UNION CARBIDE CORPORATION
CARBON PRODUCTS DIVISION

SITE INVESTIGATION

Solid Waste Management Facility
Union Carbide Corporation
Republic Plant
Town of Niagara, New York

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CONESTOGA-ROVERS & ASSOCIATES

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

This report has been prepared to consolidate and summarize the data obtained during the site investigation program conducted at the Solid Waste Management Facility (SWMF) located at Union Carbide Corporation's (UCC's) Republic Plant in the Town of Niagara, New York. The location of the SWMF is identified in Figure 1.

The site investigation has been completed as a requirement for the closure of the SWMF in accordance with State regulations. The closure of the SWMF is being completed in conjunction with the closure of UCC's operations at the Republic and National Plants.

This report supplements the 'NYSDEC Report' entitled "Engineering Investigations At Inactive Hazardous Waste Sites in the State of New York, Phase 1 Investigations, Union Carbide - Carbon Products Division Niagara Falls, Niagara County, New York Site Code: 932035, January 1987" prepared by Wehran Engineering for the New York State Department of Environmental Conversation (NYSDEC). Sections 1.0, 2.0 and 4.0 of the above referenced report are reproduced in Appendix A which includes a summary of the site history and historic analytical data.

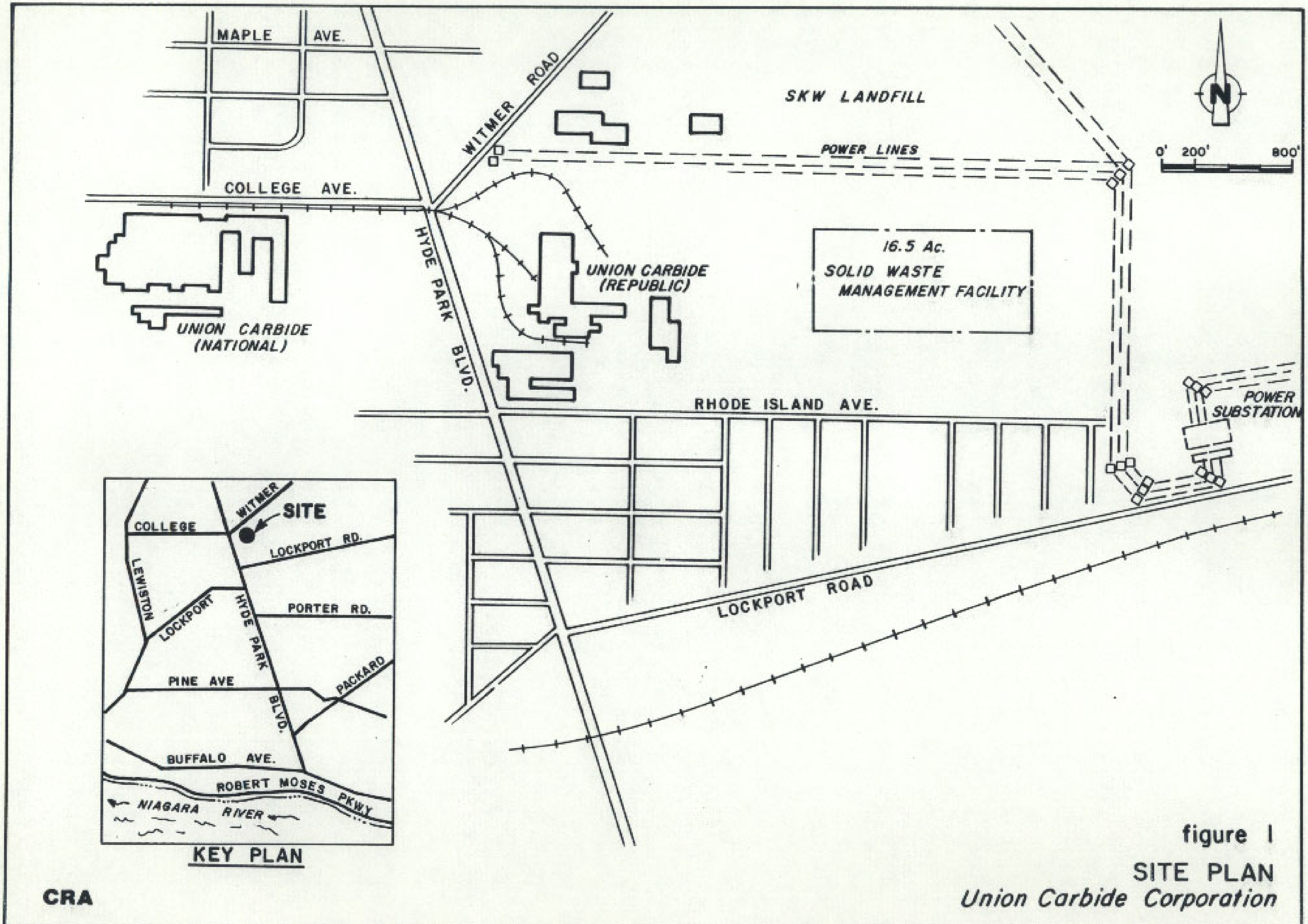

figure 1

SITE PLAN

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1851-16/06/87-4-F-0

This report evaluates and interprets new and existing data and presents an environmental assessment of site conditions.

2.0 BACKGROUND INFORMATION

2.1 SITE LOCATION

The 16.5 acre SWMF is bounded on the north and east by a Niagara Mohawk power transmission corridor, on the west by the Republic Plant production facility and on the south and east by wooded and vacant land owned by UCC. Another landfill site, owned and operated by SKW Alloys, is located north of the SWMF. A residential area is located along Rhode Island Avenue approximately 500 feet south of the Site. Figure 1, shown previously, locates the site in the context of the surrounding area.

2.2 SITE HISTORY

UCC has operated the SWMF over the past 40 years. The SWMF has operated, until recently, under Permit No. 2020 issued in 1978 by the New York State Department of Environmental Conservation (NYSDEC). In 1981, a supplemental operation plan, stating planned landfill progression, was also prepared and submitted to the NYSDEC. In conjunction with the closure of the UCC operations in Niagara Falls, the SWMF was also closed as of December 1, 1986.

Throughout the life of the SWMF, waste materials, generally consisting of carbonaceous materials, fire brick, wood, and demolition debris have been disposed of at the site. Waste placement generally progressed from east to west across the site. The wooded area to the east and south of SWMF was used by the site operators as the limit of waste disposal. Consequently, some waste, near the southeast corner, was placed beyond the defined southern boundary of the SWMF. Most of the 16.5 acre site was used for waste disposal except for the westernmost 200 feet which was generally flat and unused. Some carbonaceous wastes have been identified in this western area and in fact, in some of the surrounding areas, although the waste is present in relatively thin layers.

Although no waste has been received at the site since November, 1986, portions of the completed landfill have been regraded in conjunction with the final capping of the site. To prepare the SWMF for final capping, the site was regraded for drainage and slope stability. The steeper side slopes were trimmed back and the top portion of the landfill was graded to promote drainage in all directions. The western and central portions of the SWMF which were incomplete or unused were brought to grade, using regraded wastes, to complete the overall landfill design.

As part of the SWMF permitting requirements, three overburden monitoring wells were installed between September 1978 and March 1979. The three wells, located on Figure 2, include one upgradient well, (MW1-78) and two downgradient wells (MW2-78 and MW3-79). The three wells were installed in the glacial till which overlies the bedrock. Appendix B presents the installation reports for these three wells.

2.3 EXISTING SITE CONDITIONS

At present, the SWMF is undergoing final capping in accordance with the Closure Plan presented to and approved by NYSDEC. The capping activities will be described in a separate report, which will be submitted to the NYSDEC upon completion of the final capping activities.

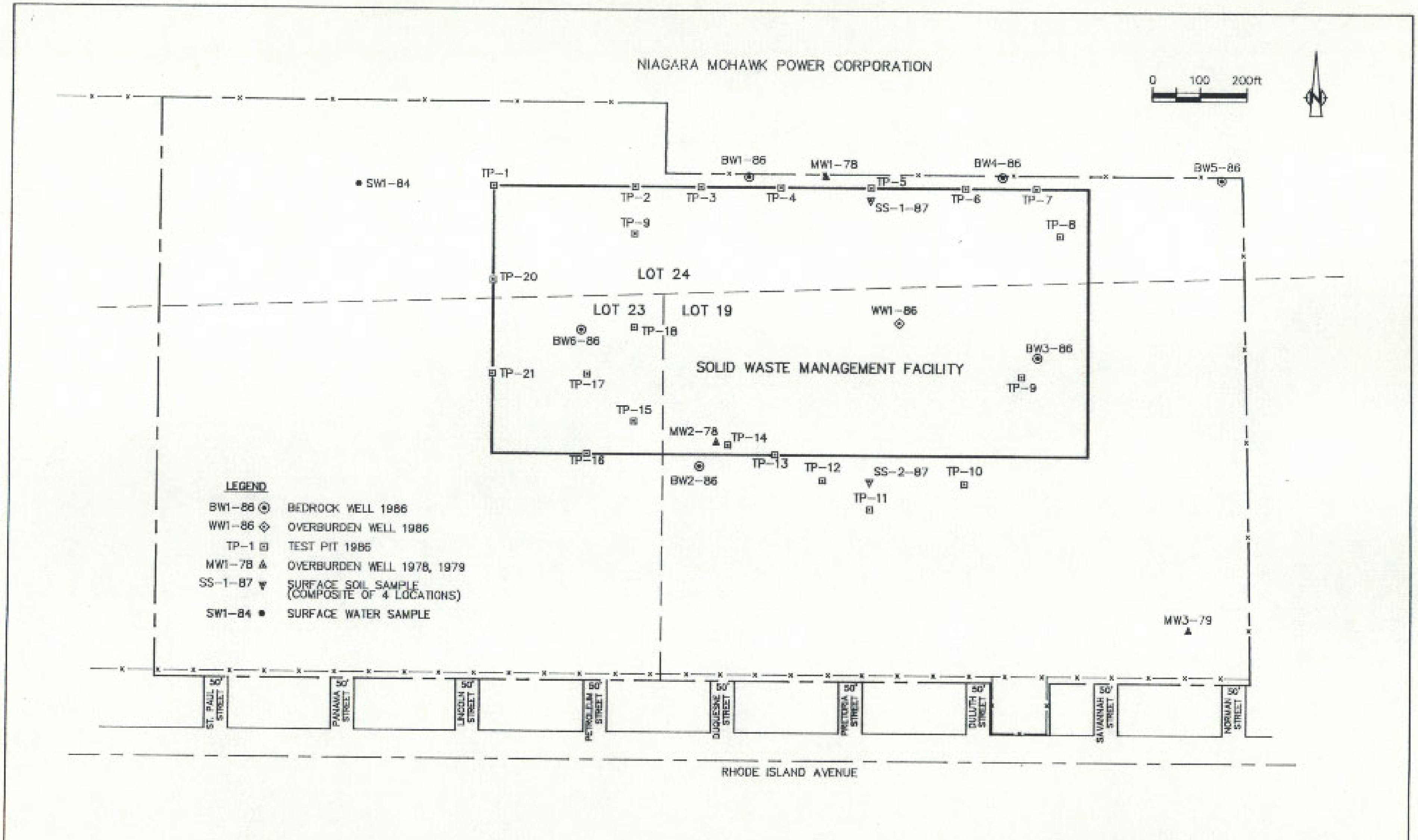

figure 2

LOCATION OF SAMPLING POINTS

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3.0 PLAN OF INVESTIGATION

The closure of the SWMF required that a hydrogeologic investigation be conducted at the site and if necessary a remedial investigation/feasibility study was to be performed. Previous investigations had been conducted at the SWMF, however, some data base deficiencies were identified. As a result, an additional hydrogeologic investigation was necessary to supplement the available data in areas of identified data base deficiencies. As outlined in Section 2.0 of the originally proposed work plan ("Proposal, Remedial Investigation/Feasibility Study, Solid Waste Management Facility, Union Carbide Corporation Republic Plant, Town of Niagara, New York", April 1986, CRA) the purpose and intent of this site investigation was as follows:

i) To review in detail the existing site data base pertaining to surficial and buried site contaminants and their potential for migration from the site through groundwater or surface water discharges.

ii) To identify and collect additional data which are necessary for a complete evaluation and characterization of site conditions including geologic stratigraphy, hydrogeologic conditions and geochemical conditions.

iii) To identify and quantify the hazards associated with present and future contaminant discharges from the site, and to assess the risk associated with such discharges in terms of adverse impact on human health and the environment.

iv) To develop a preliminary set of potentially feasible remedial actions which will mitigate the identified unacceptable adverse impacts of present or future contaminant discharges from the site, if any.

The following sections discuss the site-work conducted to achieve each of the work plan objectives and presents the results of the site investigation.

4.0 FIELD ACTIVITIES

The field activities undertaken in conjunction with the site investigation included the installation of bedrock and waste monitoring wells; the collection of hydraulic groundwater data; and the collection and chemical analysis of groundwater and soil samples. The following sections provide the details of the field activities.

4.1 WELL INSTALLATION PROCEDURES

The groundwater monitoring wells installed at the SWMF were installed in two phases. The initial group of four wells (BW1-86 through BW4-86) were installed between July 1 and July 14, 1986. All of these wells were bedrock installations. Following discussions with the NYSDEC concerning the conditions identified at the SWMF (see Section 6.2), two additional bedrock wells (BW5-86 and BW6-86) and one waste well (WW1-86) were installed between October 22 and November 4, 1986. All of the wells were installed by Earth Dimensions Inc. using a Mobile B-61 drilling rig.

Hollow stem augers were utilized to drill 6-3/4-inch diameter boreholes to bedrock except for WW1-86 which was only drilled to the top of the native clay layer underlying the site.

Continuous split-spoon samples of the overburden material were collected from all boreholes in advance of the augering operation, using the standard penetration test (SPT) method (ASTM D-1586). Soil cores were used to identify site overburden stratigraphy and to collect samples for geologic record.

For the six bedrock wells (BW1-86 to BW6-86), a 4-inch diameter steel casing was inserted into the borehole through the hollow stem augers. The casing was then grouted in place by lowering a packer to within 1-foot of the bottom of the casing and then pumping grout through the packer into the bottom of the hole forcing the grout up the outside of the casing. The augers were pulled out of the borehole as grouting continued. The grout was allowed to set for a minimum of 24-hours prior to any further work at the well.

The wells were then drilled 15 feet into bedrock utilizing a 3-inch diameter NX diamond core bit. The rock core recovered was used to identify site bedrock stratigraphy and the rock samples were collected and stored for geologic record. Figure 3 illustrates a typical bedrock well installation.

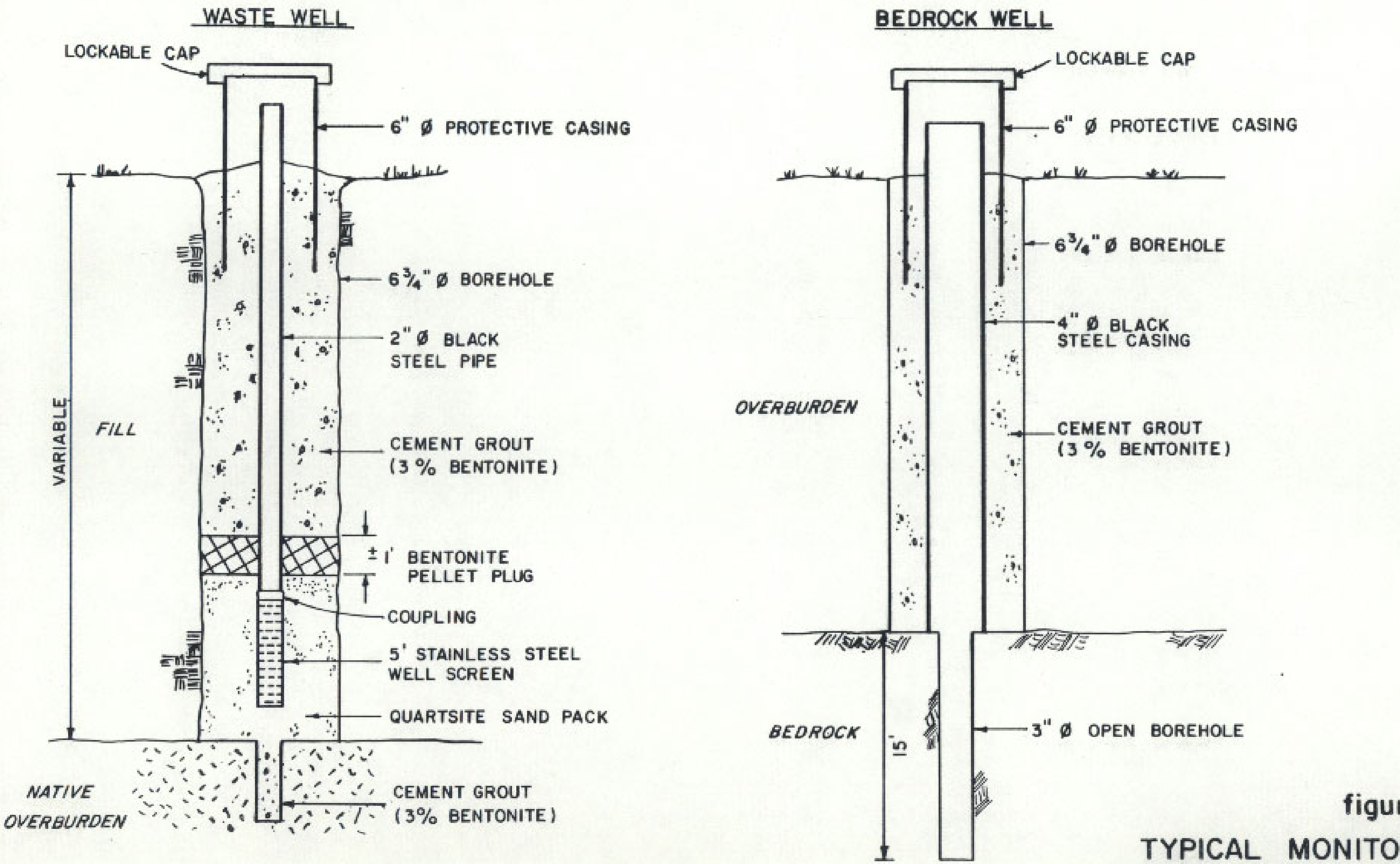

figure 3

TYPICAL MONITORING WELL INSTALLATIONS
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The waste well (WW1-86) was completed by installing a 5-foot stainless steel well screen (#10 slot) connected to a 2-inch diameter black steel riser pipe through the augers. As the augers were withdrawn, the annulus was backfilled with sand around the well screen, followed by a bentonite pellet seal and cement/bentonite grout to the ground surface. A typical waste well installation is illustrated in Figure 3.

Table 1 summarizes the well construction details for all seven wells. A complete set of stratigraphic and instrumentation logs are presented in Appendix C.

4.2 WELL DEVELOPMENT AND WATER SAMPLING

Following well installation, all of the new wells were developed using a gas-powered centrifugal pump, with the exception of WW1-86, which was dry. Development involved the removal of 10 well volumes of groundwater.

Following development, groundwater samples were collected from each well using a clean, bottom-loading stainless steel bailer and sent to Wadsworth/Alert Laboratories for chemical analysis.

TABLE 1

WELL CONSTRUCTION DETAILS

Well Number	Top of Casing Elevation (ft. AMSL)	Ground Elevation (ft. AMSL)	Drilled Depth (ft. BG)	Screen Interval		Monitored Interval	
				Ft. BG	Ft. AMSL	Ft. BG	Ft. AMSL
BW1-86	610.72	608.1	34.5	--	--	19.5 - 34.5	588.6 - 573.6
BW2-86	608.43	606.1	35.0	--	--	20.0 - 35.0	586.1 - 571.1
BW3-86	604.72	602.2	22.4	--	--	7.4 - 22.4	594.8 - 579.8
BW4-86	607.08	604.5	25.0	--	--	11.4 - 25.0	593.1 - 579.5
BW5-86	603.33	599.7	24.9	--	--	10.0 - 24.9	589.7 - 574.8
BW6-86	607.04	603.5	32.9	-	--	17.7 - 32.9	585.8 - 570.6
WW1-86	631.45	626.6	25.0	18.7 - 23.7	607.9 - 602.9	15.6 - 24.2	611.0 - 602.4

The samples were actually collected in two phases, consistent with the period in which the wells were installed. Wells BW1-86 through BW4-86 were sampled in August 1986 and wells BW5-86 and BW6-86 were sampled in November 1986. A sample from WW1-86 was not collected until April 1987, as this was the only period during which groundwater was observed to be present in the waste well. Table 2 presents the groundwater purging and sampling data for these samples.

All sampling protocols and chemical analyses were conducted in accordance with SW846 methodologies.

In April, 1987 a confirmatory sampling program was conducted which included all of the seven new well installations and the three existing overburden wells (MW1-78, MW2-78 and MW3-79). Each of the wells was purged of 5 well volumes by centrifugal or peristaltic pump prior to sample collection. Where insufficient water was available for the removal of five well volumes in one day, wells (MW1-78 and WW1-86) were purged until dry on three consecutive days. Following purging, samples were collected from each well using a clean, bottom-loading stainless steel bailer, and sent to Wadworth/Alert Laboratories for chemical analysis.

TABLE 2
SUMMARY OF GROUNDWATER SAMPLING DATA

Well Number	Top of Casing Elevation (ft.)	Initial Water Level Elevation (ft.)[1]	Initial Volume of Water in Well (gallons)	Volume Purged (gallons)	Date Sampled	Date Shipped	Comments
ROUND I:							
BW1-78	610.72	592.43	8.2	40	8/13/86	8/13/86	
BW2-78	608.43	593.16	11.1	56	8/12/86	8/13/86	
BW3-78	604.72	590.49	4.0	20	8/21/86	8/21/86	
BW4-78	607.08	593.50	5.8	30	8/21/86	8/21/86	
BW5-78	603.33	592.70	7.7	48	11/6-7/86	11/07/86	
BW6-78	607.04	595.83	12.1	60	11/11/86	11/12/86	
ROUND II: Overburden							
MW1-78	609.43	602.10	2.2	--	4/17/87	4/17/87	Pumped dry on three consecutive days (4/15-4/17/87)
MW2-78	607.54	603.27	10.1	55	4/20 - 4/24/87	4/21 & 4/24/87	Extended sampling due to low recharge rate. Coarse sediment on bailer.
MW3-79	601.61	599.04	2.0	10	4/16/87	4/17/87	

continued....

TABLE 2
SUMMARY OF GROUNDWATER SAMPLING DATA

Well Number	Top of Casing Elevation (ft.)	Initial Water Level Elevation (ft.)[1]	Initial Volume of Water in Well (gallons)	Volume Purged (gallons)	Date Sampled	Date Shipped	Comments
Bedrock							
BW1-86	610.72	599.95	9.7	50	4/16/87	4/17/87	Dull sheen on water, slight sediment, moderate odor.
BW2-86	608.43	599.85	14.5	75	4/17/87	4/17/87	Clear water, strong H_2S odor.
BW3-86	604.72	600.29	9.1	50	4/20/87	4/21/87	Duplicate sample collected.
BW4-86	607.08	600.99	7.3	40	4/16/87	4/17/87	Dull gray sheen. Slight sediment noticed.
BW5-86	603.33	599.16	8.5	45	4/16/87	4/17/87	
BW6-86	607.04	602.35	16.2	85	4/20/87	4/21/87	Brown silty sediment
Fill							
WW1-86	631.45	604.77	0.3	--	4/20 - 4/28/87	4/21 & 4/28/87	Pumped dury on three consecutive days (4/15 to 4/17/87). Extended sampling time due to low recharge rate in this well.

[1] Initial water levels recorded on April 15, 1987.

All sampling protocols and chemical analyses were conducted in accordance with SW846 methodologies. Table 2 summarizes the groundwater purging and sampling data for the April 1987 sampling event.

4.3 RECOVERY TESTING

In August, 1986 recovery tests were performed, on the initial four bedrock wells (BW1-86 through BW4-86) immediately following well development and sampling. The test method involved the introduction of a slug of known volume into the well. The water level was thus raised instantaneously. The falling water levels were measured as the well returned to static condition. However, in all cases the slug did not make an appreciable change in the water level for a sufficient time period to calculate any recovery characteristics for these wells. Consequently, the only determination that can be made is that the upper bedrock zone is highly permeable, possibly on the order of $1x10^{-2}$ cm/sec.

For comparison purposes, packer pump testing of the fractured bedrock, conducted by CRA at the Hyde Park Landfill Site (located approximately 1 mile northwest of the SWMF), yielded transmissivity values from 330 gpd/ft to 5867 gpd/ft.

Assuming an average saturated aquifer thickness of 100 feet, these values correspond to a mean (geometric) permeability of approximately $1x10^{-3}$ cm/sec. It can therefore be conservatively assumed that the permeability of the upper bedrock below the SWMF is equal to or greater than the permeabilities measured at Hyde Park.

In November, 1986 recovery tests for the additional two bedrock wells (BW5-86 and BW6-96) were performed immediately following well development and sampling. The rising water levels were measured as the well returned to static condition.

At BW5-86, water level recovery, to stable conditions, was recorded for a period of 20 minutes. The data generated was analyzed by the Hvorslev (1951) method which resulted in a calculated hydraulic conductivity of 3.9 x 10^{-4} cm/sec. Hvorslev's formula is defined as follows:

$$K = \frac{r^2 \ln (L/R)}{2 L T_o}$$

Where:

r = radius of well casing
L = length of monitored interval
R = radius of monitored interval
T_o = time where $\frac{H-h_t}{H-H_o} = 0.37$
H = static water level
H_o = water level at start of test
h_t = water level at time t

The recovery test calculations are included in Appendix D.

At BW6-86, prior to recovery testing, initial development revealed that the open bedrock borehole had silted up and therefore recovery was very slow and not indicative of actual conditions. The well was subsequently flushed with water to remove the sediment but equipment malfunction hindered the monitoring of well recovery.

4.4 TEST PIT EXCAVATIONS

As part of the final capping program for site closure, 19 shallow test pits were excavated by shovel at various locations on site, in July 1986. The purpose of the test pits was to determine the characteristics of the existing cap at the SWMF. Based on these test pit investigations, the existing cap was determined to be essentially not suitable for use as a final clay cap due to the variability of depth of clay cover.

A second test pit investigation was also conducted as part of the final capping program for site closure. A total of 21 test pits were excavated by backhoe around the perimeter of the proposed cap on February 3, 1987. The purpose of these test pits was to determine the depth to native clay in order to design the clay key for the final cap. The stratigraphic data from this test pit program is discussed in Section 5.2.1.

4.5 SURFACE SOIL SAMPLING

In February, 1987 two surface waste soil samples were collected at the site. Each sample consisted of a composite sample collected from four locations along the north and south slopes of the SMWF, respectively. The locations of the soil sampling stations are presented previously in Figure 2. These soils were collected as an alternative method of characterizing the waste materials in the SWMF. The original plan was to collect a water sample from waste well (WW1-86). However, the waste well (WW1-86) was "dry" at the time of installation and no analysis could therefore be completed to assist in the characterization of waste components at the site. The collected soil samples were sent to Wadsworth/Alert Laboratories for chemical analysis.

The reason that the sideslopes were selected as appropriate sampling stations was based on the presumption that the recent regrading of the SWMF sideslopes would offer a broad chronological cross section of the waste components disposed at the SWMF over the years of operation.

4.6 EQUIPMENT CLEANING

Following each well installation, all drilling equipment and tools were cleaned to prevent cross-contamination as follows:

- remove all soil with a wire brush; and
- clean with pressurized water.

Prior to installation, well casings and screens were cleaned with pressurized water to remove visible coatings.

All split spoon samplers and soil sample extraction tools were cleaned between boreholes as follows:

- water wash rinse to remove all foreign material;
- acetone rinse;
- hexane rinse;
- acetone rinse; and
- distilled water rinse.

All equipment was cleaned at a designated area and personnel wore appropriate health and safety equipment as specified in Section 4.8.

4.7 WASTE MATERIAL HANDLING

All soil cuttings brought to the surface during both phases of the drilling program were placed in 55-gallon drums. All drums were subsequently disposed in the landfill along with the soil cuttings.

All development water, decontamination fluids, disposable safety apparel, etc. were initially drummed and stored on site pending analysis and ultimate disposal by UCC. The water analyses from the August 1986 sampling program indicated only trace chemical presence and therefore subsequent development and purge waters were spread on the ground surface at each individual well location while disposable safety apparel was still drummed for disposal by UCC.

4.8 HEALTH AND SAFETY PROTOCOLS

During all field activities, site-specific health and safety protocols were observed. All personnel were required to wear the following equipment during well drilling, test pit excavation, well development and sample collection:

- tyvek coverall;
- rubber overboots;
- rubber and/or latex gloves;
- safety glasses; and
- hardhat.

Respirators were made available for use.

5.0 GEOLOGY

5.1 REGIONAL GEOLOGY

The Town of Niagara is situated within the Niagara Escarpment Physiographic Region with the steep sloped escarpment being the dominant landform. The surface topography slopes gently towards the crest of the escarpment.

The surficial geology of the area in the vicinity of the City of Niagara Falls and Town of Niagara has been described by Muller (1977). The overburden soils include three units, Recent Alluvium, Lacustrine Sediments and Glacial Deposits.

The Recent Alluvium includes sand, silt and gravel deposited along existing water courses. The Lacustrine Sediments consist of thin, laminated silt, clay and sand deposits formed on historical lake bottoms. The Glacial Deposits overlie the bedrock and consist of thin layers of silty clay and some sandy till.

The bedrock immediately underlying the overburden in the Niagara area is sedimentary rock of the Lockport Group of the Paleozoic Era, Middle Silurian Age (approximately 350 million years old). The Lockport Group is primarily fine-grained gray dolomite with significant weathering near the top surface. The Lockport Group is approximately 150 to 200 feet thick and is underlain by various layers of shale limestone, sandstone and siltstone that extend to a depth of at least 3000 feet. Formations underlying the Lockport include the Rochester Shale, Irondequoit Limestone, Reynales Limestone, Neagha Shale, Thorold Sandstone, Grimsby Sandstone and Shale, Power Glen Shale, Whirlpool Sandstone and Queenston Shale.

5.2 SITE GEOLOGY

5.2.1 Overburden

As discussed in Section 4.1 and 4.4, the field activities program included the collection of split spoon soil samples and the excavation of test pits to determine soil stratigraphy in the area of the SWMF.

The overburden materials encountered during the investigation are typical of those encountered in previous monitoring well installation programs throughout the SWMF area. Typically, the overburden materials can be generalized into three major soil horizons. The first and uppermost layer is fill material consisting of carbonaceous material and highly organic silt and fine sands (topsoil). The second major soil type is a layer of reddish-brown lacustrine clay and silt. The third major soil type is described as a glacial till composed of a reddish-brown mixture of silt, sand and gravel. A summary of the thickness of each unit is presented in Table 3. Each major soil type is described in more detail in the following sections.

5.2.1.1 Fill

In the immediate vicinity of the SWMF, the fill consists of various waste construction materials, including wood, vegetation, ash, brick and glass, intermixed in a grayish-black carbonaceous matrix. Also present in the fill matrix is sand, silt, clay and gravel. The fill material ranges in thickness from 0.5 to 5 feet around the SWMF and up to approximately 28 feet in the landfill itself.

Generally the fill material is coarse and consequently is very conducive to infiltration and groundwater flow.

5.2.1.2 Clay

Underlying the fill is a layer composed of reddish-brown lacustrine clay and silt. The clay and silt is usually present in thin layers, with color ranging from

TABLE 3

SUMMARY OF SITE STRATIGRAPHY

Well Number	Top of Casing (ft.)	Top of Ground (ft.)	Top of Clay (ft.)	Top of Till (ft.)	Top of Rock (ft.)
BW1-86	610.72	607.9	593.4	589.9	588.4
BW2-86	608.43	606.0	602.0	592.5	586.0
BW3-86	604.72	602.2	600.2	596.2	594.8
BW4-86	607.08	604.2	--	594.7	592.8
BW5-86	603.33	599.7	599.2	590.5	589.7
BW6-86	607.04	603.5	598.5	588.5	585.8
WW1-86	631.45	626.8	602.2	--	--
MW1-78	609.43	608.7	--	596.2	589.7
MW2-78	607.54	606.1	601.6	591.1	586.8
MW3-79	601.61	599.5	599.0	586.1	585.4
Test Pit Number					
TP-1		603.1	596.1		
TP-2		604.4	592.2		
TP-3		607.3	593.3		
TP-4		609.2	592.2		
TP-5		606.1	595.1		
TP-6		607.2	593.2		
TP-7		601.9	599.9		
TP-8		600.8	600.0		
TP-9		602.5	602.0		
TP-10		604.0	603.5		
TP-11		605.2	605.0		
TP-12		605.8	604.0		
TP-13		603.0	602.5		
TP-14		606.4	602.4		
TP-15		603.2	559.7		
TP-16		603.1	600.1		
TP-17		603.3	599.3		
TP-18		605.3	598.3		
TP-19		604.4	599.4		
TP-20		604.4	597.4		
TP-21		603.1	596.1		

reddish-brown to grayish-brown. In some areas, the material had a mottled appearance. The clay is typically very stiff with the percentage of silt increasing with depth. This unit is assumed to be more permeable in the horizontal plane than vertically, due to very thin fine sand and silt seams. The vertical permeability is expected to be orders of magnitude lower.

The clay layer ranges in thickness from 3 to 10 feet over the site with the exception of along the northern boundary where no clay was noted present at the locations of wells MW1-78 and BW4-86. The top of the clay layer is highest along the southern boundary of the site and gradually slopes toward the north and the northwest. Figure 4 illustrates the top of clay contours.

It is surmised that prior to the use of the area as a disposal facility, some of the native clay was excavated and used for fill in other areas of the Plant. Thus, throughout the SWMF area, pockets of clay have been removed.

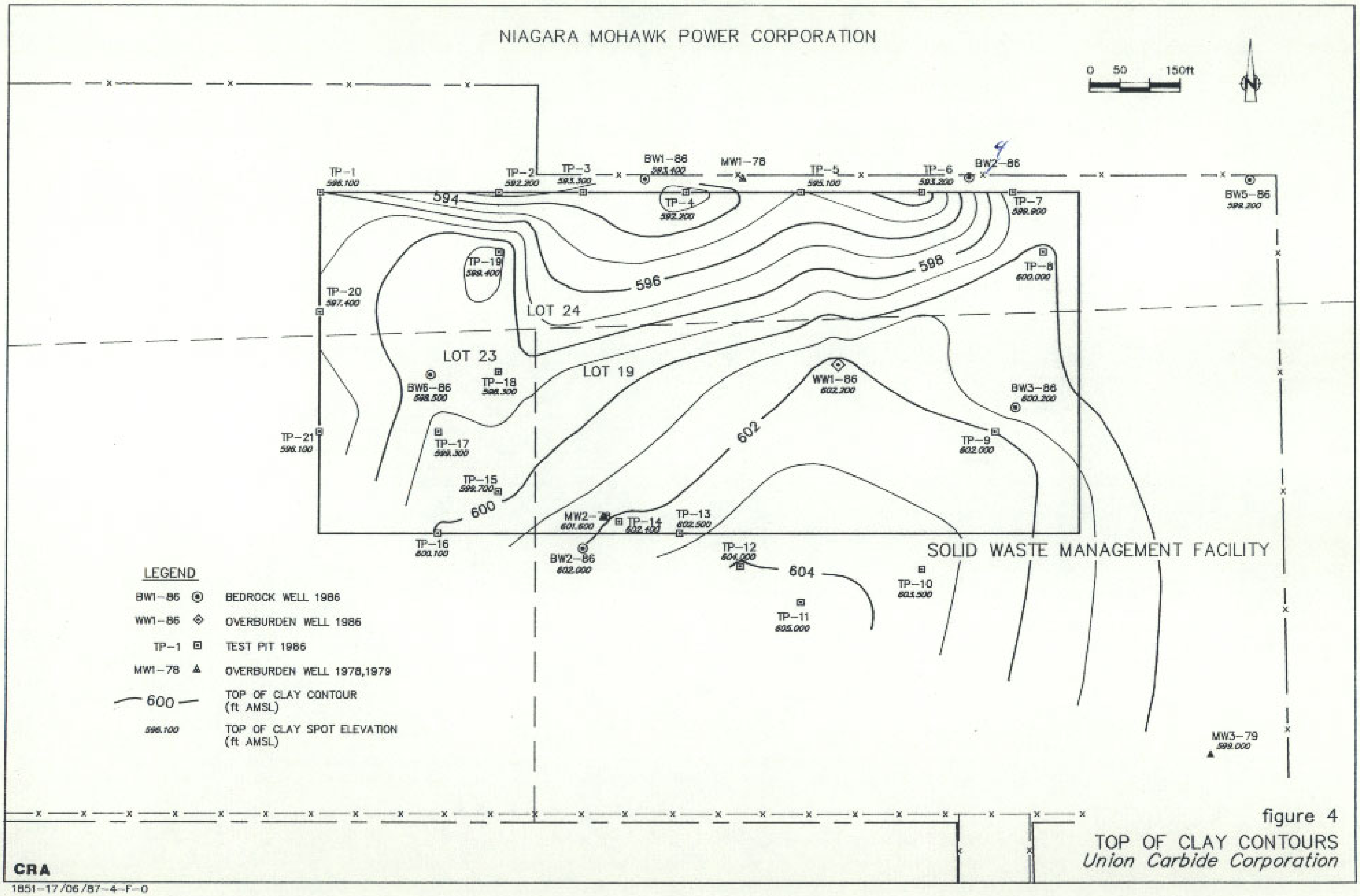

figure 4

TOP OF CLAY CONTOURS

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5.2.1.3 Till

Immediately overlying the bedrock is a layer of reddish-brown glacial till. The till is composed primarily of highly compacted silt containing sand, clay and gravel, with the gravel becoming coarser with depth. Some fragments of dolomitic bedrock are also evident in the lower reaches of the till. This layer is very firm and non-plastic and is generally considered of very low permeability due to the high silt content.

The glacial till ranges in thickness from 0.5 to 6 feet under the SWMF site. The top of the till layer is highest in the north-east corner of the site and slopes toward the south and the west.

The confining layer, consisting of the clay and till layers, ranges in thickness from 16 feet at BW2-86 along the south side of the site to 1.9 feet at BW4-86 in the north-east corner of the site. This layer serves as a low-permeability barrier isolating the overburden groundwater from the bedrock water bearing zones. As noted in the previous Section, it is not known whether the entire clay and till layer had been removed from any area beneath the Site prior to landfilling activities although every boring and test pit indicated the presence of at least some clay or till material.

5.2.2 Bedrock

The bedrock at the site is fine-grained, gray dolomite (Lockport Group) with occasional shaly partings. The dolomite is thin-bedded and fractured with occasional vugs and stylolites, and contains some gypsum, calcite and sphalinite deposits. Near the surface of the bedrock, the dolomite is weathered to a gray-brown and is highly fractured. The bedrock lies in the range of 7 to 20 feet below the original ground surface.

The top of the bedrock is highest along the eastern edge of the site and gradually slopes westerly. Figure 5 illustrates the top of bedrock contours. To further illustrate the site stratigraphy, geologic cross-sections have been prepared using the stratigraphic information obtained during the well installations.

Figure 6 illustrates the locations of the three cross-sections which are presented in Figures 7, 8 and 9.

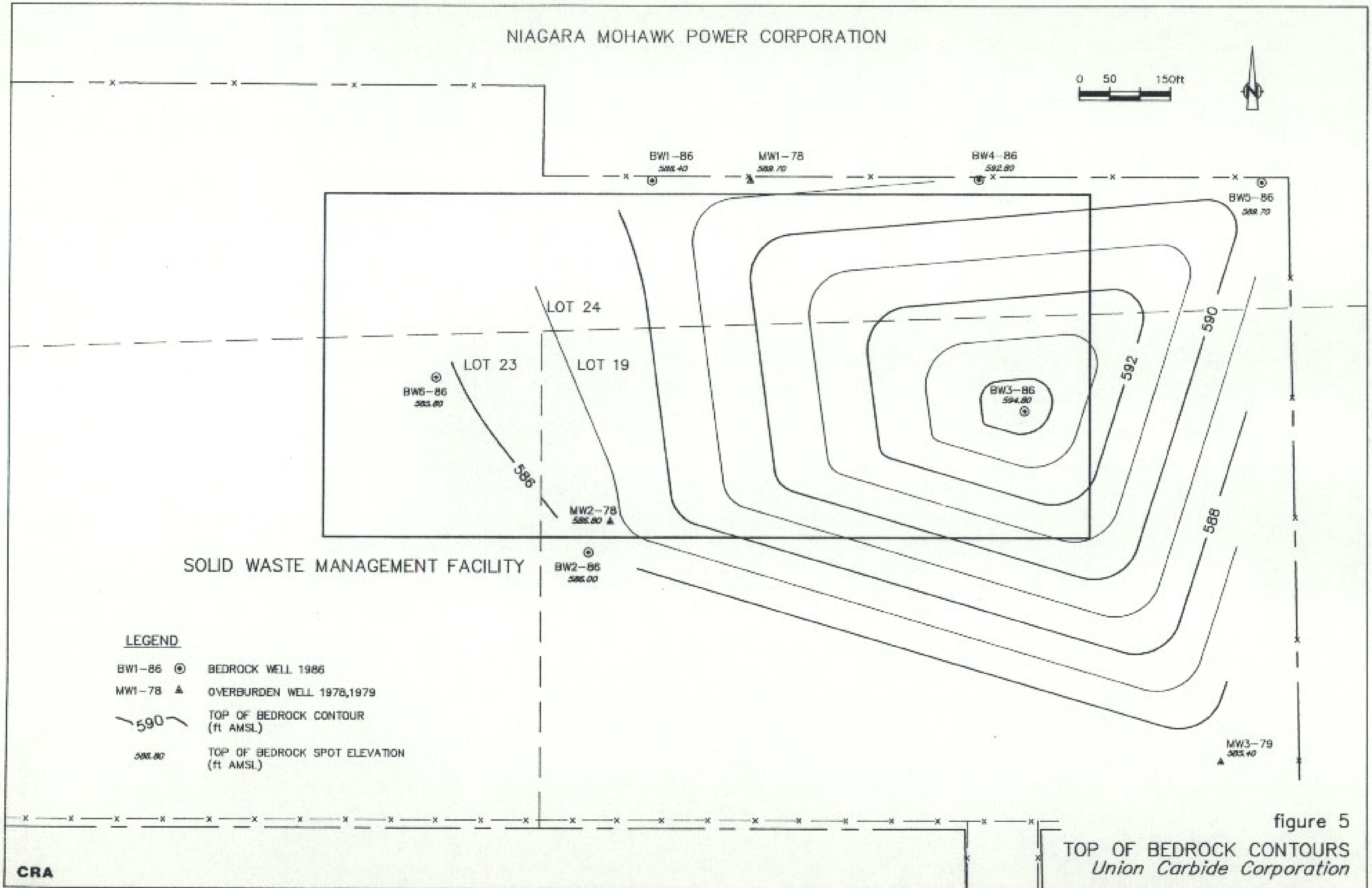

figure 5

TOP OF BEDROCK CONTOURS

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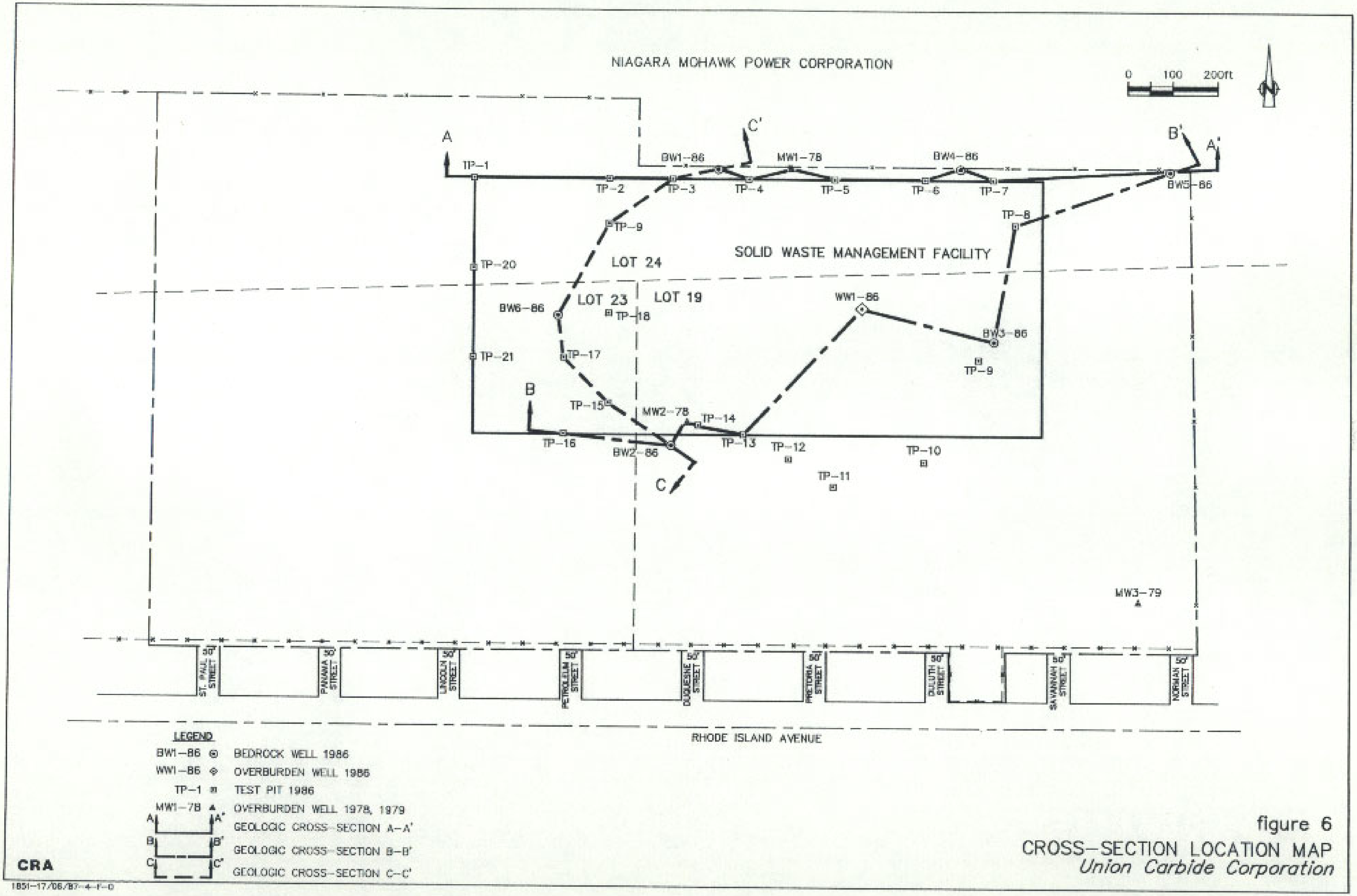

figure 6

CROSS-SECTION LOCATION MAP

Union Carbide Corporation

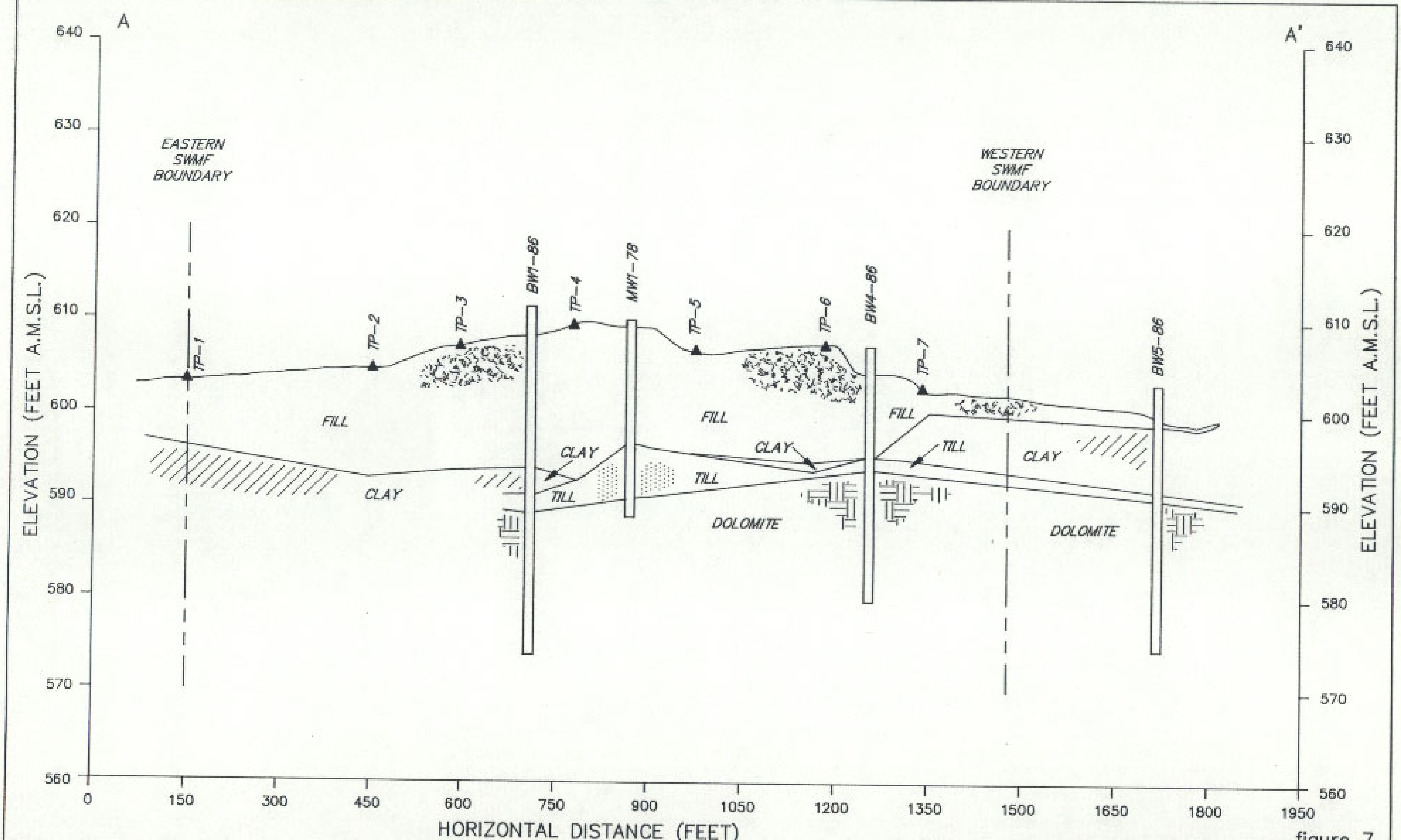

figure 7
GEOLOGIC CROSS-SECTION A - A'
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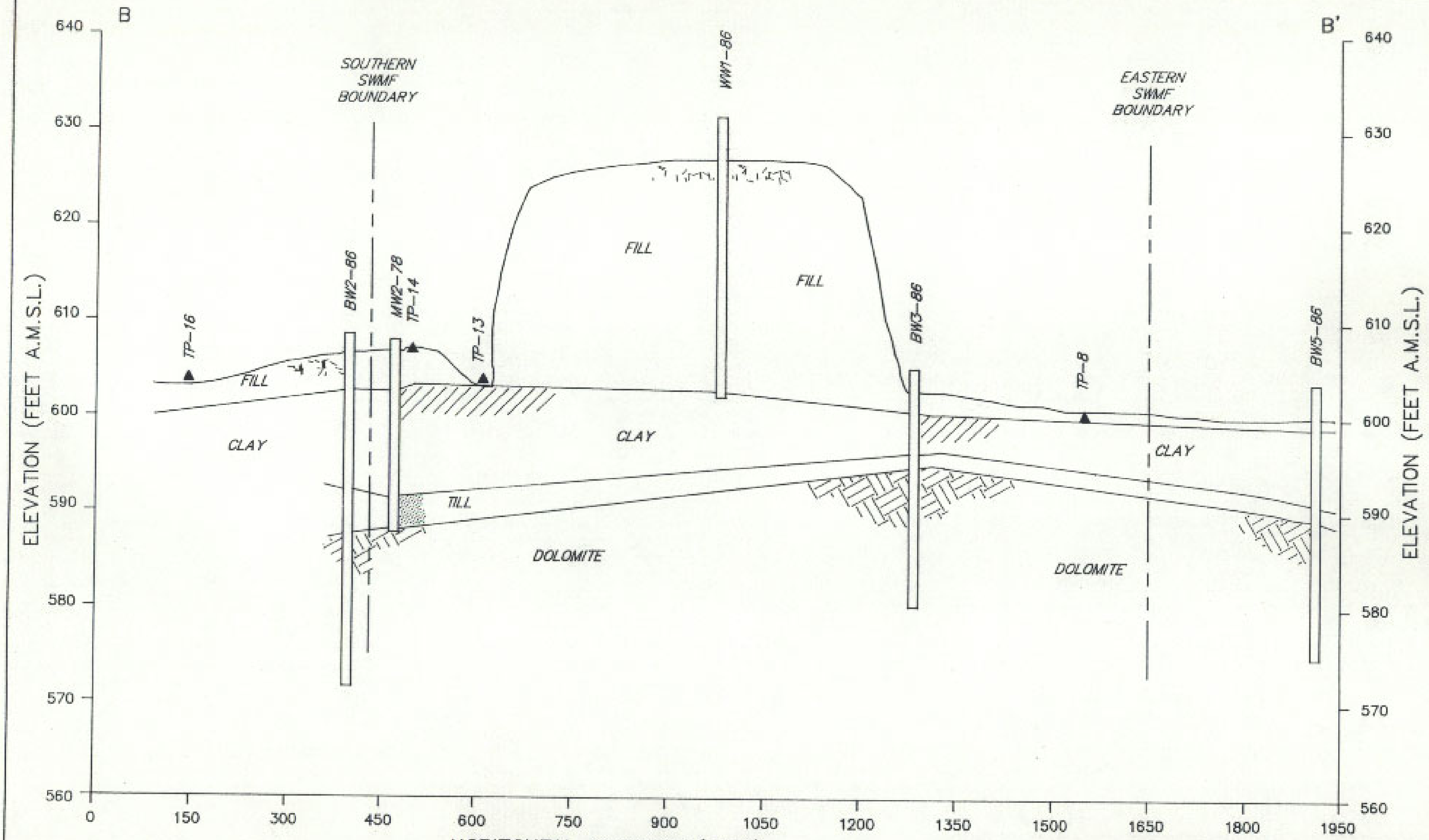

figure 8
GEOLOGIC CROSS-SECTION B – B'
Union Carbide Corporation

CRA

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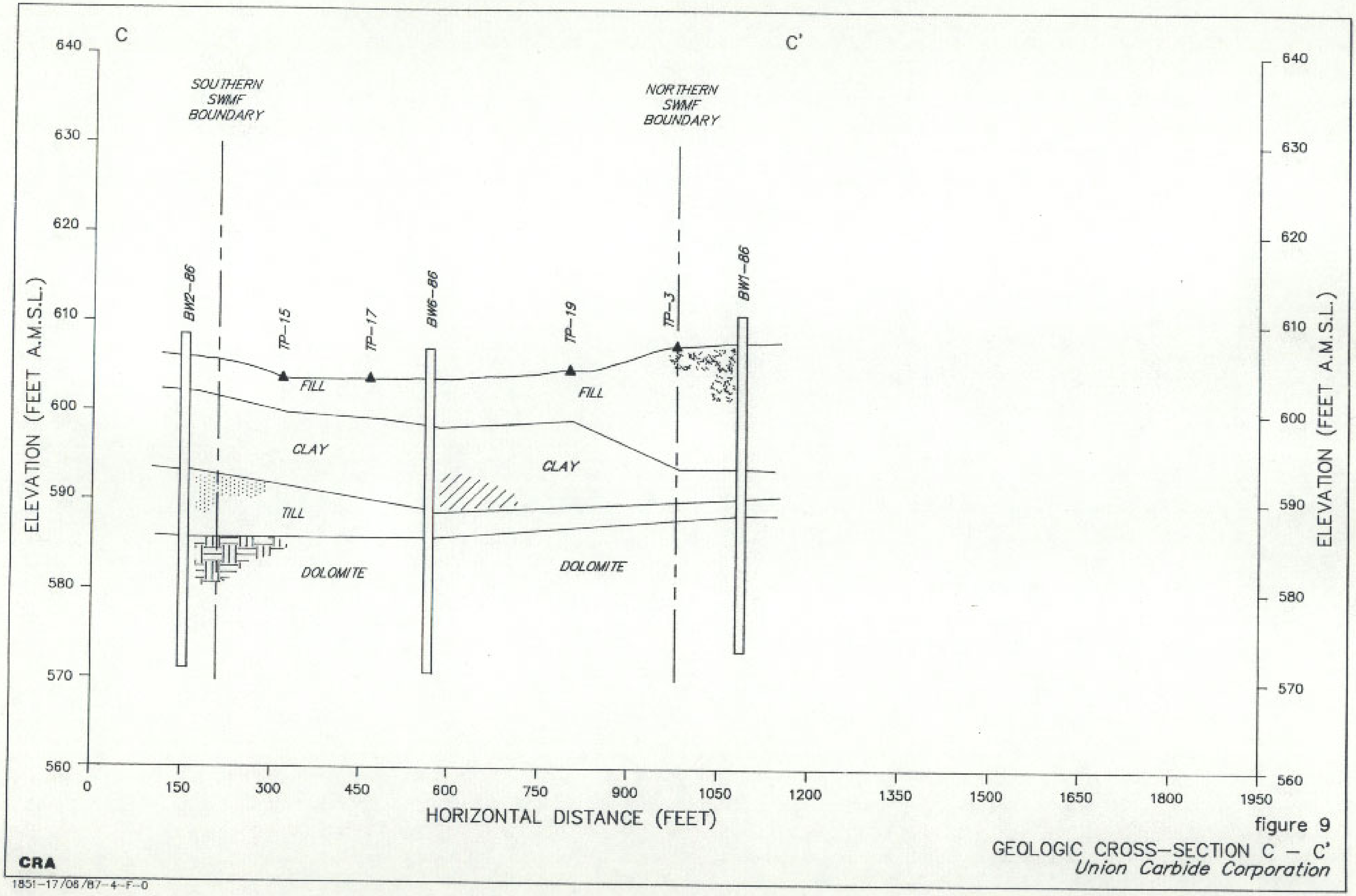

figure 9

GEOLOGIC CROSS-SECTION C – C'

Union Carbide Corporation

6.0 **GROUNDWATER CONDITIONS**

6.1 OVERBURDEN

As discussed in Sections 2.2 and 4.0, there are presently four overburden monitoring wells located in and around the SWMF, with one installed directly in the landfill waste itself. During the course of the Site Investigation, groundwater levels were measured periodically in the new wells. A complete round of groundwater level measurements from all of the wells including the four overburden wells was completed on May 26, 1987. Table 4 presents the groundwater levels measured during the course of the site investigation. The potentiometric contours for the overburden groundwater are presented in Figure 10. Based on the May 26, 1987 data, the groundwater flow in the overburden is south across the SWMF. The average gradient is 0.01 ft/ft.

It is to be noted that during the April 14, 1987 groundwater level measurements, the elevation of the groundwater measured in WW1-86 was 604.77 ft. AMSL, approximately 2 to 5 feet above the level measured in the other three overburden wells. WW1-86 was "dry" during previous water level measurement rounds, as well as during the May 1987 round. The water level recorded from the waste well indicates that the water in the well may be a result of a mounded or perched water table within the overburden.

TABLE 4

WATER LEVEL ELEVATIONS

Well Number	Date	Top of Casing Elevation (feet)	Water Level (feet)
BW1-86	7/10/86	608.99	593.22
	7/11/86	"	592.97
	7/15/86	610.72	592.55
	7/21/86	"	592.95
	7/29/86	"	592.69
	8/13/86	"	592.36
	12/08/86	"	597.90
	1/23/87	"	598.74
	2/26/87	"	597.32
	4/15/87	"	599.95
	5/26/87	"	596.63
BW2-86	7/10/86	607.00	594.61
	7/11/86	"	593.80
	7/15/86	608.43	593.57
	7/21/86	"	593.82
	7/29/86	"	593.59
	8/12/86	"	593.22
	12/08/86	"	597.78
	1/23/87	"	598.47
	2/26/87	"	597.33
	4/15/87	"	599.85
	5/26/87	"	596.65
BW3-86	7/10/86	603.54	591.27
	7/11/86	"	591.22
	7/15/86	604.72	591.16
	7/21/86	"	591.24
	7/29/86	"	590.94
	12/08/86	"	597.63
	1/23/87	"	598.06
	2/26/87	"	595.09
	4/15/87	"	600.29
	5/26/87	"	594.09
BW4-86	7/15/86	607.08	594.23
	7/21/86	"	594.31
	7/29/86	"	594.02
	8/13/86	"	593.50
	12/08/86	"	599.53
	1/23/87	"	599.83
	2/26/87	"	597.66
	4/15/87	"	600.99
	5/26/87	"	596.39

TABLE 4

WATER LEVEL ELEVATIONS

Well Number	Date	Top of Casing Elevation (feet)	Water Level (feet)
BW5-86	12/08/86	603.33	597.52
	1/23/87	"	597.40
	2/26/87	"	594.44
	4/15/87	"	599.16
	5/26/87	"	593.44
BW6-86	12/08/86	607.04	601.44
	1/23/87	"	601.62
	2/26/87	"	600.75
	4/15/87	"	607.04
	5/26/87	"	600.95
WW1-86	12/08/86	631.45	Dry
	1/23/87	"	Dry
	2/26/87	"	Dry
	4/15/87	"	604.77
	5/26/87	"	Dry
MW1-78	7/29/86	609.43	599.33
	4/15/87	"	602.10
	5/26/87	"	600.17
MW2-78	7/29/86	607.54	---
	4/15/87	"	603.27
	5/26/87	"	595.71
MW3-79	7/29/86	601.61	590.64
	4/15/87	"	599.04
	5/26/87	"	592.81

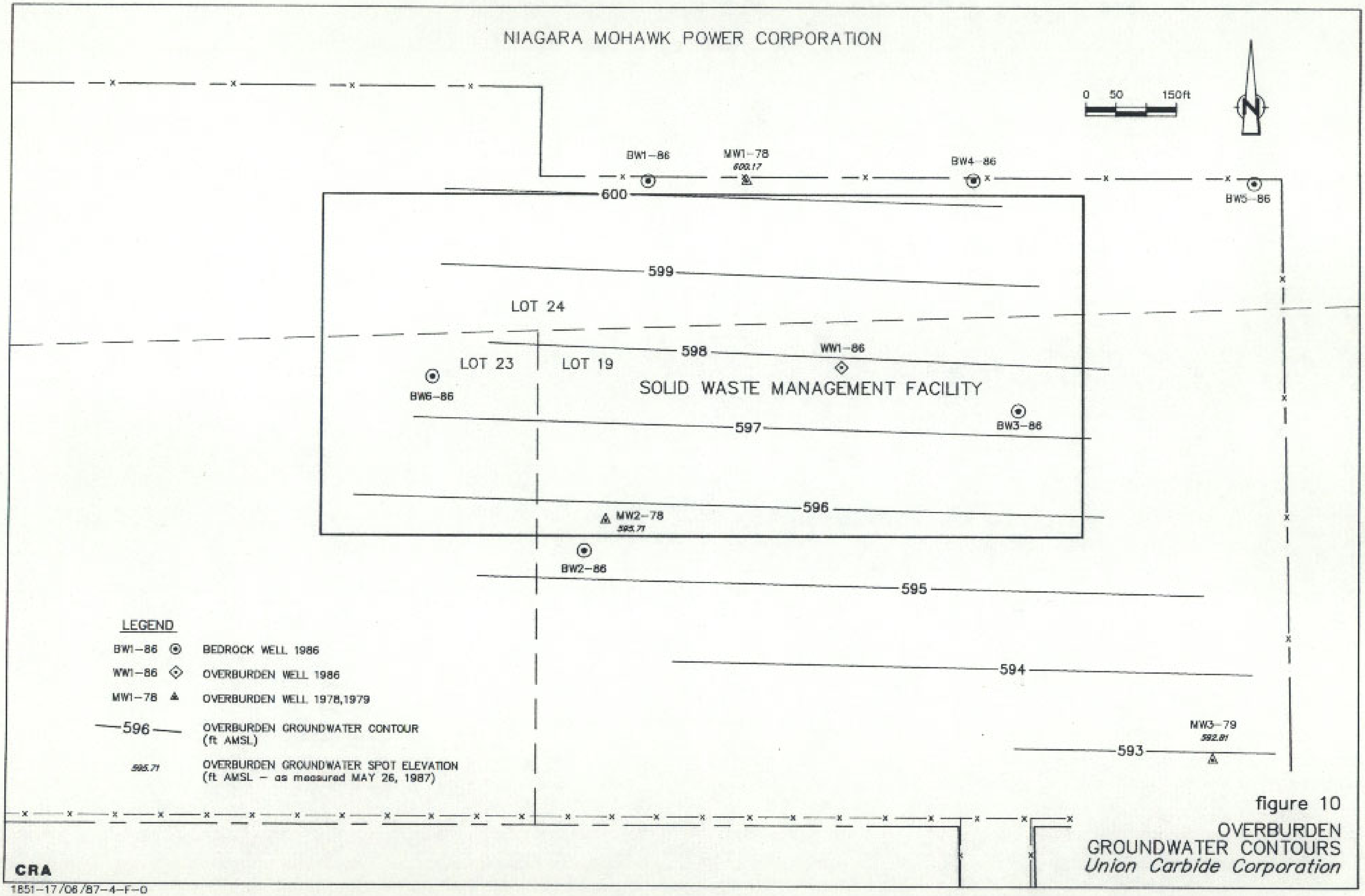

figure 10

OVERBURDEN GROUNDWATER CONTOURS

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While no groundwater was observed during the installation of WW1-86 through the center of the site, groundwater was observed in the test pits through the fill along the north side of the SWMF. Based upon the observed composition of the fill, it is apparent that the fill is the only significant water bearing unit within the overburden. The underlying clay and till units are defined as aquitard units and thus restrict the migration of perched groundwater contained within the fill both horizontally and vertically.

6.2 BEDROCK

As discussed in Section 4.0, there are presently six bedrock monitoring wells located in and around the SWMF. As with the overburden wells, groundwater levels were measured periodically. A full round of water level measurements from all six bedrock wells was completed on May 26, 1987. Table 4 summarizes the measured groundwater levels and the potentiometric contours for the bedrock groundwater are presented on Figure 11.

Based on the data collected, the groundwater flow in the bedrock formation ranges from easterly to southeasterly. The average gradient in the western portion of the site is 0.015 ft/ft. and in the eastern portion of the site the average gradient is 0.005 ft/ft.

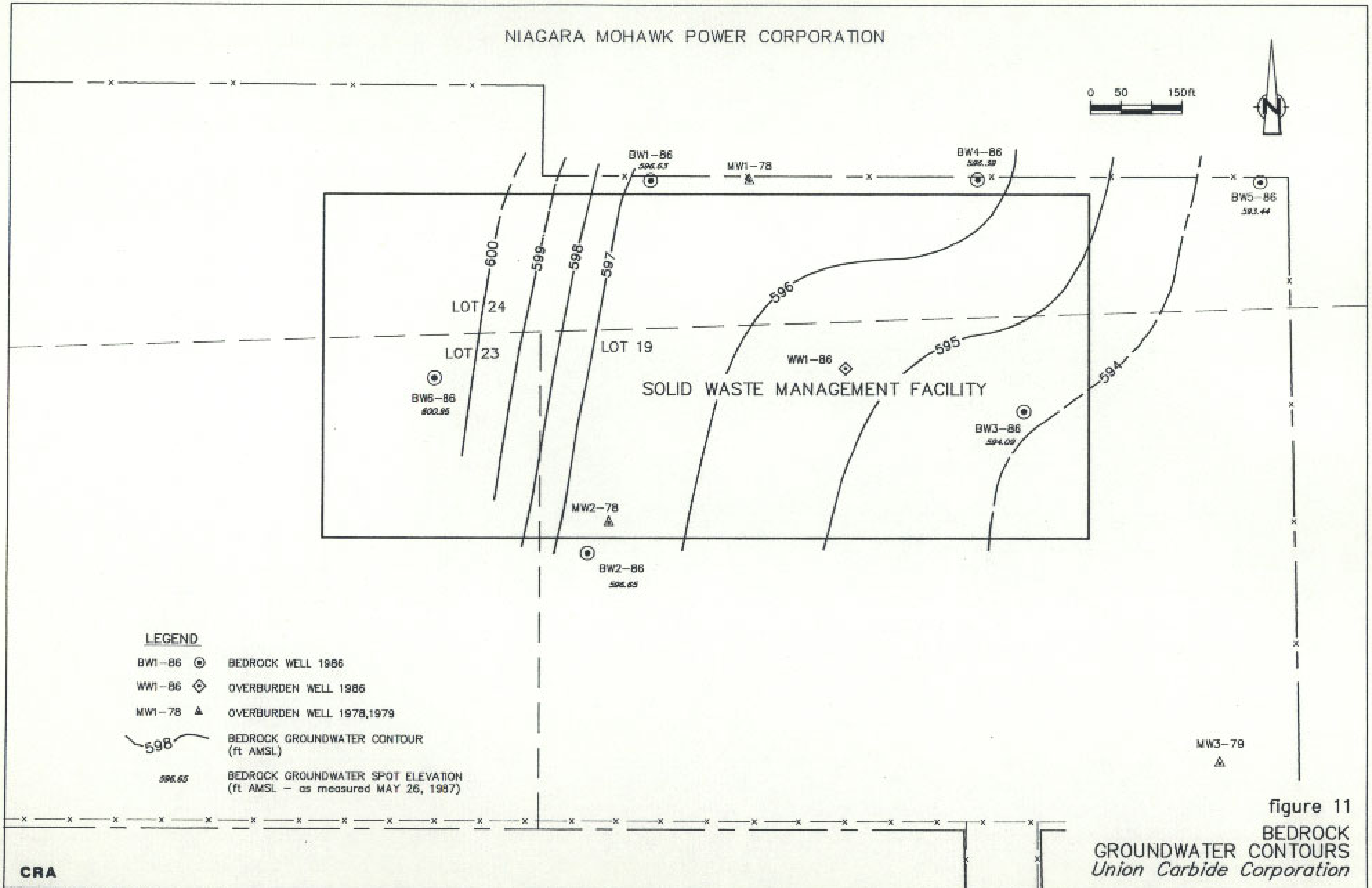


figure 11
BEDROCK
GROUNDWATER CONTOURS
Union Carbide Corporation

1851-17/06/87-4-F-0

The predominant easterly flow component of the bedrock groundwater is likely due to the relatively close proximity of the PASNY power conduits which are located approximately 2000 feet east of the site.

The conduits are constructed with vertical dewatering channels every ten feet along the exterior walls to protect the conduit structure. These vertical channels are in contact with the rock excavation face and drain to one of two main collector drains which lie beneath the conduit and extend the entire length of the conduits. As a result of the dewatering channels, the bedrock groundwater regime is significantly influenced in the vicinity of the conduits.

Initially, there was some confusion concerning the direction of bedrock groundwater flow beneath the site. This confusion arose from the well location selection criteria that was used. It was originally intended to install wells BW1-86, BW2-86 and BW3-86 approximately equi-distant around the perimeter of the site. The location of the fourth bedrock well was then to be determined by groundwater level measurements taken at the first three wells with the fourth well located equi-distant between the two wells exhibiting the downgradient position. In this case, it appeared that wells BW1-86 and BW3-86 exhibited the lowest groundwater position and therefore BW4-86 was placed in the northeast corner of the site. However, once installed, BW4-86 exhibited the highest bedrock groundwater levels on the site. This was attributed to the poor response of the well and the considerable amount of sediment that was identified in the bedrock formation. Consequently following discussions with the NYSDEC, two additional bedrock wells (BW5-86 and BW6-86) were installed to confirm the predominant easterly flow that had been anticipated. Installation of these wells confirmed that the predominant bedrock groundwater flow was easterly.

7.0 DATA ASSESSMENT

7.1 HISTORIC SAMPLING

Observation wells MW1-78, MW2-78 and MW3-79 were installed on site in 1978 and 1979 to monitor the overburden groundwater quality upgradient and downgradient of the SWMF. Following installation, these wells were monitored at regular intervals (generally quarterly) to December 1984. Tables presented in Appendix E, summarize the historical data from the quarterly groundwater monitoring program.

The concentrations of certain parameters in the groundwater samples collected from MW1-78 and MW2-78 during the quarterly monitoring program have been reported at levels which exceed New York State Groundwater Standards for Class GA Groundwater. These parameters include the following, with the stated limits indicated in brackets: total recoverable phenolics (0.001 ppm), sulfate (250 ppm), chromium (0.05 ppm), iron (0.3 ppm), lead (0.025 ppm) and mercury (0.002 ppm). Only three of these parameters were reported to be present in groundwater samples from downgradient well MW3-79 at levels which exceeded groundwater quality criteria. These parameters included the following, with the stated groundwater limits indicated in brackets: total recoverable phenolics (0.001 ppm), sulfate (250 ppm) and iron (0.3 ppm).

A surface water sample was collected from the drainage swale which drains the swampy area to the north of the SWMF. The sampling point is located approximately 300 feet west of the SWMF boundary at the intersection of the access road and the swale as shown on Figure 2. The sample was collected on December 17, 1984.

The sample was analyzed for purgeable halocarbons, polynuclear hydrocarbons, purgeable aromatics, phthalate esters and chlorinated hydrocarbons. The analysis indicated only 1,2-dichlorobenzene (8.44 ppb) was present at a level above the detectable limit, however, its concentration is approximately two orders of magnitude lower than the EPA proposed Recommended Maximum Contaminant Level (RMCL) of 620 ppb.

7.2 WASTE CHARACTERIZATION

One of the primary considerations for any site investigation is to identify the waste components that are present. At the SWMF, three waste characterization studies have been undertaken:

1. EP Toxic Study
2. analysis of soil samples from the sideslopes of the waste mound
3. analysis of groundwater samples from within the waste.

Appendix A contains Section 4.0 of the NYSDEC report which presents data from a leach test performed on a composited waste sample from the SWMF. A review of the leach test data indicates that none of the reported concentrations are in excess of EP Toxic criteria for those parameters listed in Table 1 of 40 CFR 261.24. Therefore the waste is not considered to be hazardous due to EP Toxicity.

As discussed in Section 4.5 of this report, soil samples were collected on January 16, 1987 from the side slopes of the SWMF. The soil samples were analyzed for the complete priority pollutant scan with the exception of asbestos, cyanides and dioxin. The analytical results for detected compounds are summarized in Table 5. Appendix F provides a complete summary of all compounds analyzed.

The analysis of soil sample SS1-87, collected along the north slope of the landfill, indicates the presence of various priority pollutant organics at concentrations up

TABLE 5

SUMMARY OF SOIL SAMPLE RESULTS
JANUARY 1987

Parameter 1	Soil Sample Location and Date	
	SS-1-87 (1/16/87)	SS-2-87 (1/16/87)
ORGANICS (mg/kg):		
SVOCs:		
Benzo(a)anthracene	210	ND 10
Benzo(k)fluoranthene	240	ND 10
Benzo(g,h,i)perylene	74J	ND 10
Benzo(a)pyrene	200	ND 10
Chrysene	140	ND 10
Fluoranthene	230	ND 10
Indeno(1,2,3-CD)pyrene	330	ND 10
Phenanthrene	99J	ND 10
Pyrene	210	ND 10
Pesticides/PCBs:		
Beta-BHC	0.2	0.3
Endosulfan Sulfate	0.4	0.7
INORGANICS: (mg/kg)		
Metals:		
Arsenic	0.77	1.6
Beryllium	0.20	0.12
Chromium	9.8	11
Copper	26	38
Mercury	ND0.1	0.16
Nickel	16	40
Lead	26	19
Zinc	42	48

1 Parameters summarized include only those parameters which were detected. See Appendix F for complete analytical summary.
2 NDx - Parameter not detected at detection limit x.
3 J - Estimated concentration below detection limit.

to 300 ppm. Two pesticides, beta-BHC (0.2 ppm) and endosulfan sulfate (0.4 ppm), and priority pollutant metals were also detected. The metals are generally within the range of typical background values for industrial areas as noted in the report by the U.S. Geological Survey entitled "Study and Interpretation of the Chemical Characteristics of Natural Water".

The analysis of soil sample SS2-87, collected along the south slope of the SWMF, indicates the presence of low level concentrations of beta-BHC (0.3 ppm) and endosulfan sulfate (0.7 ppm) and of various priority pollutant metals which are also generally within the range of typical background values for industrial areas.

Based upon the results of various samples collected from the solid waste it is indicated that the solid waste contains the parameters on Table 5A.

The analysis of groundwater sampled on April 20 to April 28, 1987 from WW1-86 (see Table 7, Section 7.3), indicated the presence of some of the parameters listed on Table 5A plus the following parameters:

- sulfate
- total organic halogens
- total recoverable phenolics

TABLE 5A

WASTE CHARACTERIZATION

The solid waste contains the parameters listed below:

Carbon-chloroform extractable
phenol
organic carbons
chloride
fluoride
hydrocarbon grease and oils
polar grease and oils
chlorinated hydrocarbons
benzo(a)anthracene
benzo(k)fluoranthene
benzo (g,h,i)perylene
benzo(a)pyrene
chrysene
fluoranthene
Indeno (1,2,3-cd)pyrene
phenanthrene
pyrene
Beta-BHC
endosulfan sulfate
aluminum
arsenic
berylium
cadmium
chromium
copper
iron
lead
mercury
nickel
zinc

- ammonia nitrogen
- total kjeldahl nitrogen
- calcium
- potassium
- magnesium
- manganese
- sodium

It is to be noted that the solid waste was not analyzed for the above parameters.

7.3 GROUNDWATER QUALITY

As discussed in Section 4.2, groundwater samples were collected from the bedrock wells (BW1-86 through BW4-86) during the period of August 12 to August 21, 1986. The groundwater samples were analyzed for the complete priority pollutant scan (with the exception of asbestos and dioxin) plus selected other organic compounds. These compounds included: acetone, 2-butanone, carbon disulfide, 2-hexanone, 4-methyl-2-pentanone, styrene, vinyl acetate, and o,p and m xylenes. The analytical results for detected compounds are summarized on Table 6. Appendix G provides a complete summary of all compounds analyzed.

TABLE 6

SUMMARY OF GROUNDWATER SAMPLE RESULTS
AUGUST/NOVEMBER 1986

Parameters [1]	Bedrock Well Sample Location and Date					
	BW1-86 (8/13/86)	BW2-86 (8/12/86)	BW3-86 (8/21/86)	BW4-86 (8/21/86)	BW5-86 (11/6-7/86)	BW6-86 (11/11/86)
Organics:						
VOC's (ug/L)						
Chloroethane	24	ND4 [2]	ND4	ND4	ND10	ND10
Chloroform	ND2	ND2	ND2	ND2	8J	ND10
Trans-1,2-Dichloroethene	ND2	ND2	4	32	ND10	ND10
Tetrachloroethene	ND2	ND2	ND2	52	ND10	ND10
Trichloroethene	ND2	ND2	ND2	9	ND10	ND10
Vinyl Chloride	ND2	ND2	8	52	ND10	ND10
Total Phenolics (mg/L)	ND0.25	ND0.25	ND0.005	ND0.005	0.006	ND0.005
Inorganics:						
Metals (mg/L)						
Chromium	0.05	0.05	--	--	ND0.02	ND0.02
Copper	ND0.01	0.02	ND0.1	ND0.01	ND0.01	ND0.01
Mercury	0.006	ND0.005	ND0.005	ND0.005	ND0.005	ND0.005
Nickel	0.05	ND0.04	ND0.04	ND0.04	ND0.04	ND0.04
Lead	0.10	0.19	ND0.05	ND0.05	ND0.05	ND0.05
Selenium	0.9	0.008	ND0.005	ND0.005	ND0.005	ND0.005
Zinc	4.9	25	0.37	0.30	0.17	0.03
Cyanide (mg/L)	0.01	ND0.01	ND0.005	ND0.005	ND0.005	ND0.005

[1] Parameters summarized include only those parameters which were detected. See Appendix H for complete analytical summary.

[2] NDx - Parameter not detected at detection limit x.

[3] J - Estimated concentration below detection limit.

As was also discussed in Section 4.2, groundwater samples were collected from the additional bedrock wells (BW5-86 and BW6-86) on November 6/7, 1986 and November 11, 1986, respectively. The groundwater samples were analyzed for the complete priority pollutant scan with the exception of asbestos and dioxin. The analytical results for detected compounds are also summarized on Table 6. Appendix G provides a complete summary of all compounds analyzed.

Upon evaluation of the analytical data from the August/November sampling, it became apparent that additional confirmatory sampling should be undertaken. The need for additional sampling was due to the fact that only one set of data existed for the 1986 wells. As part of this confirmatory sampling event, a Site Specific Parameter (SSP) list was developed and approved in conjunction with the NYSDEC for use in the confirmatory groundwater sampling program. The SSP list included the following set of parameters:

- Hazardous Substance List Organics
- Hazardous Substance List Inorganics
- Chloride
- Nitrite Nitrogen
- Nitrate Nitrogen
- Sulfate
- Total Organic Halogens (TOX)
- Total Organic Carbon (TOC)
- Total Recoverable Phenolics
- Ammonia Nitrogen
- Total Kjeldahl Nitrogen

The confirmatory set of groundwater samples were collected from all six bedrock wells and the three overburden wells during the period of April 15 to April 28, 1987. The analytical results for detected compounds are summarized on Table 7. Appendix H provides a complete summary of all compounds analyzed.

Only two parameters were reported at levels in excess of the New York State Groundwater Quality Standard (indicated in brackets) in groundwater samples from the overburden wells MW1-78 and MW2-78: total recoverable phenolics (0.001 ppm) and iron (0.3 ppm). Total recoverable phenolics was detected in MW2-78 at 0.07 ppm (duplicate sample was non-detect) and was not detected in MW1-78. Iron was detected in MW1-78 at 3.9 ppm and in MW2-78 at 0.14 ppm. There were no compounds detected in MW3-79 above applicable groundwater quality standards. Some of the chemical presence noted in overburden wells MW1-78 and MW2-78 may be due to the fact that these wells were drilled through the waste whereas MW3-79 was not drilled through the waste.

It is to be noted that all of the parameters reported to be present in the overburden groundwater are listed as having been found in the waste. However some of the chemical presence observed in overburden wells MW1-78 and MW2-78 may also be the result of contamination from off-site sources.

TABLE 7

SUMMARY OF GROUNDWATER SAMPLE RESULTS
APRIL 1987
BEDROCK WELLS

Parameters [1]	Sample Location and Date						
	BW1-86 (4/16/87)	BW2-86 (4/17/87)	BW3-86 (4/20/87)	BW3-86 (dup.) (4/20/87)	BW4-86 (4/16/87)	BW5-86 (4/16/87)	BW6-86 (4/20/87)
ORGANICS							
VOC's (ug/L):							
Chloroethane	82/81/82	ND10	ND20	ND20	ND20	ND10	ND10
Vinyl Chloride	ND30	ND10	16/26/21	ND20	ND20	ND10	ND10
1,2-Dichloroethane	ND30	ND10	80/86/60	36/37/36	ND20	ND10	ND10
Ethylether(4)	200/200/200	60/60/60	--	--	--	--	--
Acetone	1000/520/820	ND10	360/670/460	1500/1500/1400	700/890/1400	27/46/120	ND10
Total Xylenes	52/56/38	ND10	ND20	ND20	ND20	ND10	ND10
SVOC's (ug/L):							
Di-n-octylphthalate	ND10	ND10	ND10	7J[3]/ND10	ND10	ND10	ND10
Acenaphthene	ND10	ND10	ND10	ND10	ND10	ND10	ND10
Fluoranthene	ND10	ND10	ND10	ND10	ND10	ND10	ND10
Pyrene	ND10	ND10	ND10	ND10	ND10	ND10	ND10
Bis(2-ethylhexyl) phthalate	ND	ND10	ND10	27	ND10	ND10	ND10
Alkylated benzene (4)	--	--	--	--	--	--	--
Pesticides/PCB (ug/L):							
Heptachlor	ND0.4/ND0.2	ND0.3/ND0.4	ND0.1/0.6	ND2.0/ND2.0	ND0.05/ND0.05	ND0.05/ND0.05	ND0.05/ND0.05
4,4'-DDT	0.1/0.1	ND0.2/ND0.1	ND0.1/ND0.1	ND0.1/ND0.1	ND0.1/ND0.1	ND0.1/ND0.1	ND0.1/ND0.01

TABLE 7

SUMMARY OF GROUNDWATER SAMPLE RESULTS
APRIL 1987
BEDROCK WELLS

Parameters [1]	Sample Location and Date						
	BW1-86 (4/16/87)	BW2-86 (4/17/87)	BW3-86 (4/20/87)	BW3-86 (dup.) (4/20/87)	BW4-86 (4/16/87)	BW5-86 (4/16/87)	BW6-86 (4/20/87)
SSP (mg/L):							
Chloride	770	250	82	75	51	22	53
Nitrite Nitrogen	ND0.04	ND0.4	ND0.04	0.06	ND0.04	ND0.04	ND0.04
Nitrate Nitrogen	ND0.1	ND0.1	ND0.1	ND0.1	ND0.1	ND0.1	ND0.1
Sulfate	110	350	220	200	17	97	100
Total Organic Halogen	0.068	0.068	0.062	0.063	0.050	0.016	.002
Total Organic Carbon	81	98	11	11	50	29	11
Total Recoverable Phenolics	0.01	0.07	ND0.005	0.005	ND0.005	0.007	ND0.005
Ammonia Nitrogen	1.7	ND0.2	ND0.2	ND0.2	2.6	ND0.2	ND0.2
Total Kjeldahl Nitrogen	3.5	1.1	1.1	1.7	4.6	1.0	1.6
INORGANICS							
Metals: (mg/L)							
Aluminum	ND0.1	ND0.1	0.13	0.12	ND0.1	ND0.1	0.26
Barium	ND0.1	ND0.1	0.2	ND0.1	ND0.1	ND0.1	0.30
Calcium	200	260	150	150	97	88	210
Iron	2.4	2.2	1.6	1.6	8.2	1.7	3.6
Potassium	8.4	5.5	7.2	7.7	23	2.4	7.0
Magnesium	62	88	40	40	37	21	46
Manganese	0.32	0.66	1.0	1.0	0.17	0.14	1.4
Sodium	225	120	62	64	50	20	38
Zinc	5.0	6.1	3.0	2.9	8.5	0.18	0.23

TABLE 7

SUMMARY OF GROUNDWATER SAMPLE RESULTS
APRIL 1987
OVERBURDEN WELLS

Parameters [1]	Sample Location and Date				
	MW1-78 (4/17/79)	MW2-78 (4/20-24/87)	MW2-78 (dup.) (4/20-24/87)	MW3-79 (4/16/87)	WW1-86 (4/20-28/87)
ORGANICS					
VOC's (ug/L):					
Chloroethane	ND20	ND20		ND100	ND20
Vinyl Chloride	ND20	ND20		ND100	ND20
1,2-Dichloroethane	ND20	ND20		ND100	ND20
Ethylether (4)	--	--		--	--
Acetone	2500/1400/4000	830/820/800		3200/6300/4100	2000/1500/ND
Total Xylenes	ND20	ND20		ND100	ND20
SVOC's (ug/L):					
Di-n-octylphthalate	ND10	ND10		ND10	ND10
Acenaphthene	ND10	ND10		ND10	ND10/6J[3]
Fluoranthene	ND10	ND10		ND10	ND10/2J[3]
Pyrene	ND10	ND10		ND10	ND10/3J[3]
Bis(2-ethylhexyl) phthalate	ND10	ND10		ND10	ND10
Alkylated benzene (4)	--	--		--	--/20
Pesticide/PCB (ug/L):					
Heptachlor	ND0.1/ND0.05	ND0.3/ND0.3		ND0.05/ND0.05	ND0.1/ND0.1
4,4'-DDT	ND0.1/ND0.1	ND0.5/ND0.5		ND0.1/ND0.1	ND0.3/ND0.1

TABLE 7

SUMMARY OF GROUNDWATER SAMPLE RESULTS
APRIL 1987
OVERBURDEN WELLS

Parameters [1]	Sample Location and Date				
	MW1-78 (4/17/79)	MW2-78 (4/20-24/87)	MW2-78 (dup.) (4/20-24/87)	MW3-79 (4/16/87)	WW1-86 (4/20-28/87)
SSP (mg/L):					
Chloride	99	14		2	300
Nitrite Nitrogen	ND0.04	ND0.04		ND0.04	ND0.04
Nitrate Nitrogen	ND0.1	ND0.1		0.4	ND0.1
Sulfate	6	200		58	1,800
Total Organic Halogen	.063	.024		.016	.021
Total Organic Carbon	48	17		21	18
Total Recoverable Phenolics	ND0.005	0.07/ND		ND0.005	0.07
Ammonia Nitrogen	3.3	ND0.2		ND0.2	4.7
Total Kjeldahl Nitrogen	7.8	11		0.4	12
Metals: (mg/L)					
Aluminum	ND0.1	0.13	ND0.1	0.12	0.11
Barium	ND0.1	ND0.1	ND0.1	ND0.1	ND0.1
Calcium	85	49	44	52	350
Iron	3.9	0.14	0.07	ND0.05	23
Potassium	39	9.0	9.0	1.5	10
Magnesium	46	19	24	12	180
Manganese	0.21	0.18	0.23	ND0.01	0.89
Sodium	125	25	25/25	8	320
Zinc	0.08	ND0.01	ND0.01	0.05	0.07

[1] Parameters summarized includes only those parameters which were detected. See Appendix I for complete analytical summary.
[2] NDx - Parameter not detected at detection x.
[3] J - Estimated concentration below detection limit.
[4] Tentatively identified compound, estimated concentration.

Acetone was detected at elevated concentrations in most wells for the April 1987 sampling event. However, acetone was not detected in wells BW1-86 through BW4-86 during the August 1986 groundwater data. Acetone was also detected at elevated concentrations in the field blank collected during the April 1987 sampling round. It can therefore be concluded that the elevated levels of acetone are probably due to field or laboratory contamination since acetone is used to clean bailers between monitoring well sampling and laboratory glassware and equipment.

Based upon the data collected from the overburden wells, the groundwater quality in the overburden below and downgradient of the SWMF, is generally free of impact. It is therefore concluded that horizontal migration of the waste chemicals in the overburden is limited.

The results of analysis of the groundwater samples collected from the bedrock wells indicate the presence of typically trace concentrations of various parameters in the vicinity of the SWMF. Several parameters are identified in higher concentrations in wells at the upgradient end of the SWMF (BW1, BW2 and BW6) than in downgradient wells BW3, BW4 and BW5. Included in this group are chloride, sulfate, TOX, TOC, total recoverable phenolics, aluminum, barium, calcium, magnesium, manganese, sodium, chloroethane, ethyl ether, total xylenes and 4,4'-DDT.

The parameters detected at higher concentrations in the downgradient wells (highest concentration included in brackets) include; nitrite nitrogen (0.06 mg/L), ammonia nitrogen (2.6 mg/L), total kjeldahl nitrogen (4.6 mg/L), iron (8.2 mg/L), potassium (23 mg/L), zinc (8.5 mg/L), vinyl chloride (26 ug/L), 1,2-dichloroethane (86 ug/L), bis(2)ethylhexyl phthalate (27 ug/L) and heptachlor (0.6 ug/L). It is to be noted that many of the above parameters were not found during the characterization of the waste and therefore their source is undefined. Potential explanations of the presence of certain chemicals not detected in the waste would be groundwater contamination from off-site sources or analytical artifact.

Of the compounds detected in both the upgradient and down-gradient wells, only six compound concentrations exceeded applicable groundwater standards. These included vinyl chloride, 1,2-dichloroethane, chloride, sulfate, total recoverable phenolics and heptachlor. The occurrence of these parameters in excess of applicable groundwater standards is further discussed in Section 7.4.

Based on the analytical data collected during the waste characterization and bedrock sampling programs, it is apparent that the waste material could be the source of some of the chemicals identified in the bedrock regime. In order for this to have occurred, the low permeable clay/till layer beneath the site has probably penetrated to depth at some location. Even so, the concentrations of chemicals identified are relatively low in both the waste material and the bedrock groundwater. It is to be further noted that the groundwater quality in the area of BW5-86, which is located approximately 275 feet from the SWMF in the general downgradient direction of groundwater flow is essentially free of impact.

7.4 COMPARISON TO GROUNDWATER QUALITY CRITERIA

This section compares analytical data from the bedrock sampling completed in 1986 and 1987 to available New York State Groundwater Quality Standards and/or applicable EPA groundwater standards/criteria. This section discusses only those compounds that exceed the applicable, available standards/criteria.

The concentration of vinyl chloride has been reported to be above the New York State Groundwater Quality Standard for the protection of human health of 5 ppb. Vinyl chloride concentrations range up to 26 ppb in well BW3-86 (sampled on April 20, 1987) and 52 ppb in BW4-86 (sampled on August 21, 1986). It is to be noted that vinyl chloride was not detected in the waste characterization study and is not found consistently in the two wells where it was reported.

The concentration of 1,2-dichloroethane has been reported to exceed the EPA Proposed Maximum Contaminant Level (PMCL) of 5 ppb. A maximum concentration of 1,2-dichloroethane of 86 ppb was reported in well BW3-86 during the April 20, 1987 sample round. The duplicate sample indicated a concentration on the order of 37 ppb. This compound was not detected in any other bedrock or overburden well. This parameter was also not detected during the waste characterization study.

The concentration of heptachlor was reported to exceed the New York State Groundwater Quality Standard (human) of non-detect. The only identified concentration of heptachlor was 0.6 ppb, reported in the BW3-86 groundwater sample of April 20, 1987 but heptachlor was not detected (detection limit = 0.1 ppb) in the duplicate sample. Heptachlor was not identified in the waste characterization study.

The chloride concentration has been reported to equal the New York State Groundwater Quality Standard of 250 ppm in the BW2-86 sample of April 17, 1987. It is to be noted that the chloride concentration of the upgradient well BW1-86 sampled April 16, 1987 was 770 ppm. Downgradient concentrations (BW3-86, BW4-86 and BW5-86) were typically in the range of an order of magnitude lower.

The concentration of sulfate has been reported to be slightly above the New York State Groundwater Quality Standard of 250 ppm. Sulfate concentrations range up to 350 ppm, as reported in upgradient well BW2-86 sample of April 17, 1987. Downgradient samples were less then 200 ppm.

The concentration of total recoverable phenolics has been reported above the New York State Groundwater Standard for the prevention of organoleptic (taste) effects (0.001 ppm). Concentrations of total recoverable phenolics range up to 0.006 ppm as reported in downgradient well BW5-86 (sampled on November 8, 1986) and 0.01 and 0.7 as reported in the April 1987 sampling data for upgradient wells BW1 and BW2 respectively.

The concentrations of various of the priority pollutant metals have been reported to be above New York State Groundwater Quality Standard. These metals consist of the following at the indicated standard: chromium (0.05 ppm); lead (0.025 ppm); selenium (0.02 ppm) and zinc (5 ppm). The concentrations ranged up to 0.05 ppm of chromium at BW2-86 (August 14, 1986); 0.19 ppm of lead at BW2-86 (August 14, 1986); 0.9 pm of selenium at BW1-86 (August 14, 1986) and 8.5 ppm of zinc at BW4-86 (April 16, 1987). These highest reported concentrations are close to the Groundwater Quality Standard and many of the reported concentrations are from the upgradient wells (BW1-86 and BW4-86).

The concentrations of the inorganic compounds iron and manganese have been reported to exceed the New York State Groundwater Quality Standard or EPA Secondary Maximum Contaminant Level of 0.3 ppm and 0.05 ppm, respectively. The concentrations of iron range up to 8.2 ppm as reported in the BW4-86 groundwater sample collected on April 16, 1987. Considering that the wells have been constructed of black iron pipe, the iron concentrations are not unusual or excessive. The concentrations of manganese range up to 1.4 ppm as reported in upgradient BW6-86 groundwater sample collected on April 20, 1987.

8.0 PUBLIC AND ENVIRONMENTAL HEALTH ASSESSMENT

In order to determine whether the presence of chemicals beneath the SWMF is an environmental concern, a preliminary assessment of the potential exposure of humans and the environment to the chemicals and the risks associated with this exposure was performed.

Based on the hydrogeologic investigation undertaken, it is apparent that the singular route providing potential exposure to the chemicals at the site is via the PASNY power conduits to the Niagara River. The chemicals on site are basically contained in the upper bedrock flow regime which discharges directly to the PASNY power conduits, and indirectly to the Niagara River. Therefore, the environmental concerns regarding the presence of chemicals beneath the site are to the aquatic environment of the PASNY surface water reservoir and the Niagara River and the possible use of these waters for recreational and potable water supply downstream of the SWMF.

8.1 CHEMICAL LOADING QUANTIFICATION

8.1.1 Discharge Volume

As noted previously, the discharge of chemicals (flux) to the PASNY power conduit is limited to the upper bedrock flow regime. The chemical flux quantification of this discharge involves an interpretation of the geologic stratigraphy, flow regimes including groundwater hydraulic properties and groundwater chemistry.

The groundwater discharge volume beneath the SWMF contributing to the PASNY power conduit has been calculated for the hydraulic data of May 26, 1987. The bedrock monitoring wells (BW2-86 and BW3-86) are assumed to be representative of the average discharge conditions.

The portion of the upper bedrock stratigraphy contributing most significantly to potential chemical migration has been assumed to be the upper 15 feet. This is based solely on the extent of penetration of the bedrock wells. For the loading calculations, the water bearing stratum as measured at the downgradient wells (BW2-86 and BW3-86) is assumed to be representative of average conditions. The average aquifer thickness, end area length and gradient used for the calculation are presented in Table 8. The end area length consists of the downgradient

TABLE 8

BEDROCK AQUIFER DEFINITION

Representative Wells	Average Estimated Bottom Elevation of Water-Bearing INTERVAL (ft. AMSL)	Average Saturated Depth of Flow (ft)	End Area Length (ft)	Estimated Permeability (cm/sec)	Average Gradient	Average Discharge (L/day)
BW2-86 and BW3-86	575.5	20	1,525	1×10^{-2}	0.005	122,410

boundary of the SWMF which includes the entire eastern end and the south side of the SWMF, except the westernmost 200 feet which was unused.

The representative hydraulic conductivity for the bedrock aquifer has been conservatively estimated to be 1×10^{-2} cm/sec. This value exceeds the value of 1×10^{-3} cm/sec noted in Section 4.3 and does consider the almost instantaneous reponse of the aquifer during slug testing of the bedrock wells.

The total groundwater flow has been calculated by:

$$Q = K \frac{dh}{dl} A$$

The groundwater discharge calculation is very sensitive to hydraulic conductivity. For example, if the hydraulic conductivity value is half an order of magnitude lower than the value conservatively used, (i.e. 5×10^{-3}), the groundwater discharge would be reduced by a factor of two.

Based on this calculation, it is estimated that independent of rainfall infiltration, approximately 122,410 liters per day discharge from the eastern and southern sides of the SWMF to the PASNY power conduits. The resultant flow is presented in Table 8.

8.1.2 Chemical Quantification

To estimate the chemical loading from the groundwater beneath the SWMF, the chemical concentrations observed in each of the wells at the edge of the SWMF were averaged to calculate a typical conservative loading condition. These average concentrations were assumed to be representative of the groundwater quality for the entire downgradient boundary of the SWMF.

The mass flux to the PASNY power conduits has been calculated for all chemicals detected in bedrock wells during the April 1987 sampling round which includes the entire set of site specific parameters.

The average chemical concentrations and maximum loading of chemicals to the PASNY power conduits are summarized on Table 9.

In order to assess the most significant potential impact of groundwater discharge from the SWMF to the PASNY power conduits and the Niagara River, it is necessary to determine a worst case condition of low flow (lowest dilution potential).

TABLE 9

CHEMICAL FLUX

Chemical	Average Discharge (L/day)	Average Chemical Concentration (1)	Chemical Flux (2) (g/day)
		(ug/L)	
VOCs:			
Chloroethane	122,410	<37	<4.5
Vinyl Chloride	122,410	<20	<2.4
1,2-Dichloroethane	122,410	<38	<4.7
Ethylether	122,410	<87	<10.6
Total Xylenes	122,410	<26	<3.2
SVOCs:		(ug/L)	
Di-n-octylphthalate	122,410	<9	<1.1
Bis(2-ethylhexyl) Phthalate	122,410	<16	<2.0
Pest/PCB:		(ug/L)	
Heptachlor	122,410	<0.3	<0.04
4,4'-DDT	122,410	<0.1	<0.01
SSP:		(mg/L)	
Chloride	122,410	367	44,924
Nitrite Nitrogen	122,410	<0.05	<6.1
Nitrate Nitrogen	122,410	<0.1	<12.2
Sulfate	122,410	227	27,787

continued....

TABLE 9

CHEMICAL FLUX

Chemical	Average Discharge (L/day)	Average Chemical Concentration (1)	Chemical Flux (2) (g/day)
		(mg/L)	
SSP: (cont'd)			
Total Organic Halogens	122,410	0.066	8.1
Total Organic Carbon	122,410	63	7,712
Total Recoverable Phenolics	122,410	0.03	3.7
Ammonia Nitrogen	122,410	<0.7	<86
Total Kjeldahl Nitrogen	122,410	2.1	257
Metals:		(mg/L)	
Aluminum	122,410	<0.1	<12.2
Barium	122,410	<0.1	<12.2
Calcium	122,410	203	24,849
Iron	122,410	2.1	257
Potassium	122,410	7.0	857
Magnesium	122,410	63	7,712
Manganese	122,410	0.7	86
Sodium	122,410	136	16,648
Zinc	122,410	4.7	575

Notes: (1) Average chemical concentration calculated using 04/87 data for wells BW1-86, BW2-86 and BW3-86. In cases where data contained non-detect analyses, the detection limit was used for calculations.

(2) Chemical Flux calculated only for those chemicals which were detected in bedrock wells during 04/87 sampling.

The worst case (low flow) condition in the PASNY power conduit is assumed to be 25,000 CFS (6.1×10^{10} L/day). This is based on the following assumptions:

i) total average flow in Upper Niagara River is 150,000 CFS;

ii) daytime flow required over Niagara Falls is 100,000 CFS; and

iii) The remaining 50,000 CFS of flow in the Niagara River is evenly split (25,000 CFS) between the New York and Ontario Power Authorities.

Therefore, assuming complete mixing, the chemical flux (see Table 9) to the PASNY power conduit (neglecting dilution occurring within the PASNY power conduit due to other groundwater infiltration) would be diluted by a factor of 6.1×10^{10} L/day.

8.2 HEALTH RISK ASSESSMENT

To evaluate the potential for risk to human health resulting from chemicals present in groundwater under the SWMF, it is necessary to define the potential human concentrations with water quality standards and criteria which are protective of human health. As stated earlier, the location of the impacted groundwater and the hydrogeology of the site limits potential human exposure points to the PASNY surface water reservoir and the Niagara River below the power plant. The primary human exposures to these waters would be fish consumption from the PASNY surface water reservoir and the use of water from the lower Niagara River (downstream from the PASNY discharge) as a potable water supply.

For the assessment of PANSY surface water, it is appropriate to compare the calculated concentrations of chemicals in the PASNY power conduit to the acceptable concentrations in drinking water. In Table 10, maximum low flow concentrations have been tabulated. It is to be noted that the low flow concentrations are compared to the lesser of New York State or Federal maximum acceptable contaminant levels. For chemicals for which maximum acceptable contaminant levels were not available, the lesser of New York State or Federal recommended, proposed, guidance or water quality criteria were used which makes the assessment more conservative. Making these comparisons one finds that the predicted concentrations in the reservoir are several orders of magnitude below the estimated maximum acceptable concentrations.

TABLE 10
EVALUATION OF THE IMPACT OF
GROUNDWATER CHEMICALS ON HUMAN HEALTH

Chemical	Loading (ug/day)	Concentration in PASNY Power Conduit (ug/L) Low Flow(1)	Acceptable Concentration in Water (ug/L) Drinking Water	Aquatic (Fish)
VOCs:				
Chloroethane	$<4.5 \times 10^{6}$	$<7.4 \times 10^{-5}$	7.4×10^{2} (12)	-
Vinyl Chloride	$<2.4 \times 10^{6}$	$<3.9 \times 10^{-5}$	1×10^{0} (2)	1.0×10^{5} (10)
1,2-Dichloroethane	$<4.7 \times 10^{6}$	$<7.7 \times 10^{-5}$	8×10^{-1} (3)	1.0×10^{4} (11)
Ethylether	$<1.1 \times 10^{7}$	$<1.8 \times 10^{-4}$	-	2.1×10^{5} (11)
Total Xylenes	$<3.2 \times 10^{6}$	$<5.3 \times 10^{-5}$	4.4×10^{2} (4)	3.8×10^{3} (11)
SVOCs:				
Di-n-octylphthalate	$<1.1 \times 10^{6}$	$<1.8 \times 10^{-5}$	-	-
Bis(2-ethylhexyl)phthalate	$<2.0 \times 10^{6}$	$<3.3 \times 10^{-5}$	4.2×10^{3} (5)	6.0×10^{-1} (3)
Pest/PCB:				
Heptachlor	$<4.0 \times 10^{4}$	$<6.6 \times 10^{-7}$	2.8×10^{-4} (6)	1.0×10^{-3} (3)
4,4'-DDT	$<1.0 \times 10^{4}$	$<1.6 \times 10^{-7}$	2.4×10^{-5} (6)	1.0×10^{-3} (3)
SSP:				
Chloride	4.5×10^{7}	7.4×10^{-4}	2.5×10^{5} (7)	-
Nitrite Nitrogen	$<6.1 \times 10^{3}$	$<1.0 \times 10^{-7}$	1.0×10^{3} (4)	2.0×10^{1} (3)
Nitrate Nitrogen	$<1.2 \times 10^{4}$	$<2.0 \times 10^{-7}$	1.0×10^{4} (8)	-
Sulfate	2.8×10^{7}	4.6×10^{-4}	2.5×10^{5} (7)	-

TABLE 10

EVALUATION OF THE IMPACT OF
GROUNDWATER CHEMICALS ON HUMAN HEALTH

Chemical	Loading (ug/day)	Concentration in PASNY Power Conduit (ug/L) (1) Low Flow	Acceptable Concentration in Water (ug/L) Drinking Water	Aquatic (Fish)
SSP: (cont'd)				
Total Organic Halogens	8.1×10^{3}	1.3×10^{-7}	-	-
Total Organic Carbon	7.7×10^{6}	1.3×10^{-4}	-	-
Total Recoverable Phenolics	3.7×10^{3}	6.1×10^{-8}	1×10^{0} (3)	5.6×10^{2} (11)
Ammonia Nitrogen	$<8.6 \times 10^{4}$	$<1.4 \times 10^{-6}$	2.0×10^{3} (3)	
Total Kjeldhal Nitrogen	2.6×10^{5}	4.3×10^{-6}	-	-
Metals:				
Aluminum	$<1.2 \times 10^{4}$	$<2.0 \times 10^{-7}$	5×10^{1} (9)	1.0×10^{2}
Barium	$<1.2 \times 10^{4}$	$<2.0 \times 10^{-7}$	1×10^{3} (8)	-
Calcium	2.5×10^{7}	4.1×10^{-4}	-	-
Iron	2.6×10^{5}	4.3×10^{-6}	3.0×10^{2} (7)	3.0×10^{2} (3)
Potassium	8.6×10^{5}	1.4×10^{-5}	-	-
Magnesium	7.7×10^{6}	1.3×10^{-4}	3.5×10^{3} (3)	-
Manganese	8.6×10^{4}	1.4×10^{-6}	5.0×10^{1} (7)	-
Sodium	1.7×10^{7}	2.8×10^{-4}	2.0×10^{4} (9)	-
Zinc	5.8×10^{5}	9.5×10^{-6}	3.0×10^{2} (3)	3.0×10^{1} (3)

TABLE 10
EVALUATION OF THE IMPACT OF
GROUNDWATER CHEMICALS ON HUMAN HEALTH

NOTES

(1) PASNY Power Conduit Flow = 6.1×10^{10} L/day.

(2) Proposed Maximum Contaminant Level, Federal Register, November 13, 1985.

(3) New York State Ambient Water Quality Standards, Part 702, Appendix 31.

(4) Proposed Recommended Maximum Contaminant Level, Federal Register, November 13, 1985.

(5) New York State Groundwater Quality Standards, Part 703.

(6) Water Quality Criteria Documents, Federal Register, November 28, 1980 (1×10^{-6} cancer risk).

(7) National Secondary Drinking Water Standards, 40 CFR 143, Secondary Maximum Contaminant Levels.

(8) National Drinking Water Standards, 40 CFR 141, Maximum Contaminant Levels.

(9) Guidance Levels, Federal Register, November 13, 1985.

(10) 1/10th lowest, LC_{50} level reported, Dangerous Properties of Industrial Materials, 6th Ed., N. Irving Sax.

(11) 1/10th lowest, LC_{50} level reported, Handbook of Environmental Data on Organic Chemicals, 2nd Ed., Kavel Veischueren.

(12) USEPA Drinking Water Health Advisory for Non-Carcinogenic Effects of 1,1-Dichloroethene for Long-Term Consumption.

When this water is discharged to the Niagara River there is another dilution and the concentration is further reduced by a factor of six based on an average river flow of 150,000 CFS. Because this loading to the river is so minimal, the incremental impact on existing conditions upstream from the plant would be immeasurably small.

The figures show a wide margin of safety and one can confidently conclude that there is no potential risk of adverse effects on human health from the chemicals reported in the groundwater under the SWMF as a result of the predicted human exposure from use of the PASNY surface water reservoir for recreational purposes including fish consumption and to the lower Niagara River as potable water or from the consumption of fish from the river.

It is to be noted that the above assessment does not consider biodegradation and volatilization which would further reduce the chemical concentrations. Volatile Organic Compounds (VOCs) in particular volatilize from the water discharged to the Niagara River by the aeration from the turbulence created by the turbines located within the PASNY power plant.

8.3 ENVIRONMENTAL HEALTH RISK ASSESSMENT

To address the potential impact on environmental biota it is also necessary to compare exposure point concentrations with standards or criteria to protect aquatic life or other biota. Terrestrial animals and birds use the surface water reservoir as a source of drinking water, but because of the wide margin of safety noted above for humans (generally 1000 or greater), it is reasonable to assume the chemicals should present no risk to even the most sensitive species of birds or animals that may drink from the PASNY surface water reservoir or the Niagara River. With regard to the potential impact on fish, Table 10 presents values for acceptable exposure of fish to the reported chemicals. Where New York State Water Quality Standards were not available, these were calculated as 1/10th the LC_{50} for the most sensitive species. Because chronic effects information is generally not available on many aquatic species, risk assessments frequently apply 1/10th the LC_{50} for the most sensitive species as a benchmark for water quality criteria for chronic effects in aquatic biota in general. The acceptable values greatly exceed the maximum (low flow) concentrations predicted. Therefore, it can be concluded that there will be no adverse effect on aquatic biota from the chemicals discharged via the site groundwater.

9.0 ENVIRONMENTAL IMPACT ASSESSMENT

The Site Investigation undertaken identified that the SWMF is potentially contributing certain chemicals into the groundwater regime beneath the SWMF. None of the parameters identified are present in significant concentrations and most are less than or within the same order of magnitude of the groundwater criteria.

Although these parameters are entering the groundwater flow regime they are deemed not to be a significant environmental threat. The reasons for this are as follows:

- All of the parameters identified are present in relatively low concentrations.
- In the overburden groundwater regime, there are no significant waterbearing strata other than the fill material itself due to the relatively fine grained nature and thus low permeability of the native soil. Lateral migration of overburden groundwater flow from beneath the SWMF has been further restricted by the installation of a clay key around the entire perimeter of the SWMF. The clay key is a thin clay wall (minimum 2 feet wide) extending from the low permeability cap through the fill material into the fine-grained soils underlying the SWMF. The low permeability of the key material provides a physical barrier to lateral groundwater flow. Thus the

only potential pathway for chemical migration from the groundwater contained in the fill is through vertical migration into the upper bedrock flow regime. The areas in which this can occur is further limited to the areas in which the fine-grained soil had been excavated prior to landfilling. Consequently, the flow of groundwater into the bedrock regime is relatively limited.

The proposed cap that has been installed over the SWMF will significantly reduce even the minimal chemical loading that is currently occurring. The entire 16.5 acre site (with the exception of the wooded areas) has been covered with a low permeability cap to reduce precipitation infiltration into the SWMF. The design of the final cover consists of:

- vegetative cover (grass)
- 6-inch thick topsoil layer
- 3-inch thick sand/gravel layer (drainage layer)
- 18-inch thick clay layer.

The clay cap will be placed and compacted to a hydraulic conductivity of less than 1 x 10-7 cm/sec.

With the cap in place, precipitation that had previously infiltrated the porous waste material will be diverted off-site as non waste contact surface water. Without this infiltration, the hydraulic head that had been forcing the perched groundwater in the fill into the bedrock will have been eliminated and thus vertical groundwater flow will be significantly reduced. The reduced infiltration also means that less stripping of chemicals will occur by the infiltrating water as it passes through the fill into the groundwater zone.

Once in the bedrock groundwater flow regime, the chemicals present in the groundwater are diluted by the bedrock groundwater flow. As presented in the previous sections of this report, the only parameters that have been identified in higher concentrations downgradient of the SWMF than in upgradient groundwater are the following:

- nitrite nitrogen
- ammonia nitrogen
- total kjeldahl nitrogen
- iron
- potassium
- zinc
- vinyl chloride
- 1,2-dichloroethane
- bis(2)ethylhexyl phthalate
- heptachlor

Of these parameters, only three are present in concentrations which exceed applicable groundwater quality criteria.

Of the above listed parameters, only five were identified as possible waste components in the waste characterization studies undertaken at the SWMF.

The capping of the SWMF also eliminates the potential for surface water runoff contamination from contact with the waste material. However, the 1984 sampling of a local surface water ditch which essentially receives the flow from the entire northern half of the SWMF indicated that no surface water contamination was occurring even without the cap in place.

Given the low concentrations of the parameters identified in the groundwater, the hydrogeologic character of the SWMF and the potential for exposure, the SWMF does not pose a significant environmental risk to the public or the environment. Considering that this assessment has been performed on the SWMF prior to construction of the low permeability cap and key, the possible concerns can only be further reduced once these plans are fully implemented. Consequently, the need for any further study or remedial work is unwarranted.

10.0 CONCLUSIONS AND RECOMMENDATIONS

Based upon the results of the Site Investigation, the following conclusions and recommendations have been formulated:

- The impact of usage of the SWMF on the overburden and bedrock groundwater regime is minimal.

- The overburden material is not generally conducive to overburden groundwater flow due to its fine-grained materials.

- Some overburden groundwater flow does enter the bedrock flow regime in areas where the low permeability clay and till may possibly have been excavated prior to landfilling.

- The closure of the SWMF which includes a low permeability clay cap and key will significantly reduce infiltration into the waste. The reduced infiltration will reduce the downward movement of groundwater through the wastes into the bedrock and therefore reduce the chemical flux leaving the SWMF.

- As discussed by the Public and Environmental Health Assessment the chemical flux to the PASNY conduits and subsequently the Niagara River has no adverse environmental effect on aquatic biota, terrestrial animals or birds or upon human health.

- Historic surface water sampling identified no environmental concerns due to surface water contact with the waste and the capping of the SWMF will further reduce the potential for any future concern.

- It is concluded that the SWMF currently poses no significant adverse environmental impact.

- It is recommended that the final Site Closure Program include a Post Closure Monitoring Program to confirm the effectiveness of the capping program. The post closure monitoring program will include the collection of groundwater samples from the six bedrock wells and three overburden wells. The groundwater samples will be analyzed for the following parameters:

  ° Hazardous Substance List Volatiles
  ° Hazardous Substance List Semi-Volatiles

Samples will be collected according to the following schedule:

° Year 1 - following closure - quarterly
° Years 2 and 3 - following closure - semi-annually
° years 4 and 5 - following closure - annually

Should none of the parameters identified be of any environmental concern, the post-closure monitoring program would terminate after five years. If there is an environmental concern regarding the presence of the site specific parameters, a feasibility study will be undertaken to determine an appropriate remedial course of action and a revised monitoring program will be developed.

APPENDIX A

NYSDEC REPORT

Appendix A - NYSDEC Report includes Sections 1.0, 2.0 and 4.0 of the NYSDEC Report. For further reference see Report entitled "Engineering Investigations at Inactive Hazardous Waste Sites in the State of New York Phase I Investigations" Union Carbide-Carbon Products Division Niagara Falls, Niagara County, New York Site Code: 932035" January 1987.

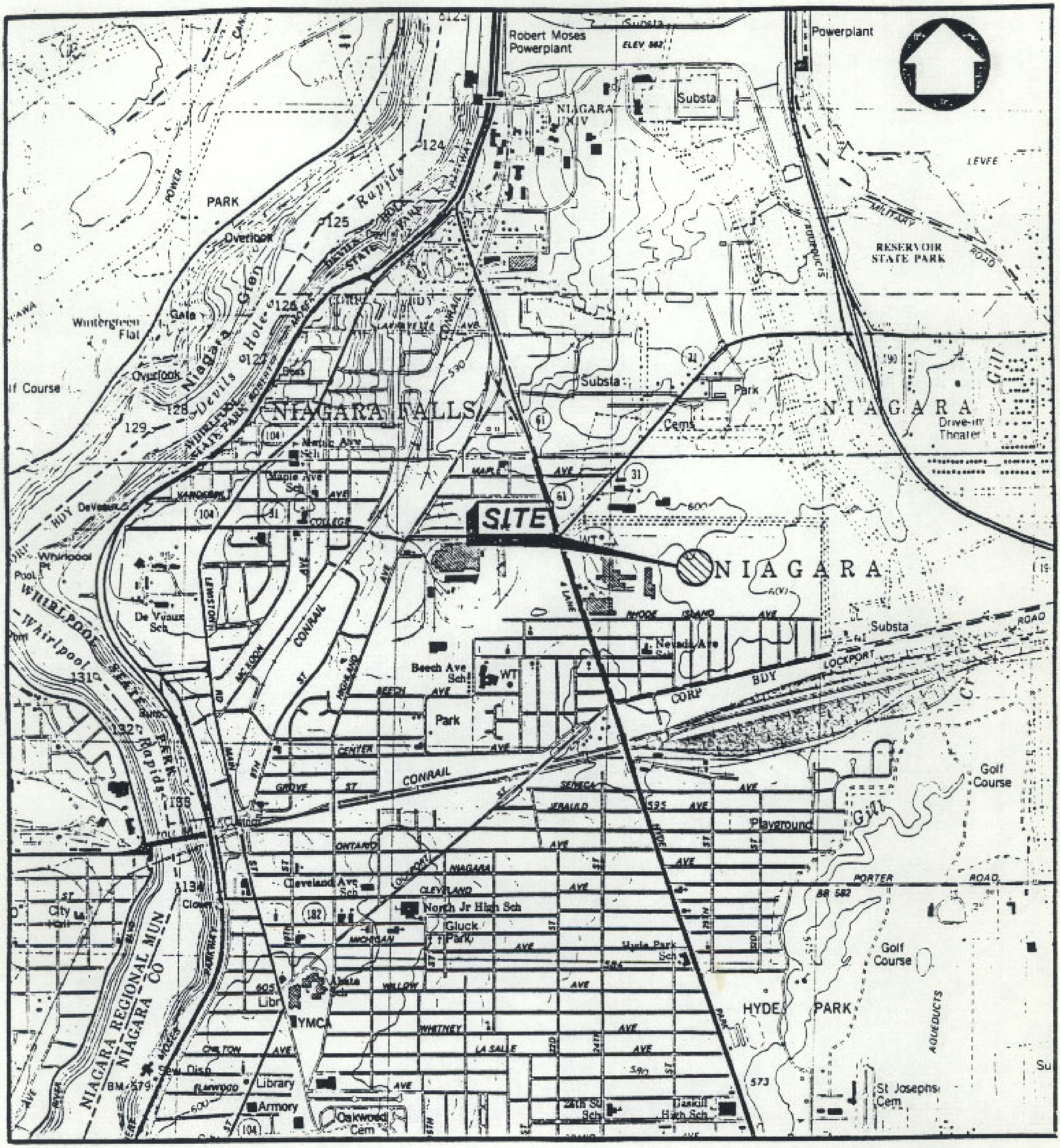
1.0 EXECUTIVE SUMMARY

The Union Carbide Republic Plant Landfill site is a 16-acre active landfill on Hyde Park Boulevard, Niagara Falls, Niagara County, New York. The site is used by Union Carbide to dispose of carbonaceous waste, fire brick and wood pallets generated during their production process. The site is not open to the general public. The site has been active during the period of 1934 through the present. The landfill services the National, Acheson and Republic locations of Union Carbide's Niagara Plant. The Union Carbide Products Division is expected to close the landfill by December 1986 in accordance with Part 360. Carbon and graphite manufacturing occurred at each of these plants. Industrial processes included calcine, mill, mix and forming carbon products, baking and graphitizing carbon products, pitch impregnation and machining of carbon products. Raw materials utilized include anthracite coal, petroleum coke and coal tar pitch.

Wehran Engineering conducted a site visit, which included a walk around the site, noting any disturbed areas, leachate etc.; as well as the use of an HNU photoionizing organic vapor detector to measure the ambient air quality.

The site appeared to be well maintained and organized. The working face is kept to a limited area and the the site is progressively closed and capped as the operation continues. There was no leachate visible and it appears that it would not be a problem due to the type of material disposed of at the site. No organic vapors were detected by the HNU.

The wastes disposed of at this site include carbonaceous dust and scrap, firebrick, waste wood and pallets. Other waste types generated and deposited on the site in the past include coke, pitch, lunch waste, silica sand, coal tars and petroleum tars (see P. Millock - S. Dorr interview, November 15, 1978), machining oils and spent sludges from degreasing (1,1,1-trichloroethane). Water quality data indicates that phenols, heavy metals, and low levels of halogenated organics exceed New York State groundwater criteria in the till hydrologic zone. Additional investigation is necessary in order to identify the types and concentrations of disposed materials and the potential health and environmental hazards. A Phase II work plan has been proposed to more accurately assess this site. The preliminary HRS score is $S_M = 11.03$.



SCALE: 1" 2000'

TOPOGRAPHY TAKEN FROM
1980
NIAGARA FALLS, N.Y
LEWISTON, N.Y.

U.S.G.S. QUADRANGLE
7.5 MIN SERIES

MAP LOCATION

FIGURE 1

SITE LOCATION MAP

UNION CARBIDE

LAT. 43°-07'-14" N LONG. 79°-01'-35" W

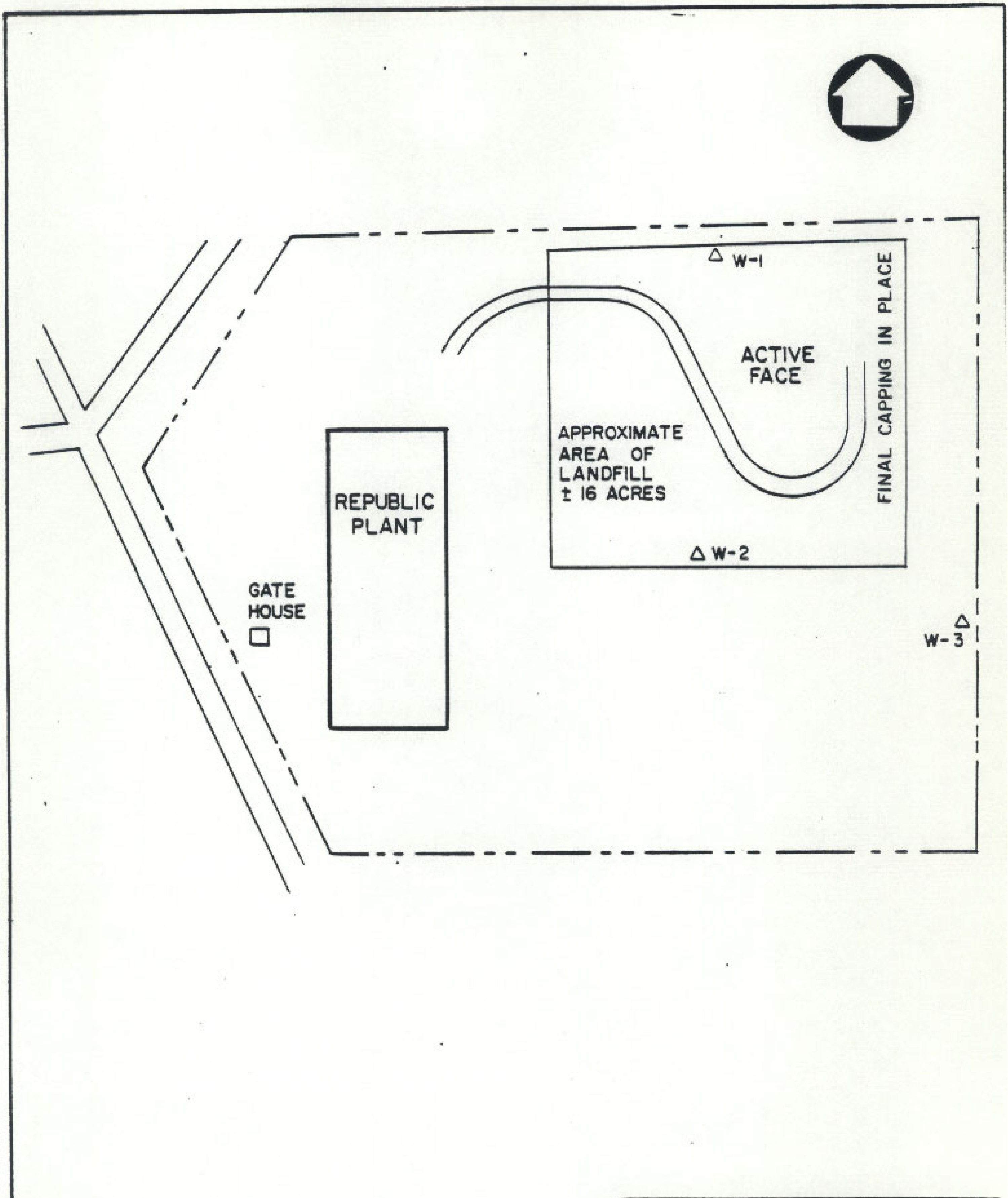


FIGURE 2

SITE SKETCH

UNION CARBIDE REPUBLIC
PLANT LANDFILL

2.0 PURPOSE

This Phase I investigation was conducted under contract to the New York State Department of Environmental Conservation Superfund Program to evaluate the potential environmental or public health hazard associated with past disposal activities at the Union Carbide Republic Plant Landfill site. Divided into two parts, this initial investigation consisted of a detailed file review of available information and an initial site investigation. The culmination of this phase is the development of a preliminary Hazard Ranking System (HRS) score.

Where information is lacking and a final score cannot be computed, recommendations will be made for a Phase II investigation designed to verify the assumptions made in the preliminary scoring and to collect the additional data needed to complete the site assessment.

4.0 SITE ASSESSMENT

4.1 SITE HISTORY

The Union Carbide Niagara Plant has facilities at three locations: the National Plant - 3625 Highland Avenue, Niagara Falls, New York; the Republic Plant - 3501 Hyde Park Boulevard, Town of Niagara, New York; and the Acheson Plant - 1930 Buffalo Avenue, Niagara Falls, New York, which officially closed October 1982. Carbon and graphite manufacturing occurred at each of these plants. Industrial processes included calcine, mill, mix and forming carbon products, baking carbon products, graphitizing carbon products, pitch impregnation and machining of carbon products. Raw materials used in the process include anthracite coal, petroleum coke and coal tar pitch. The products manufactured at the plants included specialty machined graphite, carbon liners, cathode blocks and electrodes for furnacing.

The Union Carbide Republic Plant Landfill is used exclusively by Union Carbide. The landfill was purchased from Aluminum Co. of America on July 24, 1934 and is anticipated to close operations by December 1986 in accordance with Part 360. The site is presently operating under permits granted by the DEC and the Town of Niagara.

The waste facility at the Republic location presently services the National, Acheson and Republic locations of Union Carbide's Niagara plant. The waste material consisted mainly of carbonaceous material, primarily as dust from dust collectors, and amounts to approximately 6.5 million pounds per year; fire brick wastes contribute 1.25 million pounds per year and wood scrap 1.0 million pounds per year. These materials are collected daily from all three locations and deposited together. Other waste types generated and deposited at the site include coke, pitch, lunch waste, silica sand, coal tars, petroleum tars (see P. Millock - S. Dorr interview, November 15, 1978), machining oils and spent sludges from degreasing (1,1,1-trichloroethane). Approximately 200 gallons per month of oil were collected in 55-gallon drums and taken to the dump or used on roadways in the summer. This practice stopped in 1978.

Since 1978 the only flammable materials to arrive on site have been wood scraps. These flammable materials are mixed with nonflammable materials or are covered, thus minimizing fires. Union Carbide has a 360 variance from a daily cover requirement. Waste is covered every two weeks. The cover material at one time consisted of aged waste deposited no less than five years previously. A final cover is applied at the completion of each 50-foot lift. Apparently, anywhere from six to 24 inches of material suitable to sustain plant growth has been deposited on the compacted lifts.

As of May 1982 all baghouse dust has been placed into plastic bags prior to placing the waste in the landfill. Site groundwater and surface water monitoring is conducted in conformance with the NYSDEC and Town of Niagara permit requirements. Groundwater results are submitted to the NYSDEC every six months and quarterly to the Town of Niagara.

4.2 SITE TOPOGRAPHY

The site is located in a topographically flat area at an elevation of approximately 600 feet. The landfill itself is mounded approximately 30 feet above grade with an average slope of 30 percent. Surface water to the south and southwest of the site appears to be under perched conditions and does not drain into any other surface water body. The area surrounding the site is primarily residential with some industrial-type buildings. There are five drinking water wells on Pennsylvania Avenue, 2,000 feet north of the site. Most everyone in the area is served by public water taken from the Niagara River.

4.3 SITE HYDROGEOLOGY

The site is underlain by fine grained lake sediments and glacial till, with dolomite bedrock at a depth of approximately 20 feet. Three monitoring wells have been installed in the glacial till in order to monitor the groundwater quality (Figure 2). These wells indicate that the groundwater flow direction is south-southeast with a seasonally high water table at a depth of approximately five feet.

Carbonaceous fill material was described as the surficial material at wells 1 and 2. The original soil consisted of a stone-free clayey and silty lake sediment resting on glacial till. Thickness of the lake sediment at well 3 was about 10 feet. This lake sediment mantle should be continuous across the total site as indicated in the Niagara County soil survey. However, no lake sediments were described in any of the five bore sites augered at or near well 1. Therefore the originally deposited lake sediment and part of the glacial till material was likely excavated prior to landfilling.

Permeability and infiltration of the carbonaceous fill are extremely high, as demonstrated by the rapid infiltration rate after an intense thunderstorm on September 9, 1979 (as observed by Earth Dimensions, Inc.). This would allow water to move downward in the fill and become perched on the glacial till or lake sediments. Since a portion of the glacial till over the dolomite bedrock was removed from the area near well 1, as noted during the drilling of the most easterly bore site, saturation within the fill may exist by well 1. The extent of this excavated area and this saturated fill cannot be delineated based on the existing surface fill configuration.

Saturation of the fill was not noted at the southerly site (W-2), but based on the original soil drainage characteristics, a natural water table would be present at the fill-soil contact. Water was detected in the glacial till above bedrock.

At well 3, a stone-free clayey and silty lake sediment mantles glacial till. This is similar to the glacial/till sediment sequence indicated in the Niagara County soil survey. A natural perched water table exists near the surface during wetter seasons and water was detected in the thin glacial till.

4.4 SITE CONTAMINATION

The Republic Plant site is presently being monitored on a quarterly basis in accordance with its permit agreements. The monitoring program consists of three wells -- one upgradient, two downgradient -- which are screened in the glacial till which overlies bedrock. The monitoring wells consist of carbon steel riser pipes with a 1-1/2-foot double stainless steel screens. Couplings were sealed with pipe cement.

The range of groundwater quality results from September 1978 to December 1984 are summarized in Table 1. Results indicate that elevated levels (above New York State criteria) of phenols (0.26 ppm), chromium

TABLE 1

RANGE OF GROUNDWATER QUALITY RESULTS FROM MONITORING WELLS 1, 2 AND 3

(Monitoring Dates September 1978 to December 1984)

Parameter	Units of Measure	Sample Identification		
		Well 1	Well 2	Well 3
pH	Standard Units	7.77-8.94	6.83-7.61	7.38-8.23
Specific Conductance (25°C)	umhos/cm	1,200.-1,900.	580-.3,120.	520.-2,100.
Total Coliform	Organisms/100 ml	3.6-750.	<2.-43.	2.0-15.
Biochemical Oxygen Demand (5 day)	mg/l	<2.0-110.	8.0-140.	<2.0-5.0
Chemical Oxygen Demand	mg/l	33.-344.	38.4-180.	6.8-30.
Total Organic Carbon	mg/l	11.-108.	5.5-130.	<1.0-35.
Ammonia	mg N/l	0.63-14.4	<0.5-1.8	<0.1-0.5
Total Kjeldahl Nitrogen	mg N/l	1.1-24.0	0.21-2.8	0.2-0.56
Total Phosphorus	mg P/l	<0.01-5.0	0.024-0.56	<0.02-1.0
Nitrate	mg N/l	<0.02-4.8	0.3-4.5	<0.2-2.7
Nitrite	mg N/l	<0.005-0.19	<0.01-0.19	<0.01
Chloride	mg/l	75.-440.	45.-391.	7.5-22.
Total Residue (103°C)	mg/l	1,100-1,500.	2,480.	440.-952.
Total Recoverable Phenolics	mg/l	0.011-0.235	<0.01-0.260	<0.01-0.053
Sulfate	mg/l	3.9-360.	130.-940.	9.2-650.
Alkalinity (pH 4.5)	mg/l as $CaCO_3$	330.-898.	170.-820.	240.-275
Total Hardness	mg/l as $CaCO_3$	240.-1,260.	295.-1,750.	270.-540.
True Color	Pt-Co Color Units	20.-100.	30.0-50.	50.0-70.
Carbon Chloroform Extraction	mg/l	2.0-26.9	1.6-8.0	<1.0-5.2
Methylene Blue Active Substances	mg/l	<0.1	<0.04-0.08	<0.1
Total Aluminum	mg/l	0.4-56.	0.4-5.0	<0.1-1.2
Total Arsenic	ug/l	<5.-11.4	<5.0	<5.0
Total Chromium	mg/l	0.005-0.09	<0.002-0.012	<0.005
Hexavalent Chromium	mg/l	<0.001-0.09	<0.002-0.008	<0.005
Total Copper	mg/l	0.010-0.783	<0.003-0.05	<0.003-0.042
Total Calcium	mg/l	3.5-110.	17.-275.	14.-55.
Total Iron	mg/l	3.0-280.	9.3-114.	0.27-70.
Total Lead	mg/l	0.02-0.72	<0.02-<0.04	<0.04
Total Mercury	ug/l	0.82-36.6	<0.4-2.6	<0.7-<1.0
Total Potassium	mg/l	2.2-110.	4.5-54.	3.8-6.0
Total Silver	mg/l	<0.003-0.052	<0.003-0.016	<0.005
Total Sodium	mg/l	16.0-3,500.	17.-197.	14.-75.
Halogenated Organic Scan (ECD)	ug/l as Chlorine; Lindane Standard	1.3-21.0	0.7-8.8	1.0-22.0

(0.09 ppm), lead (0.72 ppm) and mercury (36.6 ppb), plus other parameters, occur in the three monitoring wells. According to Mike Hopkins of the Niagara County Health Department, the levels of heavy metals in these wells are typical of the Niagara Falls area. A leach test performed on a composited waste sample indicates that the waste could be a substantial source of the phenols (Tables 2 and 3).

Well logs for monitoring wells 1 and 2 indicate that these wells were installed through the waste. The water quality of these wells could be directly affected by this practice. The effect on the water quality is compounded by the fact that the waste material is highly permeable and that perched water tables typically occur. The downgradient well (well 3) was not installed through the waste. Water quality data from this well indicates that contamination has occurred, suggesting that there is a potential for subsurface migration of contaminants off site. The installation of the monitoring wells is not in accordance with Chapter 4 of USEPA's Guidance Manual for the Classification of Solid Waste Disposal Facilities.

The file data and reports state that nonhazardous carbonaceous waste has been disposed of at this site. However, water quality data indicates that phenols, heavy metals and low levels of halogenated organics have contaminated the till hydrologic zone. Additional investigation needs to be done to identify the types and concentrations of disposed materials.

TABLE 2

RESULTS OF LEACH TEST ON COMPOSITED WASTE SAMPLES
ANALYSES OF SOLIDS FRACTION

Parameter	Unit of Measure	Leach Test
Carbon - Chloroform Extractable	mg/g (dry)	20.9
Phenol	ug/g (dry)	2.6
pH	Standard Units	8.02
Chemical Oxygen Demand	mg/g (dry)	439
Chloride (Water Soluble)	ug/g (dry)	73.8
Fluoride (Water Soluble)	ug/g (dry)	0.002
Cyanide (Free - Water Soluble)	ug/g (dry)	<1.0
Total Grease & Oils	mg/g (dry)	6.66
Hydrocarbon Grease & Oils	mg/g (dry)	4.95
Polar Grease & Oils	mg/g (dry)	1.45
Total Chlorinated Hydrocarbons	ug/g (dry) as Chlorine; Lindane Standard	29.6
Hexavalent Chromium (Water Soluble)	ug/g (dry)	<0.040
Total Aluminum	ug/g (dry)	819
Total Arsenic	ug/g (dry)	0.029
Total Cadmium	ug/g (dry)	0.30
Total Chromium	ug/g (dry)	10.6
Total Copper	ug/g (dry)	33.7
Total Iron	ug/g (dry)	253
Total Lead	ug/g (dry)	10.5
Total Mercury	ug/g (dry)	<0.020
Total Nickel	ug/g (dry)	24.0
Total Selenium	ug/g (dry)	<0.003
Total Zinc	ug/g (dry)	19.2
Total Solids	percent	98.8

TABLE 3

RESULTS OF LEACH TEST ON COMPOSITED WASTE SAMPLES
LEACHING TEST ON SOLIDS FRACTION

Parameter	Unit of Measure	Leach Test
Carbon - Chloroform Extractable	mg/l	<2.0
Phenol	mg/l	0.110
Total Organic Carbon	mg/l	<1.0
pH	Standard Units	8.02
Chemical Oxygen Demand	mg/l	16.2
Chloride	mg/l	18.2
Fluoride	mg/l	0.569
Cyanide (Free)	mg/l	<0.3
Total Grease & Oils	mg/l	<1.0
Hydrocarbon Grease & Oils	mg/l	<1.0
Polar Grease & Oils	mg/l	<1.0
Total Chlorinated Hydrocarbons	ug/l as Chlorine; Lindane Standard	3.70
Hexavalent Chromium	mg/l	<0.01
Soluble Aluminum	mg/l	<0.03
Soluble Arsenic	ug/l	<3.5
Soluble Cadmium	mg/l	<0.003
Soluble Chromium	mg/l	<0.003
Soluble Copper	mg/l	0.005
Soluble Iron	mg/l	<0.01
Soluble Lead	mg/l	<0.02
Soluble Mercury	ug/l	<0.5
Soluble Nickel	mg/l	<0.02
Soluble Selenium	ug/l	<2.5
Soluble Zinc	mg/l	0.007

APPENDIX B

SOILS REPORT - WELL INSTALLATION

MW1-78

MW2-78

MW3-79

EARTH DIMENSIONS, INC.
Soil Investigations and Natural Resource Assessments
797 Center Street • East Aurora, New York 14052 • (716) 655-1717

SOILS REPORT - WELL INSTALLATION

Union Carbide Corporation - Niagara Falls

Two monitoring wells were installed on the Union Carbide Corporation's landfill site in the City of Niagara Falls. The approximate placement sites were located on site by Mr. James Foreman of Union Carbide.

Soil descriptions were written at the well sites based on the split spoon samples that were taken of every major soil horizon or at every five foot increments in the thicker soil horizons. The split spoon samples were advanced through the hollow stem augers.

The most southerly well was installed September 9 with the northerly well installed September 16, 1978. The continued collapsing of the bore hole for the north end well forced the installation of a 2 inch inside diameter well instead of a 4 inch inside diameter that was installed in the southern site.

Carbonaceous fill material was described as the surficial material at both locations. The original soil consisted of a stone free clayey and silty lake sediment resting on glacial till. Thickness of the lake sediment at the southerly well site was about 10 feet. This lake sediment mantle should be continuous across the total site as indicated in the Niagara County soil survey. No lake sediments were described or observed in any of the five bore sites augered at or near the northern well location. Therefore the original lake sediment and part of the glacial till material was excavated prior to land filling industrial wastes.

Permeability and infiltration of the carbonaceous fill are extremely high as observed by the water intake after an intense thunder storm September 9. This would allow water to move downward in the fill and perch on the glacial lake or till sediments. The glacial till over the dolomite bedrock was removed from the area near the northern well site as noted during the drilling of most easterly bore site. In essence, an internal pond exists within the fill by the north well.

Continued on page 2...

The extent of this excavated area can not be delineated based on the existing surface fill configuration.

No perched water table was noted at the southerly site, but based on the original soil drainage characteristics, a natural perched water table would be present at the fill-soil contact from October through April most years. Water was detected in the glacial till in the till above bedrock, yet soil coloration would not suggest this moisture regime in this zone.

Prepared by,

Don Owens

Donald W. Owens
Soil Scientist

3178
DWO/dew

9/16/78

EARTH DIMENSIONS, INC.

Test Borings and Logs
797 Center Street • East Aurora, New York 14052 • (716) 655-1717

3178 HOLE NO. 1 (MW1-78) SURF. ELEV. ______

PROJECT: Union Carbide Corporation, Niagara Falls, New York

LOCATION: North side of property, Hyde Park Boulevard

CLIENT: RECRA Research, Inc.

DATE STARTED: 9/8/78 COMPLETED: 9/8/78

DEPTH (feet)	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N
		125	29	24		53
5	2	5	15	17		32
10	3	5	5	7		12
	4	12	24	17		41
15	5	18	21	25		46

DESCRIPTION & CLASSIFICATION

Slightly moist brown silt loam (CLAYEY-SILT) width 10 to 15% subaugular gravel, firm, nonplastic with fiberous wood.

Slightly moist grayish black carbonaceous fill ranging from powder to augular chunks, firm, nonplastic with intermixed fiberous wood, yellowish brick and glass.

---------Clear transition to ---

Wet blackish fill material with intermixed carbonaceous wood and brick chunks, loose

Moist light reddish brown dense coarse silt loam (SANDY-SILT) width 15% subaugular dolometic gravel, very firm, nonplastic

WATER TABLE & REMARKS

2 to 4 inch black powdery carbonaceous cap on surface.

Carbonaceous fill material to 12.5 feet over dense glacial till to 19 feet over dolometic bedrock.

Water seeped rapidly into hole at 9.7 feet

Water at 9.5 feet below surface at completion.

N = NUMBER OF BLOWS TO DRIVE 2 " SPOON 12 " WITH 140 lb. WT. FALLING 30 " PER BLOW.

LOGGED BY Lenhardt & Owens

EARTH DIMENSIONS, INC.

Test Borings and Logs
797 Center Street • East Aurora, New York 14052 • (716) 655-1717

3178 HOLE NO. 1 Continued (MW1-78) SURF. ELEV. ______

PROJECT Union Carbide Corporation
Niagara Falls, New York

LOCATION North side of property
Hyde Park Boulevard

CLIENT RECRA Research Inc.

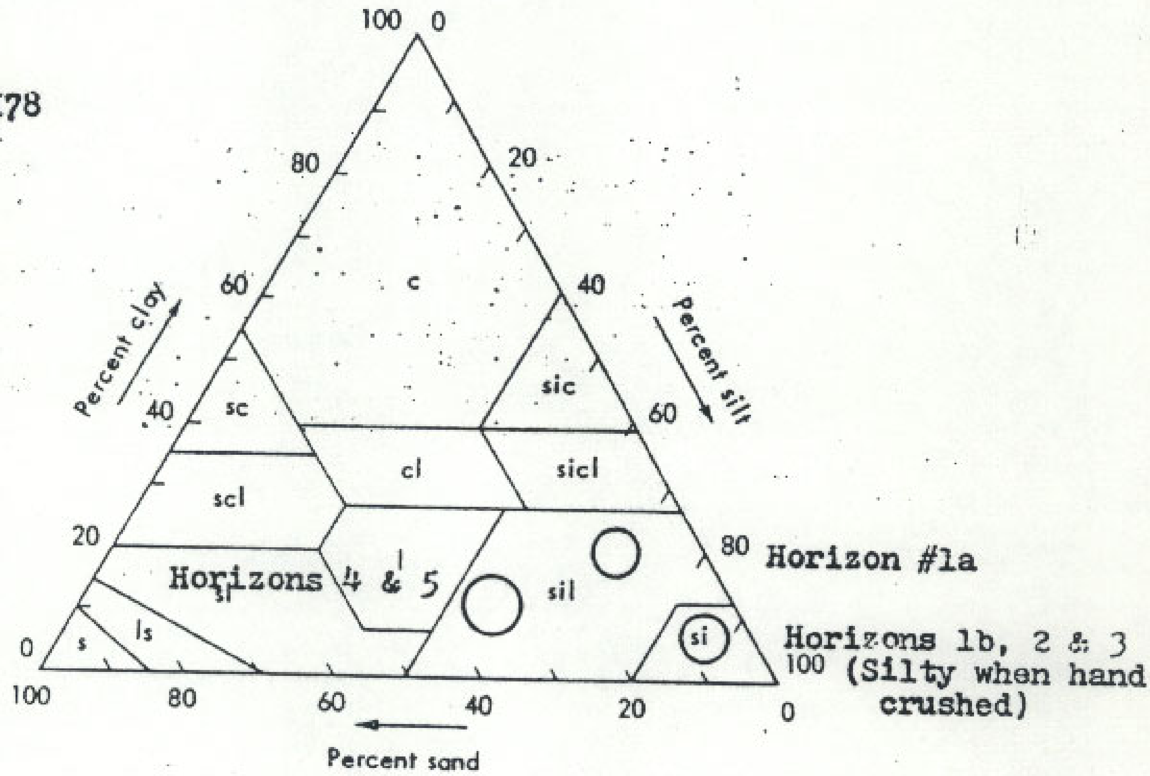
DATE STARTED 9/9/78 COMPLETED 9/9/78

DEPTH (feet)	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	DESCRIPTION & CLASSIFICATION	WATER TABLE & REMARKS
							(Same horizon as described on previous page)	
20							Gray microcrystalline dolomite bedrock	
							Sampling discontinued at 20.5 feet	PIPE NOTES Used two 10.5 foot sections of carbon steel pipe with one-4 inch coupling sealed with pipe dope. Well end packed with 1½ feet of greater than 1.5 mm well graded coarse sand and gravel below pipe and 1½ feet above pipe end. End of pipe double screened with 0.5 mm stainless steel screening. Bentonite used between 6 and 18½ foot depths to seal vertical water movement along outside of pipe. The top 6 feet was back filled with SILT-CLAY lake sediment considering the porous nature of the carbonaceous fill at this depth. Bottom of pipe 18.3 feet below surface. Pipe protruding 2.8 feet above surface.

dew N = NUMBER OF BLOWS TO DRIVE 2 " SPOON 12 " WITH 140 lb. WT. FALLING 30 " PER BLOW

HOLE #1

3178



c	Clay	scl	Sandy clay loam
si	Silt	sicl	Silty clay loam
s	Sand	cl	Clay loam
l	Loam	sil	Silt loam
sc	Sandy clay	sl	Sandy loam
sic	Silty clay	ls	Loamy sand

Textural triangle showing the percentages of clay (less than 0.002 mm), silt (0.002-0.05 mm), and sand (0.05-2.0 mm) in the basic soil textural classes (adapted from Soil Survey Staff, 1951).

EARTH DIMENSIONS, INC.

Test Borings and Logs
797 Center Street • East Aurora, New York 14052 • (716) 655-1717

3178 HOLE NO. 2 (MW2-78) SURF. ELEV. ______

PROJECT: Union Carbide Corporation, Niagara Falls, New York

LOCATION: South side of fill area, Near Hyde Park Blvd.

CLIENT: RECRA Research, Inc.

DATE STARTED: 9/9/78 COMPLETED: 9/9/78

DEPTH Feet	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	DESCRIPTION & CLASSIFICATION	WATER TABLE & REMARKS
	1	7	7	10		17	Slightly moist, grayish-black carbonaceous fill material ranging from powder to angular chunks with intermixed wood, bricks, and gravelly soil, loose to very friable, nonplastic.	Carbonaceous fill to 4.[illegible] feet over silty and clayey lake sediments to 15 feet over sandy glacial till to 19.8 feet over dolomitic bedrock
5	2	9	17	21		38	Moist, highly mottled grayish-brown silty clay loam (SILTY-CLAY) friable. ------Clear transition to ------- Moist distinctly mottled reddish-brown SILTY-CLAY with vertical dessication cracks, finely laminated structure, very firm, plastic. -------grades downwards to--------	No water observed at fi[ll] - original soil contact. Sample #2 spans contact
10	3	13	15	18		33	Moist to extremely moist, brown heavy silt loam (CLAYEY-SILT) with very thin, very fine sandy lenses, finely laminated, firm, slightly plastic.	
15	4	12	20	22		42	Extremely moist to wet reddish-brown sandy loam (SILTY-SAND) w/ 10 to 15% predominantly fine and medium subangular dolometic gravel, firm, nonplastic	Water at 13.5 feet belo[w] surface at completion.

N = NUMBER OF BLOWS TO DRIVE 2 " SPOON 12 " WITH 140 lb. WT. FALLING 30 " PER BLOW.

EARTH DIMENSIONS, INC.

Test Borings and Logs
797 Center Street • East Aurora, New York 14052 • (716) 655-1717

3178

HOLE NO. 2 Continued

SURF. ELEV. ______

PROJECT Union Carbide Corporation
Niagara Falls, New York

LOCATION South side of fill area
Near Hyde Park Blvd.

CLIENT RECRA Research, Inc.

DATE STARTED 9/9/78 COMPLETED 9/9/78

DEPTH (feet)	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	DESCRIPTION & CLASSIFICATION	WATER TABLE & REMARKS
							(Same horizon as described on previous page)	
20	5	120					Gray, microcrystalline dolomite bedrock	
							Sampling discontinued at 20.1 feet	
								PIPE NOTES Used one 10.0 feet and two 5.0 feet sections of carbon steel pipe with 2-4 inch couplings sealed with pipe dope. Well end packed with 1 foot of greater than 1.5 mm well graded coarse sand and gravel below pipe and 1½ feet above pipe end. End of pipe double screened with 0.5 mm stainless steel screening. Bentonite used to plug the surface. One foot of pipe protruded above surface.

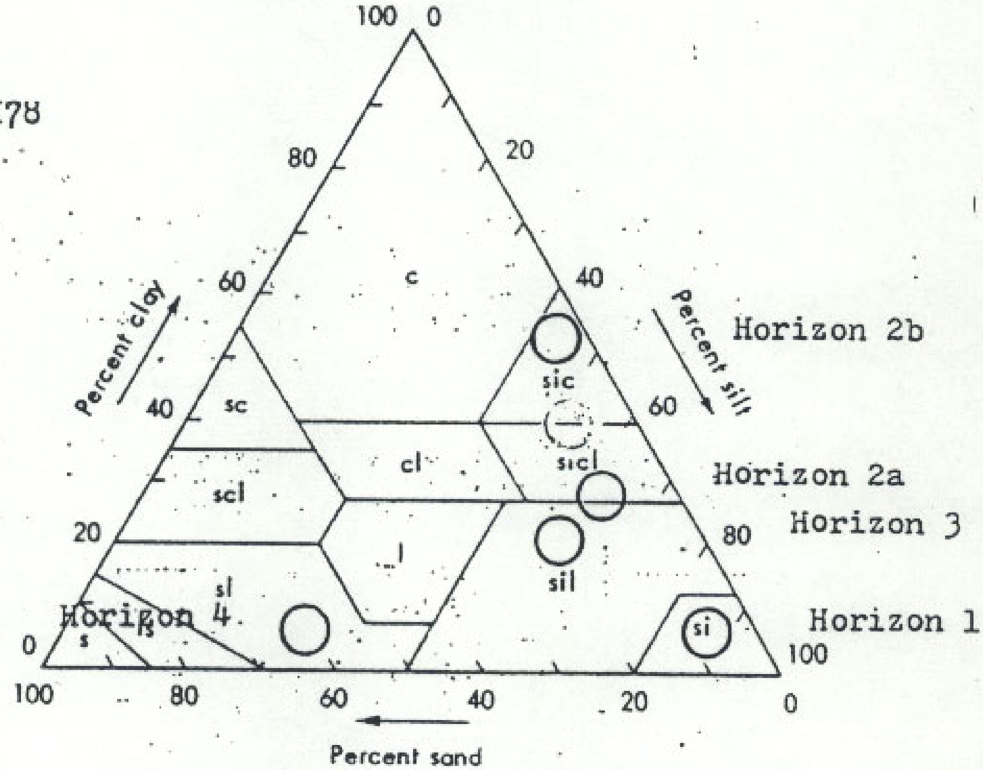
ew

N = NUMBER OF BLOWS TO DRIVE 2 " SPOON 12 " WITH 140 lb. WT. FALLING 30 " PER BLOW

Lenhardt & ...

HOLE #2

3178



c	Clay	scl	Sandy clay loam
si	Silt	sicl	Silty clay loam
s	Sand	cl	Clay loam
l	Loam	sil	Silt loam
sc	Sandy clay	sl	Sandy loam
sic	Silty clay	ls	Loamy sand

Textural triangle showing the percentages of clay (less than 0.002 mm), silt (0.002-0.05 mm), and sand (0.05-2.0 mm) in the basic soil textural classes (adapted from Soil Survey Staff, 1951).

March 31, 1979

EARTH DIMENSIONS, INC.
Soil Investigations and Natural Resource Assessments
797 Center Street • East Aurora, New York 14052 • (716) 655-1717

SOILS REPORT - WELL #3 INSTALLATION

Union Carbide Corporation - Niagara Falls

One additional monitoring well was installed on the Union Carbide Corporation's property southeast of the present landfill site in Niagara Falls. Last September, two monitoring wells were placed in the landfill.

Large boulders were encountered at the original placement site for well #3. This site was selected by Mr. James Foreman of Union Carbide. Six borings were augered in an attempt to reach bedrock. The extremely hard cherty dolomitic and granitic boulders were encountered at the following depths:

Bore number	Depth to hard boulders *
1	11.2
2	9.0
3	5.2
4	5.1
5	5.8
6	5.1

* Feet below surface.

Based on the difficulties encountered at the original placement site, permission was given to move the location further to the southeast to avoid the bouldery glacial till. This did not compromise the intended purpose of this well, to monitor the internal water table some distance from the landfill.

A stone-free clayey and silty lake sediment mantles glacial till at the original and relocated bored sites. This is similar to the glacial sediment sequence indicated in the Niagara County soil survey. The lake sediment was thinner and containing less clay at the original placement site than at the relocated site. A natural perched water table exists near the surface during wetter seasons. Water was detected in the thin glacial till yet soil coloration would not suggest this moisture regime in this zone. Two borings about 10 feet apart at the relocated well site revealed that the soil sequence was within inches at both sites.

Prepared by

EARTH DIMENSIONS, INC.

Test Borings and Logs
797 Center Street • East Aurora, New York 14052 • (716) 655-1717

HOLE NO. 3 (MW3-79) SURF. ELEV. ______

6C79 PROJECT Union Carbide Corporation
Niagara Falls, New York

LOCATION Southeastern portion of site, approximately 120 ft. north of south fence, 100 ft. west of east fence.

CLIENT Recra Research, Inc.

DATE STARTED 3/20/79 COMPLETED 3/20/79

Depth (feet)	Sample No.	0/6	6/12	12/18	18/24	N	Description & Classification	Well	Water Table & Remarks
	1	14	12	18		30	Moist dark grayish brown heavy silt loam (CLAYEY-SILT) topsoil, friable, slightly sticky 0.5	2" carbon steel pipe with bottom 1½' slotted and screened; Bentonite with clay cuttings 8.0; Gravel	Clayey lake sediments to 13.4 ft. over very dense loamy glacial till to 14.0 ft. over dolomitic rock.
5	2	13	19	26		45	Moist distinctly mottled reddish brown SILTY-CLAY with vertical gray desiccation cracks and very thin coarse silt and very fine sand lenses, extremely firm (stiff), plastic, sticky		PIPE NOTES: 15 ft. of 2 in. ID carbon steel pipe installe[d] with 2 ft. stickup above surface, bentonite with clay cuttings placed fro[m] surface to 8.0 ft. depth, gravel between 8.0 and 14.1 f[t.] depths.
10	3	10	11	15		26	---- grading downward to ---- 10.0 Moist grading to extremely moist brown SILTY-CLAY, thinly laminated clays with very thin silt lenses, very firm grading to firm, plastic, sticky 13.4		
		120					Extremely moist reddish brown gravelly sandy loam (SILTY-SAND) with 15-20% subrounded dark gray dolomitic gravel, very firm in place, massive soil structure, nonplastic 14.0		
							Gray microcrystalline dolomite 14.1		
							Description discontinued at 14.1 ft.		Water table was 13.[?] ~~ft. below surface~~ at completion.

N = NUMBER OF BLOWS TO DRIVE 2 " SPOON 12 " WITH 140 lb. WT. FALLING 30 " PER BLOW.

APPENDIX C

STRATIGRAPHIC AND INSTRUMENTATION LOGS

STRATIGRAPHIC AND INSTRUMENTATION LOG

(OVERBURDEN)

PROJECT NAME: UNION CARBIDE CORPORATION
HOLE DESIGNATION: BW1-86

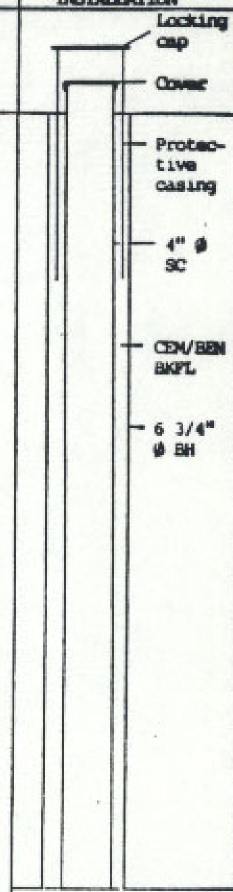
PROJECT NO.: 9-1851
DATE COMPLETED: JUNE 9, 1986

CLIENT: UNION CARBIDE CORPORATION
DRILLING METHOD: HOLLOW STEM AUGER

LOCATION: NORTH SIDE SOLID WASTE MANAGEMENT FACILITY
CRA SUPERVISOR: C. PADGINSON

DEPTH ft/m BG	STRATIGRAPHY DESCRIPTION & REMARKS		ELEVATION ft/m AMSL	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
			610.62			
			608.72			
0			608.1			
-	Gray, black & red-orange GRAVEL, CARBON PIECES, BRICK (FILL)	Wet		1	SS	8 28
-	Black, gray, red-orange & green CARBON DUST & PIECES, BRICK - some gravel, trace clay (FILL)	Wet		2	SS	10 20
- 5	Black & brown-red sandy SILT - NP, some gravel, green plastic clay 4.9'-5.1' (FILL)	Wet		3	SS	5 10
-				4	SS	20 32
- 10	Black CARBON - non-plastic, some orange color, some gravel decreasing with depth, some silt, at 8.0-10.0' some wood, becoming saturated, 10.0'-12.0' becoming sandy, no gravel (FILL)	Wet		5	SS	5 8
-				6	SS	2 5
-				7	SS	14 5
- 15	CI - Red-brown CLAY - laminated, high plasticity, silt seams at 17.0' & 17.2' (NATIVE)	Saturated		8	SS	3 5
-				9	SS	4 5
-	Red-brown sandy SILT - some clay some gravel, low to NP, subangular gravel	Saturated		10	SS	4 100+
- 20	Gray DOLOMITE		588.6			

MONITOR INSTALLATION:



NOTES:
Log continued on Stratigraphy & Instrumentation Log (Bedrock) OW1-86.

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS   WATER FOUND   STATIC WATER LEVEL

STRATIGRAPHIC AND INSTRUMENTATION LOG

(BEDROCK)

PROJECT NAME: UNION CARBIDE CORPORATION

PROJECT NO.: 9-1851

CLIENT: UNION CARBIDE CORPORATION

LOCATION: NORTHEAST CORNER SOLID WASTE MANAGEMENT FACILITY

HOLE DESIGNATION: BW1-86

DATE COMPLETED: JULY 22, 1986

DRILLING METHOD: 3" DIAMETER NX CORE

CRA SUPERVISOR: C. PADGINTON

DEPTH	DESCRIPTION OF STRATA	RUN NO.	INTERVAL	CORE RECOVERY	RQD	DRILLING WATER RETURN	WATER PRESSURE TEST	ELEVATION	MONITOR INSTALLATION
ft BG				%	%	%	cm/s	ft AMSL	
-		1	19.5	86.0	62.4	10		588.6	
- 20	Gray DOLOMITE - very fine to fine grained, vuggy, thin bedded, weathered fractures brown-gray, stylolites, pitted, shaly partings								
-									
-									
-									— 3" ø NX
-		2	24.5	97.6	71.8	12.5		583.6	
- 25									
-		3	26.2	97.8	72.0	0		581.9	
-									
-									
-									
- 30	Gray DOLOMITE - fine to medium grained, thin to medium bedded, shaly partings with calcite replacement								
-									
-	Gray DOLOMITE - fine grained, thin bedded, shaly partings weathered to brown-gray & gray, vuggy, highly fractured 34.1' -34.6'								
-									
-			34.5					573.6	
- 35									

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

WATER FOUND STATIC WATER LEVEL

NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG

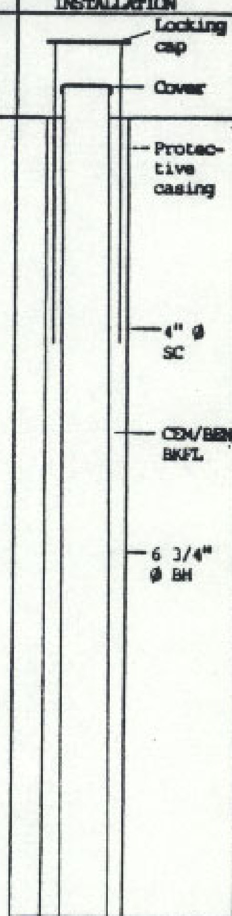
(OVERBURDEN)

PROJECT NAME: UNION CARBIDE CORPORATION
PROJECT NO.: 9-1851
CLIENT: UNION CARBIDE CORPORATION
LOCATION: SOUTH SIDE SOLID WASTE MANAGEMENT FACILITY

HOLE DESIGNATION: OW2-86
DATE COMPLETED: JULY 8, 1986
DRILLING METHOD: HOLLOW STEM AUGER
CRA SUPERVISOR: C. PADGINSON

DEPTH ft/m BG	STRATIGRAPHY DESCRIPTION & REMARKS	ELEVATION ft/m AMSL
		608.43
		607.00
0		606.1
	Black CARBON DUST & PIECES - vegetative inclusions, non-plastic (FILL) Moist	
5	CL - Red-brown silty CLAY - gray mottling, plastic, increasing silt and moisture with depth, pockets of pea gravel beginning at 7.4' (NATIVE) Moist-wet	
10	CL - Brown-red silty CLAY - plastic, silt seams every 0.3', laminated, 10.0'-12.0' trace pea gravel, red & gray laminations (NATIVE) Wet	
	Red-brown clayey SILT - red & gray laminations Wet	
15	Red-brown gravelly, clayey, sandy SILT - gravel subangular, becoming brown at 16.0', moisture increasing to saturated at 16.0' Wet	
	Brown gravelly, clayey, silty SAND Saturated	
20	Light gray & brown-gray DOLOMITE	586.1

MONITOR INSTALLATION



SAMPLE NUMBER	STATE	'N' VALUE
1	SS	11 5
2	SS	9 17
3	SS	5 17
4	SS	13 30
5	SS	9 15
6	SS	10 13
7	SS	5 11
8	SS	14 8
9	SS	10 17
10	SS	100+

NOTES:
Log continued on Stratigraphy & Instrumentation Log (Bedrock) OW2-86.

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

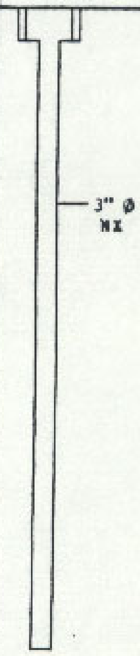
GRAIN SIZE ANALYSIS   WATER FOUND   STATIC WATER LEVEL

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

PROJECT NAME: UNION CARBIDE CORPORATION
PROJECT NO.: 9-1851
CLIENT: UNION CARBIDE CORPORATION
LOCATION: SOUTH SIDE SOLID WASTE MANAGEMENT FACILITY

HOLE DESIGNATION: BW2-86
DATE COMPLETED: JULY 22, 1986
DRILLING METHOD: 3" DIAMETER NX CORE
CRA SUPERVISOR: C. PADGINTON

DEPTH ft BG	DESCRIPTION OF STRATA	RUN NO.	INTERVAL	CORE RECOVERY %	RQD %	DRILLING WATER RETURN %	WATER PRESSURE TEST cm/s	ELEVATION ft AMSL	MONITOR INSTALLATION
20	Light gray & brown-gray DOLOMITE - fine grained, thin bedded, stylolites, shaly partings, highly fractured 20.75'-21.50', pitted	1	20.0	83.6	45.0	0		586.1	
25	Brown-gray DOLOMITE - fractures weathered to medium gray, vuggy, sandy deposits in fractures, secondary calcite deposits, medium bedded at 24.6', highly fractured zones 24.1'-24.3', 26.1'-26.5', 29.1'-29.9'								
		2	29.0	94.2	72.8	10		577.1	
30	Light gray DOLOMITE - fine to medium grained, thick bedded, pitted								
	Light gray DOLOMITE - fine grained, medium bedded								
35								571.1	



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

WATER FOUND   STATIC WATER LEVEL

NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

PROJECT NAME: UNION CARBIDE CORPORATION
PROJECT NO.: 9-1851
CLIENT: UNION CARBIDE CORPORATION
LOCATION: EAST SIDE SOLID WASTE MANAGEMENT FACILITY

HOLE DESIGNATION: OW3-86
DATE COMPLETED: JULY 7, 1986
DRILLING METHOD: HOLLOW STEM AUGER
CRA SUPERVISOR: C. PADGINSON

DEPTH ft/m BG	STRATIGRAPHY DESCRIPTION & REMARKS		ELEVATION ft/m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
			604.67	Locking cap			
			603.51	Cover			
0			602.2				
-	Black CARBON DUST & SMALL PIECES - small amount vegetation (FILL)	Moist		Protective casing	1	SS	3 3
-					2	SS	10
-	CL - Red-brown silty CLAY - red & gray mottling, some carbonized inclusions, increasing silt with depth, at bottom sand appears in deposits surrounding pea gravel (NATIVE) (TILL)	Moist		4" Ø SC			33
-				CEM/BEN BKFL	3	SS	6
- 5							12
-				6 3/4" Ø BH			
-	Red-brown silty SAND - fine to medium sand at 6.8'-7.1', some rock	Wet			4	SS	39
							100+
-	Light gray & brown-gray DOLOMITE		594.8				

NOTES:
Log continued on Stratigraphy & Instrumentation Log (Bedrock) OW3-86.

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS WATER FOUND STATIC WATER LEVEL

S T R A T I G R A P H I C   A N D   I N S T R U M E N T A T I O N   L O G

(B E D R O C K)

PROJECT NAME: UNION CARBIDE CORPORATION

PROJECT NO.: 9-1851

CLIENT: UNION CARBIDE CORPORATION

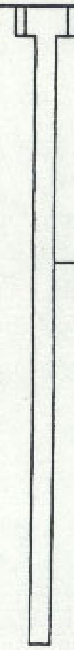
LOCATION: EAST SIDE SOLID WASTE MANAGEMENT FACILITY

HOLE DESIGNATION: BW3-86

DATE COMPLETED: JULY 23, 1986

DRILLING METHOD: 3" DIAMETER NX CORE

CRA SUPERVISOR: C. PADGINSON

DEPTH	DESCRIPTION OF STRATA	RUN NO.	INTERVAL	CORE RECOVERY	RQD	DRILLING WATER RETURN	WATER PRESSURE TEST	ELEVATION	MONITOR INSTALLATION
ft BG				%	%	%	cm/s	ft AMSL	
		1	7.5	98.0	80.0			594.8	
10	Light gray & brown-gray DOLOMITE - fine grained, shaly partings, medium bedded, pitted, becoming thin bedded at 8.4', vuggy, few stylolites, highly fractured zones 9.2'-9.6', 11.9'-12.3', calcite deposits, fine to medium grained at 10.2', fractures weathered medium gray & brown-gray, grading to very fine grained at 14.0'	2	12.4	98.0	50.4			589.9	3" ø NX
15		3	16.6	100	56.0			585.6	
20	Light gray DOLOMITE - very fine grained, stylolites, thin bedded, few pits, no vugs, fractured & weathered	4	20.2	98.0	60.0			582.1	
			22.5					579.8	

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

WATER FOUND   STATIC WATER LEVEL

NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG

(OVERBURDEN)

PROJECT NAME: UNION CARBIDE CORPORATION
PROJECT NO.: 9-1851
CLIENT: UNION CARBIDE CORPORATION
LOCATION: NORTHEAST CORNER SOLID WASTE MANAGEMENT FACILITY

HOLE DESIGNATION: BW4-86
DATE COMPLETED: JULY 11, 1986
DRILLING METHOD: HOLLOW STEM AUGER
CRA SUPERVISOR: D. OSCAR

DEPTH ft/m BG	STRATIGRAPHY DESCRIPTION & REMARKS	ELEVATION ft/m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
		607.06	Locking cap			
		605.61	Cover			
0		604.5				
	Augered through - Road fill		Protective casing			
	Brown & black GRAVEL, ASH & CARBON Moist - trace glass, stone fragments (FILL)		4" ø SC	1	SS	6
	Gray & brown-gray medium-fine SAND, Wet GRAVEL - trace ash, carbon, glass, stone fragments (FILL)		CEM/BEN BKFL			13
5				2	SS	4
						10
	Red-brown, gray & olive-gray SILT Moist-wet - some clay, trace gravel, carbon, ash (FILL)		6 3/4" ø BH	3	SS	7
						16
	Red-brown fine to medium SAND - Moist some silt, fine to medium subangular gravel, trace stone fragments (NATIVE)			4	SS	8
10						22
	No recovery Brown-gray DOLOMITE	593.1		5	SS	50+

NOTES:
Log continued on Stratigraphy & Instrumentation Log (Bedrock) OW4-86.

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS WATER FOUND STATIC WATER LEVEL

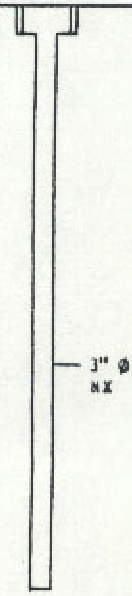
STRATIGRAPHIC AND INSTRUMENTATION LOG

(BEDROCK)

PROJECT NAME: UNION CARBIDE CORPORATION
PROJECT NO.: 9-1851
CLIENT: UNION CARBIDE CORPORATION
LOCATION: NORTHEAST CORNER SOLID WASTE MANAGEMENT FACILITY

HOLE DESIGNATION: BW4-86(?)
DATE COMPLETED: JULY 23, 1986
DRILLING METHOD: 3" DIAMETER NX CORE
CRA SUPERVISOR: C. PAGGINSON(?)

DEPTH ft BG	DESCRIPTION OF STRATA	RUN NO.	INTERVAL	CORE RECOVERY %	RQD %	DRILLING WATER RETURN %	WATER PRESSURE TEST cm/s	ELEVATION ft AMSL	MONITOR INSTALLATION
		1	11.4	97.0	81.7			593.1	
	Brown-gray DOLOMITE - fine to medium grained, thin bedded, pitted, weathered fractures								
15									
20	Brown-gray DOLOMITE - medium bedded, weathered fractures, pitted, interconnected voids at 17.4', thin bedded at 17.7' -22.6', calcite deposits, shaly partings, pitting increases with depth								3" Ø NX
		2	21.4	84.0	68.0			583.1	
25			25.0					579.5	
	NOTES: Drilling water return was not recorded.								



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

WATER FOUND STATIC WATER LEVEL

NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG

(OVERBURDEN)

PROJECT NAME: UNION CARBIDE CORPORATION

PROJECT NO.: 9-1851

CLIENT: UNION CARBIDE CORPORATION

LOCATION: NORTHEAST CORNER OF S&WP PROPERTY

HOLE DESIGNATION: BW5-86

DATE COMPLETED: OCTOBER 22, 1986

DRILLING METHOD: HOLLOW STEM AUGER

CRA SUPERVISOR: R. HOEKSTRA

DEPTH ft/m BG	STRATIGRAPHY DESCRIPTION & REMARKS	ELEVATION ft/m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
		603.33	Locking cap			
		600.43	Cover			
0		599.7				
	Dark brown clayey TOPSOIL & GRAVEL - Moist some vegetation (NATIVE)			1	SS	3
	Red-brown CLAY -some wood fragments, Moist some small root fibers		4" ø BS			8
				2	SS	7
	Red-brown CLAY -plastic, some root fibers Moist					23
- 5			Protective casing	3	SS	9
	Red-brown silty CLAY - plastic Moist-wet					16
			CEM/BEN BKFL	4	SS	7
						17
			6 3/4" ø BH	5	SS	11
	Red-brown CLAY & GRAVEL Wet					100+
- 10	Spoon & auger refusal (9.9')	589.8				
- 15						
- 20						
- 25						

NOTES:
Log continued on Stratigraphy & Instrumentation Log (Bedrock) BW5-86.

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS WATER FOUND STATIC WATER LEVEL

STRATIGRAPHIC AND INSTRUMENTATION LOG

(BEDROCK)

PROJECT NAME: UNION CARBIDE CORPORATION

PROJECT NO.: 9-1851

CLIENT: UNION CARBIDE CORPORATION

LOCATION: NORTHEAST CORNER OF SWMF PROPERTY

HOLE DESIGNATION: BH5-86

DATE COMPLETED: OCTOBER 31, 1986

DRILLING METHOD: 3" DIAMETER NX CORE

CRA SUPERVISOR: R. HOEKSTRA

DEPTH ft BG	DESCRIPTION OF STRATA	RUN NO.	INTERVAL	CORE RECOVERY %	RQD %	DRILLING WATER RETURN %	WATER PRESSURE TEST cm/s	ELEVATION ft AMSL	MONITOR INSTALLATION
10	Brown-gray DOLOMITE - very fine, aphanitic, thin to medium bedded, some stylolites, some fractures, weathered, becoming gray with depth	1	10.0	88	58	100		589.7	
15									
	Black, brown & gray DOLOMITE - saccaroidal, aphanitic, medium bedded, few weathered fractures, trace sphalerite	2	16.0	115	75	10		583.7	3" Ø NX
		3	18.0	144	100	0		581.7	
20	Brown-gray DOLOMITE - aphanitic, saccharoidal, thin to medium bedded, stylolites, very fine at 18.9' with weathered fractures, secondary calcite deposits, few voids & pits with sphalerite deposits, carbonaceous partings	4	18.9	99	50	0		580.8	
25			24.9					574.8	

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

WATER FOUND STATIC WATER LEVEL

NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG

(OVERBURDEN)

PROJECT NAME: UNION CARBIDE CORPORATION

PROJECT NO.: 9-1851

CLIENT: UNION CARBIDE CORPORATION

LOCATION: 100' WEST OF WEST EDGE OF LANDFILL

HOLE DESIGNATION: BW6-86

DATE COMPLETED: OCTOBER 24, 1986

DRILLING METHOD: HOLLOW STEM AUGER

CRA SUPERVISOR: R. HOEKSTRA

DEPTH ft/m BG	STRATIGRAPHY DESCRIPTION & REMARKS		ELEVATION ft/m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
			607.09				
			603.67				
0			603.5				
	Dark brown clayey TOPSOIL & VEGETATION - some silt (FILL)	Dry			1	SS	8
							17
	Black CARBON - some silt, some ash, trace orange brick (FILL)	Dry		4" ø SC	2	SS	3
	Black SILT - some carbon, some clay, trace ash, trace vegetation (FILL)	Saturated					5
					3	SS	1
5				Protective casing			9
	Red-brown CLAY - slightly mottled, stiff (NATIVE)	Moist			4	SS	12
							25
	Red-brown CLAY - slightly mottled, silt lense, stiff	Moist		CEM/BEN BKFL	5	SS	14
							25
10	Red-brown CLAY - slightly mottled, some gray-green silt lenses, stiff	Moist			6	SS	7
				6 3/4" ø BH			14
	Red-brown CLAY - some mottling, trace silt, very stiff	Moist			7	SS	2
	Red-brown silty CLAY	Wet					8
					8	SS	2
15	Brown SAND - some gravel, some clay, trace silt	Wet					9
					9	SS	17
	Brown clayey SAND - some large gravel	Wet	586.5				100+

Auger refusal (17.0')
Spoon refusal (17.7')

NOTES:
Log continued on Stratigraphy & Instrumentation Log (Bedrock) BW6-86.

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS   WATER FOUND   STATIC WATER LEVEL

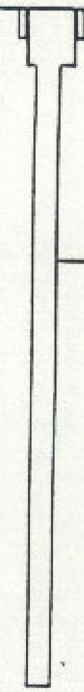
STRATIGRAPHIC AND INSTRUMENTATION LOG

(BEDROCK)

PROJECT NAME: UNION CARBIDE CORPORATION
PROJECT NO.: 9-1851
CLIENT: UNION CARBIDE CORPORATION
LOCATION: 100' WEST OF WEST EDGE OF LANDFILL

HOLE DESIGNATION: BH6-86
DATE COMPLETED: OCTOBER 28, 1986
DRILLING METHOD: 3" DIAMETER NX CORE
CRA SUPERVISOR: R. HOEKSTRA

DEPTH ft BG	DESCRIPTION OF STRATA	RUN NO.	INTERVAL	CORE RECOVERY %	RQD %	DRILLING RATE	WATER RETURN %	WATER PRESSURE TEST cm/s	ELEVATION ft AMSL	MONITOR INSTALLATION
	Brown-gray DOLOMITE - very fine, aphanitic, thin bedding many weathered fractures, carbonaceous partings	1	17.7	83	0				585.8	
20										
	Gray-brown DOLOMITE - very fine, aphanitic, thin to medium bedding, some weathered fractures, few pits with sphalerite	2	22.4	42	29				581.1	3" ø NX
25										
	Black-gray DOLOMITE - very fine, aphanitic, thin to medium bedded, highly fractured, weathered, many carbonaceous partings, several zones of sandy grain size	3	27.2	82	26				576.3	
30										
			32.9						570.6	
35										



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

WATER FOUND   STATIC WATER LEVEL

NM - NOT MEASURED

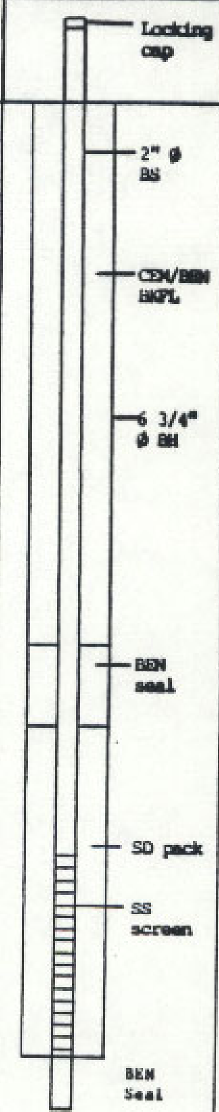
STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

PROJECT NAME: UNION CARBIDE CORPORATION
PROJECT NO.: 9-1851
CLIENT: UNION CARBIDE CORPORATION
LOCATION: TOP OF LANDFILL

HOLE DESIGNATION: MW-86
DATE COMPLETED: NOVEMBER 3, 1986
DRILLING METHOD: HOLLOW STEM AUGER
CRA SUPERVISOR: R. HOEKSTRA

DEPTH ft/m BG	STRATIGRAPHY DESCRIPTION & REMARKS		ELEVATION ft/m AMSL
			631.36
0			626.6
	Black CARBON -some flyash (FILL)	Dry	
	Red-brown CLAY -some carbon, trace silt, some green, gray & red mottling (FILL)	Dry	
	Black CARBON -some flyash (FILL)	Dry	
	Red-brown CLAY & CARBON -trace silt, trace orange brick (FILL)	Dry	
5	Black CARBON -some clay, trace silt, piece of plastic at 6.0' (FILL)	Dry	
	Black CARBON -trace silt, trace sand, pieces of plastic (FILL)	Dry	
	Black CARBON -some silt, some plastic, trace sand, piece of wood in tip of spoon (FILL)	Dry	
10	Black CARBON -some wood fragments (FILL)	Dry	
	Black CARBON -large wood fragment (FILL)	Dry	
			613.1
15	Black CARBON & WOOD fragments - some paper, pressed putrified wood/ash, trace clay at bottom (FILL)	Dry	611.0
	Black CARBON & WOOD fragments (FILL)	Dry	
	Black CARBON & WOOD fragments - trace orange brick (FILL)	Dry	607.9
20	Black CARBON & WOOD -orange brick fragment in tip of spoon (FILL)	Dry	
	Black CARBON & WOOD fragments - trace clay (FILL)	Dry	602.9
	Black CARBON & WOOD fragments - some silt (FILL)	Dry	602.4
25	Mottled red-brown, green, gray, red, & orange CLAY - trace silt (NATIVE)	Moist	601.6
	Spoon refusal 25.0' Auger refusal 24.2'		

MONITOR INSTALLATION



SAMPLE NUMBER	STATE	'N' VALUE
1	SS	21 16
2	SS	8 13
3	SS	6 5
4	SS	6 7
5	SS	21 21
6	SS	13 19
7	SS	9 6
8	SS	25 22
9	SS	13 12
10	SS	15 10
11	SS	9 20
12	SS	20 23
13	SS	15

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS   WATER FOUND   STATIC WATER LEVEL

APPENDIX D

RECOVERY TEST DATA

SINGLE WELL RESPONSE TEST - DATA

DATE (D/M/Y)	PAGE No.	FILE No.	COU
/ /	1 OF 1	1851	

PROJECT: UNION CARBIDE, REPUBLIC PLANT	PIEZOMETER NUMBER: OWS-86
LOCATION: NORTH-EAST CORNER OF SITE	WELL DIA: 3" / BOREHOLE DIA: 4"
CRA SUPERVISOR: RICK HOEKSTRA	SLUG DIMENSIONS (LXØ):
SLUG DISPLACEMENT (H-Ho): 0.27'	SCREEN INTERVAL: TO B
AQUIFER THICKNESS:	DATUM POINT:
DATUM POINT ELEV.: AMSL	STATIC WATER LEVEL (H): 10.63' B.D.
CONDITIONS: ☒ RISING ☐ FALLING	

RUN 1

TIME HR.	MIN.	SEC.	WATER LEVEL (h)	H-h	$\frac{H-h}{H-H_o}$
4	14	00	10.90	0.27	1.00
4	15	00	10.82	0.19	0.704
4	16	00	10.79	0.16	0.593
4	17	00	10.77	0.14	0.519
4	18	00	10.75	0.12	0.444
4	19	00	10.74	0.11	0.407
4	24	00	10.70	0.07	0.259
4	29	00	10.68	0.05	0.185
4	34	00	10.67	0.04	0.148

$$K = \frac{r^2 \ln(L/R)}{2 L T_o}$$

r = 2 in (5.08 cm)

L = 589.7 - 574.8 = 14.9 ft (454.152 cm)

R = 1.5 in (3.81 cm)

@ $\frac{H-h}{H-H_o}$ = .37 T_o = 345 sec. (see plot)

$$K = \frac{(5.08)^2 \ln\left(\frac{454.152}{3.81}\right)}{2(454.152)(345)}$$

$$= 3.937 \times 10^{-4} \text{ cm/sec.}$$

APPENDIX E

HISTORIC DATA - QUARTERLY SAMPLING OF OVERBURDEN WELLS

HISTORIC ANALYTICAL RESULTS
UNION CARBIDE CORPORATION - WELL MONITORING

ANALYTICAL PARAMETER	UNITS	MW1-78 3/29/79	MW1-78 4/30/79	MW1-78 11/21/79	MW1-78 6/09/80	MW1-78 11/17/80	
Ammonia	mg/l	0.63	10.0	14.4	9.1	28	
Nitrite	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	
Nitrate	mg/l	2.0	4.8	<0.2	0.45	0.32	
BOD (5 Day)	mg/l	37.5	13	22		6	
COD	mg/l	344	71.8	160	67	48	
Kjeldahl Nitrogen	mg/l	1.1	7.7	24.0	--	--	
Phosphorus	mg/l	1.1	5.0	0.62	<0.02	0.45	
Sulfate	mg/l	7.8	<1	6.0	11	3.0	
Methylene	mg/l	<0.4	--	<0.4	<0.1	<0.1	
Alkalinity	mg/l	330	780	898	770	850	
Total Solids	mg/l	1,870	1,570	1,500	1,400	1,200	
Color		--	100	--	27	35	
Total Hardness	mg/l	1,260	920	775	560	540	
Chloride	mg/l	260	190	145	103	85	
Total Coliform	MPN	430	750	2	<2	0	
Organic Carbon	mg/l	93	26.1	70	19	210	
Phenols	mg/l	0.09	<0.01	0.080	0.025	0.03	
pH	Std.	7.84	8.13	8.52	8.10	8.33	
Conductance	umhos	1,540	1,480	1,310	1,520	2,150	
Carbon Chloroform	mg/l	10.8	26.9	2.0	3.1	<1	
Chlorinated Hydrocarbons	ug/l	2.1	6.5				
Aluminum	mg/l	52	7.4	56	4.6	0.3	
Arsenic	ug/l	11.4	6.4	5.3	10	8.0	
Chromium	mg/l	0.088	0.026	0.090	0.008	<0.005	
Copper	mg/l	0.635	0.103	0.783	0.043	0.006	
Lead	mg/l	.60	0.07	0.72	0.07	0.03	
Mercury	ug/l	36.6	17	13	3.0	<2	
Iron	mg/l	170	6.5	280	27	1.9	
Potassium	mg/l	70	110	66	64	330	
Sodium	mg/l	200	160	180	200	3,500	
Calcium	mg/l	66	46	99	28	110	
Silver	mg/l	0.011	<0.003	0.052	<0.005	<0.005	
Hexavalent Chromium	mg/l			0.090	--	--	
Halogenated Organic Scan	ug/l			1.80	4.6	0.91	

HISTORIC ANALYTICAL RESULTS
UNION CARBIDE CORPORATION - WELL MONITORING

ANALYTICAL PARAMETER	UNITS	MW1-78 6/09/81	MW1-78 12/9/81	MW1-78 6/03/82	MW1-78 12/3/82	MW1-78 6/14/83	
Ammonia	mg/l	--	10				
Nitrite	mg/l	0.016	0.19				
Nitrate	mg/l	<0.1	0.47				
BOD (5 Days)	mg/l	<5	<2	<5	8	7.3	
COD	mg/l	41	33				
Kjeldahl Nitrogen	mg/l	2.4	9				
Phosphorus	mg/l	<0.02	0.16	1.6	<0.02	0.062	
Sulfate	mg/l	35	3.9	12	<1		
Methylene	mg/l	<0.03	<0.1				
Alkalinity	mg/l	890	660				
Total Solids	mg/l	1,100	1,100	1,400	975	960	
Color		40	20				
Total Hardness	mg/l	630	410				
Chloride	mg/l	87	75	95	100	82	
Total Coliform	100ml	<3	3.6				
Organic Carbon	mg/l	16	11	17	15	28	
Phenols	mg/l	<0.01	0.012	0.090	<0.01	<0.01	
pH	Std.	7.77	8.63				
Conductance	umhos	1,730	1,250	1,400	1,200	1,500	
Carbon Chloroform	mg/l	14	7.2				
Chlorinated Hydrocarbons	ug/l						
Aluminum	mg/l	<0.2	0.4				
Arsenic	ug/l	6.1	<5				
Chromium	mg/l	<0.005	<0.005				
Copper	mg/l	0.054	0.010				
Lead	mg/l	<0.03	0.05				
Mercury	ug/l	<3	<1	8.0	<0.0008	<0.0006	
Iron	mg/l	16	3.0	230	26	18	
Potassium	mg/l	2.2	59				
Sodium	mg/l	47	170				
Calcium	mg/l	32	10				
Silver	mg/l	0.015	<0.005				
Hexavalent Chromium	mg/l	<0.005	<0.005				
Halogenated Organic Scan	ug/l	21	1.3				

HISTORIC ANALYTICAL RESULTS

UNION CARBIDE CORPORATION - WELL MONITORING

ANALYTICAL PARAMETER	UNITS	MW1-78 12/2/83	MW1-78 6/08/84	MW1-78 12/5/84	MW1-78 6/14/85	MW1-78 9/11/85	MW1-78 12/5/85
Ammonia	mg/l						
Nitrite	mg/l						
Nitrate	mg/l						
BOD (5 Days)	mg/l	<2	13	<2		8.2	2.0
COD	mg/l						
Kjeldahl Nitrogen	mg/l						
Phosphorus	mg/l	0.33	0.44	0.24		0.40	0.28
Sulfate	mg/l	19	1.2	8.8		<1	5.5
Methylene	mg/l						
Alkalinity	mg/l						
Total Solids	mg/l	950	1,070	1,010		918	1,040
Color							
Total Hardness	mg/l						
Chloride	mg/l	93	100	<1		75	81
Total Coliform	MPN						
Organic Carbon	mg/l	13	23	15	12	40	111
Phenols	mg/l	0.011	<0.01	<0.01	<0.01	0.011	1.69
pH	Std.			7.68		8.19	7.63
Conductance	umhos	1,440	1,900	1,400	760	1,300	1,700
Carbon Chloroform	mg/l						
Chlorinated Hydrocarbons	ug/l						
Aluminum	mg/l						
Arsenic	ug/l						
Chromium	mg/l						
Copper	mg/l						
Lead	mg/l						
Mercury	ug/l	<0.001	<0.001	<0.0005		0.0022	0.0009
Iron	mg/l	2.6	6.4	1.5		4.0	3.75
Potassium	mg/l						
Sodium	mg/l						
Calcium	mg/l						
Silver	mg/l						
Hexavalent Chromium	mg/l						
Halogenated Organic Scan	ug/l						

HISTORIC ANALYTICAL RESULTS
UNION CARBIDE CORPORATION - WELL MONITORING

ANALYTICAL PARAMETER	UNITS	MW2-78 3/29/79	MW2-78 11/21/79	MW2-78 6/09/80	MW2-78 6/09/81	MW2-78 12/9/81	MW2-78 5/28/82
Ammonia	mg/l	1.8	<0.5	<1	<0.5	--	
Nitrite	mg/l	<0.01	<0.01	<0.01	<0.01	0.19	
Nitrate	mg/l	4.5	0.3	4.1	<0.1	2.7	
BOD (5 Days)	mg/l	<50	8	140	<5	--	--
COD	mg/l	38.4	174	180	32	--	
Kjeldahl Nitrogen	mg/l	--	2.8	<1	<0.5	--	
Phosphorus	mg/l	0.25	0.56	<0.02	<0.02	--	0.74
Sulfate	mg/l	700	750	830	330	130	69
Methylene	mg/l	<0.4	<0.4	<0.2	0.058	--	
Alkalinity	mg/l	820	804	560	170	190	
Total Solids	mg/l	--	2,480	4,600	960	--	3,700
Color		--	--	50	17.5	30	
Total Hardness	mg/l	1,630	1,750	1,680	550	--	
Chloride	mg/l	180	121	109	83	45	170
Total Coliform	MPN	<30	<2	<2	9	43	
Organic Carbon	mg/l	16.7	130	72	13	--	15
Phenolics	mg/l	0.01	0.040	0.26	<0.01	<0.01	--
pH	Std.	6.83	7.91	7.61	7.13	7.32	
Conductance	umhos	1,370	3,120	2,200	1,050	580	470
Carbon Chloroform	mg/l	--	1.6	8.0	<2	--	
Chlorinated Hydrocarbons	ug/l	0.7					
Aluminum	mg/l	5.0	0.6	3.1	<0.2	0.4	
Arsenic	ug/l	<1.7	<1.4	<2	<5	<5	
Chromium	mg/l	0.008	<0.002	<0.003	<0.005	<0.005	
Copper	mg/l	0.028	<0.003	0.008	0.050	<0.01	
Lead	mg/l	<0.02	0.03	<0.02	<0.03	<0.04	
Mercury	ug/l	<0.7	<0.4	2.9	<3	2.6	11
Iron	mg/l	33	11.7	80	9.3	29	2,100
Potassium	mg/l	6.5	6.4	7.9	54	4.5	
Sodium	mg/l	68	85	100	51	17	
Calcium	mg/l	17	275	100	70	50	
Silver	mg/l	<0.003	<0.005	<0.005	0.016	<0.005	
Hexavalent Chromium	mg/l		<0.002	--	<0.005	<0.005	
Halogenated Organic Scan	ug/l		1.47	8.8	--	--	

HISTORIC ANALYTICAL RESULTS
UNION CARBIDE CORPORATION - WELL MONITORING

ANALYTICAL PARAMETER	UNITS	MW3-79 3/29/79	MW3-79 11/21/79	MW3-79 6/09/80	MW3-79 6/09/81	MW3-79 12/9/81	
Ammonia	mg/l	0.47	0.5	<0.5	<0.5	<0.1	
Nitrite	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	
Nitrate	mg/l	1.0	<0.2	0.17	<0.1	2.7	
BOD (5 Days)	mg/l	<50	5	<2	<5	<2	
COD	mg/l	<10	30	<10	6.8	8	
Kjeldahl Nitrogen	mg/l	0.56	2.0	<0.50	<0.5	0.2	
Phosphorus	mg/l	0.04	0.06	0.03	<0.02	<0.02	
Sulfate	mg/l	650	400	260	120	110	
Methylene	mg/l	<0.4	<0.4	<0.1	<0.2	<0.1	
Alkalinity	mg/l	275	260	280	240	240	
Total Solids	mg/l	1,360	952	700	440	600	
Color		70	--	0	30	50	
Total Hardness	mg/l	940	540	480	270	270	
Chloride	mg/l	22	14	9.3	5.8	7.5	
Total Coliform	MPN	≥24,000	2	<2	15	9.1	
Organic Carbon	mg/l	9.0	35	24	3.1	<1	
Phenolics	mg/l	<0.01	<0.010	0.053	<0.01	<0.01	
pH	Std.	7.38	7.93	7.94	7.90	8.23	
Conductance	umhos	2,100	1,340	890	540	560	
Carbon Chloroform	mg/l	--	<1.0	5.2	<1	<2	
Chlorinated Hydrocarbons	ug/l	1.0					
Aluminum	mg/l	1.2	<0.1	1.4	<0.2	0.4	
Arsenic	ug/l	<1.7	<1.4	<1	<5	<5	
Chromium	mg/l	<0.003	<0.002	<0.003	<0.005	<0.005	
Copper	mg/l	0.008	<0.003	0.007	0.042	<0.01	
Lead	mg/l	<0.02	<0.02	<0.02	<0.03	<0.04	
Mercury	ug/l	<0.7	<1.0	<1	<3	<1	
Iron	mg/l	8.8	0.27	6.4	70	3.0	
Potassium	mg/l	5.5	4.2	4.1	6.0	3.8	
Sodium	mg/l	30	75	66	14	61	
Calcium	mg/l	55	14	39	42	28	
Silver	mg/l	<0.003	<0.005	<0.005	<0.005	<0.005	
Hexavalent Chromium	mg/l		<0.002	--	<0.005	<0.005	
Halogenated Organic Scan	ug/l		1.54	0.81	22	1.1	

HISTORIC ANALYTICAL RESULTS
UNION CARBIDE CORPORATION - WELL MONITORING

ANALYTICAL PARAMETER	UNITS	MW3-79 6/03/82	MW3-79 12/6/82	MW3-79 6/14/83	MW3-79 12/02/83	MW3-79 6/08/84	MW3-79 12/4/84
Ammonia	mg/l						
Nitrite	mg/l						
Nitrate	mg/l						
BOD (5 Days)	mg/l	<5	<4	<2	<2	9.6	<2
COD	mg/l						
Kjeldahl Nitrogen	mg/l						
Phosphorus	mg/l	0.03	<0.02	0.048	0.78	<0.05	<0.05
Sulfate	mg/l	74	180		9.2	45	121
Methylene	mg/l						
Alkalinity	mg/l						
Total Solids	mg/l	350	850	500	500	383	518
Color							
Total Hardness	mg/l						
Chloride	mg/l	6.7	11	3.7	5.4	2.4	2.6
Total Coliform	MPN						
Organic Carbon	mg/l	5	4.0	23	2.5	9.0	1.0
Phenolics	mg/l	<0.1	<0.01	<0.01	0.050	<0.01	<0.01
pH	Std.						6.60
Conductance	umhos	520	1,080	550	580	680	740
Carbon Chloroform	mg/l						
Chlorinated Hydrocarbons	ug/l						
Aluminum	mg/l						
Arsenic	ug/l						
Chromium	mg/l						
Copper	mg/l						
Lead	mg/l						
Mercury	ug/l	<0.5	<0.0008	<0.0006	<0.001	<0.001	<0.0005
Iron	mg/l	22	35	28	16	5.3	3.3
Potassium	mg/l						
Sodium	mg/l						
Calcium	mg/l						
Silver	mg/l						
Hexavalent Chromium	mg/l						
Halogenated Organic Scan	ug/l						

HISTORIC ANALYTICAL RESULTS

UNION CARBIDE CORPORATION - WELL MONITORING

ANALYTICAL PARAMETER	UNITS	MW3-79 6/14/85	MW3-79 12/5/85				
Ammonia	mg/l						
Nitrite	mg/l						
Nitrate	mg/l						
BOD (5 Days)	mg/l		<2				
COD	mg/l						
Kjeldahl Nitrogen	mg/l						
Phosphorus	mg/l		0.085				
Sulfate	mg/l		44				
Methylene	mg/l						
Alkalinity	mg/l						
Total Solids	mg/l		608				
Color							
Total Hardness	mg/l						
Chloride	mg/l		<1				
Total Coliform	MPN						
Organic Carbon	mg/l	2.3	44				
Phenolics	mg/l	<0.01	0.085				
pH	Std.		7.70				
Conductance	umhos	1,860	510				
Carbon Chloroform	mg/l						
Chlorinated Hydrocarbons	ug/l						
Aluminum	mg/l						
Arsenic	ug/l						
Chromium	mg/l						
Copper	mg/l						
Lead	mg/l						
Mercury	ug/l		0.0017				
Iron	mg/l		10				
Potassium	mg/l						
Sodium	mg/l						
Calcium	mg/l						
Silver	mg/l						
Hexavalent Chromium	mg/l						
Halogenated Organic Scan	ug/l						

APPENDIX F

ANALYTICAL SOIL DATA - JANUARY 1987

ANALYTICAL RESULTS
UNION CARBIDE CORPORATION - SOIL ANALYSIS

ANALYTICAL PARAMETER	UNITS	SS1-87 1/16/87	SS2-87 1/16/87				
Acenaphthene	mg/kg	<100	<10				
Acenaphthylene	mg/kg	<100	<10				
Anthracene	mg/kg	<100	<10				
Benzidine	mg/kg	<500	<50				
Benzo(a)anthracene	mg/kg	210	<10				
Benzo(b)fluoranthene	mg/kg	<100	<10				
Benzo(k)fluoranthene	mg/kg	240	<10				
Benzo(ghi)perylene	mg/kg	74J	<10				
Benzo(a)pyrene	mg/kg	200	<10				
Bis(2-chloroethoxy) methane	mg/kg	<100	<10				
Bis(2-chloroethyl)ether	mg/kg	<100	<10				
Bis(2-chloroisopropyl) ether	mg/kg	<100	<10				
Bis(2-ethylhexyl) phthalate	mg/kg	<100	<10				
4-Bromophenyl phenyl ether	mg/kg	<100	<10				
Butyl benzyl phthalate	mg/kg	<100	<10				
2-Chloronaphthalene	mg/kg	<100	<10				
4-Chlorophenyl phenyl ether	mg/kg	<100	<10				
Chrysene	mg/kg	140	<10				
Dibenzo(a,h)anthracene	mg/kg	<100	<10				
Di-n-butyl phthalate	mg/kg	<100	<10				
1,2-Dichlorobenzene	mg/kg	<100	<10				
1,3-Dichlorobenzene	mg/kg	<100	<10				
1,4-Dichlorobenzene	mg/kg	<100	<10				
3,3'-Dichlorobenzidine	mg/kg	<500	<50				
Diethyl phthalate	mg/kg	<100	<10				
Dimethyl phthalate	mg/kg	<100	<10				
2,4-Dinitrotoluene	mg/kg	<100	<10				
2,6-Dinitrotoluene	mg/kg	<100	<10				
Di-n-octyl phthalate	mg/kg	<100	<10				
Fluoranthene	mg/kg	230	<10				
Fluorene	mg/kg	<100	<10				
Hexachlorobenzene	mg/kg	<100	<10				
Hexachlorobutadiene	mg/kg	<100	<10				
Hexachlorocyclopentadiene	mg/kg	<100	<10				
Hexachloroethane	mg/kg	<100	<10				
Indeno(1,2,3-CD)pyrene	mg/kg	330	<10				
Isophorone	mg/kg	<100	<10				
Naphthalene	mg/kg	<100	<10				
Nitrobenzene	mg/kg	<100	<10				
N-Nitrosodimethylamine	mg/kg	<100	<10				
N-Nitrosodiphenylamine	mg/kg	<100	<10				
N-Nitrosodi-n-propylamine	mg/kg	<100	<10				
Phenanthrene	mg/kg	99J	<10				
Pyrene	mg/kg	210	<10				
1,2,4,Trichlorobenzene	mg/kg	<100	<10				

ANALYTICAL RESULTS

UNION CARBIDE CORPORATION - SOIL ANALYSIS

ANALYTICAL PARAMETER	UNITS	SS1-87 1/16/87	SS2-87 1/16/87				
Benzene	mg/kg	<1	<1				
Bromodichloromethane	mg/kg	<1	<1				
Bromoform	mg/kg	<1	<1				
Bromomethane	mg/kg	<1	<1				
Carbon Tetrachloride	mg/kg	<1	<1				
Chlorobenzene	mg/kg	<1	<1				
Chloroethane	mg/kg	<1	<1				
2-Chloroethylvinyl ether	mg/kg	<1	<1				
Chloroform	mg/kg	<1	<1				
Chloromethane	mg/kg	<1	<1				
Dibromochloromethane	mg/kg	<1	<1				
1,2-Dichlorobenzene	mg/kg	<1	<1				
1,3-Dichlorobenzene	mg/kg	<1	<1				
1,4-Dichlorobenzene	mg/kg	<1	<1				
1,1-Dichloroethane	mg/kg	<1	<1				
1,2-Dichloroethane	mg/kg	<1	<1				
1,1-Dichloroethene	mg/kg	<1	<1				
trans-1,2-Dichloroethene	mg/kg	<1	<1				
1,2-Dichloropropane	mg/kg	<1	<1				
cis-1,3-Dichloropropene	mg/kg	<1	<1				
trans-1,3-Dichloropropene	mg/kg	<1	<1				
Ethylbenzene	mg/kg	<1	<1				
Methylene chloride	mg/kg	<1	<1				
1,1,2,2-Tetrachloroethane	mg/kg	<1	<1				
Tetrachloroethene	mg/kg	<1	<1				
Toluene	mg/kg	<1	<1				
1,1,1-Trichloroethane	mg/kg	<1	<1				
1,1,2-Trichloroethane	mg/kg	<1	<1				
Trichloroethene	mg/kg	<1	<1				
Trichlorofluoromethane	mg/kg	<1	<1				
Vinyl chloride	mg/kg	<1	<1				

ANALYTICAL RESULTS
UNION CARBIDE CORPORATION - SOIL ANALYSIS

ANALYTICAL PARAMETER	UNITS	SS1-87 1/16/87	SS2-87 1/16/87				
4-Chloro-3-methylphenol	mg/kg	<100	<10				
2-Chlorophenol	mg/kg	<100	<10				
2,4-Dichlorophenol	mg/kg	<100	<10				
2,4-Dimethylphenol	mg/kg	<100	<10				
2,4-Dinitrophenol	mg/kg	<500	<50				
2-Methyl-4,6-dinitrophenol	mg/kg	<500	<50				
2-Nitrophenol	mg/kg	<100	<10				
4-Nitrophenol	mg/kg	<500	<50				
Pentachlorophenol	mg/kg	<500	<50				
Phenol	mg/kg	<100	<10				
2,4,6-Trichlorophenol	mg/kg	<100	<10				
Aldrin	mg/kg	<0.1	<0.1				
Alpha-BHC	mg/kg	<0.1	<0.1				
Beta-BHC	mg/kg	0.2	0.3				
Lindane	mg/kg	<0.1	<0.1				
Delta-BHC	mg/kg	<0.1	<0.1				
Chlordane	mg/kg	<0.3	<0.3				
4,4'-DDD	mg/kg	<0.1	<0.1				
4,4'-DDE	mg/kg	<0.1	<0.1				
4,4'-DDT	mg/kg	<0.1	<0.1				
Dieldrin	mg/kg	<0.1	<0.1				
Endosulfan I	mg/kg	<0.1	<0.1				
Endosulfan II	mg/kg	<0.1	<0.1				
Endosulfan Sulfate	mg/kg	0.4	0.7				
Endrin	mg/kg	<0.1	<0.1				
Endrin Aldehyde	mg/kg	<0.1	<0.1				
Heptachlor	mg/kg	<0.1	<0.1				
Heptachlor Epoxide	mg/kg	<0.1	<0.1				
Kepone	mg/kg	<0.1	<0.1				
Toxaphene	mg/kg	<1	<1				
Methoxychlor	mg/kg	<0.4	<0.4				
PCB-1016	mg/kg	<1	<1				
PCB-1221	mg/kg	<1	<1				
PCB-1232	mg/kg	<1	<1				
PCB-1242	mg/kg	<1	<1				
PCB-1248	mg/kg	<1	<1				
PCB-1254	mg/kg	<1	<1				
PCB-1260	mg/kg	<1	<1				

ANALYTICAL RESULTS
UNION CARBIDE CORPORATION - SOIL ANALYSIS

ANALYTICAL PARAMETER	UNITS	SS1-87 1/16/87	SS2-87 1/16/87				
Silver	mg/kg	<0.2	<0.2				
Arsenic	mg/kg	0.77	1.6				
Beryllium	mg/kg	0.20	0.12				
Cadmium	mg/kg	<0.2	<0.2				
Chromium	mg/kg	9.8	11				
Hexavalent Chrome	mg/kg	<0.8	<0.8				
Copper		26	38				
Mercury	mg/kg	<0.1	0.16				
Nickel	mg/kg	16	40				
Lead	mg/kg	26	19				
Antimony	mg/kg	<2	<2				
Selenium	mg/kg	<0.1	<0.1				
Thallium		<2	<2				
Zinc	mg/kg	42	48				
	mg/kg						
Phenols	mg/kg	<5	<5				

APPENDIX G

ANALYTICAL GROUNDWATER DATA -

AUGUST/NOVEMBER 1986

ANALYTICAL RESULTS - UNION CARBIDE CORPORATION

ANALYTICAL PARAMETER	UNITS	BW1-86 8/14/86		BW2-86 8/14/86		BW3-86 8/22/86		BW4-86 8/22/86		BW5-86 11/8/86		BW6-86 11/13/86	
ACENAPHTHENE	ug/l	<10		<10		<10		<10		<10		<10	
ACENAPHTHALENE	ug/l	<10		<10		<10		<10		<10		<10	
ANTHRACENE	ug/l	<10		<10		<10		<10		<10		<10	
BENZIDINE	ug/l	<50		<50		<50		<50		<50		<50	
BENZO(A)ANTHRACENE	ug/l	<10		<10		<10		<10		<10		<10	
BENZO(B)FLUORANTHENE	ug/l	<10		<10		<10		<10		<10		<10	
BENZO(K)FLUORANTHENE	ug/l	<10		<10		<10		<10		<10		<10	
BENZO(GHI)PERYLENE	ug/l	<10		<10		<10		<10		<10		<10	
BENZO(A)PYRENE	ug/l	<10		<10		<10		<10		<10		<10	
BIS(2-CHLOROETYOXY)METHANE	ug/l	<10		<10		<10		<10		<10		<10	
BIS(2-CHLOROETHYL) ETHER	ug/l	<10		<10		<10		<10		<10		<10	
BIS(2-CHLOROISOPROPYL) ETHER	ug/l	<10		<10		<10		<10		<10		<10	
BIS(2-ETHYLHEXYL)PHTHALATE	ug/l	<10		<10		<10		<10		<10		<10	
4-BROMOPHENYL PHENYL ETHER	ug/l	<10		<10		<10		<10		<10		<10	
BUTYL BENZYL PHTHALATE	ug/l	<10		<10		<10		<10		<10		<10	
2-CHLORONAPHTHALENE	ug/l	<10		<10		<10		<10		<10		<10	
4-CHLOROPHENYL PHENYL ETHER	ug/l	<10		<10		<10		<10		<10		<10	
CHRYSENE	ug/l	<10		<10		<10		<10		<10		<10	
DIBENZO(A,H)ANTHRACENE	ug/l	<10		<10		<10		<10		<10		<10	
BI-N-BUTYL PHTHALATE	ug/l	<10		<10		<10		<10		<10		<10	
1,2-DICHLOROBENZENE	ug/l	<10		<10		<10		<10		<10		<10	
1,3-DICHLOROBENZENE	ug/l	<10		<10		<10		<10		<10		<10	
1,4-DICHLOROBENZENE	ug/l	<10		<10		<10		<10		<10		<10	
3,3'-DICHLOROBENZIDINE	ug/l	<50		<50		<50		<50		<50		<50	
DIETHYL PHTHALATE	ug/l	<10		<10		<10		<10		<10		<10	
DIMETHYL PHTHALATE	ug/l	<10		<10		<10		<10		<10		<10	
2,4-DINITROTOLUENE	ug/l	<10		<10		<10		<10		<10		<10	
2,6-DINITROTOLUENE	ug/l	<10		<10		<10		<10		<10		<10	
DI-N-OCTYL PHTHALATE	ug/l	<10		<10		<10		<10		<10		<10	
FLUORANTHENE	ug/l	<10		<10		<10		<10		<10		<10	
FLUORENE	ug/l	<10		<10		<10		<10		<10		<10	
HEXACHLOROBENZENE	ug/l	<10		<10		<10		<10		<10		<10	
HEXACHLOROBUTADIENE	ug/l	<10		<10		<10		<10		<10		<10	
HEXACHLOROCYCLOPENTADIENE	ug/l	<10		<10		<10		<10		<10		<10	
HEXACHLOROETHANE	ug/l	<10		<10		<10		<10		<10		<10	
IDENO(1,2,3-CD)PYRENE	ug/l	<10		<10		<10		<10		<10		<10	
ISOPHORONE	ug/l	<10		<10		<10		<10		<10		<10	
NAPHTHALENE	ug/l	<10		<10		<10		<10		<10		<10	
NITROBENZENE	ug/l	<10		<10		<10		<10		<10		<10	
N-NITROSODIMETHYLAMINE	ug/l	<10		<10		<10		<10		<10		<10	
N-NITRODOSIPHENYLAMINE	ug/l	<10		<10		<10		<10		<10		<10	
N-NITROSODI-N-PROPYLAMINE	ug/l	<10		<10		<10		<10		<10		<10	

ANALYTICAL RESULTS - UNION CARBIDE CORPORATION

ANALYTICAL PARAMETER	UNITS	BW1-86 8/14/86	BW2-86 8/14/86	BW3-86 8/22/86	BW4-86 8/22/86	BW5-86 11/8/86	BW6-86 11/13/86
BENZENE	ug/l	<2	<2	<2	<2	<10	<10
BROMODICHLOROMETHANE	ug/l	<2	<2	<2	<2	<10	<10
BROMOFORM	ug/l	<4	<4	<4	<4	<10	<10
BROMOETHANE	ug/l	<2	<2	<2	<2	<10	<10
CARBON TETRACHLORIDE	ug/l	<4	<4	<4	<4	<10	<10
CHLOROBENZENE	ug/l	<2	<2	<2	<2	<10	<10
CHLOROETHANE	ug/l	24	<4	<4	<4	<10	<10
2-CHLOROETHYLVINYL ETHER	ug/l	<4	<4	<4	<4	<10	<10
CHLOROFORM	ug/l	<2	<2	<2	<2	8	<10
CHLOROMETHANE	ug/l	<2	<2	<2	<2	<10	<10
DIBROMOCHLOROMETHANE	ug/l	<2	<2	<2	<2	<10	<10
1,2-DICHLOROBENZENE	ug/l	<2	<2	<2	<2	<10	<10
1,4-DICHLOROBENZENE	ug/l	<2	<2	<2	<2	<10	<10
1,1-DICHLOROETHANE	ug/l	<4	<4	<4	<4	<10	<10
1,2-DICHLOROETHANE	ug/l	<2	<2	<2	<2	<10	<10
1,1-DICHLOROETHENE	ug/l	<2	<2	<2	<2	<10	<10
TRANS-1,2-DICHLOROETHENE	ug/l	<2	<2	4	32	<10	<10
1,2-DICHLOROPROPANE	ug/l	<2	<2	<2	<2	<10	<10
CIS-1,3-DICHLOROPROPENE	ug/l	<3	<3	<3	<3	<10	<10
TRANS-1,3-DICHLOROPROPRENE	ug/l	<3	<3	<3	<3	<10	<10
ETHYLBENZENE	ug/l	<2	<2	<2	<2	<10	<10
METHYLENE CHLORIDE	ug/l	<5	<5	<5	<5	<10	<10
1,1,2,2-TETRACHLOROETHANE	ug/l	<2	<2	<2	<2	<10	<10
TETRACHLOROETHENE	ug/l	<2	<2	<2	52	<10	<10
TOLUENE	ug/l	<2	<2	<2	<2	<10	<10
1,1,1-TRICHLOROETHANE	ug/l	<2	<2	<2	<2	<10	<10
1,1,2-TRICHLOROETHANE	ug/l	<2	<2	<2	<2	<10	<10
TRICHLOROETHENE	ug/l	<2	<2	<2	9	<10	<10
VINYL CHLORIDE	ug/l	<2	<2	8	52	<10	<10
ACETONE	ug/l	<10	<10	<10	<10	--	--
2-BUTANONE	ug/l	<10	<10	<10	<10	--	--
CARBON DISULFIDE	ug/l	<2	<2	<2	<2	--	--
2-HEXANONE	ug/l	<10	<10	<10	<10	--	--
4-METHYL-2-PENTANONE	ug/l	<10	<10	<10	<10	--	--
STYRENE	ug/l	<2	<2	<2	<2	--	--
VINYL ACETATE	ug/l	<2	<2	<2	<2	--	--
O,P-XYLENES	ug/l	<5	<5	<5	<5	--	--
M-XYLENES	ug/l	<5	<5	<5	<5	--	--

ANALYTICAL RESULTS - UNION CARBIDE CORPORATION

ANALYTICAL PARAMETER	UNITS	BW1-86 8/14/86	BW2-86 8/14/86	BW3-86 8/22/86	BW4-86 8/22/86	BW5-86 11/8/86	BW6-86 11/13/86
4-CHLORO-3-METHYLPHENOL	ug/l	<10	<10	<10	<10	<10	<10
2-CHLOROPHENOL	ug/l	<10	<10	<10	<10	<10	<10
2,4-DICHLOROPHENOL	ug/l	<10	<10	<10	<10	<10	<10
2,4-DIMETHYLPHENOL	ug/l	<10	<10	<10	<10	<10	<10
2,4-DINITROPHENOL	ug/l	<50	<50	<50	<50	<50	<50
2-METHYL-4,6-DINITROPHENOL	ug/l	<50	<50	<50	<50	<50	<50
2-NITROPHENOL	ug/l	<10	<10	<10	<10	<10	<10
4-NITROPHENOL	ug/l	<50	<50	<50	<50	<50	<50
PENTACHLOROPHENOL	ug/l	<50	<50	<50	<50	<50	<50
PHENOL	ug/l	<10	<10	<10	<10	<10	<10
2,4,6-TRICHLOROPHENOL	ug/l	<10	<10	<10	<10	<10	<10
ALDRIN	ug/l	<2	<1	<0.5	<0.5	<0.2	<0.5
ALPHA-BHC	ug/l	<2	<1	<0.5	<0.5	<0.2	<0.5
BETA-BHC	ug/l	<2	<1	<0.5	<0.5	<0.2	<0.5
LINDANE	ug/l	<2	<1	<0.5	<0.5	<0.2	<0.5
DELTA-BHC	ug/l	<2	<1	<0.5	<0.5	<0.2	<0.5
CHLORDANE	ug/l	<15	<5	<2	<2	<2	<1
4,4'-DDD	ug/l	<2	<1	<0.5	<0.5	<0.2	<0.5
4,4'-DDE	ug/l	<2	<1	<0.5	<0.5	<0.2	<0.5
4,4'-DDT	ug/l	<2	<1	<0.5	<0.5	<0.2	<0.5
DIELDRIN	ug/l	<2	<1	<0.5	<0.5	<0.2	<0.5
ENDOSULFAN I	ug/l	<2	<1	<0.5	<0.5	<0.2	<0.5
ENDOSULFAN II	ug/l	<2	<1	<0.5	<0.5	<0.2	<0.5
ENDOSULFAN SULFATE	ug/l	<2	<1	<0.5	<0.5	<0.2	<0.5
ENDRIN	ug/l	<2	<1	<0.5	<0.5	<0.2	<0.5
ENDRIN ALDEHYDE	ug/l	<2	<1	<0.5	<0.5	<0.2	<0.5
HEPTACHLOR	ug/l	<2	<1	<0.5	<0.5	<0.2	<0.5
HEPTACHLOR EPOXIDE	ug/l	<2	<1	<0.5	<0.5	<0.2	<0.5
TOXAPHENE	ug/l	<15	<5	<2	<2	<2	<5
METHOXYCHLOR	ug/l	<2	<1	<2	<2	<2	--
PCB-1016	ug/l	<1	<2	<1	<2	<1	<1
PCB-1221	ug/l	<1	<2	<1	<2	<1	<1
PCB-1232	ug/l	<1	<2	<1	<2	<1	<1
PCB-1242	ug/l	<1	<2	<1	<2	<1	<1
PCB-1248	ug/l	<1	<2	<1	<2	<1	<1
PCB-1260	ug/l	<1	<2	<1	<2	<1	<1

ANALYTICAL RESULTS - UNION CARBIDE CORPORATION

ANALYTICAL PARAMETER	UNITS	BW1-86 8/14/86	BW2-86 8/14/86	BW3-86 8/22/86	BW4-86 8/22/86	BW5-86 11/8/86	BW6-86 11/13/86
SILVER	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ARSENIC	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
BERYLLIUM	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
CADMIUM	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM	mg/L	0.05	0.05	<0.02	<0.02	<0.02	<0.02
HEXAVALENT CHROME	mg/L	<0.02	<0.02	--	--	<0.02	<0.02
COPPER	mg/L	<0.01	0.02	<0.1	<0.01	<0.01	<0.01
MERCURY	mg/L	0.006	<0.005	<0.005	<0.005	<0.005	<0.005
NICKEL	mg/L	0.05	<0.04	<0.04	<0.04	<0.04	<0.04
LEAD	mg/L	0.10	0.19	<0.05	<0.05	<0.05	<0.05
ANTIMONY	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
SELENIUM	mg/L	0.9	0.008	<0.005	<0.005	<0.005	<0.005
THALLIUM	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
ZINC	mg/L	4.9	25	0.37	0.30	0.17	0.03
CYANIDE	mg/L	0.01	<0.01	<0.005	<0.005	<0.005	<0.005
PHENOLS	mg/L	<0.25	<0.25	<0.005	<0.005	0.006	<0.005

APPENDIX H

ANALYTICAL GROUNDWATER DATA - APRIL 1987~~8~~

ANALYTICAL RESULTS - UNION CARBIDE CORPORATION

ANALYTICAL PARAMETER	UNITS	BW1-86 4/16/87	BW2-86 4/17/87	BW3-86 4/20/87	BW3-86 (DUP) 4/20/87	BW4-86 4/16/87	BW5-86 4/16/87
Acenaphthene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Acenaphthalene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Anthracene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Benzidine	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Benzo(A)Anthracene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Benzo(B)Fluoranthene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Benzo(K)Fluoranthene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Benzo(GHI)Perylene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Benzo(A)Pyrene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Bis(2-Chloroethoxy)methane	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Bis(2-Chloroethyl)ether	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Bis(2-Chloroisopropyl)ether	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Bis(2-Ethylhexyl)phthalate	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
4-BromophenylPhenyl Ether	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Butyl Benzyl Phthalate	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2-Chloronaphthalene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
4-Chlorophenyl Phenyl Ether	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Chrysene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Dibenzo(A,H)Anthracene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Bi-N-Butyl Phthalate	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
1,2-Dichlorobenzene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
1,3-Dichlorobenzene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
1,4-Dichlorobenzene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
3,3'-Dichlorobenzidine	ug/L	<50/<50	<50/<50	<50/<50	<10/<10	<50/<50	<50/<50
Diethyl Phthalate	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Dimethyl Phthalate	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2,4-Dinitrotoluene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2,6-Dinitrotoluene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Di-N-Octyl Phthalate	ug/L	<10/<10	<10/<10	<10/<10	7J/<10	<10/<10	<10/<10
Fluoranthene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10

continued...

ANALYTICAL RESULTS - UNION CARBIDE CORPORATION

ANALYTICAL PARAMETER	UNITS	BW1-86 4/16/87	BW2-86 4/17/87	BH3-86 4/20/87	BH3-86 (DUP) 4/20/87	BW4-86 4/16/87	BW5-87 4/16/87
Benzene	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Bromodichloromethane	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Bromoform	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Bromoethane	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Carbon Tetrachloride	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Chlorobenzene	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Chloroethane	ug/L	82/81/82	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Chloroform	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Chloromethane	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Dibromochloromethane	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
1,1-Dichloroethane	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
1,2-Dichloroethane	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
1,1-Dichloroethene	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
1,2-Dichloroethene	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
1,2-Dichloropropane	ug/L	<30/<30/<30	<10/<10/<10	80/86/60	36/37/36	<20/<20/<20	<10/<10/<10
cis-1,3-Dichloropropene	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Trans-1,3-Dichloropropene	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Ethylbenzene	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Methylene Chloride	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
1,1,2,2-Tetrachloroethane	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Tetrachloroethene	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Toluene	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
1,1,1-Trichloroethane	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
1,1,2-Trichloroethane	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Trichloroethene	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Vinyl Chloride	ug/L	<30/<30/<30	<10/<10/<10	16J/26/21	<20/<20/<20	<20/<20/<20	<10/<10/<10
Acetone	ug/L	1000/520/820	<10/<10/<10	360/670/460	1500/1500/1400	700/890/1400	27/46/120
2-Butanone	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Carbon Disulfide	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
2-Hexanone	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
4-Methyl-2-Pentanone	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Styrene	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Vinyl Acetate	ug/L	<30/<30/<30	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Total Xylenes	ug/L	52/56/38	<10/<10/<10	<20/<20/<20	<20/<20/<20	<20/<20/<20	<10/<10/<10
Ethylether	ug/L	200/200/200	60/60/60	-- -- --	-- -- --	-- -- --	-- -- --

ANALYTICAL RESULTS - UNION CARBIDE CORPORATION

ANALYTICAL PARAMETER	UNITS	BW1-86 4/16/87	BW2-86 4/17/87	BW3-86 9/20/87	BW3-86 (DUP) 4/20/87	BW4-86 4/20/87	BW5-86 4/21/87
Benzoic Acid	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
4-Chloro-3-Methylphenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2-Chlorophenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2,4-Dichlorophenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2,4-Dimethylphenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2,4-Dinitrophenol	ug/L	<50/<50	<50/<50	<50/<50	<50/<50	<50/<50	<50/<50
2-Methyl-4,6-Dinitrophenol	ug/L	<50/<50	<50/<50	<50/<50	<50/<50	<50/<50	<50/<50
2-Nitrophenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
4-Nitrophenol	ug/L	<50/<50	<50/<50	<50/<50	<50/<50	<50/<50	<50/<50
Pentachlorophenol	ug/L	<50/<50	<50/<50	<50/<50	<50/<50	<50/<50	<50/<50
Phenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2,4,6-Trichlorophenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2-Methylphenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
4-Methylphenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2,4,5 Trichlorophenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Aldrin	ug/L	<0.05/<0.10	<0.05/<0.05	<0.1 /<0.1	<0.1 /<0.1	<0.05/<0.05	<0.05/<0.05
Alpha-BHC	ug/L	<0.3 /<0.10	<0.05/<0.05	<0.1 /<0.1	<0.1 /<0.1	<0.05/<0.05	<0.05/<0.05
Beta-BHC	ug/L	<0.3 /<0.3	<0.05/<0.05	<0.1 /<0.1	<0.1 /<0.1	<0.05/<0.05	<0.05/<0.05
Lindane	ug/L	<0.3 /<0.10	<0.05/<0.05	<0.1 /<0.1	<0.1 /<0.1	<0.05/<0.05	<0.05/<0.05
Delta-BHC	ug/L	<0.3 /<0.3	<0.05/<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.05/<0.05	<0.05/<0.05
Chlordane	ug/L	<1.0 /<0.5	<0.5 /<0.5	<0.5 /<0.5	<0.5 /<0.5	<0.5 /<0.5	<0.5 /<0.5
4,4'-DDD	ug/L	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1
4,4'-DDE	ug/L	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.5 /<0.1	<0.1 /<0.1	<0.1 /<0.1
4,4'-DDT	ug/L	0.1 / 0.1	<0.2 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.2 /<0.1
Dieldrin	ug/L	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.5 /<0.1	<0.1 /<0.1	<0.1 /<0.1
Endosulfan I	ug/L	<0.3 /<0.05	<0.05/<0.05	<0.05/<0.05	<0.05/<0.05	<0.05/<0.05	<0.05/<0.05
Endosulfan II	ug/L	<0.1 /<0.1	<0.2 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1
Endosulfan Sulfate	ug/L	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1
Endrin	ug/L	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.3 /<0.3
Endrin Ketone	ug/L	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1	<0.1 /<0.1
Heptachlor	ug/L	<0.4 /<0.2	<0.3 /<0.4	<0.1 / 0.6	<2.0 /<2.0	<0.05/<0.05	<0.05/<0.05
Heptachlor Epoxide	ug/L	<0.3 /<0.05	<0.05/<0.05	<0.05/<0.05	<0.05/<0.05	<0.05/<0.05	<0.05/<0.05
Toxaphene	ug/L	<1.0 /<1.0	<3/<1	<1.0 /<1.0	<1.0 /<1.0	<1.0 /<1.0	<3.0 /<1.0
Methoxychlor	ug/L	<0.5 /<0.5	<0.5 /<0.5	<0.5 /<0.5	<0.5 /<0.5	<0.5 /<0.5	<0.5 /<0.5

ANALYTICAL RESULTS - UNION CARBIDE CORPORATION

ANALYTICAL PARAMETER	UNITS	BW1-86 4/16/87	BW2-86 4/17/87	BW3-86 4/20/87	BW3-86 (DUP) 4/20/87	BW4-86 4/16/87	BW5-86 4/16/87
Fluorene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Hexachlorobenzene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Hexachlorobutadiene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Hexachlorocylopentadiene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Hexachloroethane	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Ideno(1,2,3-CD)pyrene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Isophorone	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Naphthalene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Nitrobenzene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
N-Nitrosodimethylamine	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
N-Nitrosodiphenylamine	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
N-Nitrosodi-N-Propylamine	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
4-Chloraniline	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Dibenzofuran	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2-Methylnaphthalene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2-Nitroaniline	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
3-Nitroaniline	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
4-Nitroaniline	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Phenanthrene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Pyrene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
1,2,4-Trichlorobenzene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10

ANALYTICAL RESULTS - UNION CARBIDE CORPORATION

ANALYTICAL PARAMETER	UNITS	BW1-86 4/16/87	BW2-86 4/17/87	BW3-86 4/20/87	BW3-86 (DUP) 4/20/87	BW4-86 4/16/87	BW5-86 4/16/87	BW6-96 4/20/87
Silver	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aluminum	mg/L	<0.1	<0.1	0.13	0.12	<0.1	<0.1	0.26
Arsenic	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Barium	mg/L	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	0.3
Beryllium	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	mg/L	200	260	150	150	97	88	210
Cadmium	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Copper	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	mg/L	2.4	2.2	1.6	1.6	8.2	1.7	3.6
Mercury	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Potassium	mg/L	8.4	5.5	7.2	7.7	23	2.4	7.0
Magnesium	mg/L	62	88	40	40	37	21	46
Manganese	mg/L	0.32	0.66	1.0	2.0	0.17	0.14	1.4
Sodium	mg/L	225	120	62	64	50	20	38
Nickel	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Lead	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Antimony	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.02	<0.2
Selenium	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01
Vanadium	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	mg/L	5.0	6.1	3.0	2.9	8.5	0.18	0.23

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ANALYTICAL RESULTS - UNION CARBIDE CORPORATION

ANALYTICAL PARAMETER	UNITS	BW6-86 4/20/87	MW1 4/17/87	MW2 4/20/87	MW3 4/16/87	WW1-86 4/20/87	Field Blank 4/21/87
Acenaphthene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/6J	<10
Acenaphthalene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Anthracene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Benzidine	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Benzo(A)Anthracene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Benzo(B)Fluoranthene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Benzo(K)Fluoranthene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Benzo(GHI)Perylene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Benzo(A)Pyrene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Bis(2-Chloroethoxy)methane	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Bis(2-Chloroethyl)ether	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Bis(2-Chloroisopropyl)ether	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Bis(2-Ethylhexyl)phthalate	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
4-BromophenylPhenyl Ether	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Butyl Benzyl Phthalate	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
2-Chloronaphthalene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
4-Chlorophenyl Phenyl Ether	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Chrysene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Dibenzo(A,H)Anthracene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Bi-N-Butyl Phthalate	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
1,2-Dichlorobenzene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
1,3-Dichlorobenzene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
1,4-Dichlorobenzene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
3,3'-Dichlorobenzidine	ug/L	<50/<50	<10/<10	<10/<10	<10/<10	<50/<50	<50
Diethyl Phthalate	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Dimethyl Phthalate	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
2,4-Dinitrotoluene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
2,6-Dinitrotoluene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Di-N-Octyl Phthalate	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Fluoranthene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/2J	<10

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ANALYTICAL RESULTS - UNION CARBIDE CORPORATION

ANALYTICAL PARAMETER	UNITS	BW1-86 4/16/87	BW2-86 4/17/87	BW3-86 4/20/87	BW3-86 (DUP) 4/20/87	BW4-86 4/16/87	BW5-86 4/16/87	BW6-96 4/20/87
Chloride	mg/L	770	250	82	75	51	22	53
Nitrite Nitrogen	mg/L	<0.04	<0.04	<0.04	0.06	<0.04	<0.04	<0.04
Nitrate Nitrogen	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sulfate	mg/L	110	350	220	200	17	97	100
Total Organic Halogen	mg/L	68	68	62	63	50	16	21
Total Organic Carbon	mg/L	81	98	11	11	50	29	11
Total Recoverable Phenolics	mg/L	0.01	0.07	<0.005	0.005	<0.005	0.007	<0.005
Ammonia Nitrogen	mg/L	1.7	<0.2	<0.2	<0.2	2.6	<0.2	<0.2
Total Kjeldahl Nitrogen	mg/L	3.5	1.1	1.1	1.7	4.6	1.0	1.6

ANALYTICAL RESULTS - UNION CARBIDE CORPORATION

ANALYTICAL PARAMETER	UNITS	BW6-86 4/20/87	MW1 4/17/87	MW2 4/20/87	MW3 4/16/87	WW1-86 4/20/87	Field Blank 4/21/87
Benzene	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Bromodichloromethane	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Bromoform	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Bromoethane	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Carbon Tetrachloride	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Chlorobenzene	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Chloroethane	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Chloroform	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Chloromethane	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Dibromochloromethane	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
1,1-Dichloroethane	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
1,2-Dichloroethane	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
1,1-Dichloroethene	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
1,2-Dichloroethene	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
1,2-Dichloropropane	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
cis-1,3-Dichloropropene	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Trans-1,3-Dichloroproprene	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Ethylbenzene	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Methylene Chloride	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
1,1,2,2-Tetrachloroethane	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Tetrachloroethene	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Toluene	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
1,1,1-Trichloroethane	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
1,1,2-Trichloroethane	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Trichloroethene	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Vinyl Chloride	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Acetone	ug/L	<10/<10/10	2500/1400/4000	830/820/80	3200/6300/4100	2000/1500/<20	28/69/47
2-Butanone	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Carbon Disulfide	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
2-Hexanone	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
4-Methyl-2-Pentanone	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Styrene	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Vinyl Acetate	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Total Xylenes	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10
Ethylether	ug/L	<10/<10/10	<20/<20/<20	<20/<20/<20	<100/<100/<100	<20/<20/<20	<10/<10/<10

ANALYTICAL RESULTS - UNION CARBIDE CORPORATION

ANALYTICAL PARAMETER	UNITS	BW6-86 4/20/87	MW1 4/17/87	MW2 4/20/87	MW3 4/16/87	WW1-86 4/20/87	Field Blank 4/21/87
Fluorene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Hexachlorobenzene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Hexachlorobutadiene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Hexachlorocylopentadiene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Hexachloroethane	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Ideno(1,2,3-CD)pyrene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Isophorone	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Naphthalene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Nitrobenzene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
N-Nitrosodimethylamine	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
N-Nitrosodiphenyolamine	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
N-Nitrosodi-N-Propylamine	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
4-Chloraniline	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Dibenzofuran	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
2-Methylnaphthalene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
2-Nitroaniline	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
3-Nitroaniline	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
4-Nitroaniline	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Phenanthrene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10
Pyrene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/3J	<10
1,2,4-Trichlorobenzene	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10

ANALYTICAL RESULTS - UNION CARBIDE CORPORATION

ANALYTICAL PARAMETER	UNITS	BW6-86 4/20/87	MW1 4/17/87	MW2 4/20/87	MW3 4/16/87	WW1-86 4/20/87	Field Blank 4/21/87
Benzoic Acid	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
4-Chloro-3-Methylphenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2-Chlorophenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2,4-Dichlorophenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2,4-Dimethylphenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2,4-Dinitrophenol	ug/L	<50/<50	<50/<50	<50/<50	<50/<50	<50/<50	<50/<50
2-Methyl-4,6-Dinitrophenol	ug/L	<50/<50	<50/<50	<50/<50	<50/<50	<50/<50	<50/<50
2-Nitrophenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
4-Nitrophenol	ug/L	<50/<50	<50/<50	<50/<50	<50/<50	<50/<50	<50/<50
Pentachlorophenol	ug/L	<50/<50	<50/<50	<50/<50	<50/<50	<50/<50	<50/<50
Phenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2,4,6-Trichlorophenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2-Methylphenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
4-Methylphenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
2,4,5 Trichlorophenol	ug/L	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10	<10/<10
Aldrin	ug/L	<0.05/<0.05	<0.1 /<0.05	<0.1*/<0.01*	<0.05/<0.05	**<0.1/<0.1	<0.05/<0.05
Alpha-BHC	ug/L	<0.05/<0.05	<0.1 /<0.05	<0.3*/<0.01*	<0.05/<0.05	**<0.1/<0.1	<0.05/<0.05
Beta-BHC	ug/L	<0.05/<0.05	<0.1 /<0.05	<0.1*/<0.01*	<0.05/<0.05	**<0.2/<0.1	<0.05/<0.05
Lindane	ug/L	<0.05/<0.05	<0.1 /<0.05	<0.3*/<0.01*	<0.05/<0.05	**<0.1/<0.1	<0.05/<0.05
Delta-BHC	ug/L	<0.05/<0.05	<0.1 /<0.05	<0.1*/<0.01*	<0.05/<0.05	**<0.1/<0.1	<0.05/<0.05
Chlordane	ug/L	<0.5 /<0.5	<3.0 /<0.5	<3.0*/<3.0 *	<0.5 /<0.5	**<3.0/<1.0	<0.5 /<0.5
4,4'-DDD	ug/L	<0.1 /<0.1	<0.1 /<0.1	<0.5*/<0.5 *	<0.1 /<0.1	**<0.1/<0.1	<0.1 /<0.1
4,4'-DDE	ug/L	<0.1 /<0.1	<0.1 /<0.1	<0.5*/<0.5 *	<0.1 /<0.1	**<0.3/<0.1	<0.1 /<0.1
4,4'-DDT	ug/L	<0.1 /<0.1	<0.1 /<0.1	<0.5*/<0.5 *	<0.1 /<0.1	**<0.1/<0.1	<0.1 /<0.1
Dieldrin	ug/L	<0.1 /<0.1	<0.1 /<0.1	<0.5*/<0.5 *	<0.1 /<0.1	**<0.3/<0.1	<0.1 /<0.1
Endosulfan I	ug/L	<0.05/<0.05	<0.05/<0.05	<0.1*/<0.1 *	<0.05/<0.05	**<0.3/<0.1	<0.05/<0.05
Endosulfan II	ug/L	<0.1 /<0.1	<0.1 /<0.1	<0.3*/<0.3 *	<0.1 /<0.1	**<0.1/<0.1	<0.1 /<0.1
Endosulfan Sulfate	ug/L	<0.1 /<0.1	<0.1 /<0.1	<0.5*/<0.5 *	<0.1 /<0.1	**<0.1/<0.1	<0.1 /<0.1
Endrin	ug/L	<0.1 /<0.1	<0.1 /<0.1	<0.5*/<0.5 *	<0.1 /<0.1	**<0.5/<0.1	<0.1 /<0.1
Endrin Ketone	ug/L	<0.1 /<0.1	<0.1 /<0.1	<1.0*/<1.0 *	<0.1 /<0.1	**<0.1/<0.1	-- / --
Heptachlor	ug/L	<0.05/<0.05	<0.1 /<0.05	<0.3*/<0.3 *	<0.05/<0.05	**<0.1/<0.1	<0.05/<0.05
Heptachlor Epoxide	ug/L	<0.05/<0.05	<0.1 /<0.05	<0.1*/<0.1 *	<0.05/<0.05	**<0.1/<0.1	<0.05/<0.05
Toxaphene	ug/L	<1.0 /<1.0	<3.0 /<1.0	<13*/<13 *	<1.0 /<1.0	**<1.0/<1.0	<0.1 /<0.1
Methoxychlor	ug/L	<0.5 /<0.5	<0.5 /<0.5	<2*/< 2 *	<0.5 /<0.5	**<0.5/<0.5	<0.05/<0.05

Notes: * Data is from samples collected 4/24/87.
** Data is from samples collected 4/28/87.

ANALYTICAL RESULTS - UNION CARBIDE CORPORATION

ANALYTICAL PARAMETER	UNITS	MW1 4/17/87	MW2 4/20/87	MW3 4/16/87	WW1-86 4/20/87	Field Blank 4/21/87
Chloride	mg/L	99	14 *	2	300	3
Nitrite Nitrogen	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04
Nitrate Nitrogen	mg/L	<0.1	<0.1 *	0.4	<0.1	<0.01
Sulfate	mg/L	5	200 *	58	1,800	<5
Total Organic Halogen	mg/L	10	24 *	16	21	20
Total Organic Carbon	mg/L	48	17 *	21	18	1.2
Total Recoverable Phenolics	mg/L	<0.005	<0.07 /<0.005*	<0.005	0.07**	<0.005
Ammonia Nitrogen	mg/L	3.3	<0.2	<0.02	4.7 **	<0.2
Total Kjeldahl Nitrogen	mg/L	7.8	11	0.4	12 **	0.3

Notes: * Data is from samples collected 4/24/87.
** Data is from samples collected 4/28/87.

ANALYTICAL RESULTS - UNION CARBIDE CORPORATION

ANALYTICAL PARAMETER	UNITS	MW1 4/17/87	MW2 4/20/87	MW3 4/16/87	WW1-86 4/20/87	Field Blank 4/21/87
Silver	mg/L	<0.01	<0.01 /<0.01 *	<0.01	<0.01	<0.01
Aluminum	mg/L	<0.01	0.13 /<0.1 *	0.12	0.11	<0.1
Arsenic	mg/L	<0.005	<0.005/<0.005*	<0.05	<0.005	<0.005
Barium	mg/L	<0.1	<0.1 /<0.1 *	<0.1	<0.1	<0.01
Beryllium	mg/L	<0.005	<0.005/<0.005*	<0.005	<0.005	<0.005
Calcium	mg/L	85	49 /44 *	52	350	0.62
Cadmium	mg/L	<0.01	<0.01 /<0.01 *	<0.01	<0.01	<0.01
Cobalt	mg/L	<0.05	<0.05 /<0.05 *	<0.05	<0.05	<0.05
Chromium	mg/L	<0.02	<0.02 /<0.02 *	<0.02	<0.02	<0.02
Copper	mg/L	<0.01	<0.01 /<0.01 *	<0.01	<0.01	<0.01
Iron	mg/L	3.9	0.14 / 0.07 *	<0.05	23	<0.05
Mercury	mg/L	<0.005	<0.005/<0.005*	<0.005	<0.005	<0.005
Potassium	mg/L	39	9.0 / 9.0 *	1.5	10	<0.05
Magnesium	mg/L	46	19 /24 *	12	180	0.06
Manganese	mg/L	0.21	0.18 / 0.23 *	<0.01	0.89	<0.01
Sodium	mg/L	125	25 /25 *	8	320	1.0
Nickel	mg/L	<0.04	<0.04 /<0.04 *	<0.04	<0.04	<0.04
Lead	mg/L	<0.05	<0.05 /<0.05 *	<0.05	<0.05	<0.05
Antimony	mg/L	<0.2	<0.2 /<0.2 *	<0.2	<0.2	<0.2
Selenium	mg/L	<0.005	<0.005/<0.005*	<0.005	<0.005	<0.005
Thallium	mg/L	<0.1	<0.1 /<0.01 *	<0.1	<0.1	<0.1
Vanadium	mg/L	<0.05	<0.05 /<0.05 *	<0.05	<0.05	<0.05
Zinc	mg/L	0.08	<0.01 /<0.01 *	0.05	0.07	<0.01

continued....

Note: * Data is from samples collected 4/24/87.