratory. The Photovac results will be available in seven minutes at the well head. According to the manufacturer, the Photovac is capable of detecting 10 ppb of tetrachloroethylene at a gain setting of 10. For lower detection limits the gain may be increased to 100. The laboratory will call the USEPA Project Coordinator and Wallkill POTW with the results the following day so that a decision can be made to discharge the water to the sewer.

If the air stripper does not treat the effluent to below 5 ppb Tetrachloroethylene, the system will be shut down subject to the direction of the USEPA Project Coordinator or the effluent will be discharged untreated into the sewer line running under Highland Avenue, subject to an agreement with the Town of Wallkill POTW. As a contingency, if the effluent is pumped directly into the sewer line, we will sample the influent concentration for volatile organics pumped into the sewer and the influent concentration into the Wallkill treatment plant and at the Wallkill River discharge once per day during the test to detect Tetrachloroethylene above 5 ppb. The analysis will be completed using the Photovac gas chromatograph with one in ten samples being analyzed in the laboratory by Method 524.2. These results will be made available to the treatment plant operator who will make a daily decision that the discharge is to continue. The Photovac results will be available the same day and will be confirmed verbally the following day by Method 524.2. The QA/QC package should be available in one month after analysis. This process will be repeated on the first, second and third days of the test.

Groundwater Treatment System Sampling during Long-Term Operation

Following a favorable conclusion to the Pump Test, the groundwater from the Parella well will be pumped through a merry-go-round air stripper capable of reducing the Tetrachloroethylene concentration in the Parella well to below 5 ppb in the effluent. The following groundwater samples will be taken:

- Influent: At the Parella well, from a pet cock installed on the influent to the treatment system to indicate the water quality of the aquifer.
- Effluent: From a pet cock on the effluent to the treatment system to measure the efficiency of the air stripper imbiber beads and the discharge to the sewer or to the ground.

For quality control of the treatment process: to tune the operation of the air stripper, samples at the entrance to the second set of air lifts in the air stripper will be screened with the Photovac along with Duplicate and Blank Quality Control (QC) samples.

Once the treatment system has proved its capabilities during the Pump Test, the influent and effluent water samples from the groundwater treatment system will be analyzed on the following schedule during long-term operation of the groundwater treatment system. One effluent and influent sample round will be analyzed once per day for one week during start up, one sample round per week for the next 2 months, two sample rounds per month for the next 4 months, one sample round per month for the next 12 months and one sample round every quarter for the remainder of the groundwater remedy

- **Air Samples of Exhaust from the Air Stripper**

In the operation of the air stripper during the Pump Test, one sample of the air stripper exhaust after passing through activated carbon will be taken each day of the pump test and analyzed by NIOSH Method 1003.

During long term operation of the air stripper the air will be sampled once per day during the first week of start up and then once per month for the remainder of the air stripper operation or at whatever frequency dictated by the air permit or authorization granted by NYDEC.

The samples of air, soil and water will be taken using the protocols included in the appendix A, B and C of the Sampling Plan.

Analytical Parameters

The Photovac 10S50 is most sensitive to the specific volatile compounds at this site down to detection limits of 2 ppb and thus will be used to screen the water and air samples. The procedures to be used for the Photovac analysis are those used by USEPA Region 1 laboratory and the USEPA National Response Team and are presented in Appendix F.

- **Water Sample Parameters**

A duplicate sample of one in ten of the Photovac samples will be taken to the Laboratory for Volatile Priority Pollutant analysis. The Laboratory will analyze the water samples by USEPA Method 624 or 524.2 (for lower detection limit) to detect the full spectrum of volatile priority pollutant compounds.

After the initial water sample rounds, once the potential contaminants are identified and documented to the satisfaction of the USEPA Project Coordinator, the duplicate water samples may be analyzed by Method 601 for the target volatile organic parameter tetrachloroethylene.

As the Sampling Plan includes volatile organic analysis, travel blanks will be analyzed for volatile organics. Field blanks will be analyzed each day for volatile organics.

Specific conductance and pH will be obtained in the field.

2.11 Air Sampling

The Photovac will screen all air samples obtained from the exhaust of the air stripper by the filling of tedlar bags. To accumulate the sample a Tedlar bag will be connected to an industrial hygiene air sampling pump filling the Tedlar Bag with exhaust gas. The bagged sample will then be analyzed by the portable gas chromatograph according to the protocol detailed in Appendix F.

Each day of operation of the Pump Test, confirmatory air samples will be collected by NIOSH Method 1003 on activated charcoal, according to the protocol detailed in Section Appendix C.

During the groundwater remedy one in ten air samples analyzed with the Photovac will be confirmed with NIOSH Method 1003 in the laboratory.

Additional air samples will be taken to support the Health and Safety Monitoring program.

2.12 Community Wells

> The Sampling Plan (SAMP) is to include a plan for identifying all wells that are not connected to the alternative water supply system during and subsequent to the 1983-'84 Removal Action which are or may be affected by releases of PCE at or from the Site and which contain or which may in the future contain PCE levels of at least 5 ppb.

General Switch will test the wells of those homes identified in the Consent Order. These homes include the Seeley, Wood and Gilbert residences on Highland Avenue, last tested in August 1989 and found to have less than 5 ppb Tetrachloroethylene content. The sampling protocol for drinking water well sampling of these homes is detailed in the Appendix C. Those wells that yield water that contains 5 ppb or more of tetrachloroethylene will be connected to private water supply by General Switch.

As part of the Pump Test Plan, a door to door survey will be completed of the houses and facilities on Highland Avenue, Watkins Avenue, Commonwealth Avenue and Industrial Place and the intersecting street of Electric Avenue: to identify those wells within 1/4 mile of General Switch not yet hooked up to city water. The survey will also update the well data obtained in 1983 and including the depth of well, pumping system, well use and previous sampling. The results will be portrayed in a table and presented to the USEPA.

The report entitled "Community Wells" will include a map depicting the location of such wells. All wells in the above named streets not connected to city water will be sampled once for volatile organics by USEPA Method 624.

Historically, we have in 1983-84 been able to identify a circle of clean wells outside the affected wells. One month after the sample results of the unconnected wells are made available to the USEPA, we will submit a plan to identify a circle of clean wells around any contaminated well that in the judgement of the USEPA may be considered to be at risk and that will be added to the community well sampling.

The sampling will be conducted according to the standard procedures in the Sampling Plan for well sampling and the Quality Control Plan.

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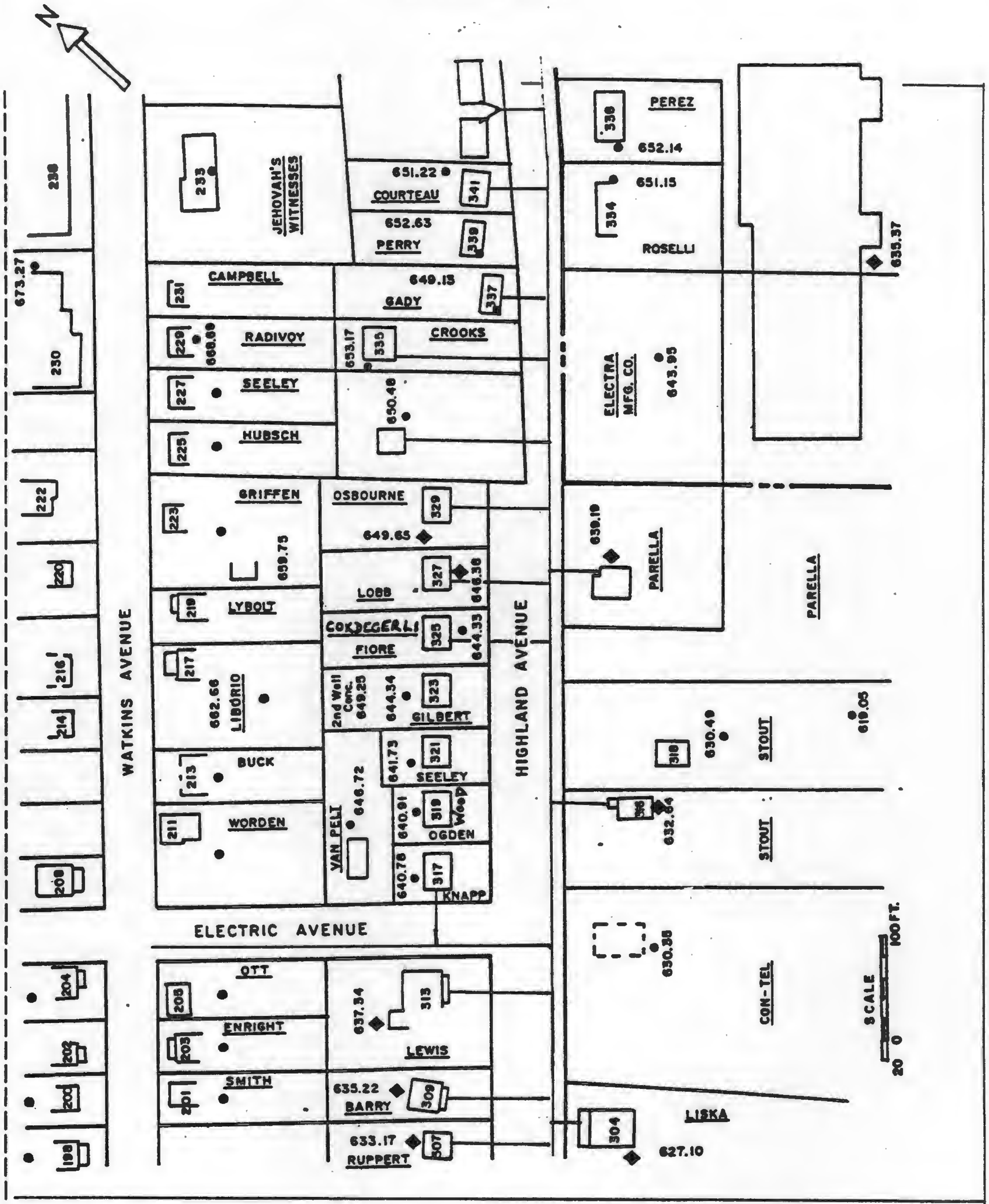

Figure 14. Location of Contaminated Wells & Water Supply Lines

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LEGEND

◆ WELLS CONTAINING GREATER THAN 50 PPB PCE

● UNCOMTAMINATED WELLS

2.13 Groundwater Level Measurements

Electro-piezometer

The Terra 8 to be installed in the Parella well and observation wells during the Pump test is a microcomputer data logger connected by cables to a number of pressure sensitive transducers that are submerged in the wells to be monitored. Changes in water levels in the wells are noted by the pressure transducers that are read by the data logger at programmable time intervals of every 1/10 of a second to once per 24 hours. The data logger stores the information that is then down-loaded to a portable IBM compatible PC (Figure 11).

- **Installation of the Data Logger**

- **Check out the data logger to see that it is operational.**
- **Set up the data logger system**

Prior to the Pump Test, the data logger system will be installed with leads into the pumping well and observation wells. The background barometric pressure gauge will be set up. The data loggers will be set up and run for 2 days before the pump on the Parella well is started to establish a good base line of water elevations. The data from the base line will be collected, graphed and reviewed before starting the Parella well pump.

The leads for the data logger are 1/4" thick microvolt electrical transmission wires that will be protected from abrasion and vandalism by suspending them overhead, 20 feet above ground from the trees along Highland Avenue. The pressure transducers are pressure sensitive in that they record changes in water level in the well, but the leads are not pressure sensitive to being walked upon or driven over and they are not affected by taking water level measurements by hand. It is prudent to use two methods to measure the water levels in the wells.

Water level elevations using the electro-piezometer system will be taken at semi-logarithmic time intervals from the pumping well and each of the observation wells periodically during the pump test, with closely timed readings at the beginning of the Pump Test, as follows:

Prior to the Pump Being Started in Hours		Time Interval Between Measurements in Minutes
minus 2880-T^0		60 min
Time Since Pumping Started (T^0) (or stopped) in Minute		
T^0	0-10 min	0.5-1 min
	10-15	1
	15-60	5
	60-300	30
	300-4320	60
4320	End of Test	

Hand Measurement

Hand measurement of the water levels in the pumping well and observation wells will be taken to confirm and calibrate the readings obtained with the electro-piezometer system and used to check that the water level is not being drawn so far down in the Parella well as to uncover the pump.

Prior to starting the pump test, two rounds of static water levels will be obtained by hand to measure groundwater levels and plot flow direction. Static water level measurements of monitoring wells will be separated by a minimum period of 1 day. Initially, care will be taken to measure water levels under non-pumping (static) conditions, where the water well is not influenced by local drawdown due to pumping at or near the well. After the pump is started, these hand readings will be taken on the same schedule as the electro-piezometer readings for the first four hours and at a minimum of twice per day during the rest of the pump test. During the groundwater remedy, the water levels in the Parella well will be taken during the groundwater sampling rounds

Relative to the surveyed elevation of the top of the inner casing (riser pipe) of each well, the depth to water will be measured using a chalked tape (see Figure 10) or hand-held electric water-level gauge. Individual water level measurements will be repeated to confirm water level elevations.

- **Groundwater Contour Map**

Water levels will be compared before and after the pumping of the Parella well. Water levels taken in the monitor wells and any water levels taken in neighboring wells and from local standing water will be compared to define the potentiometric head in the formations present on site and plotted to develop a groundwater contour map to obtain groundwater gradients to compute direction and rate of flow.

It is important to compare wells that are screened at the same depth and in the same formation for horizontal groundwater gradients and water quality. A groundwater contour map will be produced from water level measurements taken during each sampling round.

2.14 Groundwater Pumping During the Pump Test and Long-Term Pumping During the Groundwater Remedy:

o Pumping the Parella Well

Once the groundwater levels in all the wells have recovered from the short-term pump tests, during the Pump Test the Parella Well will be pumped to produce drawdown of the pumping well in a constant rate pump test at the maximum sustainable pumping rate. The response in drawdown of the water levels in the observation wells will be measured. Any unusual events such as stoppage of pumping, Changes of weather or the passage of heavy equipment will be noted. The test will be run when clear weather is forecast. The pump test of the Parella well will be divided into three parts. The falling head test, the constant head test where the pumping is continued until equilibrium is reached and the recovery stage of the water level in the wells after the pump is switched off. During the groundwater remedy, the Parella well will be pumped continuously at the optimum rate.

o Pump Test Duration

The pump test of the Parella well will extend for a minimum of 3 days (72 hours). This choice was made based upon the apparent response of the wells surrounding the Parella well such as the Osbourne and Lobb wells that responded within 1.5 hours of pumping the Parella well during the initial pump test of December 21, 1983 and similar responses of the Barry well during the short-term pump test of the Ruppert well indicating that such wells should serve as responsive monitor wells for the Parella well pump test.

Characteristics of the wells in the shale are presented in the Wallkill Well Data table. The use of these observation wells will be contingent upon initial testing and observation conducted in the well survey detailed in the next section.

Methods for Determining the Pump Rate of a Well

Bucket and Stop Watch

A 5 gallon bucket and stop watch will be used to determine the flow rate from the wells being tested. The time in minutes that it takes to fill a 5 gallon bucket from the well will be divided by 5 to obtain the rate of pumping in gallons per minute.

Flow Meter

A flow meter and totalizer will be installed on the Parella Well to indicate the discharge rate of the well and the total gallons pumped. The flow meter and totalizer will be observed frequently during the Pump Test. The readings of the flow meter will be recorded during each groundwater sample round taken during groundwater cleanup.

Pump Flow Rates

The discharge rate from the Parella well will be set initially at the rate determined by the short-term pump test, checked every hour during the first 12 hours of the test, after which the rate will be checked every 12 hours.

Method for Regulating the Pump Rate of a Well

o **Flow Restriction Valve**

A flow restriction valve will be installed on the end of the discharge hose from the pump to control the rate of discharge of the well pump. Repeated well measurements and valve adjustments will be employed to regulate the discharge from the well to control the pumping rate and hence the drawdown in the Parella well. In the second part of the pump test this method will be used to provide a constant head level in the well.

Automatic Control

A high and low water level control will be installed in the pumping well after the pump test to regulate the drawdown in the well.

Background Well Data

During the Pump Test, we will measure any change in water level in two background wells on Watkins Avenue to monitor background changes in barometric pressure so that any barometric influence on the water levels in the wells may be discounted. Watkins Avenue has been supplied with city water since before 1983 and the interference in water levels by pumping wells will be remote and insignificant. Two wells will be chosen from the wells at #202, #208 and #214 Commonwealth Avenue based upon data from the updated well survey and the ease of access to the wells. These wells are over 500 feet from the Parella well and are shallow abandoned wells that should be unaffected by pumping on Highland Avenue.

o **Data Reduction and Review**

The electro-piezometer data will be transferred into an IBM PC for display and print-out. Preliminary data from the hand measurements will be plotted during the pump test to indicate any anomalies or boundary conditions encountered and when equilibrium conditions are reached.

2.15 Surface Water and Sewer Samples

Grab samples of surface water and sewer water will be collected to identify contamination in the wetlands to the southwest of General Switch and in the sewer line along Industrial Place according to the standard operating procedures presented in the Appendix of the QA/QC Plan at the locations indicated on the attached Figure. Surface water and sewer samples will be analyzed for volatile organics by Method 624 and sediment by Method SW846.

2.16 Safety and Health Monitoring

Routine air monitoring will be completed using the protocol of EPA Region I for air monitoring using a Photovac portable GC to comply with the Health and Safety Plan. A sample will be taken with the photovac if an odor is noticed and in the morning and afternoon of site operations involving the pumping of potentially contaminated water and soil disturbance. This instrument is so sensitive to tetrachloroethylene in air, that no concentration method of a carbon absorption tube is necessary. A syringe of air is injected into the GC and run against known standards prepared in Tedlar bags as described in Appendix D. A Hnu meter will be used to scan the ambient air during site operations accordingt to the scope of work presented in the Appendix to the QA/QC Plan.

Figure 3. Water Table Elevations in the Glacial Till, Jan 1984

Shakti Consultants, Inc.

▲ **Surface water**

■ **sewer samples**

Table. PUMP TEST CHEMICAL SAMPLING PLAN SUMMARY TABLE - Sampling Parameters and Analytical Methods

Location/Matrix	Analytical Parameter	Sample Number	Method Reference	Sample Preservn	Holding Time	Unit Cost	Cost
Water							
Groundwater Samples - Short Term Pump tests							
DQ2	Photovac	4 per well x 10	Region I USEPA	Cool/4C	2 days	$500/day rental	$3000
	Priority Volatile Organics	1 in 10	Method 624	Cool/4C	7 days	$215	$860
Groundwater Before and After Pump Test							
DQ2,3,6	Photovac	1 per well x 10	Region I USEPA	Cool/4C	2 days	$500/day rental	$3000
	Priority Volatile Organics	1 per well	Method 524.2	Cool/4C	7 days	$215	$12,000
Influent samples from							
Parella well	Photovac	2/day for 4 days	Region I USEPA	Cool/4C	2 days	$500/day rental	$2000
DQ7	Priority Volatile Organics	1/day for 3 days	Method 624	Cool/4C	7 days	$215	$645
Internal QA/QC for treatment plant:							
	Photovac	2/day	Region I USEPA	Cool/4C	2 days	included in rental	
Effluent samples	Photovac	2/day	Region I USEPA	Cool/4C	2 days	included in rental	
	Priority Volatile Organics	1/day for 3 days	Method 524.2	Cool/4C	7 days	$215	$645
Field Blank	Priority Volatile Organics	1/day for 3 days	Method 624	Cool/4C	7 days	$215	$645
Quality Control (QC). spiked sample/duplicate sample	Priority Volatile Organics	3 per batch	Method 624	Cool/4C	7 days	N/C	
Air							
Air samples of exhaust	Photovac	2/day	Region I USEPA	Cool/4C	2 days		
DQ15	Priority Volatile Organics	1/day	NIOSH Method 1003	Cool/4C	7 days	$230	$690
Electro-piezometer	Water levels	20/day	Terra 8 SOP	N/A	N/A	$1500/day	$10000
						Total	$33,485

Footnote

Analytical Methods o EPA Methods 624 Methods for Chemical Analysis of Water and Wastewater (EPA-600/4-79-020)

Table. SAMPLING and ANALYSIS PLAN SUMMARY TABLE

LOCATION	TYPE	SAMPLE DEPTH	ANALYTICAL PARAMETERS	SAMPLE NUMBER	MATRIX	METHOD REFERENCE	SAMPLE PRESERVN	HOLDING TIME
Excavated Soil samples S1, S2, S3, S4 and S5 at five feet increments from each soil excavation hot spot four sides of floor and center-line		4 - 6 feet	Volatile screening Photovac 10S50	50	soil	USEPA Region I Lab (Level 2)	Immediate Analysis Water bath @ 30C	
			1 in 10 Priority Pollutant Volatile Organics	18	soil	SW 846 (Level 4)	Cool/4C	14 days
To determine vertical and horizontal distribution of volatile organics: Soil from each soil excavation at four feet and six feet horizons will be screened for volatile organics with the Photovac 10S50. Of these samples one in ten will be submitted to the Lab for confirmatory Priority Pollutant Volatile organic analysis.								
Treated Soil T1, T2, T3 T4, T5	Soil samples from the treated soil prior to return to the excavation	-	Volatile screening Photovac 10S50	50	"	"	"	
			1 in 10 Priority Pollutant Volatile organic	5	"	"	"	
To determine the final soil concentration after treatment: Soil will be screened for volatile organics with the Photovac 10S50. Of these samples one in ten will be submitted to the Lab for confirmatory Priority Pollutant Volatile organic analysis.								
Water: Parella Well		Pumping Well well	Volatile screening, Photovac	72	water	USEPA Region I Lab	"	
			Priority Pollutant Volatile Organics	12	water	Method 624/524.2 (Level 4 and 5)	"	7 days
Compare Parella well water sample results to indicate water quality of the Aquifer, trends in the groundwater cleanup. Samples analyzed for Priority Pollutant volatiles.								
Water Sample Round: Private Wells & Monitor Wells including five wells used for residential supply			Volatile screening, Photovac	34/qtr	soil	USEPA Region I Lab	Water bath @ 30C Immediate analysis	
			Priority Pollutant Volatile Organics	34/qtr		Method 524.2	Cool/4C	7 days
Compare well water sample results to indicate acceptable water quality in the wells, water quality of the Aquifer, trends in the groundwater cleanup. Samples analyzed for Priority Pollutant volatiles.								
Effluent Water	Water samples	Treatment system	Volatile screening, Photovac	70	"	"	"	
			Priority Pollutant Volatile Organics	7	"	"	"	
Determine effectiveness of treatment system. Confirm that effluent is less than 5 ppb Tetrachloroethylene for discharge to ground. Samples analyzed for Priority Pollutant volatiles.								

Table. SAMPLING PLAN SUMMARY TABLE (Continued)

LOCATION	TYPE	SAMPLE DEPTH	ANALYTICAL PARAMETERS	SAMPLE NUMBER	MATRIX	METHOD REFERENCE	SAMPLE PRESERVN	HOLDING TIME
Sewer/Surface Water along Industrial Place			Volatile Screening	30	water	USEPA Region 1 Lab	Immediate Analysis	
			Priority Pollutant Volatile Organics	7	"	Method 624	Cool/4C	14 days
Quality Control Treatment system	Water samples		Volatile organic screening Photovac	70		USEPA Region I Lab 1 in 10 QC in Lab	Immediate analysis	

Tune the operation of the stripper: internal QC using the Photovac.

LOCATION	TYPE	SAMPLE DEPTH	ANALYTICAL PARAMETERS	SAMPLE NUMBER	MATRIX	METHOD REFERENCE	SAMPLE PRESERVN	HOLDING TIME
Air Stripper stack	Air		Volatile organic screening Photovac	20		USEPA Region I Lab	Immediate analysis	
			Priority Pollutant Volatile Organics	2		NIOSH Method 1003	Iced 4C	

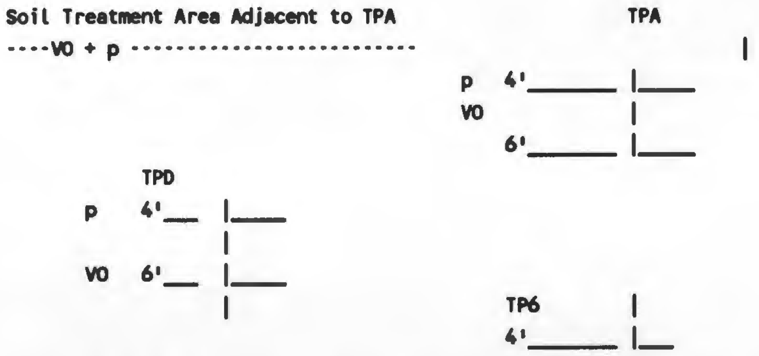
Determine the concentration of solvents in the exhaust stack. Samples analyzed for Priority Pollutant volatiles.

LOCATION	TYPE	SAMPLE DEPTH	ANALYTICAL PARAMETERS	SAMPLE NUMBER	MATRIX	METHOD REFERENCE	SAMPLE PRESERVN	HOLDING TIME
Health and Safety	Air: once per day at sites of soil disturbance and water pumping		Volatile organic screening Photovac	20		USEPA Region I Lab	Immediate analysis	
			Priority Pollutant Volatile Organics	2		NIOSH Method 1003	Iced 4C	

Determine the concentration of solvents in the ambient air. 1 in 10 samples analyzed by NIOSH Method 1003.

Additional details of the analytical methods are presented in the QA/QC plan.

SAMPLE DIAGRAM



p = Photovac soil screening and VO lab analysis repeated for each excavation

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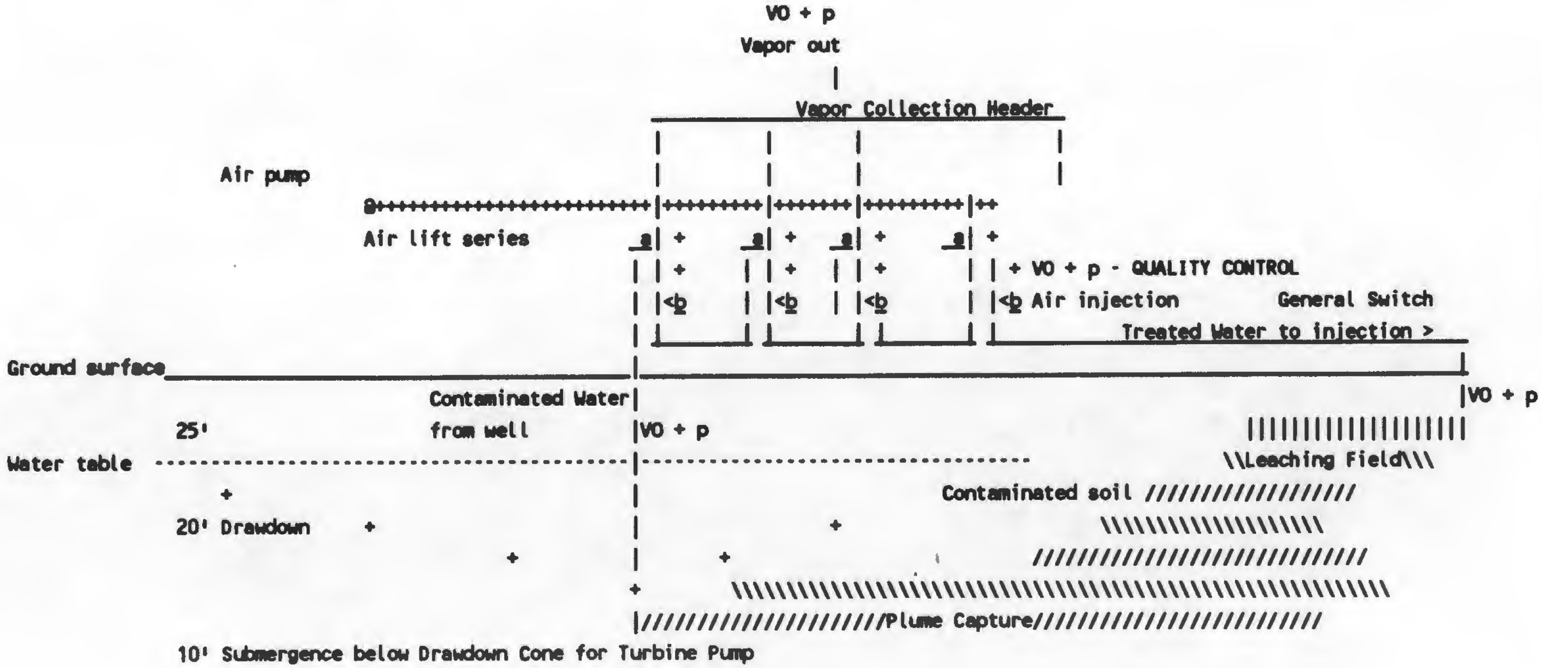
WATER SAMPLE DIAGRAM/AIR SAMPLE DIAGRAM



General Switch agreed to analyze all soil and water samples using a Photovac Portable 10S50 Gas Chromatograph and, in addition, to analyze in an independent, mutually acceptable laboratory, one of every ten water samples for all priority pollutant volatile organics by USEPA Method 624/524.2 and to analyze one in ten soil samples for all priority pollutants volatile organics (Method 846). In addition, air monitoring will be conducted using the Photovac with selected samples being analyzed in the contract laboratory by NIOSH Method 1003.

Once the type and relative concentrations of contaminants are established through repeated full priority pollutant volatile analysis, tetrachloroethylene will be selected as a worst-case indicator compound and a less expensive analysis, Method 601, will be used as the laboratory method to indicate the progress of the cleanup, with occasional Method 624/524.2 analyses. Concern that the volatile contaminants other than tetrachloroethylene may pose a potential hazard will be addressed by analyzing one in ten of the subsequent laboratory samples by Method 624.

3.0 SAMPLE EQUIPMENT AND PROCEDURES

Sampling Activity Preparation

General Switch shall give USEPA 14 days advance notice of field activity. Regardless of the immediate objective in collecting a sample, each sample will be collected, documented, transported and analyzed in such a manner that the results will be accurate.

Specific procedures and methods for the investigation and sampling of hazardous materials, as well as Department of Transportation regulations for the shipment of hazardous samples, may be found in the National Enforcement Investigations Center (NEIC) Manual, Enforcement Considerations for Evaluations of Uncontrolled Hazardous Waste Disposal Sites by Contractors and from other EPA and NJDEP Field Sampling Procedures Manual, February 1986. These procedures and regulations will be followed in all sampling investigations.

Sample Collection and Preservation

Sample collection will be accomplished for this site according to the Standard Operating Procedures of Shakti Consultants for

- Soil Sampling
- Potable and Monitoring Well Sampling
- Air Sampling
- Photovac Screening

presented in the Appendix

The method of collection and preservation of the samples will be determined using the analysis requirements and sample classifications established in the EPA manual "Methods for Chemical Analysis of Water and Wastes". Unless the receiving laboratory requires otherwise, environmental samples will be collected and preserved using the Protocol for Sampling and Preservation of Samples for this reference manual. Variance from standard practice will be noted.

Sample Containers

All sampling containers will be supplied by the Laboratory.

Soil
Each volatile organic soil sample will be collected in two 40ml glass vials fitted with teflon septa.

Water
Aqueous samples and field blanks for volatile organics will be collected in two 40 ml glass vials with teflon septa.

Air Samples
Air samples for Photovac analysis will be collected in Tedlar bags according to the protocol presented in the Appendix. Samples of air to be analyzed in the laboratory for volatile organics will be collected upon activated carbon absorption tubes or on an equivalent sorbent media.

Sample-Equipment Cleaning Procedures

All sampling equipment is constructed of inert materials (Teflon or stainless steel) and decontaminated prior to use in the field.

3.1 Soil: Sampling Equipment and Procedures

Backhoe Preparation and Cleanup

A trackhoe will dig the soil excavations. Prior to mobilization, the vehicle and ancillary equipment will be cleaned to remove all remains of prior operations. This cleaning will include brushing, detergent washing and steam cleaning. The tools and components directly contacting the excavation will be cleaned between excavations, using a detergent wash/scrub and air drying.

Soil grab samples will be obtained with the bottles themselves or spooned up with stainless steel spatulas or Teflon-coated trowels that will be cleaned in the following manner:- Thorough washing with non-phosphate detergent and tap water, utilizing a scrub brush and a tap water rinse, followed by a distilled/deionized water rinse administered with a pressure-type sprayer, followed by an acetone rinse of reagent grade for organic decontamination (or 10% acidic solution for metals), air drying and distilled water rinse.

The 40 ml vials used for volatile organic samples will be filled to capacity, tamped with a stainless steel tamper to minimize void space and placed in an iced insulated chest for shipment to the contract Laboratory. Composite soil samples will not be used. Soil samples will be collected over a six-inch deep increment.

3.2 Water: Sampling Equipment and Procedures

Each well water sample will be obtained directly from the nearest tap to the pump or a teflon bailer lowered into those wells without integral pumping systems. The bailers will be cleaned according to the manner described above. The cleaned equipment will be wrapped in aluminum foil or plastic: to prevent accidental contamination.

For each day of sampling, a field blank will be prepared by running distilled/deionized water through the sampling equipment before use. This sample will be analyzed to ensure clean equipment has been used.

Sampling will be started in areas with a low potential for contamination and continuing up to those areas with the highest potential for contamination.

Any sheens or odors will be noted. Following collection, all sample containers will be fully secured with teflon tape. The outside of sample containers will be thoroughly cleaned.

Testing for parameters of conductivity and temperature will be conducted in the field. Sample preservation of environmental samples will be performed immediately upon sample collection.

A sample for the dissolved component will be taken immediately upon evacuation of 3 to 5 well volumes. Dissolved component samples will be analyzed for volatile organics.

Clean equipment will be used and deionized water will be run through the equipment to obtain a field blank sample. The well will be sounded for total depth and water level. The fluid volume in the casing ("casing volume") will be calculated. The depth to the mid-point of the screen or the well section that is open to the aquifer from the top of the casing will be determined.

Well Development and Purging

Three methods may be used for well development and evacuation of the required well volumes: A centrifugal pump with a length of polyethylene drop hose dedicated to the well may be employed, or either an electric submersible pump or a bladder pump will be lowered into the well. The method used will be documented in the sample data sheet and in the sample report. All purging will be completed in a manner so as to minimize the loss of volatile organics.

Low-yield wells will only require purging of one water column volume prior to sampling. The water level in the well will be monitored during the purging operation to prevent the well being pumped dry.

Sampling

After lowering the purging equipment or intake into the well to a specific distance below the water level, water removal will begin. The purging device may be lowered during pumping as required to maintain submergence.

During pumping, the water level will be measured with an electric sounder or steel tape to obtain water level drawdown data as often as possible (30-second intervals). During bailing, water levels will be measured. The rate of pump discharge will be frequently measured with a bucket and stopwatch.

Deionized water will be run through the sampling equipment to obtain the field blank.

For water samples of dissolved components, a submersible pump or bladder pump will be used to evacuate the well and a bottom-loading bailer, a Kemmera sampler or a syringe sampler will be used to obtain the sample. For sampling of a floating layer, the well will not be purged and a top-loading bailer will be lowered into the well to fill from the water surface. A dedicated bailer constructed of inert Teflon will be used to collect the samples for organics. The sample taken from within the water column will be taken within 2-3 hours of the purging operation. The sampler will be fully submerged before it is withdrawn.

When a bladder sampling pump is used to collect the sample, the pump intake of the sampling pump will be lowered to mid-screen or mid-open section depth and the sample collected. Using a Kemmera sampler or syringe, the device will be lowered to the sampling level before filling. Field measurements will be entered on the field data sheets.

The sample will immediately be placed in an insulated ice chest for shipment to the contract Laboratory. The bottles destined for volatile organic analysis in the laboratory will be filled to the brim without leaving a headspace, tapped to dislodge any air bubbles and capped securely. Vials destined for volatile analysis with the Photovac will be filled 2/3 full leaving a headspace that is in equilibrium with the water.

After sampling, water level recovery will be monitored. Well discharge and drawdown data may be used to compute aquifer hydraulic conductivity and other hydraulic characteristics.

Drinking Water Wells

Raw water samples collected from a supply well will be taken as close to the well head as possible, before any treatment and, if possible, before any holding tank. The well will be pumped long enough to purge the required well volumes and ensure that the water sampled has passed within a few seconds from the well through the supply piping. A representative sample of drawn water will be obtained with a minimal residence time in the collection/distribution system. The length of time for this purging will be noted on the sampling data sheet and standardized for subsequent samples.

3.3. **Groundwater Level Measurements**

Purpose: Water level elevation will be taken from each of the completed monitoring wells on two occasions.

Procedure: Relative to the surveyed elevation of the top of the inner casing (riser pipe) of each well, the depth to water will be measured using a chalked tape. Water level measurements will be repeated to confirm water level elevations. Care will be taken to measure water levels under non-pumping (static) conditions, where the water well is not influenced by local drawdown due to pumping at or near the well.

A minimum of two rounds of static water level measures will be obtained to plot and verify ground water flow direction. Sampling episodes and static water level measures of monitoring wells will be separated by a minimum period of thirty days.

Groundwater Contour Map

Water levels taken in the monitor wells and any water levels taken in neighboring wells and from local standing water will be compared to define the potentiometric head in the formations present on site and plotted to develop a groundwater contour map to obtain groundwater gradients to compute direction and rate of flow.

3.4 Air Sampling

Sampling for Laboratory Analysis - Collection Media with Air Sampling Pumps

Sampling for organics in air will be performed by drawing air through a glass tube packed with activated charcoal. Collection media are used in conjunction with air sampling pumps to collect and concentrate air samples for subsequent laboratory analysis. The traps and adsorbent will be thoroughly cleaned before use to minimize the trap background. Clean traps ready for field use will be carefully packed in clean glass tubes to avoid contamination during handling.

There is the possibility of loss of organic material due to temperature changes, absorption on container walls, desorption, etc. Since laboratory analysis is required, the method does not provide a real-time readout of pollutant levels. The following strategies will be used for determining the level of safety and for characterizing the ambient air: Both a mine sweeping technique with the portable instrument and ambient air characterization with absorption tubes will be used to characterize the site.

Photovac Air Monitoring

The Photovac gas chromatograph will be used to characterize and identify specific chemical compounds present in the air. The protocol is detailed in Appendix A and C.

Ref: USEPA - ERT (Environmental Response Team) Standard Operating Guide for determining level of protection based on direct reading instruments

4.0. SAMPLING COSTS AND SCHEDULE

	Schedule Months 1 3 6 9 12 15 18 21 24 27 30 33 36	Sampling & Analysis Cost
Treatment System		
1 sample round Influent/effluent	35xxx Photovac	$3,500
first week	4 QC Method 624	800
1 sample round per week	8 xx Photovac	800
for the next 2 months	2 QC Method 624	400
2 sample rounds/month	8 xx Photovac	800
for the next 4 months	2 QC Method 624	400
1 sample round/month	12xxxxxxxx Photovac	1,200
for the next 12 months	2 QC Method 624	400
1 sample rounds/2 month	xxxxxxx9xxx	1,100
for the next 18 months	2 QC	400
Drinking Water Well Samples		
34 per sample round Method 624 samples will be required of monitor and water supply	10 Mthd 624 10 10	$26,000
wells each year	2 QC Mthd 624 2 QC 2 QC	1,200
Soil Samples		
During Soil Treatment Drains/Soil Treatment	60 xx Photovac	$6,000
(5 per excavation)	18 QC SW 846	4,200
Air samples		
	2 xx Niosh 2 xx 2 xx	$1,000
	1 QC Niosh 1 QC 1 QC	600
Final Well Sampling -Parella Well		
6 months after cleanup complete	624 1 xx	200
Note: QC Samples are run for the full suite of Volatile Organic Priority Pollutants	Subtotal	$49,000

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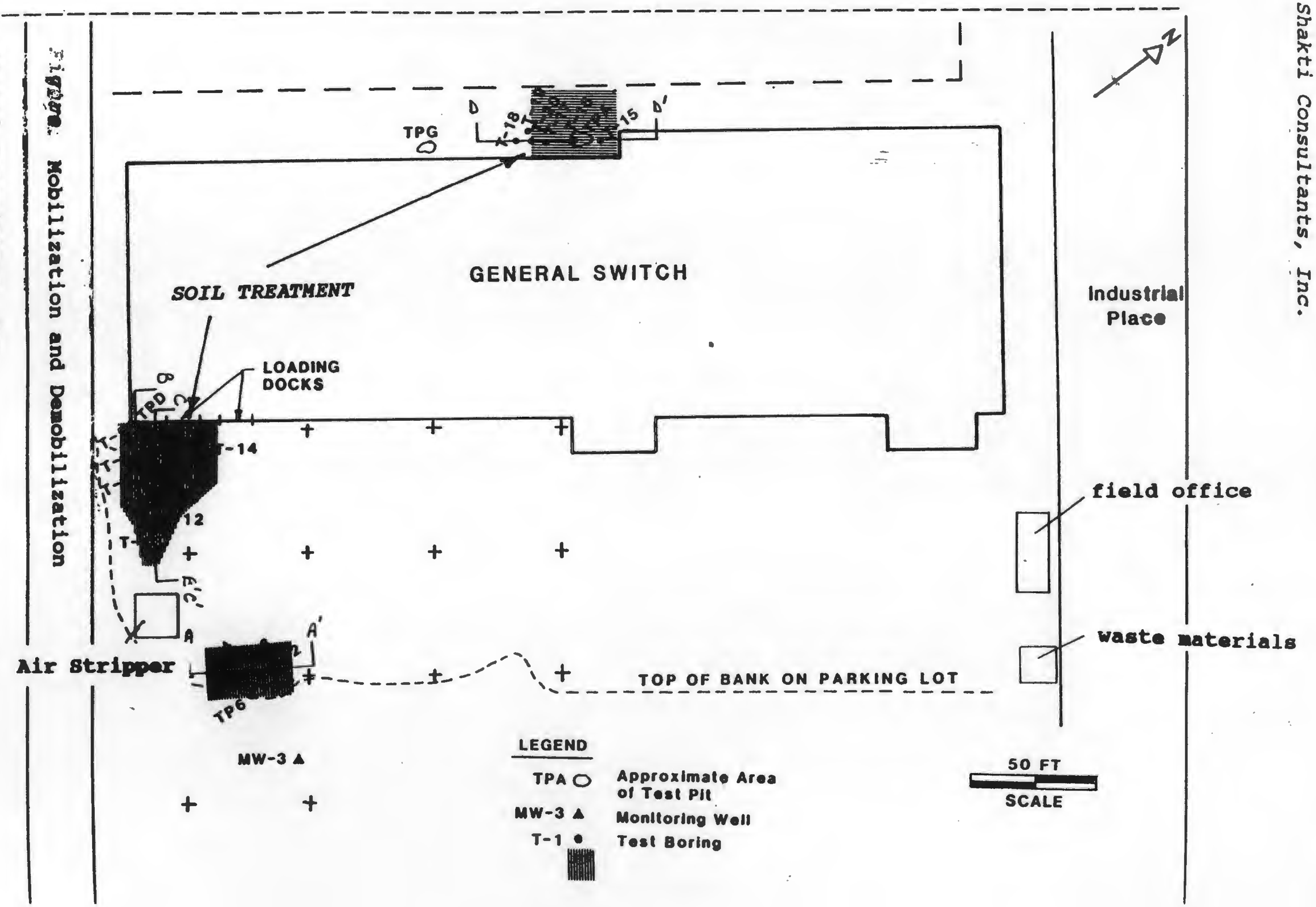
Figure . Mobilization and Demobilization



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References

1. Hydrogeologic Investigation of the General Switch Site, Fred C. Hart Associates, Inc, November 1984.

2. Soils Investigation to Determine the Extent of PCE Contamination at the General Switch Site, Fred C. Hart Associates, Inc, April 10, 1984.

3. Orange County Soil Survey

4. Frimpter, M.H. Groundwater Resources of Orange and Ulster Counties, NY, U.S. Geological Survey Paper - 1985.4.

5. Wallkill New York, Table: Summary of Water Level Measurements, November 1983 to February 1984. These water levels were taken by John Bee, a certified professional geologist, at that time employed as a geologist with the Technical Assistance Team, assisting the USEPA Emergency Response Branch Region II. The water levels were taken to obtain a fuller understanding of the water levels in the vicinity of General Switch.

6. New Jersey Geological Survey, Groundwater Report Series #1, Two Part Pump Test for Evaluating the Water Supply Capabilities of Domestic Wells.

7. Pumping Test Analysis for Low Yield Formations, Johnson Drillers Journal, Nov-Dec 1980.

8. Groundwater and Wells, Chapter 16 Collection and Analysis of Pumping Test Data, Johnson 1984.

FIGURES

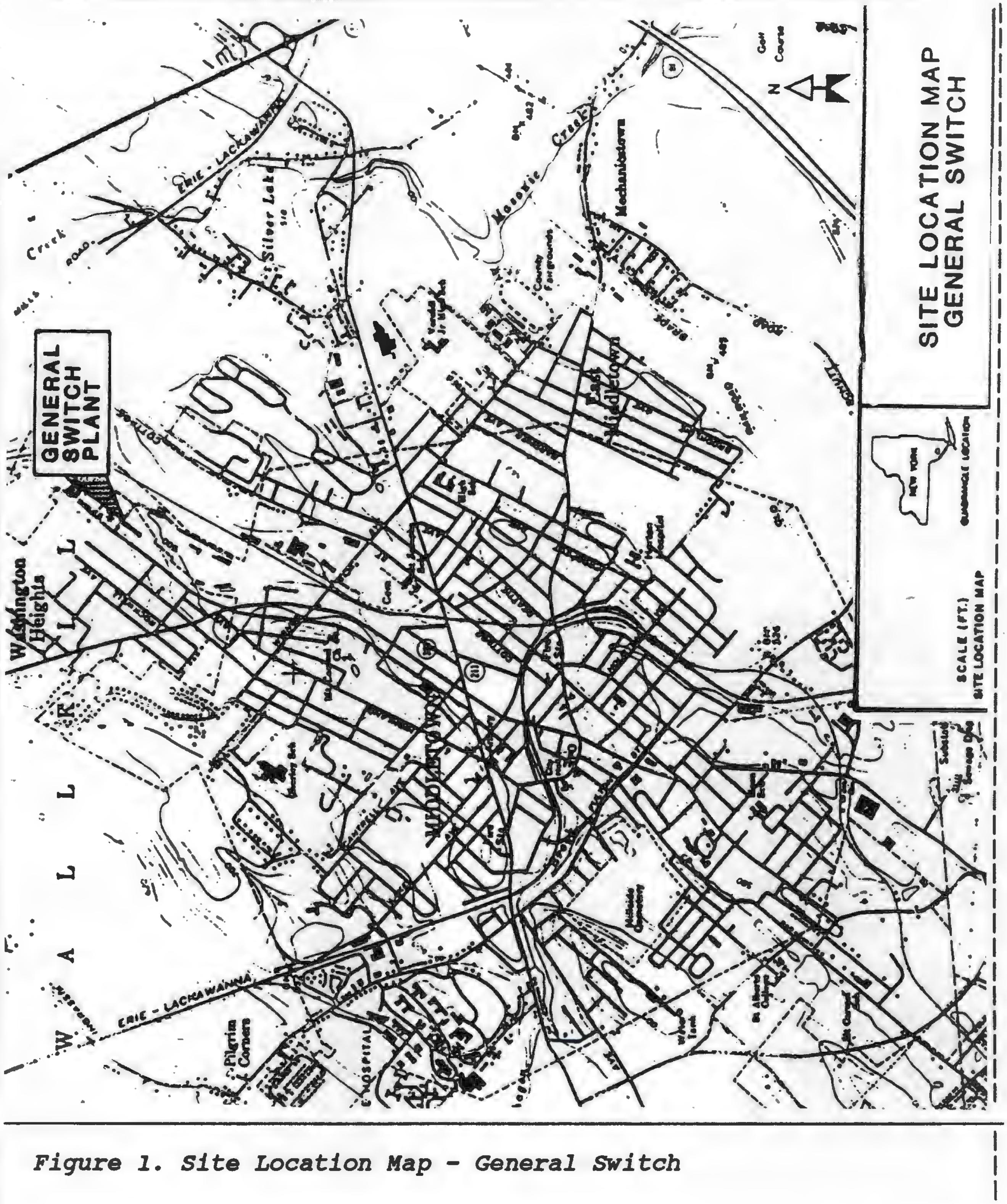

Figure 1. Site Location Map - General Switch

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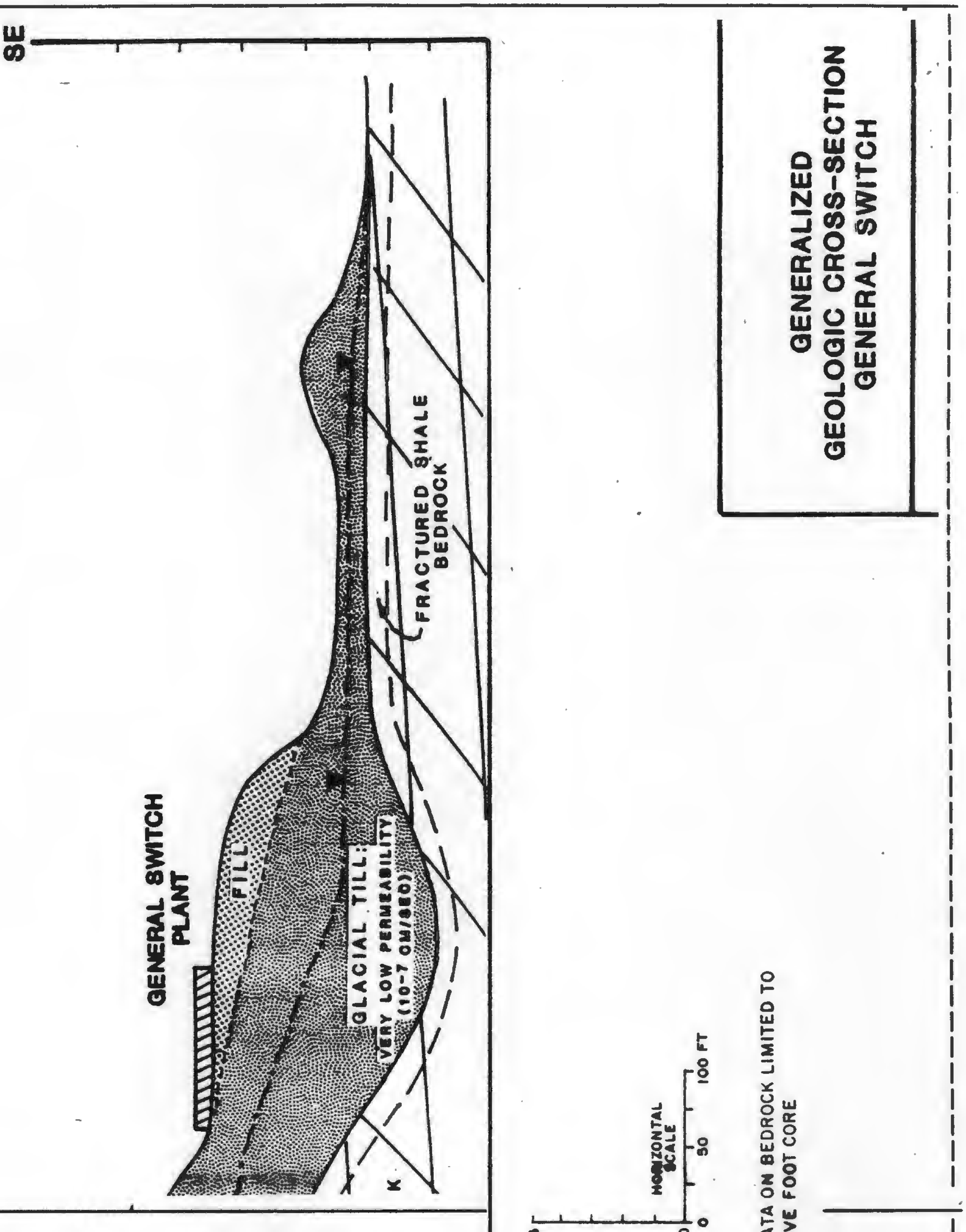
Modified from Hydrogeologic Investigation of General Switch Site,
Fred C. Hart Associates, Nov. 1984.



NOTE: DATA ON BEDROCK LIMITED TO FIVE FOOT CORE

Figure 2. Generalized Cross Section

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

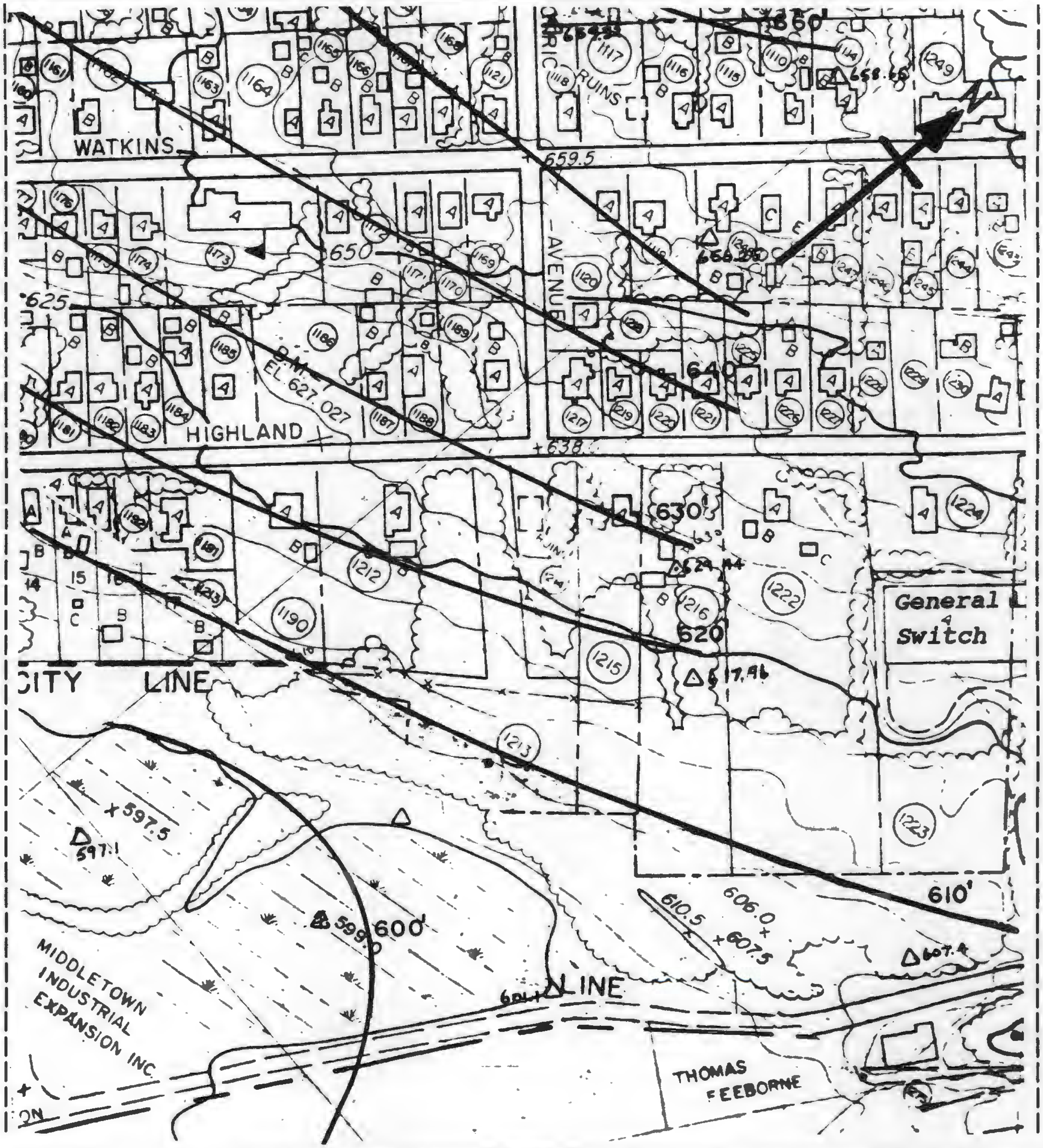


Figure 3. Water Table Elevations in the Glacial Till, Jan 1984

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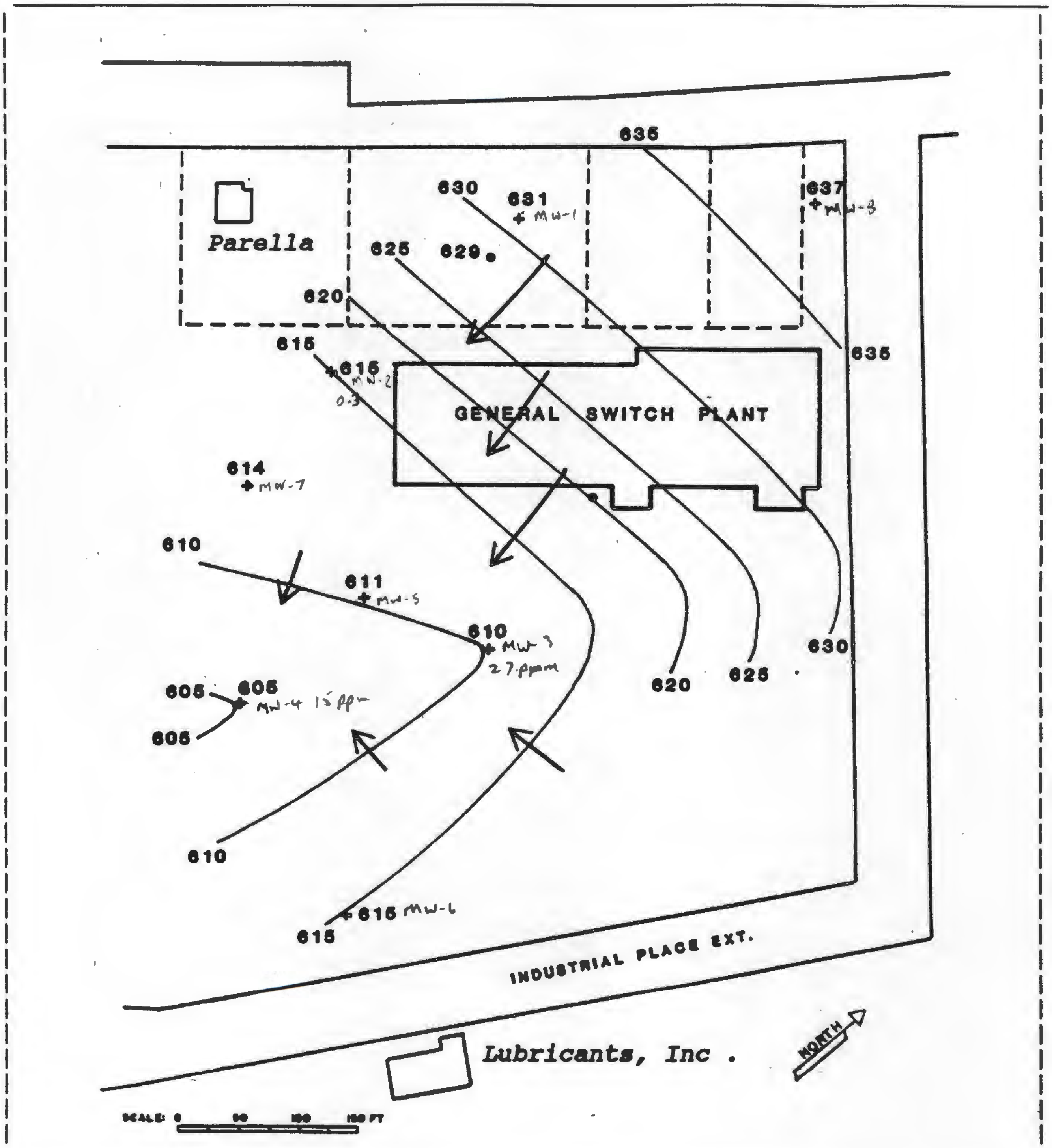

Figure 4. Contour Map of Water Levels - General Switch

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LEGEND

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

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

⟶ POTENTIAL FLOW DIRECTION

CONTOUR INTERVAL = 5'

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

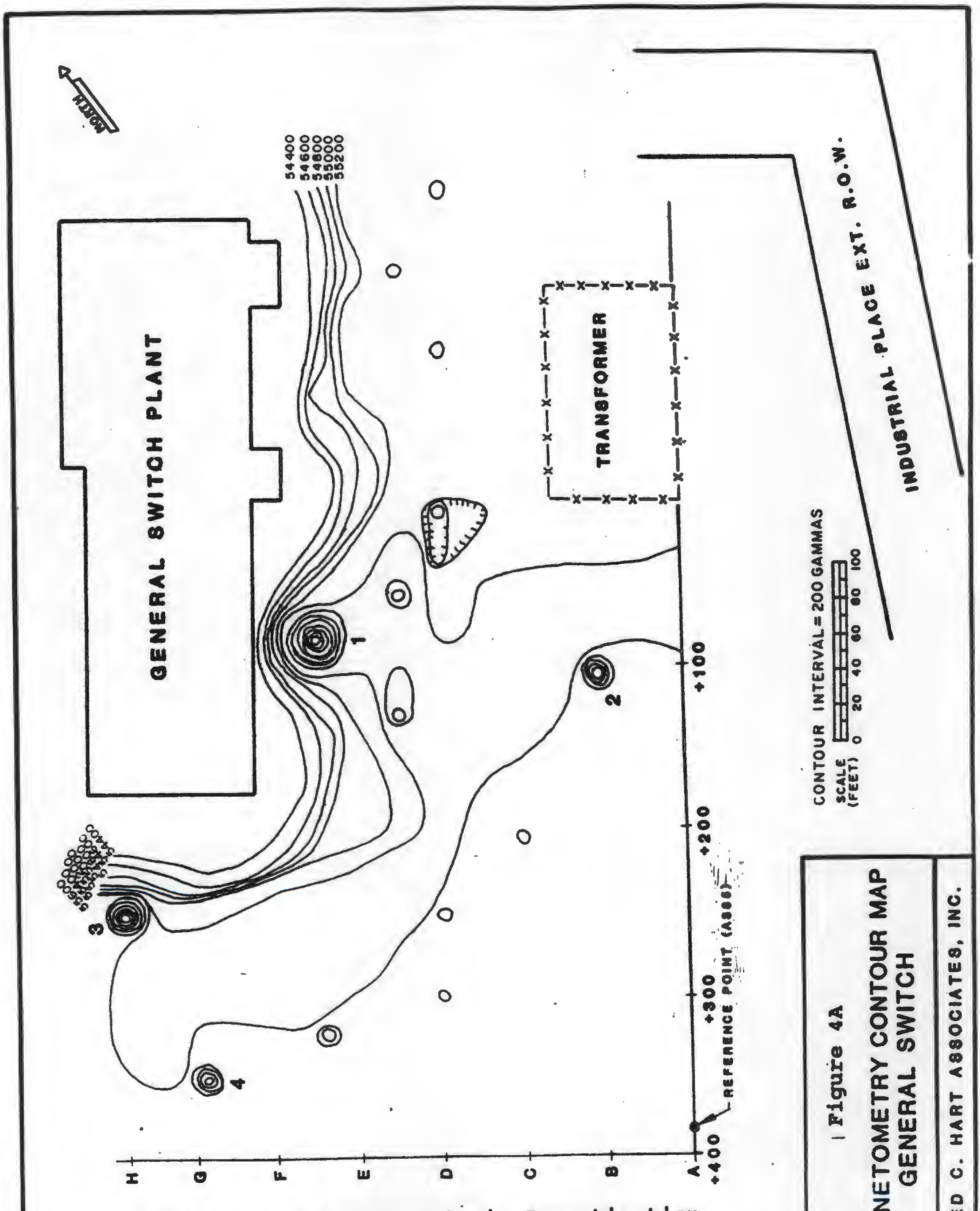

Figure 4A

MAGNETOMETRY CONTOUR MAP
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

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

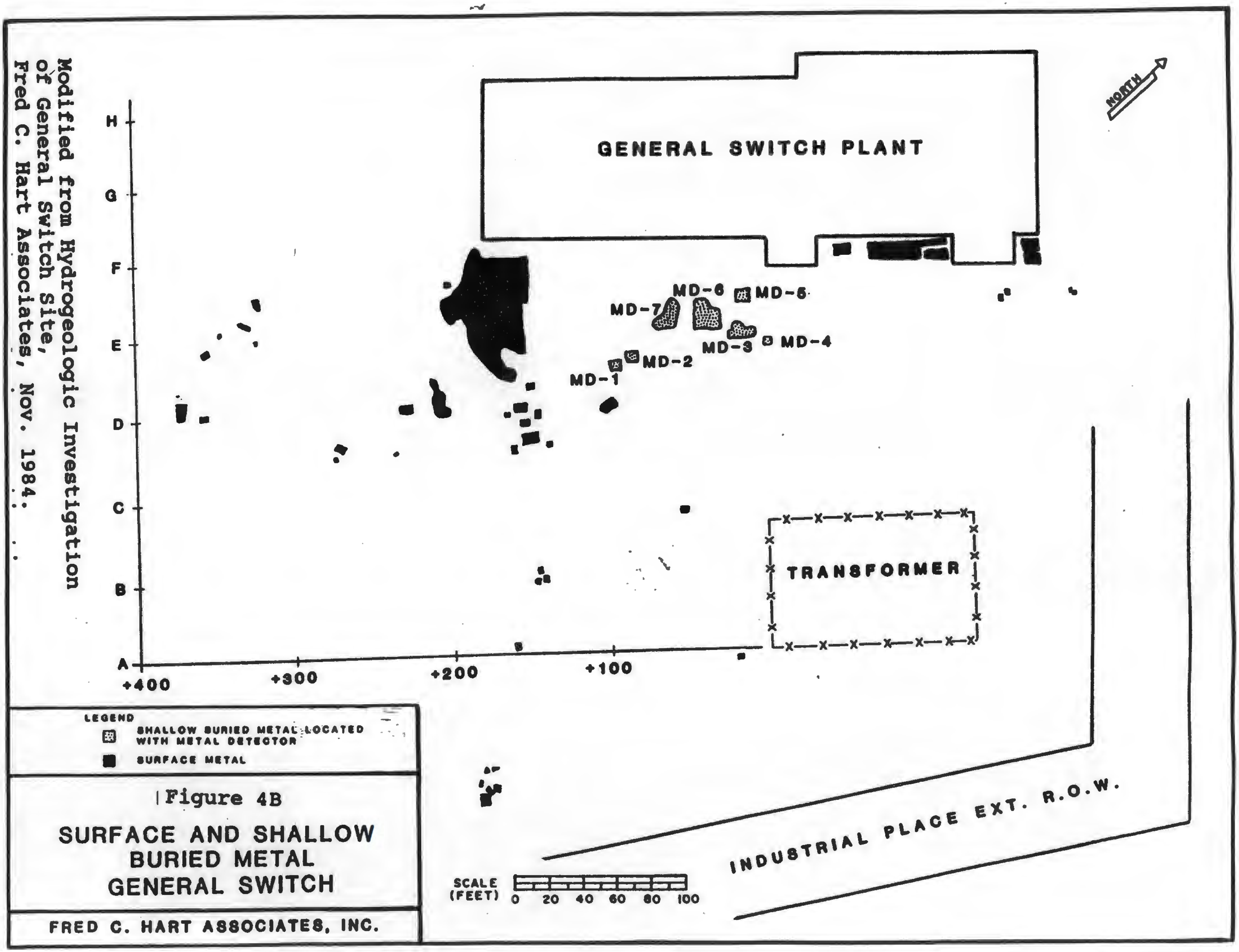

Figure 4B

SURFACE AND SHALLOW BURIED METAL GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

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

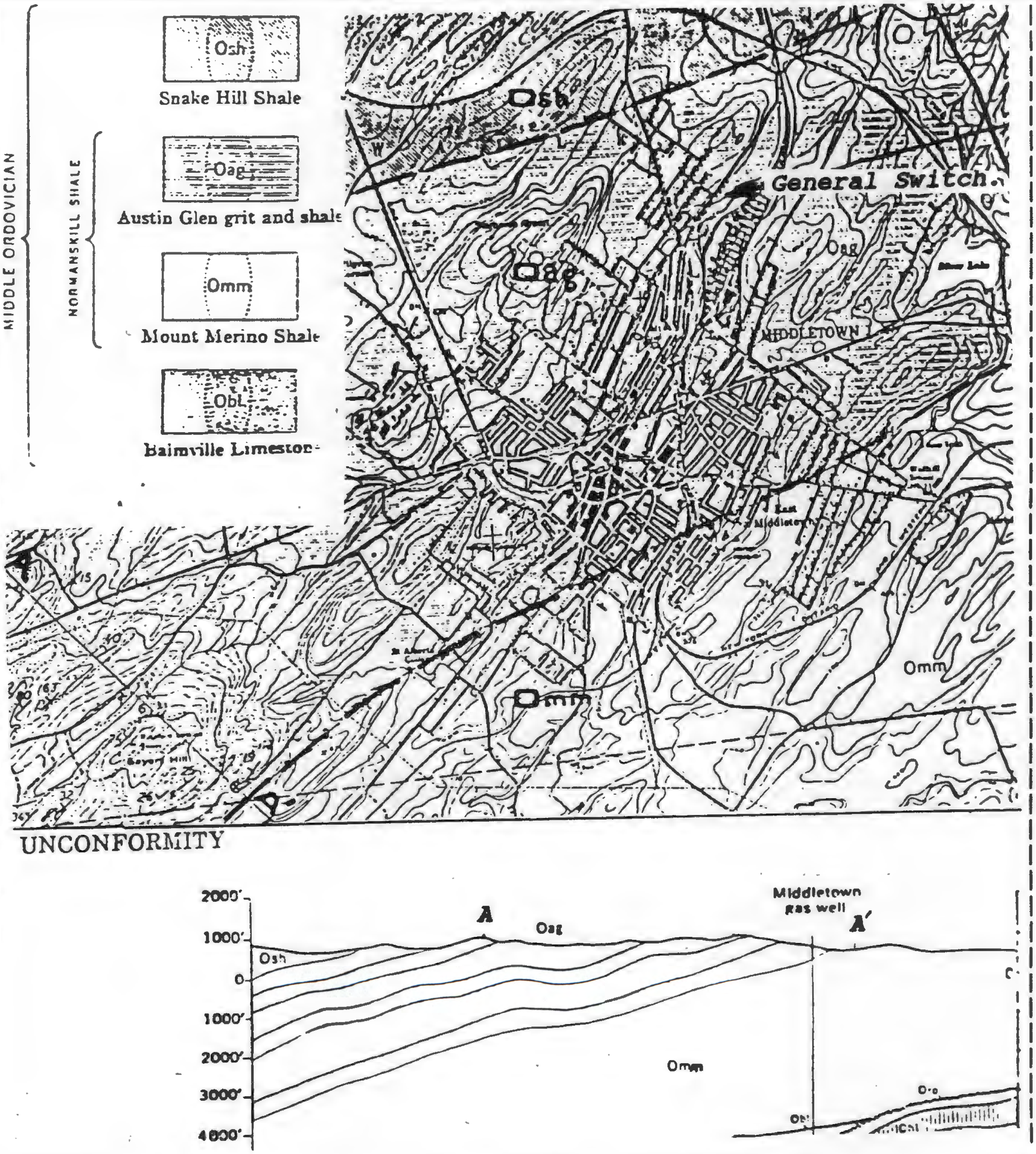

Figure 5. Geologic Map and Cross Section

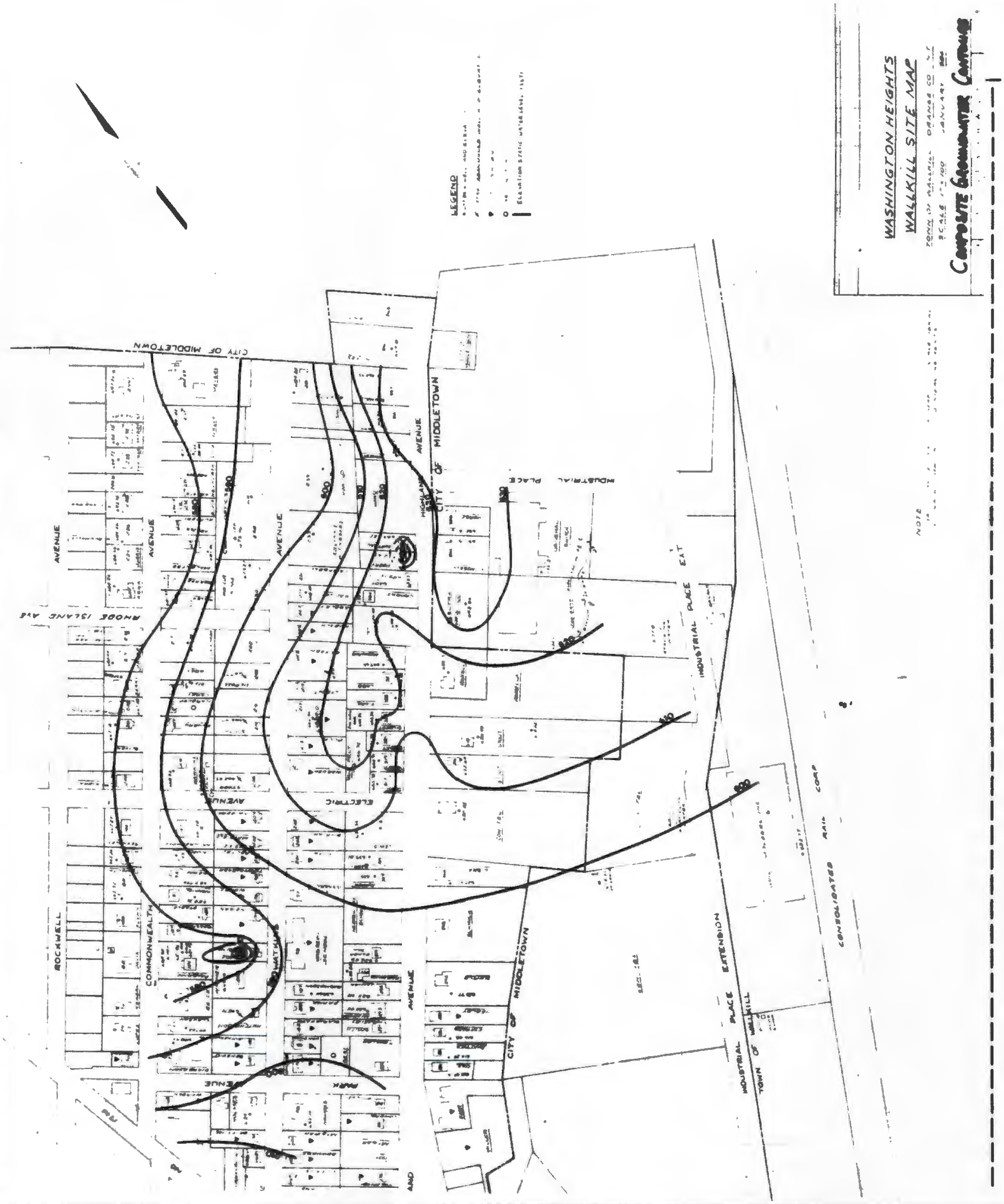

Figure 6. Composite Groundwater Contours - Washington Heights

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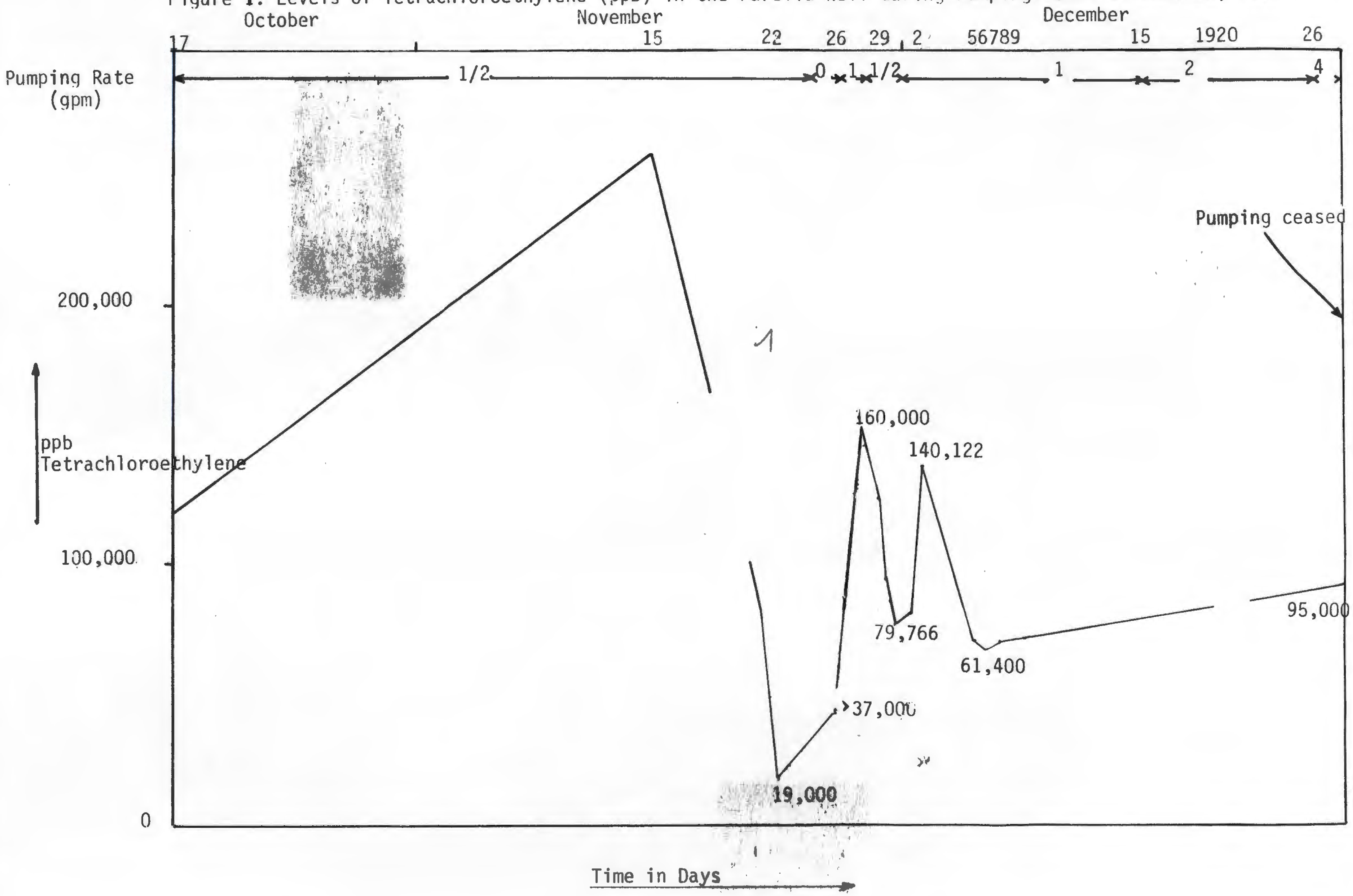
Figure 1. Levels of Tetrachloroethylene (ppb) in the Parella Well during Pumping. Oct. 17-Dec. 26, 1983



SEMI- RITH CYCL 70 NS
KEUFFEL & ESSER CO. MADE IN U.S.A.

NO. 340-L510 DIETZGEN GRAPH PAPER
SEMI-LOGARITHMIC
5 CYCLES X 10 DIVISIONS PER INCH

DIETZGEN CORPORATION
MADE IN U.S.A.

Figure 2. Plot of Data from Pump Test 1. Parella Well

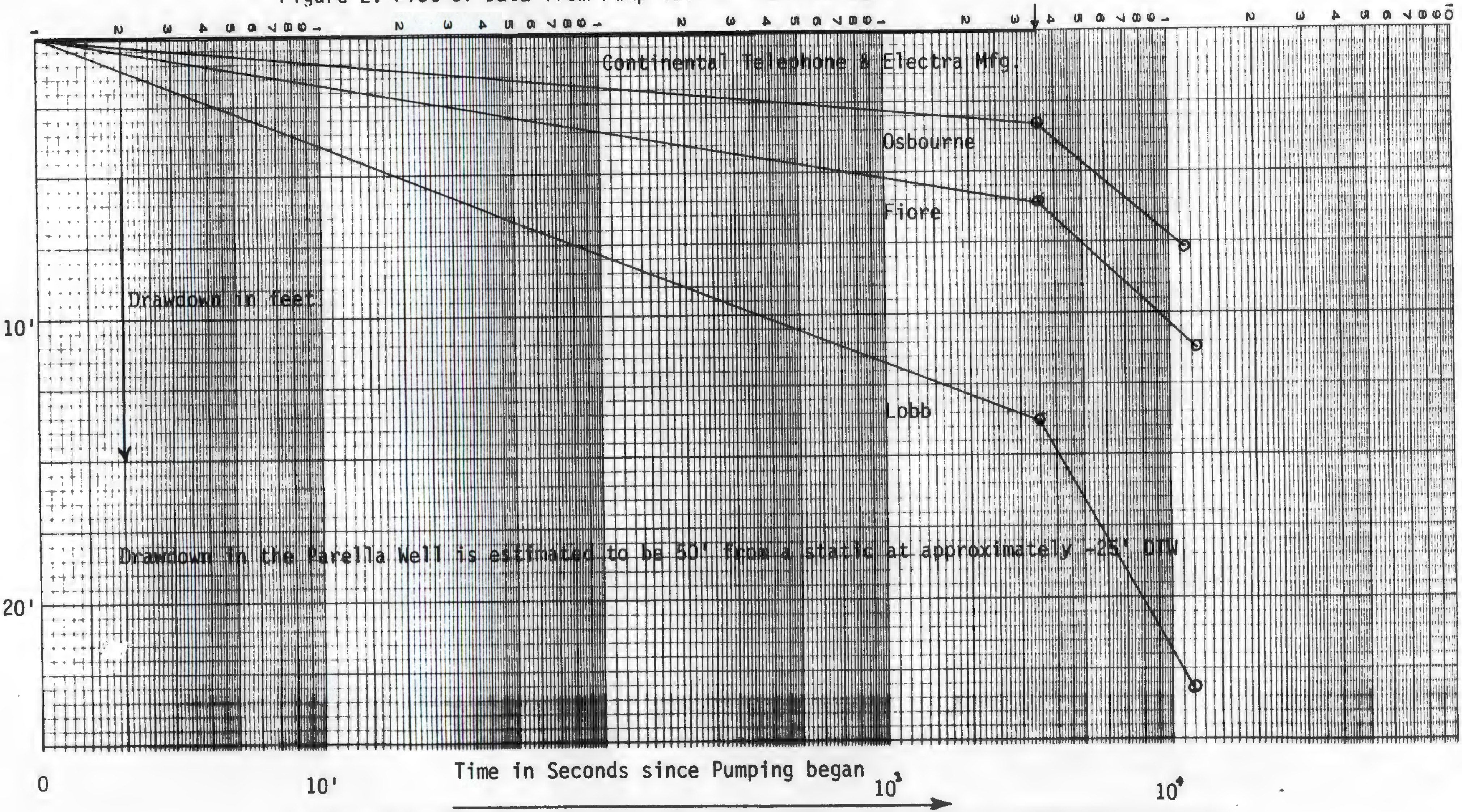


Figure 8. Plot of Data from the Pump Test 1. Parella Well

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Table 1: <u>Parella Pump Test #1</u>

Time Of Reading Flow Rate		1455-1500 hr. Static	1610-1630 hr. 4 gpm	1656-1730 hr. 4 gpm	End Of Test
Residences/Well	Distance In Feet From Parella Well	Water Levels Measured In Ft. From Top Of Casing			Total Draw-Down
Parella Well					50'*
Osbourne	185'	26.94'	30.33'	34.55'	7.61' = 34.55-26.94
Lobb	144'	25.81'	39.68'	49.00'	23.19' = 49.00-25.81
Fiore	150'	22.28'	28.37'	33.45'	11.17' = 33.45-22.28
Electra Mfg.	194'	10.38'	10.36'	10.40'	.02 = 10.40-10.38
Continental Telephone	350'	21.35'	21.37'	21.53'	.18 = 21.53-21.35

Table 2: <u>General Switch Pump Test #1</u>

2/2/84

Time Of Reading Flow Rate		Static t_o = 12:13 2 gpm	13:53 - 14:21 2 gpm	16:26 - 16:40 2 gpm	End Of Test
Residences/Well	Distance In Feet from General Switch	Water Level In Feet From Top Of Casing			Total Draw-Down
General Switch	0	13.79'	>300'	>300'	>286'
Parella	370'	23.58'	23.92'	26.16'	-2.58
Osbourne	490'	32.61'	32.94'	34.56'	-1.95
Electra Mfg.	210'	13.70'	13.61'	13.59'	+ .11**
Perry	370'	65.72'	62.04'	59.13'	+6.59
Continental Telephone	670'	23.13'	23.1'	23.13'	0
Ward	650'	79.97'	79.15'	78.83'	+1.14
Pitt	580'	33.98'	33.98'	34.05'	-.07
Perez	260'	15.82'	15.80'	16.02'	-.2
Guild Molders	1040'	7.96'	7.94'	7.94'	+.02

*Estimated at the elevation of the pump when the Parella well lost suction.

**Positive values indicate a well that is recovering.

Table 3: Ruppert Pump Test #1

Time Of Reading		Static EO=11:15	12:00-12:35	13:46-14:18	End Of Test
Flow Rate		11:05-11:15	11 gpm-6gpm	2 gpm	
Residences/Well	Distance In Feet From Ruppert Well		Water Level In Feet From Top Of Casing		Total Draw-Down
Ruppert	0	Approx 33'	180'	180'	-147'
Barry	50'	32.78'	37.95'	42.05'	-42.05'
Continental Telephone	290'	23.07'	23.55'	23.70'	-.63'
Knapp	250'	43.40'	42.32'	42.62'	+.78'
Van Pelt	310'	30.27'	29.2'	28.87'	+1.4'
Stout	400'	18.00'	18.00'	18.26'	-.26'
Robaina	270'	37.26'	37.55'	37.76'	-.5'
Estrada	480'	24.21'	24.21'	24.33'	-.12'
Morse	420'	111.13'	109.17'	107.94'	+3.19'
Rassmussen	360'	44.47'	44.50'	44.74'	-0.27'
Winner	480'	73.98'	70.16'	67.85'	+6.13'
Palermo	600'	81.53'	79.44'	77.94'	+3.59'

*Water levels at pump intake by assumption when pump broke suction: Well annulus blocked preventing direct water level measurement.

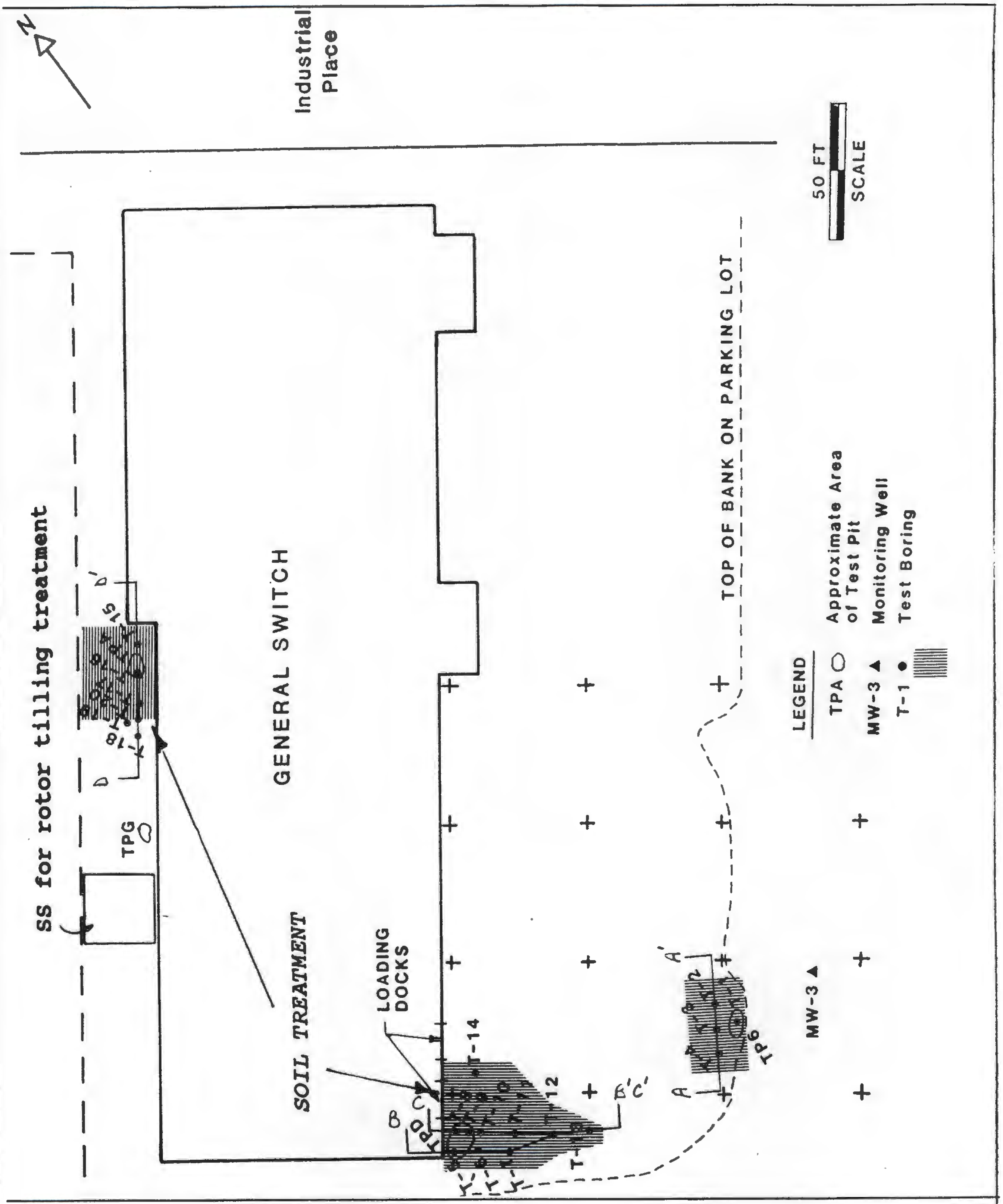

Figure 9. Location of Test Borings and Areas for Soil Treatment

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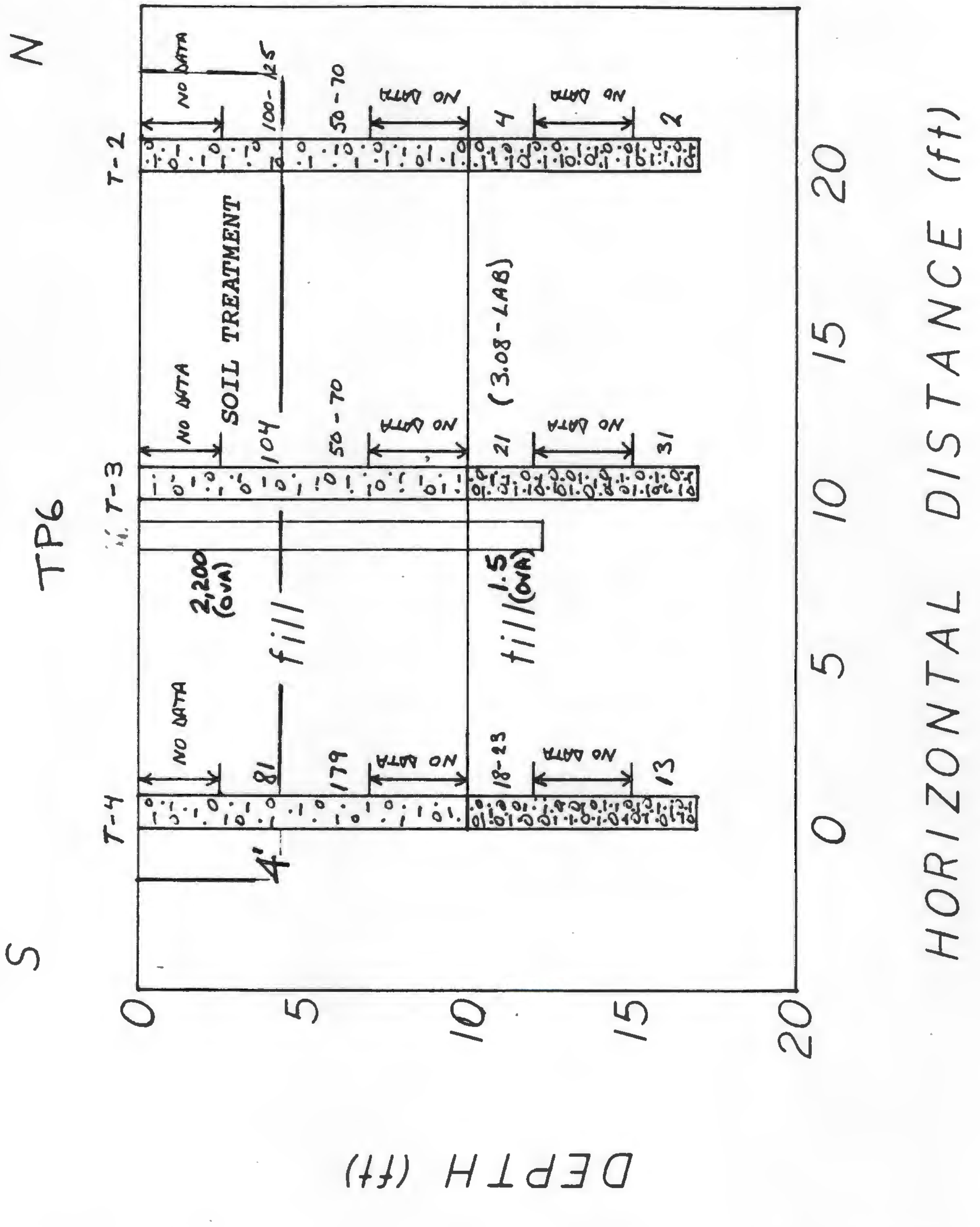

Figure 10. Cross-Section: Analytical Data & Depths for Soil Treatmen

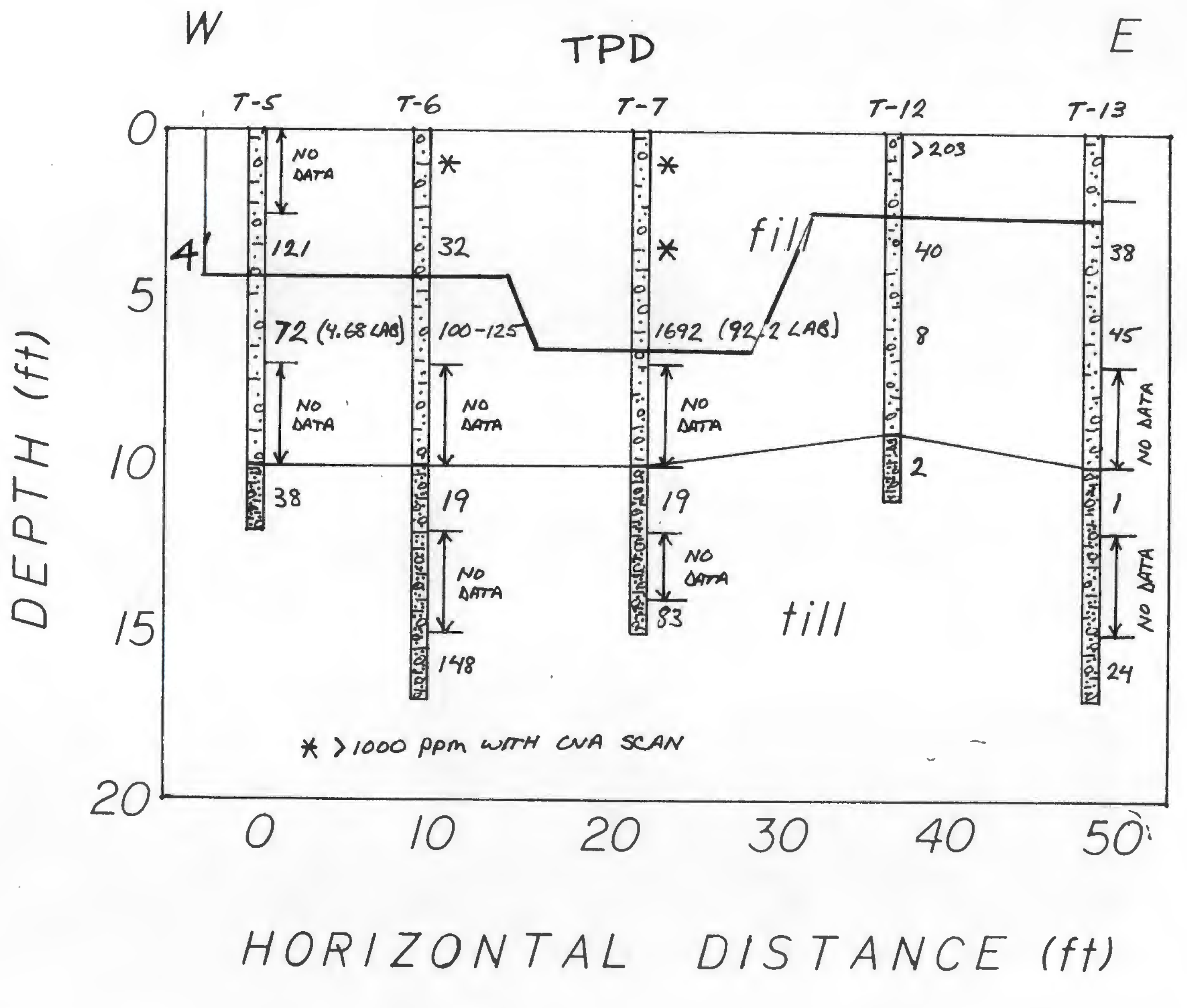

Figure 11. Cross-Section: Analytical Data & Depths for Soil Treatmen

Shakti Consultants, Inc.

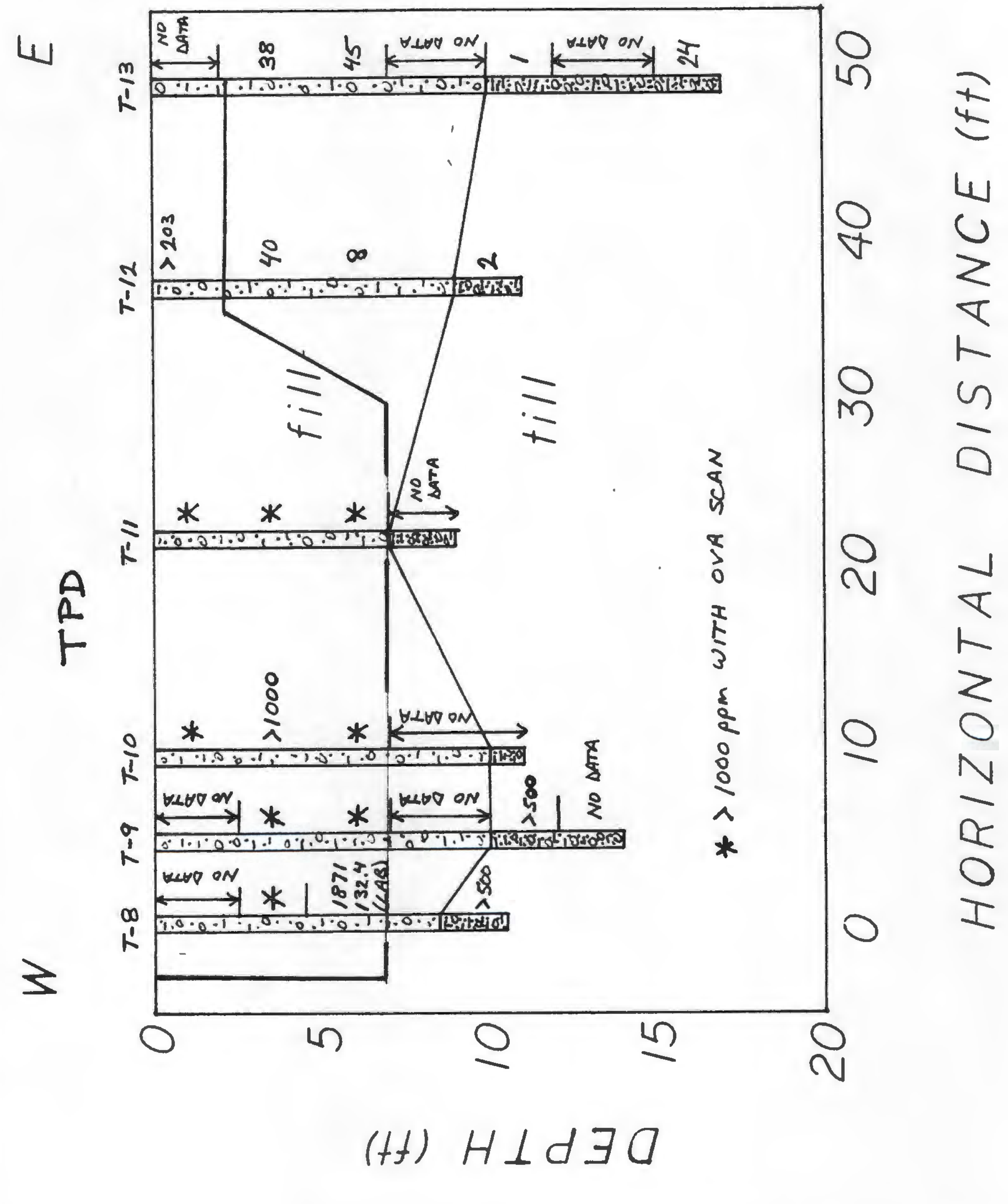

Figure 12. Cross-Section: Analytical Data & Depths for Soil Treatment

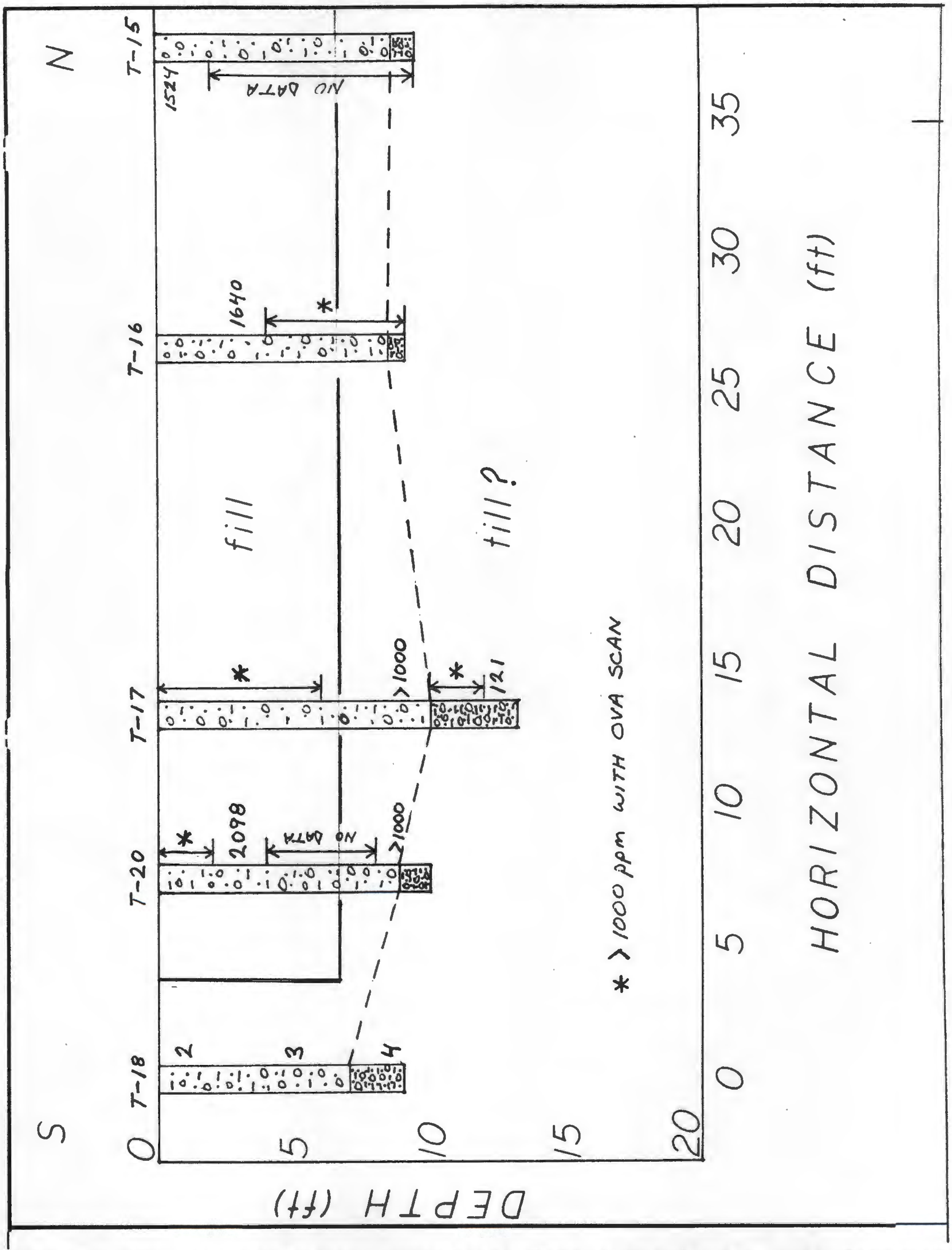

Figure 13. Cross-Section: Analytical Data & Depths for Soil Treatment

Shakti Consultants, Inc.

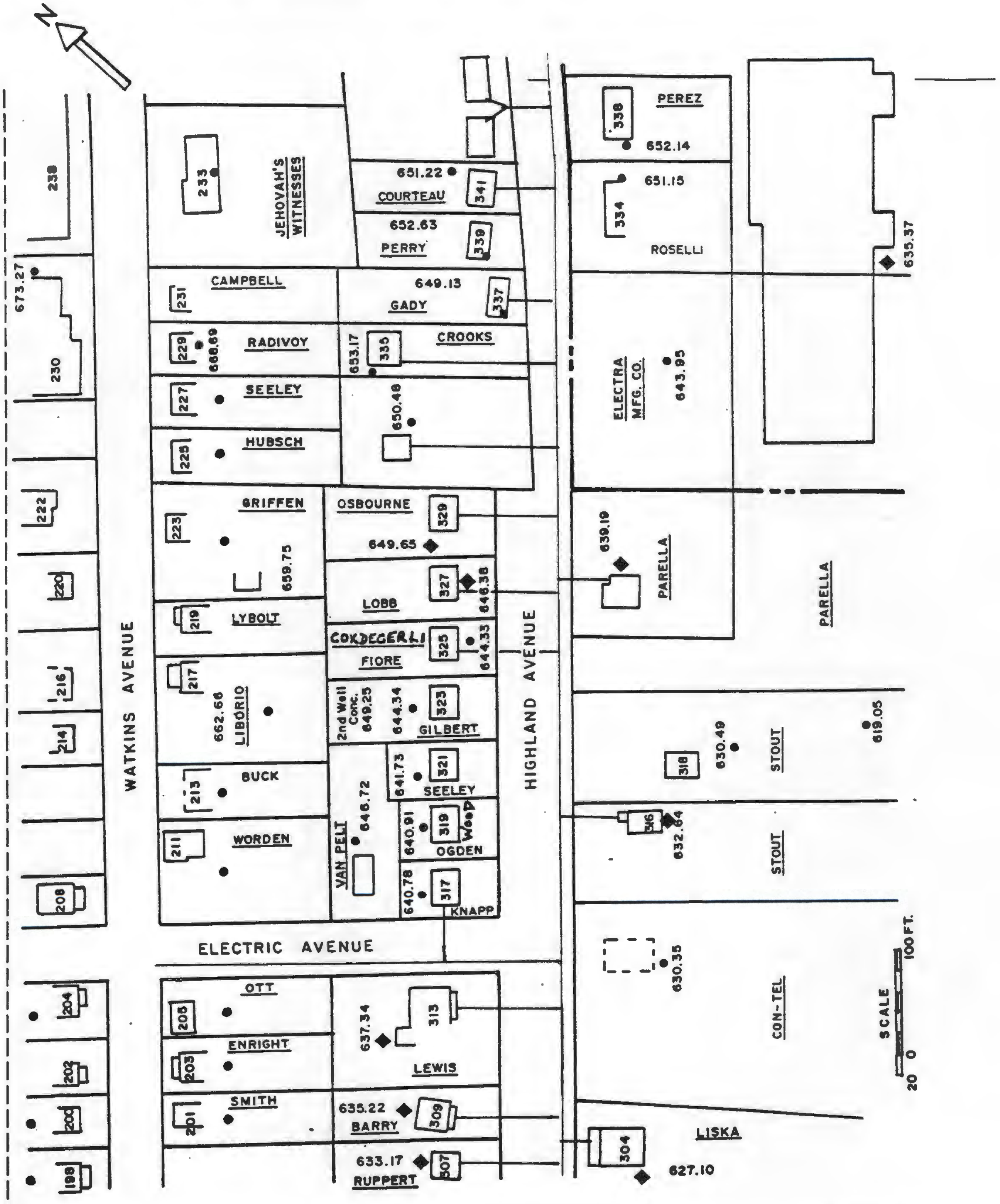

Figure 14. Location of Contaminated Wells & Water Supply Lines

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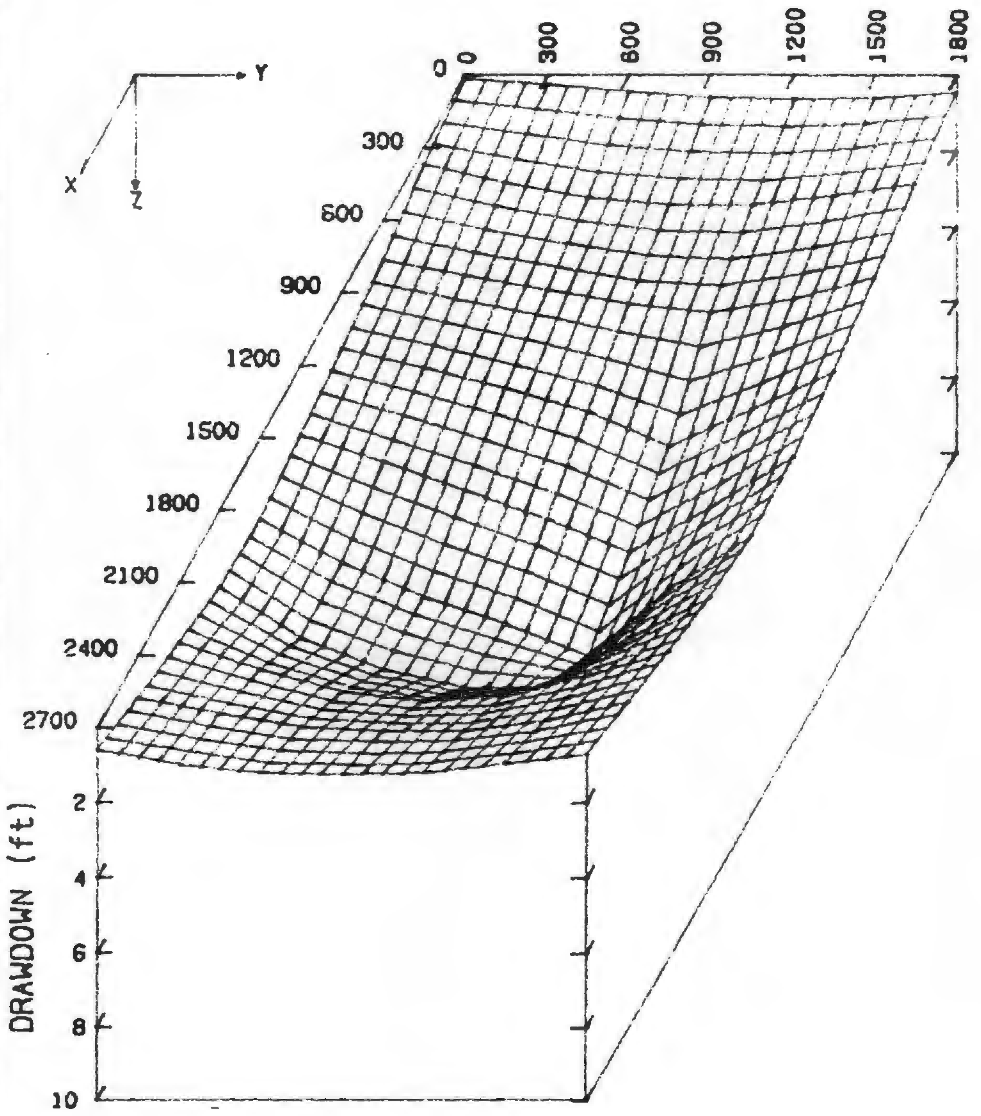
LEGEND

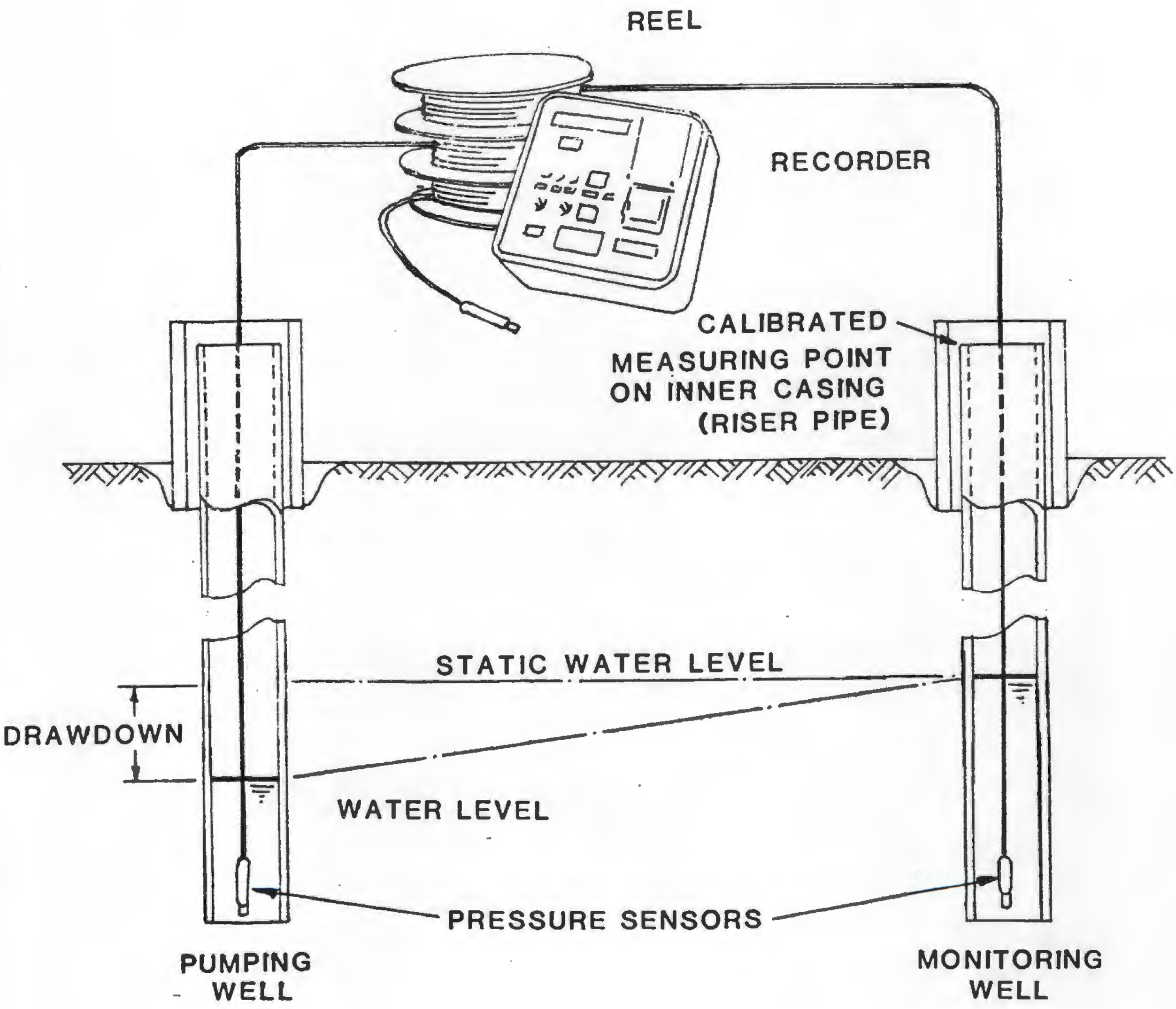
◆ WELLS CONTAINING GREATER THAN 50 PPB PCE
● UNCOMTAMINATED WELLS



GROUNDWATER LEVEL AFTER 5 YEARS OF PUMPING

NOTE: SCALE OF X AND Y AXES DIFFERS FROM THAT OF Z AXIS

Figure 15. Zone of Influence of a Pumping Well



PRESSURE TRANSDUCERS

Figure 16. Pressure Transducer System

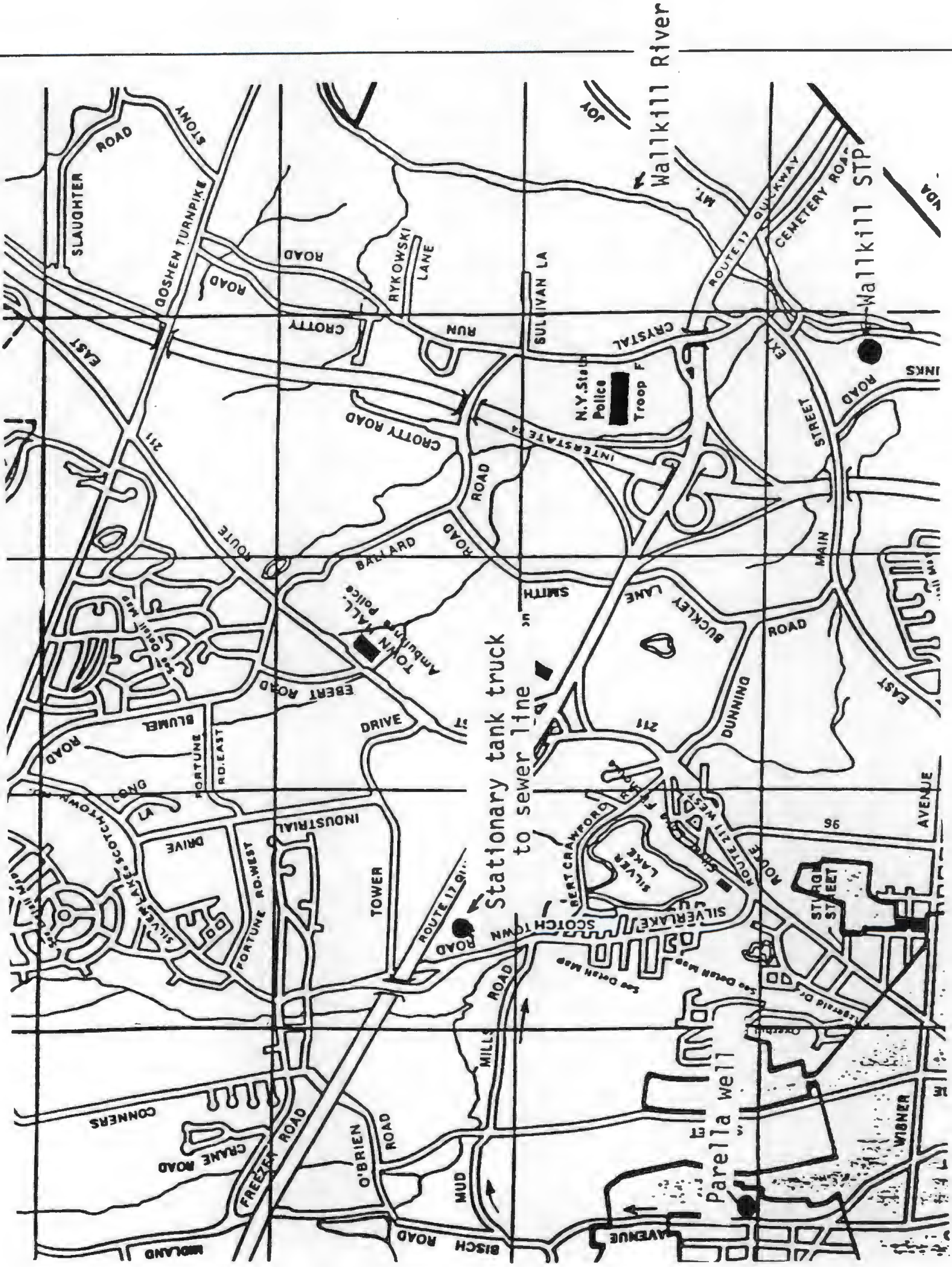


Figure 17. The Parella Well in Relation to the Wallkill STP

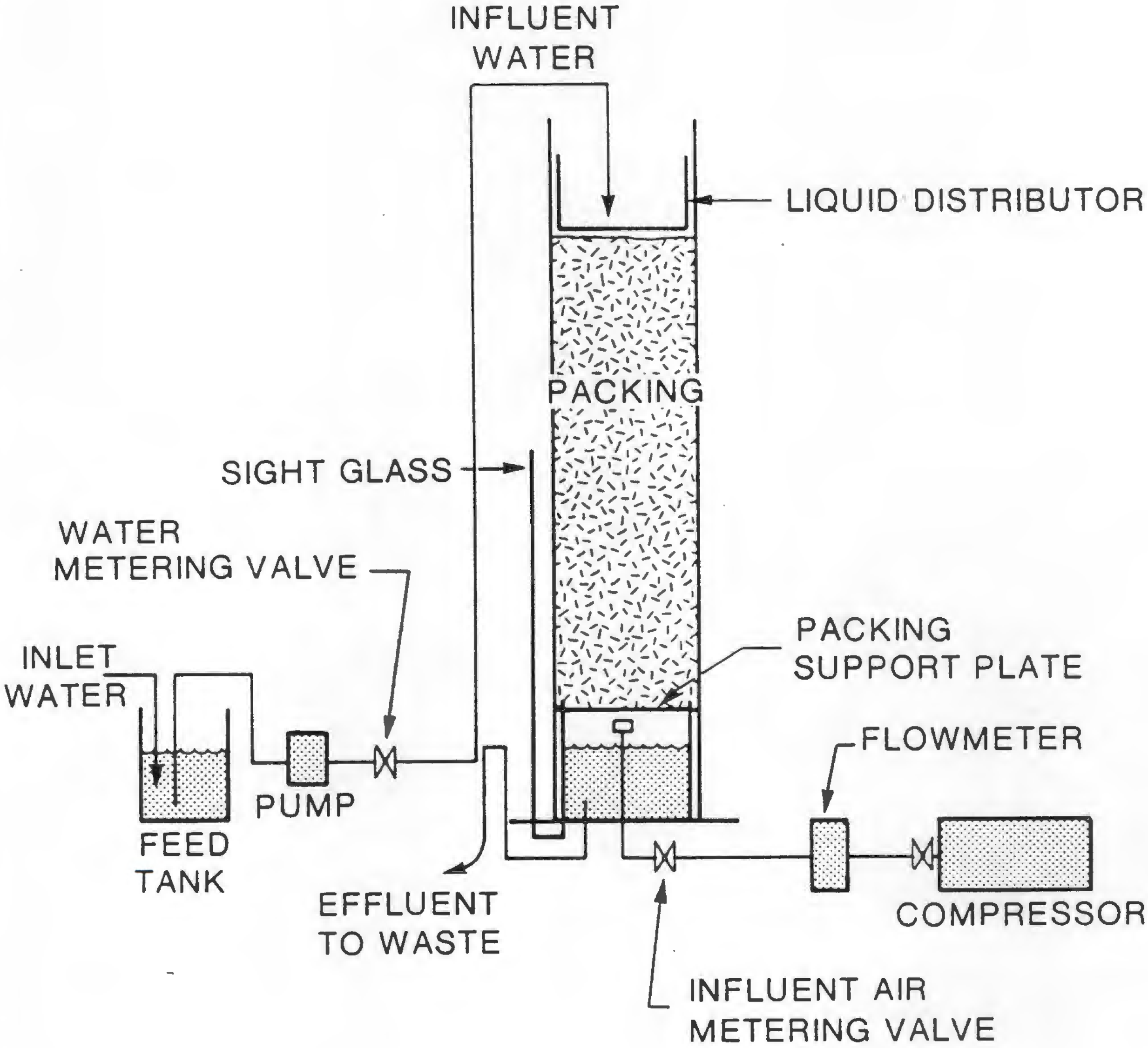


Figure 18. Packed Tower Air Stripper

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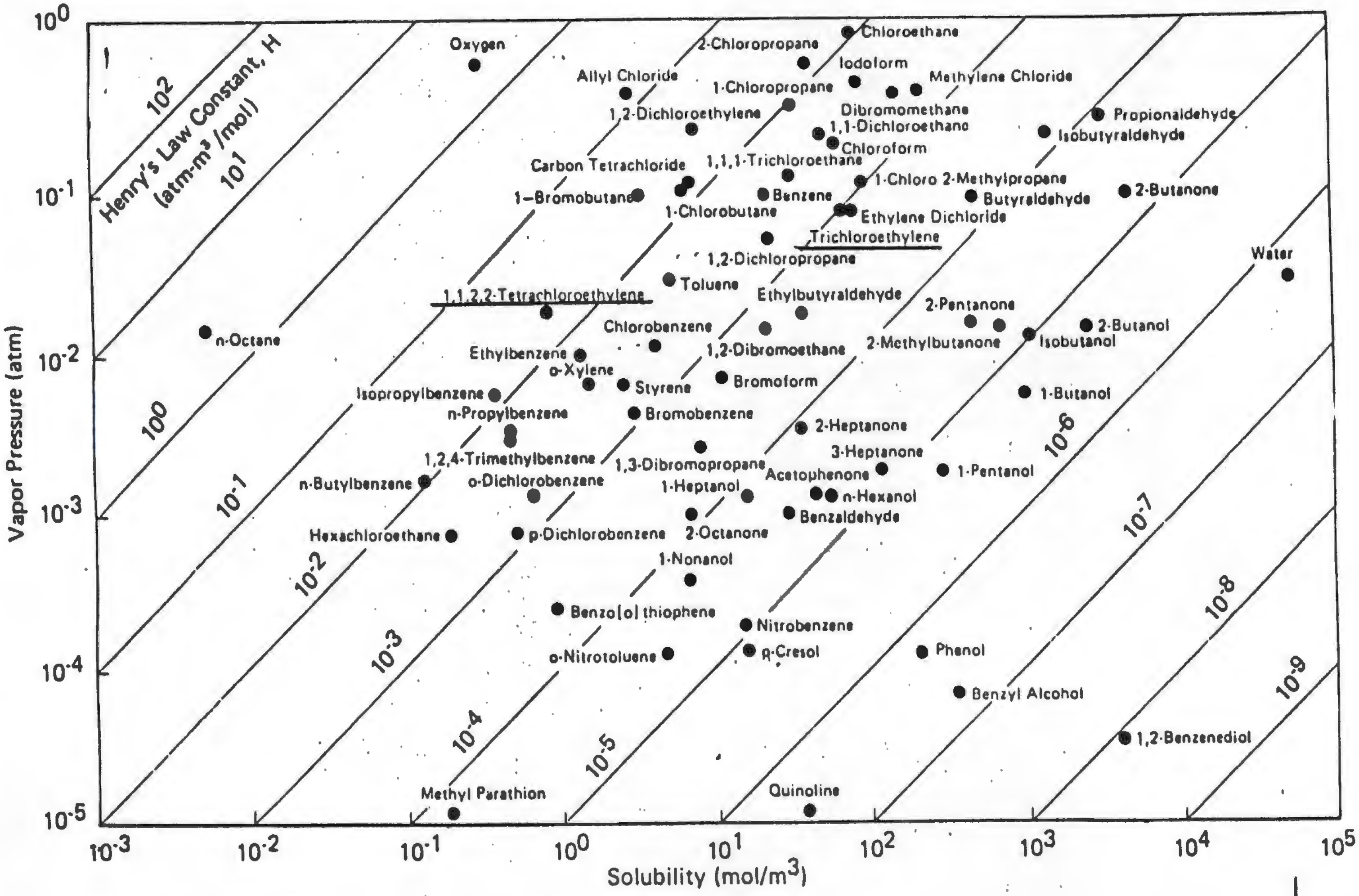
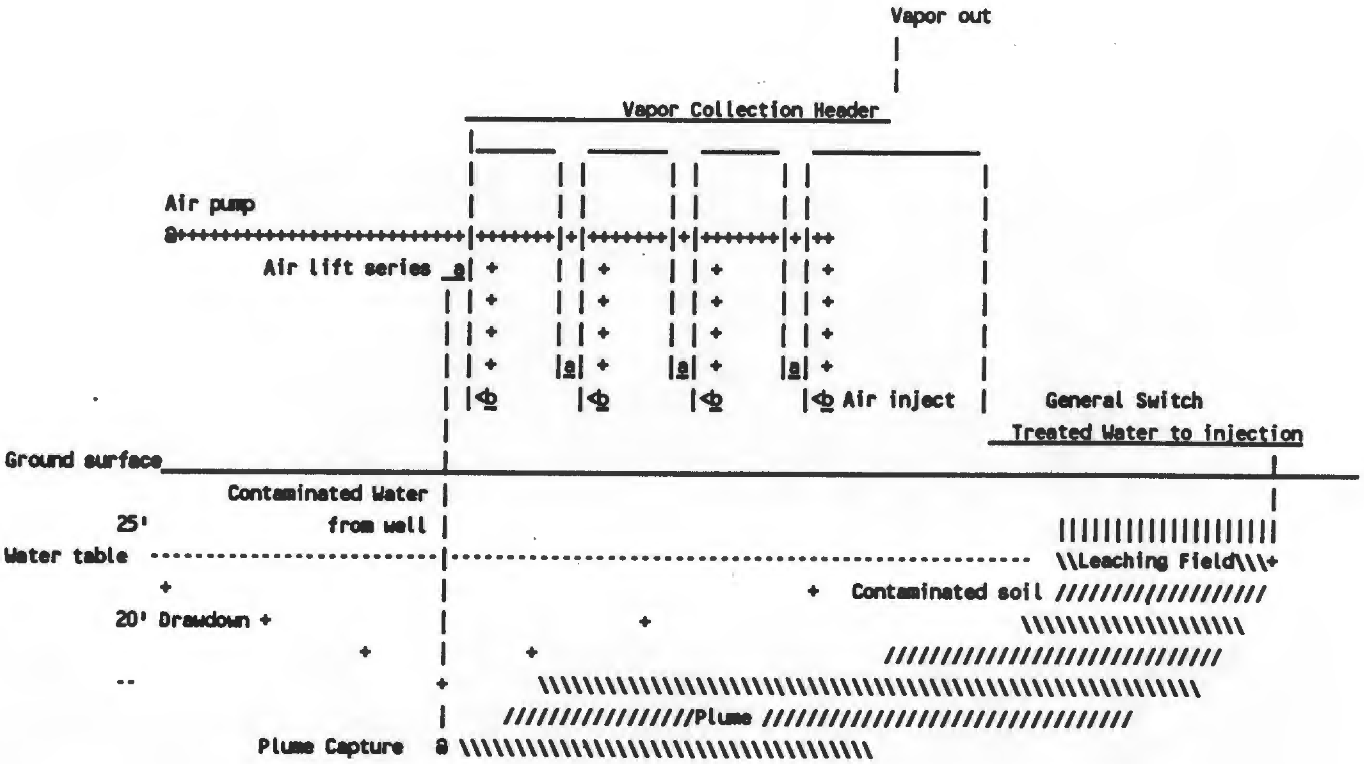
Figure 19



Source: Mackay and Yuen [15]. *(Reprinted with permission from the authors.)*

FIGURE 15–2 Solubility, Vapor Pressure and Henry's Law Constant for Selected Chemicals

Figure 20. Merry-Go-Round Air Stripper



Pump 10'Submergence below Drawdown Cone for Turbine Pump

Figure 20: Multistage Airlift System

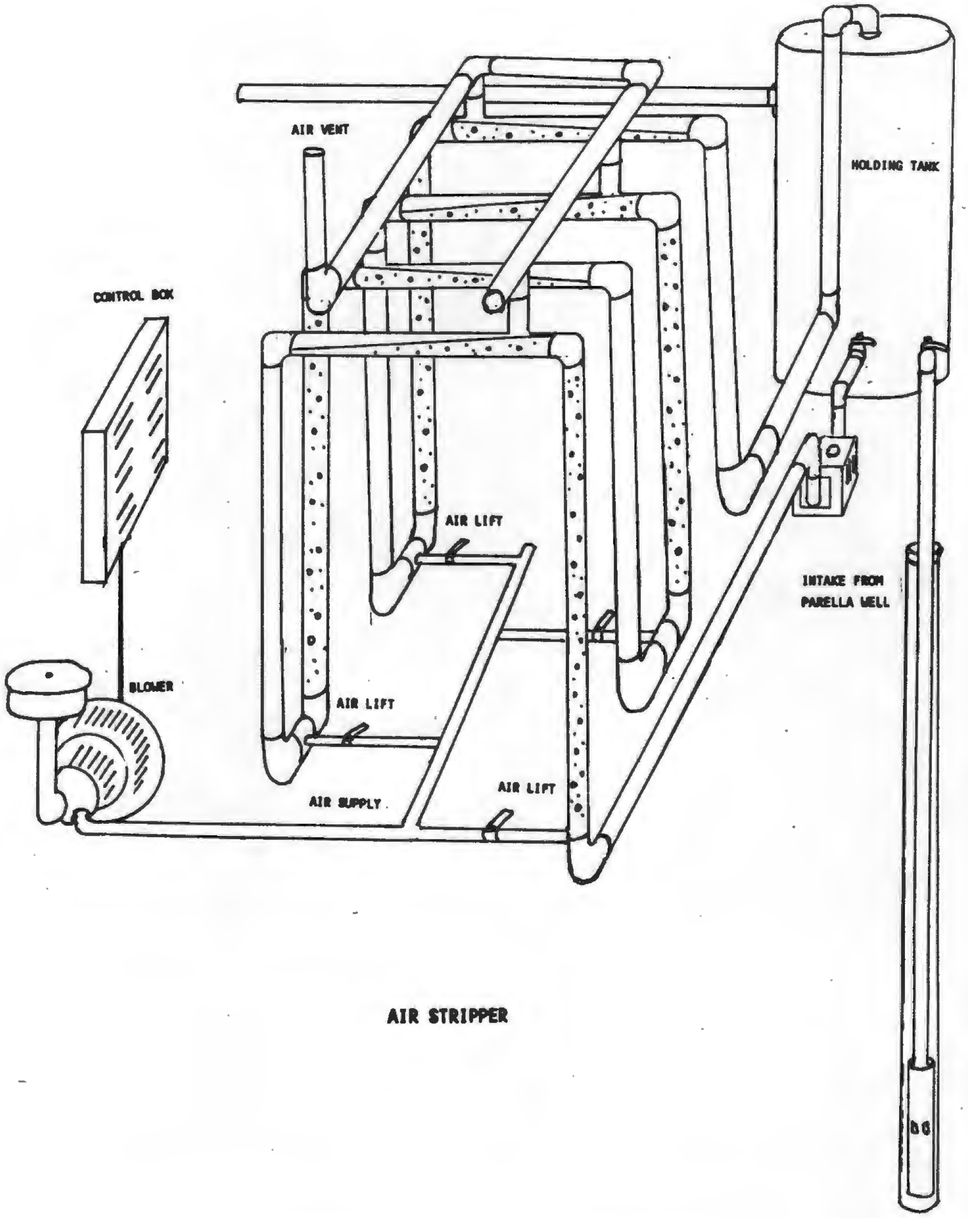


Figure 21. Merry-Go-Round Air Stripper

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*185 **Gatzmer** Avenue*
Jamesburg, NJ 08831

TYPICAL TRENCH LAYOUT

Figure 22. Trench Layout in Excavation

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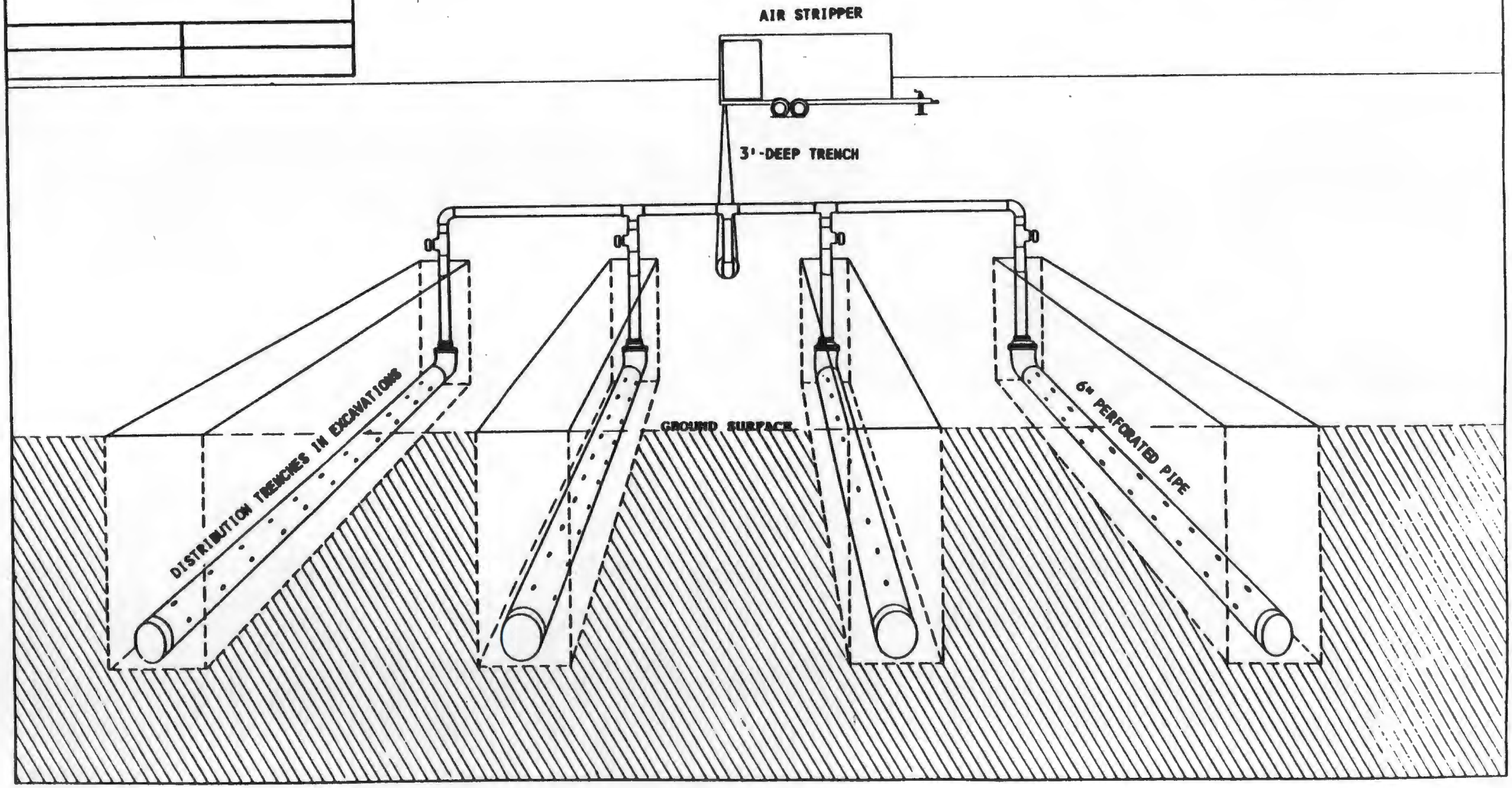

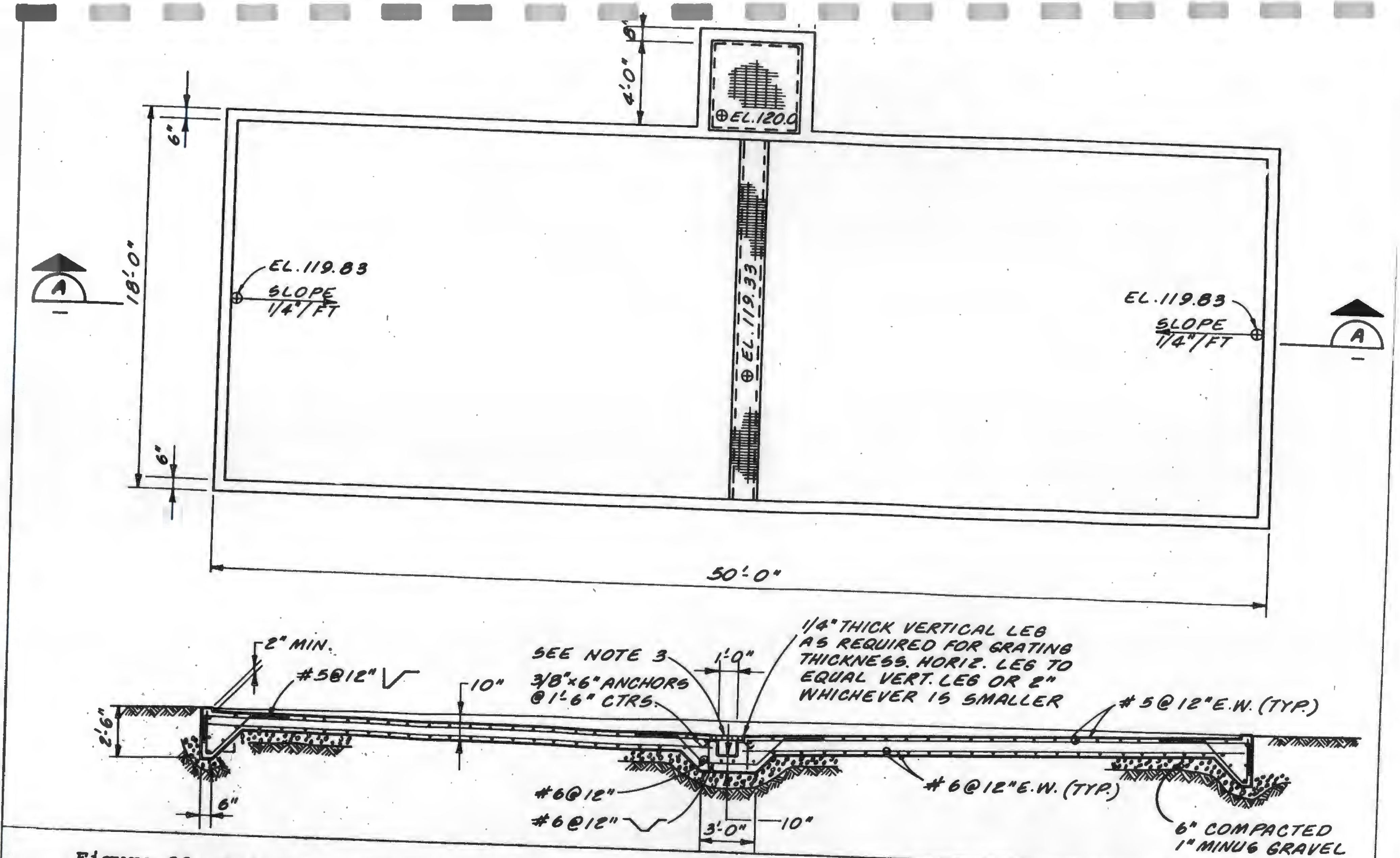

Figure 23. Soil Decontamination Pad

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LEGEND

- ◆ WELLS CONTAINING GREATER THAN 50 PPB PCE
- ● UNCOMTAMINATED WELLS
- ● Monitor Well

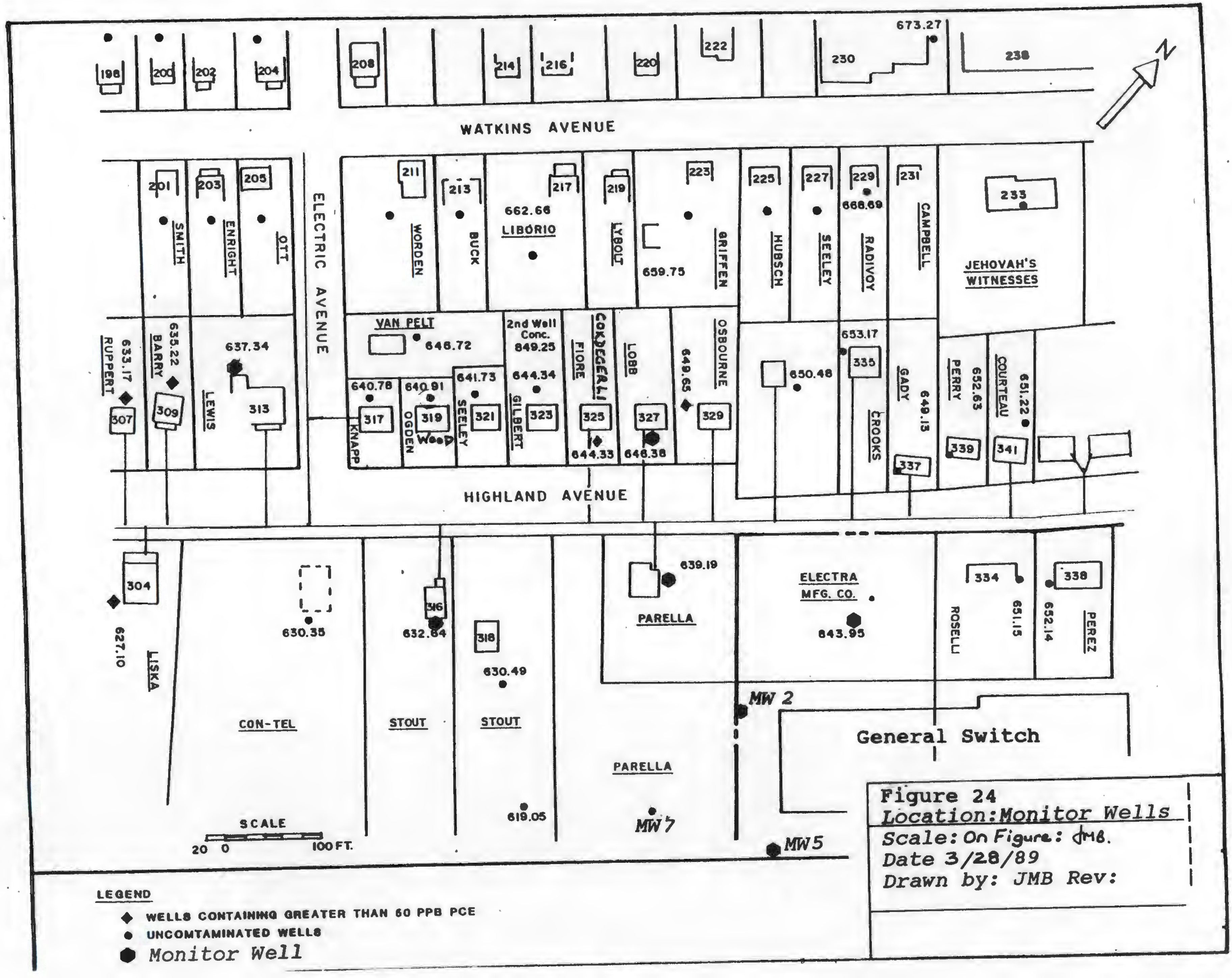


Figure 24
Location: Monitor Wells
Scale: On Figure: JMB.
Date 3/28/89
Drawn by: JMB Rev:

LEGEND

- ◆ WELLS CONTAINING GREATER THAN 60 PPB PCE
- ● UNCOMTAMINATED WELLS
- ⬢ Monitor Well

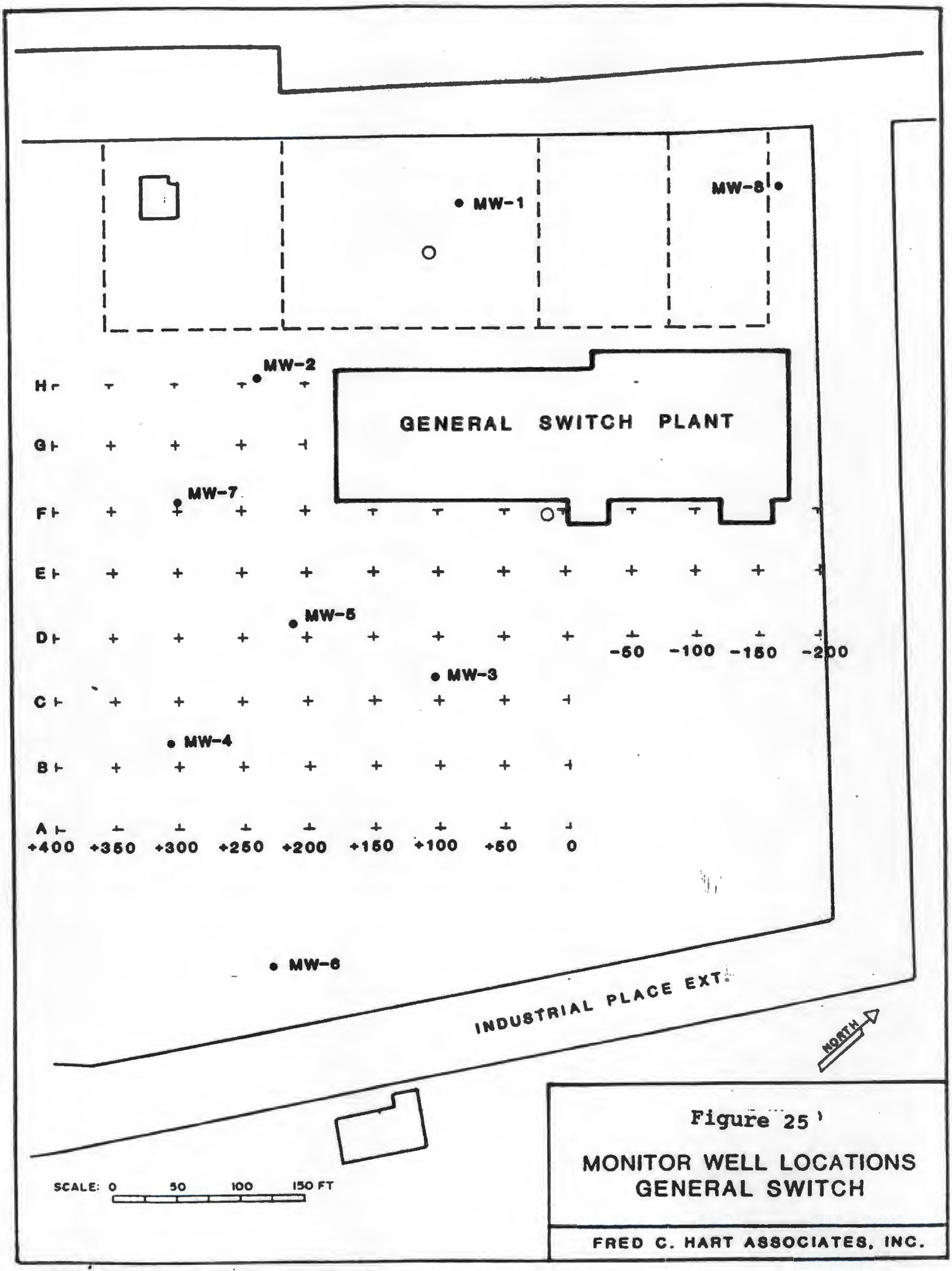
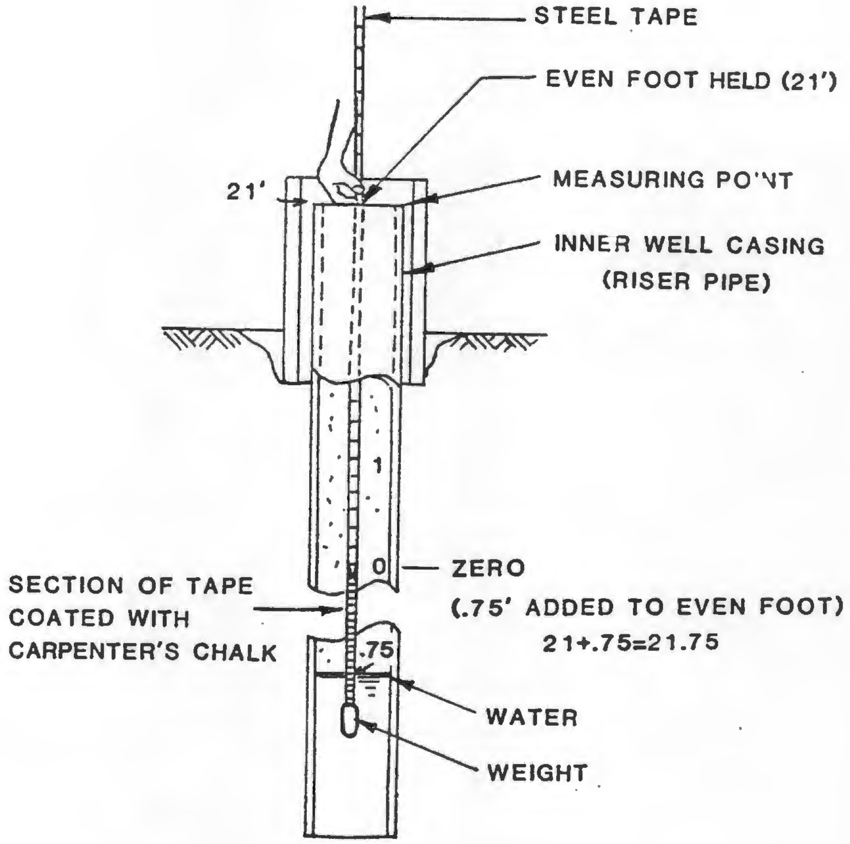


Figure 25

MONITOR WELL LOCATIONS
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

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



WETTED TAPE

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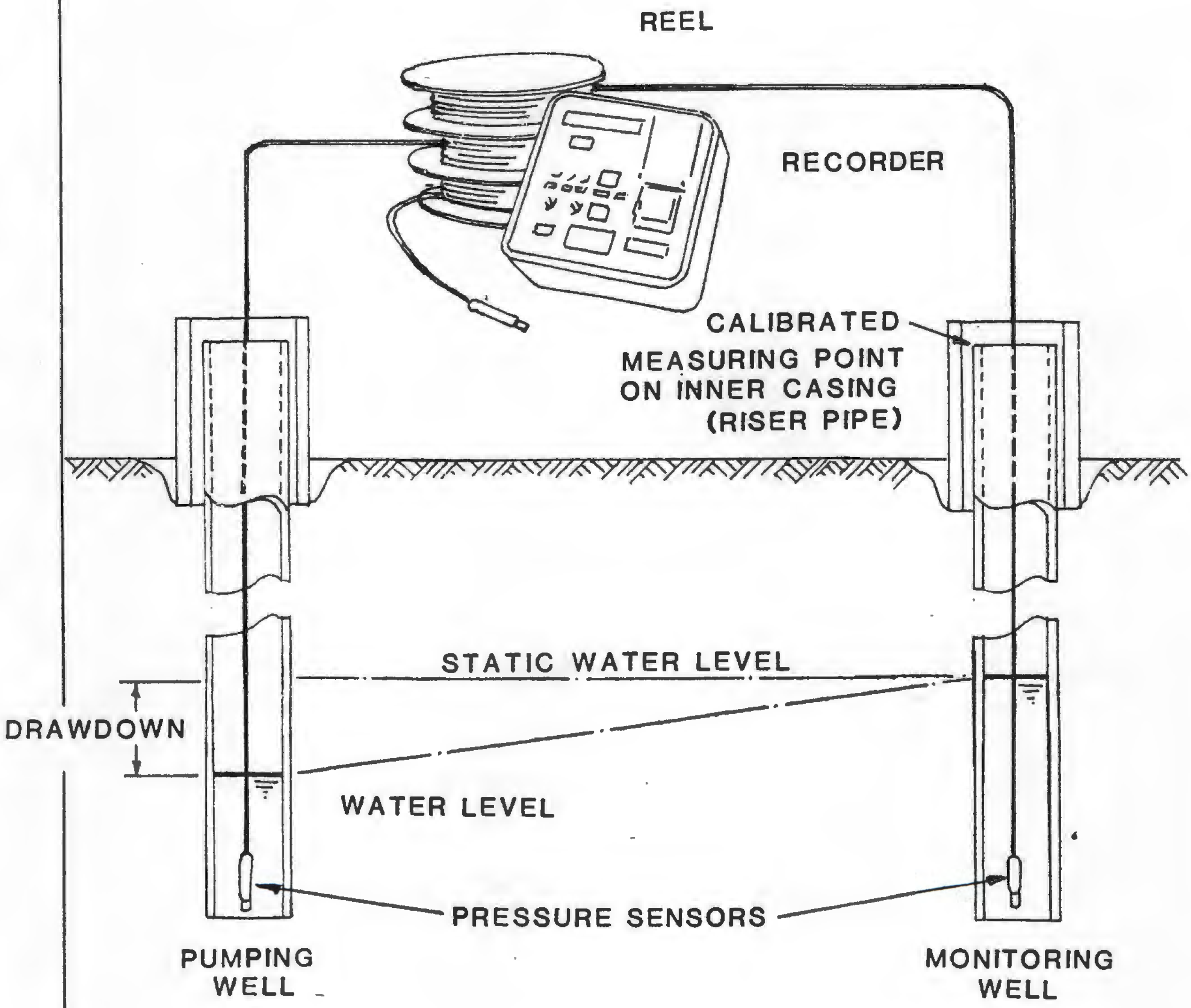
185 Gatzmer Avenue
Jamesburg, NJ 08831

Figure 26 *Example*
Water Level Measurement
Scale: N/A *:*
Date 3/ 3 /89
Drawn by: JMB Rev:



PRESSURE TRANSDUCERS

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Jamesburg, NJ 08831

Figure 27 *Example*
Water Level Measurement
Scale: N/A : jmb.
Date 3/28/89
Drawn by: JMB Rev:

185 Gatzmer Ave
Jamesburg NJ 00831

Shakti Consultants,Inc.
52 Mountaineer Dr
Elkview, WV 25071

Water Level Record Sheet

Project
Location
Well #
Reference Pt Elev.(feet)
Land Surface Elev. (feet)
Well Depth (feet)
Perforated Interval
Aquifer

Well # Date	Time	Ground Elevn.	Depth of Water below TOC	Stick-up	Depth of Water below GL	Water Level Elevation

Shakti Consultants,Inc.
185 Gatzmer Avenue
Jamesburg, NJ 08831

Figure 28 Example
Water Level Records
Scale: N/A :
Date 3/ 3/89
Drawn by: JMB Rev:

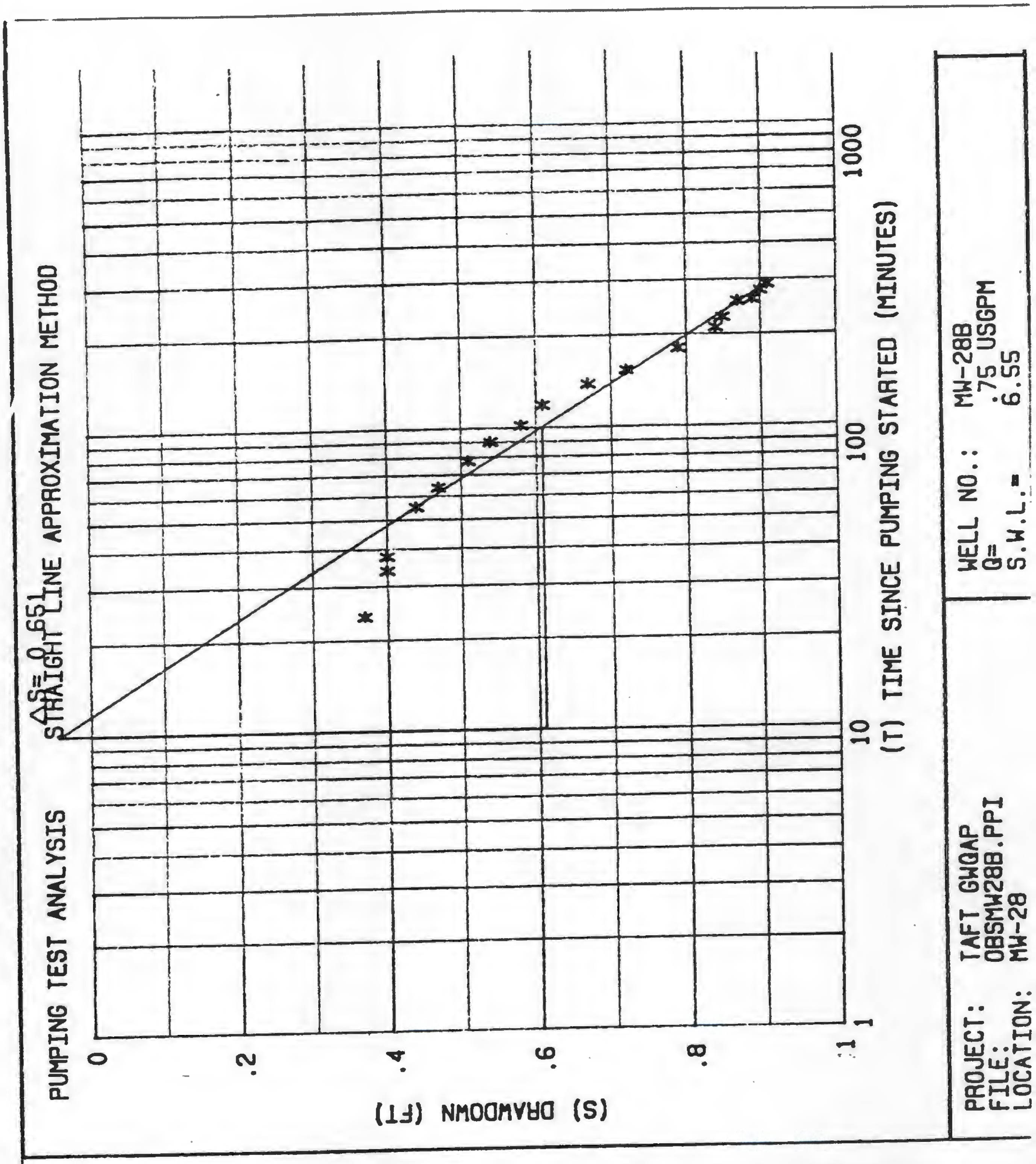

Figure 29 *Example*
Time-Drawdown Graph
Scale: N/A :
Date 3 / 3 /89
Drawn by: JMB Rev:

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Jamesburg, NJ 08831

Shakti Consultants, Inc.
Work Plan Appendix
Pump Test Plan
08/09/90

Well Logs, Fred.C Hart

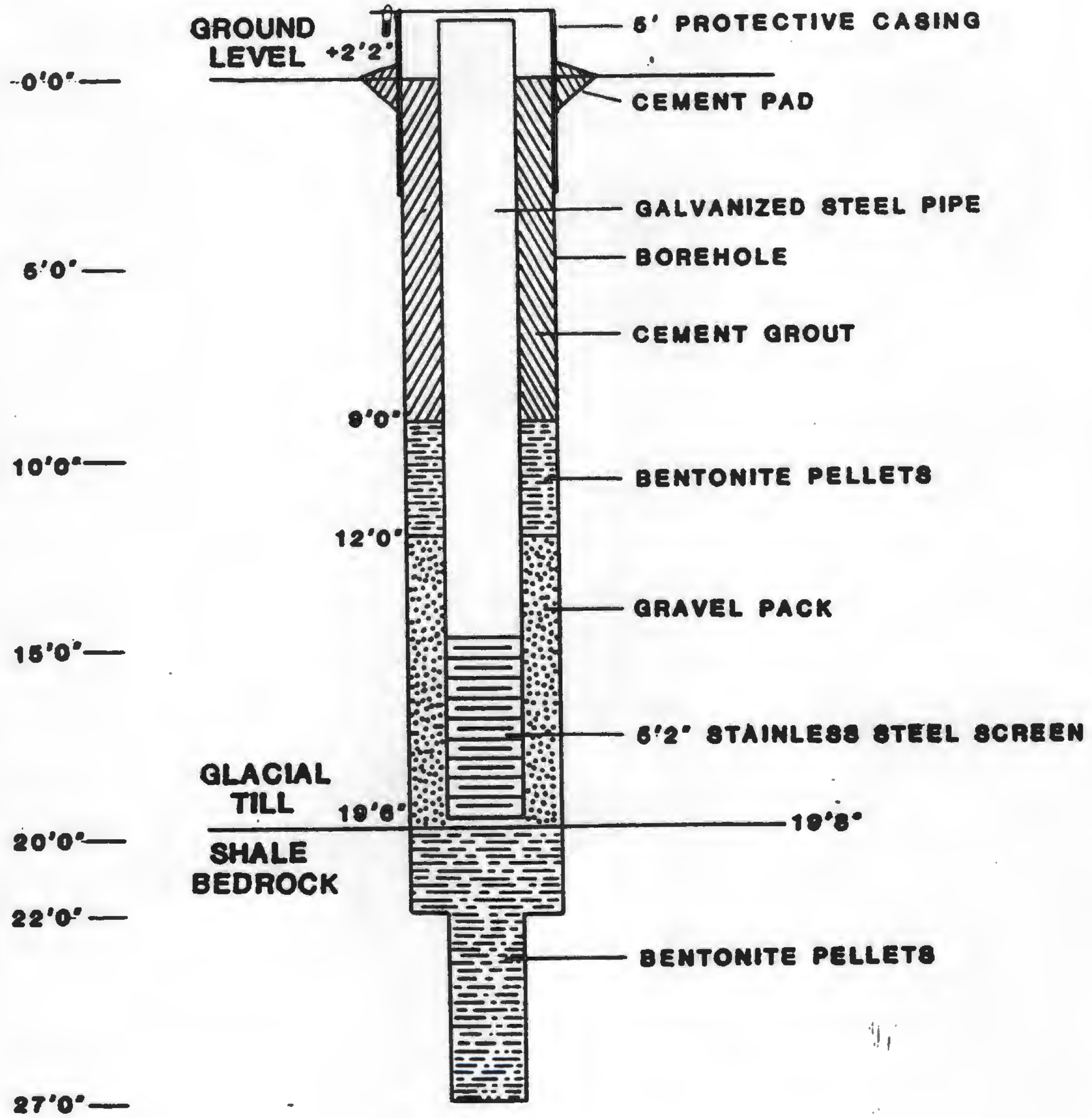

FIGURE III-11

WELL CONSTRUCTION
TEST BORING # 1
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

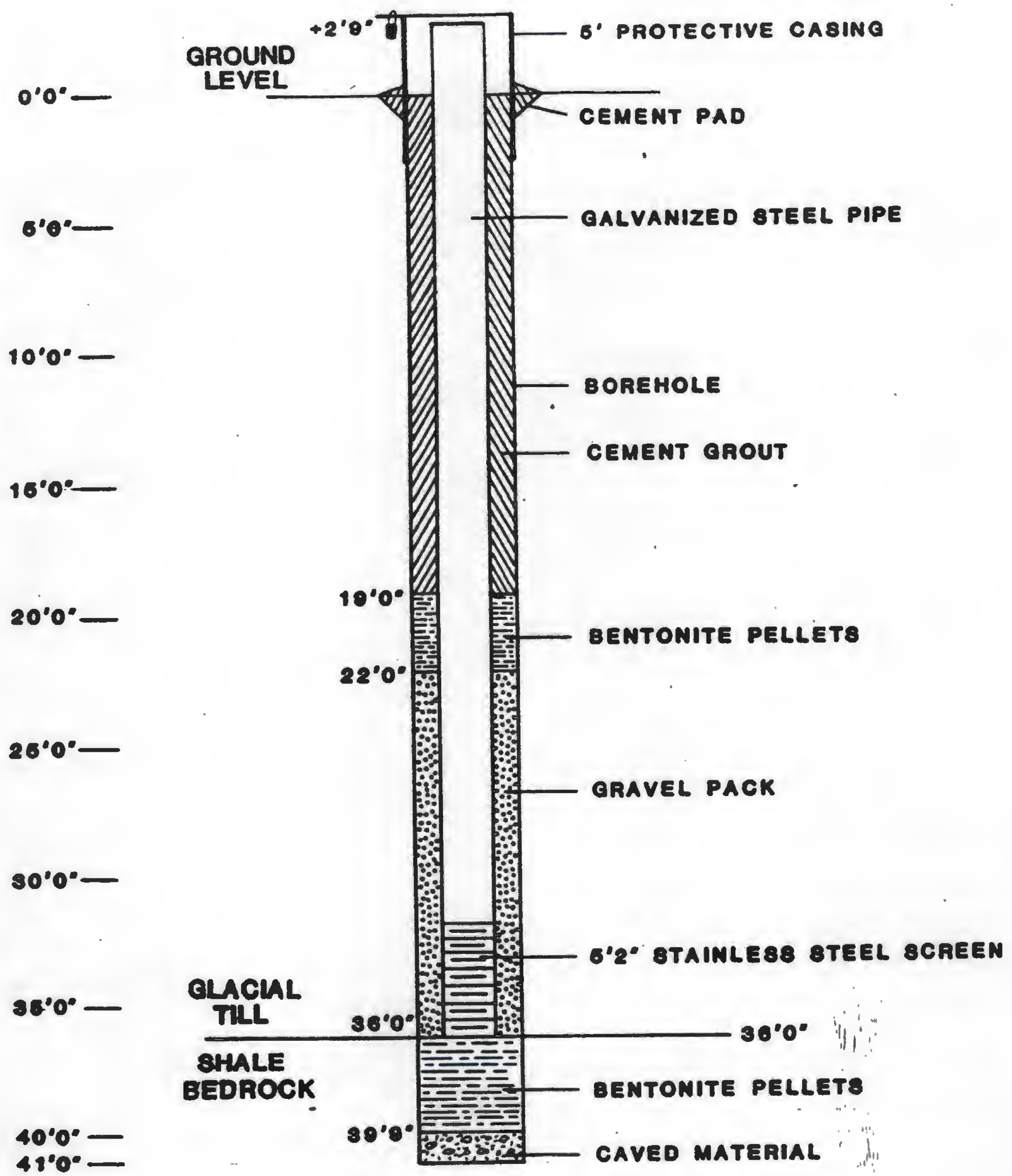

FIGURE III-12

WELL CONSTRUCTION
TEST BORING # 2
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

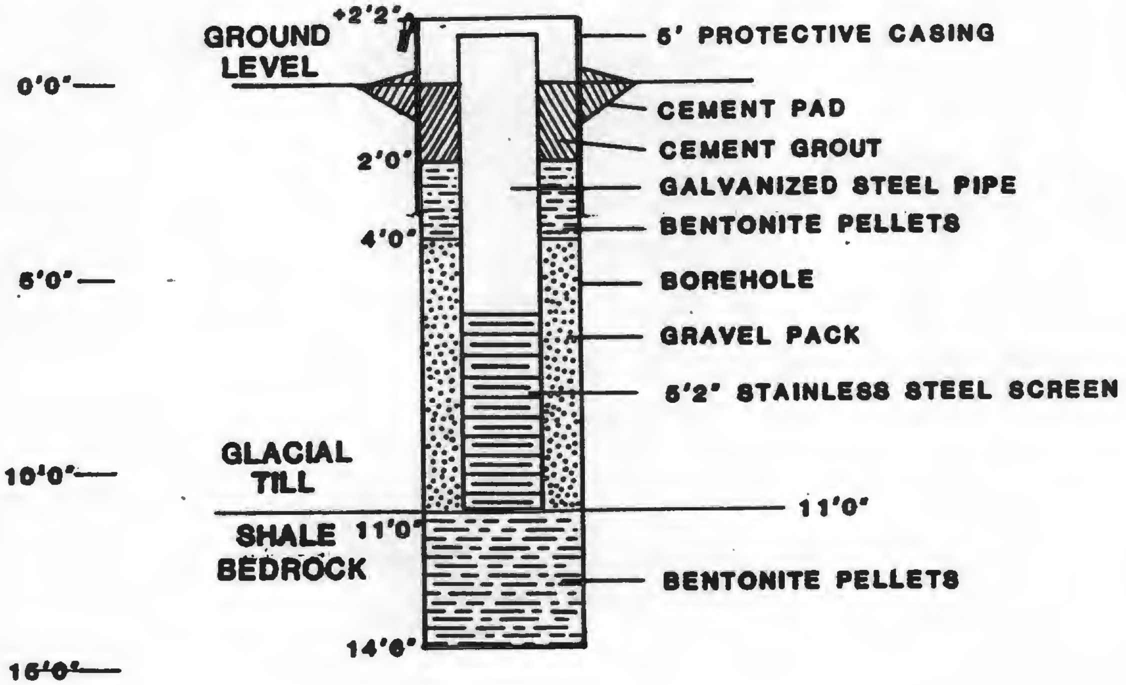

FIGURE III-13

WELL CONSTRUCTION
TEST BORING # 3
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

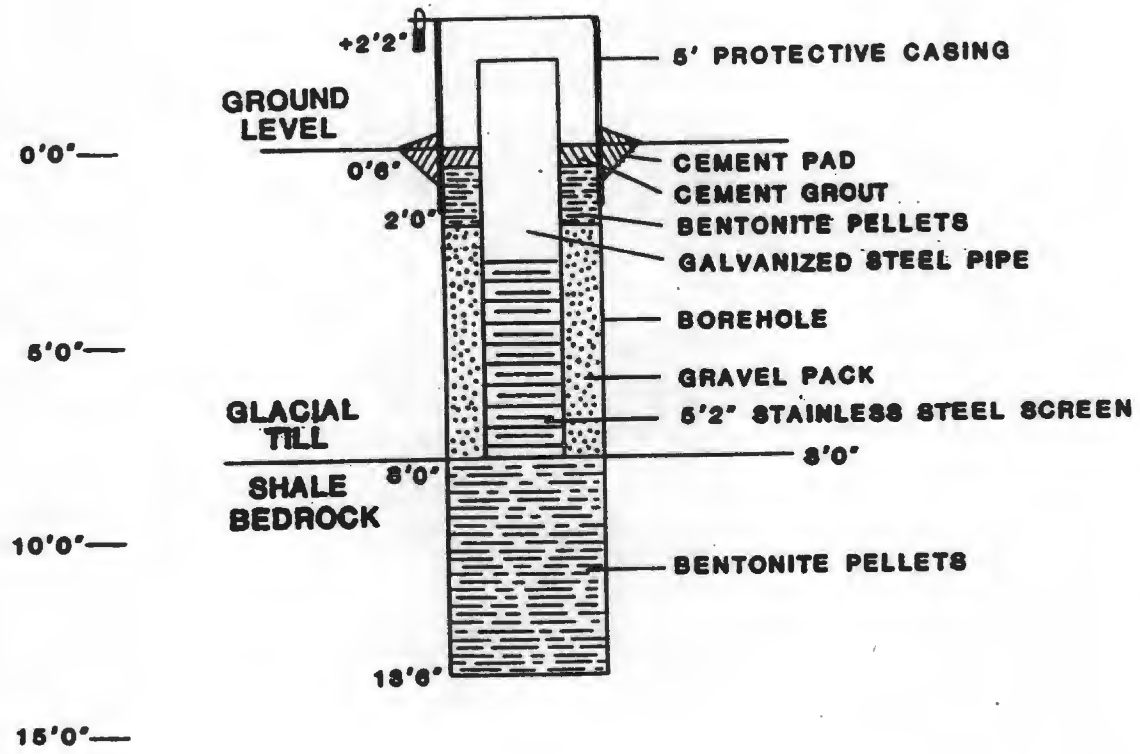

FIGURE III-14

WELL CONSTRUCTION
TEST BORING # 4
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

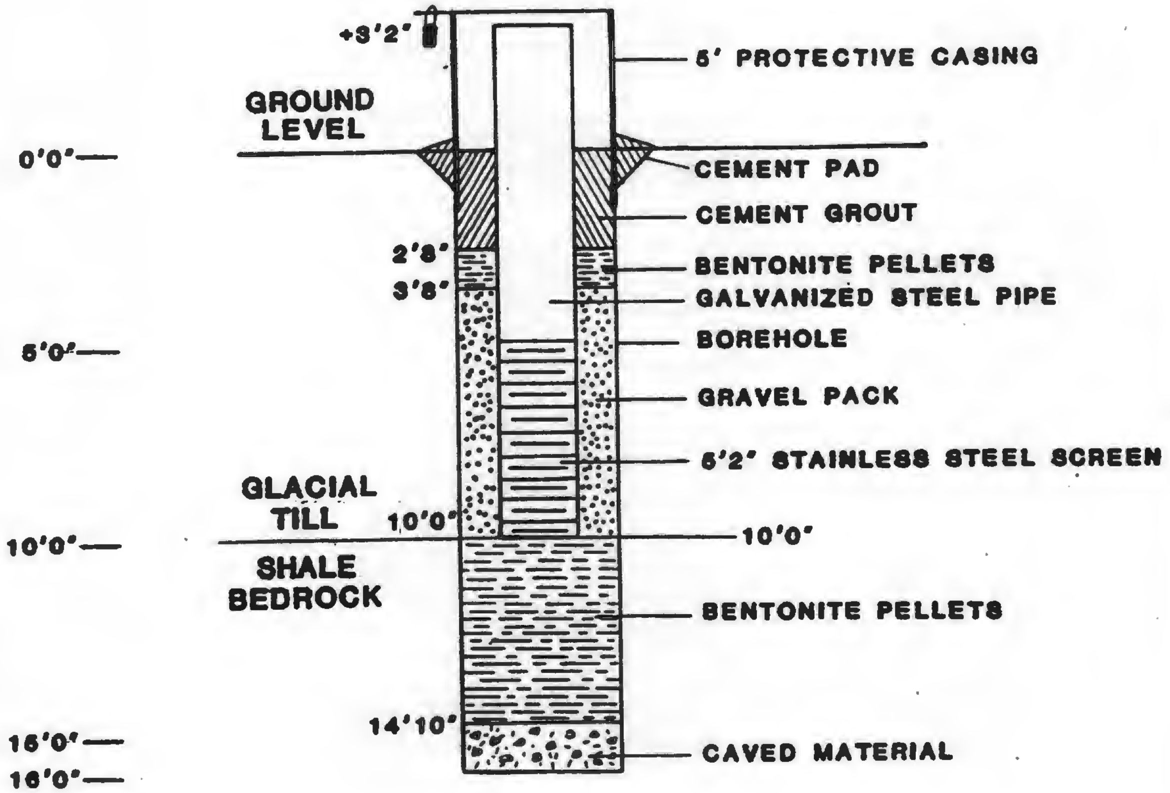

FIGURE III-15

WELL CONSTRUCTION
TEST BORING # 5
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

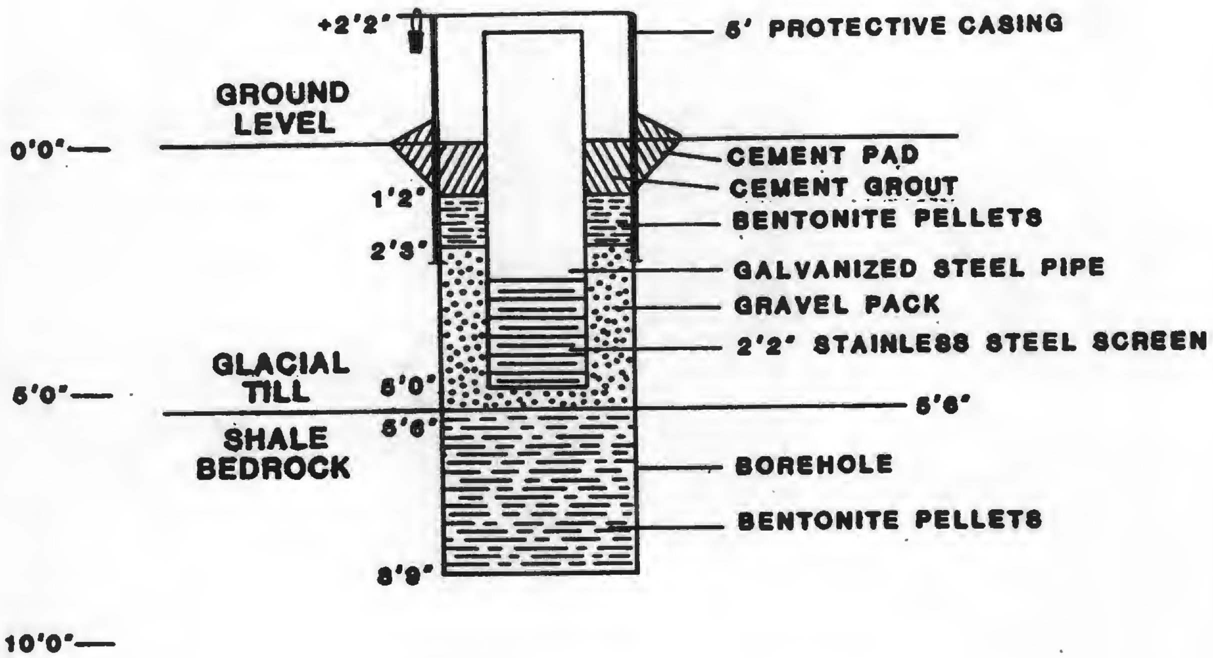

FIGURE III-16

WELL CONSTRUCTION
TEST BORING # 6
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

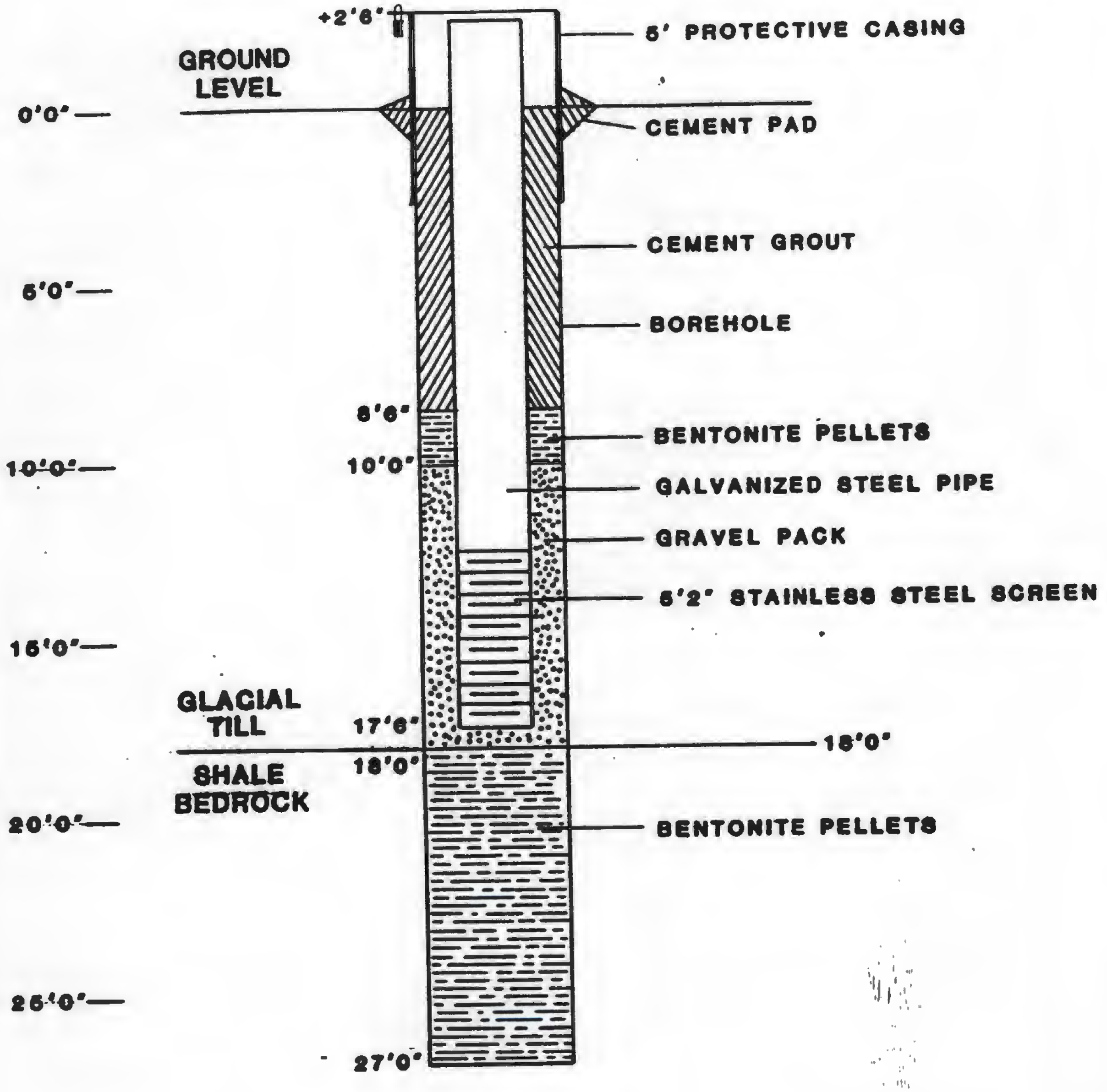

FIGURE III-17

WELL CONSTRUCTION
TEST BORING # 7
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

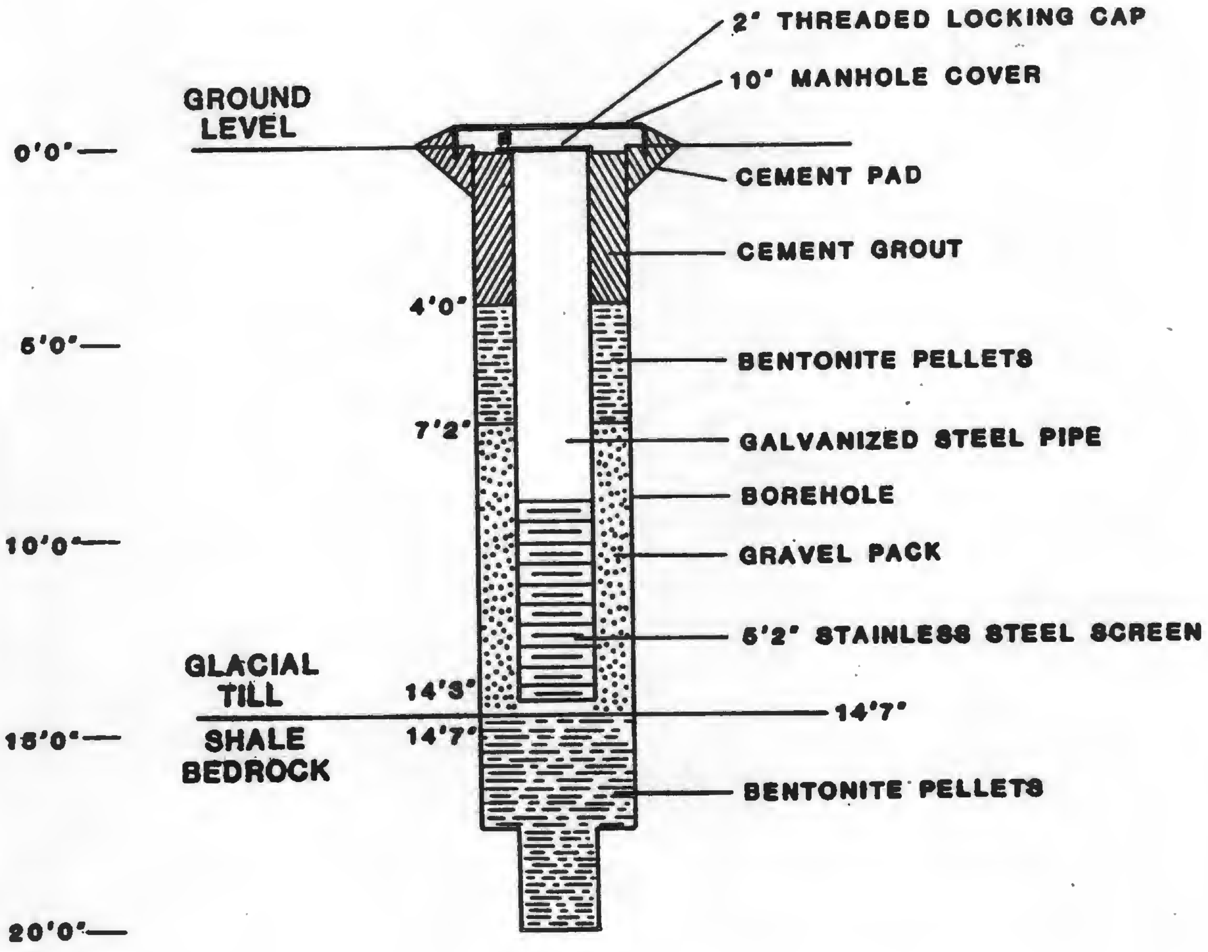

FIGURE III-18

WELL CONSTRUCTION
TEST BORING #8
GENERAL SWITCH

FRED C. HART ASSOCIATES, INC.

Sampling Plan Appendix A

Standard Operating Procedures for Soil Sampling

Excavation and Post Excavation Sampling

✓ Photovac Analysis of Soil and Water

HEADSPACE ANALYSIS OF SOIL GAS AND WATER SAMPLES

Purpose

The concentration of VOC in soil and water may be determined by analysis of the headspace over a soil or water sample. During the survey the Photovac portable gas chromatograph and Laboratory analysis program is used as a basis for correlating the Photovac results to laboratory derived VOC analysis results for soil or water samples.

Method

Sampling Procedures - Headspace analysis

Samples of soil are obtained by subcoring soil from a split spoon sampler. The 30 cu mm of soil is are placed in a 40 ml vial such that the vial is three quarters full. The vials are than placed in a warm water bath held at 30 degrees C and heated for 20 minutes to drive the volatiles into the headspace of the vial. A 100 ul injection was then drawn from the headspace of the vial with an airtight syringe and introduced into the Photovac.

Dry soil samples are prepared for analysis by the addition of 10 ml of distilled water to the VOA vials.

Water samples are obtained either as grab samples or from a precleaned bailer. The 40 ml vial is filled 3/4 full leaving a headspace from which the sample is drawn.

The VOA vials are stored upside down on ice prior to the Photovac analysis, and prior to and during shipment for laboratory analysis.

Sample Analysis

The Photovac analysis is conducted using a Photovac Model 10S50 portable gas chromatograph (GC). The Photovac GC utilizes photoionization at a stable temperature maintained by the inboard GC column oven. The sample is injected through a model SA1020 encapsulated capillary column with a packing material of CPsil 19CB, nine feet in length.

The 10S50 gas chromatograph contains a built-in integrator and 4 libraries enabling the computer to interpret a chromatogram qualitatively and quantitatively when comparing the sample to a standard of known concentrations that is run and programmed into the Photovac library.

A 100 ul aliquot of the headspace from the sample is injected into the Photovac. The GC prints out the specific peaks for the compounds at the retention time for the VOC at the specific column temperature and carrier gas flow.

Chromatograms display the library listing and show the analysis conditions including the gain setting used. The data from this chromatogram is used to evaluate other chromatograms of the standards for the calibration range and to establish a lower detection limit. For example from experience, the detection limit for Benzene in water is 10 ppb.

QA/QC

Calibration

As part of the field analytical procedure, the Photovac is calibrated with a VOC standard. A standard is injected at the beginning and at the end of the daily analysis program to confirm positive identification.

Standards: The standards are composed of VOC in water that have high sensitivity and well defined peak separation, such as Benzene, Toluene, Ethylbenzene and Xylene (BTEX).

Preparation of Water Standards

The accuracy of the standards is dependent on the precautions taken in the transfers of liquids and care taken to prevent headspace loss. Cross contamination by using contaminated syringes must also be avoided.

Procedure

Standards may be made using analytical balances. The preferred method of making standards is to weigh small quantities of the volatile organic compounds in gas-tight syringes. These quantities are transferred to 20 ml of methanol and the whole reweighed (See Appendix A, Photovac Technical Bulletin #27 and Procedure For Weighing Liquids With A Syringe"). Concentration is then calculated directly on a wt/wt basis (ppm = ug/g).

Alternatively, the densities of the compounds are used to describe the weight of known volumes. The following is an example for making water standards at low ppb concentrations of Benzene and TCE. The procedure consists of 3 parts: a stock solution in methanol (approx. 1000-5000 ppm) is made, a serial dilation is made of 1/800 in water, followed by a further 1/500 dilution in water.

The standards are made up under controlled conditions by the testing laboratory from priority pollutant standards supplied and guaranteed by Supelco.

Results of Calibration Range Injections:

	LOWER LIMIT		CENTER LIMIT		UPPER LIMIT	
Chromatograms	#3	#4	#2		#1	
	calculated	actual	calculated	actual	calculated	actual
Benzene	.875	.624/.608	10.5	10.24	105	98.49
TCE	.666	.549/.549	8.0	7.56	80	71.76
Toluene	.875	.949/.906	10.5	9.69	105	105.8
PCE	.666	.718/.761	8.0	8.59	80	93.75

Injections: A 100 ul injection of the standard is introduced into the Photovac to obtain the retention time for the VOC at the specific column temperature and carrier gas flow.

The peaks derived from the standard is labelled by the inboard computer and integrated according to the peak size. The specific peak for a compound is then identified for the computer and assigned the known concentration of the standard. This chromatogram is then retained by the inboard computer and may be recalibrated at any time.

The computer identifies the sample peak with the retention time of the standard of the identified compound. All other peaks for the identified compound obtained during the Photovac analysis are thus assigned concentrations based on, and with respect to, the standard peak size.

A sample of the standard is included in the samples for Laboratory analysis to monitor any standard drift.

Duplicate Samples: Selected duplicate samples are retained in VOA vials from the split spoon samples. Equal volumes of soil are placed in the VOA vials so that a reasonable comparison of VOC contamination between samples could be made. Based on the results of the Photovac analysis, duplicate samples are identified for laboratory analysis. One in ten samples are chosen, placed in 950 ml amber glass jars with teflon sealed lids and sent to the Laboratory. The samples identified for laboratory analysis are chosen to cover a range of of VOC concentrations from approximately 100 ppb to 100 ppm. The laboratory analysis is conducted to provide quantitative data for the selected duplicate samples. This information is used as a basis for developing a correlation between the VOC concentration in the soil identified through Laboratory analysis and the Photovac data.

Interferences: The following precautions are taken to minimize the possibility of contamination influencing results:

A field blank of distilled water accompanies samples throughout the sampling effort and is analyzed at the time that field samples are analyzed. This field blank analysis protocol identifies inaccuracies introduced during soil gas and water sample collection and transport.

Syringes are screened for contamination by injecting ultra zero air into the GC after analyzing samples containing compounds of substantial concentrations. This screens for the possibility of contamination carry-over.

At the beginning of each day ultra zero air is injected into the gas chromatograph to determine if any internal contamination is present.

Background samples are taken on-site and analyzed periodically during the daily sampling effort. In addition, samples are taken daily from an area on or off-site that has been designated to be uncontaminated.

Duplicate samples are processed through the gas chromatograph for approximately 10% of the total samples analyzed.

Decontamination of Sampling Tool and Sample Container Cleaning Procedures:

The sampling tools used in a soils investigation, may include a drill rig and split-spoon components, stainless lab spatulas and a 3/8" diameter stainless steel rod. These tools are required to obtain the soil sample and transfer and tamp the contents of the split-spoon into the 40 ml amber glass, teflon-capped septum vials or the 250 ml amber glass bottles with teflon-lined caps.

Water samples are be collected using the VOA vial to grab a sample or a teflon bailer to obtain a water sample from a properly developed and evacuated well.

Hand tools are cleaned in the following manner:
- *Thorough washing with non phosphate detergent and tap water, utilizing a scrub brush*
- *Distilled water rinse (pressure-type sprayer)*
- *Acetone rinse (Reagent grade)*
- *Air dry*
- *Distilled water rinse (twice)*

Sample Containers: The sample containers used in this collection program are prepared by the analytical laboratory selected to perform all of the analysis.

Each VOA water sample is collected in three, 40 ml, teflon-lined, septum-capped glass vials. This protocol is written in accordance with the "Interim Analysis Guideline" for Total PHC, as contained in attachment 2,E. of the <u>DRAFT Sampling Plan Guide</u> of the NJDEP.

Bottles are prepared by the laboratory in accordance with current "organic-cleaned" protocol, as follows. The bottles are acetone rinsed, methylene chloride rinsed and oven-dried at 100 degrees C for one hour.

The containers for the Photovac analysis of VOC soil samples are identical to the water sample vials, and are provided with the same laboratory prep. The field blanks and trip blank (aqueous) samples are collected in four, 40 ml vials each, of the type and "preped" as previously described.

Documentation

Field notebooks are maintained by assigned field personnel. In addition, a printout of the analysis (chromatographic data) is maintained. This analysis protocol includes a listing of the certified gas standards of the compounds, a chromatogram, the time of analysis, a summary of analysis parameters, the retention times and concentrations of identified compounds, and a details of the sampling and precolumn/backflush analysis annotated on the computer printout.

Results

The results of the Photovac and laboratory analyses are displayed in a comparison table. A correlation between the laboratory data and the Photovac data is established.

Conclusion - Detection Limits;

Using the lower limit as the detection limit allows for adequate sensitivity for analysis of contaminants in groundwater and soil. A 100 ul injection of sample at an instrument gain of 100 will show 20 ppb as shown by chromatograms #3 and #4.

PHOTOVAC
Technical Bulletin

11

SOME OF THE COMPOUNDS THAT CAN BE DETECTED USING THE PHOTOVAC 10S SERIES OF PORTABLE GCs

Many of the chemicals mentioned herein are of a hazardous nature. Photovac expressly disclaims liability for any loss or injury arising out of the use of information, materials, equipment or practices described. Safe use of any procedure, equipment or material is the responsibility of the user.

For further information on contents of this bulletin or on Photovac products, please contact:

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PHOTOVAC TECHNICAL BULLETIN NO. 11

SOME OF THE COMPOUNDS THAT CAN BE DETECTED USING THE PHOTOCAC 10S SERIES OF PORTABLE G.C.S

NOTE Many compounds with an ionisation potential of 10.6 eV or less will also be detected by the Photovac TIP* (Total Ionisables Present) Monitor

****

	eV
Acetaldehyde	10.21
Acetic acid	10.37
Acetone	9.69
Acetylene	11.41
Acetylene dichloride	9.80
Acetylene tetrabromide	
Acrolein	10.10
Acrylonitrile	10.91
Allene	9.83
Allyl alcohol	9.67
Allyl chloride	10.20
Aminoethanol	9.87
Ammonia	10.15
Aniline	7.70
Anisole	8.22
Arsine	9.89
Benzaldehyde	9.53
Benzene	9.25
Benzenethiol	8.33
Benzyl chloride	10.16
Benzonitrile	9.71
Benzotrifluoride	9.68
Bromobenzene	8.98
1-bromobutane	10.13
2-bromobutane	9.98
1-bromobutanone	9.54
1-bromo-2-chloroethane	10.63
Bromochloromethane	10.77
Bromodichloromethane	
1-bromo-3-chloropropane	
Bromoethane	10.28
Bromoethene	9.80
Bromoform	10.48
1-bromo-3-hexanone	9.26
Bromomethane	10.53
Bromomethyl ethyl ether	10.08
1-bromo-2-methylpropane	10.09
2-bromo-2-methylpropane	9.89
1-bromopentane	10.10
1-bromopropane	10.18
2-bromopropane	10.08
1-bromopropene	9.30

	eV
2-bromopropene	10.06
3-bromopropene	9.70
2-bromothiophene	8.63
o-bromotoluene	8.79
m-bromotoluene	8.81
p-bromotoluene	8.67
1,3-butadiene	9.07
2,3-butadione	9.23
n-butanal	9.83
2-butanal	9.73
n-butane	10.63
1-butanethiol	9.14
2-butanone	9.53
iso-butanol	10.47
sec-butanol	10.23
tert-butanol	10.25
2-butanol	10.1
1-butene	9.58
cis-2-butene	9.13
trans-2-butene	9.13
3-butene nitrile	10.39
n-butyl acetate	10.01
sec-butyl acetate	9.91
n-butyl alcohol	10.04
n-butyl amine	8.71
i-butyl amine	8.70
s-butyl amine	8.70
t-butyl amine	8.64
n-butyl benzene	8.69
i-butyl benzene	8.68
t-butyl benzene	8.68
Butyl cellosolve	8.68
n-butyl mercaptan	9.15
i-butyl ethanoate	9.95
iso-butyl mercaptan	9.12
i-butyl methanoate	10.46
1-butyne	10.18
2-butyne	9.85
n-butyraldehyde	9.86
Carbon disulfide	10.13
Carbon tetrachloride	11.28
Cellosolve Acetate	

	eV
Chlorobenzene	9.07
Chlorobromomethane	
1-chloro-2-bromoethane	10.63
1-chlorobutane	10.67
2-chlorobutane	10.65
1-chlorobutanone	9.54
1-chloro-2,3 epoxy propane	10.60
Chloroethane (ethyl chloride)	10.97
Chloroethene	10.00
2-chloroethoxyethene	10.61
1-chloro-2-fluorobenzene	9.16
1-chloro-3-fluorobenzene	9.21
1-chloro-2-flouroethene(cis)	9.87
1-chloro-2-fluoroethene(trans)	9.87
Chloroform	11.37
o-chloroiodobenzene	8.35
1-chloro-2-methylbenzene	8.72
1-chloro-3-methylbenzene	8.61
1-chloro-4-methylbenzene	8.78
Chloromethylethyl ether	10.08
Chloromethylmethyl ether	10.25
1 chloro-2-methylpropane	10.66
Chloroprene	
1-chloropropane	10.82
2-chloropropane	10.78
3-chloropropene	10.04
p-chlorostyrene	
2-chlorothiophene	8.68
o-chlorotoluene	8.83
m-chlorotoluene	8.83
p-chlorotoluene	8.70
Cumene (i-propyl benzene)	8.75
Crotonaldehyde	9.73
Cyanoethene	10.91
Cyanogen bromide	10.91
3-cyanopropene	10.39
Cyclobutane	10.50
Cyclohexane	9.98
Cyclohexanone	9.14
Cyclohexene	8.95
Cyclo-octatetraene	7.99
Cyclopentadiene	8.55
Cyclopentane	10.52
Cyclopentanone	9.26
Cyclopentene	9.01
Cyclopropane	10.06
2-decanone	9.40
1,3-dibromobutane	
1,4-dibromobutane	
Dibromochloromethane	10.59
Dibromochloropropane	
1,1-dibromoethane	10.19
Dibromomethane	10.49
1,2-dibromopropane	10.26

	eV
2,2-dibromopropane	
1,2-dichlorobenzene	9.07
1,3-dichlorobenzene	9.12
1,4-dichlorobenzene	8.94
1,3-dichlorobutane	
1,4-dichlorobutane	
1,4-dichloro-2-butene(cis)	
2,2-dichlorobutane	
2,3-dichlorobutane	
3,4-dichlorobutene	
Dichlorodifluoromethane(Freon12)	11.75
1,1-dichloroethane	11.06
1,2-dichloroethane	11.04
cis-dichloroethene	9.65
trans-dichloroethene	9.66
Dichloroethyl ether	
Dichloromethane	11.35
1,2-dichloropropane	10.87
1,3-dichloropropane	10.85
1,1-dichloropropanone	9.71
2,3 dichloropropene	9.82
Dicyclopentadiene	7.74
Dibutyl amine	7.69
Diethoxymethane	9.70
Diethyl amine	8.01
Diethyl ether	9.53
N-diethyl formamide	8.89
Diethyl Ketone	9.32
Diethyl Sulfide	8.43
1,2-difluorobenzene	9.31
1,4-difluorobenzene	9.15
Difluorodibromomethane	11.18
Difluoromethylbenzene	9.45
1,1-dimethoxyethane	9.65
Dimethoxymethane	10.00
Diiodomethane	9.34
Diisobutyl Ketone	9.04
Diisopropylamine	7.73
Dimethyl amine	8.24
2,3-dimethylbutadiene	8.72
2,2-dimethyl butane	10.06
2,2-dimethyl butane-3-one	9.18
2,3-dimethyl butane	10.02
2,3-dimethyl-2-butene	8.30
3,3-dimethyl butanone	9.17
Dimethyl disulfide	8.46
Dimethyl ether	10.00
Dimethylformamide	9.45
3,5-dimethyl-4-heptanone	9.04
2,2-dimethyl-3-pentanone	8.98
2,2-dimethyl propane	10.35
Dimethyl sulfide	8.69
Di-n-propyl disulfide	8.27
Di-n-propyl ether	9.27

	eV
Di-i-propyl ether	9.20
Di-n-propyl amine	7.84
Di-n-propyl sulfide	8.30
Epichlorohydrin	10.60
Ethane	11.65
Ethanal	10.21
Ethanol	10.62
Ethanethiol (Ethyl mercaptan)	9.29
Ethene (Ethylene)	10.52
Ethyl acetate	10.11
Ethyl amine	8.86
Ethyl amyl ketone	9.10
Ethyl benzene	8.76
Ethyl bromide	10.29
Ethyl butyl ketone	9.02
Ethyl chloride (Chloroethane)	10.98
Ethyl chloroacetate	10.20
Ethyl ethanoate	10.10
Ethyl disulfide	8.27
Ethylene chlorohydrin	10.90
Ethylene dibromide (EDB)	10.37
Ethylene glycol dinitrate	
Ethylene oxide	10.56
Ethyl formate	10.61
Ethyl iodide	9.33
Ethyl methanoate	10.61
Ethyl isothiocyanate	9.14
Ethyl methyl sulfide	8.55
Ethyl propanoate	10.00
Ethyl trichloroacetate	10.44
Ethylidene chloride	
Ethynylbenzene	8.82
Mono-Fluorobenzene	9.20
Mono-Fluoroethene	10.37
Mono-Fluoromethanal	11.4
Fluorotribromomethane	10.67
o-fluorotoluene	8.92
m-fluorotoluene	8.92
p-fluorotoluene	8.79
Freon 11 (CFCl3)	11.77
Freon 12 (CF2Cl2)	12.91
Freon 13 (CF3Cl)	12.91
Freon 13 B-1	12.08
Freon 14 (neat)	16.25
Freon 22 (CHClF2)	12.45
Freon 113 (CF3CCl3)	11.78
2-furaldehyde	9.21
Furan	8.89
Furfuryl alcohol	
Furfural	9.21
Hexachloroethane	
n-Hexane	10.18
n-Heptane	10.07
2-Heptanone	9.33

	eV
4-Heptanone	9.12
1-Hexene	9.46
Hexanone	
Hexamethylbenzene	7.85
Hydrazine	
Hydrogen Cyanide	13.91
Hydrogen selenide	9.88
Hydrogen sulfide	10.46
Hydrogen telluride	9.14
Iodine	9.28
Iodobenzene	8.73
1-iodobutane	9.21
2-iodobutane	9.09
Iodoethane (Ethyl iodide)	9.33
Iodomethane (Methyl iodide)	9.54
1-iodo-2-methylpropane	9.18
1-iodo-2-methylpropane	9.02
1-iodopentane	9.19
1-iodopropane	9.26
2-iodopropane	9.17
o-iodotoluene	8.62
m-iodotoluene	8.61
p-iodotoluene	8.50
Isoamyl acetate	9.90
Isoamyl alcohol	10.16
Isobutane	10.57
Isobutyl amine	8.70
Isobutyl acetate	9.97
Isobutyl Alcohol	10.47
Isobutyl formate	10.46
Isobutyraldehyde	9.74
Isopentane	10.32
Isoprene	8.85
Isopropyl acetate	9.99
Isopropyl alcohol	10.16
Isopropyl amine	8.72
Isopropyl benzene	8.75
Isopropyl ether	9.20
Isovaleraldehyde	9.71
Mesitylene	8.40
Mesityl oxide	9.08
Methanol	10.85
Methyl acetate	10.27
Methyl acrylate	10.72
Methyl amine	8.97
Methyl bromide	10.53
2-methyl-1,3-butadiene	8.85
2-methylbutanal	9.71
2-methylbutane	10.31
2-methyl-1-butene	9.12
3-methyl-1-butene	9.51
3-methyl-2-butene	8.67
Methyl n-butyl ketone	9.34
Methyl butyrate	10.07

	eV
Methyl cellosolve	
Methyl Chloroacetate	10.35
Methyl chloride	11.28
Methyl chloroform	11.25
Methylcyclohexane	9.85
4-methylcyclohexene	8.91
Methylcyclopropane	9.52
Methyl dichloroacetate	10.44
Methyl ethanoate	10.27
Methyl ethyl ketone	9.53
Methyl ethyl sulfide	8.55
2-methyl furan	8.39
Methyl iodide	9.54
Methyl isobutyl ketone	9.30
Methyl isobutyrate	9.98
1-methyl-4-isopropylbenzene	
Methyl isopropyl ketone	9.32
Methyl methacrylate	9.74
Methyl methanoate	10.82
Methyl mercaptan	9.44
2-methylpentane	10.12
3-methylpentane	10.08
2-methylpropane	10.56
2-methylpropanal	9.74
2-methyl-2-propanol	9.70
2-methylpropene	9.23
Methyl n-propyl ketone	9.39
Methyl styrene	8.35
Morpholine	8.88
Naphthalene	8.10
Nitric oxide	9.25
Nitrobenzene	9.92
Nitrotoluene	9.43
n-Nonane	
5-nonanone	9.10
n-Octane	
3-octanone	9.19
4-octanone	9.10
1-octene	9.52
n-Pentane	10.53
Pentachloroethane	11.28
1,3-pentadiene (cis)	8.59
1,3-pentadiene (trans)	8.56
Pentafluorobenzene	9.84
Pentamethylbenzene	7.92
n-pentanal	9.82
2,4-pentanedione	8.87
2-pentanone	9.39
3-pentanone	9.32
1-pentene	9.50
Perchloroethylene	9.32
Perfluoro-2-butene	11.25
Perfluoro-1-heptene	10.48
n-perfluoropropyl iodide	10.36

	eV
(n-perfluoropropyl-iodomethane)	9.96
(n-perfluoropropyl-methyl ketone)	10.58
Phenol	8.69
Phenyl ether	8.09
Phenyl isocyanate	8.77
Phosphine	9.96
Pinene	8.07
Propadiene	10.19
n-propanal	9.95
Propane	11.07
1-propanethiol	9.20
n-propanol	10.51
Propanone	9.69
Propenal (Acrolein)	10.10
Propene	9.73
Prop-1-ene-2-ol	8.2
Prop-2-ene-1-ol	9.67
Propionaldehyde	9.98
n-Propyl acetate	10.04
n-Propyl alcohol	10.20
n-Propyl amine	8.78
n-Propyl benzene	8.72
Propylene	9.73
Propylene dichloride	
Propylene oxide	10.22
n-Propyl ether	9.27
n-Propyl formate	10.54
Propyne	10.36
Pyridine	9.32
Styrene	8.47
Tetrabromoethane	
Tetrachloroethene	9.32
1,1,1,2-Tetrachloroethane	
1,1,2,2-Tetrachloroethane	
1,2,3,4-tetrafluorobenzene	9.61
1,2,3,5-tetrafluorobenzene	9.55
1,2,4,5-tetrafluorobenzene	9.39
Tetrafluoroethene	10.12
Tetrahydrofuran	9.54
Tetrahydropyran	9.26
1,2,4,5-tetramethylbenzene	8.03
2,2,4,4-tetramethyl-3-pentanone	8.65
1,1,1,2-tetrachloropropane	
1,2,2,3-tetrachloropropane	
Thioethanol	9.29
Thiomethanol	9.44
Thiophene	8.86
1-thiopropanol	9.20
Toluene	8.82
Tribromoethene	9.27
1,1,1-trichlorobutanone	9.54
1,1,1-trichloroethane	11.25
1,1,2-trichloroethane	
Trichloroethene	9.45

	eV
Trichloromethyl ethyl ether	10.08
1,1,2-trichloropropane	
1,2,3-trichloropropane	
Triethylamine	7.50
1,2,4-trifluorobenzene	9.37
1,3,5-trifluorobenzene	9.32
Trifluoroethene	10.14
1,1,1-trifluoro-2-iodoethane	10.10
Trifluoroiodomethane	10.40
Trifluoromethylbenzene	9.68
Trifluoromethylcyclohexane	10.46
1,1,1-trifluoropropene	10.9
Trimethyl amine	7.82
1,2,3-trimethylbenzene	8.48
1,2,4-trimethylbenzene	8.27
1,3,5-trimethylbenzene	8.39
2,2,4-trimethyl pentane	9.86
2,2,4-trimethyl-3-pentanone	8.82
n-Valeraldehyde	9.82
Vinyl acetate	9.19
Vinyl benzene (styrene)	8.47
Vinyl bromide	9.80
Vinyl chloride	10.00
4-vinylcyclohexene	8.93
Vinyl ethanoate	9.19
Vinyl fluoride	10.37
Vinyl methyl ether	8.93
o-xylene	8.56
m-xylene	8.56
p-xylene	8.45

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Technical Bulletin

25

SOIL GAS SAMPLING PROCEDURE

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PHOTOVAC TECHNICAL BULLETIN # 25

SOIL GAS SAMPLING PROCEDURE

INTRODUCTION

This procedure is based on an actual site investigation conducted with E.P.A. approval and is intended to provide a guide for similar investigations. Local site conditions and the type of compounds present will obviously be different and approval of the planned procedure will need local E.P.A. approval.

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A soil gas sampling and analysis program was conducted to delineate the area extent of subsurface contamination containing volatile organic compounds (VOC). Target VOC are benzene, toluene, trichloroethylene (TCE), and perchloroethylene (PCE). The following describes the field sampling methodology, the normal operation of the portable gas chromatograph, interferences and QA/QC.

METHOD

SAMPLING PROCEDURE

Prior to conducting the sampling effort, the project site area (approx. 40 acres) was delineated into a grid pattern of 100 by 100 ft. sampling stations.

A plunger bar was utilized to make a ½" diameter vertical hole approximately 5 ft. into the soil. The bar has a slide hammer enabling the operator to pound the bar out once the desired depth has been reached. Once the bar is removed a stainless steel tube (6' by ¼" OD) contained within a Teflon tube (1/8" OD) slightly longer than the stainless tube is inserted into the hole.

Attached to the end of the Teflon tube is a nail with its point just fitting into the Teflon tube, and the head of the nail just large enough to cover the end of the stainless steel tube. This arrangement is then inserted into the hole, nail-end first. When the tube has been inserted to maximum depth, withdraw the tube 3" from the bottom of the hole and release the nail by withdrawing the Teflon tube. The sample can either be taken through the Teflon tubing or the Teflon tube can be completely withdrawn and the sample taken through the stainless steel tube. Loose soil will then be packed around the tube to minimize infiltration of ambient air.

The probe of the TIP is attached either to the Teflon tube or stainless tube depending upon which of the above options is used to sample. The TIP is used to screen the soil gas to determine when the sampling tube has been purged. Once the TIP readings stabilize showing the highest reading, this value is recorded and the air bag sampling apparatus is connected. The TIP reading will be used by the G.C. operator to evaluate the injection size and gain setting in order to prevent the G.C. detector from being saturated with highly contaminated samples.

An air sampling bag is connected to the sampling tube within the desiccator. An air sampling pump is used to create a low pressure system within the desiccator causing air to be drawn up through the sample tube and filling the Tedlar Bag with soil gas. The bagged sample is now ready to be analyzed by the portable gas chromatograph.

INITIAL SCREENING

The following is the initial procedure used by the G.C. operator to evaluate injection size with respect to TIP readings. This may vary if G.C. data indicates larger or smaller injection sizes are required to stay within the working calibration range.

TIP READING (ppm)	INJECTION SIZE (µl)	GAIN SETTING
0-5	500	100
5-20	100-500	100
20-60	25-100	50
60-100	25-100	20
100-150	25-100	10

If TIP readings exceed 150 ppm the G.C. operator would make a syringe dilution using ultra zero (UZ) air as the diluter. Dilutions are made using a 1 ml syringe as follows:

1. 100 µl of sample taken from Tedlar bag
2. Using same syringe, 900 µl of UZ air taken
3. 5 min. allowed for equilibrium to be reached
4. Diluted sample within syringe is expelled to leave 100 µl of sample remaining. A 1:10 dilution is accomplished.

If dilutions are necessary, a minimum dilution of 1:2 and a maximum dilution of 1:10 would be used accordingly to TIP readings.

SAMPLE ANALYSIS

Two commercially prepared gas standards, certified to be ± 2 % of the listed concentrations would be used to calibrate the G.C:

1. Benzene (10.59 ppm) and Toluene (10.68 ppm) mixture

2. TCE (8.04 ppm) and PCE (8.28 ppm) mixture

A 12 µl injection of each standard would be made approximately after every 5 to 8 samples are run. Also, beginning daily, standards would be run before sample analysis.

The Gas Chromatograph contains a built-in integrator and 4 libraries enabling a chromatogram to be interpreted qualitatively and quantitatively when compared to known concentrations of standards.

CALIBRATION

The gas chromatograph is calibrated by injecting 12 µl of each standard mixture and programming the instrument's library. Attachment # 1 includes representative gas chromatograms, numbered 1 through 5, of the proposed standards. Chromatogram #1 includes the library listing and shows the gain setting used. The data from this chromatogram is used to evaluate other chromatograms of the standards for the calibration range and to establish a lower detection limit.

Calibration Range:

LOWER LIMIT: (Chromatogram #3 and #4) = 21 ppb Benzene and Toluene and 16 ppb TCE and PCE.

A 1 ml aliquot of each certified gas mixture was injected into a 500 ml glass dilution vessel. A 500 µl injection of this mixture is entered into the G.C. at a gain of 100. The library quantification for this injection should be (calculated concentrations):

$$\text{Benzene \& Toluene -- 21 ppb} \times \frac{500\mu l}{12\ \mu l\ \text{-(Library Injection)(LI)}} = .875\ \text{ppm}$$

$$\text{TCE \& PCE -- 16 ppb} \times \frac{500\ \mu l}{12\ \mu l\ \text{(LI)}} = .666\ \text{ppm}$$

CENTER LIMIT (Chromatograph #2): A 12µl injection was made at 100 gain of the 10.5 ppm Benzene & Toluene mix, and 8.0 ppm TCE & PCE mix.

$$\text{Benzene \& Toluene -- 10.5 ppm} \times \frac{12\ ul}{12ul\ \text{(LI)}} = 10.5\ \text{ppm}$$

$$\text{TCE \& PCE -- 8 ppm} \times \frac{12\ \mu l}{12\mu l\ \text{(LI)}} = 8.0\ \text{ppm}$$

UPPER LIMIT (Chromatogram #5); A 120 µl injection was made of the 10.5 ppm mix and 8 ppm mix. The gain being set at 10. Calculated concentration:

$$\text{Benzene \& Toluene -- 10.5 ppm} \times \frac{120\ \mu l}{12\ \mu l\ \text{(LI)}} = 105\ \text{ppm}$$

$$\text{TCE \& PCE -- 8 ppm} \times \frac{120\ \mu l}{12\ \mu l\ \text{(LI)}} = 80\ \text{ppm}$$

Results of Calibration range injections:

	LOWER LIMIT			CENTER LIMIT		UPPER LIMIT	
Chromatograms	#3	#4		#2		#1	
	calculated	actual		calculated	actual	calculated	actual
Benzene	.875	.624	.608	10.5	10.24	105	98.49
TCE	.666	.549	.549	8.0	7.56	80	71.76
Toluene	.875	.949	.906	10.5	9.69	105	105.8
PCE	.666	.718	.761	8.0	8.59	80	93.75

Detection Limits:

Using the lower limit as the detection limit will allow for adequate sensitivity. A 500 µl injection of sample at an instrument gain of 100 will show 20 ppb as shown by Chromatograms #3 and #4.

G.C. Conditions:

- 20 ml/min flow ratio
- 5% SE 30 on Chromosorb G packing
- 3 in. precolumn and 2 ft. analytical column
- gain set at 100, 50, 20 or 10
- Working Concentration Range:
  20 ppb (500 µl injection, gain 100) - 100 ppm (120 µl injection gain 10)

INTERFERENCES

The following precautions should be taken to minimize the possibility of contamination influencing results:

A field blank of ultra zero air within a Tedlar bag will accompany soil gas samples throughout the sampling effort and will be analyzed during the same time that field samples are analyzed. This field blank analysis protocol will establish if contamination by diffusion is detected subsequent to soil gas sampling analysis.

Syringes will be screened for contamination by injecting ultra zero air into the G.C. after analyzing samples containing compounds of substantial concentrations. This will minimize the possibility of contamination carry-over.

At the beginning of each day ultra zero air will be injected into the gas chromatograph to determine if any internal contamination is present.

QA/QC

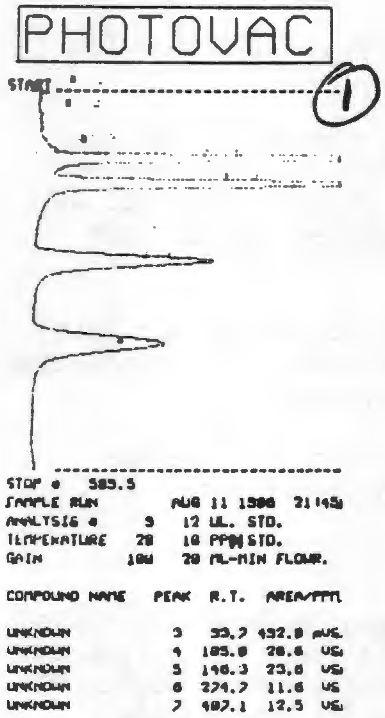
Background air samples would be taken on-site and analyzed periodically during the daily sampling effort. In addition, samples would be taken daily from an area on or off-site that has been designated to be noncontaminated. Duplicate samples would be processed through the gas chromatograph for approximately 10% of the total samples analyzed.

DECONTAMINATION

The sampling equipment would be decontaminated by purging the tubing with ambient air and then rescreening the equipment with the TIP. If contaminants are still present a soap wash, followed by high purity methanol and a distilled water rinse. Alternatively, the tubing may be discarded and replaced with new tubing.

DOCUMENTATION

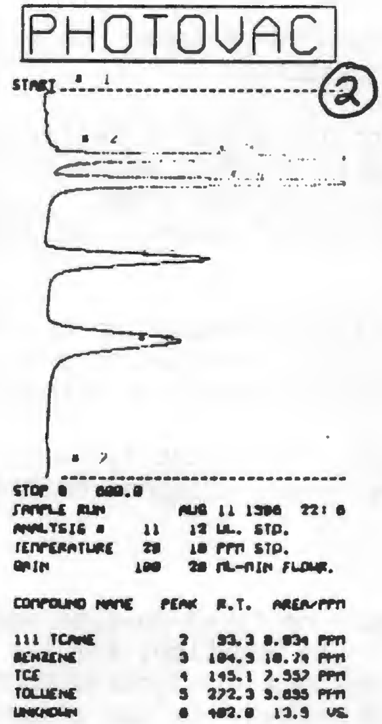
Field notebooks must be maintained by assigned field personnel. In addition, a printout of the analysis (chromatographic data) will be provided. This analysis will include a listing of the compounds (certified gas standards), a chromatogram, time of analysis, summary of analysis parameters, retention times and concentrations of identified compounds, and a program of sampling and precolumn/backflush analysis.



```
STOP @   585.5
SAMPLE RUN          AUG 11 1986  21:45
ANALYSIS #       9   12 UL. STD.
TEMPERATURE     20   10 PPM STD.
GAIN           100   20 ML-MIN FLOWR.

COMPOUND NAME   PEAK  R.T.   AREA/PPM

UNKNOWN            3   53.7 432.0 mVS
UNKNOWN            4  105.0  20.6  VS
UNKNOWN            5  146.3  23.6  VS
UNKNOWN            6  274.7  11.6  VS
UNKNOWN            7  407.1  12.5  VS
```



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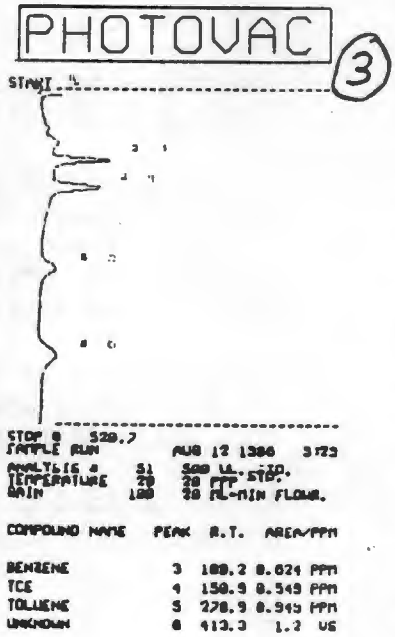
STOP @   600.0
SAMPLE RUN          AUG 11 1986  22: 0
ANALYSIS #      11   12 UL. STD.
TEMPERATURE     20   10 PPM STD.
GAIN           100   20 ML-MIN FLOWR.

COMPOUND NAME   PEAK  R.T.   AREA/PPM

111 TCANE          2   53.3 0.034 PPM
BENZENE            3  104.9 10.74 PPM
TCE                4  145.1 7.557 PPM
TOLUENE            5  272.3 3.035 PPM
UNKNOWN            6  402.0  13.9  VS
```



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STOP @   520.7
SAMPLE RUN          AUG 12 1986   3:23
ANALYSIS #      51   500 UL. STD.
TEMPERATURE     20   20 PPB STD.
GAIN           100   20 ML-MIN FLOWR.

COMPOUND NAME   PEAK  R.T.   AREA/PPM

BENZENE            3  100.2 0.024 PPM
TCE                4  150.9 0.549 PPM
TOLUENE            5  270.9 0.945 PPM
UNKNOWN            6  413.3   1.2  VS
```

```
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 1   COMPOUND    ID #  R.T.    LIMIT

BENZENE            1  105.0 20.00 PPM
TCE                2  146.3 20.00 PPM
TOLUENE            3  274.7 20.00 PPM
PCE                4  407.1 20.00 PPM
111 TCANE          5   53.7 20.00 PPM
```

```
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CALIBRATED PEAK  5,TOLUENE

SAMPLE RUN          AUG 11 1986  22: 2
ANALYSIS #      11   12 UL. STD.
TEMPERATURE     20   10 PPM STD.
GAIN           100   20 ML-MIN FLOWR.

COMPOUND NAME   PEAK  R.T.   AREA/PPM

111 TCANE          2   53.3 0.034 PPM
BENZENE            3  104.9 10.74 PPM
TCE                4  145.1 7.557 PPM
TOLUENE            5  272.3 3.035 PPM
PCE                6  402.0 0.530 PPM
```

```
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[illegible]

SAMPLE RUN          AUG 12 1986   3:30
ANALYSIS #      51   500 UL. STD.
TEMPERATURE     20   20 PPB STD.
GAIN           100   20 ML-MIN FLOWR.

COMPOUND NAME   PEAK  R.T.   AREA/PPM

BENZENE            3  100.2 0.024 PPM
TCE                4  150.9 0.543 PPM
TOLUENE            5  270.9 0.943 PPM
PCe
                   6  413.3 0.710 PPM
```

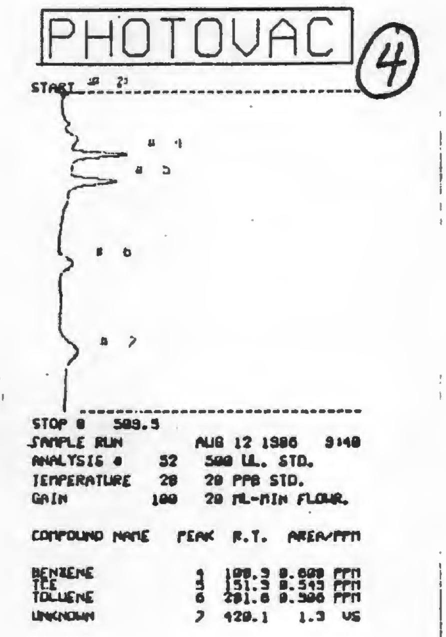

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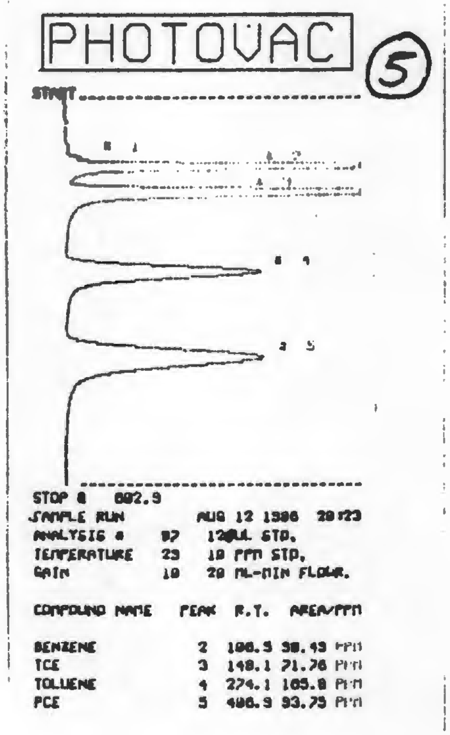
STOP @   509.5
SAMPLE RUN          AUG 12 1986   9:40
ANALYSIS #     52   500 UL. STD.
TEMPERATURE    20   20 PPB STD.
GAIN          100   20 ML-MIN FLOWR.

COMPOUND NAME   PEAK  R.T.   AREA/PPM

BENZENE            4  100.3 0.600 PPM
TCE                5  151.3 0.543 PPM
TOLUENE            6  281.6 0.300 PPM
UNKNOWN            7  420.1    1.3  VS
```



5

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STOP @   602.9
SAMPLE RUN          AUG 12 1986  20:23
ANALYSIS #     87   120UL STD.
TEMPERATURE    23   10 PPM STD.
GAIN           10   20 ML-MIN FLOWR.

COMPOUND NAME   PEAK  R.T.   AREA/PPM

BENZENE            2  100.5 30.43 PPM
TCE                3  148.1 71.76 PPM
TOLUENE            4  274.1 105.0 PPM
PCE                5  406.9 93.75 PPM
```

```
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CALIBRATED PEAK  6,TOLUENE

SAMPLE RUN          AUG 12 1986   9:41
ANALYSIS #     52   500 UL. STD.
TEMPERATURE    20   20 PPB STD.
GAIN          100   20 ML-MIN FLOWR.

COMPOUND NAME   PEAK  R.T.   AREA/PPM

BENZENE            4  100.3 0.600 PPM
TCE                5  151.3 0.543 PPM
TOLUENE            6  281.6 0.300 PPM
PCE                7  420.1 0.701 PPM
```

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Technical Bulletin

27

PREPARATION OF AQUEOUS STANDARDS FOR GROUNDWATER ANALYSIS

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PHOTOVAC TECHNICAL BULLETIN #27

PREPARATION OF AQUEOUS STANDARDS FOR GROUNDWATER ANALYSIS

This procedure is based on an actual site investigation conducted with E.P.A. approval and is intended to provide a guide for similar investigations. Local site conditions and the type of compounds present will obviously be different and approval of the planned procedure will need local E.P.A. approval.

PREPARATION OF WATER STANDARDS

This is a general guideline to be used when making water standards of volatile compounds. The example given is for Benzene and TCE, two compounds commonly found in groundwater contamination. The volumes used for generating the initial stock solution and subsequent dilutions are readily dispensable to allow the preparation of low concentration standards.

The accuracy of the standards is dependent on the precautions taken in the transfers of liquids and care taken to prevent headspace loss. Cross contamination by using contaminated syringes must also be avoided.

APPARATUS: The following apparatus is required, with care being taken to decontaminate the various items using only spectroscopic grade solvents:

1. 40 ml VOA bottles
2. Gas-tight syringes (50 ul to 100 ul).
3. Volumetric pipettes to measure 20 ml and 40 ml volumes. (Other glassware of compatible accuracy can be used as alternatives).
4. Analytical balance (and pan balance if available).

REAGENTS

1. 100 ml Methanol
2. Approximately 20 ml each of other desired reagents.
3. Organic-free water.

PROCEDURE

If analytical balances are available, then the preferred method of making standards is to weigh small quantities of the volatile organic compounds in gas-tight syringes. These quantities are transferred to 20 ml of Methanol and the whole reweighed (See Appendix A, "Procedure For Weighing Liquids With A Syringe"). Concentration is then calculated directly on a wt/wt basis (ppm = ug/g).

If analytical balances are not available, the densities of the compounds are used to describe the weight of known volumes. The following is an example for making water standards at low ppb concentrations of Benzene and TCE. The procedure consists of 3 parts: A) Making a stock solution in Methanol (approx. 1000-5000 ppm), B) 1/800 dilution in water, C) 1/500 dilution in water.

A) STOCK SOLUTION IN METHANOL

1. Using a 20 ml volumetric pipette, transfer 20 ml of Methanol to a 40 ml

VOA bottle. Cap the bottle immediately. The density of Methanol is $\frac{.7915\ \text{g}}{\text{ml}}$ at 20°C, 20 ml should weigh:

$$\frac{.7915\ \text{g}}{\text{ml}} \times 20\ \text{ml} = 15.83\ \text{g of Methanol}$$

2. Using a gas-tight 100 µl syringe, transfer 40 ul of TCE into the 20 ml of Methanol. The density of TCE is $\frac{1.465\ \text{g}}{\text{ml}}$ at 20°C therefore 40 µl weighs

$$\frac{1.465\ \text{g}}{\text{ml}} = \frac{1465\ \text{mg}}{\text{ml}} = \frac{1465\ \text{mg}}{1000\ \mu\text{l}} = \frac{1.465\ \text{mg}}{\mu\text{l}}$$

$$\text{Therefore, } 40\ \mu\text{l} \times \frac{1.465\ \text{mg}}{\mu\text{l}} = 58.6\ \text{mg TCE}$$

3. With a clean syringe, transfer 60 µl of Benzene to the TCE/Methanol mixture. The density of Benzene at 20°C is $\frac{.8794\ \text{g}}{\text{ml}}$ therefore 60 µl =

$$\frac{0.8794\ \text{g}}{\text{ml}} = \frac{0.8794\ \text{mg}}{\mu\text{l}} \times 60\ \mu\text{l} = 52.76\ \text{mg Benzene}$$

Concentration of stock solution

$$\text{for Benzene} - \frac{52.76\ \text{mg Benzene}}{52.76\ \text{mg Benzene} = 58.6\ \text{mg TCE} + 15.83\ \text{g Methanol}} =$$

$$\frac{52.76\ \text{mg Benzene}}{15.94\ \text{g total}} = \frac{52{,}760\ \mu\text{g}}{15.94\ \text{g}} = \frac{3310\ \mu\text{g}}{1\ \text{g}} = 3310\ \text{ppm}$$

$$\text{for TCE} - \frac{58.60\ \text{mg TCE}}{58.60\ \text{mg TCE} + 52.76\ \text{mg Benzene} + 15.83\ \text{g Methanol}} =$$

$$\frac{58.60\ \text{mg TCE}}{15.94\ \text{g total}} = \frac{3676\ \mu\text{g}}{1\ \text{g}} = 3676\ \text{ppm}$$

This mixture is Solution A.

B) 1st Dilution of Stock:

Withdraw 50 µl of stock solution with a 100 µl syringe and transfer into 40 ml of organic-free water within a VOA bottle. Mix by shaking for a few minutes and let stand for 15 minutes.

$$\text{Concentration} = \frac{.050\ \text{ml stock}}{40\ \text{ml water}} = \frac{1}{800} = 4.6\ \text{ppm TCE}$$

and 4.14 ppm Benzene (Solution B)

C) 2nd Dilution:

Using Solution B, withdraw 40 µl and expel into 20 ml water in a 40 ml VOA bottle. Invert the bottle and swirl a few minutes.

Let the solution sit 30 minutes to equilibrate before using.

Concentration: $\frac{40\ \mu l\ \text{Solution B}}{20\ ml\ \text{water}} =$

$\frac{.40\ ml}{20\ ml} = \frac{1}{500}$ dilution = 9.2 ppb TCE + 8.3 ppb Benzene (Solution)

Solution C is the working Standard.

NOTE: Follow chemical manufacturer's recommended safety information for the reagents used.

Precautionary Notes

1. Care should be taken not to inject liquid into the G.C.

2. When using a 10S50 or 10S70 G.C. use a separate library for water standard data. By listing the headspace concentration as the liquid concentration, from the standards, the G.C. will then print results based on liquid concentration for field samples. This approach will prevent confusion with air calibration data and negates the need for using Henry's Law to calculate vapor concentrations with respect to liquid samples.

3. When working with samples in the parts-per-billion concentration range, freshly prepared aqueous standards should be used on a daily basis. The standards should be stored with the septum screw capped VOA vial inverted.

4. Depending upon the volume of headspace used for injection into the G.C., using a clean gas-tight syringe, transfer the same volume of UZ air to replenish the headspace. Allow the standard to equilibrate for approximately 1/2 hour.

5. Typically, injection volume of headspace range from 100-500 μl.

APPENDIX A

PROCEDURE FOR WEIGHING LIQUIDS WITH A SYRINGE

Cautions/Limitations:

1. The minimum amount of liquid to be weighed is 20 µl.
2. Use only about 50%-60% of the capacity of the syringe, therefore, the minimum size syringe that can be used is 50 µl.
3. Perform procedure as quickly as possible to avoid exposure and possible volatilization.
4. For liquids that are very volatile, it is necessary to draw total sample back into syringe barrel, before weighing, to prevent liquid volatilization during weighing procedure.

Procedure

1. Use a 50 µl syringe and withdraw at least 20 µl of liquid.
2. Carefully wipe the needle and syringe dry.
3. Place syringe on analytical balance and weigh. (Tare and sample).
4. Depress plunger to empty syringe into a suitable flask containing solvent. To prevent volatilization of liquid, be sure to empty contents of the syringe under the surface of the solvent.
5. Reweigh syringe (tare), and by difference calculate the weight of the liquid taken.

Appendix A

Standard Operating Procedures for Soil Sampling

✓ Excavation and Post Excavation Sampling

Photovac Analysis of Soil and Water

Excavation and Post Excavation Sampling

This protocol outlines equipment and procedures to be used when collecting representative excavation and post-excavation soil samples from soil excavation. If groundwater is encountered, grab samples of the groundwater will be obtained.

Sampling Equipment

A backhoe and/or shovel will be used for obtaining soil samples from excavations. Prior to mobilization and following each excavation, the backhoe bucket will be washed with detergent and rinsed with tap water.

Shovels and other specific items, such as spatulas and scoops will be cleaned in the following manner: Residue oils, grit, rust and soil shall be removed with a stiff wire brush; thorough washing with non-phosphate detergent, utilizing a scrub brush; rinse with tap water; rinse with distilled/deionized water; rinse with pesticide grade acetone; total air dry; rinse with distilled or deionized water; and wrap in aluminum foil and security tape immediately after cleaning.

All wash and rinse fluids shall be collected and disposed of properly.

After cleaning, shovel points, sampling scoops, spatulas, and similar small equipment must be foil wrapped and placed in a ziplock bag (up to five per bag). A sample equipment custody record (form attached) will be completed and will accompany equipment after cleaning. When possible, cleaning of shovel points, scoops and spatulas will take place under laboratory conditions, prior to delivery to the site.

Sample Containers

The type of containers used for sample collection will be dictated by the parameters for which the sample is to be analyzed. A list of appropriate containers, with holding times, appears in this protocol.

Sample Collection Procedures

General

Sampling will be performed by staff personnel with experience in environmental sampling. The senior member of the team will be responsible for complete documentation of the sampling. Documentation will be written in ink in a field log-book, appropriately dated and signed. The team shall also maintain chain of custody records for all samples until they are shipped to the laboratory for analysis.

Prior to sampling, the sample location will be measured relative to at least two permanent, recognizable landmarks, in such a manner that the location can be reproduced to within an accuracy of one foot.

All samples will be collected with dedicated, stainless steel scoops which have been cleaned as outlined in this protocol.

If sufficient information regarding conditions at the site are known, excavation and sampling will proceed from areas of least contamination to areas of greatest contamination.

Excavations

Soil samples will be taken at the 4 and 6 foot elevations in the excavations and screened with the Photovac. One in ten samples will be analyzed by method SW846 in the laboratory.

Post-Excavation Samples

Samples will be collected as soon as possible following soil removal. If the excavation is unstable or such that the safety of the sampling team may be jeopardized, samples will be collected directly from the backhoe bucket. For excavations 20 feet square, samples will be collected from the excavation base along each sidewall and at the center line of the excavation. No less than 5 samples per excavation will be analyzed in the laboratory from each excavation. When the excavation is larger than 20 feet across but less than 30 feet across six sidewall samples will be collected. When capacity is greater than 30 feet across, eight sidewall samples will be collected. Post-excavation samples will be collected every 15 feet along the excavation center line.

Post-Treatment Sampling

Soil subject to on-site treatment will be sampled and analyzed with the Photovac to verify that cleanup is progressing. Upon obtaining satisfactory results with the Photovac, confirmatory samples will be taken for laboratory analysis before the soil is returned to the excavation. One sample will be taken for every 20 cubic yards of soil.

Stockpiled Material

Stockpile of excavated materials will be placed on and covered with 8 ml plastic and heavy tarpaulins to resist weathering. The tarpaulins will be weighted to avoid wind damage.

Analytical Parameter Selection

In general, parameter selection will be dictated by the type of material known or suspected of being stored, spilled or disposed at a site and by previous analytical data. Volatile organics will be analyzed by Method SW 846.

Sample Holding Times

The following holding times and container types will be used for soil sample collection:

Parameter	Container	Holding Time (1)
Volatile Organic	40ml vial w/teflon lined septum	14 days

---

(1) All samples must be maintained on ice from the time of collection until their arrival at the laboratory.

Field Quality Assurance/Quality Control

Field Replicates

A minimum of one post-excavation sample per day will be collected in duplicate. The number of duplicates collected should not exceed 10% of the total number of post-excavation samples collected.

Travel Blank

A travel blank will accompany the sample containers through the entire sampling program. The travel blank will be provided by the laboratory which will be performing the analysis. The travel blank will be analyzed for volatile organics.

Field Rinse Blank

The field blank will be prepared by running laboratory supplied water over an appropriately cleaned stainless steel scoop and collecting, the water in a laboratory supplied container. The field blank will be analyzed for a parameter being investigated at the site.

Travel and field duplicate blanks will only be required for post-excavation samples and will not be prepared or collected for waste classification samples.

Record Keeping -Field Data

All field data will be recorded in the bound field log-book. This data will include, but not be limited to: weather conditions, samples, lithology, measurements of excavation and the sequence in which samples were taken.

Equipment Cleaning Custody Record

An equipment cleaning custody record will be filled out and supplied with sampling equipment documenting cleaning in accordance with the procedure.

Chain of Custody

A chain of custody will be implemented during sample collection. A copy of this form is attached.

Analysis Request Form

A request for analysis form will be filed with the laboratory, indicating parameters requested as well as collection date, requested turnaround times and detection limits. A copy of this form is attached.

Appendix B

Standard Operating Procedures for Groundwater Sampling

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sopgw

STANDARD OPERATING PROCEDURES FOR POTABLE AND MONITORING WELL SAMPLING

STANDARD OPERATING PROCEDURES
POTABLE AND MONITOR WELL SAMPLING

Purpose. Representative groundwater samples can be collected from potable water supply wells or monitoring wells located within close proximity to a spill site. These wells are sampled to detect the presence and degree of contamination in the groundwater in the vicinity of each well at the time of sampling. If the results from this sampling campaign indicate groundwater contamination, then additional potable or monitoring wells located over a larger area may be sampled.

This standard operating procedure provides information on the following:

- Sample collection/preservation;
- Analytical requirements;
- Chain-of-custody control; and
- Summary Checklist
- Data sheets
- Calculation of saturated well volume
- Test procedures
- Equipment

Introduction

A detailed approach to well sampling is developed after complete review of the construction of the existing well and groundwater data.

The question of conducting interviews with home owners or public water supply officials and the extent of such interviews, is determined in the context of a public relations plan. Permission to enter property is obtained for all private well locations. For each sample location, a supplementary data sheet is completed

The information required prior to sampling of potable wells is as follows:

- *Precise location of well on property in relation to septic system or other contaminant sources*
- *Accessibility to well*
- *Name of driller and date installed*
- *Depth of well*
- *Well construction details*
- *Pump type and setting*
- *Access to the well*
- *Is water pumped into a holding tank before household distribution?*
- *Are any water treatment systems used?*
- *Well use data. Pumping rate, incidence and duration of use*

Once the well information is obtained, the precise location and method of sample collection is detailed.

In order for valid representative groundwater samples to be collected from monitor wells, it is very important to properly prepare the well prior to sample collection. This preparation entails developing groundwater flow to the well (well development), removing all the water which is standing in the casing (evacuation) and taking the sample from water which has recently been recharged from the aquifer.

If the wells can be accessed directly, an attempt is made to remove at least 3-5 well volumes prior to sample collection. If the wells cannot be reached, and the home or facility utilizes a holding tank or water treatment system, every attempt is made to grab a sample before it enters the holding tank or is treated. If this is not possible, then several holding tank volumes are evacuated prior to sample collection, and the collection method used is noted on the sample sheet. The samples are drawn directly from the tap or spigot into the sample bottles.

NOTE: *A special case is when sampling for a floating layer, which requires procedures to minimize mixing and emulsification of the separate layer or in obtaining samples at discrete depth intervals in a well.*

SAMPLING PROCEDURES

1. Water Height Measurement

After unlocking and removing the well cap, the position of the pump assembly is observed. If the pump is suspended at the top of the casing, it is lifted out of the casing. If it is submerged in the well, the pump is left in the well or measurement of the height of the water, or the static water level will be lowered and inaccurate. If the surface of the well water is below the top of a pump assembly which has been lowered into the well, the pump is partially removed and allowed to drain into the well. The pump is removed from the casing once it has drained completely. Time is allowed for the recovery of the static water level. Note this occurrence when recording the well water height.

The height of the water in the well is measured using a steel tape calibrated in decimal feet (See Water Level Measurement Section) or an equivalent method.

2. Removing Standing Water

The volume of well water to be evacuated prior to sampling is determined by subtracting the water surface measurement from the well depth. The difference is then multiplied by the appropriate gallons/foot of well volume. A bucket and stop watch or equivalent may be used to measure the rate of pumping from the well.

The method of evacuation should be pertinent to the goals of the sampling effort. In fractured rock or limestone or where the contaminant plume is at some distance or depth from the well intake, the evacuation of 3-5 well volumes may not duplicate the demands upon an aquifer caused by peak-load pumping. After extensive clothes washing, during sprinkling of gardens or extensive municipal supply pumping, the contaminant plume may temporarily be drawn upwards or sideways into the well resulting in higher health risks.

The pump location is critical to subsequent representative sampling and should be specified for each well. During evacuation, the pump should be located immediately below the water table or drawdown level in the well. Thus, all stagnant water in the borehole will be evacuated. If the pump is located at the well screen depth then stagnant water can remain in the well at the water table, and samples should only be taken at the well screen depth.

For product lighter than water, a protocol of well evacuation and 1 week of resting the well may be indicated so that floating product may again accumulate. In either case, the well screen should be located above and below the current water table to allow for seasonal fluctuations of the water table.

In cases where a well is emptied until dry and is very slow to recover, the volume required for evacuation may be reduced to two or three standing water volumes.

During the pumping of a groundwater well to take a sample, the drawdown with time may be noted to obtain the hydraulic characteristics of the aquifer involved.

Additional Considerations The nature of the pollutant parameter being monitored is the primary factor for specifying well evacuation and sampling methods. These specifications are most conveniently based on the general class of pollutant or parameter which requires monitoring in a particular program.

Physical properties include such parameters as conductance, color, pH, temperature, and turbidity. In general, most sampling methods are acceptable to monitor these parameters, provided they allow a thorough rinsing between sampling events. However, studies by Gibb, et al., (see reference below) have clearly shown that methods which affect gas composition of the sample will affect pH and volatiles concentration. Consequently, since gas lift pumping methods may leave water in the well in a disturbed and aerated condition, these methods are not suitable for well evacuation when volatiles or pH are a parameter of interest.

**Gibb, S.P.; R. M. Schuller; and R. A. Griffin. 1981. Procedures for the Collection of Representative Water Quality Data from Monitoring Wells. Illinois State Water Survey and Illinois State Geological Survey, Cooperative Groundwater Report, Champaign, Illinois.*

Similarly, since concentration of metals can be significantly influenced by changes in pH, sampling for metals should not be allowed with gas lift or suction methods. The guidance provided above for well evacuation when pH is the parameter of interest also applies for metals. In addition, equipment used for monitoring metal concentrations should be metal free. Consequently, bailers and positive displacement pumps are most suitable for sampling metals provided they are constructed of appropriate materials. The methods acceptable for well evacuation are less restricted, but gas lift methods or equipment that alter the metal concentration of water remaining in the well through leaching or adsorption should be avoided.

Inorganic, non-metallic constitutent or parameters include acidity, alkalinity, bromide, chloride, fluoride, nitrate, etc. Most of the sampling and well evacuation methods described above are generally acceptable when considering the inorganic, non-metallic parameters. However, for parameters affected by pH or dissolved-gas changes, such as alkalinity, methods that minimize changes in dissolved gas composition are recommended for sampling. These methods include bailers, squeeze pumps, piston pumps; gas lift techniques
are not recommended for well evacuation.

Generalized organic parameters include parmeters such as oil and grease, COD, TOC, TOX. Most sampling and well evacuation methods are suitable for these parameters, with the exception of the more sensitive parameters such as TOX. These sensitive parameters require methods suitable for sampling volatile organics.

It is appropriate that sampling for volatile organics be done with a glass or Teflon bailer after flushing with a non-aerating pump or bailer. Positive displacement pumps may be acceptable in sampling, provided they are constructed with suitable materals (Teflon or glass in most cases).

A well with a low yield may require a waiting period so that sufficient water reenters the well to provide a sample.

Once the required volume has been purged from the well, the sample to be analyzed may be collected.

3. Sample Collection, Preservation & Field Analyses

Wells may be sampled only after the water has been sufficiently recharged to obtain the needed amount of sample. All wells included in a given program are sampled within a one week time interval, weather permitting. Once the well is adequately evacuated, actual sampling may be performed using 1) steam cleaned bailers rinsed in distilled water, 2) dedicated bailers or 3) peristaltic pumps.

The bottom-loading bailers used are fitted with a teflon check valve at their base. Each bailer is fitted with a stainless steel wire leader and a new piece of nylon cord. A different pre-cleaned bailer is devoted to each well. If the bailer has not been used for well evacuation, the first 3 bails of water are wasted to rinse off any cleaning agents which might still be present on the bailer. The samples are poured directly from the bailer to sample jars. If filtering or chemical preservation of the samples is required these steps are followed immediately the water is removed from the well. For filtration, the use of a 0.45 micron filter is generally considered appropriate.

If dedicated bailers are not available, the bailers are steam cleaned and rinsed with distilled water. In addition, those wells which are suspected of being contaminated are sampled last in the sequence. It is prudent to avoid sampling highly contaminated wells on the same day as those wells anticipated to be clean.

For peristaltic pumps, suction tubing is dedicated to a particular well and is cleaned with distilled water between samplings.

Data relating to samples are recorded on a uniquely numbered sample documentation form. Each sample is defined with the following entries:

Date and time sample is collected
Sample I.D. number
Location of sampling point
Type of sample (e.g., soil, groundwater, surface water)
Field measurements

In addition, information regarding shipment of samples is recorded on the chain of custody forms.

Analyses of pH, temperature, and specific conductance are made in the field at the time of sampling because these parameters change rapidly and a laboratory analysis might not be representative of the true groundwater quality. Enough water from the well is removed to determine temperature of water, specific conductivity, and pH. Values for the parameters are recorded on field data sheets and the water discarded in a manner so as to avoid potential contamination.

All groundwater samples are carefully packed on ice for shipment to the R/D Lab. Proper chain-of-custody procedure is followed when transferring the samples from the field to the lab.

After each sample is obtained and placed in its container:

The sample bottle is capped and the bottle labelled. Labels show the sample number, date, sample source, preservative added, if any, and analysis to be performed.

All pertinent information is entered on field data sheets and chain-of-custody forms. Observations as to the odor or color of the water sample are included on the data sheets.

Samples are transferred to an ice chest for shipment to the laboratory.

All equipment is cleaned thoroughly between samples.

For VOA or VOX sampling:

The samples are collected in approximately 50 ml airtight, glass pharmaceutical vials with plastic caps lined by teflon septa. Each sample is clearly labeled as to location and number before the sample is collected.

Each sample consists of two 50 ml vials. Each vial is filled completely and checked to insure that no air is entrained once the cap is in place.

Each vial is wrapped to minimize the possibility of breakage during shipment.

For base neutrals/acid extractables:

Two liter jugs of water are taken and filled 2/3 full and the fill level marked on the outside of the bottle.

All analytical work is completed in compliance with standard USEPA requirements.

III. Chain of Custody Procedures

1. Sample Custody

The field sampler is personally responsible for the care and custody of unused, empty or sample filled containers until they are transferred or properly dispatched. Sample containers are kept under the custody of one designated person at any given time. A sample is under custody if:

a. It is in the samplers actual physical possession; or
b. It is in view, after being in the samplers physical possession; or
c. It is locked up to prevent tampering; or
d. It is in a designated secure area.

2. Field Log Book

Information pertinent to field sampling and measurements is recorded in a bound log book or a log book composed of the serially numbered data sheets filed in a three ring binder. The field sampling plan is appended to the log book as partial documentation of the sampling program. Specific entries that are included in the log book include at least, the following:

a. Each page dated and signed;
b. Date and time of sampling;
c. Sample identification number;
d. Location of sampling point;
e. Type of sample (e.g., grab, composite, groundwater, wastewater, sludge, soil, etc.)
f. Deviations from sampling plan;
g. Field measurements (e.g., pH, conductivity, temperature, etc.);
h. Field observations;
i. Photographs; and
j. Sample custody transfer and transport.

3. Sample Labels

Every sample container is uniquely labeled to prevent misidentification. Labels are attached to containers as they are generated in the field. The labels include the following:

a. Date and time sample collected;
b. Sample identification number;
c. Place of collection; and
d. Signature of collector.

4. Sample Seals

Sample seals are used to prevent unauthorized tampering from the time samples are collected until containers are opened in the laboratory. The seals may be attached over the sample container cap in such a way that the seal must be torn in order to open the container. The following information is recorded on each seal:

a. Date of sampling;
b. Signature of collector.

5. Chain-of-Custody Record (Field Activities)

Samples are accompanied by a Chain-of-Custody Record whenever possession of custody is transferred or relinquished. Each Chain-of-Custody Record sheet is filled out with a carbon paper duplicate before the field sample custodian relinquishes possession or arranges for shipment. The original record accompanies the samples relinquished. Each record sheet includes the following information

a. Signature of field sampler/sample custodian;

b. Beginning date-time of possession;

c. Final date-time of possession; and

d. For each sample:

e. Date-time of collection;

f. Sample identification number;

g. Location of sampling point; and sample type.

6. Transfer of Custody and Shipment

The following are guidelines for shipping non-hazardous samples:

a. Samples are sealed in containers marked with name and address of laboratory;

b. Samples are placed in a strong outside container such as a picnic cooler. Ice, dry ice or "blue ice" may be used inside plastic bags between the containers and box.

c. The outer container is sealed completely with tape or glue and the sample dispatcher signs across the tape or glue joints at several locations on the package to serve as an "outer seal."

d. The container is properly addressed and a shipping list affixed.

e. Samples may be transported by rented or common carrier air, truck, bus, railroad, and entities such as Federal Express. If sent by mail, the package registered with return receipt requested. If sent by common carrier, a Bill of Lading is used. Receipts from post offices and Bills of Lading are retained as part of the permanent documentation. A convenience is to take the sample shipment to the nearest UCC shipping department.

CLASSIFICATION SHEET

Sheet __ of __

Project: ________________ **Job #:** __________ **Drill Hole:** ____

Site Area: ________________

Contractor: ________________ **Driller:** ________________

Coordinates ____________ N/S: ____________ EW

Permit #: ________________ **Agency** ____________ State ____

Drill Method ________________ ________________

________________ ________________

Additions ________________ (Bentonite,etc. ____

Date Drilled ________________

WELL CONSTRUCTION

See well construction diagram

WELL DEVELOPMENT

Distance ____________ to Water **Submerge** ____________ vol

Vol Pumped ________________ **Rate** ________________

Pump Used: ________________ ________________

Sp C ____________ initial ____________ stable

Temp ____________ initial ____________ stable

pH ____________ initial ____________ stable

SAMPLING

Elevation : ____________ Ground

Elevn ft Top of Casing ____________ ________________

Depth To water from TOC ____________ ________________

Stickup of the casing ____________ ________________

Elev of the Ground Calcltd ________________

Water from Top of Casing ________________

GW Elev ________________ 0 Hrs 24 Hrs.

Date: ________________ **Comments** ________________

See sample documentation sheet

Comments:

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Water Level Record Sheet

Project
Location **Well #** **Reference Pt Elev.(feet)**
Land Surface Elev. (feet)
Well Depth (feet) **Perforated Interval** **Aquifer zone**

Date Time	Well	Well	Well	Well	Well	Well	Well

Comments

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Water Level Record Sheet

Project
Location
Well #
Reference Pt Elev.(feet)
Land Surface Elev. (feet)
Well Depth (feet)
Perforated Interval
Aquifer zone

Well # Date	Time	Ground Elevn.	Depth of Water below TOC	Stick-up	Depth of Water below GL	Water Level Elevation	Remarks

Comments

O&M INSPECTION CHECKLIST

DATE	PARELLA WELL	INFLUENT FLOW	INFLUENT CONC.	EFFLUENT FLOW	EFFLUENT CONC.		AIR PUMP	LEVEL IN TANK	DISCHARGE PIPING COMMENTS

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Fracture/Joint Survey

Project
Location
Date Time

Diagram		Strike	Dip	Designation	Comments

Comments:

Formula for Calculation of Saturated Well Volume

The basic Formula is $V = TT\ r^2 h$

V = Volume (ft^3)

TT = 3.14

r = Radius of monitoring well casing (ft.)

h = Height of standing water in well (ft.)

This formula is then modified to the following:

$$V = \frac{3.1416 \text{ x } r^2 \text{ x } h \text{ (inches}}{231}$$

So that the number of gallons of water per foot of pipe for any diameter can be obtained by:

No. 1. $$V = \frac{3.146 \text{ x } (1/2 \text{ diameter})^2 \text{ x } 12}{231}$$ or

No. 2. $$V = \frac{0.7854 \text{ x } (1/2 \text{ diameter})^2 \text{ x } 12}{231}$$ or

Consequently, if:

Pipe Size	Gal(s)/Ft.
2.0 in.	0.1632
3.0	0.3672
3 1/2	0.4998
4.0	0.6528
4 1/2	0.8262
5.0	1.0200
5 1/2	1.2342
6.0	1.4688

Note: 1 gallon of water = 231 cubic inches = 3.785 liters = 8.336 lbs. = 0.1337 cubic feet.

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CLASSIFICATION SHEET

Sheet __ *of* __
Project: ____________________
Job #: ____________________
Site Area: ____________________
Contractor: ____________________
Coordinates ____________________
____

Drill Method
Additions
Date Drilled

WELL CONSTRUCTION

See well construction diagram

WELL DEVELOPMENT

Well#					
Permit #:					
Distance to Water					
Submerge Volume					
Rate					
Vol Pumped					
Pump Used:					
Sp C initial					
stable					
Temp initial					
stable					
pH initial					
stable					

SAMPLING

Elevation Ground					
Elevn ft					
Top of Casing					
Depth To water from TOC					
Stickup of the casing					
Elev of the Ground					
Calcltd Water					
from Top of Casing					
GW Elev 0 Hrs					
24 Hrs.					
Date:					
Comments					

SAMPLE DOCUMENTATION

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Sample #	Site Designation	Type	Location	Depth	Other

Time Date
Site name Address

Sampled by Witness

Affiliation Address

Sampling Method

Decontamination

Type of Container Namber Volume

Field Preparation

Sample Preservation Time/Date

Preserved By

Custody Seal Volume Level on Container

Decontamination of Container

Stored In Time Date

Signature

Quality Assurance Samples (DR = Drilling Reagent,B = Backgrourd, F = Field Blank, SS = Spiked Sample):
Air Monitoring - Calibration

TRANSPORTATION

See Chain of Custody

ANALYSIS

See Analysis Request Form

Comments:

Appendix C

Standard Operating Procedures for Air Sampling

Adsorbent Tubes

Photovac

Volatile Organic Air Pollutant Analysis

Introduction

Sampling for organics in air is performed by drawing air through a glass tube packed with activated charcoal, silica gel, porous polymer resin Tenax GC or other adsorbent. The traps and adsorbent must be thoroughly cleaned before use to minimize the trap background. Clean traps ready for field use must also be carefully packed in clean glass tubes to avoid contamination during handling.

Sample Trap Preparation

Materials

Glass sampling traps:	Pyrex glass traps constructed as shown in Figure 1.
Resin	Tenax GC, 35/60 mesh.
Glass wool	
Culture tubes	Pyrex glass screw cap tubes 25 mm x 110 mm
Pyrex	9825 or equivalent.
Teflon backed silicone septa	Pierce 12722 or equivalent.
Bakelite screw caps to fit culture tubes	Pierce 13219 or equivalent.
Dessicator	Glass dessicator with activated charcoal adsorbent.

Quart paint cans with pressure fit lids.

Resin Preparation

Extract new and used Tenax GC with methanol followed by pentane in a soxhlet extractor. Extract with each solvent at least 6 hours. Dry the resin under vacuum for at least 4 hours. Sieve the dried resin to the 35/60 mesh particle size range. Seal the cleaned and sieved resin in a glass jar capped with a teflon liner. Store in a dessicator containing activated carbon.

Trap and Container Cleanup

Wash new and used glass sampling traps and culture tubes with lab soap and hot tap water. Rinse at least three times with organics free water (Millipore or equivalent). Rinse with methanol and let air dry.

Bake the cleaned tubes in an oven at 220°C for at least 1 hour. Remove from the oven and store in a dessicator containing activated carbon. Wash glass wool with methanol, air dry and bake in an oven at 220°C for at least 1 hour. Remove from the oven and store in a dessicator containing activ#ated charcoal. Bake teflon backed septa in an oven at 80°C for 30 minutes. Remove from the oven and store in a dessicator containing activated charcoal. Bake paint cans in oven at 100°C for 1 hour.

Trap Preparation

Pack about a 1 cm plug of glass wool into the trap followed by 6 cm of cleaned Ten#x GC. Lightly tap the trap on the bench to pack the resin. Add another 1 cm glass wool plug to hold the resin in place. Condition each trap at 270°C with 20-30 ml/min helium flowrate for 30 minutes. Remove the hot trap and place into a culture tube with a glass wool plug to cushion the trap. Immediately cap the tube with a teflon lined septum cap. Store the tubes in batches of 7 traps in quart paint cans.

Quality Control

Prior to sending traps to the field, remove one trap from each paint can and analyze it for contaminants. If the traps are clean, the batch is acceptable for use. Mark the trap "Field blank - label and return" and replace it in the can.

Prior to sending traps to the field, remove one trap from each paint can and spike with known amounts of chemicals from: the permeation tube system. Mark the trap "Field spike - label and return" and replace it in the can.

Options

Traps with longer resin beds may be packed in order to increase the retention volumes of pollutants.

References

"Selection and Evaluation of Sorbant Resins for the Collection of Organic Coa'pounds", EPA-600/7-77-044, April 1977.

"Developement of Method for Carcinogenic Vapor Analysis in Ambient Atmospheres", EPA-650/2-74-121, July 1974.

Health and Safety Sampling

The following procedures and policies shall be followed to determine compliance with air quality standards ("Permissible Exposure Limits" or PELs).

Procedure: Personal Exposure

The determination of noncompliance with PELs requires measurement and documentation of an overexposure to at least one employee. For air contaminants having PELs, sampling must be conducted within the breathing zone. OSHA defines the breathing zone to be a sphere approximately two (2) feet in diameter surrounding the head.

In some instances (e.g., substances in 29 CFR 1910.10021014) personal sampling is not necessary to establish the presence of the material in order to substantiate a violation.

Procedure: Full-Shift Sampling.

Full-shift sampling is defined to be a minimum of the total time of the shift less one hour; i.e., 7 hours of an 8-hour workshift or 9 hours of a 10-hour workshift. Every attempt will be made to sample the greatest exposure periods. Such exposure may occur during set-up and take-down.

Pumps may be changed to avoid pump failure due to excessive sampling periods.

General Sampling Procedures

Calibrate the pumps in accordance with standard operating procedures with the collection device appropriate for the desired contaminant. Select the employee or location to be sampled and discuss the purpose of the sampling strategy. Advise the employees not to remove or tamper with the sampling equipment. Inform the employees when and where the equipment will be removed. Instruct the employee to notify the supervisor should the sampler require temporary removal. Place the sampling equipment on the employee or ina location so that it does not interfere with work performance.

To monitor the exposure of an individual: attach the collection device (filter cassette, charcoal tube, etc.) to the shirt collar or within the employee's breathing zone. The inlet orifice should generally be in a downward vertical position to avoid contamination. Position the excess tubing so as not to interfere with the work of the employee.

Turn on the pump; record the time. Adjust the flow rate to the calibrated mark. Observe the pump operation for a short time to check the flow rate. Record the information required by the Air Sampling Data form (OSHA-91). As a minimum, check the pump flow after approximately the first half-hour, hour, and every two hours thereafter. Ensure that the sampler is still assembled properly and that the hose has not become pinched or #etached from the cassette or the pump.

In order to determine of the desired flow rate is being maintained during sampling, one of the following two methods may be used.

1) The pump rotometer reading shall be observed and noted. On subsequent checks if the pump rotometer has changed, it should be adjusted back to the initial position.

2) The precision rotometer can be plugged into the cassette, and knowing the desired precision rotometer setting, the pump flow rate can be determined.
Adjustments shall be noted on the OSHA-91.

Take detailed notes concerning visible airborne contaminants and other conditions to assist in determining appropriate engineering controls.

Prepare a blank(s) during the sample period. Before removing the pump at the end of the sample period, check the flow rate to ensure that the rotometer ball is still at the calibrated mark. If the ball is no longer at the mark, record the pump or precision rotometer reading.

Turn the pump off and record the ending time. Remove the collection device from the pump and seal it as soon as possible. Prepare the samples for transport to the laboratory for analysis.

Pumps shall be recalibrated after each day of sampling (before charging) for the pump rotometer setting last used.

Sampling Method for Organic Vapors and Gases

Organic vapors and gases may be collected on activated charcoal, silica gel, or other adsorption tubes. Immediately before sampling, break off the ends of the charcoal tube so as to provide an opening approximately one-half the internal diameter of the tube. The charging inlet or the exhaust outlet of the pump shall not be used to break the ends of the charcoal tube. The smaller section of the charcoal is used as a backup and is positioned nearest the sampling pump. The charcoal tube shall be held or attached in an approximately vertical position with the inlet either up or down suring sampling.

The air to be sampled must be drawn directly into the inlet of the glass charcoal tube and not passed through any hose or tubing before entering the tubing to the pump. Cap the charcoal tube with the supplied plastic caps immediately after sampling and seal as soon as possible. For other adsorption tubes, follow the same procedures as those of the charcoal tube with the following exceptions:
1) Tubes may be furnished by the laboratory with either caps or flame-sealed glass ends. The capped version is simply uncapped during the sampling period and recapped at the end of the sampling period.
2) The ends of the flame-sealed glass tubes are broken at the beginning of the sampling period and capped at the end of the sampling period.

For organic vapors and gases, low flow pumps are preferable, except where measuring ceiling exposures.

Attachment to: Sample Trap Preparation

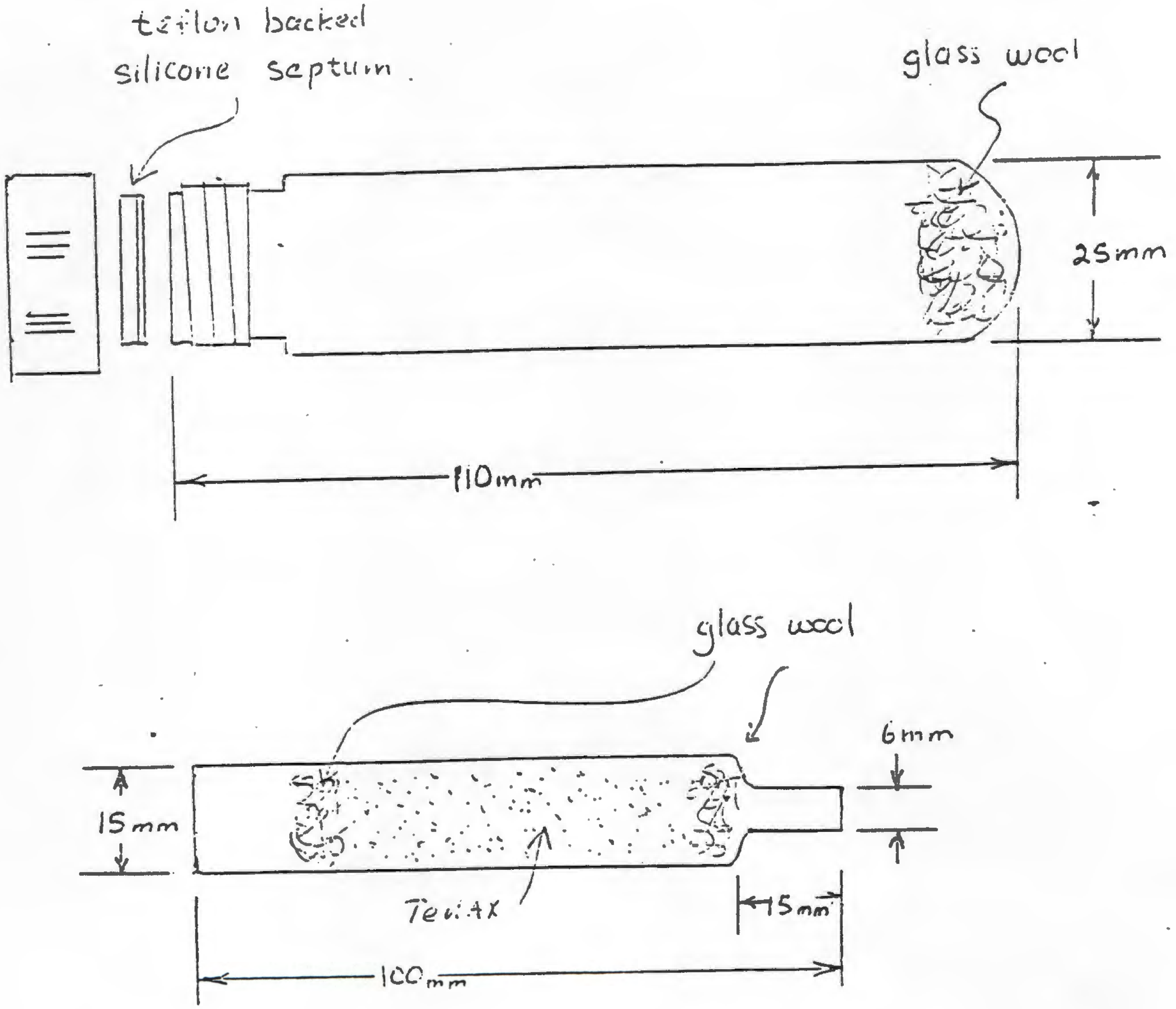

figure 1. Sampling trap and culture tube holder design.

Sample Collection

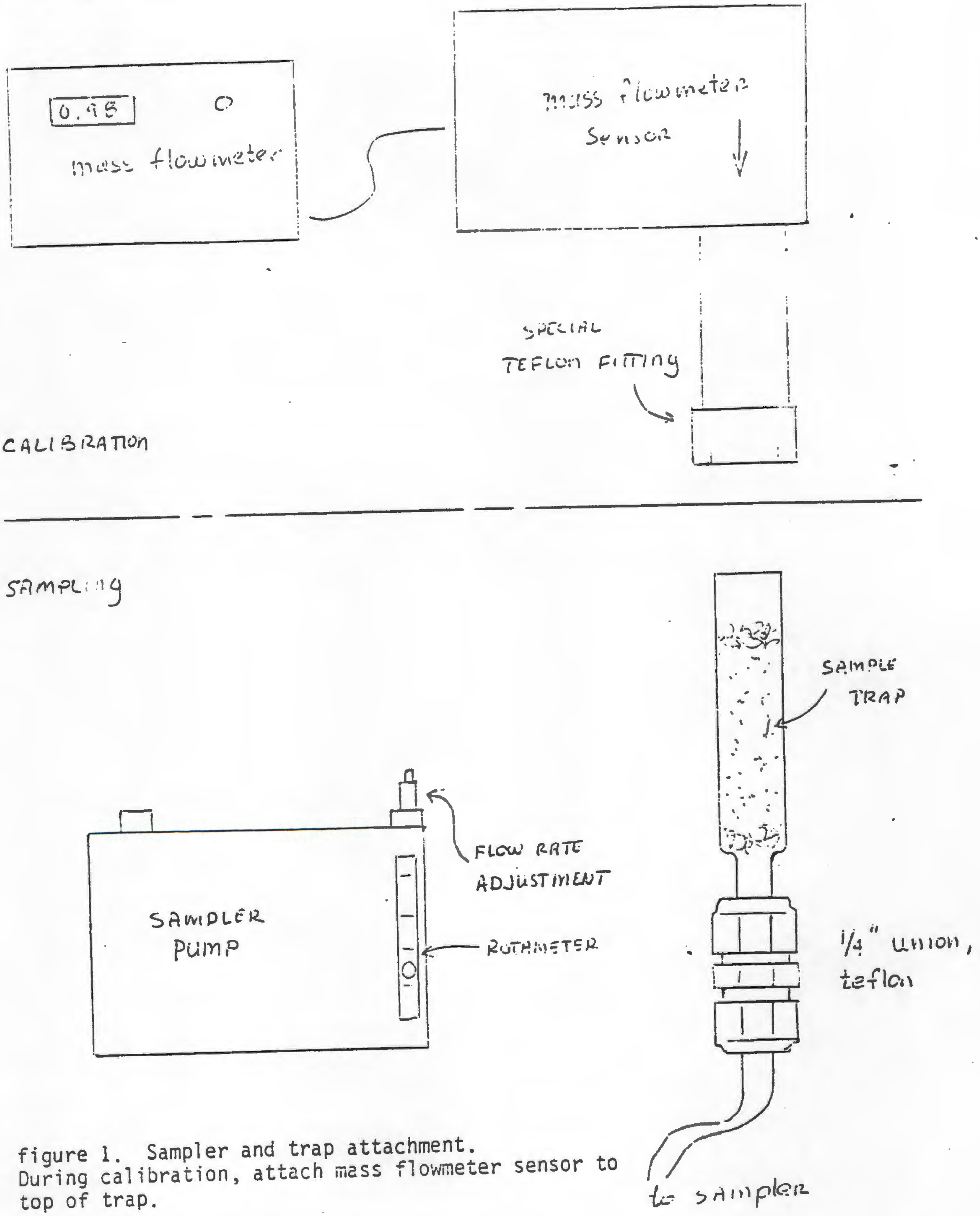

figure 1. Sampler and trap attachment.
During calibration, attach mass flowmeter sensor to top of trap.

FORMULA: Table 1

M.W.: Table 1

HYDROCARBONS, HALOGENATED

METHOD: 1003
ISSUED: 2/15/84
REVISION #1: 8/15/87

COMPOUNDS: (synonyms in Table 1)
benzyl chloride
bromoform
carbon tetrachloride
chlorobenzene
chlorobromomethane
chloroform
o-dichlorobenzene
p-dichlorobenzene
1,1-dichloroethane
1,2-dichloroethylene
ethylene dichloride
hexachloroethane
methylchloroform
tetrachloroethylene
1,1,2-trichloroethane
1,2,3-trichloropropane

SAMPLING

SAMPLER: SOLID SORBENT TUBE
(coconut shell charcoal, 100 mg/50 mg)

FLOW RATE: 0.01 to 0.2 L/min

VOL-MIN: Table 2
-MAX: Table 2

SHIPMENT: routine

SAMPLE STABILITY: not determined

FIELD BLANKS: 10% of samples

ACCURACY

RANGE STUDIED: see EVALUATION OF METHOD [1]

BIAS: not significant [1]

OVERALL PRECISION (s_r): see EVALUATION OF METHOD [1]

MEASUREMENT

TECHNIQUE: GAS CHROMATOGRAPHY, FID

ANALYTE: compounds above

DESORPTION: 1 mL CS_2, stand 30 min

INJECTION VOLUME: 5 µL

TEMPERATURES: Table 3

CARRIER GAS: N_2 or He, 30 mL/min

COLUMN: Table 3; alternates are SP-2100, SP-2100 with 0.1% Carbowax 1500 or DB-1 fused silica capillary column

CALIBRATION: standard solutions of analyte in CS_2

RANGE: Table 3

ESTIMATED LOD: 0.01 mg per sample [2]

PRECISION (s_r): see EVALUATION OF METHOD [1]

APPLICABILITY: See Table 2 for working ranges. This method can be used for simultaneous determination of two or more substances suspected to be present by changing gas chromatographic conditions (i.e., temperature program). High humidity during sampling will prevent organic vapors from being trapped efficiently on the sorbent and greatly decreases breakthrough volume.

INTERFERENCES: None identified. The chromatographic column or separation conditions may be changed to circumvent interferences.

OTHER METHODS: This method combines and replaces P&CAM 127 [3], S101 [4], S110 [5], S113 [6], S114 [7], S115 [8], S122 [9], S123 [10], S126 [11], S133 [12], S134 [13], S135 [14], S281 [15], S314 [16], S328 [17], S335 [18], S351 [19], and Method 1003 (dated 2/15/84).

REAGENTS:
1. Carbon disulfide, chromatographic quality.*
2. Analyte, reagent grade.
3. Calibration stock solutions:
   a. benzyl chloride, 10 mg/mL in n-heptane.
   b. bromoform, 10 mg/mL in n-hexane.
   c. o-dichlorobenzene, 200 mg/mL in acetone.
   d. p-dichlorobenzene, 300 mg/mL in acetone.
   e. hexachloroethane, 25 mg/mL in toluene.
4. Decane, n-undecane, octane or other internal standards (see step 6).
5. Nitrogen or helium, purified.
6. Hydrogen, prepurified.
7. Air, filtered.

*See SPECIAL PRECAUTIONS.

EQUIPMENT:
1. Sampler: glass tube, 7 cm long, 6 mm OD, 4 mm ID, flame-sealed ends with plastic caps, containing two sections of 20/40 mesh activated (600 °C) coconut shell charcoal (front = 100 mg; back = 50 mg) separated by a 2-mm urethane foam plug. A silylated glass wool plug precedes the front section and a 3-mm urethane foam plug follows the back section. Pressure drop across the tube at 1 L/min airflow must be less than 3.4 kPa. Tubes are commercially available (e.g., SKC #226-01).
2. Personal sampling pump, 0.01 to 0.2 L/min, with flexible connecting tubing.
3. Gas chromatograph, FID, integrator and column (see Table 3).
4. Vials, 2-mL, glass, PTFE-lined septum crimp caps.
5. Volumetric flasks, 10-mL.
6. Syringes, 10-µL, readable to 0.1 µL.
7. Pipet, TD, 1-mL, with pipet bulb.

SPECIAL PRECAUTIONS: Carbon disulfide is toxic and a serious fire and explosion hazard (flash point = -30 °C); work with it only in a hood. Several of the analytes are suspect carcinogens (Table 1). n-Heptane, n-hexane, and acetone are fire hazards.

SAMPLING:
1. Calibrate each personal sampling pump with a representative sampler in line.
2. Break the ends of the sampler immediately before sampling. Attach sampler to personal sampling pump with flexible tubing.
3. Sample at an accurately known flow rate between 0.01 and 0.2 L/min for a total sample size between the limits shown in Table 2.
4. Cap the samplers. Pack securely for shipment.

SAMPLE PREPARATION:
5. Place the front and back sorbent sections of the sampler tube in separate vials. Discard the glass wool and foam plugs.
6. Add 1.0 mL CS_2 to each vial. Cap each vial.
   NOTE: A suitable internal standard, such as decane [16], n-undecane [6,19], or octane [9,13,17] at 0.1% (v/v) may be added at this step and at step 8.
7. Allow to stand 30 min with occasional agitation.

CALIBRATION AND QUALITY CONTROL:
8. Calibrate daily with at least five working standards over the appropriate range (Table 3).
   a. Add known amounts of neat analyte or calibration stock solution to CS_2 in 10-mL volumetric flasks and dilute to the mark.
   b. Analyze with samples and blanks (steps 11 and 12).
   c. Prepare calibration graph (peak area vs. mg analyte).
9. Determine desorption efficiency (DE) at least once for each lot of charcoal used for sampling in the range of interest. Prepare three tubes at each of five levels plus three media blanks.

a. Remove and discard back sorbent section of a media blank sampler.
b. Inject a known amount (2 to 20 µL) of pure analyte, or calibration stock solution (see REAGENTS, 3.), directly onto front sorbent section with a microliter syringe.
c. Cap the tube. Allow to stand overnight.
d. Desorb (steps 5 through 7) and analyze together with working standards (steps 11 and 12).
e. Prepare a graph of DE vs. mg analyte recovered.

10. Analyze three quality control blind spikes and three analyst spikes to insure that the calibration graph and DE graph are in control.

MEASUREMENT:

11. Set gas chromatograph according to manufacturer's recommendations and to conditions given on page 1003-1 and in Table 3. Inject sample aliquot manually using solvent flush technique or with autosampler.
NOTE: If peak area is above the linear range of the working standards, dilute with CS_2, reanalyze and apply the appropriate dilution factor in calculations.
12. Measure peak area.

CALCULATIONS:

13. Determine the mass, mg (corrected for DE), of analyte found in the sample front (W_f) and back (W_b) sorbent sections and in the average media blank front (B_f) and back (B_b) sorbent sections.
NOTE: If $W_b > W_f/10$, report breakthrough and possible sample loss.
14. Calculate concentration, C, of analyte in the air volume sampled, V (L):

$$C = \frac{(W_f + W_b - B_f - B_b)\cdot 10^3}{V}, \text{ mg/m}^3.$$

EVALUATION OF METHOD:

Laboratory testing was performed with spiked samples and generated atmospheres using SKC Lot 105 coconut shell charcoal [1]. Results were:

Compound	Range, mg/m³	Sample Size	Precision (s_r) Overall	Precision (s_r) Measurement	Desorption Efficiency	Ref.
Benzyl chloride	2–8	10 L	0.096	0.031	0.90 @ 0.03–0.1 mg	[8]
Bromoform	3–10	10 L	0.071	0.043	0.80 @ 0.025 mg	[7]
Carbon tetrachloride	65–299	15 L	0.092	0.037	0.96 @ 1.3–4.8 mg	[16]
Chlorobenzene	183–736	10 L	0.056	0.025	0.91 @ 1.8–7.1 mg	[12]
Chlorobromomethane	640–2655	5 L	0.061	0.051	0.94 @ 3.3–13 mg	[6]
Chloroform	100–416	15 L	0.057	0.047	0.97 @ 1.8–7.4 mg	[19]
o-Dichlorobenzene	150–629	3 L	0.068	0.013	0.86 @ 0.5–1.9 mg	[14]
p-Dichlorobenzene	183–777	3 L	0.052	0.022	0.91 @ 0.7–2.7 mg	[15]
1,1-Dichloroethane	212–838	10 L	0.057	0.011	1.01 @ 1.9–8 mg	[10]
1,2-Dichloroethylene*	475–1915	3 L	0.052	0.017	1.00 @ 2.4–9.5 mg	[5]
Ethylene dichloride	195–819	3 L	0.079	0.012	0.96 @ 0.6–2.5 mg	[9]
Hexachloroethane	5–25	10 L	0.121	0.014	0.98 @ 0.05–0.2 mg	[4]
Methyl chloroform	904–3790	3 L	0.054	0.018	0.99 @ 2.9–11 mg	[17]
Tetrachloroethylene	655–2749	3 L	0.052	0.013	0.96 @ 2.1–8 mg	[18]
1,1,2-Trichloroethane	26–111	10 L	0.057	0.010	0.97 @ 0.3–1.2 mg	[13]
1,2,3-Trichloropropane	163–629	10 L	0.068	0.027	0.95 @ 1.5–6 mg	[11]

*isomer used (i.e., cis- or trans-) in evaluation unknown.

REFERENCES:

[1] Documentation of the NIOSH Validation Tests, S101, S110, S113, S114, S115, S122, S123, S126, S133, S134, S135, S281, S314, S328, S335, S351, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-185 (1977), available as Stock No. PB 274-248 from NTIS, Springfield, VA 22161.

[2] User check, UBTL, NIOSH Sequences #3990-T, 3990-U and 3990-W (NIOSH, unpublished, November 3, 1983) and 4304-J (NIOSH, unpublished, April 3, 1984).

[3] NIOSH Manual of Analytical Methods, 2nd ed., V. 1., P&CAM 127, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-A (1977).

[4] Ibid., V. 2., S101. U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-B (1977).

[5] Ibid., S110.

[6] Ibid., S113.

[7] Ibid., S114.

[8] Ibid., S115.

[9] Ibid., S122.

[10] Ibid., S123.

[11] Ibid., S126.

[12] Ibid., S133.

[13] Ibid., S134.

[14] Ibid., V. 3, S135, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-C (1977).

[15] Ibid., S281.

[16] Ibid., S314.

[17] Ibid., S328.

[18] Ibid., S335.

[19] Ibid., S351.

[20] NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards, U.S. Department of Health and Human Services, Publ. (NIOSH) 81-123 (1981), available as Stock #PB83-154609 from NTIS, Springfield, VA 22161.

[21] NIOSH Current Intelligence Bulletin 27, Chloroethanes: Review of Toxicity, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 78-181 (1978).

[22] NIOSH Current Intelligence Bulletin 20, Tetrachloroethylene (Perchloroethylene), U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 78-112 (1978).

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[24] Criteria for a Recommended Standard...Occupational Exposure to Carbon Tetrachloride, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 76-133 (1976).

[25] Criteria for a Recommended Standard...Occupational Exposure to Chloroform, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 75-114 (1975).

[26] Criteria for a Recommended Standard...Occupational Exposure to Ethylene Dichloride, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 76-139 (1976).

[27] Criteria for a Recommended Standard...Occupational Exposure to 1,1,1-Trichloroethane, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 76-184 (1976).

[28] Criteria for a Recommended Standard...Occupational Exposure to Tetrachloroethylene (Perchloroethylene), U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 76-185 (1976).

METHOD REVISED BY: G. D. Foley; Y. T. Gagnon; and K. J. Williams, NIOSH/DPSE; methods originally validated under NIOSH Contract CDC-99-74-45.

Table 1. General information.

Compound	M.W.	mg/m³ = 1 ppm @ NTP	Synonyms	OSHA/NIOSH/ACGIH (ppm)
Benzyl chloride* ($C_6H_5CH_2Cl$)	126.58	5.17	(chloromethyl) benzene; α-chlorotoluene; CAS #100-44-7	1/—/1 [20,23]
Bromoform ($CHBr_3$)	252.75	10.33	tribromomethane; CAS #75-25-2	0.5/—/0.5 (skin) [20]
Carbon tetrachloride* (CCl_4)	153.84	6.29	tetrachloromethane; CAS #56-23-5	10, C 25/C 2/5 (skin) [20,24]
Chlorobenzene (C_6H_5Cl)	112.56	4.60	monochlorobenzene; phenyl chloride; CAS #108-90-7	75/—/75 [20]
Chlorobromomethane (CH_2BrCl)	129.39	5.29	bromochloromethane; Halon 1011; CAS #74-97-5	200/—/200, STEL 250 [20]
Chloroform* ($CHCl_3$)	119.39	4.88	trichloromethane; CAS #67-66-3	C 50/C 2/10 [20,25]
o-Dichlorobenzene ($1,2\text{-}C_6H_4Cl_2$)	147.00	6.01	1,2-dichlorobenzene; CAS #95-50-1	50/—/C 50 [20]
p-Dichlorobenzene ($1,4\text{-}C_6H_4Cl_2$)	147.00	6.01	1,4-dichlorobenzene; CAS #106-46-7	75/—/75, STEL 110 [20]
1,1-Dichloroethane (CH_3CHCl_2)	98.96	4.05	ethylidene chloride; CAS #75-34-3	100/100/200, STEL 250 [20,21]
1,2-Dichloroethylene ($ClCH{=}CHCl$)	96.94	3.96	acetylene dichloride; 1,2-dichloroethene; CAS #540-59-0	200/—/200, STEL 250 [20]
Ethylene dichloride* ($ClCH_2CH_2Cl$)	98.96	4.05	1,2-dichloroethane; CAS #107-06-2	50, C 100/5, C 15/10 [20,21,26]
Hexachloroethane* (CCl_3CCl_3)	236.74	9.68	perchloroethane; CAS #67-72-1	1 (skin)/—/10 [20,21]
Methylchloroform (CH_3CCl_3)	133.42	5.45	1,1,1-trichloroethane; CAS #71-55-6	350/C 350/350, STEL 450 [20,21,27]
Tetrachloroethylene ($Cl_2C{=}CCl_2$)	165.83	6.78	perchloroethylene; CAS #127-18-4	100, C 200, P 300/—/50, STEL 200 [20,28]
1,1,2-Trichloroethane (Cl_2CHCH_2Cl)	133.41	5.45	vinyl trichloride; CAS #79-00-5	10 (skin)/—/10 (skin) [20,21]
1,2,3-Trichloropropane ($CH_2ClCHClCH_2Cl$)	147.43	6.03	allyl trichloride; glycerol trichlorohydrin; CAS #96-18-4	50/—/50, STEL 75 [20]

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*Suspect carcinogen [20,21,22].

Table 2. Sampling limits.

Compound	Air Sample Volume (L)			Working Range, ppm, at Max Sample Volume
	Min	Max	Target	
Benzyl chloride	6 @ 1 ppm	50	10	0.6 to 5.8
Bromoform	4 @ 0.5 ppm	70	10	0.2 to 4
Carbon tetrachloride	3 @ 10 ppm	150	15	2 to 105
Chlorobenzene	1.5 @ 75 ppm	40	10	10 to 430
Chlorobromomethane	0.5 @ 200 ppm	8	5	18 to 450
Chloroform	1 @ 50 ppm	50	15	2 to 190
o-Dichlorobenzene	1 @ 50 ppm	60	3	16 to 1100
p-Dichlorobenzene	1 @ 75 ppm	10	3	27 to 330
1,1-Dichloroethane	0.5 @ 100 ppm	15	10	4 to 250
1,2-Dichloroethylene	0.2 @ 200 ppm	5	3	16 to 560
Ethylene dichloride	1 @ 50 ppm	50	3	16 to 1320
Hexachloroethane	3 @ 1 ppm	70	10	0.3 to 8.3
Methylchloroform	0.1 @ 350 ppm	8	3	18 to 1450
Tetrachloroethylene	0.2 @ 100 ppm	40	3	9 to 1900
1,1,2-Trichloroethane	2 @ 10 ppm	60	10	1.8 to 64
1,2,3-Trichloropropane	0.6 @ 50 ppm	60	10	3 to 310

Table 3. Measurement parameters.

Compound	Column*	t (°C) Column/Injector/Detector	Range (mg per sample)
Benzyl chloride	A	160/170/210	0.02 to 0.15
Bromoform	A	130/170/210	0.02 to 0.15
Carbon tetrachloride	B	60/155/200	0.2 to 7
Chlorobenzene	A	105/190/250	0.4 to 10
Chlorobromomethane	A	80/170/210	0.5 to 15
Chloroform	B	75/155/200	0.4 to 11
o-Dichlorobenzene	C	140/225/250	0.1 to 3
p-Dichlorobenzene	A	140/225/275	0.2 to 4
1,1-Dichloroethane	A	50/100/175	0.4 to 12
1,2-Dichloroethylene	A	60/170/210	0.2 to 7
Ethylene dichloride	C	70/225/250	0.1 to 4
Hexachloroethane	D	110/170/210	0.02 to 0.3
Methylchloroform	C	70/225/250	0.6 to 17
Tetrachloroethylene	C	90/225/250	0.4 to 12
1,1,2-Trichloroethane	C	70/250/225	0.05 to 2
1,2,3-Trichloropropane	E	160/180/230	0.3 to 9

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*A = 3 m x 3 mm OD stainless steel, 10% SP-1000 on 80/100 mesh Chromosorb WHP.
B = 6 m x 3 mm OD, otherwise same as A.
C = 3 m x 3 mm OD stainless steel, 10% OV-101 on 100/120 mesh Chromosorb WHP.
D = 3 m x 6 mm OD glass, 3% SP-2250 on 80/100 mesh Chromosorb WHP.
E = 3 m x 3 mm OD stainless steel, 10% FFAP on 80/100 mesh Chromosorb WHP.

CORRELATION BETWEEN FIELD GC MEASUREMENT OF VOLATILE ORGANICS AND LABORATORY CONFIRMATION OF COLLECTED FIELD SAMPLES USING THE GC/MS

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A procedure has been developed to monitor low levels of volatile organics in ambient air. On a given site, a two-phase monitoring program is established. The first phase involves field measurements using a sensitive portable gas chromatograph with a photoionization detector capable of determining most solvents in the 1-50 ppb range.

Once areas of concern are defined, a few lab samples are collected for GC and GC/MS analysis. Samples (1-30 liters) are adsorbed on precleaned activated charcoal. Lab analysis is performed using a Programmed Thermal Desorber (PTD) which desorbs the contents of the field sampler into a 300 cc stainless steel piston from which aliquots are withdrawn for GC or GC/MS analysis.

Based on first phase results, a detailed field study plan is formulated. In the second phase, field collection is again done on charcoal packed tubes. In the lab, analysis is by thermal desorption, GC and GC/MS. Correlation between field data and final GC/MS confirmation has been excellent. Vapor standards are used to calibrate lab instruments and to determine recovery efficiency.

The overall technique is relatively simple, inexpensive and produces answers in a rapid turnaround time. Several New England States are equipping to use this technique in investigations of hazardous waste sites and odor complaints. In addition, other regional laboratories within EPA are currently evaluating the procedures for ambient air investigations.

CORRELATION BETWEEN FIELD GC MEASUREMENT OF VOLATILE ORGANICS AND LABORATORY CONFIRMATION OF COLLECTED FIELD SAMPLES USING THE GC/MS

Introduction

Over the past five years, there has been a dramatic increase in methods development for measurement of volatile organics in ambient air. A wide range of solid adsorbents followed by solvent extraction and thermal desorption have been reported on.[1,2] Use of cryogenic trapping, cryogenic focussing of thermally desorbed vapors and many configurations of GC and GC/MS analysis have been reported.[3] Mobile vans have been outfitted with a wide range of GC equipment for direct field measurement[4] and a van containing a mass spectrometer is also employed for ambient air measurement.[5]

In all the above methodologies except the mobile vans, an important element of monitoring is missing, real time data - the ability to measure contamination on sites by direct sampling of the ambient air with no intervening concentration step. A second element often missing is the need to have a methodology which employs currently available tools even if the technique is not yet capable of answering all the questions surrounding analysis of volatile organics in ambient air. This paper reports on a technique for direct field measurement of volatile organics in ambient air in the 1-50 ppb range. For this purpose, a portable gas chromatograph with a sensitive PID detector is employed.[6] The field measurements are used to determine contamination qualitatively and semi-quantitatively. This provides the data needed to plan for and collect time integrated samples at appropriate locations for return to the lab. In the lab the analyst can confirm by GC/MS analysis his field identifications and quantitations.

Experimental Method

Figure 1 is a photograph of the Photovac portable gas chromatograph. Sampling is done with all-glass or gas-tight syringes. The air sample is immediately injected onto one of two columns. A short column (12" Carbowax) is used first to screen for the range of volatiles present. Figure 2 shows two mixtures run on the short and long columns. Separation of cis- and trans-1,1 DCE indicates how useful even short run data can be in making preliminary identifications by retention time (RT). When a determination has been made that no significant contaminants elute after a few minutes, the same sample can be injected on the 4' SE 30 column for better separation and RT determination.

Figure 3 is a typical field chromatogram showing the presence of aliphatic hydrocarbons in the C_2-C_6 range, as well as the commonest aromatics. Using a vapor mixture of Benzene and Toluene, the field analyst can readily identify and quantify these compounds. Where more complex chromatograms are encountered, it is a relatively simple matter to run two or three standard mixtures on both columns and then use two-column RT's to make a positive identification. Even interfering

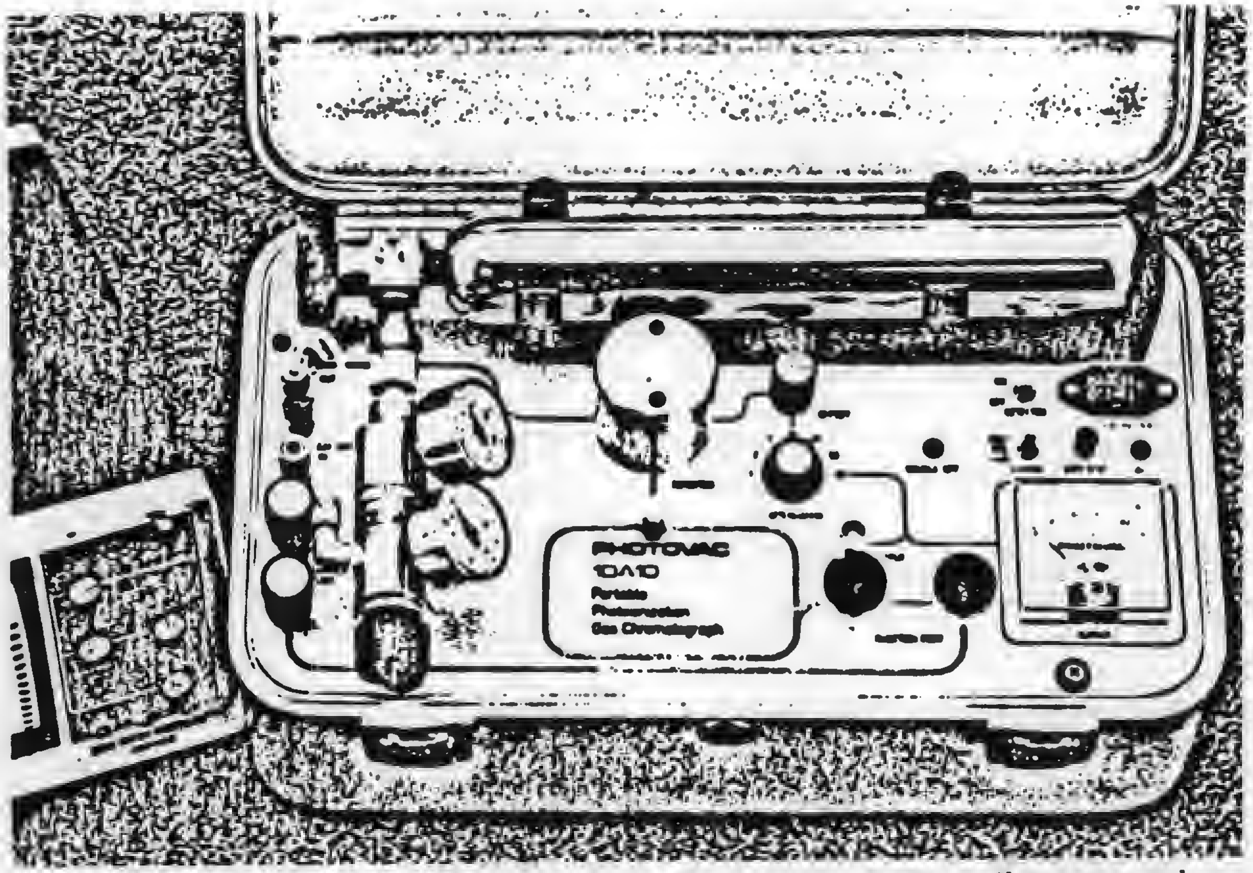

Figure 1 The Photovac 10A10 Portable Photoionization Gas Chromatograph

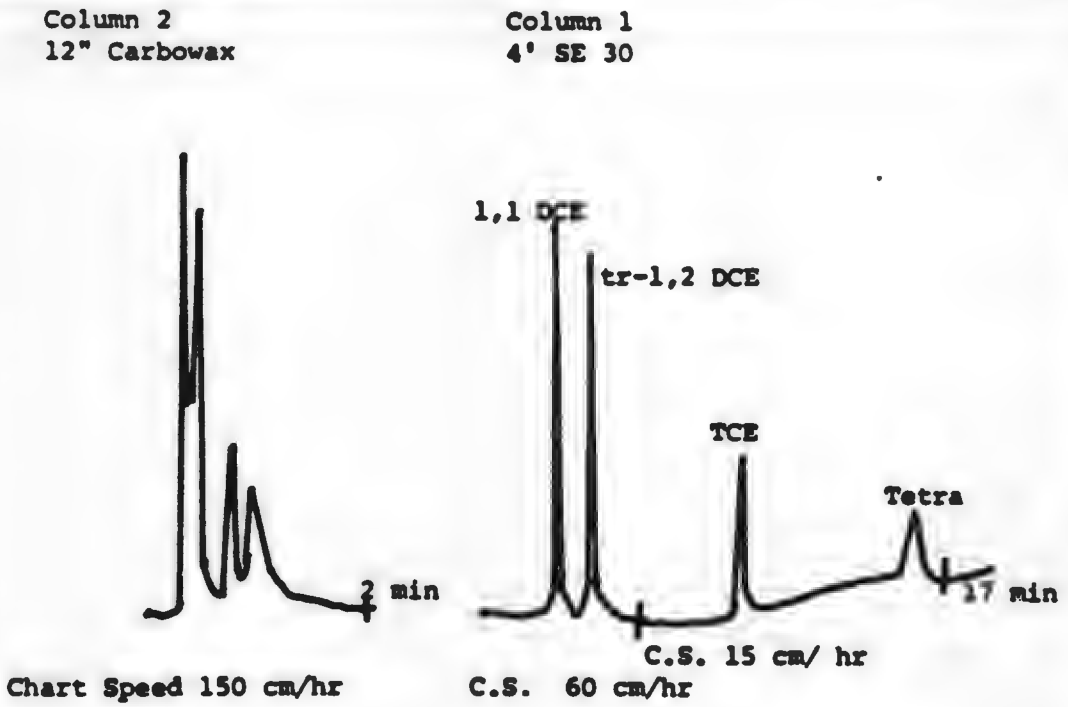

Figure 2 Chloroalkene Standard run on Both Columns of the 10A10 GC

and overlapping peaks can be tentatively identified in the field by this technique.

Organic vapor standards for field use are prepared in two ways. For qualitative identification, we often employ the headspace technique. This technique involves sampling the vapor headspace above a dilute aqueous solution of organic solvents. Such solutions are easily prepared and have amazing stability. The standards used in Figure 2 were prepared six months prior to these runs. Figure 4 shows the method used for preparation of aqueous and vapor standards. Standard B is prepared by injecting small amounts of the aqueous phases of stock samples C, D and E into a measured amount of organic free water. Stock samples C and D are simply equilibrium solutions of commonly encountered volatile solvents. In the case of very soluble solvents like acetone, a 5% solution is prepared and stored over a liquid mercury seal. The mercury prevents loss of solution strength by diffusion through the punctured septum. When an appropriate mixture has been prepared in vial B, the sample is kept in an inverted position. Again, liquid mercury prevents sample loss. The vial is only turned upright to withdraw a vapor headspace sample.

Vial A of Figure 4 indicates the method used for preparation of vapor standards. Typically 1 ul of organic liquid is injected into a stock vial and the concentration is calculated from density and vial volume. Dilutions into another vial can be made using a gas-tight syringe and careful gas handling technique. Once again, a liquid mercury seal is used to prevent loss of low level standards through septum punctures. Experience has shown that mercury sealed standards are stable for many days. Depletion is principally through withdrawal for analysis. Since stock standards are typically in the pph range (1 ul of 1,1 DCE/160cc contains 7,680 ppm) these standards can be used for months to prepare dilute standards without significant loss of strength.

Time integrated field sampling is done using 1/4" i.d. flared stainless steel tubes packed with activated charcoal. Tubes are prepared for field use by thermally desorbing at 250°C for 5 minutes into the holding chamber of a Foxboro Analytical Programmed Thermal Desorber (PTD). The chamber is a 300 cc polished stainless steel piston from which aliquots can be withdrawn for GC or GC/MS analysis. Tubes are precleaned to a background level corresponding to less than 1 ppb of volatile organics in a collected air sample. Depending on the volatile organic of interest and the volume of sampled air, detection to .01 ppb is possible with this system.

Precleaned sampling tubes are stored in individual septum sealed 40 cc vials for transport to and from the field. During field sampling, the tube is attached to a battery operated pump capable of flows from 50-500 cc/min. Sampling time and flow is adjusted to collect an adequate volume of ambient air and the exposed tube is replaced into its own sealed vial for return to the lab. Vials are stored in canisters containing activated charcoal and the sealed canisters are refrigerated during shipment and pre-analysis storage at the lab. Appropriate blanks, duplicates, backups and spikes are incorporated into

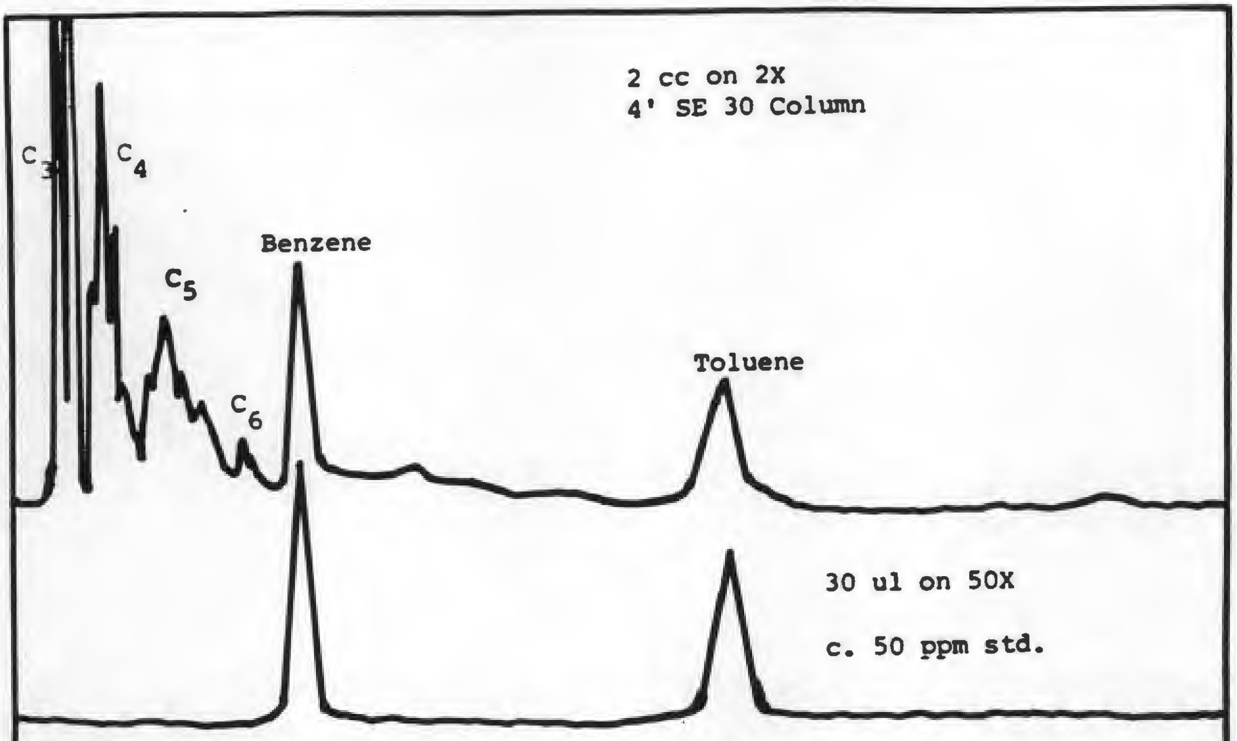

Figure 3 Field Chromatogram of Ambient Air Sample and Field Standard

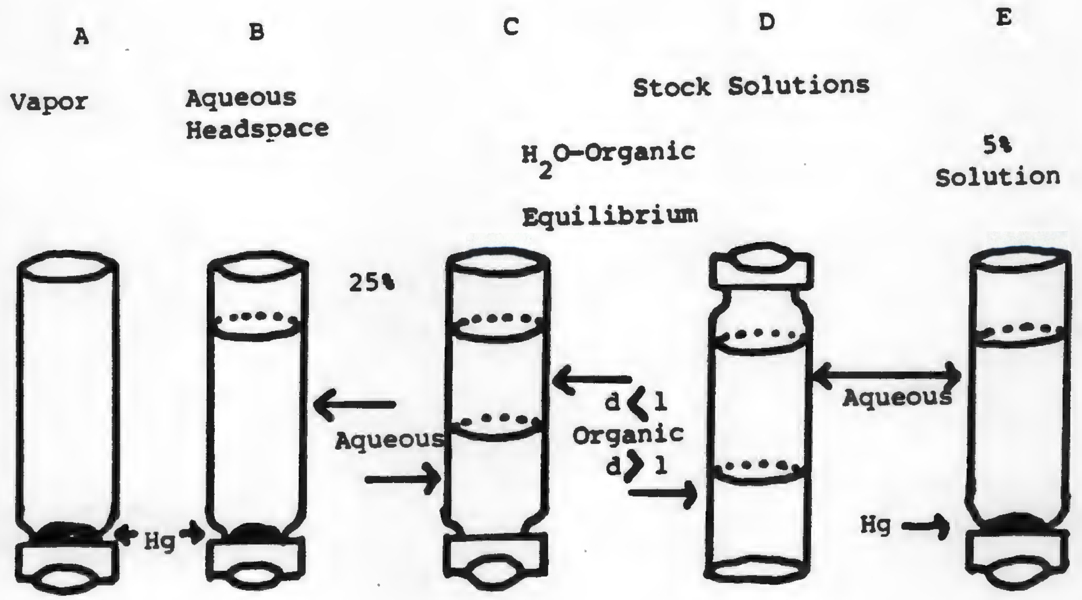

Figure 4 Standards for Lab and Field Calibration

the Quality Control program for any field study.

In the lab, analysis is carried out in two stages. The sample is thermally desorbed in the PTD at 200°C for five minutes. A first analysis is done by withdrawing a small sample (100-500 ul) and injecting into the same PID-GC that was used in the preliminary field study. Usually the pattern found in the field is repeated under the same conditions of column, flow, etc. Based on lab vapor standards (and experience), the analyst now knows the approximate composition and concentration of the field sample. Using this information, a second (much larger) vapor sample is now withdrawn from the PTD and introduced into the GC/MS for definitive qualitative and quantitative analysis.

Figure 5 shows the dry purge and trap (P&T) modification to the GC/MS for ambient air analysis. Through a Luer adapter, a large air sample can be injected onto the P&T trap. After sampling from the PTD and prior to injection into the GC/MS, a vapor spike of 100 ng of 2-chloro-propane is added to the large syringe. This serves as an internal standard for all GC/MS analyses. Vapor standards prepared as described above, are then injected <u>via</u> the dry P&T to calibrate the GC/MS system. The standards contain all identified volatiles above the GC/MS detection limit.

Finally, an adsorption-thermal desorption recovery study is run on any compounds found for which the lab has no prior recovery data. Recovery studies are performed in two ways. The first method employs a standard mixture such as the one used to calibrate the GC/MS. An appropriate sized aliquot is analyzed directly by GC or GC/MS. A second (larger) sample is loaded onto a charcoal tube using the apparatus shown in Figure 6. The spiked tube is then processed in the PTD and an aliquot is analyzed by GC or GC/MS which is exactly equivalent to the sample analyzed directly. Comparison of the two chromatograms by peak height measurements on the GC or integration on the GC/MS yields a direct recovery figure.

A second (more recent) approach is to spike a large air bag with several volatile solvents and wait a few days for equilibration with the walls. This artificial atmosphere is then sampled directly <u>via</u> syringe and analyzed by GC or GC/MS. Next a charcoal tube and pump is attached to the bag and it is sampled for 1-60 minutes at an appropriate flow rate. The collected sample is thermally desorbed and an appropriate aliquot from the PTD chamber is analyzed by the same analytical procedure. The two aliquots are sized to be exactly equivalent and % recovery is calculated by peak height or integration comparison.

Results and Discussion

Our field experience over the past four years has led us to conclude that in background air, only a few volatile organics are found above the 1 ppb level exclusive of aliphatic hydrocarbons. In most cases we find at upwind locations 1-10 ppb of benzene and 1-20 ppb of toluene along with 1-4 ppb of methyl and ethyl substituted benzenes. These aromatics are typical of automotive exhaust and/or widespread fugitive emissions from automotive fuel handling.

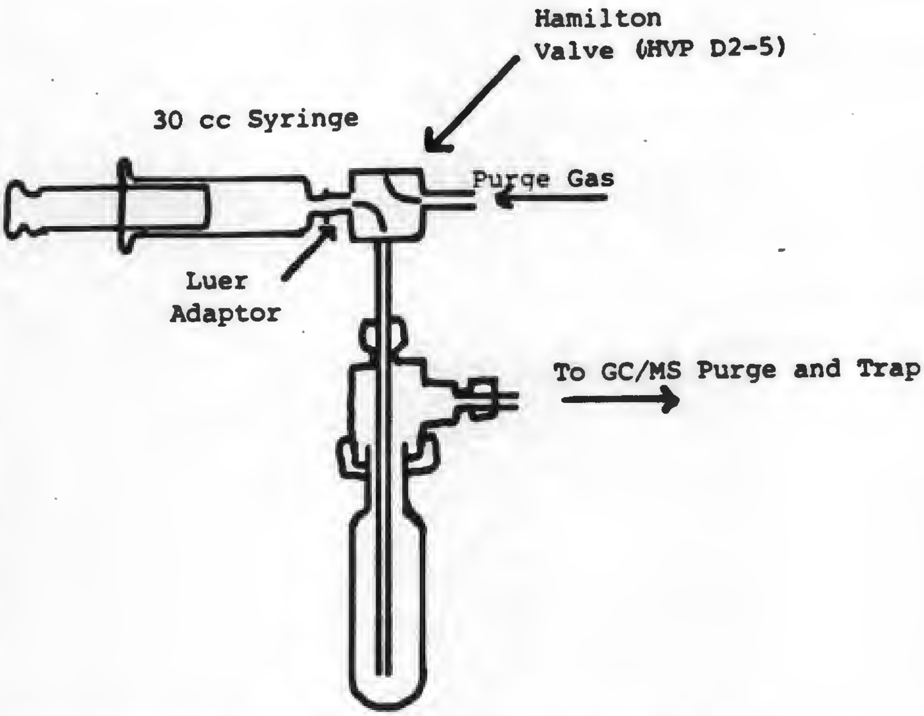

Figure 5 Dry Purge and Trap Adaptor for GC/MS

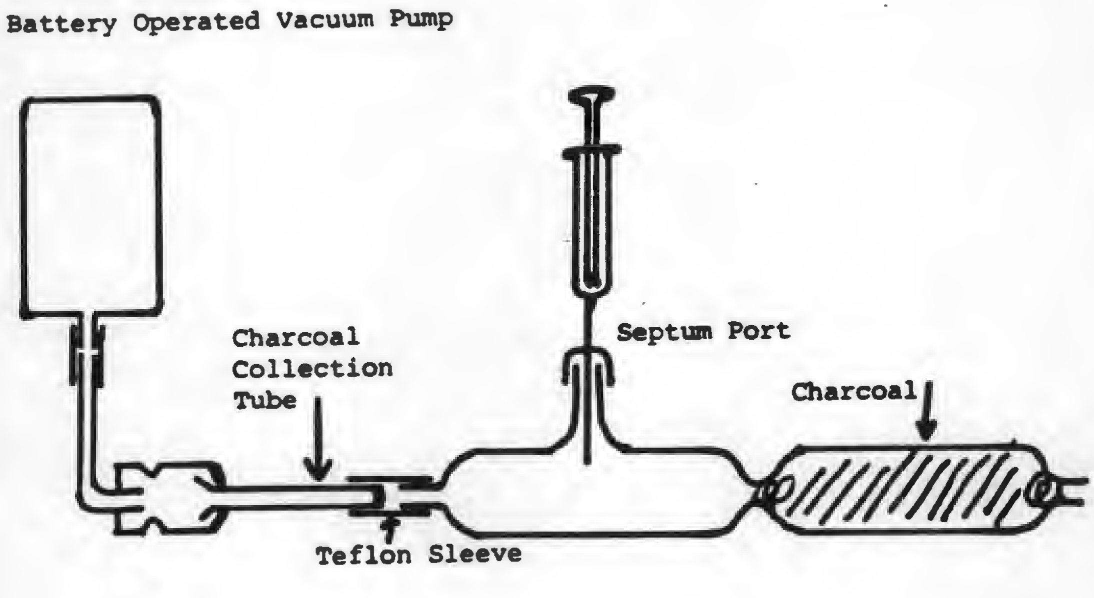

Figure 6 Spiking Device for Air Collection Tubes

These data correlate well with the findings of Singh et al[7] in their investigations of major urban areas of the Southwest. Even in the vicinity of known organic sources, such as chemical companies, spills and hazardous waste dumps or storage facilities, the levels of volatile solvents detectable at downwind sites (500-1000 ft from point sources) is usually in the 1-50 ppb range. Table I is a listing of such solvents found in 14 different field studies in the New England area over the past three years.

TABLE I

Organic Compounds Found In Field Studies

Site: Compound	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Benzene	+	+	+	+	+	+	+	+		+				
Toluene	+	+	+	+	+	+	+	+	+	+	+	+		+
Tetra	+	+	+	+		+	+	+			+	+		+
Acetone			+											+
Freon			+			+			+	+				
VCM			+								+			
Ethylbenzene			+			+								
Xylenes			+			+						+		
1,1 DCE			+											+
1,2 DCE		+	+						+					
1,1,1 TCE		+	+					+						+
CH_2Cl_2			+						+					
TCE					+			+						
THF									+					+
$CHCl_3$		+												
Nitrobenzene													+	
Ethyl Ether														+

At the present time most of the work in methods development centers around recovery efficiency for solid adsorbents. Our experience with spiking of adsorbent tubes (Method I described above) has produced useful recovery data for most of our field studies. Table II gives data for an eight-component mixture spiked onto activated charcoal using the equipment shown in Figure 6.

Table II

Adsorption-Desorption Efficiency on Activated Charcoal

Compound	% Recovery					
1,1 DCE	64	68	64	71	70	22
Benzene	>100	>100	*	106	100	100
Tetra	36	64	85	70	60	45
Chlorobenzene	78	55	70	60	52	36
Ethylbenzene	40	28	41	39	35	22
o-xylene	42	39	35	30	25	22
TCE	12	17	3	5	19	5
Toluene	76	65	86	73	50	47

* Improper recorder attenuation setting

Standard injections contain 4-8 ng of solvent. Charcoal tubes were spiked with 400-800 ng of the same standard vapor mix. When thermally desorbed, an aliquot from the PTD chamber contained 4-8 ng and was injected into the PID-GC under identical conditions. Aside from obvious fluctuations attributable to wall losses in the syringe and spiking equipment, the data on TCE are the most difficult to interpret.

A second set of recoveries was run using the same basic technique, but with fewer components in the mixture. These data are shown in Table III.

Table III

Adsorption-Desorption Efficiency on 3M Activated Charcoal

Compound	% Recovery					
Benzene	81	104	118	87	100	82
TCE	76	97	133	102	105	100
Toluene	63	100	135	82	80	88
Tetra	71	100	92	92	85	94

A modified form of activated charcoal supplied by 3M Corporation was used in this study. There is an obvious improvement in recovery of all compounds except Benzene, but precision is still rather poor.

An ongoing study of VCM on activated charcoal using the artificial bag atmosphere described above yielded more consistent recovery data (Table IV).

Table IV

Vinyl Chloride Recovery Using Freshly Packed Charcoal Tubes

Tube #	105	125	103	108	111	127	126	122	120	124	123	121
% Recovery	109	100	105	111	98	101	107	102	94	76	87	100

x = 99 sigma = 9.8

In this study, twelve tubes were packed with fresh coconut charcoal. It is not possible to determine at the present time whether improved precision and accuracy (% recovery) is due to the bag method of spiking or to the use of fresh adsorbent. This point is presently under investigation.

One example of field use of the PID-GC to investigate a PVC manufacturing facility is shown in Figure 7. The unit was operated in a station wagon parked upwind of the property. Background was extremely low at this site owing to its proximity to the ocean. Thirty-one field samples were analysed in a two-hour period and yielded a complete profile of upwind, downwind and even in-plant VCM levels. Chromatograms of selected samples taken at locations shown on Figure 7 are shown in Figure 8 together with calibration data. Because of the extremely low background, sub ppb detection limits were attainable here. A second field and lab study of a PVC facility is currently in progress and will be reported on at the March meeting.

The methodology described here has several advantages: 1) It is relatively inexpensive; 2) It employs commercially available components; 3) Use of the field GC alone is a feasible first step to ambient air investigations; 4) Real time data are generated, leading to a saving of time and expense by identifying early in a study the areas deserving of more intensive and costly investigation. 5) Where adequate laboratory support is available, complete confirming analytical data and standardization for quantification can be easily supplied.

It should be noted that sensitive chromatographic equipment cannot be placed in the hands of untrained investigators if one hopes to obtain maximum usefulness from the type of study described here.

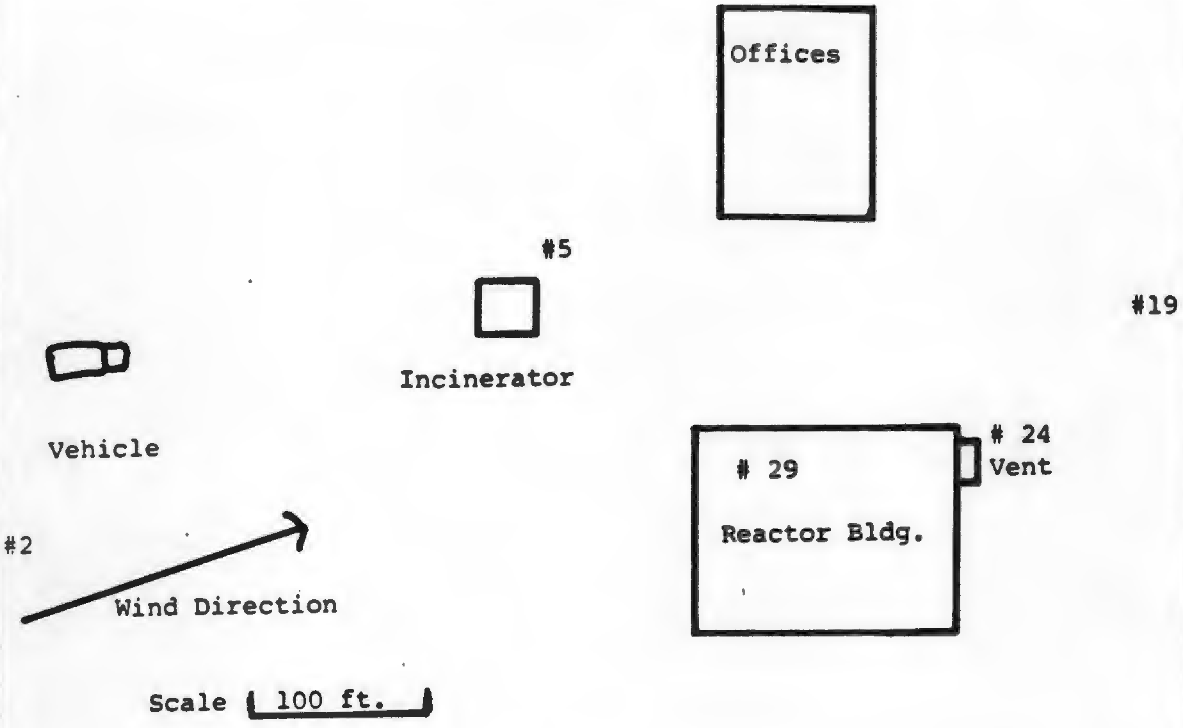

Figure 7 Field Study of a PVC Manufacturing Facility

Ambient VCM Conc. in ppb	0.1	14		590	64	3
Location	U.W. of Site	20' D. W. of Incin.	Std. 7.5 ppm	Near Vent of R. B.	Inside R. B.	100' D. W of R. B.
Sample Volume	1 cc	0.1 cc	2 ul	25 ul	0.1 cc	1 cc
Sample #	2	5	12	24	29	19

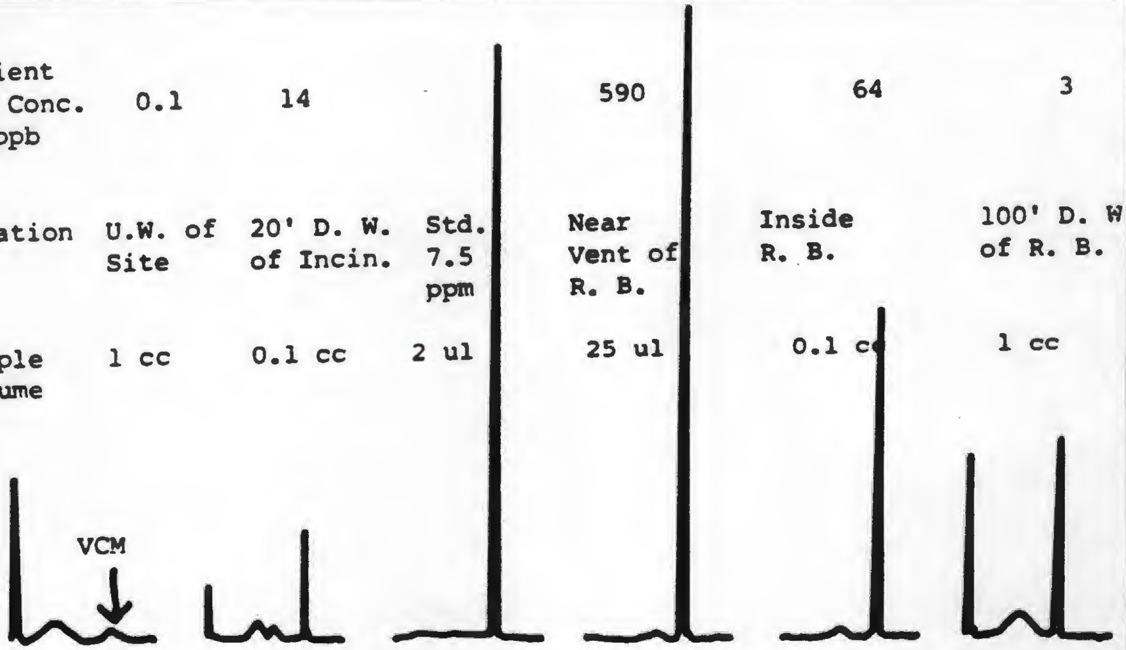

Figure 8 Field GC data at a PVC Manufacturing Facility

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RECORD OF AIR SAMPLING

Field Data Sheet Lab #60472 - Air Sample #2

The following information was recorded for the following sampling location:

Hicksville MEK Spill Site #246-82. Borehole A1 following water sampling.

a) Name of Person(s) Conducting Sample - John Bee.

Witness - Jerry Naples

b) EPA Property Number of Pump - Sample Pump #3 (No EPA #)
MSA Part #466118

c) Weather Conditions

- Ambient Temperature - 80°F.
- Wind Speed/Direction - 3 mph, from N.W.
- Barometric Pressure
- Relative Humidity
- Cloud Cover - 50%.
- Precipitation - None During Sampling.

d) Time and Date - September 9, 1982 - 1407-1507 Hr.

e) Location - Through 60 ft. of tygon tubing, the intake of which was set at 57'11" depth, one ft. above water table.

f) Sample Time - 1 Hour.

g) Calibration

- Sample Pump #3 (No EPA #)*
- Mass Flow Meter Number - 142070
- Mass Flow Meter Flow Rate (before and after use of MSA pumps; the calibration and recalibration readings.) 50cc/min & 50cc/min.

*In addition to calibrating the MSA pump a sample of calibration gas for the HNU was connected at 100 psi to the intake of the tygon - the HNU, sampling the exhaust ~~gas~~ of the pump deflected after 29 seconds, and returned to background 1 ppm after 13 minutes when the calibrating gas was disconnected. The deflection calibrated at 85 ppm with 75 ppm calibration gas (span setting #5). Without any gas pressure forcing air through the tube, deflection occurred after 24.8 seconds.

Page __ of __

AIR MONITORING DATA SHEET

te: ____________ Site Identification: ____________

erson Sampling: ____________ Qualified By: __ Other __

Meteorological Conditions

emperature: ________ °C/°F Wind Speed: ________ Direction: ________

arometric Pressure: ____________ Relative Humidity: ____________

loud Cover - Type: ____________ Amount: ____________

recipitation - Type: ____________ Amount: ____________

Instrument Data

Number: ____________ Calibration/Service Date: ____________

erson Calibrating: ____________ Qualified By: __

Calibration Data: ____________

NU: Type of Probe(s) [illegible] e)

Date Lens Cleaned: ____________

VA/GC Mode Used: ____________

Type & Number of Column: ____________

Type of Probe: ____________

Filters: ____________

____

____

tector Tubes: Type of Unit: ____________ (Bendix, Draeger, etc.)

Specific Tube(s): ____________

Tube Lot Number: ____________

Tube Expiration Date: ____________

Number of Pump Strokes/Sample Volume: ____________

____

____

Page ___ of ___

Data Sheet

Exact Location: ______________________________

Chemical Monitored: ______________________ Amount Measured: ______________

Time Started: ______________________ Time Finished: ______________

Exact Location: ______________________________

Chemical Monitored: ______________________ Amount Measured: ______________

Time Started: ______________________ Time Finished: ______________

Exact Location: ______________________________

Chemical Monitored: ______________________ Amount Measured: ______________

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Time Started: ______________________ Time Finished: ______________

Exact Location: ______________________________

Chemical Monitored: ______________________ Amount Measured: ______________

Time Started: ______________________ Time Finished: ______________

DQ CERCLA FASP ERT SARA EPA NIOSH SDWA NPL LUST OSHA

REM ATSDR DQ CERCLA FASP ERT SARA EPA NIOSH SDWA NPL LUST OSHA

ERT SARA EPA NIOSH SDWA NPL LUST OSHA REM ATSDR

CE LA FASP ERT SARA EPA NIOSH SDWA NPL LUST OSHA REM AI R DQ

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4 External DC Power Input
5 Carrier Gas Flow Controls
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7 4-Color Printer/Plotter
8 Computer Controller Module
9 Gas Fittings for Auto-Sample and Calibrant Inlets etc.
10 Low Pressure External Carrier Gas Inlet
11 High Pressure Reservoir Fill
12 Signal Output (for external recorder etc.)
13 Alpha-numeric Liquid Crystal Display
14 Automatic Calibrant Container
15 Serial/Internal Modem Port

Specifications

Detectable compounds: Aliphatic/aromatic hydrocarbons, halohydrocarbons, alcohols, ketones, aldehydes, ethylene oxide, arsine, phosphine, TRS components (including hydrogen sulfide), glycol ether solvents.

Detector:
Photovac proprietary Photoionization detector.

Sensitivity:
Better than 0.1 ppb (benzene) for 1 mL air sample with 4:1 signal-to-noise ratio. Very low quench loss in air medium.

Chromatography:
Precolumn backflush fused quartz capillary column configuration with optional isothermal oven, software selectable sample volume, automated sampling using 6 three-port miniature valves, air or inert carrier gas. All instruments offer optional manual (syringe) sampling. 10S10 is exclusively for syringe sampling.

Multi-dimensional chromatography, using two dissimilar isothermal fused quartz capillary columns.

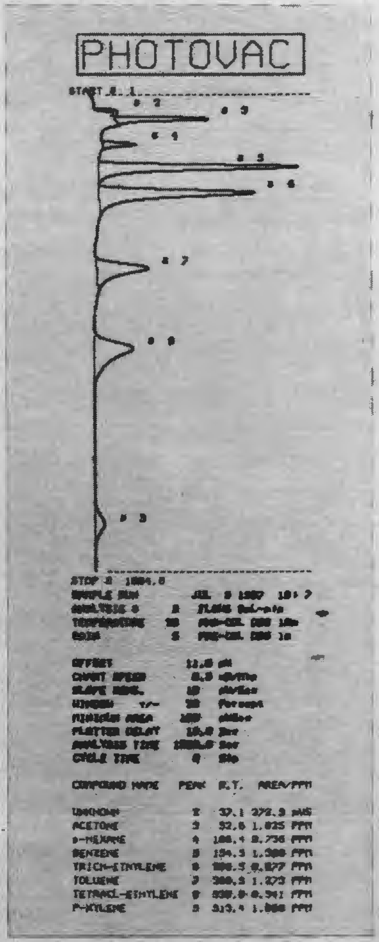
Power:
Internal batteries, external 12 V battery pack, 115 or 230 V ac mains (please specify choice). Isothermal oven requires external battery pack or mains adapter.

Calibration:
Automatic or manual, with new "peak locking" software.

Weight:
29.5 lbs (13.3 kg.)

Dimensions:
Width 18.25" (46 cm), Height 6.25" (16 cm), Depth 13.25" (34 cm).

Analysis Time:
Depends upon compounds required, almost always under 10 minutes.



10S70 PRINTOUT

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1ppb 100ppb

Automatic — Our AUTOMATED CHROMATOGRAPHY SYSTEM has a sophistication that can only be found in laboratory units costing four times as much. Features include precolumn backflush, multi-capillary column, isothermal control, direct automated sample introduction, on-board analysis and print-out of data in plain language, automatic phone communication with a remote PC, alerting the user to impending changes in a situation under surveillance, continuous monitoring capability, Time Weighted Averaging, auto-calibration.

PC Compatibility — While the computer power on-board our 10S50 and 10S70 instruments is truly phenomenal, this can be further extended through our PC DANDI* software package. This provides for direct connection of our 10S70 instrument to a local or remote PC so that a wide range of different data reductions, abstractions and presentations can be performed. Up to 200 different chromatograms — together with their analytical interpretation and set-up data — can be stored on disk. The 10S70 can **automatically "call-in"** to a remote PC and deliver data** and actual **reports, analyses and chromatograms,** whenever a particular compound under surveillance passes a predetermined level of concentration.

Service — We provide on-line advice and assistance to our customers. We are able, with the 10S70 model, to make a remote connection to an instrument and check out problems through the telephone line**. When necessary, we can generally have an instrument back in our repair shop by the following working day. We have **service centers in Huntington, NY, and in Toronto, Canada** and, with our 1 year warranty and Extended Maintenance Plan, we are in a position to be able to give assistance with **minimum down-time.**

APPLICATIONS

Environmental — Evaluation of hazardous waste sites from such viewpoints as groundwater, soil and air contamination, the assessment of risk to nearby dwellings and wells, the safety of workers involved in on-site operations are all extremely viable applications for the 10S instruments.

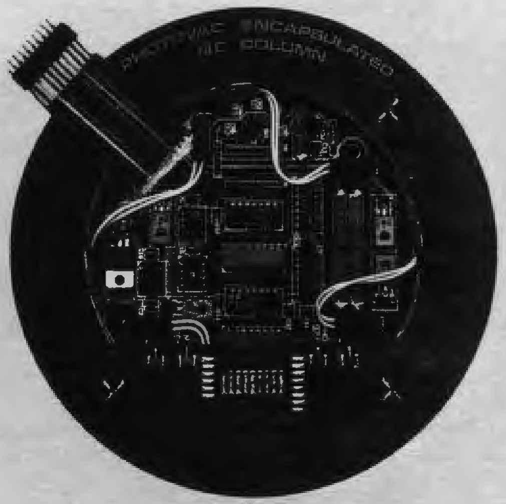
Property line measurements of fugitive emissions — and the continuous in-place surveillance of these — are areas of increasing application.

Due to the 10S70's remote capability, it is possible for senior personnel to directly access a field instrument through a phone line and assess an unexpected turn of events.

Industrial Hygiene — In-plant air quality surveillance for single or multiple toxic gases or vapors has been an absolutely ideal application for the 10S analyzers. Our instruments are used for routine or emergency "grab" sampling as well as for continuous monitoring of areas of concern. TWAs are readily available on any time-base desired.

As a industrial hygienist, imagine the benefit of being able to instantly access a network of on-site monitors from a terminal based in your office; being able to obtain real time levels and the on-going TWA level; being able to remotely adjust the analytical parameters and examine a new and unexpected incident.

PHOTOVAC 10S



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Sensitivities of better than 0.1 ppb may be obtained for a 1 mL sample. No preconcentration is required!

Specificity — New 10S instruments offer a combination of FUSED QUARTZ CAPILLARY COLUMN CHROMATOGRAPHY with sophisticated ISOTHERMAL OVEN control. These features, combined with a NEW SELF-CLEANING 18-PORT VALVE SYSTEM, ensure superbly accurate chromatography, with a high degree of confidence in the identification of compounds.

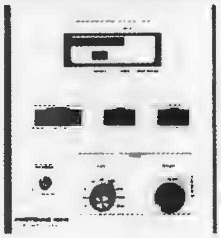
For added confidence, CONFIRMATIONAL MULTI-DIMENSIONAL CHROMATOGRAPHY, using two analytical columns in a single automated analysis, will be available FOR THE FIRST TIME in a portable instrument!

Reliability — The 10S line of chromatographs has become the tool of choice for a very wide range of different field-based operations. Reliability under these conditions has been of paramount importance and our success to date has depended upon a very reliable design. When making improvements, we have been careful not to compromise this reliability and have worked to enhance this vital aspect.

Speed — With the introduction of fused quartz capillary columns, an analysis which used to take ten minutes can now take LESS THAN TWO MINUTES.

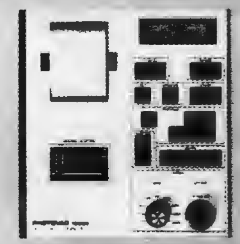
Portability — Despite improvements, such as fused quartz capillary columns, column oven, modem unit, improved valve usage, extended software and enhanced specificity, the Photovac 10S70 still weighs only 29.5 lbs (13.3 kg) and, with an optional battery pack weighing just 6 lbs (2.7 kg) lbs., provides the most weight-effective portable analysis system on the market.

The 10S Series — 4 Models Designed to Meet Your Particular Needs



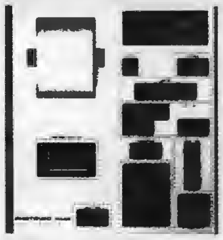
Model 10S10 - Manual

- Sample injections are made manually
- Dual column configuration
- Calibrated by interspersing samples with injections of standard
- Portable external chart recorder required (available from Photovac)
- Liquid crystal display, with bar graph
- Rechargeable carrier gas reservoir (two days approximately)
- Rechargeable battery (8 hours approximately)
- Columns immediately accessible beneath hinged cover



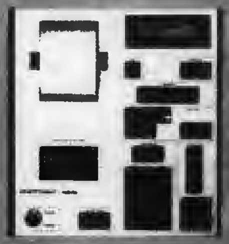
Model 10S30 - Automatic

- Contains all 10S10 features, plus:
- Computerized sample/analysis sequence with continuous monitoring
- Software selectable dual, triple or other column configurations
- Automatic backflush, using pre-column
- Chromatograms plotted for manual interpretation
- Built-in multi-color printer/plotter
- 32-character alpha-numeric liquid crystal display



Model 10S50 - Computer

- Contains all the 10S30 features, plus:
- Computerized peak identification and quantitation
- Updates stored parameters through computerized auto-calibration
- Printout of compounds by name and with ppm or ppb concentrations
- Contains four libraries of 25 compounds each
- Provides variable period Time Weighted Averaging



Model 10S70 - Communications

- Contains all 10S50 features, plus:
- Serial/internal modem port for remote terminal or PC-operation using PC DANDI®
- Fully automatic remote sensing capability
- Automatic call-in, in event of emergency
- Built-in audio alarm

Appendix D

Obtained by the Technical Assistance Team, in support of the USEPA Removal Action of 1983-1984.

- Wallkill New York: Summary of Water Level Measurements, 1983-84
- Wallkill Well Data
- Wallkill, New York, Tetrachloroethylene Sample Results

WALLKILL NEW YORK
TABLE
SUMMARY OF WATER LEVEL MEASUREMENTS

#	Residents	Top of Casing Elevation (ft)	Water Level Elevations In Feet Above Mean Sea Level									
			11/15/83	12/1/83	12/14/83	12/15/83	12/16/83	12/21/83	1/12/84	1/13/84	2/2/84	2/3/84
Industrial Place												
#	General Switch	635.37			624.77				621.74			
	Wooden Sump Opp. Contel	600.15										
2	Guild Molders	602.77							595.02		594.81	
Highland Avenue Extn.												
420	Orange Handling	628.63				616.70						
400	Kuhl Restaurant	638.84				603.31						
409	R. C. Prior	636.58										
406	F. Kuhl	628.81				622.76						
Highland Avenue												
355	Pitt	664.54				630.91				630.89		
339	Perry	654. approx.									588.28	
338	Perez	652.14	652.14									
328-332	Electra Mfg.	643.95	624.37			634.23	633.88	633.57	631.31		630.25	
330	Cornelius Merle	650.48	606.17				640.41		613.76			
329	Osbourne	649.65	602.72			604.13	622.71		619.01		617.04	
327	Lobb	646.38	606.58			596.41	606.70	620.57	617.99			
325	Fiore	644.33	607.82				622.05 607.50	622.05	617.26			
323	Gilbert	649.25	620.44				630.07					
321	Seeley	641.73	606.62					606.04	608.60			
320	Parella	639.19									615.61	

WALLKILL NEW YORK
TABLE
SUMMARY OF WATER LEVEL MEASUREMENTS

#	Residents	Top of Casing Elevation (ft)	Water Level Elevations In Feet Above Mean Sea Level			
			12/21/83	1/13/84	1/16/84	2/3/84
186	Gerald Winner	649.19				575.21
175	J. M. Holmes (Shallow)	633.09	623.00			
168	Wegenroth	639.47		611.59		
Commonwealth						
196	Reynolds	667.27			580.27	
193	Kehm (Shallow)	657.77			652.83	
183	Palermo (New)	654.90			564.77	573.37
	(Dug)	651.96				
	(Old)	651.79				
177	Claussen (Shallow)	647.65			642.60	
173	Dickerson	648.97			590.35	
243	Meyers	695.59		585.31		
229	Ruppert	683.26		576.68		
210	Berry	679.82		<579.82		

WALLKILL NEW YORK
TABLE
SUMMARY OF WATER LEVEL MEASUREMENTS

#	Residents	Top of Casing Elevation (ft)	Water Level Elevations In Feet Above Mean Sea Level								
			11/15/83	12/15/83	12/16/83	12/21/83	12/22/83	1/13/84	1/12/84	2/2/84	2/3/84
316	Stout	632.64									614.64
306-314	Continental Telephone	630.35	605.76			609.00			607.43	607.22	607.28
309	Barry	635.22			604.18				603.49		
297	Robaina	630.06							593.51		592.80
295	Janiak	623.38			589.50						
286	Estrada	616.45			595.65				592.75		
Electric											
31	Van Pelt	646.72			619.20			621.70			616.00
Watkins Avenue											
251	Saxton	684.35					601.65	595.08			
239	Wand	676.07								569.10	
238	Cosmo Optics (New)	675.96					593.34	600.17			
228	Prior King Press	673.27									
220	De Rose (Shallow)	667.77						658.65			
217	Robert Libario (Shallow)	662.66					658.53	656.25			
190	Morse	651.46						481.55			540.33
197	Rasmussen	639.64						592.79			595.17

WALLKILL NEW YORK

TABLE

SUMMARY OF WATER LEVEL MEASUREMENTS

#	Residents	Top of Casing Elevation (ft)	Water Level Elevations In Feet Above Mean Sea Level							
			11/15/83	12/1/83	12/14/83	12/15/83	12/16/83	1/12/84	1/13/84	2/3/84
319	Ogden	640.91	609.63				605.67	612.16		
	Stout Lot #4									
	Dug Well #1 (Shallow)	619.05					617.96	617.86		
	Dug Well #2 (Shallow)	630.49					629.44	629.18		
317	Knapp	640.78	592.87				600.63	599.08		597.38

WALLKILL WELL DATA

Industrial Avenue
Highland Avenue Extension

# Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
Continental Telephone Offices	No well City Used to be D&W Railroad						No well			
Wooden clad sump opposite Continental telephone		600.15								
International Diesel Electric (Midland Avenue Ext.)	City no wells								Frank Cizek w/historical society of D&W confirmed no wells.	
409 R. C. Prior	Well	655.58	6" x 480'	Submersible 2 HP	3 gpm	None			Above ground. Slow recovery	1983 W. Roacke
409 Federal Cabinet	Well	-	6" x 200'	Submersible 2 HP					Well under bldg. slab	1955 -

*Time required in minutes that well pumped @ selected gpm to obtain evacuation of 3 well volumes

WALLKILL WELL DATA

Commonwealth Avenue

#	Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
216	Joseph D. Brincherhoff and Son (343-7764)	Well	681.61	11' x 3'	Jet 1/3 HP		No			Do not drink. Use for toilet only. Dug well-inside shop.	
217	Marie Hoffman (343-9871)	Well	674.24	–			No				
220	Frank Varga (343-1754)	Well	684.56	200' x 6"	Jet 130' 1/2 HP					Drilled well for drinking, showers. Dug well for garden, washing clothes.	
221	George Muller (343-5619)	Well	681.47	–	–	–	No			1973	
223	Old Foundation										
224	William R & Marilyn Morris (342-1098)	Well	688.56	205' x 6"	Submersible		No				1966 Davis
226	Runnalls (342-5078)	Well	689.56	Below ground			Softner,calligan			Using bottled water, use well for shower.	

WALLKILL WELL DATA

Commonwealth Avenue

# Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
208 Hollis E. Johnson (342-2400)	Well	667.08	180' x 6"	Submersible 175' 1/2 HP	3 1/2 gpm	No			Slight bacteria contamination. Nauseous, boils, cleared up last week.	1974 Davis
209 Panero (342-2193)	Well		255' x 6"	Submersible 240' 1 1/2 or 2 HP	6-7 gpm	No			Well in front of house 4' out from left kitchen window (well 190' original). 1955 went dry, drilled to 255' in 1969.	1955
210 Harold C. Berry (343-8711)	Well	679.82	160' x 6"	Submersible 1/3 HP	40 gpm	No				
211 Bob Norbury (342-3962)	Well		212' x 6"	Submersible		Yes				
213 Letha Carey (342-2295)	Well	675.46	139' x 6"	Submersible		No			Sediment in water. Well covered by driveway. Do not like taste.	1950 Davis
214 Jay Mader (342-2850)	Well	680.44	170' x 6"	Jet 1 HP		No			Well covered by layer concrete slab, but hole in center. Sore throats, skin rashes.	

WALLKILL WELL DATA

Commonwealth Avenue

# Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
195 John Crudo, Jr. (342-4385)	Well	-	150' x 6"	Submersible 140'		Yes				
196 R.J. & Louise Reynolds (342-4355)	Well	667.27	240' x 6"	Submersible 200'	6 gpm	Yes			Hard water/occasional sulfur-well located in backyard in a U-shaped arrangement of concrete blocks-easy access.	1977 Davis
197 Allan J. Brincherhoff (343-2303)	Well	661.34	270' x 6"	Submersible 200' 1/2 HP	5 gpm	No			Hard water/sulfur. Well in corner of pump. Pulled yearly. Located near driveway near reflector. Plenty of water	1975 Davis
200 James Kieran (342-1152)	Well	671.56	189' x 6"	Submersible 160'		Yes. Caligan				1964
205 James Hawkins (343-5919)	Well	668.92	190' x 6"	180'	4 gpm	Softner			Pumps dry in 1 hr. very hard. Easy access through house -acess from outside.	1930
206 Wallace K. Bliven (342-0662)	Well	667.18	165' x 6"	Submersible 155'	2 gpm					

WALLKILL WELL DATA

Commonwealth Avenue

# Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
186 Flynn	Well									
187 Gessner	Well									
188 Norma Demouth (342-0862)	Well	663.32	296' x 6"	Submersible 1.5 HP		None			Well on left side of house under orange bucket.	DeRossi
189 Michael Steels (343-5656)	Well		110' x 6"	Submersible 1 HP		Softner			Well between front door step and blue post to the right.	
191 Bertha Krawiec (343-8688)	Well	654.76	240' x 6"	Submersible	3 1/2 gpm	Softner			In backyard. Hard water and sulfur.	1968 Davis
192 Hite (342-0260)	Well	665.26	177' x 6"	Submersible		Softner			Drilled well on backyard path under round slab-abandoned dug well in shed that is partially filled in. Explosive charge see data sheet.	1961 Davis
193 Theresa Kehm (342-0595)	Well	657.77	25-30' x 3'	Jet		None			Dug well. Pump in basement ment-well, rear of house near drive-covered with concrete slab.	

WALLKILL WELL DATA

Commonwealth Avenue

#	Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
183	John & Evelyn Palermo (342-3071)	Well +	654.90	276' x 6"	Submersible	5 gpm	None			Old well dry May. 1983 was 365' and have a dug well-both in left side yard, slight sulfur odor- use new well in front.	
		Abandoned Well +	651.79	365' x 6"							
		Dug well	651.96	10' x 3'							

WALLKILL WELL DATA

Commonwealth Avenue

# Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
173 Norman P. Dickerson (343-1569)	Well	648.97	6" x 250'	Submersible 200' 1/2 HP	12-15 gpm	Filter for sulfur			Some sulfur-located left side yard. Green casing. Easy access.	1972 Davis
174 Miguel Lopez (343-5928)	Well	Well under house		Jet Pump 1/2 HP	Enough for a family of 5 (accept dry spells)	None			Wife-kidney infections Well under addition in back of house. Accessed through basement.	
176 Reagan	Well	Well under house								
177 Ira S. Clauson (343-4443)	Well	647.65	13'	None					Dug well-under round slab in backyard-easy access.	1925
179 Jeff & Dale Rieck (342-6383)	Well	Well under house	-	Submersible		For sulfur			Enters house by basement window near porch in back-exact location underground.	1960
182 Mrs. Harry Davis (343-4439) (343-1061 Wo)	Well + Abandoned Well		-	Submersible		None			Abandoned well under garage. Floor-opening available.	1975 Davis

WALLKILL WELL DATA

Watkins Avenue

# Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
229 Joseph Radivoy (342-0735)	Well	668.69					221 gal assumed	63 min @ 3.5 gpm	Contaminated. TOC below ground.	
231 Clarence Campbell (342-0194)	Well	Prior King Press Well								
233 Jehovahs Witness	Well									
238 Cosmo Optics (343-2105)	Old Well#1 (Under house)	-	6" x 190'	Submersible 3/4 HP	8-10 gpm	None	280 gal.	80 min @ 3.5 min	Under house. Contaminated	1960 Davis
	New Well#2	675.96	6" x 290'	Submersible 3/4 HP	5-6 gpm	None	368 gal.	105 min. @ 3.5 gpm	Well under heavy concert slab. Contaminated	1980 Davis
239 Sal & Kay Ward (343-6643)	Well	676.07	6" x 214"	Submersible 168' 3/4 HP	8 gpm	None	256 gal	73 min @ 3.5 gpm	Contaminated. Centering guide @ 22'. Removed to water-table.	1958 Davis
251 Saxton (343-8748)	Well	684.35	6" x 250'	Submersible 200' x 1/2 HP	10 gpm	None	308 gal.	88 min. @ 3.5 gpm		

WASHINGTON HEIGHTS
WALLKILL SITE MAP
TOWN OF WALLKILL ORANGE CO., N.Y.
SCALE 1" = 100' JANUARY [illegible]

EUSTANCE & HOROWITZ, PC
CIRCLEVILLE N Y 10919

WALLKILL WELL DATA

Industrial Avenue
Highland Avenue Extension

#	Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
	Industrial Place										
	General Switch	City+ Abandoned Well	635.37	6" x 480"	Submersible 460'	2 gpm	None	537	268 mins @ 2 gpm	Well contaminated Well pumps dry in 20 mins. unless throttled back. Easy access, above ground	1981 Tomkins
17	Lubricants Inc. Packaging	City			No Well					Resident for 10 yrs. Use varsol, lubricants, trichloroethylene. Poor housekeeping	
2	Guild Molders (342 5701)	City (Drinking)	602.77	6" Centering guide @ 90'	Submersible 11 stage 11 HP		None	4		Plastic molding. Solvents used in decorating bottles	1975 Sullivan
	Orange County Corrugated	No well City Used to be D&W Railroad						No well			

*Time required in minutes that well pumped @ selected gpm to obtain evacuation of 3 well volumes.

WALLKILL WELL DATA

Highland Avenue Extension, Sands, Electric & Watkins Avenue

# Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
275 Neldham (343-3878)	City No well						No Well			
Sands										
24 Miller Realty (342-3974)	City No well						No Well			
Sam E. Fast										
Electric										
31 Van Pelt (342-0176)	Well	46.72	6" x 230"	Submersible 1/2 HP		None			Well above ground. Easy access.	1973
Watkins										
165 Sherman R. Stephens (342-1709)	City	618.13			None				Dug well. Easily accessible.	-
168 Alice Wegenroth (342-1479)	Well	636.47	6" x 70'	Submersible 60' 1/3 HP	Never ran dry				Well in sump under slab. Previous owner Perrello (361-3611)	-
170 Mrs. Brittings (342-3367)	City No well						City - No Well			
171 J.M. McEwan (343-8743)	City No well						City - No Well			

WALLKILL WELL DATA

Highland Avenue Extension

# Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
295 Vicent Janiak (342-1610)	Well	623.38	6' x 200'+	Jet 1 HP		Softener	245 gal.	93 min @ 8 gpm Softener	Some sulfur. Contaminated. Kitchen sink 2 gpm+bath 4 gpm+ + bath sink 2 gpm= 8 gpm	1950
293 Wayne Nixdorf	Well	623.45								
292 George Sleiter	Well	620.97								
291 Donna Smith (342-1157)	Well	621.87	4' x 17'	Jet 1/2 HP		Filter	25 gal	25 min @ 3 gpm. Filter	Hand dug	<1940
288 Seymour Healy (342-2998)	City	City - No Well								
286 Antonio Estrada (343-9824)	Well	616.45	6" x 170'	Submersible 1/2 HP						1976
287 Issy Tessler (342-2947)	Well		6" x 135'	Submersible 120' x 1/2 HP					Resident estimated Max pump rate 47 gpm	
282 Frank Shattuck	Well	614.29								
281 Arthur Condadi (343-2044)	City (McGawline)	No Well								
280 James Cole	Well	613.49								

WALLKILL WELL DATA

Highland Avenue Extension

# Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
316 Stout (Janice) (343-4626)	Well Temp City	632.64	6" x	Jet		Yes			Contaminated	
306-314 Continental Telephone	No resident	630.35	6" x 192'	None					Obstruction. No resident. Above ground. Casing open/cut off	
313 Chris Lewis (342-0139)		637.34							Contaminated	
309 Robert Barry (342-0714)	Well	635.22	6" x 203'	Submersible 6 stage, 180'		None			Contaminated. Temporary city water	1977 Davis
307 George Ruppert (342-0009)	Well	633.17	6" x 205'	Submersible 1/2 HP		10 gpm			Contaminated. Temporary city water. Rock @ 90' (5' into rock)	1979 Davis
304 Edward Liska	Well	627.10	6" x 137'	1/3 HP					Well TOC 3' underground 6' from house	1959 Davis
299 Hilton Eckerson	Well	626.53								
298 Schmick	Well									
297 Francisco Robaina (343-0360)	Well	630.06	6" x 200'	Submersible		None	245 gal.		Contaminated. Temporary city water.	

WALLKILL WELL DATA

Highland Avenue Extension

# Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
325 Dominick Fiore (343-2994)	Well	644.33	6" x 172'	Submersible 160', 1/4 HP	11 gpm	None			Water cooler for drinking. Contaminated. Well above ground. Easy access.	1974 Davis
323 Gilbert	Well	649.25	6" x 180'	Submersible 160'					Sounding 116' centering guide? Contaminated. In concrete sump	
321 Seeley	Well	641.73	6" x 220'	Submersible 200'		None			Above ground. Easy access.	
320 Charles Parella (342-2385 Wo) (286-1666 Ho)	Well Temp City	639.19	6" x 100'	Jet 80'	2 gpm or will loose suction	None			Below ground. Extraction well. Contaminated. Temporary city water.	
319 Gary Ogden (343-2960)	Well	640.91	6" x 215	Submersible 1/2 HP					Above ground. Contaminated.	
318 Stout Lot #4 (Ruins)	No Resident Dug Wells	#1 619.05 #2 630.49	3' x 16' 3' x 11'	None None	- -	None None			No resident. No resident.	
317 Oscar Knapp (342-5310)	Well	640.78	6" x 220'	Submersible 200', 1/2 HP	-	None			Little sulfur. above ground - easily accessible. Contaminated.	1973 Davis

WALLKILL WELL DATA

Highland Avenue Extension

# Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
337 Olive Gady (342 1741)	Well	649.73	6" x 87'	Jet 3/4 HP	–	None			Well under house	1948
335 Janet Crocks (343 8452)	Well	653.17	6" x 106'	Jet 1/2 HP					Well below grade (4-5'). Contaminated	1960 Davis
334 William Roselli (342 1744)	Well Temp City	651.15	6" x 108'	Jet 1/2 HP		None			City water 1983 from General Switch. Well below grade. Contaminated	1953 Davis
328-332 Electra Mfg.	Well	643.95	6" x 100'+	None		None			Pulled hand pump. Well open.	
330 Cornelius Merle (813 343 0698) Local:Hommer Carlisle (342-3126)	Well	650.48	6" x 265'	Submersible	–	None			Residents in Florida. Well above ground. Easy access.	1977 Davis
329 D. Osbourne (343-6745)	Well Temp City	649.65	6" x 200'	Submersible 180'					Well above ground. Easy access. Temp city water. Contaminated.	1980 Davis
327 Mrs. Lobb (342-2159)	Well Temp City	646.38	6" x 170'	Submersible 150'	4-5 pgm	None			Above ground-easy access. Contaminated.	1973 Davis

WALLKILL WELL DATA

Highland Avenue Extension

# Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
357 Chas Schmall (Dght. 342 3528 343-3529)	Well	663.93	6" x 212'	Submersible 200' 1/2 HP	15 gpm	None			Wellhead under water 12/15/83. Please call daughter	1966 Davis
355 William Pitt (343 3717)	Well	664.54	6" x 110'	Jet 99' 3/4 HP	1 gpm	None			Well pumps dry @ 4 gpm in 40 mins. V. poor yielding well. Contaminated.	1940 -
353 Ken Ernest (343 4831) Katherine Ward	Well	Well inside house Empty lot	6" x 115'	Jet 90 3/4 HP	Supplies family of 2	None			Well under house	1960
341 Chas Courteau (342 2787)	Well		6" x 165'		-		-	-	Well below grade	-
339 Ray Perry (343 3820)	Well	652.63	6" x 210'	Submersible		Sediment Filter			Well below grade (2'). Dug up.	1955
338 Raymond Perez (343 0645)	Well Temp City	652.14	6" x 60'	Jet		None			Well used for garden only during summer. Temp. water from General Switch. Contaminated.	-

WALLKILL WELL DATA

Highland Avenue Extension

# Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
(Spring nearby elev 635.00)										
420 Orange Handling (343 0641)	Well	628.63	6" x 215'	Submersible 175'	60 gpm?	None				1968 –
408 F. Kuhl (343 0991)	Well	628.81	6" x 104'	Submersible 88'	10 gpm				Heavy concrete slab	1951 Davis
400 Kuhl Restaurant (343 8871) (Martin)	Well	638.84	6" x 264'	Submersible 224', 1 HP	30 gpm				Prolific. @ 30 gpm = 1 ft. drawdown	1977 Davis
363 Alan Lent (342 5497)	Well	–	6" x 285'	Submersible	Supplies Family	None			Well 16' from rear of house. TOC 7' below grade @ ctr line of house	1964 Noyes
361 Eliz. Noyes (342 6476) (343 8847)	Well	664.87	6" x 130'	Submersible 126'		None			Rash, burning on skin. Well below grade, son could dig up well	1960 –

WALLKILL WELL DATA

Watkins Avenue

# Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
186 Gerald/Eva Winner (343-5406 Ofc.) (343-8100 Ho.)	Well	649.19	6" x 280"	Submersible 250' 3/4 HP	3 gpm	None	352 gal.	100 min @ 3.5 gpm	Well TOC below grade	1966 Davis
187 Peter H. Rasmussen (342-2329)	Well	639.64	6" x 146'	Submersible 135' 1/2 HP	7 gpm	Yes	156	44 min @ 3.5 gpm	Obstruction-centering guide at 80? Contaminated	1935
190 Louis W. Morse	Well	651.46	6" x 314'	Submersible 200 1/2 HP		Culligan			Had water supply problems with well since Palermo sunk wel. Contaminated	1970 Tompkins
194 Dianne Regan	City						City – No Well			
195 Hebrew Day School (343-8588)	City						City – No Well			
196 Wontz	City						City – No Well		Dug well filled	
198 Floyd Terwilleger (343-7150)	City						City – No Well		Authority on McGaw Line Water supply	
201 M. Smith (343-0319)	City						City – No Well			

WALLKILL WELL DATA

Watkins Avenue

# Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
219 Fred Lybolt (343-7886)	City Aband. Well	659.75	3' x 40'	None		Charcoal			Well is on #217 (common well)	1960
220 Dennis De Rose (342-4110)	City Aband. Well	667.77		None		None			Jet pump in basement. Shallow dug well under cement slab.	-
221 Janice Ranella (342-2506)	City	City – No Well								
222 Frank Currier (343-1498)	City	City – No Well								
223 Ronald Griffin (343-1191)	City	City – No Well								
225 Mr. Hubsch (342-1191)	City	City – No Well								
227 Chester Seeley (343-1074)	City	City – No Well								
228 Prior King Press (343-3318)	Well	673.27	6" x 200'	Submersible 180' 1/2 HP		None	235 gal.	78 min. @3.5 gpm	Well 6" below grade Chronic pressure loss.	1957

WALLKILL WELL DATA

Commonwealth Avenue

# Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
232 Linda Caffery (342-3533)	Well	695.73								
233 Paul Heilfurth (343-0310)	Well Dug well	683.84 686.47	155' x 6" 30' x 3'	Submersible 146' 1/2 HP	8 gpm	No			Reported rash-never goes dry 7/16/82 replaced pump and pipe dug well 30' no pump easy access.	
237 Bill Noha (343-6043)	Well	688.44							Malignant melanoma	
241 Hazel Gallo (343-0746)	Well	691.82	95' x 6"	Jet 1/2 HP		No			Gallo pump repaired 12/83.	
243 Shares Well with well #245 Meyers	Well	-								
244 Patrick Finlay (343-4929)	Well	697.32	163' x 6"	Submersible 135'	8 gpm	No				
245 M. Meyers (342-1895)	Well	695.59	256' x 8"	Submersible		Yes			Well turned cloudy for short time when 320 Highland Ave. started pumping.	

WALLKILL WELL DATA

Commonwealth Avenue

#	Resident (Telephone #)	Type of Water Supply	Elevation Top of Casing (Ft.)	Diameter Depth (Ft.)	Pump Type Depth (Ft.) H.P.	Max Pump Rate (Gal)	Water Filter	Submerged Well Volume (Gal)	Sample Protocol*	Comments	Year Drilled Driller
227	Charles J. & Alice MacEntee (342-1331) (343-7107 Work)	Well	681.50	280' x 6"	Submersible 275'	5 gpm	No			Hard/sulfur-well above ground directly to rear of house. Behind Cosmo Optics.	1977 Davis
228	W. Plantenga (342-1125)	Well	693.75		Submersible		No			Well water checked in Nov. 1 abandoned. well hard to access. Contact owner Mr. Mielke, Middletown	
229	David Ruppert (343-1753)	Well	683.26	265' x 8"	Submersible 220' 1/2 HP	5 gpm	No			2 residents w/rash 90' to bedrock 100' casing-bedrock @ 95'.	1975 Davis
230	C. Thacker (343-2155) (343-1580 Work)	Well	694.72	200' x 6"	Submersible 190'	5-6 gpm	No			Hard/sulfur. Facial rash/headaches/ nausea.	1960 Davis
231	Eugene & Shirley Block (342-4220)	Well	690.15	152' x 6"	Submersible		Softner			Well under front porch. Pump repaired in October. Galvanized pipe eaten away.	1955

3/28/84

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LOCATION

GENERAL NOTES:

1) Unless otherwise noted, sampling was performed by EPA or EPA in concert with State or County.

2) Unless otherwise noted, samples were collected after running the tap for 15 minutes.

3) Laboratories:

   a) Envirotest is a commercial laboratory located at 717 Broadway, Newburgh, New York. It is certified by the New York State Department of Health for Drinking Water Analysis. Sample analysis was performed using EPA Method 601.

   b) Clayton is a commercial laboratory located at 160 Fieldcrest Avenue, Raritan Center, Edison, New Jersey. It has received interim certification from the State of New Jersey for Water Quality Analysis. Sample analysis was performed using EPA Method 624.

   c) TAT/Photovac indicates on-site analysis by the EPA Technical Assistance Team (TAT) Contractor, Roy F. Weston. Sample analysis was conducted on a Photovac Model 10A10 portable ionization gas chromatograph equipped with a photoionization detector and an SE-30 Chromosorb 100/120 column. The system was operated at room temperature. Sample headspace was analyzed.

   d) NYSDEC/DSHW/GC indicates on-site analysis by the New York State Department of Environmental Conservation, Division of Solid and Hazardous Wastes. Sample analysis was conducted using a Hewlett-Packard gas chromatograph (GC) Model 5710A equipped with an electron capture detector and a 3% SP2100 Supelcoport 100/120 column. The GC was run isothermally at 35°C. Sample headspace was analyzed.

   e) USEPA/ESD is the EPA Region II Environmental Services Division Laboratory located in Edison, New Jersey. Sample analysis was performed using the EPA Method 624.

   f) USEPA/ERT is the EPA Environmental Response Team Laboratory located in Edison, New Jersey. Sample analysis was performed using the EPA 624 Method.

   g) NYSDHCLR - is the New York State Department of Health Center for Laboratory Research located in Albany, New York. Sample analysis was performed using EPA Method 503.1 and EPA Method 601.

4) Quality Assurance/Quality Control (QA/QC)

   a) All data reported by Envirotest and the TAT/Photovac field lab was reviewed for QA/QC by TAT II.

   b) Data reported by Clayton and the USEPA/ERT were reviewed for QA/QC by the ERT.

   c) Data reported by USEPA/ESD was reviewed for QA/QC by the ESD.

d) Data reported by the NYSDEC/DHSW/GC was reviewed for QA/QC by the NYSDEC/DHSW.

e) Data reported by the NYSDHCLR was reviewed for QA/QC by the NYSDHCLR.

f) Data reported by the Orange County Health Department (OCHD) was reviewed for QA/QC by the OCHD.

5) All samples analyzed at commercial laboratories were under EPA control unless otherwise noted.

6) All sample analysis results are reported in parts per billion (ppb) unless otherwise noted. (ug/g = microgram per gram)

WALLKILL, NEW YORK
TETRACHLOROETHYLENE SAMPLE RESULTS

COLLECTION DATE	LAB NUMBER	TETRACHLOROETHYLENE CONCENTRATION (PPB)	ANALYSIS DATE	LABORATORY	COMMENTS
* BLANK					
12/20/83		<1	01/05/84	ENVIROTEST	
01/06/84	68569	ND	01/13/84	USEPA/ESD	
01/27/84	68577	ND	02/01/84	USEPA/ESD	
02/22/84	66256	ND	02/22/84	NYSDEC/DSHW/GC	
03/07/84	66289	<1	03/08/84	NYSDEC/DSHW/GC	
* 173 COMMONWEALTH AVE, DICKERSON					
12/19/83	69171	<1	12/21/83	ENVIROTEST	
02/15/84	68874	<1	02/16/84	NYSDEC/DSHW/GC	
* 174 COMMONWEALTH AVE, LOPEZ					
12/19/83	69191	<1	12/21/83	ENVIROTEST	
02/15/84	68875	<1	02/16/84	NYSDEC/DSHW/GC	
* 176 COMMONWEALTH AVE, REAGAN					
12/19/83	69172	<1	12/21/83	ENVIROTEST	
* 177 COMMONWEALTH AVE, CLAUSON					
12/19/83	69187	<1	12/21/83	ENVIROTEST	
* 179 COMMONWEALTH AVE, RIECK					
12/20/83	68960	<1	01/03/84	ENVIROTEST	
* 182 COMMONWEALTH AVE, DAVIS					
12/19/83	69175	<1	12/21/83	ENVIROTEST	
12/20/83	69195	<1	01/05/84	ENVIROTEST	
03/07/84	66295	ND	03/08/84	NYSDEC/DSHW/GC	
* 183 COMMONWEALTH AVE, PALERMO					
12/19/83	69188	<1	12/21/83	ENVIROTEST	
02/15/84	66226	<1	02/16/84	NYSDEC/DSHW/GC	
* 186 COMMONWEALTH AVE, FLYNN					
12/19/83	68976	<1	01/05/84	ENVIROTEST	
02/15/84	66227	<1	02/16/84	NYSDEC/DSHW/GC	

WALLKILL, NEW YORK
TETRACHLOROETHYLENE SAMPLE RESULTS

COLLECTION DATE	LAB NUMBER	TETRACHLOROETHYLENE CONCENTRATION (PPB)	ANALYSIS DATE	LABORATORY	COMMENTS
* 188 COMMONWEALTH AVE, DEMOUTH					
12/19/83	69174	<1	12/21/83	ENVIROTEST	
02/15/84	66228	<1	02/16/84	NYSDEC/DSHW/GC	
* 191 COMMONWEALTH AVE, KRAWIEC					
12/19/83	68951	<1	01/05/84	ENVIROTEST	
02/15/84	66229	<1	02/16/84	NYSDEC/DSHW/GC	
* 192 COMMONWEALTH AVE, HITE					
12/19/83	69173	<1	12/21/83	ENVIROTEST	
02/15/84	66230	<1	02/16/84	NYSDEC/DSHW/GC	
* 193 COMMONWEALTH AVE, KEHM					
12/19/83	68952	<1	01/05/84	ENVIROTEST	
03/07/84	66285	ND	03/08/84	NYSDEC/DSHW/GC	
* 195 COMMONWEALTH AVE, CRUDO					
12/20/83	68958	<1	01/03/84	ENVIROTEST	
03/07/84	66294	ND	03/08/84	NYSDEC/DSHW/GC	
* 196 COMMONWEALTH AVE, REYNOLDS					
12/19/83	68977	<1	01/05/84	ENVIROTEST	
03/06/84	66268	ND	03/06/84	NYSDEC/DSHW/GC	
* 197 COMMONWEALTH AVE, BRINCKERHOFF					
12/19/83	69189	<1	12/21/83	ENVIROTEST	
02/15/84	66231	<1	02/16/84	NYSDEC/DSHW/GC	
* 200 COMMONWEALTH AVE, STEELE					
12/19/83	69200	<1	01/05/84	ENVIROTEST	
* 206 COMMONWEALTH AVE, BLIVEN					
02/15/84	66232	<1	02/16/84	NYSDEC/DSHW/GC	
* 208 COMMONWEALTH AVE, JOHNSON					
12/19/83	69192	<1	12/21/83	ENVIROTEST	
03/06/84	66269	ND	03/06/84	NYSDEC/DSHW/GC	

WALLKILL, NEW YORK
TETRACHLOROETHYLENE SAMPLE RESULTS

COLLECTION DATE	LAB NUMBER	TETRACHLOROETHYLENE CONCENTRATION (PPB)	ANALYSIS DATE	LABORATORY	COMMENTS
* 210 COMMONWEALTH AVE, BERRY					
12/19/83	69193	<1	12/21/83	ENVIROTEST	
02/15/84	66233	<1	02/16/84	NYSDEC/DSHW/GC	
* 211 COMMONWEALTH AVE, NORBURY					
12/19/83	69190	<1	12/21/83	ENVIROTEST	
03/07/84	66284	ND	03/08/84	NYSDEC/DSHW/GC	
* 213 COMMONWEALTH AVE, CAREY					
12/19/83	69196	<1	12/21/83	ENVIROTEST	
03/06/84	66270	ND	03/06/84	NYSDEC/DSHW/GC	
* 214 COMMONWEALTH AVE, MADER					
12/19/83	69194	<1	12/21/83	ENVIROTEST	
02/16/84	66235	ND	02/16/84	NYSDEC/DSHW/GC	
* 217 COMMONWEALTH AVE, HOFFMANN					
12/20/83	68953	<1	01/05/84	ENVIROTEST	
02/16/84	66236	ND	02/16/84	NYSDEC/DSHW/GC	
* 220 COMMONWEALTH AVE, VARSA					
12/20/83	68979	<1	01/05/84	ENVIROTEST	
* 221 COMMONWEALTH AVE, MUELLER					
12/19/83	69197	<1	12/21/83	ENVIROTEST	
02/16/84	66237	ND	02/16/84	NYSDEC/DSHW/GC	
* 224 COMMONWEALTH AVE, MORRIS					
12/20/83	68980	<1	01/05/84	ENVIROTEST	
02/16/84	66238	ND	02/16/84	NYSDEC/DSHW/GC	
* 226 COMMONWEALTH AVE, RUNNALLS					
12/20/83	68981	<1	01/05/84	ENVIROTEST	
02/16/84	66239	ND	02/16/84	NYSDEC/DSHW/GC	
* 227 COMMONWEALTH AVE, MACENTEE					
12/20/83	68959	<1	01/03/84	ENVIROTEST	
03/07/84	66297	ND	03/08/84	NYSDEC/DSHW/GC	

WALLKILL, NEW YORK
TETRACHLOROETHYLENE SAMPLE RESULTS

COLLECTION DATE	LAB NUMBER	TETRACHLOROETHYLENE CONCENTRATION (PPB)	ANALYSIS DATE	LABORATORY	COMMENTS
* 228 COMMONWEALTH AVE, PLANTEGA					
12/20/83	68985	<1	01/03/84	ENVIROTEST	
03/06/84	66271	ND	03/06/84	NYSDEC/DSHW/GC	
* 229 COMMONWEALTH AVE, RUPPERT					
12/19/83	69198	<1	12/21/83	ENVIROTEST	
02/16/84	66240	ND	02/16/84	NYSDEC/DSHW/GC	
* 230 COMMONWEALTH AVE, THACHER					
12/20/83	68984	<1	01/03/84	ENVIROTEST	
03/06/84	66275	ND	03/06/84	NYSDEC/DSHW/GC	
* 231 COMMONWEALTH AVE, BROCK					
12/19/83	69199	<1	12/21/83	ENVIROTEST	
03/06/84	66272	ND	03/06/84	NYSDEC/DSHW/GC	
* 232 COMMONWEALTH AVE, CAFFERY					
12/20/83	68983	<1	01/03/84	ENVIROTEST	
* 233 COMMONWEALTH AVE, HEILFURTH					
12/20/83	68954	<1	01/05/84	ENVIROTEST	
02/08/84	03907	<1	02/08/84	NYSDEC/DSHW/GC	
* 237 COMMONWEALTH AVE, NOHA					
12/20/83	68955	<1	01/05/84	ENVIROTEST	
03/06/84	66273	ND	03/06/84	NYSDEC/DSHW/GC	
* 241 COMMONWEALTH AVE, GAZZO					
12/20/83	68956	<1	01/05/84	ENVIROTEST	
* 244 COMMONWEALTH AVE, FINLEY					
12/20/83	68982	<1	01/05/84	ENVIROTEST	
03/06/84	66274	ND	03/06/84	NYSDEC/DSHW/GC	
* 245 COMMONWEALTH AVE, MEYERS					
12/20/83	68957	<1	01/05/84	ENVIROTEST	

WALLKILL, NEW YORK
TETRACHLOROETHYLENE SAMPLE RESULTS

COLLECTION DATE	LAB NUMBER	TETRACHLOROETHYLENE CONCENTRATION (PPB)	ANALYSIS DATE	LABORATORY	COMMENTS
* 31 ELECTRIC AVE, VAN PELT					
12/19/83	69170	<1	12/21/83	ENVIROTEST	
03/06/84	66276	ND	03/06/84	NYSDEC/DSHW/GC	
* 277 HIGHLAND AVE, PULUCH					
11/29/83	68523	ND	12/06/83	CLAYTON	CITY WATER
* 282 HIGHLAND AVE, SHATTUCK					
02/16/84	66234	ND	02/16/84	NYSDEC/DSHW/GC	
* 286 HIGHLAND AVE, ESTRADA					
11/28/83	69122	ND	12/06/83	CLAYTON	
01/05/84	68558	ND	01/10/84	USEPA/ESD	
* 287 HIGHLAND AVE, TESSELER					
11/28/83	69115	ND	12/06/83	CLAYTON	
03/06/84	66292	ND	03/06/84	NYSDEC/DSHW/GC	
* 291 HIGHLAND AVE, SMITH					
11/07/83		<1	11/09/93	ENVIROTEST/OCHD	
11/28/83	69121	ND	12/06/83	CLAYTON	
11/28/83	69121	<1	12/06/83	USEPA/ERT	
02/23/84	66267	ND	02/23/84	NYSDEC/DSHW/GC	
* 292 HIGHLAND AVE, PETRIZZO					
11/22/83	68503	ND	12/02/83	USEPA/ERT	
01/06/84	68565	ND	01/06/84	USEPA/ESD	
03/07/84	66286	ND	03/08/84	NYSDEC/DSHW/GC	
* 293 HIGHLAND AVE, NIXDORF					
11/29/83	69151	ND	12/06/83	CLAYTON	
01/05/84	68895	ND	01/13/84	USEPA/ESD	
01/05/84	68897	ND	01/11/84	TAT/PHOTOVAC	30 MINUTES
01/05/84	68899	ND	01/11/84	TAT/PHOTOVAC	75 MINUTES
02/22/84	66257	ND	02/22/84	NYSDEC/DSHW/GC	
* 295 HIGHLAND AVE, JANIAK					
10/17/83	34289	ND	11/15/83	NYSDHCLR	
11/28/83	69120	17	12/06/83	CLAYTON	CONTAMINATION DETEC
12/09/83	69179	ND	12/10/83	USEPA/ESD	

WALLKILL, NEW YORK
TETRACHLOROETHYLENE SAMPLE RESULTS

COLLECTION DATE	LAB NUMBER	TETRACHLOROETHYLENE CONCENTRATION (PPB)	ANALYSIS DATE	LABORATORY	COMMENTS
* 295 HIGHLAND AVE, JANIAK					
01/05/84	68894	ND	01/11/84	USEPA/ESD	
01/05/84	68898	ND	01/11/84	TAT/PHOTOVAC	30 MINUTES
01/05/84	68896	ND	01/11/84	TAT/PHOTOVAC	75 MINUTES
01/23/84		ND	01/24/84	ENVIROTEST/OCHD	
* 297 HIGHLAND AVE, ROBAINA					
12/09/83	69180	37	12/10/83	USEPA/ESD	CONTAMINATION DETECTE
01/05/84	68900	40	01/13/84	USEPA/ESD	CONTAMINATION DETECTE
01/23/84		65	01/24/84	ENVIROTEST/OCHD	> NYSDOH 50 PPB LIMIT
01/25/84	02510	46	01/25/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
01/25/84	02511	78	01/25/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 60 MINUTES
01/25/84	02512	76	01/25/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 90 MINUTES
02/14/84	68869	24	02/15/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE 30 MINUTES
02/14/84	68868	10	02/15/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
02/14/84	68871	40	02/15/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE 60 MINUTES
03/20/84	66299	5	03/20/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
* 299 HIGHLAND AVE, ECKERSON					
11/28/83	69118	ND	12/06/83	CLAYTON	
01/05/84	68562	ND	01/11/84	USEPA/ESD	
02/23/84	66265	ND	02/23/84	NYSDEC/DSHW/GC	
* 304 HIGHLAND AVE, LISKA					
10/14/83	24020	<1	10/17/83	ENVIROTEST/OCHD	
11/30/83		<1	12/02/83	ENVIROTEST/OCHD	
12/02/83	24888	<1	12/05/83	ENVIROTEST/OCHD	
01/05/84	68563	ND	01/13/84	USEPA/ESD	
02/21/84	66245	ND	02/21/84	NYSDEC/DSHW/GC	
02/21/84	66245	ND	02/21/84	NYSDEC/DSHW/GC	
* 307 HIGHLAND AVE, RUPERT					
11/25/83	69101	7000	12/06/83	CLAYTON	> NYSDOH 50 PPB LIMIT
02/03/84	03401	5517	02/03/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 30 MINUTES
02/03/84	03402	12112	02/03/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 60 MINUTES
2/03/84	03403	13985	02/03/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 180 MINUTES

WALLKILL, NEW YORK
TETRACHLOROETHYLENE SAMPLE RESULTS

COLLECTION DATE	LAB NUMBER	TETRACHLOROETHYLENE CONCENTRATION (PPB)	ANALYSIS DATE	LABORATORY	COMMENTS
* 309 HIGHLAND AVE, BARRY					
11/23/83	68544	100	12/06/83	CLAYTON	> NYSDOH 50 PPB LIMIT
12/09/83	69166	730	12/09/83	ENVIROTEST/OCHD	> NYSDOH 50 PPB LIMIT
02/07/84	03801	39	02/07/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
03/20/84	66212	118	03/20/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT
* 313 HIGHLAND AVE, LEWIS					
12/06/83	69156	ND	12/19/83	USEPA/ERT	
01/05/84	68886	ND	01/10/84	USEPA/ESD	
01/05/84	68890	<.5	01/11/84	TAT/PHOTOVAC	30 MINUTES
01/05/84	68888	<.5	01/11/84	TAT PHOTOVAC	90 MINUTES
02/21/84	66244	16	02/21/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
02/22/84	66249	8	02/22/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
02/22/84	66250	3	02/22/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE 30 MINUTES
02/22/84	66252	2	02/22/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE 60 MINUTES
02/23/84	66259	5	02/23/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
02/23/84	66261	2	02/23/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE 30 MINUTES
03/20/84	66298	27	03/20/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
* 316 HIGHLAND AVE, STOUT					
11/08/83	68805	3500	11/11/83	USEPA/ESD	> NYSDOH 50 PPB LIMIT
11/15/83	63941	ND	12/16/83	USEPA/ESD	
02/08/84	03909	2341	02/08/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT
02/08/84	03910	2536	02/08/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 30 MINUTES
02/08/84	03911	2909	02/08/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 60 MINUTES
03/21/84	66220	2700	03/21/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT
* 317 HIGHLAND AVE, KNAPP					
11/23/83	68807	ND	11/23/83	USEPA/ERT	
11/23/83	68543	ND	12/06/83	CLAYTON	
01/05/84	68557	ND	01/10/84	USEPA/ESD	
02/22/84	66253	11	02/22/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
02/23/84	66260	9	02/23/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
02/23/84	66262	10	02/23/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE 30 MINUTES
03/20/84	66300	9	03/20/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE

WALLKILL, NEW YORK
TETRACHLOROETHYLENE SAMPLE RESULTS

COLLECTION DATE	LAB NUMBER	TETRACHLOROETHYLENE CONCENTRATION (PPB)	ANALYSIS DATE	LABORATORY	COMMENTS
* 319 HIGHLAND AVE, OGDEN					
11/08/83	68806	ND	11/08/83	USEPA/ERT	
11/23/83	68542	ND	12/06/83	CLAYTON	
01/05/84	68885	ND	01/10/84	USEPA/ESD	
01/05/84	68887	ND	01/11/84	TAT/PHOTOVAC	30 MINUTES
01/05/84	68889	.2	01/11/84	TAT/PHOTOVAC	90 MINUTES
02/22/84	66251	<1	02/22/84	NYSDEC/DSHW/GC	
* 320 HIGHLAND AVE, PARELLA					
10/17/83	34292	120000	11/15/83	NYSDHCLR	> NYSDOH 50 PPB LIM
11/15/83	63940	260000	11/17/83	USEPA/ESD	> NYSDOH 50 PPB LIM
11/22/83	68501	76000	12/02/83	USEPA/ERT	> NYSDOH 50 PPB LIM
11/23/83	68535	1900	12/06/83	CLAYTON	> NYSDOH 50 PPB LIM
11/26/83	69105	>37000	12/06/83	USEPA/ERT	> NYSDOH 50 PPB LIM
11/28/83	69114	160000	12/06/83	USEPA/ERT	> NYSDOH 50 PPB LIM
11/29/83	68548	126000	12/06/83	USEPA/ERT	> NYSDOH 50 PPB LIM
11/29/83		87000	12/06/83	NYSDHCLR	> NYSDOH 50 PPB LIM
11/30/83	69138	96480	12/15/83	TAT/PHOTOVAC	> NYSDOH 50 PPB LIM
12/01/83	69124	79766	12/15/83	TAT/PHOTOVAC	> NYSDOH 50 PPB LIM
12/02/83	69142	83000	12/08/83	USEPA/ERT	> NYSDOH 50 PPB LIM
12/03/83	69146	140122	12/15/83	TAT/PHOTOVAC	> NYSDOH 50 PPB LIM
12/06/83	69150	73000	12/29/83	USEPA/ERT	> NYSDOH 50 PPB LIM
12/07/83	69157	70300	12/08/83	USEPA/ERT	> NYSDOH 50 PPB LIM
12/07/83	34205	72000	12/08/83	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIM
12/08/83		72000	12/15/83	NYSDHCLR	> NYSDOH 50 PPB LIM
12/09/83	69165	61400	12/29/83	USEPA/ERT	> NYSDOH 50 PPB LIM
12/29/83	69152	95000	12/29/83	USEPA/ERT	> NYSDOH 50 PPB LIM
01/06/84	68568	56000	01/12/84	USEPA/ESD	> NYSDOH 50 PPB LIM
01/12/84		65805	01/13/84	TAT/PHOTOVAC	> NYSDOH 50 PPB LIM
01/25/84	02507	64000	01/25/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIM
01/27/84	68576	53000	02/01/84	USEPA/ESD	> NYSDOH 50 PPB LIM
02/07/84	03802	65796	02/07/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIM
02/07/84	03803	62007	02/07/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIM 30 MINUTES
02/07/84	03804	58718	02/07/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIM 60 MINUTES
03/22/84	64221	44500	03/22/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIM
* 321 HIGHLAND AVE, SEELY					
10/14/83	24040	ND	10/17/83	ENVIROTEST/OCHD	
11/08/83	68804	ND	11/11/83	USEPA/ERT	
11/23/83	68541	ND	12/02/83	USEPA/ERT	
01/05/84	68561	ND	01/11/84	USEPA/ESD	
03/07/84	66283	<1	03/08/84	NYSDEC/DSHW/GC	

WALLKILL, NEW YORK
TETRACHLOROETHYLENE SAMPLE RESULTS

COLLECTION DATE	LAB NUMBER	TETRACHLOROETHYLENE CONCENTRATION (PPB)	ANALYSIS DATE	LABORATORY	COMMENTS
* 323 HIGHLAND AVE, GILBERT					
11/07/83		<1	11/09/83	ENVIROTEST/OCHD	
11/08/83	68803	ND	11/11/83	USEPA/ERT	
11/23/83	68540	ND	12/06/83	CLAYTON	
11/30/83		<1	12/02/83	ENVIROTEST/OCHD	
12/01/83	24888	<1	12/05/83	ENVIROTEST/OCHD	
01/05/84	68556	ND	01/11/84	USEPA/ESD	
03/07/84	66282	ND	03/08/84	NYSDEC/DSHW/GC	
* 325 HIGHLAND AVE, FIORE					
10/14/83	24020	<1	10/17/83	ENVIROTEST/OCHD	
11/08/83	68801	<1	11/11/83	USEPA/ERT	
11/23/83	68516	ND	12/02/83	USEPA/ERT	
11/30/83		<1	12/02/83	ENVIROTEST/OCHD	
12/01/83	24888	<1	12/05/83	ENVIROTEST/OCHD	
01/05/84	68876	ND	01/13/84	USEPA/ESD	
01/05/84	68879	.2	01/11/84	TAT/PHOTOVAC	30 MINUTES
01/05/84	68884	.3	01/11/84	TAT/PHOTOVAC	75 MINUTES
02/22/84	66258	<1	02/22/84	NYSDEC/DSHW/GC	
* 327 HIGHLAND AVE, LOBB					
10/14/83	24020	1800	10/17/83	ENVIROTEST/OCHD	> NYSDOH 50 PPB LIMIT
10/17/83	34288	2500	11/15/83	NYSDHCLR	> NYSDOH 50 PPB LIMIT
11/08/83	68802	1600	11/11/83	USEPA/ERT	> NYSDOH 50 PPB LIMIT
11/22/83	68512	720	12/02/83	USEPA/ERT	> NYSDOH 50 PPB LIMIT
11/26/83	69107	410	12/06/83	USEPA/ERT	> NYSDOH 50 PPB LIMIT
11/27/83	69109	880	12/02/83	USEPA/ERT	> NYSDOH 50 PPB LIMIT
11/28/83	69112	1700	12/02/83	CLAYTON	> NYSDOH 50 PPB LIMIT
02/14/84	68870	42	02/15/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
02/14/84	68872	70	02/15/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 30 MINUTES
02/14/84	68873	77	02/15/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 60 MINUTES
03/20/84	66213	39	03/20/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
* 329 HIGHLAND AVE, OSBORNE					
11/07/83		900	11/08/83	ENVIROTEST/OCHD	> NYSDOH 50 PPB LIMIT
11/08/83	68814	2400	11/11/83	USEPA/ERT	> NYSDOH 50 PPB LIMIT
02/06/84	03701	207	02/06/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT
02/06/84	03702	92	02/06/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 30 MINUTES
02/06/84	03703	52	02/06/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 60 MINUTES
03/20/84	66211	41	03/20/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE

WALLKILL, NEW YORK
TETRACHLOROETHYLENE SAMPLE RESULTS

COLLECTION DATE	LAB NUMBER	TETRACHLOROETHYLENE CONCENTRATION (PPB)	ANALYSIS DATE	LABORATORY	COMMENTS
* 335 HIGHLAND AVE, CROOKS					
11/07/83		<1	11/08/83	ENVIROTEST	
11/23/83	68518	28	12/06/83	CLAYTON	CONTAMINATION DETECTE
11/08/83	68808	ND	11/11/83	USEPA/ERT	
12/09/83	69177	ND	12/10/83	USEPA/ESD	
01/05/84	68878	ND	01/13/84	USEPA/ESD	
01/05/84	68881	ND	01/11/84	TAT/PHOTOVAC	30 MINUTES
01/05/84	68883	ND	01/11/84	TAT/PHOTOVAC	75 MINUTES
02/21/84	66242	ND	02/21/84	NYSDEC/DSHW/GC	
* 337 HIGHLAND AVE, GADY					
11/08/83	68809	ND	11/11/83	USEPA/ERT	
11/30/83		<1	12/02/83	ENVIROTEST/OCHD	
12/01/83	24888	<1	12/05/83	ENVIROTEST/OCHD	
01/05/84	68877	ND	01/13/84	USEPA/ESD	
01/05/84	68880	ND	01/11/84	TAT/PHOTOVAC	30 MINUTES
01/05/84	68882	ND	01/11/84	TAT/PHOTOVAC	50 MINUTES
02/21/84	66243	ND	02/21/84	NYSDEC/DSHW/GC	
* 338 HIGHLAND AVE, PEREZ					
10/17/83	34293	7	11/15/83	NYSDHCLR	CONTAMINATION DETECTE
11/08/83	68813	ND	11/11/83	USEPA/ERT	
11/28/83	69123	2	12/06/83	CLAYTON	CONTAMINATION DETECTE
01/05/84	68891	ND	01/10/84	USEPA/ESD	
01/05/84	68892	2.6	01/11/84	TAT/PHOTOVAC	CONTAMINATION DETECTE 30 MINUTES
01/05/84	68893	1	01/11/84	TAT/PHOTOVAC	CONTAMINATION DETECTE 45 MINUTES
* 339 HIGHLAND AVE, PERRY					
11/08/83	68810	ND	11/11/83	USEPA/ERT	
11/22/83	68510	ND	12/02/83	USEPA/ERT	
01/05/84	68560	ND	01/11/84	USEPA/ESD	
03/07/84	66281	ND	03/08/84	NYSDEC/DSHW/GC	
* 341 HIGHLAND AVE, COURTEAU					
11/08/83	68811	ND	11/11/83	USEPA/ERT	
11/22/83	68509	ND	12/02/83	USEPA/ERT	
01/05/84	68555	ND	01/10/84	USEPA/ESD	
03/07/84	66290	ND	03/08/84	NYSDEC/DSHW/GC	

WALLKILL, NEW YORK
TETRACHLOROETHYLENE SAMPLE RESULTS

COLLECTION DATE	LAB NUMBER	TETRACHLOROETHYLENE CONCENTRATION (PPB)	ANALYSIS DATE	LABORATORY	COMMENTS
* 344 HIGHLAND AVE, ROSELLI					
10/14/83	24020	<1	10/17/83	ENVIROTEST/OCHD	CITY WATER
11/07/83		<1	11/09/83	ENVIROTEST/OCHD	CITY WATER
11/08/83	68812	ND	11/11/83	USEPA/ERT	CITY WATER
* 353 HIGHLAND AVE, ERNEST					
11/22/83	68505	ND	12/02/83	USEPA/ERT	
01/05/84	68554	ND	01/09/84	USEPA/ESD	
03/07/84	66280	ND	03/08/84	NYSDEC/DSHW/GC	
* 355 HIGHLAND AVE, PITT					
11/28/83	69117	165	12/06/83	CLAYTON	> NYSDOH 50 PPB LIM
12/09/83	69167	<1	12/10/83	ENVIROTEST/OCHD	
01/05/84	68559	ND	01/11/84	USEPA/ESD	
03/07/84	66296	ND	03/08/84	NYSDEC/DSHW/GC	
* 357 HIGHLAND AVE, SCHMALL					
11/22/83	68507	ND	12/02/83	USEPA/ERT	
01/05/84	68551	<2	01/09/84	USEPA/ESD	
03/06/84	66279	ND	03/06/84	NYSDEC/DSHW/GC	
* 361 HIGHLAND AVE, NOYES					
11/22/83	68506	ND	12/02/83	USEPA/ERT	
01/05/84	68553	ND	01/09/84	USEPA/ESD	
03/06/84	66278	ND	03/06/84	NYSDEC/DSHW/GC	
* 363 HIGHLAND AVE, LENT					
11/28/83	69116	ND	12/06/83	CLAYTON	
01/05/84	68551	ND	01/09/84	USEPA/ESD	
03/06/84	66293	ND	03/06/84	NYSDEC/DSHW/GC	
* 400 HIGHLAND AVE, KUHL					
11/22/83	68504	ND	12/02/83	USEPA/ERT	
03/06/84	66277	ND	03/06/84	NYSDEC/DSHW/GC	
* 408 HIGHLAND AVE, KUHL					
11/22/83	68505	ND	12/02/83	USEPA/ERT	
01/05/84	68564	<2	01/13/84	USEPA/ESD	

WALLKILL, NEW YORK
TETRACHLOROETHYLENE SAMPLE RESULTS

COLLECTION DATE	LAB NUMBER	TETRACHLOROETHYLENE CONCENTRATION (PPB)	ANALYSIS DATE	LABORATORY	COMMENTS
* 409 HIGHLAND AVE, FEDERAL CABINET					
01/06/84	68567	ND	01/12/84	USEPA/ESD	
02/23/84	66263	ND	02/23/84	NYSDEC/DSHW/GC	
* 409A HIGHLAND AVE, R.C. PRYOR					
01/06/84	68566	ND	01/11/84	USEPA/ESD	
02/23/84	66264	ND	02/23/84	NYSDEC/DSHW/GC	
* LOT NO.4 HIGHLAND AVE, STOUT					
11/15/83	63941	ND	12/16/83	USEPA/ESD	
* SEWER MANHOLE ON HIGHLAND AND PARK AVE					
12/07/83	34206	<2	12/08/83	NYSDEC/DSHW/GC	
01/26/84	02607	11	01/26/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
* INDUSTRIAL PLACE - MANHOLE AT STREET END					
1/26/84	02606	23.5	01/26/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
01/26/84	02605	1250	01/26/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT
* INDUSTRIAL PLACE SECOND MANHOLE					
12/07/83	34208	720	12/08/83	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT
* INDUSTRIAL PLACE, GENERAL SWITCH					
10/17/83	34621	1100	11/29/83	NYSDHCLR	> NYSDOH 50 PPB LIMIT
12/22/83	68991	1294	12/22/83	TAT/PHOTOVAC	> NYSDOH 50 PPB LIMIT
12/22/83	68992	2156	12/22/83	TAT/PHOTOVAC	> NYSDOH 50 PPB LIMIT 30 MINUTES
12/22/83	68993	3877	12/22/83	TAT/PHOTOVAC	> NYSDOH 50 PPB LIMIT 45 MINUTES
12/29/83	68999	2051	12/29/83	TAT/PHOTOVAC	> NYSDOH 50 PPB LIMIT
12/29/83	69000	1772	12/29/83	TAT/PHOTOVAC	> NYSDOH 50 PPB LIMIT
02/02/84	03304	1320	02/02/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 120 MINUTES
02/02/84	03305	1760	02/02/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 180 MINUTES
02/02/84	03306	1660	02/02/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 240 MINUTES
02/02/84	03301	1440	02/02/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 30 MINUTES
2/02/84	03302	1480	02/02/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 60 MINUTES
02/02/84	03303	1340	02/02/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 90 MINUTES

WALLKILL, NEW YORK
TETRACHLOROETHYLENE SAMPLE RESULTS

COLLECTION DATE	LAB NUMBER	TETRACHLOROETHYLENE CONCENTRATION (PPB)	ANALYSIS DATE	LABORATORY	COMMENTS
* INDUSTRIAL PLACE, GENERAL SWITCH - SEWER LINE					
01/26/84	02603	667	01/26/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT
* INDUSTRIAL PLACE, GENERAL SWITCH - SOIL					
10/18/83	34412	UG/G 450	10/20/83	NYSDHCLR	> NYSDOH 50 PPB LIMIT
10/18/83	34413	UG/G 1.2	10/20/83	NYSDHCLR	CONTAMINATION DETECTE
12/07/83	34103	<1	12/07/83	NYSDEC/DSHW/GC	SURFACE
12/07/83	34101	UG/G 126	12/07/83	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 1 FOOT DEEP
12/07/83	34101	UG/G 17.5	12/07/83	NYSDEC/DSHW/GC	CONTAMINATION DETECTE SURFACE
12/07/83	34101	UG/G 115	12/07/83	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT 2 FEET DEEP
12/08/83	34102	UG/G 4.7	12/08/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE 2 1/2 FEET DEEP
* INDUSTRIAL PLACE, GENERAL SWITCH COOLING WATER					
12/07/83	34209	20	12/08/83	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
* INDUSTRIAL PLACE, GUILD MOLDERS					
01/12/84	68571	ND	01/13/84	TAT/ PHOTOVAC	
* INDUSTRIAL PLACE, GUILD MOLDERS - PROCESS WATER					
12/21/83	68962	<1	01/03/84	ENVIROTEST	
* INDUSTRIAL PLACE, HERTZBURG BRUSH - 1ST MANHOLE					
12/21/83	68961	280	01/03/84	ENVIROTEST	> NYSDOH 50 PPB LIMIT
01/26/84	02601	32	01/26/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
* INDUSTRIAL PLACE, HERTZBURG BRUSH - 3RD MANHOLE					
01/26/84	02602	46	01/26/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
* INDUSTRIAL PLACE, JUNKYARD - MANHOLE IN MIDDLE					
01/26/84	02606	608	01/26/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT
01/26/84	02609	168	01/26/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT
* INDUSTRIAL PLACE, LUBE PACKING - MANHOLE					
2/07/83	34207	2400	12/08/83	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT
01/26/84	02604	1400	01/26/84	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT

WALLKILL, NEW YORK
TETRACHLOROETHYLENE SAMPLE RESULTS

COLLECTION DATE	LAB NUMBER	TETRACHLOROETHYLENE CONCENTRATION (PPB)	ANALYSIS DATE	LABORATORY	COMMENTS
* INDUSTRIAL PLACE, LUBE PACKING - SOIL					
12/08/83	34203	UG/G <1	12/08/83	NYSDEC/DSHW/GC	1 FOOT DEEP
12/08/83	34204	UG/G 2.7	12/08/83	NYSDEC/DSHW/GC	CONTAMINATION DETECTE 6 INCHES DEEP
12/08/83	34201	UG/G 4.5	12/08/83	NYSDEC/DSHW/GC	CONTAMINATION DETECTE 1 FOOT DEEP
12/08/83	34201	UG/G 3.5	12/08/83	NYSDEC/DSHW/GC	CONTAMINATION DETECTE 3 FEET DEEP
12/08/83	34202	UG/G 3.2	12/08/83	NYSDEC/DSHW/GC	CONTAMINATION DETECTE SURFACE
12/08/83	34202	UG/G <1	12/08/83	NYSDEC/DSHW/GC	1 FOOT DEEP
12/08/83	34203	UG/G <1	12/08/83	NYSDEC/DSHW/GC	1 FOOT DEEP
* INDUSTRIAL PLACE, STREAM SAMPLE					
12/29/83	68998	0.6	12/29/83	TAT/PHOTOVAC	
* 29 PARK AVE, EBERT					
2/21/84	66246	ND	02/21/84	NYSDEC/DSHW/GC	
* 34 PARK AVE, DUCO					
11/23/83	68550	ND	12/06/83	CLAYTON	
02/23/84	66266	ND	02/23/84	NYSDEC/DSHW/GC	
* RD3 BISCH RD, GOODRICH					
12/21/83	68963	<1	01/03/84	ENVIROTEST	
02/22/84	66254	ND	02/22/84	NYSDEC/DSHW/GC	
* RD3 MAPLE RD, HOFFMAN					
12/21/83	68964	<1	01/03/84	ENVIROTEST	
02/22/84	66255	ND	02/22/84	NYSDEC/DSHW/GC	
* 103 ROCKWELL AVE, PENNINGTON					
02/21/83	68986	<1	01/03/84	ENVIROTEST	
* 167 ROCKWELL AVE, BILA					
02/21/84	66241	ND	02/21/84	NYSDEC/DSHW/GC	

WALLKILL, NEW YORK
TETRACHLOROETHYLENE SAMPLE RESULTS

COLLECTION DATE	LAB NUMBER	TETRACHLOROETHYLENE CONCENTRATION (PPB)	ANALYSIS DATE	LABORATORY	COMMENTS
* 172 ROCKWELL AVE, BROWN					
02/08/84	03907	<1	02/08/84	NYSDEC/DSHW/GC	
* SPIKE					
12/20/83	68978	93	12/28/83	ENVIROTEST	
12/20/83	68978	92	01/05/84	ENVIROTEST	
* MIDDLETOWN STP EFFLUENT					
12/07/83	34214	4	12/08/83	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
01/18/84	01813	<1	01/24/84	NYSDEC/DSHW/GC	
01/19/84	01906	<1	01/24/84	NYSDEC/DSHW/GC	
02/08/84	03904	1	02/08/84	NYSDEC/SDHW/GC	CONTAMINATION DETECTE
02/09/84	04002	1	02/09/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
* MIDDLETOWN STP INFLUENT					
10/18/83	34414	260	10/20/83	NYSDHCLR	> NYSDOH 50 PPB LIMIT
12/07/83	34213	30	12/08/83	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
1/19/84	01907	3	01/24/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
02/08/84	03803	9	02/08/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
02/09/84	04001	6	02/09/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
* MONHAGEN BROOK - DOWNSTREAM OF MIDDLETOWN STP					
12/07/83	34211	4	12/08/83	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
01/18/84	01814	<1	01/24/84	NYSDEC/DSHW/GC	
01/19/84	01905	<1	01/24/84	NYSDEC/DSHW/GC	
02/08/84	03906	1	02/08/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
02/09/84	04004	1	02/09/84	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
* MONHAGEN BROOK - UPSTREAM OF MIDDLETOWN STP					
12/07/83	34212	ND	12/08/83	NYSDEC/DSHW/GC	
01/18/84	01812	<1	01/24/84	NYSDEC/DSHW/GC	
01/19/84	01904	<1	01/24/84	NYSDEC/DSHW/GC	
02/08/84	03905	<1	02/04/84	NYSDEC/DSHW/GC	
02/09/84	04003	<1	02/09/84	NYSDEC/DSHW/GC	
* TANK TO SEWER					
11/23/83	68545	>12000	12/06/83	CLAYTON	> NYSDOH 50 PPB LIMIT
11/26/83	69108	38900	12/06/83	USEPA/ERT	> NYSDOH 50 PPB LIMIT
11/27/83	69110	16300	12/06/83	USEPA/ERT	> NYSDOH 50 PPB LIMIT
1/28/83	69113	7000	12/06/83	USEPA/ERT	> NYSDOH 50 PPB LIMIT
11/29/83	68549	5300	12/06/83	USPEPA/ERT	> NYSDOH 50 PPB LIMIT
11/29/83		2300	12/03/83	NYSDHCLR	> NYSDOH 50 PPB LIMIT

WALLKILL, NEW YORK
TETRACHLOROETHYLENE SAMPLE RESULTS

COLLECTION DATE	LAB NUMBER	TETRACHLOROETHYLENE CONCENTRATION (PPB)	ANALYSIS DATE	LABORATORY	COMMENTS
* TANK TO SEWER					
12/01/83	69125	29023	12/15/83	TAT/PHOTOVAC	> NYSDOH 50 PPB LIMIT
12/01/83	69141	44798	12/15/83	TAT/PHOTOVAC	> NYSDOH 50 PPB LIMIT
12/03/83	69145	25979	12/15/83	TAT/PHOTOVAC	> NYSDOH 50 PPB LIMIT
12/05/83	69153	53000	12/16/83	USEPA/ERT	> NYSDOH 50 PPB LIMIT
12/06/83	69176	48000	12/19/83	USEPA/ERT	> NYSDOH 50 PPB LIMIT
12/07/83		33000	12/19/83	NYSDHCLR	> NYSDOH 50 PPB LIMIT
11/25/83	69103	34000	12/30/84	USEPA/ERT	> NYSDOH 50 PPB LIMIT
* TANK TO SEWER BOTTOM					
12/07/83	34105	25000	12/08/83	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT
* TANK TO SEWER TOP					
12/07/83	34104	33000	12/08/83	NYSDEC/DSHW/GC	> NYSDOH 50 PPB LIMIT
* WALKILL RIVER AT COUNTY ROAD #53					
01/19/84	01902	<1	01/24/84	NYSDEC/DSHW/GC	
* WALLKILL RIVER - DOWNSTREAM OF WALLKILL STP					
12/07/83	69164	ND	12/20/83	USEPA/ERT	
12/07/83	34109	<2	12/08/83	NYSDEC/DSHW/GC	
* WALLKILL RIVER - UPSTREAM OF WALLKILL STP					
11/23/83	68537	ND	12/06/83	USEPA/ERT	
12/07/83	69163	ND	12/20/83	USEPA/ERT	
12/07/83	34108	10	12/08/83	NYSDEC/DSHW/GC	CONTAMINATION DETECTE
01/19/84	01910	<1	01/24/84	NYSDEC/DSHW/GC	
* WALLKILL RIVER AT MIDWAY ROAD					
01/19/84	01901	<1	01/24/84	NYSDEC/DSHW/GC	
* WALLKILL RIVER AT ROUTE 17M					
01/19/84	01903	<1	01/24/84	NYSDEC/DSHW/GC	
* WALLKILL STP EFFLUENT					
11/23/83	68520	FAILED QC	12/06/83	CLAYTON	
11/24/83	68547	11	12/06/83	CLAYTON	CONTAMINATION DETECTE
1/29/83		10	12/03/83	NYSDHCLR	CONTAMINATION DETECTE
12/01/83	69140	1	12/15/83	TAT/PHOTOVAC	CONTAMINATION DETECTE
12/02/83	69144	2	12/06/83	USEPA/ERT	CONTAMINATION DETECTE

TABLE III-9 (CONTINUED)

POTABLE WELL SAMPLING DATA

(PCE values in ug/liter)

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

TABLE III-9 (CONTINUED)

POTABLE WELL SAMPLING DATA

(PCE values in ug/liter)

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

* Represents replicate analysis.

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

LT = Less than.

NAR = No available range.

TABLE III-9

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

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

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SHAKTI CONSULTANTS INC.
185 GATZMER AVENUE
P.O. BOX

DATE: 08/17/89
JOB No: 894356
PROJECT No:
SAMPLE RECEIVED: 08/04/89

ATTN: JOHN BEE

SAMPLE SUMMARY

SAMPLE No	COLLECTED			POINT OF COLLECTION
	DATE	TIME	BY	
E916351	08/04/89	14:15	JMB	GROUND WATER - ERNEST, 353 HIGHLAND
E916352	08/04/89	14:10	JMB	GROUND WATER - SEELEY, 321 HIGHLAND
E916353	08/04/89	14:00	JMB	GROUND WATER - GILBERT, 323 HIGHLAND
E916354	08/04/89	23:45	JMB	GROUND WATER - STOUT, 316 HIGHLAND
E916355	08/04/89	23:30	JMB	GROUND WATER - WOOD, 319 HIGHLAND
E916356	08/04/89	14:35	JMB	GROUND WATER - GUILD MOLDERS, INDUSTRIAL PLACE

VINCENT J. PUGLIESE
VICE PRESIDENT

Shakti Consultants, Inc.
Proposal for Final Cleanup - Wallkill, NY

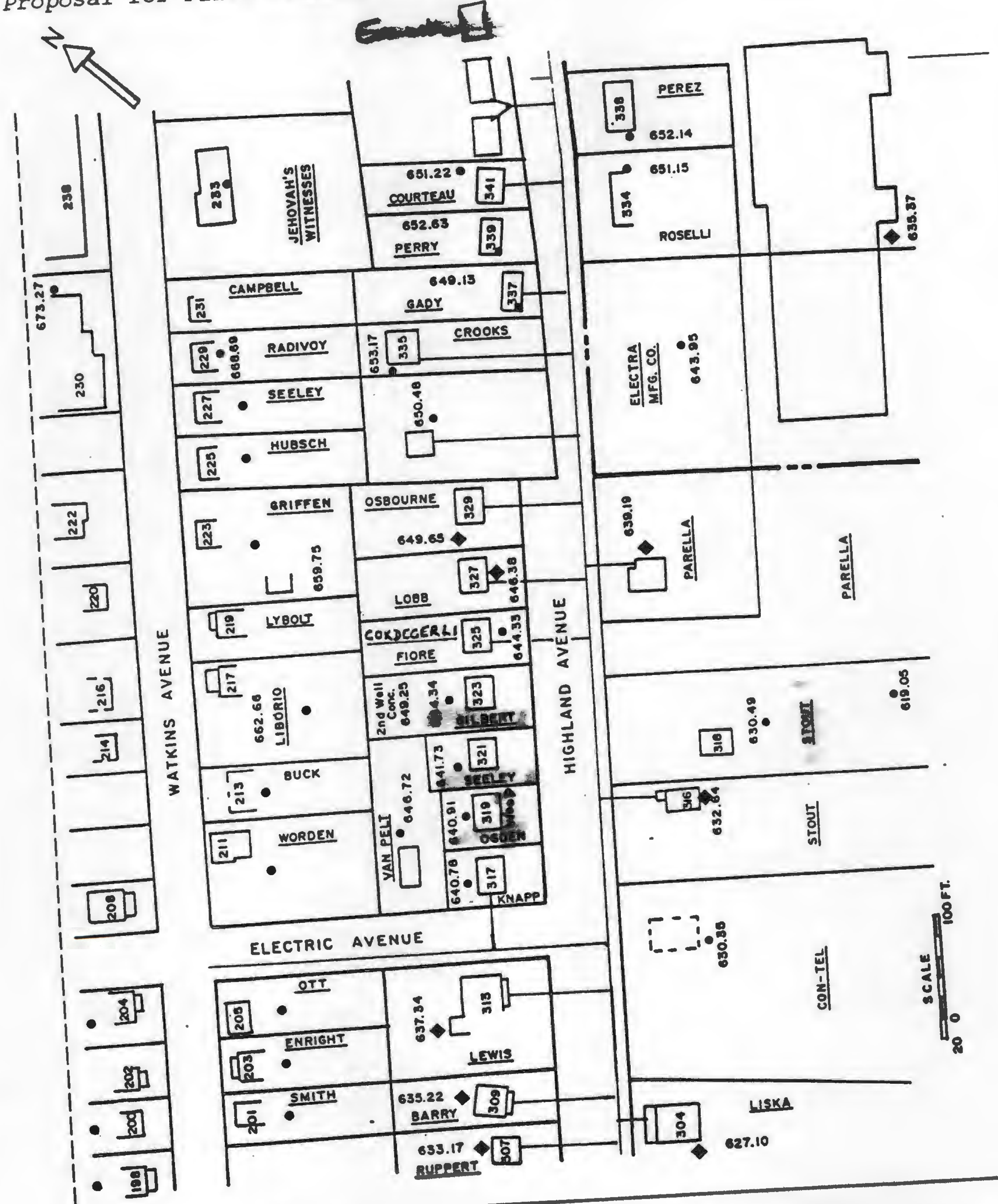

Figure 14. Location of Contaminated Wells & Water Supply Lines

Shakti Consultants, Inc.

LEGEND

◆ WELLS CONTAINING GREATER THAN 50 PPB PCE
● UNCOMTAMINATED WELLS

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ANALYSIS REPORT FOR VOLATILE ORGANICS BY GC/MS

CLIENT : SHAKTI CON.
LAB SAMPLE #: E916351
MATRIX : WATER

METHOD : EPA 624
ANALYSIS DATE: 08/08/89
DATA FILE : >A4554

COMPOUND	RESULT (ug/L)	MDL (ug/L)	Q
1) ACROLEIN	ND	100	
2) ACRYLONITRILE	ND	100	
3) BENZENE	ND	5.0	
4) BROMOFORM	ND	5.0	
5) BROMODICHLOROMETHANE	ND	5.0	
6) BROMOMETHANE	ND	10	
7) CARBON TETRACHLORIDE	ND	5.0	
8) CHLOROBENZENE	ND	5.0	
9) CHLOROETHANE	ND	10	
10) 2-CHLOROETHYL VINYL ETHER	ND	10	
11) CHLOROFORM	ND	5.0	
12) CHLOROMETHANE	ND	10	
13) cis-1,3-DICHLOROPROPENE	ND	5.0	
14) DIBROMOCHLOROMETHANE	ND	5.0	
15) 1,2-DICHLOROBENZENE	ND	5.0	
16) 1,3-DICHLOROBENZENE	ND	5.0	
17) 1,4-DICHLOROBENZENE	ND	5.0	
18) 1,1-DICHLOROETHANE	ND	5.0	
19) 1,2-DICHLOROETHANE	ND	5.0	
20) 1,1-DICHLOROETHYLENE	ND	5.0	
21) trans-1,2-DICHLOROETHYLENE	ND	5.0	
22) trans-1,3-DICHLOROPROPENE	ND	5.0	
23) 1,2-DICHLOROPROPANE	ND	5.0	
24) ETHYLBENZENE	ND	5.0	
25) METHYLENE CHLORIDE	ND	5.0	
26) 1,1,2,2-TETRACHLOROETHANE	ND	5.0	
27) TETRACHLOROETHYLENE	ND	5.0	
28) TOLUENE	ND	5.0	
29) 1,1,1-TRICHLOROETHANE	ND	5.0	
30) 1,1,2-TRICHLOROETHANE	ND	5.0	
31) TRICHLOROETHYLENE	ND	5.0	
32) TRICHLOROFLUOROMETHANE	ND	5.0	
33) VINYL CHLORIDE	ND	10	
34) m-XYLENE	ND	5.0	
35) p,o-XYLENE	ND	5.0	

ND = NOT DETECTED
MDL= METHOD DETECTION LIMIT

QUALIFIERS (Q)

J =INDICATES AN ESTIMATED VALUE BELOW MDL
B =INDICATES COMPOUND FOUND IN THE ASSOCIATED BLANK AS WELL AS IN SAMPLE

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ANALYSIS REPORT FOR VOLATILE ORGANICS BY GC/MS

CLIENT : SHAKTI CON.
LAB SAMPLE #: E916352
MATRIX : WATER

METHOD : EPA 624
ANALYSIS DATE: 08/08/89
DATA FILE : >A4548

	COMPOUND	RESULT (ug/L)	MDL (ug/L)	Q
1)	ACROLEIN	ND	100	
2)	ACRYLONITRILE	ND	100	
3)	BENZENE	ND	5.0	
4)	BROMOFORM	ND	5.0	
5)	BROMODICHLOROMETHANE	ND	5.0	
6)	BROMOMETHANE	ND	10	
7)	CARBON TETRACHLORIDE	ND	5.0	
8)	CHLOROBENZENE	ND	5.0	
9)	CHLOROETHANE	ND	10	
10)	2-CHLOROETHYL VINYL ETHER	ND	10	
11)	CHLOROFORM	ND	5.0	
12)	CHLOROMETHANE	ND	10	
13)	cis-1,3-DICHLOROPROPENE	ND	5.0	
14)	DIBROMOCHLOROMETHANE	ND	5.0	
15)	1,2-DICHLOROBENZENE	ND	5.0	
16)	1,3-DICHLOROBENZENE	ND	5.0	
17)	1,4-DICHLOROBENZENE	ND	5.0	
18)	1,1-DICHLOROETHANE	ND	5.0	
19)	1,2-DICHLOROETHANE	ND	5.0	
20)	1,1-DICHLOROETHYLENE	ND	5.0	
21)	trans-1,2-DICHLOROETHYLENE	ND	5.0	
22)	trans-1,3-DICHLOROPROPENE	ND	5.0	
23)	1,2-DICHLOROPROPANE	ND	5.0	
24)	ETHYLBENZENE	ND	5.0	
25)	METHYLENE CHLORIDE	ND	5.0	
26)	1,1,2,2-TETRACHLOROETHANE	ND	5.0	
27)	TETRACHLOROETHYLENE	ND	5.0	
28)	TOLUENE	3.5	5.0	J
29)	1,1,1-TRICHLOROETHANE	ND	5.0	
30)	1,1,2-TRICHLOROETHANE	ND	5.0	
31)	TRICHLOROETHYLENE	ND	5.0	
32)	TRICHLOROFLUOROMETHANE	ND	5.0	
33)	VINYL CHLORIDE	ND	10	
34)	m-XYLENE	ND	5.0	
35)	p,o-XYLENE	ND	5.0	

ND = NOT DETECTED
MDL= METHOD DETECTION LIMIT

QUALIFIERS (Q)

J =INDICATES AN ESTIMATED VALUE BELOW MDL
B =INDICATES COMPOUND FOUND IN THE ASSOCIATED BLANK AS WELL AS IN SAMPLE

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ANALYSIS REPORT FOR VOLATILE ORGANICS BY GC/MS

CLIENT : SHAKTI CON.
LAB SAMPLE #: E916353
MATRIX : WATER

METHOD : EPA 624
ANALYSIS DATE: 08/08/89
DATA FILE : >A4549

	COMPOUND	RESULT (ug/L)	MDL (ug/L)	Q
1)	ACROLEIN	ND	100	
2)	ACRYLONITRILE	ND	100	
3)	BENZENE	ND	5.0	
4)	BROMOFORM	ND	5.0	
5)	BROMODICHLOROMETHANE	ND	5.0	
6)	BROMOMETHANE	ND	10	
7)	CARBON TETRACHLORIDE	ND	5.0	
8)	CHLOROBENZENE	ND	5.0	
9)	CHLOROETHANE	ND	10	
10)	2-CHLOROETHYL VINYL ETHER	ND	10	
11)	CHLOROFORM	ND	5.0	
12)	CHLOROMETHANE	ND	10	
13)	cis-1,3-DICHLOROPROPENE	ND	5.0	
14)	DIBROMOCHLOROMETHANE	ND	5.0	
15)	1,2-DICHLOROBENZENE	ND	5.0	
16)	1,3-DICHLOROBENZENE	ND	5.0	
17)	1,4-DICHLOROBENZENE	ND	5.0	
18)	1,1-DICHLOROETHANE	ND	5.0	
19)	1,2-DICHLOROETHANE	ND	5.0	
20)	1,1-DICHLOROETHYLENE	ND	5.0	
21)	trans-1,2-DICHLOROETHYLENE	ND	5.0	
22)	trans-1,3-DICHLOROPROPENE	ND	5.0	
23)	1,2-DICHLOROPROPANE	ND	5.0	
24)	ETHYLBENZENE	ND	5.0	
25)	METHYLENE CHLORIDE	ND	5.0	
26)	1,1,2,2-TETRACHLOROETHANE	ND	5.0	
27)	TETRACHLOROETHYLENE	ND	5.0	
28)	TOLUENE	3.1	5.0	J
29)	1,1,1-TRICHLOROETHANE	ND	5.0	
30)	1,1,2-TRICHLOROETHANE	ND	5.0	
31)	TRICHLOROETHYLENE	ND	5.0	
32)	TRICHLOROFLUOROMETHANE	ND	5.0	
33)	VINYL CHLORIDE	ND	10	
34)	m-XYLENE	ND	5.0	
35)	p,o-XYLENE	ND	5.0	

ND = NOT DETECTED
MDL= METHOD DETECTION LIMIT

QUALIFIERS (Q)

J =INDICATES AN ESTIMATED VALUE BELOW MDL
B =INDICATES COMPOUND FOUND IN THE ASSOCIATED BLANK AS WELL AS IN SAMPLE

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ANALYSIS REPORT FOR VOLATILE ORGANICS BY GC/MS

CLIENT : SHAKTI CON.
LAB SAMPLE #: E916354
MATRIX : WATER

METHOD : EPA 624
ANALYSIS DATE: 08/08/89
DATA FILE : >A4565
>A4618

COMPOUND	RESULT (ug/L)	MDL (ug/L)	Q
1) ACROLEIN	ND	100	
2) ACRYLONITRILE	ND	100	
3) BENZENE	ND	5.0	
4) BROMOFORM	ND	5.0	
5) BROMODICHLOROMETHANE	ND	5.0	
6) BROMOMETHANE	ND	10	
7) CARBON TETRACHLORIDE	ND	5.0	
8) CHLOROBENZENE	ND	5.0	
9) CHLOROETHANE	ND	10	
10) 2-CHLOROETHYL VINYL ETHER	ND	10	
11) CHLOROFORM	ND	5.0	
12) CHLOROMETHANE	ND	10	
13) cis-1,3-DICHLOROPROPENE	ND	5.0	
14) DIBROMOCHLOROMETHANE	ND	5.0	
15) 1,2-DICHLOROBENZENE	ND	5.0	
16) 1,3-DICHLOROBENZENE	ND	5.0	
17) 1,4-DICHLOROBENZENE	ND	5.0	
18) 1,1-DICHLOROETHANE	ND	5.0	
19) 1,2-DICHLOROETHANE	ND	5.0	
20) 1,1-DICHLOROETHYLENE	ND	5.0	
21) trans-1,2-DICHLOROETHYLENE	19	5.0	
22) trans-1,3-DICHLOROPROPENE	ND	5.0	
23) 1,2-DICHLOROPROPANE	ND	5.0	
24) ETHYLBENZENE	ND	5.0	
25) METHYLENE CHLORIDE	ND	5.0	
26) 1,1,2,2-TETRACHLOROETHANE	ND	5.0	
27) TETRACHLOROETHYLENE	1300	100	
28) TOLUENE	ND	5.0	
29) 1,1,1-TRICHLOROETHANE	ND	5.0	
30) 1,1,2-TRICHLOROETHANE	ND	5.0	
31) TRICHLOROETHYLENE	190	5.0	
32) TRICHLOROFLUOROMETHANE	ND	5.0	
33) VINYL CHLORIDE	ND	10	
34) m-XYLENE	ND	5.0	
35) p,o-XYLENE	ND	5.0	

ND = NOT DETECTED
MDL= METHOD DETECTION LIMIT

QUALIFIERS (Q)

J =INDICATES AN ESTIMATED VALUE BELOW MDL
B =INDICATES COMPOUND FOUND IN THE ASSOCIATED BLANK AS WELL AS IN SAMPLE

ANALYSIS REPORT FOR VOLATILE ORGANICS BY GC/MS

CLIENT : SHAKTI CON.
LAB SAMPLE #: E916355
MATRIX : WATER

METHOD : EPA 624
ANALYSIS DATE: 08/08/89
DATA FILE : >A4566

	COMPOUND	RESULT (ug/L)	MDL (ug/L)	Q
1)	ACROLEIN	ND	100	
2)	ACRYLONITRILE	ND	100	
3)	BENZENE	ND	5.0	
4)	BROMOFORM	ND	5.0	
5)	BROMODICHLOROMETHANE	ND	5.0	
6)	BROMOMETHANE	ND	10	
7)	CARBON TETRACHLORIDE	ND	5.0	
8)	CHLOROBENZENE	ND	5.0	
9)	CHLOROETHANE	ND	10	
10)	2-CHLOROETHYL VINYL ETHER	ND	10	
11)	CHLOROFORM	ND	5.0	
12)	CHLOROMETHANE	ND	10	
13)	cis-1,3-DICHLOROPROPENE	ND	5.0	
14)	DIBROMOCHLOROMETHANE	ND	5.0	
15)	1,2-DICHLOROBENZENE	ND	5.0	
16)	1,3-DICHLOROBENZENE	ND	5.0	
17)	1,4-DICHLOROBENZENE	ND	5.0	
18)	1,1-DICHLOROETHANE	ND	5.0	
19)	1,2-DICHLOROETHANE	ND	5.0	
20)	1,1-DICHLOROETHYLENE	ND	5.0	
21)	trans-1,2-DICHLOROETHYLENE	ND	5.0	
22)	trans-1,3-DICHLOROPROPENE	ND	5.0	
23)	1,2-DICHLOROPROPANE	ND	5.0	
24)	ETHYLBENZENE	ND	5.0	
25)	METHYLENE CHLORIDE	ND	5.0	
26)	1,1,2,2-TETRACHLOROETHANE	ND	5.0	
27)	TETRACHLOROETHYLENE	ND	5.0	
28)	TOLUENE	ND	5.0	
29)	1,1,1-TRICHLOROETHANE	ND	5.0	
30)	1,1,2-TRICHLOROETHANE	ND	5.0	
31)	TRICHLOROETHYLENE	ND	5.0	
32)	TRICHLOROFLUOROMETHANE	ND	5.0	
33)	VINYL CHLORIDE	ND	10	
34)	m-XYLENE	ND	5.0	
35)	p,o-XYLENE	ND	5.0	

ND = NOT DETECTED
MDL= METHOD DETECTION LIMIT

QUALIFIERS (Q)

J =INDICATES AN ESTIMATED VALUE BELOW MDL
B =INDICATES COMPOUND FOUND IN THE ASSOCIATED BLANK AS WELL AS IN SAMPLE

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ANALYSIS REPORT FOR VOLATILE ORGANICS BY GC/MS

CLIENT : SHAKTI
LAB SAMPLE #: E916356
MATRIX : WATER

METHOD : EPA 624
ANALYSIS DATE: 08/09/89
DATA FILE : >A4588

	COMPOUND	RESULT (ug/L)	MDL (ug/L)	Q
1)	ACROLEIN	ND	100	
2)	ACRYLONITRILE	ND	100	
3)	BENZENE	ND	5.0	
4)	BROMOFORM	ND	5.0	
5)	BROMODICHLOROMETHANE	ND	5.0	
6)	BROMOMETHANE	ND	10	
7)	CARBON TETRACHLORIDE	ND	5.0	
8)	CHLOROBENZENE	ND	5.0	
9)	CHLOROETHANE	ND	10	
10)	2-CHLOROETHYL VINYL ETHER	ND	10	
11)	CHLOROFORM	ND	5.0	
12)	CHLOROMETHANE	ND	10	
13)	cis-1,3-DICHLOROPROPENE	ND	5.0	
14)	DIBROMOCHLOROMETHANE	ND	5.0	
15)	1,2-DICHLOROBENZENE	ND	5.0	
16)	1,3-DICHLOROBENZENE	ND	5.0	
17)	1,4-DICHLOROBENZENE	ND	5.0	
18)	1,1-DICHLOROETHANE	44	5.0	
19)	1,2-DICHLOROETHANE	ND	5.0	
20)	1,1-DICHLOROETHYLENE	ND	5.0	
21)	trans-1,2-DICHLOROETHYLENE	ND	5.0	
22)	trans-1,3-DICHLOROPROPENE	ND	5.0	
23)	1,2-DICHLOROPROPANE	ND	5.0	
24)	ETHYLBENZENE	ND	5.0	
25)	METHYLENE CHLORIDE	ND	5.0	
26)	1,1,2,2-TETRACHLOROETHANE	ND	5.0	
27)	TETRACHLOROETHYLENE	ND	5.0	
28)	TOLUENE	ND	5.0	
29)	1,1,1-TRICHLOROETHANE	12	5.0	
30)	1,1,2-TRICHLOROETHANE	ND	5.0	
31)	TRICHLOROETHYLENE	ND	5.0	
32)	TRICHLOROFLUOROMETHANE	ND	5.0	
33)	VINYL CHLORIDE	ND	10	
34)	m-XYLENE	ND	5.0	
35)	p,o-XYLENE	ND	5.0	

ND = NOT DETECTED
MDL= METHOD DETECTION LIMIT

QUALIFIERS (Q)

J =INDICATES AN ESTIMATED VALUE BELOW MDL
B =INDICATES COMPOUND FOUND IN THE ASSOCIATED BLANK AS WELL AS IN SAMPLE

Appendix D

Permits

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233-3505

Henry G. Williams
Commissioner

April 1, 1987

MEMORANDUM

TO: Regional Water Engineers, Bureau Directors, Section Chiefs

SUBJECT: Division of Water Technical and Operational Guidance Series (2.1.1)
GROUNDWATER CONTAMINATION REMEDIATION STRATEGY
(Originator: Mr. Halton)

I. PURPOSE

To establish strategies for source control and remediation of groundwater contamination.

II. DISCUSSION

This document applies to chronic groundwater contamination incidents for which the Division of Water (DOW) has lead responsibility for source control and groundwater remediation. These cases are identified in the August 14, 1984 MOU between DOW and the Division of Solid and Hazardous Waste (DSHW). The MOU says that DOW has lead responsibility if the source of the groundwater contamination is:

1. Any recurring point source discharge.
2. Petroleum or chemical products which, if leaked or spilled, would not constitute a hazardous waste under RCRA/Part 370.
3. Leaks or spills of waste materials other than hazardous wastes.
4. Unknown.

This document does not apply to immediate or short-term response to spills, or to cases for which DSHW has lead responsibility.

DOW is responsible for the site investigation, at least until the source is identified. However, this document assumes that a site investigation has already taken place. It considers two issues; the control of continuing sources of contamination and the remediation of contaminated groundwater plumes (see figure 1).

III. GUIDANCE

1. Step I deals with on-going sources of contamination (see figure 2). "Source Control"(1) will be required if there is a violation of water quality standards (ground or surface). A source control program must eliminate the violation if technologically feasible. If not, the program must accomplish all that is technologically feasible. Cost will not be considered.

Responsibilities

1. The RWE, in consultation with BSPR, has the following responsibilities:

   a. Final selection/approval of source control and plume management programs.

   b. To determine when an impairment exists.

   c. To decide if termination of a plume management program can be considered, or, if not, to decide if there are any acceptable alternatives to continuing.

   d. To provide overall supervision and coordination for all site investigations, monitoring, negotiations with the owner, assemblage of case reports, and liaison with the Regional Attorney on enforcement cases.

2. BSPR, in consultation with the RWE, has the following responsibilities:

   a. To conduct detailed hydrogeologic evaluations of the site at the request of the RWE and to identify sources of contamination where possible.

   b. To advise on all hydrogeologic technical issues, including site monitoring, evaluation of consultant reports, and options for plume management and source control. Review of cost/benefit data.

   c. To render the decision on when a plume management effort has reached a technical "dead end".

3. BWFD/BMA, in consultation with the RWE, are responsible for the regulation of any point source discharge from the site to ground or surface waters.

4. NYSDOH shall be consulted by the RWE regarding:

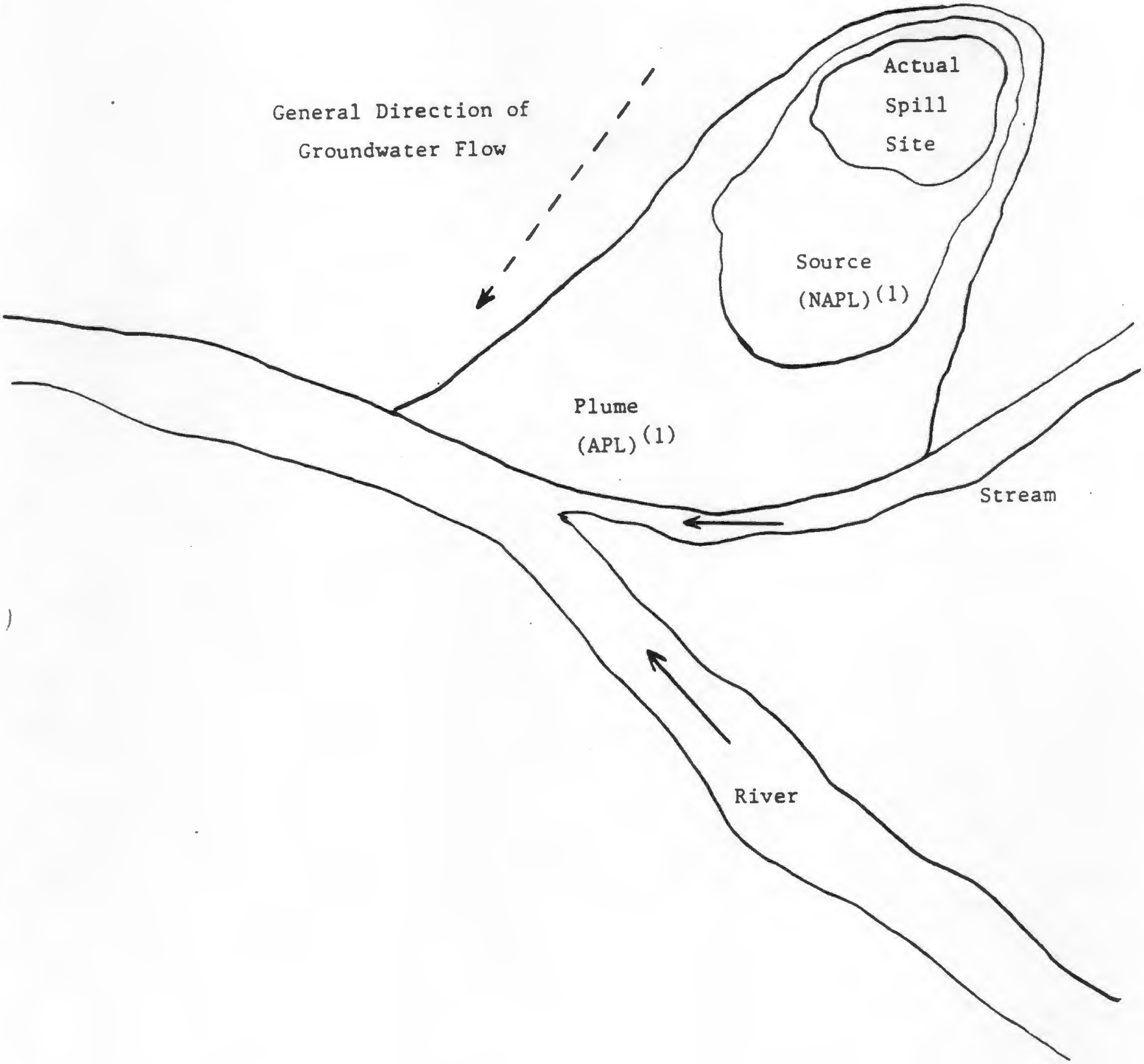
   a. Acceptable levels of chemicals in drinking water, if not covered by existing water quality standards.

   b. Acceptability of public water supplies.

   c. Risk assessment regarding residual contamination.

Figure 1

Groundwater Contamination by Past Chemical Spill



(1) - See Glossary

Figure 2

Step I - Source Control

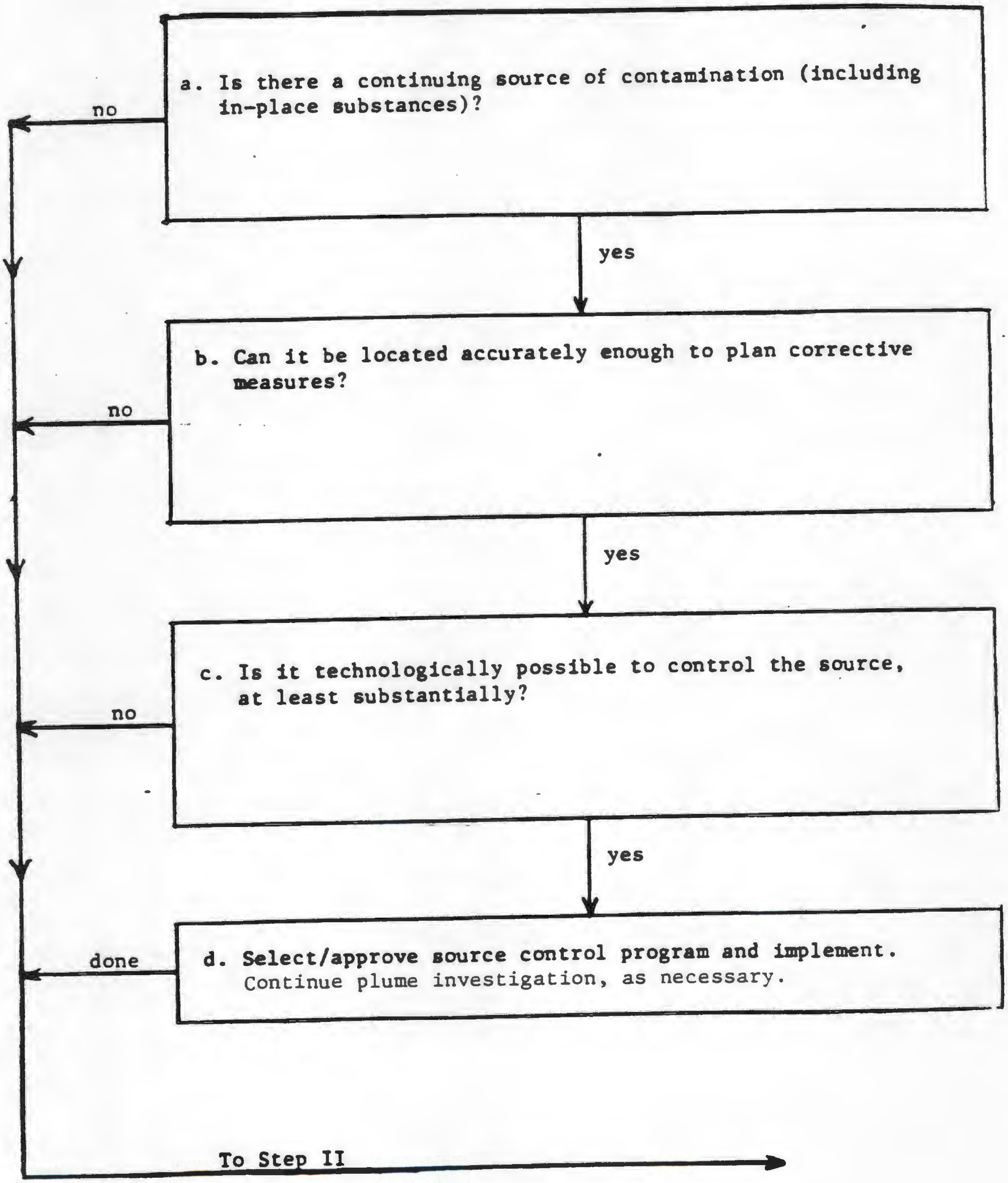
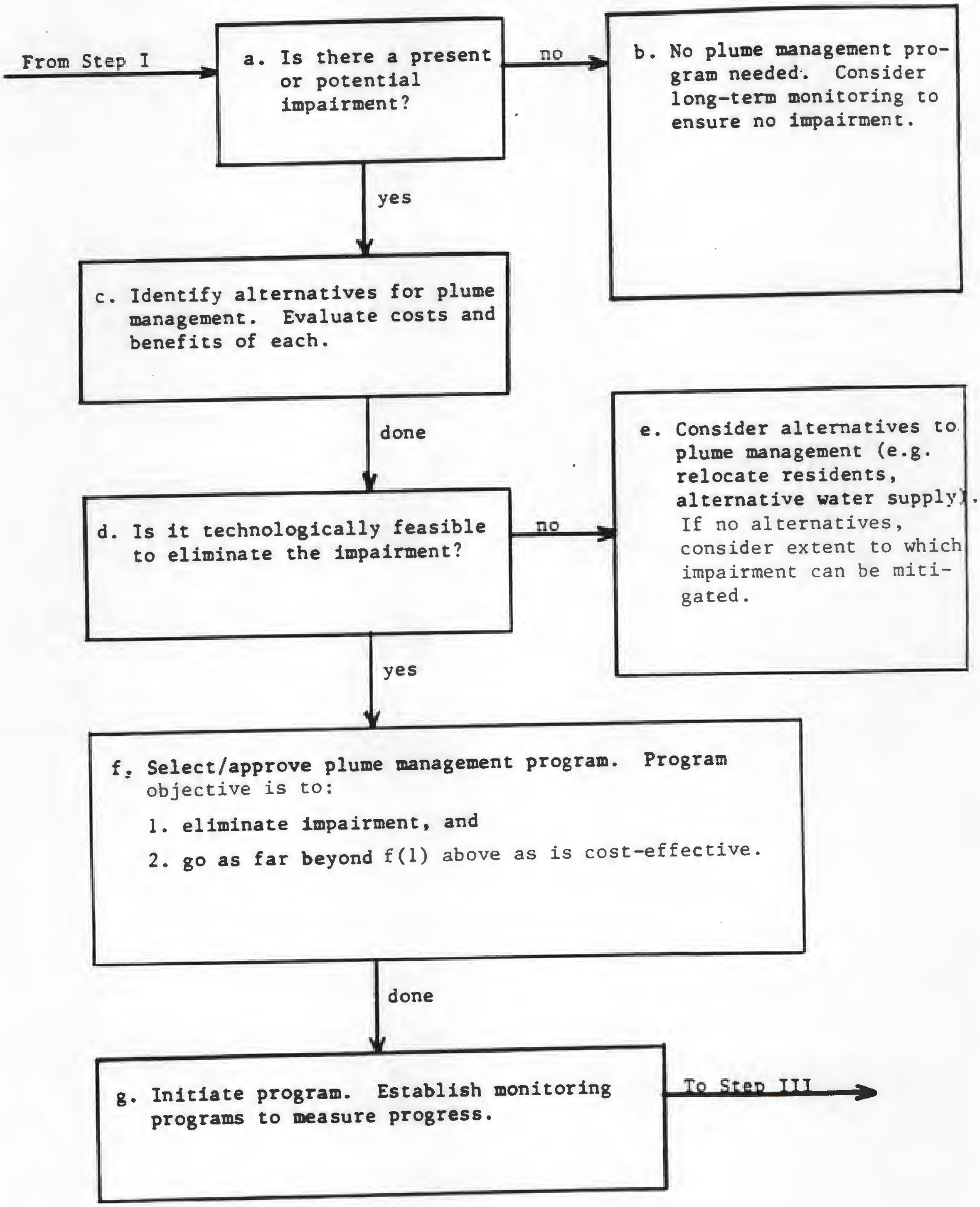


Figure 3

Step II - Plume Management



a. Is there a present or potential impairment?

b. No plume management program needed. Consider long-term monitoring to ensure no impairment.

c. Identify alternatives for plume management. Evaluate costs and benefits of each.

d. Is it technologically feasible to eliminate the impairment?

e. Consider alternatives to plume management (e.g. relocate residents, alternative water supply). If no alternatives, consider extent to which impairment can be mitigated.

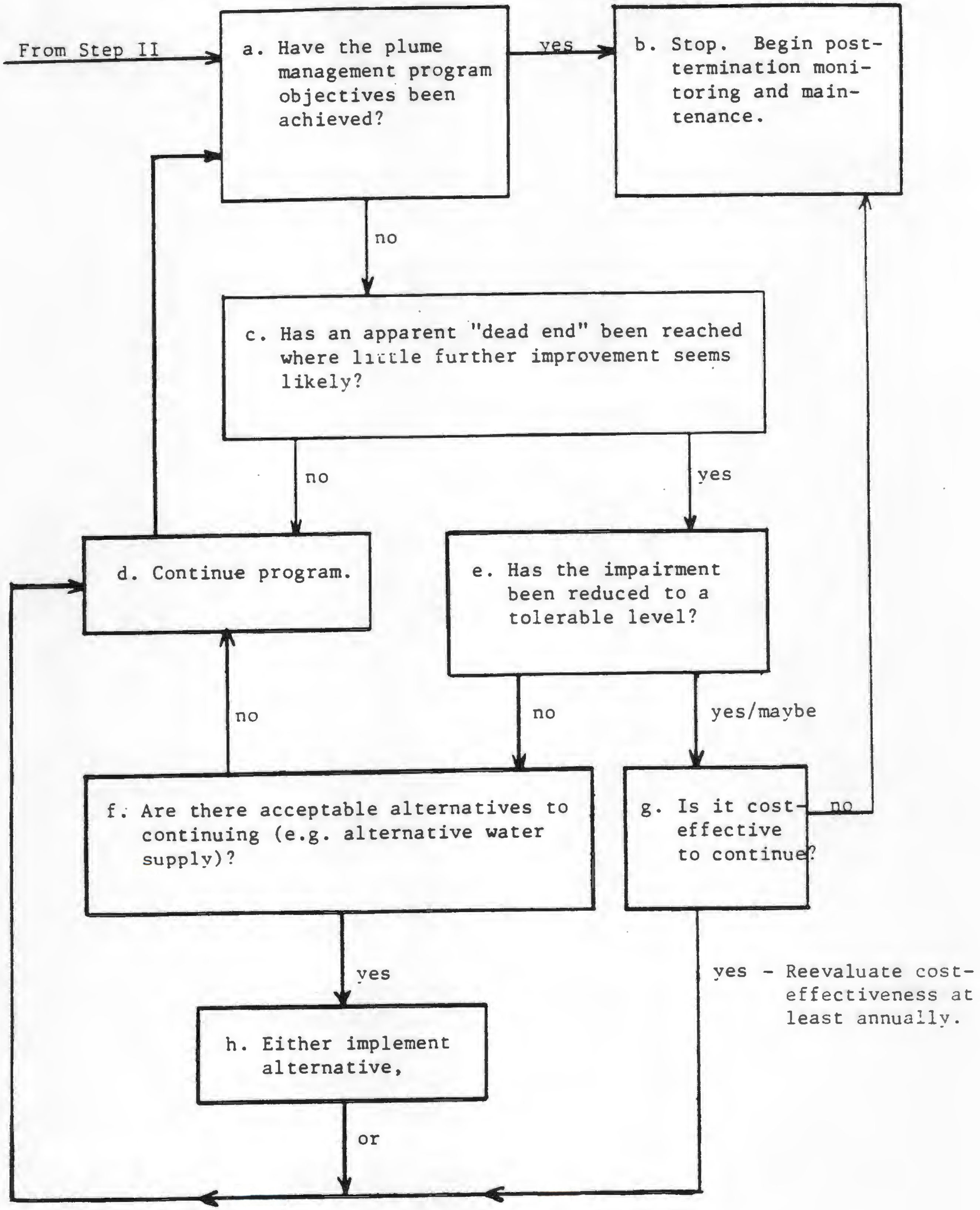
f. Select/approve plume management program. Program objective is to:

1. eliminate impairment, and
2. go as far beyond f(1) above as is cost-effective.

g. Initiate program. Establish monitoring programs to measure progress.

Figure 4

Step III - Termination



SUMMARY OF CODE REVISION

STANDARDS

General MCLs

The **New York State Department of Health** has adopted standards to limit organic chemical contamination of public drinking water supplies. The code revision (to Part 5 of the State Sanitary Code) establishes maximum contaminant levels (MCLs) or standards for:

Principal Organic Contaminant (POC) - 0.005 mg/l (5 ug/l)
Unspecified Organic Contaminant (UOC) - 0.050 mg/l (50 ug/l)
Total of POCs and UOCs - 0.10 mg/l (100 ug/l)

POCs would be defined as any organic chemical belonging to any of six general chemicals classes:

Halogenated Alkanes
Halogenated Ethers
Halobenzenes and Substituted Halobenzenes
Benzene and Alkyl- or Nitrogen-Substituted Benzenes
Substituted, Unsaturated Aliphatic Hydrocarbons
Halogenated Non-aromatic Cyclic Hydrocarbons

POCs, by definition, exclude trihalomethanes and other organic chemicals with a specific MCL of their own.

UOCs would be defined as any organic chemical not covered by another MCL.

The Department recognizes the possible need for exceptions from the proposed MCLs for POCs and UOCs if the presence of a specific organic chemical does not represent contamination and sufficient, valid scientific information demonstrates that they do not pose an unreasonable risk to human health. When justified, the regulation contains provisions to allow for the establishment of a more lenient (higher) MCL.

The regulation also allows a water supplier to submit justification for a higher MCL for up to 60 days following application of a paint or lining to a potable water appurtenance. The Commissioner may allow the higher MCL if he determines that no unreasonable risk to human health would result.

The Department recognizes the need to use a stricter (lower) interim guideline value for a contaminant which lacks a chemical-specific MCL but for which the available toxicological data are judged sufficient to warrant more stringent control. The regulation allows for consideration of lower interim guidelines when justified. The Department believes that, from a public health perspective, the benefits associated with the broad nature of the general MCLs outweigh the fact that interim guidelines may have to be used in some cases. For example, the existing guidelines for PCBs - 1 ug/l; aldicarb - 7 ug/l; carbofuran - 15 ug/l; atrazine - 25 ug/l will be retained until a specific MCL for each chemical is developed.

Individual MCLs

The code revision includes a specific MCL of 0.002 mg/l (2 ug/l) for vinyl chloride and lowers the existing MCLs for two organic chemicals. The revised MCLs are 0.050 mg/l (50 ug/l) for both methoxychlor and 2,4-D.

Implementation Dates

The effective date of the MCLs in this code revision is January 9, 1989. Monitoring and other requirements are effective as of publication in the State Register.

MONITORING

Contaminants

The code revision requires monitoring for certain organic chemicals and allows State discretion to require monitoring of other organic chemicals when the State believes that contaminants have been or may be present in concentrations which exceed the MCL. All community water systems are required to monitor for the 52 POCs listed on Table 1 and for vinyl chloride. The code uses the same nomenclature of the Environmental Laboratory Approval Program, so chemical names used previously in the proposal are listed in parentheses on Table 1.

The monitoring requirement also extends to noncommunity systems that regularly serve at least 25 of the same persons, four hours or more per day, for four or more days per week, for 26 or more weeks per year. These systems are called nontransient, noncommunity water systems.

The contaminants must be analyzed by EPA methods 502.2, 524.1, 524.2 or a combination of 502.1 and 503.1. The analysis must be capable of detecting the contaminants as low as 0.0005 mg/l (0.5 ug/l). All systems that serve 150 or more service connections from groundwater sources also must analyze at least one sample from each source for 1,2-dibromoethane (EDB) and 1,2-dibromo-3-chloropropane (DBCP). EPA Method 504, with a detection level of 0.00002 mg/l (0.02 ug/l), must be used for EDB and DBCP.

Since POCs are defined by the chemical class above, the standard applies to many more chemicals than those listed on Table 1. The regulations allow the State to require monitoring for other contaminants (POCs or UOCs) when the State believes they might exceed the MCL or present a risk to public health.

Location of Sample Collection

The regulations require each source to be sampled at specific locations dictated by ground or surface sources. The location of sampling for each groundwater source is at or before the first service connection and prior to mixing with other sources. The regulations allow the State to specify another location. This provision can be used to require monitoring following treatment to remove organics or to accept certain sources as representative of other nearby sources in the same aquifer under certain conditions at State discretion.

The regulations require systems with surface sources to sample at points in the distribution system representative of each source or at entry point or points to the distribution systems after any treatment plant.

Initial Sampling

The initial monitoring requirement for each source depends on the type and size of the system as scheduled below:

System Type/Size	Required Samples per source
Community serving 10,000 or more persons	One per quarter for one year by 12/31/88
Community serving 3,300-9,999 persons	One per quarter for one year by 12/31/89
Community serving fewer than 3,300 persons and more than 149 service connections	One per quarter for one year by 12/31/90
Community serving fewer than 150 service connections	One by 6/30/91
Nontransient, Noncommunity	One by 6/30/92
Noncommunity	State Discretion

Systems serving over 10,000 persons were notified by mail in October 1987 to perform the required sampling under existing Code, Section 5-1.75, and EPA regulations.

As with other contaminants, the State may use Section 5-1.51(e) to require a system to monitor sooner or more frequently whenever the potential exists for an MCL violation. Consequently, systems with sources that have been shown by previous monitoring to be contaminated may be required to monitor before the above schedule.

Vulnerability to Contamination

The State will assess the vulnerability to contamination of all sources of water supply based on:

a. previous monitoring results

b. number of persons served by the public water system

c. proximity of the system to a larger system

d. proximity to commercial or industrial use, disposal or storage of volatile synthetic organic chemicals; and

e. the degree of protection afforded the source of water supply.

Detailed guidance in determining vulnerability will be developed similar to EPA's as presented in the Federal Register, November 13, 1985, Volume 50, No. 219.

For systems serving fewer than 150 service connections, more than one sample will be required for those sources that are determined to be vulnerable. Following a determination of nonvulnerability, the State may reduce initial and some of the repeat

sampling described below for intermediate sized systems (more than 150 service connections, but population less than 3,300 persons). It is unlikely that systems serving 3,300 or more persons would have monitoring reduced since EPA's guidance considers all systems this large to be vulnerable to contamination. Statewide surveys show that volatile organic chemicals are more than twice as likely to be found in sources of these larger systems.

Repeat Monitoring

At those sources where contaminants are detected, (at 0.0005 mg/l or above) monitoring would be required to continue on quarterly intervals. Systems with 150 or more service connections for which contaminants are not detected would be required to repeat monitoring every three years. Systems with fewer than 150 service connections would not be required to repeat monitoring unless they are determined to be vulnerable.

DETERMINATION OF COMPLIANCE

If the results of a sample exceed the MCLs, the supplier of water would be required to collect one to three confirmation samples as soon as practical but no later than 30 days. If the average of all samples (monitoring sample plus confirmation sample(s)) exceeds the MCL, a MCL violation occurs. Those systems with sources that exceed the MCLs after the effective date will be put on a compliance schedule and required to provide public notification. Both short and long-term compliance strategies will be developed. The long-term strategy in most cases, would be to develop alternative sources or provide treatment. Potential short-term strategies include an alternative water source, minimal use of a contaminated source, such as stand-by for peak demand, conservation measures, temporary treatment, and consumer advisories.

Persistent violators of MCLs, or monitoring and reporting requirements will be subject to enforcement actions as for other contaminants regulated in the code.

NOTIFICATION

The supplier of water must make State, consumer and public notification for MCL or other violations according to requirements similar to those existing for other contaminants.

The regulations also require systems to notify its consumers as to the availability of monitoring results for volatile organic chemicals. Notification will be included in the first set of water bills issued by the system after the receipt of the result or by other written notice within three months. The State would accept as written notice, a one-time publication in a daily newspaper of general circulation in the area served by your system. The notice should:

1. identify a person and supply the telephone number to contact for information on the monitoring results, and
2. where appropriate, state that quarterly monitoring will continue for the remainder of the year.

A legal notice is acceptable provided it is conspicuous and does not contain unduly technical language, unduly small print or similar problems that frustrate the purpose of the notice.

[illegible] described below [illegible] sized systems [illegible] than 150 service [illegible] population less than 1000 [illegible] likely that systems serving [illegible] would carry monitoring [illegible] EPA's guidelines [illegible] to be [illegible]. Statewide surveys [illegible] chemicals are more than twice as likely to be found [illegible]

[illegible]

[illegible] sources where [illegible] are detected, [illegible] 2005 [illegible] required [illegible] quarterly intervals. Systems [illegible] for which [illegible] not detected would be [illegible] every three years [illegible] with fewer than 150 [illegible] a repeat [illegible]

[illegible] OF COMPLIANCE

[illegible] results of a sample [illegible] MCLs, [illegible] samples of water should be obtained [illegible] to confirm [illegible] as soon as practical but no later [illegible] samples [illegible] occurs. [illegible] with sources that exceed [illegible] will be put on [illegible] schedule and required to provide [illegible] short and long-term [illegible] will be developed. [illegible] in most cases [illegible] alternative water [illegible] such as [illegible] for peak demand [illegible]

[illegible] violations of MCLs [illegible] monitoring and reporting requirements [illegible] enforcement actions [illegible] contaminants regulation [illegible]

[illegible]

[illegible] consumers and public notification [illegible] according to [illegible] similar to [illegible] requirements.

[illegible] regulations also require systems to notify its consumers as to the availability of monitoring results for volatile organic chemicals. Notification will be included in the first set of water bills issued by the system after the receipt of the results [illegible] notice within three months. [illegible] written notice [illegible] publication in a daily newspaper of general circulation in the area [illegible] the notice should:

1. identify a person and supply the telephone number to contact for [illegible] monitoring results, and
2. [illegible] state that [illegible] monitoring will continue [illegible] the year.

A legal notice is acceptable provided it is conspicuous and does not [illegible] technical language, [illegible] small print or similar problems that frustrate the purpose of the notice.

TABLE 1
ORGANIC CHEMICALS IN REQUIRED MONITORING
VINYL CHLORIDE AND 52 PRINCIPAL ORGANIC CONTAMINANTS
(AS PER ENVIRONMENTAL LABORATORY APPROVAL PROGRAM)

CHEMICAL NAME ELAP NOMENCLATURE	CHEMICAL NAME USED PREVIOUSLY IN PROPOSAL
benzene	
bromobenzene	
bromochloromethane	
bromomethane	
n-butylbenzene	
sec-butylbenzene	
tert-butylbenzene	
carbon tetrachloride	
chlorobenzene	
chloroethane	
chloromethane	
2-chlorotoluene	(o-chlorotoluene)
4-chlorotoluene	(p-chlorotoluene)
dibromomethane	
1,2-dichlorobenzene	(o-dichlorobenzene)
1,3-dichlorobenzene	(m-dichlorobenzene)
1,4-dichlorobenzene	(p-dichlorobenzene)
dichlorodifluoromethane	
1,1-dichloroethane	
1,2-dichloroethane	
1,1-dichloroethene	(1,1-dichloroethylene)
cis-1,2-dichloroethene	(cis-1,2-dichloroethylene)
trans-1,2-dichloroethene	(trans-1,2-dichloroethylene)
1,2-dichloropropane	
1,3-dichloropropane	
2,2-dichloropropane	
1,1-dichloropropene	
cis-1,3-dichloropropene	
trans-1,3-dichloropropene	
ethylbenzene	
hexachlorobutadiene	
isopropylbenzene	
p-isopropyltoluene	(p-cymene)
methylene chloride	(dichloromethane)
n-propylbenzene	
styrene	
1,1,1,2-tetrachloroethane	
1,1,2,2-tetrachloroethane	
tetrachloroethene	(1,1,2,2-tetrachloroethylene)
toluene	
1,2,3-trichlorobenzene	
1,2,4-trichlorobenzene	
1,1,1-trichloroethane	
1,1,2-trichloroethane	
trichloroethene	(1,1,2-trichloroethylene)
trichlorofluoromethane	(fluorotrichloromethane)
1,2,3-trichloropropane	
1,2,4-trimethylbenzene	
1,3,5-trimethylbenzene	
m-xylene	
o-xylene	
p-xylene	

OP	LOCATION	FACILITY	EMISSION POINT	
F				I

A ADD
C CHANGE
D DELETE

READ INSTRUCTIONS CONTAINED IN FORM 76-11-12 BEFORE ANSWERING ANY QUESTION

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROCESS, EXHAUST OR VENTILATION SYSTEM

APPLICATION FOR PERMIT TO CONSTRUCT OR CERTIFICATE TO OPERATE

COPIES
WHITE - ORIGINAL
GREEN - DIVISION OF AIR
WHITE - REGIONAL OFFICE
PINK - FIELD REP
YELLOW - APPLICANT

SECTION A

1 NAME OF OWNER/FIRM			9 NAME OF AUTHORIZED AGENT		10 TELEPHONE	19 FACILITY NAME (IF DIFFERENT FROM OWNER/FIRM)	
2 NUMBER AND STREET ADDRESS			11 NUMBER AND STREET ADDRESS			20 FACILITY LOCATION (NUMBER AND STREET ADDRESS)	
3 CITY - TOWN - VILLAGE	4 STATE	5 ZIP	12 CITY - TOWN - VILLAGE	13 STATE	14 ZIP	21 CITY - TOWN - VILLAGE	22 ZIP
						23 BUILDING NAME OR NUMBER	24 FLOOR NAME OR NUMBER
6 OWNER CLASSIFICATION A ☐ COMMERCIAL B ☐ INDUSTRIAL C ☐ UTILITY D ☐ FEDERAL E ☐ STATE F ☐ MUNICIPAL G ☐ EDUC INST H ☐ HOSPITAL I ☐ RESIDENTIAL J ☐ OTHER			15 NAME OF P.E. OR ARCHITECT PREPARING APPLICATION	16 N.Y.S. P.E. OR ARCHITECT LICENSE NO.	17 TELEPHONE	25 START UP DATE / MO YR	26 DRAWING NUMBERS OF PLANS SUBMITTED
7 NAME & TITLE OF OWNERS REPRESENTATIVE	8 TELEPHONE		18 SIGNATURE OF OWNERS REPRESENTATIVE OR AGENT WHEN APPLYING FOR A PERMIT TO CONSTRUCT			27 PERMIT TO CONSTRUCT A ☐ NEW SOURCE B ☐ MODIFICATION	28 CERTIFICATE TO OPERATE A ☐ NEW SOURCE B ☐ MODIFICATION C ☐ EXISTING SOURCE

SEC. B

29 EMISSION POINT ID	30 GROUND ELEVATION (FT)	31 HEIGHT ABOVE STRUCTURES (FT)	32 STACK HEIGHT (FT)	33 INSIDE DIMENSIONS (IN)	34 EXIT TEMP (°F)	35 EXIT VELOCITY (FT/SEC)	36 EXIT FLOW RATE (ACFM)	37 SOURCE CODE	38 HRS/DAY	39 DAYS/YR	40 % OPERATION BY SEASON Winter	Spring	Summer	Fall

SEC. C

41 DESCRIBE PROCESS OR UNIT		
	1	2
	3	4
	5	6
	7	8

SEC. D

EMISSION CONTROL EQUIPMENT ID	CONTROL TYPE	MANUFACTURER'S NAME AND MODEL NUMBER	DISPOSAL METHOD	DATE INSTALLED MONTH / YEAR	USEFUL LIFE
42	43	44	45	46 /	47
48	49	50	51	52 /	53

SECTION E

CALCULATIONS

SECTION F

CONTAMINANT NAME	CONTAMINANT CAS NUMBER	INPUT OR PRODUCTION	UNIT	ENV. RATING	EMISSIONS ACTUAL	EMISSIONS UNIT	EMISSIONS HOW DET	EMISSIONS PERMISSIBLE	% CONTROL EFFIC'CY	HOURLY EMISSIONS (LBS/HR) ERP	HOURLY EMISSIONS (LBS/HR) ACTUAL	ANNUAL EMISSIONS (LBS/YR) ACTUAL	ANNUAL EMISSIONS (LBS/YR) 10ˣ	ANNUAL EMISSIONS (LBS/YR) PERMISSIBLE
54	55 - -	56	57	58	59	60	61	62	63	64	65	66	67	68
69	70 - -	71	72	73	74	75	76	77	78	79	80	81	82	83
84	85 - -	86	87	88	89	90	91	92	93	94	95	96	97	98
99	100 - -	101	102	103	104	105	106	107	108	109	110	111	112	113
114	115 - -	116	117	118	119	120	121	122	123	124	125	126	127	128
129	130 - -	131	132	[illegible]	134	135	136	[illegible]	138	139	140	141	142	143

SEC. G

SOLID FUEL TYPE	SOLID FUEL TONS/YR	SOLID FUEL %S	LIQUID FUEL TYPE	LIQUID FUEL THOUSANDS OF GALLONS/YR	LIQUID FUEL %S	GAS TYPE	GAS THOUSANDS OF CF/YR	GAS BTU/CF	APPLICABLE RULE	APPLICABLE RULE
144	145	146	147	148	149	150	151	152	153	154

Upon completion of construction sign the statement listed below and forward to the appropriate field representative

THE PROCESS, EXHAUST OR VENTILATION SYSTEM HAS BEEN CONSTRUCTED AND WILL BE OPERATED IN ACCORDANCE WITH STATED SPECIFICATIONS AND IN CONFORMANCE WITH ALL PROVISIONS OF EXISTING REGULATIONS.

155 SIGNATURE OF AUTHORIZED REPRESENTATIVE OR AGENT

DATE

AGENCY USE ONLY

156 LOCATION CODE	157 FACILITY ID. NO.	158 U.T.M. (E)	159 U.T.M. (N)	160 SIC NUMBER	161 DATE APPL. RECEIVED	162 DATE APPL. REVIEWED	163 REVIEWED BY
		.	.		/ /	/ /	

PERMIT TO CONSTRUCT

164 DATE ISSUED	165 EXPIRATION DATE	166 SIGNATURE OF APPROVAL	167 FEE
/ /	/ /		

168.
1. DEVIATION FROM APPROVED APPLICATION SHALL VOID THIS PERMIT
2. THIS IS NOT A CERTIFICATE TO OPERATE
3. TESTS AND/OR ADDITIONAL EMISSION CONTROL EQUIPMENT MAY BE REQUIRED PRIOR TO THE ISSUANCE OF A CERTIFICATE TO OPERATE

CERTIFICATE TO OPERATE

169 DATE ISSUED	170 EXPIRATION DATE	171 SIGNATURE OF APPROVAL	172 FEE
/ /	/ /		

173.
1. ☐ INSPECTED BY________________ DATE________
2. ☐ INSPECTION DISCLOSED DIFFERENCES AS BUILT VS. PERMIT, CHANGES INDICATED ON FORM
3. ☐ ISSUE CERTIFICATE TO OPERATE FOR SOURCE AS BUILT
4. ☐ APPLICATION FOR C.O. DENIED ________ DATE ________ INITIALED

174 SPECIAL CONDITIONS:

1	2
3	4
5	6
7	8

Appendix E

Technical References

The Johnson
Drillers
Journal

November-December 1980 *Vol. 52. No. 6*

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Customer Service	612-636-3900
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New Jersey. Thorofare	
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Telex	834693

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Robert J. Lacey III	318-362-1180
Louisiana. Scott	
Harry J. Boudreaux. Mgr.	318-233-2376
James R. Hardin	318-233-2376
Texas. Houston	
Buddy Wayne Anderson	713-525-4285

Revert Product Manager

Minnesota. St. Paul	
Glenn Carpenter	612-636-3900

Geophysical Equipment

Minnesota. St. Paul	
Charles Howe	612-636-3900

About the cover: R. J. Strasser rigs at the Marmes site on the Snake River. north of Walla Walla. Wash.. Article begins on page 7.

Pumping Test Analyses for Low Yield Formations

The driller can determine aquifer characteristics that help him to discover ground water flow patterns, the effects of dewatering or the migration of pollution plumes.

BY DAVID C. SCHAFER

OCCASIONALLY IT IS necessary to determi
aquifer characteristics of very low yieldi
formations — those with transmissivities l
than 500 gallons per day per foot. Though
terest in these aquifers is certainly not becaus
their productive capability. it may be desira
to determine ground water flow characteris
even in these low yield formations in order
determine such things as regional ground wa
flow patterns, effect of dewatering or migrat
of pollution plumes near point sources
contamination.

Different Approach Is Required

Conventional pumping test analysis using
standard time drawdown graph often does
work effectively in low T (transmissivity) for
tions for two reasons. First, the pumped w
low specific capacity (gallons per minute per
of drawdown) may cause the pump to break
tion during the test and it may be impractic
throttle back the pumping rate sufficientl
prevent this. Second. even if a constant pum
rate can be maintained without breaking
tion. most of the data obtained will proi

Mr. Schafer is a hydrologist and a regional manager
headquarters office of Johnson Division. UOP In

The Johnson
Drillers
Journal

[illegible]

The driller can [illegible] characteristics [illegible] to discover ground water [illegible] how [illegible] the effects of [illegible] of the migration of pollution [illegible]

By David [illegible]

O[illegible] aquifer characteristics [illegible] formations [illegible] than 900 [illegible] their product [illegible] the determin[illegible] even on the [illegible] determine [illegible] flow patterns [illegible] of pollution [illegible] contaminants.

[illegible] approach [illegible]

Conventional [illegible] standard [illegible] were affected [illegible] tions for [illegible] specific capacity [illegible] drawdown [illegible] use during the [illegible] though [illegible] prevent this [illegible] can be [illegible] tion [illegible]

[illegible]

reflect casing storage effects rather than true aquifer parameters (see "Casing Storage Can Affect Pumping Test Data," Jan-Feb. 1978. *Johnson Drillers Journal*). Thus a different approach is required.

The best method for analyzing these formations is to pump a substantial portion of the casing empty, then shut the pump off and measure water levels as they recover. In ordinary pumping tests these measurements correspond to the non-pumping portion of the test. However, in low T formations this "recovery period" is actually the "pumping period!"

After pump shut-off, the casing slowly begins filling with water. This water comes from the aquifer and actually represents the water pumped during this so called "pumping period." The pumping rate is determined by measuring the volume of casing filled in a given length of time.

During the test, careful measurements are made of time since pumping began (t) along with drawdown (s) at each of these times. Then a calculation is made to determine Q for each time t and finally the ratio s/Q is computed for each measured drawdown value. The ratio is simply the reciprocal of the specific capacity.

A graph is then constructed showing t versus the ratio s/Q plotted as usual on semi-logarithmic graph paper with t on the log scale. A straight line of best fit is drawn through the data points and T is calculated as follows:

$$T = \frac{264}{\Delta(s/Q)}$$

where $\Delta(s/Q)$ is the change in s/Q over one log cycle of graph paper.

This graph has the unique advantage that it will accurately reflect aquifer transmissivity independent of casing storage effects. In addition it will be sensitive to nearby recharge and/or negative boundaries and will reveal these conditions like any ordinary time drawdown graph.

To see how this technique works it is best to work an example. Table 1 shows data obtained from a 6-inch well pumped at 10 gpm for 15 minutes. Drawdown after 15 minutes of pumping measured 90 feet.

The next data point was recorded two minutes following pump shut-off or 17 minutes since pumping started. At this time the pumping water level was 85.66 feet, indicating that 4.34 feet of casing had filled during the two minute interval.

The annulus between the 6-inch casing and 1¼" drop pipe holds 1.4 gallons per foot so that the volume of casing filled is 1.4 times 4.34, or 6.08 gallons in two minutes. Thus,

$$\begin{aligned} Q &= 6.08 \text{ gallons/2 minutes} \\ &= 3.04 \text{ gpm} \end{aligned}$$

finally,

$$\begin{aligned} s/Q &= 85.66 \text{ ft}/3.04 \text{ gpm} \\ &= 28.2 \text{ ft/gpm} \end{aligned}$$

which is plotted at a time of 17 minutes on the

TABLE 1

Pumping rate = 10 gpm
Pumping period = 15 minutes
Drawdown at pump shut off = 90 ft
Casing — 6" I.D.
Drop pipe — 1¼" I.D.

Time in minutes since pumping started (t)	Drawdown in feet (s)	Number of feet of casing filled	Time in minutes required to fill	Volume filled divided by time required in gallons per minute (Q)	s/Q in feet per gallon per minute
15 (pump shut off)	90				
17	85.66	4.34	2	3.04	28.2
20	79.7	5.96	3	2.78	28.6
30	64.2	15.5	10	2.17	29.5
40	51.9	12.3	10	1.72	30.2
60	35.6	13.3	20	1.14	31.1
80	24.6	11.0	20	.77	31.8

backcasting storage effects rather than true aquifer parameters (see "Casing Storage Can Affect Pumping Test Data," Jan-Feb 1985 Johnson Drillers Journal). Thus a different approach is required.

[illegible] method [illegible] analyzing these [illegible] uses only a substantial portion [illegible] the pump off and the [illegible] In ordinary [illegible] might correspond to the [illegible] However [illegible] "recovery period" is [illegible]

[illegible] the [illegible] two columns [illegible] represents the water [illegible] so called [illegible] is determined by [illegible] casing filled in a two [illegible]

[illegible] careful measurements are [illegible] pumping period [illegible] with [illegible] these times [illegible] Q for each time [illegible] Q is computed for each [illegible] value. The ratio is [illegible] specific capacity.

[illegible] constructed showing [illegible] plotted as [illegible] paper with [illegible] line drawn through the [illegible] calculated as follows:

where Δs/Q is [illegible] cycle of graph paper.

This graph [illegible] the [illegible] that [illegible] value [illegible] the negative [illegible] positive [illegible] the [illegible] working example [illegible] drawdown [illegible] about 90 feet.

The test data [illegible] following [illegible] pump [illegible] level [illegible] interval.

[illegible] Q = [illegible] gallons per minute

finally,

[illegible]

which is plotted [illegible]

TABLE 1

Pumping period = 15 minutes

Drawdown at pump shut off = 90 ft.

Casing — 6" I.D.

Drop pipe — 1¼" I.D.

Time (minutes)	Drawdown in feet	[illegible]	Time (minutes)	[illegible]
[illegible]	85.65	[illegible]	2	[illegible]
[illegible]	79.7	[illegible]	3	[illegible]
30	74.2	[illegible]	10	[illegible]
40	[illegible]	[illegible]	10	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	24.5	[illegible]	[illegible]	[illegible]

graph shown in Figure 1.

This analysis is repeated for each drawdown measurement. The resultant calculated s/Q values are shown in Table 1 and plotted in Figure 1. The formation T value from the graph is

$$T = \frac{264}{\Delta(s/Q)}$$
$$= 264/5.3$$
$$= 49 \text{ gpd/ft}$$

Conventional Analysis Not Effective

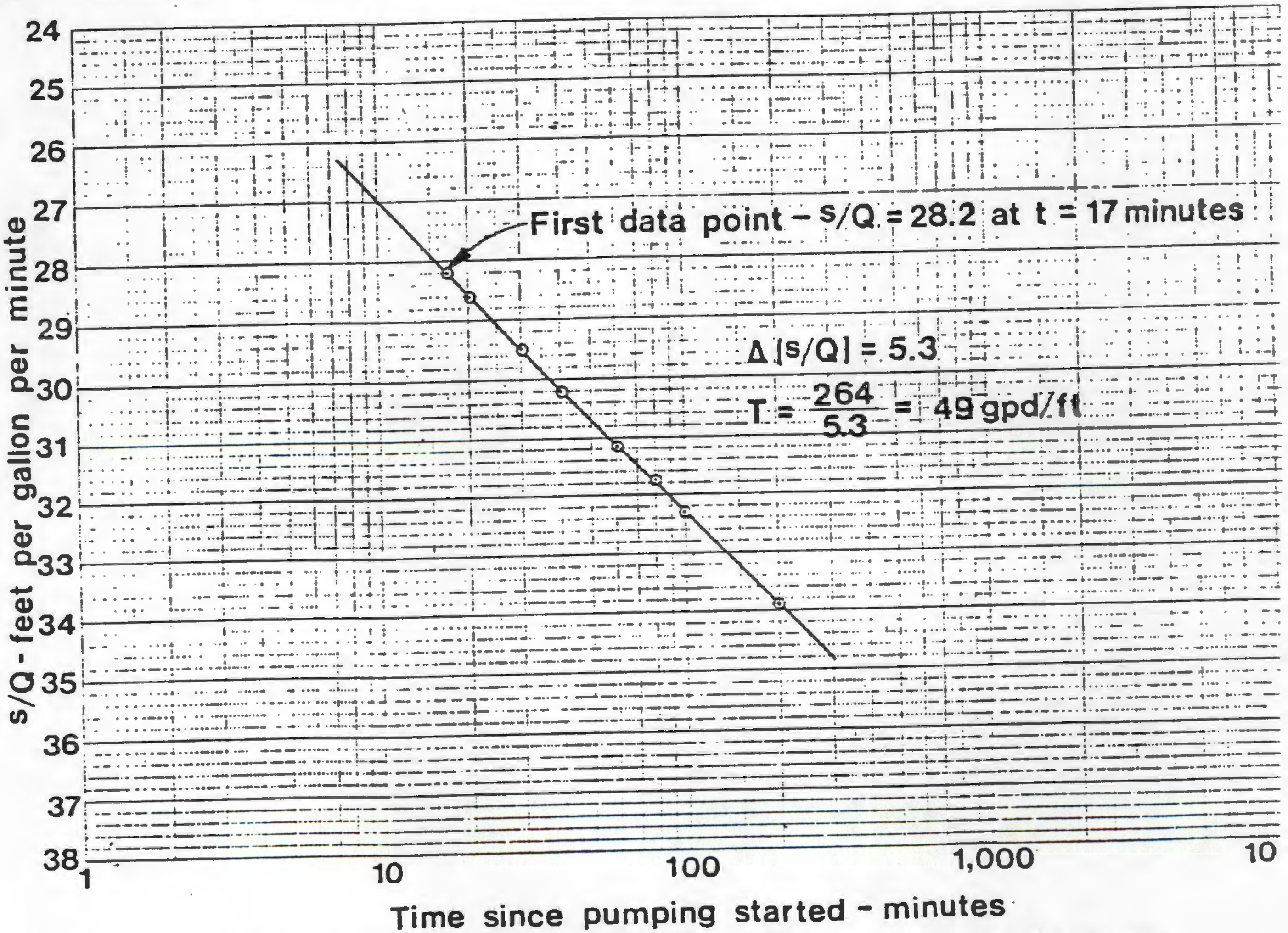
Examination of the hydraulic characteristics of this well (not included here) shows that if a conventional time drawdown graph had been used, casing storage effects would have lasted for approximately twelve hours. This means that data recorded in the first twelve hours of pumping would have been useless and longer pumping than this would have been required to obtain any usable data at all. However, data collected after twelve hours of pumping probably would be more influenced by boundary conditions than by aquifer transmissivity. Thus, in practice, it actually might have been impossible to determi the T value using conventional analysis tech niques regardless of the length of the test. Th value of the method described above become very clear: it may be the only way to determine values in certain low yielding aquifers.

In order to maximize the accuracy of th method, it is best to unload (empty) the casin as rapidly as possible. Thus it is actually bett to use a high capacity pump than a low capaci pump in analyzing extremely low-yielding well

Another good idea is to unload the casing wi compressed air since this can typically be done one minute or less.

Recorded Data Must Be Accurate

An additional important consideration is th all data recorded for this type of analysis must absolutely accurate. Small errors in the record values of time and/or drawdown can result large errors in the calculated values of s/Q. F best results, drawdown should be recorded to t nearest hundredth of a foot and timed to t nearest second or two.



In low transmissivity situations, readings are taken after pump shut-off. In this method, s/Q is the reciprocal of the specific capacity and t is time measured after shut-off as water begins to enter the casing.

Appendix F

Correspondence

SHAKTI CONSULTANTS INC.
185, Gatzmer Avenue
Jamesburg, NJ 08831
(201) 521-2322

August 23, 1989

Reviewed by Walter & Marty

sent August 29th, 1989.

Dr. Fluoro Cuison
18 Long Drive
Liberty, NY 12754

Dear Mr Cuison,

As we discussed by telephone, we are requesting access to your well at 320 Highland Avenue, Middletown and the use of your well for a groundwater remediation program we are undertaking. This groundwater remediation program is part of the environmental clean-up being carried out under the U.S. Environmental Protection Agency's direction.

In order to treat the groundwater in the vicinity of your property, it is necessary to pump the groundwater from your well. This groundwater will then be piped in a trench from the top of your well (adjacent to the East wall of your house) across to the General Switch property. There it will be treated in accordance with an Environmental Protection Agency approved process. It will be cleaned and then will recharge the aquifer.

After the initial installation of the piping and restoration of your property, all services to and from the well will be underground so as not to inconvenience the users of your property.

After the Environmental Protection Agency determines that the groundwater has been properly and completely treated, we will re-close the well head in accordance with the standards of the Middletown Department of Health code.

This work is a continuation of the Environmental Protection Agency's approved clean-up which was commenced several years ago. As part of that activity your property was connected to the Wallkill municipal water supply. At that time your well was decommissioned and your property placed into the public water supply distribution system.

Would you please indicate your permission by signing the attached copy of this letter and returning it to me in the attached envelope.

Yours sincerely,

John Bee : Regarding the former Parella Well

John Bee
President, Shakti Consultants, Inc.

Senior Geologist
CPG#6173 American Institute of
Professional Geologists

Dr. Fluoro Cuison

Stroock & Stroock & Lavan

Seven Hanover Square
New York, New York 10004-2594

212 806 5400
Telecopiers:
212 806 6006
212 806 5919
Telex:
177693 STROOCK UT

Direct Dial:

212-806-6469

August 2, 1990

Thomas Darcy, Esq.
Decker and Darcy
20 Roberts Street
P.O. Box A
Middletown, New York 10940

Subject: Access Agreement for Well at
320 Highland Avenue
Wallkill, New York

Dear Mr. Darcy:

You have indicated that your client Dr. Fluoro Cuison has agreed to permit access to the well located on his property at 320 Highland Avenue in Wallkill, New York for the purpose of work to be carried out under the Consent Decree in U.S. v. General Switch Corporation, 87 Civ. 8789 (RJW).

The initial phase of this work will consist of reconditioning the well and conducting a pump test. Reconditioning the well will involve opening the well and fitting it with a submersible pump and piping. The pump test to determine whether the well is suitable for extracting contaminated water from the well field will last a minimum of 72 hours and a maximum of 96 hours. (If the pump test confirms that the well is suitable for intercepting the contaminated groundwater, pumping from the well will continue, but that pumping will require only infrequent visits to the site for routine maintenance of the pump.) The parties requiring access to the well will be Laurwal Holding Corporation (f/k/a General Switch Corporation) and its authorized representatives and the U.S. Environmental Protection Agency and its representatives, including contractors. We have previously provided evidence of insurance for the work to be performed at the 320 Highland Avenue site.

Should you or Dr. Cuison at any time have any questions about the nature of the work, please do not hesitate to contact John Bee of

Washington D.C. 20036-4652
1150 Seventeenth Street, N.W.
202 452 9250

Los Angeles, CA 90067-3086
2029 Century Park East
213 556 5800

Miami, FL 33131-2385
200 S. Biscayne Boulevard
305 358 9900

General Switch will then submit to the USEPA a Remedial Design Plan following the initial pump test program. The Remedial Design Plan will consist of the design and specifications of the air stripper and we will ask the USEPA to inspect and approve the air stripper as built. Following startup, and approval of the Remedial Design Plan, general switch will submit an Initial Testing Program. The results of this program will be submitted to the USEPA in an Initial Testing Program Report. The Initial Testing Program Report will detail the demonstrated efficiency of the proposed remedial soil and groundwater treatment systems and the plans for any proposed alternative water supply connections along with the appropriate schedules.

General Switch and its contractor will then be available for a Final Inspection in conjunction with EPA and/or its designated representatives and contractors. The Final Inspection will include a walk-through of the entire project to determine project consistency with the RD Report and EPA-approved O&M Plan prior to start up of the cleanup.

Sincerely,

John Bee

John Bee
President, Shakti Consultants, Inc.
Certified Professional Geologist # 6173
American Institute of Professional Geologists

SHAKTI CONSULTANTS INC.

185, Gatzmer Avenue
Jamesburg, NJ 08831
(201) 521-2322

January 10, 1990

Mr Walter Stern
General Switch Co.
Middletown, New York 10940

Martin Baker, Esq. and Gregory Belcamino
Stroock, Stroock and Lavan
Seven Hanover Square
New York, New York 10004

RE: United States v General Switch Corporation
S.D.N.Y. (87 Civ. 8789)

Dear Mr. Martin Baker and Gregory Belcamino,

According to the requirements of the Consent Order, we present the Sampling, Analysis and Monitoring Plan and the required attachments: the Quality Assurance/Quality Control Plan, Health and Safety, and Combined Overall Site Management and Operations & Maintenance Plans for General Switch Corporation. We have prepared the various protocols in detail for your review and EPA's acceptance so that they may be appended to the consent decree. We believe that the requirements for various plans prior to site work have been met. The connection to wells plan is incorporated into the Work Plan. The Initial Testing Program is detailed in the Sampling Plan and Pump Test Plan.

Initial Testing Program

Following fabrication of the air stripper, the pump test and sampling of neighborhood wells will be conducted along with a demonstration of the feasibility of the soil treatment. General Switch will submit the information from the pump test in a Pump Test Report.

Shakti Consultants, Laurwal Holding Corporation's Project Manager. Mr. Bee's telephone number is 201-521-2322.

Since the work is dependent upon the season, I appreciate your continuing attention to this matter. Please request Dr. Cuison to indicate that he agrees to allow access to his property for the purposes of this work by signing and returning to me the attached copy of this letter.

Thank you for your assistance in obtaining Dr. Cuison's consent to this Access Agreement. If you require any additional information, please do not hesitate to contact me.

Sincerely,

Gregory R. Belcamino
GRB:mfm

cc: John Bee

ACCUTEST
2235 Route 130, Dayton, NJ 08810 201-329-0200

CHAIN OF CUSTODY

JOB NO.:	
PROJECT NO.:	
FACILITY NAME:	

SEND RESULTS TO

CLIENT SHAKTI CONSULTANTS

ADDRESS 185 GATZMER AVE

CITY JAMESBURG STATE / ZIP NJ 08831

ATTENTION JOHN BEE TELEPHONE (201) 521 2322

BILL TO: GENERAL SWITCH
2 INDUSTRIAL PLACE
MIDDLETOWN NY

REQUESTED TURN AROUND:
☐ 1 WEEK ☐ 2 WEEKS ☐ 3 WEEKS ☒ NORMAL

APPROVED:

☐ OTHER:

ACCUTEST ID	DATE SAMPLED	TIME SAMPLED	SMPL BY	MAT RIX	NO CONT	PRES	pH	FIELD ID / POINT OF COLLECTION	ANALYSES REQUESTED
	8/4/89	2:15PM	JMB	H2O.	3 VOA	ICED		ERNEST, 353 HIGHLAND	624 + 15.
	"	2:10PM	JMB	"	"	"		SEELEY, 321 HIGHLAND	624 + 15
	8/4/89	2:00PM	JMB	"	"	"		GILBERT, 323 HIGHLAND	624 + 15
	"	11:45PM	JMB	"	"	"		STOUT, 316 HIGHLAND	624 + 15
	"	11:30PM	JMB	"	"	"		WOOD, 319 HIGHLAND	624 + 15.
	"	2:35PM	JMB	"	"	"		GUILD MOLDERS, INDUSTRIAL PL.	624 + 15.

1. RELINQUISHED BY: J Bee	DATE/TIME: 8/4/89 6:40 PM	1. RECEIVED BY:	3. RELINQUISHED BY:	DATE/TIME:	3. RECEIVED BY:	SAMPLE LOCATION:
2. RELINQUISHED BY:	DATE/TIME: 08/04/89 18 40	2. RECEIVED BY:	4. RELINQUISHED BY:	DATE/TIME:	4. RECEIVED BY:	

DELIVERABLE PACKAGE (check one)
☐ ECRA TIER II ☐ NJPDES ☐ TIER I ☐ NORMAL QC ☒ OTHER Results.

COMMENTS: