2021 Hazardous Waste Scanning Project

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Note 1: Each category is separated by a period "."
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ENGINEERING INVESTIGATIONS AT INACTIVE HAZARDOUS WASTE SITES IN THE STATE OF NEW YORK

PRELIMINARY SITE ASSESSMENT
Volume 1

E-FILED

Union Carbide Corporation
Carbon Products Division Site
Site Number 932035
Town of Niagara, Niagara County

April 1995

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Prepared for:

New York State Department
of Environmental Conservation
50 Wolf Road, Albany, New York 12233
Michael D. Zagata, Commissioner

Division of Hazardous Waste Remediation
Michael J. O'Toole, Jr., P.E., Director

Prepared by:

Ecology and Environment Engineering, P.C.

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1. SITE ASSESSMENT SUMMARY

1.1 INTRODUCTION

Under the New York State Department of Environmental Conservation (NYSDEC) Superfund Standby Contract, Ecology and Environment Engineering, P.C., (E & E) conducted a Preliminary Site Assessment (PSA) at the Union Carbide Corporation, Carbon Products site (site No. 932035). This report summarizes PSA activities conducted to date at the site.

1.2 PURPOSE

The purpose of the PSA is to provide NYSDEC with the information necessary to properly assess and classify a site according to one of the following categories of hazardous waste sites pursuant to Section 27-1305 of the Environmental Conservation Law:

- **Class 1**: Causing or presenting an imminent danger or causing irreversible or irreparable damage to the public health or environment - immediate action required;
- **Class 2**: Significant threat to the public health or environment - action required;
- **Class 3**: Does not present a significant threat to the public health or environment - action may be deferred;
- **Class 4**: Site properly closed - requires continued management; or
- **Class 5**: Site properly closed, no evidence of present or potential adverse impact - no further action required.

If one of the above categories does not apply to the site or if disposal of consequential amounts of hazardous waste were not documented, the site may be deleted from the Registry of Inactive Hazardous Waste Disposal Sites.

1.3 SITE DESCRIPTION

The Union Carbide Corp., Carbon Products Division site is an inactive 16.48-acre capped landfill located within the 64-acre parcel near the southeast corner of the intersection of Hyde Park Boulevard and Witmer Road (see Figure 1-1). The site is owned by UCAR Carbon Corporation (UCC) formerly Union Carbide Corp., who was the exclusive owner and operator since the landfill's inception in 1934. Formerly part of Union Carbide Corp.'s 90-acre Republic Plant facility, the plant is now inactive, and the 26-acre portion of the 90-acres which contained all plant facilities was sold to Niagara Vest in 1987. The remaining 64-acre UCC parcel includes the 16.48-acre landfill site and is essentially undeveloped (see Figure 1-2). PSA work conducted for the capped landfill included the entire 64-acre property to characterize contaminant distribution.

The 16.48-acre landfill is a NYSDEC-permitted solid waste management facility (SWMF), which was properly capped in 1987. The capped landfill is a rectangular in shape and includes a 30-foot high, flat-topped mound. The bottom perimeter of the raised landfill slope does extend out of the 16.48-acre site boundaries to the north and south, but appears to be properly capped throughout its aerial extent. The remainder of the 64-acre UCC property is generally flat with the exception of a 6- to 7-foot high "L" shaped berm which rises above grade along the western and part of the southern property boundaries. This berm contains a municipal waterline.

During E & E's 1993 PSA field investigation, no indications of leachate from the landfill or evidence of surface water flow from or to the site were observed. A marshy area of shallow standing water in the southwest corner of the property is adjacent to and presumably caused by the aboveground municipal waterline berm which acts as a dike.

The site contains no buildings and is covered with various types of vegetation. Mowed grass covers the entire 16.48-acre capped landfill, and tall grass, brush, and trees cover the remainder of the 64 acre UCC property. Currently, 20 groundwater monitoring wells are located around the site, and one gravel covered road is used to access the site. An 8-foot-high, chain-link fence with barbed wire completely surrounds the generally rectangular shaped UCC property, and a locked gate restricts vehicular access to the site. The only activity performed at the site is quarterly sampling of groundwater monitoring wells. The landfill has been owned and operated exclusively by UCC since its inception in 1934. Industrial wastes, primarily carbon and graphite dust, firebrick, and packaging products, were brought from three area manufacturing plants and buried in the landfill (NYSDEC 1981).

The UCC site is bound on the north and east by Niagara Mohawk Power company property which contains large steel towers that support high-voltage electrical power lines. The western property boundary adjoins the former 26-acre Republic Plant facility now owned by Niagara Vest, a holding company. Many residential homes are present south of the site along Rhode Island Avenue. Evidence of unauthorized use of the UCC property exists along the southern boundary, including brush and other yard wastes, and holes cut into the southern site fence which have been repaired by UCC more than once (E & E 1991).

Site inspections performed by E & E and others have consistently shown air quality readings (i.e., OVA, HNu, O_2/explosimeter, and rad-mini) at background levels within the breathing zone (E & E 1991).

Residents within 3 miles of the site are supplied with municipal drinking water that is obtained from surface water intakes in the Niagara River, which is located more than 3 miles south and upstream of the site (USGS 1980).

1.4 HAZARDOUS WASTE SITE DISCUSSION

The landfill was permitted first by the Town of Niagara in 1973 and properly closed in 1987. The landfill site was used exclusively by UCC from 1934 to 1987 to dispose of wastes from its three area manufacturing plants. The wastes primarily consisted of carbonaceous dust and scraps, fire brick, and packaging materials. Wastes known to have been deposited include coke, pitch, coal tar, petroleum tars, and phenols. Documentation pertaining to hazardous waste disposed of on site includes disposal of 400 pounds of spent sludges from degreasing which contain 1,1,1-trichloroethane, and 320 pounds of Halowax 1006 (chlorinated naphthalene solid). Halowax is reportedly chemically stable, resistant to acids and alkalies. It is believed that the D003 waste listed on the generator form (Appendix H, Record 10) includes Halowax mixed with other spent maintenance waste. This waste was reactive; however, Halowax itself does not exhibit any RCRA characteristics. In addition, up to 200 gallons of drummed waste oil were brought to the site each month and either deposited in the landfill or spread over site roadways for dust control purposes during summer months until 1978 (E & E 1991). Maps of the landfill indicate fill was deposited west of and north of presently capped 16.48-acre landfill (UCAR 1993).

A study conducted by Conestoga-Rovers and Associates (CRA) in 1987 and 1988 concluded that fill material was also present over an approximately 20-acre area west of the landfill. Fill thicknesses ranged from 0 to 12 feet (averaging 5.4 feet) and consisted primarily of solids similar to those known to have been deposited in the capped landfill (CRA 1988). Three buried 55-gallon steel drums of waste were also discovered during CRA's investigation. The drums contained a black solid, tar-like material mixed with miscellaneous trash. Sample analyses performed on the drummed waste and soils surrounding the drums indicated that the drummed material was an off-specification material. This material may be an altered form of an impregnating compound called code 88, which was formerly used at the UCC facilities. Code 88 is known to contain coal tar pitch, diethyl sulfate, and furfural. The drum samples contained, xylene, naphthalene, anthracene, phenol, ammonia, and diethyl sulfate. The drums were overpacked and properly disposed of off site (CRA 1988). Surface and subsurface soils collected during the CRA were found to contain several pesticides, polyaromatic hydrocarbons (PAHs), and metals above background levels.

Groundwater samples have been collected quarterly from on-site monitoring wells for several years. Results have consistently shown the presence of chlorinated hydrocarbons and metals at levels above state class GA water standards (UCAR 1993).

1.5 SUMMARY OF PSA WORK

The PSA Task 1 report was submitted to NYSDEC in October 1991 (E & E 1991). Based on the document review and site inspection, E & E concluded that hazardous waste had been disposed of on site and recommended reclassification to a Class 3 site (NYSDEC 1984). However, the report stated that hydrogeologic conditions at the site were not fully understood and would require additional study. E & E performed additional PSA activities in 1993 in accordance with NYSDEC's abbreviated work plan to obtain further information. The field tasks included geophysical surveys, monitoring well installation, groundwater elevation monitoring, and sampling of surface water, sediment, surface soils, subsurface soils, and groundwater.

A surface water sample collected in 1993 contained a trace of one pesticide (beta-BHC), and/or iron which exceeded the NYSDEC Class D surface water standard. The sediment sample contained low levels of chloroform and 2-butanone as PAHs and diethylphthalate. Calcium, lead, and magnesium were also detected in the sediment sample at levels above the upper limit of the 90th percentile for soils in the eastern United States (Shacklette and Boerngen 1984).

Surface and subsurface soil samples contained low levels of three volatile organic compounds (VOCs), moderate-to-high levels of PAHs, dibenzofuran, carbazole, 1,2,4-trichlorobenzene, hexachlorobenzene, and 14 separate pesticides. Metals detected in surface and subsurface soils at concentrations above the 90th percentile included calcium, chromium, cobalt, copper, lead, magnesium, manganese, mercury, nickel, selenium, and zinc. Of these metals, cobalt, lead and magnesium were detected in surface soil samples at a concentration above the observed range in background samples. RCRA hazardous waste characteristics tests were performed on some of the more highly contaminated surface and subsurface soil samples. None of the samples failed these tests.

Groundwater samples from overburden and interface wells contained three VOCs, but at levels below NYSDEC Class GA standards. Five metals were detected in one or more of these wells at concentrations exceeding their respective Class GA standard or guidance value.

Groundwater samples collected from bedrock monitoring wells contained six VOCs, one semivolatile organic compound, and six metals at concentrations exceeding NYSDEC Class GA standards. Of the metals, lead and zinc are not believed to be naturally occurring at such levels in groundwater.

Based on sample results, the history and condition of the site (i.e., it is properly capped, vegetated, and fenced), it is recommended that the site be reclassified as a Class 3 and that further investigation and groundwater monitoring be performed both on site and north of the site to determine the source and extent of the contamination. Regular patrols by the site owner are also recommended to minimize unauthorized site entry by vandals.

Upon the completion of the PSA field tasks, a PA score was calculated for the site. The PA score is designed to provide a means to differentiate sites based on potential threats to human health and the environment. The Union Carbide site received an overall PA score of 4, out of a possible 100. (See Section 3.7 for more information about the PA score.)

1.6 NYSDEC SITE CLASSIFICATION FORMS

The NYSDEC Registry Site Classification Decision Form and Classification Worksheet, are presented on pages 1-7 and 1-8. These forms provide information necessary to properly classify the site in accordance with 6 NYCRR 375.

CLASSIFICATION WORKSHEET

Site: Union Carbide Corp., Carbon Products Division Site County: Niagara Region: 9

1. Hazardous waste disposed? ☒ Yes (to 2) ☐ No (Stop) ☐ Unknown (Stop)

2. Consequential amount of hazardous waste? ☒ Yes (to 3) ☐ No (Stop) ☐ Unknown (to 3)

3. Part 375-1.4(a)(1) applies? ☐ No (to 4) ☒ Unknown (to 4)

☐ Yes (as checked below; Class 2; to 5)

☐ a. endangered or threatened species
☐ b. streams, wetlands, or coastal zones
☐ c. bioaccumulation
☐ d. fish, shellfish, crustacea, or wildlife
☐ e. fire, spill, explosion, or toxic reaction
☐ f. proximity to people or water supplies

4. Part 375-1.4(a)(2) applies? ☒ No (Class 3; Stop) ☐ Unknown (Class 2a; Stop)

☐ Yes (Class 2; to 5)

5. Factor(s) considered in making this determination: Documented hazardous waste (spent degreasing sludges) disposal occurred in the unlined landfill. Since proper capping of the landfill in 1987, post-closure groundwater samples collected from on-site monitoring wells have consistently contained organic contaminants at levels above NYSDEC Class GA standards. The contaminated groundwater is in a fractured bedrock aquifer which flows to the west, south, and east from a groundwater divide transecting the site. The source of groundwater contamination is uncertain. The site has been inactive since 1987, is completely fenced. No drinking water wells or groundwater discharge points exist near the site.

SUMMARY

Consequential Hazardous Waste ☒ Yes ☐ No ☐ Unknown

Significant Threat ☐ Yes ☒ No ☐ Unknown

Proposed Classification 3

Site Number 932035

June 21, 1994
Date

Signature and Title

New York State Department of Environmental Conservation
Division of Hazardous Waste Remediation

REGISTRY SITE CLASSIFICATION DECISION

1. Site Name: Union Carbide Corp., Carbon Products Division Site
2. Site No. 932035
3. Town/City/Village: Niagara
4. County: Niagara

5. Region 9
6. Classification Current: 2a Proposed: 3 Modify

7. Location of Site (see Figure 1-1 for site location)
a. Quadrangle Niagara Falls, New York
b. Site Latitude 43° 07' 14" N Longitude 79 01' 35" W
c. Tax Map Number 130.20

8. Briefly Describe the Site (see Figure 3-1 for site plan)
The site is located in the Town of Niagara, Niagara County, New York.

The site is a 16.48-acre landfill located with the 64-acre parcel and used from 1934 to 1987 by Union Carbide to dispose of industrial solid wastes from three plants which manufactured carbon and graphite products. Hazardous waste disposal has been documented. The site was permitted until proper closure in 1987. Quarterly groundwater sampling continues. Site is inactive and completely fenced.

a. Area 16.48 acres
b. EPA ID Number NYD002106896
c. Completed ☒ Phase I ☐ Phase II ☒ PSA ☐ RI/FS ☒ PA/SI ☐ Other

9. Hazardous Wastes Disposed

400 lbs - spent sludges from degreasing (1,1,1-TCA) (a F001 listed waste)
320 lbs - halowax 1006 (a D003 listed waste)
>200 gallons - all waste oils were deposited in unlined landfill.

10. Analytical Data Available
a. ☐ Air ☒ Groundwater ☒ Surface Water ☒ Soil ☒ Waste ☒ EPTox ☐ TCLP
b. Contravention of Standards or Guidance Values

In December 1993, groundwater samples exceeded State Class GA groundwater standards for:

Vinyl chloride
Chloroethane
Total 1,2-DCE
TCE
PCE
Hexachlorobutadiene
1,1-DCE
Iron
Lead
Sodium
Chromium
Manganese
Zinc

11. JUSTIFICATION FOR CLASSIFICATION DECISION

Site is inactive, fenced, properly capped and groundwater is sampled quarterly. No groundwater wells are used for drinking within 3 miles of the site. Source of groundwater contamination is uncertain.

12. Site Impact Data
a. Nearest surface water: Distance 2,300 ft. Direction East Classification C
b. Nearest groundwater: Depth 4 ft. Flow Direction West, south & east ☐ Sole Source ☐ Primary ☐ Principal
c. Nearest water supply: Distance >15,800 ft. Direction South Active? ☒ Yes ☐ No
d. Nearest building: Distance 1,000 ft. Direction West Use Leased industrial
e. In State Economic Development Zone? ☐ Yes ☒ No
f. Crops or livestock on site? ☐ Yes ☒ No
g. Documented fish or wildlife mortality? ☐ Yes ☒ No
h. Impact on special status fish or wildlife resource? ☐ Yes ☒ No
i. Controlled site access? ☒ Yes ☐ No
j. Exposed hazardous waste? ☐ Yes ☒ No
k. HRS Score 4
l. For Class 2: Priority Category _____

13. Site Owner's Name UCAR Carbon Company, Inc.
14. Address 3625 Highland Avenue, Niagara Falls, New York 14302
15. Telephone Number 716/278-3275

16. Preparer

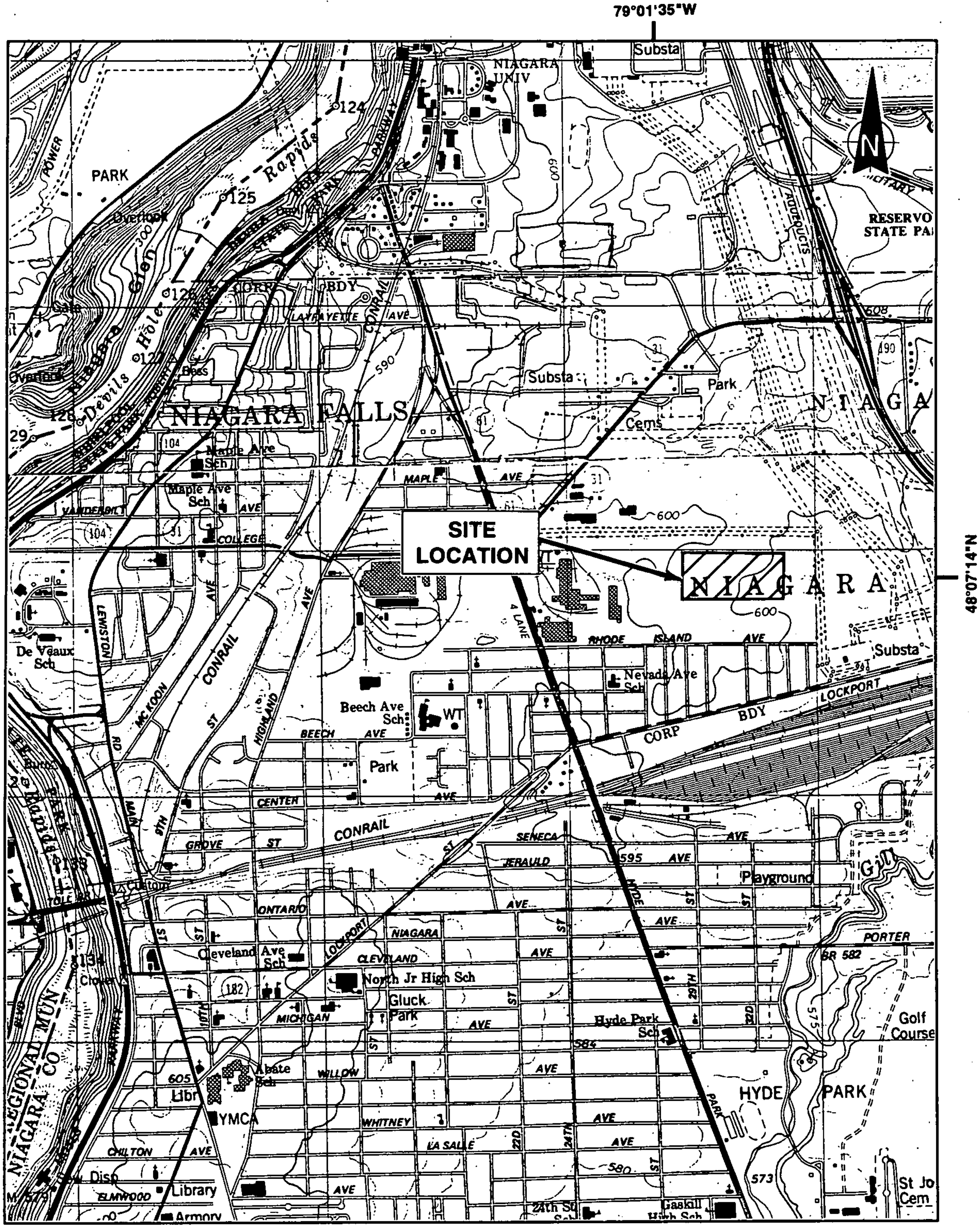
Signature Date

Jim Richert, Geologist,
Ecology & Environment Engineering, P.C.
Name, Title, Organization

17. Approved

Signature Date

Name, Title, Organization

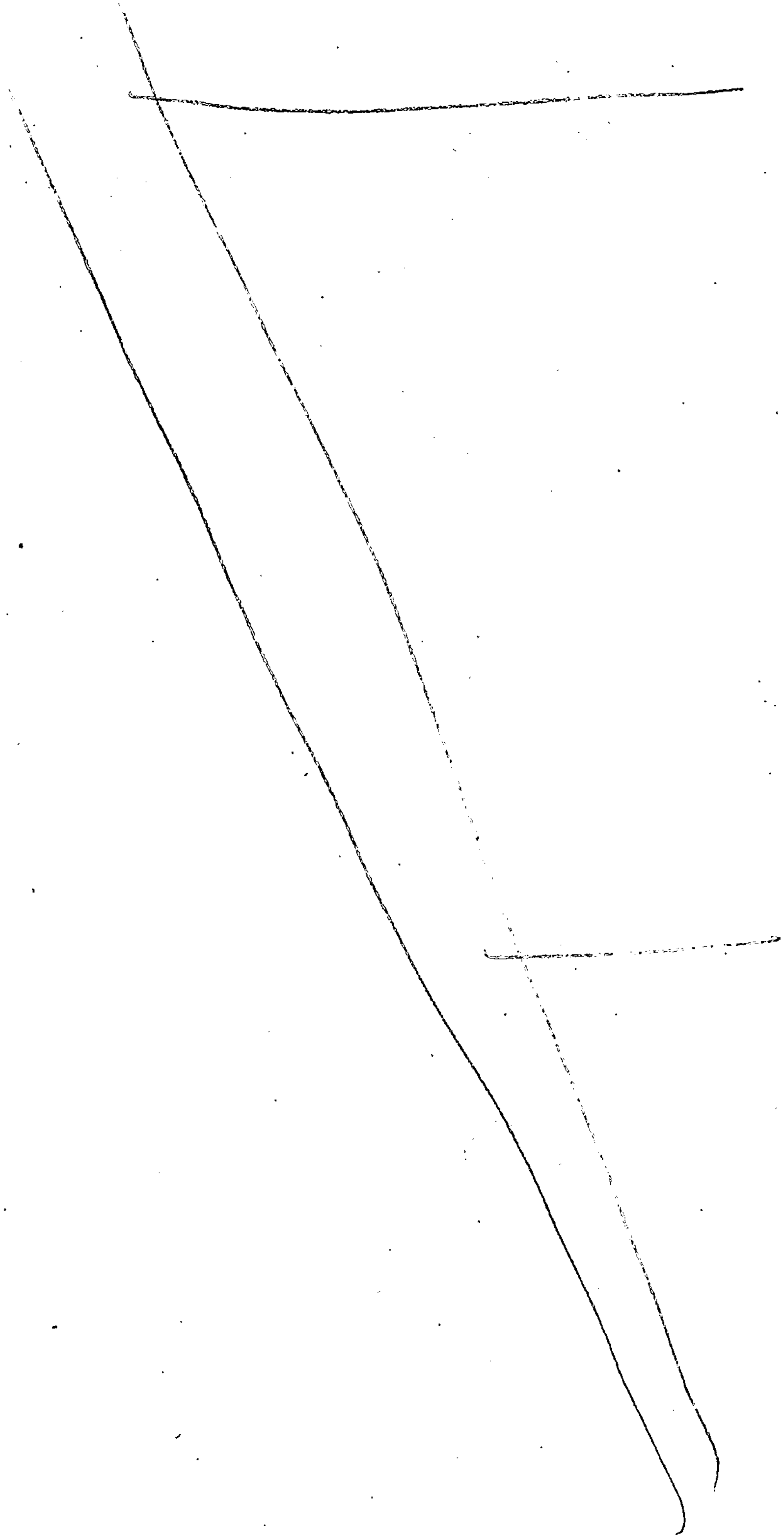


SOURCE: USGS 7.5 Minute Series (Topographic) Quadrangle: Niagara Falls, NY, 1980; Lewiston, NY, 1980.

SCALE 1"=2000'

0 2000 4000 Feet

Figure 1-1
LOCATION MAP, UNION CARBIDE CORP., CARBON PRODUCTS DIVISION SITE



EXECUTIVE SUMMARY

Under the New York State Department of Environmental Conservation (NYSDEC) Superfund Standby Contract, Ecology and Environment Engineering, P.C., (E & E) conducted a Preliminary Site Assessment (PSA) at the Union Carbide Corporation, Carbon Products Division site (site No. 932035).

The Union Carbide Corp., Carbon Products Division site is a 16.48-acre inactive, capped landfill located on a 64-acre parcel of undeveloped land in the Town of Niagara, Niagara County, New York. The entire 64-acre parcel has been owned and operated exclusively by the UCAR Carbon Company (UCC), formerly Union Carbide, and it includes the landfill which began operation in 1934. The PSA investigation involved the entire 64-acre UCC property in order to effectively characterize the landfill and any on- or off-site contaminant migration.

The site is a NYSDEC-permitted solid waste management facility (SWMF) which was properly capped in 1987 and includes a 30-foot mound. No buildings exist on the UCC property, which is covered with various types of vegetation and surrounded by an 8-foot high chain-link fence with a locked gate.

The site was part of Union Carbide's Republic Plant, which manufactured carbon and graphite products. Carbon and graphite wastes from two other Union Carbide plants were also landfilled on the Republic Plant property. Waste products included carbonaceous waste (primarily as dust from dust collectors), fire brick waste, raw materials, and packaging (composed mostly of wooden pallets). Other waste types generated and deposited at the site include coke, pitch, cafeteria waste, silica sand, coal tars, petroleum tars, machining oils, spent sludges (F001) from degreasing operations (1,1,1-trichloroethane), and halowax 1006 (D003) (chlorinated naphthalene solid) waste. In addition, approximately 200 gallons of oil month were collected in 55-gallon drums and taken to the landfill or used for dust control on site roadways during summer months.

Site maps and sketches provided by UCC show that active dumping occurred west and north of the present day landfill boundary (UCC 1993). In 1978, the landfill was issued state permit No. 32N03 as a SWMF. This permit was renewed as necessary throughout the active life of the landfill.

In 1984 the site was added to the NYSDEC registry of Inactive Hazardous Waste sites and designated as a Class 2a site. Wehran Engineering began a Phase I investigation of the landfill for NYSDEC in 1984 and concluded that the site posed a potential threat to groundwater. A phase II investigation was recommended to better characterize the site.

Conestoga-Rovers and Associates (CRA) performed an investigation in 1987. The study showed that approximately 20 acres of the 64-acre UCC property located between the closed landfill site and the western property boundary were covered with an average of 5.4 feet of fill material. Three buried drums were also sampled, overpacked, removed from the site, and properly disposed of. Sample results indicated that the drum contents exhibited characteristics of an off-specification material that may be an altered form of the impregnating compound Code 88, which was formerly used at the UCC facilities. Contaminants found in the fill included polynuclear aromatic hydrocarbons (PAHs) and pesticides at levels which were consistent with those found in the closed landfill. The CRA investigation report concluded that the site did not pose hazards and that remedial measures were not required. In 1987, the United States Environmental Protection Agency (EPA) performed a site investigation at the landfill under the Field Investigation Team (FIT) program. The field investigation included a site inspection and sampling of groundwater and surface soil. Low levels of PAHs were detected in surface soil samples. The report concluded that the landfill site did not pose concern as a significant source of off-site contaminant migration.

The 1991, PSA Task 1 report prepared by E & E recommended reclassification of the site as a Class 3 site with continued quarterly monitoring of groundwater, but it conceded that understanding of the site hydrogeology was limited. As a result additional PSA activities were performed by E & E. Field tasks included geophysical surveys, monitoring well installation, groundwater elevation monitoring, and sampling of surface water, sediment, surface and subsurface soils, and groundwater. The surface water sample results indicated the presence of one pesticide (beta-BHC) at a very low level, and the presence of iron at a concentration above the NYSDEC Class D surface water standard. The sediment sample contained low levels of chloroform, 2-butanone, PAHs, and diethylphthalate. Calcium, lead, and magnesium were also detected in the sediment sample at levels above the upper limit of the 90th percentile of the range observed in eastern United States soils (Shacklette and Boerngen 1984).

Surface and subsurface soil samples contained low levels of three volatile organic compounds (VOCs), and moderate to high levels of PAHs, dibenzofuran, carbazole, 1,2,4-trichlorobenzene, hexachlorobenzene, and 14 separate pesticides. Metals detected in surface and subsurface soils at concentrations above background levels included calcium, chromium, cobalt, copper, lead, magnesium, manganese, mercury, nickel, selenium, and zinc. Of these metals, cobalt, lead and magnesium were detected at concentrations exceeding the observed range in background soil samples. None of the samples failed tests for Resource Conservation and Recovery Act (RCRA) hazardous waste characteristics. Groundwater samples contained six VOCs, one semivolatile organic compound, and six metals at levels above NYSDEC Class GA standards.

As required by NYSDEC, post-closure groundwater sampling has been performed quarterly on some of the on-site well since 1987. Results of these sampling events consistently show that upgradient well BW-4 contains VOCs, specifically vinyl chloride, at levels above state class GA groundwater standards (NYSDEC 1989; UCC 1991).

A Preliminary Assessment (PA) score of 4 was calculated for the Union Carbide site. Based on the sample results discussed above and the history and condition of the site (i.e., inactive, properly capped, vegetated, and fenced), it has been determined through the PSA investigation that the Union Carbide site does not present a significant threat to the public health or the environment. Based on further data obtained, E & E confirms that the site be reclassified as a Class 3 site with further investigation and groundwater monitoring to determine the source and extent of the contamination.

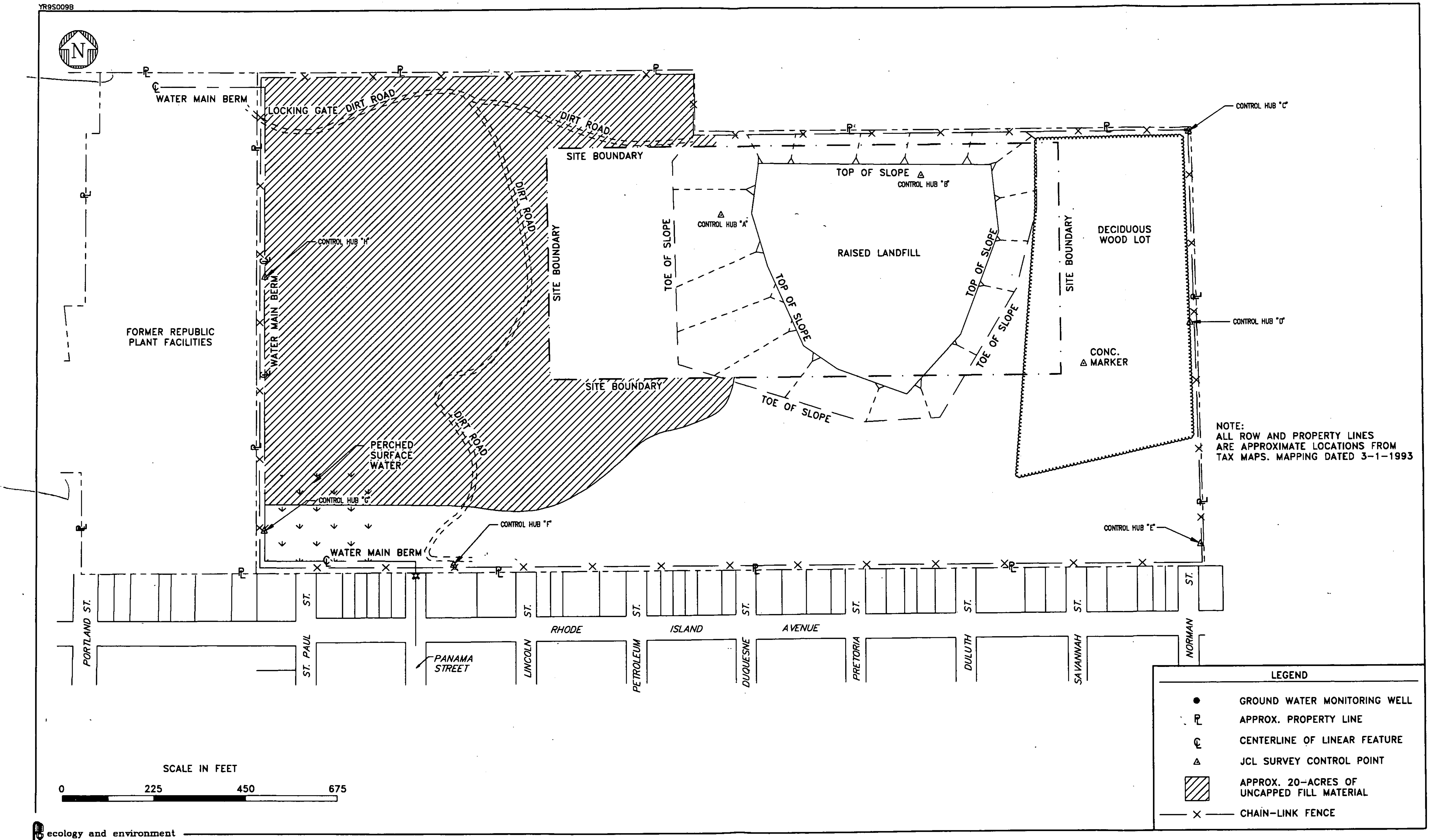


Figure 1-2 UNION CARBIDE SITE MAP

2. SITE HISTORY

In 1910 the National Carbon Company, now the UCAR Carbon Company, Inc., (UCC) began manufacturing operations in Niagara County, New York. The Republic Plant was built in 1919 by the Republic Carbon Company, which sold it in 1925 to the Aluminum Corporation of America (ALCOA). ALCOA sold the plant to National Carbon in 1934. National Carbon changed its name to the Union Carbide Corporation in 1963, and changed it again to UCAR Carbon Company, Inc., (UCC) in 1989.

The Republic Plant was one of three area facilities owned and operated by Union Carbide under the name of Niagara Plant. The listed address of the Republic Plant is 3501 Hyde Park Boulevard, Town of Niagara, New York. The National Plant is located at 3625 Highland Avenue, and the Acheson Plant is located at 1930 Buffalo Avenue, both in the City of Niagara Falls, New York. The Acheson Plant closed in 1982 and the Republic Plant closed in 1987; the National Plant remains active.

Carbon and graphite manufacturing occurred at each of the three Niagara plants, and wastes from all three plants were landfilled on the Republic Plant property. The plants manufactured coal-based carbon products which were used by alloy reduction smelters (i.e., carbon and graphite). Industrial processes at the plants included calcining, milling, mixing, forming carbon products, baking and graphitizing, pitch impregnation, and machining of carbon products. Raw materials used in the process include anthracite coal, petroleum coke, and coal tar pitch. Products manufactured at the plants included specialty machined graphite, carbon liners, cathode blocks and electrodes for furnacing. Waste products from plant operations included carbonaceous waste, primarily as dust from dust collectors, fire brick waste, and raw materials packaging which was composed mostly of wooden pallets but included steel banding, cardboard, styrofoam, plastic, and raw materials bags. Other waste types generated and deposited at the site include coke, pitch, cafeteria waste, silica sand, coal tars, petroleum tars, machining oils, spent sludges from degreasing operations (1,1,1-trichloroethane), and halowax 1006 (chlorinated naphthalene solid). Halowax is reportedly chemically stable, resistant to acids and alkalies. It is believed that the D003 waste listed on the generator form (Appendix H, Record 10) include Halowax mixed with other spent maintenance waste. This waste was reactive; however, Halowax itself does not exhibit any RCRA characteristics. The degreasing sludges were deposited in the landfill in 1975 and 1976 and totaled 400 pounds. The halowax 1006 was deposited over an eight-year period from 1968 to 1976 and totaled 320 pounds. Also, approximately 200 gallons of oil per month were collected in 55-gallon drums and taken to the landfill or used for dust control on site roadways in the summer. This practice stopped in 1978.

The 16.48-acre landfill reportedly began operations in 1934 and was used exclusively by Union Carbide Corp. However, site maps and sketches provided by UCC show that in 1958 fill was placed in an area west of the landfill boundary. A 1964 map shows an area where landfilling took place on what is now Niagara Mohawk (NIMO) land, which is adjacent to the northern site property boundary and near the capped landfill area (see Appendix H). UCC alleges that this dumping was performed by the Town of Niagara, who at the time, had permission from NIMO to dump ash waste from the town's incinerator. A 1978 map shows a perimeter fence which was installed in 1975 (UCAR 1993).

The landfill was first permitted by the Town of Niagara as a solid waste landfill in 1973, and this permit was renewed in 1981 and again in 1985. In 1978, shortly after the SWMF permit process was centralized by NYSDEC, the landfill was issued state permit No. 32N03 as a SWMF and the permit was renewed as required throughout its active life. In 1978 the volume of waste in the landfill was calculated at 148,800 cubic yards, and the remaining capacity was calculated at 280,000 cubic yards. Between 1978 and 1984, only 37,000 cubic yards (approximately 5,000 cubic yards/year) had been used, leaving 243,000 cubic yards of available space.

Since obtaining a permit from the state in 1978, groundwater sampling of on-site wells has been performed. The site was added to the NYSDEC Registry of Inactive Hazardous Waste sites in 1984 and designated as a 2a site, which means that additional information is needed to assign a classification (NYSDEC 1992). Also in 1984, Wehran Engineering began a Phase I investigation of the 16.48-acre landfill for NYSDEC. The phase

I report was finalized in 1987 and concluded that the site posed a potential threat to groundwater. A phase II investigation was recommended (Wehran 1987).

Upon the closing of the Republic Plant in 1987, Union Carbide officially closed the landfill under an approved NYSDEC closure plan. As required by NYSDEC, post-closure groundwater sampling has taken place quarterly since the closure and results of these sampling events consistently showed that well BW-4 contained volatile organics, specifically vinyl chloride, at levels above state class GA groundwater standards (see Figure 1-2).

After the closing of the Republic Plant in 1987. Union Carbide sold the western 26-acre portion of the 90-acre lot which contained all plant structures to Niagara Vest, a holding company. The remaining 64 acres contains the 16.48 acre closed landfill and no structures. In 1987, Union Carbide allowed the Town of Niagara to construct a portion of a municipal water supply line along the western edge of the property. During the excavation for the pipeline, waste material was encountered well outside of the capped landfill boundaries. As a result, the waterline was installed in an aboveground berm and a field investigation was performed to assess the nature and extent of the waste material outside of the closed landfill (Union Carbide 1987).

CRA was contracted by UCC to perform the investigation which included a geophysical survey, 30 test pit excavations, well installation, and sampling of soil in wastes from three buried drums, surface water, groundwater, and water from the watermain both upstream and downstream of the site. The investigation determined that approximately 20 acres of the property between the closed landfill and the western property boundary were covered with an average of 5.4 feet of fill material. In addition, three buried drums were sampled, overpacked, removed from the site, and properly disposed of. Sample results indicated that the drum contents exhibit characteristics of an off-specification material and may be an altered form of the impregnating compound, Code 88, formerly used at the UCC facilities (Union Carbide 1987). The investigation concluded that the watermain was unaffected by the fill material buried adjacent to it; groundwater quality in a shallow perched zone is unaffected by the fill material; and soil contaminants found, including PAHs and pesticides, are consistent with levels found in the closed landfill. The CRA investigation report concluded that the study area was nonhazardous and that remedial measures were not required (CRA 1988).

In 1988, the United States Environmental Protection Agency (EPA) published a Site Inspection Report which summarized a 1987 investigation performed at the landfill by the NUS Corporation under the Field Investigation Team (FIT) program. The field investigation included a site inspection and sampling of groundwater and surface soil. Low levels of PAHs were detected in surface soil samples. The EPA report included a Hazard Ranking System (HRS) score which was well below the minimum score necessary for inclusion on the National Priorities List (NPL). The report concluded that the landfill site is not believed to pose a significant concern as source of off-site contaminant migration (NUS 1988; Santella 1990).

In 1991, a NYSDEC Task 1 PSA was performed by E & E. The purpose of the PSA was to provide information sufficient to reclassify the site. The Task 1 PSA report recommended reclassification of the site to a Class 3 site with continued quarterly groundwater monitoring.

3. PSA TASK DISCUSSION

Task 1 of the PSA, a data records search and assessment, was performed in 1991 by E & E under contract to NYSDEC. The PSA was continued by E & E with fieldwork performed from August 1993 to October 1994. The scope of work for the PSA was prepared by NYSDEC, and all field tasks were performed using NYSDEC's abbreviated work plan. Variations from the work plan, resulting from judgements made in the field, were made with the concurrence of NYSDEC representatives. These variations include the following:

- Because of the scarcity of surface water on and near the site during the surface sampling event, only one surface water/sediment sample set was collected of the three sets proposed in the work plan.
- No leachate was observed on site; therefore, none of the proposed leachate samples was collected.
- One additional groundwater sample was collected for a total of 20 groundwater samples. This sample was collected from well OW-1, which was mistakenly not included in the work plan.
- Only three of the planned five subsurface soil samples were collected for chemical analysis from well borings because indications of contamination were not observed in all of the well borings planned for sampling.
- In order to most effectively characterize the overburden at the site, three additional subsurface soil samples were collected for geotechnical analysis for a total of eight subsurface soil samples.
- Two additional drill water samples (a total of three) were collected due to changes in water source and handling equipment used throughout the drilling program.

- Due to the lack of groundwater in both the overburden and interface at one of the locations proposed for interface well GW-7A, bedrock well GW-11B was installed. The total number of interface and bedrock wells changing from the proposed four and four to three and five, respectively.

- A proposed 48-hour well water level monitoring program was increased to a seven-day program, and data was collected and incorporated from several off-site sources as well.

These changes are discussed in the appropriate sections that follow.

3.1 PSA TASK 1 REPORT

Task 1 of the PSA for the Union Carbide site included a file review, site inspection, and report preparation. The file review and data search were conducted utilizing state, county, municipal, and site-specific sources. This information was compiled from existing data and new sources.

The site inspection was conducted on May 6, 1991, to assess site conditions, observe any evidence of hazardous substances or wastes present, photograph the site, conduct preliminary air monitoring using a photoionization detector (PID), a flame ionization detector (FID), and a radiation meter, and confirm information obtained from the file review and data search. During the site inspection, no air readings above background levels were obtained on site using the air monitoring equipment.

In general, the site appeared to be well-maintained and was in good condition. The site was secured by an 8-foot-high, chain-link fence with barbed wire on top. Although completely fenced, evidence was observed to indicate site use, presumably by the residents of homes adjacent to the southern site boundary. Such evidence included numerous bike paths, piles of yard waste, and holes cut in the site fence between the site and some of the residences. Union Carbide personnel were observed repairing these holes during the site inspection.

3.2 PRE-FIELD INVESTIGATION

Continuation of the PSA for the Union Carbide site involved several field activities, which are described in the following sections. Prior to initiating field activities, E & E performed several other tasks. In June 1993, E & E submitted the Project Management Work

Plan to NYSDEC for approval. This document included the abbreviated technical work plan prepared by NYSDEC for the site, in addition to a technical approach for management and performance of field tasks, laboratory analyses, and report preparation.

In June 1993, E & E also submitted the General Health and Safety Plan (HASP) and a Quality Assurance Project Plan (QAPjP) to NYSDEC for review. The HASP outlined the health and safety procedures and protocols to be followed during site characterization sampling, and field activities. Information gathered during Task 1 of the PSA was used to generate a site-specific safety plan.

In August 1993, E & E submitted the final QAPjP to NYSDEC for approval. The QAPjP presents the policies, organization, objectives, functional activities, and specific quality assurance (QA) and quality control (QC) activities implemented for this project. The QAPjP was developed in accordance with NYSDEC and EPA guidance documents to ensure that all technical data generated by E & E's Analytical Services Center (ASC) meet specified data quality objectives.

In addition to preparation of these documents, tax maps were reviewed and a site reconnaissance was performed. The site reconnaissance was conducted by E & E on August 10, 1993. During the site reconnaissance, a PID, and flame ionization detector (FID), and a Rad-mini radiation detector were used for air monitoring. No readings above background were observed at any of the sample locations.

The site was observed to be in the same general condition as during the Task 1 site inspection (see Section 1.3). The site appeared to be unused and well kept. Healthy vegetation covers the entire site, except on the road surfaces. Besides the capped, raised landfill surface, which supports a thick mowed grass cover, the site is covered with tall grass, young and mature deciduous trees, brush and in the northwestern portion, tall reeds. No structures exist on the site, and vehicular access is restricted by a locked gate across the only entrance.

As observed during the May 6, 1991 inspection, yard waste remains in the southern portion of the site and holes were discovered in the southern portion of the site fence. Union Carbide personnel were repairing the fence during the E & E's site reconnaissance visit. No evidence of landfill waste or leachate seeps were observed.

3.3 GEOPHYSICAL INVESTIGATION

E & E performed a geophysical survey of the site on August 19 and 30, 1993. The survey was performed to aid in safely locating the proposed soil borings and monitoring wells. Forty-foot by 40-foot grids with 10-foot data station spacings were established at both soil borings (B-1 and B-2) and all eight well locations (GW-7B, GW-8A and B, GW-9A and B, GW-10A and B, and GW-11B).

The geophysical survey was performed using an EG&G Geometrics Model G-856 proton precession magnetometer and a Geonics Limited Model EM31 ground conductivity meter. One reading was recorded with the magnetometer at each grid station, and four readings were recorded with the conductivity meter, one on each instrument orientation.

Several contour maps of each survey grid were generated to illustrate the geophysical results. Several anomalies were detected in each grid using both the EM31 and the magnetometer. Anomalies were caused by known surface objects and unknown subsurface objects. Based on the contour maps, locations free of suspected subsurface debris were chosen for the soil borings and monitoring wells. Details pertaining to each survey grid are presented in Appendix B.

3.4 GROUNDWATER MONITORING WELLS

3.4.1 Well Installation

Two soil borings were drilled and eight monitoring wells were drilled and installed at the Union Carbide site from September 21 to October 5, 1993 (see Figure 3-1). All boring wells were drilled and constructed by Buffalo Drilling Company under the guidance of an E & E geologist and health and safety coordinator. The borings were drilled to provide samples of subsurface soils from an area of suspected contamination. The wells were drilled to characterize the subsurface by collecting soil and rock core samples from well borings, to assess the hydrogeology of the site, and to provide locations for the collection of groundwater samples for chemical analysis.

Soil boring and monitoring well locations were selected based on NYSDEC's abbreviated work plan for the site. Two 10-foot deep boreholes (B-1 and B-2) and eight groundwater monitoring wells, including four interface wells (GW-7A, GW-8A, GW-9A and GW-10A) and four bedrock wells (GW-7B, GW-8B, GW-9B and GW-10B), were proposed.

Due to the lack of groundwater in both the overburden and interface at the proposed GW-7A location, a bedrock well (GW-11B) was installed instead of the planned interface well. Six of the wells were drilled in pairs of interface and bedrock wells (GW-8A and B, GW-9A and B, and GW-10A and B). At each well pair location, the bedrock well was drilled and sampled to bedrock first and then the interface well installed with a 5-foot slotted screen placed on top of the overburden/-bedrock interface. The bedrock wells are open-core holes located from 5 feet below bedrock surface to 10 to 15 feet below the bedrock surface. Well construction and elevation data are presented in Table 3-1, and well logs are presented in Appendix C.

All overburden was drilled with 4.25-inch inside diameter (ID) hollow-stem augers. Rock coring was performed for rock sockets using HX-sized (nominal 4-inch diameter) rock coring tools and open core holes were cored with NX-sized (nominal 3-inch diameter) tools. All wells were constructed with a 2-inch ID polyvinyl chloride (PVC) screen and riser, and all screens had 0.010-inch slots. A filter pack composed of N-OO sized sand was placed around the interface well screens, and the wells were sealed with bentonite and cement/bentonite grout. Each well was completed with a 2-foot by 2-foot square concrete drainage pad and 4-inch ID, locking, aboveground, protective steel casing.

During the augering of the overburden portion of each bedrock well, subsurface soil samples were collected with a 2-foot-long split-spoon sampler according to the methods described in American Society for Testing and Materials (ASTM) method designation D-1586. Split-spoon samples were collected continuously throughout each soil boring and bedrock well. Each soil sample was screened with a FID and PID for volatile organic vapors and visually classified by an E & E geologist. FID readings up to 50 ppm above background were observed in soil samples from two well borings and both soil borings (see Appendix C). One subsurface soil sample was collected from each borehole for chemical analysis (see Section 3.5.5).

In addition to the samples discussed above, eight subsurface soil samples were collected for geotechnical analyses. The samples were subject to grain-size distribution analysis (ASTM D-422), Atterberg limits testing (ASTM D-4318), and natural moisture content analysis (ASTM D-2216). All geotechnical analyses were performed by Atlantic Testing Laboratories Ltd. of Canton, New York. The geotechnical results, including the gradation curves and a summary table, are presented in Appendix D.

All well drilling equipment was decontaminated before and after use by high-pressure steam cleaning. The water used for rock coring, drilling-related decontamination and well construction was obtained from the Town of Niagara Water Authority. The first two days of drilling activity were completed using water hauled to the site in a plastic tank from the town water tower location on Lockport Road. This water is identified as Drill Water A. After the second day of drilling, water was obtained (by permit) from town hydrant No. 126, located adjacent to the site along Rhode Island Avenue. This water sample is identified as Drill Water B. The same plastic tank was filled using this hydrant until September 29, 1993, when a larger steel tank was used in place of the smaller, insufficient sized, plastic tank. This water sample is identified as Drill Water C. Due to the change in water source (tower to hydrant) and change in tank composition (plastic to steel), three separate drill water samples were collected. Nine organic compounds were detected in one or more of the drill water samples (see Table 3-2 and 3-3). Of particular interest, the drill water sample collected from the steel tank contained toluene and total xylenes at levels above state groundwater standards. None of the organics detected in the drill water sample were detected in the groundwater samples collected from the bedrock wells which were cored with water from the steel water tank. If the low level organics did enter some of the bedrock wells from the steel water tank, they apparently were volatilized during the coring process or removed during the well development or purging process. Iron was detected in two of the three drill water samples at levels exceeding state standards.

All wells were developed on October 4 and October 5, 1993. Development was performed to restore the natural hydraulic properties of the aquifer material immediately adjacent to the boreholes and to enhance flow into the wells. Well recharge rates were moderate to high. In the three interface wells, 10 to 37 standing well volumes of water were removed, and pH, conductivity, and turbidity measurements stabilized. The final pH levels in these wells ranged from 6.68 to 7.02, and final conductivities ranged from 1,080 to 2,570 microSiemens per centimeter (μS/cm). Due to the high clay and silt content of the overburden, final turbidity readings were high, ranging from 695 to greater than 1,000 nephelometric turbidity units (NTUs). In the five bedrock wells, 19 to 38 well volumes of water were removed. Final pH measurements in these wells ranged from 5.05 to 6.88, and final conductivities ranged from 810 to 3,590 μS/cm. Turbidity of the water in the bedrock wells ranged from 9 to 44 NTUs, which was much lower than the turbidity measured in the interface wells.

3.4.2 Geology

The geology beneath the Union Carbide site consists of a relatively thin overburden cover above fractured dolostone bedrock. The overburden at the site ranges from approximately 7 to 26 feet thick, excluding the raised landfill which is approximately 30 feet above the surrounding grade. The overburden generally thickens away from the top of bedrock high under the landfill. It is relatively thick (over 30 feet) west of the site property at well MW-3B, and it is thinnest (less than 15 feet) on the eastern edge of the site property at BW-5 and MW-3. Since the site is relatively level, the general westward thickening of overburden across the site is caused by a corresponding generally westward dip of the top of bedrock layer beneath the site (see Figures 3-2 and 3-3).

The overburden beneath the site consists of three distinct units: fill material, glaciolacustrine clay and silt, and glacial till. The uppermost overburden layer is fill material, though it is not always present. The fill material is composed of demolition debris, wood, ash, brick, and glass intermixed with a black sand to cobble-size carbonaceous matrix. This layer was found to be present over an approximately 20-acre portion of the 64-acre site property, and is known to extend off site to the north and west (CRA 1988). This 20-acre portion is located generally in the northwest portion of the site property and does not include any of the 16.48-acre capped landfill, the fill of which is known to be similar in composition to the fill outside of it. Thickness of the fill layer ranges from zero to 12 feet across the site property. Samples of the fill material were collected for chemical analyses and results indicated the presence of some organic contamination (see Section 3.5.4).

A layer of glaciolacustrine clay is located beneath the fill material and is found at the surface over the rest of the site. These deposits were made up of stratified reddish brown clay with varying amounts of silt, sand, and gravel deposited in glacial lakes. This layer was encountered in all on-site borings and ranged from approximately 6 to 18 feet thick.

A relatively thin layer of glacial till is located beneath the glaciolacustrine clay layer and covers the underlying dolostone bedrock. The till was encountered while drilling each monitoring well and it was composed of unstratified reddish-brown clay and sand with varying amounts of silt, gravel, and cobbles, as well as dolostone fragments from the underlying bedrock. The till was encountered at thicknesses ranging from 3 to 8 feet.

The bedrock beneath the overburden at the site is the Lockport Dolostone formation of the Middle Silurian-age Lockport group. The Lockport formation is a fine-to-coarse, crystalline, thin-to-massive bedded dolostone, limestone, and shaly dolostone with vugs containing gypsum and calcite. The upper 10 to 25 feet of this unit create a moderately permeable zone that contains relatively abundant bedding planes and vertical joints enlarged by dissolution of dolostone and abundant solution cavities left by the dissolution of gypsum (USGS 1987).

The bedrock bedding planes dip generally to the south-southwest at a rate of approximately 30 feet per mile (USGS 1987). The uppermost bedrock surface was mapped across the site using all available well data (see Figure 3-3). Like the bedding planes, the top of the bedrock surface also sloped in a general south and west direction, but a bedrock high was discovered beneath the northeast corner of the capped landfill, between wells BW-3 and BW-4. This rises to approximately 10 feet above the surrounding bedrock surface and results in the thin overburden there (see Figure 3-2). The stratigraphy beneath the site is presented in two east-west cross sections in Figures 3-4 and 3-5; detailed boring and well logs are provided in Appendix C.

3.4.3 Hydrogeology

Groundwater is present beneath the site in both the overburden and the bedrock. The saturated zone in the overburden is primarily composed of stratified glaciolacustrine sediments of clay, silt, and sand over a more dense glacial till made up of unsorted clay to cobble-size particles. The till layer is an aquitard, slowing the downward flow of groundwater from the overlying sediments into the bedrock.

Three of the 20 site monitoring wells are screened above the till layer (WW-1, OW-1 and OW-2). The water level in these wells suggests a northwest flow, but the number and location of these wells makes any estimate of flow direction speculative.

Six of the 20 wells (MW-1,2,3 and GW-8A, 9A, and 10A) were screened in the overburden, but they penetrate the till and their well screens rest on the bedrock surface. These wells are designated as interface wells because of their contact with the overburden/bedrock interface. They provided water elevation data that indicates a general westward groundwater flow in this zone west of the landfill and an easterly flow east of the landfill (see Figure 3-6). Existing well MW-2 was found to be virtually dry, but the screen of this well is projected to be below the water table and implies that the well screen was plugged.

The bedrock aquifer was identified as the Lockport Dolostone, the principal source of groundwater in the Niagara Falls area. The Lockport is 80 to 158 feet thick in the area and can be divided into two major water-bearing zones. The upper zone is located in the top 10 to 25 feet of rock, beneath its contact with the overburden. This upper zone is moderately permeable and contains relatively abundant horizontal bedding planes and vertical joints, both of which have been enlarged by dissolution of the dolostone rock matrix and solution cavities left by dissolution of gypsum. The lower water-bearing zone contains low to moderately permeable bedding planes, of which as many as seven have been identified that are between fine-grained crystalline dolostone layers of low permeability. Hydraulic conductivity of the upper bedrock zone ranges from 1.8×10^{-3} to 5.3×10^{-3} cm/sec, while the lower zones range from 3.53×10^{-4} to 7.06×10^{-4} cm/sec (Maslia and Johnston 1982).

Most of the recharge to the bedrock aquifer is from the infiltration of rainfall and snowmelt through the overburden. Precipitation in the Niagara Falls New York area is evenly distributed throughout the year and averages 30 inches per year. Most recharge occurs from November to April when evapotranspiration is lowest (USGS 1987).

The rate of recharge depends on the thickness, degree of saturation, and permeability of the overlying unconsolidated deposits, which ranges from 4.0×10^{-7} to 9.5×10^{-5} cm/sec. The average annual recharge from precipitation is estimated to be 5 to 6 inches per year (LaSala 1967), but is greater where the bedrock is at or near the surface. Generally, water levels fluctuate less than 6 feet annually.

Groundwater discharge in the Niagara Falls area is influenced by the New York State Power Authority (NYPA) Niagara Power Project (Power Project). The Power Project consists of two hydroelectric powerplants separated by a forebay canal that receives water from the upper Niagara River through two, 4-mile-long, parallel buried conduits. Since the beginning of Power Project operations in 1962, groundwater within 0.5 mile of the buried conduits has seeped into the drain system that surrounds the conduits. Groundwater flows along the outside of the conduits both south from the forebay canal and north from the upper Niagara River toward the Falls Street tunnel, a former combined sewer and storm drain that crosses the conduits 0.65 mile north of the river. The constantly changing water elevation of the forebay canal affects the water levels in the drain system that surrounds the conduits. This affects the potentiometric surface of groundwater in the bedrock within 0.5 mile of the conduits. High water levels in the forebay canal decreases the gradient of the bedrock groundwater potentiometric surface toward the conduits. Low forebay levels have the reverse effect.

The Power Project can produce up to 1,950,000 kilowatts of electric power from the Lewiston and Robert Moses Hydroelectric Plants. The water used to generate this power is obtained from the upper Niagara River and discharges into the lower river (below Niagara Falls). The Power Project can draw over 100,000 cubic feet per second, but because Canada has a similar power project which draws water from the river and the aesthetic beauty of Niagara Falls is protected, the amount of water drawn by the Niagara Power project is regulated seasonally. During the tourist season (April to October 31), at least 100,000 cubic feet of water per second must flow over the falls during daylight hours and 56,000 at night. During the rest of the year, at least 50,000 cubic feet per second must flow over the falls at all times (USGS 1987).

The water level in the forebay canal also is regulated daily depending on how much water is needed for power generation. During periods of peak electrical demand (weekdays from 8:00 a.m. to 4:00 p.m.), water is discharged into the forebay from the conduits and a storage reservoir above the Lewiston Plant.

A study of groundwater elevation fluctuation was performed at the Union Carbide site by E & E for NYSDEC. The study involved monitoring the groundwater level in nine bedrock wells over a six-day period from December 1 through December 7, 1993, and it was accomplished using NYSDEC-owned electronic data loggers which recorded water levels every 15 minutes over the six-day period. In addition to the well data hourly meteorologic data, both precipitation and barometric pressure were obtained from the National Weather Service office at the Buffalo Airport. Data was also obtained from NYPA and included hourly forebay elevations and conduit flow rates. Data was obtained from CRA for a 72-hour groundwater pump test which was performed at the Hyde Park Landfill site, located 1.5 miles north of the Union Carbide site, from November 29 to December 2, 1993. All of the data was reduced, plotted, and evaluated by E & E to determine what factors affect the groundwater elevations in the Union Carbide site bedrock wells.

The CRA pump test did not cause any observable effect on the Union Carbide wells. This is not surprising since the rate of water extraction during the test at Hyde Park was very low, approximately 4 gallons per minute. In addition, the southernmost Hyde Park well, which is the well nearest the Union Carbide site, was not drawn down by the pump test.

Data obtained from NYPA showed that the rate of flow in the conduits has no bearing on groundwater elevation variation and showed that the conduits are sufficiently sealed from the surrounding groundwater. However, the pumping of water from the conduit drainage system does affect the potentiometric surface of the groundwater in the bedrock. Further, the changes in water elevation in the forebay seem not to be reflected in the water elevation changes in the wells at the Union Carbide site.

The lack of correlation between forebay and well fluctuations can be explained by one or more reasons: The Union Carbide site may be far enough away from the forebay and conduits to be affected by forebay fluctuation; the magnitude of the fluctuations (less than 10 feet) during the six-day monitoring period was too low to be reflected in the on-site wells; or, according to a CRA representative, only wells close to the conduits and the forebay and whose water levels are below the maximum forebay water elevations are affected by forebay fluctuations (CRA 1994). All of the wells at the Union Carbide site have water levels above the highest possible forebay water elevation. Figure 3-7 presents the forebay elevation data for the six-day monitoring period.

A review of the meteorological data concluded that changes in barometric pressure did not correlate with variations in water elevations in the monitored wells. Precipitation, on the other hand, did correlate with the well data. Three separate rain events occurred during the monitoring period; the largest event occurred on December 4 at 0.72 inches, and it raised the water elevation in all nine of the monitored wells. The total rise in water level varied from well to well and ranged from approximately 0.15 to 1.0 foot. Wells closer to the eastern site boundary reacted more to the rain event than wells at the western side of the site. This difference in well response is attributed to the difference in overburden thickness across the site (see Figure 3-2). The overburden thickens from east to west as does the thickness of the unsaturated overburden. The thicker overburden deposits can absorb more precipitation and reduce and slow recharge to the bedrock aquifer beneath. Figures 3-8 and 3-9 provide elevation data for the nine wells monitored.

A complete set of water levels was measured in the bedrock wells prior to sampling on December 8, 1993 (see Table 3-4). The water elevations were contoured and they revealed a groundwater divide which runs from the north of the site, between wells BW-1 and BW-4, and over to the southeast near well GW-7B. This groundwater divide is likely caused by the discharge of water along the conduit drainage system. The divide runs under the capped landfill, indicating that contaminants from the unlined landfill which reach the bedrock aquifer would travel in two directions (west and east) from the landfill (see Figure 3-10).

A second round of water levels was contoured, based upon previous data obtained on October 29, 1993. The second set confirmed the groundwater surface contours based on the December 1993 data. The second set also showed a north-south oriented divide, but the divide was located further to the west through wells GW-8B and BW6. This change in the location of the divide may be caused by seasonal precipitation variations and/or variations in the pumping of groundwater from the NYPA drainage system. Appendix G presents hydrologic data collected from CRA, the National Weather Service, NYPA and the NYSDEC data loggers as part of the groundwater elevation monitoring task.

3.5 SAMPLING

Surface water, sediment, surface soil, subsurface soil, and groundwater samples were collected at and around the site by E & E from August 11, 1994 to October 18, 1994 (see Figure 3-1). Sample locations were selected with the concurrence of the NYSDEC field representative and were based on information provided in NYSDEC's abbreviated work plan for the site. All sample collection, shipping, handling, and analytical procedures were performed in accordance with the QAPjP (E & E 1993a). Additionally, field and sampling procedures were performed in accordance with the work plan (E & E 1993), and HASP (E & E 1993c). Sample analysis was performed by E & E's ASC in accordance with NYSDEC's 1991 Analytical Services Protocol. All analytical data pertaining to the site with the exception of the groundwater samples (BW-2, BW-3, BW-4) collected on October 18, 1994 were third-party qualified by ChemWorld, Inc. With NYSDEC approval, all field samples with the exception of groundwater samples collected on October 18, 1994, were split with a CRA representative for UCC. Table 3-5 summarizes the samples collected and analyses performed, and data summary forms are provided in Appendix E. Tables 3-6 through 3-18 present the compounds and analytes detected in each media sampled.

Tentatively identified compounds (TICs) are presented with the data summary forms in Appendix E.

3.5.1 Surface Water

One surface water sample (SW-1) was collected at the site on August 11, 1993 (see Figure 3-1). The sample was collected from an area of perched surface water in the southwest corner of the site along the aboveground water main berm. This sample was submitted for Target Compound List (TCL) organic and inorganic analyses. A matrix spike/matrix spike duplicate (MS/MSD) sample set and one trip blank were analyzed with this sample for QA/QC purposes.

The only organic compound detected in surface water sample SW-1 was the pesticide beta-BHC, which was detected at a low concentration of 0.055 μg/L (see Table 3-6). No NYSDEC Class D surface water standard exists for this compound.

Sixteen inorganic analytes were detected in SW-1 (see Table 3-7). Although the perched water from which the sample was collected is not a NYSDEC-listed waterbody, the results for this sample were compared to NYSDEC Class D surface water standards and guidance values for screening purposes. Several of the Class D surface water standards are based on hardness (NYSDEC 1993). Therefore, the hardness of these samples was calculated based on the individual concentrations of Mg^{2+} and Ca^{2+} and an equation provided in Freeze and Cherry (1979). Iron was the only analyte to exceed the Class D standard. Iron is commonly found in western New York at such background levels.

3.5.2 Sediment

One sediment sample (SED-1) was collected on August 11, 1993, in conjunction with the surface water sample (see Figure 3-1). This sample was analyzed for full TCL parameters.

Organic results showed the presence of three VOCs in the sediment sample: acetone, chloroform and 2-butanone (see Table 3-6). Several PAHs and diethylphthalate were also detected.

Inorganic results were compared to background concentrations in eastern United States soils and other surficial materials (Shacklette and Boerngen 1984). The results were compared to both the observed range and the upper limit of the 90th percentile, which represents the statistical concentration below which 90% of the Shacklette and Boerngen study's samples fell. Eighteen of the 24 inorganic analytes were detected in the sediment sample (see Table 3-7). Calcium, lead, and magnesium exceeded the upper limits of the 90th percentile, but they were within the observed range.

3.5.3 Surface Soil

Fourteen surface soil samples (S-1 to S-14) were collected on August 11, 1993 (see Figure 3-1). All sample locations were monitored using a FID and PID. No PID readings were observed, but FID readings of 1.6 and 1.2 ppm above background were observed at sample locations S-10 and S-14. All 14 samples were analyzed for full TCL parameters, and samples S-1, S-2, S-3, S-13 and S-14 were also tested for ignitability, corrosivity and reactivity. Sample S-2 was also tested for lead according to the EP Toxicity method. One MS/MSD sample set was collected at location of sample S-7 for QA/QC purposes.

Two VOCs were detected. Chloroform was detected at low levels in four samples and xylene was detected at a very low level in sample S-2 (1 μg/kg), which was collected off site (see Table 3-8).

Several semivolatiles were detected in surface soil samples (see Table 3-8). Total PAH concentrations ranged from an estimated 25 μg/kg in sample S-6 to an estimated 2,000,000 μg/kg in S-9. Many individual PAHs were detected in one or more samples (see Appendix E). Other semivolatile organics detected in surface soil samples include dibenzofuran, which is closely related to PAHs, and carbazole. Dibenzofuran was detected in eight samples at concentrations ranging from an estimated 400 μg/kg to an estimated 12,000 μg/kg. The compound 1,2,4-trichlorobenzene (TCB) was detected in one sample, and hexachlorobenzene was detected in one sample. Carbazole was detected in 10 samples at concentrations ranging from an estimated 58 to an estimated 21,000 μg/kg. The compound 1,2,4-TCB was detected at an estimated concentration of 14,000 μg/kg, and hexachlorobenzene was detected at an estimated concentration of 1,300 μg/kg.

Fifteen pesticides were also detected in at least one surface soil sample. Samples S-4, S-5, and S-6 were free of any pesticides, while sample S-8 contained eight pesticides. One pesticide, endrin ketone, was present in all 11 samples which contained pesticides. PCBs were not detected in surface soil samples.

Twenty-three of the 24 inorganic analytes tested for were detected in at least one surface soil sample (see Table 3-9). The results were compared to background concentrations in eastern United States soils and other surficial materials (Shacklette and Boerngen 1984). The following metals were detected at concentrations exceeding the upper limit of the 90th percentile, but not the observed range: calcium in samples S-1, S-5, S-8, S-11, S-12, and S-14; cobalt in S-6 and S-12; copper in S-2, S-8, S-9, S-10, S-12, S-13 and S-14; lead in all 14 samples except S-5 and S-6; magnesium in S-1 and S-10, manganese in S-7; mercury in S-8 and S-13; nickel in S-6, S-10 and S-12; and zinc in S-1, S-2, S-4, S-8, S-10, S-12 and S-14. In addition, the following metals exceeded the observed range: cobalt in S-10; lead in S-2; and magnesium in S-10. Both samples S-2 and S-10 were collected off of UCC property.

Five samples (S-1, S-2, S-3, S-13 and S-14) were subjected to reactivity, corrosivity, and ignitability tests, and sample S-2 was analyzed for EP-Tox lead. All five samples passed these tests, and they are not considered RCRA hazardous waste based on these test results (see Table 3-10). On December 10, 1993, sample S-2 was resampled and analyzed for TAL lead and EP-TOX lead. The TAL lead concentration was 1,560 mg/kg. The EP-Tox lead result is shown on Table 3-10.

3.5.4 Subsurface Soil

Six subsurface soil samples were collected from two shallow soil borings (B-1 and B-2) and three of the eight well borings (GW-8B, GW-10B, and GW-11B). Soil borings B-1 and B-2 were drilled to identify the black "ooze" material which was reportedly encountered during a previous site excavation for a municipal waterline (CRA 1988). Although no "ooze" as described by CRA was encountered in either boring, wet carbon dust was encountered, which may have been the substance described previously.

Samples from the soil and well borings were collected based on air screening levels from the PID or FID and/or visual observation of contamination (i.e., discoloration, staining, sheen, etc.). Sample GW-11B was collected from an apparently clean and native soil to be used as a background representation. All subsurface soil samples were analyzed for full TCL organics and inorganics including cyanide. Additionally, samples B-1.1 and B-2.2 were analyzed for RCRA hazardous waste characteristics.

Four VOCs were detected in at least one subsurface soil sample (see Table 3-11). Carbon disulfide was detected in sample GW-10B; 2-butanone was detected in samples B-1.1 and B-2.2; toluene was detected in sample B-2.1; and total xylenes were detected at low concentrations in sample B-2.1.

Several semivolatiles were detected in all samples except the background sample. Total PAHs were detected at estimated concentrations ranging from 32,000 to 1,700,000 μg/kg. Dibenzofuran and carbazole were detected in all samples except the background sample.

Low levels of six pesticides were detected in four of the six subsurface soil samples, but they were not detected in the background sample. No PCBs were detected in any of the samples.

Twenty-one of the 24 inorganic analytes tested for were detected in at least one sample (see Table 3-12). The results were compared to background concentrations in eastern United States soils and other surficial materials (Shacklette and Boerngen 1984). The following nine metals were detected above the upper limit of the 90th percentile, but they did not exceed the observed range: calcium, chromium, cobalt, copper, lead, magnesium, nickel, selenium and zinc. Lead was detected most frequently, or in 4 of 6 samples. The background sample, GW-11B, contained calcium at a concentration above the 90th percentile. Cyanide was detected in samples GW-10B and GW-11B at estimated concentrations of 0.94 mg/kg and 1.1 mg/kg, respectively.

Results of the RCRA hazardous waste characteristics tests performed on two of the six samples, are summarized in Table 3-13. Both samples passed the toxicity, reactivity, corrosivity, and ignitability tests, and neither is considered RCRA hazardous waste based on these test results.

3.5.5 Groundwater

Groundwater samples were collected from all 20 monitoring wells. Eight of the wells (GW-7B, GW-8A and 8B, GW-9A and 9B, GW-10A and 10B and GW-11B) were newly installed; 12 wells were installed prior to the PSA investigation. All wells were sampled from December 8 to December 10, 1993. All eight new wells and three of the previously installed wells (BW-2, BW-4 and MW-1) were analyzed for full TCL parameters; the remaining nine wells were analyzed for VOCs only. For QA/QC purposes, an MS/MSD sample set was collected from well GW-7B and a trip blank was analyzed for VOCs for each of the three sampling days. One of the three drill water samples (Drill Water C) from the steel tank, contained low levels of toluene and total xylenes at levels above state standards (see Table 3-2). The water from the steel tank was used for decontamination and rock coring purposes. None of the organics found in the Drill Water C sample were detected in the newly installed bedrock groundwater monitoring wells. If the low-level organics did enter some of the bedrock wells from the steel water tank, they apparently were volatilized during the coring process or removed during the well development or purging process. A second round of groundwater samples were collected on October 18, 1994 from upgradient well BW-4 and downgradient wells BW-2 and BW-3. These groundwater samples were analyzed for TCL parameters (volatiles only).

Prior to sample collection, water level and total well depth measurements were recorded for each well, and each well was purged of at least three standing well volumes or until dry. The wells were then allowed to recharge for sample collection. The organic sample portion was collected on the same day as purging, and in cases where the clarity of the water was less than 50 NTUs (GW-7B, GW-9B, GW-10B, and GW-11B), the metals sample was also collected.

In the remainder of the wells (except BW-2) to be sampled for full TCL, the metals portion of the sample was collected the day after purging. Samples for inorganic analyses were collected the day after purging, as specified in the QAPjP, to allow time for suspended sediment in the wells to settle and thereby yield a sample with a relatively low turbidity. Inspection of the metals aliquot confirmed a noticeable increase in water clarity since the time of purging.

The overburden and interface wells contained low concentrations of only three VOCs. Acetone, carbon disulfide, and 1,2-DCE were detected in one or more of the nine wells at concentrations below applicable standards (see Table 3-14).

Bedrock wells contained VOCs in one or more well samples (see Tables 3-15 and 16). Six of the 10 VOC compounds were detected at concentrations above the NYSDEC Class GA standards: chloroethane, Total 1,2-DCE, chloroform, PCE, TCE, and vinyl chloride. 1,1-DCE was detected at an estimated concentration equal to the NYSDEC Class GA standard in bedrock well BW-4 on December 1993 but was below the standard when sampled in October 1994. The analytical results from the three wells sampled on October 18, 1994 generally confirmed the analytical results obtained from these wells in December 1993. No new compounds were detected in any of the three wells and concentrations were all within the same order of magnitude as the first set of data. Only one semivolatile organic compound, hexachlorobutadiene, was detected in the bedrock wells. Hexachlorobutadiene was detected in well BW-4 at a concentration of 20 μg/L, which is above the NYSDEC standard of 5 μg/L. No PCBs or pesticides were detected in any of the site wells. Results of this round of sampling confirm results of ongoing quarterly sampling which indicate that well BW-4 is the most contaminated well on site. Seven organic compounds were detected in this well, six of these at concentrations above NYSDEC standards.

Fourteen of the 24 inorganics analyzed for were detected in one or more of the four sampled interface wells (see Table 3-17). Five of these inorganics, chromium, iron, magnesium, manganese, and sodium were detected in at least one well at a concentration above the NYSDEC Class GA standard. With the exception of chromium, which was found in well MW-1, E & E has found that these metals are found to be naturally occurring at such levels in western New York.

Fifteen metals were detected in samples collected from seven bedrock wells (see Table 3-18). Six metals were detected at concentrations exceeding the NYSDEC standard in one or more wells: iron, lead, magnesium, manganese, sodium, and zinc. The metals that pose greatest concern are lead and zinc, due to their known toxicity. These metals were found in wells GW-11B, BW-2 and BW-4 at concentrations exceeding the NYSDEC standard. Cyanide was not detected in any of the groundwater samples collected at the site.

3.6 SURVEYING

Following completion of the sampling activities, the site was surveyed by a licensed surveyor to a vertical accuracy of 0.05 feet and a horizontal precision of 1/10,000 using the National Geodetic Survey benchmark SMC 20A. This benchmark is located at the southwest corner of the intersection of Hyde Park Boulevard and College Avenue in the City of Niagara Falls, at an elevation of 588.52 feet above mean sea level (MSL). The horizontal datum used was magnetic north with assumed coordinates. Survey control point coordinates and all PSA sampling points are provided in Table 3-19.

The physical features of the site and all PSA sampling locations were surveyed. The survey data were used to create all figures in this report. Property lines were not surveyed.

County of Niagara tax maps numbers 130.19, 130.20, 130.82, 130.83, and 130.84 were used to approximate the property boundaries shown on the figures. For the purpose of property owner identification, Figure 3-11 presents property lines and corresponding parcel numbers.

3.7 PA SCORE

The purpose of the PA score is to assist in differentiating sites that pose little or no potential threat to human health and the environment from sites that warrant further investigation based on their potential threat. The PA score is a screening-level compilation of existing information pertaining to a site and its surrounding environment, with emphasis on obtaining comprehensive information on targets (i.e., populations and resources that might be threatened by a potential release from the site). The score is a simplified version of the Hazard Ranking System (HRS) and can be used to quantitatively assess a limited number of factors. A site with an HRS score of 28.5 or greater is eligible for inclusion on the National Priorities List.

The factors used to determine the PA score are likelihood of release, targets, and waste characteristics. Likelihood of release is the relative potential for a hazardous substance to migrate from the site. Targets include people, physical resources (drinking water wells or intakes), and environmental resources (sensitive environments) that may be threatened by a release from the site. Waste characteristics are an estimation of the type and quantity of hazardous waste at the site. These factors are then applied to the various exposure pathways (groundwater, surface water, soil, and air) to derive an overall site score.

The results of PA scoring (out of 100) for the Union Carbide site are as follows:

- Overall site score: 4
- Groundwater pathway score: 1
- Surface water pathway score: 4
- Soil pathway score: 3
- Air pathway score: 5

A release to groundwater has been confirmed as evidenced by analytical results from groundwater samples collected from on-site monitoring wells. The groundwater route is not considered to be a major exposure pathway; area residents obtain drinking water from municipal supplies, and no known drinking water wells are used within the 4-mile-radius target distance limit.

A release to surface water was not suspected because no primary off-site migration route has been identified, but off-site surface water samples were not collected. There are no drinking water intakes located downstream of the site within the 15-mile target distance limit, and no sensitive environments are known to have been affected by the site.

Air is not considered to be a major exposure pathway because there have been no documented releases. However, due to the proximity of the residential area, a secondary target population was included in the air pathway score.

The soil pathway is not considered to be a major exposure pathway. No resident population was identified as there are no residences on or within 200 feet of the area of observed soil contamination. Only on-site workers were identified as potential targets for the soil exposure pathway.

Table 3-1

MONITORING WELL CONSTRUCTION DATA
UNION CARBIDE SITE

Well Number	Date Completed	Total Depth	Depth to Bedrock	Depth of Bottom of Inner Casing	Screened Interval	Open Corehole Interval	Ground Elevation	Elevation of TOIC
GW-7B	10-1-93	29.66	14.7	19.4	NA	19.4 - 29.66	600.22	603.08
GW-8A	9-23-93	17.50	17.4	12.4	12.4 - 17.4	NA	601.46	604.04
GW-8B	9-23-93	27.50	17.4	22.70	NA	22.70 - 27.50	601.53	603.90
GW-9A	10-1-93	20.25	19.9	15.25	15.25 - 20.25	NA	601.48	603.29
GW-9B	10-1-93	29.50	19.9	24.80	NA	24.80 - 29.50	601.24	603.40
GW-10A	9-30-93	27.70	25.70	22.70	22.70 - 27.70	NA	600.48	603.17
GW-10B	10-1-93	36.25	25.70	30.70	NA	30.70 - 36.25	600.45	603.29
GW-11B	10-1-93	25.40	11.9	16.00	NA	16.00 - 25.40	599.35	601.89

Note: All depths and intervals are expressed in feet below ground surface and elevations in feet above mean sea level.

Key:

NA = Not applicable.

Table 3-2

ORGANIC COMPOUNDS DETECTED IN DRILL WATER SAMPLES (SEPTEMBER 23 AND 29, 1993) UNION CARBIDE SITE (μg/L)

Compound	Drill Water A	Drill Water B	Drill Water C	NYSDEC Class GA Standard[a]
Volatiles				
Bromodichloromethane	7 J	8 J	9 J	50[b]
Chloroform	13	18	17	5
Dibromochloromethane	3 J	4 J	4 J	5
Ethylbenzene	ND	ND	2 J	5
Toluene	ND	ND	8 J	5
Xylenes (Total)	ND	ND	5 J	5
Semivolatiles				
Naphthalene	1 J	ND	ND	10[b]
Dimethylphthalate	1 J	ND	ND	50[b]
bis(2-ethylhexyl)phthalate	5 J	1 J	5 J	50

Note: Shaded values exceed Class GA standard.

[a] NYSDEC 1993.

[b] NYSDEC Class GA Guidance Value.

Key:

J = Reported value is estimated.
ND = Not detected.

Table 3-3

INORGANIC ANALYTES DETECTED IN DRILL WATER SAMPLES (SEPTEMBER 23 AND 29, 1994) UNION CARBIDE SITE (μg/L)

Analyte	Drill Water A	Drill Water B	Drill Water C	NYSDEC Class GA Groundwater Standard[a]
Aluminum	349	3,000	1,280 J	NA
Arsenic	ND	1.5 J	1.2 J	25
Barium	21.1 J	32.1 J	29.7 J	1,000
Calcium	32,100	81,400	59,100	NA
Chromium	7.6 J	23.0	13.7	50
Copper	3.6 J	5.2 J	3.1 J	200
Iron	106	2,290	1,280	300
Lead	1.1 J	2.2 J	ND	25
Magnesium	8,360	9,690	9,450	35,000[b]
Manganese	3.4 B	47.7 J	31.2 B	300
Potassium	1,380 J	2,230 J	1,950 J	NA
Sodium	9,720	9,990	11,200	20,000
Vanadium	ND	8.5 J	ND	NA
Zinc	24.0 J	39.9 J	33.3 J	300

Note: Shaded values exceed NYSDEC Class GA groundwater standard.

[a] NYSDEC 1993.
[b] NYSDEC Guidance Value.

Key:

B = Value is below the contract detection limit but above the laboratory instrument detection limit.
J = Reported value is estimated.
NA = No NYSDEC Class GA Groundwater Standard or guidance value available.
ND = Not detected.

Table 3-4

WATER ELEVATION DATA
UNION CARBIDE SITE
(Data/Level [TOIC])

Well Number	10/4/93	10/5/93	10/29/93 Pre-PASNY Change	12/1/93 Telog Installation	12/3/93	12/6/93	12/8/93 Presampling
	Pre-development						
GW-7B	—	587.63	589.32	594.30	—	—	595.56
GW-8A	593.32	—	594.67	596.67	596.99	597.61	597.45
GW-8B	592.02	—	593.57	595.01	—	—	595.74
GW-9A	-	589.16	591.83	594.59	594.73	595.21	595.03
GW-9B	588.60	—	590.96	592.28	—	—	592.74
GW-10A	—	589.29	590.75	591.44	591.62	591.88	591.81
GW-10B	—	588.69	590.80	591.43	—	—	591.80
GW-11B	—	587.53	589.25	594.28	—	—	595.56
BW-1	—	—	592.80[a]	595.99	—	—	596.80
BW-2	—	—	592.95	595.19	—	—	595.89
BW-3	—	—	—	—	—	—	595.80
BW-4	—	—	593.07	596.83	—	—	597.95
BW-5	—	—	589.86	—	—	—	596.13
BW-6	—	—	594.66	—	—	—	596.23
MW-1	—	—	597.52	—	—	—	599.07
MW-2	—	—	588.00	—	—	—	588.09
MW-3	—	—	589.40	—	—	—	599.40
OW-1	—	—	598.54	—	—	—	599.47
OW-2	—	—	596.65	—	—	—	597.73
WW-1	—	—	—	—	—	—	603.32[b]
MW-3B[c]	—	—	—	590.74	—	—	—

Note: All elevations are in feet above mean sea level. Vertical datum reference is benchmark SMC 20A (Elevation 588.52).

[a] Measured from top of outer casing.

[b] Measured on December 9, 1993 due to equipment blocking access to well.

[c] Carborundum well.

Key:

TOIC = Top of inner casing.

Table 3-5

SAMPLING AND ANALYSIS SUMMARY
UNION CARBIDE SITE

Sample Number	Target Compound List				Cyanide	RCRA Hazardous Waste Characteristics				
						EP Toxicity				
	Volatiles	Semivolatiles	Pesticides/ PCBs	Metals		Organics	Metals	Ignitability	Corrosivity[a]	Reactivity[b]
Groundwater										
Existing Wells										
BW-1	X	—	—	—	—	—	—	—	—	—
BW-2	X	X	X	X	X	—	—	—	—	—
BW-3	X	—	—	—	—	—	—	—	—	—
BW-4	X	X	X	X	X	—	—	—	—	—
BW-5	X	—	—	—	—	—	—	—	—	—
BW-6	X	—	—	—	—	—	—	—	—	—
MW-1	X	X	X	X	X	—	—	—	—	—
MW-2	X	—	—	—	—	—	—	—	—	—
MW-3	X	—	—	—	—	—	—	—	—	—
WW-1	X	—	—	—	—	—	—	—	—	—
OW-1	X	—	—	—	—	—	—	—	—	—
OW-2	X	—	—	—	—	—	—	—	—	—
New Wells										
GW-7B	X	X	X	X	X	—	—	—	—	—
GW-8A	X	X	X	X	X	—	—	—	—	—
GW-8B	X	X	X	X	X	—	—	—	—	—

Table 3-5

SAMPLING AND ANALYSIS SUMMARY
UNION CARBIDE SITE

Sample Number	Target Compound List				Cyanide	RCRA Hazardous Waste Characteristics				
						EP Toxicity		Ignitability	Corrosivity[a]	Reactivity[b]
	Volatiles	Semivolatiles	Pesticides/ PCBs	Metals		Organics	Metals			
GW-9A	X	X	X	X	X	—	—	—	—	—
GW-9B	X	X	X	X	X	—	—	—	—	—
GW-10A	X	X	X	X	X	—	—	—	—	—
GW-10B	X	X	X	X	X	—	—	—	—	—
GW-11B	X	X	X	X	X	—	—	—	—	—
Surface Water										
SW-1	X	X	X	X	X	—	—	—	—	—
Sediment										
SED-1	X	X	X	X	X	—	—	—	—	—
Surface Soil										
S-1	X	X	X	X	X	—	—	X	X	X
S-2	X	X	X	X	X	—	Lead only	X	X	X
S-3	X	X	X	X	X	—	—	X	X	X
S-4	X	X	X	X	X	—	—	—	—	—
S-5	X	X	X	X	X	—	—	—	—	—
S-6	X	X	X	X	X	—	—	—	—	—
S-7	X	X	X	X	X	—	—	—	—	—
S-8	X	X	X	X	X	—	—	—	—	—

Table 3-5

SAMPLING AND ANALYSIS SUMMARY
UNION CARBIDE SITE

Sample Number	Target Compound List				Cyanide	RCRA Hazardous Waste Characteristics				
						EP Toxicity				
	Volatiles	Semivolatiles	Pesticides/ PCBs	Metals		Organics	Metals	Ignitability	Corrosivity[a]	Reactivity[b]
S-9	X	X	X	X	X	—	—	—	—	—
S-10	X	X	X	X	X	—	X (lead only)	—	—	—
S-11	X	X	X	X	X	—	—	—	—	—
S-12	X	X	X	X	X	—	—	—	—	—
S-13	X	X	X	X	X	—	—	X	X	X
S-14	X	X	X	X	X	—	—	X	X	X
Subsurface Soil										
B-1.1 (6-8")	X	X	X	X	X	X	X	X	X	X
B-2.1 (2-4')	X	X	X	X	X	—	—	—	—	—
B-2.2 (6-8')	X	X	X	X	X	X	X	X	X	X
GW-8B (14-16')	X	X	X	X	X	—	—	—	—	—
GW-10B (2-4')	X	X	X	X	X	—	—	—	—	—
GW-11B (4-6')	X	X	X	X	X	—	—	—	—	—

[a] Corrosivity results are pH values.

[b] Reactivity results are values for total cyanide and total sulfide.

Table 3-6

ORGANIC COMPOUNDS DETECTED IN SURFACE WATER AND SEDIMENT SAMPLES (AUGUST 11, 1993) UNION CARBIDE SITE

Compound	SW-1 (in µg/L)	NYSDEC Class D Surface Water Standard[a]	SED-1 (in µg/kg)
Volatiles			
Acetone	ND	NA	89
Chloroform	ND	NA	3 J
2-Butanone	ND	NA	180
Semivolatiles			
Total PAHs	ND	NA	1,200 J
Diethylphthalate	ND	NA	450
Pesticides			
beta-BHC	0.055	NA	ND

[a] NYSDEC 1993.

Key:

NA = Not available.
J = Reported value is estimated.
ND = Not detected.

Table 3-7

INORGANIC ANALYTES DETECTED IN SURFACE WATER AND SEDIMENT SAMPLES (AUGUST 11, 1993) UNION CARBIDE SITE

Analyte	ppb SW-1 (in µg/L)	NYSDEC Class D Surface Water Standard[a] (in µg/L)	ppm SED-1 (in mg/kg)	Background Concentrations in Eastern U.S. Soils and Other Surficial Materials[b]: Upper Limit of the 90th Percentile (in mg/kg)	Background Concentrations in Eastern U.S. Soils and Other Surficial Materials[b]: Observed Range (in mg/kg)
Aluminum	12,600	NA	7,640 764800	128,000	7,000 - >100,000
Arsenic	5.8 J	360[c]	4.0	16.0	<0.1 - 73
Barium	182 J	NA	90.9	867	10 - 1,500
Beryllium	ND	ND	0.49 J	1.81	<1 - 7
Cadmium	ND	ND	0.98 J	NA	0.01 - 7.0[d]
Calcium	94,800	NA	51,900	14,400	100 - 280,000
Chromium	22.7	5,009[e]	16.4 J	112	1 - 1,000
Cobalt	15.5 J	NA	11.6 J	19.8	<0.3 - 70
Copper	46.2	60[e]	23.9	48.7	<1 - 700
Iron	23,000 J	300	16,200	54,100	100 - >100,000
Lead	26.7	425[e]	121	33.0	<10 - 300
Magnesium	31,100	NA	16,400	10,700	50 - 50,000
Manganese	891	NA	493	1,450	<2 - 7,000
Nickel	37.5 J	4,929[e]	19.9	38.2	<5 - 700
Potassium	2,820 J	NA	964 J	23,500	50 - 37,000
Sodium	1,410 J	NA	134 J	17,400	<500 - 50,000
Vanadium	22.4 J	190	20.2	140	<7 - 300
Zinc	188	940[d]	93.0	104	<5 - 2,900

Note: Shaded values exceed the Class D standard or upper limit of the 90th percentile.
Surface water and sediment samples collected on August 11, 1993.

[a] NYSDEC 1993.
[b] Shacklette and Boerngen 1984 (except as noted).
[c] Dissolved form.
[d] Dragun 1988.
[e] Standard based on hardness.

Key:

J = Reported value is estimated.

Table 3-8

ORGANIC COMPOUNDS DETECTED IN SURFACE SOIL SAMPLES
UNION CARBIDE SITE (AUGUST 11, 1993)
(μg/kg)

Compound	S-1	S-2	S-3	S-4	S-5	S-6	S-7
Volatiles							
Chloroform	ND	9 J	ND	ND	ND	ND	8 J
Total xylenes	ND	1 J	ND	ND	ND	ND	ND
Semivolatiles							
Phenol	ND	980 J	ND	ND	ND	ND	ND
Total PAHs	420,000 J	50,000 J	7,200 J	2,100 J	79 J	25 J	4,300 J
Dibenzofuran	400 J	ND	ND	ND	ND	ND	ND
Carbazole	2,400 J	ND	87 J	ND	ND	ND	58 J
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	ND	ND
Pesticides							
alpha-BHC	ND	ND	ND	ND	ND	ND	ND
beta-BHC	ND	ND	ND	ND	ND	ND	ND
delta-BHC	ND	ND	ND	ND	ND	ND	ND
gamma-BHC	ND	ND	ND	ND	ND	ND	ND
Heptachlor	ND	11 J	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND	5.3 J
4,4'-DDE	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	ND	ND	ND	ND	ND	ND	4.3 J
Endrin ketone	79 J	53 J	5.9 J	ND	ND	ND	6.0 J
Endrin aldehyde	ND	35	ND	ND	ND	ND	ND
alpha-Chlordane	ND	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ND	ND	ND	ND	ND	ND	ND

Key at end of table.

Table 3-8

ORGANIC COMPOUNDS DETECTED IN SURFACE SOIL SAMPLES UNION CARBIDE SITE (AUGUST 11, 1993)

(μg/kg)

Compound	S-8	S-9	S-10	S-11	S-12	S-13	S-14
Volatiles							
Chloroform	3 J	ND	ND	ND	ND	3 J	ND
Total xylenes	ND	ND	ND	ND	ND	ND	ND
Semivolatiles							
Phenol	ND	ND	ND	ND	ND	ND	ND
Total PAHs	1,000,000 J	2,000,000 J	150,000 J	440,000 J	450,000 J	1,200,000 J	460,000 J
Dibenzofuran	5,000 J	2,100 J	550 J	1,600 J	1,900 J	12,000 J	4,900 J
Carbazole	17,000 J	8,200 J	1,500 J	6,900 J	7,400 J	21,000 J	8,800 J
1,2,4-Trichlorobenzene	14,000 J	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	1,300 J	ND	ND	ND	ND	ND	ND
Pesticides							
alpha-BHC	5,800 J	ND	ND	ND	ND	ND	ND
beta-BHC	4,000 J	ND	ND	ND	ND	ND	ND
delta-BHC	ND	ND	ND	ND	ND	19 J	ND
gamma-BHC	730 J	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	170	47	690 D	ND	ND
4,4'-DDE	ND	130	43 J	51	54 J	37 J	39 J
Endrin	ND	110 J	ND	ND	ND	ND	ND
Endosulfan II	ND	110 J	ND	39 J	ND	110 J	47 J
4,4'-DDD	ND	ND	ND	ND	ND	52 J	ND
4,4'-DDT	ND	ND	ND	ND	ND	ND	ND
Endrin ketone	820	1,200 D	150	190	140	230 J	210
Endrin aldehyde	380		ND	ND	ND	ND	ND
alpha-Chlordane	710	ND	120 J	27 J	350 J	ND	ND
gamma-Chlordane	ND	ND	ND	ND	ND	ND	ND

Key at end of table.

Table 3-8 (Cont.)

Note: Semivolatile dilution factors: S-1 and S-8 - 50x
S-2 - 5x
S-9 - 100x then reanalyzed at 200x
S-10 - 10x
S-11, S-12, and S-14 - 25x
S-13 - 100x.

Pesticide/PCB dilution factors: S-1, S-10, S-11, S-13, and S-14 - 10x
S-2 - 5x
S-8 - 100x then reanalyzed at 1,000x
S-9 and S-12 - 10x then reanalyzed at 100x.

Key:

ND = Not detected.
J = Reported value is estimated.
D = Result from dilution analysis.

Table 3-9

INORGANIC ANALYTES DETECTED IN SURFACE SOIL SAMPLES UNION CARBIDE SITE (AUGUST 11, 1993)

(mg/kg)

Analyte	Sample Number				
	S-1	S-2	S-3	S-4	S-5
Aluminum	4,870	9,750	13,000	16,300	8,060
Arsenic	4.2	5.7	7.9	7.0	5.1
Barium	85.1	301	141	157	59.3
Beryllium	0.28 J	0.29 J	0.89 J	1.2 J	0.41 J
Cadmium	0.96 J	2.5	1.3 J	1.6	0.72 J
Calcium	50,600	13,200	6,110	5,940	52,600
Chromium	25.9 J	38.7 J	47.5 J	37.8 J	15.7 J
Cobalt	7.4 J	13.3	15.0	16.8	12.5
Copper	31.0	205	31.7	26.5	23.2
Iron	11,900	24,200	37,900	28,400	19,800
Lead	54.6	498[c]/1,560[c]	46.4	75.1	5.1
Magnesium	15,800	1,580	3,110	5,400	8,380
Manganese	446	499	604	466	726
Mercury	ND	0.18	ND	ND	ND
Nickel	26.0	35.2	28.9	28.8	24.1
Potassium	751 J	703 J	1,330 J	1,130 J	765 J
Selenium	ND	ND	0.37 J	ND	ND
Silver	ND	1.1 J	ND	ND	ND
Sodium	192 J	492 J	177 J	94.6 J	129 J
Thallium	0.28 J	ND	0.42 J	0.51 J	ND
Vanadium	13.3	16.6	30.4	36.0	20.6
Zinc	130	682	82.2	113	45.4
Cyanide	ND	0.58	ND	ND	ND

Key at end of table.

Table 3-9

INORGANIC ANALYTES DETECTED IN SURFACE SOIL SAMPLES UNION CARBIDE SITE (AUGUST 11, 1993) (mg/kg)

Analyte	S-6	S-7	S-8	S-9	S-10
Aluminum	23,200	9,860	3,140	1,220	1,330
Arsenic	6.9	7.9	10.1	6.0	6.4
Barium	183	134	70.7	24.5 J	38.0 J
Beryllium	1.8	0.89 J	0.35	ND	ND
Cadmium	2.0	0.86 J	1.3	ND	1.1
Calcium	2,440	4,550	26,100	2,260	10,800
Chromium	37.4 J	33.6 J	48.3	61.8 J	60.0 J
Cobalt	27.1	12.7	7.9	4.3 J	85.0^c
Copper	38.4	29.6	193	116	105
Iron	37,200	18,900	9,670	3,360	6,940
Lead	14.5	55.4	79.7	44.8	117
Magnesium	8,410	2,300	5,900	692 J	61,700^c
Manganese	892	1,620	380	93.2	374
Mercury	ND	ND	0.31	ND	ND
Nickel	49.8	20.9	27.1	28.8	98.1
Potassium	1,690	1,090 J	311	137 J	258 J
Selenium	ND	0.33 J	0.56	0.41 J	ND
Silver	ND	ND	ND	ND	ND
Sodium	119 J	ND	112	ND	161 J
Thallium	0.37 J	0.46 J	0.48	0.24 J	0.22 J
Vanadium	48.0	24.9	26.6	16.7	15.8
Zinc	86.0	64.2	126	53.5	325
Cyanide	ND	ND	ND	ND	ND

Key at end of table.

Table 3-9

INORGANIC ANALYTES DETECTED IN SURFACE SOIL SAMPLES UNION CARBIDE SITE (AUGUST 11, 1993)
(mg/kg)

Analyte	Sample Number				Background Concentrations in Eastern U.S. Soils[a]	
	S-11	S-12	S-13	S-14	Upper Limit of the 90th Percentile	Observed Range
Aluminum	2,200	5,460	1,260	3,580	128,000	7,000 - >100,000
Arsenic	4.3	8.5	3.2	6.5	16.0	<0.1 - 73
Barium	35.7 J	72.3	38.0 J	88.2	867	10 - 1,500
Beryllium	ND	0.51 J	ND	0.35 J	1.81	<1 - 7
Cadmium	0.76 J	0.94 J	0.69 J	1.0 J	NA	0.01 - 7.0[b]
Calcium	19,500	25,700	4,410	19,100	14,400	100 - 280,000
Chromium	42.1 J	86.9 J	32.7 J	38.9 J	112	1 - 1,000
Cobalt	6.8 J	22.3	2.8 J	8.9 J	19.8	<0.3 - 70
Copper	41.0	108	64.3	97.9	48.7	<1 - 700
Iron	3,740	13,700	6,000	13,400	54,100	100 - >100,000
Lead	61.0	59.8	42.8	56.4	33.0	<10 - 300
Magnesium	9,600	5,100	1,230	5,910	10,700	50 - 50,000
Manganese	159	381	38.4	380	1,450	<2 - 7,000
Mercury	ND	ND	1.3	0.25	0.265	0.01 - 3.4
Nickel	27.3	48.3	16.3	34.3	38.2	<5 - 700
Potassium	281 J	622 J	188 J	763 J	23,500	50 - 37,000
Selenium	ND	0.55 J	ND	0.29 J	0.941	<0.1 - 3.9
Silver	ND	ND	ND	ND	NA	NA
Sodium	174 J	169 J	137 J	109 J	17,400	<500 - 50,000
Thallium	0.33 J	0.63 J	ND	0.24 J	13.8	2.2 - 23
Vanadium	26.6	30.4	45.3	20.2	140	<7 - 300
Zinc	59.6	133	63.3	312	104	<5 - 2,900
Cyanide	0.73	ND	ND	0.81	NA	NA

Key at end of table.

Table 3-9 (Cont.)

Note: Shaded values exceed the upper limit of the 90th percentile but not the observed range, unless noted. Second value for lead in sample S-2 is from December 10, 1993.

[a] Shacklette and Boerngen 1984, except as noted.
[b] Dragun 1988.
[c] Value exceeds observed range.

Key:

J = Reported value is estimated.
NA = No applicable value given.
ND = Not detected.

Table 3-10

IGNITABILITY, CORROSIVITY, AND REACTIVITY RESULTS FOR SURFACE SOIL SAMPLES (AUGUST 11, 1993)
UNION CARBIDE SITE

Parameter	S-1	S-2	S-3	S-13	S-14	S-10	Regulatory Level[a]
Reactivity							
• Cyanide, Total (mg/kg)	ND	0.58	ND	ND	0.81	NA	250
• Sulfide, Total (mg/kg)	ND	ND	52	65	ND	NA	500
Corrosivity (pH)	8.6	7.9	6.8	8.6	8.4	NA	2>pH/12.5
Ignitability	No flash @ 140°F	No flash @ 140°F	No flash @ 140°F	No flash @ 140°F	No flash @ 140°F	NA	No flash below 140°F
EP Tox Lead (µg/L)	NA	389	NA	NA	NA	ND	5,000

Note: Sample S-2 was sampled for EP-TOX lead on December 10, 1994.

[a] 6 NYCRR 371.3.

Key:

ND=Not detected.

Table 3-11

ORGANIC COMPOUNDS DETECTED IN SUBSURFACE SOIL SAMPLES UNION CARBIDE SITE (SEPTEMBER 22, 24, AND 29, 1993)

(μg/kg)

Compound	B-1.1 (6-8 feet)	B-2.1 (2-4 feet)	B-2.2 (6-8 feet)	GW-8B (14-16 feet)	GW-10B (2-4 feet)	GW-11B (4-6 feet)
Volatiles						
Carbon disulfide	ND	ND	ND	ND	3 J	ND
2-Butanone	21	ND	15 J	ND	ND	ND
Toluene	ND	1 J	ND	ND	ND	ND
Total xylenes	ND	4 J	ND	ND	ND	ND
Semivolatiles						
Total PAHs	430,000 J	1,700,000 J	360,000 J	32,000 J	44,000 J	ND
Dibenzofuran	2,600 J	10,000 J	1,700 J	270 J	340 J	ND
Carbazole	8,200 J	37,000 J	6,400 J	730 J	770 J	ND
Pesticides						
Heptachlor	ND	25 J	ND	ND	ND	ND
Aldrin	ND	ND	57 J	ND	ND	ND
Heptachlor epoxide	ND	94 J	290 J	26 J	ND	ND
Dieldrin	ND	420 J	120 J	ND	300 J	ND
4,4'-DDE	ND	49 J	62 J	ND	ND	ND
alpha-Chlordane	ND	310	73 J	ND	280 D	ND

Note: Semivolatile dilution factors:

B-1.1 and B-2.2 - 20x
B-2.1 - 200 x
GW-8B (14-16') - 2 x
GW-10B (2-4') - 5 x

Pesticide/PCB dilution factors:

B-1.1 and GW-8B (14-16') - 5x
B-2.1 and B-2.2 - 10x
GW-10B (2-4') - 10x
then reanalyzed at 100x.

Key:

J = Reported value is estimated.
ND = Not detected.

Table 3-12

INORGANIC ANALYTES DETECTED IN SUBSURFACE SOIL SAMPLES UNION CARBIDE SITE (SEPTEMBER 22, 24, AND 29, 1993)

(all values reported in mg/kg)

Analyte	B-1.1 (6-8 feet)	B-2.1 (2-4 feet)	B-2.2 (6-8 feet)	GW-8B (14-16 feet)	GW-10B (2-4 feet)	GW-11B (4-6 feet)	Background Concentrations in Eastern U.S. Soils[a]	
							Upper Limit of the 90th Percentile	Observed Range
Aluminum	965	4,650	21,600	7,260	3,650	11,700	128,000	7,000 - 100,000
Arsenic	4.0	7.7	9.5	1.6 J	9.1	4.6	16.0	0.1 - 73
Barium	25.8 J	46.6 J	127	38.4 J	47.1 J	62.2	867	10 - 1,500
Beryllium	ND	0.32 J	1.1 J	0.30 J	0.47 J	0.54 J	1.81	<1 - 7
Cadmium	ND	0.94 J	1.2 J	1.1 J	0.67	0.81 J	NA	0.01 - 7.0[b]
Calcium	2,130 J	35,400 J	5,700 J	87,500 J	10,200 J	51,900 J	14,400	100 - 280,000
Chromium	24.8	23.5	65.1	10.7	162	18.0	112	1 - 1,000
Cobalt	5.8 J	7.7 J	20.9	6.6 J	7.0 J	13.7	19.8	<0.3 - 70
Copper	54.7	119	42.6	15.2	106	23.7	48.7	<1 - 700
Iron	10,200	10,100	29,700	10,800	12,700	20,900	54,100	100 - >100,000
Lead	35.0	129	54.2	29.7	68.1	5.7	33.0	<10 - 300
Magnesium	695 J	10,100	5,080	37,700	3,740	9,470	10,700	50 - 50,000
Manganese	113 J	212 J	928 J	444 J	212 J	750 J	1,450	<2 - 7,000
Nickel	36.5	23.4	35.2	12.5	46.0	25.0	38.2	<5 - 700
Potassium	ND	877 J	2,500	2,050	ND	1,810	23,500	50 - 37,000
Selenium	0.72 J	1.8 J	0.9 J	ND	1.5 J	ND	0.941	<0.1 - 3.9
Sodium	ND	250	ND	258 J	ND	219 J	17,400	<500 - 50,000
Thallium	ND	1.1 J	0.43 J	ND	ND	ND	13.8	2.2 - 23
Vanadium	40.3 J	59.5 J	46.0 J	17.1 J	56.2 J	28.0 J	140	<7 - 300
Zinc	174	94.1	132	193	92.9	64.6	104	<5 - 2,900
Cyanide	ND	ND	ND	ND	0.94 J	1.1 J	NA	NA

Key at end of table.

Table 3-12 (Cont.)

Note: Shaded values exceed the upper limit of the 90th percentile but not the observed range.

[a] Shacklette and Boerngen 1984, except as noted.
[b] Dragun 1988.

Key:

NA = Not available.
ND = Not detected.
J = Reported value is estimated.

Table 3-13

HAZARDOUS WASTE CHARACTERISTICS RESULTS FOR SUBSURFACE SOIL SAMPLES (SEPTEMBER 22, 1993) UNION CARBIDE SITE

	B-1.1 (6-8 feet)	B-2.2 (6-8 feet)	Regulatory Level[a]
Toxicity			
• Barium (μg/L)	592	641	100,000
• Cadmium (μg/L)	ND	5.7	1,000
• Chromium (μg/L)	ND	7.2	5,000
Reactivity			
• Cyanide, Total (mg/kg)	ND	ND	250
• Sulfide, Total (mg/kg)	ND	ND	500
Corrosivity (pH)	8.3	7.9	2>pH>12.5
Ignitability	No flash @ 140°F	No flash @ 140°F	No flash below 140°F

[a] 6 NYCRR 371.3.

Key:

ND = Not detected.
NA = No applicable level.

Table 3-14

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN AND INTERFACE GROUNDWATER SAMPLES (DECEMBER 8, 9, AND 10, 1993) UNION CARBIDE SITE

(μg/L)

Compound	WW-1	OW-1	OW-2	MW-1	MW-2	MW-3	GW-8A	GW-9A	GW-10A	NYSDEC Class GA Standard[a]
Volatiles										
Acetone	17	9 J	ND	15	36	10	18	11	8 J	50[b]
Carbon disulfide	ND	ND	ND	ND	5 J	ND	3 J	ND	ND	NA
Total 1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	2 J	5[c]

Note: Groundwater samples collected on December 8, 9, and 10, 1993.

[a] NYSDEC 1993.
[b] Guidance value.
[c] Standard for individual cis and trans isomers.
[d] Standard applies to each isomer (1,2, 1,3, and 1,4) individually.

Key:

ND = Not detected.
J = Reported value is estimated.

Page 1 of 2

Table 3-15

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER SAMPLES
UNION CARBIDE SITE (DECEMBER 8, 9, AND 10, 1993)
(µg/L)

Compound	BW-1	BW-2	BW-3	BW-4	BW-5	BW-6
Volatiles	617'	612'	70'	811		
Vinyl chloride	ND	ND	42	70	ND	ND
Chloroethane	ND	7 J	ND	ND	ND	ND
Acetone	10	ND	9 J	ND	29	ND
Carbon disulfide	3 J	5 J	ND	ND	ND	ND
1,1,-Dichloroethene	ND	ND	ND	5 J	ND	ND
total 1,2-Dichloroethene	11	ND	19	350 E	ND	ND
Chloroform	ND	ND	ND	6 J	ND	ND
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND
Trichloroethene (TCE)	3 J	ND	ND	270 E	ND	ND
Tetrachloroethene (PCE)	ND	ND	ND	110	ND	ND
Semivolatiles						
Hexachlorobutadiene	ND	ND	ND	20	ND	ND

Table 3-15

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER SAMPLES (DECEMBER 8, 9, AND 10, 1993) UNION CARBIDE SITE (μg/L)

Compound	GW-7B	GW-8B	GW-9B	GW-10B	GW-11B	NYSDEC Class GA Standard[a]
Volatiles		37	5	7	6	
Vinyl chloride	ND	ND	ND	ND	ND	2
Chloroethane	ND	ND	ND	ND	ND	5
Acetone	ND	14	5 J	7 J	ND	50[b]
Carbon disulfide	ND	ND	ND	ND	ND	NA
1,1,-Dichloroethene	ND	ND	ND	ND	ND	5[c]
total 1,2-Dichloroethene	ND	9 J	ND	1 J	5 J	7
Chloroform	ND	ND	ND	ND	ND	5
1,1,1-Trichloroethane	ND	ND	ND	ND	1 J	5
Trichloroethene (TCE)	ND	13	ND	ND	ND	5
Tetrachloroethene (PCE)	ND	ND	ND	ND	ND	5
Total Xylenes	ND	ND	ND	ND	ND	5
Semivolatiles						
Hexachlorobutadiene	ND	ND	ND	ND	ND	5

Note: Shaded values exceed Class GA standard.

[a] NYSDEC 1993.
[b] Guidance value.
[c] Standard for individual cis and trans isomers.

Key:

ND = Not detected.
J = Reported value is estimated.
E = Exceeded calibration range.

Table 3-16

VOLATILE ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER SAMPLES (OCTOBER 18, 1994) UNION CARBIDE SITE

Compound	Sample Number			NYSDEC Class GA Standard[a]
	BW-2	BW-3	BW-4	
Chloroethane	8 J	ND	ND	5
Chloroform	ND	ND	8 J	5
1,1-Dichloroethene	ND	ND	2 J	5[b]
Total 1,2-Dichloroethene	ND	8 J	230	7
Tetrachloroethene (PCE)	ND	ND	230	5
Trichloroethene (TCE)	ND	ND	310	5
Vinyl chloride	ND	7 J	52	2

Note: Shaded values exceed Class GA standard.

[a] NYSDEC 1993.

[b] Standard for individual cis and trans isomers.

Key:

J = Reported value is estimated.
ND = Not detected.

Table 3-17

INORGANIC ANALYTES DETECTED IN INTERFACE GROUNDWATER SAMPLES (DECEMBER 8, 9, AND 10, 1993) UNION CARBIDE SITE (µg/L)

Analyte	GW-8A	GW-9A	GW-10A	MW-1	NYSDEC Class GA Groundwater Standard
Aluminum	233	252	413	159 J	NA
Arsenic	4.5 J	ND	1.5 J	2.0 J	25
Barium	279	30.7	82.5 J	91.6 J	1,000
Calcium	167,000	137,000	135,000	33,900	NA
Chromium	ND	ND	ND	60.9	50
Copper	ND	ND	ND	71.9	200
Iron	9,350	374	1,040	9,840	300
Lead	1.4 J	1.3	11.5	12.4	25
Magnesium	99,500	49,600	55,700	84,400	35,000[b]
Manganese	456	111	149 J	114 J	300
Nickel	6.1 J	ND	4.7 J	22.0 J	NA
Potassium	26,600	8,090	145,000	39,400	NA
Sodium	188,000	14,600	52,800	91,600	20,000
Zinc	44.6	11.5	ND	249 J	300

Note: Shaded values exceed the Class GA standard or guidance value.

[a] NYSDEC 1993.
[b] Guidance value.

Key:

J = Reported value is estimated.
NA = Not available.
ND = Not detected.

Table 3-18

INORGANIC ANALYTES DETECTED IN BEDROCK GROUNDWATER SAMPLES (DECEMBER 8, 9, AND 10, 1993)
UNION CARBIDE PROPERTY SITE
(µg/L)

Analyte	GW-7B	GW-8B	GW-9B	GW-10B	GW-11B	BW-2	BW-4	NYSDEC Class GA Groundwater Standard[a]
Aluminum	316	107 J	233	138 J	306	1,330 J	188 J	NA
Arsenic	9.2 J	1.4 J	ND	ND	1.0 J	4.6 J	4.4 J	25
Barium	88.4 J	34.0 J	221	107 J	63.0 J	292 J	375	1,000
Cadmium	ND	ND	ND	ND	ND	5.2 J	2.6 J	10
Calcium	97,900 J	61,100 J	291,000 J	123,000 J	115,00 J	273,000 J	97,900	NA
Chromium	ND	ND	ND	ND	ND	5.5 J	ND	50
Copper	ND	ND	ND	ND	ND	4.5 J	ND	200
Iron	1,120	ND	253	160	431	10,700 J	3,730	300
Lead	8.7	1.5 J	1.3 J	1.2 J	50.8	603 J	18.7	25
Magnesium	43,800	71,900	114,000	49,800	57,500	132,000 J	70,200	35,000[b]
Manganese	85.2	12.3 J	64.9	ND	229	418 J	139 J	300
Nickel	ND	ND	ND	ND	ND	20.5 J	8.8 J	NA
Potassium	ND	17,200	4,750 J	10,500	2,250 J	7,420 J	19,500	NA
Sodium	14,900	106,000	214,000	55,200	51,300	198,000 J	65,800	20,000
Zinc	148	52.7	5.5 J	9.8 J	380	18,500 J	3,200 J	300

Note: Shaded values exceed the Class GA standard or guidance value.

[a] NYSDEC 1993
[b] Guidance value.

Key:

J = Reported value is estimated.
NA = Not available.
ND = Not detected.

Table 3-19

COORDINATES OF SURVEY CONTROL POINTS AND SOURCE LOCATIONS UNION CARBIDE SITE

Description	Northing (feet)	Easting (feet)	Elevation (feet)
Sample/Well Locations			
BW-1	5965.5629	6234.1152	609.29
BW-2	5350.2091	6140.7344	606.28
BW-3	5588.5887	6851.4190	602.39
BW-4	5969.8929	6770.8153	604.60
BW-5	5969.6681	7273.6532	600.04
BW-6	5636.1489	5885.5127	607.78
MW-1	5965.9842	6396.7568	609.20
MW-2	5402.0999	6175.5454	607.17
MW-3	5007.9148	7231.7704	599.89
MW-3B	5125.8899	4509.3453	599.18
WW-1	5657.7233	6559.3084	630.12
OW-1	5337.3438	5403.5131	602.31
OW-2	5935.0706	5248.7223	599.82
GW-7B	5063.6110	7227.4801	600.22
GW-8A	6107.3632	5965.7024	601.46
GW-8B	6102.3864	5965.1602	601.53
GW-9A	4979.8362	5519.7902	601.48
GW-9B	4974.4916	5525.4738	601.24
GW-10A	5601.1811	4945.5068	600.48
GW-10B	5607.3366	4945.7679	600.45
GW-11B	5486.9956	7273.0477	599.35
SW/SED-1	4933.8041	5112.7342	599.95
S-1	6019.9183	6329.4076	609.40
S-2	6018.9877	6610.1233	603.33
S-3	5879.0062	7221.5387	599.42
S-4	5397.5886	7221.6791	599.35
S-5	5134.9101	6792.5815	601.43
S-6	5084.3016	6462.1085	604.77
S-7	5177.8000	6101.2369	602.61

Table 3-19

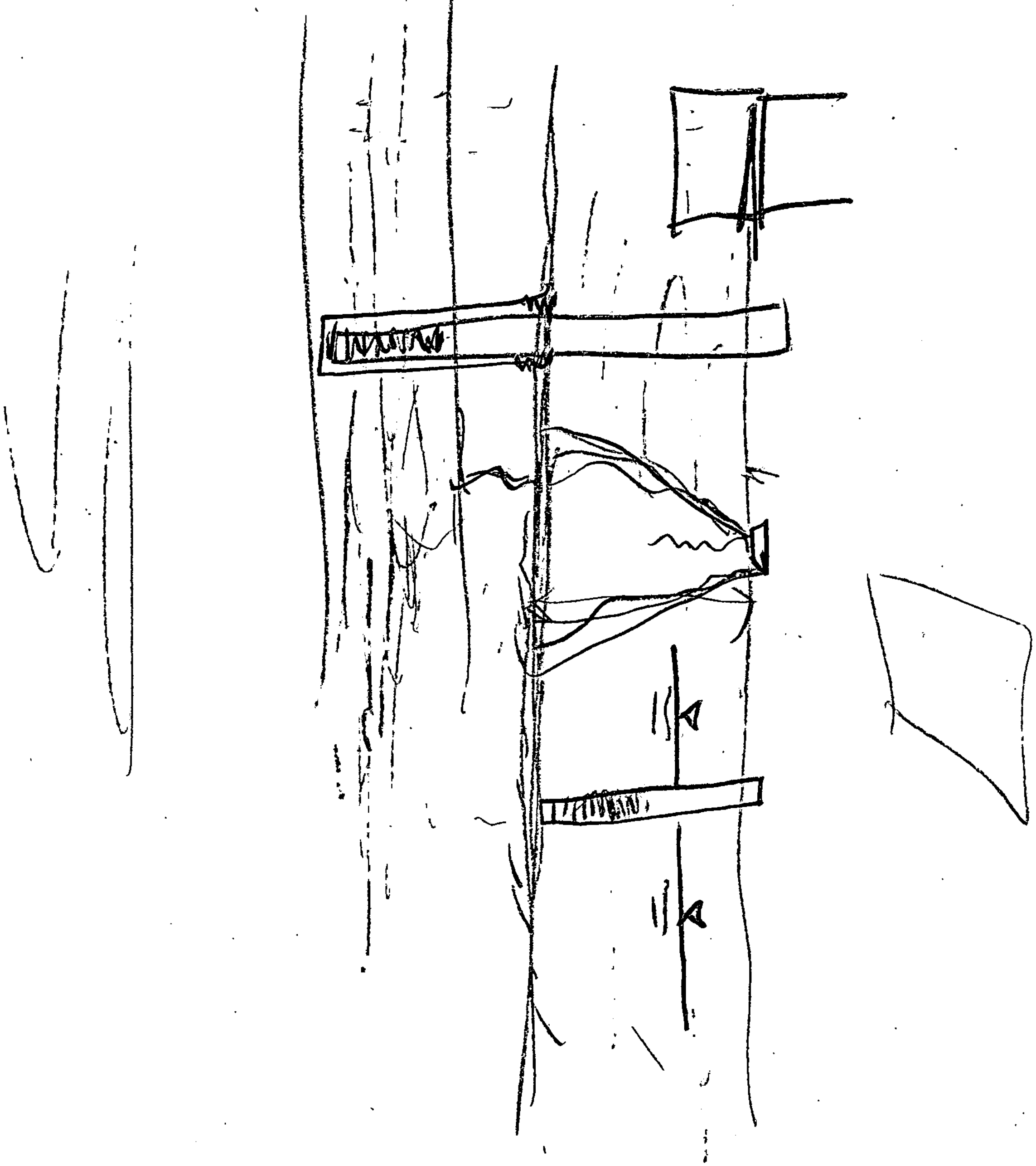
COORDINATES OF SURVEY CONTROL POINTS AND SOURCE LOCATIONS UNION CARBIDE SITE

Description	Northing (feet)	Easting (feet)	Elevation (feet)
S-8	5444.7260	5357.1094	600.78
S-9	5956.2806	5280.3754	599.98
S-10	5410.0438	4946.9730	600.30
S-11	5893.4955	4930.8338	600.40
S-12	5846.2461	4769.1690	598.91
S-13	6110.3753	5633.5713	603.96
S-14	6004.2396	6000.8935	610.72
B-1	5933.2625	5024.5936	599.44
B-2	5839.4597	5023.0844	598.93
SKW-5[a]	6483.2631	4737.9970	600.09
SKW-5A[a]	6473.9072	4734.5534	599.74
Survey Control Points			
Control Hub A	5773.7492	6124.6138	621.44
Control Hub B	5869.6550	6618.6458	626.87
Control Hub C	5973.3908	7276.2693	600.10
Control Hub D	5502.6908	7276.3446	599.75
Control Hub E	4957.5242	7297.8357	599.12
Control Hub F	4915.7269	5465.9725	601.62
Control Hub G	5000.0000	5000.0000	606.85
Control Hub H	5626.2900	5000.000	607.71
Conc. Marker	5403.1241	7014.4554	603.50
NW Landfill Corner	5940.7575	5694.3378	603.46
SW Landfill Corner	5371.3567	5702.0026	603.22
NE Landfill Corner	5947.4081	6955.9835	601.05
SE Landfill Corner	5377.4764	6959.3620	602.86

[a] SKW Alloy wells not shown on Figure 3-1.

Notes: Sample points and site corner markers shown on Figure 3-1. Control hubs shown on Figure 1-2.

Vertical control based on NAS benchmark SMC 20A (elevation = 588.52 feet above mean seal level). Horizontal control based on magnetic north and assumed coordinates.



YR9S002B

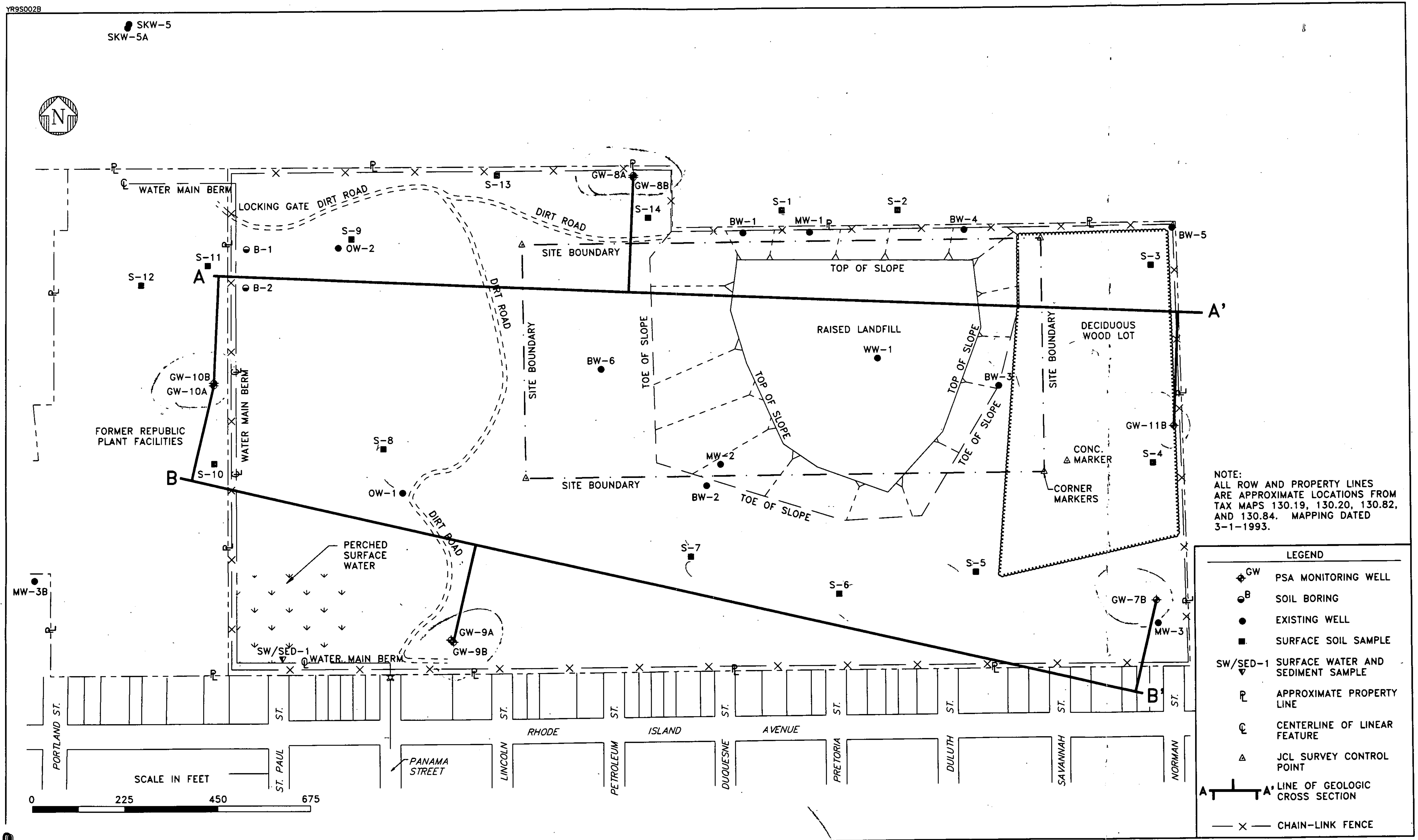


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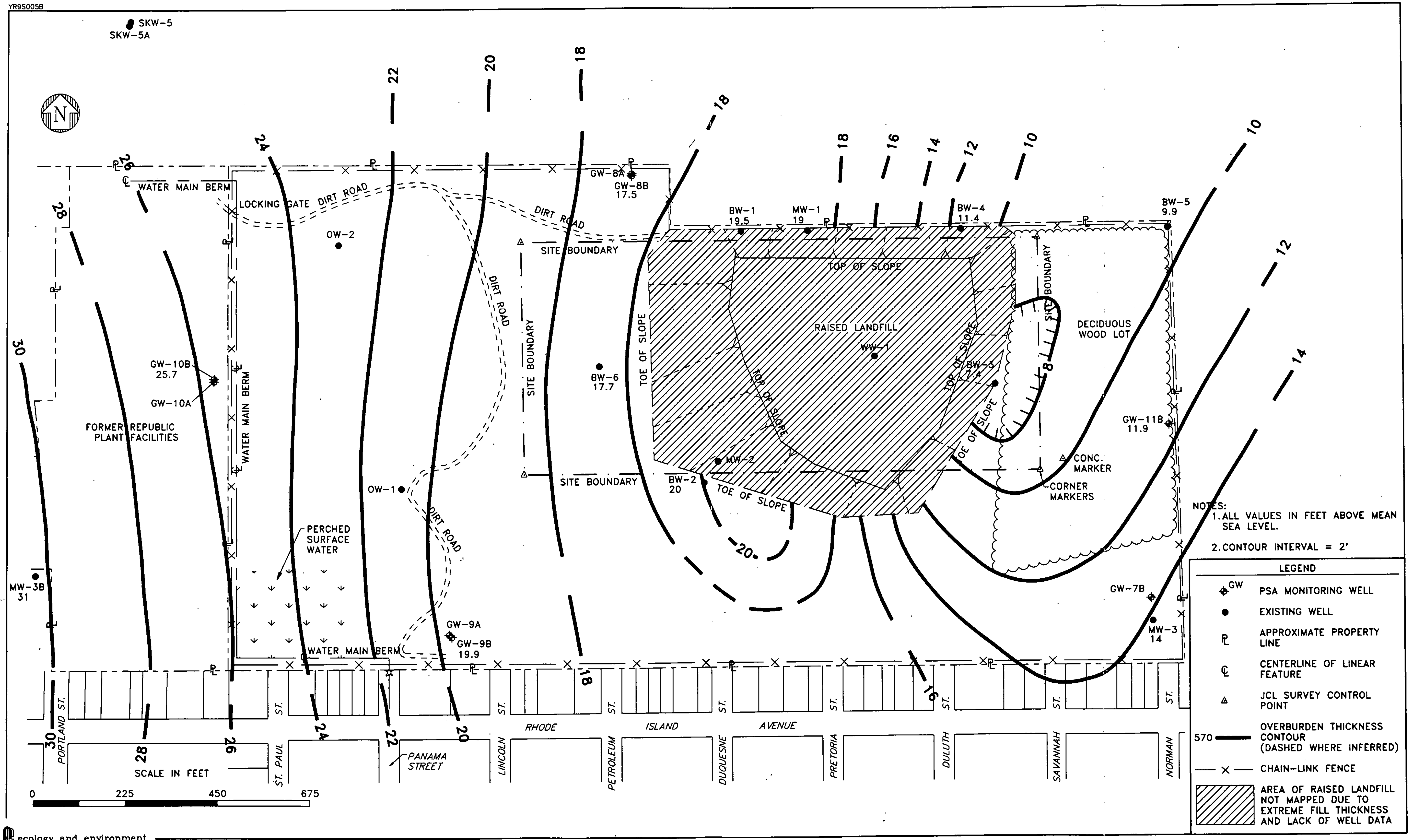
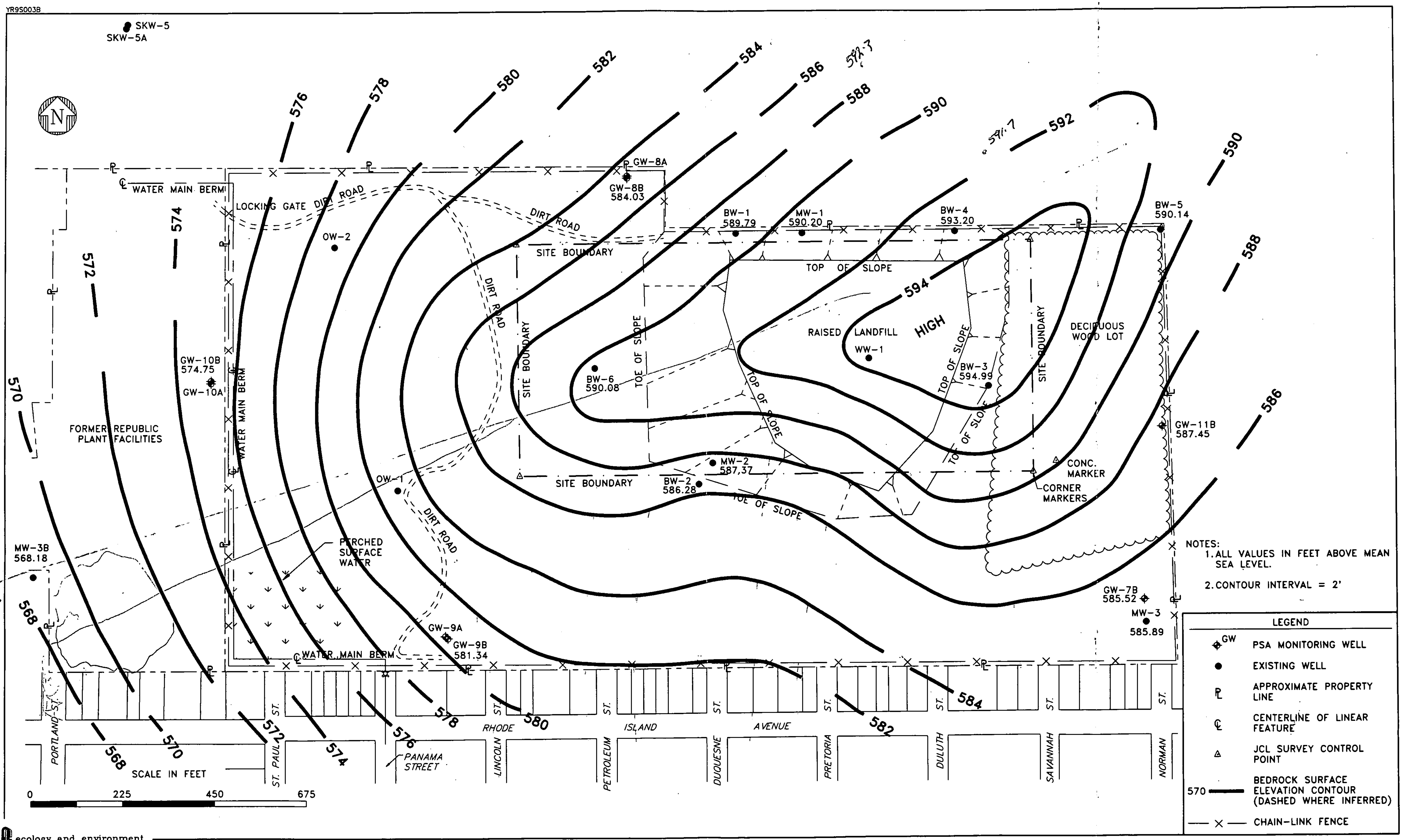
Figure 3-1 SAMPLE, WELL, AND CROSS SECTION LOCATION MAP UNION CARBIDE SITE



NOTES:
1. ALL VALUES IN FEET ABOVE MEAN SEA LEVEL.
2. CONTOUR INTERVAL = 2'

Figure 3-2 OVERBURDEN THICKNESS MAP UNION CARBIDE SITE



NOTES:

1. ALL VALUES IN FEET ABOVE MEAN SEA LEVEL.
2. CONTOUR INTERVAL = 2'

LEGEND

⌖GW	PSA MONITORING WELL
●	EXISTING WELL
ℙ	APPROXIMATE PROPERTY LINE
℄	CENTERLINE OF LINEAR FEATURE
△	JCL SURVEY CONTROL POINT
570 ━━	BEDROCK SURFACE ELEVATION CONTOUR (DASHED WHERE INFERRED)
—×—	CHAIN-LINK FENCE

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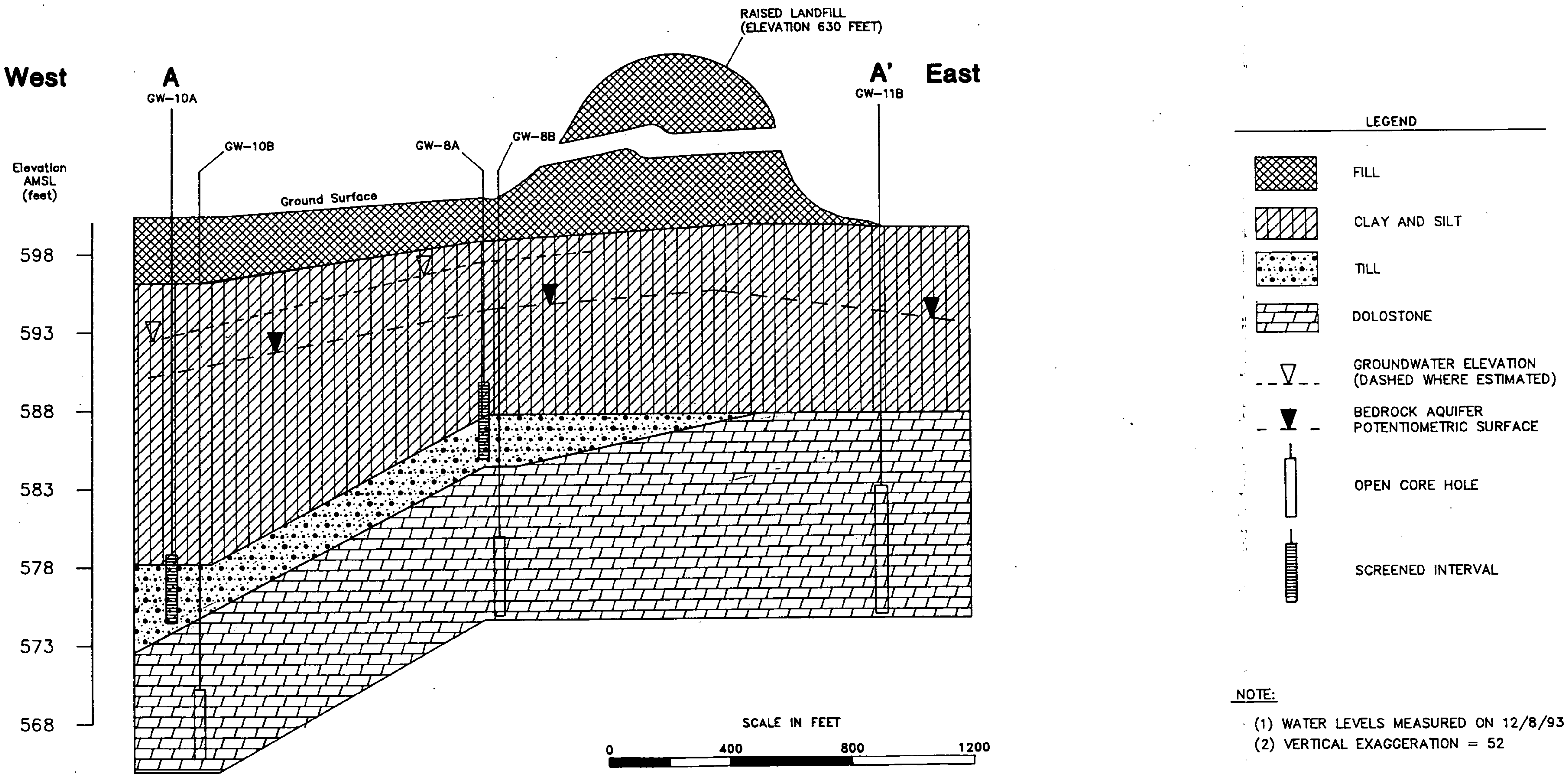
Figure 3-3 TOP OF BEDROCK CONTOUR MAP UNION CARBIDE SITE

YR9S007B



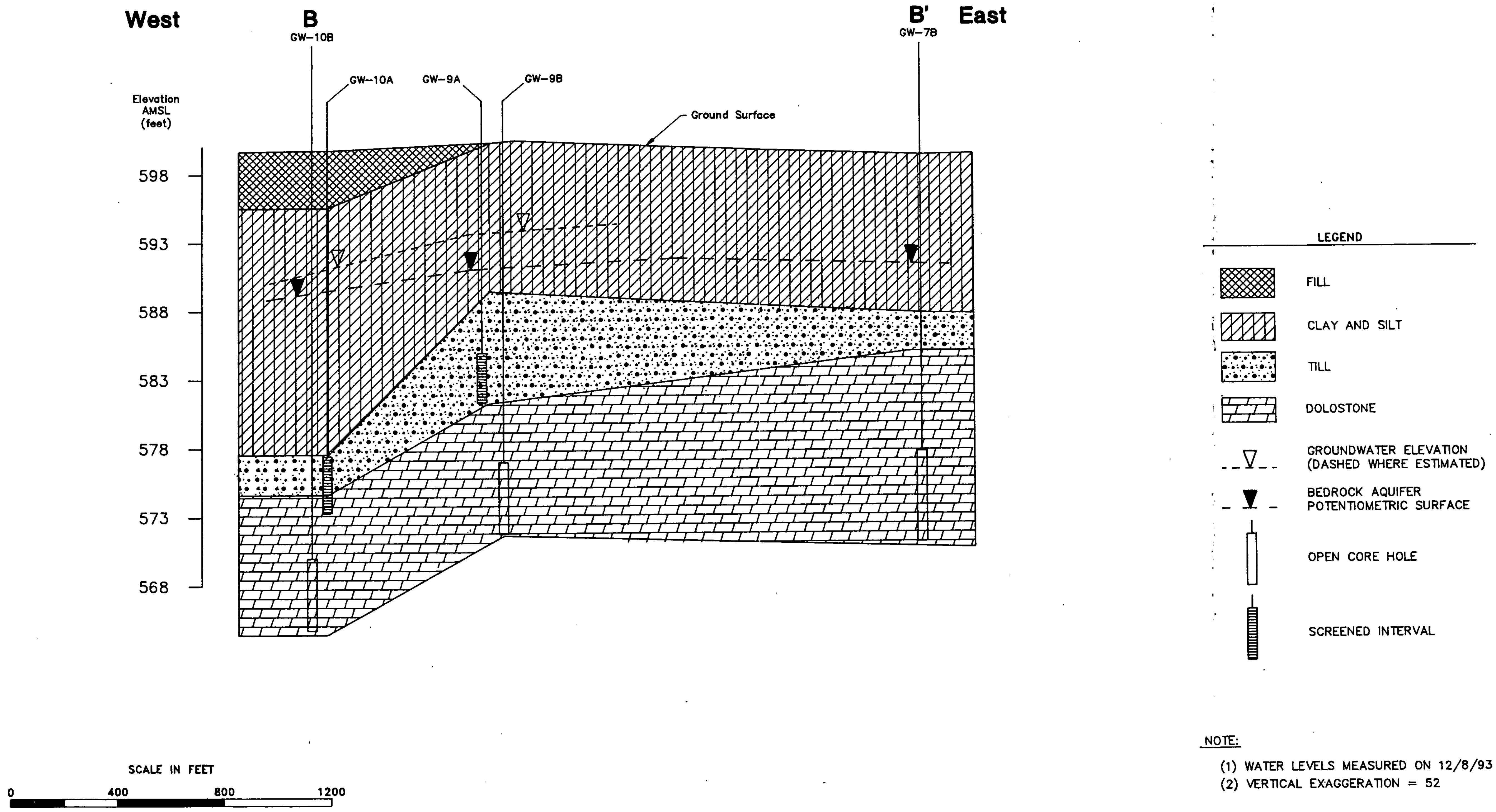
NOTE:

(1) WATER LEVELS MEASURED ON 12/8/93

(2) VERTICAL EXAGGERATION = 52

Figure 3-4 GEOLOGIC CROSS-SECTION A-A'
UNION CARBIDE SITE

YR9S008B



NOTE:

(1) WATER LEVELS MEASURED ON 12/8/93

(2) VERTICAL EXAGGERATION = 52

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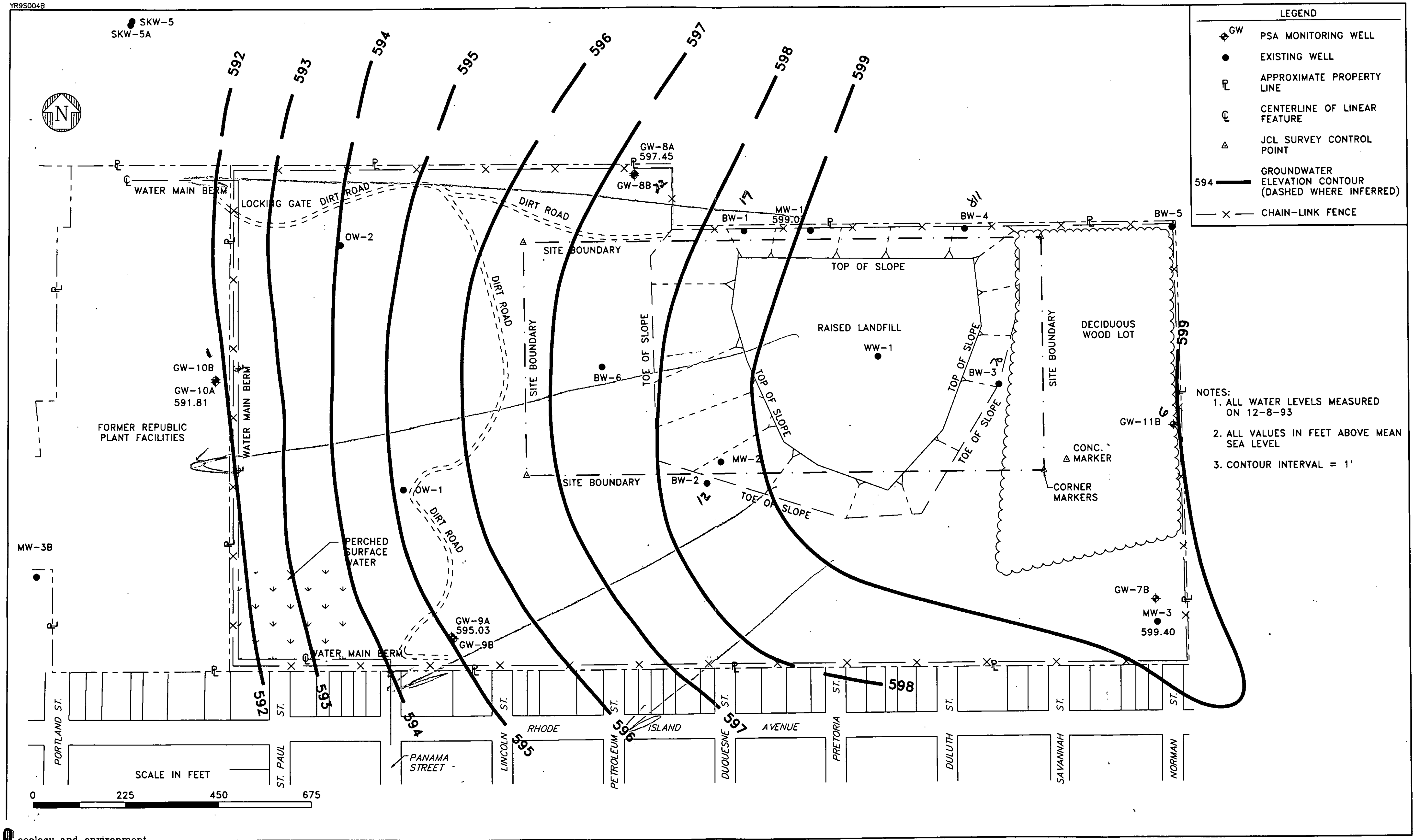
Figure 3-5 GEOLOGIC CROSS-SECTION B-B' UNION CARBIDE SITE



NOTES:
1. ALL WATER LEVELS MEASURED ON 12-8-93
2. ALL VALUES IN FEET ABOVE MEAN SEA LEVEL
3. CONTOUR INTERVAL = 1'

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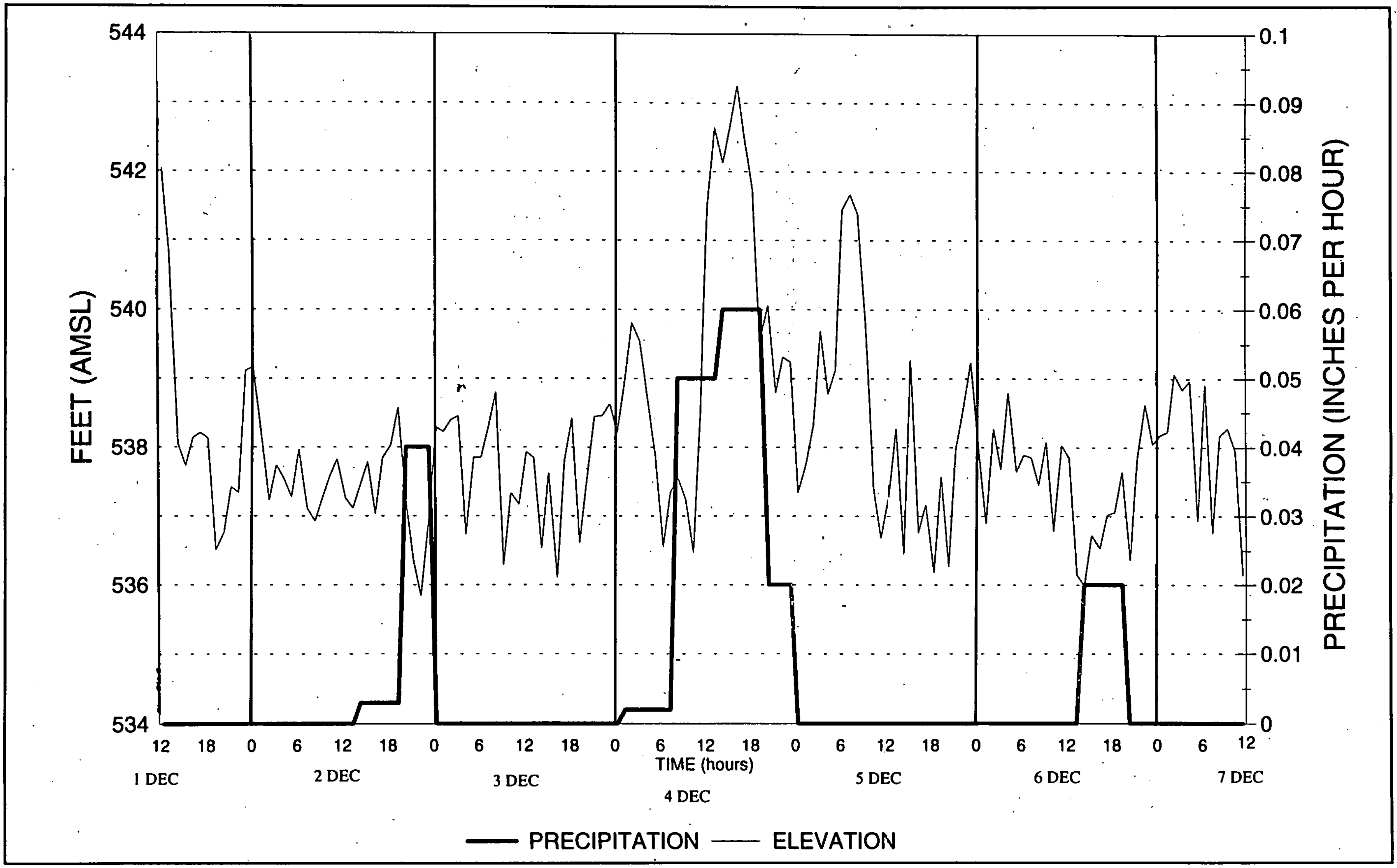
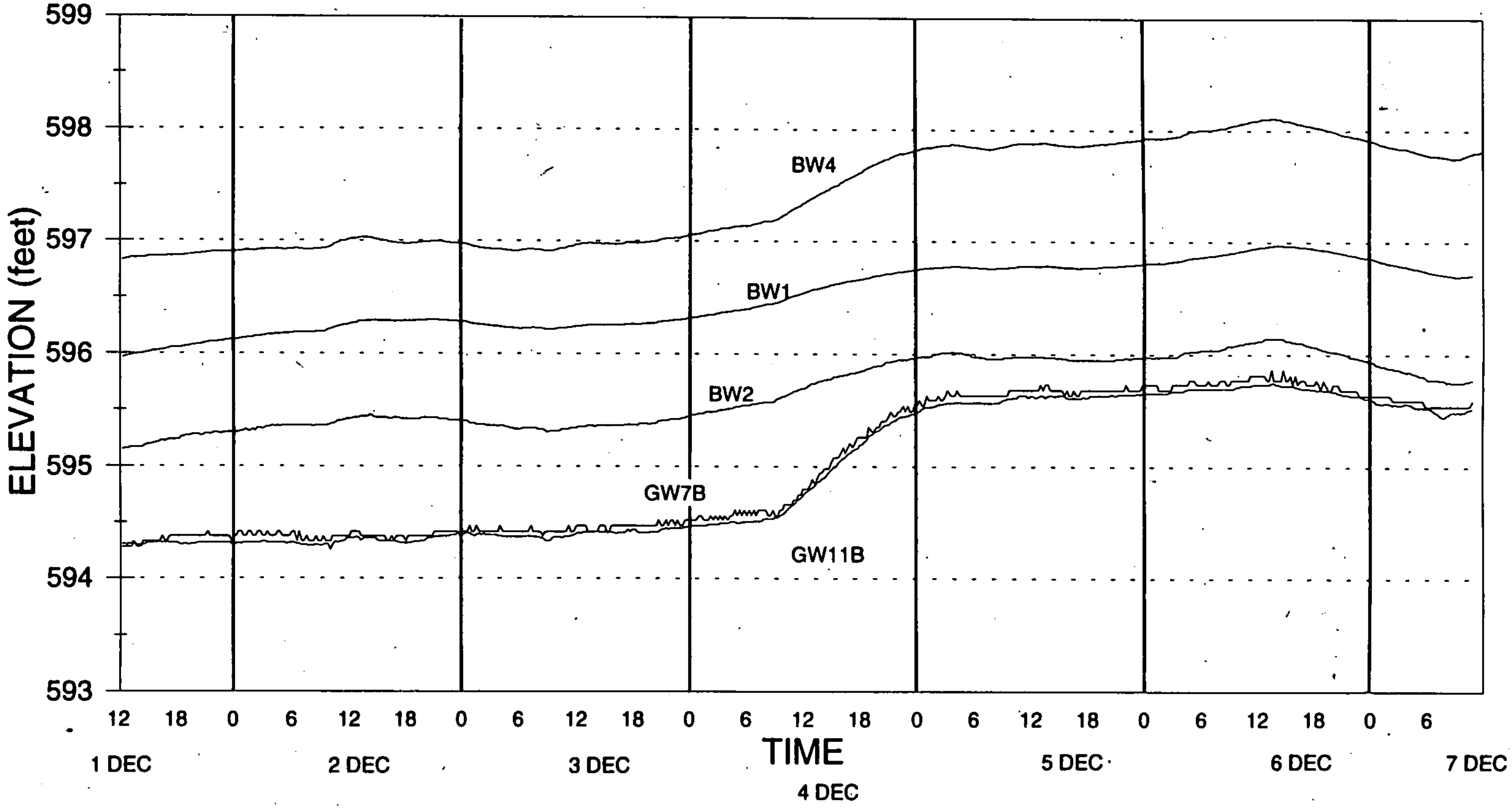
Figure 3-6 INTERFACE ZONE POTENTIOMETRIC SURFACE MAP UNION CARBIDE SITE



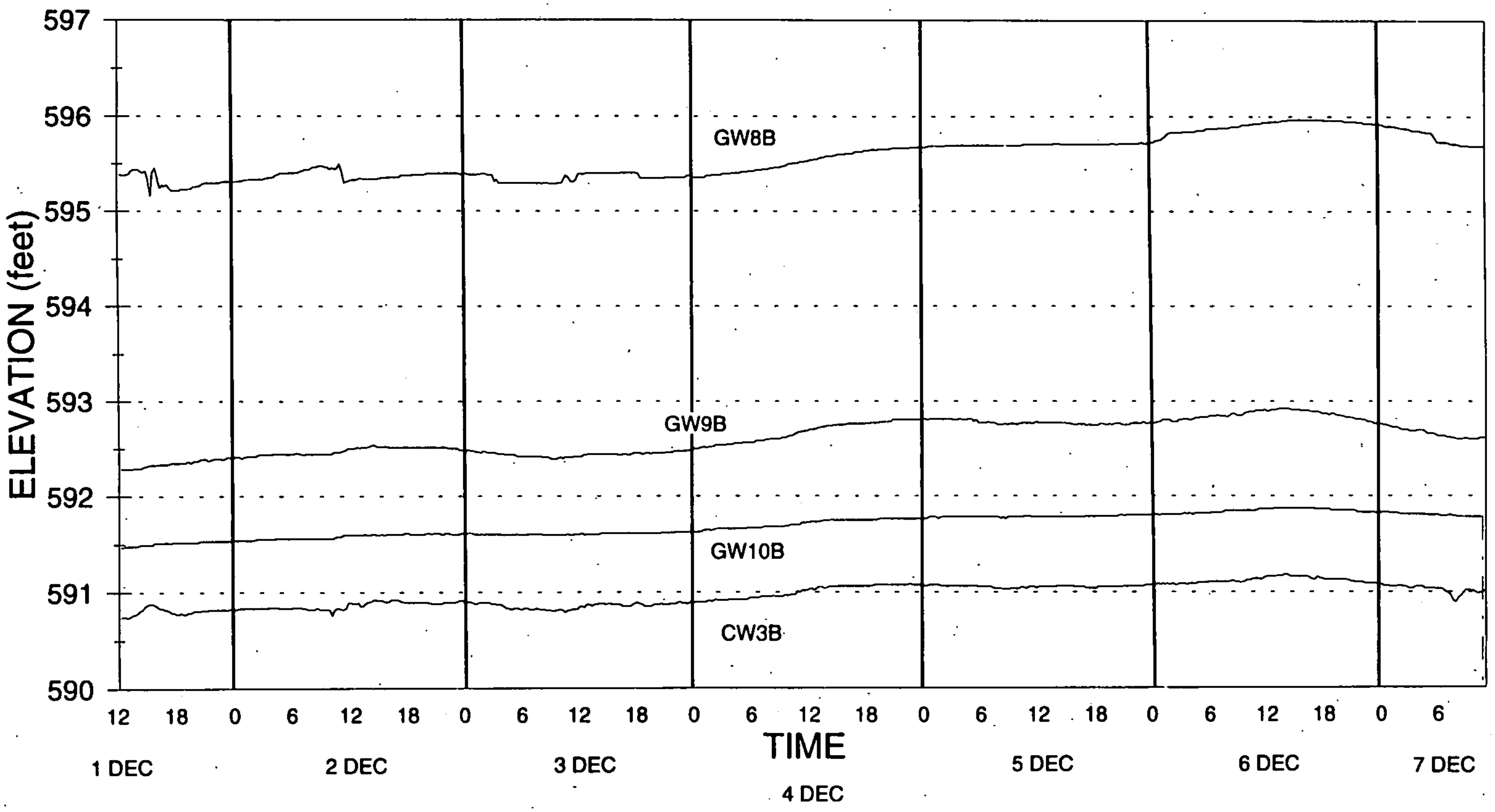
SOURCE: Ecology and Environment, Inc. 1994

Figure 3-7 NYPA FORBAY ELEVATIONS AND PRECIPITATION DATA



SOURCE: Ecology and Environment, Inc. 1994

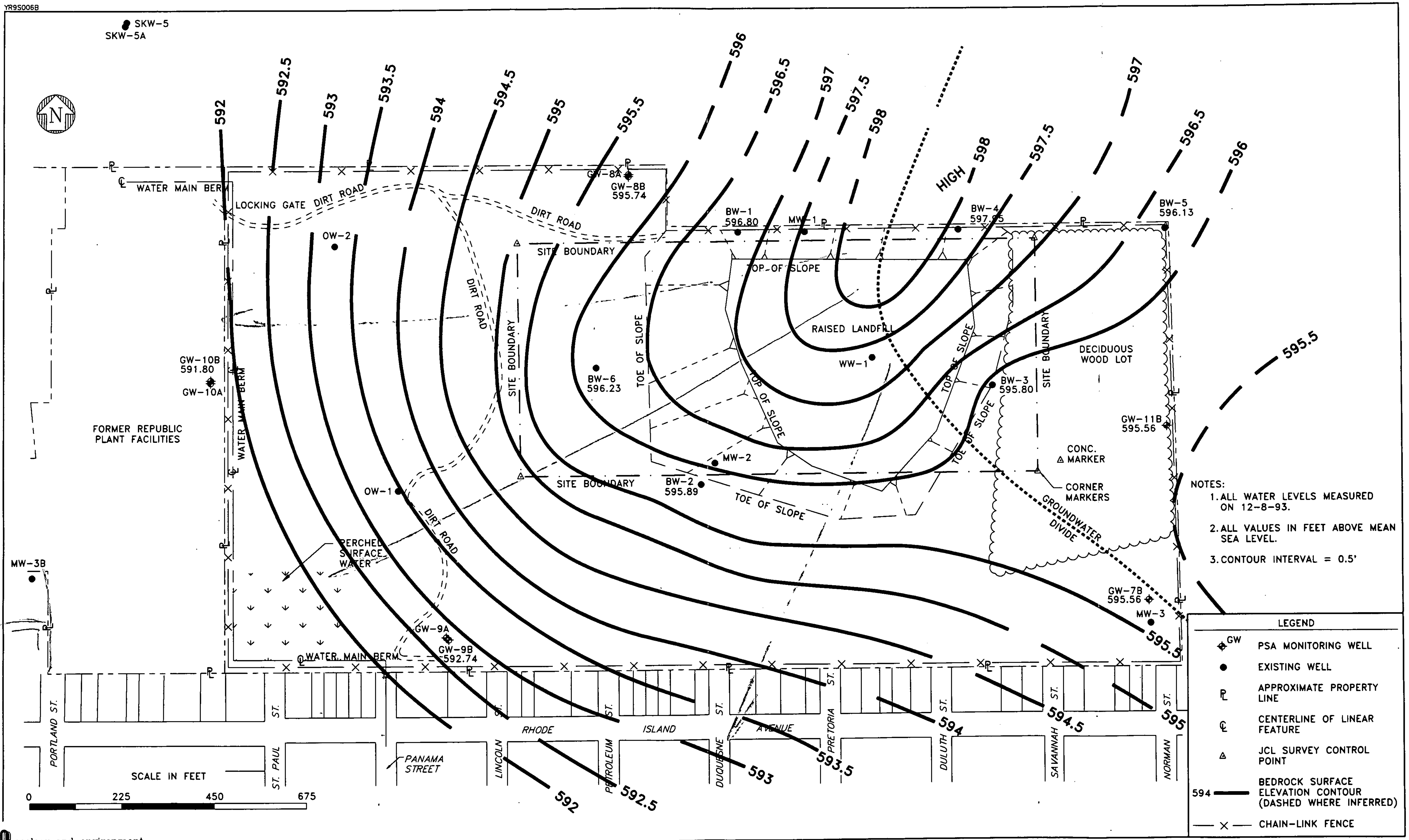
Figure 3-8 **UNION CARBIDE SITE, WATER ELEVATIONS FOR WELLS BW1, BW2, BW4, GW7B, GW11B DECEMBER 1, 1993 - DECEMBER 7, 1993**



SOURCE: Ecology and Environment, Inc. 1994

Figure 3-9 UNION CARBIDE SITE, WATER ELEVATIONS FOR WELLS GW8B, GW9B, GW10B, CW3B DECEMBER 1, 1993 - DECEMBER 7, 1993

YR9S006B



NOTES:

1. ALL WATER LEVELS MEASURED ON 12-8-93.
2. ALL VALUES IN FEET ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 0.5'

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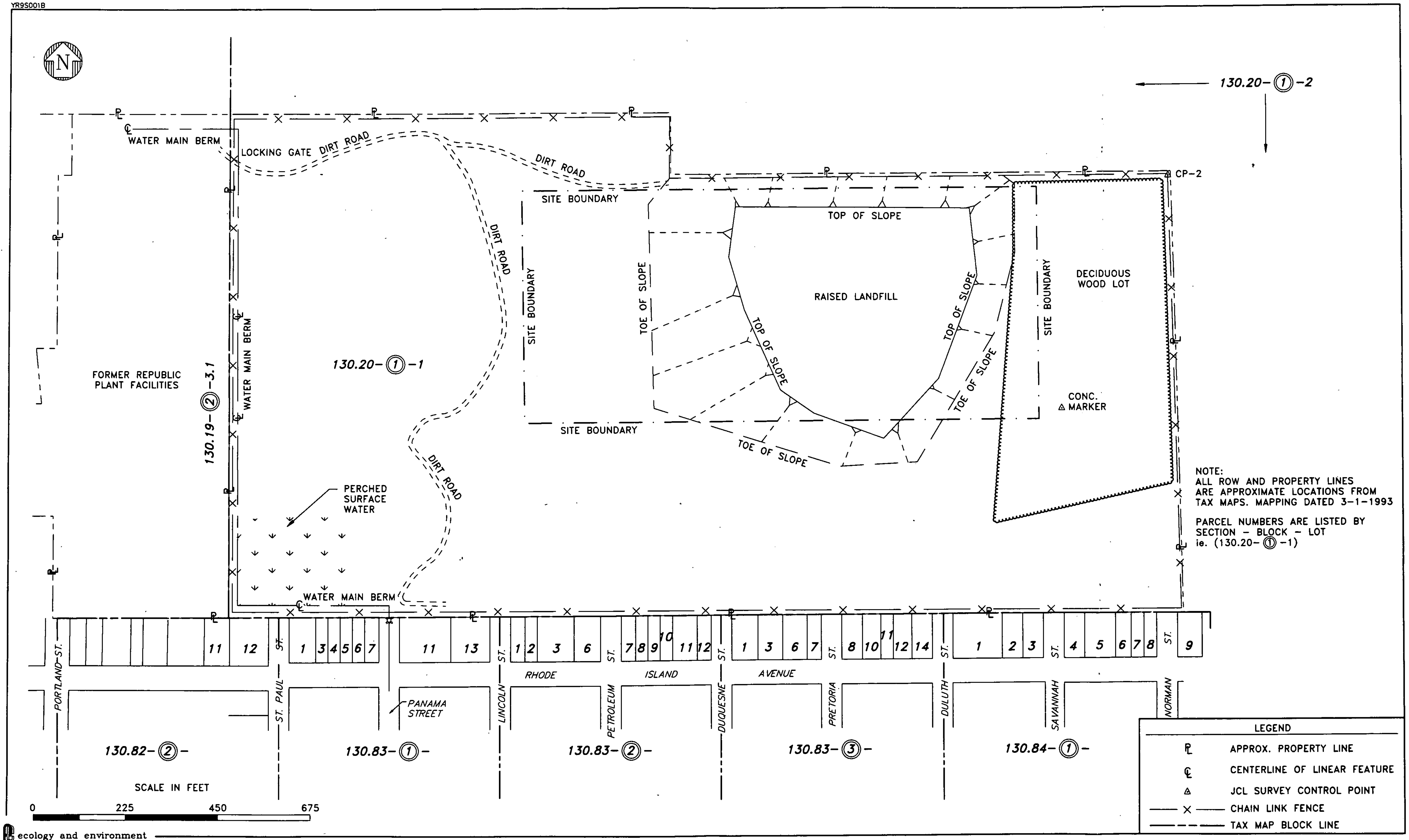
Figure 3-10 BEDROCK AQUIFER POTENTIOMETRIC SURFACE MAP UNION CARBIDE SITE



NOTE:
ALL ROW AND PROPERTY LINES ARE APPROXIMATE LOCATIONS FROM TAX MAPS. MAPPING DATED 3-1-1993

PARCEL NUMBERS ARE LISTED BY SECTION - BLOCK - LOT
ie. (130.20-①-1)

Figure 3-11 PROPERTY BOUNDARY MAP
UNION CARBIDE SITE

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4. CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

The Union Carbide site is a 16.48-acre landfill located within a 64-acre parcel within the Town of Niagara, Niagara County, New York. The landfill was active from 1934 to 1987 and was used to dispose of industrial wastes generated from UCC's three Niagara plants which included mostly carbonaceous dust, fire brick, and raw materials packaging. Documentation of hazardous waste disposal at the site includes, spent degreasing sludges, halowax, and waste oil.

The landfill was permitted by the town in 1973 and by the state in 1978, and remained properly permitted until its closure in 1987. Since proper closure, groundwater quality monitoring has been performed through quarterly sampling.

Since the closing of the landfill, several site investigations have been performed. In 1988, UCC contracted CRA to conduct a study to assess the nature and extent of waste material outside of the capped landfill boundaries. The CRA report determined that in addition to the 16.48-acre capped landfill, approximately 20 acres of UCC property adjacent and west of the capped landfill is covered with an average of 5.4 feet of fill material similar in composition to that of the landfill. Also in 1988, NUS performed a site inspection for USEPA. The site inspection report concluded that, based on the results of surface soil and groundwater samples collected, the landfill is not a significant source of concern for the off-site migration of contaminants.

In 1991, E & E prepared a PSA Task 1 report for NYSDEC. This report recommended reclassification of the site to a Class 3, but it acknowledged that the site hydrogeology and groundwater contaminant migration was not completely determined.

PSA site investigations conducted in 1991 and 1993 determined that the capped landfill is unlined and unvented, but it does not appear to have a venting or leachate problem. The property is entirely fenced, but periodically the fence is cut and the site entered by vandals. Surface and subsurface soil samples collected off of the landfill contain contaminants, but not at levels to be considered RCRA hazardous waste.

Surface water and sediment samples were essentially free of contaminants, and surface water is primarily undergoes evapotranspiration or infiltrates into the overburden and then bedrock. No surface water drainage pathways were observed during the PSA investigations.

Groundwater, particularly in the bedrock monitoring wells, contains contaminants at levels exceeding NYSDEC standards. The groundwater is not used as a source of drinking water within 3 miles of the site. A monitoring study of groundwater elevations determined that a north and south groundwater divide transects the site causing flow to the west and east. This divide shifts with seasonal and possibly with NYPA pumping variations. The most contaminated monitoring well is located along the northern site boundary and is relatively upgradient of the other site wells. At least some of the contamination found in this well appears to originate at an off-site source, possibly the Niagara Mohawk land adjacent to the site or the SKW landfill site located farther north.

4.2 RECOMMENDATIONS

It has been determined through the PSA investigation that the Union Carbide site does not present a significant threat to the public health or the environment. It is recommended that the site be reclassified from a 2A to a Class 3 on the NYSDEC Registry of Inactive Hazardous Waste Sites.

Although hazardous waste disposal has been documented and groundwater at the site contains organic contaminants, groundwater is not used as a drinking water source within 3 miles of the site and a post-closure monitoring program remains in effect at the site. Because the most contaminated well (BW-4) is upgradient on the northern property boundary, the source of the groundwater contaminants remains uncertain. Further study is recommended for the area north of the site to determine the hydrology of this area, and to determine how the site is affected by potential off-site contamination. A soil gas survey may help to determine optimal locations of off-site monitoring wells and help to delineate a possible contaminant plume.

Contamination was detected in several wells; therefore, it is recommended that the post-closure groundwater sampling program, which does not include all wells, be re-evaluated to most effectively monitor contaminant distribution and contaminant concentrations. Because the site fence is vandalized periodically, a regular schedule of site patrol is recommended to minimize site access.