

Site Investigation Report

**New Cassel Industrial Area
89 Frost Street
101 Frost Street
770 Main Street
North Hempstead, New York**

**LFR Project No. EM7-2074
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Prepared for

McDermott, Will & Emery
50 Rockefeller Plaza
New York, NY 10020

 **Levine·Fricke·Recon**
ENGINEERS, HYDROGEOLOGISTS & APPLIED SCIENTISTS

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EXECUTIVE SUMMARY

Several properties within the New Cassel Industrial Area in North Hempstead, New York are listed on the New York State Department of Environmental Conservation Registry of Inactive Hazardous Waste Disposal Sites. Site investigations have been performed throughout the area to attempt to determine the source and nature and extent of impact. Levine·Fricke·Recon Inc. (LFR; formerly Levine·Fricke and Recon Environmental) was retained to evaluate the properties located at 89 Frost Street, 101 Frost Street, and 770 Main Street in order to determine the rationale for the listing of these properties.

LFR evaluated existing data reported by others, installed three new monitoring wells and one Geoprobe, collected new soil and groundwater samples, performed aquifer analysis, fate and transport calculations, and developed a stratigraphic model for the area.

Our findings demonstrate that based on the chemical, stratigraphic and analytical data, there is no proof that the source of impacted groundwater originated onsite. The migration of chlorinated volatile organic compounds is primarily controlled by the noncontinuous clay stratigraphy which underlies the area. The onsite stratigraphic data indicates that the clay is shallow at the western portion of 89 and 101 Frost Street. The clay dips down to the north and pinches out laterally to the east and south, where the highest concentrations of compounds are detected. This suggests that an offsite source of chlorinated compounds located west of monitoring well LFR-2, could migrate downdip along the clay until the clay pinches out. The clay appears to pinch out in the western portion of 89 and 101 Frost Street, and the center of 770 Main Street. Therefore the source of impacted groundwater may be offsite to the west of 89 and 101 Frost Street.

Small concentrations of various chlorinated compounds detected in onsite soils are below cleanup criteria. Based on analysis of groundwater/soil vapor data, it can be shown that these small concentrations detected in onsite soils may be due to volatilization from the impacted groundwater.

1.0 INTRODUCTION

Approximately 200 industrial and commercial businesses occupy the 170 acre New Cassel Industrial Area (NCIA) in North Hempstead, Nassau County, New York. In 1985, the Nassau County Department of Health (NCDH) identified impacted groundwater at the NCIA, and in response, the New York Department of Environmental Conservation (NYDEC) classified the entire site as a Class 2 Inactive Hazardous Waste Disposal Site in 1988.

This report addresses the 3 properties located at 89 Frost Street, 101 Frost Street, and 770 Main Street within Block 328 of the NCIA. These 3 sites were delisted in 1992, and subsequently relisted in 1996. In July 1996, delisting petitions for all three sites were submitted to NYDEC and denied.

LFR has performed additional evaluation of the 3 subject properties. The objective of this evaluation is to understand the effects of local stratigraphy on groundwater flow in the vicinity of the subject properties and to assess the hydrogeologic assumptions on which DEC has based its listing of the subject properties on the registry of Inactive Hazardous Waste Disposal Sites. LFR's evaluation included:

- installation of 3 monitoring wells and 1 Geoprobe;
- sampling and analyses of soil and groundwater;
- correlation of stratigraphic information;
- aquifer analyses (slug tests); and
- fate and transport calculations and modeling.

This report documents our findings and is submitted to support the new delisting petitions which are dated February 27, 1997.

2.0 PREVIOUS INVESTIGATIONS

Several previous investigations performed within the NCIA are listed in section 7.0 of this report. The subject sites were relisted on the hazardous site registry in 1996 based on the findings of the Multisite PSA Report (LMS, 1996), which was designed and implemented to further delineate the plumes, locate the sources, and assess the potential threats of impact in the NCIA. Data collected and evaluated for that study included site inspections, research of historic operations, analyses of soil and groundwater samples collected with Geoprobe, and ground penetrating radar. Isopleth maps were created based on groupings of PCE-related compounds, TCA-related compounds, and BTEX compounds.

The results of LFR's current investigation reveal additional information and data which challenge some of the conclusions in the Multisite PSA Report.

3.0 FIELD INVESTIGATION

On February 12 and 13, 1997, LFR personnel supervised the installation of three monitoring wells and one Geoprobe, collected soil and groundwater samples and performed slug tests.

3.1 Monitoring Well Installation and Development

Miller Environmental Group installed three monitoring wells (LFR-1, LFR-2, and LFR-3) to an average depth of 65 feet under the supervision of LFR geologists. Well locations are shown on Figure 2. A summary of monitoring well data is included in Table 1. Well construction lithologic logs are included in Appendix 1. All wells were drilled using 8" hollow stem augers. Split spoon samples were collected every five feet from 20 to 45 feet, then continuously until the water table was reached. The wells were then advanced by drilling ten feet past the water table. Cuttings and split spoon samples were logged and field screened using a photoionization detector.

The wells were constructed of 4" Schedule 40 PVC pipe. The lower 20 feet were screened with .010" screen. The riser on each well extended to approximately 0.3 feet below grade. The #0 sand pack was emplaced from the base of the well to 40 feet below grade. This was then sealed with two feet of bentonite, then backfilled with cuttings to 1 foot below grade. The upper foot was sealed with neat cement. Each well was provided with a locking cap and flush mount 6" manhole.

Well development was carried out immediately after construction of each well by geologists from Anson Environmental Ltd. Each well was developed using a submersible pump until sediment-free. Approximately 8 volumes of water were removed from each well.

In addition, a Geoprobe boring (LFR-4) was advanced by Miller Environmental inside the building at 770 Main Street as shown on Figure 2.

A licensed surveyor determined elevations of the three monitoring wells so that these new wells could be tied into the existing monitoring well network.

3.2 Soil and Groundwater Sampling

During drilling, sediment samples were obtained from each lithology from each well and sampled for soil moisture, porosity, bulk density and total organic carbon (TOC). The sediment interval which exhibited the highest photoionization device (PID) reading

was collected for halogenated volatile organic compounds (VOC) analysis via USEPA Method 8010.

After purging the wells and allowing the aquifer to equilibrate, field measurements were taken for temperature, Eh, pH, conductivity and dissolved oxygen. Groundwater samples were then collected from each well and the Geoprobe boring using laboratory decontaminated disposable bailers. Groundwater samples were analyzed for halogenated volatile organic carbons via USEPA Method 601. One field blank was collected on each sampling event day for QA/QC purposes. VOC samples were placed in coolers at 3°C under chain of custody and delivered to a New York certified laboratory.

3.3 Slug Testing

LFR personnel performed slug tests on LFR-1, LFR-2, and LFR-3. A pressure transducer was set into the well connected via cable to a data logger, which was programmed to record water levels every second for five minutes. Next, a solid cylindrical slug, 5 feet long and .25 ft in diameter, was lowered below the water level. The data logger automatically recorded the water level response to the slug injection test. After the water level had completely recovered, the data logger was reset to record every second for five minutes. The slug was quickly pulled from the well, while the water levels were automatically recorded to obtain the slug withdrawal response. In the office, the data were downloaded to a computer. LFR used the program AQTESOLV to plot the slug withdrawal data and calculate hydraulic conductivity using the Bouwer and Rice method.

4.0 RESULTS

4.1 Groundwater Analytical Results

Groundwater field measurements for temperature, Eh, pH, conductivity and dissolved oxygen are included in Table 2. Halogenated compounds were detected in all four groundwater samples. Analytical results are included in Table 3. Tetrachloroethene was the compound detected at highest concentrations in all wells ranging from 244 ug/L in LFR-1 to 51,780 ug/L in LFR-3.

4.2 Soil Analytical Results

Laboratory analyses of the soils exhibiting the highest PID field screening results indicated that only chloromethane and tetrachloroethylene were detected in soils. VOC analytical results are included in Table 4. Chloromethane was detected in all three borings at concentrations ranging from 310 - 598 ug/kg. Tetrachloroethene was detected only in LFR-1 at concentration of 300 ug/kg.

Tables 5 and 6 contain analytical results of soil samples from each lithology that were analyzed for bulk density, soil moisture, porosity, and total organic carbon.

4.3 Slug Test Results

Onsite hydraulic conductivity(k) data determined from slug tests are presented in Table 7. Hydraulic conductivity onsite was determined to range from 8×10^{-3} ft/min in LFR-1 to 1.7×10^{-2} ft/min in LFR-3.

5.0 DISCUSSION

The following discussion demonstrates how the areal extent of impacted groundwater is controlled by fate and transport mechanisms as well as localized stratigraphy.

5.1 Fate and Transport

The compounds detected in the groundwater under the subject sites are chlorinated volatile organic compounds. Chlorinated hydrocarbons such as tetrachloroethene degrade in the environment through dechloro-hydrogenation. Through this process chlorine atoms are removed and replaced by hydrogen. Tetrachloroethene can degrade to trichloroethene; trichloroethene and 1,1,1 trichloroethene can degrade to form various dichloroethene isomers; and so on. This can be the result of hydrolysis or biological degradation. The process is controlled by the quantity and type of bacteria present and whether the aquifer is aerobic or anaerobic. The rate of degradation is greater for anaerobic bacteria. Several forces control the transport of these compounds in the subsurface. In general, the following three conditions must be evaluated to understand the transport of the compounds of concern: movement of the compounds in the aqueous phase in the unsaturated soil; transport in the groundwater below the water table; and volatilization of the compounds from the groundwater and migration of the vapors through the soil.

Movement of solubilized compounds through the soil is controlled by local saturation. As a pore becomes saturated the fluid moves down to the next pore. When the grain size is constant the movement of the fluid is nearly vertical; however, when the grain size changes the fluids will move laterally along the boundary of the change in grain size. This phenomenon does not only occur at clay - sand interfaces but will occur along bedding plans and microfacies (Figure 3). This lateral dispersion can result in lateral migration of tens of feet in soils like those found at the site.

The lateral movement of compounds of concern can result in the translation of an apparent source area. Compounds released at the surface can move laterally across artificial property boundaries. The result can be that groundwater plumes appear to be emanating from a site where no release has occurred.

Once the compounds of concern have reached the water their movement is governed by advection (the movement of the groundwater), dispersion, density gradients, and molecular diffusion. Advection will cause the plume to move down hydraulic gradient. Dispersion will cause the plume to expand laterally and cause the concentration gradient to decrease. Density gradients will cause the denser contaminants within the water to sink as they move down gradient. Molecular diffusion will decrease the concentration gradient.

Once the compounds of concern reach the water table the forces acting on them will cause them to move down gradient and cause the concentration of the compounds to decrease. These factors tend to merge compounds from several sources and make source identification of old plumes difficult.

Finally, the volatile compounds found in the groundwater will partition into the vapor phase above the water table. The volatilized compounds will migrate through the soil and can result in low concentration of compounds of concern being detected in soil samples above the groundwater. Elevated concentrations of these compounds may be detected in areas where the soil moisture is higher than average for the soil.

LFR performed a groundwater/soil vapor model to evaluate possible soil concentrations that could result from volatilization of compounds in groundwater. Table 8 presents the possible concentration of tetrachloroethene in soil at equilibrium calculated from onsite soil total organic carbon and soil moisture data, and onsite volatile concentrations in groundwater.

As an example, the model indicates that at equilibrium, if the soil has a soil moisture content of 10%, a total organic carbon content of 0.002% and a tetrachloroethene concentration of 20,000 ug/l in the groundwater, the concentration of tetrachloroethene in a soil sample would be approximately 6.56 ug/l. Based on site data, it is possible that soil concentrations up to 1,150 ug/kg could result from volatilization of compounds from groundwater.

The results of the model suggest that under the range of soil moisture content and total organic carbon found at the site, the concentrations of volatile organic compounds found in soil samples could be the result of volatilization of the compounds of concern from the groundwater. This suggests that even though soils at the site contain low levels of the compounds of concern, they may not be the source of the groundwater contamination. In fact, the reverse may be true. The compounds found in the groundwater may be impacting the soil.

5.2 Groundwater Flow

On February 13, 1997, LFR collected synoptic groundwater levels from monitoring wells LFR-1, LFR-2, LFR-3, Anson MW-5, Anson MW-6, Anson MW-10, and the

alley well. These water levels were used to create a water table map (Figure 2) which shows groundwater flow toward the southwest in the shallow aquifer.

5.3 Stratigraphy

Stratigraphic controls are an important factor governing groundwater flow and the migration of various compounds. The near surface sediments in the NCIA consist of glacial outwash deposits of porous sands and gravel, interspersed with silt and clay deposits which act as barriers to groundwater flow.

In order to evaluate stratigraphic controls within the study area, LFR created a fence diagram or three-dimensional cross-section (Figure 3) based on the lithographic logs from monitoring wells LFR-1, LFR-2, LFR-3, Anson MW-5, Anson MW-6, Anson MW-7, and Anson MW-10. Similar lithologies were correlated between the wells showing the aerial distribution of coarse and medium to fine gravel and sand aquifers and low permeability silty clays.

The fence diagram shows that the clay horizon is not continuous and has its shallowest expression at 50' below grade in LFR-2. The clay dips down to the north where it is seen at 65' below grade in LFR-1. The clay dies out to the east and is not observed in Anson MW-6. Similarly, the clay dies out to the south, as it is not observed in LFR-3.

In the model, a source of chlorinated compounds released west of LFR-2 would migrate down through the aquifer and would then follow the stratigraphic dip of the clay. Once the clay unit dies out to the east and south, the solubilized compounds essentially fall off the edge and impact the deeper and surrounding aquifer.

5.4 Groundwater Isopleths

Previous reports by LMS included isopleth maps for PCE-related compounds and TCA-related compounds. PCE-related compounds were defined to include the sum of the individual measured concentrations of PCE, TCE, cis-1,2 DCE, trans 1,2-DCE, 1,1-DCE and vinyl chloride.

TCA-related compounds were defined to include the sum of the individual measured concentrations of 1,1,1 TCA, 1,1 DCA, and 1,2-DCA.

Utilizing the new groundwater data from LFR-1, LFR-2, LFR-3, and LFR-4 and the most recent groundwater data from the LMS report, LFR created compound-specific isopleth maps for tetrachloroethelene, trichloroethene, cis 1,2-dichloroethene, and 1-1,1 trichloroethane, the four compounds detected at highest concentrations. Specific individual compounds were evaluated to see if there were separate sources and separate individual plumes. An isopleth map for each compound was created for three groundwater intervals as in the LMS report: water table - 65'; 65' - 85'; and below 85'. Figures 4 through 15 contain the respective groundwater isopleth maps. Figures 16, 17,

and 18 show soil isopleth maps for tetrachloroethene at less than 30', trichloroethene at less than 30' and tetrachloroethene at greater than 40' below grade.

The tetrachloroethene isopleths (Figures 4, 5, 6) show concentrations above 10,000 ug/l in all three horizons with the north-south axis plunging to the west with depth. The upgradient axis appears to the western boundary of 89 and 101 Frost Streets.

The trichloroethene isopleths (Figures 7, 8, 9) appear as two or more distinct plumes, with one located at the western boundary of 101 Frost and the other located along the northeastern area of 770 Main. The southern plume shows its highest concentration on 1121 Old Country Road at the current Toyota dealership.

The 1,1,1-trichloroethane isopleths (Figures 10, 11, 12) show an irregularly shaped plume to the west of 101 Frost Street over several properties to the west of the subject properties.

The cis 1,2-dichloroethene isopleths (Figures 13, 14, 15) show a plume reaching east of 770 Main Street toward 1121 Old Country Road. At the deepest interval the highest concentration is located at 1121 Old Country Road.

The soil isopleth maps for tetrachloroethene (Figure 16) and trichloroethene (Figure 17) at 30' and tetrachloroethene > 40' (Figure 18) show small restricted plumes at concentrations below their respective cleanup criteria.

6.0 CONCLUSIONS

Based on the chemical, analytical, and geologic data collected during this and previous investigations, there is no proof that the source of the impacted groundwater originated on the subject sites. By comparing the chemical and lithologic information from the three newly installed monitoring wells and Geoprobe with existing soil and groundwater data, LFR correlated subsurface stratigraphy to understand and demonstrate the factors controlling plume migration. The migration of chlorinated hydrocarbons dissolved in water onsite is primarily controlled by noncontinuous silty clays which when present, act to divert the flow of the water. The contaminants of concern will flow along the clay lenses before impacting the bulk of the groundwater. Thus, the water containing compounds of concern could migrate from an offsite source before impacting the water table below the subject sites.

Our stratigraphic data show that the clay at the far western boundary of 89 and 101 Frost Street in LFR-2 is relatively shallow at 50 feet below grade (Figure 3). It dips down to the north and is observed 15' deeper across the east west axis of 101 Frost Street as demonstrated in monitoring wells LFR-1, Anson-5, and Anson-7. From LFR-2, the clay pinches out laterally to the east as it is not observed in Anson-6. To the south of LFR-2, the clay pinches out laterally as it is not observed in LFR-3. Additional

proof of lateral discontinuity is shown by the presence of clay further south in Anson-10.

The stratigraphy suggests that a solvent release west of the subject properties and west of LFR-2 would migrate down through the sediment until encountering the clay, and then follow the clay downdip. Upon reaching the lateral terminus of the clay, the compounds of concern would spill over, impacting the surrounding area. To the east of LFR-2, the terminus of the clay is in the rear of 89 Frost Street. To the south, the terminus of the clay is located within 770 Main Street. Indeed, these two areas exhibit the highest concentrations of compounds detected onsite as demonstrated in the groundwater isopleth maps (Figures 4-15).

Concentrations of compounds detected in the onsite soils are not excessive and are in fact below NYDEC criteria. Based on our groundwater/soil vapor model, the small concentrations observed in the soils could be attributable to volatilization of compounds from the groundwater into the soils.

In summary, it has been demonstrated that onsite impacted groundwater could result from an offsite source west of LFR-2, which has migrated along the clay to the subject properties. Furthermore, the small observed concentrations in the onsite soils could result from volatilization of the compounds from the groundwater into the soils.

7.0 REFERENCES

Lawler, Matuskey & Skelly Engineers, February 1995, Site Investigation Report, New Cassel Industrial Area Site.

Lawler, Matuskey & Skelly Engineers, March, 1996, Multisite PSA Report, New Cassel Industrial Area Site.

Anson Environmental Ltd, May 1992, Phase II Investigation Report for Nassau County Section II Block 328.

Anson Environmental Ltd, April 1996, Environmental Investigation, 101 Frost Street, Westbury, NY

Anson Environmental Ltd, April 1996, Environmental Investigation, 89 Frost Street, Westbury, NY

Anson Environmental Ltd, April 1996, Environmental Investigation, 770 Main Street and 1111 Old Country Road, Westbury, NY

TABLES

TABLE 1

Monitoring Well Data

Well ID	Elevation Top of PVC *	Total Depth of Well	Screened Interval
LFR-1	126.91	65' bg	45-65' bg
LFR-2	126.01	65' bg	45-65' bg
LFR-3	122.37	65' bg	45-65' bg

Water Level Measurements from February 13, 1997.

* elevation relative to mean sea level

bg = below grade

TABLE 2

Groundwater Field Measurements

Well ID	T°	Eh	pH	Conductivity	Dissolved Oxygen
units	C	millivolts	s.u.	umhos	mg/l
LFR-1	9.2	1300	6.3	196	8.93
LFR-2	11.5	280	6.5	154	7.42
LFR-3	12.5	580	6.0	191	7.82

TABLE 3

Detected Halogenated Compounds in Groundwater (ug/L)

Sample ID Sample Date	LFR-1 2/12/97	LFR-2 2/12/97	LFR-3 2/13/97	LFR-4 2/13/97	Field Blank 2/12/97	Field Blank 2/13/97	NYDEC Standard
1,1-Dichlorethene	6.7	ND	ND	ND	ND	ND	5
1,1-Dichlorethane	7.3	ND	ND	ND	ND	ND	5
Trans-1,2-Dichlorethene	ND	ND	ND	2.5	ND	ND	5
Chloroform	ND	ND	1.3	ND	ND	ND	5
cis-1,2-Dichloroethene	ND	ND	54	351	ND	ND	5
1,1,1-Trichlorethane	134	6.6	3.4	3.1	ND	ND	5
Trichlorethene	123	44	166	563	ND	ND	5
Tetrachloroethane	244	9720	51780	6010	ND	ND	5
1,2-Dichlorobenzene	ND	ND	3.3	ND	ND	ND	5

ND = Not Detected above the minimum detection limit
ug/L = micrograms per liter

TABLE 4

Detected Halogenated Compounds in Soil (ug/kg)

Sample ID	LFR-1	LFR-2	LFR-3	
Sample Date	2/12/97	2/12/97	2/13/97	
Sample Depth	40-42 feet	54-56 feet	20-22 feet	NYDEC Standard
Chloromethane	598	580	310	5,400,000
Tetrachloroethene	300	ND	ND	1,400

ND = Not Detected above the minimum detection limit

ug/kg = micrograms per kilogram

TABLE 5**Soil Analytical Results**

Sample	Depth	Lithology	Bulk Density	Soil Moisture (%)	Porosity (%)
LFR 1	30 - 32	coarse sand	1.57 g/cm ³	3.28	36
LFR 1	51 - 53	fine to medium sand	1.28 g/cm ³	6.00	35
LFR 2	29 - 31	coarse sand	1.56 g/cm ³	2.94	37
LFR 2	48 - 49.5	clayey silt	1.91 g/cm ³	20.63	40
LFR 2	52 - 54	fine to medium sand	1.73 g/cm ³	10.9	33
LFR 3	36 - 38	coarse sand	1.47 g/cm ³	2.72	36
LFR 3	49 - 51	fine to medium sand	1.53 g/cm ³	3.60	38

TABLE 6

Soil Analytical Results

Sample	Depth	Lithology	Total Organic Carbon mg/l
LFR 1	35 - 37	coarse sand	1,540
LFR 1	49 - 51	fine to medium sand	1,740
LFR 2	29 - 31	coarse sand	386
LFR 2	48 - 49.5	clayey silt	579
LFR 3	30 - 32	coarse sand	18,200
LFR 3	47 - 49	fine to medium sand	1,530

TABLE 7

Hydraulic Conductivity Results from Slug Test

Well	K (ft/min)	K (cm/sec)
LFR-1	8×10^{-3}	4×10^{-3}
LFR-2	5.7×10^{-3}	2.9×10^{-3}
LFR-3	1.7×10^{-2}	8.6×10^{-3}

1 cm/sec = 1.97 ft/min

Freeze & Cherry: clean sand K-range = 5×10^{-4} to 1
 silty sand K-range = 10^{-5} to 10^{-1}

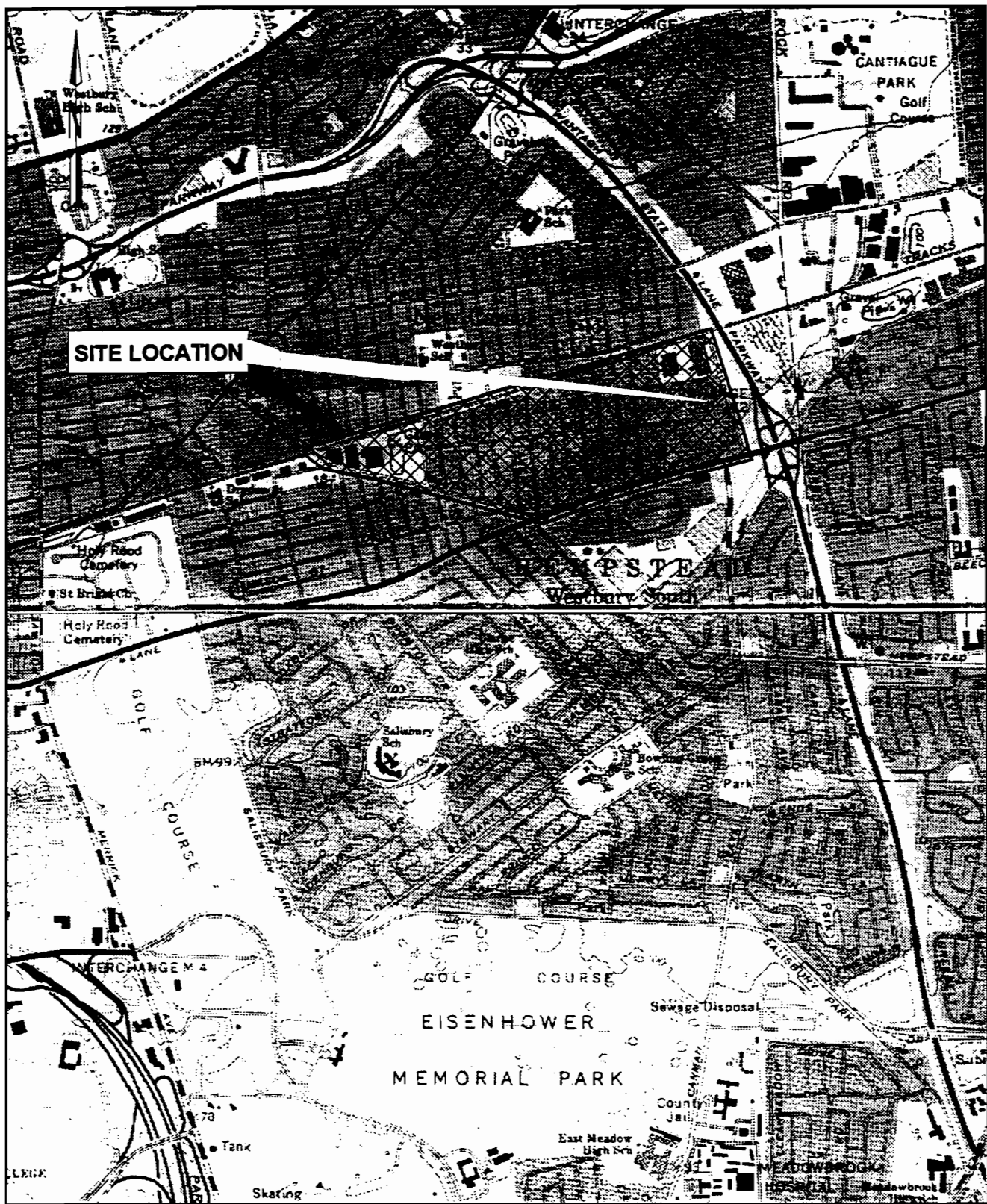
TABLE 8

Concentration of Tetrachloroethene
in Soil at Equilibrium (ug/kg)

Percent Soil Moisture and 0.002% TOC*							
Concentration in Groundwater (ug/l)	1%	2%	3%	4%	5%	10%	20%
5	0.00119	0.00124	0.00129	0.00134	0.00139	0.00164	0.00214
100	0.0238	0.0248	0.0258	0.0268	0.0278	0.0328	0.0428
1000	0.238	0.248	0.258	0.268	0.278	0.328	0.428
10000	2.38	2.48	2.58	2.68	2.78	3.28	4.28
20000	4.76	4.96	5.16	5.36	5.56	6.56	8.56
50000	11.9	12.4	12.9	13.4	13.9	16.4	21.4
Percent Soil Moisture and 2% TOC*							
Concentration in Groundwater (ug/l)	1%	2%	3%	4%	5%	10%	20%
5	0.11405	0.1141	0.11415	0.1142	0.11425	0.1145	0.115
100	2.281	2.282	2.283	2.284	2.285	2.29	2.3
1000	22.81	22.82	22.83	22.84	22.85	22.9	23
10000	228.1	228.2	228.3	228.4	228.5	229	230
20000	456.2	456.4	456.5	456.8	457	458	460
50000	1140.5	1141	1141.5	1142	1142.5	1145	1150

* Range of TOC and soil moisture observed onsite.

FIGURES



0 2000 ft

SCALE
1 in. = 2000 ft

Map source:

USGS 7.5-minute quadrangle series,
Freeport, NY, 1969, photorevised 1979,
Hicksville, NY, 1967, photorevised 1979.



Figure 1

Site Location

NEW CASSEL INDUSTRIAL AREA
Levine Fricke Recon

from

LAWLER, MATUSKY & SKELLY ENGINEERS LLP
Pearl River, New York