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REMEDIAL INVESTIGATION REPORT
MOBIL OIL CORPORATION
FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NEW YORK

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REMEDIAL INVESTIGATION REPORT
MOBIL OIL CORPORATION
FORMER TAPPAN TERMINAL
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INTRODUCTION

Mobil Oil Corporation (Mobil) retained Leggette, Brashears & Graham, Inc. (LBG) to conduct a Remedial Investigation (RI) at their former Tappan Terminal (the site) located in Hastings-on-Hudson, New York. The field activities were conducted in accordance with the Focused Remedial Investigation/Feasibility Study Work Plan (The Work Plan) prepared for Mobil in November 1995. The Work Plan was approved by the New York State Department of Environmental Conservation (NYSDEC) in September 1996, and included soil and ground-water sampling for the purpose of supplementing data obtained during previous investigations, and preparation of a Citizen Participation Plan. Results of the previous investigations and the rational for the RI sampling activities, are fully described in The Work Plan which is attached, without Appendices, as Appendix I.

The RI was conducted between September 20 and 27, 1996. The sampling activities and investigation results are discussed in the following sections. The Citizen Participation Plan is attached as Appendix II.

SOIL INVESTIGATION

The purpose of the additional soil sampling was to further delineate the extent of soil impact and provide additional data needed for The Feasibility Study and Risk Assessment. The soils investigation included the collection of 22 shallow soil samples at 18 pre-determined locations across the Mobil property. The samples were analyzed for asbestos, polychlorinated biphenyls (PCBs), metals, petroleum hydrocarbons and organic carbon: a sampling inventory is presented on Table 1. Soil samples analyzed for asbestos were collected from 0-2 inches bg (below grade) while samples from the same location for PCB and metals analysis, and all other samples, were collected from between 0 and 1 foot bg. The sampling locations, which are presented on Figure 1, and sampling parameters were based on the results of previous investigations and the site history as described in The Work Plan (Appendix I).

Asbestos

Four soil samples, SS-1 through SS-4, were collected and analyzed for asbestos along the sites northern boundary (Figure 1). The Anaconda wire property, which is an adjacent property to the north, is considered a potential source of asbestos due to former wire milling activities which took place on that site. Asbestos analysis has not been included in previous investigations and no potential sources of asbestos are known to have existed on the site.

The soil samples for asbestos were collected between 0 and 2 inches bg using a clean, stainless steel spoon. Each sample was homogenized in a clean stainless steel bowl and transferred to a laboratory supplied plastic bag. The bags were placed in a cooler and shipped by overnight delivery to Environmental Services Laboratory in Princeton, New Jersey (ESL) for analysis using the polarized light microscopy (PLM) method. All sampling equipment was decontaminated between sampling locations using an Alconox/water mixture. The equipment was then rinsed with deionized water and wrapped with aluminum foil for reuse.

Polychlorinated Biphenyls (PCBs)

Ten soil samples, SS-2, SS-4 and SS-8 through SS-15, were analyzed for PCBs (Table 1). As described in Appendix I, PCBs were detected onsite during previous investigations and a pad mounted electrical transformer was formerly located on the site. It is not known if the transformer contained PCB oil.

The PCB soil samples were collected between 0 and 1 foot bg using a clean, stainless steel hand auger. Two soil samples, SS-2 and SS-4, were collected from the northern property boundary; two samples, SS-12 and SS-13, were collected from the area between where former Tank Nos. 5 and 6 were located; four samples, SS-8 through SS-10, were collected from the former transformer area in the southern portion of the site; and two samples, SS-14 and SS-15 were collected from the drainage paths leading from the adjacent Uhlich Property (Figure 1). The soil samples were homogenized in clean, stainless steel bowls and transferred to laboratory supplied glass containers. The samples were stored in a cooler and delivered overnight to ESL for analysis of PCBs using EPA Method 8080. All sampling equipment was decontaminated between sampling locations using an Alconox/ water mixture. The equipment was then rinsed with deionized water and wrapped with aluminum foil for reuse.

Metals

Five soil samples, SS-1, SS-2, and SS-5 through SS-7, were analyzed for total chromium and lead content (Table 1). Metals have been detected onsite during previous investigations and industrial operations involving metals are known to have occurred on the property prior to Mobils ownership (Appendix I). The metal samples were collected between 0 and 1 foot bg using a clean, stainless steel hand auger. Two soil samples, SS-1 and SS-2, were collected along the northern property boundary and three samples, SS-5 through SS-7, were collected at the former location of building 19 where metal extraction activities took place (Figure 1). The samples were homogenized in clean, stainless steel bowls and transferred to laboratory supplied glass containers. They were then stored in a cooler and delivered overnight to ESL for analysis. All sampling equipment was decontaminated between sampling locations using an Alconox/ water mixture. The equipment was then rinsed with deionized water and wrapped with aluminum foil for reuse.

Petroleum Hydrocarbons

Six soil samples, SS-12 and SS-14 through SS-18, (Figure 1) were analyzed for petroleum hydrocarbons. Petroleum hydrocarbons have been detected during previous site investigations and there are several potential sources including a fuel oil release on the adjacent Uhlich property, and the former onsite storage of petroleum products (Appendix I).

Each soil sample was collected from 0-1 foot bg except SS-18 which was collected from the soil/ground-water interface (approximately 2.5 feet bg). One sample, SS-12, was collected from the area between where Tank Nos. 5 and 6 were formerly located. Samples SS-14 and SS-15 were collected from the drainage path leading from the adjacent Uhlich Property. Samples SS-16 and SS-17 were collected 75 feet west of OW-19 and SS-18 was collected from the northern limit of the 1994 fuel-oil excavation. The soil samples were stored in a cooler and delivered overnight to ESL for analysis by EPA Methods 8021 and 8270. All sampling equipment was decontaminated between sampling locations using an Alconox/water mixture. The equipment was then rinsed with deionized water and wrapped with aluminum foil for reuse.

Organic Carbon

Two samples, SS-2 and SS-15, collected from between 0 and 1 foot bg, were selected for analysis of organic carbon. The results of this analysis will be used as an input parameter for fate and transport modeling which will be conducted as part of The Feasibility Study and Risk Assessment. These samples were randomly selected from two different areas of the site.

Quality Assurance Samples

In accordance with The Work Plan field blanks, trip blanks and matrix spike/matrix spike duplicate (ms/msd) samples were analyzed to verify sample integrity.

The field blank for soil sampling was prepared by pouring laboratory supplied deionized water over sampling equipment which had been decontaminated in the field. The rinse water was collected in laboratory supplied containers and submitted with the soil samples for analysis of volatile and semi-volatile organics by EPA Methods 8021 and 8270, and PCBs by EPA Method 8080. One laboratory prepared trip blank was also submitted with the soil samples and analyzed for volatile organics by EPA Method 8021.

To check for the possibility of sample matrix interference with the analytical methods, one soil sample was selected by the laboratory as an ms/msd sample. This sample is spiked with known concentrations of contaminants and then analyzed by the applicable method. The analysis results are then compared to the spiked concentrations to determine if there was any variation caused by the sample matrix.

The quality assurance samples were collected at the following rates; one field blank per day, one trip blank per cooler, and one ms/msd for every 20 samples.

Additional Drilling

In accordance with The Work Plan, additional drilling on Mobil property was to be initiated if the presence of a clay layer beneath the former Anaconda facility could not be confirmed. A review of the boring logs for the Anaconda property, obtained through the Freedom of Information Act, indicate that a significant clay layer is present beneath that property and therefore additional drilling was not necessary. Most of the borings were terminated in the clay within a few feet of the clay surface which was encountered between 11 and 32 ft bg. However, borings MW-3B and MW-1B penetrated 61.5 and 36 feet of clay respectively. The thickness of clay encountered on the Mobil site during the drilling of MW-D1 was 24 feet between approximately 20 and 44 ft bg. A summary of the depth to clay beneath Anaconda is shown on Table 2, the boring logs are attached in Appendix III.

GROUND-WATER INVESTIGATION

Ground-water samples were collected from the existing onsite monitor wells in order to assess the current ground-water quality and provide additional data for The Feasibility Study and Risk Assessment. Prior to sampling, a minimum of three standing volumes of water were removed from each well using either a clean, dedicated, disposable, polyethylene bailer or a suction pump equipped with dedicated polyethylene piping. The field parameters pH, conductivity and temperature were monitored during the evacuation process to ensure that representative samples were collected. The results of the field parameter measurements are shown on Table 3. The ground-water samples were collected using dedicated, disposable, polyethylene bailers. All samples were stored in an ice filled cooler and delivered overnight to ESL for analysis of the parameters discussed below.

Chlorobenzene and Miscellaneous VOCs

Samples from all of the monitor wells located on the site were analyzed for chlorobenzene using EPA Method 8240. The purpose was to delineate the extent and concentration of chlorobenzene across the entire site. Chlorobenzene has been detected in the ground-water during previous investigations and was reportedly used and stored onsite by a prior owner (Appendix I). The laboratory analysis also included other volatile organic compounds previously detected in the ground-water beneath the property including benzene, toluene, ethylbenzenes, xylenes, carbon disulfide, trichloroethylene and dichlorobenzene.

Ethyl Ether

Samples from selected wells were analyzed for ethyl ether by EPA Method 8240. The wells were selected based on the results of previous investigations as discussed in The Work Plan (Appendix I). Ethyl Ether was also reportedly used and stored onsite by a previous owner.

Quality Assurance Samples

Field blank, trip blank and ms/msd samples were analyzed as part of the ground-water program to verify sample integrity. The rates and sampling methods for the ground-water quality assurance samples were the same as those for the soil samples (page 3).

In addition to the above samples, a blind duplicate sample was submitted for analysis as a check on laboratory accuracy. The duplicate sample was collected from OW-12 and labeled MW-28. All of the ground-water quality assurance samples were analyzed for volatile organics and ethyl ether by EPA Method 8240.

Fluid-Level Measurements

On September 20, 1996 the depth to water was measured in each monitor well at the site using an oil/water interface probe. A ground-water elevation contour map was constructed using these measurements and is shown on Figure 2. Free phase hydrocarbons were not detected in any of the wells.

INVESTIGATION RESULTS

SOIL QUALITY

Asbestos

Asbestos fibers were identified in three of the four soil samples collected from the northern property boundary including, SS-1, SS-2 and SS-3. However, the concentrations were all less than 1-percent asbestos by weight per sample. In accordance with New York State Regulations, an asbestos containing material is one which contains greater than 1 percent asbestos by weight. Copies of the original laboratory results and the chain of custody form are included in Appendix IV.

yeah but Note its available

Polychlorinated Biphenyls (PCBs)

Eight soil samples, SS-2, SS-4, SS-8 and SS-11 through SS-15 contained concentrations of PCBs (Arochlor 1254 or Arochlor 1260) above the laboratory detection limit. Arochlor 1254 was only detected in Soil Sample SS-11 at a concentration of 400 ug/kg (micrograms per kilogram). Arochlor 1260 was detected in eight of the soil samples at concentrations ranging from 130 ug/kg (SS-8) to 3,800 ug/kg (SS-12). The results of laboratory analysis are shown on Table 4. Copies of the original laboratory results and the chain-of-custody form are included in Appendix IV.

3.8 ppm

Metals

Chromium and lead were detected in each of the five soil samples that were analyzed for these parameters (Table 1). The concentrations of chromium ranged from 11 mg/kg (milligrams per kilogram) in SS-2 to 75 mg/kg in SS-7. The concentrations of lead ranged from 180 mg/kg in SS-2 to 940 mg/kg in SS-6. The results of laboratory analysis are shown on Table 4. A copy of the original laboratory results and the chain-of-custody form are included in Appendix IV.

Petroleum Hydrocarbons

Petroleum hydrocarbon compounds were detected in all of the soil samples analyzed for those parameters including SS-12, and SS-14 through SS-18 (Figure 1).

These samples were analyzed by EPA Methods 8021 and 8270 and the results are summarized on Tables 5 and 6. As shown on the Tables, the highest concentrations detected were of semi-volatile compounds in SS-18 which ranged from 5,950 ug/kg for benzo (g,h,i) perylene to 17,700 ug/kg for pyrene. This sample was collected in the vicinity of the 1994 fuel oil excavation. Copies of the original laboratory results and chain-of-custody form are included in Appendix IV.

GROUND WATER QUALITY

Chlorobenzene, Ethyl Ether and Miscellaneous VOCs

Chlorobenzene was detected in 15 of the 26 ground-water samples collected during the investigation. The concentrations of chlorobenzene ranged from 5.2 ug/l (micrograms per liter) in MW-16 to 19,700 ug/l in MW-12. Ethyl Ether was detected in 11 of the 21 samples for which it was analyzed. The concentrations ranged from 10 ug/l in OW-9A to 28,000 ug/l in MW-13. Benzene was detected in 3 of 26 ground-water samples and was the only other VOC detected. The concentrations were 7.6 ug/l in OW-12, 33 ug/l in MW-13, and 962 ug/l in MW-15. The ground-water quality results are summarized on Table 7 and Figure 3. Copies of the laboratory report and chain of custody form are included in Appendix V.

QUALITY ASSURANCE SAMPLES

Results for the quality assurance samples are included with the laboratory reports in Appendices IV and V. The analyzed parameters were not detected in any of the field or trip blanks and no quality control or quality assurance problems were reported by the laboratory. The results of the blind duplicate analysis are included on Table 7 and show a concentration variation of 8% or less for the two samples analyzed from OW-12.

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March 1997
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TABLES

TABLE 1

MOBIL OIL CORPORATION
FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NEW YORK

Soil Sampling Inventory
September 26 and 27, 1996

Sample I.D. ee figure 1 for locations)	Laboratory Analysis					Sample Location
	EPA Method 8021	EPA Method 8270	PCBs	Asbestos	Lead and Chromium	
SS-1				X	X	Northern property line
SS-2[1/]			X	X	X	Northern property line
SS-3				X		Northern property line
SS-4			X	X		Northern property line
SS-5					X	North of former Tank No. 6
SS-6					X	North of former Tank No. 6
SS-7					X	North of former Tank No. 6
SS-8			X			Former electrical transformer
SS-9			X			Former electrical transformer
SS-10			X			Former electrical transformer
SS-11			X			Former electrical transformer
SS-12	X	X	X			Between former Tank Nos. 5 and 6
SS-13			X			Between former Tank Nos. 5 and 6
SS-14	X	X	X			Northern drainage ditch on eastern property line
SS-15[1/]	X	X	X			Southern drainage ditch on eastern property line
SS-16	X	X				75 feet west of OW-19A
SS-17	X	X				75 feet west of OW-19A
SS-18	X	X				Northern edge of former No. 6 fuel-oil excavation

Asbestos soil samples collected between 0 and 2 inches below grade; SS-18 was collected from 2.5 ft bg, all others were collected between 0 and 1 ft bg

nv tbl tap

TABLE 2

MOBIL OIL CORPORATION
FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NEW YORK

Summary of the Depth to Clay on the Anaconda Property
(see Appendix 1 for boring logs)

Well I.D.	Depth to Clay	Boring Termination Depth	Feet of Clay Penetrated
MW-D1 (Mobil Well)	20	65	24
MW-1A	23	25	2
MW-1B	24	76	36 clay terminated at 60 ft.bg.
MW-2A	17	20	3
MW-3A	---	18	0
MW-3B	14	91	61.5 clay terminated at 75.5 ft bg
TB-1	11	14	3
TB-3	12	14	2
TB-5	---	21	0
TB-6	---	4	0
TB-6B	20.5	22	1.5
TB-7	15.8	18	2.2
TB-8	25	30	5
TB-9	---	34	0
TB-10	23	26	3
TB-11	18.5	20	1.5
TB-12	15.5	18	2.5
TB-13	14.2	20	5.8
TB-14	---	7	0
TB-15	13	16	3
TB-16	27	29	2
TB-17	29	30	1
TB-17B	---	12	0
TB-18	32	33	1
TB-19	---	24	0
TB-20A/B	16	20	0.5
TB-21	---	7	0

TABLE 3

MOBIL OIL CORPORATION
FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NEW YORK

Summary of Field Parameter Results

Well I.D.	Top of Casing Elevation (feet)	Depth to Water 9/20/96 (ft btoc)[1/]	Ground-Water Elevation (feet)	Total Depth (ft btoc)	Conductivity (umhos)	Temperature (°F)	pH	Standing Volumes Removed
MW-1A	5.26	3.62	1.64	13.40	1012 1069 1212	67 67 67	7.70 7.57 7.58	1 2 3
MW-4	5.12	3.26	1.86	11.80	4600 3250 3110	61 58 59	6.89 7.08 7.17	1 2 3
MW-5	4.58	2.92	1.66	10.90	2550 2490 2290	60 59 59	7.52 7.77 7.71	1 2 3
MW-6	6.28*	5.15	1.13	12.70	849 824 841	65 66 66	7.89 7.73 7.68	1 2 3
MW-7A	7.01	5.83	1.18	14.90	6730 5600 5200	67 65 64	7.39 7.76 7.80	1 2 3
MW-9A	7.56	5.91	1.65	13.90	1274 1245 1232	61 62 62	7.81 7.57 7.53	1 2 3
MW-10	5.39	3.82	1.57	10.58	1230 1363 1250	63 63 63	7.72 7.68 7.59	1 2 3
MW-12	5.47	3.52	1.95	14.30	2940 2960 3040	61 62 62	5.89 5.88 5.88	1 2 3
MW-13	6.84	5.49	1.35	13.60	543 1356 --	62 61 --	8.01 6.92 --	1 2 went dry
MW-14	5.09	3.70	1.39	13.50	695 778 --	63 62 --	7.08 7.00 --	1 2 went dry
MW-15	6.15	4.36	1.79	13.50	1286 1430 1295	61 61 61	6.31 6.22 6.25	1 2 3

*TOC elevation was re-surveyed on September 25, 1996 and changed to 6.28 feet.

TABLE 3
(continued)
MOBIL OIL CORPORATION
FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NEW YORK

Summary of Field Parameter Results

Well I.D.	Top of Casing Elevation (feet)	Depth to Water 9/20/96 (ft btoc)[1/]	Ground-Water Elevation (feet)	Total Depth (ft btoc)	Conductivity (umhos)	Temperature (°F)	pH	Standing Volumes Removed
MW-16	9.63	7.53	2.10	13.80	953	64	6.78	1
					901	64	6.75	2
					1013	64	6.70	3
MW-17	9.82	7.13	2.69	15.50	1552	62	6.65	1
					1640	62	6.66	2
					1630	62	6.68	3
MW-S1	6.86	5.07	1.79	29.40	1838	62	7.30	1
					1852	63	7.25	2
					1114	63	7.77	3
MW-D1	6.81	4.00	2.81	66.50	988	63	7.74	1
					1027	62	7.92	2
					1022	62	7.93	3
*OW-1	4.90	--	--	--	--	--	--	--
OW-5A	5.98	4.30	1.68	13.70	3120	61	7.69	1
					2880	61	7.49	2
					2460	60	7.10	3
OW-8	5.41	3.58	1.83	14.40	7140	63	7.16	1
					6850	62	7.13	2
					6700	62	7.04	3
OW-9A	6.56	6.48	0.08	13.90	1274	61	7.81	1
					1245	62	7.57	2
					1232	62	7.53	3
OW-12	8.68	6.62	2.06	16.30	1407	61	4.83	1
					1474	61	4.96	2
					1490	62	5.32	3
OW-15	7.77	6.02	1.75	17.65	753	64	8.20	1
					789	64	7.93	2
					773	64	7.80	3
OW-17	8.25	6.43	1.82	11.25	2240	62	5.74	1
					2360	62	5.92	2
					2370	62	5.96	3

* OW-1 was not found and may have been destroyed

TABLE 3
(continued)
MOBIL OIL CORPORATION
FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NEW YORK

Summary of Field Parameter Results

Well I.D.	Top of Casing Elevation (feet)	Depth to Water 9/20/96 (ft btoc)[1/]	Ground-Water Elevation (feet)	Total Depth (ft btoc)	Conductivity (umhos)	Temperature (°F)	pH	Standing Volumes Removed
OW-19A	5.29	2.38	2.91	10.90	4990 4150 2670	64 63 63	6.39 6.52 6.56	1 2 3
OW-20	8.33	5.53	2.80	13.75	823 1326 1482	62 62 62	7.14 6.75 6.62	1 2 3
OW-21	5.86	4.69	1.17	16.45	638 771 984	62 62 62	7.23 6.86 6.85	1 2 3
OW-25	4.78	2.72	2.06	12.73	6430 6920 6900	62 62 62	6.75 6.93 6.95	1 2 3
OW-26	4.28	NM	---	NM	NS	NS	NS	---
OW-27A	4.91	3.76	1.15	11.15	2160 2090 2080	66 65 65	7.44 7.30 7.35	1 2 3

[1/] Feet below top of casing

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TABLE 4

MOBIL OIL CORPORATION
FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NEW YORK

Soil Quality Summary
PCBs, Metals and Organic Carbon

Sample I.D. (see figure 1 for locations)	PCB-Arochlor 1254 (ug/kg)[1/]	PCB-Arochlor 1260 (ug/kg)	Chromium (mg/kg)[2/]	Lead (mg/kg)	Organic Carbon (% Volatile Solids)
SS-1	NA[3/]	NA	34	480	NA
SS-2	ND[4/]	500	11	180	5.6
SS-3	NA	NA	NA	NA	NA
SS-4	ND	140	NA	NA	NA
SS-5	NA	NA	38	450	NA
SS-6	NA	NA	28	940	NA
SS-7	NA	NA	75	650	NA
SS-8	ND	130	NA	NA	NA
SS-9	ND	ND	NA	NA	NA
SS-10	ND	ND	NA	NA	NA
SS-11	400	330	NA	NA	NA
SS-12	ND	3,800	NA	NA	NA
SS-13	ND	220	NA	NA	NA
SS-14	ND	1,100	NA	NA	NA
SS-15	ND	690	NA	NA	13

Micrograms per kilogram

Milligrams per kilogram

Not analyzed

Not detected above the method detection limit (see Appendix II for detection limits)

TABLE 5

MOBIL OIL CORPORATION
FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NEW YORK

Soil Quality Summary
EPA Method 8021

Sample I.D.	Benzene (ug/kg)[1]	Toluene (ug/kg)	Ethyl-benzene (ug/kg)	p&m Xylene (ug/kg)	o-Xylene (ug/kg)	Isopropyl benzene (ug/kg)	n-Propyl benzene (ug/kg)	1,3,5-Tri methyl benzene (ug/kg)	1,2,4-Tri methyl benzene (ug/kg)	sec-Butyl benzene (ug/kg)	p-Isopropyl toluene (ug/kg)	n-Butyl benzene (ug/kg)	Naphthalene (ug/kg)
SS-12	ND[2]	ND	397	ND	ND	106	380	1180	489	627	214	3,370	1,920
SS-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS-15	ND	ND	ND	ND	ND	164	ND	804	336	335	ND	834	2,030
SS-16	7.1	9.0	ND	23	17	4.0	18	13	28	10	4.8	31	15
SS-17	6.6	9.4	ND	24	15	2.5	14	12	25	6.1	3.0	29	16
SS-18	7.4	6.7	9.7	6.7	5.4	2.0	ND	7.5	7.0	13	ND	7.8	28

/ Micrograms per kilogram
/ Not detected above the method detection limit

TABLE 6

MOBIL OIL CORPORATION
FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NEW YORK

Soil Quality Summary
EPA Method 8270

Sample I.D.	Phenanthrene (ug/kg)[1]	Anthracene (ug/kg)	Fluoranthene (ug/kg)	Pyrene (ug/kg)	Benzo (a) anthracene (ug/kg)	Chrysene (ug/kg)	Benzo (b) fluoranthene (ug/kg)	Benzo (k) fluoranthene (ug/kg)	Benzo (a) pyrene (ug/kg)	Indeno (1,2,3-cd) pyrene (ug/kg)	Dibenzo(a,h) anthracene (ug/kg)	Benzo (g,h,i) perylene (ug/kg)
SS-12	5,080	ND[2]	6,440	10,700	ND	ND	ND	ND	ND	ND	ND	ND
SS-14	1,650	489	3,090	3,900	1,919	2,280	2,210	1,890	2,280	1,820	465	1,710
SS-15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS-16	4,240	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS-17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS-18	6,480	ND	9,850	17,700	ND	11,300	7,640	ND	7,390	ND	ND	5,950

/ Micrograms per kilogram

/ Not detected above the method detection limit

TABLE 7

MOBIL OIL CORPORATION
FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NEW YORK

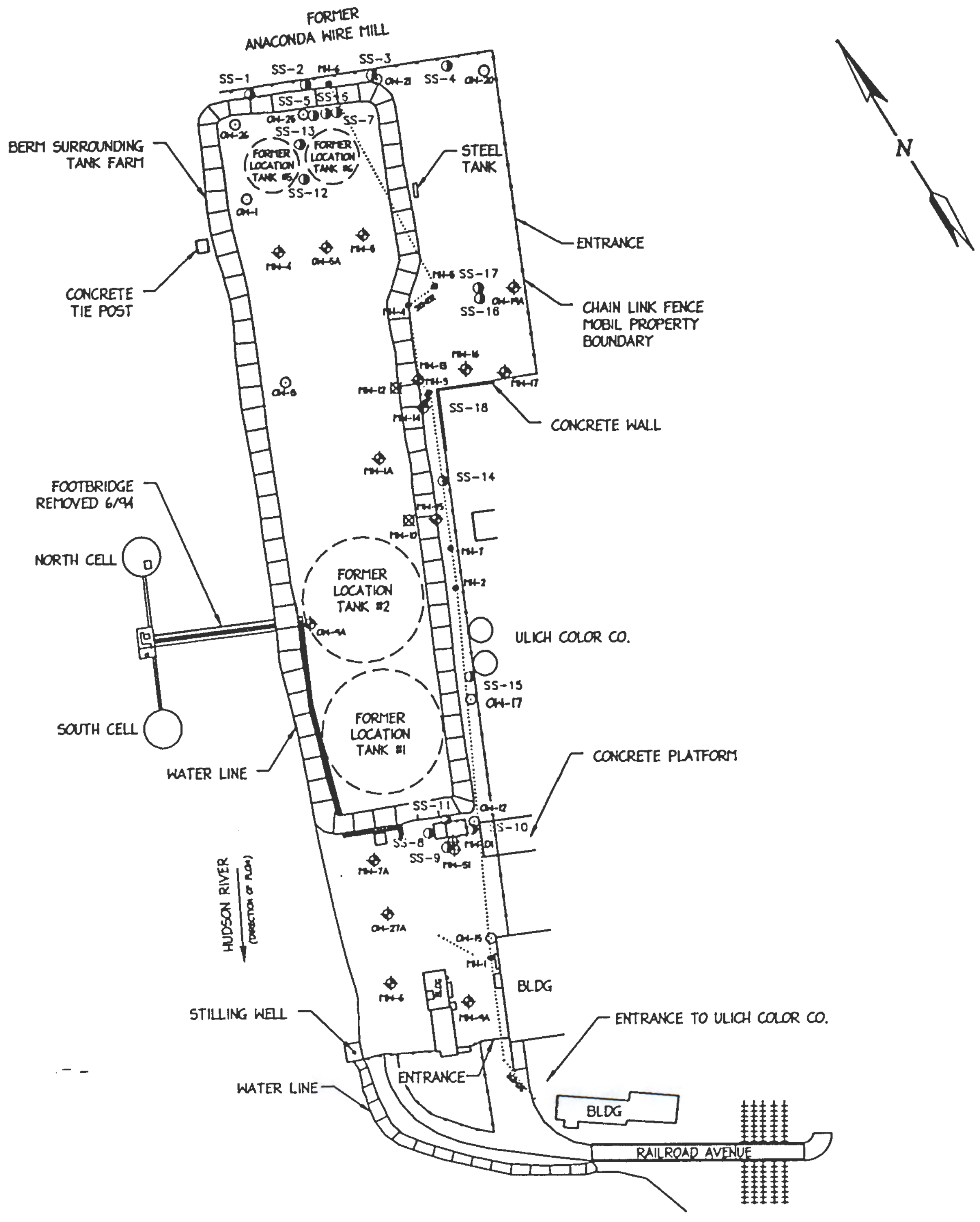
Ground-Water Quality Summary
EPA Method 8240

Well I.D.	Date	Chlorobenzene (ug/l)[1/]	Ethyl Ether (ug/l)	Benzene (ug/l)
MW-1A	09/20/96	682	ND	ND
MW-4	09/25/96	ND	310	ND
MW-5	09/25/96	ND	126	ND
MW-6	09/20/96	ND	NA	ND
MW-7A	09/20/96	16	NA	ND
MW-9A	09/20/96	1,230	NA	ND
MW-10	09/20/96	5,380	ND	ND
MW-12	09/24/96	19,700	11,800	ND
MW-13	09/25/96	917	28,000	33
MW-14	09/24/96	1,350	64	ND
MW-15	09/24/96	11,100	ND	962
MW-16	09/24/96	5.2	ND	ND
MW-17	09/24/96	ND	ND	ND
MW-S1	09/20/96	2,360	ND	ND
MW-D1	09/20/96	ND	NA	ND
OW-5A	09/25/96	ND	66	ND
OW-8	09/25/96	8.2	428	ND
OW-9A	09/25/96	ND	10	ND
OW-12/MW-28 Blind Duplicate	09/24/96	10,000/10,800	ND/ND	7.6/7.8
OW-15	09/20/96	101	NA	ND
OW-17	09/24/96	14,000	ND	ND
OW-19A	09/24/96	ND	719	ND
OW-20	09/24/96	ND	ND	ND
OW-21	09/24/96	ND	2,240	ND
OW-25	09/25/96	ND	116	ND
OW-27A	09/20/96	1,920	ND	ND

1/ Micrograms per liter
ND Not detected
NA Not analyzed

compounds.tbl\tap

FIGURES



LEGEND:

⊠ 4-INCH DIAMETER NEW MONITOR WELL
◈ 4-INCH DIAMETER MONITOR WELL
○ 2-INCH DIAMETER OBSERVATION WELL
⊕ 6-INCH DIAMETER TEST WELL
◗ SOIL SAMPLE LOCATION
• MANHOLE FOR SANITARY SEWER
··· SANITARY SEWER

0 180
SCALE IN FEET

MOBIL OIL CORPORATION
FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NEW YORK

SOIL SAMPLE LOCATIONS

DATE	REVISED

PREPARED BY:
LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Engineering Services
110 Corporate Park Drive
Suite 112
White Plains, NY 10604
(914) 694-5711

DRAWN:	MRV	CHECKED:	JB	DATE:	3/12/97	FIGURE:	1

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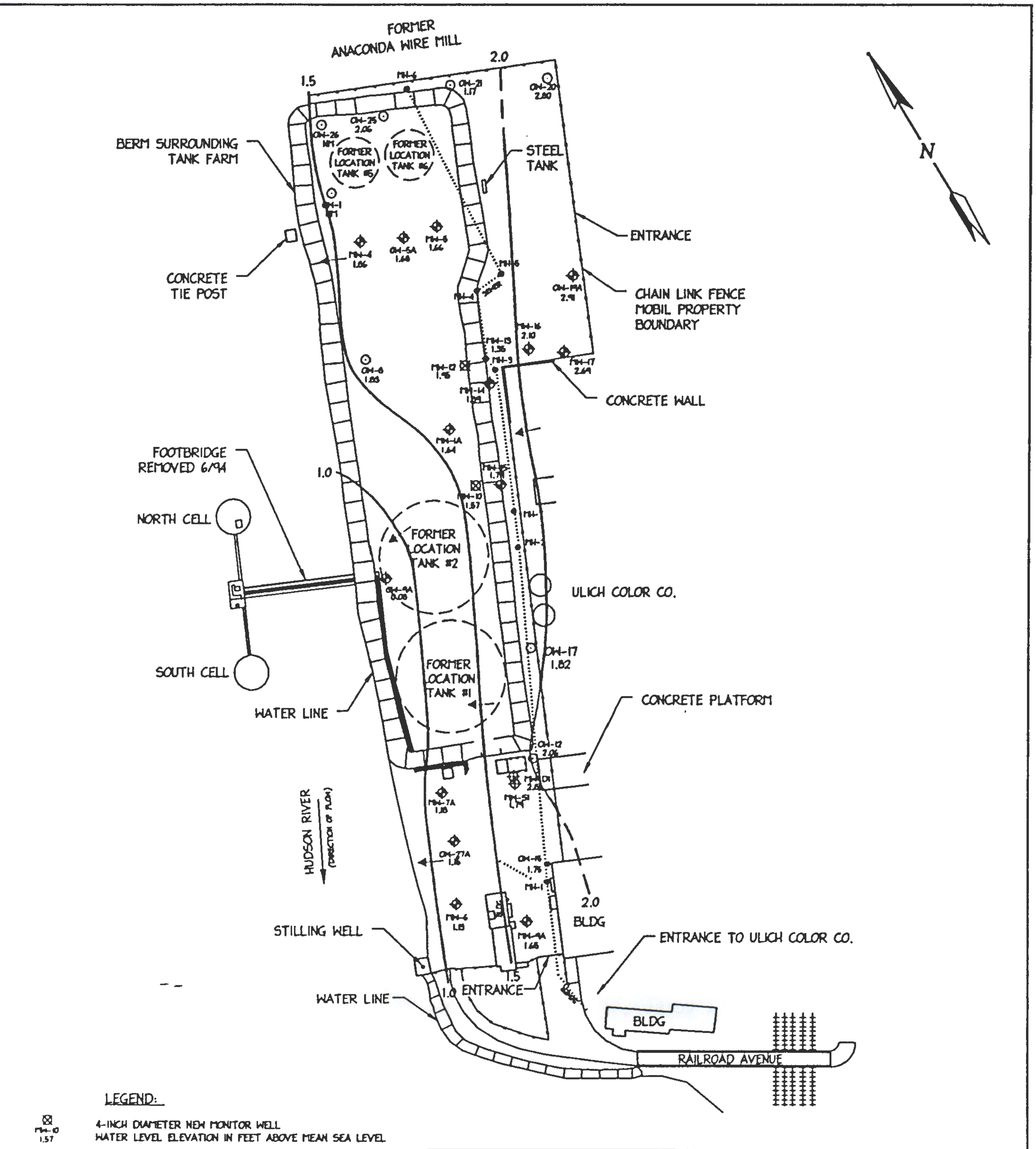

LEGEND:

⊠ MW-10 1.57	4-INCH DIAMETER NEW MONITOR WELL WATER LEVEL ELEVATION IN FEET ABOVE MEAN SEA LEVEL
◈	4-INCH DIAMETER MONITOR WELL
⊙	2-INCH DIAMETER OBSERVATION WELL
⊕	6-INCH DIAMETER TEST WELL
....	SANITARY SEWER
• MH-1	MANHOLE FOR SANITARY SEWER
1.0 ——	GROUND-WATER ELEVATION CONTOUR IN FEET (DASHED WHERE INFERRED)
——▶	DIRECTION OF GROUND-WATER FLOW

0 180
SCALE IN FEET

MOBIL OIL CORPORATION
FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NEW YORK

GROUND-WATER ELEVATION CONTOUR MAP
SEPTEMBER 20, 1996

DATE	REVISED

PREPARED BY:
LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Engineering Services
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White Plains, NY 10604
(914) 694-5711

DRAWN:	TLC	CHECKED:	JB	DATE:	3/14/97	FIGURE:	2

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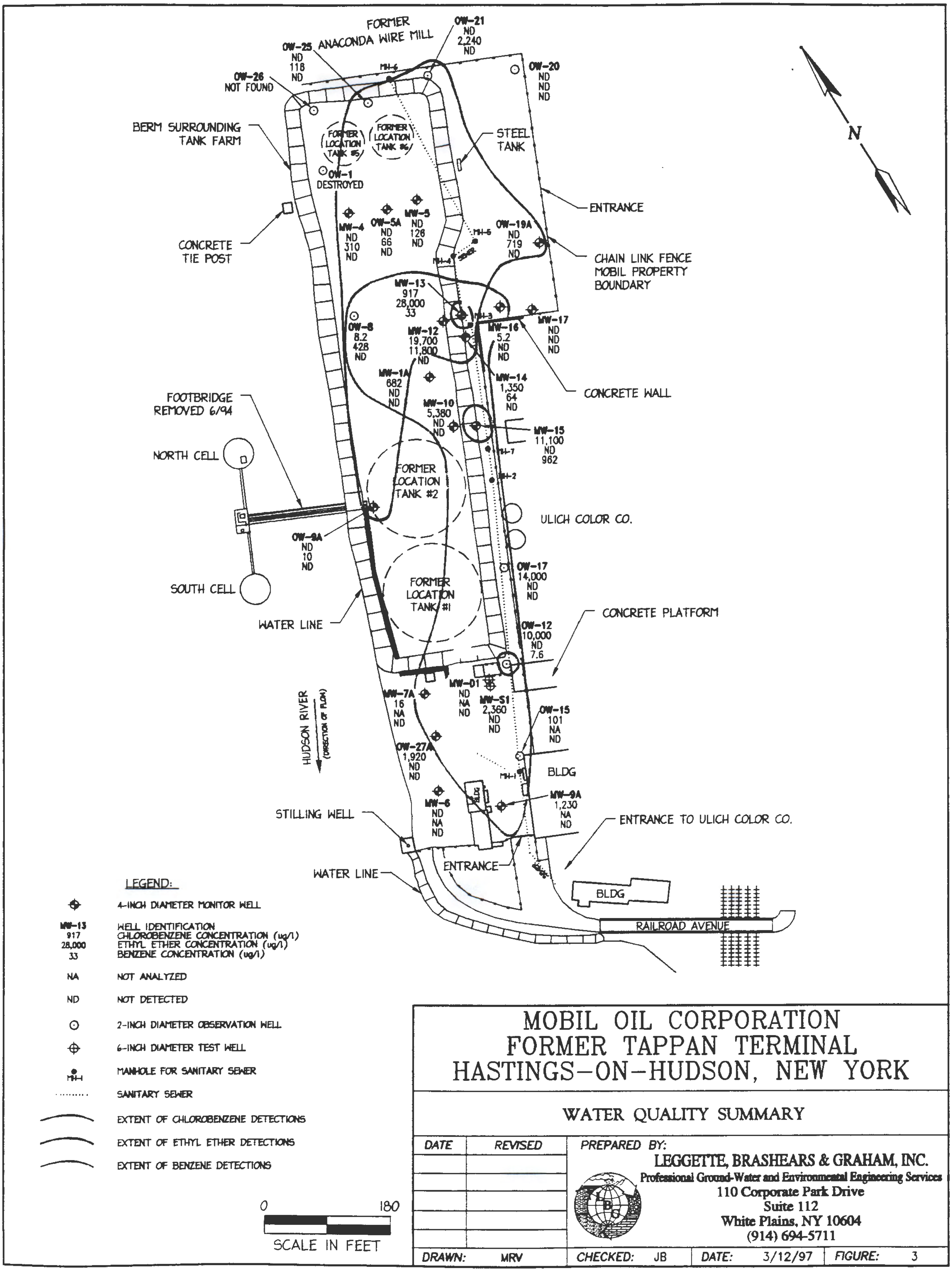

MOBIL OIL CORPORATION
FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NEW YORK

WATER QUALITY SUMMARY

DATE	REVISED

PREPARED BY:

LEGGETTE, BRASHEARS & GRAHAM, INC.
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110 Corporate Park Drive
Suite 112
White Plains, NY 10604
(914) 694-5711

DRAWN: MRV | *CHECKED:* JB | *DATE:* 3/12/97 | *FIGURE:* 3

O:\DWG\TERMINAL\TAPPAN\F2SEP96.DWG

Mobil Oil Corporation

3225 GALLOWS ROAD
FAIRFAX, VIRGINIA 22037-0001

December 19, 1995

Mr. Keith Brown
New York State Department of
Environmental Conservation
21 South Putt Corners Road
New Paltz, NY 12561-1696

RE: NYSDEC SITE #3-60-015
FORMER TAPPAN TERMINAL

Dear Mr. Brown:

In behalf of Mobil Oil Corporation and Chevron Chemical Company, enclosed is our submittal for the focused Remedial Investigation/Feasibility Study workplan to be conducted on the Mobil former terminal site in Hastings-on-Hudson, New York. Once reviewed and approved by your department, this will become the scope under the consent order that we will execute. As a courtesy, this workplan has been reviewed and commented on by Carpenter Environmental representing the Hudson Riverkeeper Fund.

The workplan is a comprehensive review of all the historic site investigations and remediation that has already occurred. With all improvements removed, there are no ongoing or potential sources of new impacts to the site. As previously discussed with the DEC, our plan focuses on quantification of potential risks to human health and the environment based on the existing levels of contaminants. Based on this analysis, the feasibility study will focus on the need and level of effort necessary to reduce this risk to acceptable levels.

In order to expedite your review and comments, I will be available for any questions that you may have on the proposed workplan at (703) 849-3726.

Sincerely,

Gary A. Stumpf

Gary A. Stumpf

cc(w/o enclosure): Karl S. Coplan, Esq. - Pace Environmental Litigation Clinic
Thomas Deal, Esq.- Chevron Chemical Co.
Keith Harriton, Esq. - Harriton & Migano
Jim Heston, Esq. - Mobil Oil Corp.
James C. Orr, Esq. - Wilson, Elser, Moskowitz, Edelman & Dicker
Steven Russo, Esq. - Sive, Paget & Riesel, P.C.

APPENDIX I

WORK PLAN FOR COMPLETION OF A FOCUSED REMEDIAL INVESTIGATION/ FEASIBILITY STUDY
MOBIL PROPERTY
HASTINGS-ON-HUDSON, NEW YORK

VOLUME I OF IV

Prepared For

Mobil Oil Corporation

November 1995

Prepared By

LEGGETTE, BRASHEARS & GRAHAM, INC.
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Foster Wheeler Environmental
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Bellevue, WA 98004-4405

Prepared at the Request of Legal Counsel
Whiteman, Osterman and Hanna
Albany, New York

WOH File
Copy

TAPPAN TERMINAL - HASTINGS-ON-HUDSON, NEW YORK
NYSDEC INACTIVE HAZARDOUS WASTE SITE CODE 360015
EPA TECHNICAL DIRECTIVE DOCUMENT NO. 02-8809-01

REPORT ON SUBSURFACE INVESTIGATION AT ADJACENT PAUL UHLICH AND CO. PLANT PROPERTY

Volume I

November 1989

LAWLER, MATUSKY & SKELLY ENGINEERS
Environmental Science & Engineering Consultants
One Blue Hill Plaza
Pearl River, New York 10965

Prepared at the Request of Legal Counsel
Whiteman, Osterman and Hanna
Albany, New York

TAPPAN TERMINAL - HASTINGS-ON-HUDSON, NEW YORK

NYSDEC INACTIVE HAZARDOUS WASTE SITE CODE 360015

EPA TECHNICAL DIRECTIVE DOCUMENT NO. 02-8809-01

REPORT ON SUBSURFACE INVESTIGATION AT ADJACENT PAUL UHLICH AND CO. PLANT PROPERTY

Hastings-on-Hudson, New York

VOLUME I

November 1989

LMSE-89/0651&442/095

LAWLER, MATUSKY & SKELLY ENGINEERS
Environmental Science & Engineering Consultants
One Blue Hill Plaza
Pearl River, New York 10965

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CHAPTER 1

INTRODUCTION

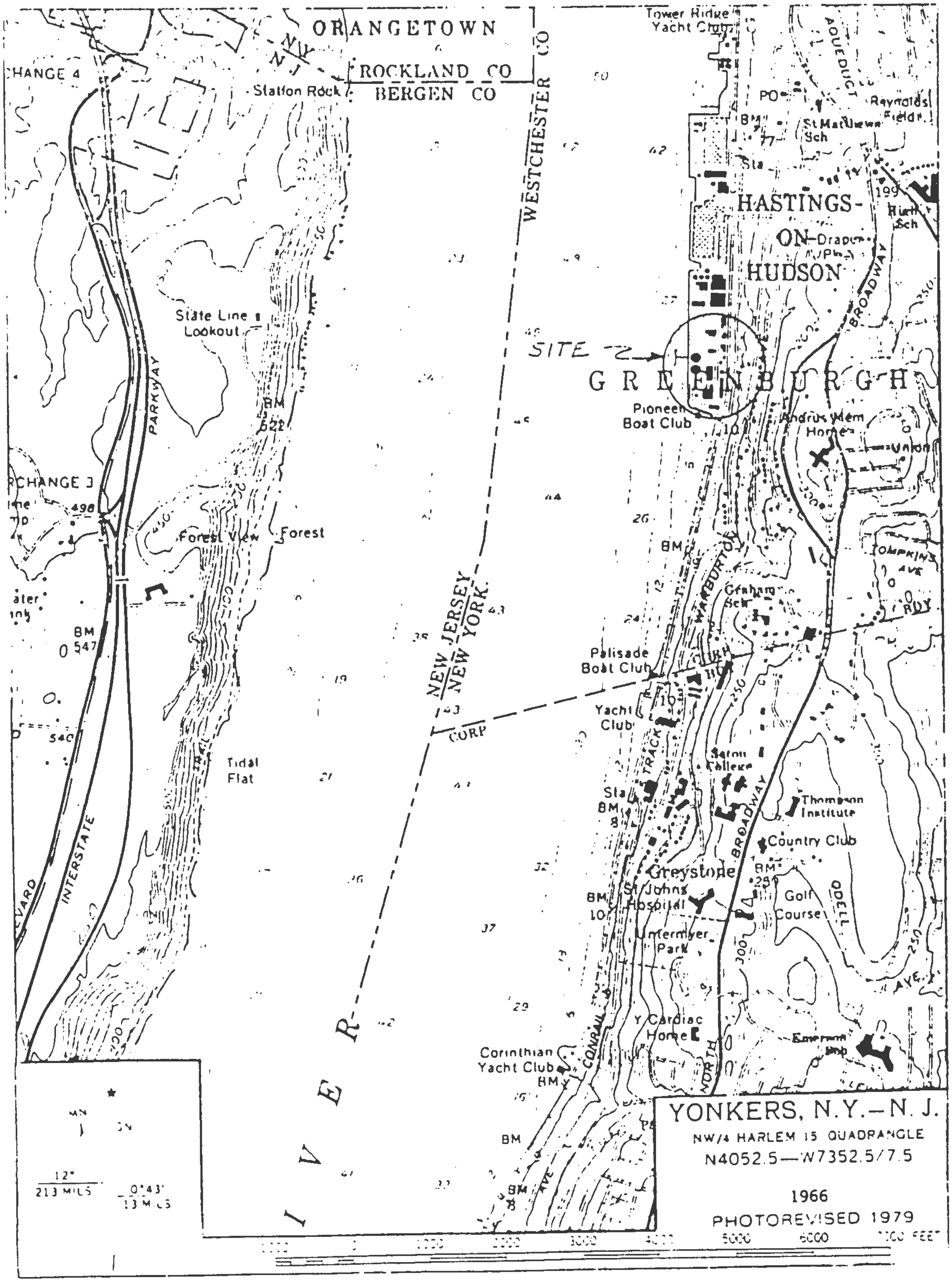
1.1 OBJECTIVE

The purpose of this report is to document a subsurface environmental investigation conducted in 1989 by Lawler, Matusky & Skelly Engineers (LMS) at the Paul Uhlich and Co. (Uhlich) plant property at One Railroad Avenue, Hastings-on-Hudson, New York, which is adjacent to the Tappan Terminal (NYSDEC Inactive Hazardous Waste Site Code 360015; EPA Technical Directive Document No. 02-8809-01; see Figure 1-1). The field investigation entailed the following activities:

- Advancing borings with a drill rig and collection of soil samples
- Construction, development, slug testing, and sampling of groundwater monitoring wells
- Construction and sampling of soil gas probes
- Installation of well points to measure water table depth
- Horizontal and vertical survey of the subsurface test locations
- Magnetometry survey of the reported site of an underground gasoline tank
- On-site and laboratory testing of soil, groundwater, and soil gas samples

The investigation was conducted in two phases. The first phase (January-April 1989) included 19 soil borings, four of which were completed as groundwater monitoring wells. The soil gas probes, well points, and magnetometry activities were conducted during this phase. Except as noted in Chapter 2, Phase 1 was conducted in con-

FIGURE 1-1
LOCATION MAP



formance with the Proposed Plan for Environmental Investigation at Paul Uhlich and Co. Plant Property (LMS 1988).

The second phase (June-July 1989) entailed seven additional borings, three of which were completed as groundwater monitoring wells. The locations for these borings and wells were selected based on the findings from the first phase. In all, there were 26 borings and seven monitoring wells on the Uhlich property. Also in June, LMS sampled four monitoring wells on the adjacent Mobil Oil Corporation (Mobil) property. The scope of these activities is fully documented in Chapter 2.

1.2 BACKGROUND

Except for Subsection 1.2.1, this section of the report is provided by Uhlich. The information set forth was developed from a variety of sources, including the direct knowledge of Uhlich personnel concerning activities of third parties who occupied the site, and old documents, including maps relating to the history of the site and its occupants which are in the public record or to which Uhlich has had access. Uhlich believes that, on the basis of the information available to it, the information presented is accurate in all respects.

1.2.1 Development of the Site

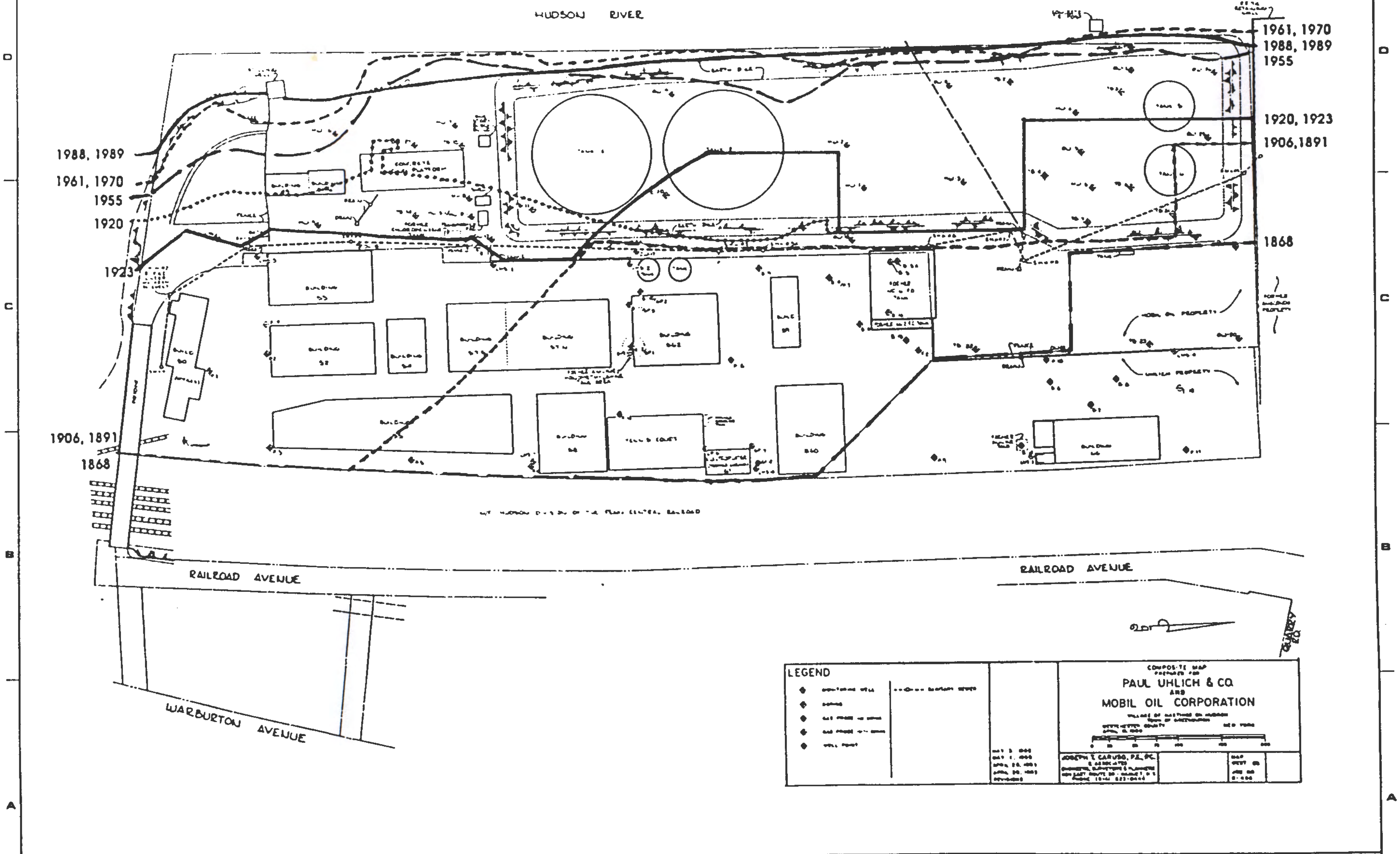
1.2.1.1 Overview. The property on which the subsurface investigation was conducted by LMS is part of a fill area in the Hudson River. The bulk of the fill area is now owned by three separate parties. The northern portion, formerly owned by the Anaconda Wire & Cable Company (Anaconda), is apparently owned by the Harbor at Hastings Associates. The southern portion, formerly owned by Zinsser & Company, Inc. (Zinsser), and its successor, Harshaw Chemical Co. (Harshaw), is referred to as the Southern Fill Area and is now subdivided into two parcels. The western portion adjacent to the Hudson River is owned by Mobil. The eastern portion is owned by Uhlich (see Drawing 1, a foldout map at the back of this report).

The Southern Fill Area was filled at various times. Figure 1-2 depicts the fill sequence of the former Zinsser/Harshaw property, now owned by Uhlich and Mobil. The following information was used in preparing the historical shoreline configurations for this figure. Reproductions of the source drawings are presented at the back of this report.

1.2.1.2 Shoreline 1868. The information on this shoreline was taken from the Harbor at Hastings 1989 draft environmental impact statement (DEIS) prepared by Parish & Weiner, Inc. It comes from a reproduction of Plate 35, Historic Background of Hastings Waterfront - 1868, found in the Beers Atlas. The delineation of the shoreline for the properties is at best a rough estimate because of the poor quality of the map, the small scale (1 in. = 600 ft), and the distortion of certain prominent features, such as the railroad. Drawing 2 (in the back of this report) is a reproduction of this map.

1.2.1.3 Shoreline 1891/1906. In Figure 1-2 the 1906 shoreline configuration (Drawing 3) was derived from a U.S. Army Corps of Engineers (COE) blueprint titled Pierhead and Bulkhead Line for the Easterly Shore of the Hudson River at the Village of Hastings, New York (COE 1906). The scale appears fairly accurate (within 9%). However, shoreline and property lines are not clearly differentiated. The information on the 1891 shoreline was derived from a reproduction in the DEIS of a historical plate from the Atlas of the Hudson River Valley (Drawing 4). This drawing (Plate 36, Historical Background of Hastings Waterfront - 1891) appears to match the plotted contours of the 1906 plot. However, the shoreline con-

FIGURE 1-2



SEQUENCE OF FILLING OF THE UHLICH AND MOBIL PROPERTIES

Lawler, Matusky & Skelly Engineers

figuration in Figure 1-2 should be considered a rough estimate because of the poor quality and lack of scale on the source map.

1.2.1.4 Shoreline 1920/1923. The 1920 configuration (see Drawing 5) was derived from a 1935 letter and map to attorneys Kelly, Hewitt & Harte by J.L. Berstron of Zinsser. Because this map appears to have been generated to emphasize building layout and not shoreline position, the shoreline configuration may be arbitrary, not the result of a detailed survey. The 1923 shoreline in Figure 1-2 was based on a blueprint titled Map A in the Application of Zinsser and Company, Inc., for a Grant of Land Under the Waters of the Hudson River, Hastings-on-Hudson, Westchester County, New York (see Drawing 6). This map shows a metes and bounds survey of the high water line. Both the 1920 map and the 1923 map fully match the placement of the water line on the northern portion of the Southern Fill Area. However, the maps suggest that a portion of the southern shoreline was dredged. Given the history of continuous filling at the site, it is possible that no dredging took place from 1920 to 1923 and that one or both of the maps are inaccurate on the south.

1.2.1.5 Shoreline 1944/1955. In Figure 1-2 the 1945 shoreline (Drawing 7) is derived from an insurance report (American Appraisal Company 1945). The 1955 shoreline (Drawing 8) was based on a blueprint labeled the Harshaw Chemical Company, Zinsser and Company Plot Plan Showing Outdoor Storage Tanks (Harshaw Chemical Company 1955). The poor quality of these prints precludes accurate measurement of the shoreline. Furthermore, the information on the shoreline may be inaccurate because the map appears to have been prepared primarily to document the contents of bulk storage tanks.

1.2.1.6 Shoreline 1961/1970. The 1961 shoreline in Figure 1-2 was based on a map (Drawing 9) by surveyor Harold Becker prepared for Tappan Tanker Terminal, Inc. (TTT) (Becker 1961). The 1970 shoreline (Drawing 10) was based on a map by surveyor A.E. Kolenda prepared for Mobil (Kolenda 1970). Both drawings show that the northern shoreline is the bulkhead. However, the alignment of the high water line in the southern portion of the site may have been arbitrary, not an actual measurement because the map was prepared primarily for building and property line placement. The 1970 shoreline, near the stilling well (southwest corner), closely follows the 1988 shoreline.

1.2.1.7 Shoreline 1988. The 1988 configuration of the shoreline is derived from the Mobil base map updated by Leggette, Brashears & Graham (LBG) for its groundwater and soil quality investigation of the Mobil property (LBG 1987). Although this map is not presented here, the features of the Mobil property depicted on the LMS base map (Drawing 1) are traced from the LBG map.

1.2.2 Prior Owners and Users of the Southern Fill Area

The following is a summary of information known to Uhlich concerning occupants of the Southern Fill Area.

1.2.2.1 Zinsser & Company, Inc. Zinsser created a substantial portion and owned all of the Southern Fill Area from approximately 1897 until 1955. When the U.S. entered World War I, Zinsser leased the southern half of their property to the U.S. government. This lease ended in 1920. Zinsser manufactured dyes and pigments, and also fine chemicals used mainly in photographic processes. Documents and maps depicting locations of storage facilities, tanks, and process areas (including a solvent recovery operation) were supplied to LMS for its use in designing and carrying out its subsurface investigation (Drawings 5 through 8).

1.2.2.2 Harshaw Chemical Co. Harshaw acquired Zinsser in 1955 and continued the operations until September 1961.

1.2.2.3 Tappan Tanker Terminal, Inc. TTT purchased the entire Southern Fill Area from Harshaw in September 1961. The sanitary sewer on what is now the Mobil property was constructed in 1961 or 1962 (see Drawing 1 for the alignment of this sewer). Westchester County approved the already constructed sewer on 10 December 1964. Some time prior to 1964 TTT constructed the large fuel oil storage tanks located on the portion of the area currently owned by Mobil. TTT operated a fuel oil storage facility until early 1971 and leased space to various enterprises. Uhlich understands that from October 1968 to at least 30 December 1970 TTT held an authorization from COE for the disposal at sea of certain liquid waste products of Nepera Chemical Co., Inc. The waste products appear to have been toluene, benzene, pyridene, alpha and beta picoline, 2 RCN, and 3 RCN. Uhlich understands that TTT stored these liquid waste products in the easterly one of the two smaller fuel oil storage tanks located on the north end of the property now owned by Mobil and piped the waste from this tank to ships for disposal at sea. From April 1971 to July 1975 TTT, under the name TTT Properties, Inc., leased and sold off portions of the Southern Fill Area (see below).

1.2.2.4 Paul Uhlich and Company, Inc. Through Uhlco Realty Corp. (a wholly owned subsidiary merged into Uhlich in 1986), Uhlich leased buildings and property in the eastern portion of the Southern Fill Area from TTT from October 1964 to July 1975. Uhlich has manufactured organic pigments since 1964. Uhlich occupied portions of Buildings 50, 52, 53, 55, and 49A during the lease period. This property represented approximately one-half of the property currently owned by Uhlich. Uhlich purchased the property it now owns from TTT in July 1975. Since 1975 Uhlich has also leased and rented buildings on its property to various tenants as described below. For locations of buildings referred to above and elsewhere in this report, see Drawing 1. Uhlich reports that since its pigment manufacturing operations use only water as a carrying medium and since it has never manufactured dyes, it has never used chlorobenzene, aniline, monomethylamine, ethyl ether, isopropyl ether, benzene, trichloroethylene, or tetrachloroethylene.

1.2.2.5 Mobil Oil Corporation. Mobil leased the western portion of the Southern Fill Area from TTT from July 1970 to December 1974, purchasing it in December 1974. Mobil was engaged in storing, wholesaling, and distributing (directly and through Robison Oil, an affiliate of Mobil) Nos. 2, 4, and 6 fuel oils from 1975 until 1985. Mobil operated two large steam boilers on its premises and maintained both a No. 6 fuel oil storage tank on Uhlich's property and a sewer line running north-south on the Mobil side of the border between the Uhlich and Mobil properties. This sewer services both Uhlich and Mobil. Maintenance of the sewer is the responsibility of Mobil, according to the 1974 Bridge, Roads and Utilities Agreement between TTT Properties, Inc., and Mobil. Mobil reports that it has never used chlorobenzene, aniline, ethyl ether, monomethylamine, isopropyl ether, benzene, trichloroethylene, or tetrachloroethylene.

1.2.2.6 Petroleum Heat & Power (Petro). This fuel oil distributor leased Building 66 from TTT between 1962 and 1975, and continued to lease the building from Uhlich from 1975 to September 1979. The premises were used for offices and a maintenance garage. Fuel delivery trucks were parked and serviced on these premises. Fuel oil was drawn from the TTT and Mobil oil distribution rack.

1.2.2.7 Whaleco Fuel Oil. This company assumed Petro's lease from Uhlich in September 1979 and used the premises in the same manner until February 1986.

1.2.2.8 Hastings Roofing, Inc. This company rented Building 59 from TTT for a period of years until 1975 and from Uhlich from 1975 until 1984. The building was used for offices and for storing roofing materials. Pickup trucks were parked and maintained on the premises.

1.2.2.9 Hastings Moving & Storage. Under leases from Uhlich, this company has stored home furniture and maintained offices in Buildings 58 and 57N from July 1975 to the present. Prior to 1975 the company leased these premises from TTT. It leased (but did not occupy) Building 66 from August 1986 to May 1987 when the lease was transferred to Caldara (see below).

1.2.2.10 Caldara Movers (Caldara). Under lease from Uhlich Caldara has stored household goods and trucks in Building 66 from May 1987 to the present.

1.2.2.11 Ricci Bros. (Ricci). Ricci, a general contractor, occupied Building 57S from 1972 to 1979 and former Building 12 from 1979 to April 1985 under leases from Uhlich. The premises were used for storage and maintenance of earthmoving and paving equipment. Since April 1985 Ricci has rented vacant land north of Building 60 for the same purpose.

1.2.2.12 Donald Brown Roofers. This company occupied Building 57S from 1975 until 1979 and occupied Building 12 from 1979 to 1981. It stored trucks and roofing material on the premises.

1.2.2.13 Koski & Schmidt Services (K&S). This company, which was in the machinery transport and rigging business, rented Building 61 and adjacent land from Uhlich from 1975 to 1983. K&S stored machinery and trucks on the leased premises and used Building 61 for offices and storage.

1.2.2.14 J.F. Macri (Macri). From 1966 to 1975 this company rented office space from Uhlich in Building 50 and stored trucks and equipment in Building 57N. Macri was in the machinery moving business.

1.2.2.15 Villard Contracting Co. (Villard). Villard was a general contractor and carpenter. From 1964 to 1974 it leased space from Uhlich in Building 57S for storage of trucks and equipment.

1.2.2.16 Awards Etc. (Awards). From 1977 to December 1982 this company rented the first floor of Building 50 from Uhlich and manufactured trophies. Since January 1983 Awards has leased Buildings 60 and 61 for the same purpose. Awards stores small quantities of electroplating chemicals in Building 61. Awards' effluent is monitored by the Westchester County Sewer Department. Uhlich is not aware of any failure of Awards to be in compliance with environmental regulations.

1.2.2.17 Geigy Chemical Corp. (Geigy). From December 1967 to 1970 Geigy leased Building 59 from TTT. Uhlich understands that Geigy stored (but did not manufacture) nonexplosive, noncombustible agricultural pesticides in this space. Uhlich does not know the specific pesticides stored by Geigy.

1.2.2.18 Quirk, Lawler & Matusky Engineers (QLM). QLM, predecessor firm of LMS, rented the first floor of Building 50 from TTT between July 1967 and June 1972. The rental space was used primarily as an sanitary analytical laboratory to conduct wet chemistry analyses (BOD, TSS, pH, etc.) on natural water and wastewater samples. During the 1970s, biological studies were conducted on fish samples preserved with formalin on the property.

1.2.2.19 William Hall. Prior records indicate that this individual was granted access to the property by TTT. His status as a possible tenant and his activities, if any, are unknown to Uhlich.

1.2.2.20 George Smith. Prior records indicate that this individual was granted access to the property by TTT. His status as a possible tenant and his activities, if any, are unknown to Uhlich.

1.2.2.21 Phillip Eades Trucking & Hauling. This company rented Building 57N from TTT for an unknown length of time beginning in September 1964. The nature of the trucking is unknown.

1.2.2.22 Steri Research Laboratory, Inc. Uhlich understands that this company leased the westerly portion of the first floor of Building 50 from TTT for an unknown period commencing in 1962. Their activities are unknown to Uhlich.

1.3 PRIOR RELEVANT SUBSURFACE INVESTIGATIONS

1.3.1 Leggette, Brashears & Graham, Inc.

In March 1987 LBG issued a report on an environmental investigation of the Mobil property conducted at Mobil's request (LBG 1987). Groundwater and subsurface soil samples were collected to detect any soil or groundwater contamination on the Mobil property. Of the 38 borings advanced, 26 were completed as groundwater monitoring wells. Since that report was issued, LBG reportedly conducted additional investigations. Appendix A presents summary tables based on their original analyses. LBG's boring and monitoring well locations are depicted on Drawing 1 (foldout at the back of this report).

LBG found chlorobenzene in the groundwater near the eastern boundary (Uhlich side) of the Mobil site. LBG attributed this to chemicals emanating from the Uhlich property. Uhlich advises that chlorobenzene, which is used in dye manufacturing, is not used in pigment manufacturing and that they have not used chlorobenzene. Both Mobil and LBG appeared to be unaware of the 1955 Zinsser map (Drawing 8) that records a former chlorobenzene tank on what is now the Mobil property near the eastern boundary.

LBG also found petroleum hydrocarbons (PHC) in three soil areas in the northern half of the Mobil site. Two of the zones bordered the Uhlich property. Diethyl ether and isopropyl ether were found in the groundwater in the northern half of the Mobil property bordering the Uhlich and former Anaconda properties and near the center of the western side of that property.

Colored subsurface soils were found along the Mobil-Uhlich property line. LBG attributed the staining to leakage from the sanitary sewer that services the two properties and to overland flow. No hazardous chemicals were present in the stained soils.

The New York State Department of Environmental Conservation (NYSDEC) placed the Mobil property on the registry of inactive hazardous waste sites (Site Code 360015) after it received a copy of the LBG report.

1.3.2 U.S. Environmental Protection Agency

During the investigation, LMS acquired from the U.S. Environmental Protection Agency (EPA) a report on a preliminary assessment of the Mobil property prepared by NUS Corporation (NUS) in December 1988 (NUS 1988). EPA involvement was initiated after the LBG report was released. Attached to the NUS report was a report prepared for Mobil on a June 1987 sampling at the Mobil property (Mobil Research and Development Corporation 1987). Uhlich advises that NUS erroneously characterized it as a dye manufacturer. Uhlich advises that it has only manufactured pigments for which water, rather than organic chemicals, is used as a carrying medium.

In October 1989 EPA released a NUS report of a screening site investigation (SSI) during which four Mobil monitoring wells (OW-1, MW-4, OW-25, and OW-19; see Drawing 1) were sampled on the northern portion of the Mobil property (NUS 1989). NUS also collected six soil samples on the property. Tables 1-1 and 1-2 summarize the analytical results for groundwater and soil, respectively.

No organics were detected in the groundwater samples. No chemicals were detected in OW-19, which is just downgradient of the Uhlich-Mobil property line. NUS collected one soil sample from a drainage way that directs storm water from the Uhlich property to the Mobil property. Low levels of PCBs and four semivolatile compounds were measured in this sample; barium was the only metal detected, at a concentration of 1300 mg/kg. There was no assessment for petroleum hydrocarbons. NUS concluded that concern about air, groundwater, and on-site exposure pathways "is minimal" for this site. No mention was made about the chlorobenzene in the wells on the southern portion of the site. Because of adjacent or nearby striped bass and blue crab fisheries, NUS expressed a concern about surface water contamination of the Hudson River originating from the soils (apparently from erosion). NUS therefore recommended that the site be given high priority for further evaluation in a Listing Site Inspection (LSI). The LSI would include additional on-site sampling and investigation of blue crabs in the vicinity of the site.

1.3.3 Former Anaconda Property

Harbor at Hastings Associates, apparent owners of the former Anaconda property, have proposed a residential and mixed-use development for the land north of the Mobil and Uhlich properties. In compliance with New York's State Environmental Quality Review Act (SEQRA), the developers submitted a DEIS on the proposed project to the Village of Hastings-on-Hudson in January 1989. The DEIS documents past investigative work concerning industrial contaminants detected in the soil and groundwater: volatile organic compounds (VOCs), polyaromatic compounds (PAHs), PCBs, and heavy metals. Where relevant, the findings of the DEIS have been integrated into the Uhlich investigation. As of this writing, a final EIS has

TABLE 1-1

EPA ANALYTICAL RESULTS FOR MOBIL MONITORING WELLS

PARAMETER	CONCENTRATION (ug/l)				
			OW-25		
	OW-1	MW-4	SAMPLE	DUPLICATE	OW-19
Metals					
Silver	33.6	4.4	-	-	-
Cadmium	16.3	6.4	-	-	-
Arsenic	-	69.5	-	49.3	-
Lead	-	1880	-	1000	-
Mercury	-	-	-	8.4	-
Others	-	-	-	-	-
Volatiles	-	-	-	-	-
Semivolatiles	-	-	-	-	-
PCBs/Pesticides	-	-	-	-	-

- compound not detected.

TABLE 1-2

EPA ANALYTICAL RESULTS FOR MOBIL SOIL SAMPLES

	CONCENTRATION (mg/kg)					
PARAMETER	S-1 BETWEEN TANKS 5 & 6	S-2 DRAINAGE PATH FROM UHLICH PROPERTY	S-3 TRANSFORMER AREA	S-4 DUPLICATE SAMPLE OF S-3	S-5 DRAINAGE PATH SW OF BLDG. 1	S-6 BANK OF HUDSON RIVER
Metals						
Arsenic	-	-	31.3	32.7	-	-
Barium	-	1300	-	-	-	1160
Cobalt	60.2	-	-	-	-	-
Copper	1800	-	974	1070	350	416
Lead	1050	-	-	-	-	1600
Mercury	-	-	-	-	2.5	1.3
Vanadium	-	-	112	122	-	-
Zinc	4190	-	2080	1810	-	-
Others	-	-	-	-	-	-
PCBs/Pesticides						
Aroclor 1260	0.33	0.38	-	-	-	0.25
Endosulfan I	-	-	0.043	0.043	-	-
Others	-	-	-	-	-	-
Volatiles						
Semivolatiles						
Phenanthrene	-	0.81	2.3	0.2	0.44	-
Anthracene	-	-	0.48	-	-	-
Fluoranthene	-	-	-	-	-	11.1
Pyrene	-	-	-	-	-	2.4
Benzo(a) anthracene	-	0.81	2.4	2.2	0.41	0.85
Chrysene	-	-	-	-	-	0.87
Bis(2-ethylhexyl) phthalate	-	-	-	-	-	0.91
Benzo(b) fluoranthene	-	2.9	3.0	3.5	0.74	1.2
Benzo(a)pyrene	-	1.4	-	1.8	-	0.87
Others	-	-	-	-	-	-

- compound not detected.

apparently been submitted, but LMS has not had the opportunity to review this latest submission.

CHAPTER 2

FIELD INVESTIGATION

2.1 PRELIMINARY ACTIVITIES

As indicated previously, the LMS field investigation was conducted in two phases. Planning for Phase 1 specified that four monitoring wells be constructed on the west side of the Uhlich property adjacent to the Mobil property line. To avoid confusion with the LBG wells, these four wells were labeled LMS-1, LMS-2, LMS-3, and LMS-4. LMS-1 was located opposite (just east of) the former Zinsser/ Harshaw chlorobenzene tank. LMS-2 was located downgradient of a former Zinsser/Harshaw solvent recovery operation. According to Drawing Z-1009-5 for the equipment layout of Zinsser facilities (Harshaw Chemical Co. 1958), this operation was near the southwest corner of Building 62. LMS-3 was located to describe the groundwater expected to be flowing west from the southwest corner of the Uhlich property. LMS-4 was located in the northern portion of the property in the vicinity of the ether groundwater plume described by LBG.

Fourteen additional borings were planned for Phase 1. B-1 was located southeast of the former chlorobenzene tank. B-2 was located in the vicinity of former aniline and monomethylamine tanks shown in the 1955 Zinsser/Harshaw map (Drawing 8); this boring was completed as a soil gas probe (GP-1). Borings B-3, B-4, and B-5 were located near former bulk petroleum storage vessels and areas of suspected petroleum spills. Borings B-6, B-7, and B-8 were located to describe petroleum levels in the soil in the northern leased areas of the Uhlich property. Boring B-9 was located to describe subsurface conditions near new construction contemplated by Uhlich. Borings B-10 and B-11 (completed as gas probes GP-2 and GP-3, respectively) were located to describe subsurface conditions around the previously mentioned Zinsser/Harshaw solvent recovery operation. Borings B-12 and B-13 (planned to be completed as gas probes GP-4 and GP-5, respectively) were located around an underground gasoline storage tank shown in the 1955 Zinsser/Harshaw map (Drawing 8). (As detailed in Section 2.2.1, these borings were not drilled.) Boring B-14 was located in the vicinity of a former Zinsser/Harshaw aniline tank. Boring B-15 was planned to describe the subsurface near a former electrical transformer that may have contained PCBs.

Four soil gas probes (GP-6, GP-7, GP-8, and GP-9) were planned for the area around Building 61, which is leased by Awards, Etc.; three were finally constructed. These probes were planned as a cost-effective means of initially screening possible subsurface impacts of this establishment.

Eleven water level probes (essentially well points) were also constructed during Phase 1 to measure water table elevations.

Three additional groundwater monitoring wells were installed during Phase 2. LMS-5 and LMS-6 were located to describe the condition of the groundwater flowing onto the Uhlich property from the east. LMS-7 was located to describe the condition of the groundwater flowing southeast from the Uhlich property toward the railroad tracks. The southeasterly direction of the flow, discovered during Phase 1, was unexpected.

During Phase 2, boring B-16 was located to confirm the reported petroleum concentrations in the soil of the former bulk petroleum storage area. Boring B-17 was advanced to confirm anomalous findings of monomethylamine in the soil samples collected from boring B-2 during Phase 1.

Borings B-18 and B-19 were located to collect soil samples for metals and semivolatiles analysis.

Before subsurface drilling, LMS personnel walked the property with Uhlich representatives to mark underground utilities and designate locations for flush-grade curb boxes required for monitoring wells and well points. The ground elevation near each proposed well and well point was measured by Joseph Caruso and Associates (Caruso), a licensed surveyor retained by LMS. This preliminary survey allowed the water table to be mapped as the subsurface activities progressed, and thereby helped in the selection of the final locations of probes/wells yet to be installed. A health and safety plan (HASP) was prepared at this time for the protection of the field crews during the investigation (Appendix B).

2.2 GEOPHYSICAL INVESTIGATION

2.2.1 Magnetometry

In January 1989 a magnetometry survey was conducted by Alpine Ocean Seismic Survey, Inc. (Alpine), in the vicinity of a reported underground Zinsser/Harshaw gasoline tank (Appendix C). The location of the tank is shown on Drawing 8 (at the back of this report). Anomalous readings attributed to subsurface metal scrap precluded an accurate conclusion about either the existence or the location of the tank. Consequently, LMS decided that the contemplated borings and gas probes in the vicinity (B-12/GP-4 and B-13/GP-5) could not be installed safely, and that aspect of the field program was suspended. A backhoe will be mobilized if further investigation of the tank is warranted.

2.2.2 Groundwater Occurrence

Uhlich personnel have reported a soil formation that they describe as having a pronounced underground water flow from east to west beneath the property. (As noted below, no such formation was found during this investigation.) The general alignment of this formation was thought to be from the approximate center of Building 55 (where distinct structural settlement can be observed from the roof and fascia lines) toward the alley between Buildings 54 and 57S (see Drawing 1 at the back of this report). If such a formation exists, it might be a permeable subsurface zone that directs groundwater flow from east of the property west through the Uhlich property to the Mobil property. The formation would then be expected to influence the movement of chemicals in the groundwater.

Resistivity and electromagnetic (EM) techniques were considered for mapping the water-bearing formations at the property. Alpine inspected the property and concluded that overhead electrical lines, subsurface water distribution pipes, and buildings would interfere with both types of surveys. A resistivity survey would be further hindered by the large number of holes that would have to be cut into the pavement covering much of the property. These limitations, coupled with the difficulties encountered with subsurface metal scrap during the magnetometry survey, forced the cancellation of this portion of the investigation. It should be noted that one well point (P-5) and one monitoring well (LMS-1) were installed in the reported alignment of the formation and that the former chlorobenzene tank on the Mobil property is also in this alignment.

2.3 SOIL BORINGS

Phase 1 drilling was conducted between 31 January and 10 February 1989 with a Diedrich D-50 drill rig operated by an LMS subcontractor, Kendrick Drilling, of Chester, New York. Phase 2 drilling was conducted with the same rig during 7-13 June 1989. All activities were supervised by an LMS geologist. The locations of the 26 borings (19 in Phase 1; seven in Phase 2) are depicted in Drawing 1.

Borings were advanced by driving a 2-in. outside diameter (O.D.) split spoon with a 140-lb hammer in accordance with the standard penetration test procedure (ASTM D-1586). Continuous split-spoon sampling was conducted in each boring to at least 2 ft below the water table and deeper where required by the plan of study. Above the water table the borehole was sufficiently stable to allow drilling to proceed without advancing augers or casing. The split spoons were decontaminated with steam at a designated area on-site.

Each split-spoon sample was scanned with an HNU Model PI 101 photoionization detector (PID) fitted with a 10.2 eV lamp. An MSA 361 combustible gas indicator (CGI) was used during Phase 1 to monitor selected open boreholes for explosive gases. The fill/soil characteristics, PID readings, sheens, and odors were logged for each sample by an on-site LMS geologist.

Dedicated, laboratory-cleaned stainless steel spoons were used to place soil samples into laboratory-cleaned sample containers for subsequent analysis. Volatiles samples were placed in pairs of 40-ml vials fitted with Teflon-lined septums. Samples for other types of analyses were placed in wide-mouth amber glass containers (minimum 100-g) fitted with Teflon-lined lids. If there was sufficient recovery, an additional sample collected from every split spoon was retained on-site in drillers' jars. Appendix D contains the geologist's logs for all 26 soil borings.

Seven of the borings were completed as groundwater monitoring wells to allow for the collection of groundwater samples and the observation of water table elevations. Soil gas probes were constructed in three of the borings to allow for the detection of volatile constituents in the surrounding soil pore spaces.

2.4 MONITORING WELL INSTALLATION

During Phase 1, four groundwater monitoring wells were installed to intercept groundwater moving downgradient from the Uhlich property toward the adjacent Mobil property (Drawing 1). Except for LMS-2, which had to be relocated about 40 ft south to avoid interference with a newly constructed acid bulk storage tank system, the wells were located as initially planned. However, the new location still allowed for a description of the groundwater downgradient of the former Zinsser/Harshaw solvent recovery operation. During Phase 2, two upgradient wells and one downgradient well were installed on the east side of the property.

Before the monitoring wells were installed, continuous split-spoon sampling was conducted to locate the depth to water and to study the subsurface lithology (Section 2.3). Once the split-spoon sampling was completed, temporary, 4-in. inside diameter (I.D.) hollow-steel casing was driven to 10 ft below the water table. This casing was steam cleaned before each use. The subsurface materials trapped within the casing were drilled out with a roller bit. Air and clean water were constantly circulated down the drill bit to ensure that the casing was cleared of all sediments. Once cleared, 1 ft of No. 2 Morie sand was placed at the bottom of the borehole. A 2-in. I.D. schedule 40 PVC 0.010 slot screen with 2-in. I.D. schedule 40 PVC riser was placed down the hollow-steel casing and allowed to rest on the sand at the bottom of the boring. This placement was designed to allow the PVC screen to extend to at least 1 ft above the water table so that any floating material could be sampled; none was observed, however. The water table at LMS-5 is about 0.2 ft above the top of the screen. The annular space between the screen and the borehole was gradually filled with No. 2 sand as the casing was raised. The sand surrounding the well screen acts as a filter, keeping fine-grained sediments from entering the well. The sand was filled to at least 0.5 ft above the top of the well screen.

During retraction of the temporary casing at LMS-3, the bottom 2-ft section of hollow-steel casing became detached in the sand-packed annular space of the well. As the casing had been decontaminated with steam, it should not impact upon the integrity of any water samples drawn from this well. Because the casing section is below the water table, any material floating on top of the water table can still be observed.

A minimum 1-ft-thick bentonite pellet seal was placed above the sand pack. The remainder of the annular space was sealed with concrete grout. LMS-2, LMS-3, and LMS-7 have locking protective steel stickup casings set in the concrete grout over the PVC risers. LMS-1, LMS-4, LMS-5, and LMS-6 have watertight, flush-mount curb boxes set in the concrete over the PVC risers; the risers have locking watertight caps. Detailed diagrams of all four monitoring wells are included with the drilling logs in Appendix D.

2.5 GROUNDWATER LEVEL MONITORING PROBES

Twelve groundwater level monitoring probes (Drawing 1) were installed during Phase 1 to measure the depth to groundwater at different areas on the site. This information was used to calculate water table elevations so that groundwater flow direction could be determined.

The-probes are screened galvanized steel well points, driven by the drill rig into the ground below the water table. The points are 1.25 in. I.D. and 3 ft long with 2 ft of screen. Galvanized steel riser pipe extends from the screen to the ground surface. Approximately 2 ft of stickup above grade was allowed; locking caps were designed and installed by Uhlich personnel. Four probes (P-3, P-9, P-10, and P-11) were finished in flush-grade curb boxes secured with watertight locking caps. Probe P-1, initially completed with a standard stickup, was destroyed by vehicular traffic and subsequently reconstructed in a flush-grade curb box during Phase 2.

Also during Phase 2, probe P-4 was removed and replaced by monitoring well LMS-7.

2.6 SOIL GAS

On 7 February 1989 six soil gas probes (Drawing 1) were installed and monitored on the Uhlich property: three (GP-6, GP-7, GP-8) around the perimeter of the electroplater garage; two (GP-2, GP-3) at the former Zinsser/Harshaw solvent recovery operation; one (GP-1) at the former aniline/monomethylamine tank location. GP-9, a probe planned for the area near the electroplating shop, was not constructed because there was insufficient space between the fence and building to allow access by the drill rig. Because three gas probes were installed in this general vicinity, the loss of GP-9 did not significantly impact upon the investigation of the electroplating area. As described previously, the existence and location of the putative underground gasoline tank could not be confirmed. Therefore, for safety reasons, the gas probes planned for this area (GP-4 and GP-5) were not constructed.

The soil gas probes were constructed by first forming a borehole. At designated boring locations split spoons were advanced; 2-in.-diameter steel rods were driven elsewhere (GP-6, GP-7, GP-8). Polyethylene tubing (0.25 in.) was placed approximately 1 ft above the water table. The boreholes were backfilled with No. 2 Morie sand and sealed at the top with bentonite pellets.

Upon completion, each soil gas probe was purged of three borehole air volumes with a Masterflex peristaltic pump. During and immediately following this activity, the soil gas was monitored with the PID. The 10.2 eV lamp used in the PID is satisfactory for detecting most of the solvents used in electroplating and metal finishing operations. Sensitivity of the lamp in responding to aniline, chlorobenzene, and monomethylamine, chemicals investigated especially at borings/gas probes B-1, B-2/GP-1, B-10/GP-2, B-11/GP-3, and B-13, are as follows:

CHEMICAL	IONIZATION POTENTIAL (eV)	SENSITIVITY (RELATIVE TO 10 ppm)
Aniline	7.70	11.3
Chlorobenzene	8.90	13.0
Monomethylamine	8.97	2.5

Field notes are presented in Appendix E; the results are discussed in Chapter 3.

2.7 PERMEABILITY TESTING

Permeability calculations are useful in determining the rate of groundwater movement. Permeability test results, expressed as hydraulic conductivity, give the rate of flow of water in gallons per day through a cross section of 1 ft^2 (gpd/ft^2). On 3 March 1989 LMS conducted permeability slug tests on each of the four Phase 1 monitoring wells. This test measures the time it takes for the well to reach equilibrium after a volume of water is displaced by a slug made of, in this case, solid stainless steel. A submersible pressure transducer coupled with a strip-chart recorder recorded the aquifer response to the instantaneous head displacement caused by the quick lowering of the slug below the static water table. The strip-chart recording plotted a continuous curve correlating the relative active falling head to time.

The field data from these slug tests were then used in a mathematical formula developed by Bouwer and Rice (1976). The calculation, based on the Thiem equation of steady-state flow to a well, is applicable to completely or partially penetrating wells in unconfined aquifers. The equation gives the hydraulic conductivity (gpd/ft^2) for the aquifer near the well. An example and results of the permeability calculations are included in Appendix F.

The aquifer in the vicinity of the monitoring wells was found to have permeabilities on the order of 10^3 gpd/ft^2 (10^{-1} cm/sec) detailed as follows:

LMS-1	7800 gpd/ft^2	(0.37 cm/sec)
LMS-2	5700 gpd/ft^2	(0.27 cm/sec)
LMS-3	2800 gpd/ft^2	(0.13 cm/sec)
LMS-4	1900 gpd/ft^2	(0.09 cm/sec)

On a scale that ranges from 10^{-8} gpd/ft^2 (10^{-12} cm/sec) for unfractured metamorphic rock to 10^5 gpd/ft^2 (10^1 cm/sec) for coarse gravel, these permeabilities are typical of coarse sands and fine gravels. These results are consistent with the coarse-grained fill and sands and gravel found in the borings for the four wells. Permeability results reported in the DEIS for the Anaconda development to the north are on the order of 10^1 gpd/ft^2 (10^{-3} cm/sec), typical of finer-grained sands, but reasonably close to those for the Uhlich property.

2.8 WELL DEVELOPMENT

The main objective of well development is to increase well productivity and sample quality. Because the wells were screened in fill consisting of ash and other material, well development had to be monitored carefully. Development was accomplished by intermittent pumping and surging. This was done on 21 February 1989 for the Phase 1 wells and 14 June 1989 for the Phase 2 wells. Pumping was accomplished with a 0.5 hp centrifugal pump fitted with well-dedicated polypropylene tubing. The pump was operated at the maximum rate at which the saturated material would produce sufficient head to maintain a constant flow of water. A stainless steel bailer was used to vigorously surge the water column. (LMS-1 was initially developed by hand with a bailer.) This process forced water back into the sand pack from the well and cleaned the borehole of fine-grained material that had been compacted along its walls during the drilling process. Surging water also moved the sand pack, and the settling that resulted decreased its porosity, which increased its filtering capabilities. Measurements were made and records were kept of turbidity (using a field nephelometer), temperature, pH, and specific conductivity of the purged groundwater. Also measured and recorded was the volume of water purged after each slug surge and at varying intervals during pumping. These measurements are reported in Appendix G, along with the equipment calibration data.

The purge volumes and turbidities at the end of development were as follows:

WELL	TOTAL VOLUME PURGED (gal)	TURBIDITY (NTU)
LMS-1	110	>1000
LMS-2	480	8.5
LMS-3	300	4
LMS-4	610	12
LMS-5	28	25
LMS-6	720	6
LMS-7	570	6

Except for LMS-1, which was developed by hand, development produced clear water, well within the New York State Department of Environmental Conservation (NYSDEC) monitoring well guidance of 50 NTU. LMS-1 was subsequently redeveloped by pumping for approximately 1 hr on 1 March, the day of the Phase 1 groundwater sampling; approximately 660 gal were purged to achieve a final turbidity of 10 NTU. LMS-5 was found to have a low yield (28 gal) and accordingly the final turbidity was higher, but still within the 50 NTU target.

2.9 GROUNDWATER SAMPLING

Phase 1 sampling was conducted on four wells on 1 March 1989, approximately one week after development (except for LMS-1, which was redeveloped on 1 March). Phase 2 sampling was conducted during 20-21 June for the seven wells on the Uhlich property and the four wells on the Mobil property. LBG (Mobil's consultant) collected split samples from the Mobil wells. In addition, on 6 July, LBG collected samples from all seven Uhlich wells; LMS collected a split sample from one well on that day. As detailed below, the samples were analyzed for different parameters depending on the date of sampling.

Before sampling, the wells were purged of three to five volumes of water with a vacuum pump fitted with well-dedicated Tygon tubing. Turbidity, pH, conductivity, and temperature were measured during purging and later during sampling. Turbidity and pH calibration were monitored in the field and adjusted as required. (Conductivity meters are calibrated in the LMS laboratory on a weekly basis.) Two conductivity meters were used on site: one for measuring conductivity in every well and the other for assessing quality control with a duplicate sample. Field data sheets, including calibration records, are presented in Appendices H, I, and J for the March, June, and July sampling, respectively. For LMS-1, two different meters were used to measure conductivity during the Phase 1 and Phase 2 samplings; the measurements were within 3%. Turbidity was measured following sampling to help assess the impact of the sampling activities on well water clarity. All postsampling turbidities were below 50 NTU except at LMS-4, which increased from 6 to 90 NTU after sampling during Phase 1.

Because of the high permeability of the aquifer, the water levels in the monitoring wells recovered quickly following purging (Appendices H, I, and J), and sampling was conducted soon after. Nonvolatiles were first sampled with a peristaltic pump and dedicated Tygon tubing. Volatiles samples were collected from the middepth of the water column with laboratory-cleaned Teflon bailers. This procedure and order of sampling ensured that water turbidity would be kept to a minimum.

During the Phase 2 sampling conducted during 20-21 June 1989, a filtered (dissolved) metals sample was collected from each well. Filtering was accomplished on-site with a vacuum apparatus immediately following collection of the well water. The apparatus consisted of a 0.45-micron filter, filter clamp, vacuum flask, and vacuum pump. Unused (fresh) filters and separate laboratory-cleaned filter clamps and vacuum flasks were used for each sample.

Before the bailers and peristaltic pump/Tygon tubing were used, a field blank was collected by running deionized water through the equipment. The volatiles field blank was subsequently analyzed; no compounds were detected. If sample contamination from the field equipment had been suspected, the analytical laboratory would have been authorized to analyze the nonvolatile fractions of the field blank. However, no evidence of sample contamination was found, and the blank was not analyzed during Phase 1. Though no contamination was suspected, the dissolved metals field blank was also analyzed during Phase 2 because of the number of procedures involved in conducting the filtering.

Sample containers were filled as follows:

PARAMETER	MINIMUM VOLUME (ml)	CONTAINER	PRESERVATIVE
Water Samples			
Metals	1000	P	HNO_3 to pH <2
PHC	1000	G	H_2SO_4 to pH <2
PCBs	1000	G	
VOCs	2-40	G	
AE/BN	1000	G	

P - Plastic
G - Glass container
PHC - Petroleum hydrocarbons
AE - Acid extractable organic compounds
BN - Base/neutral organic compounds

Immediately following collection, each sample was labeled with the well identification number, job number, date, time, parameters for which the container was specifically filled, and preservative added. Containers were placed in iced coolers to maintain a constant temperature at or close to 4°C. Sample custody was documented continuously (Appendices H, I, and J).

As previously mentioned, LBG collected samples from the Uhlich wells on 6 July. The sampling was observed by LMS and one split sample was collected from LMS-2. The field data sheets are presented in Appendix J.

Procedures employed by LBG were identical to those used by LMS except as follows:

1. Dedicated bailers rather than pumps were used to purge the wells prior to sampling.

2. In-line filters rather than a vacuum apparatus were used to collect the dissolved metals samples.

Conductivities were independently measured by both LBG and LMS. LMS equipment was used to monitor sample turbidity.

2.10 SURVEYING

Horizontal and vertical surveying of the drilling locations was conducted by Joseph Caruso and Associates. The vertical survey was correlated to the same arbitrary vertical 100-ft datum utilized by LBG so that there could be better coordination of investigations on the Mobil and Uhlich properties. The elevations of the wells and well points based on the LBG datum are presented in Table 2-1. Caruso also verified the locations and measured the vertical elevations of the sewer inverts at each manhole of the sanitary sewer that services the Uhlich and Mobil properties (Table 2-2).

From the horizontal survey and an earlier property survey map, Caruso prepared a base map for the Uhlich property. By superimposing this map on the LBG base map for the Mobil property, a single base map was produced for the two parcels. Selected Mobil wells bordering the Uhlich property were surveyed by Caruso to tie the Uhlich wells into the same vertical datum. The Mobil property was not surveyed, however.

2.11 ANALYTICAL PROCEDURES

2.11.1 PHC

All PHC analyses were conducted by Envirotest Laboratories (Envirotest) of Newburgh, New York. EPA infrared spectrophotometric

TABLE 2-1

VERTICAL SURVEY: WATER LEVEL PROBES AND MONITORING WELLS

LOCATION	TOP ELEVATION
P-1[a]	98.97
P-2	102.42
P-3	98.86
P-4[b]	102.12
P-5	101.08
P-6	101.53
P-7	98.27
P-8	99.07
P-9	99.63
P-10	98.73
P-11	99.80
P-12	101.34
LMS-1	100.22
LMS-2	101.21
LMS-3	100.50
LMS-4	98.54
LMS-5	99.39
LMS-6	100.07
LMS-7	103.06

TOP - Top of piezometer.
Elevations in feet relative to Mobil datum of 100.00.

[a] Reconstructed in flush-grade curb box in June 1989. Previously TOP elevation was 100.61.

[b] Removed in June 1989.

TABLE 2-2

SANITARY SEWER MANHOLE ELEVATIONS

DESIGNATION	ELEVATION	
	RIM	INVERT
SMH 1	98.68	96.01
SMH 2	Buried under macadam pavement	
SMH 3	98.02	95.26
SMH 4	98.49	94.34
SMH 4A	99.46	94.13
SMH 5	98.91	93.98 8-in. VCP 95.46 12-in. CIP
SMH 5A	99.56	93.90 94.40
SMH 6	98.06	93.41
SMH 7	98.17	92.9±
SMH 8	98.56	92.82
SMH 9	97.21	92.09

Elevations in feet relative to Mobil datum of 100.00.

VCP - Vitrified clay pipe.
CIP - Cast iron pipe.

Method 418.1 was used for both groundwater and soil samples (modified method for soil samples).

2.11.2 Soil Analyses

Envirotest analyzed one soil sample for PCBs with gas chromatography (GC) by EPA Method 8080.

All other laboratory analyses were conducted by CAMO Laboratories (CAMO) of Poughkeepsie, New York. For soil samples, parameter groups included priority pollutant volatile organic compounds (VOCs), priority pollutant acid extractable organic compounds (acid extractables), base/neutral organic compounds (base/neutrals), PCBs, and total and leachable metals. VOC soil samples were analyzed with GC/MS (mass spectrometry) by EPA Method 8240, a purge and trap method. CAMO performed a forward library search of the EPA/NIH/NBS mass spectral library to identify and quantify up to 15 nonpriority pollutant compounds of the greatest apparent concentration in the purgeable organic fraction of the priority pollutant scan. For Phase 1 analyses, the method was modified to include analytical standards for monomethylamine, which also required that the run time of the equipment be modified to encompass the early purge of this chemical. This procedure was added because of the reported bulk storage of monomethylamine north of Building 57 by Zinsser/Harshaw. For Phase 2, monomethylamine was separately analyzed by direct injection into a flame ionization detector to avoid the problems of carryover into the GC that were experienced during Phase 1.

Analysis for AE compounds in soils was conducted with GC/MS by EPA Method 8270, a capillary column method, modified to incorporate an additional aniline standard for soil samples collected near former aniline bulk storage tanks. This procedure resulted in the analysis of all priority pollutant acid extractables and a tentative identification/quantification of nonpriority pollutant acid extractables, as noted above for VOCs. Soil was analyzed for acid extractables only during Phase 1.

Two soil samples were analyzed for base/neutrals during Phase 2. Analysis was conducted with GC/MS by EPA Method 8250. Also during Phase 2, several selected soil samples were analyzed for EP toxicity (arsenic, cadmium, and lead only). The extract was also analyzed for copper, iron, manganese, and zinc, referred to here as leachable metals. The soil samples were also analyzed for total metals. Table 2-3 lists the methods used for the metals analyses. As detailed in Chapter 3, some of the Phase 2 metals analyses were conducted on soil samples collected during Phase 1 and archived in drillers' jars by Uhlich. The absence of chemical cleaning of these jars does not materially impact upon these types of analyses. The sample selection was biased so that mostly samples containing ash and/or slag would be analyzed.

2.11.3 Water Analyses

During Phase 1 the VOC analyses on water samples were conducted with GC/MS by EPA Method 624, modified to incorporate additional standards for monomethylamine, diethyl ether, ethyl ether, and ispropyl ether. The ether standards were included because of LBG's report of ether in the groundwater on the northern portion of the Mobil property and near the center of the western side of that property. During Phase 2 the VOC analyses were conducted by EPA Methods 601 and 602 (GC methods). This changed protocol for VOCs allowed a lower laboratory dilution of some samples during analysis and also provided two separate measurements of chlorobenzene, analyzed by both Method 601 and Method 602. As with the Phase 2 analyses for soils, monomethylamine was analyzed separately from the other volatiles by direct injection into a flame ionization detector.

TABLE 2-3

ANALYTICAL PROCEDURES FOR METALS

PARAMETER	EPA METHOD WATER	 SOIL
Antimony	204.1	
Arsenic	206.2	7060
Beryllium	210.1	
Cadmium	213.1	7130
Chromium	218.1	7190
Copper	220.1	7200
Iron	236.1	7380
Lead	239.1	7421
Manganese	243.1	7460
Mercury	245.1	
Nickel	249.1	
Selenium	270.2	
Silver	272.1	
Thallium	279.2	
Zinc	289.1	7950

Blank - metals not tested.

Base/neutrals and acid extractables were analyzed for with GC/MS by EPA Method 625, modified to include the additional aniline standard. As with the soil samples, a tentative identification/quantification of nonpriority pollutant compounds was also made.

PCBs were analyzed with GC by EPA Method 608 during Phase 1 only; cyanide was analyzed by EPA Method 335 during Phase 1 only. All Phase 1 groundwater samples were analyzed for priority pollutant metals plus iron and manganese (see Table 2-3 for analytical methods) and chlorides (EPA Method 325.2). During Phase 2 the metals analyses on groundwater samples were limited to arsenic, copper, iron, lead, manganese, and zinc.

The samples collected by LBG during June and July 1989 were apparently delivered to the Mobil laboratory in Paulsboro, New Jersey. As of this writing, Mobil has not released a report on these samples, and LMS does not know whether the samples were ever analyzed.

2.12 Water Level Measurements

Static water levels were measured several times in selected Uhlich and Mobil monitoring wells and water level probes during the course of the investigation. The information is summarized in Appendix K.

LMS and LBG measured water levels in all Uhlich and Mobil wells on 20 June. It took approximately 3 hrs to complete the measurements on the Mobil property. LBG indicated that continuous measurements were made at the Mobil wells in 1987 to determine lag times between the tidal fluctuations and water level response in the wells, but that information has not been formally reported. As a result, most of the 20 June data on the Mobil wells cannot be interpreted. Therefore, the groundwater flow patterns estimated by LMS are limited to the Uhlich wells and the Mobil wells along the Mobil-Uhlich property line that appear to exhibit minimal tidal fluctuations.

CHAPTER 3

FINDINGS

3.1 GEOLOGY AND HYDROGEOLOGY

3.1.1 Geology

The bedrock underlying the Uhlich property is identified as the Inwood Marble and Fordham Gneiss formations, according to the 1970 U.S. Geological Survey (USGS) geologic map of New York. The principal rock of the Inwood Marble formation, which overlies the Fordham Gneiss, is a dolomitic marble. "Dolomitic" refers to the presence of the mineral dolomite, a calcium and magnesium carbonate (Schuberth 1968). According to the NUS report, the fracture zones in the bedrock occur at a depth of 350 ft. Borings advanced to bedrock on the former Anaconda property north of the Uhlich property indicate that the bedrock consists predominantly of gneiss, with several limestone intrusions. Depth to bedrock in these borings ranged from 50 to 100 ft. LMS advanced borings to a maximum depth of 18 ft without encountering bedrock.

According to the NUS report, there is only one water supply well penetrating the Fordham Gneiss within a 4-mile radius of the Tappan Terminal. This well serves the Andrus Memorial Home, 0.3 miles southeast of the property. The direction of groundwater flow in the rock in this vicinity is undoubtedly from east to west toward the Hudson River. Therefore, the bedrock aquifer below the Tappan Terminal is downgradient of this supply. (Note that "no significant contaminants" were detected in a 1989 NUS sample of water from this well.)

The native overburden identified in the Anaconda DEIS consists of 10- to 50-ft-thick sands overlain by organic silts and clays 7 to 26 ft thick. The Anaconda findings are similar to LBG's findings for the Mobil property. LBG reported a silt and clay lens 2 to 4 ft below grade at drill site OW-12. The clay was not found elsewhere at that site. Because LMS observed no clay at nearby borings B-1 and LMS-1, it appears to be limited. Some thin layers of clay and silt and clay were found in the fill elsewhere (B-3, B-3A, and B-5) on the Uhlich property.

Historical maps uncovered during this investigation (Figure 1-2) show that the northern quarter of the Uhlich property was filled no later than 1868. A survey of the Hudson River shoreline (COE 1906) indicates that the southern half of the Uhlich property and most of the Mobil property was still underwater until 1906. Most of the remainder of the Uhlich property was filled in by 1923, and the Mobil property by 1942. LMS encountered only fill, which consisted primarily of crushed stone and brick and ash along with sands, silts, glass, and wood, except at the easternmost side of the property, where native sediments were encountered at LMS-5 and LMS-6 (Figure 1-2). The 14-16 ft sample from LMS-5 was a clayey silt with gravel, grading to all clayey silt. The 13-15 ft sample from LMS-6 had a small recovery (0.1 ft) of gray silt. These silts and clays are most likely native sediments of the Hudson River. There was no recovery for the deep sample (16-18 ft) at LMS-7, probably because of the soupy texture of the subsurface material.

3.1.2 Hydrogeology

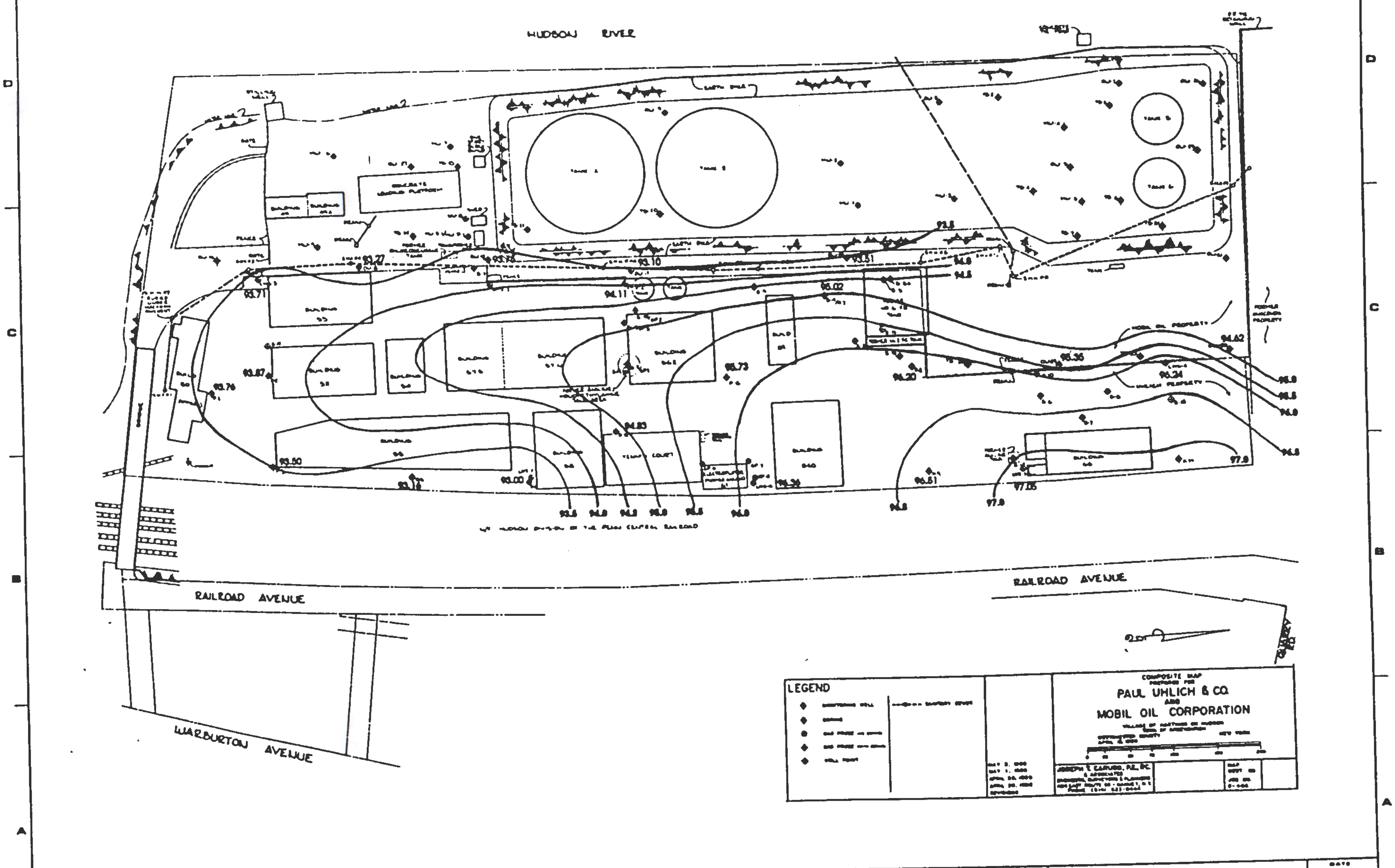
The depth to the water table is relatively shallow throughout the site (Appendix K), ranging from approximately 3 ft to 6 ft below grade. A water table contour map (Figure 3-1) has been constructed from water level data collected on 20 June 1989. Because the water level data from the Mobil wells were collected over a 3-hr period, only the data from the least tidally influenced Mobil wells closest to the Mobil/Uhlich property line were incorporated into the contouring.

As indicated in Figure 3-1, direction of groundwater flow is generally from inland toward the Hudson River and Mobil property. There is, however, a north to south flow through the center of the Uhlich property that eventually trends both west toward the Mobil property and east toward the railroad tracks. The eastward flow of groundwater from the center of the Uhlich property has a comparatively steep gradient in the area of Building 58. However, measurements taken along the eastern Uhlich property line indicate that groundwater flows north to south along the railroad, possibly a result of the highly permeable fill commonly used for railroad construction. Old storm sewers in that area may also impact on the groundwater movement. Several inquiries made to determine the availability of information on the subsurface of this portion of the railroad produced nothing. Copies of the correspondence are presented in Appendix L.

Because most of the property is covered with asphalt, the groundwater is likely recharged from upgradient areas to the northeast. The existence of the westward-flowing underground formation reported by Uhlich personnel between Buildings 54 and 57S is not confirmed by the water table map.

LBG studied the influence of Hudson River tidal fluctuations on the water levels in the Mobil monitoring wells. Although the tidal influence on the water table is significant in areas close to the Hudson River, it decreases with distance from the river and becomes negligible (0.1 to 0.2 ft) at the Uhlich/Mobil property line. Therefore, the continuous water level recording contemplated for the LMS investigation was not initiated for the Uhlich property.

FIGURE 3-1



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20 JUNE 1989

WATER TABLE ELEVATION
AT THE UHLICH PROPERTY

1

The water table elevation and sanitary sewer are profiled in Figure 3-2. The water table is below the invert line along the southern two-thirds of the sanitary sewer (SMH 1 through 6). There is possible leakage (exfiltration) here from the sanitary sewer to the groundwater. The water table intersects the invert between SMH 6 and 7 and is above the invert line along the northern one-third of the sanitary sewer. Potential leakage (infiltration) here is from the groundwater into the sewer.

3.2 CHEMISTRY RESULTS - OVERVIEW

The chemistry results for groundwater sampled in March, June, and July are presented in Appendices H, I, and J, respectively. The chemistry results for soil samples are presented in Appendix M. Tables 3-1 through 3-4 (soil samples) and 3-5 through 3-8 (groundwater samples) summarize the results as follows:

- Table 3-1. Soil Sampling Results - Petroleum Hydrocarbons Samples. This table summarizes Envirotest's PHC results for 21 soil samples and observations made during sample collection (PID measurements and presence of odors or staining), as noted in the drill logs.

- Table 3-2. Soil Sampling Results - Volatiles. This table summarizes CAMO's volatiles results for soil samples along with observations made during drilling. Chlorobenzene, toluene, and trichloroethylene were present in these samples. (Section 3.7.8 discusses the monomethylamine results.) No other volatiles were detected and there were no additional nonpriority pollutant peaks in the chromatograms for these samples.

- Table 3-3. Soil Sampling Results - Base/Neutrals. Two samples collected in June were analyzed for base/neutrals.

- Table 3-4. Soil Sampling Results - Metals. This table summarizes the analyses for total metals and EP toxicity for arsenic and lead. The extracts for the toxicity tests were also analyzed for

FIGURE 3-2
SANITARY SEWER PROFILE

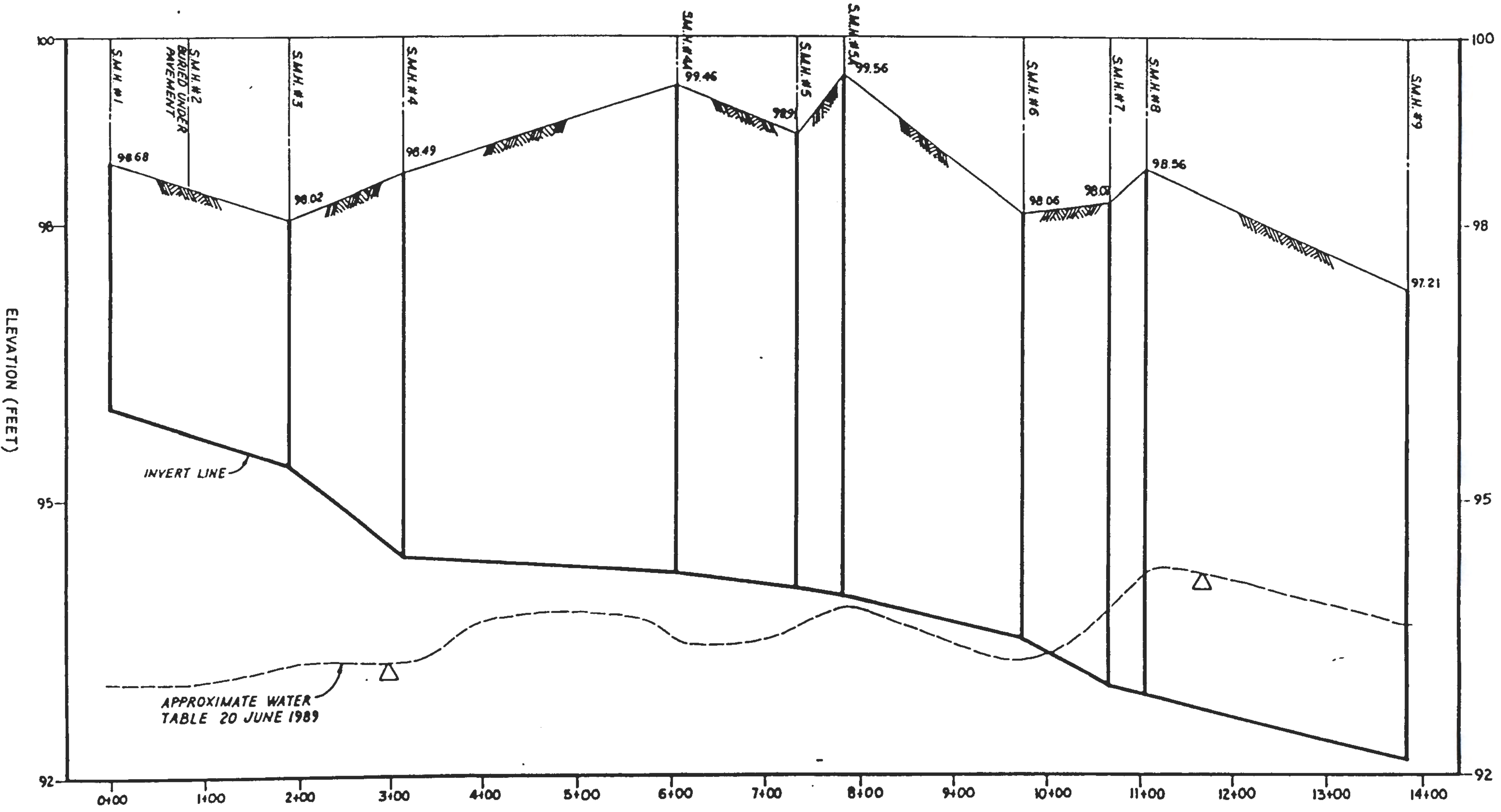


TABLE 3-1

SOIL SAMPLING RESULTS - PETROLEUM HYDROCARBONS

LOCATION	DEPTH (ft)	PHC CONCENTRATION (mg/kg)	DRILLING OBSERVATIONS PID (ppm)	ODOR	STAINING
B-3 Previous No. 6 FO tank	4-6	330	0	P	
	8-10	12,000	0	SP	Oily sheen
B-4 100 ft S of B-3 (oil spill area)	0-2	2,200	0		
	2-4	46	0-4	P	
	4-6	<23	0-2	P	
B-5 100 ft SE of B-3 (former No. 2 FO tank)	0-2	580	0		
	2-4	390	0-10	SP	
	4-6	120	200	VSP	
B-6 Northern site (lease area)	0-2	840	0		
	4-6	<20	0-6	SP	
B-7 Northern site (lease area)	0-2	8,200	1-16	P	
	4-6	1,000	0		
B-8 Northern site (lease area)	0-2	3,000	0	P	
	4-6	76	0	P	
B-9 Contemplated pH system	2-4	230	1	a	
	8-10	<23	0-1		Sheen on water
B-10 Zinsser/Harshaw solvent recovery area	2-4[b]	11,800	1-20	SP	
B-16 Previous No. 6 FO tank	2-4	3,700	0		Saturated with oil. Black.
	4-6	16,000	1		
LMS-2	2-4	350	7	VSP	
	4-6	6,400	7	VSP	

[a] Slight unpleasant (chemical) odor.
[b] Also analyzed for volatiles (Table 3-3).

FO - Fuel oil
P - Petroleum
SP - Strong petroleum
VSP - Very strong petroleum

Note: All analyses performed on January-February 1989 samples except B-16 (June 1989).

TABLE 3-2

SOIL SAMPLING RESULTS - VOLATILES

		CONCENTRATION (mg/kg)					DRILLING OBSERVATIONS		
LOCATION		CHLOROBENZENE	TOLUENE	TRICHLOROETHYLENE	MONOMETHYLAMINE	OTHERS[a]	PID (ppm)	ODOR	STAINING
B-1	3-5 ft	0.4	0.37	<0.1	b	<0.1	1-14	SlC	
B-1	9-11 ft	2.9	0.4	<0.1	b	<0.1	0.5		
B-2	2-4 ft	<1	<1	<1	b	<1	0		
B-2	6-8 ft	<1	<1	<1	b	<1	0	DO	
B-10	2-4 ft[c]	120	<0.1	<0.1	b	<0.1	1-20	SP	
B-10	4-6 ft	42	<0.1	<0.1	b	<0.1	30	SP	
B-10	8-10 ft	89	<0.1	<0.1	b	<0.1	20		
B-11	6-8 ft	0.2	<0.1	<0.1	b	<0.1	-	P	
B-17	2-4 ft				<250		-		
LMS-1	2-4 ft	1.2	0.3	0.4	b	<0.1	0		
LMS-1	8-10 ft	21	<0.1	<0.1	b	<0.1	0.5		

B-1 and LMS-1 located near former chlorobenzene tank.
B-2 located near former monomethylamine tank.
B-10 and B-11 located near former solvent recovery and downgradient of B-2.

SlC - slight chemical
DO - decaying organic
SP - strong petroleum
P - petroleum

[a] Detection limits for some volatiles, e.g., acrolein, are higher than shown in this table. See Appendix H for detection limits for each chemical. No additional nonpriority pollutant peaks were present in the chromatograms for these samples.

[b] See Section 3.7.8 for discussion of monomethylamine results.

[c] Also analyzed for PHC - 11,800 mg/kg (Table 3-2).

Note: All analyses performed on January-February 1989 samples except B-17 (June 1989).

TABLE 3-3

SOIL SAMPLING RESULTS - BASE/NEUTRALS

PARAMETER	CONCENTRATION (mg/kg) B-19 (6-8 ft)	 B-16 (2-4 ft)
Bis(2-ethylhexyl)phthalate	<1.0	3.6
Fluoranthene	<1.0	5.3
Chrysene	<1.0	3.4
Pyrene	<1.0	9.6
Phenanthrene	<1.0	6.0
Anthracene	<1.0	1.7
Benzo(a)anthracene	<1.0	2.4
Benzo(b)fluoranthene	<1.0	1.4
Benzo(a)pyrene	<1.0	1.5
Others	<1.0	<1.0

Note: All analyses performed on June 1989 samples.

TABLE 3-4

SOIL SAMPLING RESULTS - METALS

	DEPTH	TOTAL METAL (mg/kg)						LEACHABLE METALS (ug/l)					
BORING	(ft)	As	Cu	Fe	Pb	Mn	Zn	As	Cu	Fe	Pb	Mn	Zn
LMS-1	4-6[a]	27	9800	49800	570	111	300	<5	69000	460	<500	360	530
LMS-1	10-12[a]	20	345	25200	200	55	72	<5	60000	90	<500	350	610
LMS-2	6-8[a]	3	2040	6100	1960	62	3600	7	290	1560	<500	570	23000
LMS-3	4-6[a]	5	920	13550	100	66	2400	<5	9200	330	<500	140	38000
LMS-4	2-4	6	590	8900	550	505	530	<5	200	100	<500	250	2100
LMS-5	14-16	4	20	20400	40	485	60	<5	30	170	<500	5950	140
LMS-6	2-4[b]	19	187	11350	190	169	870	21	90	<50	<500	120	700
LMS-7	2-4	2	126	30000	110	240	144	5	160	90	<500	2400	900
LMS-7	4-6[a,b,c]	31	244	28400	1760	244	104	<5	120	<50	3900	1130	450
B-2	4-6[a]	15	550	17000	33	148	265	<5	780	110	<500	570	4800
B-9	4-6[a]	5	630	30700	3140	1530	2000	<5	2100	80	1000	32000	1800
B-10	4-6[a]	10	325	16000	480	119	740	<5	80	470	<500	1200	1700
B-16	2-4[a,b]	24	199	4620	880	770	184	11	50	790	<500	2060	4600
B-16	6-8	1	51	16600	60	234	61	6	60	1780	<500	3980	170
B-18	2-4	3	74	12300	100	420	57	<5	100	60	<500	5000	400
B-18	6-8	1	16	5650	50	169	44	<5	120	1400	<500	2480	260
B-18	10-12	9	15	4270	60	258	44	<5	40	2830	<500	2700	230
B-19	4-6	36	250	18050	920	22	320	<5	6550	90	<500	180	3300
EP toxicity limit:								500			5000		

[a] Ash present (drill log).

[b] Slag present (drill log).

[c] Chromiumlike flakes present (drill log). Sample also analyzed for chromium: 16 mg/kg and <30 ug/l.

Note: All analyses were performed on June 1989 samples except that LMS-1, LMS-2, LMS-3, LMS-4, B-2, B-9, and B-10 samples were collected during January-February 1989 and analyzed in June 1989.

TABLE 3-5

GROUNDWATER SAMPLING RESULTS

19 March 1989

PARAMETER	CONCENTRATION (ug/l unless otherwise noted) LMS-1	LMS-2	LMS-3	LMS-4	TOGS[a]
Metals					
Antimony	10	<10	<10	<10	3
Arsenic	5	8	8	14	25
Copper	20	300	320	270	1,000
Lead	20	97	89	670	25
Silver	10	10	<10	10	50
Zinc	20	120	300	680	5,000
Iron	440	740	2,200	7,700	300
Manganese	450	890	40	760	300
On-Site Chemistries					
pH (SU)	6.2	6.6	6.4	7.1	6.5-8.5
Conductivity (umhos/cm)	1,897	1,640	996	989	
Temperature (°C)	13.1	9.7	10.5	7.9	
Turbidity (NTU)	16	18	54	6	
PHC	<500	<500	<500	<500	
PCBs[b]	<10	<10	<10	<10	0.1
Chlorides (mg/l)	320	320	178	116	250
Volatiles					
Chlorobenzene	8,100	1,000	240	33	20
Toluene	<100	28	19	140,000	50
Tetrachloroethylene	<100	27	31	43	0.7
Benzene	<100	<10	43	<5	ND
Methylene chloride	<100	<10	<10	1,400	50
Monomethylamine	<1,000	<1,000	<1,000	<1,000	
Ethers[c]	<50	<50	<50	<50	
Others[d]	<100	<10	<10	<5	
Semivolatiles					
2-Chlorophenol	12	<10	<10	<10	1
Benzo(b)fluoranthene	<10	<10	23	<10	2
Others[e]	<10	<10	<10	<10	

Not detected - beryllium (<10 ug/l), cadmium (<10 ug/l), chromium (<10 ug/l), mercury (<0.2 ug/l), nickel (<50 ug/l), selenium (<5 ug/l), thallium (<10 ug/l), cyanide (<20 ug/l).

ND - none detectable.

pH, conductivity, and temperature measured on site by LMS; PHC by Envirotest; all others by CAMO.

[a] The Class GA guidance values, presented for general reference only, are not considered appropriate for this area, which has the characteristics of a Class GSA or GSB aquifer.
[b] See Section 3.3 for a discussion of sample interferences.
[c] Diethyl ether, ethyl ether, isopropyl ether.
[d] Detection limits for some volatiles, e.g., acrolein, are higher than shown in this table. See Appendix H for detection limits for each chemical. No additional nonpriority pollutant peaks were present in the chromatograms for these samples.
[e] No other semivolatiles, including aniline as an acid extractable, were detected (10 ug/l detection limit for most compounds - see Appendix H). No additional nonpriority pollutant peaks were present in the chromatograms for these samples.

TABLE 3-6

GROUNDWATER SAMPLING RESULTS

20-21 June 1989

PARAMETER	LMS-1	LMS-2	LMS-2[a]	LMS-3	LMS-4	LMS-5	LMS-6	LMS-7	OW-12	OW-17	OW-18	OW-19
	CONCENTRATION (ug/l) unless otherwise noted											
EPA Method 602 VOCs												
Chlorobenzene	4000	1700	800	190	<1	<1	<1	<1	7000	4000	1000	<1
Benzene	<100	<10	11	<1	<1	5	<1	<1	<100	<100	<100	<1
Toluene	<100	<10	<10	<1	<1	1	<1	<1	<100	<100	<100	<1
Ethylbenzene	<100	<10	<10	<1	<1	3	<1	<1	<100	<100	<100	<1
Xylenes	<300	<30	<10	<3	<3	7	<3	<3	<300	<300	<300	<3
1,4-Dichlorobenzene	<300	<30	<10	<3	<3	32	<3	<3	<300	<300	<300	<3
Others	<300	<30	<10	<3	<3	<3	<3	<3	<300	<300	<300	<3
EPA Method 601 VOCs												
Chlorobenzene	5200	1500	900	200	<1	<1	<1	<1	10000	4800	1300	<1
Dichlorodifluoromethane	<100	<10	<10	<1	<1	13	<1	<1	<100	<100	<100	<1
Trans-1,2-dichloroethylene	<100	<10	<10	<1	<1	2	<1	<1	<100	<100	<100	<1
Others	<100	<10	<10	<1	<1	<1	<1	<1	<100	<100	<100	<1
Monomethylamine (mg/l)	<10	<10	<10						<10	<10		
Metals (Total)												
Arsenic	3	<3	<5	<3	4	<3	<3	3	<3	4	<3	<3
Copper	70	70	510	120	30	40	40	40	150	30	40	20
Iron >300	180	440	1100	1500	890	5000	510	1200	23000	570	800	250
Lead 25	4	<3	38	16	11	10	5	10	28	110	5	10
Manganese >300	390	1320	1100	150	440	1800	70	340	610	960	1020	2220
Zinc	70	30	110	160	30	20	70	40	2400	60	140	20
Metals (Dissolved)												
Arsenic	<3		<5			<3		<3	<3			
Copper	50		30			40		20	30			
Iron	220		850			2900		270	18000			
Lead	<3		<5			5		<5	27			
Manganese	390		1100			200		220	540			
Zinc	50		30			60		50	170			
Chlorides (mg/l)	400	340	247	420	110	4420	215	720	218	560	760	680
Turbidity (NTU)	2	4.5	10	2.5	5	11	2.5	20	25	5	9	8.5
pH (SU)	6.2	6.4	6.6	6.5	7.0	7.1	7.1	7.3	5.6	6.5	6.7	7.1
Conductivity (umho/cm)	2200	2580	1520	2710	990	11500	1470	2600	1830	2570	3170	2070

[a] Sampled 6 July 1989.

Note: LMS-5 sample analyzed for PHC (<500 ug/l).

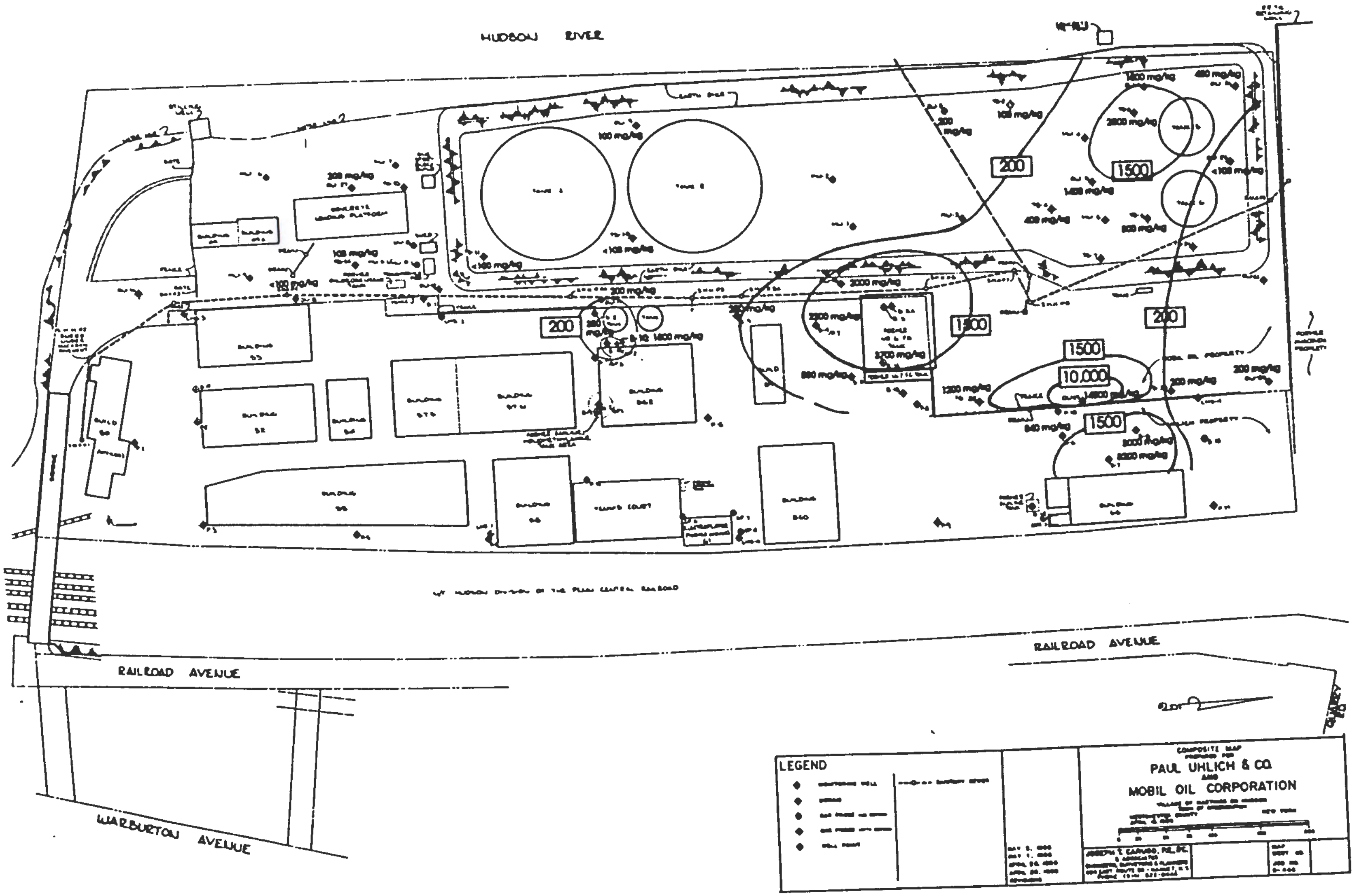
TABLE 3-7

COMPARISON OF ANALYTICAL RESULTS - UHLICH WELLS

March, June, and July 1989

PARAMETER	CONCENTRATION (ug/l unless otherwise noted)								
	LMS-1		LMS-2			LMS-3		LMS-4	
	MAR	JUN	MAR	JUN	JUL	MAR	JUN	MAR	JUN
Volatiles									
Chlorobenzene (Method 624)	8100		1000			240		33	
Chlorobenzene (Method 601)		5200		1500	900		200		<1
Chlorobenzene (Method 602)		4000		1700	800		190		<1
Tetrachloroethylene	<100	<100	27	<10	<10	31	<1	43	<1
Methylene chloride	<100	<100	<10	<10	<10	<10	<1	1400	<1
Benzene	<100	<100	<10	<10	11	43	<1	<5	<1
Toluene	<100	<100	28	<10	<10	19	<1	14000	<1
Metals (Total)									
Arsenic	10	3	<10	<3	<5	<10	<3	<10	4
Copper	20	70	300	70	510	320	120	270	30
Iron	440	180	740	440	1100	2200	1500	7700	890
Lead	20	4	97	<3	38	89	16	670	11
Manganese	450	390	890	1320	1100	40	150	760	440
Zinc	20	70	120	30	110	300	160	680	30
Chlorides (mg/l)	320	400	320	340	247	178	420	116	110
Turbidity (NTU)	16	2	18	4.5	10	54	2.5	6	5
pH (SU)	6.2	6.2	6.6	6.4	6.6	6.4	6.5	7.1	7.0
Conductivity (umhos/cm)	1897	2200	1640	2580	1520	996	2719	989	990

FIGURE 3-3



◆ 200 mg/kg PHC concentration (mg/kg)

-[200]- Contour line of approximate concentration (mg/kg)

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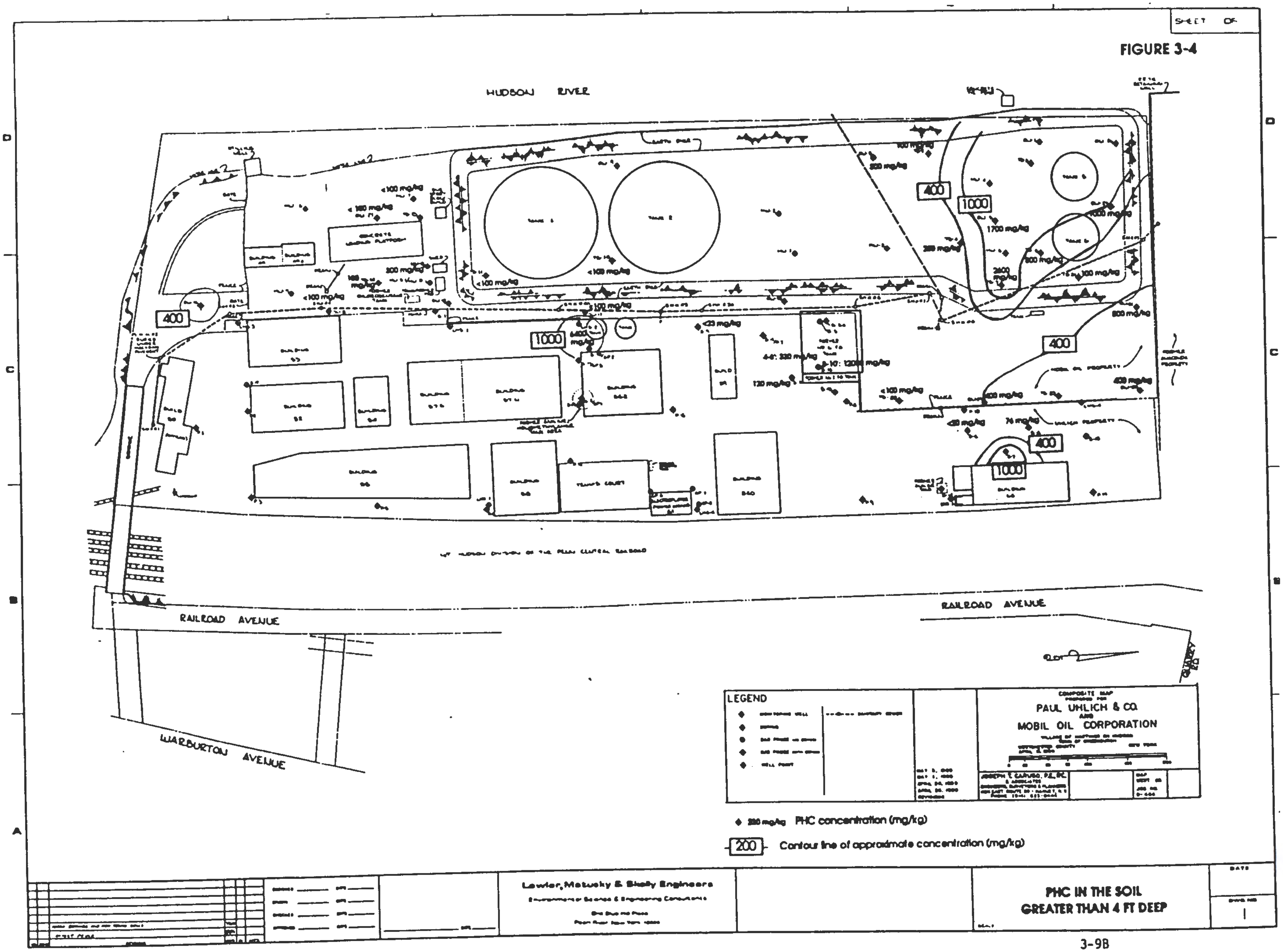
PHC IN THE SOIL 0-4 FT DEEP

1

3-9A



◆ 200 mg/kg PHC concentration (mg/kg)

$\boxed{200}$ Contour line of approximate concentration (mg/kg)

FIGURE 3-4

PHC IN THE SOIL
GREATER THAN 4 FT DEEP

TABLE 3-8

COMPARISON OF ANALYTICAL RESULTS - MOBIL WELLS

November 1986 and June 1989

PARAMETER	CONCENTRATION (ug/l unless otherwise noted)							
	OW-12		OW-17		OW-18		OW-19	
	1986	1989	1986	1989	1986	1989	1986	1989
Volatiles								
Chlorobenzene (Method 624)	12380		9520		907		<6	
Chlorobenzene (Method 601)		1000		4800		1300		<1
Chlorobenzene (Method 602)		7000		4000		1000		<1
1,2-Dichlorobenzene[a]	<1.9	<300	64.3	<300	48.4	<300	<1.9	<300
1,3-Dichlorobenzene[a]	<1.9	<300	<1.9	<300	22.7	<300	<1.9	<300
1,4-Dichlorobenzene[a]	BMDL 4.4	<300	154	<300	74.9	<300	<4.4	<300
Metals (Dissolved)								
Arsenic	<5	<3	<5		<5		6	
Copper	<50	30	<50		<50		<50	
Iron		18000						
Lead	<50	27	<50		<50		<50	
Manganese		540						
Zinc	2070	170	<60		<50		70	
pH (SU)	5.8	5.6	6.4	6.5		6.7	7.1	7.1
Conductivity (umho/cm)	73	1830	120	2570		3170	60	2070

June 1989 chlorobenzene concentrations calculated from average of Methods 601 and 602 results.
BMDL 4.4 - Chemical present below 4.4 ug/l method quantification limit.

[a] Base/neutral (EPA Method 625) analysis for 1986 sample.

copper, iron, manganese, and zinc. Most of the samples contained ash and slag. One sample was tested for chromium.

- Table 3-5. Groundwater Sampling Results (1 March 1989). This table summarizes CAMO's results for priority pollutant metals, iron, manganese, cyanide, chlorides, volatiles, and semivolatiles as well as LMS' results for pH, conductivity, temperature, and turbidity. Envirotest's results for PHC are also shown. Because of the elevated chloride and conductivity levels in the groundwater and because the groundwater is in an estuarine segment of the Hudson River, the fill might be either a Class GSA or GSB aquifer. Because there are no GSA water quality criteria, NYSDEC regional staff have used GA criteria as a frame of reference to evaluate similar sites along the Hudson. Therefore, the NYSDEC TOGS 85-W-38 guidance values for Class GA groundwaters are presented for general information. However, LMS does not consider these values to be appropriate to the site because the aquifer is high in chlorides and is man-made fill in an estuarine segment of the Hudson River.

- Table 3-6. Groundwater Sampling Results (20-21 June 1989). This table summarizes CAMO's laboratory report and LMS' field measurements. Four samples (LMS-1, LMS-2, OW-12, and OW-17) were tested for monomethylamine. Four dissolved metals samples (LMS-1, LMS-5, LMS-7, and OW-12) were analyzed; the remainder have been temporarily archived. These samples were selected to cover a range of turbidities and to obtain at least one dissolved metals analysis for each property. As indicated previously, chlorobenzene was analyzed by two methods.

- Table 3-7. Comparison of Analytical Results - Uhlich Wells (March, June, and July 1989). This table summarizes the comparable March and June analyses for LMS-1, LMS-2, LMS-3, and LMS-4 and the July analyses for LMS-2.

- Table 3-8. Comparison of Analytical Results - Mobil Wells (November 1986 and June 1989). This table summarizes the comparable November 1986 analysis reported by LBG and the June 1989 analysis by LMS for OW-12, OW-17, OW-18 and OW-19.

In the four soil samples (B-2: 2-4 ft and 6-8 ft; B-14: 0-2 ft and 4-6 ft) analyzed for acid extractables (plus aniline), none were detected at the detection limits of 10 or 50 ug/kg, depending on the compound.

The following sections of this chapter discuss these findings. For ready reference, Table 3-9 summarizes the organic gas measurements and other observations during drilling and also shows the PID measurements for the gas probes.

3.3 PCBs

3.3.1 Soil

One soil sample was analyzed by Envirotest Laboratories for PCBs (B-15: 2-4 ft). None were detected at a 0.58 mg/kg detection limit. (See Appendix M for the laboratory's data sheet.)

NUS reported trace (0.38 mg/kg) PCBs in the surficial soil sample collected from the nearby drainage way from the Uhlich to the Mobil property. Therefore, trace levels may also be present on the adjacent Uhlich property, but the source of the PCBs on the Mobil drainage way is unknown.

The June 1987 Mobil report reproduced in the 1988 NUS report also indicated that PCBs were present on the Mobil property. Concentrations in the 3.6 to 8.6 mg/kg range were attributed to transformers. That report indicated that PCBs may have migrated onto the Mobil property from the former Anaconda property, but no data were presented.

TABLE 3-9

SUMMARY OF VAPOR MEASUREMENTS DURING DRILLING

	OPEN BOREHOLE		PID	PID MEASUREMENTS OF SPLIT-SPOON SAMPLES (ppm)					
LOCATION	CGI (% LEL)	PID (ppm)	GAS PROBE (ppm)	0-2 ft	2-4 ft	4-6 ft	6-8 ft	8-10 ft	10-12 ft
South of Site									
B-19				0	0	0	0		
LMS-3				0	0	0	0		
LMS-7				2-3	5	3	5		
Near Former Chlorobenzene Tank									
B-1				0	0	1-14[a]	0	0	0.5
LMS-1	0			0	0	0	0	0	0.5
Near Former Zinsser/ Harshaw Solvent Recovery Area and Aniline/Monomethylamine Tanks									
B-2/GP-1			0.0	0	0	0	0		
B-10/GP-2			2.8	0	1-20[b]	30[b]	14[b]	20[b]	
B-11/GP-3			1.1	0			0[b]		
B-17									
LMS-2	25			7[b]	7[b]	7[b]	13[b]	7[b]	
Northern Half of Site									
B-3				0		0[b]	0-1[b]	0[b]	
B-3A				0	0	0-7[b]			
B-4				0	0-4[b]	0-2[b]			
B-5				0	0-10[b]	200[d]			
B-6	0			0	0	0-6[b]			
B-7	0	0		1-16	0	0			
B-9	30	0		0	1[a]	0-1[a]	0-1[a]	0-1[a]	
B-14[c]				4[a]	1[a]	0			
B-15				0	0				
B-16				0	0	1	1	0	0
B-18									
LMS-4	0			0	0	0			
LMS-5									
Electroplater									
GP-6			1.3						
GP-7			2.8						
GP-8			0.2						
LMS-6				0	0	0	0		

---

[a] Chemical odor.

[b] Petroleum odors.

[c] Aniline tank area.

[d] See Section 3.6.1.

3.3.2 Groundwater

None of the Uhlich monitoring wells contained detectable levels of PCBs, although CAMO reported a high level of interference in the PCB extracts and a 100-fold dilution was required to complete the analyses. As a result, the detection limit was high (10 ug/l).

According to the 1987 Mobil report appended to the NUS report, PCBs were detected (28 ug/l) in one Mobil groundwater sample collected from OW-1. The 1989 NUS sample from this well contained no PCBs.

3.4 ANILINE AND ACID EXTRACTABLES

3.4.1 Soil

Four soil samples were analyzed for aniline and other acid extractables:

B-2 (monomethylamine/aniline tank area): 2-4 ft and 6-8 ft
B-14 (aniline tank area): 0-2 ft and 2-4 ft

At a 0.01 mg/kg detection limit, no aniline or other acid extractables were detected in the soil samples.

3.4.2 Groundwater

No aniline or other acid extractables were detected in the groundwater samples, although 12 ug/l of 2-chlorophenol was present in the LMS-1 sample. This chemical was detected at higher concentrations in two downgradient Mobil monitoring wells (OW-12: 44.7 ug/l; OW-17: 79.3 ug/l). No use of 2-chlorophenol was reported by either Mobil or Uhlich. The only other acid extractable measured in a Mobil well was 2,4-dichlorophenol (4.4 ug/l).

3.5 BASE/NEUTRALS

3.5.1 Soil

No base/neutrals were detected in one soil sample (B-19: 6-8 ft). Bis(2-ethylhexyl)phthalate was reported in the B-16, 2-4 ft sample. The reported presence of this compound may be a result of laboratory contamination, however, which is common, rather than actual environmental conditions. Eight other compounds were detected in the B-16 sample. The drill log for this boring indicates that a portion of this sample was saturated with tar. Benzo(a) b-fluoranthene, one of the nine base/neutral compounds present in this soil sample, was also detected in February in downgradient well LMS-3 (23 ug/l).

All four base/neutrals reported by NUS in the sample collected from the Mobil swale that drains from the Uhlich property were present in the B-16 sample. Benzo(a)fluoranthene + Benzo(b) Fluoranthen was present in the B-16 sample, but not in the NUS sample. Uhlich reports that these chemicals are not used in its pigment manufacturing. No documentation has been uncovered linking the chemicals to Zinsser/Harshaw. It is likely that the base/neutrals in the NUS sample are derived from asphalt particles as the Uhlich property is largely paved.

3.5.2 Groundwater

Benzo(b)fluoranthene, the only base/neutral detected in the Uhlich groundwater samples (23 ug/l in LMS-3), was not present in any of the Mobil wells.

Other base/neutrals, most notably 1,2-, 1,3-, and 1,4-dichlorobenzene, were present in Mobil wells in OW-17 and OW-18. As noted above, these chemicals were not present in the Uhlich wells, one of which (LMS-2) is directly upgradient of OW-17.

3.6 PHC

3.6.1 Soil

Petroleum hydrocarbon (PHC) is the indicator parameter for petroleum products, such as fuel oils, and also for some petrochemicals. Most of the soil samples contained measurable concentrations of PHC, some at near-saturation levels (as a rule of thumb, 30,000 mg/kg is considered saturated). Envirotest Laboratories' quality control data, which show good precision and accuracy, are presented in Appendix H.

Surficial (0-4 ft) PHC concentrations are depicted in Figure 3-3, in the deeper soils in Figure 3-4. These figures also show the concentrations reported by LBG on the Mobil property. In the northern portion of the Uhlich property (B-6, B-7, and B-8) surficial PHC concentrations were in the 840-8200 mg/kg range. The lowest concentration (840 mg/kg in B-6) was detected in the soil closest to the Mobil property. The surficial concentrations increase toward Building 66, which at one time housed a fuel oil distributor. With the exception of OW-19 adjacent to B-6, where 14,500 mg/kg was measured, concentrations decrease toward the Mobil property in this area. PHC concentrations rapidly attenuate with depth and decrease toward the Mobil property line (Figure 3-4), suggesting that separate sources account for the PHC on the Mobil and Uhlich properties in this area.

Borings B-3, B-4, B-5, and B-9 were advanced in the vicinity of two former No. 2 fuel oil tanks (5000 and 12,000 gal) and one former No. 6 fuel oil tank (250,000 gal) shown on the 1955 Zinsser map (Section 1.2.1.5). Uhlich further reports that this tank constantly leaked. As depicted in Figure 3-2, surficial PHC concentrations center around this tank. The relatively low PHC concentration (120 mg/kg) for the B-5, 4-6 ft sample is not believed to be representative because the nearby B-16, 4-6 ft sample contained 16,000 mg/kg, which conforms more closely to other samples from that area. The low B-5, 4-6 ft concentration may be a result of earth moving during the demolition of the former fuel oil tanks in that area. It is not understood why the concentration at this depth would be so low when such a high PID measurement was recorded for that same sample.

Because concentrations generally attenuate with depth (Figure 3-4), one of the highest PHC concentrations found on the Uhlich property (12,000 mg/kg) was in the 8-10 ft deep soil at B-3, well below the water table. Because soils from only one nearby boring (B-9: <23 mg/kg) and none from any nearby Mobil borings were collected for PHC analysis at this depth, the extent of the PHC at this depth is unknown.

PHC is also centered around the former Building 62 Zinsser/Harshaw solvent recovery (B-10 and LMS-2). Based on LBG's results for the two soil samples analyzed at boring OW-17 (2-4 ft: 200 mg/kg; 10-12 ft: <100 mg/kg), the hydrocarbons in this zone of PHC in the soil do not extend to the Mobil property.

3.6.2 Groundwater

Although PHC was present in the soil, no floating product was present in the Uhlich monitoring wells and no PHC was detected (0.5 mg/l detection limit) by Envirotest in the groundwater samples. These findings are consistent with the June 1987 Mobil report. The Mobil study, which achieved a lower detection limit of 0.1 mg/l, indicated that Mobil groundwater samples contained low levels of PHC: 2.2 mg/l in OW-5 and 0.2 mg/l in OW-16, which is adjacent to the southern end of the Uhlich site. Floating product at OW-18 on the Mobil property is 0.5 in. thick.

3.7 METALS

3.7.1 Soils

Based on the Phase 1 sampling results for metals in groundwater, 18 soil samples were analyzed in Phase 2 for six metals (arsenic, copper, iron, lead, manganese, and zinc). The results for total and leachable metals in soil are summarized in Table 3-4. Most of the samples contained copper and lead at concentrations higher than typically measured in native soils. Zinc was also elevated in half of the samples (compared to native soils); iron and manganese were typical of concentrations commonly seen in native soils.

For the most part, samples containing ash or slag were selected for analysis. Those containing ash or slag tended to contain and leach more metals than non-ash samples, although there were exceptions. None of the samples were EP toxic. The LMS-7, 4-6 ft sample leached 3.9 mg/l of lead; the toxicity limit is 5 mg/l.

3.7.2 Groundwater

Copper, lead, zinc, iron, and manganese were detected in all seven Uhlich wells. Arsenic was present at trace concentrations in LMS-1 and LMS-4. CAMO's quality control data for metals (Appendix H) show good precision and accuracy. Beryllium, cadmium, chromium, mercury, nickel, selenium, and thallium were not detected in either the Uhlich or the Mobil wells. Neither LMS nor LBG tested any samples for barium, the only metal detected by NUS in the soil sample collected from the Mobil drainage way near the Uhlich property (see Table 1-2). Antimony was present at the 10 ug/l detection limit in only one well (LMS-1); silver at the 10 ug/l detection limit in three wells (LMS-1, LMS-2, and LMS-3). Although these elements were not detected in the Mobil wells, the Mobil detection limits were higher for those samples. The concentrations for antimony, lead, manganese, and iron were higher than the GA criteria in at least one Uhlich well. (As stated previously, the area groundwater is not classified, but has the general characteristics of a GSA or GSB groundwater. Because there are no GSA or GSB criteria, the GA criteria are discussed to provide a general reference.) The highest manganese and iron concentrations were measured in upgradient well LMS-5.

It is suspected that infiltrating rainwater and groundwater flow leach lead and other metals from the ash fill observed in most of the Uhlich borings and that this leachate accounts for some of the metals concentrations in the monitoring well samples. As explained below, mixing of the site fill with the water in the monitoring wells can add metals to the groundwater samples and result in reported metals concentrations that are higher than actually exist.

The highest zinc concentration measured in Phase 1 (680 ug/l in LMS-4) was not verified by the Phase 2 sampling for that well (30 ug/l) in June. Otherwise the Uhlich zinc concentrations still ranged widely, from 20 to 300 ug/l, but were well within even GA criteria.

The Uhlich monitoring wells contained detectable levels of copper and lead:

	CONCENTRATION (ug/l)					
	COPPER		LEAD		TURBIDITY (NTU)	
	Mar	Jun	Mar	Jun	Mar	Jun
LMS-1	20	70	20	4	16	2
LMS-2	300	70	97	<3	18	4.5
LMS-3	320	120	87	16	54	2.5
LMS-4	270	30	670	11	6	5
LMS-5		40		10		11
LMS-6		40		5		2.5
LMS-7		40		10		2

Note: July 1989 LMS-2 sample contained 510 ug/l copper and 38 ug/l lead. Turbidity was 10 NTU.

All of the copper concentrations and all of the June 1989 lead concentrations were within the TOGS criteria. Three out of four March concentrations and the one July concentration were above.

The temporal variation in lead concentrations appears to be at least in part the result of the variation in turbidity, best demonstrated by the findings for LMS-2. As noted in Section 2.8, the Uhlich well turbidities are low. In addition, the metals water samples collected by LMS were first drawn with a peristaltic pump (rather than with a bailer) to minimize any increase in turbidity. Though the turbidities are low, sample-to-sample variations are still unavoidable. High turbidity levels can produce higher measured metals concentrations than are actually present in the groundwater, especially for lead, which has a relatively high affinity for solids. Turbidity is an indicator for soil solids in the sample, and, as indicated in Section 3.7.1, the site soils contain relatively high concentrations of lead.

LBG did not detect lead and copper in the Mobil groundwater samples. However, LBG field filtered all the groundwater samples (presumably before preservation) except those from OW-5 and OW-18, which were laboratory filtered. Filtration removes suspended solids containing metals, thereby causing lower measured metals concentrations. The purpose of filtering is to remove those suspended solids that are found in the well but not in the groundwater. However, solids in the well might also scavenge metals in the groundwater, and filtering could result in lower measured concentrations than actually exist. Conversely, not filtering may result in overstating metals concentrations, particularly if the sample is turbid. NYSDEC typically does not accept filtered results for groundwater assessments.

The impact of filtering is demonstrated by the differences in the filtered and unfiltered samples (see Table 3-6). All filtered concentrations are lower except for two zinc results, attributable to normal analytical variability. Though the impact of filtering in reducing metals concentrations is apparent, there is only one instance where the reduction lowered the concentration from above the TOGS guidance to below the guidance. In this case, filtering lowered the lead concentration in the July 1989 LMS-2 sample from 38 to <5 ug/l.

3.7.3 June 1989 Field Blank

The CAMO Laboratories report shows substantial metals concentrations in the total metals field blank for June 1989, particularly for iron (310 ug/l), lead (99 ug/l), and manganese (40 ug/l). CAMO analyzed this sample in duplicate to confirm the findings. To help identify the cause of this contamination, CAMO was authorized to analyze the chlorides field blank (after preservation at the laboratory) and the dissolved metals field blank (preserved on-site) for these three metals. The results are summarized in Table 3-10. As indicated, the dissolved metals blank was free of metals, ruling out an improperly cleaned sample container or contaminated preservative as a contaminant source. As the chlorides blank was also free of metals, use of contaminated field blank water can be eliminated as a possible cause.

Laboratory contamination during sample digestion seems unlikely because the total and dissolved lead concentrations in the well samples are relatively low, in the <3-28 ug/l range, except for OW-17 at 100 ug/l.

By the process of elimination, it is suspected that the contamination is a result of either fugitive dust entering the container while it was open or inadvertent contact with the ground by one of the free ends of the Tygon tubing before the blank was col-

TABLE 3-10

METALS IN GROUNDWATER FIELD BLANKS

June 1989

PARAMETER	CONCENTRATION (ug/l) TOTAL METALS	DISSOLVED METALS	CHLORIDES[a]
Arsenic	<3		
Copper	10		
Iron	310	<50	<50
Lead	99	<5	<5
Manganese	40	<10	<10
Zinc	10		

[a] After preservation by CAMO.

lected. Thus, there is reason to believe that the June 1989 metals results are valid.

3.8 VOLATILES

3.8.1 Ethers

Ethers found by LBG on the Mobil property do not appear to measurably affect the Uhlich property. The CAMO detection limit, however, was 50 ug/l for the three ethers, and the concentrations in nearby Mobil wells OW-19 and OW-20 were 70 and 11 ug/l, respectively.

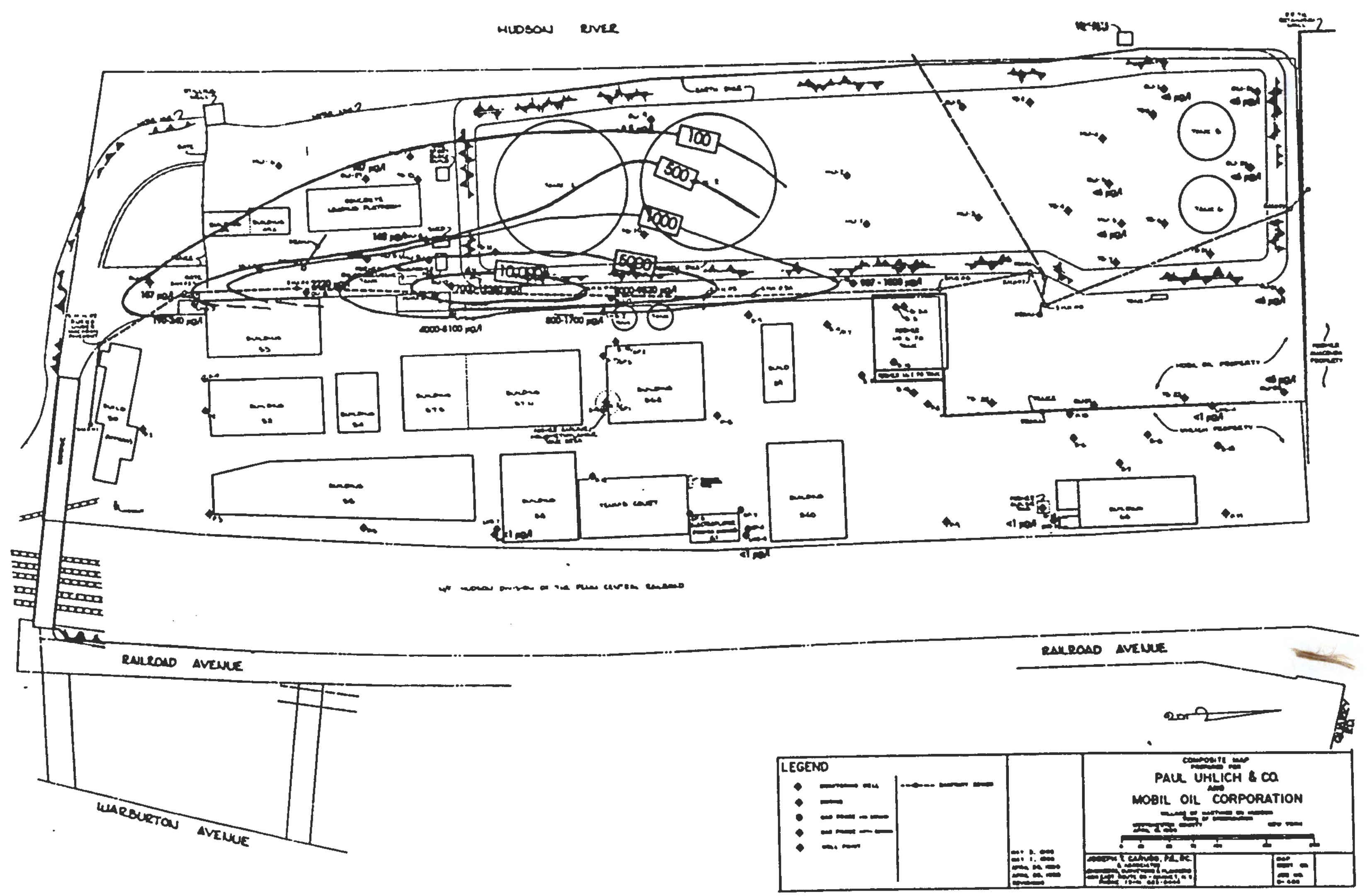
3.8.2 Chlorobenzene

3.8.2.1 Soil. LMS collected 10 soil samples for volatiles analysis (Table 3-2). No comparable soil test is documented in the Mobil reports. Low (less than 21 mg/kg) concentrations of chlorobenzene are present in soil around LMS-1, located near the former chlorobenzene tank. This finding, as explained in Section 3.8.2.2, suggests that the Uhlich chlorobenzene groundwater concentrations at this location are largely a result of diffusion and groundwater movement. Higher concentrations (42-120 mg/kg) were found at the western corner of Building 62, near the former Zinsser/Harshaw solvent recovery operation.

3.8.2.2 Groundwater. Figure 3-5 depicts chlorobenzene concentrations in the groundwater based on the November 1986 LBG sampling of the Mobil wells and the March, June, and July 1989 LMS samplings of the Uhlich wells. Concentrations are highest near OW-12 and the former chlorobenzene tank area, and consistently decline with distance from the tank.

SHEET OF

FIGURE 3-5



◆ 8100 µg/l Chlorobenzene concentration (Range if more than one sample)

100 Contour line of approximate chlorobenzene concentration (µg/l)

Lawler, Matusky & Skelly Engineers

Environmental Science & Engineering Consultants

11/86 Sampling - Mobil wells
3/89 Sampling - Uhlich wells
6/89 Sampling - Mobil and Uhlich wells

CHLOROBENZENE IN THE GROUNDWATER

DATE

1

For the June analyses the Methods 601 and 602 chlorobenzene analyses agree for most of the samples. The relative percent differences (RPDs) were less than 6% for seven sets of samples; three (LMS-1, OW-17, and OW-18) RPDs were in the 18-26% range. There was less agreement for one set of samples from Mobil well OW-12 (RPD 35%).

With one exception, all positive concentrations are higher for Method 601 than for Method 602. Because the Method 601 spiked recovery was approximately 80%, actual concentrations may be even higher. No spiked chlorobenzene recoveries were reported by CAMO for Method 602 because chlorobenzene and xylenes co-elute.

The July (LMS-2 only) and June chlorobenzene concentrations are close to those measured by Method 624 in March 1989 (for Uhlich wells, see Table 3-7) and November 1986 (for Mobil wells, see Table 3-8). At most, concentrations dropped by one-half at LMS-1 and OW-17 since the previous samplings. The two June 1989 analyses for LMS-4 reported no chlorobenzene present; 33 ug/l had been measured in March 1989. The June findings are considered more representative of actual environmental conditions at LMS-4 since they better match those for nearby wells.

The likely source of this chemical in the groundwater is the former chlorobenzene tank area. The extent of chemical in the groundwater to the north suggests that chemical product may have flowed along a drainage swale that reportedly predated (before 1961 or 1962) the sanitary sewer servicing the two properties. Neither Uhlich, a pigment manufacturer, nor Mobil, a petroleum distributor, report using chlorobenzene. Its presence in the Uhlich groundwater may be in part a result of diffusion in the groundwater and stormwater runoff from west to east during the Zinsser/Harshaw tenure.

The concentration of chlorobenzene in LMS-2, the monitoring well immediately downgradient of the former Zinsser/Harshaw solvent recovery operation, was considerably less than the concentration in OW-17, the next farther downgradient well. Therefore, the soil in the vicinity of B-10 and B-11 (near the former solvent recovery operation) is at most a minor source of chlorobenzene to the groundwater.

3.8.3 Toluene

Trace concentrations (less than 0.4 mg/kg) of toluene were present in three of the 10 soil samples tested. For the March 1989 sampling the concentrations were <100, 28, 19, and 1400 ug/l, respectively. No toluene was detected in the water samples collected from these wells in June 1989, nor in the samples from LMS-5, LMS-6, and LMS-7. Because the March 1989 concentrations in LMS-4 (140,000 ug/l) appear high in light of the fact that toluene was not detected in any of the downgradient Mobil wells and no toluene was detected in June, the March detections are not considered an accurate reflection of the groundwater chemistry at LMS-4.

It should be noted, however, that CAMO's analysis of the March LMS-4 sample was initially conducted by analyzing a 50 ug/l standard, then a method blank, and then the sample itself subjected to a dilution factor (DF) of 10. The measured toluene concentration was too high to be measured (off-scale). A 30 ug/l standard was analyzed and then two method blanks were analyzed to verify that no residual contamination remained in the equipment. The final toluene analysis was then conducted with a DF of 1000. The measured output was 140 ug/l, resulting in a sample concentration (140 ug/l x 1000) of 140,000 ug/l. Though apparently valid, these results are still considered anomalous and were not confirmed by subsequent sampling.

3.8.4 Methylene Chloride

This chemical was detected only in the LMS-4 groundwater sample (1400 ug/l) and not in any of the Mobil water samples in March. Since methylene chloride is a common laboratory contaminant, CAMO thoroughly reviewed their quality control data to verify the results. Confirmation was obtained with the multiple dilutions needed for the toluene analysis. At the DF of 10, the measured concentration was 135 ug/l; for the DF of 1000, 1.15 ug/l. These results are consistent, and CAMO reported the DF-10 run. As for toluene, the March analytical results, though confirmed by CAMO, are still anomalous in light of the concentrations in the nearby wells and no detectable methylene chloride in any of the June samples.

3.8.5 Tetrachloroethylene

This chemical was present in three March Uhlich well samples (LMS-2, LMS-3, and LMS-4) in the 27-43 ug/l range but was not detected in any of the June samples. No tetrachloroethylene was detected in any of CAMO's soil samples.

3.8.6 Trichloroethylene

A trace amount (0.4 mg/kg) of trichloroethylene was detected in only one of the 10 soil samples, but not in any groundwater sample.

3.8.7 Benzene

Benzene was not detected by either LBG or NUS in samples collected from the Mobil monitoring wells, only in the sample collected in March from LMS-3 at a concentration of 43 ug/l. It did not reappear in June. Benzene was detected just above the method detection limit (11 ug/l) in July in one of the three samples collected from LMS-2. The concentration in LMS-5 was 5 ug/l. The development water in LMS-5 had a fuel-like odor, suggesting the benzene might be the result of a gasoline spill. Neither Mobil nor Uhlich report using benzene.

3.8.8 Monomethylamine

As noted in Chapter 2, the standard purge and trap GC/MS analyses conducted in March 1989 for the volatiles of interest (Method 624 for groundwater and Method 8240 for soil) were modified to incorporate an additional standard for monomethylamine because a Zinsser/Harshaw monomethylamine bulk storage tank was located between Buildings 57 and 62.

Monomethylamine is not easily detected by the analytical column method used by CAMO for the March analyses. As a result, the detection limits were high (1000 ug/l); no monomethylamine was detected in any of the groundwater samples. Selected June groundwater samples were analyzed for monomethylamine by direct injection into a flame ionization detector to achieve a lower detection limit of 10 ug/l; none was detected.

Boring B-17 was advanced in June 1989 to collect soil beneath the former monomethylamine tanks. The soil was analyzed similarly to the method used on the June groundwater sample. At a 250 mg/kg detection limit, no monomethylamine was detected. Based on the June chemistry, observations during drilling of the borings in the vicinity (no odors), and the soil gas tests, LMS concludes that the subsurface at the Uhlich property has not been materially impacted by monomethylamine.

CAMO's reported concentrations for monomethylamine in the 10 Phase 1 soil samples are presented in Appendix H on a wet weight basis. Conversations with CAMO personnel revealed significant problems with the analysis. The affinity of monomethylamine for the purge trap and the analytical column caused the standards and samples to carry over intermittently from one run to the next. Even though one blank would be run after analysis and would appear free from carryover, the next blank would have a contamination problem from carryover in the analytical system. The analyst was never certain whether the monomethylamine peak detected in the sample was due solely to the sample or whether it was influenced by some previous analysis.

3.9 CONDUCTIVITY AND pH

Reflecting the measured concentrations of chlorides and various metals, the conductivities in the Uhlich wells are relatively high and typically range from 1000 to 2600 umhos/cm. However, the groundwater at upgradient well LMS-5 had the highest conductivity (11,500 umhos/cm) and also the highest chlorides concentration (4420 mg/l).

The conductivities measured by LMS in the four Mobil wells were in the 1800-3200 umhos/cm range; the conductivities reported by LBG for these same wells are much lower, however (less than 120 umhos/cm). The cause of this difference is unknown. The LMS measurements are approximately the same from sampling to sampling and are also consistent with the elevated chlorides concentrations in the groundwater. Therefore, the higher conductivities measured by LMS are considered the accurate description of the groundwater.

The groundwater pH on the Uhlich property is in the 6.2 to 7.3 range. While pH tends to drop from upgradient to downgradient, the highest pH was recorded in LMS-7, the downgradient well located near the railroad track.

3.10 ELECTROPLATER

The gas concentrations registered by the probes installed around the electroplating operation in Building 61 were all low (0.2-2.8 ppm). The probes were constructed as a cost-effective means for describing possible impacts of the plating operations on the Uhlich property.

3.11 COLOR

Some green stains (LMS-3: 2-4 ft) and orange sand (B-19: 2-4 ft) were encountered during drilling at the Uhlich property. Most of the fill material was black, however, often because of the presence of petroleum. Therefore, colors associated with dyes and/or pigments could not be observed in the soil. LBG observed colors in the soil at several locations on the Mobil property and Mobil analyzed some soil samples for color in their laboratory. However, we do not understand why the LBG descriptions of some of these analyzed samples report no coloration whereas the as-received description by Mobil states that color is visible. LBG attributed the color in the deep Mobil soils to leakage from the sewer on the Mobil property. If LBG's allegation is correct, their findings would then be consistent with those of LMS.

When the three wells on the south side of the Mobil property were sampled, LMS observed that all had purple- or violet-colored water. Only LMS-1 and LMS-2 were reported as having colored water (purple and blue) when sampled. LBG's conclusion that the colors are not hazardous appears reasonable in light of the chemical analyses conducted on the Mobil and Uhlich soils and groundwater.

REFERENCES CITED

American Appraisal Company, The. 1945. Report for insurance coverage. Zinsser & Company, Inc.

Becker, H. 1961. Survey of property. Prepared for Tappan Tanker Terminal, Inc.

Bouwer, H., and R.C. Rice. 1976. A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells. Water Resources Res. 12(3): 423-428.

Harshaw Chemical Company. 1955. Zinsser and Company plot plan.

Harshaw Chemical Company. 1958. Equipment layout. Drawing No. Z-1009-5.

Kolenda, A. 1970. Survey of property. Prepared for Mobil Oil Corp.

Lawler, Matusky & Skelly Engineers (LMS). 1988. Proposed plan for environmental investigation at Paul Uhlich and Co. plant property, Hastings-on-Hudson, New York. Prepared for Whiteman, Osterman and Hanna.

Leggette, Brashears & Graham, Inc. (LBG). 1987. Ground-water and soil quality investigation at the Mobil Oil Corporation Tappan Terminal, Hastings-on-Hudson, Greenburgh, New York. Prepared for Mobil Oil Corporation.

Mobil Research and Development Corporation. 1987. Tappan Terminal environmental sampling. Prepared for Mobil Oil Corporation.

New York State Department of Environmental Conservation (NYSDEC). 1985. Ambient water quality standards and guidance values. Memorandum.

NUS Corporation. 1988. Preliminary assessment Mobil Oil Tappan terminal. Final draft. Field investigation team activities at uncontrolled hazardous substances facilities - Zone I. Prepared for U.S. Environmental Protection Agency.

NUS Corporation. 1989. Final draft. Screening Site Inspection, Mobil Oil Tappan Terminal. Prepared for U.S. Environmental Protection Agency.

Parish & Weiner Inc. 1989. Environmental impact statement, Hastings-on-Hudson, New York. Vol. I. Draft report.

REFERENCES CITED
(Continued)

Schuberth, C.J. 1968. The Geology of New York City and Environs. New York: Natural History Press. 304 pp.

U.S. Army Corps of Engineers (COE). 1906. Pierhead and bulkhead line for the easterly shore of the Hudson River at the Village of Hastings, New York.

U.S. Geological Survey (USGS). 1970. Geologic map of New York.

Zinsser & Company (Zinsser). 1935. Pictorial report on government buildings 1919-1935. Letter by J.L. Berstron to Kelly, Hewitt & Harte.